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CSAP 2020 WEBINAR

GASOLINE and DIESEL PCOCs in SOIL and GROUNDWATER

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FORMAT:

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- All attendees will be muted and must type in questions in the “chat” function
- If your question relates to a specific slide number (located in the bottom left corner) please note the slide number in your question
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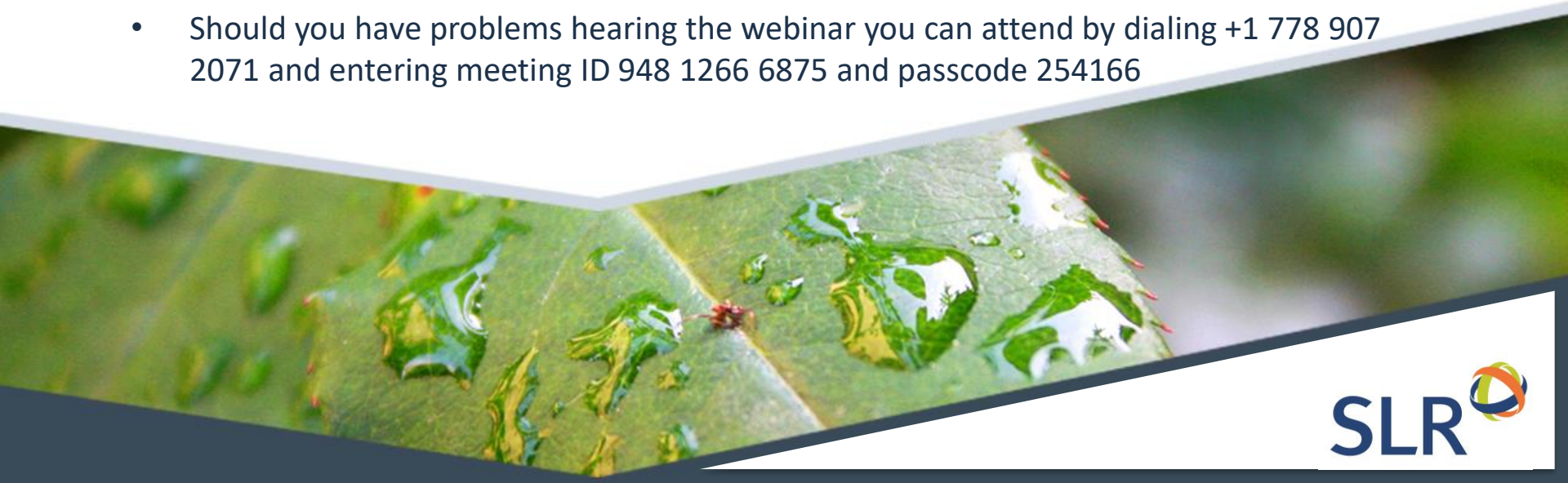

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PRESENTERS:

- Robert Symington, CSAP Webinar Coordinator
- Erin Robson and Sam Reimer, SLR Consulting (Canada) Ltd.

STUDY CONTRIBUTERS:

- Anthony Collett, Rebecca Page and Forest Pimm, SLR Consulting (Canada) Ltd.

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PRESENTATION OVERVIEW:

- CSAP Introduction
- Objectives
- Background
- Approach
- Findings
- Limitations

CSAP Introduction

Regulatory History - 2008

- Stage 6 Amendments to the Contaminated Sites Regulation, December 12, 2008
- Added the Schedule 11. Generic Numerical Vapour Standards to the CSR- New Schedule 11 will provide numerical standards for vapour.
- Schedule 11 was not divided by substance class CSAP responded by commissioning the “Soil Vapour Advice and Practice Guidelines Development - Stage 1” issued in 2009 to assist practitioners in using professional judgement.
- Analytical suites when undertaking soils vapour investigations at sites containing gasoline, diesel and dry cleaning substances

CSAP Introduction

Regulatory History - 2017

- Stage 10 (Omnibus) and Stage 11 (Housekeeping) Amendments to the Contaminated Sites Regulation, October 31, 2017
- As a result, CSR numerical standards for some substances… “were added” … for a number of newly prescribed substances, completely new standards were introduced.
- Substance classes were not included in this version and again required a degree of professional judgement by practitioners.
- CSAP again responded by commissioning the “2018 Potential Contaminants of Concern at Commercial and Industrial Land Uses” by PGL which covered of a variety of common contaminating activities and was a desk study of published information.

OBJECTIVES

SLR 2020 PCOC STUDY OBJECTIVES

The primary objectives of the work undertaken by SLR were:

- to assist Approved Professionals (APs) and consultants preparing instruments and Site Investigation reports and
- to support their use of professional judgement to select potential contaminants of concern (PCOCs) in soil and groundwater relating to the release of hydrocarbons, with a particular focus on gasoline and diesel releases.

The report is factual in nature and intentionally avoids providing conclusions or inferring policy.

BACKGROUND

2009 CSAP Vapour Advice and Practice Guidelines

- Identified substances to be analyzed when gasoline, diesel, waste oil or drycleaner areas of potential environmental concern (APECs) were present.
- Based on former (2009) CSR Schedule 11 substance list
- According to the Ministry of Environment (MoE, 2009), vapour PCOCs “include all substances that are both a) associated with the activities listed in Schedule 2 of the Regulation carried out on or near the site and b) listed in Schedule 11.”
- Current Schedule 3.3 is essentially the same list of substances as former Schedule 11

APs / CONSULTANTS SHOULD REVIEW THIS DOCUMENT AS BACKGROUND FOR SLR REPORT

BACKGROUND

2009 CSAP Vapour Advice and Practice Guidelines

Gasoline Sites

- PCOC List: benzene, toluene, ethylbenzene, xylenes (BTEX), 1,3,5-trimethylbenzene (1,3,5-TMB), 1,2,4-trimethylbenzene (1,2,4-TMB), n-hexane, n-decane, naphthalene, 1,3-butadiene, methylcyclohexane, isopropylbenzene, volatile petroleum hydrocarbons (VPHv), 1,2-dibromoethane (1,2-DBA), 1,2-dichloroethane (1,2-DCA) and methyl tert-butyl ether (MTBE)
- Rationale: based on the parameters listed in CSR Schedule 11 and on gasoline composition data in the Total Petroleum Hydrocarbon (TPH) Working Group Vol. 2: Composition of Petroleum Mixtures (Potter, 1998)
- 1,2-DBA, 1,2-DCA and MTBE included due to historical use as gasoline additives.
- Inclusion of 1,2-DBA, 1,2-DCA and MTBE as PCOCs should be evaluated by APs during the Stage 1 PSI (i.e., based on historical file review and known dates of product storage/handling) and only include as PCOCs where necessary.

BACKGROUND

2009 CSAP Vapour Advice and Practice Guidelines

Diesel Sites

- PCOC List: BTEX, 1,3,5-TMB, 1,2,4-TMB, n-decane, naphthalene and VPHv.
- Rationale: based on the parameters listed in CSR Schedule 11 and data showing the composition of diesel provided in the TPH Working Group Vol. 2: Composition of Petroleum Mixtures (Potter, 1998).
- 1,2,4-TMB is not listed in the TPH Working Group document; however, the substance has been considered as a diesel-related parameter in other regulatory jurisdictions

BACKGROUND

2018 Potential Contaminants of Concern at Commercial and Industrial Land Uses

- Specific land uses and activities were chosen from CSR Schedule 2
- PCOCs were selected from CSR Schedules 3.1 (soil), 3.2 (water), 3.3 (vapour) and 3.4 (sediment)
- Section 2.5 page 14 of the report identifies PCOC associated with PHC product distribution and/or storage and includes BTEX, VPH, LEPH, HEPH, PAHs, TEL, 1,2-DBA, 1,2-DCA and MTBE, with a more detailed list of other potential "secondary" PCOCs included on page 25
- SLR used the information in this document as a starting point for the current study

APs / CONSULTANTS SHOULD REVIEW THIS DOCUMENT AS BACKGROUND FOR SLR REPORT

2020 PCOC STUDY

Site Selection Process

- 204 legal instruments processed by CSAP from Nov 1, 2017 to end of March 2020
- SLR obtained and screened all 204 instruments
- Summarized in Appendix A Table A-1 of SLR Report

TABLE A-1: INSTRUMENT SCREENING

File Retrieval Candidate?	Date	Instrument Type	Num or Risk	Apparent Source Type	Comment	COCs - SOIL							COCs - GROUNDWATER					
						BTEX	VPH	LEPH	HEPH	PAHs	VOCs	Fuel Additives	BTEX	VPH	LEPH	PAHs	VOCs	Fuel Additives
	2018-07-27	CoC	R	Drycleaner	source site? TCE, PERC, VC, 1,2-CIS-TCE, DCE			X			X						X	
	2018-07-27	CoC	R		Adjacent Site, DCE, 1,2-cis-TCE, PERC												X	
	2018-07-27	CoC	R		adjacent site?, TCE, PERC, DCE, 1,2-CIS-TCE												X	
	2018-07-23	CoC	R		site adjacent to former service station	X							X	X	X	X		
YES	2018-07-23	CoC	R	Service Station	source site, EPH and VH listed	X	X	X	X				X	X	X	X		
	2018-03-12	Det - Neg																
	2018-07-06	Det - Neg																

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2020 PCOC STUDY

ENV Site Information Requests

- SLR Identified 42 sites with potentially relevant PHC information and requested 162 reports
- Summarized in Appendix A Table A-2 of SLR Report

SLR PCOC Project Site #	Instrument Type	Total # Docs (Sch D)	Candidate?	Fuel VOCs PCOCs?	FILE REVIEW COMMENTS
SITE 19	CoC	18	YES	N	Former Fuel BP. Fuel VOCs only IDed as PCOCs for Vapour. VOCs PCOCs for barrel storage, warehouse, fill. VOCs identified as GW contaminants.
SITE 11	CoC	6	YES	YES	Specific VOCs listed as PCOCs assoc w Fueliing (EDB and DCA), additional VOCs assoc w solvents and waste oil. PHCs and VOCs listed as contaminants.
SITE 18	CoC	23	YES	YES	ENV indicated no additional electronic records. Fuel VOCs PCOCs. 135-TMB exceedances in GW.
SITE 17	CoC	24	MAYBE	N	Former Fuel Service Stn. Fuel VOCs not IDed as PCOCs. VOCs analyzed assoc w waste oil, sumps etc. Off-Site Drycleaner. 8 VOCs in soil, PHC+VOC ND. Several ND VOC GW samples, not confirmed if any have elevated PHCs.
	CoC	10	NO		Diesel source. No VOCs in soil. 3 VOCs in gw both PHC and VOCs ND in all 3 samples.

2020 PCOC STUDY

Final Site Selection and Data Compilation

- Focused on sites with detectable PHCs where VOCs and PAHs were also analyzed
- The majority of VOC data was “incidental” VOC data for waste oil or auto service APECs and not designed to target fuel APECs directly
- Data from 15 “best” candidate sites was pooled and uploaded into Esdat database
- Each site was assigned a new random ID number to allow blind treatment of data

2020 PCOC STUDY

Statistical Evaluation by Substance

- # samples analyzed
- # samples detectable
- # samples > CSR standards
- Frequency of detection
- Frequency of exceeding standards

Comparisons between concurrent results

- 1,3,5-trimethylbenzene (1,3,5-TMB) & 1,2-dichloroethane (1,2-DCA) vs benzene & xylenes
- 1-methylnaphthalene (1-MN) & 2-methylnaphthalene (2-MN) vs LEPH & naphthalene

SUMMARY OF FINDINGS

Soil data summary

Data for PCOCs in soil compared to CSR Schedule 3.1 numerical standards for two land uses:

- Residential low density (RL_{LD}) land use standards (Table 1 in report)
- Commercial (CL) land use standards (Table 2 in report)
- Comparisons were based on generic or lowest of matrix standards for intake of contaminated soil, groundwater used for drinking water, toxicity to soil invertebrates and plants, and groundwater flow to surface water used by aquatic life (freshwater / marine)
- No attempt was made to identify which factors applied at an individual site

SUMMARY OF FINDINGS

Soil data summary

Key observations that are apparent or inferred from the data include the following:

- Soil analytical datasets are dominated by the common PHC substances BTEX/VPHs (n = >2200) , LEPHs/HEPHs (n = >1100) and PAHs (e.g., naphthalene, n = 637), with far fewer samples for most other fuel-related VOCs. This may reflect that the largest portions of the soil datasets are represented by samples collected and analyzed pre-omnibus (i.e., before Nov. 1, 2017);
- The frequency of detection of substances in soil is relatively low (<40% for all PHCs, <25% for BTEX and VPHs), likely reflecting a larger portion of confirmatory samples and delineation samples in the overall soil datasets included in submissions made to CSAP in support of CSR instruments;

SUMMARY OF FINDINGS

Soil data summary

Several substances were found to rarely or never exceed the lowest RL_{LD} soil standards, for example:

- 2-MN (1 of 534 samples)
- 1,2-DCA (0 of 564 samples)

Several substances were found to rarely or never have detectable concentrations in soil, for example:

- styrene (2 of 1533 samples)
- 1,3-butadiene (0 of 255 samples)

SUMMARY OF FINDINGS

Groundwater data summary

- The groundwater results were compared to the DW and AW standards, focusing on the lowest of these applicable site-specific factors for a particular substance
- No attempt was made to identify which specific water use(s) applied at an individual site
- IW and LW water uses were not considered

SUMMARY OF FINDINGS

Groundwater data summary

Key observations from the groundwater data include the following:

- Groundwater analytical data are dominated by the common PHC substances BTEX/VPHw, LEPHw, and PAHs, with far fewer samples available for most other fuel-related VOCs.
- This may in part reflect that significant portions of the groundwater datasets are represented by samples collected and analyzed before Nov. 1, 2017, when CSR water standards came into effect for many of the fuel-related VOCs.
- The frequency of detection (no. of samples with detectable concentrations / total no. of samples) was >10% for most substances. The exceptions were styrene, MTBE, 1,3-butadiene, n-decane and 1,2-dibromoethane.

SUMMARY OF FINDINGS

GROUNDWATER STATISTICAL SUMMARY – GENERAL PHC PARAMETERS	benzene	toluene	ethylbenzene	total xylenes	styrene	MTBE	VPHw	LEPHw
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Number of Results	2018	2014	2012	2015	1003	1555	1954	1252
Number of Detects	801	808	847	936	13	47	561	543
Frequency of Detection (%)	39.7%	40.1%	42.1%	46.5%	1.3%	3.0%	28.7%	43.4%
Frequency of Exceeding Lowest Standard (detects only) (%)	67.9%	62.5%	43.7%	55.3%	0.0%	6.4%	47.6%	69.1%
Frequency of Exceeding Lowest Standard x 10 (detects only) (%)	41.8%	36.8%	8.4%	27.6%	0.0%	0.0%	2.3%	12.0%

SUMMARY OF FINDINGS

GROUNDWATER STATISTICAL SUMMARY – PAH AND VOC PARAMETERS	PAHs			VOCs					
	methylnaphthalene, 1-	methylnaphthalene, 2-	naphthalene	butadiene, 1,3-	dibromoethane, 1,2-	dichloroethane, 1,2-	isopropylbenzene	propylbenzene, 1-	trimethylbenzene, 1,3,5-
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Number of Results	96	774	1094	138	225	383	52	10	98
Number of Detects	46	270	487	2	12	43	22	3	41
Frequency of Detection (%)	**47.9%**	**34.9%**	**44.5%**	**1.4%**	**5.3%**	**11.2%**	**42.3%**	**30.0%**	**41.8%**
Frequency of Exceeding Lowest Standard (detects only) (%)	**39.1%**	**33.3%**	**57.9%**	**100.0%**	**50.0%**	**62.8%**	**0.0%**	**0.0%**	**56.1%**
Frequency of Exceeding Lowest Standard x 10 (detects only) (%)	**0.0%**	**6.7%**	**26.3%**	**0.0%**	**0.0%**	**16.3%**	**0.0%**	**0.0%**	**7.3%**

SUMMARY OF FINDINGS

Groundwater data summary

- For samples with detectable concentrations of individual substances, LEPHw had the highest detection frequency (69.1%), with six other substances (BTX, naphthalene, 1,2-DCA and 1,3,5-TMB) exceeding 50%.
- Fuel-related VOCs showed similar detection frequencies as the more common PHCs, despite far fewer analytical results.
- The frequency of exceeding 10x the lowest numerical standard was >10% for six substances (BTX, LEPHw, naphthalene, 1,2-DCA), with benzene having the highest frequency of exceeding 10x DW (41.8%).
- For samples with concurrent data for BTEX/VPHw and fuel-related VOCs, most data came from a small number of sites, and samples with concurrent detectable data were small (n = 20 for 1,2-DCA; n = 33 for 1,3,5-TMB).

SUMMARY OF FINDINGS

Groundwater data summary

- For most concurrent samples, when fuel-related VOCs exceeded the lowest numerical standards (generally DW), BTEX compounds also exceeded the DW numerical standards.
- This was also generally the case for 1-MN and 2-MN (DW standards) when compared to LEPHw (AW standard) and naphthalene (AW and DW standards). However, the DW quotients for 1-MN were consistently higher than the DW quotients for naphthalene, indicating that 1-MN is the more likely constituent to exceed the DW standard when both substances are analyzed in the same sample.
- For samples in which they were detected, concentrations frequently exceeded the DW standards for 1,2-DCA (62.8%), 1,3,5-TMB (56.1%), 1-MN (39.1%) and 2-MN (33.3%).

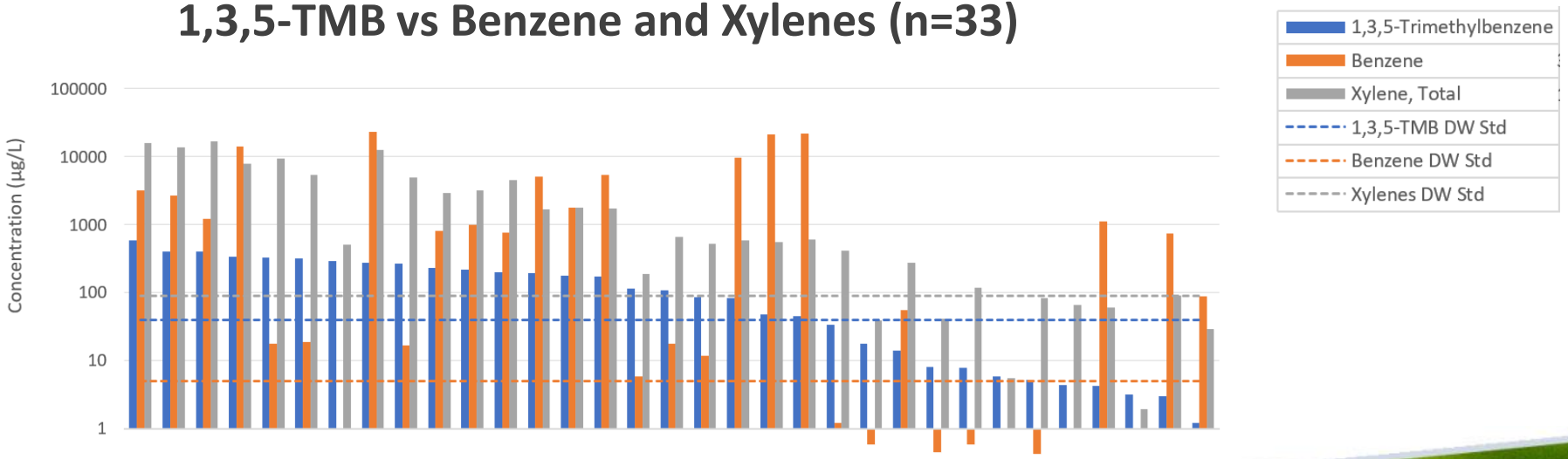
SUMMARY OF FINDINGS

Substance (no. of detects)	1,3,5-TMB (n= 41)		1,2-DCA (n = 43)	
Concurrent Substance	Benzene	Xylenes	Benzene	Xylenes
No. of Concurrent Samples with Detected Concentrations	33	33	20	20
Maximum Concentration (concurrent concentration) in µg/L	590 (3230)	590 (16,000)	590 (9100)	590 (1500)
No. of Concurrent Samples > DW Standard (no. > DW for benzene or xylenes)	21 (20)	21 (21)	13 (10)	13 (7)

SUMMARY OF FINDINGS

Comparison of Concurrent Results

1,3,5-TMB vs Benzene and Xylenes (n=33)



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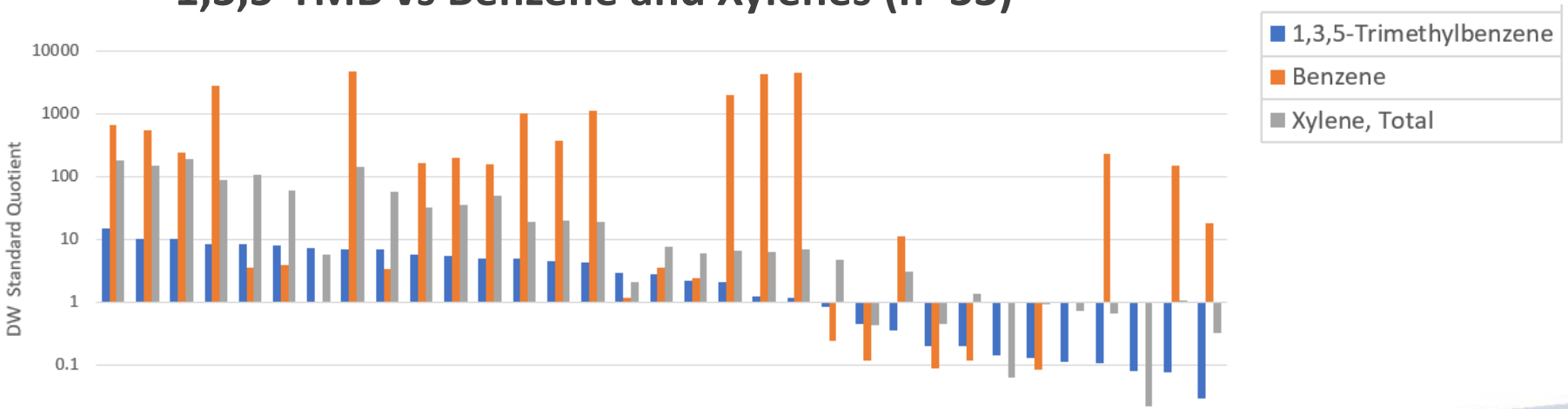
SUMMARY OF FINDINGS

DW Standard as Quotient

1,3,5-TMB vs Benzene and Xylenes (n=33)



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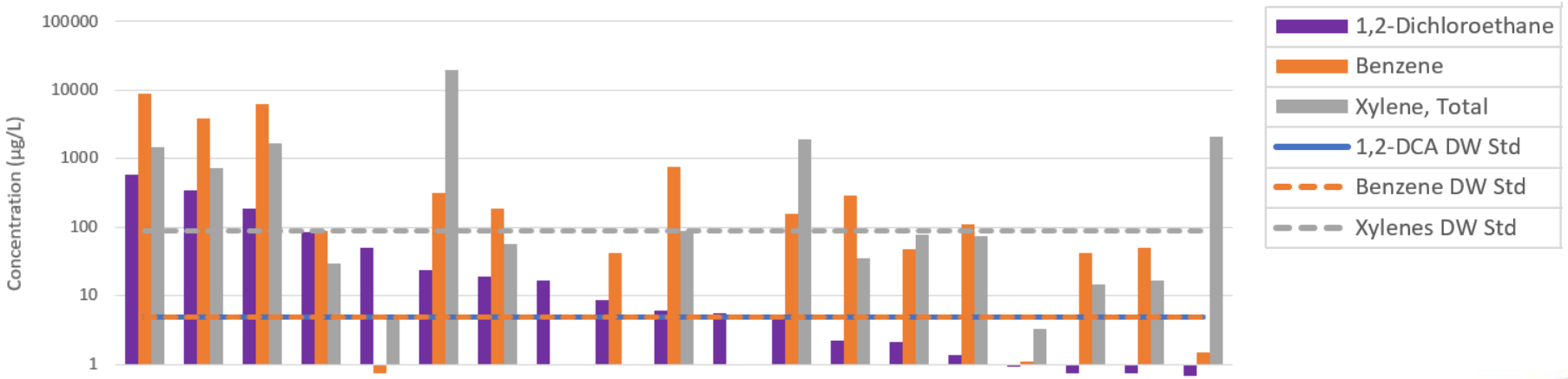
SUMMARY OF FINDINGS

Comparison of Concurrent Results

1,2-DCA vs Benzene and Xylenes (n=19)



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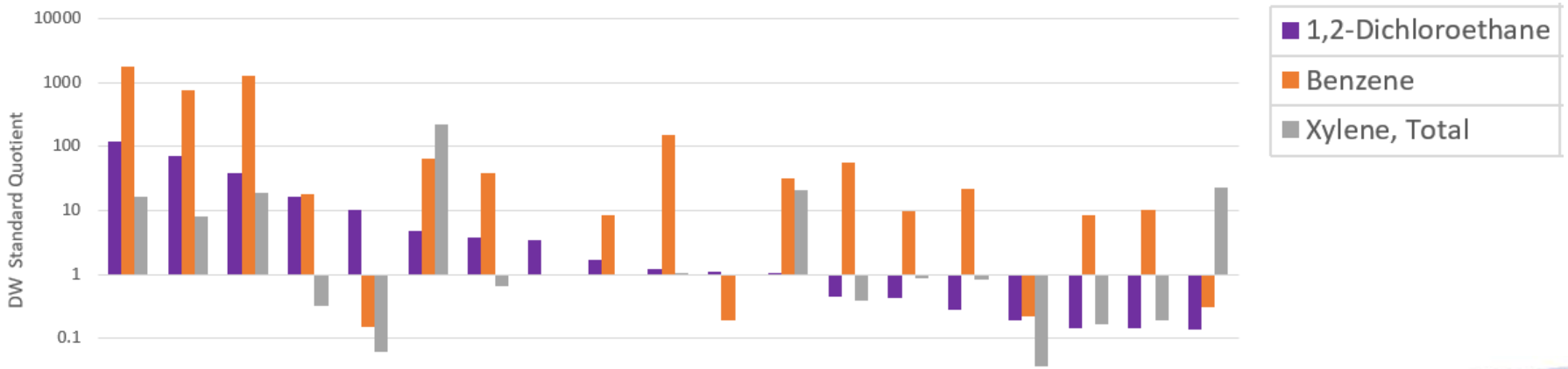
SUMMARY OF FINDINGS

DW Standard as Quotient

1,2-DCA vs Benzene and Xylenes (n=19)



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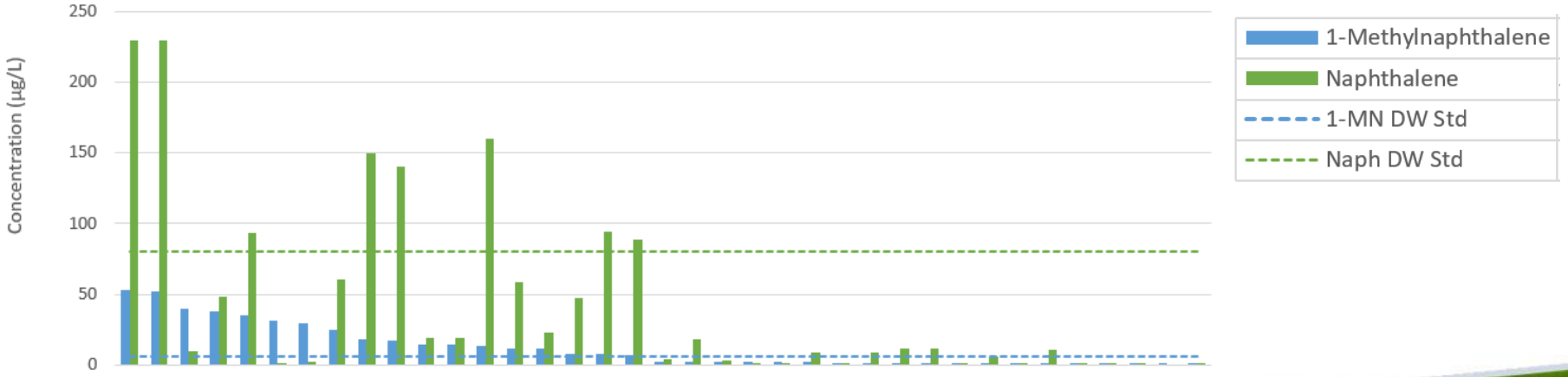
SUMMARY OF FINDINGS

Comparison of Concurrent Results

1-MN vs Naphthalene (n=37)



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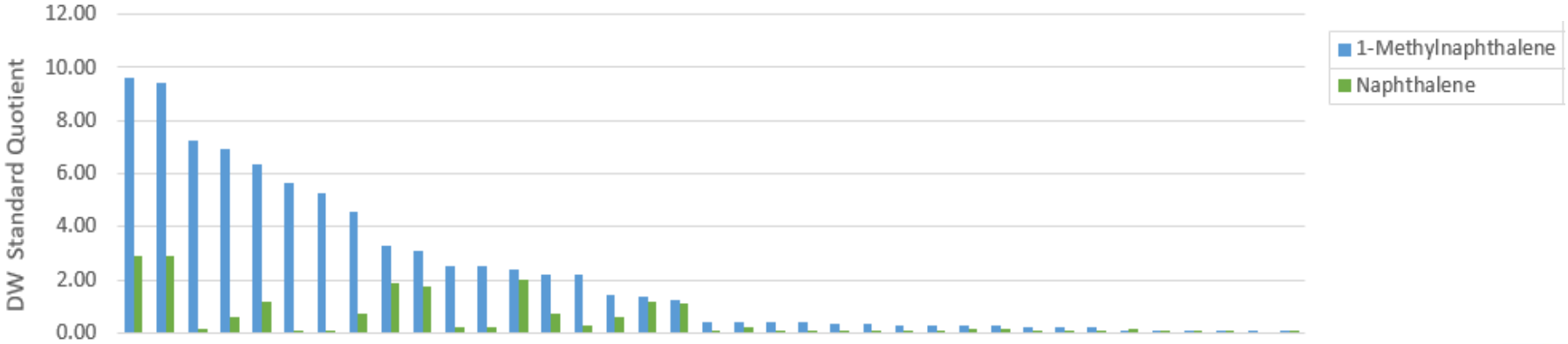
SUMMARY OF FINDINGS

DW Standard as Quotient

1-MN vs Naphthalene (n=37)



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DATASET LIMITATIONS

- The effects of sampling frequency and total numbers of samples from discrete sampling locations at individual sites relative to other sites was not factored into the data. It is unknown whether this had a significant effect on the data generated for this study.
- It is anticipated that a larger portion of delineation samples and post-remediation samples (vs. investigation samples) were included in the overall soil and groundwater datasets given that submissions made to CSAP were in support of CSR instruments (i.e., to demonstrate compliance), likely overweighting the proportion of lower concentration samples as compared to concentrations in initial pre-remediation samples, many of which predated November 1, 2017 (i.e., pre-omnibus) when analysis of fuel-related VOCs would have been infrequent.

DATASET LIMITATIONS

- The concurrent datasets are typically too small to conduct further meaningful data evaluation without having additional datasets with fuel-related VOCs and PAHs to supplement the interpretations contained herein.

CLOSURE

Contaminated sites practitioners use professional judgement to select PCOCs in soil and groundwater relating to the release of petroleum hydrocarbons. The findings of this study, which focussed on contamination primarily associated with gasoline and diesel releases, may provide preliminary indications of the frequency that some CSR regulated fuel-related VOCs and PAHs occur, which may assist practitioners in their selection of PCOCs at sites with suspected or known PHC contamination.

Thank you

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Next webinar: CSAP Submission Manager

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