Application of Alum to Improve Post-Dredging Water Quality at the Ashland/NSP Superfund Site Pilot Project

Steve Garbaciak, Rich Onderko, Denis Roznowski, Sharon Kozicki, Mark Ciardelli, Rob Brillhart, Jill Morris, John Wisher, and Ken Aukerman (Foth); Brian Bell (Envirocon); Tyler Lee (JF Brennan)

WEDA SUMMIT & EXPO '18

Outline

- Overview of site and pilot project
- In situ water treatment options
- Bench tests
- Column tests
- Field application

Superfund Site Location

SITE LOCATION MAP

COUNTY LOCATION MAP

NOT TO SCALE

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Ashland/NSP Lakefront Superfund Site
Phase 1
Phase 2

Phase 1 (2013-2014) - Source Control

Phase 2 – Waterway Cleanup

- Breakwater Construction
- 2016 Pilot Project
- 2017-2018 Full Scale Project

Breakwater Construction

Phase 2 - Pilot Project (2016)

Pilot Project Objectives

- Targeted Sediment Removal
  - Pilot Study Dredge Area
- Successfully Demonstration of Dredging Technology
  - Sediment Standards
  - Water Quality Standards
  - ROD Requirements

Pilot Project Objectives

Analyte	Project Water Quality Standard (µg/L)
1,2,4-Trimethylbenzene	12.3
1,3,5-Trimethylbenzene	12.3
Benzene	0.34
Ethylbenzene	14
Toluene	--
m+p,xylene	
Xylenes (Total)	27
1-Methylnaphthalene	433
2-Methylnaphthalene	24.3
Acenaphthene	38
Acenaphthylene	--
Anthracene	0.035
Fluorene	--
Naphthalene	6.2
Phenanthrene	3.6
Benzo[a]anthracene	0.025
Benzo[a]pyrene	0.003
Benzo[b]fluoranthene	0.003
Benzo[e]pyrene	--
Benzo[g,h,i]perylene	7.64
Benzo[k]fluoranthene	0.14
Chrysene	0.07
Dibenzo[a,h]anthracene	0.003
Dibenzofuran [a]	--
Fluoranthene	1.9
Indeno[1,2,3-c,d]-pyrene	0.03

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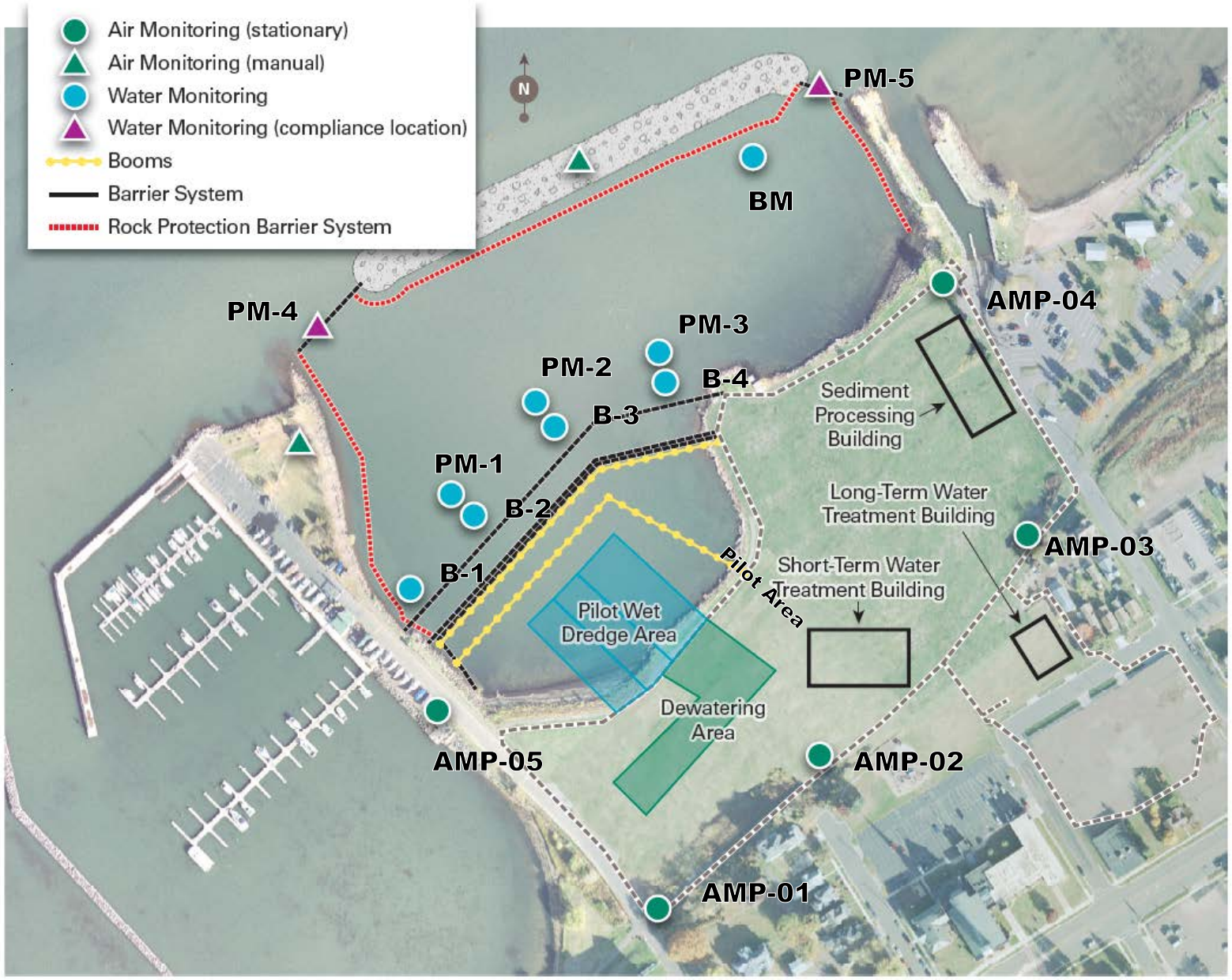
Project Design Overview



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Pilot Project Overview
- Summary of Work Completed

- 40,000 square foot Pilot Study Dredge Area
- 8,000 cubic yards Removed
- 520 truckloads to Sub-Title D Landfill
- 12,000 tons of Woody/Concrete Debris and Sediments
- 4 million gallons Water Treated
- 9.5 ppm tPAH SWAC achieved

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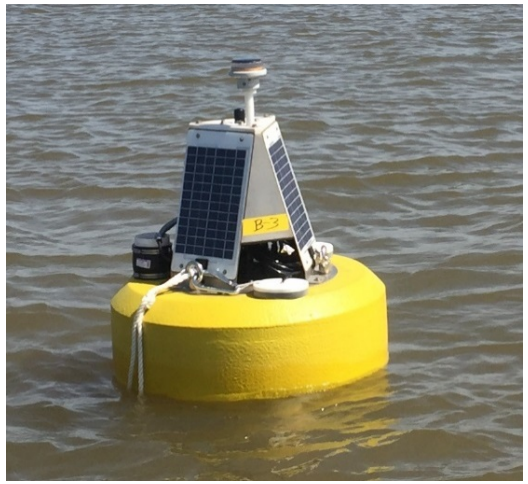
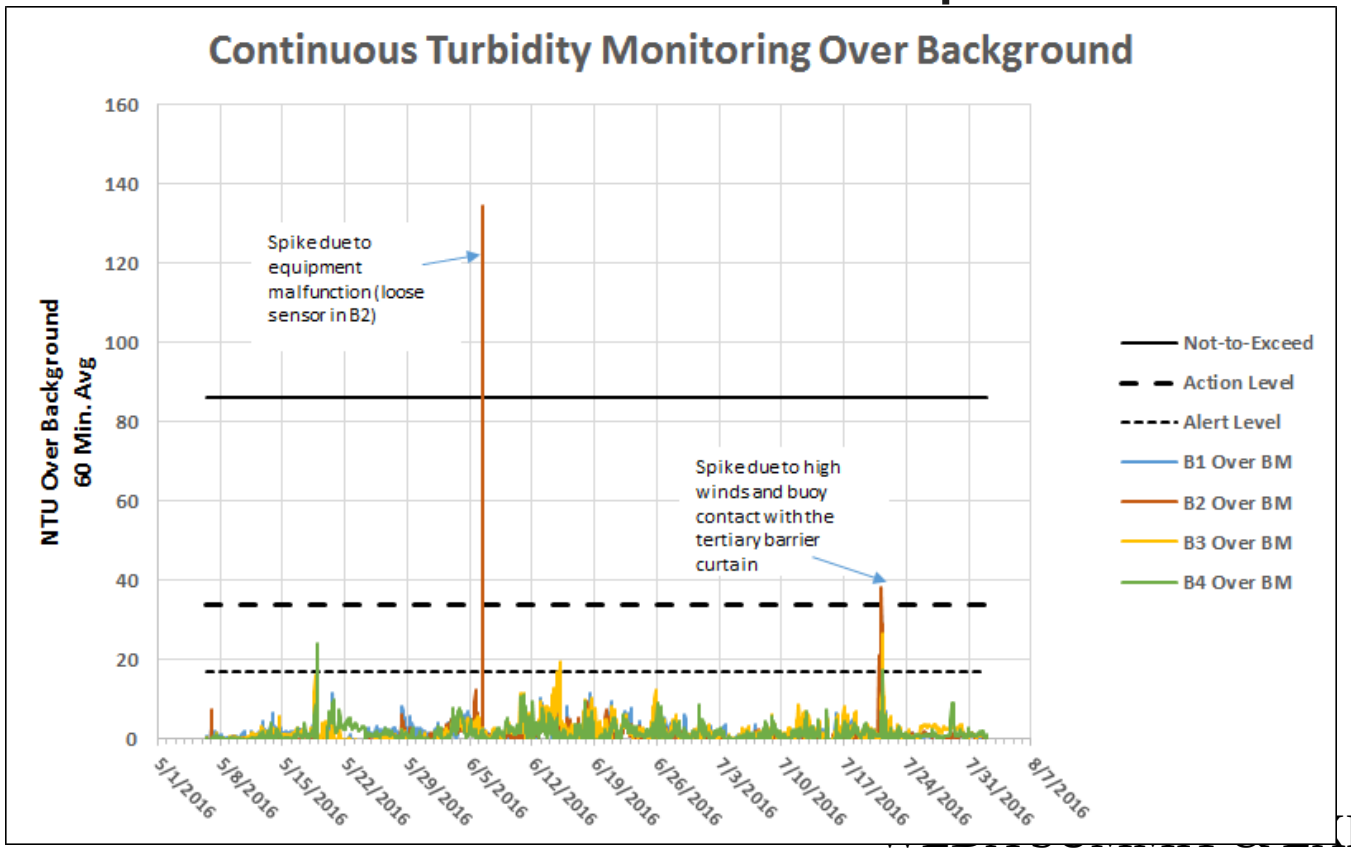
Summary of Monitoring Effort



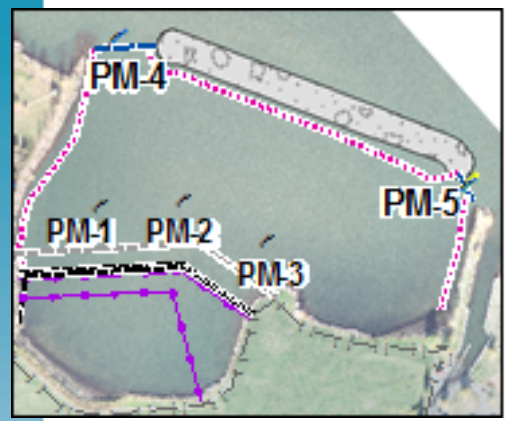
Turbidity Results

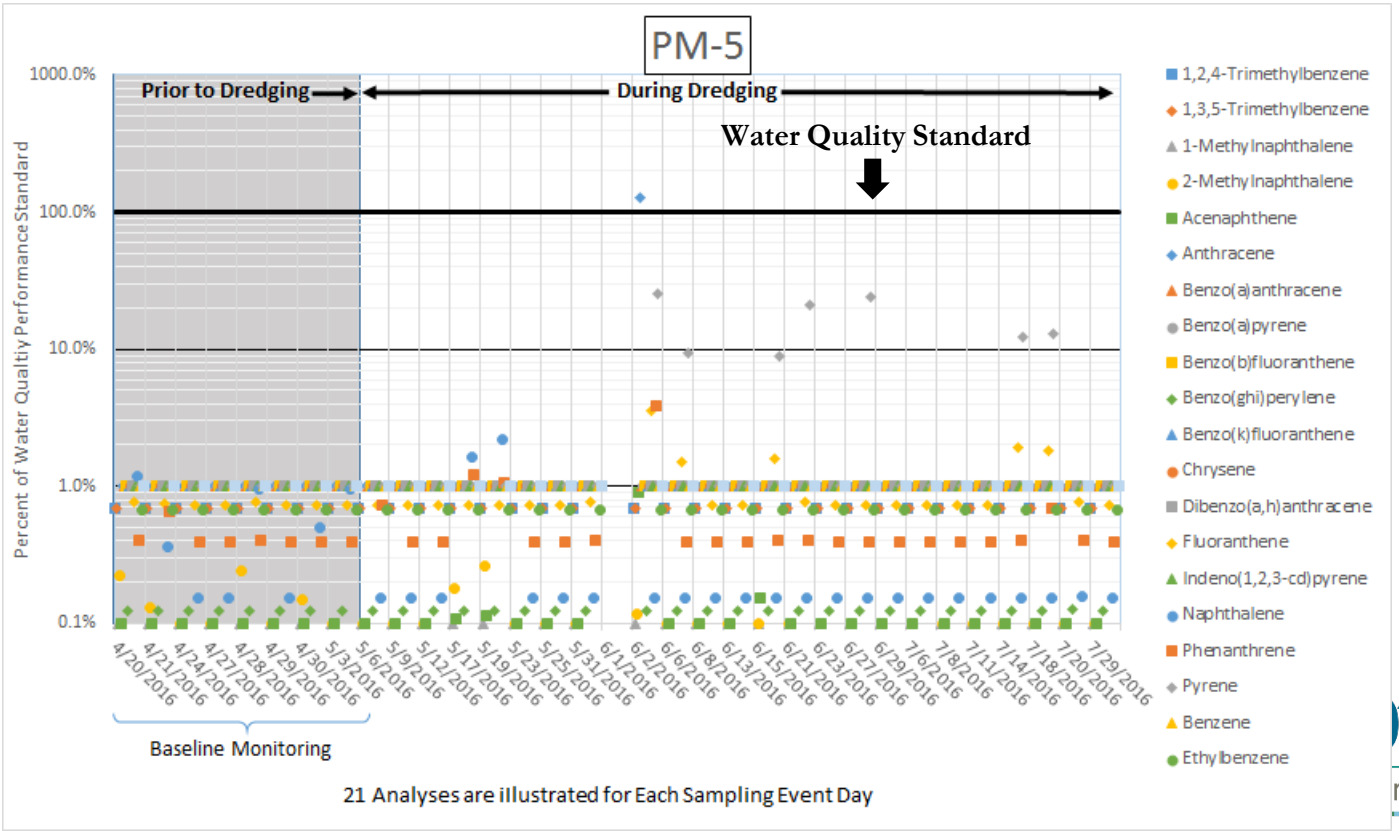
- No Results over Action Levels
  - Thousands of water samples measured



Monitoring Results – Surface Water COCs

- Over 1,300 monitoring analyses at PM-4 and PM-5, one result for one constituent above compliance value - within range of baseline conditions:





Need for treatment

- Surface water quality standards must be met prior to demobilizing silt curtains
- Clay and silt particles drove high turbidity
- Impending winter conditions limited available settling time

In situ water quality treatment options

- Literature search, vendor calls
  - Pond and lake treatment
  - Active dredging treatments
  - Carriage water slurry and sediment treatment
  - Oil spill remediation
  - Ex-situ water treatment
- No directly comparable projects found

In situ water quality treatment options (cont.)

- Options identified
  - Chopped hay, cottonseed meal, manure, *Moringa oleifera* seeds, walnut shells
  - Powdered/granular organic carbon
  - Organoclay
  - Gypsum
  - Alum
  - Cationic/anionic polymer

Bench scale jar tests

- GAC, PAC, GOC, POC settleability
  - GOC settling velocity too high (100x)

Material	Settle Time (second)	Liquid Depth (feet)	Settling Velocity (feet/second)
GAC	326	1.14	0.0035
PAC	720	1.14	0.0016
GOC	5	1.14	0.23
POC	1,800	1.14	0.00063

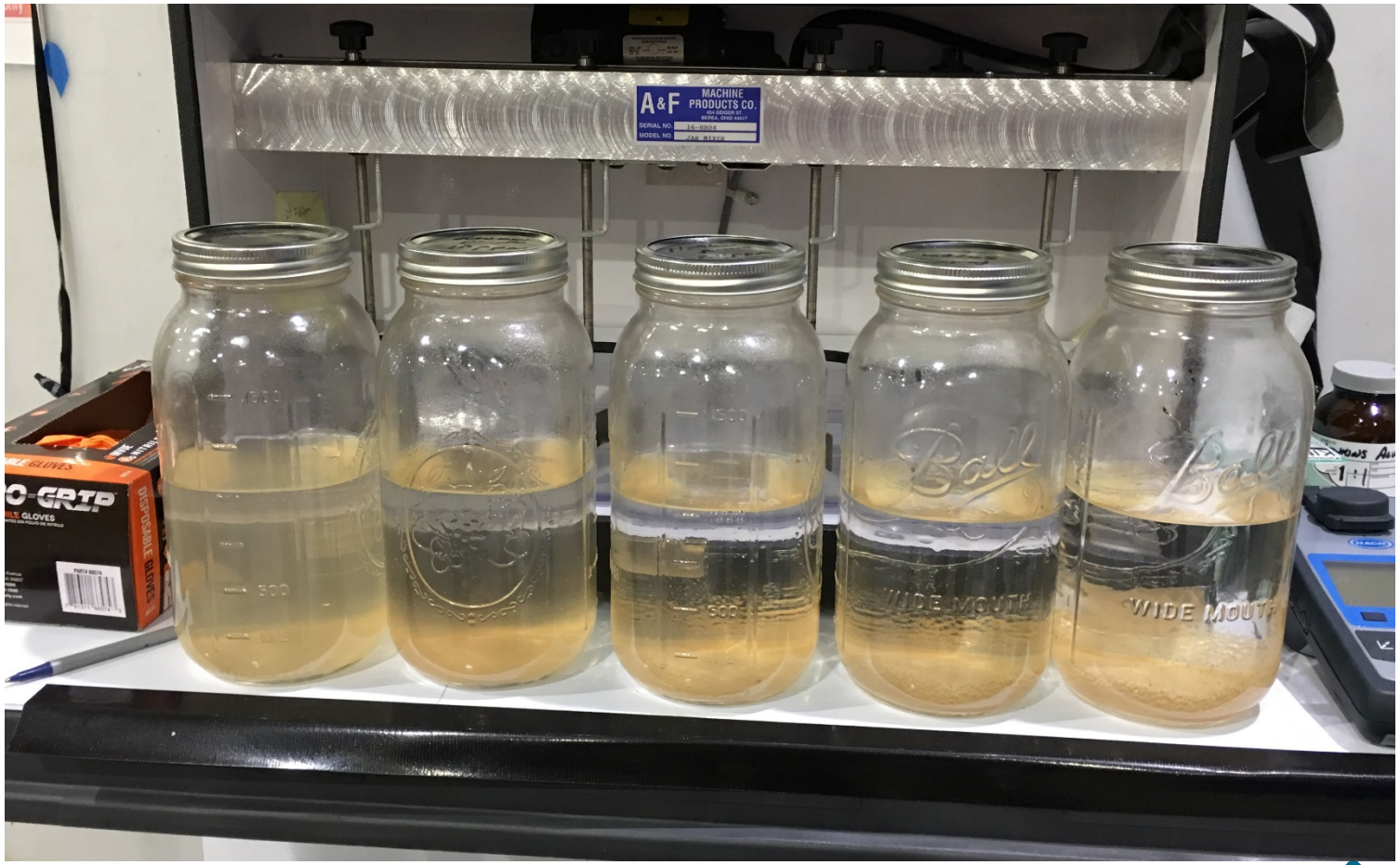
Bench scale jar tests

- 1.5 L jar tests
  - GAC, PAC and POC alone from 100 to 1,600 mg/L
  - Alum at 25, 50 and 100 ppm
  - PAC + Alum
  - POC + Alum
  - Simultaneous and delayed additions

Bench scale jar tests

Analyte	Result (µg/L)
1,2,4-Trimethylbenzene	<0.17
1,3,5-Trimethylbenzene	<0.17
Benzene	<0.20
Ethylbenzene	<0.19
Toluene	<0.17
Xylene, m & p	<0.38
Xylenes (Total)	<0.58
1-Methylnaphthalene	<0.048
2-Methylnaphthalene	<0.048
Acenaphthene	0.2
Acenaphthylene	0.19
Anthracene	<0.048
Benzo(a)anthracene	**0.52**
Benzo(a)pyrene	**0.53**
Benzo(b)fluoranthene	**0.51**
Benzo(e) pyrene	0.47
Benzo(g,h,i)perylene	0.43
Benzo(k)fluoranthene	**0.27**
Chrysene	**0.47**
Dibenzo(a,h)anthracene	<0.024
Dibenzofuran	<0.019
Fluoranthene	1.0
Fluorene	<0.048
Indeno(1,2,3-cd)pyrene	**0.35**
Naphthalene	<0.048
Phenanthrene	<0.048
Pyrene	**0.86**
Turbidity (NTU)	**95.1**

Bench scale jar tests



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Bench scale jar tests

- GAC reduced COCs 11 to >93%
- PAC reduced COCs 40 to >95% (above 800 mg/L dose)
- POC reduced COCs <10% at doses up to 1,200 mg/L
- POC reduced COCs >76% at 1,600 mg/L dose
- Alum alone reduced COCs >95% at 25-50 ppm dose

Column settling tests

- New sample of dredge area water collected
  - Similar characteristics to bench scale test sample

Column settling tests

- 8-foot columns filled with 68 liters of water
- Tested additions of:
  - PAC
  - PAC + delayed alum
- Sampled every 0.5 feet for TSS and at surface plus mid-depth for COCs
- Samples collected at time zero, 0.5, 1, 3, 24, 48, 168 hours
- Climate controlled lab ~ 10 ^{o}C

Column settling tests

- Baseline test showed turbidity reduction of 54% over 168 hours (TSS reduced 89%)
- Baseline test showed COC reductions up to 83% in 72 hours and 88% over 168 hours
- PAC reduced all POCs to below project standards after 48 hours except benzo(k)fluoranthene and all ND at 168 hours
- PAC + delayed alum reduced all COCs below project standards after 24 hours

Field application

- Jar tests at conclusion of dredging
  - 10, 20, 30, 40 mg/L Alum dose
  - 30 mg/L optimal
- Alum applied with standard herbicide field sprayer and 100 gallon tank over 8 hours

Field application

Field application

Field application

Field application

Project Team

LATHAM & WATKINS LLP

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