



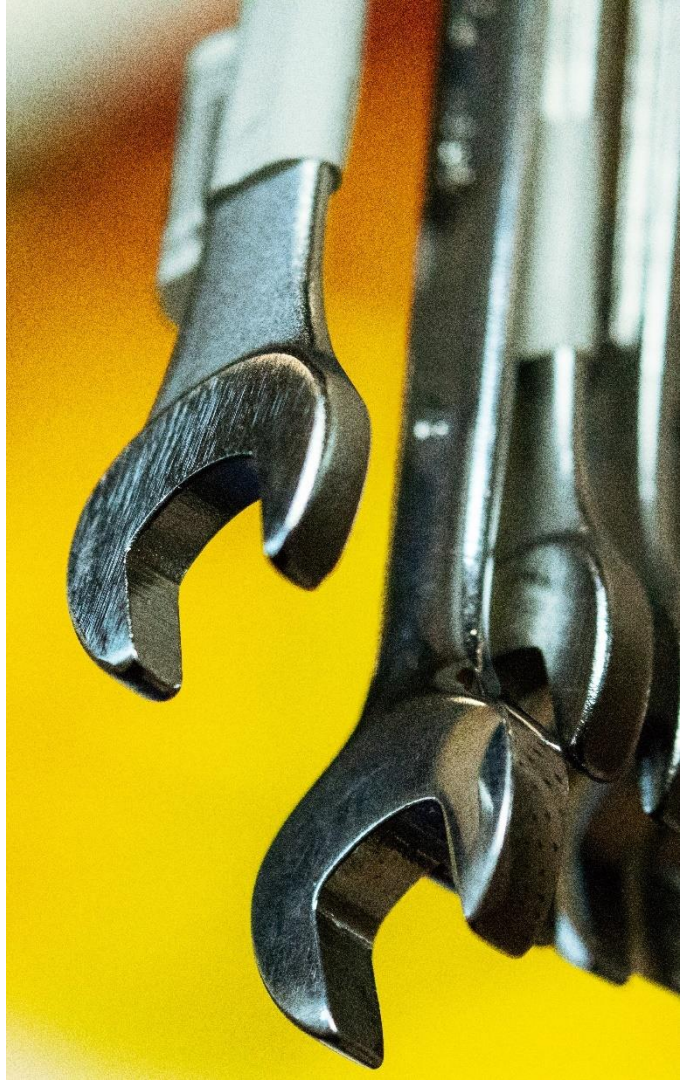
2021 Results of OPG's Pickering and Darlington Environmental Monitoring Programs

September 20, 2022
PNGS CAC Meeting

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Agenda

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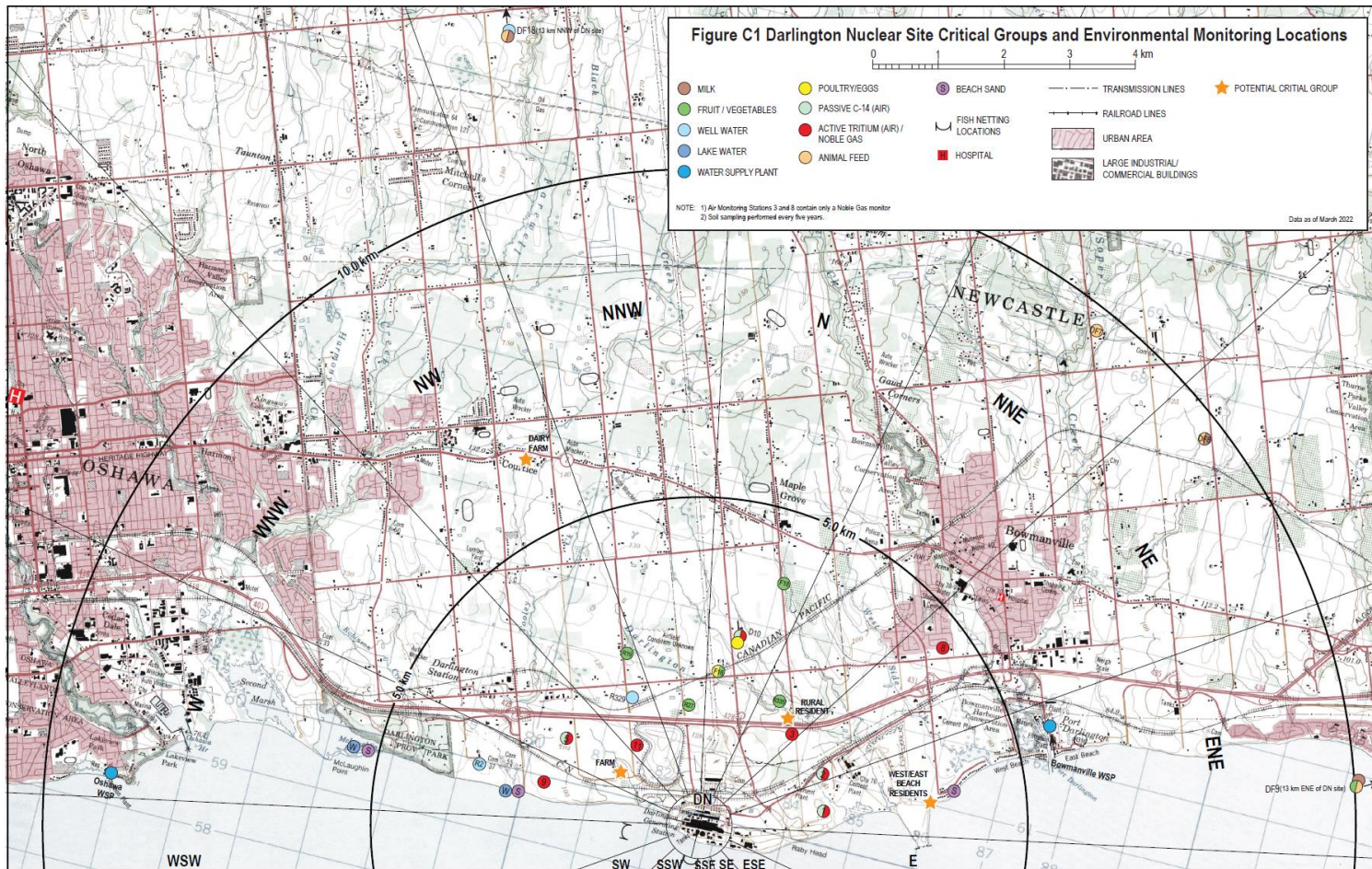
Environmental Monitoring Programs

Key Objectives

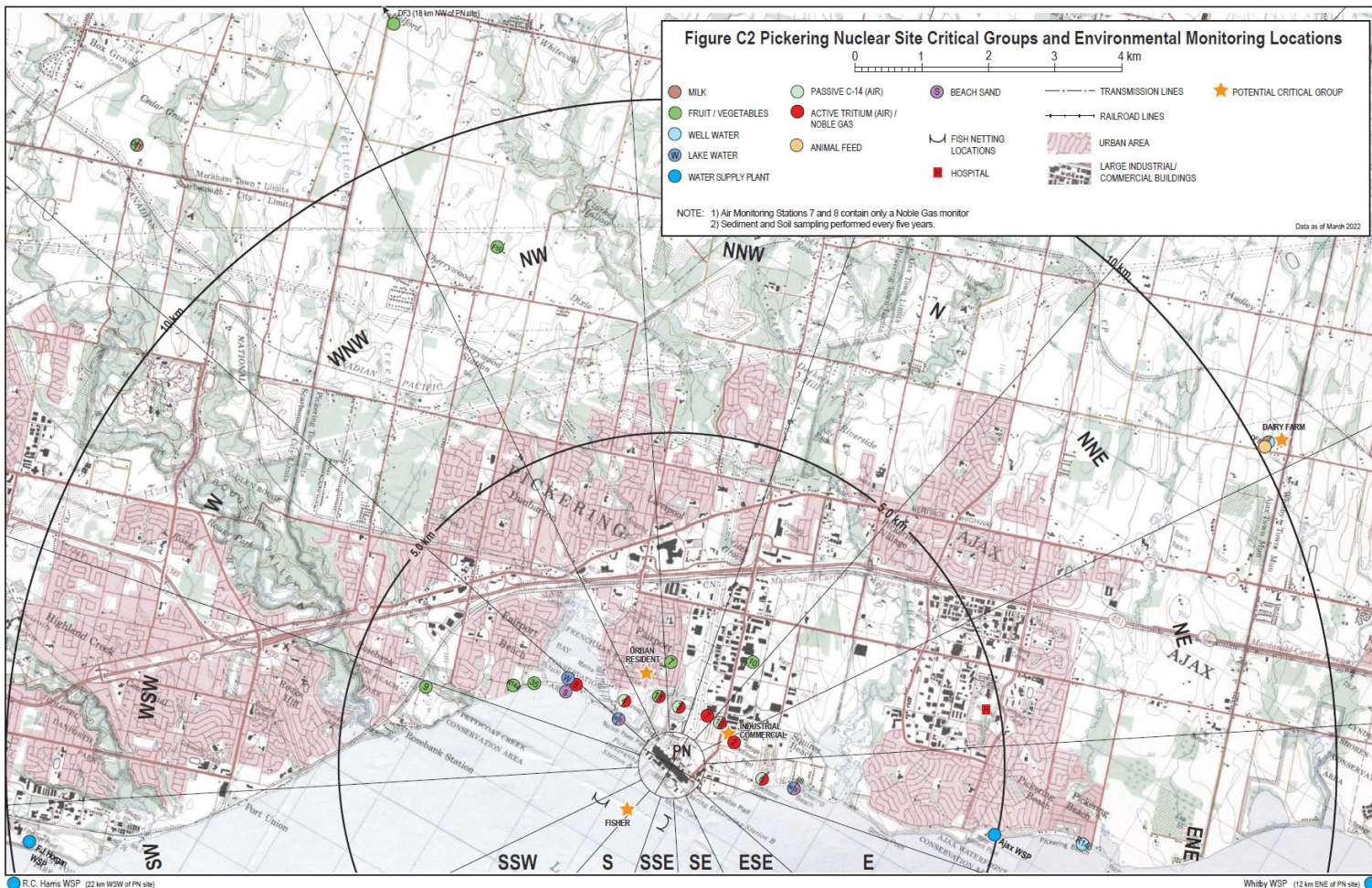
- Demonstrate, independent of effluent monitoring, the effectiveness of containment and effluent control
- Demonstrate compliance with limits on the concentration/intensity of contaminants/physical stressors in the environment
- Provide data to assess the level of risk on human health and the environment and/or to confirm predictions made by environmental risk assessments



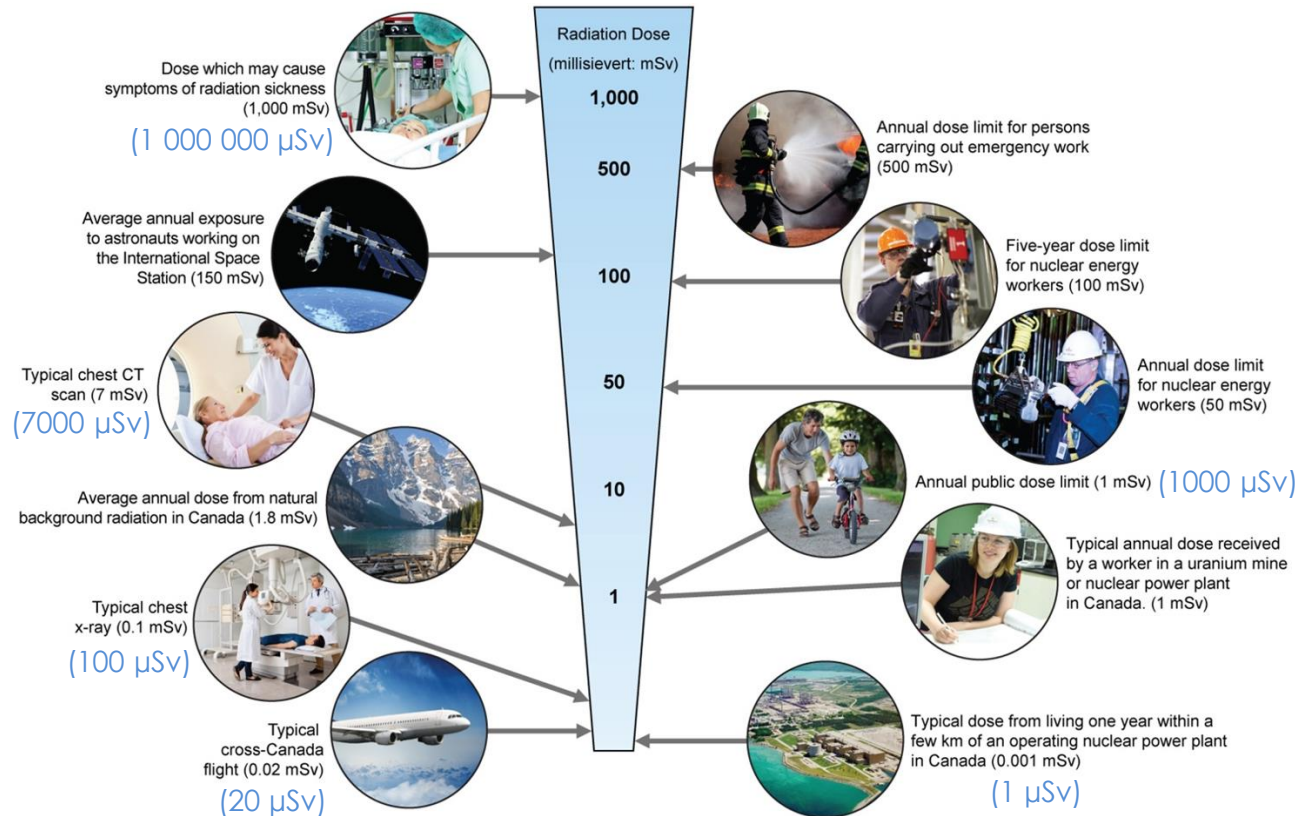
DN Critical Groups and Sampling Locations



PN Critical Groups and Sampling Locations



Radiation Dose Examples

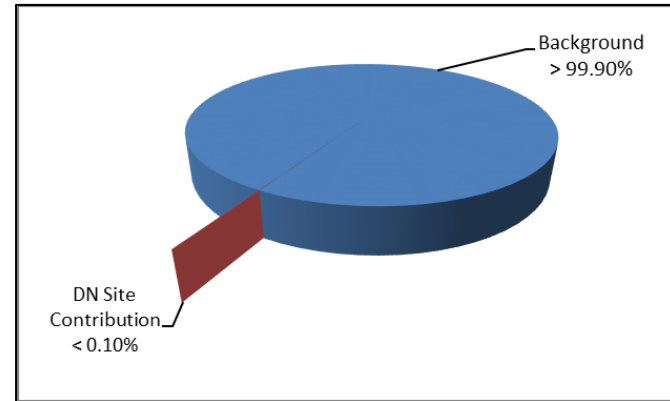
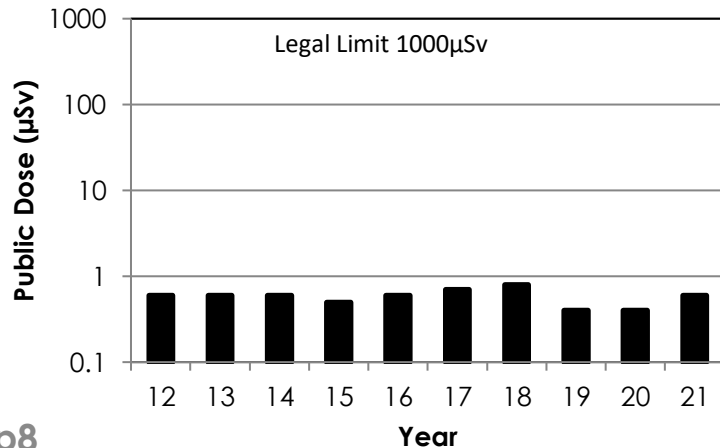


2021 EMP Summary

- Annual public doses resulting from PN and DN operations were 2.0 μSv and 0.6 μSv respectively; 0.2% of the annual regulatory limit for PN and < 0.1% of the annual regulatory limit for DN
- Station radiological emissions remained at very small fractions of their respective Derived Release Limits (DRLs)
- Dose calculations and annual report were reviewed and verified by an independent third party
- 2021 EMP report was submitted to CNSC on April 25, 2022 and is available on www.opg.com

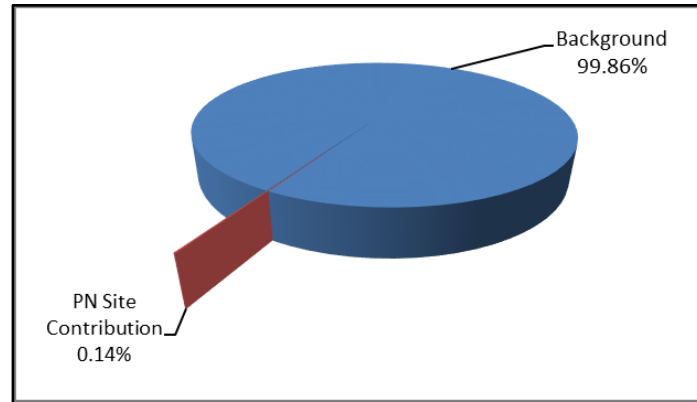
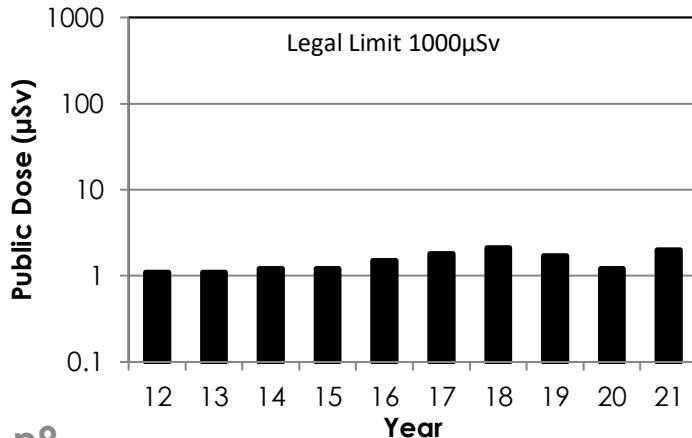
Darlington Station 2021 Public Dose

- 2021 public dose was 0.6 μSv , represented by the Farm adult
- Darlington public dose continues to be very low and is consistent with the 2020 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 2021 Public Dose

- 2021 public dose was 2.0 μSv , represented by the Urban Resident adult
- Pickering public dose continues to be very low and is consistent with the 2020 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



2021 Results of Radioactive Emissions Monitoring

Site Emissions ^(d)	DN		PNA & PNB (Units 1-8) ^(e)	
	Bq	% DRL	Bq	% DRL
AIR				
Tritium Oxide	2.6E+14	0.53	5.2E+14	0.51
Elemental Tritium ^(a)	1.7E+13	<0.01	NA	NA
Noble Gas ^(b)	2.7E+13	0.07	1.4E+14	0.54
I-131 ^(c)	1.5E+08	<0.01	9.7E+06	<0.01
Particulate	2.0E+07	<0.01	1.1E+07	<0.01
C-14	1.2E+12	0.10	2.6E+12	0.12
WATER				
Tritium Oxide	1.9E+14	<0.01	4.8E+14	0.06
Gross Beta/Gamma	1.6E+10	0.05	1.2E+11	6.41
C-14	1.9E+09	<0.01	4.6E+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)

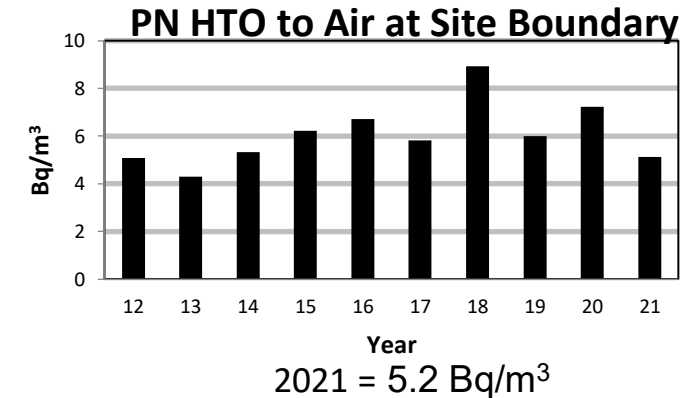
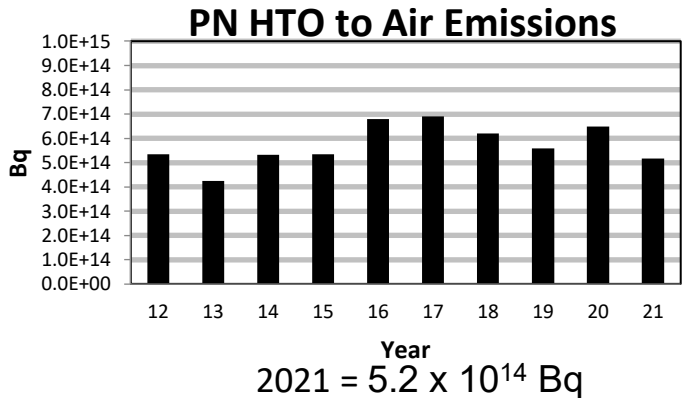
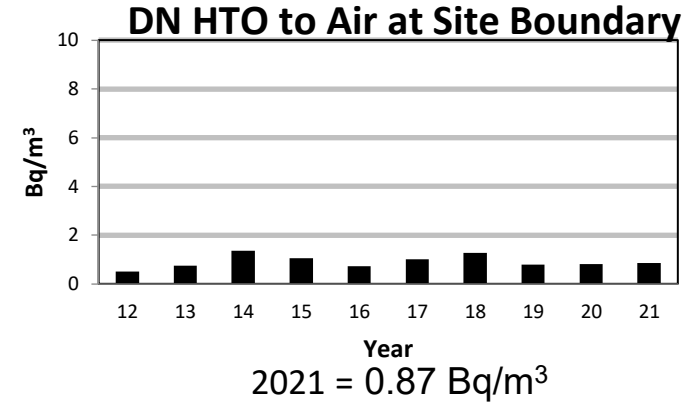
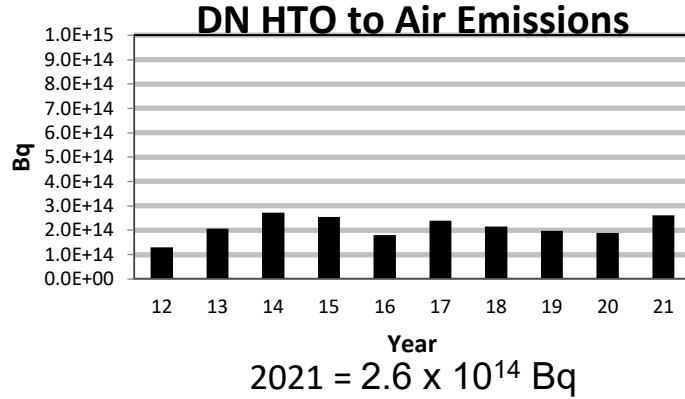
(d) Annual air emissions are the sum of continuous samples analysed weekly.

Note that if interim Noble Gas sampling is in place, samples may not be continuous.

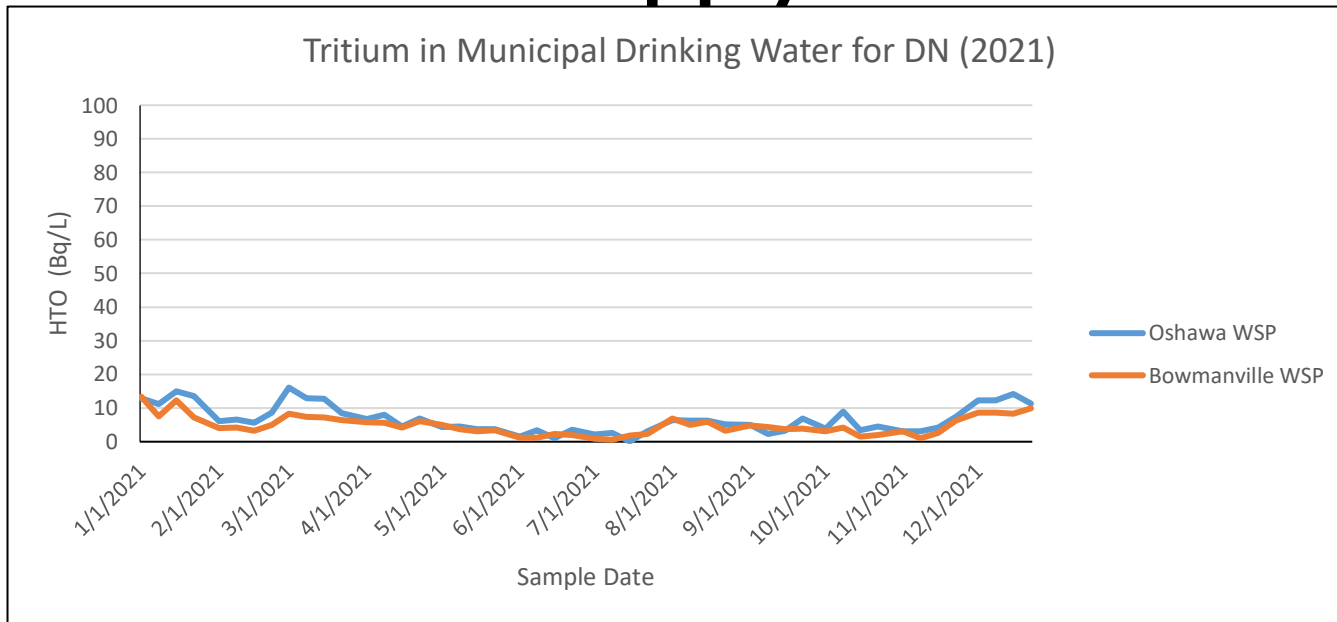
Annual water emissions are the sum of monthly composite samples for C-14, and weekly composite samples for tritium oxide and gross beta/gamma.

(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

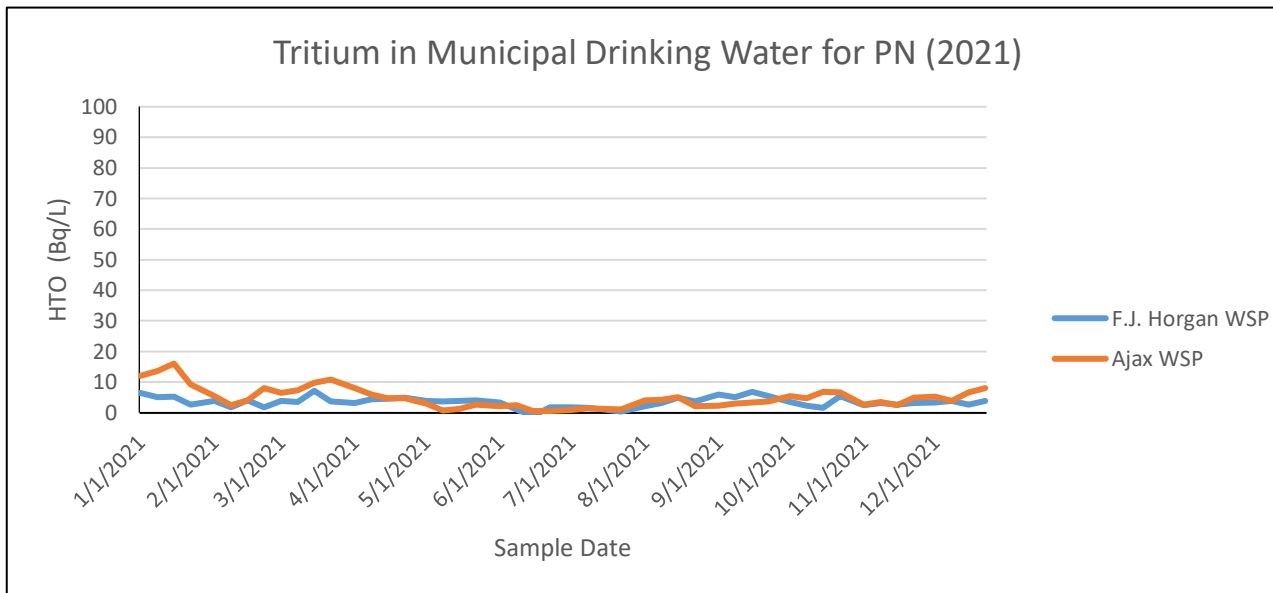


Tritium at Water Supply Plants near DN



- Average HTO Concentrations: Oshawa = 6.6 Bq/L , Bowmanville = 4.8 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

Tritium at Water Supply Plants Near PN



- Average HTO Concentrations: F.J. Horgan = 3.5 Bq/L, Ajax = 4.9 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)}	3.00E-02	4.5E-02
NO ₂ to Air ^(c)	1.50E+01	2.6E+01
CO ₂ to Air ^{(b)(c)}	4.60E+03	2.8E+03
Ammonia to Air	1.20E+01	4.8E+00
Hydrazine to Air ^(d)	2.20E-02	5.2E-03
Ozone Depleting Substances (ODS) Releases ^(e)	2.4E-01	2.3E-02
WATER		
Ammonia to Water	1.6E+00	6.9E-01
Hydrazine to Water ^(d)	1.8E-01	2.6E-01

- 2021 emissions continue to be reported through 2022, therefore the 2021 EMP Report summarized the complete set of emissions for 2020
- In 2020, there were three ODS releases of R134a (tetrafluoroethane) refrigerant at DN, in excess of 100kg. The spills were reported to the Spills Action Centre and regulatory authorities.

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.

2021 Environmental Monitoring Program Results

- Site emissions remained at a very small fraction of their respective DRLs.
- 935 laboratory analyses performed for the 2021 dose calculation.
- The 2021 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 of 7000 Bq/L and OPG's voluntary commitment of 100 Bq/L.
- The overall EMPs encompass other programs that are reported separately.

Other Monitoring Programs

Impingement and Entrainment Monitoring Program

- Annual reporting of fish impingement is required by Fisheries and Oceans Canada (DFO) to ensure ongoing compliance with conditions of the PN Fisheries Act Authorization issued to OPG in January 2018.
- Results of the 2021 monitoring program are presented in the Pickering Nuclear 2021 Impingement Monitoring Report submitted to both DFO and CNSC and will be available on OPG.com.
- The combined biomass of all species and ages impinged in 2021 was 1,585.1 kg, a rate equivalent to 0.32 kg per million cubic metres of station intake volume.
- Alewife (507.4 kg; 32%) and Gizzard Shad (307.85 kg; 19.4% of total biomass) were most common, as expected.
- Results of the 2022 monitoring program will be issued in 2023.
- Owing to intake design refinements and its later construction date, DN employs a more advanced intake structure. Therefore, the Authorization value at DNGS is approximately 1/3 of the value at PNGS, and impingement and entrainment monitoring at DNGS is only required after the completion of the Darlington Refurbishment project.



Environmental Risk Assessments (ERAs)

2020 Darlington ERA

- The updated 2020 DN ERA has been completed and is available on OPG.com. The results of the following are included in the DN ERA:
 - A 2019 supplementary study on hydrazine concentrations in lake water at the outlet of the DN diffuser to analyze the result using a lower detection limit. This study was designed to remove uncertainty surrounding human exposure to hydrazine through drinking water and fish ingestion. The results indicate that there are no health risks for human receptors due to the exposure of hydrazine in drinking water and in fish.
 - A 2019 supplementary study on the filtered and unfiltered concentrations of aluminum in the DN CCW to clarify the risk to ecological receptors in Lake Ontario. As the dissolved aluminum did not exceed its screening criteria, aluminum was not carried forward as a chemical contaminant of potential concern for ecological health in the ERA.



Environmental Risk Assessments (ERAs)

2021 PN ERA

- The updated 2021 PN ERA has been completed and submitted to the CNSC. It will be available online once comments from CNSC, if any, are addressed.
- Overall, both the DN and PN ERAs concluded that the sites are operating in a manner that is protective of human and ecological receptors residing in the surrounding area.



Looking Ahead

- The Ministry of the Environment, Conservation and Parks performed audits of the Health Physics Laboratory in February and August, 2021. There were no non-compliant findings for either audit. Overall, the Inspection rating for both audits was 100%.
- There was one CNSC Field Inspection on March 5, 2021. The inspection did not result in any adverse conditions found.
- In 2021, no major changes to the routine sampling program were identified. A routine review and revision of the Management of the Environmental Monitoring Programs procedure document was completed in 2021.
- No supplementary studies are planned in 2022 as part of the EMP.
- 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, which will be undertaken in 2023.

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