5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

MEMORANDUM

TO: Mr. Robert Antonelli, Jr. – City of Worcester DPW&P

FROM: Frank Ricciardi, PE, LSP, Daron Kurkjian, PE, Tony Zerilli,

DATE: June 7, 2017

SUBJECT: Bench-Scale Study Results, Salisbury Pond

On behalf of the City of Worcester, Weston & Sampson is pleased to provide the results of a bench-scale study evaluating the feasibility of Salisbury Pond dredging. The purpose of the study was to better understand the sediment characteristic and simulate dredging and dewatering techniques methods to reduce disposal weight. Reduced sediment mass and water weight will reduce transport and disposal costs that, based on arsenic-impacts to sediment, are high.

Site History:

In May 2016, Weston & Sampson collected sediments samples for laboratory analysis to pre-characterize Salisbury Pond sediment. The purpose of this sampling effort was to evaluate disposal options for dredged sediment. The analytical results from this pre-characterization indicate that arsenic detections above in-state landfill disposal levels are present across a large area of the pond. Please refer to Figure 1 for areas which exceed in-state disposal levels (Comm-97). Sediments in the northwestern lobe of the pond have arsenic concentrations that on average are below the Comm-97 standards, however, MassDEP does not typically allow averaging of results for waste characterization purposes.

Weston & Sampson recommended and performed a bench-scale study to evaluate potential dredging methods and dewatering technologies. The bench-scale study summarized in this memo provided data allowing for more accurate cost estimating for Salisbury pond dredging project.

Bench-Scale Study:

On December 13, 2017, Weston & Sampson collected sediment samples for the bench-scale study. Weston & Sampson collected five sediment samples for the following off-Site laboratory geotechnical analysis.

- Percent solids/percent moisture analysis
- Sieve analysis with hydrometer testing to determine clay fraction
- ASTM D4318 – Test method for Liquid Limit, Plastic Limit and Plasticity Index of Soils, Atterberg limits.

Ice on the pond restricted sediment coring to the far west, north and east of the pond, however representative samples were collected from accessible pond locations. The sediment sample locations are depicted on Figure 1.

Weston & Sampson also collected 15 gallons of sediment and 15 gallons of surface water for dredging and dewatering bench-scale testing. Six grab sediment samples were composited to provide the volume needed for the sediment sample. Surface water was collected from various locations across the pond. Please refer to Figure 1 for a graphical depiction of the sediment sample locations. The sediment and surface water samples were appropriately packaged and shipped to GeoTesting Express, Inc. of Acton, Massachusetts and Infrastructure Alternatives, Inc. (IAI) of Rockford, Michigan for evaluation of dry and wet dredging scenarios as further detailed below:

1) Wet Dredging Scenario: Hydraulic Dredging
    a. Evaluate geotube (filter bag dewatering) with bench-scale analysis of dewatering efficiency at 24 hours, 7 days, and 28 days.
    b. Chemical conditioning analysis.

2) Mechanical Dredging (Wet and Dry Dredging Scenario):
    a. Decant free water from sediment, bench-scale testing of various polymers and coagulants.
    b. Evaluate percent water reduction, change in weight after decanting and post-dewatering.
    c. Record dewatering time and efficiency.

Please refer to Attachments A & B for the geotechnical and bench-scale study results summarized in the section below.

Results:

Geotechnical Results:

The geotechnical data generated from this study indicated that sediment ranged from approximately 40 to 50 percent solids. Based on Particle Size Analysis by ASTM D422, the sediment consisted of 75 to nearly 100 percent fines (silt and/or clay). One exception was sample SED-2 that was mostly sand.

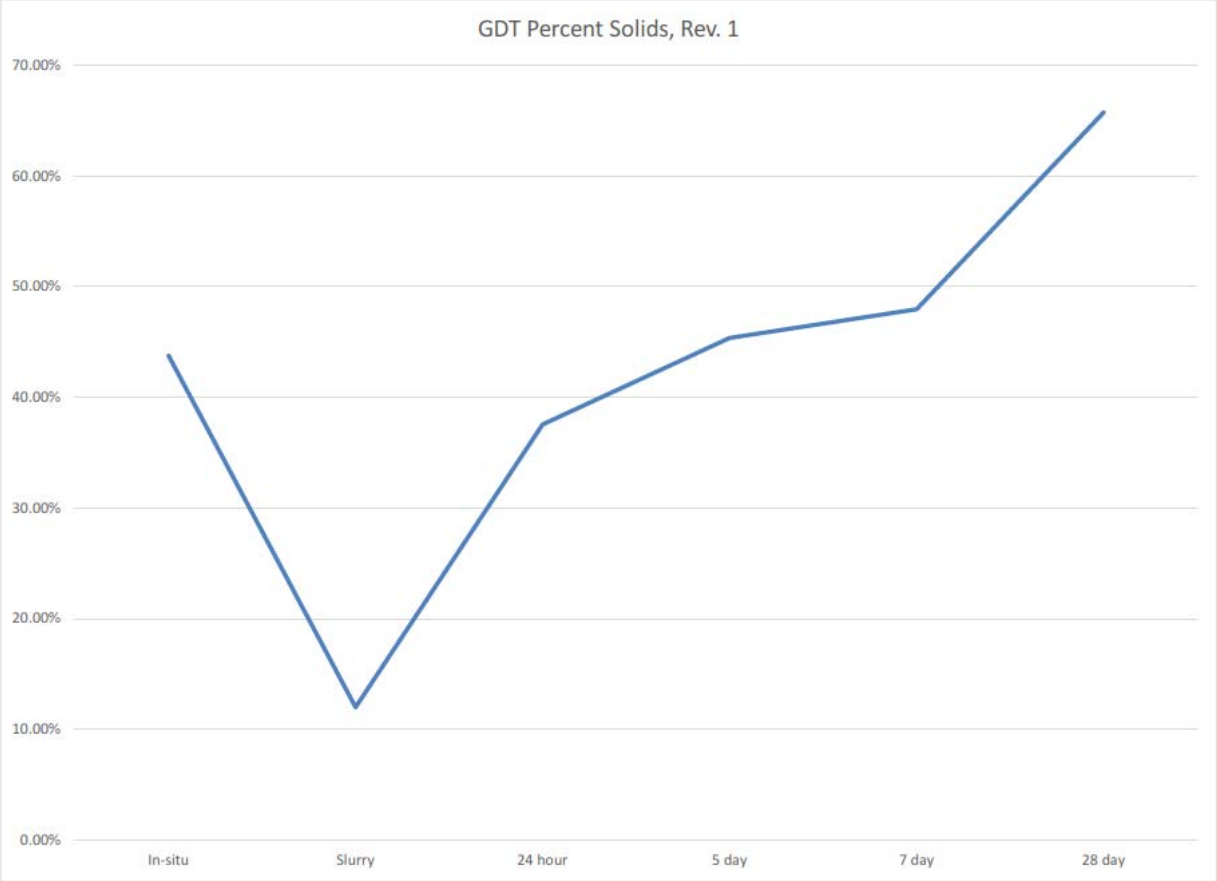
Based on Weston & Sampson's prior knowledge of the high level of fines, we submitted the sediment samples for Atterberg Limits analysis by ASTM D4318. This analysis was used to determine if fines were silt or clay. The Atterberg Limits analytical results indicated that the sediment to be elastic silt and not clay. While fines are the most difficult grain size to dewater, silt is preferable and less costly to dewater than clay. Please refer to Attachment A for the geotechnical results.

Bench-Scale Study Results:

Concurrent to geotechnical analysis, the composite samples of 15 gallons of sediment and 15 gallons of pond surface water were submitted for a hydraulic/mechanical dredging bench-scale study. The results of this study found that the sediments would be suitable for wet or dry dredging techniques.

In wet dredging, either a liquid slurry or fully saturated sediment is generated. To evaluate dewatering alternatives of these wet sediments, coagulants and geotubes were evaluated. IAI evaluated approximately a dozen different polymer coagulants in jar tests. Jar testing was performed by adding a preset volume of coagulant to a sediment sample and recording the water release rate, water clarity and appearance of floc. The best performing coagulant was WaterSolve's Solve-9248; this coagulant had a high water release rate, good water clarity and low appearance of floc. A photo of the jar tests is presented above and the full results of the coagulant review are included in Attachment B.

To simulate sediment agitation and creation of a liquid slurry during hydraulic dredging, IAI mixed pond sediment, surface water and coagulant (Solve-9248) into a slurry. This slurry was then pumped into Geotubes to evaluate dewatering. In the short-term and within five days the slurry shed water and achieved a moisture content of its *in situ* pre-mixed state. After 28 days, the dewatering effective increased significantly with water content reductions of approximately 20 percent.



A paint filter test was also conducted with the pond sediment to assess if the material has free liquids that would preclude transportation. Simulated wet mechanical dredging indicated free liquids were present even after 24 hours of passive drainage. Amendments were required to pass paint-filter test in the simulated wet mechanical dredging scenario. Amendments including Portland cement and Calciment bound free liquids to pass the paint filter test. This has implications for the off-Site disposal as the stabilizing agents and sediment blending would result in increased mass of sediment resulting in additional costs and disposal tonnages.

Finally, dry dredging techniques, such as draining portions of the pond using temporary dams, were reviewed. The provided sediment was amended with limited pond water to simulate the dryer conditions

likely after draining the pond. After 24 hours of passive drainage, the sediment passed paint filter tests without the need for amendments. As amendments add weight by binding free water, dry dredging showed promise for reduced weight. Please refer to Attachment B for the full bench-scale study results including photographs of the testing processes and graphs of bench-scale data. Based on the geotechnical results, dry dredging of the silty sediment would represent construction challenges as saturated silts have limited bearing capacity for heavy equipment. Extensive construction mats would be required in a dry dredging scenario.

Generated Water:
The contact water generated from the Geotubes was identified to contain dissolved arsenic. Similarly, contact water generated from draining excavated sediment in wet/dry mechanical scenarios would also contain dissolved arsenic. Based on this, Weston & Sampson recommends particulate filtration followed by granular activated carbon (GAC) adsorption for arsenic removal from dewatering fluids prior to return to the pond.

Cost Review:

Weston & Sampson has developed initial cost estimates of the various dredging technologies. With approximately 50,000 CY of sediment to remove and dispose of off-Site, total project costs can be reduced by performing the work in phases and/or focusing on the northern lobe of the pond that is less-impacted and in more-time sensitive need of dredging. Another option to save costs would be to meet with the MassDEP and request approval to relocate these soils within Worcester at a similarly arsenic-impacted Site. The relocated sediment would then require a cover system. This would require an appropriate receiving location in the City of Worcester and MassDEP approval but is the least costly alternative available. Meeting with the MassDEP may also be useful to request in-state disposal of the northern lobe sediment that on average are below Comm-97 arsenic standards but have several individual locations that are above the arsenic standard.

Using MassDEP approved disposal options, Weston & Sampson has prepared preliminary cost estimates for sediment removal, summarized below:

Alternative	Estimated Costs (million)	Comments
Hydraulic Dredging	Full Pond = $9.0	Sediment pumped to geotubes for dewatering. Less equipment needed than mechanical dredging.
	North Lobe = $4.3 South Lobe = $5.0	
Wet Mechanical Dredging	$14.7	Most costly option.
Dry Dredging	$8.5	AquaDam cannot exceed 10', amendment (added weight) needed to pass paint filter test
Excavator Dredging from Shore	$2.4	Includes removal from shore only (i.e. to a distance of 30'). Significant vegetation clearing, restoration of the shore and removal of peninsula and island are not included in this cost estimate.

Conclusions and Recommendations:

Weston & Sampson has prepared this memo to summarize the results of the Salisbury Pond bench scale study. Results indicate several dredging techniques are suitable for the pond and that the sediments are typically silt. Space constraints in the pond's urban location limit handling/sediment

management options. The City's budgetary and timing goals will also inform which technology is best suited.

While dry dredging is the least costly option for full pond dredge, odors and construction noise will require the most management. Each section of dry dredging will require draining the dredge area, placement of mats to traverse soft sediment and use of heavy excavation machinery. To minimize the noise and odor impacts to the neighborhood, Weston & Sampson recommends hydraulic dredging with geotubes. This option will readily remove sediment and achieve dewatering. As requested by the City of Worcester, Weston & Sampson will provide samples of the geotube materials.

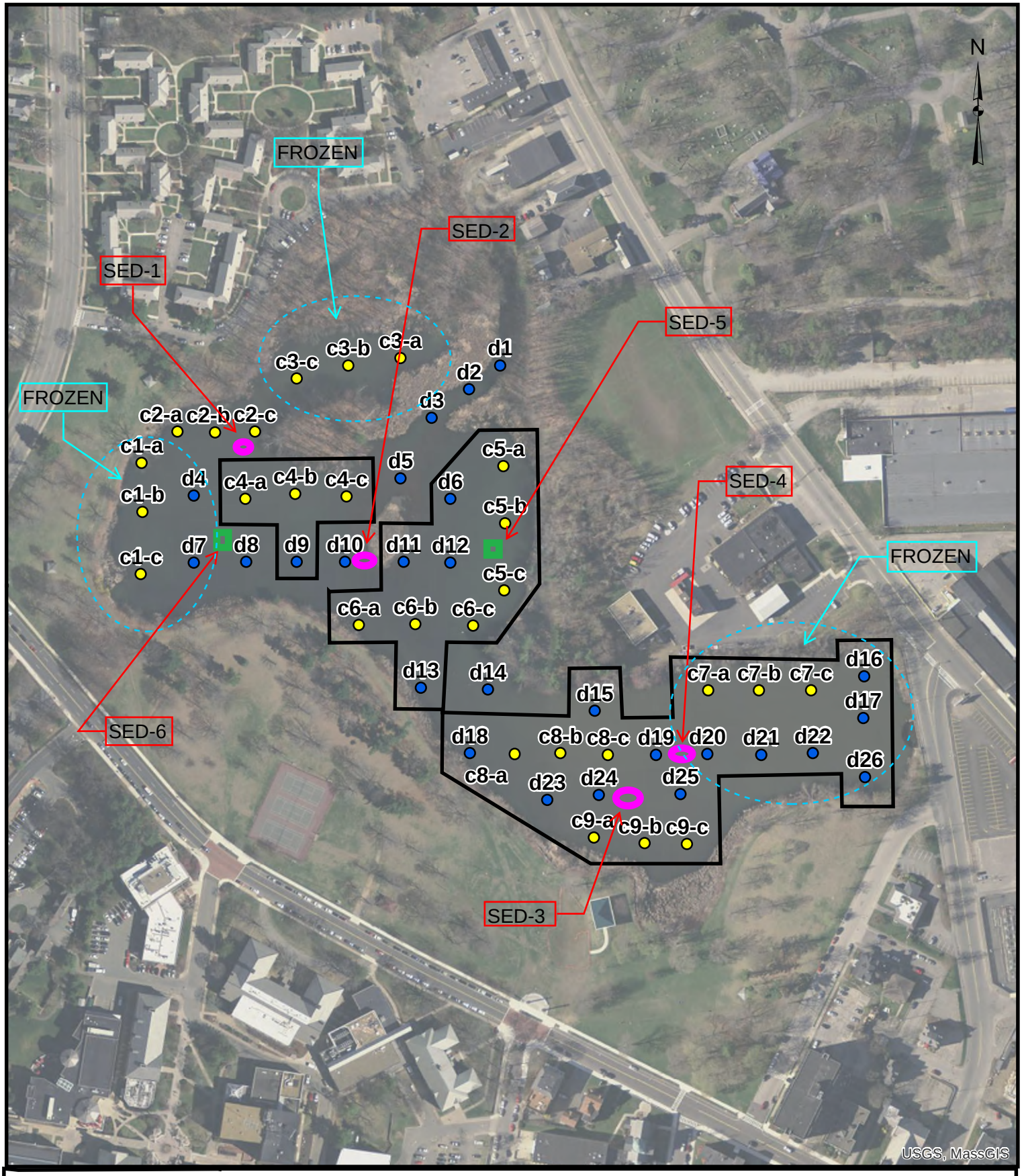
The most significant dredging cost is transport and disposal of arsenic-impacted sediment. Weston & Sampson has reviewed dewatering technologies to reduce sediment weight. Treatment of sediment for removal of arsenic is also costly. Obtaining site-specific approval from MassDEP to dispose of this portion of the sediment in-state may be possible considering that average concentrations in the northwestern lobe are below Comm-97 standards. At this time, costs are presented assuming only the western-most sediment can be disposed of in-state.

Weston & Sampson has also reviewed a fourth option of a partial pond dredge whereby sediment along the pond perimeter is excavated using standard excavating equipment located on the bank or on swamp mats placed on the water's edge. Assuming an accessible reach of 30 feet into the pond from the bank, this would remove approximately 10,000 CY of sediment. A challenge with this approach is the vegetation on portions of the shore would require clearing prior to excavation work followed by appropriate restoration upon completion of excavation activities. This shore-based option would be a less costly option as shore-accessible soils are limited in volume and disposal includes limited stockpiling and on-Site treatment to bind free water.

Table 1
PRELIMINARY COST ESTIMATE
SALISBURY POND DREDGING
WORCESTER, MA

Description	Unit	Unit Cost	Alternative 1: Hydraulic Dredging of Sediment in Wet - Full Pond		Alternative 1A: Hydraulic Dredging of Sediment in Wet - Northern Lobe only		Alternative 1B: Hydraulic Dredging of Sediment in wet - Southern Lobe only		Alternative 2: Mechanical Wet Dredging		Alternative 3: Mechanical Dry Dredging		Alternative 4: Shore-Based Dredging	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Site Preparation					0									
Mob/Demob	LS		1	$75,000	1	$75,000	1	$75,000	1	$75,000	1	$75,000	1	$20,000
Permitting (SWPPP, CGP, etc.)	LS		1	$10,000	1	$10,000	1	$10,000	1	$10,000	1	$10,000	1	$10,000
Establish Fenced Sediment Staging/Dewatering Areas	EA	$30,000	1	$30,000	1	$30,000	1	$30,000	1	$30,000	1	$30,000	2	$60,000
Vegetative clearing	Acre	$20,000											1	$20,000
Temporary Perimeter Fencing	LF	$12											1,700	$20,400
Gravel access road	CY	$25											400	$10,000
Straw wattles for access road	LF	$7											1,500	$10,500
Access road relocation (assume 3 set-ups)	EA	$10,000											3	$30,000
Turbidity Curtain	LF	$30									300	$9,000	1,000	$30,000
Turbidity Monitoring	MO	$2,500											4	$10,000
Sediment Dredging														
Hydraulic dredging - equipment and geotubes	CY	$70	50,000	$3,500,000	25,000	$1,750,000	25,000	$1,750,000						
Odor Control	LS		1	$10,000	1	$10,000		$10,000	1	$50,000	1	$50,000		
Sediment Excavation														
Mechanical Wet-Dredging														
Barge and Excavator, Equipment	CY	$100							50,000	$5,000,000				
Mechanical Dry-Dredging														
Excavation, Bulk, Scrappers, Common Earth, 1000' haul, Crew 1	CY	$20									25,000	$500,000		
Excavation, Bulk,Scrappers, Common Earth, 1000' haul, Crew 2	CY	$20									25,000	$500,000		
Excavation, Bulk,Scrappers, Common Earth, 1000' haul, Land-based	CY	$20											10,000	$200,000
Construction Mats	LS										1	$50,000	1	$20,000
Construct Dam														
Purchase and Place 200' AquaDam (max. 10' high)	LS										1	$100,000		
Draining Pond & Dewatering Dredged/Excavated Sediment														
60 HP, 1500 GPM Centrifugal Pump	EA	$10,000									2	$20,000		
Pumping, 4 " Trash Pumps 8 Hrs day (10 pumps)	DAY	$2,000									200	$400,000		
Dewatering liquid treatment system for draining pond	LS										1	$250,000		
Handling of Dewatered Sediment at Dewatering Cell														
Amendment for Wet Dredging - Amendment and Blending	CY	$25							50,000	$1,250,000				
Amendment for Wet Dredging - Amendment and Blending - shore-accessible sediment only	CY	$25							10,000	$250,000			1	$250,000
Amendment for Dry Dredging - Amendment and Blending	CY	$10									50,000	$500,000		
Handling of Wet Sediment Transport to Dewatering Cell	CY	$10							50,000	$500,000				
Handling of Drained Sediment Transport to Dewatering Cell	CY	$2									50,000	$100,000		
Dewatering liquid treatment system - Hydraulic dredging	LS		1	$300,000	1	$200,000	1	$200,000						
Dewatering liquid treatment system - Wet sediment	LS								1	$460,000				
Dewatering liquid treatment system - Dry sediment	LS										1	$300,000		
Dewatering liquid treatment system - Shore Sediment	LS												1	$230,000
Transport & Disposal														
Instate disposal	Tons	$35	11,330	$396,550	11,330	$396,550								
Hyrdaulic Dredging Out-of-state portion of northern lobe	Tons	$85	12,620	$1,072,700	12,620	$1,072,700								
Hyrdaulic Dredging Out-of-state - full south lobe	Tons	$85	23,950	$2,035,750			23,950	$2,035,750						
Mechanical Wet	Tons	$85							53,500	$4,547,500				
Mechanical Dry	Tons	$85									48,200	$4,097,000		
Instate disposal - land-based only	Tons	$35											2,400	$84,000
Mechanical Wet - land based only	Tons	$85											9,600	$816,000
Site Restoration														
Loaming and Seeding	SY	$5	10,000.00	$50,000	5,000	$25,000	5,000	$25,000	10,000	$50,000	10,000	$50,000	20,000	$100,000
Tree Planting	ACRE	$30,000											2	$60,000
SUBTOTAL CONSTRUCTION COSTS				$7,480,000		$3,570,000		$4,136,000		$12,223,000		$7,041,000		$1,981,000
20% Contingency				$1,496,000		$714,000		$827,000		$2,445,000		$1,408,000		$396,000
TOTAL CONSTRUCTION COSTS				**$8,980,000**		**$4,280,000**		**$4,960,000**		**$14,670,000**		**$8,450,000**		**$2,380,000**

Notes:
Engineer's estimate is within minus 30 percent to plus 50 percent of actual prices.
CY = cubic yard
SF = square foot
SY = square yards
LS = lump sum
LF = linear foot
SY = square yard



SampleType

- Composite
- Discrete
- COMM-97 Exceedance
- GeoTesting Sampling & IAI
- IAI Sediment & Surface water only

FIGURE1
WORCESTER, MA
SALISBURY POND DREDGING FEASIBILITY STUDY

SAMPLING LOCATIONS

200 0 200
Scale In Feet

Weston&Sampson

Path: O:\Worcester MA\Salisbury Pond Dredging\GIS\maps\technical memo\sed thickness 2016.mxd User: PetersenT Saved: 5/23/2016 3:56:26 PM Opened: 6/2/2016 10:26:26 AM

ATTACHMENT A:
GEOTECHNICAL REPORT

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York

www.geotesting.com

Transmittal

TO:

Daron Kurkjian

Weston & Sampson Engineers

5 Centennial Drive

Peabody, MA 01960

DATE: 1/6/2017	GTX NO: 305772
RE: Salisbury Pond	

COPIES	DATE	DESCRIPTION
	1/6/2017	**December 2016 Laboratory Test Report**

REMARKS:

SIGNED: Joe Tomei, Laboratory Manager

CC:

APPROVED BY: Nancy Hubbard, Project Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

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Atlanta
Chicago
Los Angeles
New York
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January 6, 2017

Daron Kurkjian
Weston & Sampson Engineers
5 Centennial Drive
Peabody, MA 01960

RE: Salisbury Pond, (GTX-305772)

Dear Daron:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received five samples from you on 12/13/2016. These samples were labeled as follows:

Sample
Sed-1
Sed-2A
Sed-2B
Sed-3
Sed-4

GTX performed the following tests on these samples:

5 ASTM D2216 - Moisture Contents
5 GTX-S1076 - Total Solids
4 ASTM D422 - Grain Size Analyses - Sieve and Hydrometer
1 ASTM D422 - Grain Size Analysis - Sieve Only
4 ASTM D4318 - Atterberg Limits

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Joe Tomei
Laboratory Manager

GeoTesting EXPRESS

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New York
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Geotechnical Test Report **1/6/2017**

GTX-305772
Salisbury Pond

Client Project No.: 2160304

Prepared for:

Weston & Sampson Engineers

Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	---	Tested By:	GA
Sample ID:	---	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400759		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
---	Sed- 1	---	Wet, very dark gray silt with sand	160.4
---	Sed- 2A	---	Wet, very dark gray silt with sand	95.1
---	Sed- 2B	---	Wet, very dark gray sand with silt	32.9
---	Sed- 3	---	Wet, very dark gray silt	109.2
---	Sed- 4	---	Wet, very dark gray silt	168.7

Notes: Temperature of Drying : 110º Celsius

Client Name:	Weston & Sampson Engineers
Project Name:	Salisbury Pond
Project Location:	---
GTX #:	305772
Tested By:	ga
Checked By:	emm
Report Date:	12/21/16

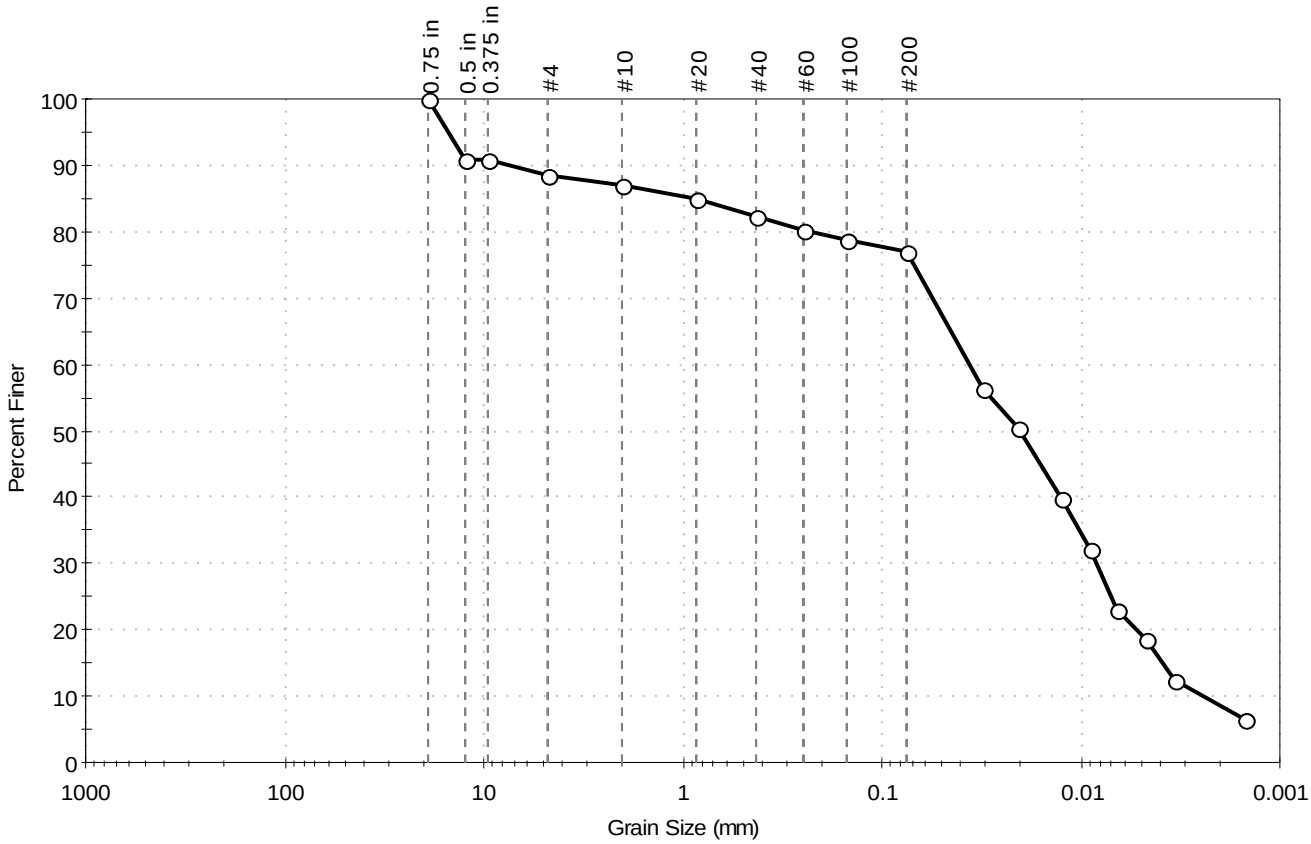
Total Solids

Boring ID	Sample ID	Depth, ft	Visual Description	Moisture Content, %	Total Solids, %
---	Sed-1	---	Wet, very dark gray silt with sand	160.4	38.4
---	Sed-2A	---	Wet, very dark gray silt with sand	95.1	51.3
---	Sed-2B	---	Wet, very dark gray sand with silt	32.9	75.3
---	Sed-3	---	Wet, very dark gray silt	109.2	47.8
---	Sed-4	---	Wet, very dark gray silt	168.7	37.2

Notes: Moisture Content = (mass of water) / (mass of dry soil)
Total Solids = (mass of dry soil) / (mass of wet soil)

Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-1	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400760		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	11.4	11.6	77.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	91		
0.375 in	9.50	91		
#4	4.75	89		
#10	2.00	87		
#20	0.85	85		
#40	0.42	82		
#60	0.25	80		
#100	0.15	79		
#200	0.075	77		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0312	56		
---	0.0207	50		
---	0.0126	40		
---	0.0091	32		
---	0.0065	23		
---	0.0047	19		
---	0.0033	12		
---	0.0015	6		

Coefficients

D_{85} = 0.8596 mm D_{30} = 0.0084 mm
D_{60} = 0.0363 mm D_{15} = 0.0039 mm
D_{50} = 0.0203 mm D_{10} = 0.0024 mm
C_u = 15.125 C_c = 0.810

Classification

ASTM Elastic silt with sand (MH)

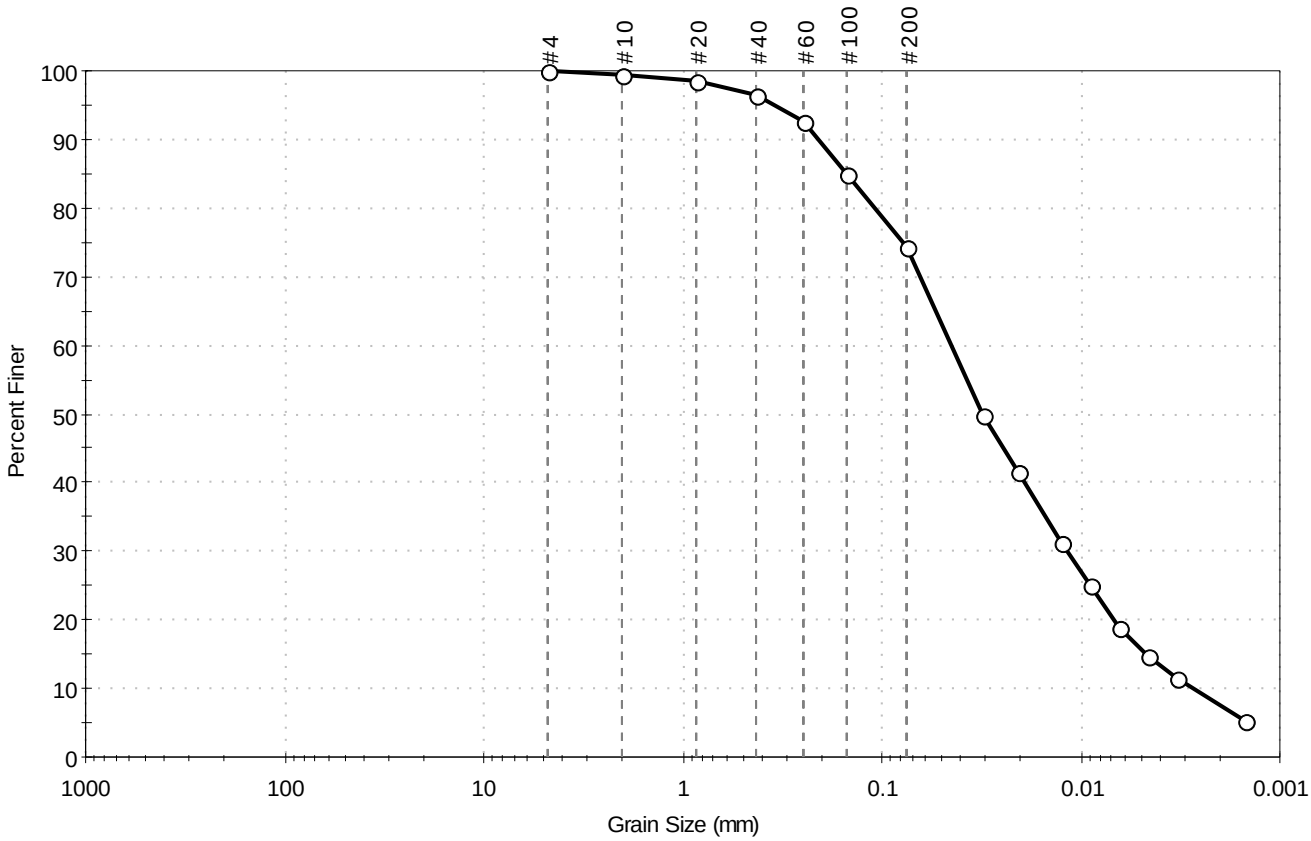
AASHTO Clayey Soils (A-7-5 (47))

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-2A	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400761		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	25.7	74.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	99		
#40	0.42	97		
#60	0.25	93		
#100	0.15	85		
#200	0.075	74		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0310	50		
---	0.0205	42		
---	0.0125	31		
---	0.0090	25		
---	0.0065	19		
---	0.0047	15		
---	0.0033	12		
---	0.0015	5		

Coefficients

D_{85} = 0.1504 mm D_{30} = 0.0116 mm
D_{60} = 0.0447 mm D_{15} = 0.0048 mm
D_{50} = 0.0310 mm D_{10} = 0.0027 mm
C_u = 16.556 C_c = 1.115

Classification

ASTM Elastic silt with sand (MH)

AASHTO Clayey Soils (A-7-5 (16))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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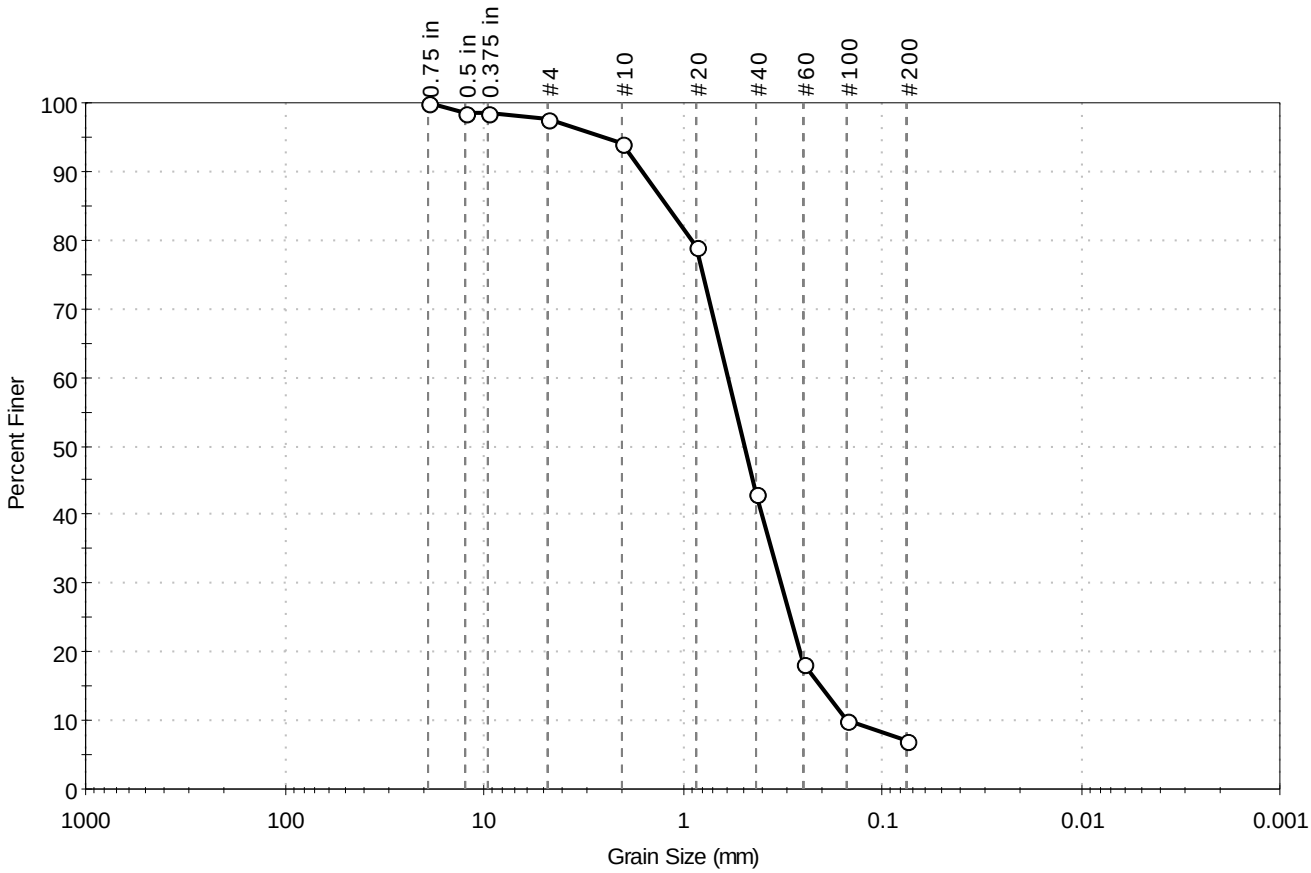
Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-2B	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400768		
Test Comment:	---				
Visual Description:	Wet, very dark gray sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.4	90.6	7.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	98		
0.375 in	9.50	98		
#4	4.75	98		
#10	2.00	94		
#20	0.85	79		
#40	0.42	43		
#60	0.25	18		
#100	0.15	10		
#200	0.075	7.0		

Coefficients

D_{85} = 1.1849 mm D_{30} = 0.3214 mm

D_{60} = 0.5887 mm D_{15} = 0.2033 mm

D_{50} = 0.4861 mm D_{10} = 0.1466 mm

C_u = 4.016 C_c = 1.197

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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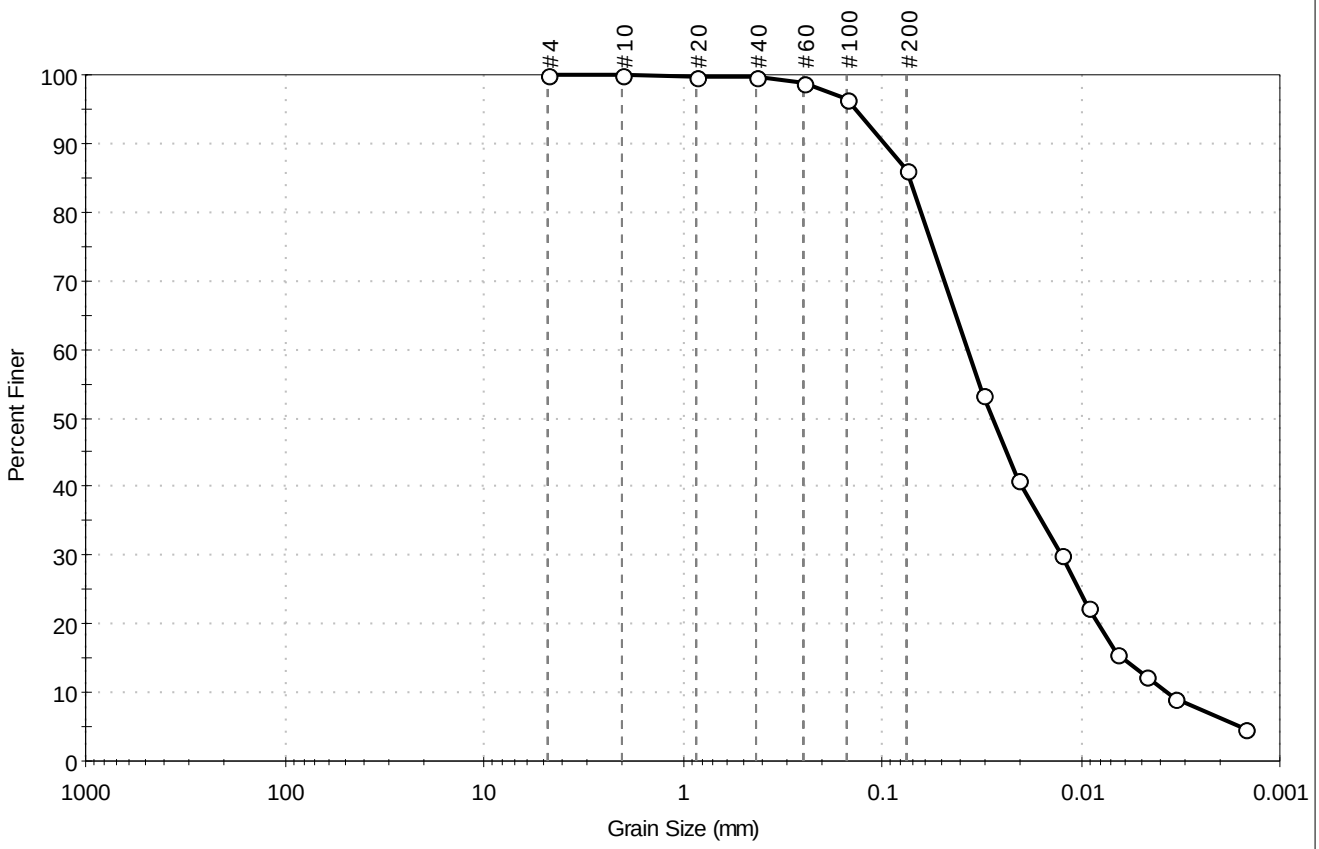
Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-3	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400762		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	14.0	86.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	96		
#200	0.075	86		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0311	53		
---	0.0207	41		
---	0.0126	30		
---	0.0091	22		
---	0.0066	16		
---	0.0047	12		
---	0.0033	9		
---	0.0015	5		

Coefficients

D_{85} = 0.0730 mm D_{30} = 0.0125 mm
D_{60} = 0.0373 mm D_{15} = 0.0061 mm
D_{50} = 0.0279 mm D_{10} = 0.0037 mm
C_u = 10.081 C_c = 1.132

Classification

ASTM Elastic silt (MH)

AASHTO Clayey Soils (A-7-5 (24))

Sample / Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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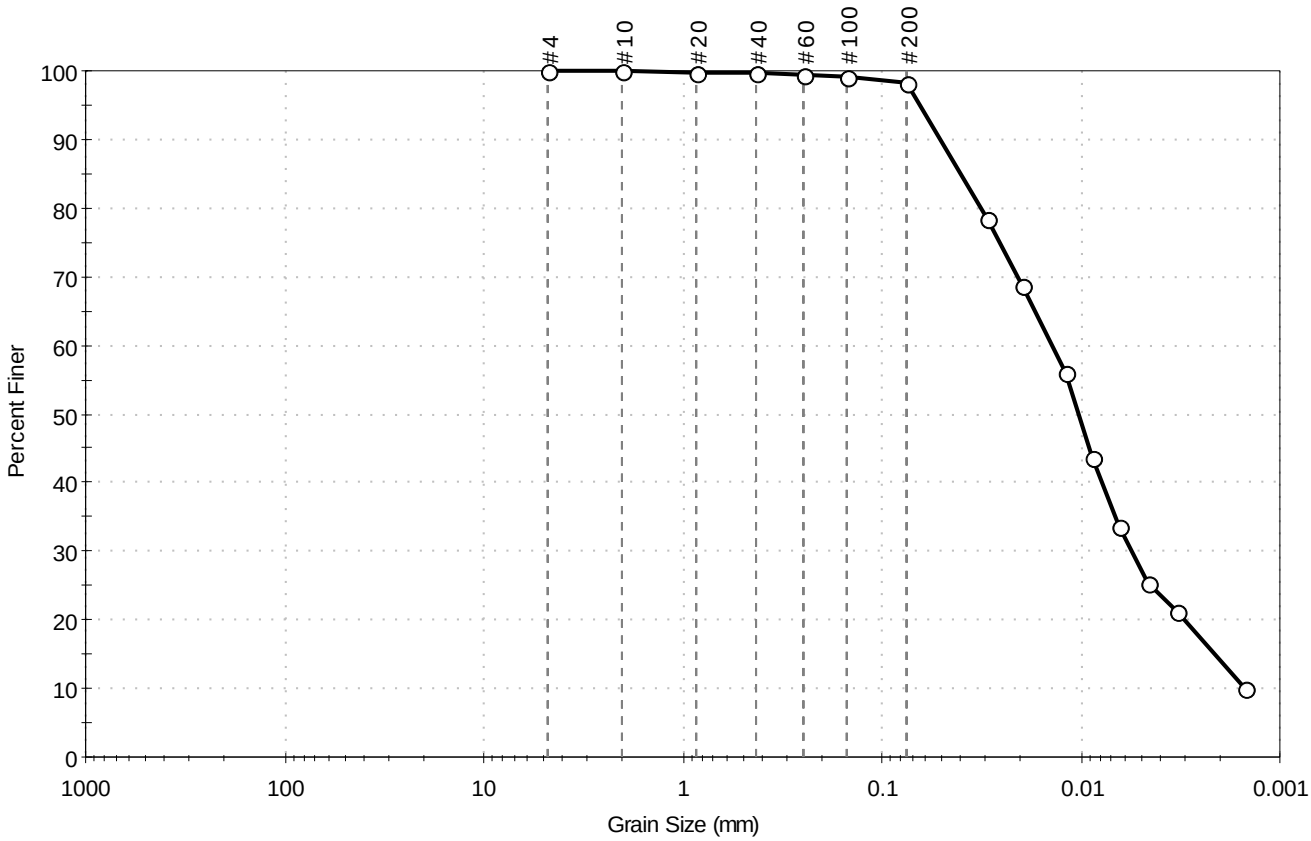
Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-4	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400763		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	1.7	98.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	99		
#200	0.075	98		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0296	78		
---	0.0199	69		
---	0.0119	56		
---	0.0088	44		
---	0.0064	34		
---	0.0046	25		
---	0.0033	21		
---	0.0015	10		

Coefficients

D_{85} = 0.0403 mm D_{30} = 0.0055 mm
D_{60} = 0.0140 mm D_{15} = 0.0021 mm
D_{50} = 0.0103 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Elastic silt (MH)

AASHTO Clayey Soils (A-7-5 (80))

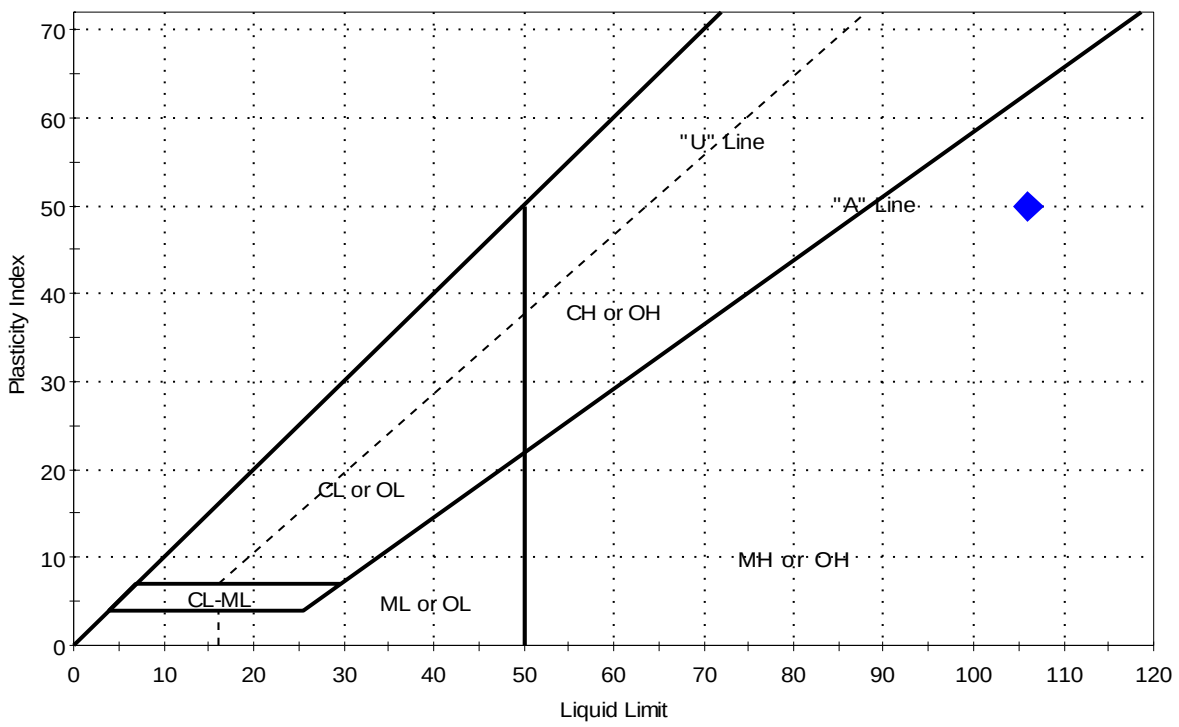
Sample / Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

printed 12/21/2016 11:33:02 AM

Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-1	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400764		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt with sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	Sed-1	---	---	160	106	56	50	2.1	Elastic silt with sand (MH)

Sample Prepared using the WET method

18% Retained on #40 Sieve

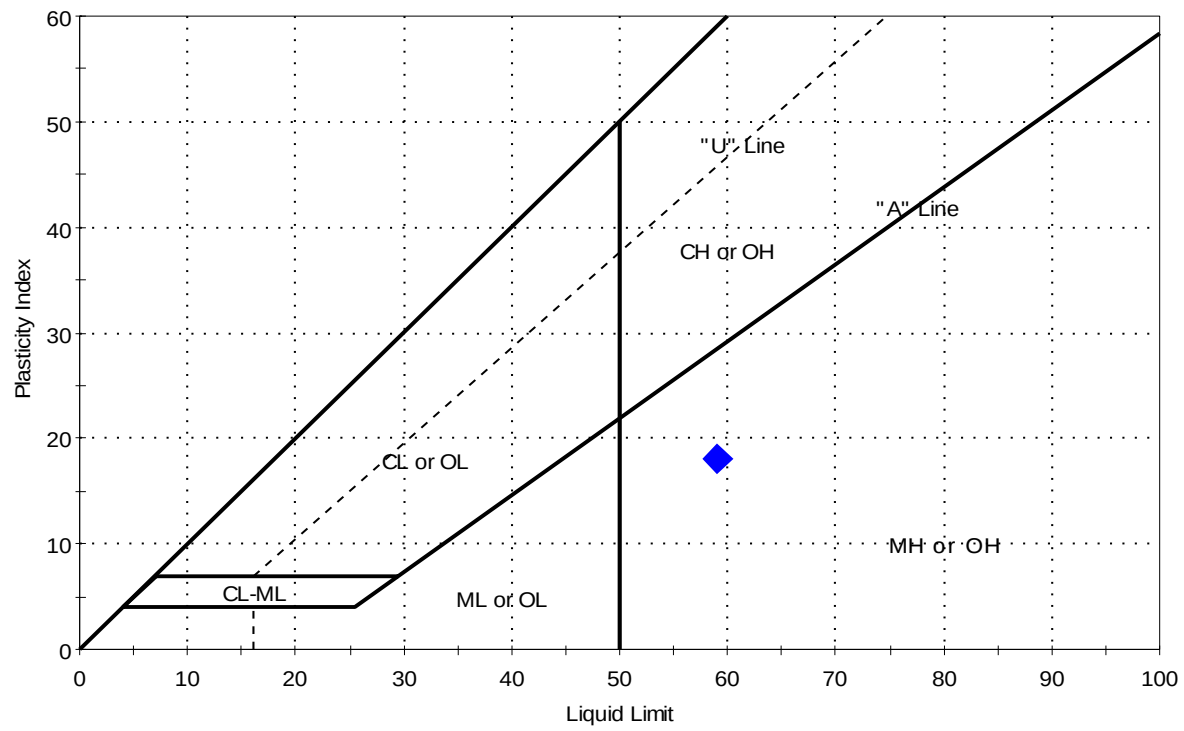
Dry Strength: HIGH

Dilatancy: NONE

Toughness: MEDIUM

Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-2A	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400765		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt with sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	Sed-2A	---	---	95	59	41	18	3	Elastic silt with sand (MH)

Sample Prepared using the WET method

3% Retained on #40 Sieve

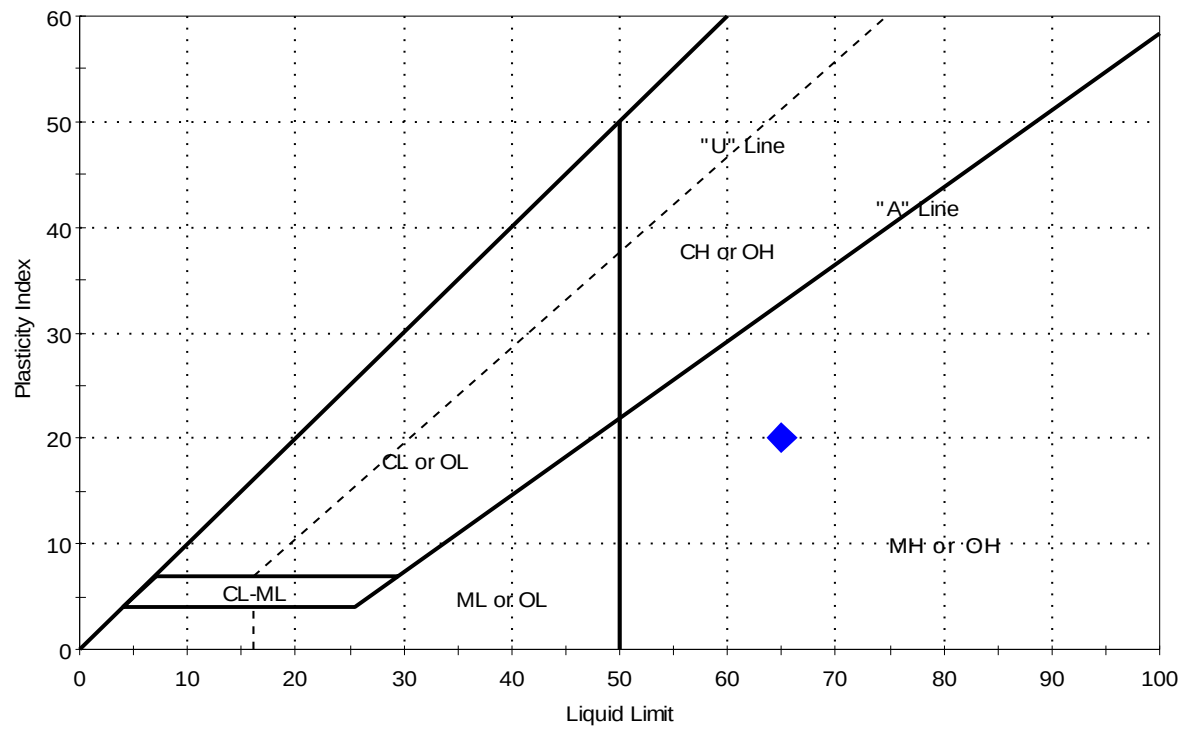
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: MEDIUM

Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-3	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400766		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	Sed-3	---	---	109	65	45	20	3.2	Elastic silt (MH)

Sample Prepared using the WET method

0% Retained on #40 Sieve

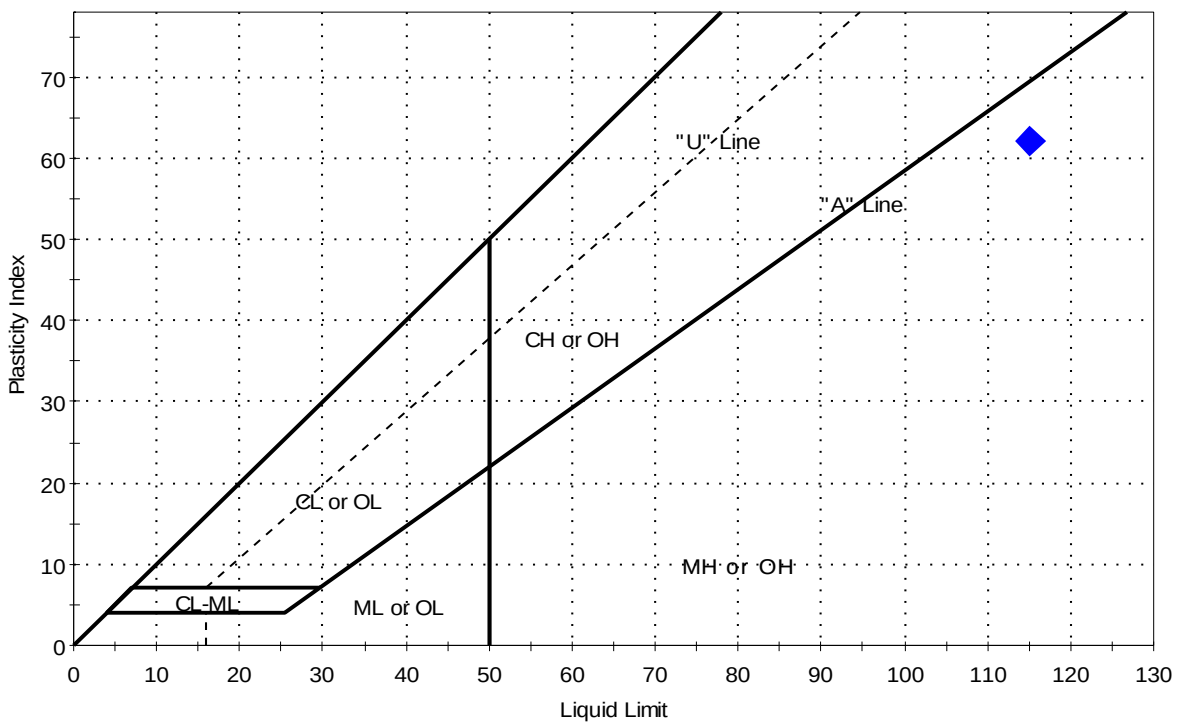
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: MEDIUM

Client:	Weston & Sampson Engineers				
Project:	Salisbury Pond				
Location:	---			Project No:	GTX-305772
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	Sed-4	Test Date:	12/20/16	Checked By:	emm
Depth :	---	Test Id:	400767		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	Sed-4	---	---	169	115	53	62	1.9	Elastic silt (MH)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: MEDIUM

GeoTesting EXPRESS

CHAIN OF CUSTODY

GeoTesting Express, Inc.
125 Nagog Park
Acton, MA 01720
800-434-1062 Toll Free
978-635-0424 Phone
978-635-0266 Fax

Sales Order No.:
GTX No.:

Company Name: Weston & Sampson
Address: 5 Centennial Drive. Peabody, MA
Contact: Daron Kurkjian
e-mail: KurkjianD@wseinc.com
Phone Number: 800-SAMPSON
Fax Number:
Project Name: Salisbury Pond
Project Number: 2160304
Project Location: Salisbury Pond

Sample Type: 1. Soil 2. Geosynthetic 3. Rock 4. Concrete 5. Other
Container Type: 1. Bucket 2. Bag 3. Jar 4. Tube 5. Roll

Analysis

Sample Identification	Container Size	Container Type	Sampling Date	Sampling Time	Sample Type	% Solids	% Moisture	Sieve w/hydrometer for Clay Fraction	ASTM D-4318 - Liquid Limit, Plastic Limit, Plasticity Index Atterberg Limits	Sieve ONLY		Comments
Sed-1	4x 8oz	3	12/13/16	1230	1	X	X	X	X			
Sed-2A	4x 8oz	3	12/13/16	1030	1	X	X	X	X			
Sed-2B	4x 8oz	3	12/13/16	1030	1	X	X			X		
Sed-3	4x 8oz	3	12/13/16	0945	1	X	X	X	X			
Sed-4	4x 8oz	3	12/13/16	1130	1	X	X	X	X			

Relinquished By:	Date: 12/13/16 Time: 1455	**Received By:**	Date: 12/13/16 Time: 1455
Relinquished By:	Date: Time:	**Received By:**	Date: Time:
Relinquished By:	Date: Time:	**Received By:**	Date: Time:
SHIPPED VIA:			

Turn-Around Time Requested:
No. of Business Days: _____

Special Instructions:

GeoTesting EXPRESS

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

February 6, 2017

Mr. Daron G. Kurkjian, P.E., Project Manager
Weston & Sampson
5 Centennial Drive
Peabody, MA 01960

SALISBURY POND TREATABILITY REPORT, Rev. 1

Mr. Kurkijan,

Infrastructure Alternatives has performed a series of treatability evaluations on sediment samples provided by Weston & Sampson, collected from Salisbury Pond, in Worcester, MA. Results are presented, below.

Test Results

- Polymer product screening and gravity drainage test was performed by a trusted polymer vendor. The vendor recommended a single product application of Solve-9248 at a dose of 3.2 lbs./dry ton, for geotextile tube dewatering.
- Geotube® Dewatering Test results indicated the material passed paint filter test (EPA 9095B) after 24 hrs., and exceeded in-situ percent solids (ASTM D2216) after 5 days. Density of the in-situ material was found to be 79.29 lbs./cu. ft., and the density of the GDT contents after 28 days was 66.26 lbs./cu. ft. The dry cake density was 48.14 lbs./cu. ft.
- A dose of 3.65 lbs./dry ton of Solve-9248 was utilized in the GDT. This dose was selected based on jar testing in our shop and our experience with geotextile tube dewatering.
- Arsenic was found in the filtrate collected from the GDT test, at 84.8 mg/L or about 8.5 times the U.S. drinking water drinking water standard (MCL).
- Simulation of mechanical dredging in the dry, and subsequent amendment testing, showed the material passed paint filter test and exceeded in-situ percent solids after 24 hrs., without amendment. With the addition of 3% of amendment, the material passed paint filter and exceeded in-situ percent solids after 1 hr.
- Simulation of mechanical dredging in the wet, and subsequent amendment testing, showed the material passed paint filter test and exceeded in-situ percent solids after 24 hrs., with the addition of 0.5% of Portland Cement and 1% of Calciment. The material passed paint filter test and exceeded in-situ percent solids after 1 hr., with the addition of 10% Portland cement and 14% of Calciment.

Summary

Evaluations indicate this material can be effectively dewatered in geotextile tubes, and/or stabilized with amendment. Our test results indicate that amended dewatered sediment can realize better than in-situ percent solids almost directly, and that non-amended sediment can reach similar percent solids, given a bit more time.

Therefore, if the project completion is budget-sensitive, the cost for amendments can be avoided, given ample time to allow the dewatered material to continue in the geotextile tubes. If, on the other hand, the project completion is schedule-sensitive, amendment addition can decrease the sediment dewatering time requirement.

Due to the presence of arsenic, it is likely that contact water treatment will be required, regardless of which material removal and handling methods are selected.

Please let us know if you have any questions about this report. We welcome an opportunity to work further with Weston & Sampson, as a technical approach is developed for this project.

Sincerely,

INFRASTRUCTURE ALTERNATIVES, INC.

Scott A. Ponst

Scott Ponstein, Project Manager
616-866-1600 ext. 22

Enclosed:
- Dewatering Performance Trial Report
- GDT Summary
- Amendment Testing Summary
- Photo Log
- Percent solids graphs
- Filtrate chemical analysis
- Safety Data Sheets for polymer and amendment products

DEWATERING PERFORMANCE TRIAL
SALSISBURY POND

For:
Infrastructure Alternatives
7888 Childsdale Avenue
Rockford, MI 49341
(616) 866-1600

By:
WaterSolve, LLC
5031 68th St., SE
Caledonia, MI 49316
www.gowatersolve.com
616-575-8693

December 22, 2016

1. Scope of Work

WaterSolve, LLC was tasked to perform a Geotube® dewatering performance trial and cone tests on a sample from Salisbury Pond. The objectives of these dewatering trials were to identify chemical conditioning program(s), identify polymer flocculant(s), and dosing rate(s) for a potential Geotube® dewatering application. The objectives of subsequent Cone tests were to measure total solids (TS) of the flocculated, contained, and dewatered residual after passage through the GT500D Geotube® fabric.

2. Materials & Methods

Two 5 gallon buckets were delivered to WaterSolve's Laboratory (Caledonia, MI) on December 20, 2016. Preliminary testing determined dilution would be necessary. A 1:2 dilution (sample: provided water) was used to identify the correct chemical conditioning. Samples of residual were mixed 1:2, and were placed in graduated, glass jars.

Several polymers (emulsions) were "made-down" (200-mL) at a 0.5% concentration for this dewatering trial. Polymer (4 to 10-mL; 133 to 333-ppm) was added to a sample with a 10-mL plastic syringe and moderately tumbled five to seven times. Observations of water release rate, water clarity, and flocculent appearance were recorded on appropriate data sheets (Appendix A). Polymer(s) that flocculated and dewatered these residuals most effectively were re-evaluated with lower doses in order to isolate the most efficient dewatering and flocculating polymer(s). A Hach DR 2800 was used to measure TSS (Total Suspended Solids) and an 2100P Turbidimeter was used to measure Turbidity after the samples were poured through the Geotube® GT500D fabric with a measurable limit of up to 750-mg/L suspended solids and 1000 NTU's, respectively.

Percent total solids (dry weight) of the initial residual samples, diluted residual samples, and dewatered cake samples (captured on GT500D Geotube® fabric) were measured.

3. Results

Chemical conditioning with Solve 9248 was determined to flocculate and dewater the residual most effectively compared to the other chemical conditioning programs (Appendix A). Water release volume and flocculent appearance were good to excellent at a 7-mL (233-ppm, 3.2-lbs/dry ton) dose of Solve 9248 in the 150-mL sample.

Prior to dilution, the sample was measured at 53.1-percent dry weight solids. The diluted test sample (1:2, sample: provided water) was 14.5-percent dry weight solids. After passing a 1000-mL diluted (1:2) and conditioned (233-ppm Solve 9248) test sample through the GT500D Geotube® fabric, percent solids increased to 41.0-percent after sixty minutes of drying time. From this 1000-mL sample, 650-mL and 720-mL of water was released in one minute and sixty minutes, respectively, after passage through the filter. TSS and Turbidity on the filtrate was 54-mg/L and 52 NTU, respectively.

4. Recommendations

We recommend an application of Solve 9248 (233-ppm, 3.2-lbs/dry ton) for dewatering residuals in a Geotube® application in order to pass paint filter test for subsequent disposal. The dose may vary based on the solids concentration in the pumped line. Additional evaluation is recommended for determining optimal inline percent solids thresholds for Geotube® performance including filtrate release and solids consolidation over time.

Solve 9248 is required to be made-down at 0.5-percent with a polymer make-down unit or aged in batch/feed tanks prior to injection into the residual line. Moderate mixing energy is required between the polymer introduction point and the Geotube® containers (e.g., two to three bends in the discharge line and/or inline static mixers). To ensure the most effective treatment of the residuals, the polymer dose should be spilt and be injected at multiple points within the line.

Expected time to being able to pass a Paint Filter Test is unpredictable in a Geotube® container from these bench-scale experiments. An onsite, laboratory hanging bag or Geotube® dewatering trial (GDT) may be used and is recommended if the timeline for achieving project goals of dry weight solids and Geotube® filtrate characteristics are in question for this application. Additional dewatering evaluations over time are recommended if project objectives for consolidation are greater than passing a Paint Filter Test.

Please note, while a composite sample may give us an indication of an average treatment scenario, it does not indicate pockets of concern for treatment effectiveness or areas that may require a higher or lower dose of chemistry, or contain higher in situ solids, since the areas of concern may be masked by factors of dilution from other areas.

Due to potential variability of the material, daily on-site testing and chemical conditioning verification are recommended during pumping operations.

Page 1 of 1

WaterSolve, LLC

Clearly thinking about your water treatment!

DEWATERING PERFORMANCE TRIAL

Date: 12/22/16
Analyst: DCW

Customer: IAI
Location: SALISBURY POND
Equipment in Service: GEOTUBE

1=Best *6=Worst*

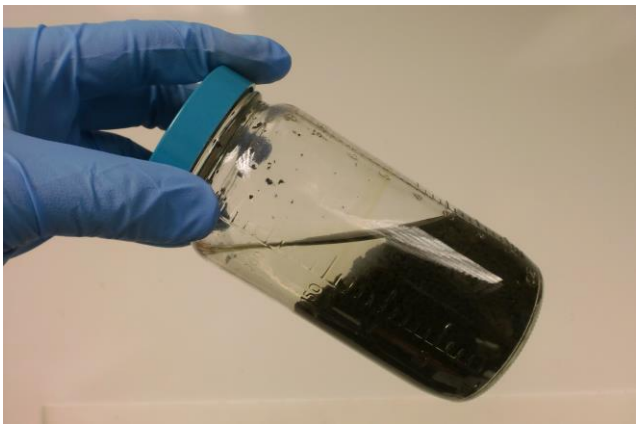
Jar Number	Polymer Name	Polymer Dosage (mL)	Sample Size (mL)	Water Rel. Rate (1 - 6)	Water Clarity (1 - 6)	Floc Appearance (1 - 6)	Comments

Polymer make-down concentration = 0.5 %
Dilution of test sample = 1:2 SEDIMENT PROVIDED WATER

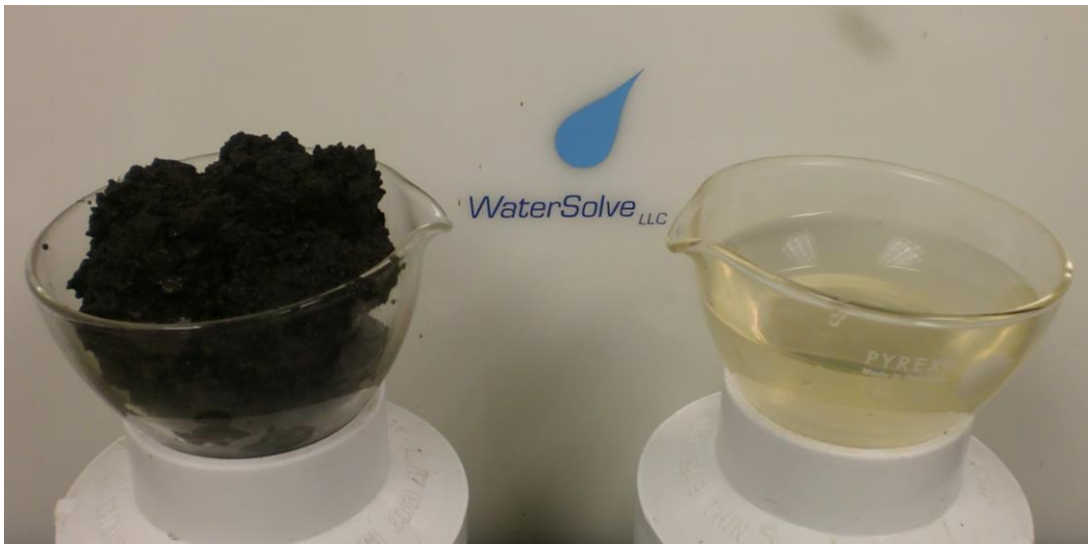
Jar Number	Polymer Name	Polymer Dosage (mL)	Sample Size (mL)	Water Rel. Rate (1 - 6)	Water Clarity (1 - 6)	Floc Appearance (1 - 6)	Comments
1	137	4mL	150mL	5	5	5	
2	137	8mL	150mL	1	1-2	1	FEW FINES
3	137	10mL	150mL	1	1-2	1	
4	134	8mL	150mL	3	3	3	
5	210B	8mL	150mL	1	1-2	1-2	
6	213B	8mL	150mL	1	1-2	1-2	
7	213C	8mL	150mL	1	1-2	1-2	
8	216B	8mL	150mL	1	1-2	1-2	
9	216D	8mL	150mL	3	3	3	
10	218B	8mL	150mL	1	1-2	1	
11	218C	8mL	150mL	3	3	3	
12	9222	8mL	150mL	2	2	2	
13	9244	8mL	150mL	2	3	2	
14	9248	8mL	150mL	1	1-2	1	
15							
16							
17	137	7mL	150mL	1	3	1-2	
18	9248	7mL	150mL	1	3	1	
19							
20	162	8mL	150mL	5	5	5	
21							
22							
23							
24							
25							
26							
27							
28							

Cone Test / RDT: 1000mL sample conditioned with 53 mL of 9248 poured thru GT500D Geotube® filter.
Filtrate Quality: TSS- 54 mg/L Turbidity- 52 NTU Filtrate collected@ 1min: 650 60min: 720

Appendix B – Photographs



One hundred fifty milliliters of diluted sample prior to conditioning (Left). One hundred fifty milliliters of diluted sample conditioned with Solve 9248 (Right).



One thousand milliliters of diluted sample conditioned with Solve 9248 was poured through the GT500D Geotube® fabric. The captured cake (Left) and filtrate (Right) are shown above.

Appendix C – Percent Solids

Total Solids Determination - Percent Dry Weight

Customer Name/Application IPI / SALISBURY POND

Date 12/21/16 Technician DCW Oven Temperature 105 °C

Sample ID RAW INSITU Dish Number 5 Dilution Ø

Dish (dry) = 48.683 g Dish, Sample (wet) = 150.821 g Dish, Sample (dry) = 102.881 g

Dish, sample (wet) – Dish (dry) = 102.138 (A) Dish, sample (dry) – Dish (dry) = 54.198 (B)

Total Solids B ÷ A x 100 = 53.1 % Dry Weight Solids

Sample ID RAW HOMOGENIZED Dish Number 4 Dilution Ø

Dish (dry) = 48.649 g Dish, Sample (wet) = 164.092 g Dish, Sample (dry) = 103.568 g

Dish, sample (wet) – Dish (dry) = 115.443 (A) Dish, sample (dry) – Dish (dry) = 54.919 (B)

Total Solids B ÷ A x 100 = 47.6 % Dry Weight Solids

Sample ID 1:1 DILUTION Dish Number 7 Dilution 1:1

Dish (dry) = 50.622 g Dish, Sample (wet) = 132.087 g Dish, Sample (dry) = 73.143 g

Dish, sample (wet) – Dish (dry) = 81.465 (A) Dish, sample (dry) – Dish (dry) = 22.521 (B)

Total Solids B ÷ A x 100 = 27.6 % Dry Weight Solids

Sample ID 1:2 DILUTION Dish Number 1 Dilution 1:2

Dish (dry) = 49.226 g Dish, Sample (wet) = 129.419 g Dish, Sample (dry) = 60.818 g

Dish, sample (wet) – Dish (dry) = 80.193 (A) Dish, sample (dry) – Dish (dry) = 11.592 (B)

Total Solids B ÷ A x 100 = 14.5 % Dry Weight Solids

Sample ID CONE TEST / HOME Dish Number 1 Dilution Ø

Dish (dry) = 50.847 g Dish, Sample (wet) = 191.715 g Dish, Sample (dry) = 108.645 g

Dish, sample (wet) – Dish (dry) = 140.868 (A) Dish, sample (dry) – Dish (dry) = 57.798 (B)

Total Solids B ÷ A x 100 = 41.0 % Dry Weight Solids

Appendix D – Chain of Custody

WaterSolve LLC

5031 68th Street SE
Caledonia, MI 49316
Phone (616)575-8693
www.gowatersolve.com

Chain of Custody Record

Pg. ____ of ____

COC# Lab

For Lab Use Only

Received By

Date Received

Lab Bin #

WS Job #

Project Lab Tech.

Client Name: **Scott Ponstein**
Address: **7888 Childsdale Ave.**
City, State Zip: **Rockford, MI 4941**
Phone/Email: **616-550-9863, sponstein@infralt.com**

Project Name: **Salisbury Pond**
Client Project No./P.O. No.
Contact/Report : **Scott Ponstein**
Invoice To : **cjohnson@infralt.com**

Analysis Requested

Schedule	Matrix Code	Sample Number		Field Sample ID	Container ID/Type	Sample Date	Sample Time	Comp	Grab	Matrix	Geotube® Dewatering	Settling Application	Other* (comments)	Total Suspended Solid Limit mg/L	Turbidity Limit NTU	pH Limit range	Other** (comments) Limit Units	Other***(comments) Limit Units	Sample Comments
			1	SPTW - COMP 1 Sed	5 gal	12/13	13:30	X		S	X								
			2	SPTW - Water	5 gal	12/13	13:30		X	W	X								
			3																
			4																
			5																

Please note any known hazardous material contained in the samples or any other helpful information about the samples below.

Sampled By (print) **Weston & Sampson**

Sampler's Signature

Company **Weston & Sampson**

Relinquished by Scott A. Pond Date 12/20/16 Time

Is this sample designated as hazardous waste per RCRA?
(X)No ( ) Yes (comments)_____

How Shipped? Hand__X___ Carrier_____
Tracking No.

Received by Date Time

Sample Comments

Project Information Briefly describe the project objectives:

Type of Material/Residual ___ Municipal Wastewater ___ Municipal Water Treatment _X_ Lake/Pond/River Sediment (circle one) ___ Industrial/Process ___ Mine Drainage ___Other _____

Application ___ Geotube® Dewatering ___ Settling ___Clarification ___ Mechanical Dewatering ___Thickening ___ Other_____

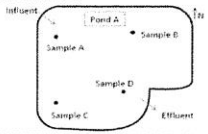
How was the sample obtained? ___ Individual Core(s) (Best sample collection technique with only solids from core, discard overlying water, overlying water should be sent seperately) _X_ Composite (PLEASE NOTE, while a composite sample may give us an indication of an average treatment scenario, it does not indicate pockets of concern for treatment effectiveness or areas that may require a higher or lower dose of chemistry, or contain higher in-situ solids since the area of concern may be masked by factors of dilution from other areas) ___ Other_____

Are there specific requirement or permit limitations? (i.e. filtrate turbidity,TSS, or other parameters)

Where will the filtrate/treatment effluent be discharged?

Solids concentration of sample (% dry weight solids)
if known _____% In-situ _____%

Please draw a diagram of the body of water and identifiy where the samples were collected.



Project Comments

MSDS - Available upon request.

INFRASTRUCTURE ALTERNATIVES

Geotube Dewatering Test Results

Project ID:	Salisbury Pond	Date:	1/5/2017
Location:	Worcester, MA	Time:	16:00

In-situ % Solids:	43.75%	Water Added (mL):	26775
Slurry % Solids:	11.99%	Sediment Added (mL):	8925
GDT % Solids after 24 hours:	37.53%	Polymer Used (lbs/DT)	3.65
GDT % Solids after 5 days:	45.35%	Polymer Added (mL)	1645
GDT % Solids after 7 days:	47.95%		
GDT % Solids after 28 days:	65.73%		

Time (Min.)	Pore Water Collected (L)	Estimated Pore Water Flow Rate (mL/min)	Pore Water Turbidity (NTU)	
0-5	18760	3752.0000	35.5	
5-10	3300	1100.0000	51.7	
10-30	1200	80.0000	72	
30-60	1075	35.8333	32.7	
24 hr	590	9.8333	78.5	
Total	24925			

Notes: Heavy yellow color in filtrate. It is presumed to be caused by oxidation of dissolved iron. Turbidity tests were completed on filtrate from the RDT; the turbidity increased nearly 300% after sitting for 30 minutes. Michigan-10 metals analysis was requested for the GDT filtrate. (waiting on results).

Analyst: Scott Ponstein

INFRASTRUCTURE ALTERNATIVES

Wet Mechanical Dewatering Test Results

Project ID: Salisbury Pond

Date: 1/12/2017

Location: Worcester, MA

Time: 10:00

In-situ % Solids: 43.75%

Water Added (mL) 1000

Ex-situ % Solids: 38.04%

Sediment Added (mL) 5000

Amendment	Dose Rate (% Weight)	Test Results (1 hour post-amendment)	
		Percent Solids (% weight)	Paint Filter (Pass/Fail)
Portland Cement	5%	42.15%	Fail
Portland Cement	7%	43.14%	Fail
Portland Cement	10%	45.27%	Pass
Portland Cement	12%	47.15%	Pass
Portland Cement	14%	47.40%	Pass
Calciment	5%	42.00%	Fail
Calciment	7%	43.30%	Fail
Calciment	10%	45.49%	Fail
Calciment	12%	46.01%	Fail
Calciment	14%	47.58%	Pass

Notes: Portland Cement performed better with wet material, pass the paint filter test with 10% by weight, where Calciment showed similar percent solids, it did not pass paint filter till 14% by weight was added.

Analyst: Scott Ponstein

INFRASTRUCTURE ALTERNATIVES

Wet Mechanical Dewatering Test Results

Project ID: Salisbury Pond

Date: 1/12/2017

Location: Worcester, MA

Time: 13:00

In-situ % Solids: 43.75%

Water Added (mL) 1000

Ex-situ % Solids: 38.04%

Sediment Added (mL) 5000

Amendment	Dose Rate (% Weight)	Test Results (24 hours post-amendment)	
		Percent Solids (% weight)	Paint Filter (Pass/Fail)
Portland Cement	0.5%	44.65%	Pass
Portland Cement	1%	43.03%	Pass
Portland Cement	3%	45.73%	Pass
Portland Cement	5%	47.26%	Pass
Portland Cement	7%	49.13%	Pass
Portland Cement	10%	50.69%	Pass
Portland Cement	12%	51.43%	Pass
Portland Cement	14%	52.89%	Pass
Calciment	0.5%	42.84%	Fail
Calciment	1%	44.84%	Pass
Calciment	3%	46.89%	Pass
Calciment	5%	48.04%	Pass
Calciment	7%	48.88%	Pass
Calciment	10%	51.93%	Pass
Calciment	12%	53.29%	Pass
Calciment	14%	55.71%	Pass

Notes: The sample passed passed paint filter after 24 hrs. with 0.5% Portland cement by weight added. The sample amended with 1% Calciment by weight passed paint filter after 24 hrs.

Analyst: Scott Ponstein

INFRASTRUCTURE ALTERNATIVES

Dry Mechanical Dewatering Test Results

Project ID: Salisbury Pond

Date: 1/11/2017

Location: Worcester, MA

Time: 10:00

In-situ % Solids: 43.75%

Water Added (mL) 500

Ex-situ % Solids: 41.71%

Sediment Added (mL) 5000

Amendment	Dose Rate (% Weight)	Test Results (1 hour post-amendment)	
		Percent Solids (% weight)	Paint Filter (Pass/Fail)
Portland Cement	1%	42.83%	Fail
Portland Cement	3%	44.22%	Fail
Portland Cement	5%	45.03%	Pass
Portland Cement	7%	46.36%	Pass
Calciment	1%	42.58%	Fail
Calciment	3%	44.34%	Fail
Calciment	5%	45.42%	Pass
Calciment	7%	47.26%	Pass

Notes: Portland Cement and Calciment performed equally well, passing paint filter after 1 hour, with 5% by weight added to the sediment.

Analyst: Scott Ponstein

INFRASTRUCTURE ALTERNATIVES

Dry Mechanical Dewatering Test Results

Project ID: Salisbury Pond

Date: 1/11/2017

Location: Worcester, MA

Time: 13:00

In-situ % Solids: 43.75%

Water Added (mL) 500

Ex-situ % Solids: 41.71%

Sediment Added (mL) 5000

Amendment	Dose Rate (% Weight)	Test Results (24 hours post-amendment)	
		Percent Solids (% weight)	Paint Filter (Pass/Fail)
None	0%	48.08%	Pass
Portland Cement	0.5%	47.73%	Pass
Portland Cement	1%	50.30%	Pass
Portland Cement	3%	49.89%	Pass
Portland Cement	5%	52.82%	Pass
Portland Cement	7%	54.06%	Pass
Calciment	0.5%	48.79%	Pass
Calciment	1%	50.44%	Pass
Calciment	3%	50.62%	Pass
Calciment	5%	52.90%	Pass
Calciment	7%	54.20%	Pass

Notes: All test passed paint filter, including no amendment added to the sediment. For sediment excavated in the dry, 24 hours of dry time with good weather conditions could produce material that will pass paint filter without the addition of amendment.

Analyst: Scott Ponstein

INFRASTRUCTURE ALTERNATIVES

Mixing the sediment with water to create a slurry

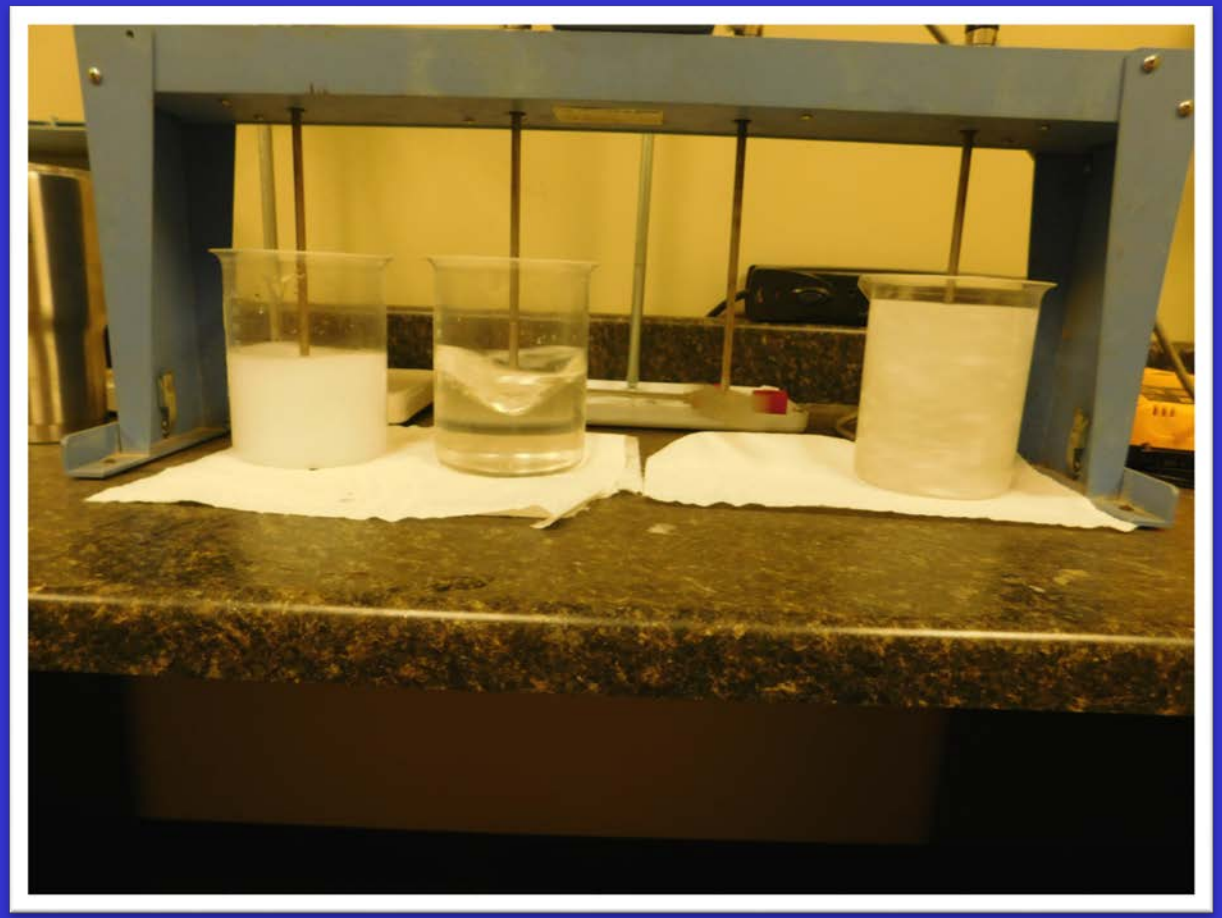
Jar testing polymer

INFRASTRUCTURE ALTERNATIVES

Comparing jar test results

Evaluating floc formation and separated water clarity

INFRASTRUCTURE ALTERNATIVES



Mixing polymer solution for GDT

Homogenizing the sediment slurry

INFRASTRUCTURE ALTERNATIVES

Mixing polymer-slurry

Adding polymer to slurry

INFRASTRUCTURE ALTERNATIVES

Filling GDT container

GDT container releasing filtrate

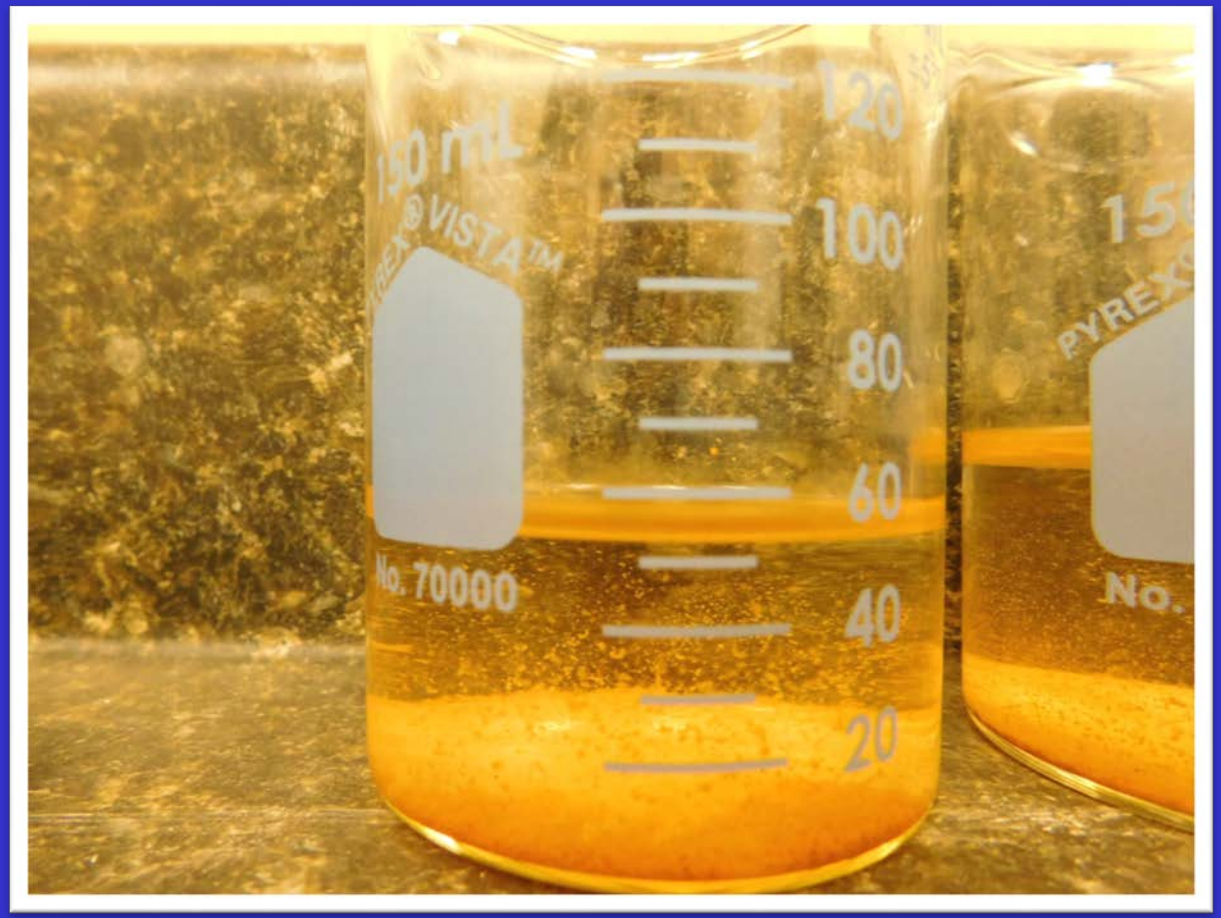
INFRASTRUCTURE ALTERNATIVES

Collecting filtrate from GDT container

Close up of filtrate collection

INFRASTRUCTURE ALTERNATIVES

Filtrate samples precipitating solids



Close up of filtrate precipitating solids

INFRASTRUCTURE ALTERNATIVES

Comparison of filtered and raw filtrate, side-by-side

GDT container after 24 hrs. dewatering

INFRASTRUCTURE ALTERNATIVES

Paint filter test

Alternate view

INFRASTRUCTURE ALTERNATIVES

Close up of paint filter test

Amendment test samples

INFRASTRUCTURE ALTERNATIVES

Amendment test samples

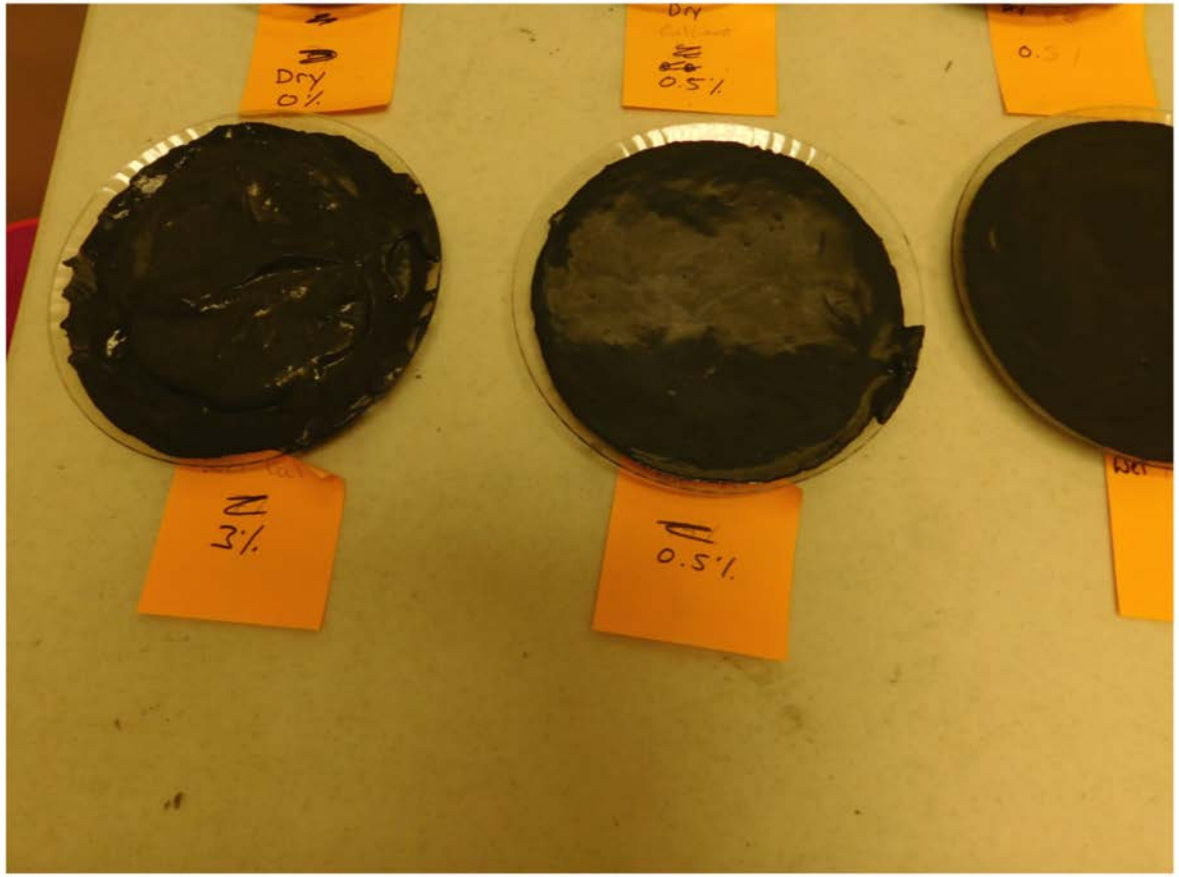
Amendment test samples

INFRASTRUCTURE ALTERNATIVES

Amendment test samples

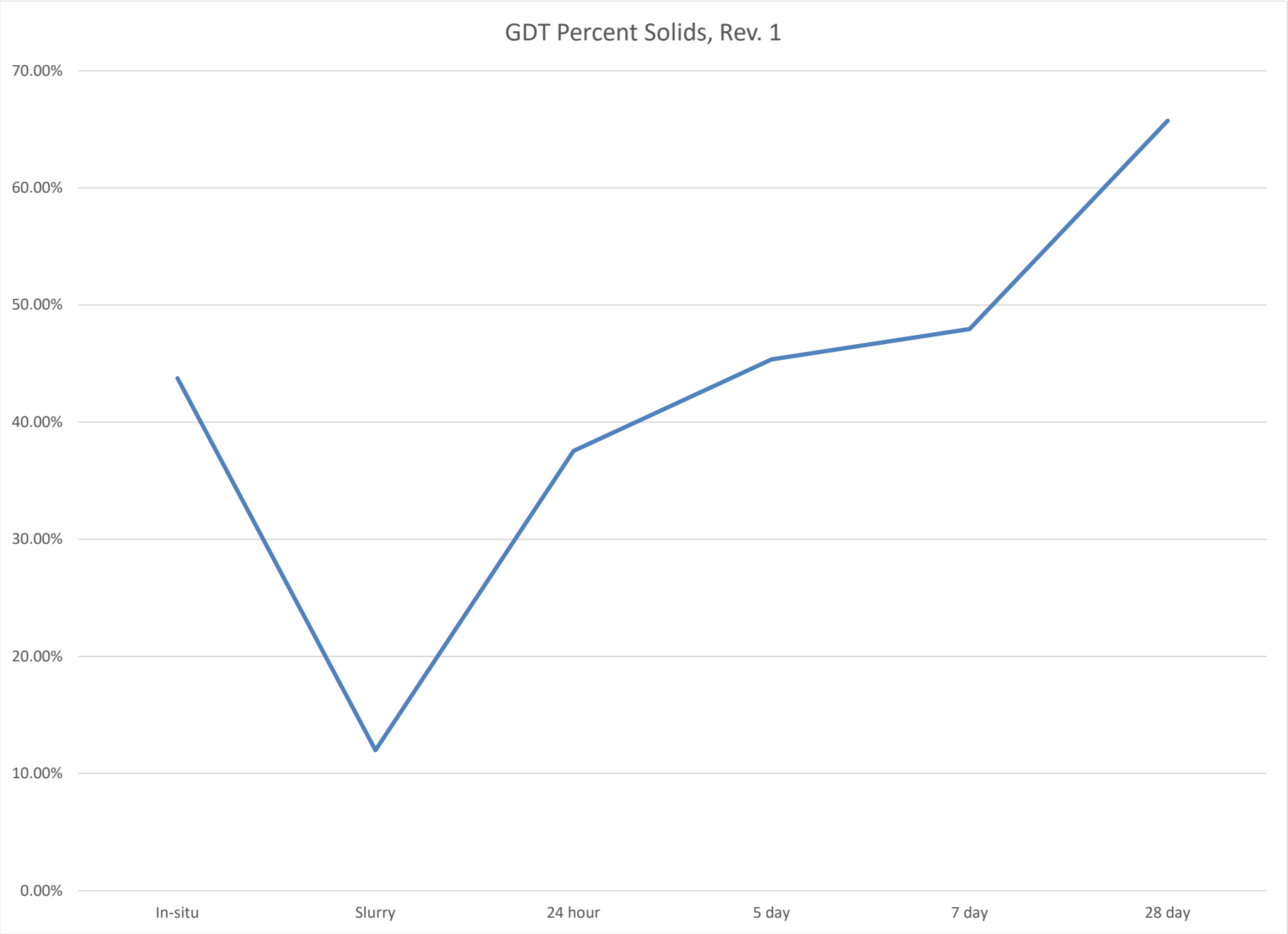
Amendment test samples

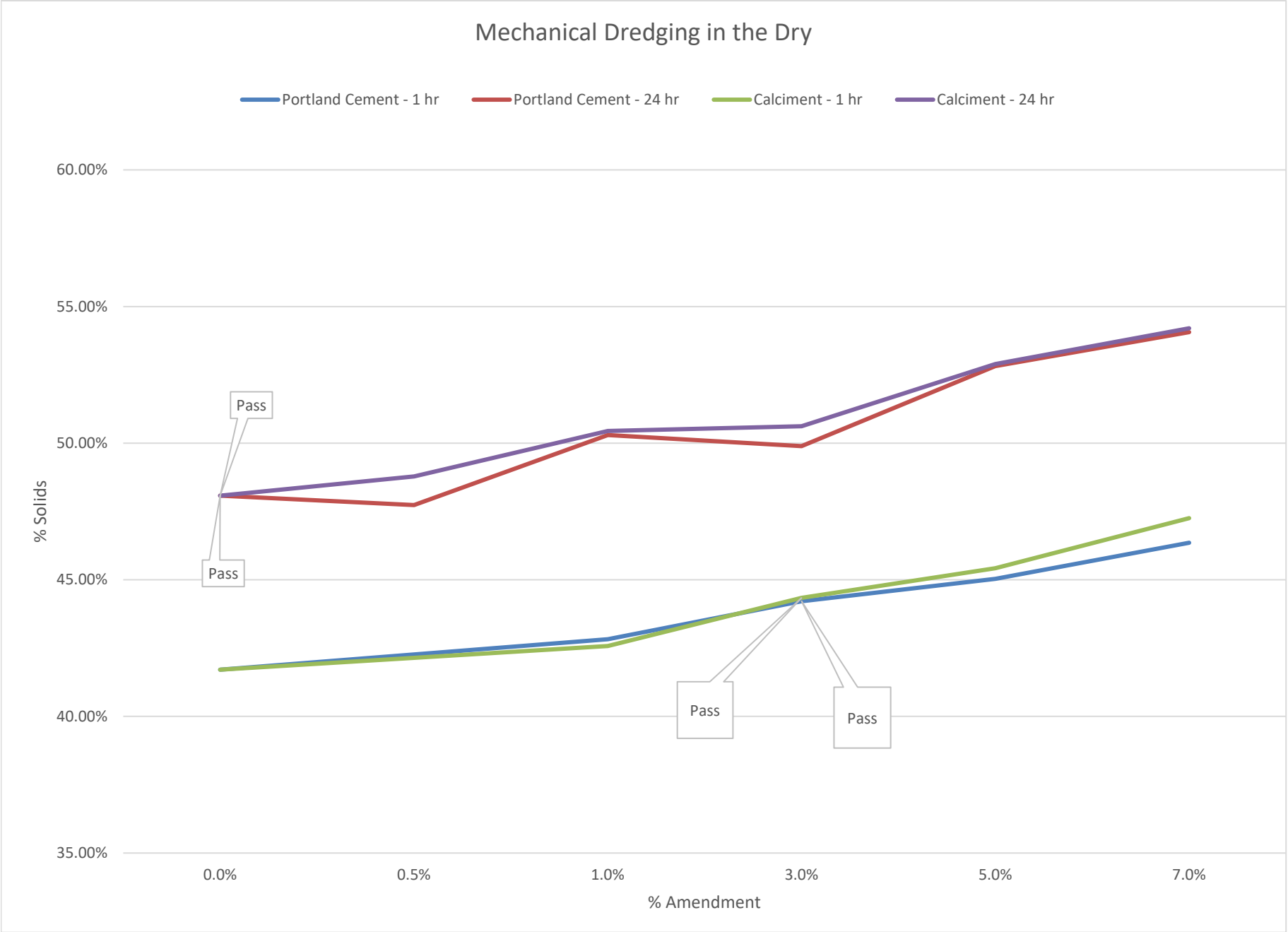
INFRASTRUCTURE ALTERNATIVES

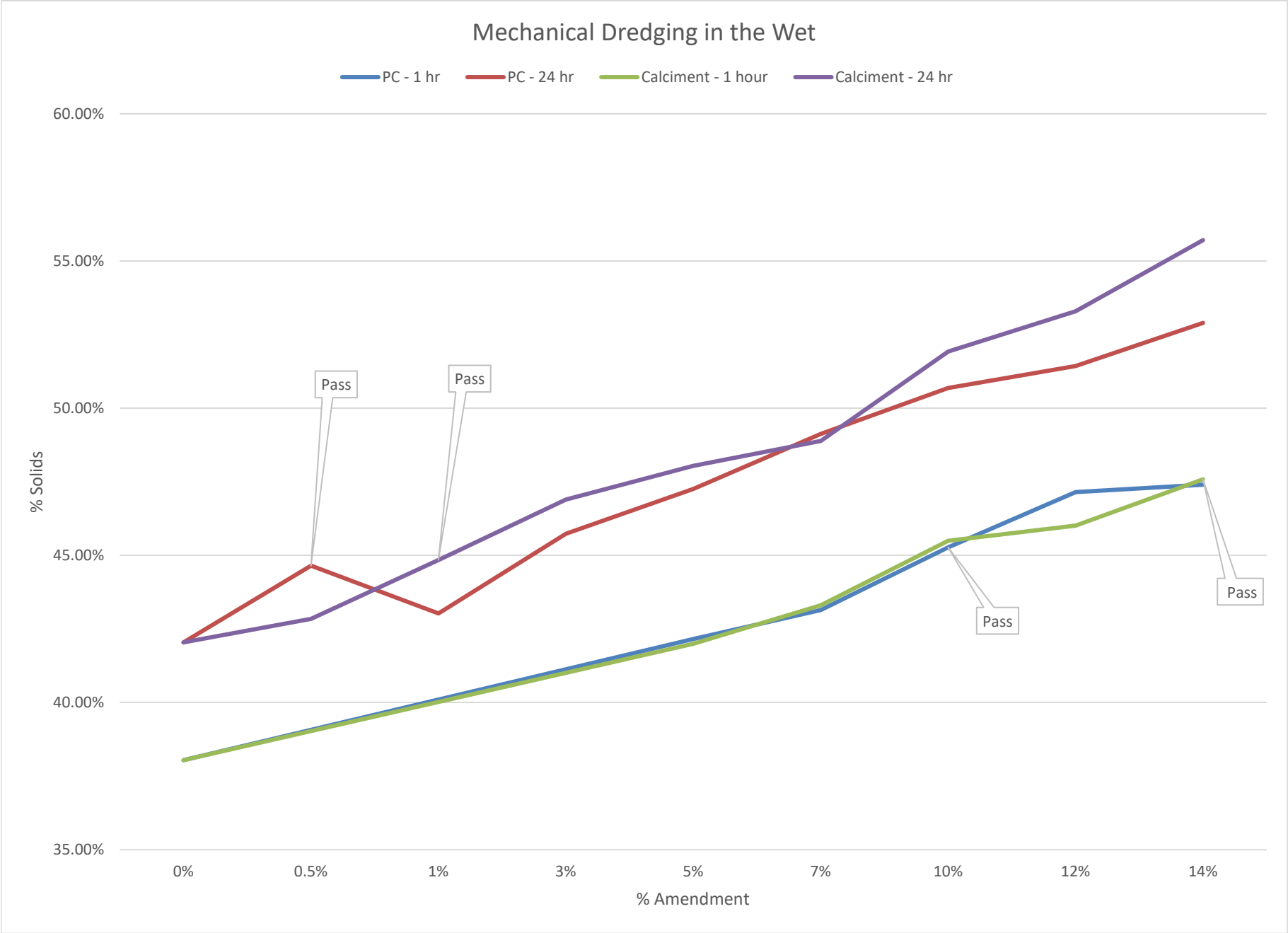


Amendment test samples

Amendment test samples


GDT Percent Solids, Rev. 1
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
In-situ
Slurry
24 hour
5 day
7 day
28 day


Mechanical Dredging in the Dry
Portland Cement - 1 hr
Portland Cement - 24 hr
Calciment - 1 hr
Calciment - 24 hr
60.00%
55.00%
50.00%
45.00%
40.00%
35.00%
% Solids
Pass
Pass
Pass
Pass
0.0%
0.5%
1.0%
3.0%
5.0%
7.0%
% Amendment


Mechanical Dredging in the Wet
PC - 1 hr
PC - 24 hr
Calciment - 1 hour
Calciment - 24 hr
60.00%
55.00%
50.00%
45.00%
40.00%
35.00%
% Solids
Pass
Pass
Pass
Pass
0%
0.5%
1%
3%
5%
7%
10%
12%
14%
% Amendment

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental ▪ Laboratory

Date: *11-Jan-17*

Customer Name: Infrastructure Alternatives
7888 Childsdale NE
Rockford, MI 49341

Contact Name: Mr. Scott Ponstein
7888 Childsdale NE
Rockford, MI 49341

Project: Salisbuy Pond (SPTW-510)

Project No: 2010398

Lab Order: 1701122

Matrix: GROUNDWATER
Sampled By: S. Ponstein

Lab ID: 1701122-001
Client Sample ID: IAI-SPTW-1-5-17

Collection Date: 1/5/2017
Received Date: 1/5/2017

Analyses	Result	PQL	Units	DF	Date Analyzed
METALS, TOTAL		**EPA 6010B**			Analyst: **SB**
Silver	< 6.00	6.00	µg/L	1	1/9/2017
METALS, TOTAL		**SM3113B**			Analyst: **SB**
Arsenic	84.8	1.00	µg/L	1	1/9/2017
METALS, TOTAL		**EPA 245.1**	**(SW7470A)**		Analyst: **SB**
Mercury	< 0.00020	0.00020	mg/L	1	1/11/2017
METALS, TOTAL		**EPA 6010B**			Analyst: **SB**
Barium	150	2.0	µg/L	1	1/9/2017
Cadmium	< 4.0	4.0	µg/L	1	1/9/2017
Chromium	< 8.0	8.0	µg/L	1	1/9/2017
Copper	< 4.0	4.0	µg/L	1	1/9/2017
Lead	< 10	10	µg/L	1	1/9/2017
Zinc	52	2.0	µg/L	1	1/9/2017
METALS, TOTAL		**SM3113B**			Analyst: **SB**
Selenium	< 1.00	1.00	µg/L	1	1/9/2017
TOTAL SUSPENDED SOLIDS		**SM 2540 D**			Analyst: **AB**
Residue-non-filterable (TSS)	73.333	4.0000	mg/L	1	1/9/2017

3260 Evergreen Drive, NE Grand Rapids, MI 49525 t. 616-364-7600 f. 616-364-4222 www.preinnewhof.com

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental ▪ Laboratory

Date: *27-Jan-17*

Customer Name: Infrastructure Alternatives
7888 Childsdale NE
Rockford, MI 49341

Contact Name: Mr. Scott Ponstein
7888 Childsdale NE
Rockford, MI 49341

Project: SPTW-510

Project No: 2010398

Lab Order: 1701652

Matrix: GROUNDWATER

Sampled By: S. Ponstein

Lab ID: 1701652-001
Client Sample ID: IAI-SPTW-FE

Collection Date: 1/26/2017
Received Date: 1/26/2017

Analyses	Result	PQL	Units	DF	Date Analyzed
METALS, TOTAL		**EPA 200.7**			Analyst: **SB**
Iron	53.3	0.010	mg/L	1	1/27/2017

BaseReport-
Continuous

3260 Evergreen Drive, NE Grand Rapids, MI 49525 t. 616-364-7600 f. 616-364-4222 www.preinnewhof.com

Solve 9248

Safety Data Sheet

Date Issued: 03/17/2016
Date Revised: 03/17/2016

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Solve 9248**
Company Identification: WaterSolve, LLC
5031 68th Street
Caledonia, Michigan 49316, USA www.gowatersolve.com
For Product Information: 616-575-8693
For Chemical Emergency Spill, Leak, Fire, Exposure, or Accident
Call CHEMTREC Day or Night
Within USA and Canada: 1-800-424-9300
Outside USA and Canada: +1 703-527-3887 (collect calls accepted)

Recommended use of the chemical and restrictions on use
Use of Substance/Mixture: **Flocculating agent**
29 CFR 1910. 1200 (OSHA HazCom 2012)

2. HAZARDS IDENTIFICATION

GHS CLASSIFICATION
Skin irritation: **Category 2**
Specific target organ systemic Toxicity – single exposure: **Category 3 (Central nervous system)**

GHS LABEL ELEMENT

Hazard pictograms:
Signal Word: **WARNING!**

Hazard Statements: **Causes skin irritation.**
May cause drowsiness or dizziness.

Precautionary Statements:
PREVENTION: Avoid breathing dust/fume/gas/mist/vapors/spray
Wash skin thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Wear Protective gloves.

RESPONSE:
IF ON SKIN: Wash with plenty of soap and water.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
Call a POISON CENTER or doctor/physician if you feel unwell.
If skin irritation occurs: Get medical advice/attention.
Take off contaminated clothing and wash before reuse.
STORAGE: Store in a well-ventilated place. Keep container tightly closed.
Store locked up**.**
DISPOSAL: Dispose of contents/container to an approved waste disposal plant.
OTHER HAZRDS: Static Accumulating liquid

3. COMPOSITION / INFORMATION ON INGREDIENTS

Substance/Mixture: Mixture
Chemical nature: Static accumulator
Chemical nature: Defatter

Hazardous or Regulated Components

Chemical Name	CAS#	Classification	CONCENTRATION %
ALIPHATIC HYDROCARBON	254504001-5164	Flam. Liq. 4; H227 Skin Irrit. 2; H315 STOT SE 3; H336	>=20.00 - < 30.00
ALCOHOL ALKOXYLATES	254504001-5466	Acute Tox. 4; H302 Skin Irrit. 2; H315 Eye Dam. 1; H318	>= 1.50 - <5.00

Trade Secret Composition- Conceal the Identity + Concentration

4. FIRST AID MEASURES

General Advice: Move out of dangerous area. Call a POISON CENTRE or doctor/physician if exposed or you feel unwell. Show this safety data sheet to the doctor in attendance. Symptoms of poisoning may appear several hours later. Do not leave the victim unattended.

If swallowed: Obtain medical attention. Do NOT induce vomiting. Do not give milk or alcoholic beverages. Never give anything by mouth to a drowsy or unconscious person. If possible, do not leave individual unattended. If symptoms persist, call a physician.

In case of Skin Contact: First aid is not normally required. Remove contaminated clothing and shoes without delay. However it is recommended that exposed areas be cleaned by washing with soap and water. Do not reuse contaminated clothing without laundering. Get medical attention if irritation develops or persists.

In case of Eye Contact: Flush eyes with water as a precaution. Remove contact lenses. Protect unharmed eye. If eye irritation persists, consult a specialist.

If Inhalation: Move to fresh air. If unconscious place in recovery position and seek medical advice. Consult a physician after significant exposure.

Most important symptoms and effects, both acute and delayed:

- Inhalation of high concentrations of this material, as could occur in enclosed spaces or during deliberate abuse, may be associated with cardiac arrhythmias. Sympathomimetic drugs may initiate cardiac arrhythmias in persons exposed to this material.
- This material is an aspiration hazard. Potential danger from aspiration must be weighed against possible oral toxicity (See Section 2 – Swallowing) when deciding whether to induce vomiting.
- Signs and symptoms of exposure to this material through breathing, swallowing, and/or passage of the material through the skin may include: stomach or intestinal upset (nausea, vomiting, diarrhea), irritation (nose, throat, airways), lung irritation, drowsiness, confusion, irregular heartbeat, convulsions. Causes skin irritations. May cause drowsiness or dizziness.

Notes to physician: No hazards which require special first aid measures.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media: Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Water spray, foam, carbon dioxide or dry chemical.
Unsuitable extinguishing media: High volume water jet.
Specific hazards during firefighting:
Do not allow run-off from fire fighting to enter drains or water courses.

Hazardous combustion products:
Carbon dioxide and carbon monoxide, Hydrocarbons, Nitrogen oxides (NOx), toxic fumes
Specific extinguishing methods: Product is compatible with standard fire-fighting agents.
Keep containers cool by spraying with water if exposed to fire.
Further information: When product is wet it causes a danger for slipping. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.
Special Protective Equipment for fire-fighters:
Firefighters, and others exposed, wear self-contained breathing apparatus and protective suit. Wear full firefighting protective clothing. Use NIOSH/MSHA approved respiratory protection.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures:
Use personal protective equipment. Ensure adequate ventilation. Persons not wearing protective equipment should be excluded from area of spill until clean-up has been completed. Material can create slippery conditions.
Environmental precautions:
Do not let product enter drains. Prevent further leakage or spillage if safe to do so. If the product contaminates rivers and lakes or drains inform respective authorities. Do not flush into surface water or sanitary sewer system. Do not allow contact with soil, surface or ground water.
Methods and materials for containment and cleaning up:
Keep in suitable, closed containers, for disposal. Soak up with inert absorbent and non-combustible absorbent material, (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Other information:
Comply with all applicable federal, state, international and local regulations.

7. HANDLING AND STORAGE

ADVICE ON SAFE HANDLING:
Avoid formation of aerosol. Provide sufficient air exchange and /or exhaust in work rooms. Do not breathe vapours/dust. Do not smoke. Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and / or solid), all hazard precautions given in the data sheet must be observed. Avoid exposure-obtain special instructions before use. This material is slippery when wet. Do not eat, drink or smoke when using this product and in application area. For personal protection (see Section 8). Dispose of rinse water in accordance with local and state and national regulations. Keep away from heat and sources of ignition. Handle in accordance with good industrial hygiene and safety practice.

CONDITIONS FOR SAFE STORAGE:
Keep container tightly closed in a dry and well-ventilated place. Keep away from food, drink and smoking. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Observe label precautions. Electrical installations/working materials must comply with the technological safety standards. Store in original container in a cool, dry ventilated area.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Components with workplace control parameters

COMPONENTS	CAS-No.	Value type (form of exposure)	Control parameters/permissible concentration	Basis
ALIPHATIC HYDROCARBON	254504001 -5164	TWL	200 mg/m³ Non-aerosol (as total hydrocarbon vapor)	ACGIH
		REL	100 mg/m³	NIOSH/GUIDE

Engineering measures:
Provide sufficient mechanical (general and / or local exhaust) ventilation to maintain exposure below exposure guidelines (if applicable) or below levels that cause known, suspected or apparent adverse effects.

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and immediately after handling the product. Avoid contact with skin and eyes. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation.

Personal protective equipment:

Respiratory protection:

In case of vapour formation use a respirator with an approved filter. A NIOSH-approved air-purifying respirator with an appropriate cartridge and/or filter may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits (if applicable) or if overexposure has otherwise been determined. Protection provided by air-purifying respirators is limited. Use a positive pressure, air-supplied respirator if there is any potential for uncontrolled release, exposure levels are not known or any other circumstances where an air-purifying respirator may not provide adequate protection.

Hand protection:

The suitability for a specific workplace should be discussed with the producers of the protective gloves.

Eye protection

Wear tightly fitting splash-proof safety goggles or face-shield if there is a potential for exposure of the eyes to liquid, vapor or mist. Ensure that eyewash stations and safety showers are close to the workstation location.

Skin and body protection

Wear as appropriate impervious clothing, safety shoes. Wear resistant gloves (consult your safety equipment supplier). Choose body protections according to the amount and concentration of the dangerous substances at the work place. Launder clothing before reuse. If skin irritation develops, contact your facility health and safety professional or your local safety equipment supplier to determine the proper personal protective equipment for your use.

Hygiene measures: Wash hands before breaks and at the end of the workday. When using do not eat, drink or smoke when using this product.

9. PHYSICAL AND CHEMICAL PROPERTIES

General Information

Physical state:	liquid
Appearance:	viscous
Color:	White
Odor:	mild, hydrocarbon-like
Odour threshold:	No data available
pH:	(ca.) 3.7 , Concentration: 10 g/l (20º C)
Melting point/freezing point:	<5 ºF / -15ºC
Boiling Point boiling range:	217°F/103°C
Flash point:	> 212°F/>100°C Method : Cleveland open cup
Evaporation Rate:	<1
Flammability (solid, gas):	No data available
Flammability (liquids):	Static Accumulating liquid
Explosive properties:	No data available
Lower / upper limits:	No data available
Vapor Pressure:	23.300 hPa @ 20°C Method: ASTM D 2879-86
Relative vapor density:	No data available
Relative density:	1.03 – 1.04
Density:	Approximate 1.03 g/cm³
Solubility in Water:	Soluble
Solubility in other solvents:	No data available
Partition coefficient (n-octanol/water):	No data available
Thermal decomposition:	No data available
Viscosity, dynamic	(>) 7 mPa.s @ 40°C
Viscosity, kinematic	(>) 20.5 mm2/.s @ 40°C
Oxidizing properties:	No data available

10. STABILITY AND REACTIVITY

Reactivity: No decompositions if stored and applied as directed.
Chemical Stability: Stable under recommended storage conditions.
Possibility of Hazardous reactions: Product will not undergo hazardous polymerization.
Conditions to avoid: Heat, flames and sparks.
Incompatible Materials: Aluminum, copper, copper alloys, strong acids, strong oxidizers agents, strong bases, strong reducing agents.
Hazardous decomposition products: Carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure: Inhalation, skin absorption, skin contact, eye contact, ingestion
Acute toxicity: Not classified based on available information.

Components:
ALIPHATIC HYDROCARBON:
Acute oral Toxicity: LD 50 Rat: > 5,000 mg/kg
Acute inhalation toxicity: LD 50 Rat, male and female: > 5.28 mg/l
Exposure time: 4 hr.
Test atmosphere: vapour
Method: OECD Test Guideline 403
Assessment: No adverse effect has been observed in acute inhalation toxicity tests.

Acute dermal toxicity: LD 50 Rabbit: > 2,000 mg/kg
Assessment: No adverse effect has been observed in acute dermal toxicity tests.
ALCOHOLS ALKOXYLATES:
Acute oral toxicity: LD 50 Rat: 1380 mg/kg

Skin corrosion/irritation: Causes skin irritation.
Product: Result: Possibly irritating to skin. Repeated exposure may cause skin dryness or cracking.

Components:
ALIPHATIC HYDROCARBON: Irritating to skin.
ALCOHOLS ALKOXYLATES: Irritating to skin.
Serious eye damage/eye irritation: Not classified based on available information.
Product: Possibly irritating to eyes.
Unlikely to cause eye irritation or injury.

Components:
ALIPHATIC HYDROCARBON: Mildly irritating to eyes.
ALCOHOLS ALKOXYLATES: Risk of serious damage to eyes.

Respiratory or skin sensitization: Skin sensitization:
Not classified based on available information
Respiratory sensitization:
Not classified based on available information
Germ cell mutagenicity: Not classified based on available information
Carcinogenicity: Not classified based on available information
Reproductive toxicity: Not classified based on available information
STOT – single exposure: May cause drowsiness or dizziness.

Components:

ALIPHATIC HYDROCARBON: May cause drowsiness or dizziness.
STOT – repeated exposure: Not classified based on available information
Aspiration toxicity: Not classified based on available information

Further information

Product: Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting. Concentrations substantially above the TLV value may cause narcotic effects. Solvents may degrease the skin.

Carcinogenicity:

IARC: No component of this product presents at levels greater than or equal to 0.1 % is identified as probable, possible or confirmed human carcinogen by IARC.

OSHA: No component of this product present at levels greater than or equal to 0.1 % is identified as carcinogen or potential carcinogen by OSHA.

NTP: No component of this product presents at levels greater than or equal to 0.1 % is identified as a known or anticipated carcinogen by NTP.

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12. ECOLOGICAL INFORMATION

Ecotoxicity

Product:

Toxicity to fish: LC 50 fathead minnow (*Pimephales promelas*): 11 mg/l
Exposure time: 48hr.

Toxicity of daphnia and other Aquatic invertebrates: LC 50 Water flea (*Ceriodaphnia dubia*): 1.75 mg/l
Exposure time: 48hr.

Components:

ALIPHATIC HYDROCARBON:

Toxicity to fish: LC 50 Rainbow trout (*Oncorhynchus mykiss)* 2 - 5 mg/l
Exposure time: 96hr. Test Method: semi-static test
Test substance: WAF Method: OECD Test Guideline 203

The information given is based on data obtained from similar substances.

Toxicity of daphnia and other Aquatic invertebrates: EL 50 Water flea (*Daphnia magna*): 1.4 mg/l
Exposure time: 48hr. Test Method: static test
Test substance: WAF Method: OECD Test Guideline 202

The information given is based on data obtained from similar substances.

Toxicity to Algae: EL50 green algae (*Pseudokirchneriella subcapitata):*>1-3 mg/l
Exposure time: 72hr. Test Method: static test
Test substance: WAF Method: OECD Test Guideline 201

The information given is based on data obtained from similar substances.

Toxicity of daphnia and other Aquatic invertebrates (Chronic toxicity) :
NOEL: Species: Water flea (*Daphnia magna*): 0.48 mg/l
Exposure time: 21 d Test Method: semi-static test
Test substance: WAF Method: OECD Test Guideline 211

The information given is based on data obtained from similar substances.

ALCOHOL ALKOXYLATES:

Toxicity to fish: LC50 Fish: > 1 – 10 mg/l
Exposure time: 96h Test Type: static test

Toxicity of daphnia and other
Aquatic invertebrates: **E**C50 Daphnia Water flea: > 1 – 10 mg/l
Exposure time: 48h Test Type: static test
Toxicity to Algae: ErC50 green algae: > 0.1 – 1.0 mg/l
Exposure time: 96h Test Type: static test

Toxicity of daphnia and other Aquatic
Invertebrates (Chronic toxicity): EC10 Daphnia water flea: 0.17mg/l
Exposure time: 21 d
Ecotoxicology Assessment:
Acute aquatic toxicity: Very toxic to aquatic life.

Persistence and degradability
Product:
Biochemical Oxygen Demand (BOD): Biochemical oxygen demand 383,000 mg/l
Chemical Oxygen Demand (COD): 1,930,000 mg/l Method: Chemical Oxygen demand
Components:
ALIPHATIC HYDROCARBON:

Biodegradability: Result: Inherently biodegradable
Biodegradation: 58.6% Exposure time: 28 days
Method: OECD Test Guideline 301F

ALCOHOL ALKOXYLATES:
Biodegradability: Result: Readily biodegradable.
Bioaccumulative potential
Components:
No data available
Mobility in soil
Components:
No data available
Other adverse effects:
No data available
Components:
No data available
Product:
Additional ecological information: An environmental hazard cannot be excluded in the event of unprofessional handling or disposal. Toxic to aquatic life with long lasting effects.
Components:

13. DISPOSAL CONSIDERATIONS

Disposal methods:
General Advice: The product should not be allowed to enter drains, water courses or the soil. Do not contaminate ponds, waterways or ditches with chemical or used container. Send to a licensed waste management company. Dispose of in accordance with all applicable local, state, international and federal regulations.
Contaminated packaging: Empty remaining contents. Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

14. TRANSPORT INFORMATION

International Transport Regulations

ID NUMBER	PROPER SHIPPING NAME	*HAZARD CLASS	SUBSIDIARY HAZARDS	PACKING GROUP	MARINE POLLUTANT /LTD. QTY.
U.S. DOT -ROAD					Not dangerous goods
U.S. DOT - RAIL					Not dangerous goods
U.S. DOT – INLAND WATERWAYS					Not dangerous goods
TRANSPORT CANADA - ROAD					Not dangerous goods
TRANSPORT CANADA - RAIL					Not dangerous goods
TRANSPORT CANADA – INLAND WATERWAYS					Not dangerous goods
INTERNATIONAL MARITIME DANGEROUS GOODS					Not dangerous goods
INTERNATIONAL AIR TRANSPORT ASSOC. - CARGO					Not dangerous goods
INTERNATIONAL AIR TRANSPORT ASSOC. - PASSENGER					Not dangerous goods
MEXICAN REGULATION FOR THE LAND TRANSPORT OF HAZARDOUS MATERIALS AND WASTES					Not dangerous goods

***ORM = ORM-D, CBL=COMBUSTIBLE LIQUID**

Marine pollutant		yes

Dangerous goods description (if indicated above) may not reflect package size, quantity, end-use or region-specific exceptions that can be applied. Consult shipping documents for description that are specific to the shipment.

15. REGULATORY INFORMATION

SARA Hazard Classification
SARA 311/312
Acute health hazard

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Tiltle III, Section 313.

California Prop. 65-WARNINGS!
Proposition 65 warnings are not required for this product based on the results of a risk assessment.

The components of this product are reported in the following inventories:

TSCA:	On TSCA Inventory
DSL:	This product containers one or more components that are not on the Canadian DSL and have annual quantity limits.
AUSTR:	On the inventory, or in compliance with the inventory.
ENCS:	On the inventory, or in compliance with the inventory.
KECL:	On the inventory, or in compliance with the inventory.
PHIL:	On the inventory, or in compliance with the inventory.
IECSC:	On the inventory, or in compliance with the inventory.

Inventories:
AICS (Australia), DSL (Canada), IECSC (China), REACH (European Union), ENCS (Japan), ISHL (Japan), KECI (Korea), NZloC (New Zealand), PICCS (Philippines), TSCA (USA)

Registration: Trade Secret

Chemical Name	IDENTIFICATION NUMBER
ALIPHATIC HYDROCARBON	254504001-5164
ALCOHOL ALKOXYLATES	254504001-5466

Further information

Full text of H-Statements referred to under Sections 2 and 3.

H-227	Combustible liquid.
H302	Harmful if swallowed.
H315	Causes skin irritation.
H318	Causes serious eye damage.
H336	May causes drowsiness or dizziness.
H400	Very toxic to aquatic life.

DATE ISSUED: 03/17/2016
DATE REVISED: 03/17/2016 **Revision number: 1.4**

OTHER INFORMATION

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Reasonable care has been taken in the preparation of this information, but the manufacturer makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. The manufacturer makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. This information is for the specific material described only and may not be valid if the material is used in combination with any other materials or in any process. The user is responsible to determine the completeness of the information and suitability for the user's own particular use. The knowledge and belief of the company, the information is accurate and reliable as of the date indicated but the company makes no express or implied warranty of merchantability for the material or the information. The company makes no express or implied warranty of fitness for a purpose for the material or for the information. Users of any chemical should educate themselves on all aspects of its use by independent investigation of current scientific and medical knowledge that the material can be used safely. Both the supplier and manufacturer make no representations and assume no liability for any direct, incidental or consequential damages resulting from its use. Both the supplier and manufacturer make no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. This information is for the specific material described only and may not be valid if the material is used in combination with any other materials or in any process. The user is responsible to determine the completeness of the information and suitability for the user's own particular use. Users of any chemical should educate themselves on all aspects of its use by independent investigation of current scientific and medical knowledge that the material can be used safely. The buyer assumes all responsibility for using and handling the product in accordance with applicable federal, state and local regulations.

List of abbreviations and acronyms that could be, but not necessarily are, used in the safety data sheet:

ACGIH: American Conference of Industrial Hygienists
BEI: Biological Exposure Index
CAS Chemical: Abstracts Service (Division of the American Chemical Society)
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act
CMR: Carcinogenic, Mutagenic or Toxic for Reproduction
DOT: Department of Transportation
FG: Food grade
FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act
GHS: Globally Harmonized System of Classification and Labeling of Chemicals
H-statement: Hazard Statement
HMIRC: Hazardous Materials Information Review Commission
HMIS: Hazardous Materials Identification System

IATA: International Air Transport Association
IATA-DGR: Dangerous Goods Regulation by the “International Air Transport Association” (IATA)
ICAO: International Civil Aviation Organization
ICAO-TI (ICAO): Technical Instructions by the “International Civil Aviation Organization”
IMDG: International Maritime Code for Dangerous Goods
ISO: International Organization for Standardization
logPow: octanol-water partition coefficient
LCxx: Lethal Concentration, for xx percent of test population
LDxx: Lethal Dose, for xx percent of test population
ICxx: Inhibitory Concentration for xx of a substance
ECxx: Effective Concentration of xx
N.O.S.: Not otherwise Specified
NFPA: National Fire Protection Association
NIOSH: National Institute for Occupational Safety and Health
OECD: Organization for Economic Co-operation and Development
OEL: Occupational Exposure Limit
OSHA: Occupational Safety and Health Administration
P-Statement: Precautionary Statement
PBT: Persistent, Bioaccumulative and Toxic
PMRA: Health Canada Pest Management Regulatory Agency
PPE: Personal Protective Equipment
RTK: Right to Know
STEL: Short-term exposure limit
SDS Safety Data Sheet
STOT: Specific Target Organ Toxicity
TLV: Threshold Limit Value
TWA: Time-weighted average
VPVB: Very Persistent and Very Bioaccumulative
WEL: Workplace Exposure Level
WHMIS: Workplace Hazardous Materials Information System
(WAF): water-accommodated fraction

CEMENT & CONCRETE PRODUCTS™

C6: Portland Cement Based Concrete Products

SAFETY DATA SHEET
(Complies with OSHA 29 CFR 1910.1200)

SECTION I: PRODUCT IDENTIFICATION

The QUIKRETE® Companies
One Securities Centre
3490 Piedmont Road, Suite 1300
Atlanta, GA 30305
Revision: Nov-16
SDS C6

Emergency Telephone Number
(770) 216-9580
Information Telephone Number
(770) 216-9580

QUIKRETE® Product Name	Item #(s)
Fast-Setting Concrete Mix	1004-50, -60
All-Star Fast Setting Concrete Mix	1004-50
Commercial Grade FastSet™ Concrete Mix	1004-51
Post Haste	1004-65
Q-MAX Pro Concrete Mix	1004-81
All-Star 10 Minute Instant Post Mix	1005-51
FastSet™ Water-Stop Cement –Zip & Mix	1121-15
Commercial Grade FastSet™ Cement	1124-92
Hydraulic Water Stop	1126-00
Concrete Resurfacer	1131-40
Multipurpose Concrete Resurfacer	1131-45
Bonded Topping Mix	1133-04, 1018, 1017
FastSet™ Stucco Patch	1139-92
Architectural Finish	1220-55
Quick Setting Cement	1240-00
Commercial Grade FastSet™ Repair Mortar – Zip And Mix	1241
Commercial Grade FastSet™ Repair Mortar	1241-60
Rapid Road Repair	1242-50, -51, -52, -80
Polymer Modified Structural Concrete – Extended Set	1242-85
Rapid Hardening Sand Mix	1243-50
Commercial Grade FastSetTM Polymer Modified DOT Mix	1244-54
Commercial Grade FastSet™ DOT Mix	1244-56
Commercial Grade FastSet™ DOT Deck Repair – Polymer Modified	1244-58
Commercial Grade FastSet™ DOT Mix – Extended	1244-81
Exterior use Anchoring Cement	1245-80, -81
Commercial Grade FastSet™ Non-Shrink Grout	1585-09, -20, -50
Commercial Grade FastSet™ All-Crete	1585-59
Mix 801 FastSet™ DOT PM Overlay	NR801552/80801552

Product Use: Portland cement-based, rapid-setting materials for general construction or repair.

SECTION II - HAZARD IDENTIFICATION

Hazard-determining components of labeling: Silica, Portland cement

2.1 Classification of the substance or mixture

Carcinogen – Category 1A
Skin Corrosion – Category 1B
Skin Sensitization – Category 1B
Specific Target Organ Toxicity Repeat Exposure – Category 1
Specific Target Organ Toxicity: Single Exposure – Category 3

2.2a Signal word DANGER!

2.2b Hazard Statements

May cause cancer through chronic inhalation
Causes severe skin burns and serious eye damage
May cause an allergic skin reaction
Causes damage to lungs through prolonged or repeated inhalation
May cause respiratory irritation

2.2c Pictograms

2.2d Precautionary statements

Do not handle until all safety precautions have been read and understood.
Wear impervious gloves, such as nitrile. Wear eye protection, and protective clothing.
Do not eat, drink or smoke when using this product.
Wash thoroughly after handling.
Use only in a well-ventilated area.
Do not breathe dust.

If swallowed: Rinse mouth. Do NOT induce vomiting.
If inhaled: Remove person to fresh air and keep comfortable for breathing.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If on skin (or hair): Remove immediately all contaminated clothing and wash before re-use. Rinse skin or hair with water.

If significant skin irritation or rash occurs: get medical advice or attention.
Immediately seek medical advice or attention if symptoms are significant or persist.

Store in a well-ventilated place. Keep container tightly closed.
Dispose of contents/containers in accordance with all regulations.

2.3 Additional Information
The Portland cement in this product can cause serious, potentially irreversible damage to skin, eye, respiratory and digestive tracts due to chemical (caustic) burns, including third degree burns. Burns from Portland cement may not cause immediate pain or discomfort. You cannot rely on pain to alert you to cement burns. Therefore precautions must be taken to prevent all contact with Portland cement. Cement burns can become worse even after contact has ended. If there is contact with this product, immediately remove all product from body and thoroughly rinse with water. If you experience or suspect a cement burn or inflammation you should immediately see a health care professional.

Skin burns and irritation may be caused by brief exposure, though often are caused by extended exposure of 15 minutes, an hour, or longer. Interaction of Portland cement with water or sweat releases a caustic solution which produces the burns or irritation. Any extended exposure should be treated as though a burn has occurred until determined otherwise.

Skin contact with Portland cement can also cause inflammation of the skin, referred to as dermatitis. Signs and symptoms of dermatitis can include itching, redness, swelling, blisters, scaling, and other changes in the normal condition of the skin. Signs and symptoms of burns include the above and whitening, yellowing, blackening, peeling or cracking of skin.

The Portland cement in this product may cause allergic contact dermatitis in sensitized individuals. This overreaction of the immune system can lead to severe inflammation. Sensitization may result from a single exposure to the low levels of Cr(VI) in Portland cement or repeated exposures over months or years. Sensitization is long lasting and, after sensitization, even very small quantities can trigger the dermatitis. Sensitization is uncommon. Individuals who experience skin problems, including seemingly minor ones, are advised to seek medical attention.

2.3a HNOC – Hazards not otherwise classified: Not applicable

2.3b Unknown Acute Toxicity: None
2.3C WHMIS Classification
Class D2B – Skin/Eye Irritant
Class D2A – Chronic Toxic Effects – Carcinogen
Class E – Corrosive Material

2.3d Label Elements According To WHMIS

Hazard Symbols

Signal Word
DANGER!

SECTION III - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components	CAS No.	% by Weight
Sand, Silica, Quartz	14808-60-7	40-70*
Portland Cement	65997 15 1	10-30*
Calcium Sulfoaluminate	65997-16-2	10-30*
Calcium Aluminate	12042-68-1	5-10*
Calcium Sulfate	10101-41-4	1-5*
Limestone Dust	01317-65-3	1-5*

*The concentrations ranges are provided due to batch-to-batch variability.
None of the constituents of this material are of unknown toxicity.

SECTION IV – FIRST AID MEASURES

4.1 Description of the first-aid measures

General information:

After inhalation: Remove person to fresh air. If breathing is difficult, administer oxygen. If not breathing, give artificial respiration. In case of unconsciousness, place patient stably in side position for transportation.

After skin contact: Wash skin with cool water and pH-neutral soap or a mild detergent. If significant skin irritation or rash occurs: get medical advice or attention.

After eye contact: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

After swallowing: Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately. Never give anything by mouth to an unconscious person.

4.2 Most important symptoms/effects, acute and delayed

Inhalation: May cause respiratory tract irritation. Causes damage to organs through prolonged or repeated inhalation. This product contains crystalline silica. Prolonged or repeated inhalation of respirable silica from this product can cause silicosis.

Skin contact: The Portland cement in this product can cause serious, potentially irreversible damage to skin, eye, respiratory and digestive tracts due to chemical (caustic) burns, including third degree burns.

Burns from Portland cement may not cause immediate pain or discomfort. You cannot rely on pain to alert you to cement burns. Therefore precautions must be taken to prevent all contact with Portland cement. Cement burns can become worse even after contact has ended. If there is contact with this product, immediately remove all product from body and thoroughly rinse with water. If you experience or suspect a cement burn or inflammation you should immediately see a health care professional.

Skin burns and irritation may be caused by brief exposure, though often are caused by extended exposure of 15 minutes, an hour, or longer. Interaction of Portland cement with water or sweat releases a caustic solution which produces the burns or irritation. Any extended exposure should be treated as though a burn has occurred until determined otherwise.

Skin contact with Portland cement can also cause inflammation of the skin, referred to as dermatitis. Signs and symptoms of dermatitis can include itching, redness, swelling, blisters, scaling, and other changes in the normal condition of the skin. Signs and symptoms of burns include the above and whitening, yellowing, blackening, peeling or cracking of skin.

The Portland cement in this product may cause allergic contact dermatitis in sensitized individuals. This overreaction of the immune system can lead to severe inflammation. Sensitization may result from a single exposure to the low levels of Cr(VI) in Portland cement or repeated exposures over months or years. Sensitization is long lasting and, after sensitization, even very small quantities can trigger the dermatitis. Sensitization is uncommon. Individuals who experience skin problems, including seemingly minor ones, are advised to seek medical attention.

Eye Contact: Causes serious eye damage. Symptoms may include discomfort or pain, excess blinking and tear production, with marked redness and swelling of the conjunctiva.

Ingestion: May be harmful if swallowed. Ingestion may cause discomfort and/or distress, nausea or vomiting.

4.3 Indication of immediate medical attention and special treatment needed:
Immediately seek medical advice or attention if symptoms are significant or persist.

SECTION V - FIRE FIGHTING MEASURES

5.1 Flammability of the Product: Non-flammable and non-combustible
5.2 Suitable extinguishing agents: Treat for surrounding material
5.3 Special hazards arising from the substance or mixture: None
5.3a Products of Combustion: None
5.3b Explosion Hazards in Presence of Various Substances: Non-explosive in presence of shocks

SECTION VI – ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures: Wear personal protective equipment (See section VIII). Keep unprotected persons away.

6.2 Methods and material for containment and cleaning up:
Do not allow to enter sewers/ surface or ground water. Dispose of unwanted materials and containers properly in accordance with all regulations.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND STORAGE

7.1 Handling
Precautions for safe handling: Ensure good ventilation/exhaustion at the workplace. DO NOT BREATHE DUST. In dusty environments, the use of an OSHA, MSHA or NIOSH approved respirator and tight fitting goggles is recommended. Wear appropriate PPE (See section 8).Do not mix with other chemical products, except as indicated by the manufacturer. Do not get in eyes, on skin or clothing. Good housekeeping is important to prevent accumulation of dust.

7.2 Storage
Requirements to be met by storerooms and receptacles: No special requirements.
Information about storage in one common storage facility: Not required.
Further information about storage conditions: Keep out of the reach of children. Keep container tightly closed and prevent exposure to humidity. Do not allow water to contact the product until time of use to preserve product utility.

SECTION VIII – EXPOSURE CONTROL MEASURES / PERSONAL PROTECTION

8.1 Components with limit values that require monitoring at the workplace:

Hazardous Components	CAS No.	PEL (OSHA) mg/M^3	TLV (ACGIH) mg/M^3
Silica Sand, crystalline	14808-60-7	0.1	0.025 (resp)
Portland Cement	65997-15-1	5 (resp) 15 (total)	10 (resp)
Calcium Sulfoaluminate	65997-16-2	15	10
Calcium Aluminate	12042-68-1	5 (resp) 15 (total)	1 (resp)
Calcium Sulfate	10101-41-4	5 (resp) 15 (total)	10 (resp)
Limestone Dust	01317-65-3	5 (resp) 15 (total)	10 (resp)

8.2 Exposure Controls
Use ventilation adequate to keep exposures below recommended exposure limits.

8.3 General protective and hygienic measures

Keep away from foodstuffs, beverages and feed. Immediately remove all soiled and contaminated clothing. Wash hands before breaks and at the end of work. Avoid contact with the eyes and skin.

8.3a Personal protective equipment

Protection of hands:
Wear gloves of adequate length to offer appropriate skin protection from splashes. Nitrile, Butyl and PVC gloves have been found to offer adequate protection for incidental contact. Precautions must be observed because burns occur with little warning -- little heat is sensed.

Eye protection:
Wear approved eye protection properly fitted dust- or splash-proof chemical safety glasses.

Respiratory protection:
A NIOSH-approved dust mask or filtering face piece is recommended in poorly ventilated areas or when permissible exposure limits may be exceeded. Respirators should be selected by and used under the direction of a trained health and safety professional, following requirements found in OSHA's respirator standard (29 CFR 1910.134) and ANSI's standard for respiratory protection (Z88.2).

SECTION IX - PHYSICAL/CHEMICAL CHARACTERISTICS

General Information

Appearance	Form: Granular Solid
	Color: Gray to gray-brown colored
	Odor: None
pH-value at 20°C (68 °F):	13 (10%)
Boiling point/Boiling range:	Not applicable
Flash point:	Not applicable
Auto igniting:	Product is not self-igniting
Vapor pressure at 21°C (70°F)	Not available
Density at 25°C (77 °F):	2.6 to 3.15

Solubility in / Miscibility with

Water:	Insoluble
VOC content:	0 g/L VOC

SECTION X – STABILITY AND REACTIVITY

10.1 Reactivity
No dangerous reaction known under conditions of normal use.
10.2 Chemical stability
Stable under normal storage conditions. Keep in dry storage.

10.3 Possibility of hazardous reaction
No dangerous reaction known under conditions of normal use.
10.4 Thermal decomposition / conditions to be avoided
No decomposition if used according to specifications.
10.5 Incompatible materials
Contact of silica with powerful oxidizing agents such as fluorine, chlorine trifluoride, manganese trioxide, or oxygen difluoride may cause fires
10.6 Hazardous Decomposition or By-products
Silica will dissolve in Hydrofluoric Acid and produce a corrosive gas – silicon tetrafluoride.

SECTION XI – TOXICOLOGICAL INFORMATION

11.1 Exposure Routes: Skin contact, skin adsorption, eye contact, inhalation, or ingestion.

11.2 Symptoms related to physical/chemical/toxicological characteristics:

Inhalation: May cause respiratory tract irritation. Causes damage to organs through prolonged or repeated exposure. This product contains crystalline silica. Prolonged or repeated inhalation of respirable silica from this product can cause silicosis.

Skin contact: Causes skin irritation. Handling can cause dry skin, discomfort, irritation, and dermatitis. May cause sensitization by skin contact. Product becomes extremely alkaline when exposed to moisture, and can cause alkali burns and affect the mucous membranes.

Eye Contact: Causes serious eye damage. Symptoms may include discomfort or pain, excess blinking and tear production, with marked redness and swelling of the conjunctiva.

Ingestion: Harmful if swallowed. Ingestion may cause discomfort and/or distress, nausea or vomiting.

11.3 Delayed, immediate and chronic effects of short-term and long-term exposure
Short Term
Skin Corrosion/Irritation: Causes severe skin burns.
Serious Eye Damage/Irritation: Causes severe eye damage.
Respiratory Sensitization: Not available
Skin Sensitization: May cause an allergic skin reaction.
Specific Target Organ Toxicity-Single Exposure: (Category 3) may cause respiratory irritation.
Aspiration Hazard: Not available
Long Term
Carcinogenicity: May cause cancer through chronic inhalation.
Germ Cell Mutagenicity: Not available
Reproductive Toxicity: Not available

Specific Target Organ Toxicity- Repeated Exposure: (Category 1) Causes damage to lungs through prolonged/repeated exposure
Synergistic/Antagonistic Effects: Not available.

SECTION XII – ECOLOGICAL INFORMATION

12.1 Ecotoxicity
May cause long-term adverse effects to the aquatic environment. Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system. Must not reach bodies of water or drainage ditch undiluted or un-neutralized

12.2 Persistence and degradability
No further relevant information available.

12.3 Bioaccumulative potential:
No further relevant information available.

12.4 Mobility in soil
No further relevant information available.

12.5 Other Adverse Effects
No further relevant information available.

SECTION XIII – DISPOSAL CONSIDERATIONS

13.1 Waste Disposal Method
The packaging and material may be land filled; however, material should be covered to minimize generation of airborne dust. This product is not classified as a hazardous waste under the authority of the RCRA (40CFR 261) or CERCLA (40CFR 117&302). Disposal must be made in accordance with local, state and federal regulations.

13.2 Other disposal considerations
Uncleaned packaging
Recommendation: Disposal must be made in accordance with local, state and federal regulations.
Recommended cleansing agent: Water, if necessary with cleansing agents.

SECTION XIV – TRANSPORT INFORMATION

	DOT (U.S.)	TDG (Canada)
UN-Number	Not Regulated	Not Regulated
UN proper shipping name	Not Regulated	Not Regulated
Transport Hazard Class(es)	Not Regulated	Not Regulated
Packing Group (if applicable)	Not Regulated	Not Regulated

14.1 Environmental hazards:
Not Available

14.2 Transport in bulk according to Annex II of Marpol 73/78 and the IBC Code
Not available

14.3 Special precautions for user
Do not handle until all safety precautions have been read and understood.

SECTION XV – OTHER REGULATORY INFORMATION

15.1 Safety, Health and Environmental Regulations/Legislations specific for the chemical

Canada
WHMIS Classification: Considered to be a hazardous material under the Hazardous Products Act as defined by the Controlled Products Regulations and subject to the requirements of Health Canada's Workplace Hazardous Material Information (WHMIS). This document complies with the WHMIS requirements of the Hazardous Products Act (HPA) and the CPR.

15.2 US Federal Information

SARA 302/311/312/313 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302, 311, 312 or 313.
RCRA: Crystalline silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or its regulations, 40 CFR §261 et seq.
CERCLA: Crystalline silica (quartz) is not classified as a hazardous substance under regulations of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 40 CFR §302.
Emergency Planning and Community Right to Know Act (SARA Title III): Crystalline silica (quartz) is not an extremely hazardous substance under Section 302 and is not a toxic chemical subject to the requirements of Section 313.
FDA: Silica is included in the list of substances that may be included in coatings used in food contact surfaces, 21 CFR §175.300(b)(3)(xxvi).
NTP: Respirable crystalline silica, primarily quartz dusts occurring in industrial and occupational settings, is classified as Known to be a Human Carcinogen.
OSHA Carcinogen: Crystalline silica (quartz) is not listed.

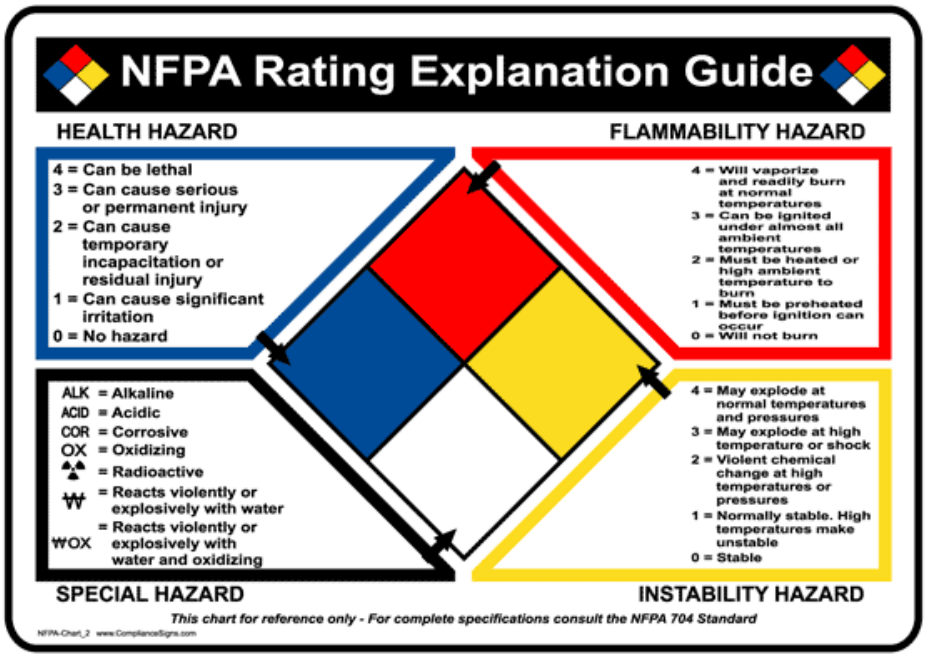
15.3 State Right to Know Laws

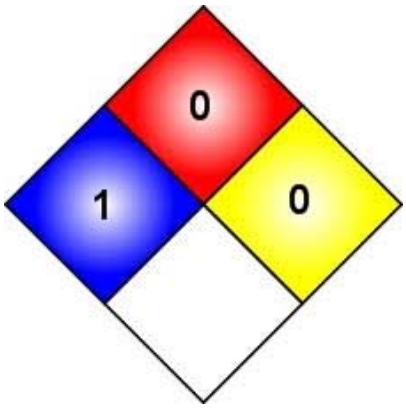
California Prop. 65 Components
WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.
California Inhalation Reference Exposure Level (REL): California established a chronic REL of 3 µg for silica (crystalline, respirable). A chronic REL is an airborne level of a substance at or below which no adverse health effects are anticipated in individuals indefinitely exposed to the substance at that level.
Massachusetts Toxic Use Reduction Act: Silica, crystalline (respirable size, <10 microns) is "toxic" for purposes of the Massachusetts Toxic Use Reduction Act.

15.4 Global Inventories

DSL All components of this product are on the Canadian DSL list.
TSCA No.: Crystalline silica (quartz) appears on the EPA TSCA inventory under the CAS No. 14808-60-7. All constituents are listed in the TSCA inventory.

15.5 NFPA Ratings





SECTION XVI – OTHER INFORMATION

Last Updated: November 29, 2016

NOTE: The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, express or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to silica contained in our products.

Prepared by

The QUIKRETE® Companies
Phone (800) 282-5828
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End of SDS

2440 Dayton Xenia Rd, Suite D
Beavercreek, OH 45434
888-431-0218
www.mintekresources.com

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Section 1. Identification

Product Name	Distributor	Telephone
Calciment® BA	Mintek Resources, Inc. PO Box 340187 Beavercreek, OH 45434	937-431-0218 Office 937-431-1305 Fax 800-424-9300 CHEMTREC

Chemical Name
Calcium Oxide, Calcium Carbonate, Calcium Hydroxide

Uses
De-Watering, Solidification, Fixation, Neutralization, Agriculture

SECTION 2. HAZARDS IDENTIFICATION

Classification of the substance or mixture


GHS03 Exclamation Mark


GHS05 Corrosion

Signal word Danger

Hazard-determining components of labeling
Calcium Oxide, Calcium Carbonate, Calcium Hydroxide

Hazard Statements
H303 May be harmful if swallowed
H315 Causes skin irritation
H319 Causes serious eye irritation
H335 May cause respiratory irritation

Precautionary statements
P101 If medical advice is needed, have product container or label at hand

P102	Keep out of reach of children
P280	Wear protective gloves, clothing, eye protection
P281	Use personal protective equipment as required
P284	Wear respiratory protection

Section 3. Composition				
Component	**Formula**	**% Wt.**	**CAS No.**	**PEL**
Calcium Carbonate	$CaCO_3$	10-40	1317-65-3	10 mg/m^3
Calcium Oxide	CaO	10-60	1305-78-8	2 mg/m^3
Calcium Hydroxide	$Ca(OH)_2$	0-70	1305-78-8	5 mg/m^3
Calcium Magnesium Carbonate	$CaMg(CO_3)_2$	0-10	16389-88-1	10 mg/m^3
Crystalline Silica Quartz	SiO_2	0-30	14808-60-7	0.1 $mg/m^{3\ respirable}$
Aluminum Oxide	Al_2O_3	0-15	1344-28-1	10 mg/m^3
Ferric Oxide	Fe_2O_3	0-5	1309-37-1	15 mg/m^3
Magnesium Oxide	MgO	0-60	1309-48-4	5 mg/m^3
Sulfur Trioxide	SO_3	5-30	7704-34-9	10 mg/m^3

SECTION 4. First-Aid Measures

Effects:

Inhalation: **Acute:** Irritation, sore throat, cough, sneezing. **Chronic:** Persistent coughing and breathing problems. Long-term exposure to silica can cause a chronic lung disorder, silicosis.

Eyes: **Acute:** Severe irritation, intense tearing, burns. **Chronic:** Possible blindness when exposure is prolonged.

Skin: **Acute:** Removes natural skin oils, blotches, itching and superficial burns in case of sweating. **Chronic:** No known effects.

Ingestion: **Acute:** Sore throat, stomach aches, cramps, diarrhea, vomiting. **Chronic:** No known effects.

Treatments:

Inhalation: Move victim to fresh air. Seek medical attention if necessary. If breathing has stopped, give artificial respiration.

Eyes: Immediately flush eyes with large amounts of water for at least 15 minutes. Pull back the eyelid to make sure all the lime dust has been washed out. Seek medical attention immediately. Do not rub eyes.

Skin: Flush exposed area with large amounts of water. Seek medical attention immediately.

Ingestion: Give large quantities of water or fruit juice. Do not induce vomiting. Seek medical attention immediately. Never give anything by mouth if victim is rapidly losing consciousness or is unconscious or convulsing.

SECTION 5. Fire-Fighting Measures

Flash Point: Non-flammable

Autoignition Temperature: Non-flammable

Inflammability Limits: None, Non combustible solid, but will support combustion by liberation of oxygen

Explosion Risk: None by itself, but heat produced by reaction with strong acids can generate steam and pressure

Hazardous Combustion Products: Decomposes to produce calcium oxide (CaO), which can react with water to produce steam and pressure

Extinguishing Media: Use dry chemical fire extinguisher. Do not use water or halogenated compounds, except that large amounts of water may be used to deluge small quantities of lime kiln dust. Use appropriate extinguishing media for surrounding fire conditions.

Fire Fighting Instructions: Keep personnel away from and upwind of fire. Wear full fire-fighting turn-out gear (full Bunker gear), and respiratory protection (self-contained breathing apparatus.

SECTION 6. Accidental Release Measures

Individual and collective precautions: Avoid creating conditions which release dust – use mechanical vacuums to remove dust from work spaces.

Avoid inhalation of Dust: Wear respiratory protection – minimum NIOSH N-95 Dust Mask.

Cleaning methods (Leaks & Spills): Use personal protective equipment (eyes, skin and inhalation, see Section 8). Use dry methods (vacuuming, sweeping) to collect spilled materials. Avoid generating dust. For large spills, evacuate area downwind of clean-up area operations to minimize dust exposure. For small spills, store spilled materials in dry, sealed plastic or metal containers. Dust residue on surfaces may be washed with water.

Precautions for the protection of the environment: May not be released into surface waters without controls (increases pH).

Waste Disposal: Dispose according to federal, provincial/state and local environmental regulations.

SECTION 7. Handling and Storage

Handling: In open air or in ventilated places, avoid skin and eye contact, avoid creating airborne dust.

Storage: Store in dry places sheltered from humidity. Keep away from acids. Keep out of reach of children.

SECTION 8. Exposure Controls/Personal Protection

Exposure Limits:

Calcium Carbonate: 15 mg/m^3 (total dust), 5 mg/m^3 (respirable) (OSHA); 10 mg/m^3 (ACGIH, O. Reg. 833);
Calcium oxide: 5 mg/m^3 (OSHA); 2 mg/m^3 (ACGIH, O. Reg. 833);
Calcium Magnesium Carbonate: 10 mg/m^3 (ACGIH, OSHA)
Calcium Magnesium Oxide: 2 mg/m^3 (ACGIH, OSHA)
Magnesium Carbonate: 15 mg/m^3 (total dust), 5 mg/m^3 (respirable) (OSHA); 5 mg/m^3 (ACGIH, O. Reg. 833); 10 mg/m^3 (ACGIH, O. Reg. 833);
Calcium Hydroxide: mg/m^3 (total dust), 5 mg/m^3 (respirable) (OSHA); 5 mg/m^3 (ACGIH, O. Reg. 833)
Magnesium oxide: 15 mg/m^3 (OSHA); 10 mg/m^3 (ACGIH, O. Reg. 833)
Silica (crystalline quartz): 2.5 mg/m^3 (total dust), 0.8 mg/m^3 (respirable) (OSHA); 0.5 mg/m^3 (respirable – ACGIH); 0.1 mg/m^3 (O. Reg. 845)

Engineering Controls: Use ventilation and dust collection to control exposure to below applicable limits.

Respiratory Protection: Wear NIOSH N-95 Dust Mask.

Eye Protection: Eye protection (chemical goggles, safety glasses and/or face shield) should be worn where there is a risk of lime exposure. Contact lenses should not be work when working with lime products.

Hand Protection: Use clean dry gloves.

Skin Protection: Cover body with suitable clothes (long sleeves shirts and trousers). Use over the angle waterproof caustic resistant footwear.

SECTION 9. Physical and Chemical Properties

Appearance:	Solid, brown/white/tan/gray granular
Odor:	Odorless
Odor Threshold:	NA
pH:	12.4 pH graduated solution at 25º C
Melting Point:	1410º C
Boiling Point:	1565º C
Flash Point:	NA
Evaporation Rate:	NA
Flammability:	NA
Upper/Lower Flammability	NA
Vapor Pressure (+tº)	Non volatile.
Vapor Density (air=ml):	Non volatile.
Relative Density:	720-1130 kg/ m^3
Solubility in Water:	0.100 – 1.125g/100g – reactive with water to product $Ca(OH)_2$ with large amounts of heat
Partition coefficient:	NA
Auto-Ignition Temperature:	NA
Decomposition Temperature:	580ºC
Viscosity:	NA

SECTION 10. Stability and Reactivity

Stability:	Stable products, not very soluble.
Decomposition temperature:	580ºC, forms calcium oxide (CaO) and water.
Reactivity:	Reacts with acids to form calcium salts while generating heat. Reacts with carbon dioxide in air to form calcium carbonate.
Conditions to avoid:	Vicinity of incompatible materials.
Incompatible materials:	Acids; reactive fluoridated, brominated or phosphorous compounds; aluminum (may form hydrogen gas), reactive powdered metals; organic acid anhydrides; nitro-organic compounds; interhalogenated compounds.
Hazardous decomposition products:	Calcium oxide (CaO).

SECTION 11. Toxicological Information

Toxicity:	LD_{50} oral (rat) for calcium hydroxide is 7340 mg/kg. This product is not listed by MSA, OSHA, or IARC as a carcinogen, but this product may contain crystalline silica, which has been classified by IARC as (Group 1) carcinogenic to humans when inhaled in the form of quartz or cristobalite. No reported Carcinogenicity, Reproductive Effects, Teratogenicity or Mutagenicity.
Exposure Limits:	Refer to Section 8.
Irritancy:	Can cause severe irritation of eyes, skin, respiratory tract and gastrointestinal tract.
Chronic Exposure:	Inhalation of silica can cause a chronic lung disorder, silicosis.

SECTION 12. Ecological Information

Alkaline substance that increases pH to 12.4 in a saturated water solution at 25ºC.
Calcium hydroxide gradually reacts with CO_2 in air to form calcium carbonate ($CaCO_3$).
Calcium carbonate is ecologically neutral.
Uncontrolled spillage in surface waters should be avoided since the increase pH could be detrimental to fish.
Harmful to aquatic life in high concentration.

SECTION 13. Disposal Considerations

Dispose according to federal, provincial/state and local environmental regulations.

SECTION 14. Transportation Information

Classification: TDG: Not listed for ground transportation
HMR: Not listed for ground transportation

TDG: Transportation of Dangerous Goods Regulation (Canada)
HMR: Hazardous Materials Regulation (USA)

SECTION 15. Regulatory Information

Symbol: **WHMIS Rating**
D2A, E
NFPA RATING
HEALTH-3 SPECIFIC HAZARD – ALK FLASH POINTS-0 REACTIVITY-1
HMIS RATING
HEALTH-2 SPECIFIC HAZARD – ALK FLASH POINTS-0 REACTIVITY-1

SECTION 16. Other Information

Original Prepared: 05/13/13
Revision Date: 10/15/14
Revision #: 1

Calciment can be removed from vehicles using rags dampened with dilute vinegar. After applying dilute vinegar, vehicles (especially chrome surfaces) must be washed with water.

ATTACHMENT C:
Disposal Options Summary

As listed in the June 2016 Weston & Sampson memo related to dredging options, disposal alternatives were discussed. The elevated arsenic greatly limits in-state re-use options.

Weston & Sampson has evaluated the following alternative waste handling policies below and found the policies below <u>would not</u> provide a path for in-state re-use for the Salisbury Pond sediment:

1. The MassDEP Beneficial use determination (BUD).
2. The MassDEP Similar Soils policy (WSC 13-500).
3. The MassDEP policy COMM-94-007 "Interim Policy for Sampling, Analysis, Handling and Tracking Requirements for Dredged Sediment Reused or Disposed at Massachusetts Permitted Landfills"
4. The MassDEP Interim Remediation Waste Management Policy for Petroleum Contaminated Soils #WSC-94-400 provides soil recycling options under asphalt batching.

Based on the lack of in-state disposal alternatives, out-of-state disposal is the most cost effective alternative for the dredged sediment. The Waste Management Turnkey Landfill in Rochester, New Hampshire and other landfills in New York and beyond can accept the dredged sediment. The proximity to rail may provide an alternative to transport over roadways. The transport and disposal costs to out-of-state landfills are approximately $85/ton of sediment.

As the disposal costs are high, the City of Worcester may also evaluate options for on-Site or alternate brownfield location capping. The MassDEP would require either an impermeable surface feature (asphalt, concrete, etc.) or a demarcation barrier and three-feet of cover to separate these sediments. Weston & Sampson has experience designing cover systems and limiting access to impacted materials.

The in-state re-use of these sediments would require MassDEP coordination and approval. The MassDEP may approve the on-Site re-use and capping of dredged sediment if benefits can be shown. These would include reduced carbon emissions of transport of sediment out-of-state. A similarly-impacted upland area for the placement and covering of these sediments would be required. The MassDEP may reject the proposal to relocate impacted sediments based on their contaminant concentrations.

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