ONTARIOPOWER GENERATION **Report**

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2024 PICKERING NUCLEAR GROUNDWATER MONITORING PROGRAM RESULTS

2024 Pickering Nuclear Groundwater Monitoring Program Results

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Revision Summary

Revision Number	Date	Comments
000	2025-04-02	Initial Issue

Land Acknowledgement

The lands and waters on which the Pickering Nuclear Generating Station (PNGS) is situated are within the traditional and treaty territory of the Williams Treaties First Nations, which includes Curve Lake First Nation, Hiawatha First Nation, Alderville First Nation, Chippewas of Beausoleil First Nation, Chippewas of Georgina Island First Nation, Chippewas of Rama First Nation, and the Mississaugas of Scugog Island First Nation.

The PNGS is within the territory of the Gunshot Treaty and the Williams Treaties of 1923. The Gunshot Treaty Rights were reaffirmed in 2018 in a settlement with Canada and the Province of Ontario.

To acknowledge the treaty and traditional territory, is to recognize the rights of the First Nations. It is to recognize the history of the land, predating the establishment of the earliest European colonies. It is also to acknowledge the significance for the Indigenous peoples who lived and continue to live upon it, to acknowledge the people whose practices and spiritualties are tied to the land and water and continue to develop in relation to the territory and its other inhabitants today.

ALDERVILLE FIRST NATION | BEAUSOLEIL FIRST NATION | CURVE LAKE FIRST NATION | GEORGINA ISLAND FIRST NATION | HIAWATHA FIRST NATION | SCUGOG ISLAND FIRST NATION | RAMA FIRST NATION

Executive Summary

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

- Objective 1: Monitor changes to on-site groundwater quality for the timely detection of groundwater quality changes;
- Objective 2: Evaluate the potential for adverse off-site impacts from PNGS groundwater; and
- Objective 3: Confirm predominant on-site groundwater flow characteristics at the PNGS site.

The findings in 2024 with respect to the above objectives are:

- Objective 1:
    - Tritium concentrations in groundwater in the vicinity of Units 1 and 8 showed minor fluctuations in some locations. Concentrations of tritium in downgradient locations remain below risk-based evaluation criteria and monitoring will continue within these locations. The tritium concentrations in groundwater at other wells in the vicinity of the system structures and components were consistent with results for previous years. Fluctuations in tritium concentrations are associated with ongoing operations or the expected migration of tritium associated with historical releases to groundwater.
    - Dissolved iron concentrations in groundwater at East and West Landfills were stable and remained below the Evaluation Criteria.
    - The results for the remediation approach of natural attenuation of petroleum hydrocarbons present in Units 1 to 4 Standby Generators (SGs, or SG-A), Units 5 to 8 SGs (or SG-B), Emergency Power Generators (EPG), and EPG3 areas are consistent with historical results.
    - Petroleum Hydrocarbon (PHC) concentrations were not detected in groundwater at Fukushima Diesel Generators and Standby Boiler.
- Objective 2: Tritium concentrations within the site boundary wells and shoreline wells are stable and remain within historical ranges, with 2 of the 30 locations showing increasing or probable increasing concentrations. Off-site effects of tritium in groundwater to Lake Ontario are not observed.

- Objective 3: The interpreted groundwater flow pattern remains unchanged in 2024 compared to the interpretations from recent years.

1.0 INTRODUCTION

Ontario Power Generation (OPG) Pickering Nuclear Generating Station (PNGS) 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 following three primary objectives are addressed by specific objectives detailed in the N288.7-compliant PNGS Groundwater Protection Plan (GWPP) and Groundwater Monitoring Program (GWMP) (Ecometrix, 2023a):

Objective 1: Monitor changes to on-site groundwater quality for the timely detection of inadvertent releases to groundwater:

- Tritium concentrations in groundwater near system structures and components (SSCs).
- Dissolved iron concentrations in groundwater at East and West Landfills.
- Petroleum hydrocarbon (PHC) concentrations in groundwater at Units 1 to 4 Standby Generators (SGs, or SG-A), Units 5 to 8 SGs (or SG-B), Emergency Power Generators (EPG), and EPG3.
- PHC concentrations in groundwater at Fukushima Diesel Generators and Standby Boiler

Objective 2: Evaluate the potential for adverse off-site impacts from PNGS groundwater:

- Tritium concentrations in groundwater in Perimeter Wells - monitor tritium at site perimeter wells to establish tritium concentrations at the PNGS site boundaries and to confirm no adverse off-site impacts.

Objective 3: Confirm predominant on-site groundwater flow characteristics at the PNGS site:

- Hydraulic Head Measurements – measure hydraulic head in selected monitoring wells to confirm the groundwater flow conditions across the PNGS site and to support the interpretation of constituent migration in groundwater.

The groundwater sampling and monitoring program conducted in 2024 followed the Sampling and Analysis Plan (SAP) for 2024 (OPG, 2024). This report presents groundwater data collected at PNGS for the period from January 1st to December 31st, 2024.

1.1 Summary of Hydrogeological Characteristics at the PNGS

Eight hydrostratigraphic units (HUs) have been identified beneath PNGS through historical assessments. Of the eight HUs, four main groundwater flow systems have been identified for the site:

- Shallow/Water Table (HU 1-3) - Aquifer;
- Intermediate Overburden (HU 6) - Aquitard;
- Deep Overburden (HU 7) – Aquifer; and
- Deep Bedrock (HU 8) – Aquitard.

HUs 4 and 5 are not always observed, and where they are observed, are generally thin and grouped into the shallow groundwater system. The shallow groundwater system is an aquifer, and the intermediate overburden and bedrock groundwater flow systems are considered to be aquitards. The deep overburden groundwater system may represent an aquifer. Groundwater migration into this HU from overlying HUs is considered to be limited due to the low permeability of the till materials in HU 6.

2.0 2024 PROGRAM DESIGN

The groundwater monitoring program design is detailed in the PNGS GWPP and GWMP (Ecometrix, 2023a). The N288.7-compliant 2024 Sampling and Analysis Plan (SAP) was developed to meet the relevant components of the objectives listed above, incorporating sampling methods, laboratory analytical methods, quality assurance and quality control requirements, in addition to the sampling locations for each objective and schedule for each quarter

Groundwater quality results are provided in Appendix A. Refer to Section 6.0 of this report for details on the sampling nomenclature used in the groundwater program.

2.1 Objective 1 Methodology

2.1.1 Tritium Concentrations in Groundwater Near SSCs

In 2024, as per the SAP, groundwater samples were collected from 125 sampling locations for tritium analysis. This includes monitoring wells, foundation drains, sumps, and groundtubes, the locations of which are illustrated in Figure 1. Most of the locations sampled are near the operating reactors.

The 2024 SAP specified the sampling locations and frequency (e.g., quarterly, annually) of sampling tritium concentrations in groundwater at each location.

Groundwater samples analyzed for tritium were collected from the following key areas in 2024:

- PN Unit 1 to 4 (U1-4) Reactor Buildings (RBs), Vacuum Building;
- Turbine Auxiliary Bay (TAB) for U1-4 and Unit 5 to 8 (U5-8);
- Irradiated Fuel Bays (IFBs) for U1-4 and U5-8; and
- Upgrading Plant Pickering (UPP).

Water levels were collected at each monitoring well prior to the collection of samples by OPG technicians. Following the water level measurements and prior to sample collection, each monitoring well was purged to remove standing water to obtain representative groundwater samples. Collected samples were analyzed for tritium concentrations by the OPG PNGS Chemistry Laboratory.

The groundwater data generated from the sampling program were subsequently interpreted to assess the stability of, or changes in, groundwater quality (trends). Analytical results of groundwater tritium concentrations for Objective 1 are presented in Appendix A (Table A-1, Table A-2, Table A-3, and Table A-4).

2.1.2 Dissolved iron concentrations at East and West Landfills

In 2024, two groundwater samples were collected downgradient of the East and West Landfills, one sample for each landfill along the Lake Ontario shoreline. Samples were collected by Pottinger Gaherty Environmental Consultants Ltd. (PGL). Samples were submitted to Bureau Veritas (BV), a laboratory accredited to ISO/IEC 17025 for analysis of dissolved iron concentrations. Analytical results at these locations are presented in Appendix A (Table A-5). Figure 2 shows the locations of the two wells that were monitored in 2024.

2.1.3 PHC concentrations in groundwater at U1-4 SGs, U5-8 SGs, U1-4 SG Overflow Area, EPG and EPG3

A monitored natural attenuation (MNA) program was implemented in the SG-A, SG-A Overflow area, and SG-B areas following remedial activities undertaken in 2011. MNA program monitors the long-term hydrocarbon mass attenuation that occurs through volatilization, dissolution, and natural microbial degradation processes. Groundwater monitoring results in these three areas have, in the past, been reported under separate cover. The MNA program for these areas was incorporated into the GWMP in 2019, and the results of this programs are discussed in the annual report for PNGS.

In 2024, as per the SAP and the GWMP (Ecometrix, 2023a; OPG, 2024), water levels and petroleum hydrocarbon free-phase product thicknesses were measured at 20 monitoring wells near the U1–4 SGs, U1-4SG Overflow Area and U5-8 SG. If free-phase product was present in the wells, the thickness of the product and depth to water were the only measurements taken. If free-phase product was not present, groundwater samples were collected for analysis of PHCs PHC Fractions 2 and 3 (PHC F2 to F3), and dissolved iron. In 2024, 15 wells were sampled where no product was observed. The samples from these wells were analyzed for PHC F2 to F4 and two wells were sampled and analyzed for dissolved iron. Groundwater was sampled using low-flow methodology. Samples for PHCs, and dissolved iron were submitted to BV for analysis. Figure 3 shows the locations of the wells that were monitored in 2024.

Product thicknesses and water quality analytical results for U1-4 SGs, U5-8 SGs, EPG, and EPG3 are presented in Appendix A (Table A-6a and Table A-6b, respectively).

2.1.4 PHCs at Fukushima Diesel Generators

Five groundwater samples were collected from monitoring wells associated with the Fukushima diesel generators in 2024. Samples were collected by PGL. Four of these locations were sampled and analyzed for PHCs (F1 to F4) and BTEX, and one was sampled and analyzed for dissolved iron. All samples were submitted to BV. Analytical results for groundwater quality within the area of the Fukushima Diesel Generators are presented in Table A-7 (Appendix A). Figure 4 shows the locations of the wells that were monitored in 2024.

2.2 Objective 2 Methodology

The 2024 SAP included the sampling of monitoring well clusters at the site boundary to assess for adverse off-site impacts from PNGS groundwater. Boundary wells are located across the entire site in directions upgradient or cross-gradient to the SSCs and provide spatial information on background groundwater quality conditions. Shoreline wells are also monitored downgradient to the SSCs to assess for off-site impacts from PNGS groundwater. Figure 5 shows the locations of the site perimeter wells. Analytical results for monitoring wells sampled at the PNGS perimeter are presented in Table A-6 (Appendix A)

The methodology for groundwater collection, analysis, and data evaluation in the perimeter wells was the same as what is described above for Objective 1.

2.3 Objective 3 Methodology

The GWMP requires an annual review of the interpreted groundwater flow directions using a set of water levels collected from several site groundwater monitoring wells over a short period of time (10 days). The groundwater flow patterns at the site form the basis for interpreting the migration of constituents in groundwater, so changes in groundwater flow directions could affect the interpreted migration of these constituents.

Groundwater elevation contours were generated from water levels measured over a period of 8 days in the third quarter of 2024 (July 16 to 24, 2024, and the average of the daily mean lake elevation of 75.02 m in Lake Ontario for this period (IJC, 2025). These groundwater contours were used to infer the groundwater flow patterns in 2024 for comparison to historical flow directions.

Figure 1: 2024 Tritium Monitoring Locations for Objective 1

Figure 2: 2024 Dissolved Iron Monitoring Locations for Objective 1 – East and West Landfill

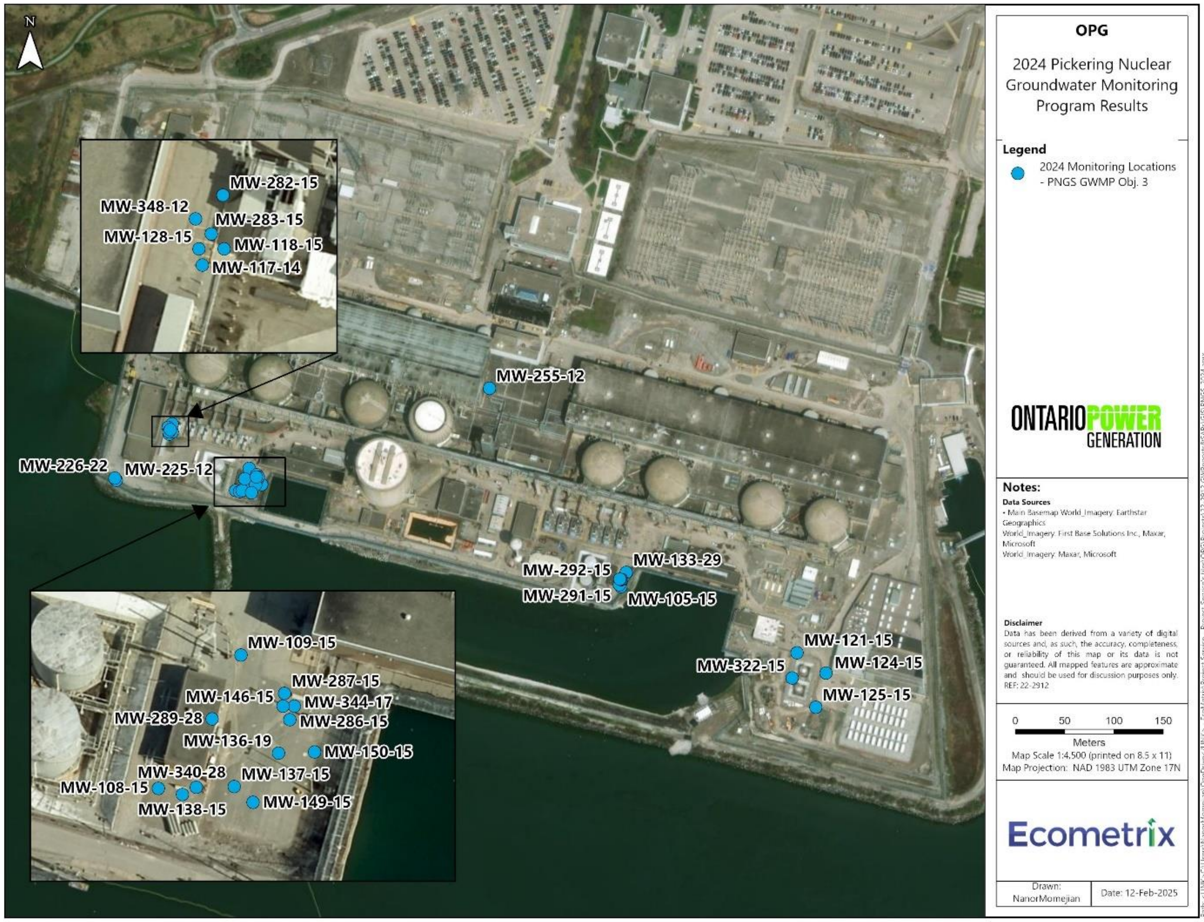


Figure 3: 2024 PHC, BTEX, and Dissolved Iron Monitoring Locations for Objective 1 - SG-A, SG-B, and SG-A Overflow Tank Area, EPG and EPG3

Figure 4: 2024 PHC, BTEX and Dissolved Iron Monitoring Locations for Objective 1 – Fukushima Diesel Generators

Figure 5: 2024 Monitoring Locations for Objective 2

3.0 2024 PROGRAM RESULTS

3.1 Objective 1 Results

3.1.1 Tritium Concentrations in Groundwater Near SSCs

The groundwater data collected in 2024 from the areas surrounding SSCs at PNGS indicate that, overall, the tritium concentrations in groundwater have remained consistent with results for previous years, fluctuating within expected ranges caused by ongoing operations or the movement of historical tritium releases to groundwater. The following were also observed in 2024.

Elevated tritium concentrations were measured at PN U1-U4 near GS-A, as well as near the Upgrading Towers A and B. Tritiated groundwater around U1 is expected to migrate south and west to actively pumped sumps and then managed through site operations. Tritium concentrations in downgradient locations are not inferred to impact groundwater end-use.

An increase in tritium concentrations was also noted in groundwater within the vicinity of Unit 8. Tritium concentrations in groundwater downgradient of U8 remain below risk-based evaluation criteria and monitoring will continue within these locations.

Further discussion is provided in the sections below.

3.1.1.1 U1-4 Reactor Building Area Overview

The 2024 groundwater sampling results within the area of the U1-4 RBs, Vacuum Buildings, and TABs are presented in Table A-1 (Appendix A). The majority of the monitoring wells in this area are sampled quarterly. The distributions of maximum annual tritium concentrations within the vicinity of U1-4 area, including the U1-4 IFBs, are presented for HU 1-3 in Figure 6, HU 6 in Figure 7, and HU 7 in Figure 8.

Key sampling locations are discussed in further detail below, by specific area.

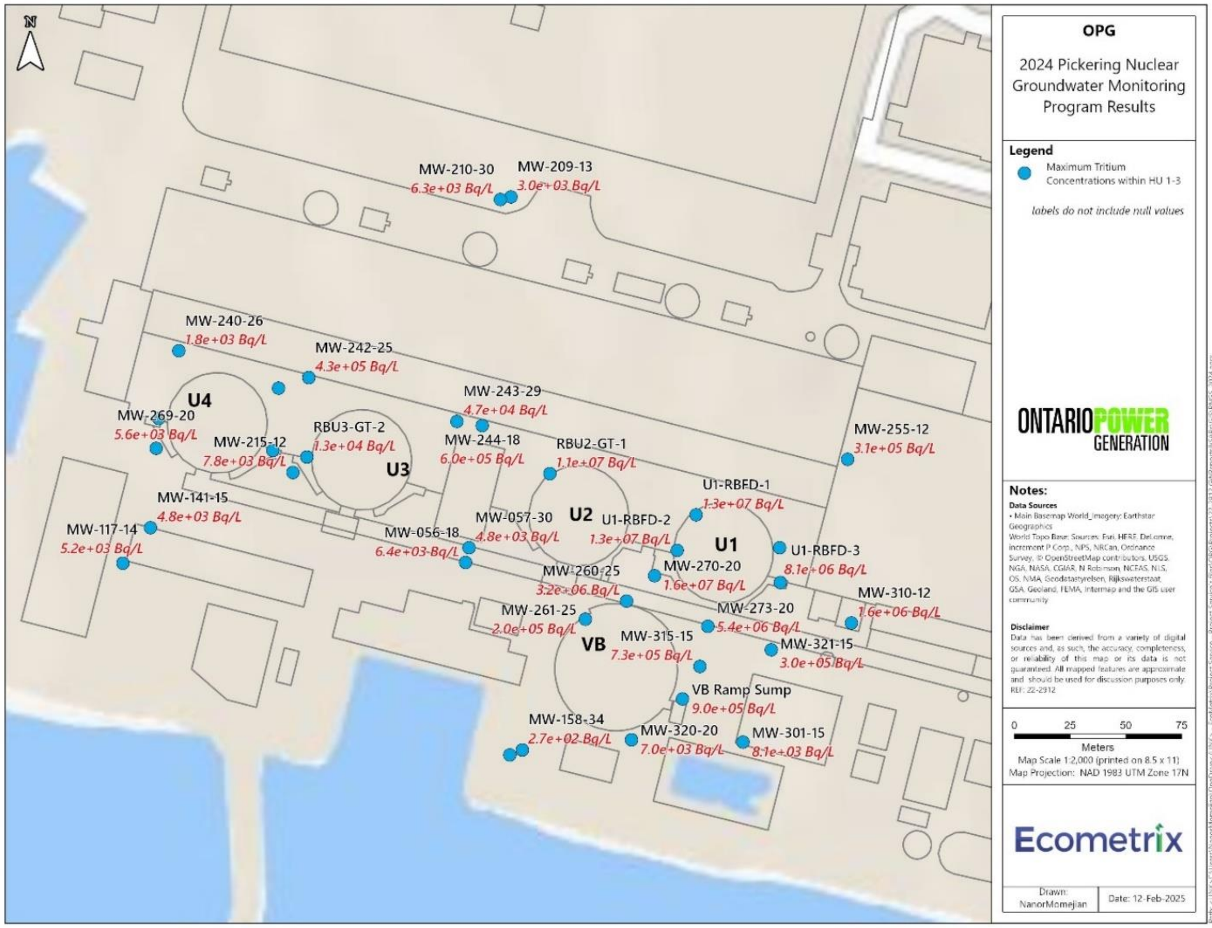


Figure 6: 2024 Annual Maximum Tritium Concentrations within HU 1-3, Units 1 to 4, and IFB-A

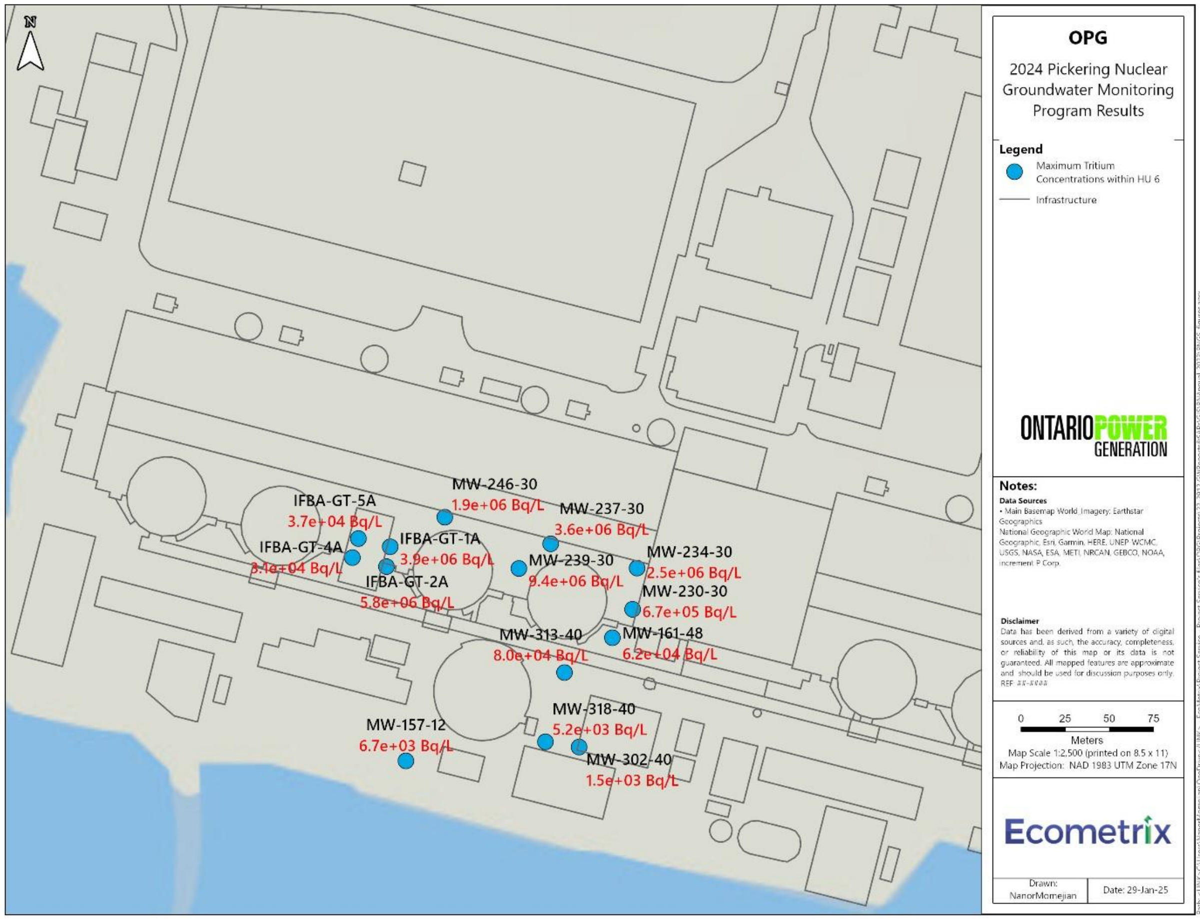


Figure 7: 2024 Annual Maximum Tritium Concentrations within HU 6, Units 1 to 4, and IFB-A

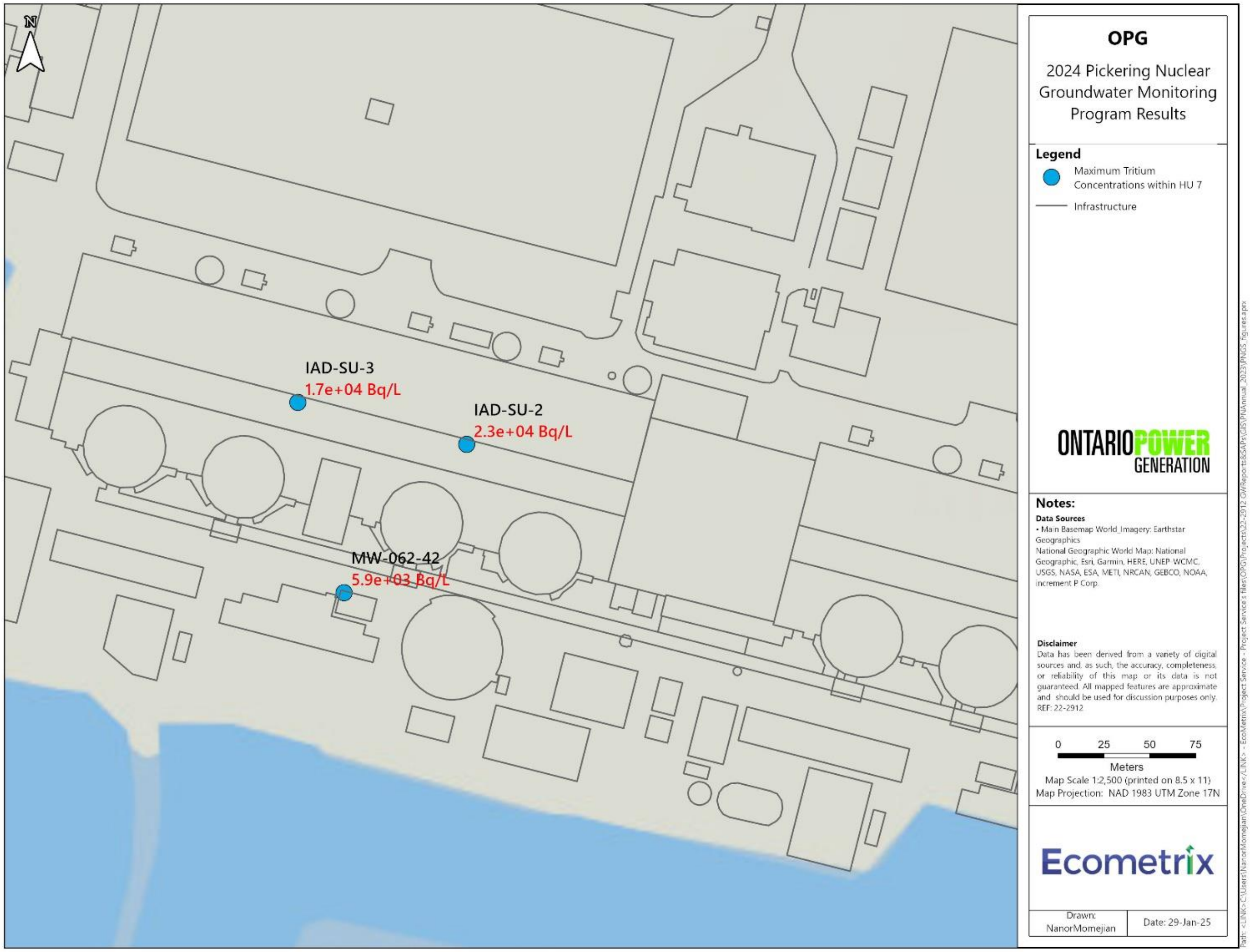


Figure 8: 2024 Annual Maximum Tritium Concentrations within HU 7, Units 1 to 4, and IFB-A

U1 and U2 Areas

Tritium concentrations within several monitoring wells, including wells towards the south-southeast of U1 (MW-313-40, MW-321-15) and south of the Vacuum Building Ramp Sump (VBRS; MW-157-12, MW-318-40 and MW-320-20), demonstrate statistically increasing trends; however, the majority of the concentrations observed in 2024 are consistent with historical concentrations. The concentrations of tritium within these wells are likely attributed to the downgradient migration of the heavy water leaks identified at U1 in 2023. Tritium concentrations within other wells in the vicinity of U1 (U1-RBFD-1, U1-RBFD-2, U1-RBFD-3, MW-270-20, MW-273-20, MW-260-25) demonstrate stable, decreasing trends or no trends with the inclusion of 2024 data. Based on the historical migration of a heavy water leak in 2020, this tritiated groundwater plume is expected to continue migrating toward the VBRS, which acts as a hydraulic sink and collects a portion of groundwater in the U1 and U2 areas (Ecometrix, 2023b). Additionally, groundwater in the area of U1 is also known to migrate north towards the actively pumped TAB foundation drains and west towards U1-4 IFBs (Ecometrix, 2020). Tritiated groundwater is collected at this actively pumped location and discharged via a monitored pathway. Furthermore, groundwater concentrations closest to Lake Ontario (within MW-157-12) remain several orders of magnitude below the risk-based evaluation criterion, therefore risk to groundwater end-uses is not expected based on the concentrations observed. Monitoring will continue at these monitoring wells to characterize the migration of tritiated groundwater. Higher concentrations of tritiated groundwater were observed in HU 1-3 towards the TAB and the VBRS, as depicted in Figure 9.

Tritium concentrations in remaining wells and groundtubes within the vicinity of U1 and U2 remained within historical ranges reflective of routine operations. Graph 1 to Graph 9 display tritium concentrations over time at U1-RBFD-3, MW-157-12, MW-270-20, MW-273-20, MW-313-40, MW-315-15, MW-321-15, and the VBRS.

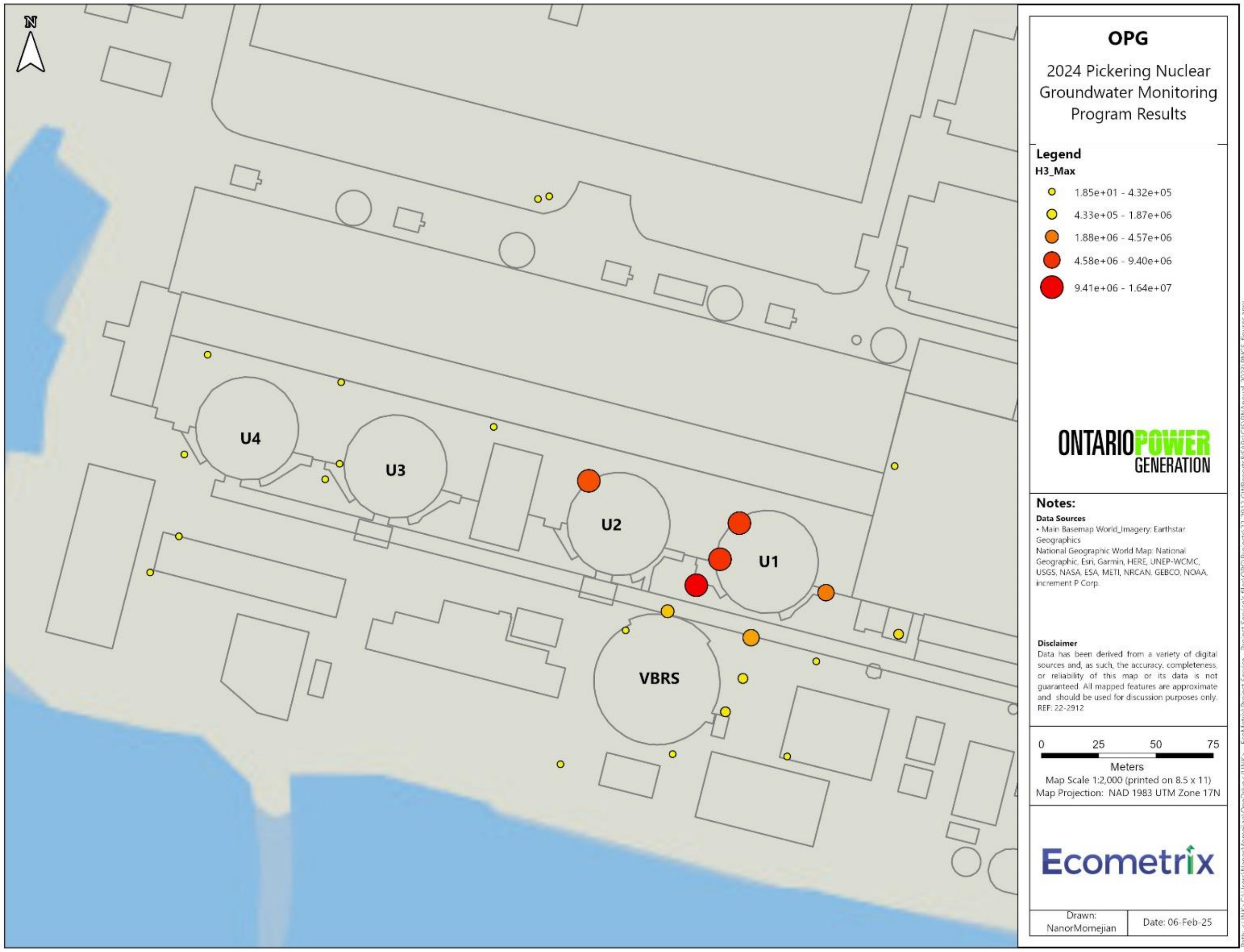
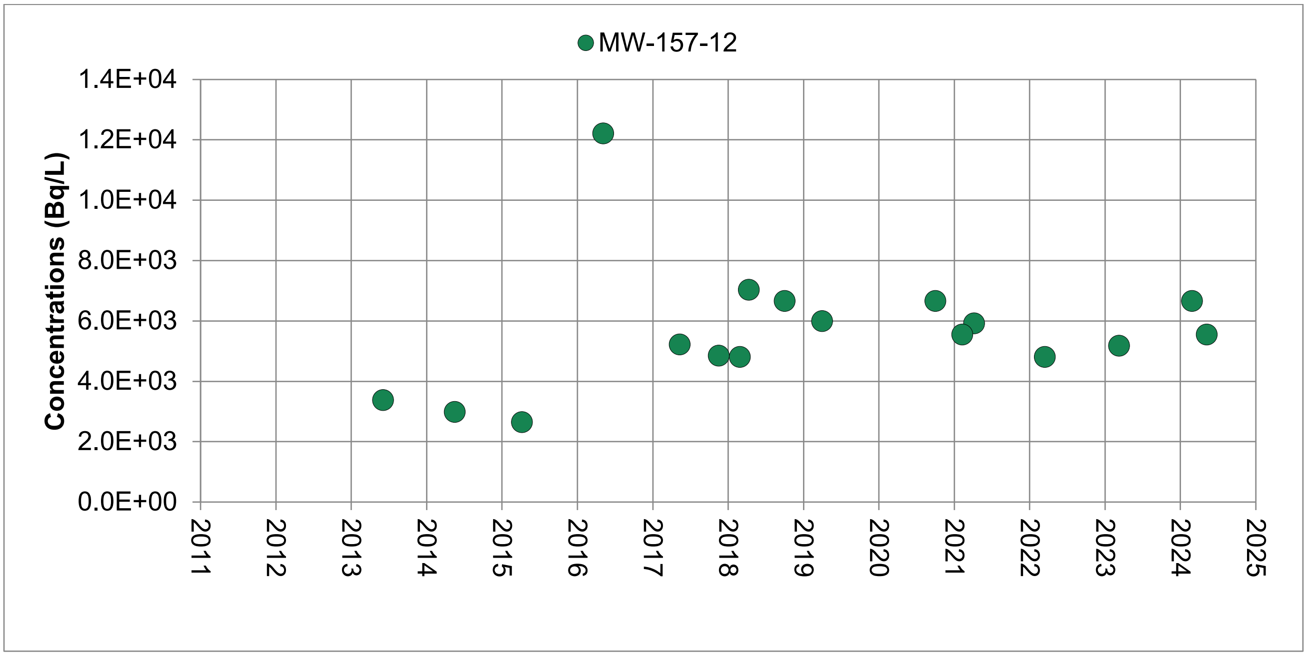
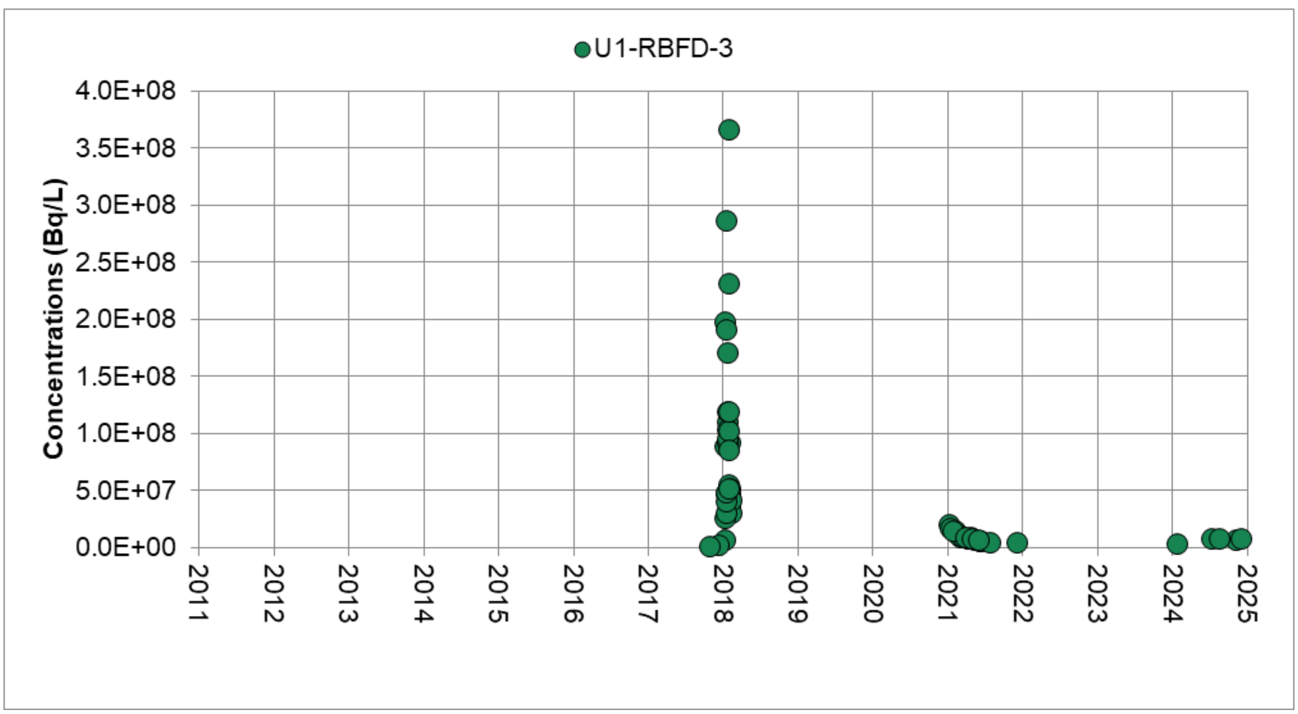


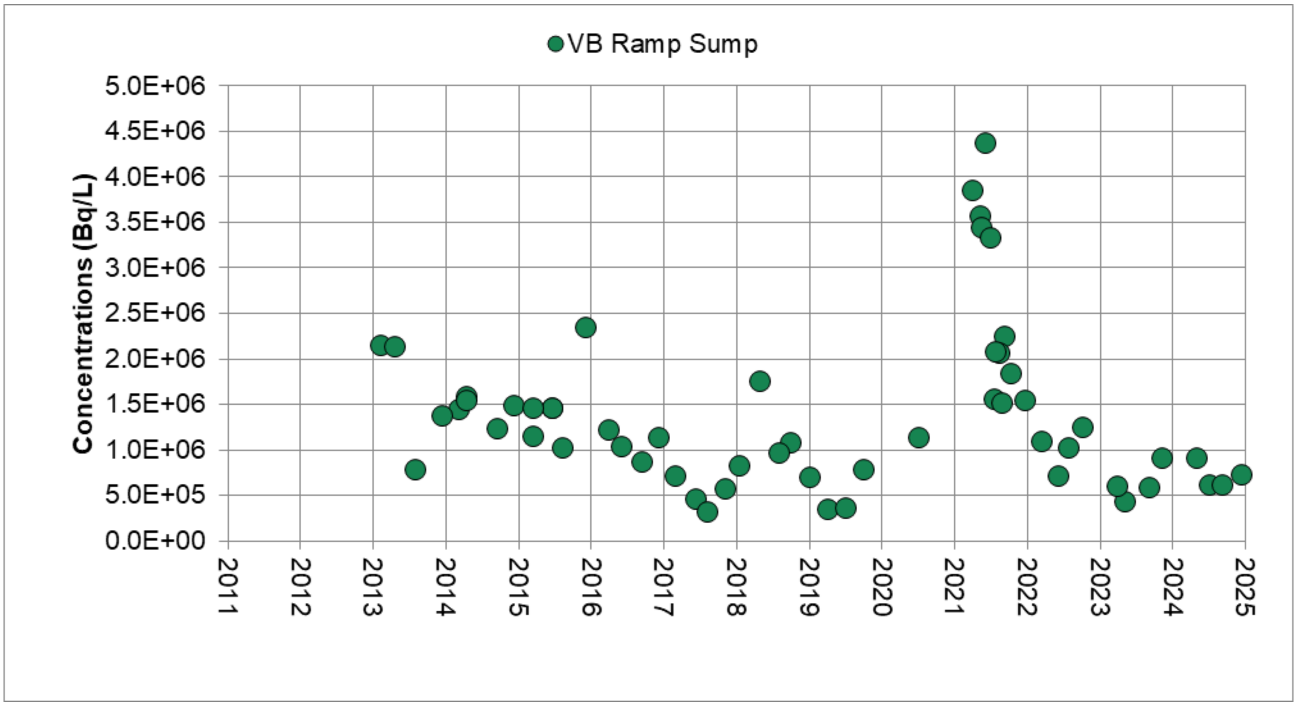
Figure 9: Maximum Tritium Concentrations in 2024 Showing Elevated Concentrations Around the TAB Drains and VBRS in HU 1-3



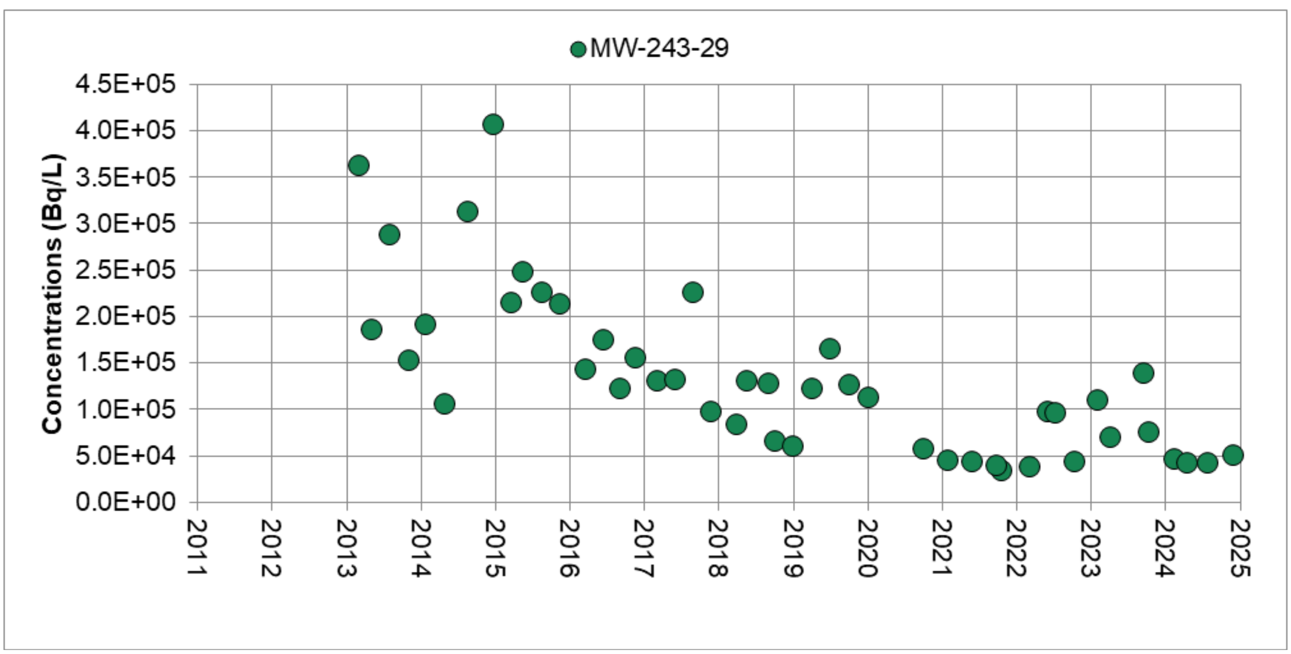
Graph 1: Tritium concentrations at MW-157-12



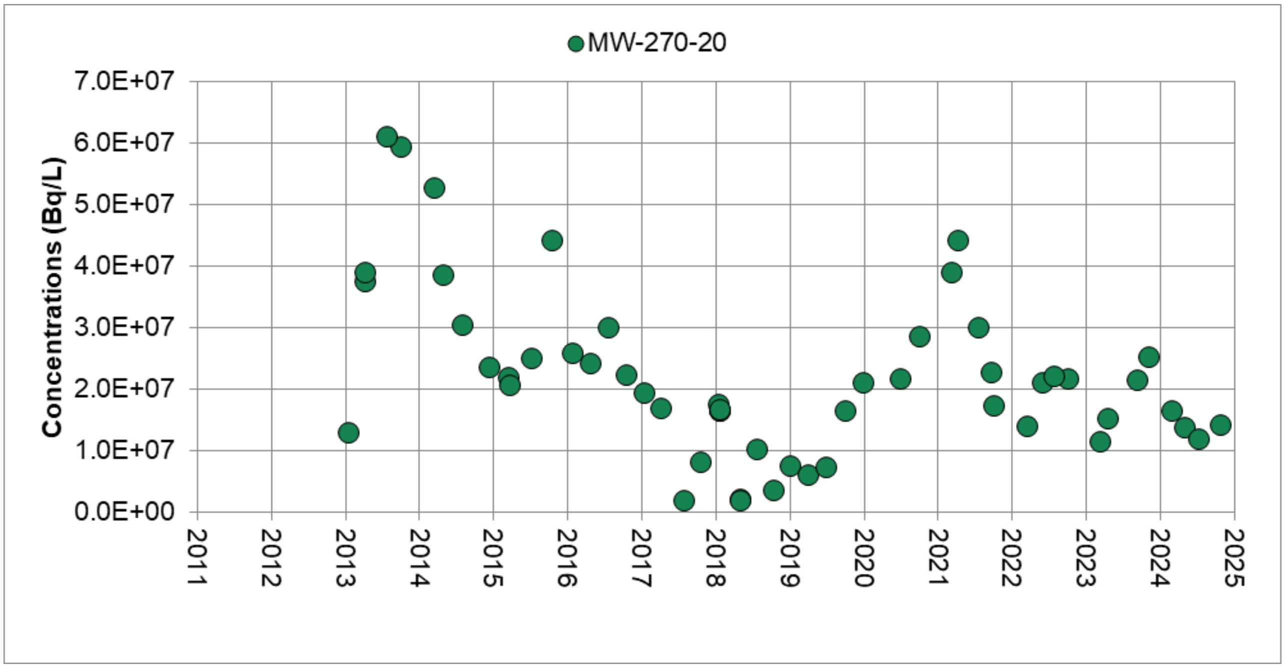
Graph 2: Tritium Concentrations at U1-RBFD-3



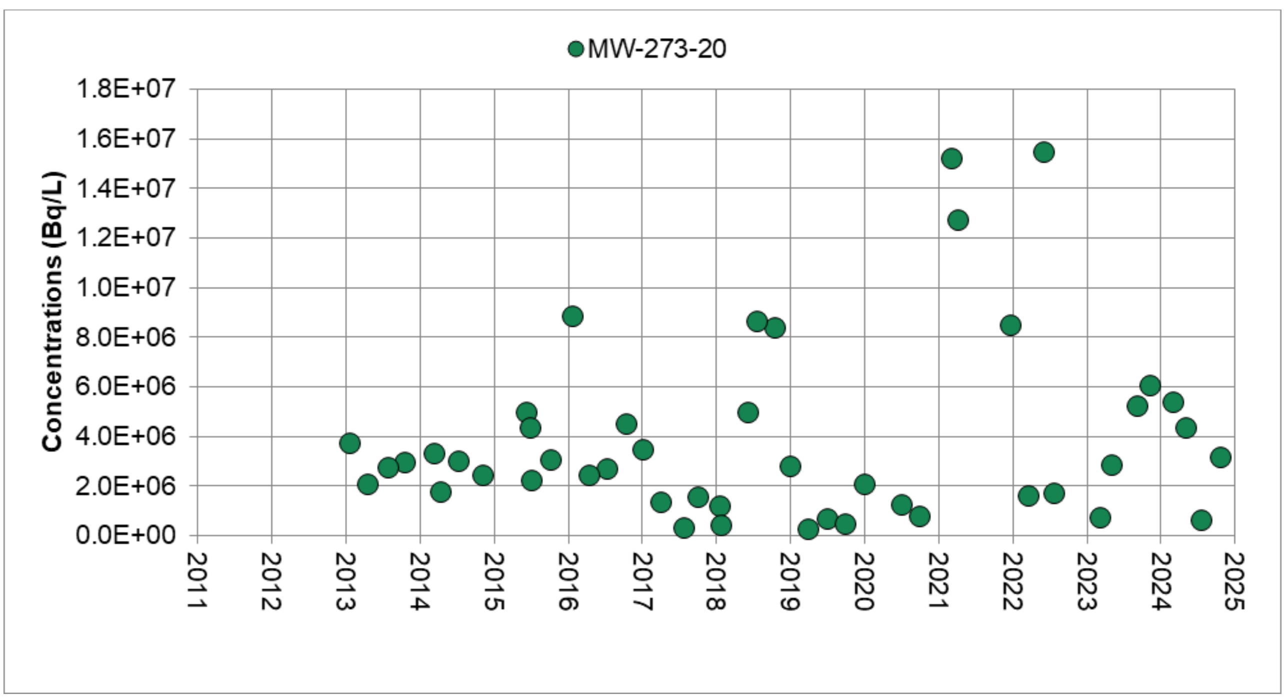
Graph 3: Tritium Concentrations at Vacuum Building Ramp Sump



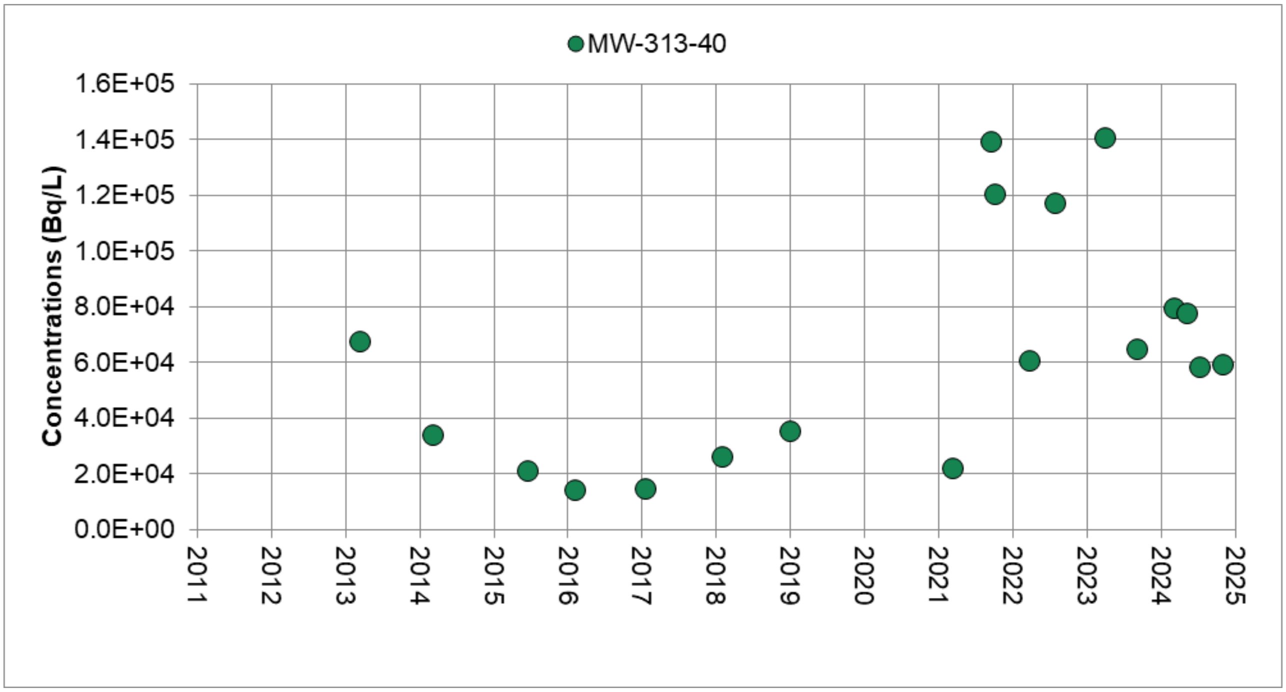
Graph 4: Tritium Concentrations at MW-243-29



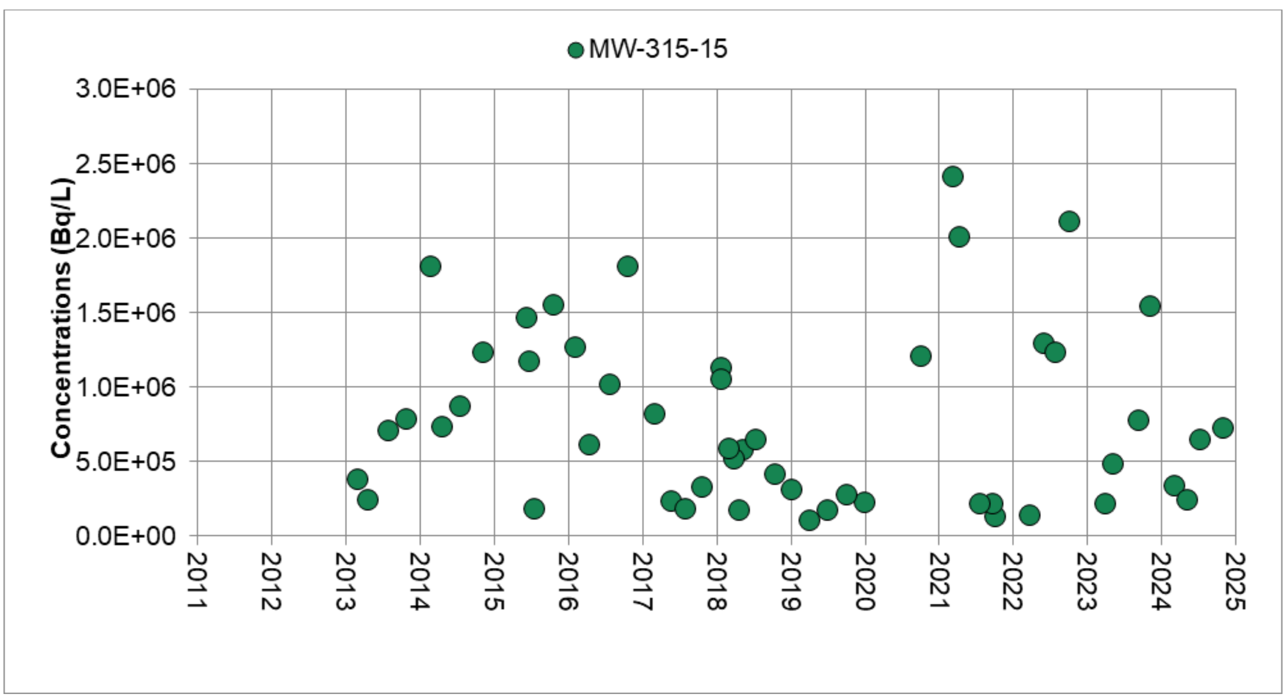
Graph 5: Tritium Concentrations at MW-270-20



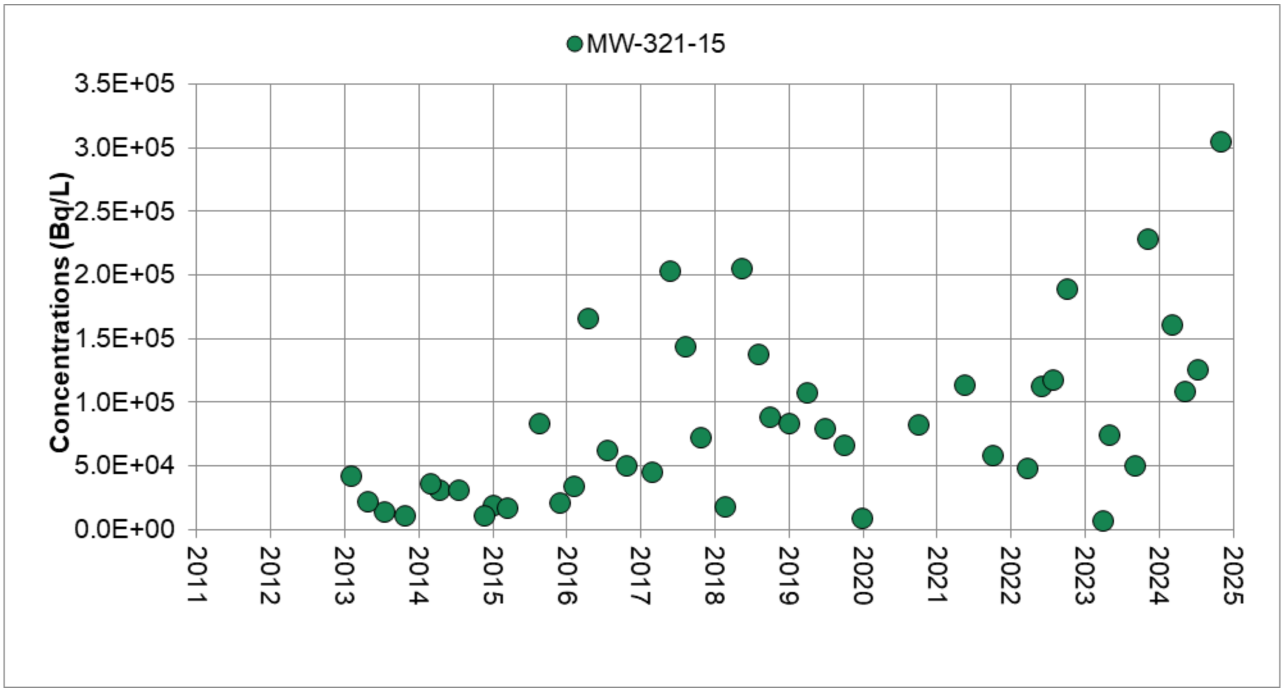
Graph 6: Tritium Concentrations at MW-273-20



Graph 7: Tritium Concentrations at MW-313-40



Graph 8: Tritium Concentrations at MW-315-15

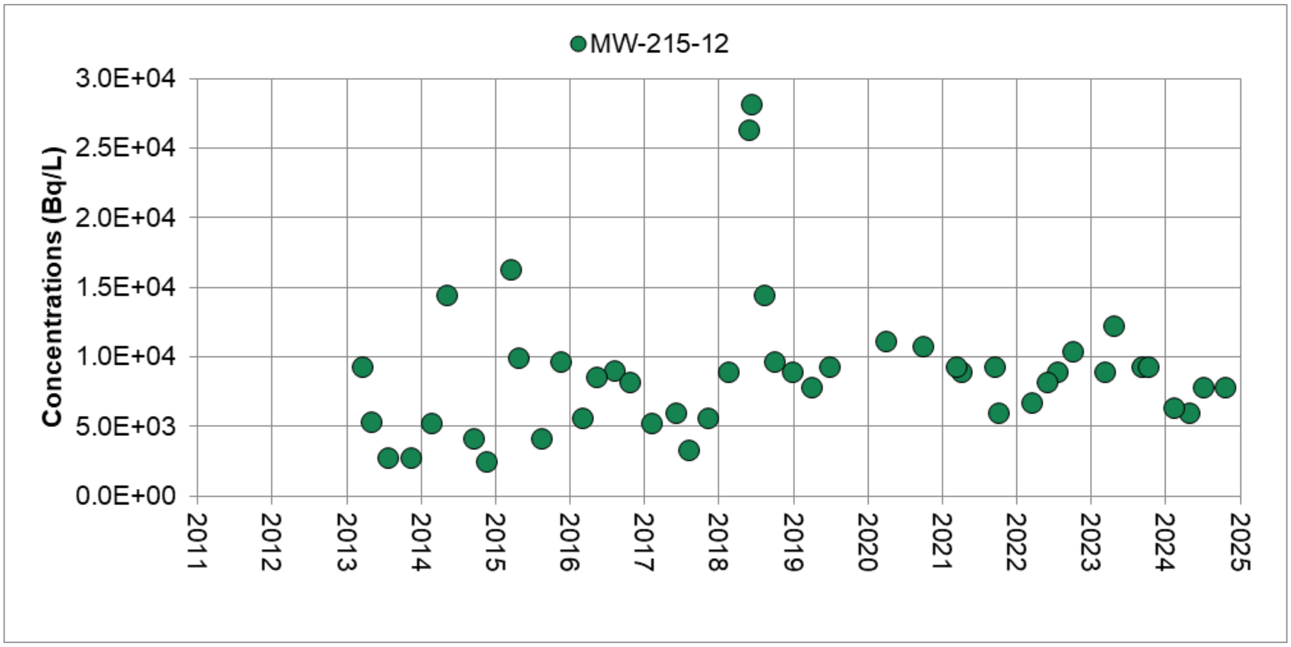


Graph 9: Tritium Concentrations at MW-321-15

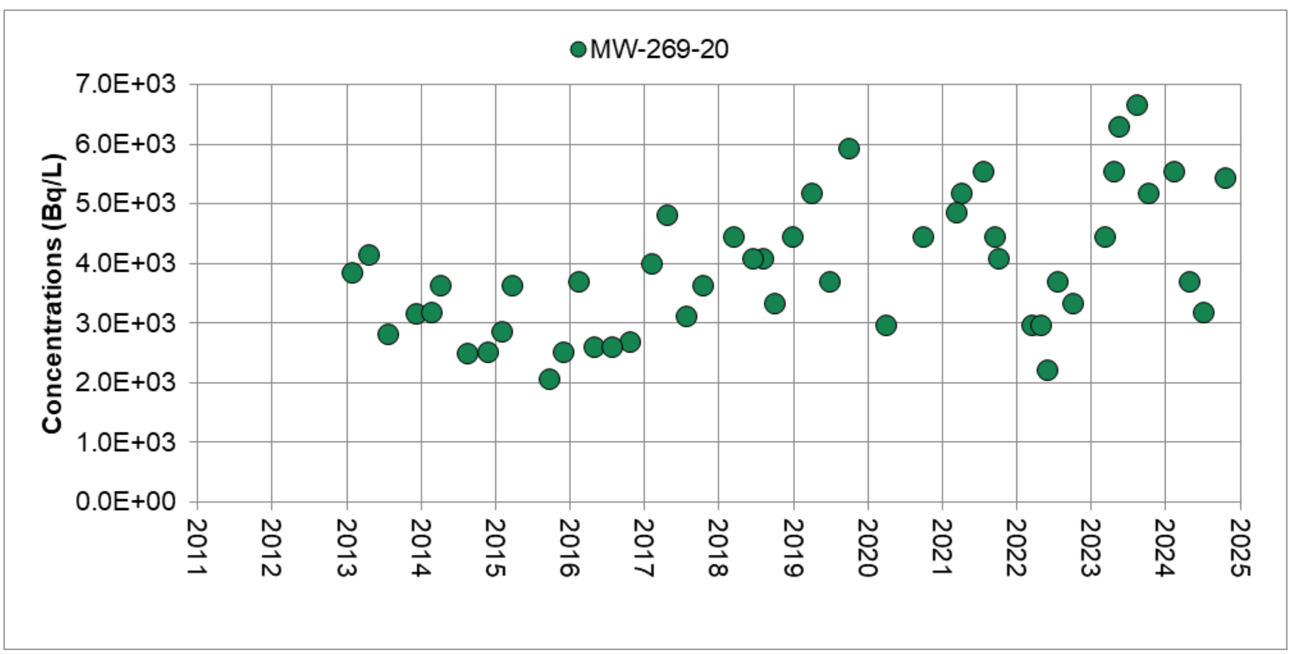
U3 and U4 Area

Tritium concentrations at MW-269-20 (within the vicinity of U4) demonstrate an increasing trend according to the Mann Kendall statistical analysis; however, as shown in Figure 6, the tritium concentrations at this well in 2024 are consistent with the concentrations observed at nearby wells and groundtubes near U3 and U4, and fall within ranges that reflect routine operations at the site. Therefore, the statistical trend does not represent a new source or an increased risk to groundwater or surface water quality at the site. Monitoring will continue at these locations to observe the fluctuations in tritium within groundwater.

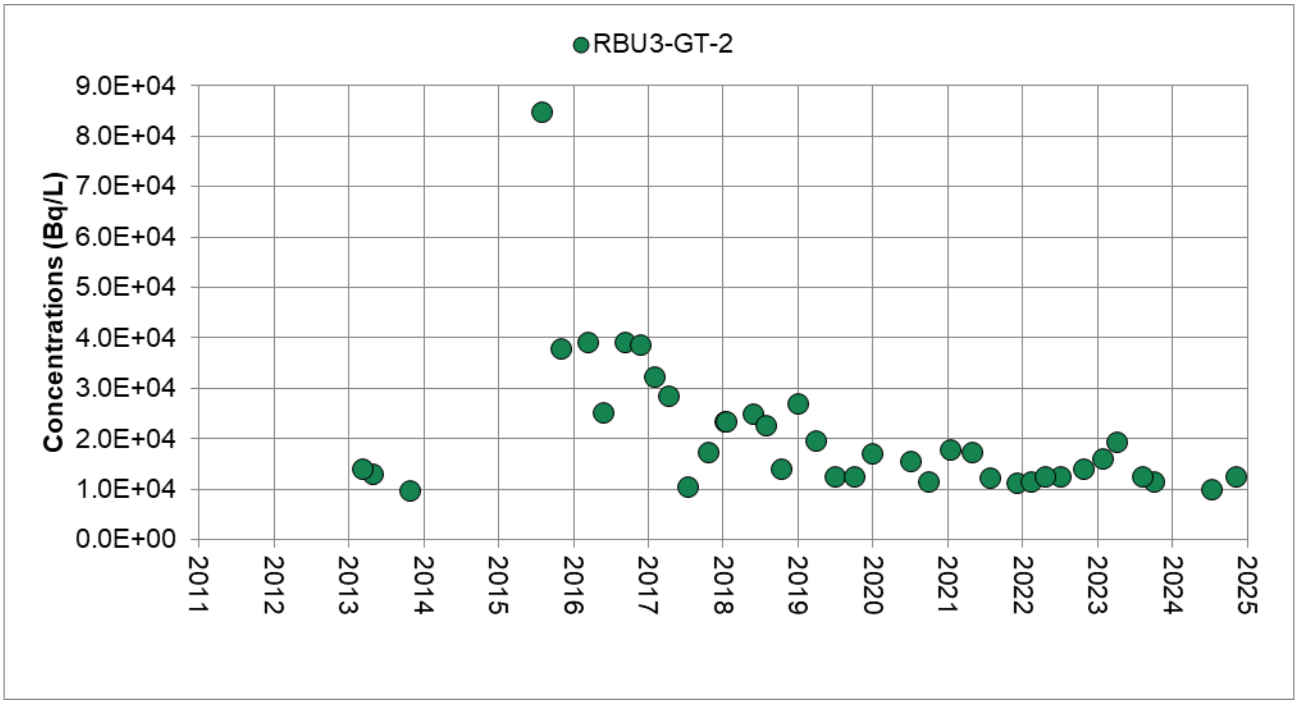
Graph 10 to Graph 13 illustrate the results for selected monitoring wells and groundtubes within the vicinity of U3 and U4.



Graph 10: Tritium Concentrations at MW-215-12



Graph 11: Tritium Concentrations at MW-269-20



Graph 12: Tritium Concentrations at RBU3-GT-2

3.1.1.2 U5-8 Reactor Building Area Overview

The 2024 groundwater sampling results in the area of U5-8 are presented in Table A-2 (Appendix A). Distributions of the annual maximum tritium concentrations in the area of U5-8 within HU1-3, HU 6, and HU 7 are presented in Figure 10 to Figure 12, respectively.

Key sampling locations are discussed in further detail below by specific area.

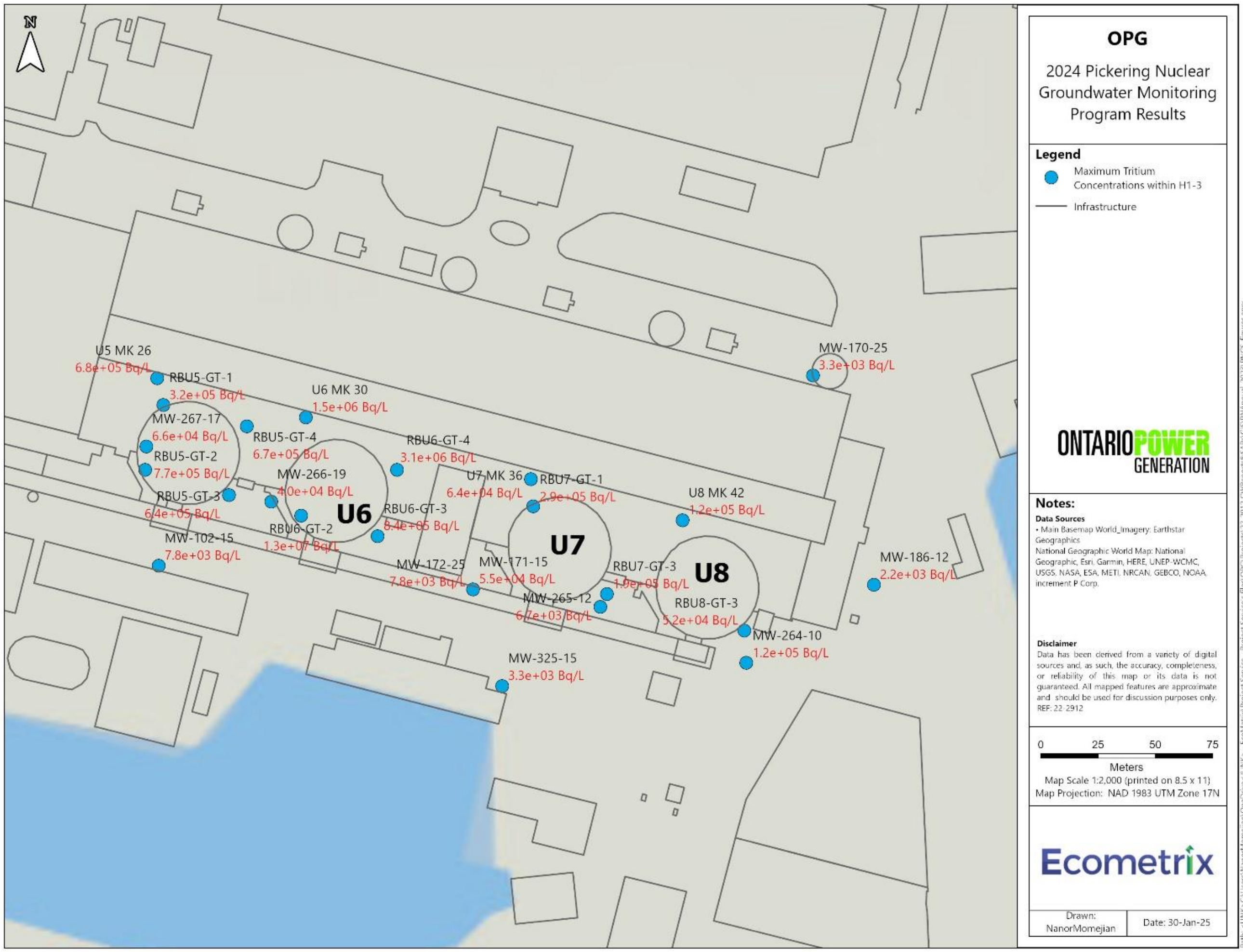


Figure 10: 2024 Annual Maximum Tritium Concentrations in HU 1-3, Unit 5 to 8, and IFB-B

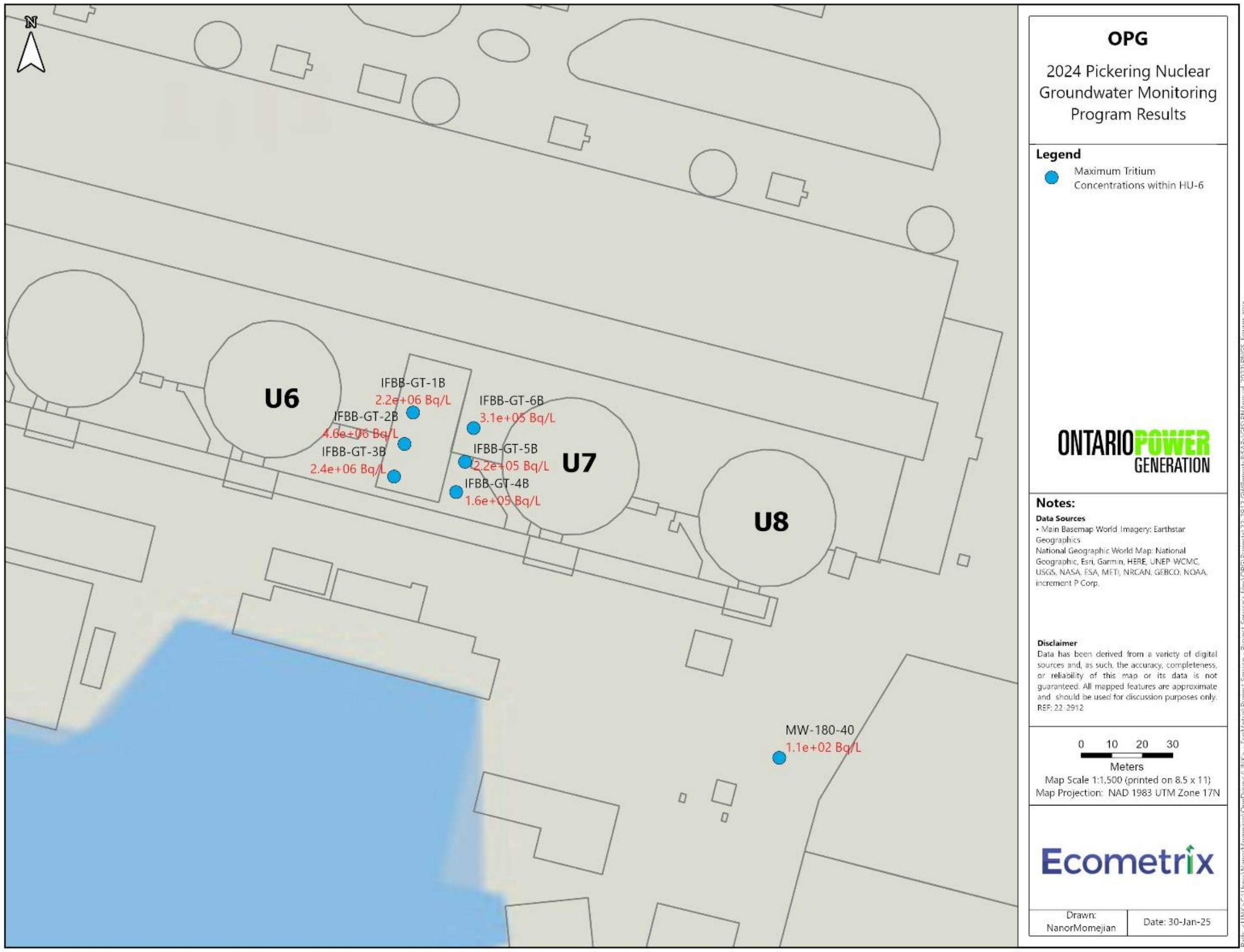


Figure 11: 2024 Annual Maximum Tritium Concentrations in HU 6, Unit 5 to 8, and IFB-B

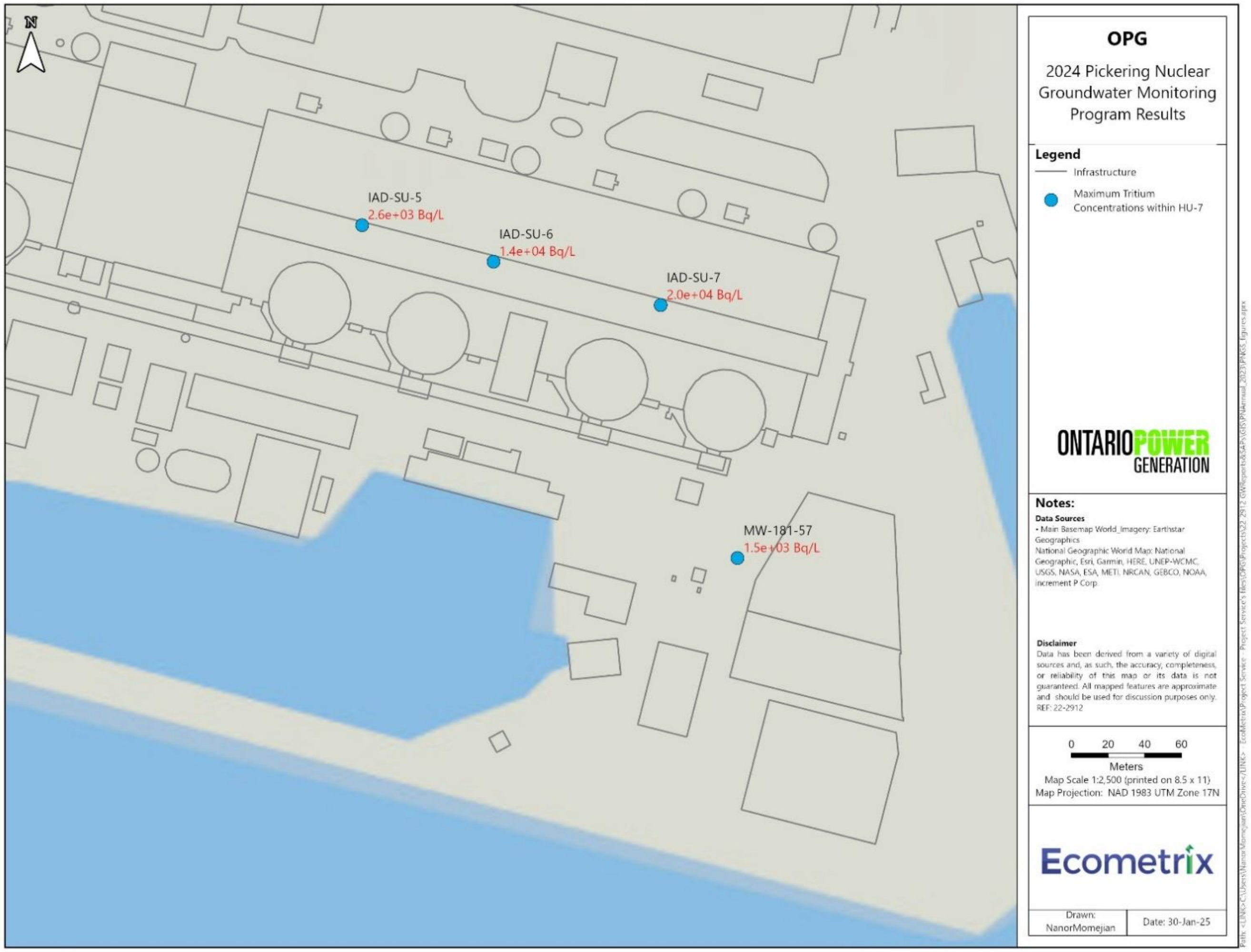


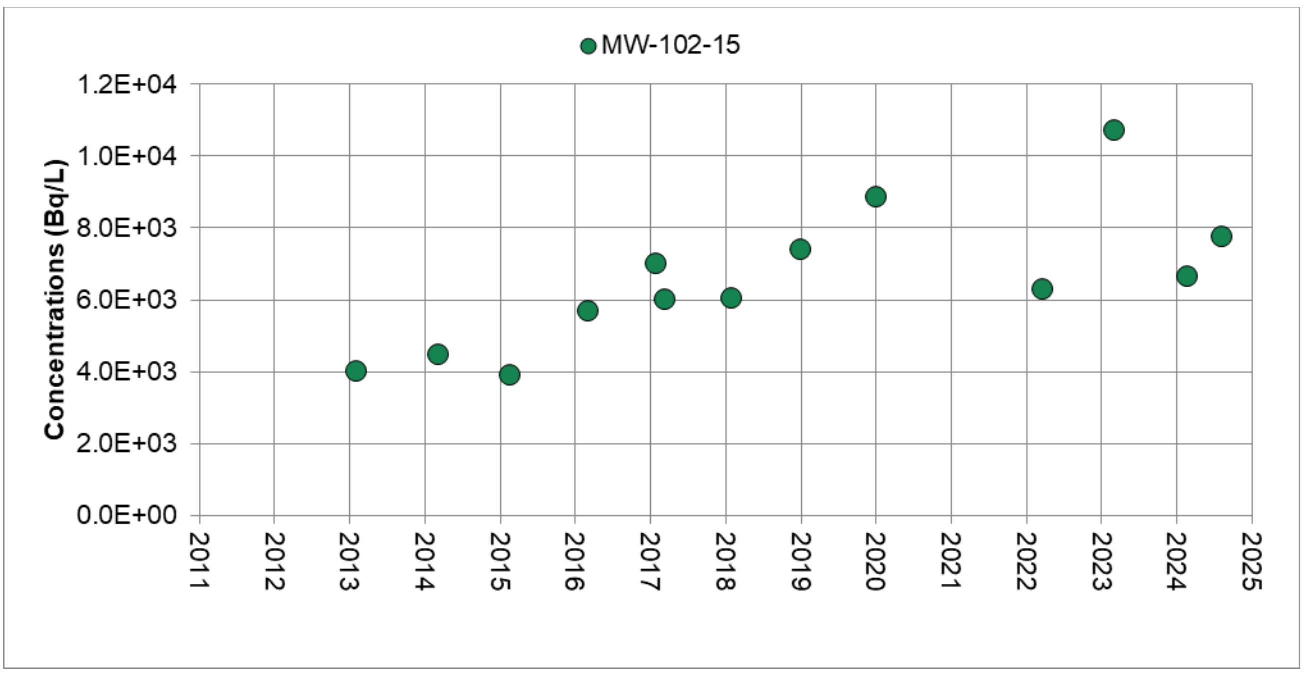
Figure 12: 2024 Annual Maximum Tritium Concentrations in HU 7, Unit 5 to 8

U5 and U6 Area

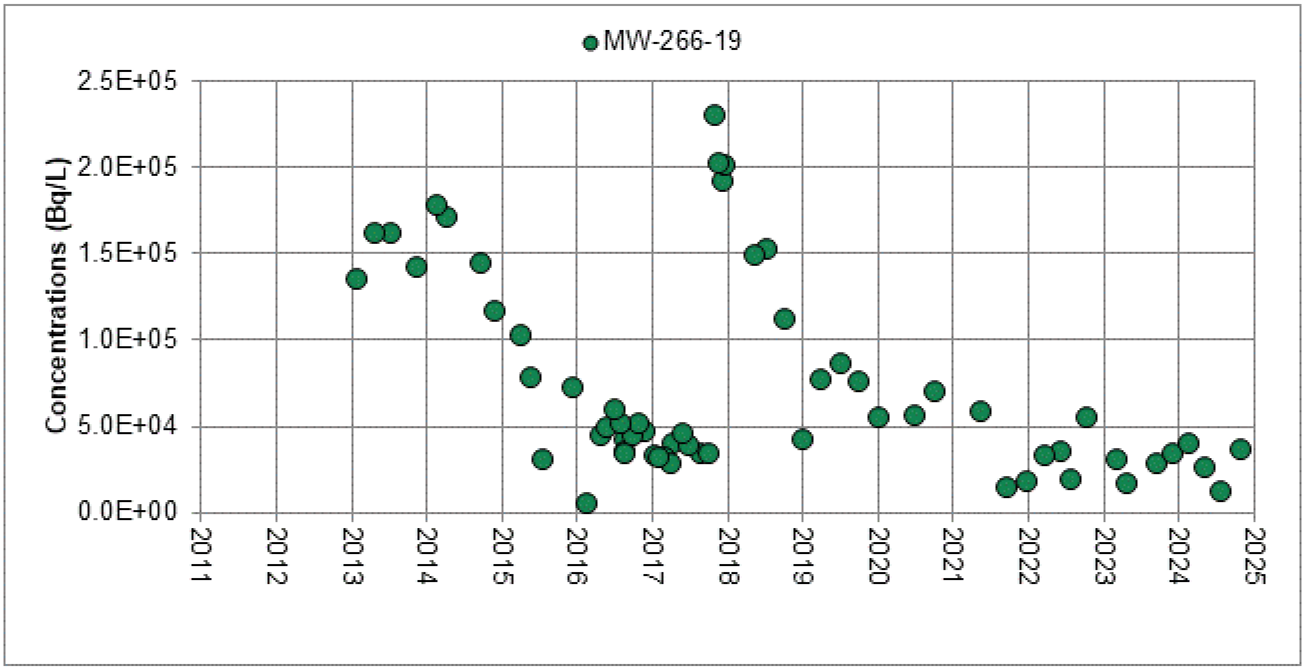
According to Mann Kendall statistical analysis, there is an overall increasing trend in tritium concentrations at MW-102-15 between 2013 and 2024; however, the tritium concentration trend has been stabilized since 2020. The tritium concentrations at this well in 2024 are consistent with the concentrations observed at nearby wells and groundtubes near U5 and U6 and fall within ranges that reflect routine operations at the site. These observations do not indicate any additional risk to the environment.

Tritium concentrations in the other monitoring wells, groundtubes, and RB foundation drain sumps are within historical concentrations reflective of routine operations. Groundwater in these locations will continue to be monitored.

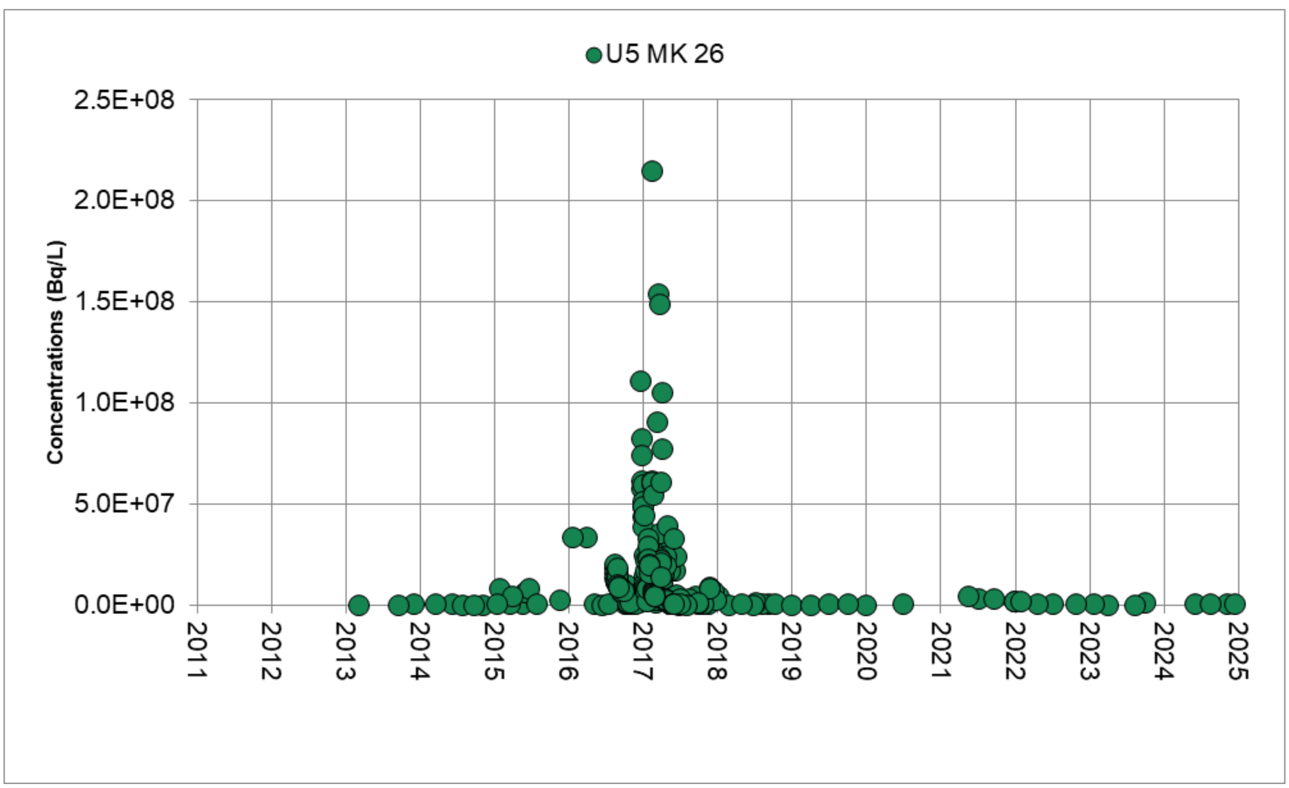
Graph 13 to Graph 20 present data from MW-264-10, the U5 and U6 RB foundation drains, selected groundtubes (RBU5-GT-1 to RBU5-GT-4), and MW-267-17.



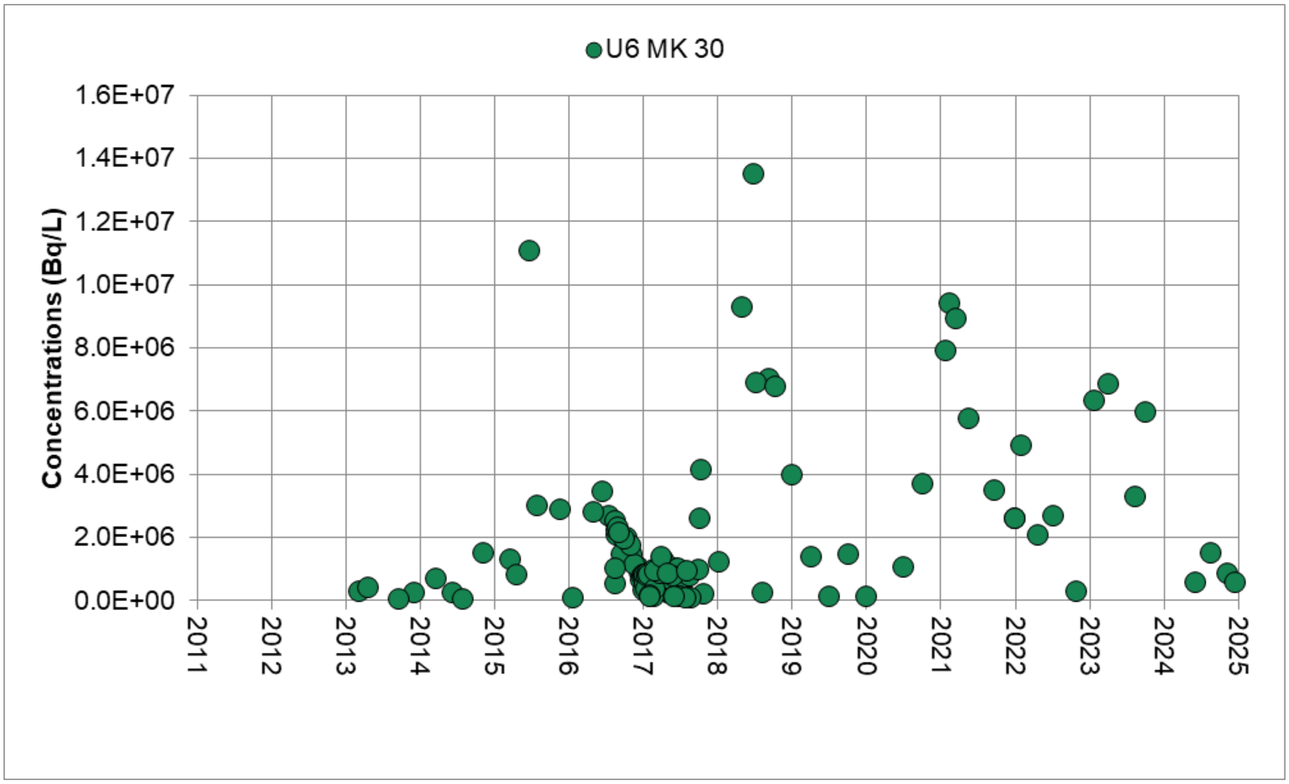
Graph 13: Tritium Concentrations at MW-102-15



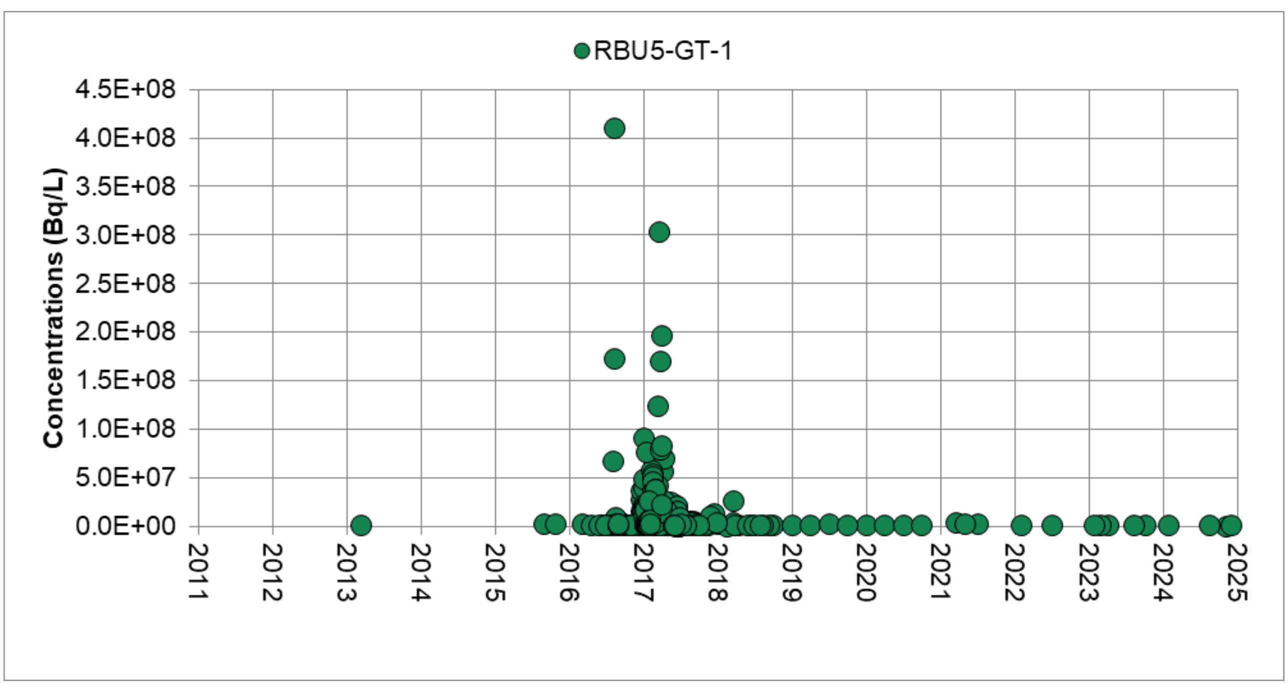
Graph 14: Tritium Concentrations at MW-266-19



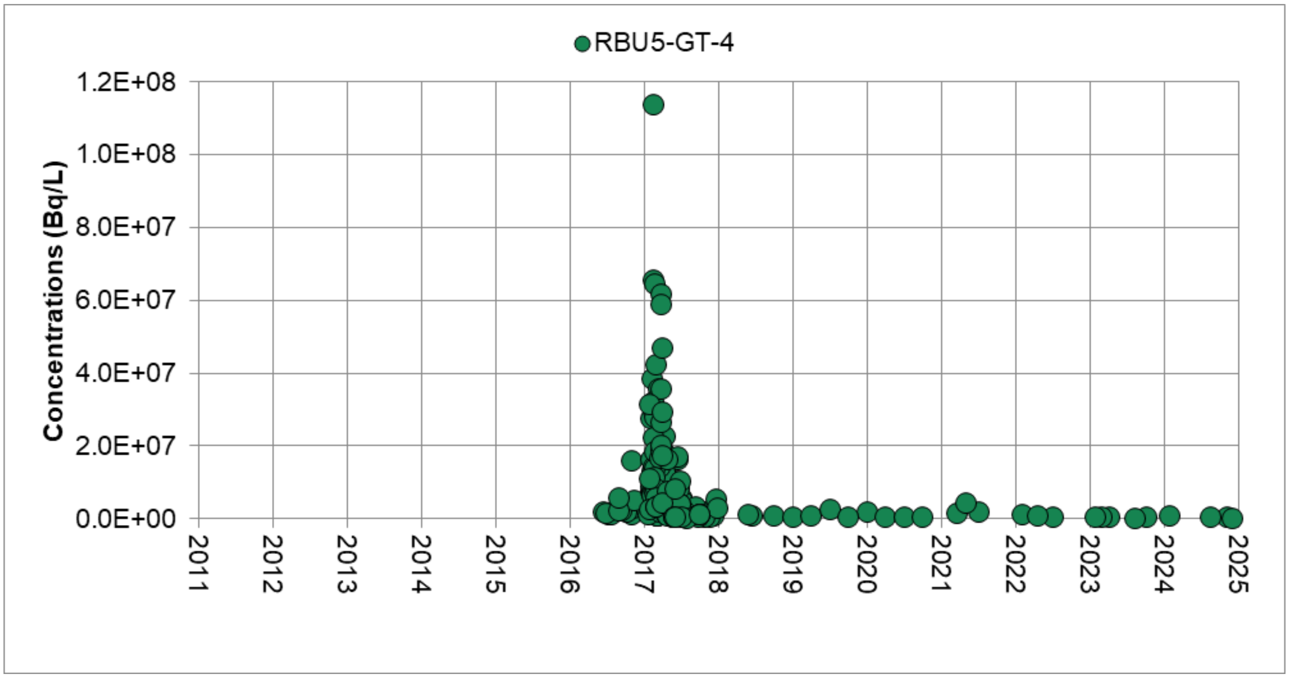
Graph 15: Tritium Concentrations at U5 MK 26



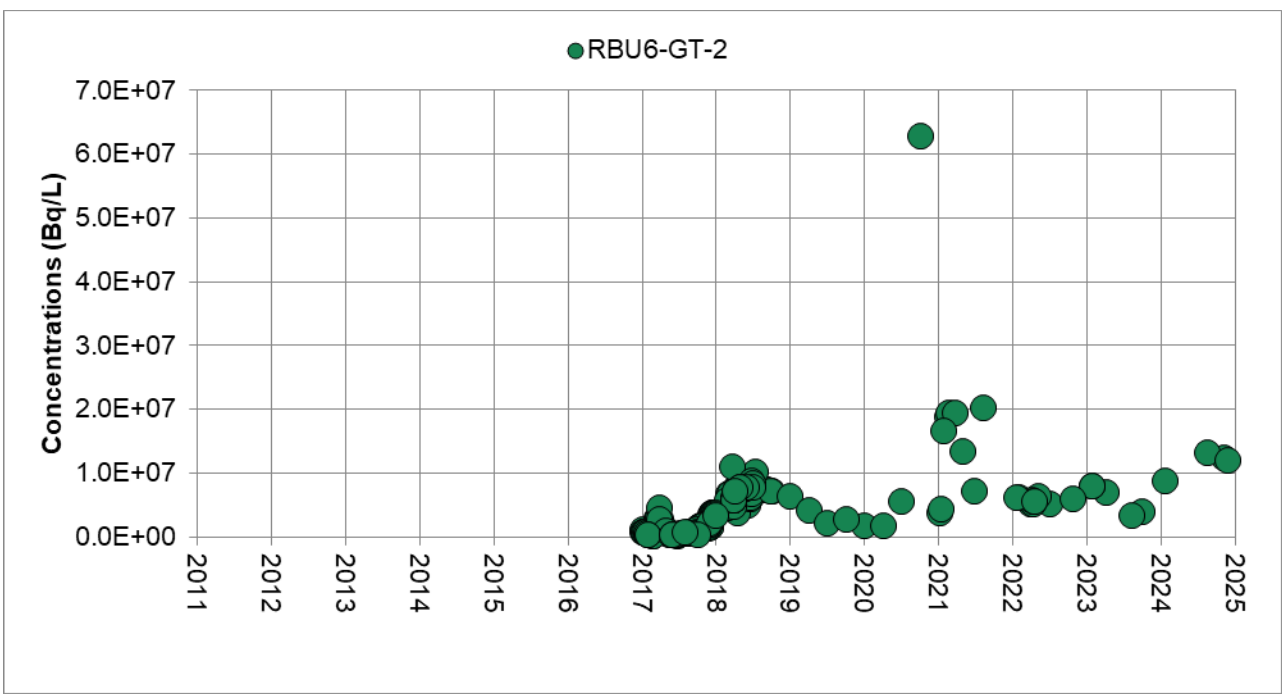
Graph 16: Tritium Concentrations at U6 MK 30



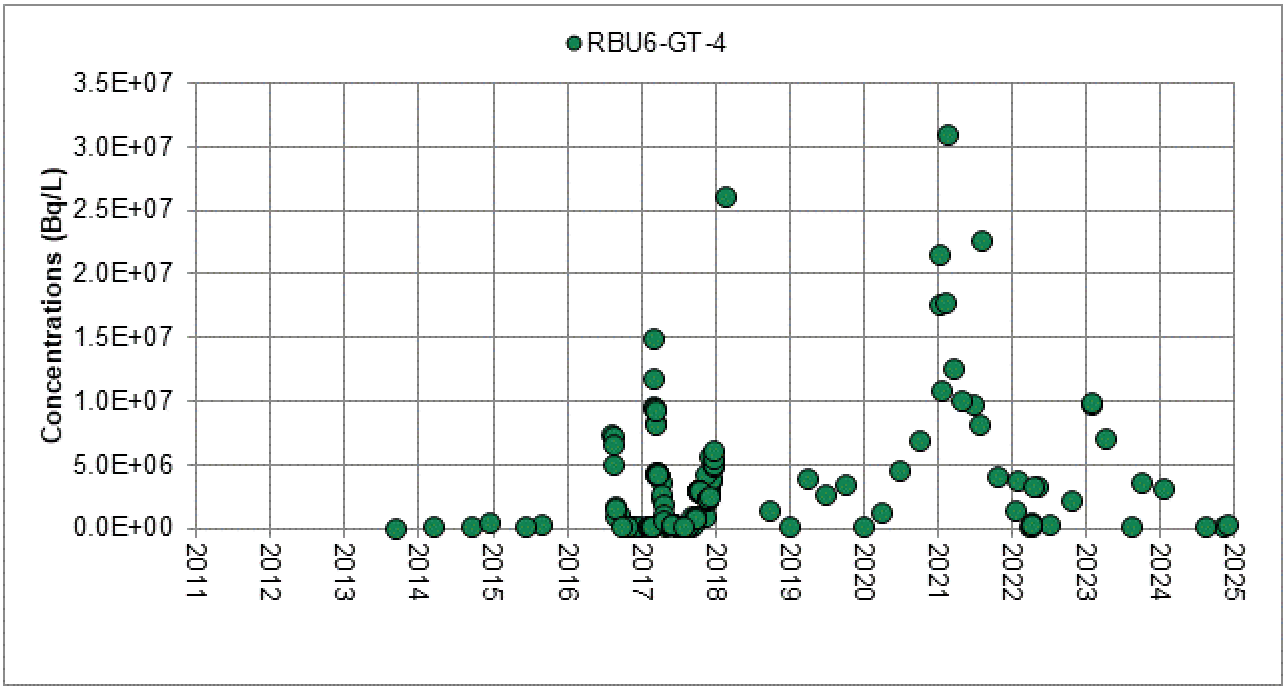
Graph 17: Tritium Concentrations at RBU5-GT-1



Graph 18: Tritium Concentrations at RBU5-GT-4



Graph 19: Tritium Concentrations at RBU6-GT-2



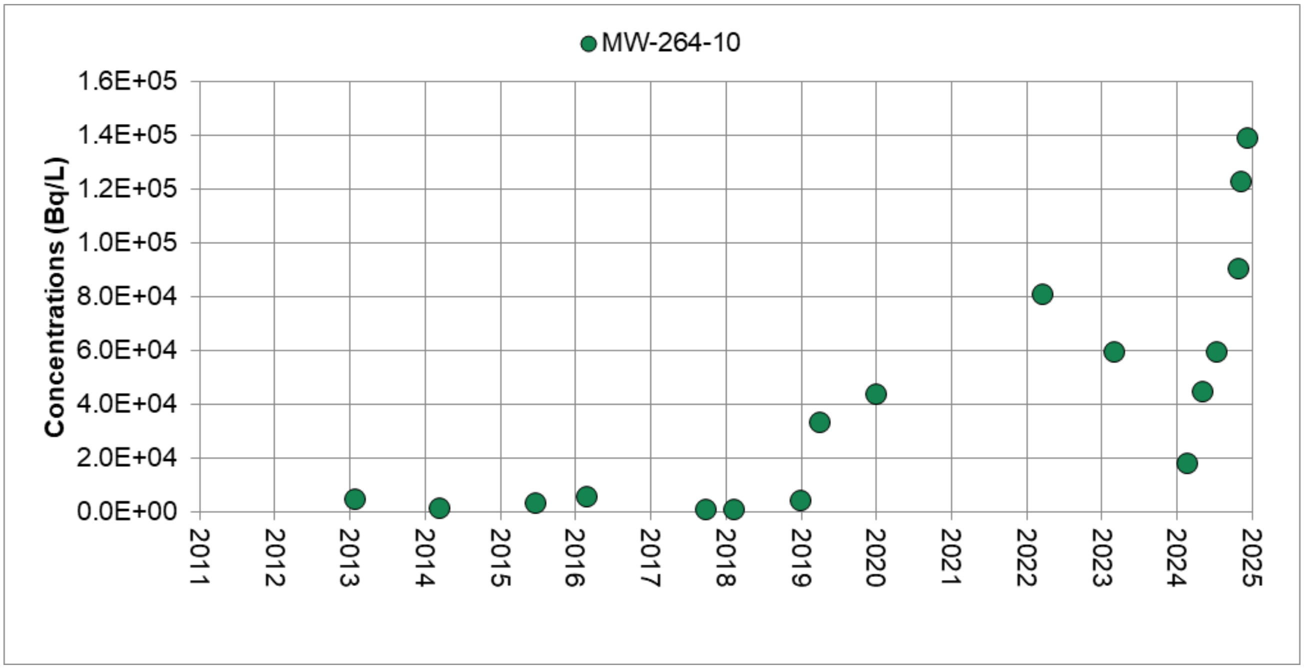
Graph 20: Tritium Concentrations at RBU6-GT-4

U7 and U8 Area

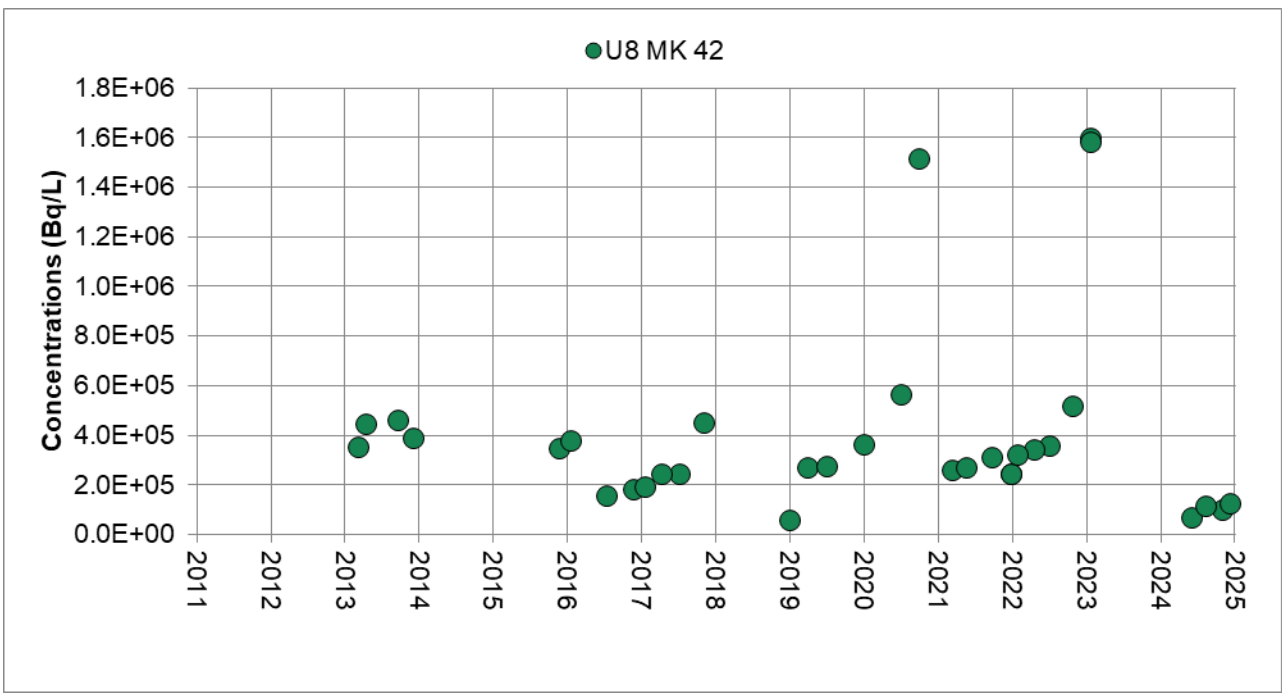
Increasing tritium concentrations were noted using the Mann Kendall statistical analysis at the monitoring well MW-264-10, located southeast of U8. Meanwhile, MW-181-57 located near U8, shows no trend. The concentrations at both wells are still several orders of magnitude below the risk-based evaluation criteria applicable for the site. As such, off-site impacts to end-use are not expected based on the 2024 tritium concentrations. Further monitoring is in progress to evaluate tritium concentrations in groundwater at this well.

The 2024 tritium concentrations from the U7 and U8 groundtubes as well as the remaining wells monitored within the U7 and U8 area remain within a range considered to reflect fluctuations associated with routine operations. Groundwater in the U8 area will continue to be monitored.

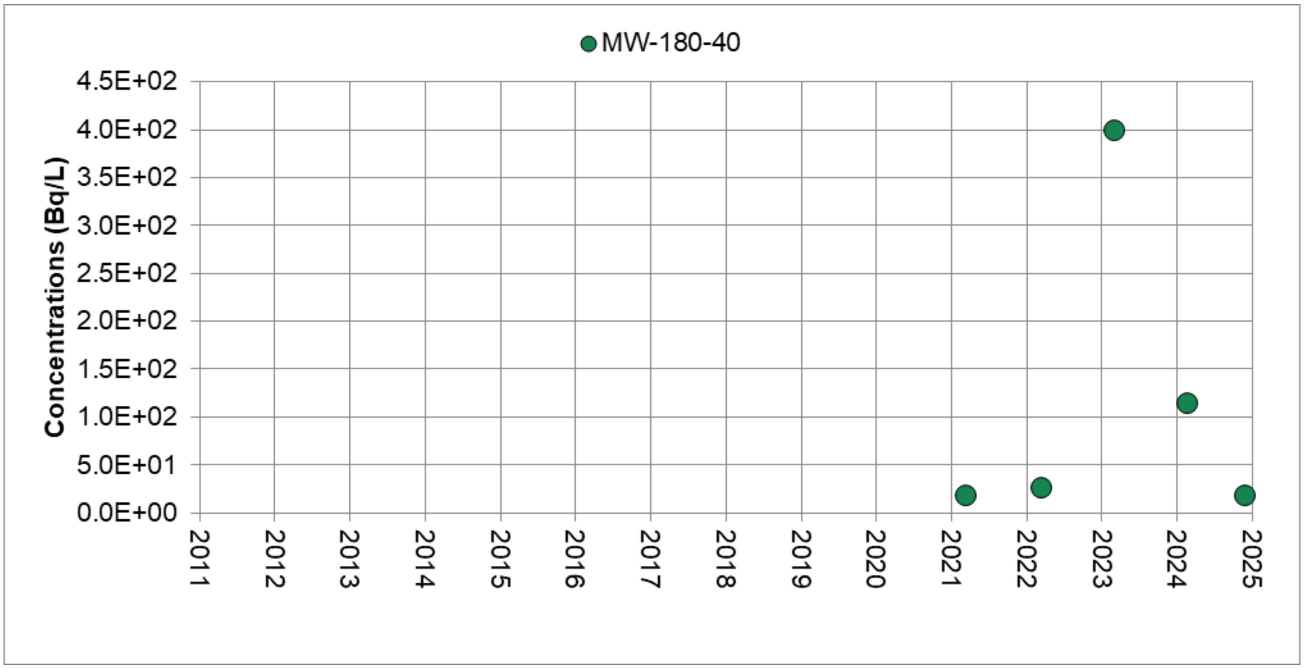
Graph 21 to Graph 24 illustrate the data for RBU7-GT-1, RBU7-GT-3, U7 MK36, MW-265-12, and MW-325-15.



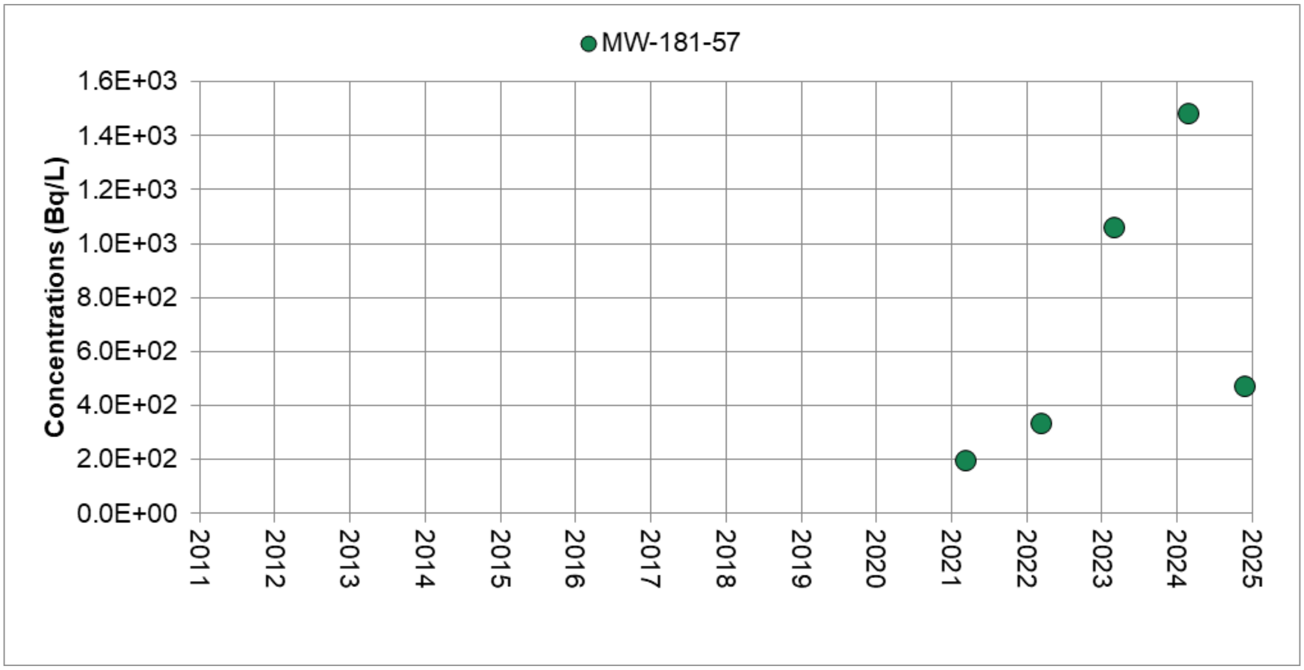
Graph 21: Tritium Concentrations at MW-264-10



Graph 22: Tritium Concentrations at U8 MK 42



Graph 23: Tritium Concentrations at MW-180-40



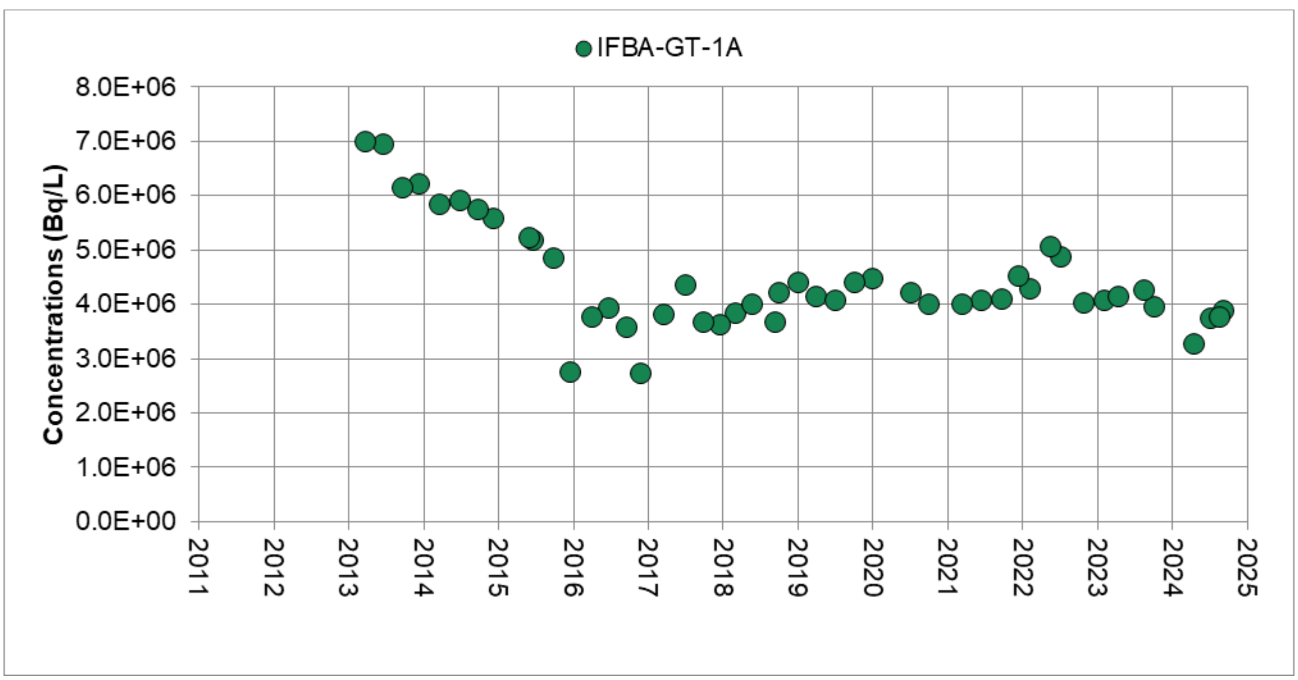
Graph 24: Tritium Concentrations at MW-181-57

3.1.1.3 Irradiated Fuel Bay Areas

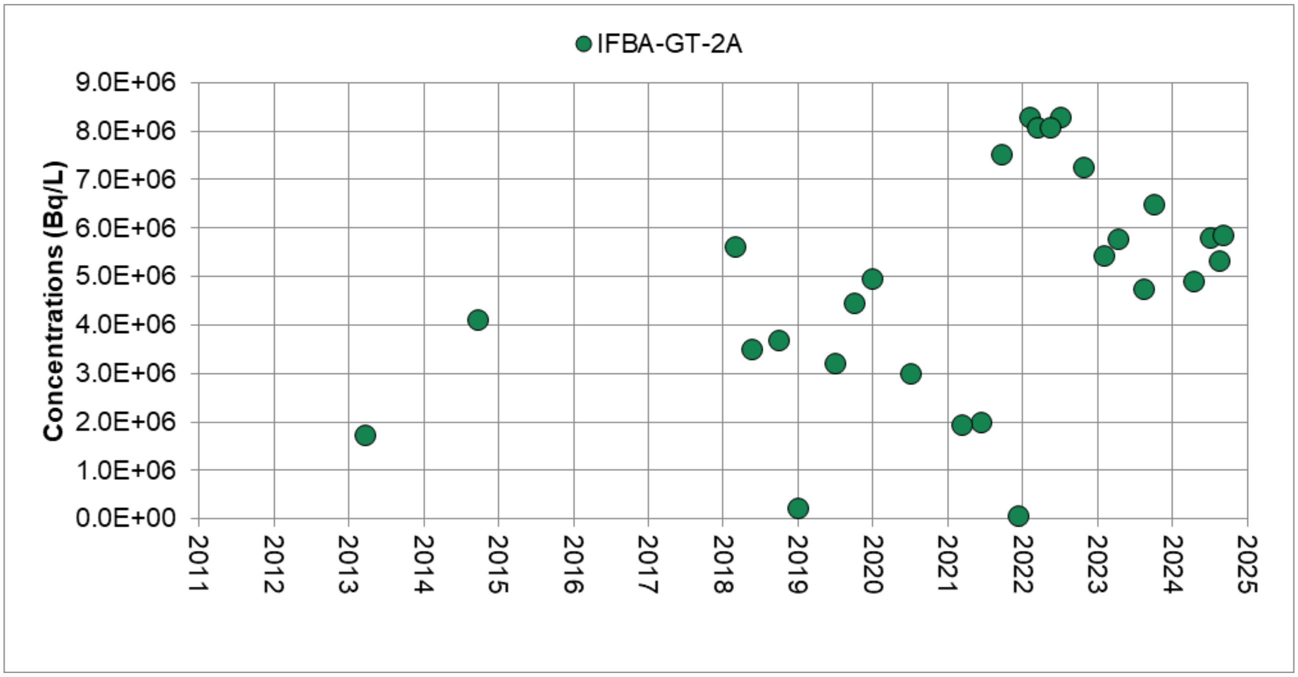
IFB-A

Historically, the eastern groundtubes (IFBA-GT-1A and IFBA-GT-2A) showed higher tritium concentrations compared to IFBA-GT-4A and IFBA-GT-5A to the west. In 2024, IFBA-GT-5A demonstrated a decreasing trend, while tritium concentrations within IFBA-GT-2A demonstrated an increasing trend. MW-244-18, which is in the vicinity of the IFBs, is still demonstrating an increasing trend when considering concentrations since 2013; however, concentrations in 2024 show a decreasing trend since 2022. Increased tritium concentrations within the eastern IFBs and MW-244-18 are expected as a component tritiated groundwater from the 2020 and 2023 heavy water leaks at U1 area migrates toward the U1-U4 IFB-A and TAB foundation drains. Therefore, the statistical trend does not represent a new source or an increased risk to groundwater or surface water quality.

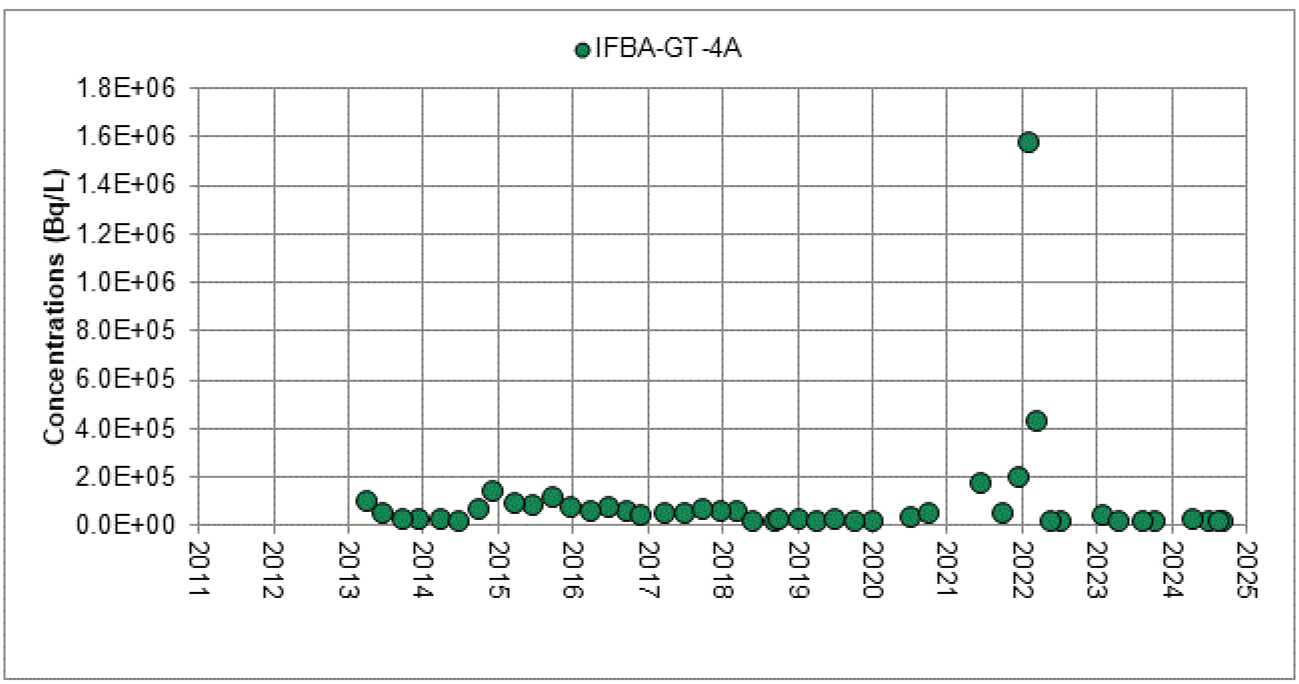
Tritium concentrations over time for the IFB-A groundtubes and MW-244-18 are presented in Graph 25 to Graph 29. The 2024 tritium sample results are presented in Table A-3 (Appendix A). Figure 13 and Figure 14 also display the annual maximum tritium distributions of U1-4 IFBs in HU 1-3 and HU 6, respectively.



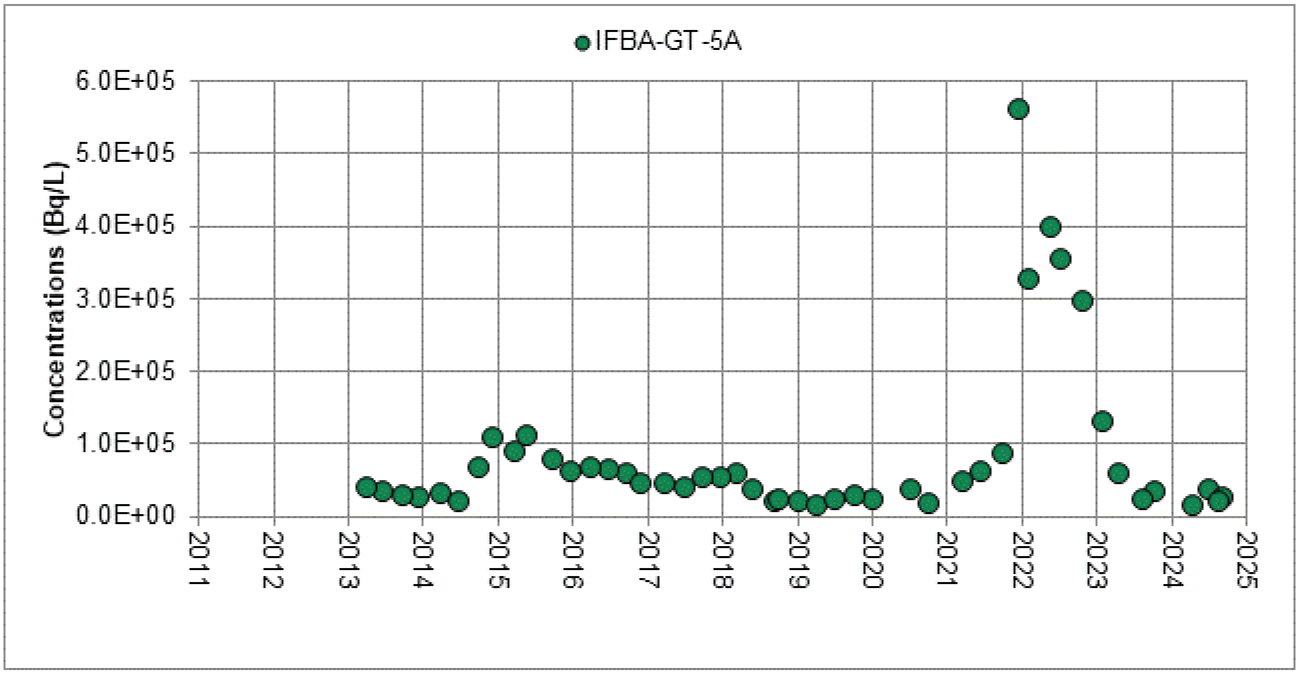
Graph 25: Tritium Concentrations at IFBA-GT-1A



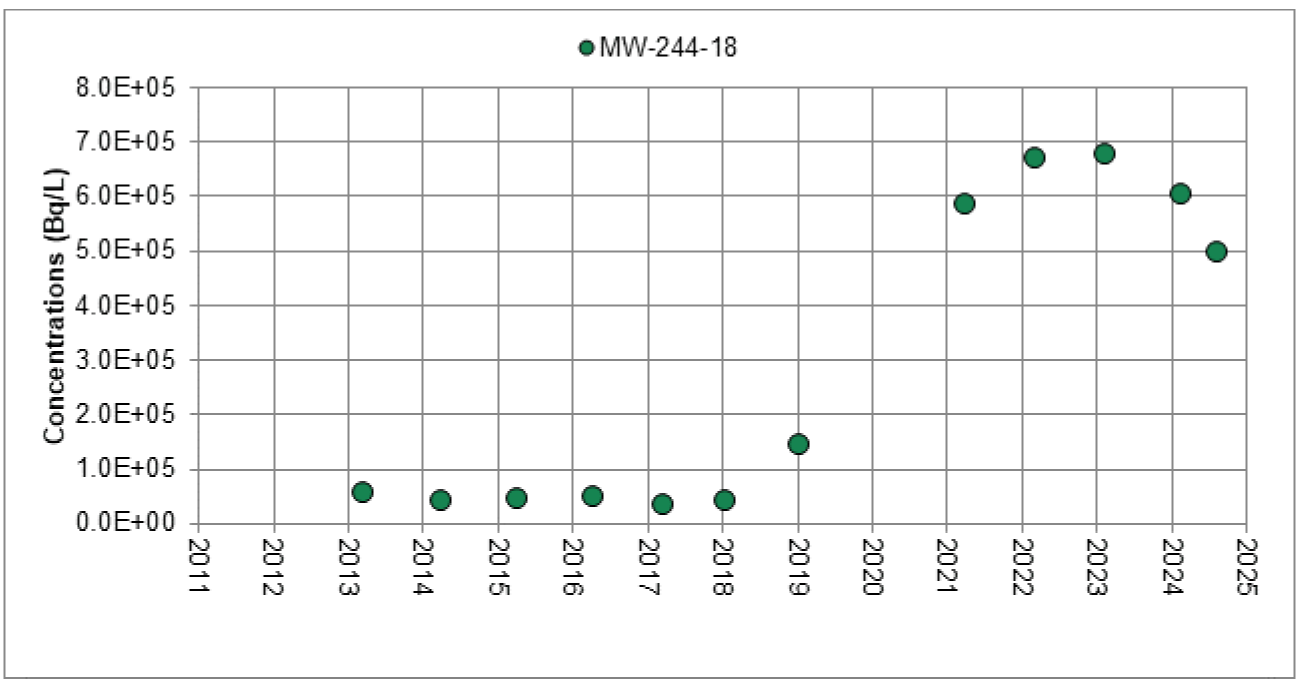
Graph 26: Tritium Concentrations at IFBA-GT-2A



Graph 27: Tritium Concentrations at IFBA-GT-4A



Graph 28: Tritium Concentrations at IFBA-GT-5A



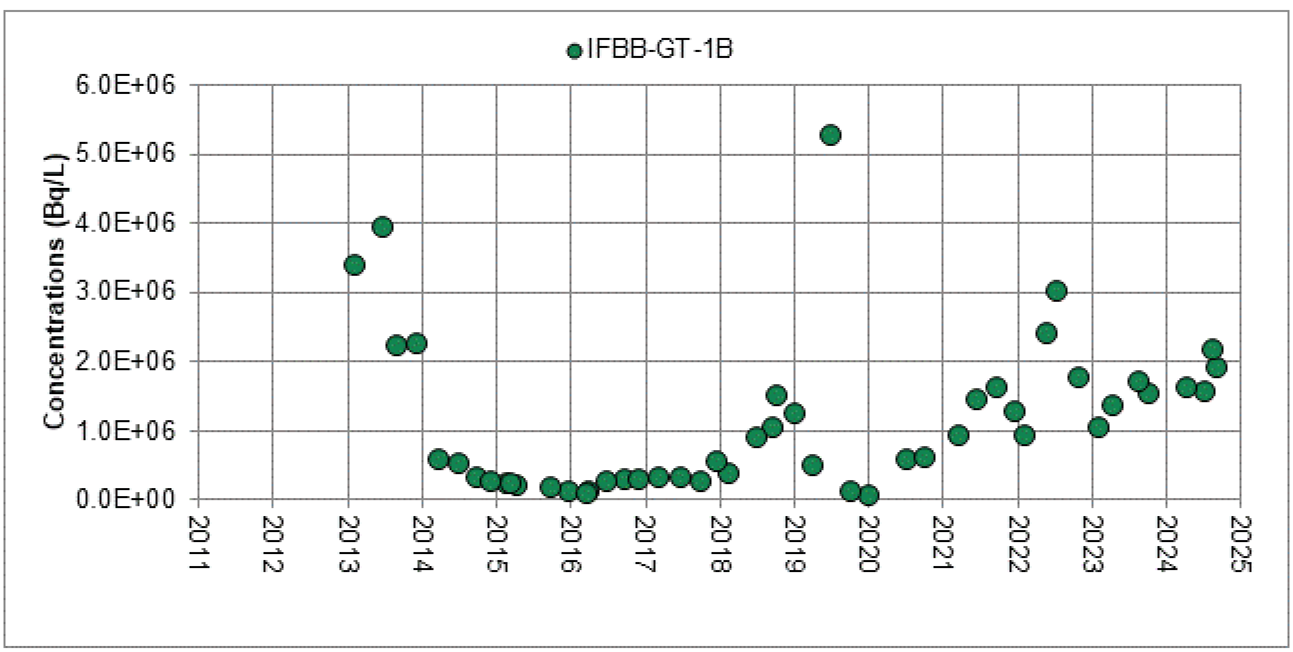
Graph 29: Tritium Concentrations at MW-244-18

IFB-B

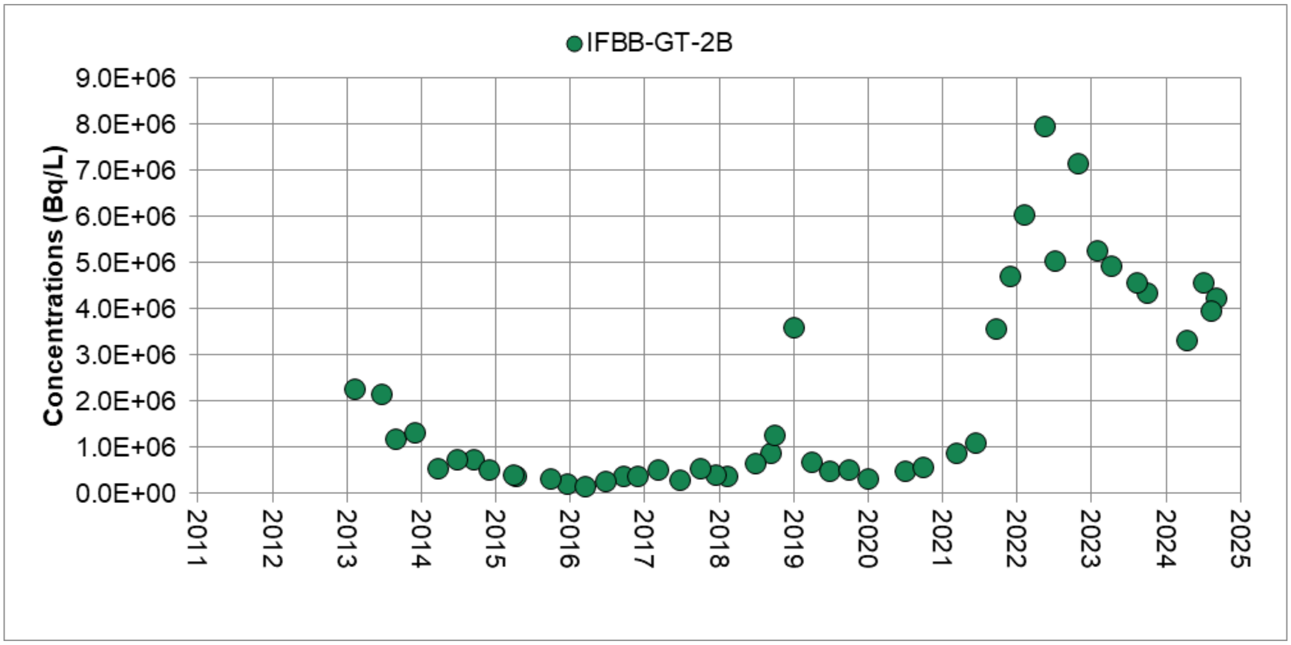
The groundwater results collected from sampling locations in the Irradiated Fuel Bay area located between U 6 and U 7 (IFB-B) are described below.

In 2024, tritium concentrations in the western groundtubes (IFBB-GT-1B, IFBB-GT-2B, and IFBB-GT-3B) demonstrate overall increasing trends over the period of record, although the 2024 concentrations are within the historical ranges observed at each groundtube, thus they do not pose additional risk to the environment. In addition, tritium concentrations in each of the eastern groundtubes (IFBB-GT-4B, IFBB-GT-5B, and IFBB-GT-6B) demonstrate stable trends with a slight increase at IFBB-GT-6B in Q3. A review of the available groundwater flow conditions suggests groundwater moves from U6, beneath the IFB-B area and ultimately towards the TAB inactive drainage (IAD) sumps. The tritium concentrations within the western IFB-B groundtubes and groundwater monitoring wells near the IFB-Bs are still within historical range. Groundwater quality in this area will continue to be monitored.

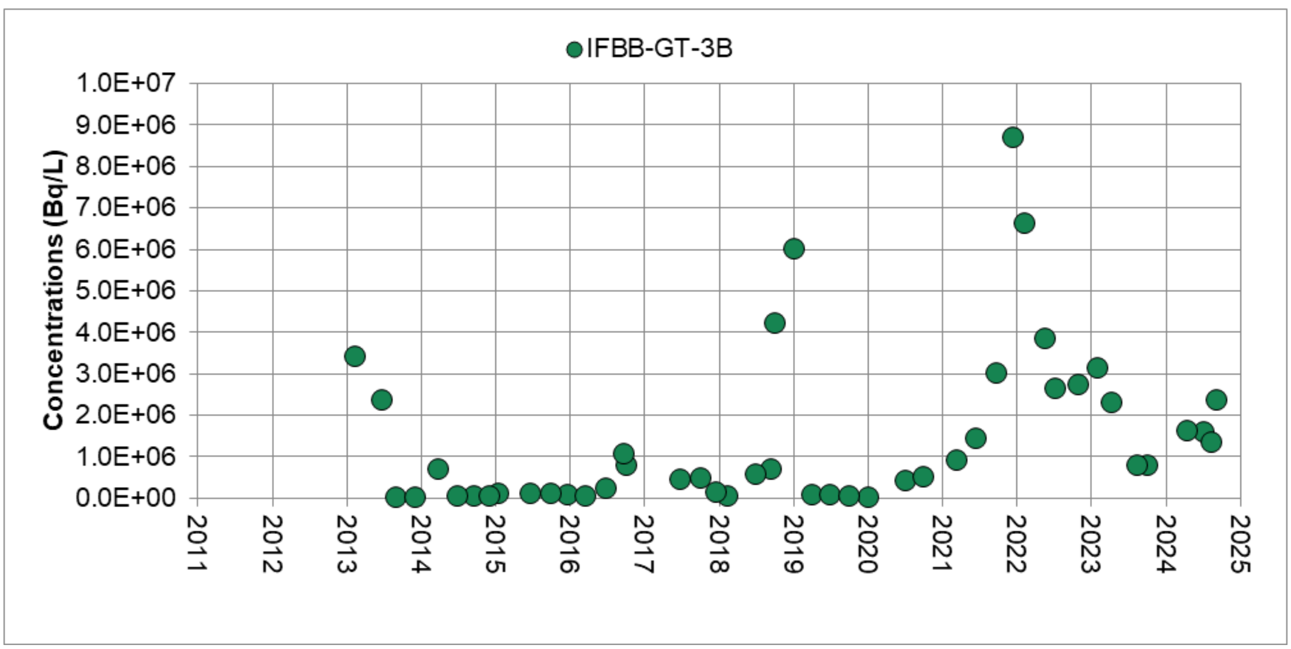
Tritium concentrations over time for the IFB-B groundtubes and monitoring wells are presented in Graph 30 to Graph 35. The 2024 tritium sample results are presented in Table A-3 (Appendix A). Figure 15 also displays tritium distributions of the U5-8 IFBs in HU 6.



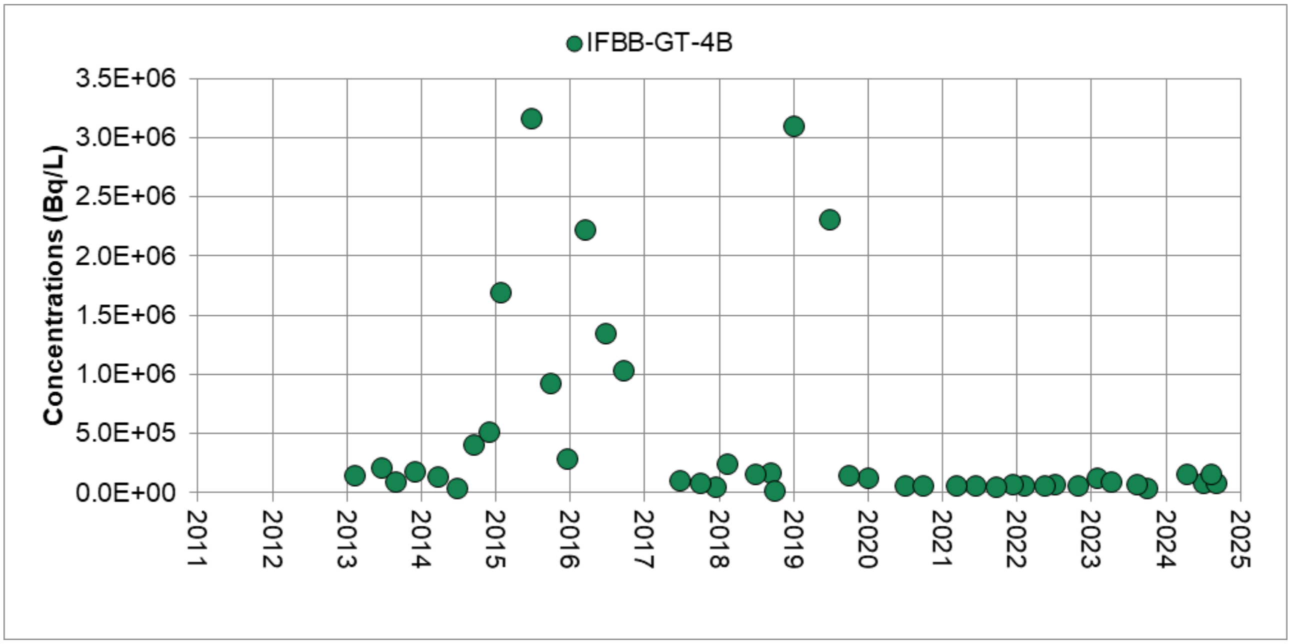
Graph 30: Tritium Concentrations at IFBB-GT-1B



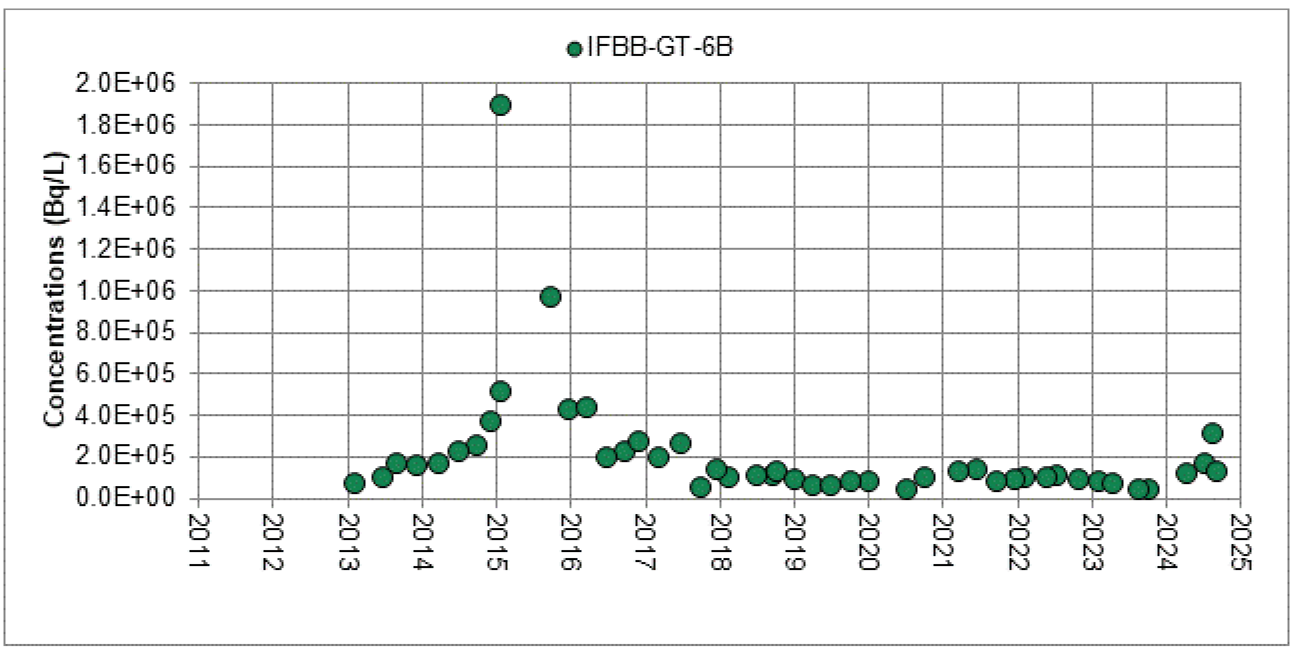
Graph 31: Tritium Concentrations at IFBB-GT-2B



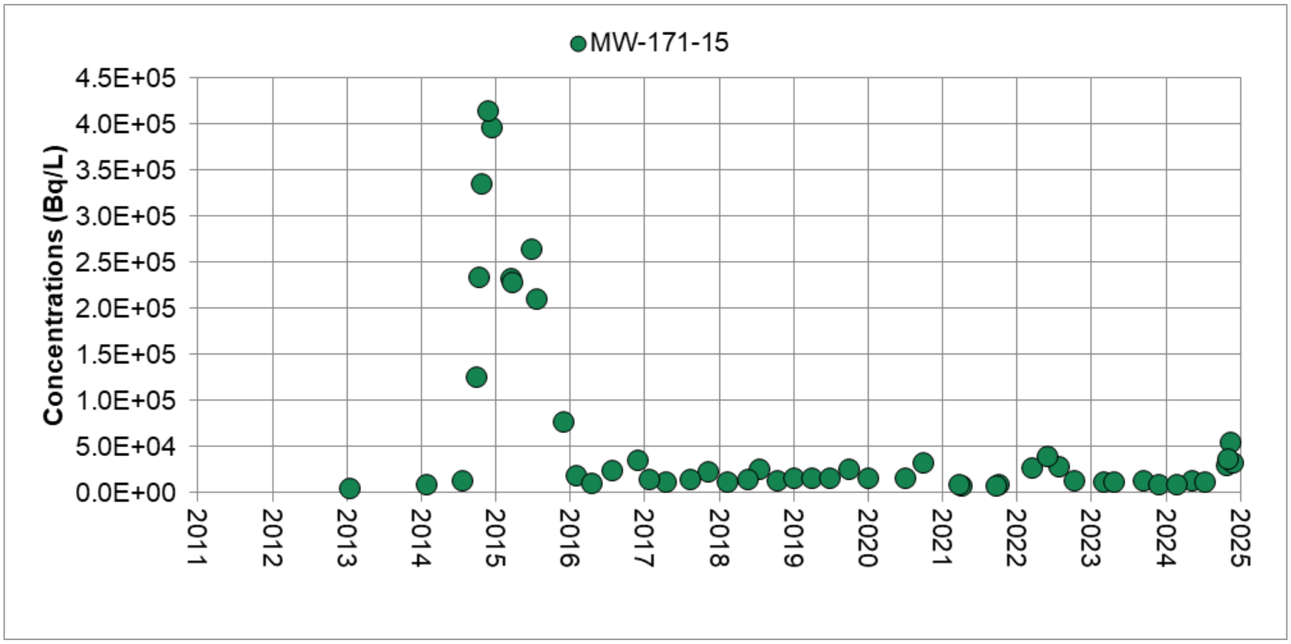
Graph 32: Tritium Concentrations at IFBB-GT-3B



Graph 33: Tritium Concentrations at IFBB-GT-4B



Graph 34: Tritium Concentrations at IFBB-GT-6B



Graph 35: Tritium Concentrations at MW-171-15

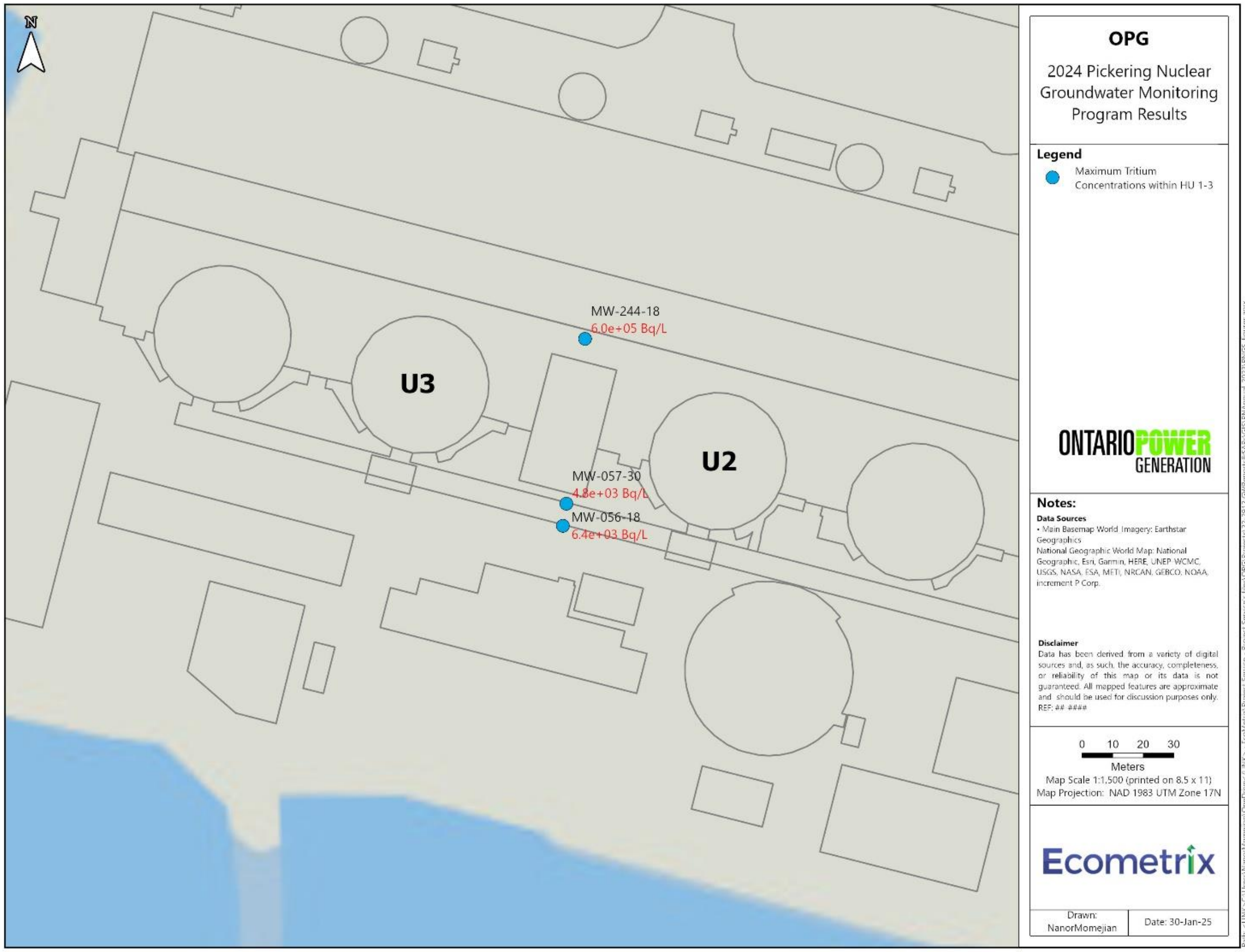


Figure 13: 2024 Annual Maximum Tritium Concentrations at IFB-A in HU 1-3

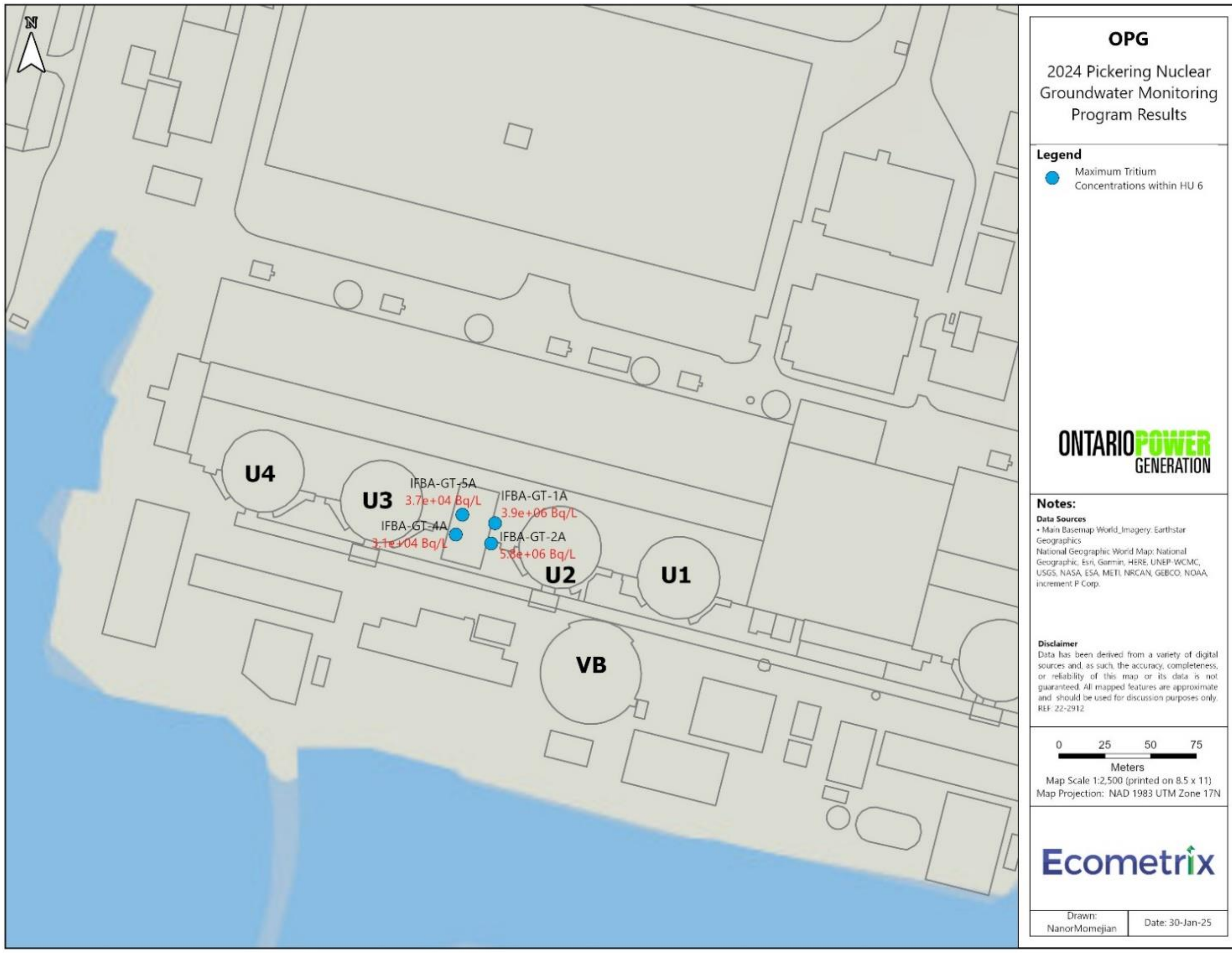


Figure 14: 2024 Annual Maximum Tritium Concentrations at IFB-A in HU 6

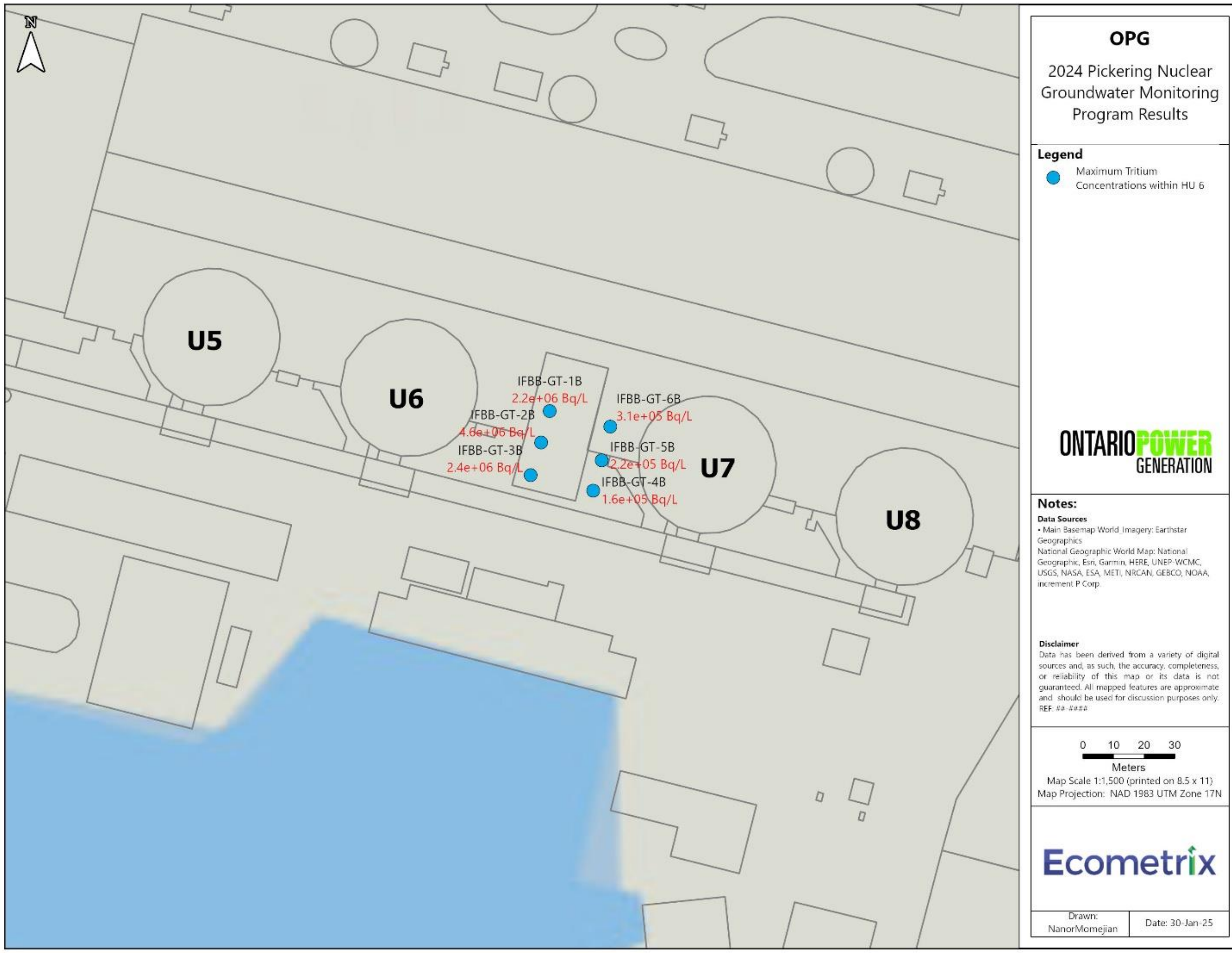
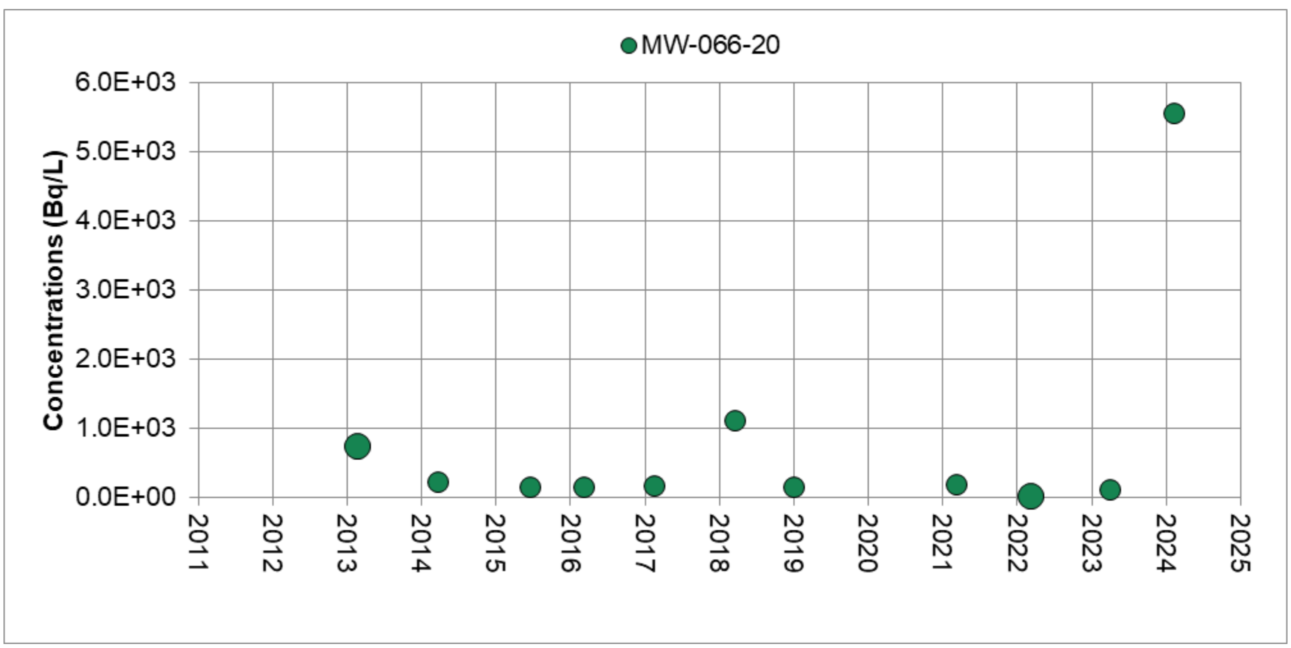


Figure 15: 2024 Annual Maximum Tritium Concentrations at IFB-B in HU 6

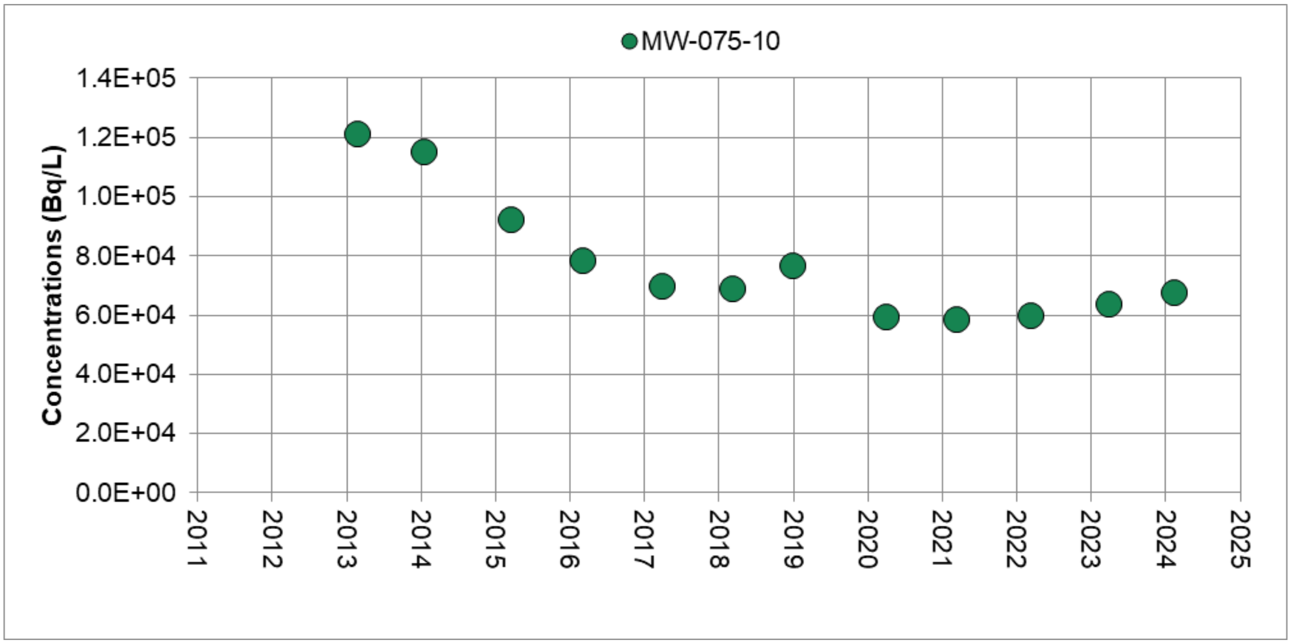
3.1.1.4 Upgrading Plant Pickering Area

Decreasing and stable trends are generally observed at the majority of monitoring wells located within the vicinity of the UPP, except for a probable increasing statistical trend at MW-093-20. However, the 2024 concentration for MW-093-20 remains within the range reflective of routine operations. Therefore, the statistical trend does not represent a new source or an increased risk to groundwater or surface water quality in 2024. Additionally, the tritium concentration at MW-066-20 has increased in 2024 compared to historical results.

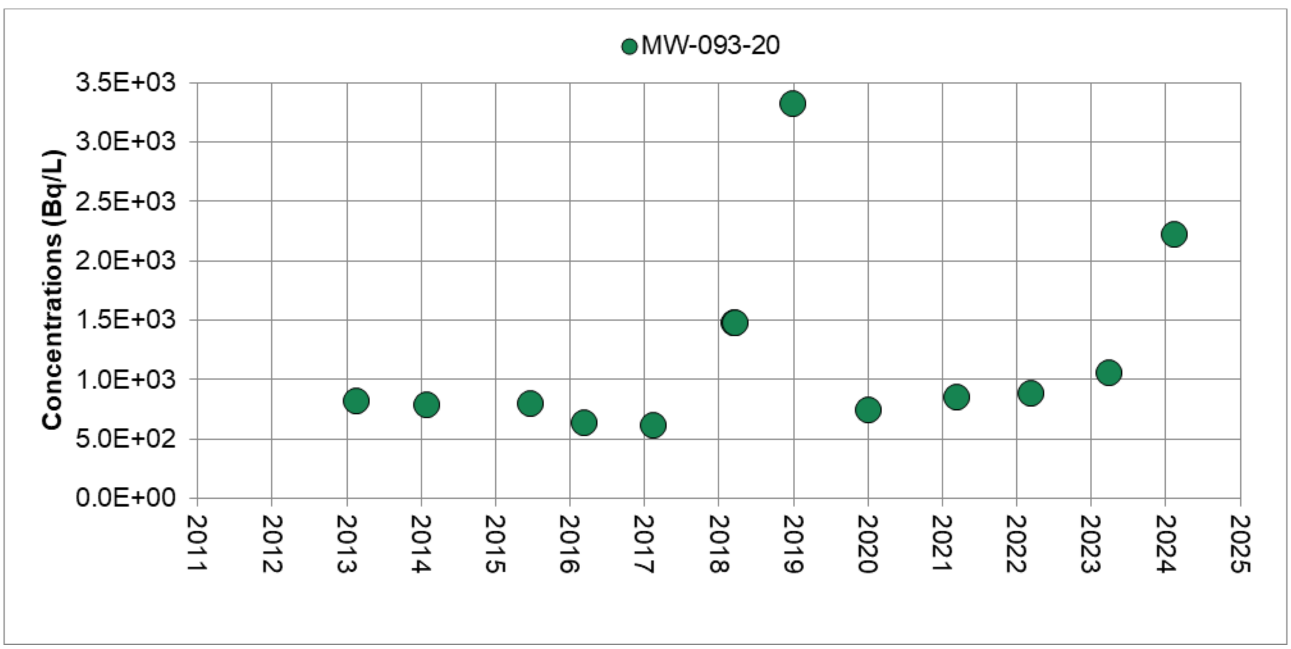
Tritium concentrations in groundwater over time for the UPP area are presented in Graph 36 to Graph 39. The 2024 sample results for tritium concentrations in groundwater at the locations sampled in the UPP area are presented in Table A-4 (Appendix A). Figure 16 and Figure 17 display the annual maximum tritium concentration distributions within HU 1-3 and HU 6 in the UPP area.



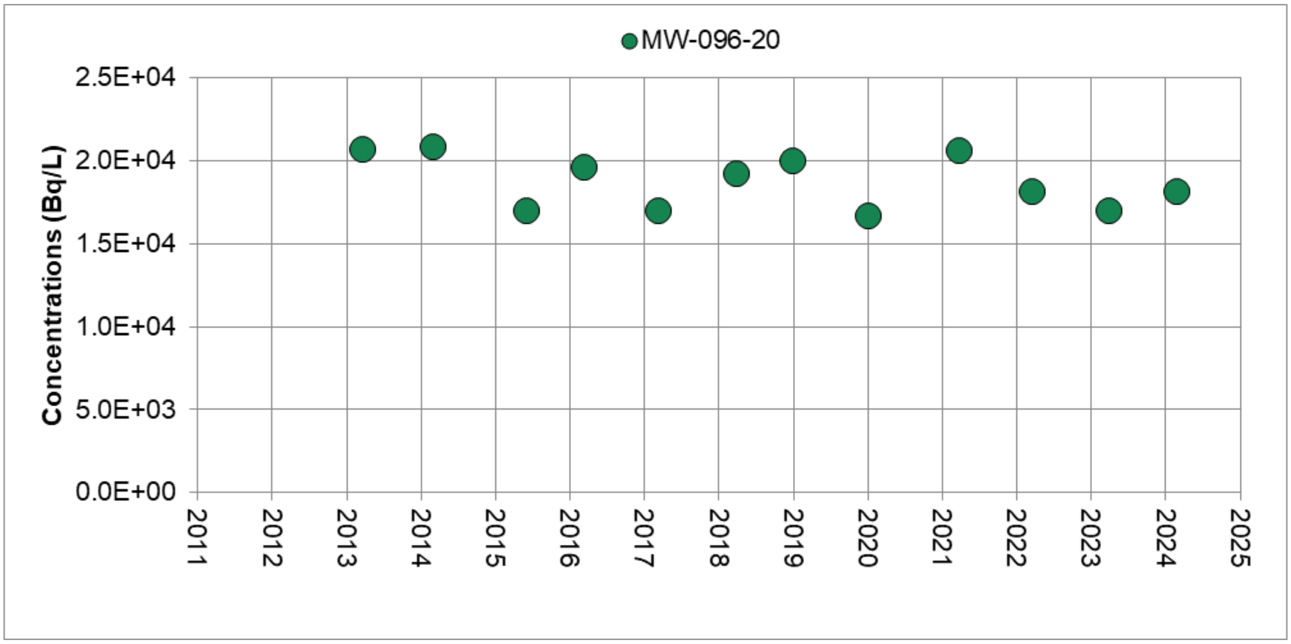
Graph 36: Tritium Concentrations at MW-066-20



Graph 37: Tritium Concentrations at MW-075-10



Graph 38: Tritium Concentrations at MW-093-20



Graph 39: Tritium Concentrations at MW-096-20

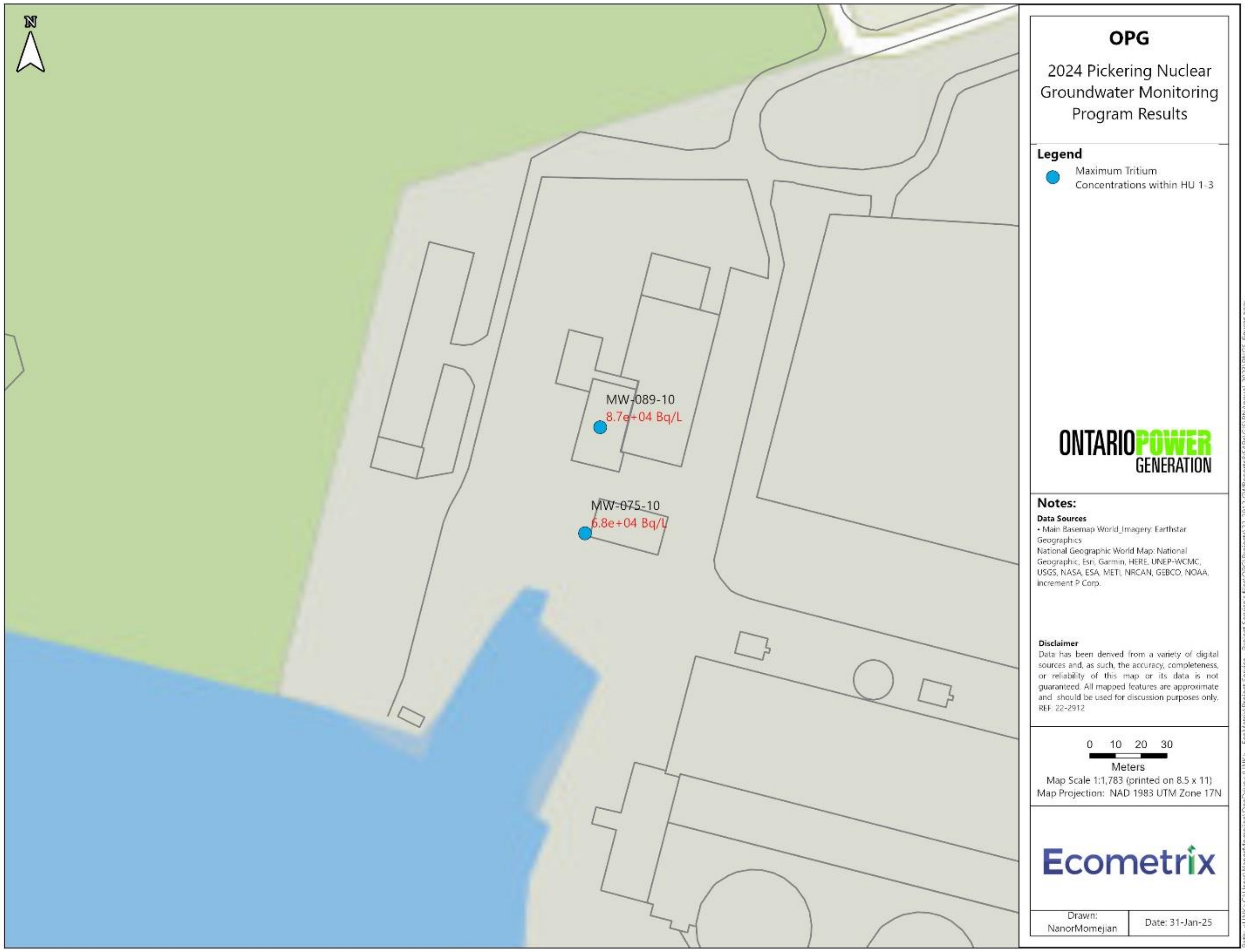


Figure 16: 2024 Annual Maximum Tritium Concentrations in HU 1-3, UPP

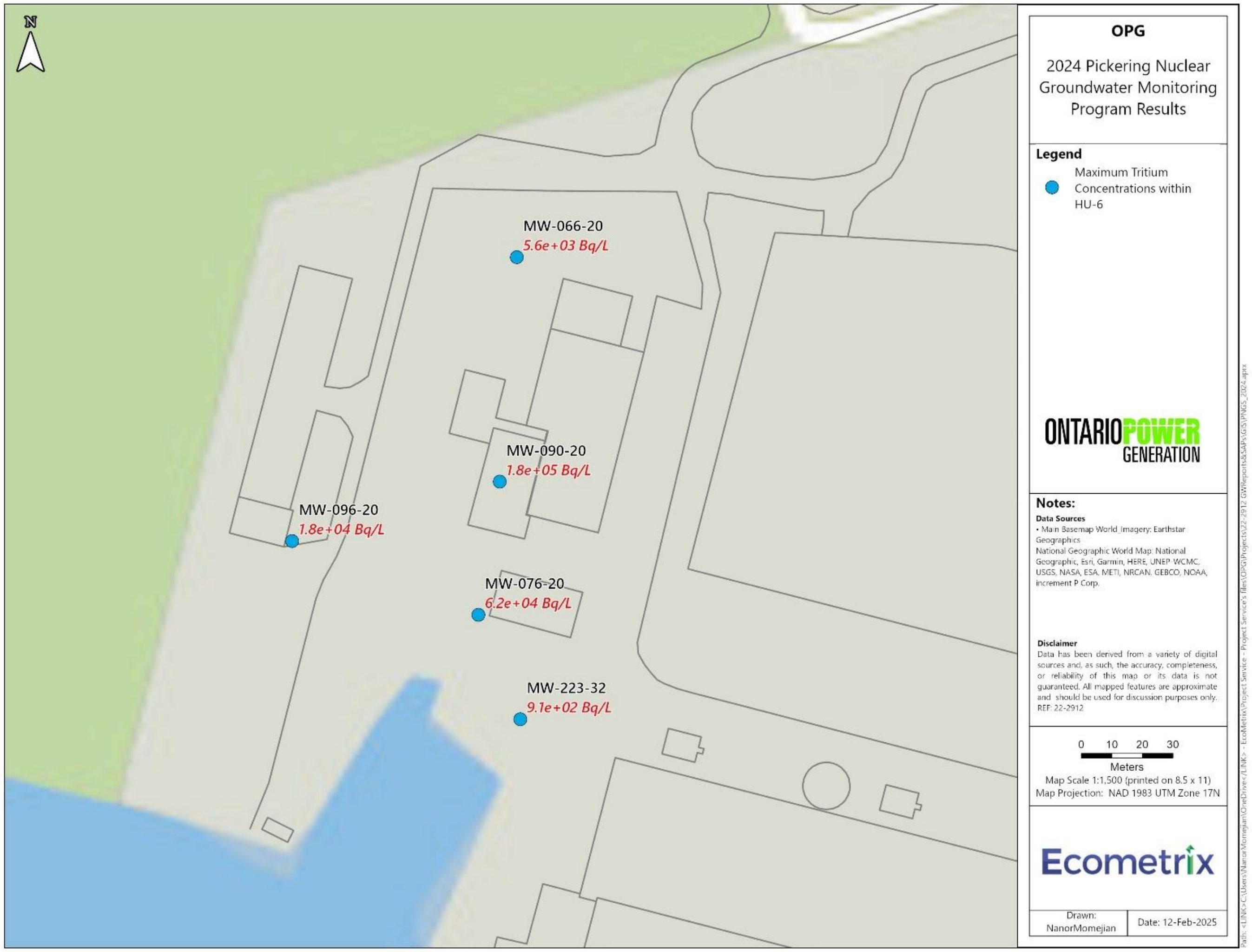


Figure 17: 2024 Annual Maximum Tritium Concentrations in HU 6, UPP

3.1.2 Dissolved Iron concentrations at East and West Landfills

Table A-5 (Appendix A) summarizes the dissolved iron concentrations at the wells associated with the East and West Landfill. Monitoring wells MW-024-20 and MW-205-35 were sampled in 2024 for dissolved iron analysis at the East and West Landfills, respectively. Dissolved iron concentrations were 1,000 µg/L and 1,900 µg/L, respectively. These concentrations were within the historical range, and below the groundwater numeric evaluation criteria.

3.1.3 PHC Concentrations in Groundwater at Units 1 to 4 SG, Units 5 to 8 SG, EPG, and EPG3

Table A-6a (Appendix A) summarizes the product thickness at the wells associated with the SG-A, SG-A overflow area, SG-B, EPG and EPG3. As shown in the table, 15 monitoring wells were monitored for product thickness measurements within the vicinity of U1-4 SGs, Overflow Area, UU5-8 SG, EPG, and EPG3 in 2024. Table A-6b (Appendix A) summarized the list of monitoring wells sampled for PHC F2 and F3 and dissolved iron analyses, where free-phase hydrocarbon product was not present. The measured PHC product thickness and hydrocarbons in groundwater in these areas were within the historical ranges for each well in recent years.

Table A-6b summarizes the PHC (F2 and F3) and dissolved iron concentrations at the 17 wells sampled in 2024 which were sampled. The locations MW-136-19, MW-146-15 and MW-289-28 were not sampled in 2024 because free product was present at in 2024. The concentrations were below the numerical evaluation criteria, with the exception of the PHC F2 for all sampled wells. The dissolved iron concentrations in MW-226-22 exceeds applicable evaluation criteria and background value. Despite it not being required in the 2024 SAP (OPG, 2024) MW-282-15 was sampled and analyzed for PHCs, BTEX and dissolved iron. PHC F2 and dissolved Iron at this location exceeded applicable evaluation criteria and background value.

The localized presence of PHCs and iron at concentrations above the groundwater evaluation criteria are expected in these areas, where remediation using a natural monitored attenuation approach is ongoing (PGL, 2025).

3.1.4 PHC and dissolved iron concentrations in groundwater at Fukushima Diesel Generators

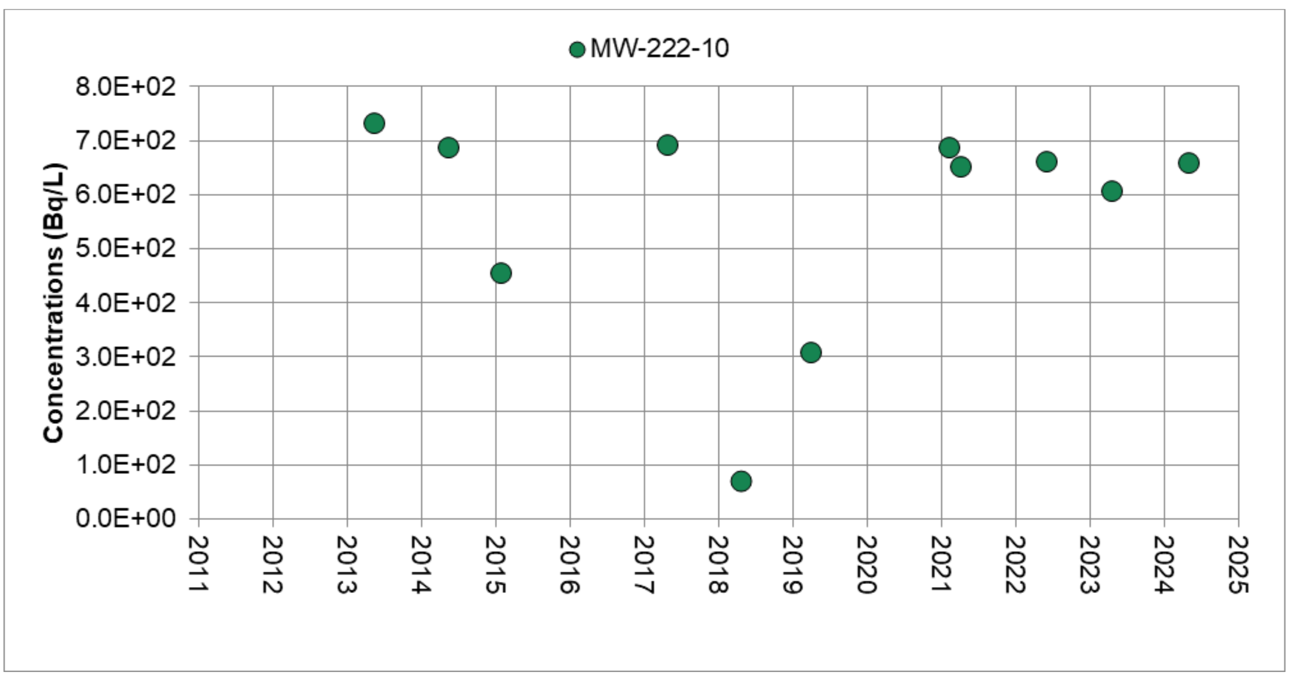
Table A-7 (Appendix A) summarizes the PHC, BTEX and dissolved iron concentrations at the wells associated with the Fukushima Diesel Generators. As shown in the table, 5 monitoring wells associated with the Fukushima diesel generators were sampled for the analysis of PHCs and BTEX and one monitoring well was sampled for the analysis of dissolved iron in 2024. The PHC and BTEX concentrations remained below the detection limits, and the dissolved iron concentration remained below the groundwater numeric evaluation criteria.

3.2 Objectives 2 Results

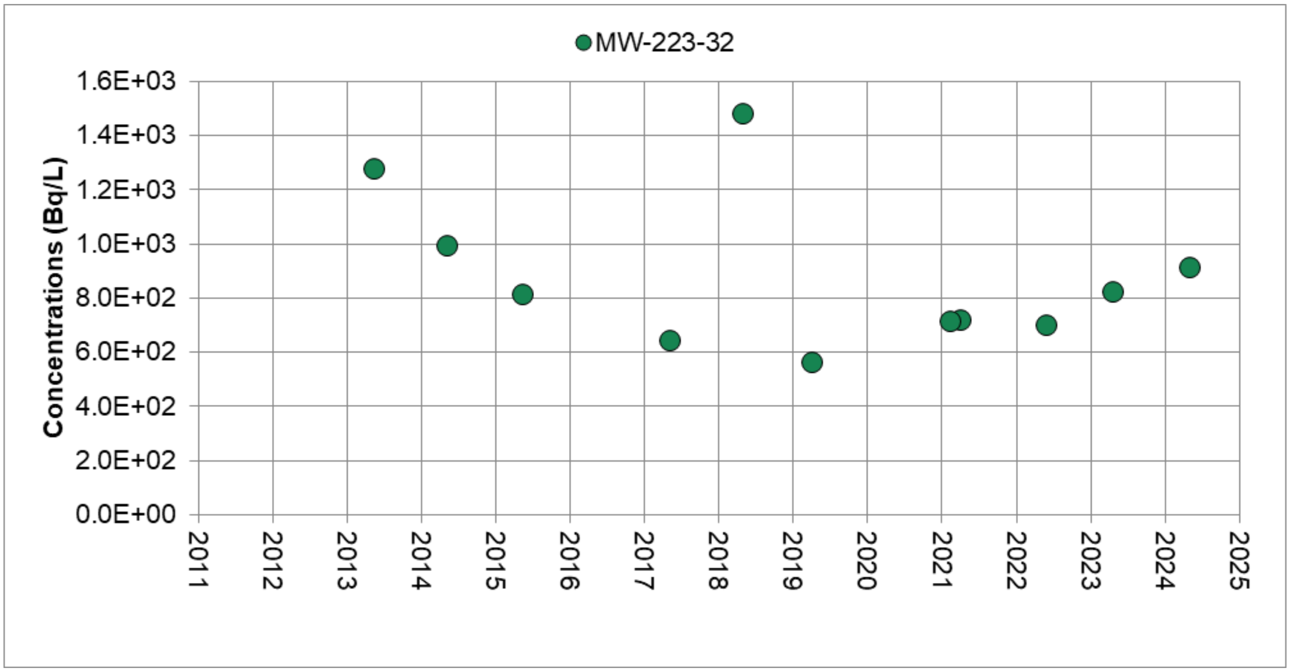
3.3.1 Site Perimeter Overview

Table A-8 (Appendix A) summarizes the tritium concentrations at each of the perimeter wells, and the annual maximum tritium concentrations within HU1-3, HU 6, and HU 7 are in Figure 18 to Figure 20, respectively. Tritium results within MW-164-13, MW-165-24, MW-225-12, MW-204-24, and remaining shoreline wells are shown below in Graph 40 to Graph 50.

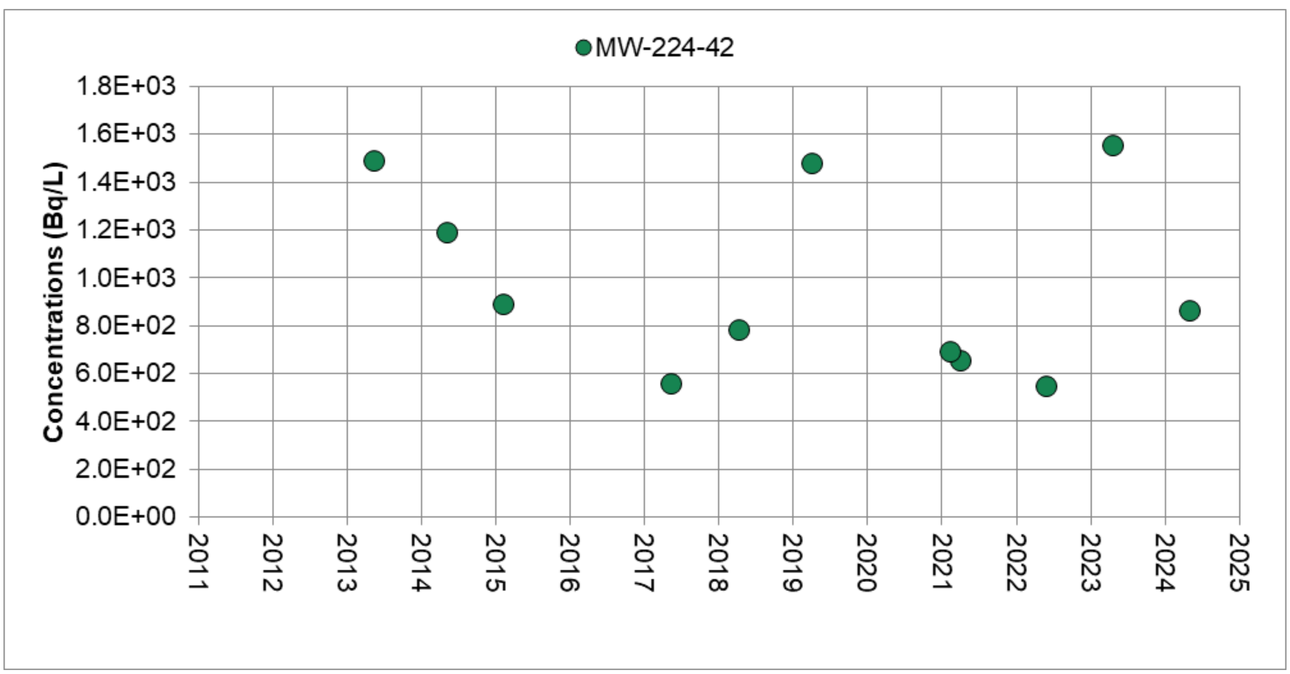
Overall, tritium concentrations in the boundary and shoreline wells at the site perimeter are several orders of magnitude below groundwater evaluation criteria. The tritium concentrations demonstrate a decreasing, stable, or no trend in all wells except shoreline well MW-165-24 and boundary well MW-205-35. Fluctuations in the tritium concentrations at these locations are within the range of historical concentrations at other perimeter wells. The trend statistics suggest low magnitude increasing or probable increasing trends at these locations; however, they are not attributed to activity or a spill and do not suggest offsite migration of the plume or an increased risk. The tritium concentrations at the boundary and shoreline wells at the site perimeter remain below groundwater evaluation criteria and demonstrate the absence of off-site impacts from tritium in groundwater at PNGS.



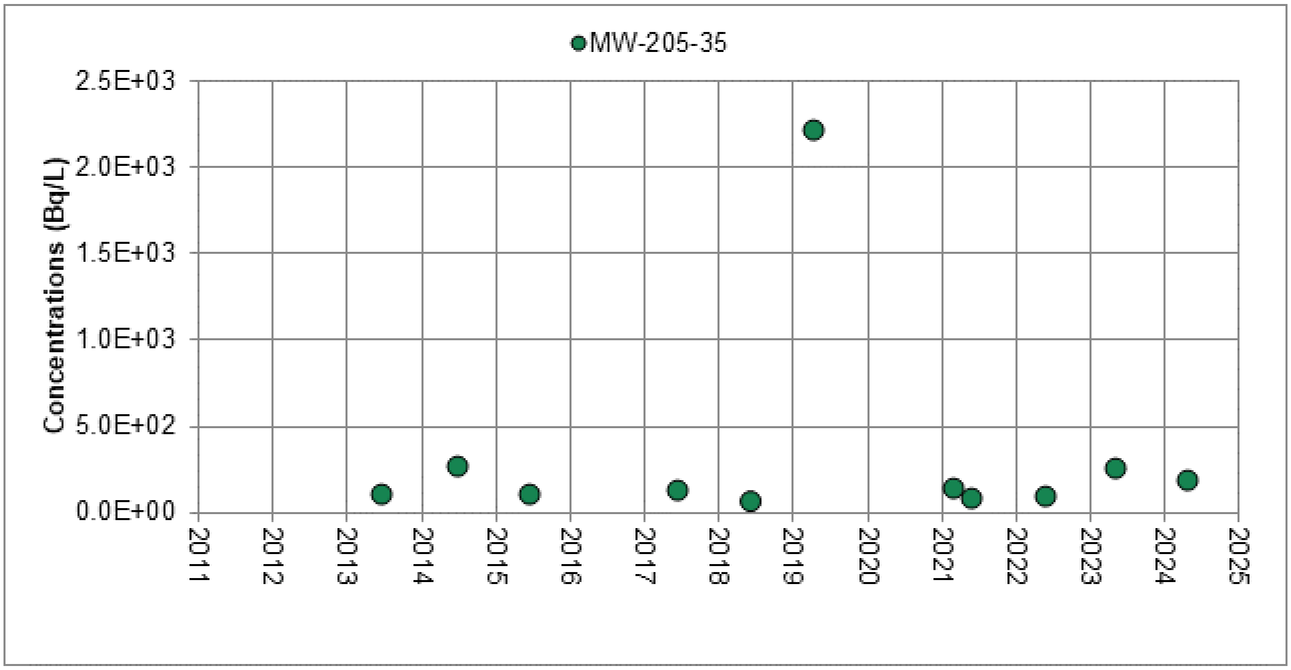
Graph 40: Tritium Concentrations at MW-222-10



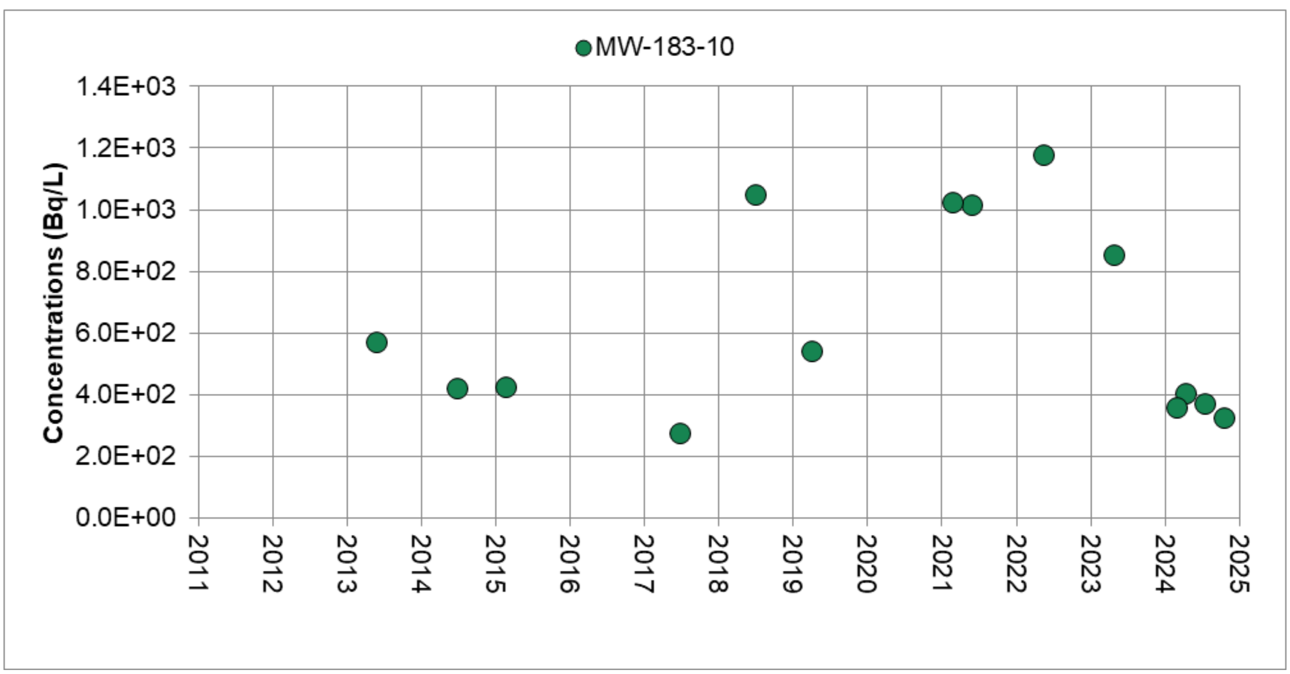
Graph 41: Tritium Concentrations at MW-223-32



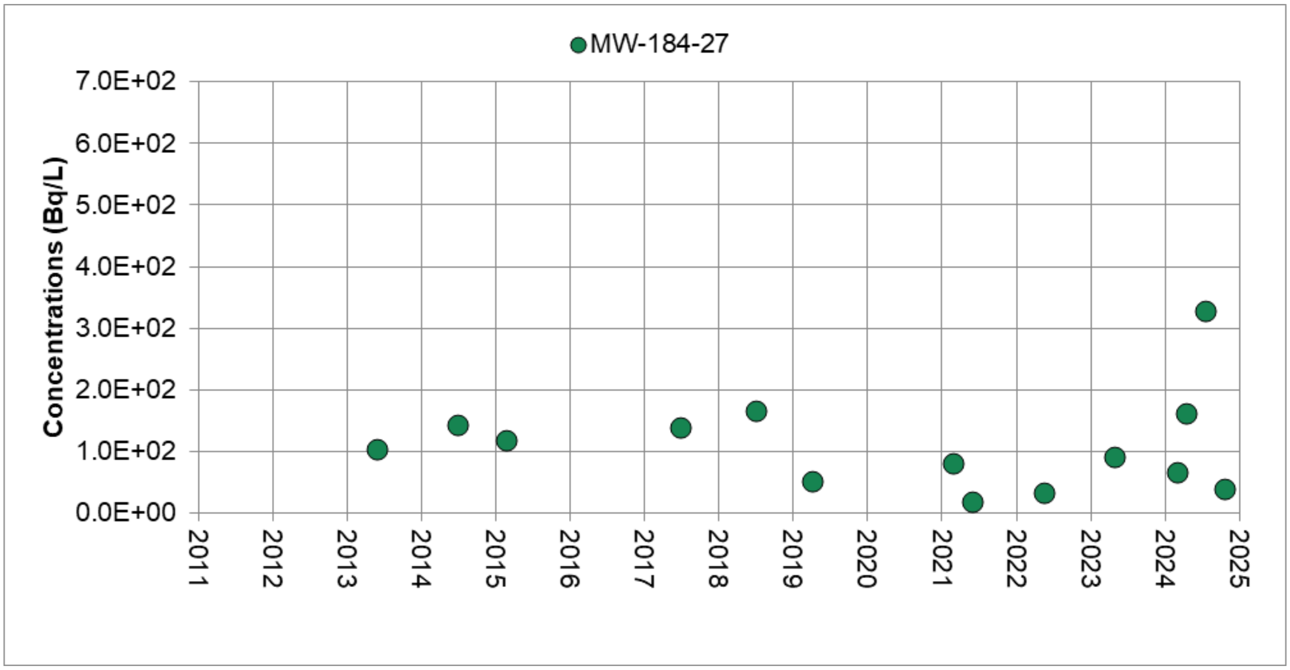
Graph 42: Tritium Concentrations at MW-224-42



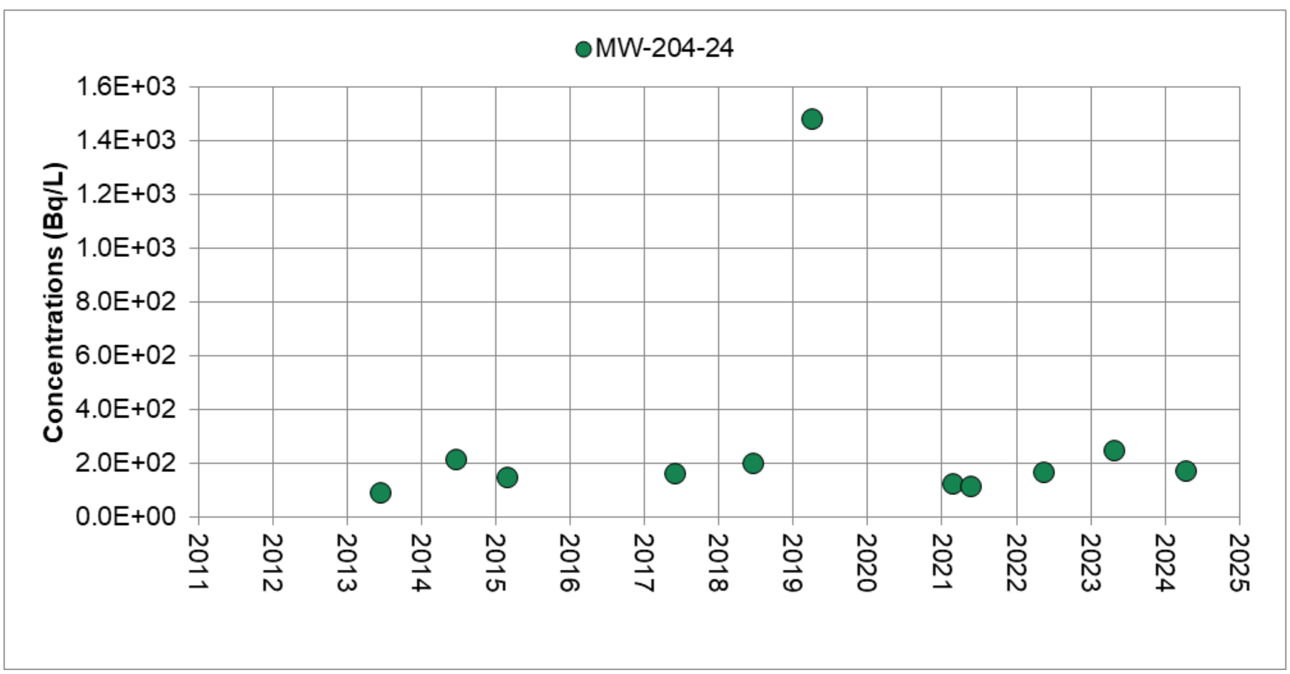
Graph 43: Tritium Concentrations at MW-205-35



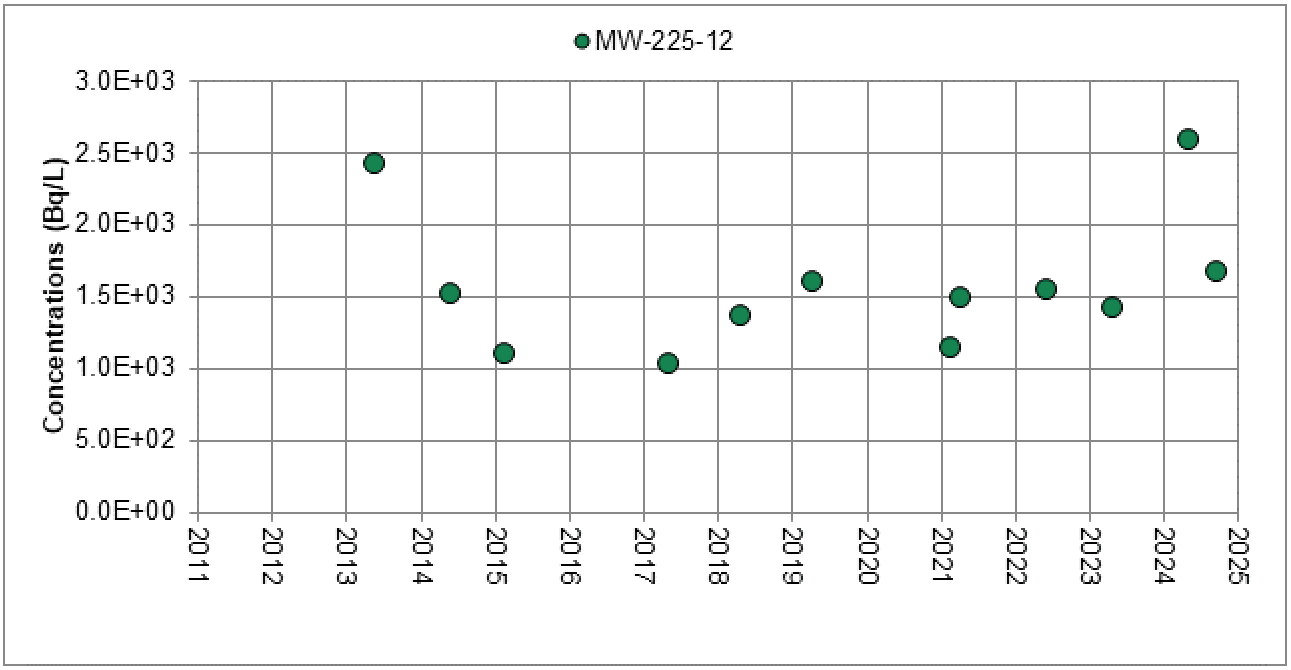
Graph 44: Tritium Concentrations at MW-183-10



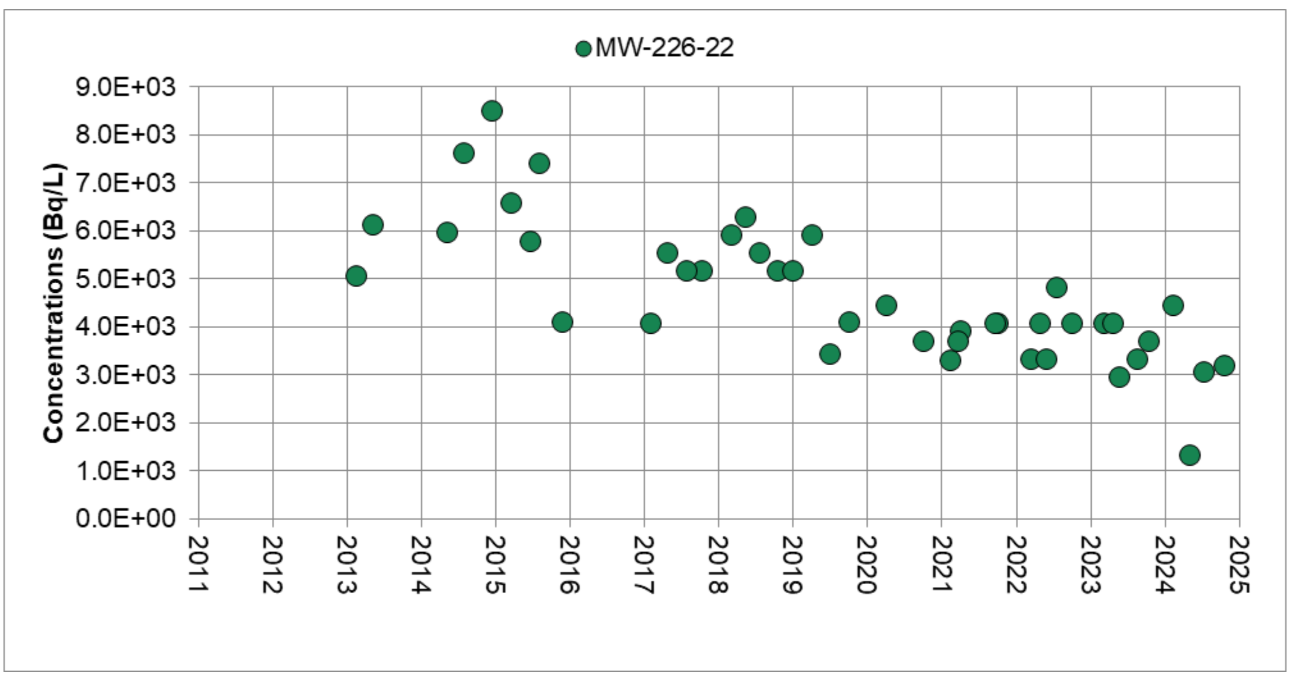
Graph 45: Tritium Concentrations at MW-184-27



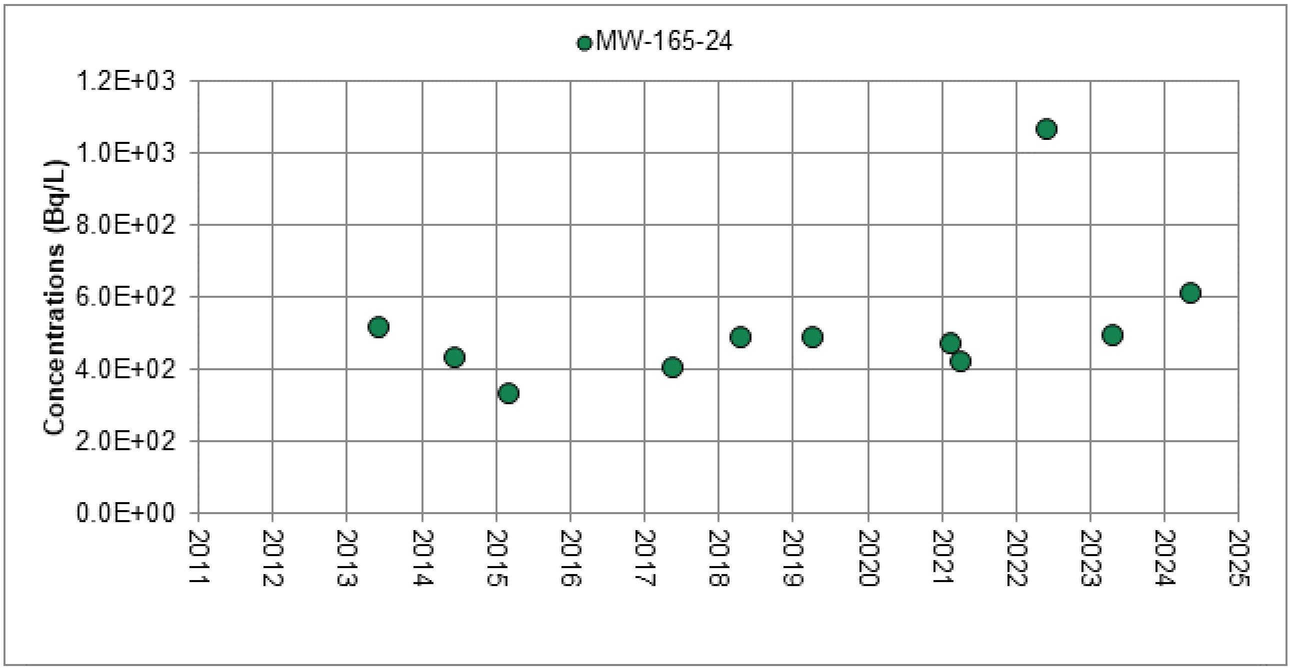
Graph 46: Tritium Concentrations at MW-204-24



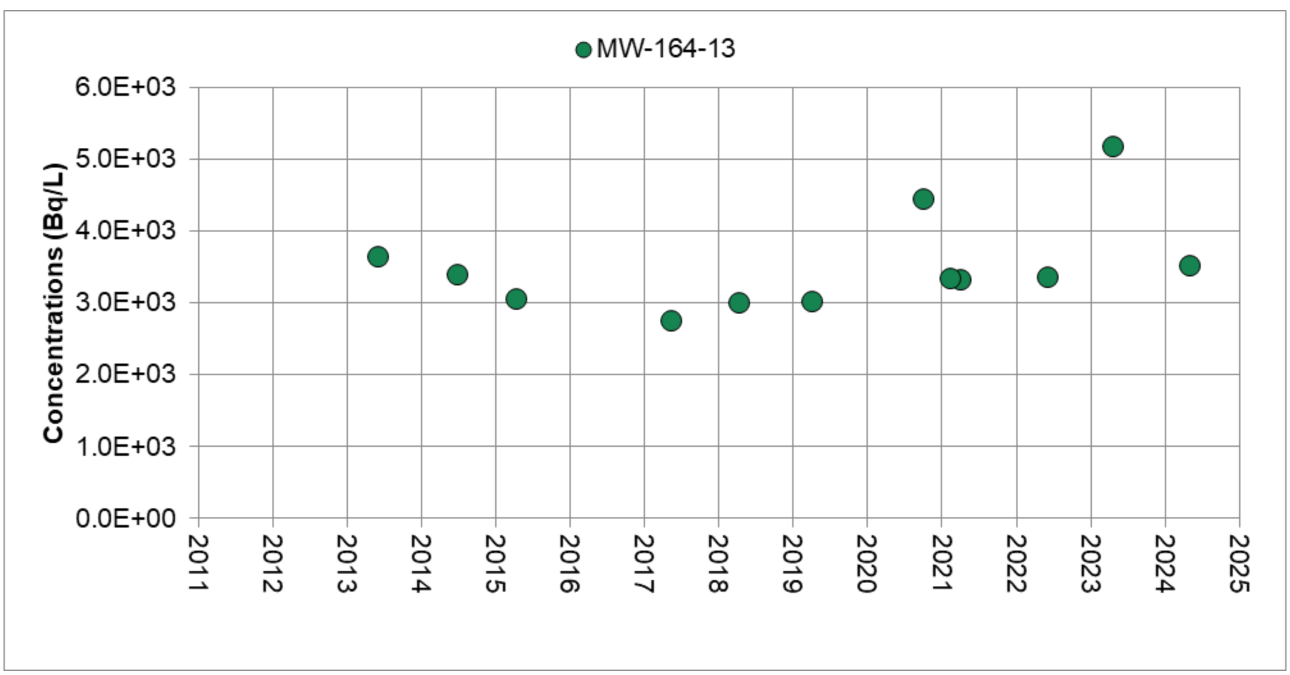
Graph 47: Tritium Concentrations at MW-225-12



Graph 48: Tritium Concentrations at MW-226-22



Graph 49: Tritium Concentrations at MW-165-24



Graph 50: Tritium Concentrations at MW-164-13

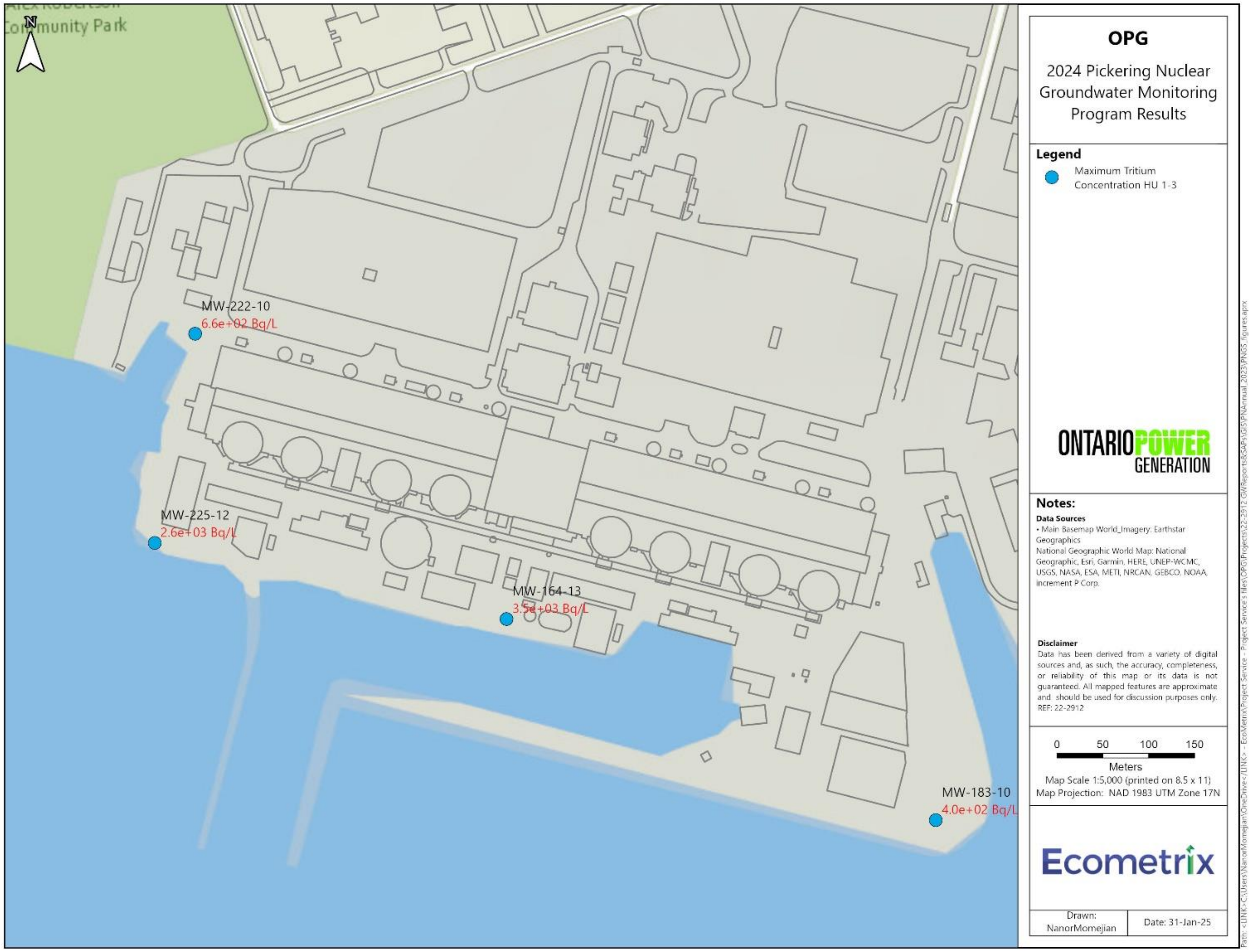


Figure 18: 2024 Annual Maximum Tritium Concentrations in HU 1-3, Site Perimeter

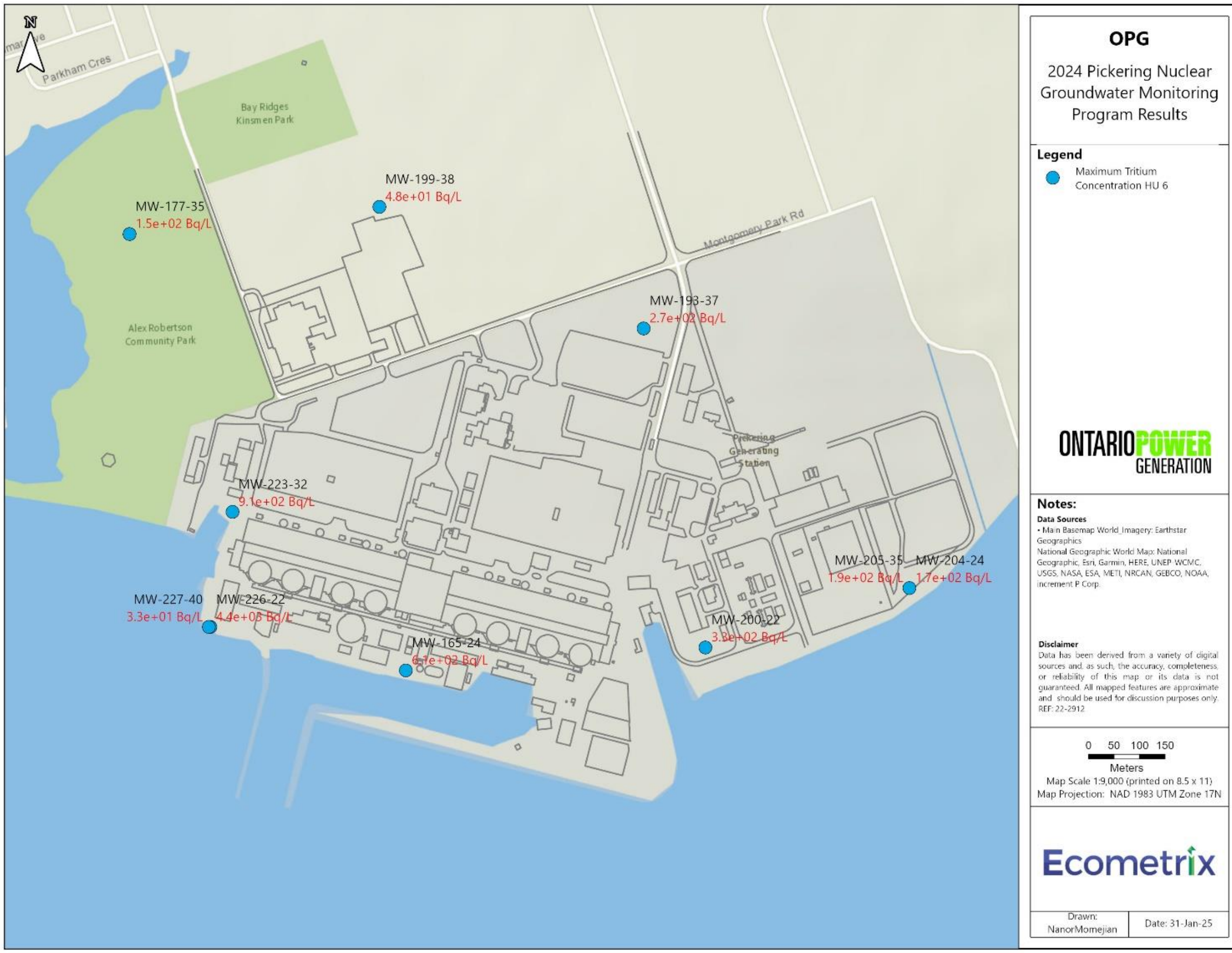


Figure 19: 2024 Annual Maximum Tritium Concentrations in HU 6, Site Perimeter

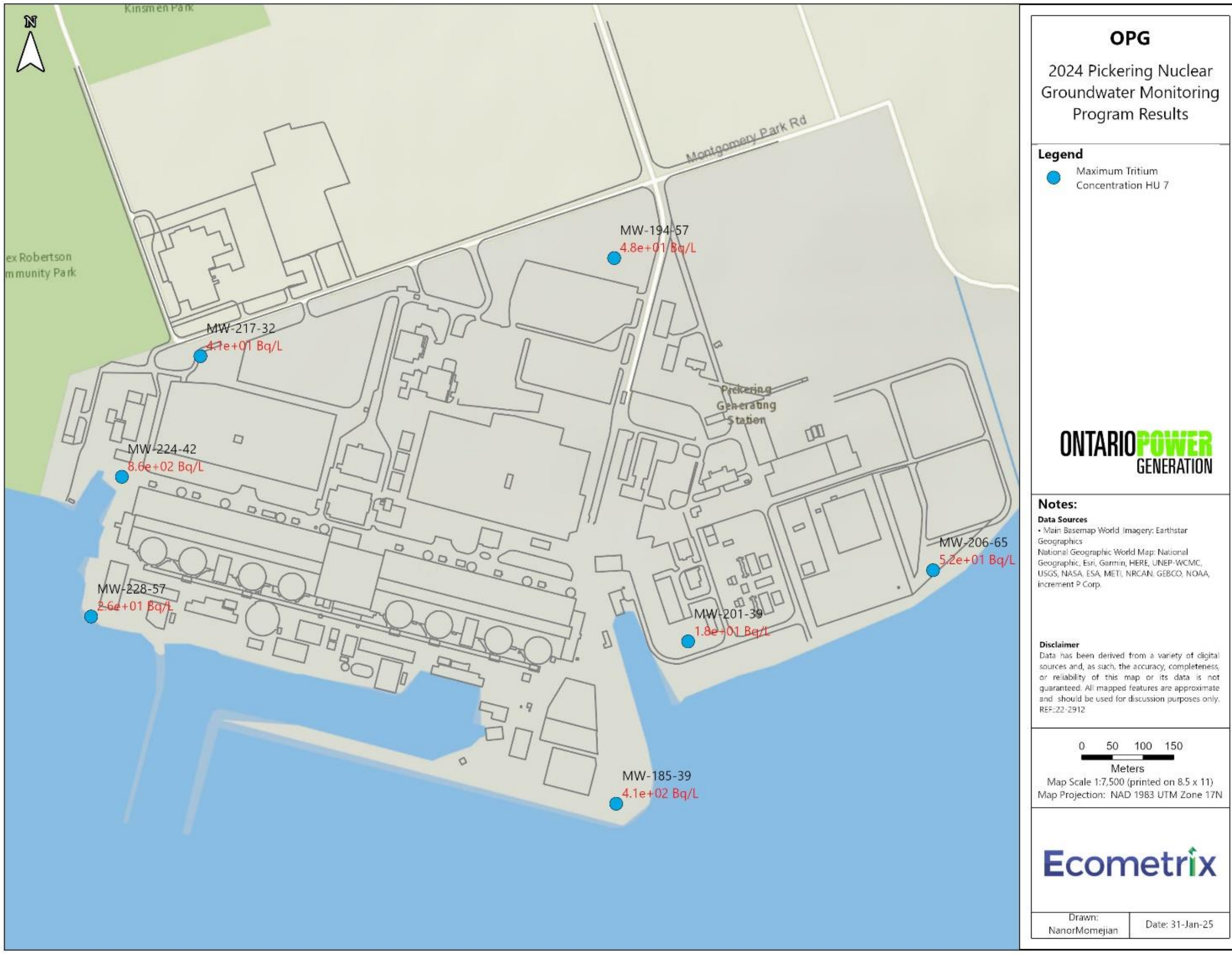


Figure 20: 2024 Annual Maximum Tritium Concentrations in HU 7, Site Perimeter

3.3 Objective 5 Results

3.2.1 Overview of Groundwater Flow Direction

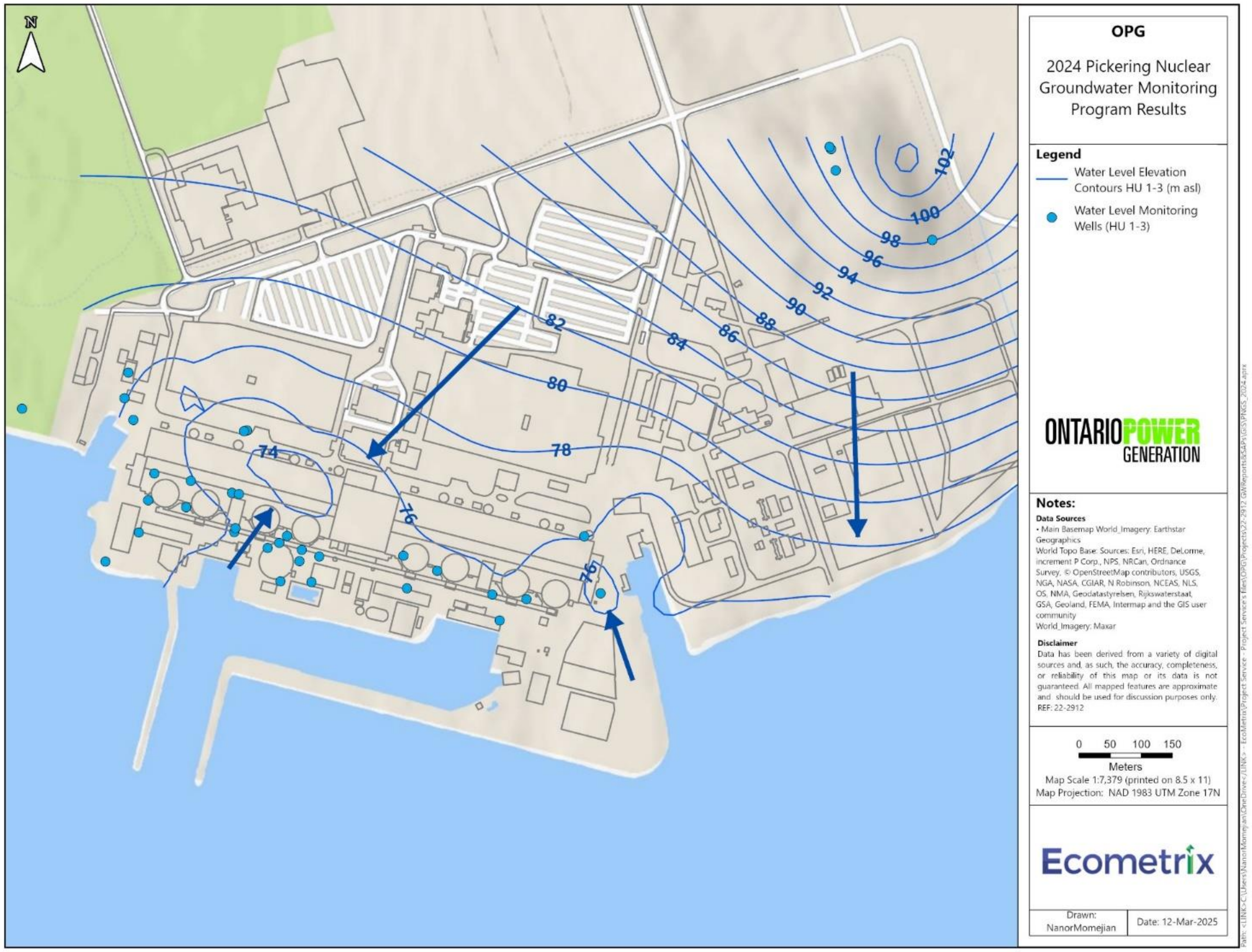
The interpreted groundwater contours and groundwater flow directions are presented in Figure 21 for HU 1-3. The groundwater flow directions inferred for HUs beneath the PNGS from hydraulic head data collected in 2024 are consistent with historical interpretations.

In the shallower groundwater table (HU 1-3; Figure 21), the groundwater flowing generally from the landfill area towards the station buildings to the southwest, and towards the Lake Ontario in the south.

Closer to the reactor units, groundwater flow directions are more complex due to subsurface structures and active pumping in the TAB foundation drains and VBRS. The general groundwater flow direction is interpreted to be south-southwest towards the lake, with influence from the pumping activities around the reactor buildings. Groundwater within the vicinity of U1-4 is inferred to migrate towards the TAB and IFB-A. In the U5-8 area, groundwater is generally inferred to migrate towards the TAB. The TAB foundation drains collect groundwater and terminate in the TAB IAD sumps associated with each reactor building. These sumps also collect other station process water. The water collected in the IAD sumps is eventually discharged via a monitored pathway.

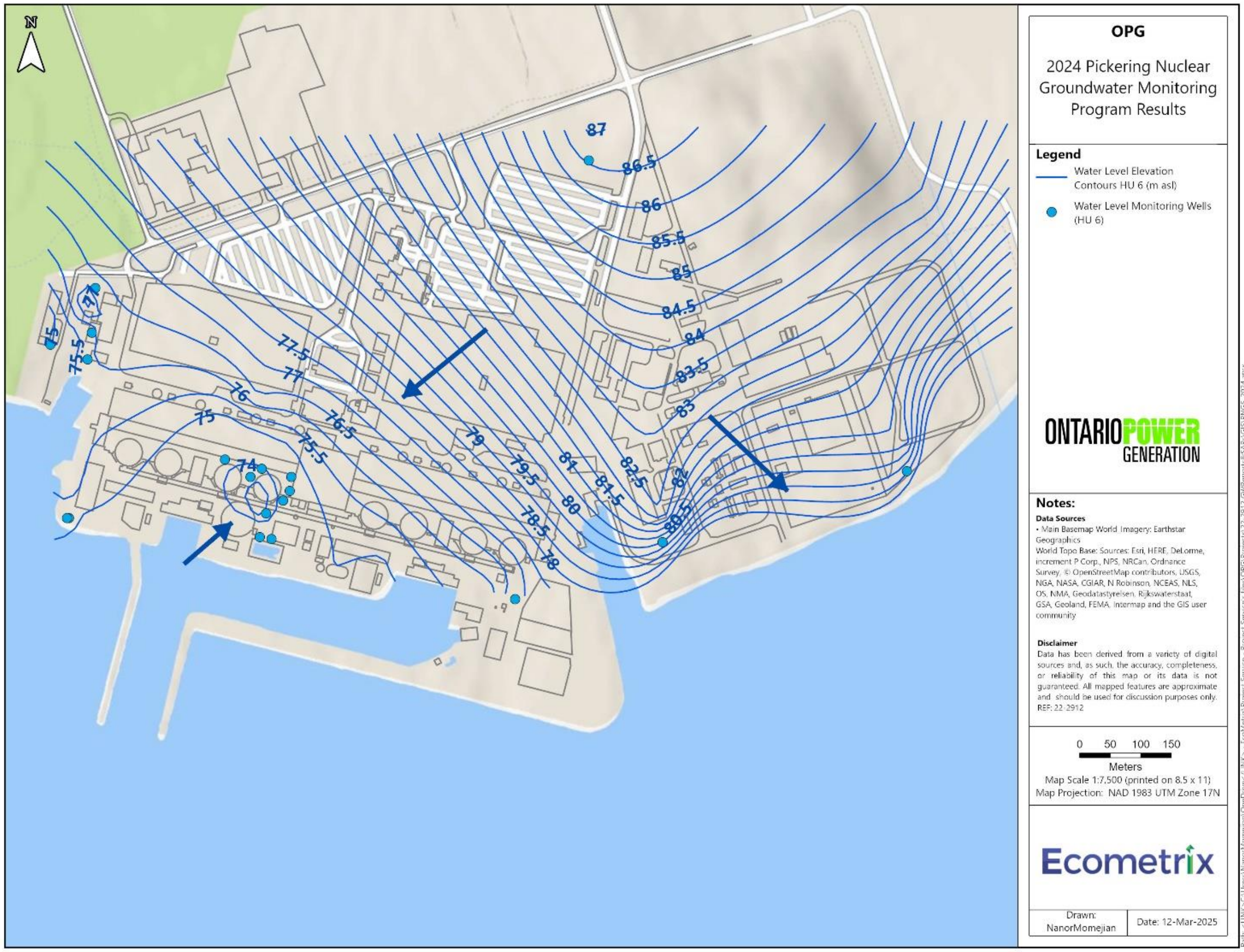
Groundwater within the area of U1-2 in HU 1-3 is interpreted to migrate towards the VBRS. As mentioned above, the VBRS acts as a hydraulic sink, diverting a portion of groundwater in U1 and U2 areas towards the VBRS.

Water levels collected from wells installed within HU 6 (Figure 22) are generally consistent with historical values. Thus, the historically inferred groundwater flow directions towards Lake Ontario in both HUs remains unchanged.
Overall, the groundwater monitoring completed in 2024 was sufficient to determine groundwater flow conditions at the site and support the understanding of the migration of chemical and radiological constituents in groundwater throughout the site.



Note: Groundwater contours were developed using water level measurements collected between July 17 to 24, 2024. The Lake Ontario elevation used to determine groundwater contours was the average of daily mean water elevations between July 17 to 24, 2024 (IJC, 2025).

Figure 21: 2024 Q3 Shallow (HU 1-3) Groundwater Elevation Contours



Note: Groundwater contours were developed using water level measurements collected between July 17 to 24, 2024. The Lake Ontario elevation used to determine groundwater contours was the average of daily mean water elevations between July 17 to 24, 2024 (IJC, 2025).

Figure 22: 2024 Q3 Shallow (HU 6) Groundwater Elevation Contours

4.0 2024 PROGRAM QUALITY ASSURANCE/QUALITY CONTROL

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

4.1 Quality Assurance Programs for Laboratories

The PNGS Chemistry Laboratory performs laboratory activities according to a documented quality assurance program.

4.2 Quality Control Results

Blind duplicate samples were collected at a prescribed frequency to measure sampling and analytical performance as outlined in the GWMP and 2024 SAP. Field blanks samples were collected at a prescribed frequency to monitor any potential contamination that could influence the samples due to the ambient air conditions. Trip blanks were also collected at a prescribed frequency to measure any sources of contamination during sample transport process.

The 2024 sampling program included the collection of 53 blind duplicate samples for tritium concentration analysis. The reported tritium concentrations and calculated relative percent differences (RPD) between the blind duplicates are presented in Table A-9 (Appendix A). The GWMP recommended an RPD between duplicate samples be less than 20%. As shown in Table A-9, show 10 out of the total 53 samples calculated RPDs were over 20%. Most of these high RPD values are attributed to potential laboratory errors and potential of cross contamination with during the sampling or the analysis. Based on these results, the approach to duplicate sampling should be reviewed for the 2025 program, and an independent third-party laboratory verification would be recommended.

In 2024, 7 field duplicate samples were collected for PHCs, BTEX and dissolved iron concentrations. The results and calculated RPD are presented in Table A-9b (Appendix A). The calculated RPDs from these analyses were below 20% as recommended in the PNGS GWMP.

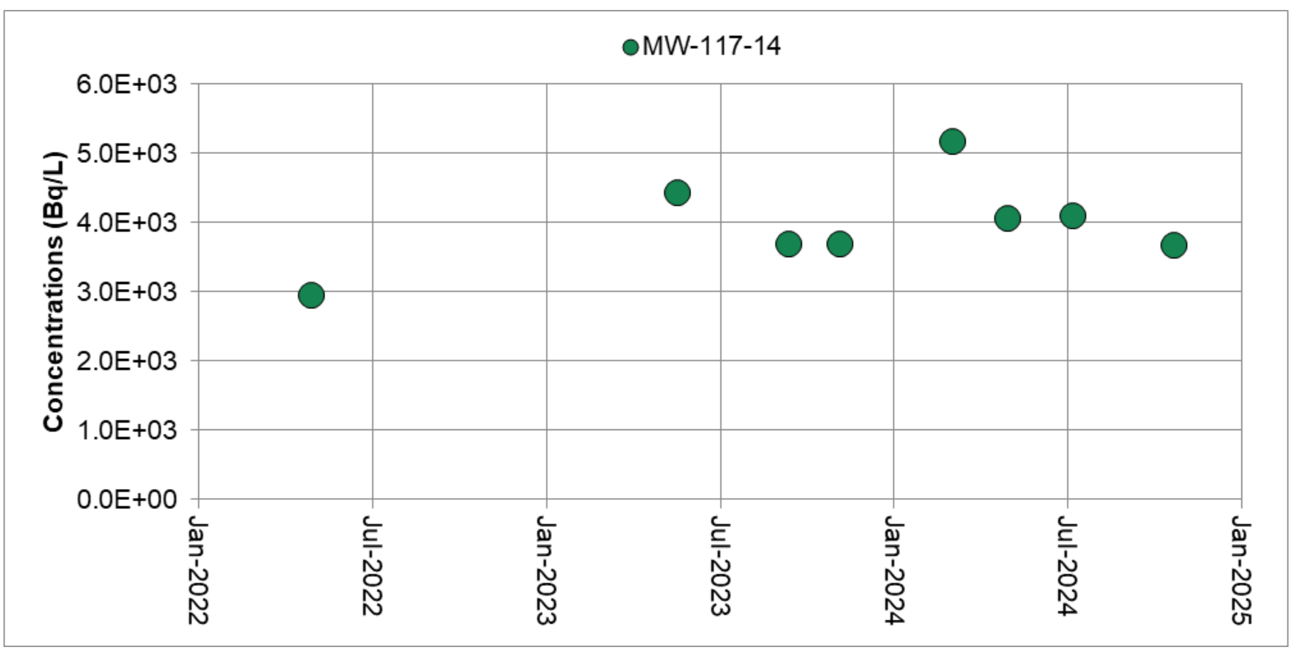
The field blank and trip blank samples are collected when organic parameters are collected for analysis. Three field blanks and three trip blanks submitted with the PHC samples in 2024. The analyses of the field and trip blanks showed concentrations below the detection limits and satisfy the data quality objectives for the site.

5.0 SUPPLEMENTARY STUDIES AND AUDITS

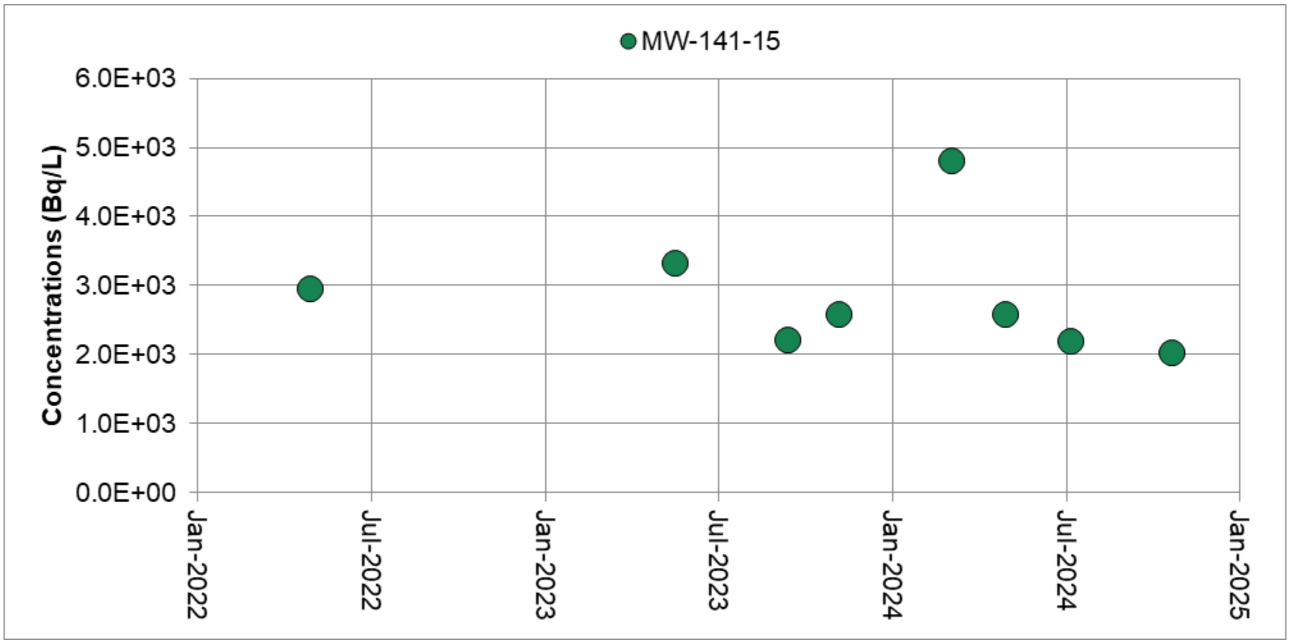
The Auxiliary Irradiated Fuel Bay (AIFB) is located to the west of the SG-A Overflow Area. The AIFB structure consists of an inner wall and an outer wall and stores active materials as well as cooling and purification components. During a routine inspection in 2023, a leak of the inner wall was identified, and repairs are in progress. Water leaking into the interspaces of the inner and outer wall is captured and recirculated back into the inner tank. Water within the tank system represents a potential tritium source to groundwater. Based on the monitoring results of 2024, there is no sign of impact to groundwater from the operations of the AIFB.

Monitoring wells MW-117-14 and MW-141-15 located west of the AIFB, were part of a supplementary study in 2023 (Graph 51 and 52). These wells were sampled quarterly in 2024 and analysed for tritium as part of Objective 1. The sample results are presented in Table A-1 (Appendix A). Tritium concentrations in groundwater were within the expected range of background in shallow groundwater within vicinity of U1-4. Monitoring for tritium will continue at these locations.

Monitoring wells MW-225-12 (Graph 47) to MW-229-70 are located south along the shoreline downgradient of the AIFB (Table A-8; Appendix A). Tritium concentrations within all wells demonstrated decreasing or stable trends, are several orders of magnitude below the tritium evaluation criteria for the site and are not expected to pose a risk to groundwater end-uses at these wells.



Graph 51: Tritium Concentrations at MW-117-14



Graph 52: Tritium Concentrations at MW-141-15

6.0 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 feet
Reactor Building Foundation Drainage Groundtube	RBU*X*-GT-*Y*	*X* represents the unit associated with the groundtube *Y* represents the position (1 is northwest, 2 is southwest, 3 is southeast, 4 is northeast)
Reactor Building Foundation Drainage Sump	U*X* MK *YY*	*X* represents the unit associated with the sump *Y* is a unique identifier
Irradiated Fuel Bay Groundtube	IFBA-GT-*X*A IFBB-GT-*X*B	*X* is a unique identifier
TAB Foundation Drainage	IAD-SU-*X*-*Y*	*X* represents the unit associated with the foundation drainage *Y* represents the orientation of the

		drainage line (1 is north and 2 west)
TAB Inactive Drainage Sump	IAD-SU-*X*	*X* represents the unit associated with the sump

7.0 ACRONYMS

AIFB	Auxiliary Irradiated Fuel Bay
Bq/L	Becquerel per Litre
BTEX	Benzene / Toluene / Ethylbenzene / Xylene
CSA	Canadian Standards Association
EPG	Emergency Power Generator
GWMP	Groundwater Monitoring Program
GWPP	Groundwater Protection Plan
HU	Hydrostratigraphic Unit
IAD	Inactive Drainage
IFB	Irradiated Fuel Bay
MECP	Ministry of Environment, Conservation and Parks
MNA	Monitored Natural Attenuation
OPG	Ontario Power Generation Inc.
PHC	Petroleum Hydrocarbon
PNGS	Pickering Nuclear Generating Station
RB	Reactor Building
RPD	Relative Percentage Difference
SAP	Sampling and Analysis Plan
SG	Standby Generator
SSC	Systems Structures and Components
TAB	Turbine Auxiliary Bay
UPP	Upgrading Plant Pickering
VBRS	Vacuum Building Ramp Sump
VOC	Volatile Organic Compound

8.0 REFERENCES

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Ecometrix (Ecometrix Incorporated), 2023a. Groundwater Protection and Monitoring Programs for Pickering Nuclear - CSA N288.7 Implementation. Report No. P-REP-07294-00002. September.

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OPG (Ontario Power Generation), 2024. 2024 Pickering Nuclear Groundwater Sampling and Analysis Plan. Report No. P-PLAN-10120-00005.

PGL (PGL Environmental Consultants), 2025. 2024 Biennial Report Monitored Natural Attenuation Program. Pickering Nuclear Generating Station. Report No. 2259– 01.25. January.

Appendix A: Tables A-1 to A-9

Table A-1: Tritium Concentrations in Groundwater Samples - Units 1 to 4, Vacuum Building Areas and Units 1 to 4 Turbine Auxiliary Bays

Monitoring Location	Frequency	HU	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
IAD-SU-1	Quarterly	HU 7	N/A	N/A	N/A	N/A
IAD-SU-1-1	Quarterly	HU 7	--	--	--	--
IAD-SU-1-2	Quarterly	HU 7	--	--	--	--
IAD-SU-2	Quarterly	HU 7	N/A	N/A	N/A	22,940
IAD-SU-2-1	Quarterly	HU 7	--	--	--	--
IAD-SU-2-2	Quarterly	HU 7	--	--	--	--
IAD-SU-3	Quarterly	HU 7	17,390	11,840	11,100	17,020
IAD-SU-3-1	Quarterly	HU 7	--	--	--	--
IAD-SU-3-2	Quarterly	HU 7	--	--	--	--
IAD-SU-4	Quarterly	HU 7	N/A	N/A	N/A	N/A
IAD-SU-4-1	Quarterly	HU 7	--	--	--	--
IAD-SU-4-2	Quarterly	HU 7	--	--	--	--
MW-064-21	Annual	HU 1-3	--	N/A	--	--
MW-117-14	Quarterly	HU 1-3	5,180	4,070	4,107	3,678
MW-141-15	Quarterly	HU 1-3	4,810	2,590	2,190	2,024
MW-157-12	Annual	HU 6	6,660	5,550	--	--
MW-158-34	Annual	HU 1-3	1,110	118	--	--
MW-161-48	Quarterly	HU 6	61,050	60,310	61,790	57,350
MW-209-13	Annually	HU 1-3	2,960	--	--	--
MW-210-30	Annually	HU 1-3	6,290	--	--	--
MW-215-12	Quarterly	HU 1-3	6,290	5,920	7,770	7,807
MW-230-30	Quarterly	HU 6	598,290	606,800	666,000	573,500
MW-234-30	Quarterly	HU 6	2,170,420	2,482,700	2,279,200	2,075,700
MW-237-30	Quarterly	HU 6	3,589,370	3,500,200	3,566,800	3,156,100
MW-239-30	Quarterly	HU 6	8,406,400	8,436,000	9,398,000	7,585,000
MW-240-26	Annual	HU 1-3	1,850	--	--	--
MW-242-25	Quarterly	HU 1-3	432,160	226,810	250,490	202,390
MW-243-29	Quarterly	HU 1-3	46,990	41,810	41,810	51,060
MW-246-30	Quarterly	HU 6	1,797,090	1,872,200	1,853,700	1,583,600
MW-247-35	Annual	HU 6	N/A	--	--	--
MW-255-12	Quarterly	HU 1-3	306,730	301,920	297,850	236,800
MW-260-25	Quarterly	HU 1-3	762,200	2,375,400	3,145,000	3,230,100
MW-261-25	Quarterly	HU 1-3	143,190	92,130	201,280	163,910
MW-269-20	Quarterly	HU 1-3	5,550	3,700	3,167	5,439
MW-270-20	Quarterly	HU 1-3	16,428,000	13,653,000	11,803,000	14,171,000
MW-273-20	Quarterly	HU 1-3	5,385,720	4,329,000	625,300	3,170,900
MW-301-15	Quarterly	HU 1-3	7,770	7,030	7,400	8,140
MW-302-40	Annual	HU 6	1,480	--	--	--
MW-310-12	Quarterly	HU 1-3	1,381,950	1,161,800	817,700	1,576,200
MW-313-40	Semi-Annual	HU 6	79,550	77,700	58,460	59,200
MW-315-15	Quarterly	HU 1-3	340,400	241,980	647,500	725,200
MW-318-40	Quarterly	HU 6	4,070	3,700	5,180	4,144
MW-320-20	Quarterly	HU 1-3	7,030	6,290	6,512	5,439
MW-321-15	Quarterly	HU 1-3	160,580	108,410	125,430	304,880
RBU2-GT-1 or GT-2	Quarterly	HU 1-3	10,656,000	11,026,000	7,585,000	5,106,000
RBU2-GT-3 or GT-4	Quarterly	HU 1-3	N/A	11,988,000	7,881,000	11,951,000
RBU3-GT-2	Quarterly	HU 1-3	N/A	12,580	9,990	N/A
RBU3-GT-3	Quarterly	HU 1-3	N/A	N/A	N/A	N/A
RBU4-GT-2	Quarterly	HU 1-3	N/A	N/A	N/A	N/A
RBU4-GT-3 or GT-4	Quarterly	HU 1-3	N/A	N/A	N/A	N/A
U1-RBFD-1	Quarterly	HU 1-3	10,989,000	11,248,000	12,691,000	11,137,000
U1-RBFD-2	Quarterly	HU 1-3	11,507,000	10,915,000	12,691,000	11,211,000
U1-RBFD-3	Quarterly	HU 1-3	3,515,000	6,660,000	12,987,000	7,955,000
U1-RBFD-4	Quarterly	HU 1-3	N/A	N/A	12,987,000	N/A
VB Ramp Sump	Quarterly	HU 1-3	903,540	614,200	621,600	729,270
U1-RBFD-1	Quarterly	HU 1-3	N/A	N/A	N/A	N/A
U1-RBFD-2	Quarterly	HU 1-3	--	--	--	--
U1-RBFD-3	Quarterly	HU 1-3	--	--	--	--
U1-RBFD-4	Quarterly	HU 1-3	N/A	N/A	N/A	22,940
VB Ramp Sump	Quarterly	HU 1-3	--	--	--	--

Note:
"--" - Sample not required
N/A - Sample was not collected

Table A-2: Tritium Concentrations in Groundwater Samples - Units 5 to 8 and Units 5 to 8 Turbine Auxiliary Bays

Monitoring Location	Frequency	HU	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
IAD-SU-5	Quarterly	HU 7	N/A	2,590	1,643	N/A
IAD-SU-5-1	Quarterly	HU 7	--	--	--	--
IAD-SU-5-2	Quarterly	HU 7	--	--	--	--
IAD-SU-6	Quarterly	HU 7	2,960	N/A	13,838	1,935
IAD-SU-6-1	Quarterly	HU 7	--	--	--	--
IAD-SU-6-2	Quarterly	HU 7	--	--	--	--
IAD-SU-7	Quarterly	HU 7	19,240	19,610	16,280	17,760
IAD-SU-7-1	Quarterly	HU 7	--	--	--	--
IAD-SU-7-2	Quarterly	HU 7	--	--	--	--
IAD-SU-8	Quarterly	HU 7	N/A	N/A	N/A	N/A
IAD-SU-8-1	Quarterly	HU 7	--	--	--	--
IAD-SU-8-2	Quarterly	HU 7	--	--	--	--
MW-102-15	Annual	HU 1-3	6,660	--	7,770	--
MW-170-25	Annual	HU 1-3	3,330	--	--	--
MW-180-40	Annual	HU 6	115	--	--	<18.5
MW-181-57	Annual	HU 7	1,480	--	--	474
MW-186-12	Annual	HU 1-3	2,220	--	--	603
MW-264-10	Quarterly	HU 1-3	18,130	44,770	59,570	139,120
MW-265-12	Annual	HU 1-3	6,660	--	--	--
MW-266-19	Quarterly	HU 1-3	40,330	25,900	12,580	37,000
MW-267-17	Quarterly	HU 1-3	65,860	31,450	27,750	25,160
MW-325-15	Annual	HU 1-3	3,330	--	--	--
MW-330-23	Annual	HU 1-3	--	--	3,038	--
MW-331-25	Annual	HU 1-3	--	--	--	--
MW-332-12	Annual	HU 1-3	--	--	--	--
MW-333-26	Annual	HU 1-3	--	--	--	--
MW-338-40	Annual	HU 1-3	--	--	--	--
RBU5-GT-1	Quarterly	HU 1-3	318,940	83,250	270,100	161,320
RBU5-GT-2	Quarterly	HU 1-3	127,650	765,900	395,900	352,240
RBU5-GT-3	Quarterly	HU 1-3	N/A	636,400	455,100	N/A
RBU5-GT-4	Quarterly	HU 1-3	673,400	313,760	388,500	204,240
RBU6-GT-2	Quarterly	HU 1-3	8,695,000	12,358,000	13,246,000	11,914,000
RBU6-GT-3	Quarterly	HU 1-3	843,600	333,000	176,120	173,530
RBU6-GT-4	Quarterly	HU 1-3	3,071,000	80,660	87,320	322,640
RBU7-GT-3	Quarterly	HU 1-3	37,740	28,120	191,660	188,330
RBU8-GT-3	Quarterly	HU 1-3	29,970	23,310	20,720	51,800
U5 MK 26	Quarterly	HU 1-3	603,100	444,000	290,820	677,100
U6 MK 30	Quarterly	HU 1-3	595,700	843,600	1,531,800	564,250
U7 MK 36	Quarterly	HU 1-3	34,410	10,730	24,420	63,640
U8 MK 42	Quarterly	HU 1-3	67,710	97,680	115,440	122,470

Note:
"--" - Sample not required
N/A - Sample was not collected

Table A-3: Tritium Concentrations in Groundwater Samples - Units 1 to 8 Irradiated Fuel Bays

Monitoring Location	Frequency	HU	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
MW-056-18	Semi-Annual	HU 1-3	5,920	--	6,401	--
MW-057-30	Quarterly	HU 1-3	4,070	4,810	4,366	4,588
MW-062-42	Annual	HU 7	5,920	--	--	--
MW-244-18	Annual	HU 1-3	604,210	--	499,500	--
IFBA-GT-1A	Quarterly	HU 6	3,737,000	3,885,000	3,774,000	3,281,900
IFBA-GT-2A	Quarterly	HU 6	5,809,000	5,846,000	5,328,000	4,884,000
IFBA-GT-4A	Quarterly	HU 6	23,310	21,460	21,830	31,450
IFBA-GT-5A	Quarterly	HU 6	36,630	25,900	21,460	16,280
Unit 5-8 IFB						
MW-171-15	Quarterly	HU 1-3	9,250	12,580	11,100	54,760
MW-172-25	Semi-Annual	HU 1-3	7,770	--	7,770	--
IFBB-GT-1B	Quarterly	HU 6	1,564,730	1,933,250	2,183,851	1,620,600
IFBB-GT-2B	Quarterly	HU 6	4,565,800	4,218,370	3,942,424	3,304,100
IFBB-GT-3B	Quarterly	HU 6	1,611,720	2,365,040	1,363,783	1,628,370
IFBB-GT-4B	Quarterly	HU 6	77,330	78,070	157,879	156,510
IFBB-GT-5B	Quarterly	HU 6	105,080	184,630	223,332	213,860
IFBB-GT-6B	Quarterly	HU 6	164,280	132,460	309,727	116,180

Note:
"--" - Sample not required
N/A - Sample was not collected

Table A-4: Tritium Concentrations in Groundwater Samples - Upgrading Plant Pickering

Monitoring Well	Frequency	HU	Background Value (if applicable) (Bq/L)	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
MW-066-20	Annual	HU 5/HU 6	1,571	5,550	--	--	--
MW-075-10	Annual	HU 1-3	6,000	67,710	--	--	--
MW-076-20	Annual	HU 6	1,571	62,160	--	--	--
MW-089-10	Annual	HU 1-3	6,000	86,950	--	--	--
MW-090-20	Quarterly	HU 6	1,571	180,190	176,120	183,890	179,820
MW-091-35	Annual	HU6/HU 7	1,571	21,460	--	--	--
MW-093-20	Annual	HU 5	--	2,220	--	--	--
MW-096-20	Annual	HU 6	1,571	18,130	--	--	--

Note:
"--" - Sample not required

Table A-5: Dissolved Iron Concentrations in Groundwater Wells at East and West Landfill

Location	Quarter	HU	Background Value (µg/L)	Evaluation Criteria (µg/L)	Dissolved Iron (µg/L)
MW-024-20	Q3	HU 6	1,000	3,000	1,800
MW-205-35	Q3	HU 6	1,000	3,000	2,700

Note:

The background values and evaluation criteria were established as described in the 2020 PNGS GWMP: Groundwater Protection and Monitoring Programs for Pickering Nuclear - CSA N288.7 Implementation

Table A-6a: Product Thicknesses in Groundwater Wells - Units 1 to 4 SG

Year	Quarter	Standby Generator A						
		MW-137-15	MW-138-15	MW-286-15	MW-287-15	MW-289-28	MW-340-28	MW-344-17
2011	Q1	ND	ND	ND	-	ND	ND	ND
	Q2	ND	ND	ND	-	ND	ND	ND
	Q3	ND	0.051	ND	-	ND	ND	ND
	Q4	0.082	0.002	0.120	-	ND	0.028	0.019
2012	Q1	0.003	ND	0.001	-	ND	0.035	ND
	Q2	0.180	0.005	0.105	-	0.006	0.010	0.070
	Q3	0.100	0.030	0.002	-	ND	0.021	ND
	Q4	0.005	0.050	0.033	-	ND	0.022	ND
2013	Q1	0.002	0.001	0.037	-	ND	0.002	ND
	Q2	0.004	ND	0.068	-	ND	ND	ND
	Q3	ND	ND	0.225	-	ND	ND	ND
2014	Q2	0.130	0.007	0.095	-	ND	ND	0.002
	Q3	0.100	0.001	0.1	-	ND	0.001	0.001
	Q4	0.145	0.020	0.103	-	ND	ND	0.008
2015	Q2	0.135	ND	0.023	-	0.002	ND	0.012
	Q3	ND	ND	ND	-	ND	ND	ND
	Q4	0.2	ND	0.137	-	ND	ND	0.047
2016	Q2	0.193	ND	0.194	-	ND	ND	ND
2018	Q2	0.249	0.053	0.372	-	ND	0.492	0.009
	Q3	0.311	ND	ND	-	ND	0.404	ND
	Q4	0.001	0.807	ND	-	ND	0.19	ND
2020	Q3	ND	0.078	ND	-	ND	ND	ND
	Q4	0.195	0.38	ND	-	ND	0.060	ND
2021	Q1	0.256	0.086	0.208	0.084	-	0.114	0.08
	Q2	0.168	0.268	0.082	ND	-	0.012	0.058
	Q3	0.028	0.001	0.084	0.001	-	0.102	0.005

Year	Quarter	Standby Generator A						
		MW-137-15	MW-138-15	MW-286-15	MW-287-15	MW-289-28	MW-340-28	MW-344-17
	Q4	0.104	0.017	0.180	ND	-	0.002	0.002
2022	Q1	0.15	0.003	0.224	0.001	-	0.008	0.003
	Q1 Supplementary	0.12	-	0.11	-	-	-	-
	Q2	0.068	0.005	0.117	0.001	-	0.084	0.059
	Q3	0.121	0.042	0.125	ND	0.006	0.074	0.086
	Q4	0.132	0.322	0.088	0.001	-	0.073	0.049
2023	Q1	0.045	0.0001	0.087	0.0001	-	0.063	0.0004
	Q2	0.108	0.001	0.147	0.001	-	0.057	0.069
	Q3	0.114	0.001	0.108	0.001	-	0.015	0.023
	Q4	0.125	0.005	0.098	0.001	-	0.057	0.01
2024	Q1	0.089	0.001	0.059	0.001	0.001	0.049	0.01
	Q2	0.105	0.016	0.083	0.001	0.001	0.055	0.03
	Q3	0.135	0.006	0.096	0.001	0.001	0.054	0.05
	Q4	0.092	0.055	0.080	0.001	0.001	0.040	0.03

Year	Quarter	SG A Overflow Area					Standby Generator B		
		MW-118-15	MW-128-15	MW-282-15	MW-283-15	MW-348-12	MW-142-24	MW-291-15	MW-292-15
2011	Q1	0.170	0.070	ND	ND	-	ND	ND	ND
	Q2	0.180	0.080	ND	ND	-	ND	ND	ND
	Q3	ND	0.215	ND	0.060	-	ND	ND	ND
	Q4	0.040	ND	ND	0.010	-	0.010	0.053	ND
2012	Q1	0.015	ND	ND	0.080	-	ND	0.030	ND
	Q2	0.002	0.059	ND	0.057	-	ND	0.055	ND
	Q3	ND	0.030	ND	0.030	-	ND	0.166	0.011

Year	Quarter	SG A Overflow Area					Standby Generator B		
		MW-118-15	MW-128-15	MW-282-15	MW-283-15	MW-348-12	MW-142-24	MW-291-15	MW-292-15
	Q4	ND	0.080	ND	0.035	-	ND	0.060	0.030
2013	Q1	ND	0.002	ND	ND	-	0.01	0.015	ND
	Q2	ND	0.075	ND	ND	-	ND	ND	ND
	Q3	ND	0.121	ND	0.075	-	0.05	ND	ND
2014	Q2	ND	0.035	ND	0.13	-	ND	ND	0.01
	Q3	ND	0.001	ND	0.100	-	ND	ND	0.001
	Q4	ND	0.025	ND	0.240	-	ND	ND	0.007
2015	Q2	ND	0.05	ND	ND	-	ND	ND	0.002
	Q3	0.005	0.253	ND	ND	-	ND	ND	ND
	Q4	ND	0.218	ND	0.115	-	ND	ND	ND
2016	Q2	0.003	ND	ND	0.12	-	ND	ND	ND
2018	Q2	ND	0.023	ND	0.013	-	0.016	ND	ND
	Q3	0.001	ND	ND	ND	-	ND	ND	ND
	Q4	ND	ND	ND	ND	-	ND	ND	ND
2020	Q3	ND	0.298	0.222	ND	-	0.004	ND	ND
	Q4	0.001	0.032	ND	0.071	-	ND	ND	ND
2021	Q1	-	-	-	-	-	-	-	-
	Q2	-	-	-	-	-	-	-	-
	Q3	-	-	-	-	-	-	-	-
	Q4	-	-	-	-	-	-	-	-
2022	Q1	0.001	0.001	-	0.067	-	0.001	-	-
	Q1 Supplementary	-	-	-	-	-	-	-	-
	Q2	0.005	0.181	-	0.073	-	0.001	-	-
	Q3	-	-	ND	-	0.001	-	0.011	0.01
	Q4	-	-	-	-	-	-	-	-
2023	Q1	-	-	-	-	-	-	-	-
	Q2	-	-	-	-	-	-	-	-

Year	Quarter	SG A Overflow Area					Standby Generator B		
		MW-118-15	MW-128-15	MW-282-15	MW-283-15	MW-348-12	MW-142-24	MW-291-15	MW-292-15
	Q3	-	-	-	-	-	-	-	-
	Q4	-	-	-	-	-	-	-	-
2024	Q1	0.001	0.001	ND	0.106	0.001	0.001	0.001	0.012
	Q2	-	0.001	-	-	-	-	-	-
	Q3	0.001	0.005	0.001	0.115	0.001	0.001	0.001	0.001
	Q4	-	0.271	-	-	-	-	-	-

Notes:
"--": product thickness was not measured
"ND" : No detectable product

Table A-6b: Petroleum Hydrocarbon Concentrations in Groundwater Wells - Units 1 to 4 SG Analytical Results

Location	Quarter	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylene Total (µg/L)	PHC F1-BTEX (µg/L)	PHC F2 (µg/L)	PHC F3 (µg/L)	PHC F4 (µg/L)	Dissolved Iron (µg/L)
Standby Generator A										
MW-108-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-109-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-136-19	Q3	NA	NA	NA	NA	NA	NA	NA	NA	-
MW-146-15	Q3	NA	NA	NA	NA	NA	NA	NA	NA	-
MW-149-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-150-15	Q1	-	-	-	-	-	<100	<200	-	-
MW-150-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-289-28	Q3	NA	NA	NA	NA	NA	NA	NA	NA	-
Standby Generator A Overflow Area										
MW-117-14	Q3	-	-	-	-	-	<100	<200	<200	-
MW-225-12	Q3	-	-	-	-	-	-	-	-	<20
MW-226-22	Q3	-	-	-	-	-	-	-	-	10,000
Standby Generator B										
MW-105-15	Q1	-	-	-	-	-	<100	<200	-	-
MW-105-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-133-29	Q1	-	-	-	-	-	<100	<200	-	-
MW-133-29	Q3	-	-	-	-	-	<100	<200	-	-
MW-151-20	Q3	-	-	-	-	-	<100	<200	-	-
Emergency Power Generator										
MW-121-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-124-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-125-15	Q3	-	-	-	-	-	<100	<200	-	-
MW-322-15	Q3	-	-	-	-	-	<100	<200	-	-
Background Value		0.5	0.8	0.5	72	420	150	500	500	1,000

Evaluation Criteria	4,600	14,000	1,800	3,30 0	420	170	500	500	3,000

Note:

Highlight	Exceeds applicable background value

"--" - Sample not required or product was present in well preventing groundwater sample collection

Table A-7: Petroleum Hydrocarbon and Dissolved Iron Concentrations in Groundwater Wells - Fukushima Diesel Generators

Location	Quarter	Benzene	Toluene	Ethylbenzene	Xylene Total	PHC F1-BTEX	PHC F2	PHC F3	PHC F4	Dissolved Iron
MW192-18	Q3	<0.2	<0.2	<0.2	<0.4	<25	<100	<200	<200	-
MW196-20	Q3	<0.2	<0.2	<0.2	<0.4	<25	<100	<200	<200	-
MW197-15	Q3	<0.2	<0.2	<0.2	<0.4	<25	<100	<200	<200	-
MW-201-39	Q3	<0.2	<0.2	<0.2	<0.4	<25	<100	<200	<200	590
MW-326-10	Q3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Background Value		0.5	0.8	0.5	72	420	150	500	500	1,000
Evaluation Criteria		4,600	14,000	1,800	3,300	420	170	500	500	3,000

Notes:

The background values and evaluation criteria were established as described in the 2020 PNGS GWMP: Groundwater Protection and Monitoring Programs for Pickering Nuclear - CSA N288.7 Implementation

"--" - Sample not required

N/A - Sample was not collected

Table A-8: Tritium Concentrations in Groundwater - Site Perimeter Wells

Monitoring Well	Frequency	HU	Background Value (if applicable) (Bq/L)	Q1 (Bq/L)	Q2 (Bq/L)	Q3 (Bq/L)	Q4 (Bq/L)
Boundary Wells							
MW-176-23	Annual	HU 5	--	--	81.4	--	--
MW-177-35	Annual	HU 6	1571	--	148	55.5	--
MW-185-39	Annual	HU 7	--	351.5	407	133.2	155.4
MW-192-18	Annual	HU 5	--	--	362.6	--	--
MW-193-37	Annual	HU 6	1571	--	266.4	--	--
MW-194-57	Annual	HU 7	--	--	29.6	48.1	--
MW-195-73	Annual	HU 8	--	--	48.1	<18.5	--
MW-197-15	Annual	HU 5 / HU 6	1571	--	654.9	--	--
MW-198-20	Annual	HU 5 / HU 6	1571	--	273.8	192.4	--
MW-199-38	Annual	HU 6	1571	--	48.1	--	--
MW-200-22	Annual	HU 6	1571	--	333	--	--
MW-201-39	Annual	HU 7	--	--	18.5	--	<18.5
MW-204-24	Annual	HU 6	1571	--	170.2	--	--
MW-205-35	Annual	HU 6	1571	--	188.7	--	--
MW-206-65	Annual	HU 7	--	--	51.8	--	--
MW-207-87	Annual	HU 8	--	--	<18.5	--	--
MW-216-15	Annual	HU 5 / HU 6	1571	--	384.8	377.4	--
MW-217-32	Annual	HU 7	--	--	22.2	40.7	--
MW-224-42	Annual	HU 7	--	--	862.1	--	--
MW-227-40	Annual	HU 6	1571	--	33.3	--	--
MW-228-57	Annual	HU 7	--	--	25.9	--	<18.5
MW-229-70	Annual	HU 8	--	--	103.6	--	--
Shoreline Wells			**Evaluation Criteria (Bq/L)**				
MW-164-13	Annual	HU 1-3	1.00E+08	--	3,511.3	--	--
MW-165-24	Annual	HU 6		--	610.5	--	--
MW-225-12	Annual	HU 1-3		--	2,597.4	1,683.5	--
MW-226-22	Quarterly	HU 6		4,440	1,343.1	3,063.6	3,200.5
MW-183-10	Annual	HU 1-3		358.9	403.3	370	321.9
MW-184-27	Annual	HU 5 / HU 6		66.6	162.8	329.3	40.7
MW-222-10	Annual	HU 1-3		--	658.6	--	--
MW-223-32	Annual	HU 6 / HU 7		--	913.9	--	--

Notes:
"--" - Sample not required

Table A-9: Tritium Quality Control Results

Location	Sample Date	Units	Sample Values		RPD (%)
			Duplicate	Primary	
MW-158-34	27-Feb-2024	Bq/L	266	1,110	122.6
MW-210-30	13-Feb-2024	Bq/L	344	6,290	179.3
MW-302-40	05-Mar-2024	Bq/L	196	1,480	153.2
MW-062-42	27-Feb-2024	Bq/L	6,771	5,920	13.4
MW-066-20	13-Feb-2024	Bq/L	355	5,550	175.9
MW-093-20	13-Feb-2024	Bq/L	1,354	2,220	48.4
MW-267-17	07-May-2024	Bq/L	32,227	31,450	2.4

Notes:

RPD: Relative percent difference

Table A-9b: PHC, BTEX and Iron Quality Control Results, Duplicate Samples and Relative Percent Differences (RPD)

Sample Type	Sample ID	Sample Date	Benzene		Toluene		Ethylbenzene		Xylene Total	
			µg/L	RPD(%)	µg/L	RPD(%)	µg/L	RPD(%)	µg/L	RPD(%)
Primary	**MW-108-15**	31-Jul-24	-	-	-	-	-	-	-	-
Duplicate	**Z002 (MW-108-15)**	31-Jul-24	-		-		-		-	
Primary	**MW-282-15**	28-Mar-24	<0.2	-	<0.2	-	<0.2	-	<0.4	-
Duplicate	**Z002 (MW-282-15)**	28-Mar-24	<0.2		<0.2		<0.2		<0.4	
Primary	**MW-225-12**	07-Aug-24	-	-	-	-	-	-	-	-
Duplicate	**Z003 (MW-225-12)**	07-Aug-24	-		-		-		-	
Primary	**MW-105-15**	28-Mar-24	-	-	-	-	-	-	-	-
Duplicate	**Z001 (MW-105-15)**	28-Mar-24	-		-		-		-	
Primary	**MW-105-15**	30-Jul-24	-	-	-	-	-	-	-	-
Duplicate	**Z001 (MW-105-15)**	30-Jul-24	-		-		-		-	
Primary	**MW-205-35**	06-Aug-24	-	-	-	-	-	-	-	-
Duplicate	**Z002 (MW-205-35)**	06-Aug-24	-		-		-		-	
Primary	**MW-201-39**	07-Aug-24	<0.2	N/A	<0.2	N/A	<0.2	N/A	<0.4	N/A
Duplicate	**Z001 (MW-201-39)**	07-Aug-24	<0.2		<0.2		<0.2		<0.4	

Sample Type	Sample ID	Sample Date	F1 -BTEX		F2 (C10-C16)		F3 (C16-C34)		F4 (C34-C50)		Dissolved Iron	
			µg/L	RPD(%)	µg/L	RPD(%)	µg/L	RPD(%)	µg/L	RPD(%)	µg/L	RPD(%)
Primary	**MW-108-15**	31-Jul-24	-	-	<100	N/A	<200	N/A	-	-	-	-
Duplicate	**Z002 (MW-108-15)**	31-Jul-24	-		<100		<200		-		-	
Primary	**MW-282-15**	28-Mar-24	<25	-	280	11.3	<200	N/A	<200	N/A	6400	4.6
Duplicate	**Z002 (MW-282-15)**	28-Mar-24	<25		250		280		<200		6700	
Primary	**MW-225-12**	07-Aug-24	-	-	-	-	-	-	-	-	<20	N/A
Duplicate	**Z003 (MW-225-12)**	07-Aug-24	-		-		-		-		<20	
Primary	**MW-105-15**	28-Mar-24	-	-	<100	N/A	<200	N/A	-	-	-	-
Duplicate	**Z001 (MW-105-15)**	28-Mar-24	-		<100		<200		-		-	
Primary	**MW-105-15**	30-Jul-24	-	-	<100	N/A	<200	N/A	-	-	-	-
Duplicate	**Z001 (MW-105-15)**	30-Jul-24	-		<100		<200		-		-	
Primary	**MW-205-35**	06-Aug-24	-	-	-	-	-	-	-	-	2700	3.8
Duplicate	**Z002 (MW-205-35)**	06-Aug-24	-		-		-		-		2600	
Primary	**MW-201-39**	07-Aug-24	<25	N/A	<100	N/A	<200	N/A	<200	N/A	590	19.8
Duplicate	**Z001 (MW-201-39)**	07-Aug-24	<25		<100		<200		<200		720	

Notes:
N/A: RPDs could not be calculated as at least one sample value was below detection or the lab duplicate was not analyzed for that parameter.

Table A-9c: Quality Control Results, Trip and Field Blank

Sample Type	Sample Date	Benzene	Toluene	Ethylbenzene	Xylene Total
		µg/L	µg/L	µg/L	µg/L
FIELD BLANK	28-Mar-24	<0.2	<0.2	<0.2	<0.4
FIELD BLANK	06-Aug-24	<0.2	<0.2	<0.2	<0.4
FIELD BLANK	09-Aug-24	<0.2	<0.2	<0.2	<0.4
TRIP BLANK	28-Mar-24	<0.2	<0.2	<0.2	<0.4
TRIP BLANK	06-Aug-24	<0.2	<0.2	<0.2	<0.4
TRIP BLANK	09-Aug-24	<0.2	<0.2	<0.2	<0.4

Sample Type	Sample Date	F1 -BTEX	F2 (C10-C16)	F3 (C16-C34)	F4 (C34-C50)
		µg/L	µg/L	µg/L	µg/L
FIELD BLANK	28-Mar-24	<25	<100	<200	<200
FIELD BLANK	06-Aug-24	<25	<100	<200	<200
FIELD BLANK	09-Aug-24	<25	<100	<200	<200
TRIP BLANK	28-Mar-24	<25	<100	<200	<200
TRIP BLANK	06-Aug-24	<25	<100	<200	<200
TRIP BLANK	09-Aug-24	<25	<100	<200	<200