

Soil Vapour.....

Which Regulation?

What Sampling Technique?

What Equipment ?



May 2026

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What is PASSIVE vs Active air sampling?

1. **Active Sampling** : Air Sampling that requires a pump of some sort
2. **Passive Sampling**: Air Sampling device operates on the principal of passive diffusion or sampling into an evacuated cylinder (canister)





Air SamplingTHREE QUESTIONS WE MUST ASK!

1. What kind of air is being sampled & is there a regulation driving this sampling?
2. Do you have an analyte **target list & required reporting limits**?
3. Do you have a required **sampling time**, or does it matter?

Outline

- **US- EPA** → Methods TO-15, TO-17
- **Federal** – Health Canada & CCME
- **Maritimes** – RBCA
- **Ontario** – Regulation 153/04
- **Alberta** – AEP
- **British Columbia** – BCMOE – Sch.11 & BC CSAP
- PFAS in Air by OTM-50 & OTM-45 update

Silonite vs Summa (USEPA TO-15)



SILONITE CANISTER vs SUMMA & UNCOATED CANISTER

SILONITE



100% inertness tested prior to shipment. Polished internal surface prior to Silonite™ coating for the most inert surface possible.

All Entech Canisters are coated in Silonite™ to ensure there is no chance for corrosion and the subsequent loss of reactive compounds.



Silonite™ canisters are the only "inertness-repairable" canisters on the market. No need to fear canister inertness testing. Entech's renewal process can return old Silonite™ cans to often better than new conditions.

Externally electro-polished "after" Silonite™ coating to provide a more analytical and professional look.



UNCOATED

Rapidly lose their ability to recover important VOCs such as Carbon Tetrachloride.

During the manufacturing of 6L half shells, organic contaminants in the form of grease and oils become trapped in the surface pores found in all stainless steel sheet metal.

Interior will easily corrode.

SUMMA

The metal oxides found in SUMMA canisters can actually be catalytic in promoting certain chemical reactions.

Because of the limited inertness of the SUMMA canister, a certain amount of water vapor is actually needed to allow Air Toxic compounds to remain stable. Even aromatic hydrocarbons can be lost to the surface of a SUMMA canister if enough water isn't present.

Thermal Desorption Tube Sampling (USEPA TO-17)

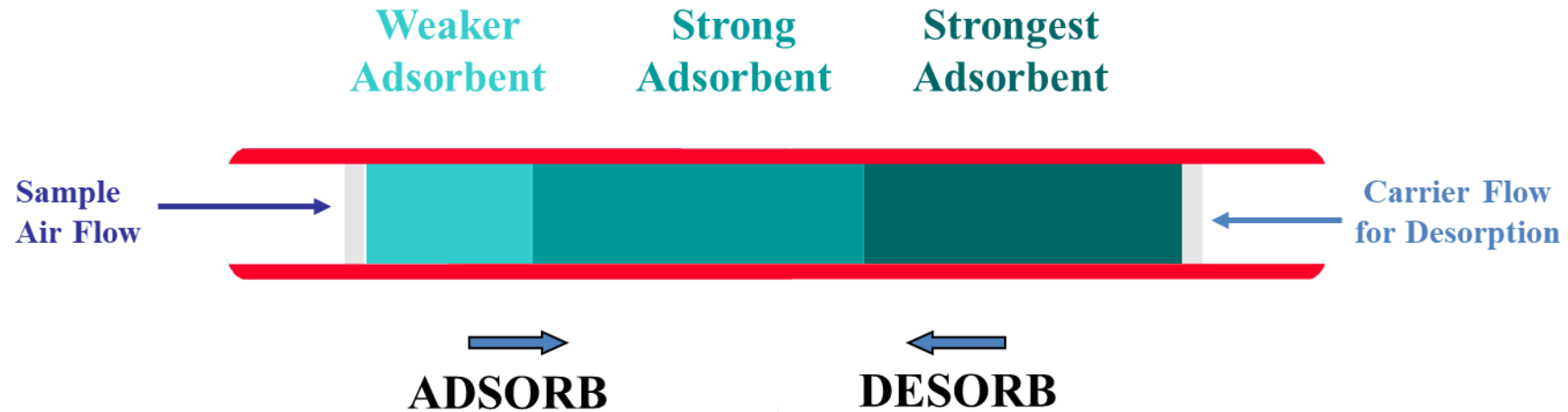
- Considerations
- Type of sample taken?
- Flowrate?
- Sampling Time / Volume?





Thermal Desorption (TD) Tubes : active sampling(USEPA TO-17)

- For active sampling, a multi-adsorbent TD tube (PerkinElmer SVI) that offers wide VOC molecular range, large safe sampling volumes (SSV), good water management & low media background
- For passive sampling, a specific single-adsorbent TD tube & cap



Quality Control Protocol – Blanks

- **Travel/trip blank**

- As per the updated EPA TO15 requirements, a canister travel blank is filled with UHP Nitrogen
- TD tube left unopened (normally field blank is done)

- **Field blank**

- Canister filled in the field with UHP air or nitrogen in a similar manner to sample
- TD tube opened & immediately closed at sampling location

- **Background blank**

- Ambient air collected near building being sampled

- **Equipment blank**

- Ambient air drawn through entire sampling train





Quality Control – Duplicate Samples

Considerations

- Type of sample taken?
- Same or different flow?
- Same or different time?

Suggestions

- Co-located (side-by-side) for indoor air
- Simultaneous for sub-slab & soil gas using one flow controller
- Equalized pressure in joined canisters provides uniform filling

Potential contamination from different flow controllers can be an issue

Same sampling time requires flow controller set to double the flow rate



Quality Control – Do's /Don'ts

Do's	Don'ts
<ul style="list-style-type: none">• Use clean & dedicated sample train materials• Select Teflon or Nylaflow T tubing that doesn't off-gas VOCs which could exceed regulatory limits• Soil Gas Probes – Seal when not sampling• Stainless Steel is best, but rigid PVC (sufficiently old to have low levels of VOCs) is a practical alternative• Use small diameter probes & tubing to reduce purge volume	<ul style="list-style-type: none">• No glue or tape except Teflon tape• Do not use: Tygon®, Low Density Polyethylene (LDPE), Silicone, Polyvinyl Chloride (PVC) or Nylon (Extra-Flex)• Do not use freshly cut or scratched rigid PVC



Canister Cleaning Procedure

- Canisters are cleaned by filling with nitrogen and evacuating to complete vacuum under heat
- 6L cans are cleaned for 2 days and go through 10 cycles mentioned above
- 1.4 L cans and bottle vacs are cleaned for 3 days and go through 15 cycles mentioned above
- Flow controllers are cleaned by flushing with nitrogen under heat for 24 hours before calibrating the flow rate on a digital flow meter
- All additional parts are continuously stored under heat to clean and maintain cleanliness
- All canisters are individually proofed; however, we only report 1 in a batch into our LIMS (**meets batch proofing requirements, but we actually proof all cans**) .

By individually proofing each canister, the client is able to request the individual proof certificate (\$100) after analysis based on data received.

This saves cost for the client as they can pick and choose which canister proofs they want.

US- EPA TO-15 or TO-17 ?



EPA TO-15

- Canisters (passivated/under vacuum)
- VOC Compounds
- Whole Air
- RL is affected by underfilling canister

E



EPA TO-17

- Thermal Desorption Tubes (TD tubes)
- VOC compounds
- Safe Sampling Volumes (SSV)
- RL is affected by volume of sample taken

EPAE

Federal Documents :



Health Canada & Canadian Council for Ministers of the Environment (CCME)

CCME

- CCME's primary guidance for soil vapour is the **2014 Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours – update 2016**
- Canister / Sorbent Tube
- BTEX F1/F2 with or without subfractionation

Health Canada

- Federal Contaminated Sites Risk Assessment in Canada, Part VII: Guidance for Soil Vapour Intrusion Assessment at Contaminated Sites – 2023
- Canister / Sorbent Tube
- Health Based Indoor Air / Chlorine degradation



Maritimes – Atlantic Risk-Based Corrective Action (RBCA), 2024



Which document ?

V4 User Guidance, August 2022

(note : that screening level tables are in: Atlantic Canada Tier II, July 2021)



Nova Scotia



New Brunswick



Prince Edward Island

What technique, target analysis ?

Passivated Canister , BTEX , F1/F2 & aliphatic /aromatics

Sometimes additional chlorinated VOCs :tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethane, 1,1-dichloroethane, vinyl chloride



Newfoundland

What equipment ?

Canister, flow controller, duplicate sampler, travel blank, teflon tubing , nut/ferrule fittings



Ontario Regulation 153/04



Which document ?

Technical Guidance for Soil Vapour Intrusion Assessment, MECP 2021

What target analysis ?

BTEX , F1/F2 with or without aliphatic /aromatics ,
Sometimes additional chlorinated VOCs only, Reg 153/04 Health Based Indoor Air
Utilize conceptual site model, see also section 5.3
Monitoring Well , Vapour Pins, Sub-Slab

What equipment ?

Canisters , TD tubes (thermal desorption- NO F1F2)
If sampling from vapour pins – nut /ferrules?
Purging !



SVI Sampling – Petroleum Hydrocarbons (PHC)

- **PHC Target Compounds**

- Analysis based on EPA TO-15 method
- BTEX or other PHCs target list

- **PHC F1 and F2**

- Analysis based on CCME standard method (water & soil)
- Total F1 & F2 and corrected for BTEX & naphthalene

- **PHC Sub-Fractions (aliphatic & aromatic)**

- No standardized methodology, ALS Waterloo method based on Atlantic RBCA (water, soil) & BCMOE (air) methods
- C6-C8, C>8-C10, C>10-C12 & C>12-C16 aliphatic & aromatic sub-fractions



Alberta



Alberta Tier One (AEP- Alberta Environment Protection)

Which document?

Alberta Tier One Soil and Groundwater Remediation Guidelines, June 2024

Soil Vapour reference : CCME (2014) *some projects defer to BC MOE CSR Protocol 11, April 2026 “

What target analysis?

BTEX F1/F2 + aliphatic / aromatic subfractionation

BE AWARE of Trichloroethylene RL required if chlorinated VOCs are needed!

What equipment?

Canister if F1/F2 (with or without aliphatic aromatic subfractionation) are needed

Thermal Desorption Tube (only if VHV volatile hydrocarbons/volatile petroleum hydrocarbons in the vapour phase is acceptable)

Other considerations : blank , duplicate , background, Teflon tubing , nut/ferrules



British Columbia

British Columbia — BC guidance doc & BC Contaminated Sites Approved Professionals (CSAP)



BC – Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings, May 2011 (Golder Associates)

- Canisters, **TD Tubes** –preferred in BC, Tedlar bags
- Outlines sampling techniques with insights

BC CSAP –Guidance on the Assessment of Soil Vapour to Air Pathway- 2020,2022, 2024

- Complements BC Ministry of the Environment's requirements, eg Protocol 22 & Technical Guidance 4
- Sampling depends on approach and site conditions

****BC MOE CSR Protocol 11, April 2026****



Soil Vapour Intrusion Guidance Documents

Ontario	Draft Technical Guidance: Soil Vapour Intrusion Assessment – MECP 2021
British Columbia	BC MOE CSR Protocol 11, April 2026 Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings – May 2011
BC CSAP	Guidance on the Assessment of the Soil Vapour to Air Pathway -2020,2022,2024
Health Canada	Federal Contaminated Sites Risk Assessment in Canada, Part VII: Guidance for Soil Vapour Intrusion Assessment at Contaminated Sites – 2023
AEP	Draft document to Alberta Tier 1 June 2024
CCME	Canadian Council for Ministers of the Environment – Contaminated Sites -2016
US EPA	OSWER Technical Guide For Assessing and Mitigating Vapour Intrusion Pathway from Subsurface Vapor Sources to Indoor Air – 2015, CA EPA 2023

Guidance documents may be available for other provinces – please let me know

Thank you to Ian Hers for updating this list



Complementary Techniques – Why Use Canisters or TD Tubes?

Canisters:

- Quantitative recovery of **low MW VOCs** (C1-C3 range)
- Prior **knowledge of VOCs air concentration** is not a controlling factor in sampling (no saturation or safe sampling volume issues)
- Silica coated canisters provide best **stability of VOCs**, including sulphur & other reactive compounds
- **Multiple** (sample dilutions) & **different** (instruments) analyses are possible from the same canister

TD Tubes:

- Good recovery of **higher MW VOCs** (e.g. siloxanes, low MW PAHs, etc.)
- Good recovery of **polar VOCs** through adsorption on tube media
- Volume of air collected can be adjusted **to meet low regulatory limits**
- Small size – personal & area sampling; easy to ship
- Passive sampling – enables extended sampling times without a pump. Sampling applications include: fencelines (EPA 325), buildings (walls, ducts), confined spaces, pipelines, wells, etc.



Common occurrences in Canister Sampling

Canisters:

- Loosening or tightening of fittings
- Twisting off Dust Caps
- Improper filling of canisters
- Duplicate sampling with quick connects – sampling time
- Checking vacuum
- Using timers
- Paperwork

TD tubes:

- End caps left off
- End caps difficult to remove



Interpreting Results

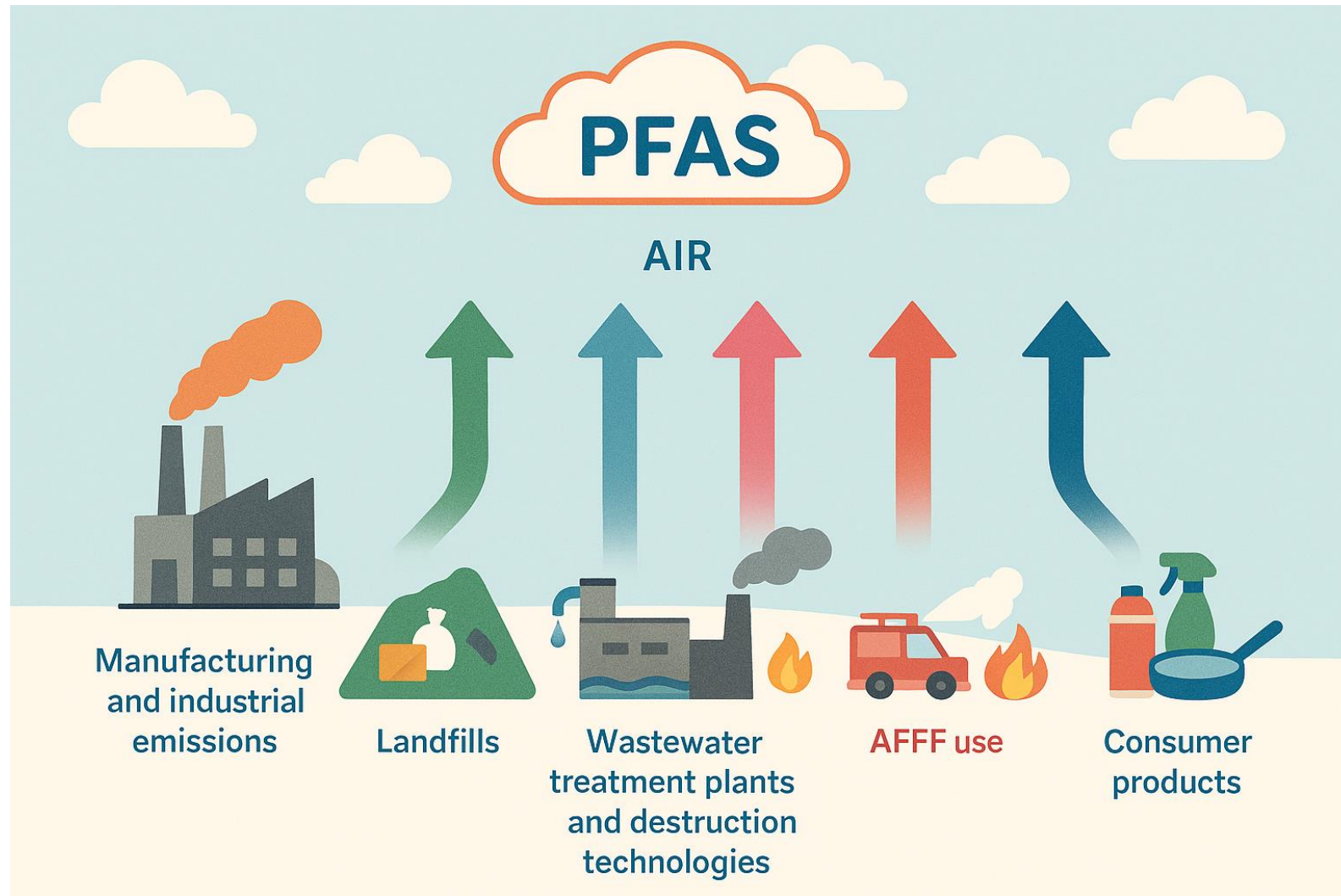
Canister Data:

- ppbv vs $\mu\text{g}/\text{m}^3$
- Batch QC
- Individual proof vs batch proof
- Qualified data for canister at or above atmospheric pressure
- Impact of underfilled canisters

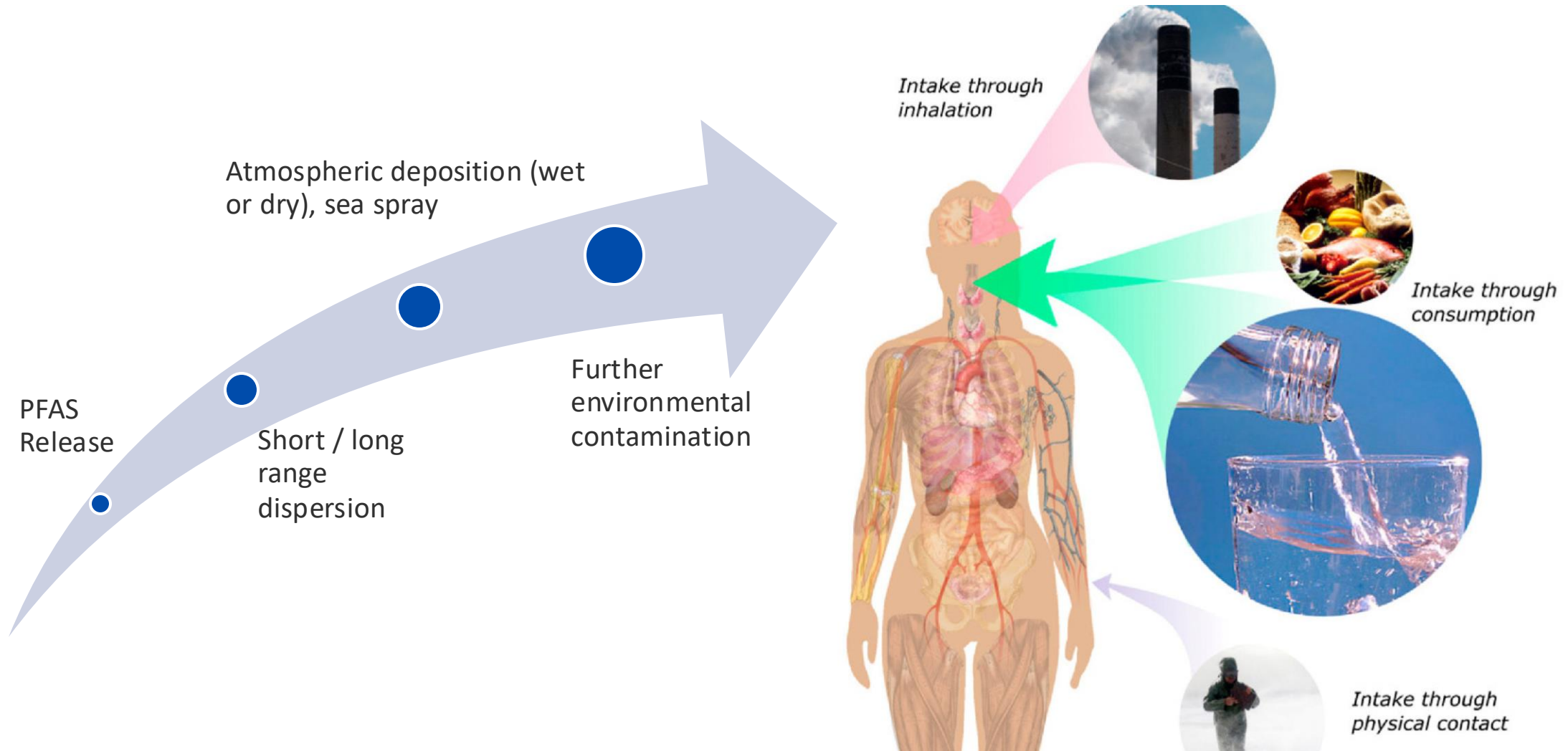
TD tubes:

- Sampling time vs Reporting limit
- Safe Sampling Volumes (SSV)

PFAS in Air - Where



PFAS in Air -Why : Environmental and Health Implications

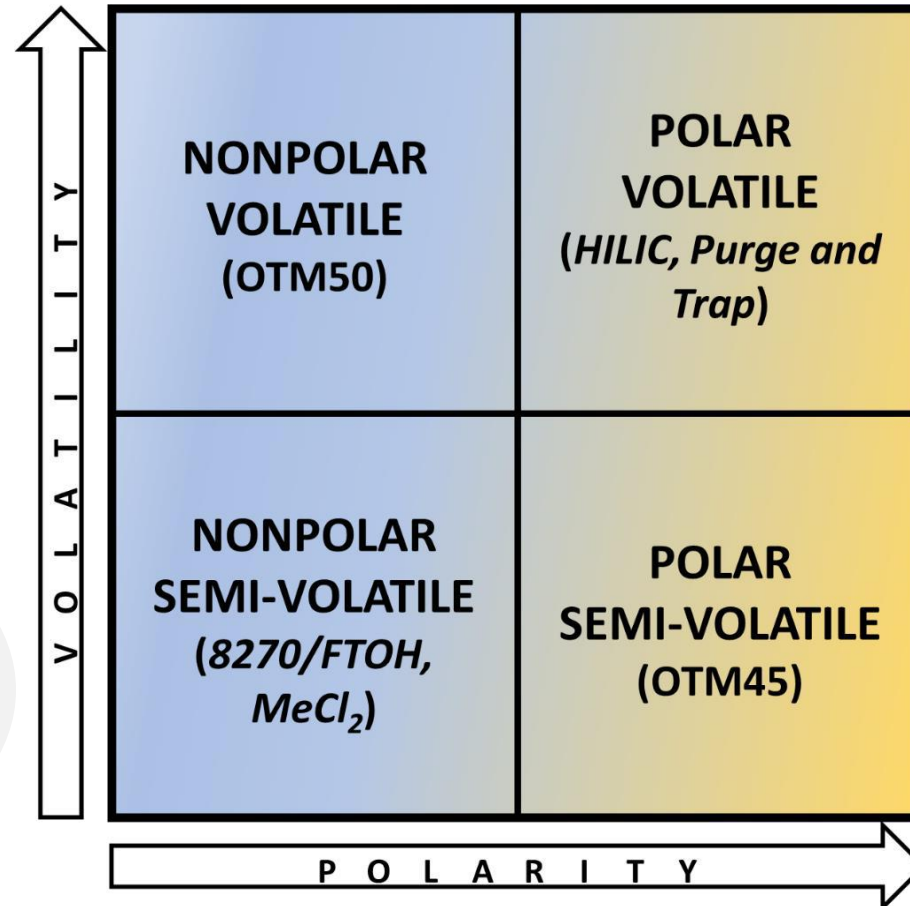




PFAS in Air-When: Air Monitoring for Survey or Control

- **Stack/source sampling**
- Canister collection
- GC-MS/MS
- 30 compounds (mostly PID)

- **Ambient sampling**
- ASTM D8591 - TD tubes
- OTM-55 - PUF/XAD traps solvent elution
- GC-MS/MS or LC-MS/MS
- FTOH, sulfonamides and others



Not many known compounds in this category

- **Stack/source sampling**
- Sampling train collection
- LC-MS/MS
- 49 compounds (typical water analytes)

Source: US EPA

PFAS in Air -How? Evacuated Canisters, GC-MS/MS and a BIG Autosampler

Sampling Times : 4,10, 20 or 60 minutes



1.4L Silonite canister
Dedicated PFAS canisters

Passivated silicon ceramic lined stainless-steel



Agilent 7010D GC-MS/MS
Entech 7200-PFAS pre-concentrator and SK-75 autosampler



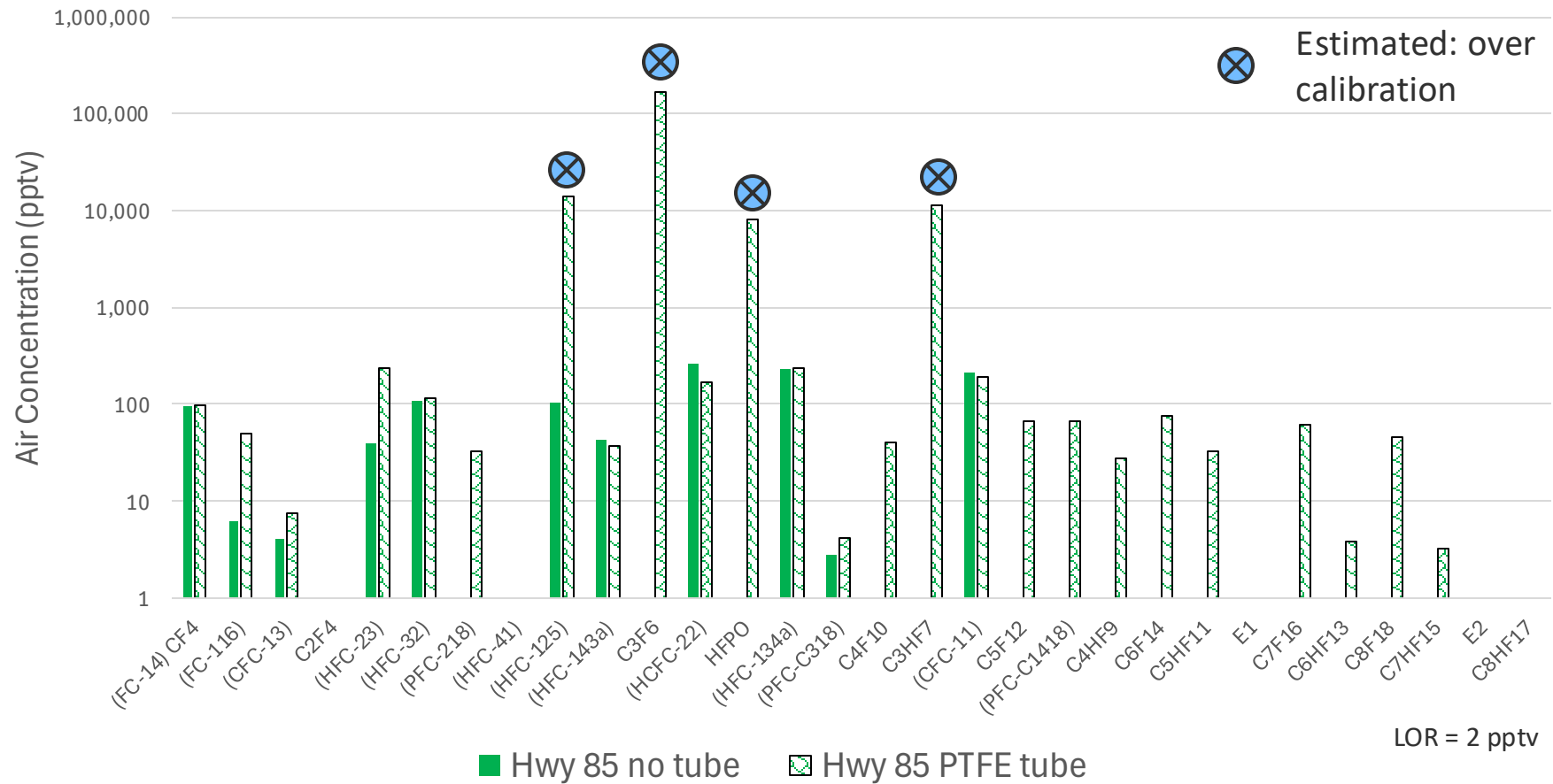
PFAS in Air → GC-MS/MS Method Reporting Limits

Parameter	Synonym	OTM50 QRL (3xMDL)	ALS LOR
		----- ppbv -----	
Tetrafluoromethane	(FC-14)	0.090	0.002
Hexafluoroethane	(FC-116)	0.037	0.002
Chlorotrifluoromethane	(CFC-13)	0.037	0.002
Tetrafluoroethene	C2F4	0.033	0.002
Trifluoromethane	(HFC-23)	0.150	0.002
Difluoromethane	(HFC-32)	0.048	0.002
Octafluoropropane	(PFC-218)	0.037	0.002
Fluoromethane	(HFC-41)	0.057	0.002
1,1,1,2,2-Pentafluoroethane	(HFC-125)	0.037	0.002
1,1,1-Trifluoroethane	(HFC-143a)	0.096	0.002
Hexafluoropropene	C3F6	0.037	0.002
Chlorodifluoromethane	(HCFC-22)	0.033	0.002
Hexafluoropropylene oxide	HFPO	0.063	0.002
1,1,1,2-Tetrafluoroethane	(HFC-134a)	0.048	0.002
Octafluorocyclobutane	(PFC-C318)	0.037	0.002
Decafluorobutane	C4F10	0.037	0.002

Parameter	Synonym	OTM50 QRL (3xMDL)	ALS LOR
		----- ppbv -----	
1H-Heptafluoropropane	C3HF7	0.042	0.002
Trichlorofluoromethane	(CFC-11)	0.042	0.002
Dodecafluoropentane	C5F12	0.069	0.002
Octafluorocyclopentene	(PFC-C1418)	0.037	0.002
1H-Nonafluorobutane	C4HF9	0.033	0.002
Tetradecafluorohexane	C6F14	0.048	0.002
1H-Perfluoropentane	C5HF11	0.048	0.002
Heptafluoropropyl-1,1,1,2-tetrafluoroethyl ether	E1	0.042	0.002
Hexadecafluoroheptane	C7F16	0.037	0.002
1H-Perfluorohexane	C6HF13	0.048	0.002
Octadecafluorooctane	C8F18	0.037	0.002
1H-Perfluoroheptane	C7HF15	0.033	0.002
2H-Perfluoro-5methyl-3-6,dioxanonane	E2	0.037	0.002
1H-Perfluorooctane	C8HF17	0.037	0.002

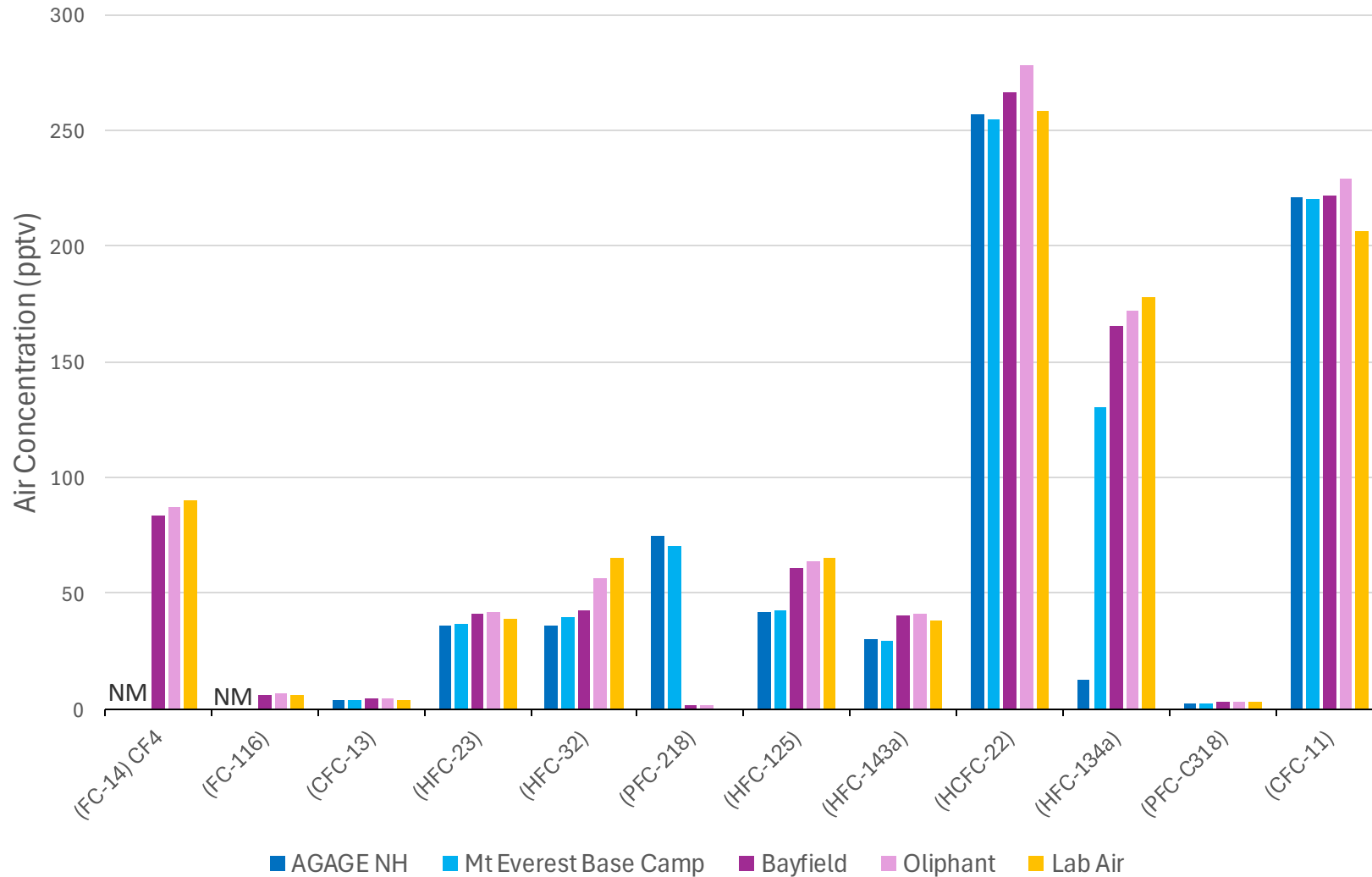
- ALS Limits of Reporting (LOR) are higher than our statistically derived LOQ for each compound.

OTM-50 – Sampling Tubing Investigation



Sampling Tubing NOT pre-conditioned!

OTM-50 Ambient Air Comparison



Questions?



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Acknowledgement:

- *Andrea Armstrong -Air Quality Manager, ALS Waterloo, ON*
- *Sylvia Fisher –Air Quality Technical Specialist, ALS Waterloo, ON*
- *Heather Lord- Global PFAS Practice Lead*