2023 Results of OPG's Pickering and Darlington Environmental Monitoring Programs

September 13, 2024
DNHC Meeting

ONTARIO POWER GENERATION

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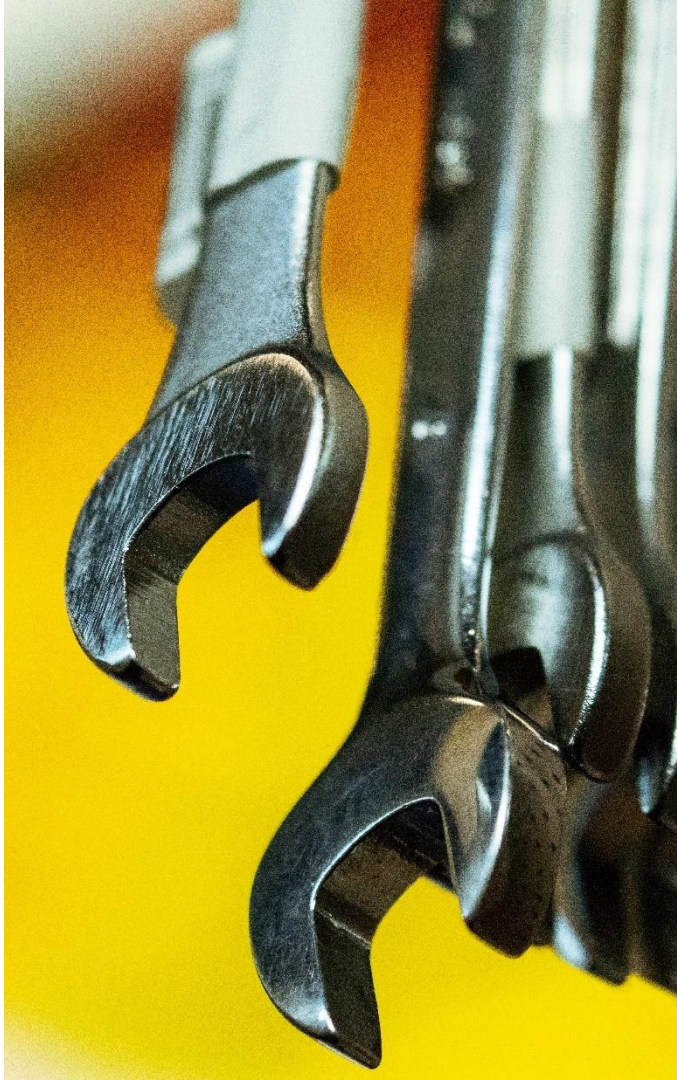
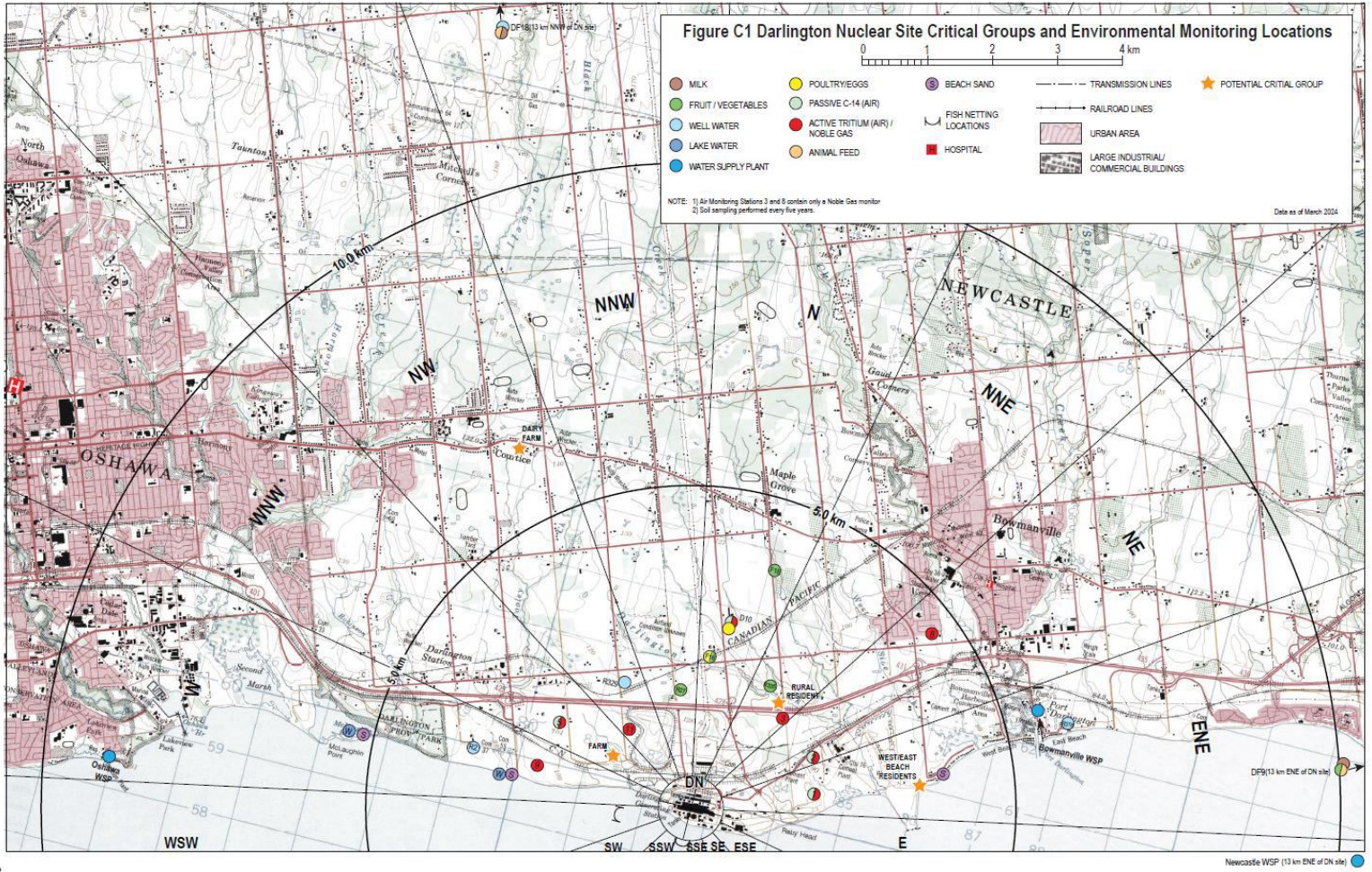


Environmental Monitoring Programs

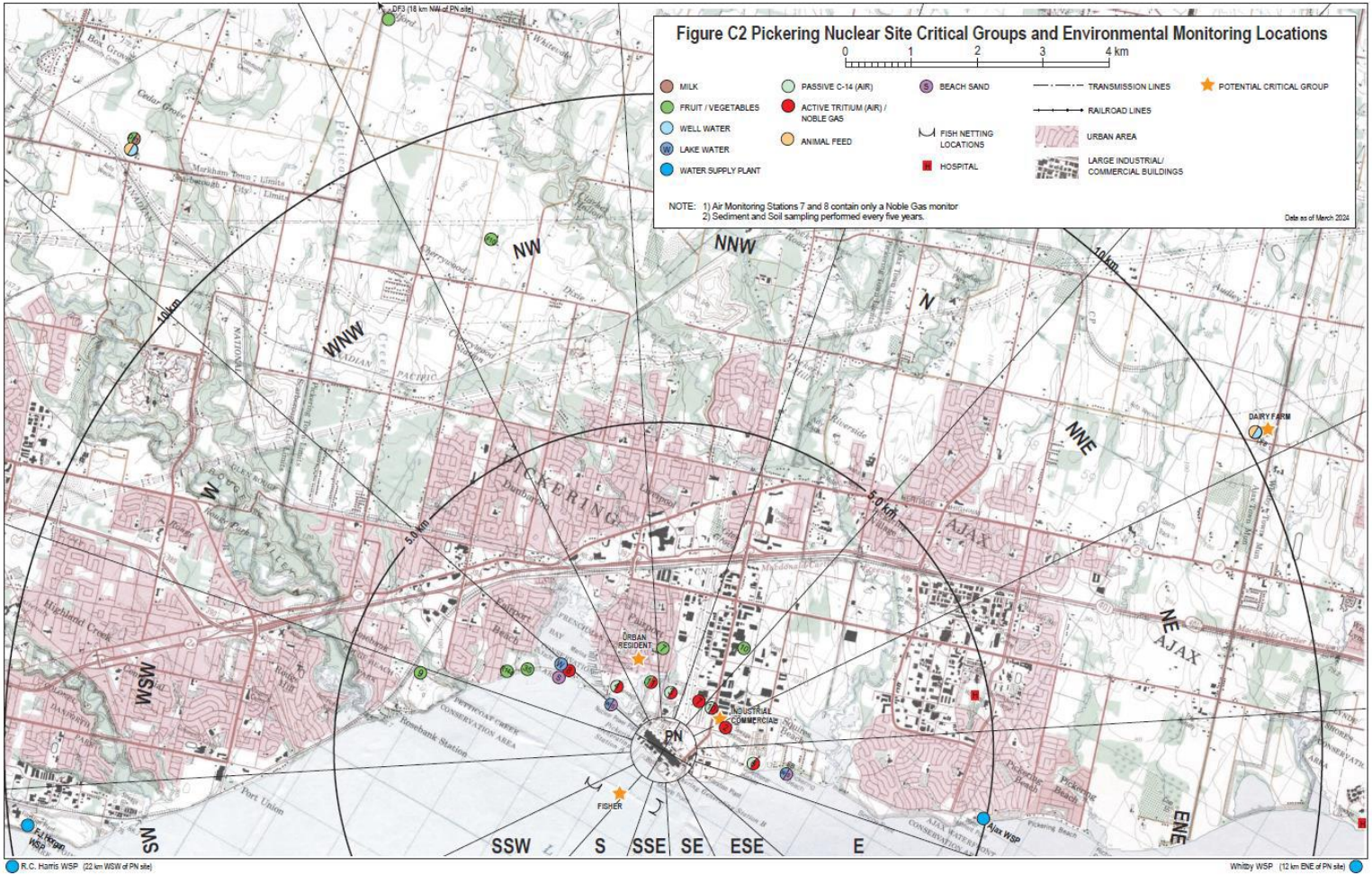
Key Objectives

- Provide data to assess the level of risk on human health and the environment resulting from operation of OPG nuclear facilities;
- Demonstrate, independent of effluent monitoring, the effectiveness of containment and effluent control;
- Demonstrate compliance with limits on the concentration/intensity of contaminants/physical stressors in the environment;
- Confirm predictions made by environmental risk assessments, refine models used, and reduce the uncertainty in the predictions made by these assessments and models.

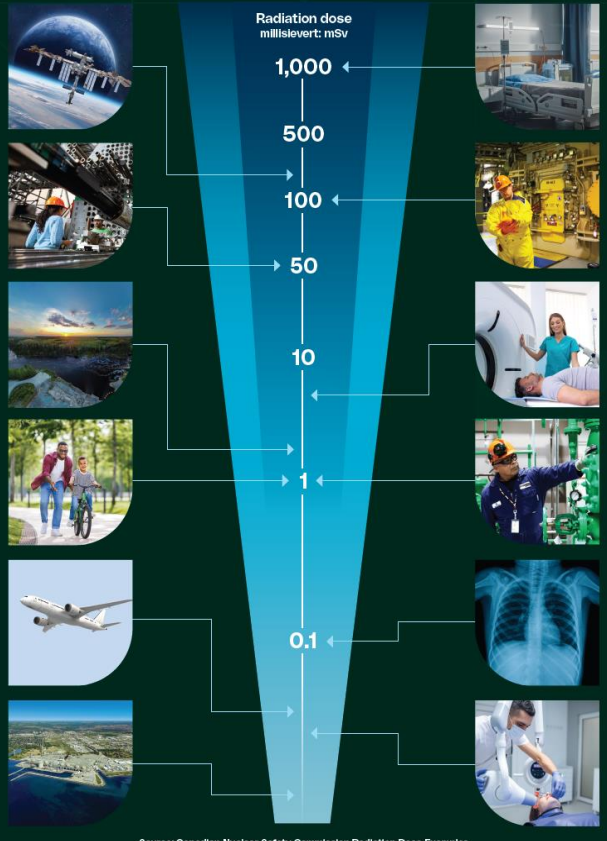
DN Critical Groups and Sampling Locations



PN Critical Groups and Sampling Locations



Radiation dose examples



150 mSv: Average annual exposure to astronauts working on the International Space Station

50 mSv: Annual dose limit for nuclear energy worker

1.8 mSv: Average annual dose from natural background radiation in Canada

1 mSv: Annual public dose limit

0.02 mSv: Typical cross-Canada flight

0.001 mSv: Typical dose from living one year within a few km of an operating nuclear power plant

1,000 mSv: Dose that may cause symptoms of radiation sickness

100 mSv: Five-year dose limit for nuclear energy workers

7 mSv: Typical chest CT scan

1 mSv: Typical annual dose received by a worker in a uranium mine or nuclear power plant in Canada

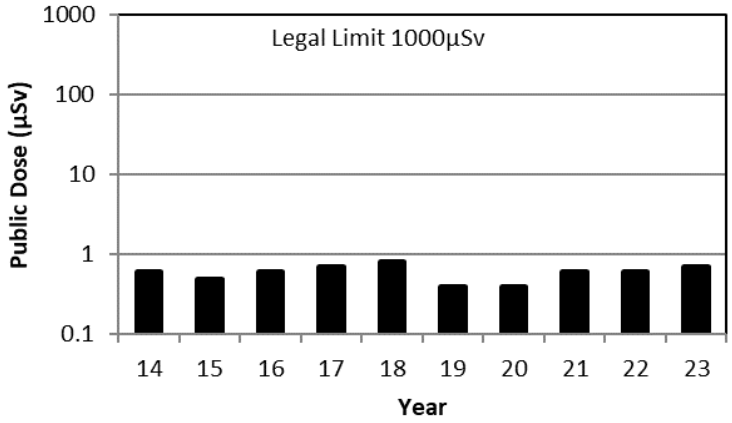
0.1 mSv: Typical chest x-ray

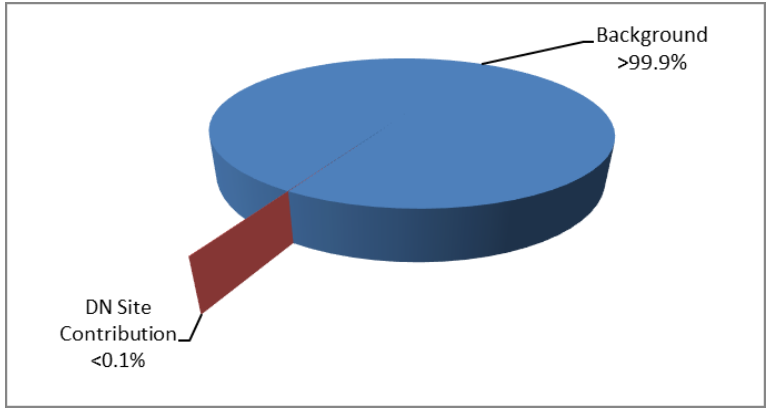
0.005 mSv: Dental x-ray

Source: Canadian Nuclear Safety Commission Radiation Dose Examples

Darlington Station 2023 Public Dose

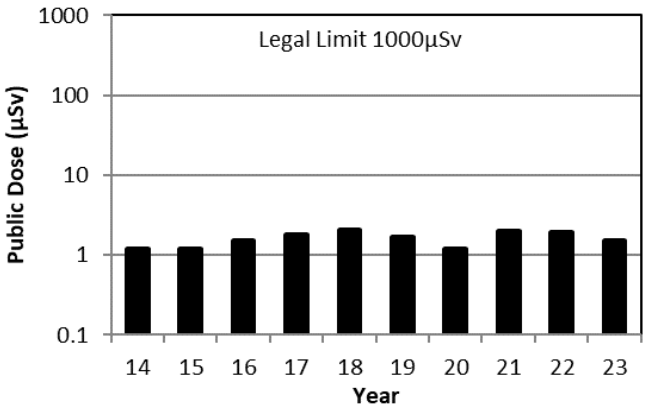
- 2023 public dose was 0.7 µSv, represented by the Farm adult
- Darlington public dose continues to be very low and is consistent with the 2022 dose
- HTO, C-14, and noble gases are the main dose contributors
- < 0.1% of annual regulatory limit of 1000 µSv and < 0.1% of annual natural background radiation of 1,400 µSv

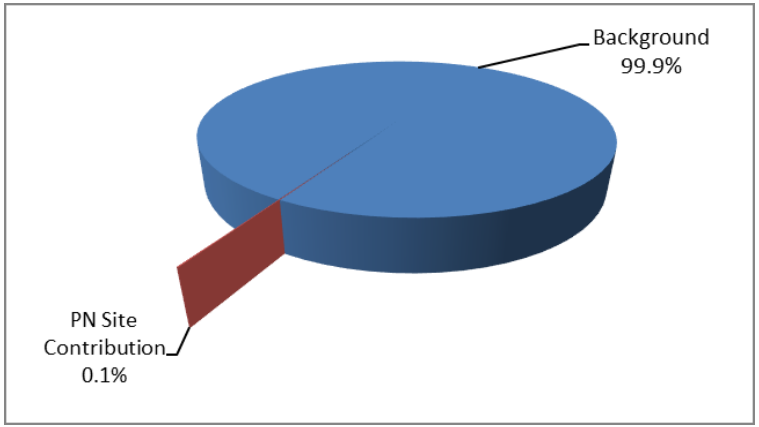




Pickering Station 2023 Public Dose

- 2023 public dose was 1.5 µSv, represented by the Urban Resident adult
- Pickering public dose continues to be very low and is consistent with the 2022 dose
- HTO and noble gases are the main dose contributors
- 0.2% of annual regulatory limit of 1000 µSv and 0.1% of annual natural background radiation of 1,400 µSv





2023 Results of Radiological Emissions Monitoring

Site Emissions[d]	DN		PNA & PNB (Units 1-8)[e]	
	Bq	% DRL	Bq	% DRL
AIR				
Tritium Oxide	5.3E+14	1.06	4.8E+14	0.47
Elemental Tritium [a]	1.8E+15	0.22	NA	NA
Noble Gas [b]	4.4E+13	0.12	1.2E+14	0.45
I-131[c]	1.2E+08	<0.01	1.0E+07	<0.01
Particulate	2.8E+07	<0.01	1.2E+07	<0.01
C-14	1.1E+12	0.09	3.2E+12	0.12
WATER				
Tritium Oxide	2.7E+14	<0.01	3.8E+14	0.05
Gross Beta/Gamma	1.7E+10	0.05	2.2E+10	1.19
C-14	2.2E+08	<0.01	3.3E+09	<0.01

NOTES: NA = Not Applicable, Bq = Bequerels

(a) Emissions from Darlington Tritium Removal Facility

(b) Units for noble gas emissions are Bq-MeV

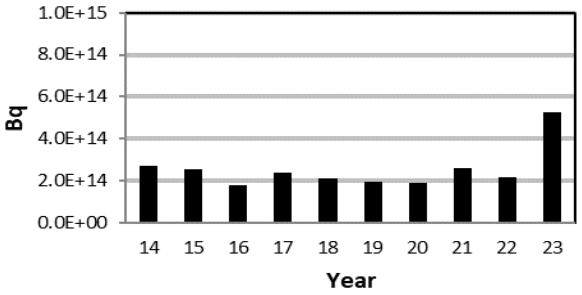
(c) Weekly samples are usually < Method Detection Limit (MDL)

(d) Annual air emissions are the sum of continuous samples analysed weekly.
Note that if interim Noble Gas sampling is in place, samples may not be continuous.
Annual water emissions are the sum of monthly composite samples for C-14, and weekly composite samples for tritium oxide and gross beta/gamma.

(e) As of 2019 PN DRLs and emissions are for PNA and PNB combined rather than separate as in the past.

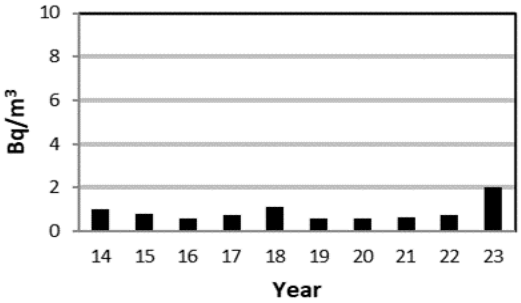
Emissions and EMP Data

DN HTO to Air Emissions



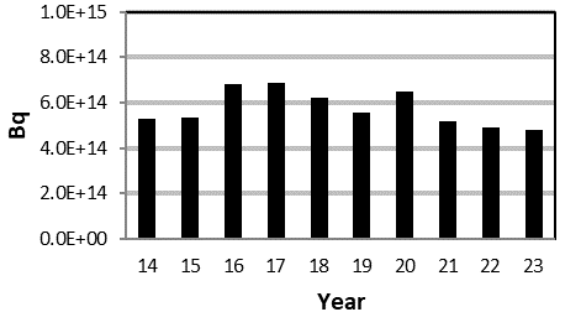
2023 = 5.3 x 10^{14} Bq

DN HTO to Air at Site Boundary



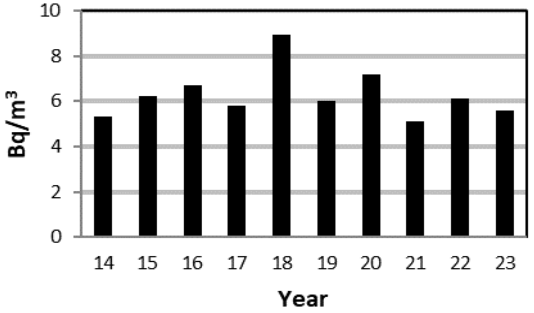
2023 = 1.8 Bq/m^3

PN HTO to Air Emissions



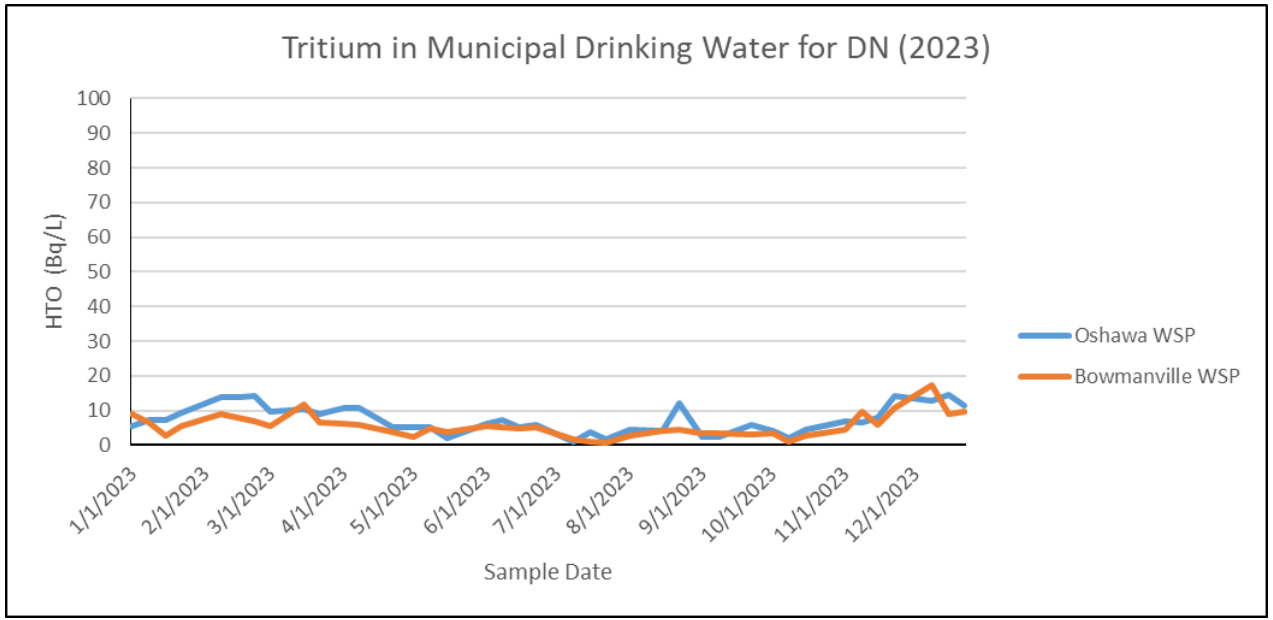
2023 = 4.8 x 10^{14} Bq

PN HTO to Air at Site Boundary



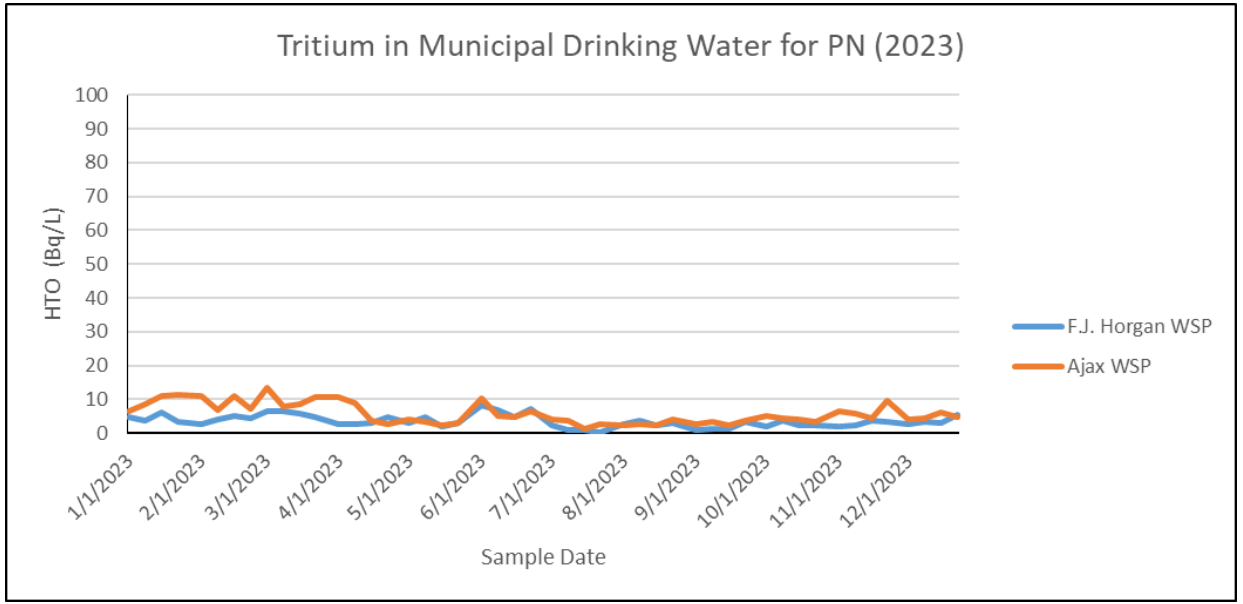
2023 = 5.7 Bq/m^3

Tritium at Water Supply Plants near DN



- Average HTO Concentrations: Oshawa = 7.3 Bq/L , Bowmanville = 5.7 Bq/L
- Ontario Drinking Water Quality Standard is 7000 Bq/L
- Water Supply Plant annual average concentrations far below OPG's commitment of < 100 Bq/L

Tritium at Water Supply Plants Near PN



- Average HTO Concentrations: F.J. Horgan = 3.5 Bq/L, Ajax = 5.8 Bq/L
- Ontario Drinking Water Quality Standard is 7000 Bq/L
- Water Supply Plant annual average concentrations far below OPG's commitment of < 100 Bq/L

Results of Non-Radiological Emissions Monitoring

Hazardous Material [a]	DN	PN
	Mg	Mg
AIR		
SO_2 to Air[b][c]	6.0E-02	6.0E-02
NO_2 to Air[c]	3.2E+01	3.4E+01
CO_2 to Air[b][c]	5.9E+03	6.2E+03
Ammonia to Air	1.2E+01	6.6E+00
Hydrazine to Air[d]	2.9E-02	5.4E-03
Ozone Depleting Substances (ODS) Releases[e]	2.9E-04	3.5E-05
WATER		
Ammonia to Water	1.9E+00	6.9E-01
Hydrazine to Water[d]	2.5E-01	2.7E-01

NOTES:

Mg = Megagrams

(a) Hazardous Materials as calculated for NPRI reporting requirements

(b) Reported in OPG Sustainable Development Report as an OPGN aggregate value.

(c) Based on annual fuel consumption.

(d) Based on annual consumption.

(e) Based on estimated quantity when a release occurs.

- 2023 emissions continue to be reported through 2024, therefore the 2023 EMP Report summarized the complete set of emissions for 2022.
- In 2022, there were no ODS releases in excess of 100kg at DN or PN. Any ODS releases between 10 kg and 100 kg are reported to Environment Canada in semi-annual halocarbon release reports.
- In 2022, there were no regulatory non-compliances associated with the sulphur dioxide, nitrogen oxides, carbon dioxide, hydrazine or ammonia emissions.

2023 Environmental Monitoring Program Summary

- 891 laboratory analyses performed for the 2023 dose calculation
- Site emissions remained at a very small fraction of their respective DRLs.
- The 2023 site public doses remains a small fraction of both the annual legal dose limit and the annual natural background radiation in the area.
- Tritium in drinking water measured at local water supply plants remained at a small fraction of the Ontario Drinking Water Quality Standard (7000 Bq/L) and OPG's voluntary commitment (100 Bq/L).
- Dose calculations and annual report were reviewed and verified by an independent third party.
- 2023 EMP report was submitted to CNSC on April 25, 2024 and is available on www.opg.com.
- The overall EMPs encompass other programs that are reported separately.

Impingement & Entrainment

- Results of the 2023 monitoring program are presented in the Pickering Nuclear 2023 Impingement Monitoring Report submitted to both DFO and CNSC and will be available on www.opg.com
- The combined biomass of all species and ages impinged in 2023 was 2,511 kg, a rate equivalent to 0.51 kg per million cubic metres of station intake volume.
- The residual impingement and entrainment impacts at both PNGS and DNGS are counterbalanced by offset measures.
    - An allocated portion of the OPG Big Island Wetland habitat bank, situated in the Bay of Quinte, is an offset measure for both PNGS and DNGS.
    - Additional offset measures for PNGS include stocking of Atlantic Salmon into Duffins Creek and the construction and monitoring of the Simcoe Point Wetland at the mouth of Duffins Creek.

Audits & Inspections

- The Ministry of the Environment, Conservation and Parks (MECP) performed an audit of the Health Physics Laboratory (HPL) in May, 2023. There was one finding to confirm whether there is a statement about processing drinking water samples without undue delay present in documentation and one request for evidence of sampling instructions provided to clients. The one finding and one request for evidence were completed and responses were accepted by the MECP.

- MECP conducted an unannounced inspection at HPL between November 2023 and January 2024. There were no non-compliant findings during this inspection. The Final Inspection Rating was 100%.

- An independent audit of the EMPs is conducted once every five years by OPG's Nuclear Oversight department. The most recent audit was just concluded in May 2024. Results concluded that the managed system controls for the EMPs are generally effective. One finding (related to NSS-WWMF EMP documentation) and six insights are currently under review and will be addressed accordingly.

Looking Ahead

- In 2023, no major changes to the routine sampling program were identified. Non-intent revisions to EMP documentation were identified through recent inspections and self-assessments and will be implemented.
- No supplementary studies are planned in 2024 as part of the EMP.
- The site-specific surveys, which identify the potential critical groups for DN and PN EMPs, are currently under review and will be revised accordingly.
- Changes to the EMP as a result of the latest PN and DN ERAs will be identified and captured in the next EMP design review.

ONTARIO POWER GENERATION