Sustainable Approach to Environmental Laboratory Analyses

Johnny Mitchell
Pace®

Agenda

- What is Environmental Sustainability with respect to Sampling and Analysis Programs?
- What are Challenges faced by pending regulatory activity?
- What Options do we have to Overcome these Pending Challenges?

What is Environmental Sustainability?

Environmental sustainability is the responsibility to conserve natural resources and protect global ecosystems to support health and wellbeing, now and in the future.

The U.S. EPA defines it as “meeting today’s needs without compromising the ability of future generations to meet their needs.”

Sustainable Materials Management

- Use materials in the most productive way with an emphasis on using less.
- Reduce toxic chemicals and environmental impacts throughout the material life cycle.
- Assure we have sufficient resources to meet today's needs and those of the future.

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Methylene Chloride

- volatile, colorless liquid with a chloroform-like odor.
- used in industrial processes including paint stripping, pharmaceutical manufacturing, paint remover manufacturing, and metal cleaning and degreasing.
- most common means of exposure to methylene chloride is inhalation and skin exposure.
- OSHA considers methylene chloride to be a potential occupational carcinogen.

Methylene Chloride

Methylene Chloride is the primary solvent for environmental analytical extraction procedures due to several properties:

1. **Immiscible with water - forms two distinct layers on contact.**
2. **Polar molecule - will extract a wide range of materials**
3. **Denser than water – can be easily separated in extraction**

Methylene Chloride

Methylene Chloride can contribute to ozone depletion, so can be considered a green-house gas, but:

1. Contribution to ozone depletion is relatively insignificant, less than 1%.
2. Short lived substance with an atmospheric lifetime of <0.4 years.
3. Average atmospheric concentrations have remained relatively stable since 2013

Methylene Chloride

Methylene Chloride does have potential health risks:

1. **Acutely lethal**
2. **Neurotoxin with chronic exposure**
3. **Hepatic toxin with chronic exposure**
4. **Human carcinogen**

Methylene Chloride

In June of 2023, EPA announced a proposal to address the "unreasonable risk of injury to human health" of Methylene Chloride (DCM) through a phased approach to:

1. Prohibit the manufacture, processing, and distribution of DCM
2. Prohibit most industrial and commercial uses of DCM
3. Require a workplace chemical protection program (WCPP)
4. Require recordkeeping and downstream notification for conditional allowed uses of DCM

ENVIRONMENTAL PROTECTION AGENCY
40 CFR Part 751 [
EPA–HQ–OPPT–2020–0465; FRL–8155–01–
OCSPP]
RIN 2070–AK70

Methylene Chloride; Regulation Under the Toxic Substances Control Act (TSCA)
AGENCY: Environmental Protection Agency (EPA).
ACTION: Final rule.

Summary:

Applies to approximately 47 entities

Includes NAICS Code 541380 Testing Laboratories and Services

Finalized an ECEL under TSCA section 6(a) of 2 ppm (8 mg/m3) as an 8-hour TWA

Finalized an ECEL action level at half of the 8-hour ECEL, or 1 ppm (4 mg/m3) as an 8-hour TWA.

Air Conc Condition Initial Monitoring	Periodic Monitoring Requirement
< ECEL action level < EPA STEL.	ECEL and EPA STEL every 5 yrs
< ECEL action level and > EPA STEL.	ECEL every 5 yrs, EPA STEL every 3 months
> ECEL action level < ECEL; and < EPA STEL.	ECEL every 6 months
> ECEL action level and < ECEL; and > EPA STEL	ECEL every 6 months EPA STEL every 3 months
>ECEL	ECEL every 3 months EPA STEL every 3 months

Current Laboratory Methylene Chloride Concerns

Typical AVG Laboratory exposure levels at 2 - 4 X ECEL (2 ppm) with full volume extraction

With minimal 100 ml sample volume extraction, AVG Laboratory exposure exceeds ECEL Action Level (1 ppm)

Current Laboratory Methylene Chloride Concerns

Primary Extraction Solvent for EPA methods for Semivolatile Organics, Chlorinated and Organophosphorus Pesticides, Total Petroleum Hydrocarbons, Herbicides, Disinfection Byproducts (i.e., HAA's)

Methods generally written for large volume extractions of 100-1000 ml of sample using up to 360 ml Methylene Chloride or greater

Potential Laboratory Methylene Chloride Reduction Remedies

1. Use of method minimum sample volume
    a. For full Semivolatile Organic extraction a reduction from 360 ml to 36 ml
    b. Requires sequential extraction processes
2. Combination of multiple historical extractions into a single extraction using method minimum sample volume of 100 ml (SW846 3510C Reduced Volume (RV))
    a. Combination of Organochlorine Pesticides and Semivolatile Organics into a single extraction
    b. Reduces solvent usage from maximum 540 ml to 36 ml using sequential extractions

DCM Usage in Environmental Analyses

Extraction	Volume Sample	Volume MeCl2	Final extract Volume	Injection Volume
3510 - as published	1000ml	360ml	1.0ml	2ul
3550 – as published	30g	180mls	1.0ml	2ul

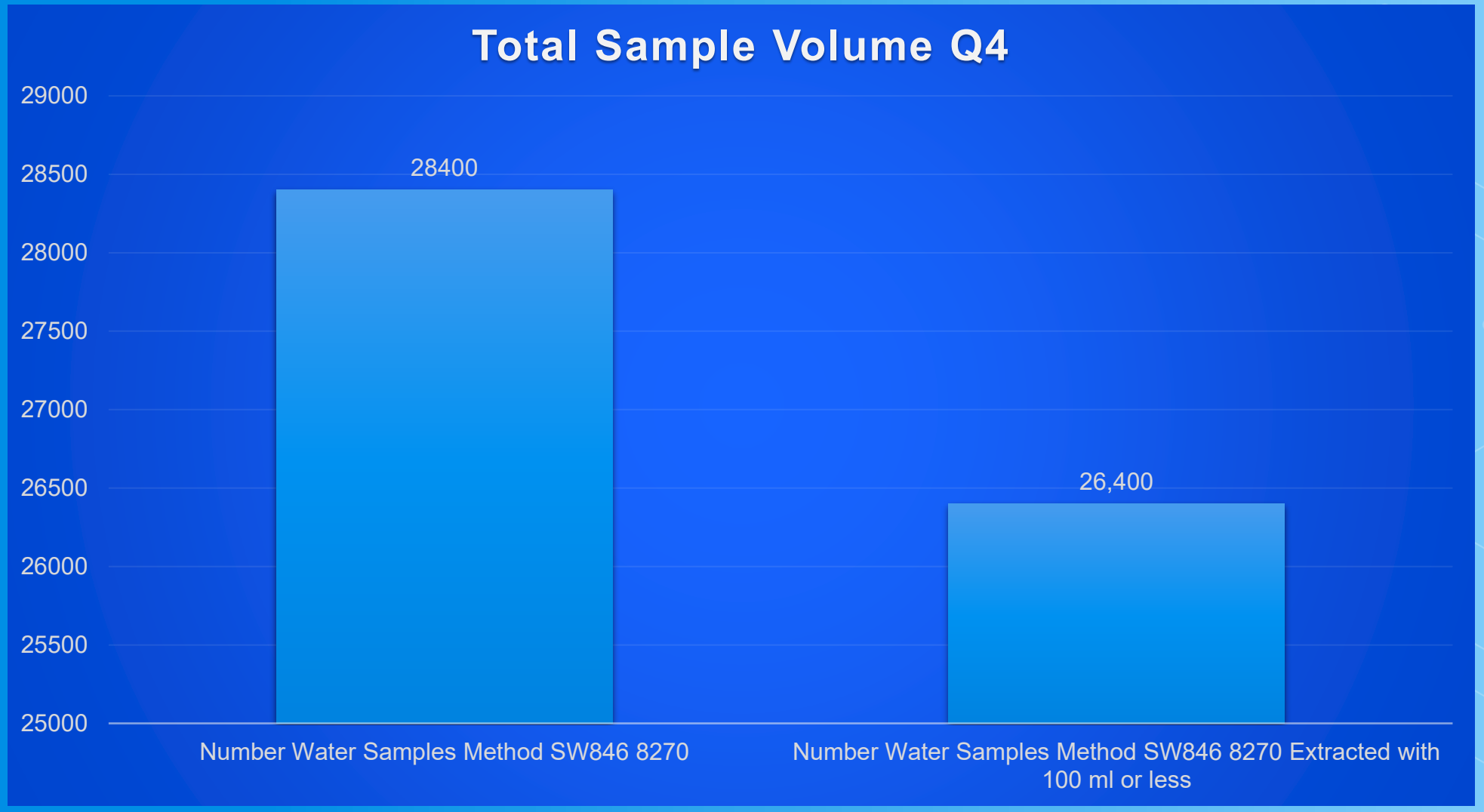
Pace Analytical performs more than 600,000 organic extraction analyses annually. As written, More than 150,000 liters of methylene chloride would be used in those procedures using the EPA methods as originally published, with potential releases to the atmosphere without significant And costly remediation systems.

WHAT CAN WE DO?

Extraction	Volume Sample	Volume MeCl2	Final extract Volume	Injection Volume
3510 - reduced volume	100ml	36ml	0.5ml	20ul
3511 - as published	40ml	2ml	0.5ml	25ul
3546 Microwave	15g	15ml	15ml	25ul

Pace Analytical performs more than 600,000 organic extraction analyses annually. Using Reduced volume procedures, methylene chloride usage and potential emissions have been Lowered to 15,000 liters or less – an approximate 90% reduction

Example Sustainability Summary-Q4 2024



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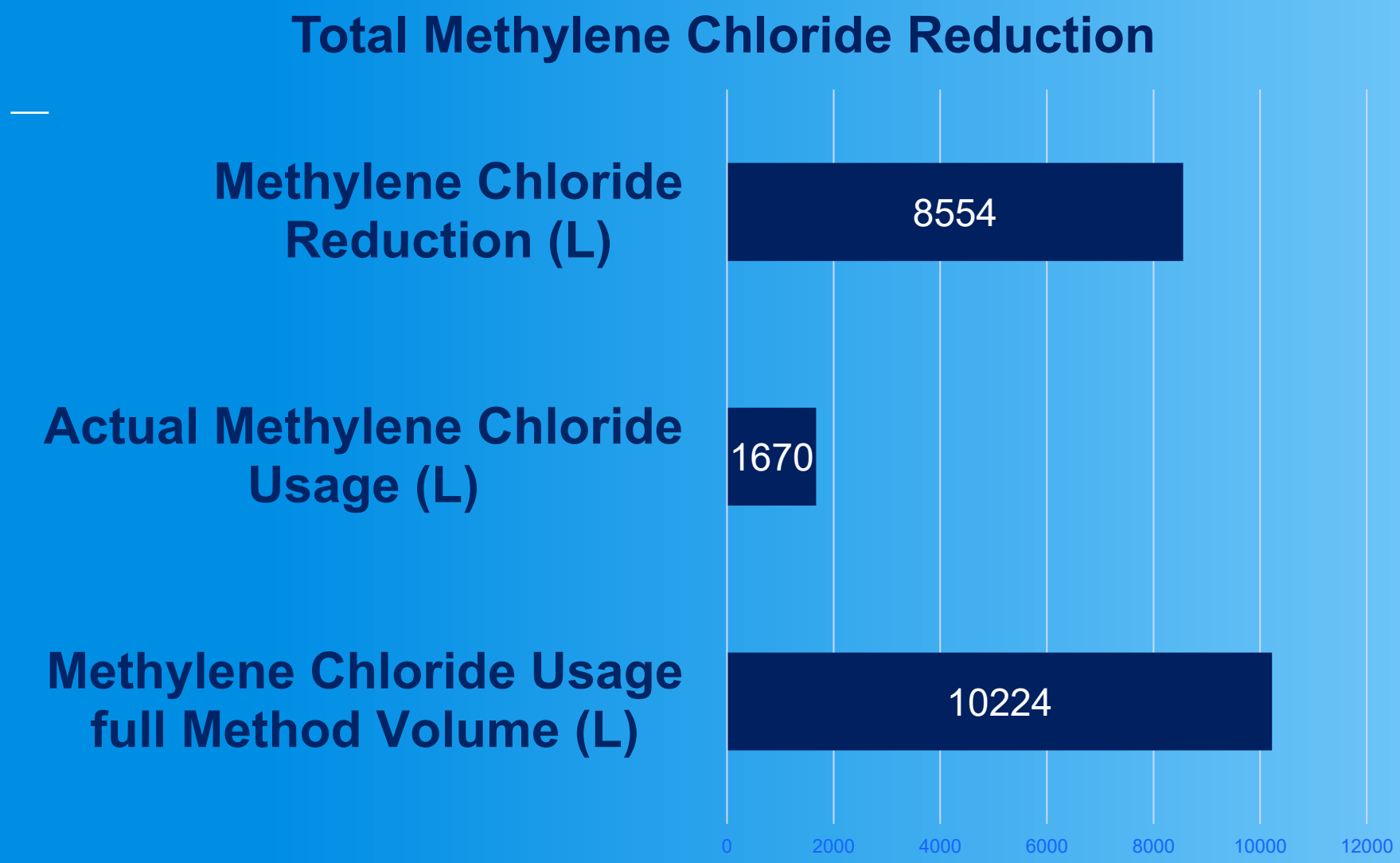
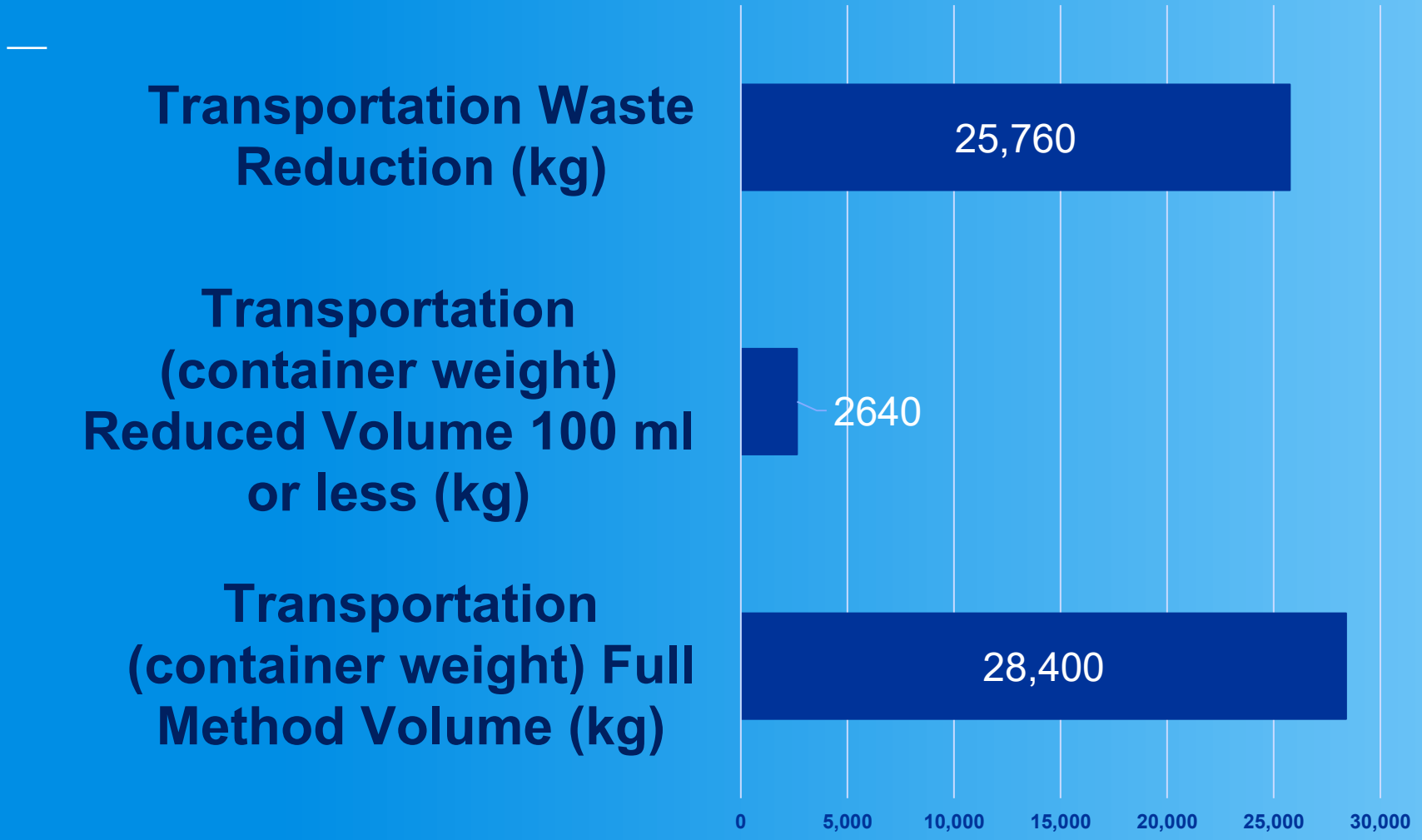


Example Sustainability Summary-Q4 2024

Transportation Weight Reduction



Potential Laboratory Methylene Chloride Reduction Remedies (Continued)

3. Use of Micro-extraction methods (EPA 3511)
    a. Reduction to minimal 3-5 ml solvent
    b. Allows single-increment extraction process
    c. Total solvent reduction at 99%
    d. Total extraction time reduction from 7-8 hrs. total to 2.5 hrs.

Additional Study – Microextraction

- Extraction using SW846 Method 3511
  - Single extraction
  - pH 3
  - 4 ml methylene chloride
  - Final extract volume 4 ml
- Analytes listed in 40 CFR 136 Method 625.1
  - Tables 1 and 2
- Final LOQ 2.0 ug/L with select phenolics at 10 ug/L

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Additional Study – Calibration from 5 u/L to 100 ug/L Method 3511

	Concentration ug/L	**Avg**	**%RSD**	Correlation Coefficient
Compound				
Benz[a]anthracene	Average RF	1.060	13.400	
Nitrobenzene	Average RF	1.790	16.800	
2-Nitrophenol	Average RF	0.064	9.150	
2,4-Di methylphenol	Average RF	0.280	10.300	
2,4-Dichlorophenol	Average RF	0.240	15.500	
Benzo[b]fluoranthene	Average RF	1.980	4.990	
Benzo[k]fluoranthene	Average RF	1.920	15.000	
Benzo[a]pyrene	Average RF	0.960	7.150	
Pentachlorophenol	Quadratic	0.075	29.700	0.9997
Naphthalene	Average RF	0.740	4.750	
Hexachlorobutadiene	Average RF	0.380	2.560	
4-chloro-3-	Average RF	0.220	11.900	
Phenol	linear			0.9991

THANK YOU

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