100% REMEDIAL DESIGN

LOWER SOUTH POND SEDIMENTS ADJACENT TO WEST HIDE PILE

Industri-plex Operable Unit 2
(including Wells G&H Operable Unit 3) Superfund Site
Woburn, Massachusetts

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July 31, 2014

SDMS Doc ID 564612

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LIST OF ACRONYMS

Acronym	Agency/Organization/Definition
AAD	Atlantic Avenue Drainway
AOB	Ammonia-Oxidizing Bacteria
ARAR	Applicable or Relevant and Appropriate Requirement
AUL	Activity and Use Limitation
BECo	Boston Edison Company Drainway
CBCA	Cranberry Bog Conservation Area
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Contaminant of Concern
CPM	Critical Path Method
CQA	Construction Quality Assurance
CRSP	Community Relations Support Plan
CSM	Conceptual Site Model
CTDs	Conductivity, Temperature and Depth sensors
DO	Dissolved Oxygen
DC	Design Considerations
DETS	Dewatering Effluent Treatment System
DP	Drive Point
ECs	Erosion and Sedimentation Controls
EDC	Engineering Design Components
EHP	East Hide Pile
EMP	Environmental Monitoring Plan
EPA	United States Environmental Protection Agency
FDT	Fluorescent Dye Tracer
FEMA	Federal Emergency Management Agency
FLM	Former Lake Mishawum
FML	Flexible Membrane Liner
FSP	Field Sampling Plan
GSIP	Groundwater/Surface Water Investigation Plan
HASP	Site-specific Health & Safety Plan
HB	Halls Brook
HBHA	Halls Brook Holding Area
IC	Institutional Control
LSP	Lower South Pond

MassDEP	Massachusetts Department of Environmental Protection
MBTA	Massachusetts Bay Transportation Authority
NBSD	New Boston Street Drainway
NOB	Nitrite-Oxidizing Bacteria
NRWQC-CCC	National Recommended Water Quality Criterion
O&M	Operations and Maintenance
ORP	Oxidation Reduction Potential
OU1	Operable Unit 1 (Industri-plex Site)
OU2	Operable Unit 2 (Industri-plex Site)
PDI	Pre-Design Investigation
PF	Profiling
POND	HBHA Pond
POP	Project Operations Plan
QAPP	Quality Assurance Project Plan
RAO	Response Action Objective
RD/RA	Remedial Design/Remedial Action
RDC	Remedial Design Contractor
RDWP	Remedial Design Work Plan
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
ROW	Right of Way
S.U.	Standard pH Units
SAP	Sampling and Analysis Plan
SC	Supervising Contractor
SMP	Site Management Plan
SOW	Statement of Work
SWMP	Surface Water Monitoring Plan
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
VOC	Volatile Organic Compound
WHP	West Hide Pile

1.0 INTRODUCTION

1.1 Scope and Objective

This draft 100% Remedial Design (100% RD) has been prepared for the remediation of Lower South Pond (LSP) sediments adjacent to West Hide Pile (WHP) on behalf of Pharmacia LLC by its Attorney-in-Fact Monsanto Company and Stauffer Management Company LLC, as litigation agent for Bayer CropScience Inc. (collectively, the Settling Defendants or SDs) for the Industri-plex Operable Unit 2 Superfund Site (including Wells G&H Operable Unit 3), also referred to as the Site, and located in Woburn, Massachusetts (see Figure 1). The objective of this document is to present the 100% RD for the portion of the Site identified above, as required pursuant to the terms of the Consent Decree (CD) entered in Civil Action No. 1:08-cv-10325 and the Statement of Work (SOW) appended to the CD. This 100% RD report is being submitted following EPA's conditional approval of the 100% Remedial Design (100% RD) related to the LSP sediments adjacent to WHP (abbreviated LSP-WHP below) via EPA's letter dated June 30, 2014. The LSP-WHP work is being expedited relative to other portions of the Site.

Pre-design investigations (PDIs) outlined in the Remedial Design Work Plan (RDWP; approved by EPA on March 25, 2011) and the associated PDI modifications approved by EPA throughout the investigation were completed to gather information supporting the design of remedies that are consistent with the provisions of the CD and SOW. PDI-9 is the designation for the PDI work completed in support of the investigation and RD for LSP-WHP. PDI-9 data were collected and summarized in the 30% RD and herein for data collected post-30% RD submission.

EPA provided comments and conditional approval of the March 2012 30% RD in a letter dated August 6, 2013. EPA comments have been addressed and are incorporated into sections of this document and the associated appendices as appropriate. In addition, Settling Defendants' corresponding individual responses to EPA's enumerated comments on the draft 100% RD for LSP sediments are attached in Appendix I.

1.2 Document Organization

The text for LSP-WHP expands on the design information presented in the 30% RD, incorporating additional data collected post 30% RD submittal, EPA's comments on the 30% RD (including EPAs development of the sediment Preliminary Remediation Goal (PRG) for LSP-WHP), Settling Defendants' responses to EPA comments on the draft 30% RD, and various other interactions with EPA as applicable. This information is compiled herein and organized in the following text description.

- Post 30% RD PDI-9 data summary
- Design components and objectives to meet Performance Standards identified in the ROD and CD/SOW
- References to drawings, calculations, and specifications relevant to the design
- Design basis, updated as needed from the 30% RD
- Overview of the 100% RD
- Staging and site preparation details

- Material management plan details
- Details on Means and Methods will be selected by the Contractor and approved by the Engineer. The final construction sequence and elements may change in accordance with the Contactor's construction Means and Methods and will be detailed in the Final Remedial Action Work Plan provided under separate cover.

Supporting information for the 100% LSP-WHP RD is provided in the following appendices. A brief description is provided below:

- Appendix A – 100% RD Supporting Information (Drawings, Specifications, and Calculations)

  Detailed Drawings, Specifications, and Calculations are provided in Appendix A.

- Appendix C – Draft Contingency Plan

  The process to address the onsite construction workers and the local affected population in the event of an accident or emergency is detailed in Appendix C.

- Appendix E – Select Pages from the Field Sampling Plan portion of the Draft Remedial Action Work Plan and Remedial Action Project Operations Plans

  The Field Sampling Plan portion of the draft Remedial Action Work Plan (RAWP) related to WHP-LSP work are updated and attached to reflect EPA comments on the draft 100% RD for this area.

- Appendix I – Response to EPA Comments on the LSP-WHP Remedial Design

  This response lists EPA's comment, Settling Defendants summary response, and noting the way the comment was addressed.

The following items are not included/reproduced again for this standalone excerpt pertaining to WHP-LSP. Please refer to the version supplied in the March 2014 submittal.

- Appendix B – Draft Constructability Review Memorandum

  Drawings and specifications presented herein were subjected to a review process for the overall constructability of the LSP-WHP remedy and the results are detailed in Appendix B.

- Appendix D – Draft Performance Standards and ARAR Attainment Plan

  Applicable or Relevant and Appropriate Requirements (ARARs) are summarized, along with the Performance Standards, in Appendix D as they relate to LSP-WHP.

- Appendix E – Draft Remedial Action Work Plan and Remedial Action Project Operations Plans

  The draft Remedial Action Work Plan (RAWP) contains interrelated Project Operation Plan (POP) documentation that will guide the construction and associated sampling and monitoring of the selected remedy described in the RD document. The Final RAWP, including information supplied by the selected Contractor under separate cover (e.g., Contractor submittals and work plan documentation), presents a summary of the construction and delivery strategy, schedule for work, proposed means and methods, change order procedures, lines of and frequency of communications during RA, subcontractor submittal/approval process, and cost estimates.

- Appendix G – Draft Operation and Maintenance Plan

  The Draft Operations and Maintenance Plan in Appendix G describes normal operation and maintenance of associated remedial equipment, potential operations problems, routine process monitoring and analysis, and record keeping and reporting requirements.

The following items are not included herein, but will be provided in the Final 100% RD for the remainder of the project, updated to reflect EPA comments per the SDs response to comments included in Appendix I (attached).

- Appendix F – Draft Institutional Control Plan: A Draft Institutional Controls Plan was included in the March 2014 95% RD submittal that includes the WHP-LSP area. However, for this standalone document, the draft IC Plan has been omitted but will be carried forward in the Final 100% RD for the remaining project elements.

- Appendix H – Draft Environmental Monitoring Plan: Long term compliance monitoring and sampling frequencies are described in the Environmental Monitoring Plan (EMP). The Final 100% RD EMP for the remainder of the project will include long-term sampling for the LSP sediments adjacent to the WHP.

2.0 PDI-9 DATA AND CONCEPTUAL SITE MODEL

2.1 General

Groundwater, surface water and sediment data was collected at the site over multiple sample events from May 2011 to June 2014 as part of PDI-9 investigations. Sample results were provided to EPA in the 30% RD (submitted April 2012), a PDI-9 data package on June 26, 2012, and via email on July 11, 2014. Sample locations are shown on Figure 2 and 3, and Drawing G-403. Following is a summary of the PDI-9 work completed to date.

2.2 Background

There are four hide piles of various sizes within the Industri-Plex Site, which were formed by consolidating waste from various portions of the Industri-Plex Site. The WHP is located on the western shoreline of LSP as shown on Figure 4, inset. Benzene has been known to be a contaminant in the WHP since early investigations in the 1990s, but was recently observed to be elevated in a small area of sediment in the northwest section of LSP. These elevated concentrations in sediment prompted additional work to investigate the source, fate, and transport of the benzene and to delineate the impacted sediment and organic fill soils.

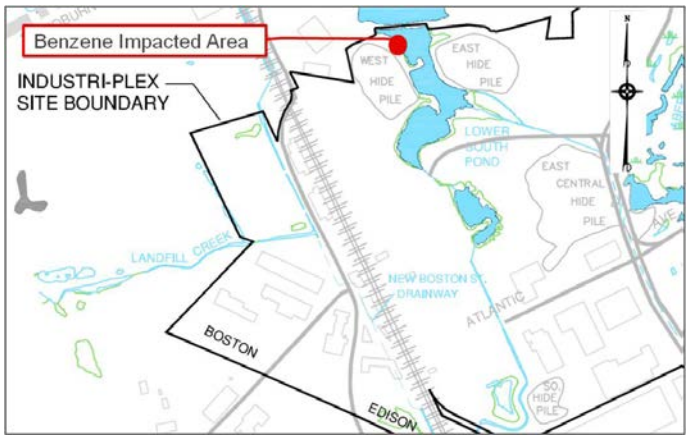

Figure 4: Location of Benzene Impacted Area

2.3 Site Setting

The WHP is approximately 4 acres in size and forms a large mound. The top of the mound is generally flat and slopes downward in all directions. The toe of the slope intersects with paved parking areas to the northwest, upland to the west, and LSP to the south, east, and northeast. The elevation of the top of the WHP is approximately El 94 feet.[1] The ground surface of benzene-impacted area lies within a generally flat area between the WHP and LSP. The water surface of LSP is approximately El 71. The WHP slopes down to the west to upland area ranging from approximately El 85 to 90. Along the northern edge of the WHP the topography rises to a paved parking area at approximately El 96. Power lines traverse the center of the WHP in an east-west orientation with two transmission towers installed on the top of the WHP. Figure 5 is an aerial photograph showing the general site setting.

[1] All elevations noted in feet (ft) relative to National Geodetic Vertical Datum of 1929 (NGVD).

Figure 5: Site Setting West Hide Pile

2.3.1 Geology

Geological information was acquired from several soil borings and Membrane Interface Probe (MIP) profile explorations conducted in the area between the WHP and LSP where the benzene impact is located.

- **Fill -** The WHP consists of fill containing consolidated animal hide residuals and waste material from the former industrial operations conducted at the Industri-Plex site. As described in the MSGRP RI (see MSGRP pg 3-13), the fill material at the hide pile areas consist of manufactured or construction debris and waste sludge mixed with natural geologic materials such as silty sand, gravel, or topsoil. At the base of the WHP, in the general benzene-impacted area adjacent to the northwest section of LSP, there is a rip-rap stone toe drain present at the ground surface. The toe drain extends into LSP. Below the stone, an approximate 0-2 ft-thick layer of sand and silty sand is present.

- **Organic Silt/Fill -** Explorations completed during recent investigations between the WHP and LSP indicate a layer of organic silt/fill material is present, typically ranging from 3-5 ft in thickness. In two of the explorations, hair (i.e., hide residuals) was observed in the organic silt indicating this material may have been naturally deposited and then disturbed during construction of the WHP with hide residuals and associated waste materials becoming incorporated into the organic material. It is also possible that the organic silt represents waste material (i.e., fill) containing hide residuals; therefore, this deposit is designated organic silt/fill.

- **Sand Deposit -** A naturally deposited gray, fine-to-medium sand layer was observed underlying the organic silt/fill material at approximately 7.5-9.5 ft depths below ground surface (bgs) and underlying the LSP sediment material. The thickness of this deposit has not been determined as recent explorations conducted in the area between the WHP and LSP and within LSP have not fully penetrated the sand deposit. Due to the limited number of soil samples collected from this small localized area, the geologic origin/strata determination has not been determined, although a glaciolacustrine deposit is likely.

- **Bedrock -** Bedrock was not encountered in any of the recent explorations conducted in the area between the WHP and LSP; however, based on the MSGRP RI, bedrock is estimated between El 55 and 60 in the vicinity of the benzene-impacted area. During the recent MIP Profiling, explorations were advanced to an approximately El 50 (i.e., approximately 21.5 ft bgs) before encountering refusal. Therefore the bedrock elevation is slightly deeper at the benzene-impacted areas than estimated in the MSGRP.

- **LSP Sediment -** A sediment deposit was typically observed within LSP adjacent to the WHP benzene-impacted area. The sediment layer observed ranged in thickness from 2-5 ft, and typically consisted of a soft, black organic soil (silt) material. A black organic peat layer was detected in several of the explorations within the sediment layer.

2.3.2 Hydrogeology

- **Surface Water -** The LSP is approximately 4 acres in size with a maximum water depth of approximately 5 ft. Drainage swales around the periphery of the WHP and toe drains installed as part of the WHP cover control surface runoff discharging into and out of LSP. LSP also receives surface water from Upper South Pond, located north of LSP, via a culvert. LSP drains to the south via the Atlantic Avenue Drainway (AAD) under baseflow conditions. Under high water conditions the LSP also drains to the Aberjona River along Commerce Way. The LSP water surface under baseflow conditions is typically observed at approximately El 71.6.

- **Groundwater -** In general, regional groundwater flow is generally to the south as shown on Figure 6 from the MSGRP RI. The focused benzene-impacted area investigations were completed in an area approximately 0.25 acre in size and thus have limited ability to look at larger scale groundwater flow paths.

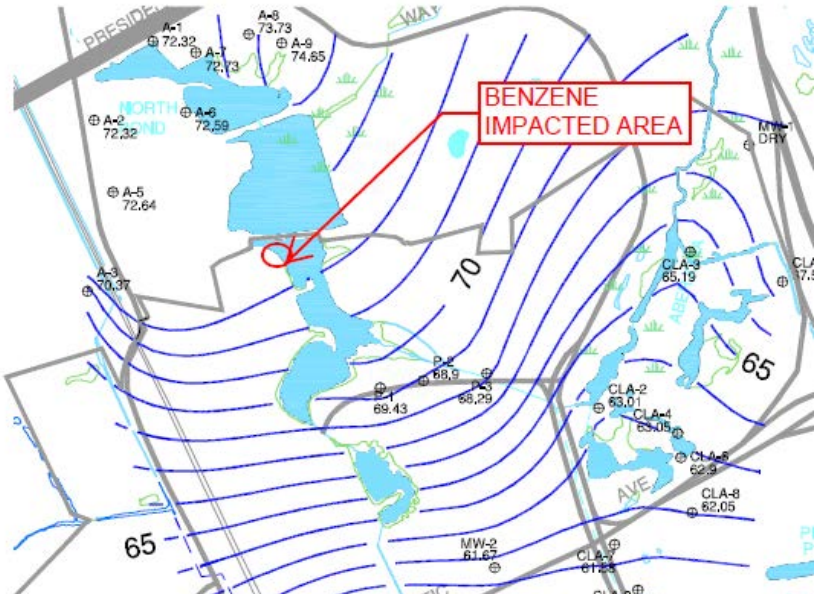

Figure 6: Regional Groundwater Flow from MSGRP RI

- **Groundwater Levels -** Groundwater level measurements were made on four occasions for the four well couplets installed at the WHP. Water levels are presented in Table I. Groundwater elevations were estimated for the wells screened in the organic silt/fill and for the underlying sand. Figures 7a through 7d present groundwater elevations for four dates in the organic silt/fill and Figures 8a through 8d present groundwater elevations for the same four dates for the underlying sand. As shown on the figures, groundwater flow within the organic silt/fill is generally toward the south, consistent with the regional groundwater flow shown in Figure 6 (inset above). The sand underlying the organic silt/fill exhibits groundwater flow paths toward the west. Based on samples collected from sampling ports within the toe drain, and groundwater samples from profiling piezometers in the fill material above the organic layer, the shallow groundwater above the organic silt/fill did not exhibit elevated benzene concentrations, and therefore is not associated with the benzene-impacted area. Groundwater flow directions are based on measurements taken in December 2012, and May and November 2013.

Table I Summary of Water Level Data							
				MEASUREMENT DATE			
SAMPLE LOCATION		**REFERENCE ELEVATION (ft)**	**DEPTH (ft) EL. (ft)**	**12/4/2012**	**12/6/2012**	**5/4/2013**	**11/1/2013**
MW-104	**MW-104S**	76.26	DEPTH (ft)	4.7	4.77	4.61	4.93
			EL. (ft)	71.56	71.49	71.65	71.33
	MW-104D	76.18	DEPTH (ft)	4.63	4.67	4.59	4.92
			EL. (ft)	71.55	71.51	71.59	71.26
MW-105	**MW-105S**	76.43	DEPTH (ft)	4.8	4.9	4.71	5.03
			EL. (ft)	71.63	71.53	71.72	71.4
	MW-105D	75.93	DEPTH (ft)	4.35	4.41	4.31	4.64
			EL. (ft)	71.58	71.52	71.62	71.29
MW-106	**MW-106S**	76.29	DEPTH (ft)	5	4.93	4.62	5.12
			EL. (ft)	71.29	71.36	71.67	71.17
	MW-106D	76.43	DEPTH (ft)	4.88	4.9	4.82	4.99
			EL. (ft)	71.55	71.53	71.61	71.44
MW-107	**MW-107S**	75.12	DEPTH (ft)	3.6	3.71	3.5	3.73
			EL. (ft)	71.52	71.41	71.62	71.39
	MW-107D	75.02	DEPTH (ft)	3.45	3.48	3.41	3.71
			EL. (ft)	71.57	71.54	71.61	71.31

- **Hydraulic Conductivities -**
  Slug testing was conducted to obtain hydraulic conductivity estimates from a total of eight wells installed at WHP, along the northwest shoreline of LSP (four well couplets). Hydraulic conductivity measurements were conducted in wells installed both in the organic silt/fill layer and in the underlying sand deposit. The shallow wells (designated with "S") were screened in the organic silt/fill deposit (the layer exhibiting elevated benzene concentrations), while the deep wells (designated with "D") were screened in the sand deposit underlying the organic silt/fill layer. A summary of the slug testing results is shown in Table II (inset). Results of the slug testing indicate the organic silt/fill layer exhibits hydraulic conductivities approximately three orders of magnitude lower than the underlying sand deposit.

Table II – Summary of Horizontal Hydraulic Conductivity Estimates	
Location/Unit	**K_h (cm/sec)**
Organic Silt/Fill	
MW-104S	2.96E-06
MW-105S	6.57E-06
MW-106S	3.69E-06
MW-107S	5.71E-06
Geo. Mean	**4.50E-06**
Sand	
MW-104D	4.00E-03
MW-105D	8.67E-03
MW-106D	2.14E-03
MW-107D	3.24E-03
Geo. Mean	**3.94E-03**

- **Horizontal Hydraulic Gradients -** The horizontal component of the hydraulic gradient was calculated based on the four well clusters installed in the benzene-impacted area. Horizontal gradients were calculated between wells along groundwater flow paths based on Figures 7a-7d and 8a-8d. The gradients were evaluated between both the shallow and deep screened wells within the couplets. Horizontal hydraulic gradient data is shown in Table III (inset).

Table III Horizontal Gradients

Organic Silt/Fill Deposit				Horizontal Distance(ft)	WL Vertical Diff. (ft)	Horizontal Gradient (unitless)
MW-105 to MW-104	**Location**	**MW-105S**	**MW-104S**			
	Screen Center El.	**67.00**	**67.60**	16		
	12/4/2012	71.63	71.56		0.07	**0.004**
	12/6/2012	71.53	71.49		0.04	**0.003**
	5/14/2013	71.72	71.65		0.07	**0.004**
	11/2/2013	71.4	71.33		0.07	**0.004**
MW-105 to MW-106	**Location**	**MW-105S**	**MW-106S**			
	Screen Center El.	**67.00**	**65.80**	47		
	12/4/2012	71.63	71.29		0.34	**0.007**
	12/6/2012	71.53	71.36		0.17	**0.004**
	5/14/2013	71.72	71.67		0.05	**0.001**
	11/2/2013	71.4	71.17		0.23	**0.005**
MW-105 to MW-107	**Location**	**MW-105S**	**MW-107S**			
	Screen Center El.	**67.00**	**59.30**	40		
	12/4/2012	71.63	71.52		0.11	**0.003**
	12/6/2012	71.53	71.41		0.12	**0.003**
	5/14/2013	71.72	71.62		0.10	**0.002**
	11/2/2013	71.4	71.39		0.01	**0.000**
			Average gradient in the Organic Silt/Fill Deposit **0.003**			
Sand Deposit						
MW-105 to MW-104	**Location**	**MW-105D**	**MW-104D**			
	Screen Center El.	**61.00**	**61.5**	16		
	12/4/2012	71.58	71.55		0.03	**0.002**
	12/6/2012	71.52	71.51		0.01	**0.001**
	5/14/2013	71.62	71.59		0.03	**0.002**
	11/2/2013	71.29	71.26		0.03	**0.002**
MW-107 to MW-106	**Location**	**MW-107D**	**MW-106D**			
	Screen Center El.	**59.30**	**59.70**	**22**		
	12/4/2012	71.57	71.55		0.02	**0.001**
	12/6/2012	71.54	71.53		0.01	**0.000**
	5/14/2013	71.61	71.61		0.00	**0.000**
MW-106 to MW-107	**Location**	**MW-106D**	**MW-107D**			
	Screen Center El.	**59.70**	**59.30**	**22**		
	11/2/2013	71.44	71.31		0.13	**0.006**
			Average gradient in the Glaciolacustrine Sand Deposit **0.002**			

In addition to the data presented in the Table III above, the water level in LSP is typically maintained at approximate El 71.6 but fluctuates based on precipitation. As shown in Table III, the gradients are generally small within the organic silt/fill deposit.

- **Vertical Hydraulic Gradients -** Vertical hydraulic gradients were calculated from the four well couplets installed at the benzene area. The gradients were evaluated at each well couplet between the shallow well screens installed within the impacted organic silt/fill material, and the deeper well screens installed within the underlying sand. Vertical hydraulic gradient data is shown in Table IV.

Table IV Vertical Gradients						
				WL Diff (ft)	**Vert Diff. (ft)**	**Vertical Gradient (unitless)**
MW-104	**Location**	**MW-104S**	**MW-104D**			
	Screen Center El.	**67.60**	**61.50**		6.10	
	12/4/2012	71.56	71.55	-0.01		-0.002
	12/6/2012	71.49	71.51	0.02		0.003
	5/14/2013	71.65	71.59	-0.06		-0.010
	11/2/2013	71.33	71.26	-0.07		-0.011
MW-105	**Location**	**MW-105S**	**MW-105D**			
	Screen Center El.	**67.00**	**61.00**		6.00	
	12/4/2012	71.63	71.58	-0.05		-0.008
	12/6/2012	71.53	71.52	-0.01		-0.002
	5/14/2013	71.72	71.62	-0.10		-0.017
	11/2/2013	71.4	71.29	-0.11		-0.018
MW-106	**Location**	**MW-106S**	**MW-106D**			
	Screen Center El.	**65.80**	**59.70**		6.10	
	12/4/2012	71.29	71.55	0.26		0.043
	12/6/2012	71.36	71.53	0.17		0.028
	5/14/2013	71.67	71.61	-0.06		-0.010
	11/2/2013	71.17	71.44	0.27		0.044
MW-107	**Location**	**MW-107S**	**MW-107D**			
	Screen Center El.	**65.60**	**59.30**		6.30	
	12/4/2012	71.52	71.57	0.05		0.008
	12/6/2012	71.41	71.54	0.13		0.021
	5/14/2013	71.62	71.61	-0.01		-0.002
	11/2/2013	71.39	71.31	-0.08		-0.013

Results of the vertical hydraulic gradient data indicate the vertical gradient fluctuates, but is primarily downward at couplet MW-104, consistently downward in couplet MW-105, typically upward at MW-106, and variable at MW-107.

- **Average Linear Velocities -** The average linear velocity provides the rate that water is moving through the pore space in the aquifer and provides an assessment of travel time without taking into account contaminant retardation within the aquifer. The average linear velocity ($\tilde{v}$) is determined by the equation: $\tilde{v}=Ki/n$, where "*K*" is the hydraulic conductivity, "i" is the horizontal gradient and "*n*" is the effective porosity. Average linear velocity was calculated for the two near surface soil strata encountered at shallow depths: the organic silt/fill layer and the underlying sand deposit, as summarized in Table V (inset below).

Table V Average Linear Velocity Estimates					
Geologic Unit	**Kh (cm/sec)**	**i (unitless)**	**n (estimated %)**	**Velocity (cm/sec)**	**Velocity (feet/year)**
Organic Silt/Fill	4.50E-06	0.003	0.2	**6.75E-08**	**6.98E-02**
Sand	3.94E-03	0.002	0.25	**3.15E-05**	**3.26E+01**

The calculated average linear velocities confirm that the groundwater velocities in the organic silt/fill are much lower than in the underlying sand. Based on these calculations it would take groundwater traveling in the organic silt/fill approximately 143 years to travel a distance of

10 ft. Groundwater in the underlying sand would take approximately 0.6 years to travel the same distance. These results also suggest that the benzene was placed with or emplaced into the organic silt/fill deposits as it would have taken centuries for the benzene to have migrated from an upgradient source through the organic silt to reach its current distribution.

2.4 Contaminant Distribution

Investigations completed to date have defined a small area in the LSP where benzene concentrations in sediment exceed the benzene PRG developed by EPA (e.g., 1.472 mg/kg) that may pose ecological risk, specifically risk to benthic macroinvertebrates. Initially, it was unclear if the elevated benzene concentrations observed in this sediment within the LSP were the result of active contaminated groundwater migration from the WHP into the LSP sediments, or if the benzene was pre-existing and bound to remnant organic-rich sediments within LSP. Figure 9 (attached) provides the WHP and LSP area cover certification information and details showing limits of the OU1 remedial activities.

In the following sections, we describe the known sources of benzene in the WHP, and the observed benzene concentrations in soil, sediment, groundwater, and surface water.

2.4.1 Known Benzene Sources in the West Hide Pile

We were unable to find detailed descriptions regarding composition of the WHP landfill in terms of its filling history and associated spatial distribution of contamination. Of the work completed to date as part of the MSGRP RI, a grid-based soil gas survey by Roux provides the best indication of the relative heterogeneity of the landfill. See Figure 10 (inset) for graphical representation of this soil gas work.

Figure 10: Historic Soil Gas Investigation of West Hide Pile

Historical groundwater samples collected within OU2 in Figure 11 show benzene impacted groundwater in the vicinity of the impacted sediments, but limited impacts to groundwater in surrounding and downgradient wells (groundwater flows generally in a southeasterly orientation relative to the WHP area). As shown on the image, there is a known source of benzene in the vicinity of the 10 Atlantic Avenue parcel.

Figure 11: Historic Groundwater Data-Benzene. Note: Red symbols indicate benzene in groundwater >4 ug/L; Green symbols indicate benzene in groundwater < 4 ug/L.

As part of PDI-9, additional groundwater samples were collected in the vicinity of the WHP and surrounding areas. The results also show impacts in the area of concern discussed herein, but very limited impacts in surrounding and downgradient areas (see Figure 12). If the WHP is a potential source of benzene in groundwater, one would expect benzene impacts in downgradient areas based on the regional groundwater flow paths presented above.

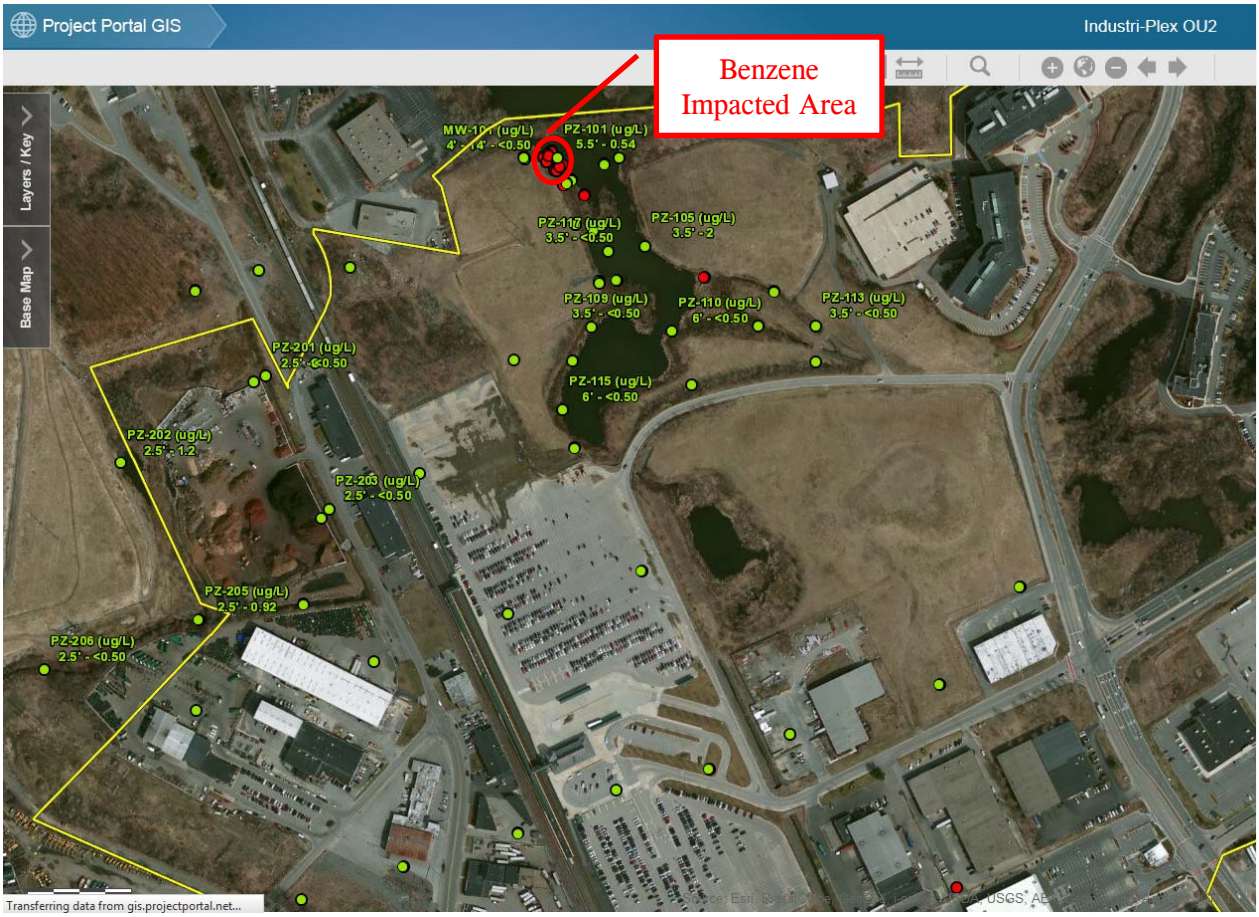

Figure 12: PDI-Based Groundwater Data - Benzene. Note: Red symbols indicate benzene in groundwater >4ug/L; Green symbols indicate benzene in groundwater <4 ug/L.

2.4.2 Benzene in Soil/Sediment

In addition to sediment sampling conducted to delineate the approximate limits of the impacted sediments within LSP (as described in the 30% RD Document), four separate upland soil and LSP sediment sampling explorations types/programs were conducted in the area.

2.4.2.1 Soil

A variety of explorations were conducted to evaluate benzene concentrations in upland soil, adjacent to the impacted area in LSP. A total of 25 MIP profiles were completed to assess total VOCs in soil and groundwater. In addition, four soil borings were completed with GeoProbe drilling equipment. The MIP data confirmed the highest concentrations of benzene 1) were located along the pond edge (e.g., near SP-2 sediment location), and 2) were found within a fine-grained organic silt/fill deposit between approximately 4-8 ft bgs. Soil samples collected from soil borings confirmed that the benzene was associated with fine-grained organic silt/fill similar to the organic sediment located in LSP. Refer to Table VI for soil sample results. The soil boring completed at location MW-105D exhibited the highest benzene concentration observed at 1,400 mg/kg (in organic silt/fill layer). This location is also near the highest sediment concentration observed in LSP. Soil samples collected from the sand below the organic layer exhibited relatively low benzene concentrations. The MIP profiling also indicated that benzene concentrations were much lower in soil both above and below the organic silt/fill layer. Cross

sections presented in Figures 13 through 16 show the location and elevation of both soil/sediment and groundwater samples and the analytical data results for benzene.

Results of the numerous sediment and organic silt/fill samples collected from within the benzene impacted area clearly indicated that elevated benzene concentrations are present in organic-rich sediment and the corresponding organic fill soils, while samples collected from the naturally deposited sand layer underlying the LSP sediments and upland organic fill soils, indicate much lower concentrations, including several below the detection limit.

2.4.2.2 Sediment

Several rounds of sediment sampling were performed in support of PDI-9 as described below.

June-July 2011 – Initial sediment characterization as described in the RDWP and documented in the 30% RD submission. A total of 17 samples were collected from 17 locations across the LSP (PZ-100 series). Based on this initial phase, the sample collected at PZ-101 exhibited 30 mg/kg of benzene. The sediment in the vicinity of PZ-101 was further investigated, as discussed below. Table VII summarized sediment quality data.

August-October 2011 – Three separate sample events were conducted to characterize sediment proximate to PZ-101. These investigation phases included:

1. PZ-101 series, using compass direction/orientation as a suffix). In August 2011, 3 samples (from 3 locations) were collected and analyzed. Benzene concentrations observed > 1 mg/kg in all three locations.
2. PZ-101 series, using compass direction/orientation as a suffix). In September 2011, 5 samples (from 5 locations) were collected and analyzed. Benzene concentrations observed > 1 mg/kg in three of the five locations, including one location (PZ-101SSE-SE) where benzene was reported at 380 mg/kg.
3. SE-series. In September and October 2011, 8 samples (from 8 locations) were collected and analyzed. Benzene was not detected in samples collected at locations SE-302, SE-303, and SE-308 through SE-311, which were 35 to 75 ft from of the PZ-101 sediment sampling location. Benzene was detected at a concentration of 120 mg/kg at SE-301 located approximately 30 ft southeast of PZ-101.

The work performed in 2011 is summarized in greater detail in the 30% RD. The following summarizes post-30% RD work completed for PDI-9.

June 2012 – Sediment profiling via multi-depth sediment sample cores was conducted in June 2012 along the edge of LSP where benzene had been identified based on prior work. A total of 9 samples were collected from 3 locations (CS-series). Benzene concentrations exceeded 1 mg/kg in 2 of the 9 samples (both collected from location CS-1 located northwest of PZ-101).

October 2012 – Two separate sample events were conducted to characterize sediment in LSP for benzene. These investigation phases included:

1. SE-series (SE-317 through SE-319). In October 2012, 3 samples (from 3 locations generally north of PZ-101) were collected and analyzed. Benzene concentrations observed <0.1 mg/kg in all three locations.
2. SP-series (SP-1 through -3). In October 2012, multi-depth sediment profiling, including 9 samples (from 3 locations generally running along the edge of water with SP-1 located northwest, SP-2 nearby, and SP-3 southeast of PZ-101) were collected and analyzed. Benzene concentrations observed >1 mg/kg in 6 of the 9 samples from SP-1 and SP-2. Benzene concentrations in the three samples collected from SP-3 were all below 1 mg/kg. In addition, sediment porewater sampling was performed at these locations to assess benzene partitioning.

Based on the work described above, the conceptual site model was updated and preliminary extent of sediment removal was defined, as presented in the March 2014 100% RD submission for WHP-LSP recognizing that additional work remained to be performed. This additional PDI-9 work involved pre-remediation waste characterization, sediment dewatering characterization, loose sediment thickness probing ("peat probes"), and lateral delineation sampling and analysis. This work is described below.

April – July 2014 – The following additional PDI work was conducted to finalize the horizontal remediation limits and collect additional data to support design.

1. Pre-remediation Waste Characterization and Dewatering Testing – A composite sample was collected from within the footprint of the sediment proposed for removal to assess its preliminary waste characteristics and support dewatering testing with solidification reagents. This sample, designated LSP-COMP-041014-1430, was analyzed for total benzene (to assess the relative amount of benzene in the bulk sediment matrix for comparison to other pre-existing data), TCLP VOCs, TCLP metals, RCRA characteristics (including reactivity, corrosivity, and ignitability), and paint filter (to assess free water). The benzene concentration in the bulk matrix was 6 mg/kg, which exceeds the benzene PRG but is significantly less than the maximum observed at other locations (e.g., SP-2-SE-01-101812, where benzene was reported at 940 mg/kg). In addition, the unsolidified sample failed the paint filter test (i.e., a "positive" test result).

   The sediment was tested for its dewatering characteristics and requirements, the results of which are summarized in Appendix A. A sample aliquot of successfully dewatered sediment (the sample with 5% by wet weight Type I Portland Cement addition) was then shipped to the analytical testing laboratory for post-solidification waste characterization testing. The benzene concentration in the bulk sample remained approximately the same (6.1 mg/kg); however, the TCLP benzene declined from pre- to post-solidification from 0.34 mg/L to 0.024 mg/L, indicating the pre-solidification benzene TCLP was slightly below the RCRA TCLP criteria (note: the RCRA benzene TCLP threshold is 0.5 mg/L) and the Portland Cement bound up some of the benzene. The solidified sample passed the paint filter test (i.e., a "negative" test result from the laboratory). The results of the pre- and post-solidification testing are summarized in Table VIII. The results of this preliminary testing indicate the waste will likely be non-hazardous if solidified, however, it should be noted that given the benzene concentration variability observed spatially in sediment, additional waste characterization testing at the frequencies required by applicable landfills may indicate some portion of the waste may exceed the RCRA TCLP benzene criteria and require hazardous waste management.

2. Sediment Thickness Probing – Loose sediment thickness was probed to estimate the thickness of loose, organic sediment in the LSP remediation area to facilitate the sediment removal design. Probes were performed on a grid as shown on Figure 17. The thickness of loose organics were estimated to range up to 5.4 ft thick measured below sediment-water interface, with an overall average thickness of 3.9 ft based on the PP-series results where organics were encountered. Data are summarized in Table IX.

3. Pre-remediation Delineation Sediment Coring – The initial round of delineation coring (DC-series) in April 2014 consisted of performing eleven (11) sediment cores in the organic layer along the perimeter of the proposed sediment removal area (see Drawing G-404), sectioning the cores into two sample intervals: a 0- to 6-in. depth sample and a greater than 6 inches. In total, 22 samples (two at each of the eleven locations) were analyzed for total benzene in the bulk sediment matrix. Based on this initial round of sampling and analysis, the extent of sediment removal over a large majority of the perimeter was defined, however several locations exhibited concentrations above the benzene PRG, requiring additional sampling events performed in May 2014 (13 additional samples from 7 locations). The limits of sediment removal were defined based on this work.

In summary, multiple sediment sampling rounds were performed to identify the horizontal extent of sediment exhibiting benzene concentrations greater than the PRG of 1.472 mg/kg. Table VII summarized sediment quality data. Sediment sample locations are shown on Figure 18 and Drawing G-404. Drawing G-404 illustrates the revised sediment removal limits based on the outcome of testing described above.

2.4.3 Benzene in Groundwater

Five separate groundwater/pore water sampling explorations types/programs were conducted in the benzene area as part of the supplemental investigations undertaken following the initial PDI work included in the 30% design submittal. The groundwater and sediment porewater data are included in Table X (attached). Locations are provided on Figure 3. Key findings from groundwater sampling included:

- Groundwater collected at shallow depths above the organic silt/fill deposit exhibited low benzene concentrations ranging from less than 0.5 ug/L to 12 ug/L.
- Groundwater samples collected from within the organic silt/fill deposit (e.g., approximately 4-8 ft bgs) exhibited much higher benzene concentrations ranging from 440 ug/L to 390,000 ug/L. The maximum concentration of 390,000 ug/L was observed at location MW-107S located on the shoreline of LSP.
- Porewater collected within the organic sediments in LSP exhibited a range of benzene concentrations from less than 0.5 ug/L to maximum benzene concentration of 82,000 ug/L at location SP-2 at a depth of 1.5-2.0 ft below the sediment surface.
- The highest porewater concentration observed at location SP-1 and SP-2 (SP-3 exhibited ND results) were located at a depth of 1.5 ft to 2.0 ft below the sediment surface.
- Groundwater collected from the sand underlying the organic silt/fill deposit exhibited a range for benzene concentration from less than 0.5 ug/L to 1,800 ug/L at location CS-2. Location CS-2 appears to be an outlier as the other eight samples collected from the sand exhibited benzene concentrations below 16 ug/L. It is possible that as the piezometers were installed

through the highly contaminated organic silt there was some "drag down" of organic silt and sorbed benzene into the sand layer that may have produced the benzene detections.

- Based on groundwater quality downgradient (more regionally) from the area of benzene-contaminated LSP sediments, a benzene source derived from such sediments does not appear to exist.

2.4.4 Benzene in Surface Water

As part of PDI-9, 18 surface water samples were collected from LSP. The locations are shown on Figure 19, and Table XI presents the surface water data. As shown in the table, all the sample results were non-detect with the exception of PZ-108, which exhibited an estimated concentration of 0.38 ug/L, below the typical detection limit of 0.5 ug/L. The data indicate that there are no significant impacts to surface water, including at location PZ-101, which is located in the area of greatest sediment impacts (e.g., SP-2).

2.4.5 Benzene Partitioning

Partitioning calculations were conducted to evaluate the distribution of benzene between soil/sediment samples and co-located groundwater/porewater samples. Table XII presents the portioning calculations. Based on studies published on benzene partitioning, the K_{OC} was used to assess equilibrium as noted in the table. As shown in the table, the calculated K_{OC} is much higher than predicted for many of the samples with elevated benzene concentrations based on literature values, indicating that benzene concentrations in soil and ground water (or sediment/porewater) are not in equilibrium (between the sorbed phase and the dissolved phase). Moreover the data show that the benzene is enriched in the sorbed phase indicating that the soil/sediment is the source of benzene in the groundwater. One location MW-107 shows that the groundwater may be enriched relative to the soil. However, the fraction of organic carbon (F_{OC}) value reported for MW-107 is almost 9%, which is approximately four times the F_{OC} typically observed in the organic silt/fill or sediment.

2.5 Discussion and Conceptual Site Model

Although the WHP is a known source of benzene-containing waste, the data collected indicate that there is an area of benzene impact within the organic silt located immediately adjacent to and in a small portion of the LSP. It also appears that the benzene is bound up with the organic content of the soils and sediments with limited migration potential. Ongoing risk to the LSP is minimized as the groundwater flow within the organic silt deposit flows to the south. Therefore, if there was migration of benzene with groundwater it would not be discharging to the LSP in the area impacted. Based on the hydraulic conductivity estimates and gradients observed, groundwater transport is limited to less than 1 inch per year within the organic silt layer. Benzene is readily retarded through sorption to the highly organic material in the subsurface, and therefore benzene migration would be less than estimated for groundwater. It appears that conditions exist within the impacted area that limits the degradation of benzene. It is widely believed that benzene degradation is reduced under anaerobic conditions. If under anaerobic conditions, the appropriate electron acceptors are not available, degradation will be further limited. The low permeability of the organic silt prevents collection of sufficient groundwater to gather field parameters. However, the high organic carbon content and persistence of benzene suggest anaerobic conditions exist within the organic silt/fill. Accordingly the data suggest degradation of benzene in the identified source area is limited or nonexistent as very high concentrations exist many years after the waste was generated.

Based on the extensive amount of data collected in this localized area of the WHP and LSP, it appears that the elevated concentrations of benzene are associated with the organic silt/fill deposits that extend from the impacted sediments identified in the LSP to the west beneath the edge of the WHP fill materials. Based on the relationship between the sediments and the organic silt/fill (see cross sections in Figure 13 through 16), it is likely the organic silt/fill was also in place before the OU1 remedy was implemented. The concentrations of benzene within the organic deposits are variable; however the highest concentrations are along the edge of the WHP and located in LSP sediments. Partitioning calculations completed on co-located soil and groundwater indicate that the soil and groundwater are either in equilibrium or that the benzene is associated with the solids (e.g., very high K_{oc}). This implies that the source of benzene is the organic solids located near the edge of LSP, not from contaminated groundwater migration emanating from the WHP. Based on the hydrogeologic data, groundwater moves at a very low rate (i.e., 0.07 ft/yr) within the organic silt deposits and that ongoing discharge from groundwater to surface water is not considered to be a significant concern. Furthermore, the hydraulic gradients observed at the site indicate that groundwater within the organic silt is flowing to the south away from the impacted sediments in LSP. It appears that degradation of benzene is limited within the organic silt layer as the concentrations remain very high. Although the low permeability of this formation precluded collection of ORP data, it is likely that anaerobic/anoxic conditions exist within the deposit and preclude significant degradation of benzene.

3.0 LOWER SOUTH POND - WEST HIDE PILE REMEDY DESIGN (GW-4)

The approximate area of WHP-LSP excavation shown on Drawing G-404 (see Appendix A) includes both sediment currently under water and an area of soil immediately to the west of the sediment area to provide an added buffer. The sediments above the PRG in the LSP will be dredged, disposed off-site and restored. Some of the soils adjacent to these sediments and under the eastern portion of WHP's existing OU1 protective cover will be removed, disposed off-site, and restored so that these soils do not impact the restored sediments and as part of the construction means and methods to facilitate sediment removal. A removal and disposal remedy for this portion of the Site will be implemented in lieu of the in situ bioremediation remedy identified in the ROD.

3.1 Design Components and Objectives to meet Performance Standards

Elevated benzene sediment and porewater concentrations were identified in the area shown in Drawing G-404. Based on benzene risk criteria developed by EPA, it was determined that unacceptable risk to ecological receptors exists within the impacted portion of LSP.

It was posited in the ROD that the WHP may be a source of ongoing discharge of groundwater containing benzene to the LSP, which would be the mechanism resulting in benzene-impacted sediment identified within the pond. The PDI-9 data collected and summarized in Section 2 above indicate that the identified area of benzene impact resides in an organic silt deposit in a limited portion of the LSP immediately adjacent to the WHP and select upland soils beneath the OU1 cover. The benzene is bound to the organic material in the soils and sediments which limits its migration potential. There is minimal groundwater flow within the organic silt deposit, and groundwater flows to the south and not towards the LSP. Therefore, if benzene were being transported via groundwater from the WHP, it would not be discharging to the LSP in the area where impacted sediment was identified. Also, based on the hydraulic conductivity estimates and gradients observed, groundwater transport is limited to less than 1 inch per year within the organic silt layer, further limiting the potential for benzene migration via groundwater. Supporting data and calculations are summarized in Section 2 above.

In summary, the current CSM developed based on the data collected and described in Section 2 supports the proposed sediment removal action in LSP. The benzene impact within the LSP is in a stable and isolated condition, and no significant amount of benzene is either migrating to or from this location. Because of this, a remedial approach different from the in situ bioremediation remedy identified in the ROD (i.e., groundwater treatment in the footprint of WHP) is necessary to address the impacted sediments. The remedial action proposed involves the removal of sediments from the LSP at concentrations above the ecological PRG established by EPA for this component of the remedy of 1.472 mg/kg for benzene, as well as some of the benzene impacted soils adjacent to these sediments under the eastern portion of WHP's existing OU1 protective cover to establish a buffer and facilitate sediment removal.

3.2 Design Basis

As summarized in greater detail in Section 2 above, sample results and data analysis support the following CSM:

- The area of benzene impact is located within the organic silt/fill deposits close to the shore of LSP and sediment overlying the silt layer within the LSP.

- The organic silt/fill deposits exhibit significantly lower (3 orders of magnitude) hydraulic conductivity than the underlying sand deposits.
- Upland organic silt/fill soils and sediments contaminated with benzene located along the northwestern shoreline of LSP are likely remnant wetland sediments or historical fill material, which were either covered in place or moved during implementation of the OU1 remedy.
- Benzene concentrations in and partitioning coefficients for LSP sediments indicate that any migration of dissolved benzene in the impacted area is from sediments into groundwater and not vice-versa.
- Aerial photographs from 1938-2008 indicate that the area of LSP with impacted sediments show discrete fill deposits that have now been identified as co-located with the area of benzene impact.
- There is no evidence of significant migration of benzene in the groundwater from any location upgradient of the benzene impacted organic silt and sediment identified during the PDI investigation.

These results provide multiple lines of evidence that the benzene contaminated sediment in the vicinity of PZ-101 in LSP is not the result of groundwater or migration of benzene from the WHP (an upgradient source), but is a discrete area of historic contaminant deposition. This organic silt/fill deposit in LSP is amenable to excavation to remove the identified source of benzene.

Data collected during the PDI-9 investigations was used to calculate a PRG for impacted sediment within LSP, adjacent to the WHP. This "Ecological PRG development and evaluation of sediment toxicity of benzene" was issued by EPA on August 6, 2013 (dated July 31, 2012 and revised July 26, 2013), and indicated a benzene PRG of 1.472 mg/kg in sediment should be used as a basis for remediation. The development of the PRG considered the habitat, receptors and complete exposure pathways. The primary receptors considered were the benthic invertebrates and possible amphibians that burrow in sediment. A range of sediment benchmark values were calculated using Total Organic Carbon (TOC) data from the site and EPA's ECOTOX toxicology data with the final bench value derived from the geometric mean of the range of values calculated. SD's have adopted EPA's PRG solely for the purpose of completing the 100% design and implementing this aspect of the remedial action.

3.3 100% Design

Based on the results of PDI-9, the 100% RD therefore focuses on removing impacted material present at concentrations above the PRG of 1.472 mg/kg for benzene within the footprint of the LSP and along a small portion of the upland soil.

Sediment removal addresses the contaminated sediments exceeding EPA's recommended PRG value by physically removing the sediments (with appropriate engineering controls), dewatering the sediment, and disposing of the contaminated sediments at an approved permitted off-site disposal facility. Post-removal monitoring will be performed to confirm there is no re-contamination of the sediment in this area. Given the shallow water depth, small removal volume, process-intensive and space-demanding nature of the sediment processing facilities for hydraulic and mechanical dredging methods, mechanical excavation "in-the-dry" has been identified as the best means of sediment removal for LSP.

Drawings associated with the Lower South Pond Sediments adjacent to West Hide Pile are provided in Appendix A. Calculations and additional supporting documents for the WHP design components are also presented in Appendix A.

3.3.1 100% Design Overview

3.3.1.1 Pre-Construction Sampling

PDI-9 results summarized in Section 2.4.2.2 were used to estimate the lateral and vertical extent of sediments contaminated with benzene above the PRG (Drawing G-404). As described above, additional sediment delineation cores were collected in 2014 after the March 2014 100% RD was submitted for the WHP-LSP in an effort to confirm the extent of benzene contaminated sediment greater than the PRG and determine the horizontal removal limits of the excavation before contractor mobilization. The pre-construction samples were collected from locations shown on Figure 18 and Drawing G-404.

Pre-construction sampling was also completed to characterize the sediment for waste disposal (TCLP VOCs, TCLP SVOCs, TCLP metals, TCLP pesticides, TCLP herbicides, total PCBs, ignitability, corrosivity, reactivity, and paint filter test) and evaluate the appropriate type and percentage of solidification agent to be applied to the excavated sediment. See Section 2.4.2.2 for a data summary. Any supplemental testing required by the disposal facility will be incorporated into construction activities.

Sediment thickness probing (sometimes referred to as “peat” probes) was performed in April 2014. The probing was performed along the proposed layout of the temporary cofferdam and in the area of proposed sediment removal in order to verify the thickness of soft sediment. The sediment thickness data is summarized in Section 2.4.2.2.

3.3.1.2 Sediment Removal Volume

The sediment removal volume is currently estimated to be approximately 900 in-place cubic yards (cy)[2]. The approximate extent of sediment removal from WHP-LSP is shown on Drawing G-404 in Appendix A. The actual volume is contingent upon confirmatory samples collected during the excavation activities. Based on the data collected to date, the target for the sediment removal in this area is the organic silt, which can be distinguished visually from the underlying sand. As such, the vertical extent of sediment removal may be guided by combination of visual evidence of organic silt and PID results. In the event areas of organic silt are encountered that exhibit low benzene concentrations below the PRG, the vertical extent of sediment removal may terminate before encountering the underlying sand layer and the organic material at the base of the excavation and will be subjected to confirmatory testing.

3.3.1.3 Sediment Removal Method

The primary method of sediment removal will be by mechanical excavation in the dry, requiring dewatering and treatment of the effluent. As described in more detail below, the sediment removal area will be accessed from the western shore of LSP (see Drawing C-400 in Appendix A).

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[2] The estimated area is 6,200 sq ft, and with an average sediment thickness of 3.9 ft based on the sediment thickness probes, the estimated in-place sediment removal volume is approximately 900 cy.

3.3.1.4 Confirmatory Sampling

After removal of the impacted sediment, confirmatory samples will be collected at the bottom of the excavation. If results indicate benzene concentrations are still greater than 1.472 mg/kg, additional sediment will be removed. Confirmatory samples will continue to be collected and analyzed until concentrations of benzene in the excavation are below 1.472 mg/kg. Confirmatory sampling and testing for benzene will be performed by the Contractor during construction. The proposed confirmatory verification sample locations are on an approximate 20-ft grid as shown on Drawing C-403. The lateral extent of sediment removal has been delineated already, as summarized in Section 2 and shown on Drawing G-404. Turnaround times and other sampling requirements are described in specification Section 023200 - Sampling, Testing, and Data Evaluation.

During construction, the Contractor will also be performing dewatering discharge sampling (described below and outlined in Specification Section 312319) and any supplemental facility-specific waste disposal characterization sampling. The Contractor will also collect post-solidification samples for waste disposal characterization if the solidification agent dosage rate is adjusted beyond the dose identified during pre-construction testing.

3.3.1.5 Backfilling and Wetlands Restoration

Sediment removal activities will be conducted as shown on Drawings C-403.

The excavation areas within LSP will be restored to pre-remediation elevations. As shown on Detail 1, Drawing C-409, restoration will involve (from bottom up): a non-woven geotextile fabric (Mirafi 1160N or approved equal), wetland organic soil, and an erosion control blanket. After the contaminated sediment removal area is restored, the rip-rap (removed as needed to facilitate excavation) will be replaced and any disturbances made to the existing WHP permeable cap system toe-drain will be repaired and restored as shown on Detail 2, Drawing C-409. Other impacts to the existing OU1 cover system will be restored in general conformance with the OU1 cover design as described in the specifications and shown on the Drawings.

At the upland edge of the excavation will be a boundary of (from bottom up): a geotextile separation layer (Mirafi 1160N or approved equal), 6-in. thick layer of Aquagate + PAC™ (10% PAC formulation), and wetland soil. The addition of the 6-in. thick Aquagate + PAC™ layer is to provide an additional level of protectiveness in the event groundwater with levels of residual benzene migrates toward/into the remediated area in the future. Aquagate + PAC™ is an aggregate that has been coated with activated carbon powder, and has been designed for sediment remediation applications. The larger particle size of Aquagate + PAC™ allows free flow of groundwater and the activated carbon coating provides high sorptive capacity to treat any residual VOCs that may remain. The 10% by weight PAC formulation is specified for this application to increase longevity. Breakthrough time for the Aquagate+PAC™ was estimated using the model created by Lambert & Reible (2008) with the Capsim 2.6 model code. Based on the model run, approximately 100+ year service life before breakthrough is forecast. Refer to memo and calculation output file (attached) for additional input information and output results (see Appendix A).

In the event the existing permeable cap is disturbed during construction activities (contractors will take measure to avoid such a disturbance), it will be restored as shown in Detail 1, Drawing C-409 alongside the additional site restoration activities. Additional restoration will be completed at the staging areas and around the work area. Straw wattles, crushed stone, geotextile, and all components

of drainage systems will be removed and disposed of properly. Site conditions will be restored to preconstruction status as shown on Drawing C-408.

3.3.2 Staging and Site Preparation

3.3.2.1 Access Considerations

An Access Agreement will likely need to be negotiated with a private land owner for access to the WHP from the Anderson Regional Transportation Center (ARTC) Access Road.

The proposed temporary access road off of the ARTC Access Road is shown on Drawing C-400 (Appendix A). Where the temporary access road crosses the existing WHP drainage swale, a 12-in. diameter pipe will be installed beneath the proposed access roadway. Along the proposed roadway, the existing vegetated surface will be scarified to prepare the subgrade to receive the geotextile where necessary. Cutting into the geosynthetic portion of the existing WHP cap and cover system for temporary access roadway construction will not be permitted. Crushed stone will be added on top of the geotextile to create a level roadway and appropriate slope to match existing grades while straw wattles will be used for erosion control. Details for the roadway are shown on Detail 1, Drawing C-405.

3.3.2.2 Construction Staging Area

A construction staging area will be established in close proximity to the work area as indicated on Drawings C-400. The construction staging area will be enclosed by temporary construction fence and include a temporary bathroom, access gate, and temporary construction vehicle parking and equipment storage. Grading will be performed as required.

3.3.2.3 Sediment Stockpile Management Area

A sediment staging area and a sediment stockpile management area will be established as indicated on Drawings C-400 and C-403. The sediment staging area will be adjacent to the Lower South Pond where the sediment will be allowed to dewater back into the pond area being excavated. Once the material is initially dewatered the sediment will be transported using low ground pressure articulated trucks to the stockpile management area located on the WHP. The sediment stockpile management area will include a bermed and sloped area that will be lined with both geotextile and a geomembrane (per Detail 1, Drawing C-407). The entire area will be bermed with haybales, and lined as indicated on the drawings, and covered daily to minimize rain water contributions into the stockpile. Specific means and methods are documented in the RAWP provided under separate cover. Limited stabilization of the material will be performed in the excavation area, and the material will be loaded into off-road, low ground pressure articulating truck(s) and transported to a sediment holding cell on the top of the WHP. Loading of the material into trucks will be performed with the truck on clean base. The swing area outside of the excavation limits will be protected with poly sheeting.

3.3.2.4 Additional Site Preparation Activities

Additional site preparation activities will include the abandonment of four (4) monitoring wells, removal of one piezometer (PZ-101) within the excavation, and the modification of five (5) monitoring wells in the vicinity of the construction area (see Drawing C-402) and the removal of existing rip rap as

necessary from the sediment excavation area. One piezometer (PZ-101) located within the footprint of the LSP sediment removal will be excavated as a means of removal.

Wells that are modified will be cut down to match existing surrounding grades and then roadway boxes will be installed. These wells will be protected during construction activities. Wells that are marked to be destroyed will be abandoned in accordance with Specifications Section 332900.

The existing rip rap located within the benzene-contaminated sediment removal area will be removed if necessary prior to sediment excavation and stockpiled for reuse later as shown on Drawing C-403.

3.3.3 Material Management Plan

3.3.3.1 Erosion and Sedimentation Controls

As described above for the various upland work areas, erosion and sedimentation controls will be installed to prevent erosion of contaminated materials into surrounding wetlands and/or surface water bodies. In addition, an impermeable silt curtain (a portion of which will have permeable panels) will be installed surrounding the excavation work area within LSP as shown on the Drawings. The Contractor will monitor effectiveness of these upland and in-pond erosion and sedimentation control measures by performing visual inspections and water quality sampling at the locations identified on Drawings C-400 and C-401, and following requirements outlined in Specification Section 312500. Figure 20 outlines the surface water monitoring program approach.

3.3.3.2 Dewatering and Dewatering Effluent Treatment during Sediment Excavation Activities

The mechanical excavation of benzene-impacted sediments from the LSP will need to take place under dry conditions. To achieve dry conditions, a temporary 10 ft cofferdam structure (Port-a-Dam or similar) will be installed within the LSP as shown on Drawing C-403. Surface water will be pumped out of the area enclosed by the temporary cofferdam. Additional well point system will then be installed as required to allow excavation in the dry.

Dewatered liquids will be treated by the DETS, shown on Drawings C-400 and C-403. The DETS system will include, at minimum, a baffled fractionation tank (as shown on Drawing C-403 and Detail 5, Drawing C-406) and a bag filter system as specified in Section 312319. In addition to the standard DETS treatment equipment outlined in Specification Section 312319, the contractor will have activated carbon vessels on site that will be incorporated into the DETS. The activated carbon vessel will be used to remove benzene[3] that is anticipated to be in the surface water and/or sediment pore water.

The impounded area will be pumped dry by initially pumping at a higher pumping rate using a pump installed in the water column. This will also develop a proper seal with the temporary cofferdam structure. Once the surface water level is observed to be approximately 1 ft above the mud-line, the bulk of the surface water column inside the cofferdam will then have been removed (thus creating differential head and improved seal of the Port-a-dam structure) and remaining water will be dewatered through the well point system (as necessary), likely at a slower pumping rate, during excavation.

[3] Groundwater and pore-water benzene values collected during the PDI-9 investigations range from 0.5 to 390,000 μg/L with an average value of 41,362 μg/L and a median of 1,800 μg/L.

After treatment, water will be discharged via hose into the LSP outside the silt curtain within the existing riprap cover located at the shoreline. This discharge will be monitored to ensure no erosion occurs. The system monitoring and sampling program will be performed as outlined in Specification Section 312319 and summarized in the FSP (Appendix E, Attachment E4).

3.3.3.3 Material Handling

Sediments will be excavated, stockpiled adjacent to or within the excavation to allow dewatering under self-weight, partially solidified if practicable and placed into off-road dump trucks for transport to the sediment stockpile management area (see Drawing C-403).

Based on the sediment characteristics, solidification of the excavated sediment will likely be needed in addition to gravity dewatering. As described in Section 2.4.2.2, a 5% by wet weight Type I Portland Cement addition was identified through preliminary testing. Sediment will then be tested as needed per the receiving facility test requirements, loaded onto trucks, and transported to appropriately-permitted off-site disposal facility.

3.3.3.4 Waste Disposal

Chemical testing results to date indicate that the LSP benzene-contaminated sediment may not be suitable, without treatment (solidification/stabilization) for acceptance at a non-hazardous landfill facility due to the potential for leaching of benzene. Concentrations of benzene in sediment in the bulk matrix were greater than 20 times the RCRA limit (i.e., the 20 times rule of thumb) in select locations and testing of a composite sample indicated a pre-solidification TCLP benzene concentration of 0.34 mg/L (slightly below the 0.5 mg/L RCRA limit for benzene) at a bulk matrix benzene concentration of 6 mg/kg, which is low relative to select sample locations in the LSP sediment. Post-solidified sediment exhibited a lower TCLP benzene concentration of 0.024 mg/L. See Section 2.4.2.2 for additional information regarding the dewatering testing and preliminary waste characterization testing program performed for PDI-9. In the event that the excavated, stabilized sediment exceeds the RCRA Toxicity Characteristics Leaching Procedure (TCLP) limit for benzene, the material will be disposed at an EPA approved hazardous waste landfill facility.

TABLE VI
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SOIL
INDUSTRI-PLEX OU2, WOBURN, MA

Location	MW-104D			MW-105D			
Sample ID	MW-104D-01-112712	MW-104D-02-112712	MW-104D-03-112712	MW-105D-01-112612	MW-105D-02-112612	MW-105D-03-112612	MW-105D-04-112712
Sample Date	11/27/2012 9:00	11/27/2012 9:30	11/27/2012 10:00	11/26/2012 12:30	11/26/2012 13:00	11/26/2012 13:30	11/27/2012 14:00
Sample Depth	3.5' - 4.5'	6' - 7'	12' - 13'	4' - 5'	5' - 6'	10.5' - 11.5'	3.5' - 7.5'
Lab Sample ID	L1221354-01	L1221354-02	L1221354-03	L1221295-04	L1221295-05	L1221295-06	L1221354-08
VOCs (ug/kg)							
BENZENE	70000	120000	1.6U	240000	1400000	1.8U	-
OTHERS (%)							
TOTAL ORGANIC CARBON	2.17	2.065	0.023	0.593	1.305	0.0425	-
TOTAL SOLIDS	64	73	75	62	61	80	60

NOTES:
1. "-" Indicates Data Not Collected

TABLE VI
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SOIL
INDUSTRI-PLEX OU2, WOBURN, MA

Location	MW-106D				MW-107D		
Sample ID	MW-106D-01-112712	MW-106D-02-112712	MW-106D-03-112712	MW-106D-04-112712	MW-107D-01-112612	MW-107D-02-112612	MW-107D-03-112612
Sample Date	11/27/2012 11:30	11/27/2012 12:00	11/27/2012 12:30	11/27/2012 13:00	11/26/2012 9:00	11/26/2012 9:30	11/26/2012 10:00
Sample Depth	3.4' - 4.4'	7' - 8'	13' - 14'	4.5' - 8.5'	5.5' - 6.5'	7.5' - 8.5'	11.75' - 12.75'
Lab Sample ID	L1221354-04	L1221354-05	L1221354-06	L1221354-07	L1221295-01	L1221295-02	L1221295-03
VOCs (ug/kg)							
BENZENE	27000	320000	5.1	-	510000	8800	1.5U
OTHERS (%)							
TOTAL ORGANIC CARBON	1.455	1.955	0.0205	-	8.845	0.6715	0.0115
TOTAL SOLIDS	77	73	80	78	25	79	80

NOTES:
1. "-" Indicates Data Not Collected

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location		CS-1			CS-2				CS-3	
Sample ID **Sample Date** **Sample Depth** **Lab Sample ID**	**EPA Sediment Criteria for Lower South Pond**	CS-1-SE-01-060412 6/4/2012 9:13 0' - 0.5' L1209866-01	CS-1-SE-04-060412 6/4/2012 9:20 2.5' - 3.5' L1209866-02	CS-1-SE-05-060412 6/4/2012 9:30 3.5' - 4.5' L1209866-03	CS-2-SE-01-060412 6/4/2012 11:05 0' - 0.5' L1209866-04	CS-2-SE-02-060412 6/4/2012 11:08 0.5' - 1.5' L1209866-05	CS-2-SE-03-060412 6/4/2012 11:10 1.5' - 2.4' L1209866-06	CS-2-SE-04-060412 6/4/2012 11:12 2.4' - 3' L1209866-07	CS-3-SE-01-060412 6/4/2012 12:02 0' - 0.5' L1209866-08	CS-3-SE-02-060412 6/4/2012 12:05 0.5' - 1.3' L1209866-09
VOCs (ug/kg)										
BENZENE	1472	**23000**	**14000**	100J	3.8U	R	8.7J	160	1.5U	1.1U
OTHERS (%)										
TOTAL ORGANIC CARBON		2.8	0.522	11	4.06	11.6	12.3	1.28	0.01U	0.067
TOTAL SOLIDS		53.2	63	27.4	39	18.2	20.2	79	62.2	89.4

NOTES:
1. "-" Indicates Data Not Collected

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PZ-101EE-SE	PZ-101E-SE	PZ-101NNE-SE	PZ-101NN-SE	PZ-101NNW-SE	PZ-101N-SE	PZ-101-SE	
Sample ID	PZ-101EE-SE-01-092211	PZ-101E-SE-081811	PZ-101NNE-SE-01-092211	PZ-101NN-SE-01-092211	PZ-101NNW-SE-01-092211	PZ-101N-SE-081811	2287-FD-001-062811	PZ-101-SE-01-062811
Sample Date	9/22/2011 14:00	8/18/2011 9:10	9/22/2011 13:50	9/22/2011 13:30	9/22/2011 14:35	8/18/2011 9:25	6/28/2011 0:00	6/28/2011 14:39
Sample Depth	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'
Lab Sample ID	L1115141-03	L1112788-04	L1115141-02	L1115141-01	L1115141-04	L1112788-03	L1109541-02	L1109541-10
VOCs (ug/kg)								
BENZENE	**14000J**	**36000**	14U	**2100J**	99J	**3300**	**12000J**	**30000J**
OTHERS (%)								
TOTAL ORGANIC CARBON	-	-	-	-	-	-	1.41	1.63
TOTAL SOLIDS	-	-	-	-	-	-	-	-

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PZ-101S-SE	PZ-101SSE-SE	PZ-102E-SE	PZ-102N-SE	PZ-102-SE	PZ-102S-SE	PZ-102W-SE
Sample ID	PZ-101S-SE-081811	PZ-101SSE-SE-01-092211	PZ-102E-SE-01-122111	PZ-102N-SE-01-122111	PZ-102-SE-01-062711	PZ-102S-SE-01-122111	PZ-102W-SE-01-122111
Sample Date	8/18/2011 9:00	9/22/2011 14:50	12/21/2011 10:15	12/21/2011 9:45	6/27/2011 12:15	12/21/2011 9:55	12/21/2011 9:30
Sample Depth	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'
Lab Sample ID	L1112788-02	L1115141-05	L1121390-03	L1121390-02	L1109441-05	L1121390-04	L1121390-01
VOCs (ug/kg)							
BENZENE	**62000**	**380000J**	-	-	2.3U	-	-
OTHERS (%)							
TOTAL ORGANIC CARBON	-	-	-	-	4.76J	-	-
TOTAL SOLIDS	-	-	60	64	-	59	71

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PZ-103-SE	PZ-104-SE	PZ-105-SE	PZ-106-SE	PZ-107-SE	PZ-108-SE	PZ-109-SE	PZ-110-SE
Sample ID	PZ-103-SE-01-062811	PZ-104-SE-01-062811	PZ-105-SE-01-062711	PZ-106-SE-01-062811	PZ-107-SE-01-062711	PZ-108-SE-01-062711	PZ-109-SE-01-062811	PZ-110-SE-01-062711
Sample Date	6/28/2011 14:10	6/28/2011 12:08	6/27/2011 11:20	6/28/2011 11:21	6/27/2011 10:24	6/27/2011 9:43	6/28/2011 10:40	6/27/2011 14:44
Sample Depth	0' - 0.5'	0' - 0.5'	0' - 0.25'	0' - 0.5'	0' - 0.5'	0' - 0.08'	0' - 0.5'	0' - 0.5'
Lab Sample ID	L1109541-09	L1109541-08	L1109441-04	L1109541-07	L1109441-03	L1109441-02	L1109541-06	L1109441-08
VOCs (ug/kg)								
BENZENE	2.4U	3.1U	2.3U	1.4U	2.7	R	R	1.9U
OTHERS (%)								
TOTAL ORGANIC CARBON	3.45	3.49	2.6J	0.401	2.99J	15.9J	3.22	3.11J
TOTAL SOLIDS	-	-	-	-	-	-	-	-

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PZ-111-SE	PZ-112-SE	PZ-113-SE	PZ-114-SE	PZ-115-SE	PZ-116-SE	PZ-117-SE	SE-300
Sample ID	PZ-111-SE-01-062811	PZ-112-SE-01-062711	PZ-113-SE-01-062711	PZ-114-SE-01-062811	PZ-115-SE-01-062811	PZ-116-SE-01-070811	PZ-117-SE-01-070111	SE-300-SE-01-092211
Sample Date	6/28/2011 10:05	6/27/2011 14:00	6/27/2011 9:00	6/28/2011 8:50	6/28/2011 9:35	7/8/2011 11:45	7/1/2011 12:05	9/22/2011 14:15
Sample Depth	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 6'	0' - 0.5'
Lab Sample ID	L1109541-05	L1109441-06	L1109441-01	L1109541-03	L1109541-04	L1110149-04	L1109834-01	L1115141-06
VOCs (ug/kg)								
BENZENE	1.6U	2.1U	R	2.4U	1.7U	10U	17U	32J
OTHERS (%)								
TOTAL ORGANIC CARBON	1.31	3.11J	6.46J	2.88	3.09	13.4	9.55	-
TOTAL SOLIDS	-	-	-	-	-	-	-	-

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	SE-301	SE-302	SE-303		SE-308	SE-309	SE-310	SE-311
Sample ID	SE-301-SE-01-092211	SE-302-SE-01-103111	2287-FD-001-103111	SE-303-SE-01-103111	SE-308-SE-01-103111	SE-309-SE-01-103111	SE-310-SE-01-103111	SE-311-SE-01-103111
Sample Date	9/22/2011 15:10	10/31/2011 13:10	10/31/2011 0:00	10/31/2011 13:55	10/31/2011 15:00	10/31/2011 15:15	10/31/2011 15:35	10/31/2011 14:50
Sample Depth	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'	0' - 0.5'
Lab Sample ID	L1115141-07	L1118011-01	L1118011-08	L1118011-02	L1118011-04	L1118011-05	L1118011-06	L1118011-03
VOCs (ug/kg)								
BENZENE	**120000J**	3.7U	R	2.6U	R	R	R	R
OTHERS (%)								
TOTAL ORGANIC CARBON	-	-	-	-	-	-	-	-
TOTAL SOLIDS	-	-	-	-	-	-	-	-

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	SE-317	SE-318	SE-319	SP-1			SP-2		
Sample ID	SE-317-SE-01-100212	SE-318-SE-01-100212	SE-319-SE-01-100212	SP-1-SE-01-101812	SP-1-SE-02-101812	SP-1-SE-03-101812	SP-2-SE-01-101812	SP-2-SE-02-101812	SP-2-SE-03-101812
Sample Date	10/2/2012 10:10	10/2/2012 9:30	10/2/2012 10:00	10/18/2012 13:05	10/18/2012 13:10	10/18/2012 13:15	10/18/2012 13:50	10/18/2012 13:55	10/18/2012 14:00
Sample Depth	0' - 0.5'	0' - 0.5'	0' - 0.5'	0.5' - 1'	1.5' - 2'	2.5' - 3'	0.5' - 1'	1.5' - 2'	2.5' - 3'
Lab Sample ID	L1217676-01	L1217676-02	L1217676-03	L1218828-01	L1218828-02	L1218828-03	L1218828-04	L1218828-05	L1218828-06
VOCs (ug/kg)									
BENZENE	13	22UR	12UR	**4800**	**29000**	**28000**	**940000**	**110000**	**460000J**
OTHERS (%)									
TOTAL ORGANIC CARBON	-	-	-	1.415	2.43	2.105	18.4	1.61	13.5
TOTAL SOLIDS	53	14	28	57	64	58	46	65	24

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	SP-3	SP-3		DC-03		DC-04	
Sample ID	SP-3-SE-01-101812	SP-3-SE-02-101812	SP-3-SE-03-101812	DC-3-SE-01-040914-1100	DC-3-SE-02-040914-1105	DC-4-SE-01-040914-1120	DC-4-SE-02-040914-1125
Sample Date	10/18/2012 14:30	10/18/2012 14:35	10/18/2012 14:40	4/9/2014 11:00	4/9/2014 11:05	4/9/2014 11:20	4/9/2014 11:25
Sample Depth	0.5' - 1'	1.5' - 2'	2.5' - 3'	0.0 - 0.5	2.5 - 3.5	0.0 - 0.5	1.5 - 2.5
Lab Sample ID	L1218828-07	L1218828-08	L1218828-09	L1407363-11	L1407363-12	L1407363-13	L1407363-14
VOCs (ug/kg)							
BENZENE	11UJR	180J	52	980	770	18	110
OTHERS (%)							
TOTAL ORGANIC CARBON	3.74	17.35	14.1				
TOTAL SOLIDS	17	12	55	63	57.7	11.7	18.7

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	DC-05		DC-06			DC-08	
Sample ID	DC-05-SE-01-041014-0840	DC-05-SE-02-041014-0845	DC-06-SE-01-041014-0910	DC-06-SE-02-041014-0915	2287-FD-01-041014 (DC-06-SE-02-041014-0915)	DC-08-SE-01-041014-1050	DC-08-SE-02-041014-1055
Sample Date	4/10/2014 8:40	4/10/2014 8:45	4/10/2014 9:10	4/10/2014 9:15	4/10/2014	4/10/2014 10:50	4/10/2014 10:55
Sample Depth	0.0 - 0.5	1.0 - 2.3	0.0 - 0.5	1.0 - 2.7		0.0 - 0.5	2.0 - 3.5
Lab Sample ID	L1407532-01	L1407532-02, R1	L1407532-03, R1	L1407532-04, R1	L1407532-09, R1	L1407532-07, R1	L1407532-08, R1
VOCs (ug/kg)							
BENZENE	12U	18U	10U	6.2U	9.6U	12U	17U
OTHERS (%)							
TOTAL ORGANIC CARBON							
TOTAL SOLIDS	13.8	15.8	15.1	40.0	26.0	13.6	15.1

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	DC-09		DC-10			DC-11	
Sample ID	DC-9-SE-01-040914-1440	DC-9-SE-02-040914-1445	DC-10-SE-01-040914-1400	2287-FD-01-040914 (DC-10-SE-01-040914-1400)	DC-10-SE-02-040914-1405	DC-11-SE-01-040914-1250	DC-11-SE-02-040914-1255
Sample Date	4/9/2014 14:40	4/9/2014 14:45	4/9/2014 14:00	4/9/2014	4/9/2014 14:05	4/9/2014 12:50	4/9/2014 12:55
Sample Depth	0.0 - 0.5	1.0 - 1.5	0.0 - 0.5		2.0 - 3.4	0.0 - 0.5	1.0 - 2.2
Lab Sample ID	L1407363-04	L1407363-05	L1407363-02	L1407363-06	L1407363-03	L1407363-15	L1407363-16
VOCs (ug/kg)							
BENZENE	13U	20U	14U	18U	18	**2900**	12
OTHERS (%)							
TOTAL ORGANIC CARBON							
TOTAL SOLIDS	12.4	14.1	12.0	13.2	17.7	20.2	19.8

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	DC-12		DC-14		DC-15		DC-16		
Sample ID	DC-12-SE-01-040914-1015	DC-12-SE-02-040914-1020	DC-14-SE-01-041014-0945	DC-14-SE-02-041014-0950	DC-15-SE-01-041014-1120	DC-15-SE-02-041014-1125	DC-16-SE-01-050814-1125	DC-16-SE-02-050814-1130	0774-FD-050814 (DC-16-SE-02-050814-1130)
Sample Date	4/9/2014 10:15	4/9/2014 10:20	4/10/2014 9:45	4/10/2014 9:50	4/10/2014 11:20	4/10/2014 11:25	5/8/2014 11:25	5/8/2014 11:30	5/11/14 14:12
Sample Depth	0.0 - 0.5	2.5 - 3.5	0.0 - 0.5	1.0 - 3.0	0.0 - 0.5	2.0 - 3.5	0.0 - 0.5	1.5 - 2.5	
Lab Sample ID	L1407363-09	L1407363-10	L1407532-05, R1	L1407532-06, R1	L1407532-11, R1	L1407532-12	L1409827-01	L1409827-02	L1409827-06
VOCs (ug/kg)									
BENZENE	8.4	**1800**	11U	18U	9.2U	8.2	13	20	38
OTHERS (%)									
TOTAL ORGANIC CARBON									
TOTAL SOLIDS	49.5	57.9	13.0	13.9	12.3	17.3	15.1	18.2	20.3

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	DC-18		DC-20	DC-22		DC-23		
Sample ID	DC-18-SE-01-050814-1150	DC-18-SE-01-050814-1155	DC-20-SE-01-050814-1100	DC-22-SE-01-053014-0945	DC-22-SE-02-053014-0950	DC-23-SE-01-053014-1035	DC-23-SE-02-053014-1040	5052-FD-01-053014 (DC-23-SE-02-053014-1040)
Sample Date	5/8/2014 11:50	5/8/2014 11:55	5/8/2014 11:50	5/30/2014 9:45	5/30/2014 9:50	5/30/2014 10:35	5/30/2014 10:40	5/30/2014
Sample Depth	0.0 - 0.5	1.5 - 2.5	0.0 - 0.5	0.0 - 0.5	1.0 - 2.0	0.0 - 0.5	1.0 - 2.0	DC-23 1.0 - 2.0 FT
Lab Sample ID	L1409827-03	L1409827-04	L1409827-05	L1411715-01	L1411715-02	L1411715-03	L1411715-04	L1411715-09
VOCs (ug/kg)								
BENZENE	6.9	**1800**	1.7U	4.7	**1600**	3.4U	130	23
OTHERS (%)								
TOTAL ORGANIC CARBON								
TOTAL SOLIDS	26.9	66.2	44.6	54.7	62.7	32.7	49.6	34.3

NOTES:
1. "-" Indicates Data Not Colle

TABLE VII
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Location	DC-24		DC-25	
Sample ID	DC-24-SE-01-053014-1110	DC-24-SE-02-053014-1115	DC-25-SE-01-053014-1200	DC-25-SE-02-053014-1205
Sample Date	5/30/2014 11:10	5/30/2014 11:15	5/30/2014 12:00:00 AM	5/30/2014 12:05:00 AM
Sample Depth	0.0 - 0.5	0.5 - 1.5	0.0 - 0.5	0.5 - 1.5
Lab Sample ID	L1411715-05	L1411715-06	L1411715-07	L1411715-08
VOCs (ug/kg)				
BENZENE	3.6U	4.4U	2.4U	2.8U
OTHERS (%)				
TOTAL ORGANIC CARBON				
TOTAL SOLIDS	35.3	49.6	35.8	58.9

NOTES:
1. "-" Indicates Data Not Colle

TABLE VIII
SUMMARY OF PRE- AND POST-SOLIDIFICATION DATA - SEDIMENT
PDI-09 WEST EAST HIDE PILE INVESTIGATION-SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

LOCATION	**LSP-COMP-041014-1430**	**LSP-COMP-PC**
SAMPLING DATE	**4/10/2014**	**5/1/2014**
LAB SAMPLE ID	**L1407532-13 L1408632-01**	**L1409284-01**
VOCs (mg/kg)		
Benzene	6	6.1
TCLP VOCs (mg/l)		
Chloroform	ND(0.0075)	ND(0.0075)
Carbon tetrachloride	ND(0.005)	ND(0.005)
Tetrachloroethene	ND(0.005)	ND(0.005)
Chlorobenzene	ND(0.005)	ND(0.005)
1,2-Dichloroethane	ND(0.005)	ND(0.005)
Benzene	0.34	0.024
Vinyl chloride	ND(0.01)	ND(0.01)
1,1-Dichloroethene	ND(0.005)	ND(0.005)
Trichloroethene	ND(0.005)	ND(0.005)
1,4-Dichlorobenzene	ND(0.025)	ND(0.025)
2-Butanone	ND(0.05)	ND(0.05)
Total TCLP VOCs	0.34	0.024
TCLP SVOCs (mg/l)		
Hexachlorobenzene	-	ND(0.01)
2,4-Dinitrotoluene	-	ND(0.025)
Hexachlorobutadiene	-	ND(0.01)
Hexachloroethane	-	ND(0.01)
Nitrobenzene	-	ND(0.01)
2,4,6-Trichlorophenol	-	ND(0.025)
Pentachlorophenol	-	ND(0.05)
2-Methylphenol	-	ND(0.025)
3-Methylphenol/4-Methylphenol	-	ND(0.025)
2,4,5-Trichlorophenol	-	ND(0.025)
Pyridine	-	ND(0.025)
Total TCLP SVOCs	-	ND
TCLP Herbicides (mg/l)		
2,4-D	-	ND(0.025)
2,4,5-TP (Silvex)	-	ND(0.005)
TCLP Metals (mg/l)		
Arsenic	0.09	ND(1)
Barium	0.18	0.12
Cadmium	ND(0.1)	ND(0.1)
Chromium	0.02	ND(0.2)
Lead	ND(0.5)	ND(0.5)
Mercury	ND(0.001)	ND(0.001)
Selenium	ND(0.5)	ND(0.5)
Silver	ND(0.1)	ND(0.1)
TCLP Pesticides (mg/l)		
Lindane	-	ND(0.0001)
Heptachlor	-	ND(0.0001)
Heptachlor epoxide	-	ND(0.0001)
Endrin	-	ND(0.0002)
Methoxychlor	-	ND(0.001)
Toxaphene	-	ND(0.001)
Chlordane	-	ND(0.001)
PCBs (mg/kg)		
Aroclor 1016	-	ND(0.0716)
Aroclor 1221	-	ND(0.0716)
Aroclor 1232	-	ND(0.0716)
Aroclor 1242	-	ND(0.0716)
Aroclor 1248	-	0.0955
Aroclor 1254	-	ND(0.0716)
Aroclor 1260	-	ND(0.0716)
Aroclor 1262	-	ND(0.0716)
Aroclor 1268	-	ND(0.0716)
Total PCBS	-	0.0955
General Chemistry		
Solids, Total (%)	28	42
pH	7.7	11.7
Cyanide, Reactive (mg/kg)	ND(10)	ND(10)
Sulfide, Reactive (mg/kg)	ND(10)	ND(10)
Paint Filter Liquid	POSITIVE	NEGATIVE
Ignitability	NI	NI

Notes:
1. Data presented not validated.
2. "ND" indicates a non-detect result. The value presented is the reporting limit.

TABLE IX
SUMMARY OF SEDIMENT THICKNESS PROBING DATA
PDI-09 WEST EAST HIDE PILE INVESTIGATION-SEDIMENT
INDUSTRI-PLEX OU2, WOBURN, MA

Exploration ID	Date	Depth of Water	Water Surface Elevation	Mudline Elevation	Organic Deposits			Riprap			Natural Sand		Notes
					Depth to Top	Elevation of Top	Thickness	Depth to Top	Elevation of Top	Thickness	Depth to Top	Elevation of Top	
		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	
SS-1	4/10/2014	1.8	71.77	69.97	1.8	70.0	2.5	NE	NE	NE	4.3	67.5	
SS-2	4/10/2014	2.0	71.77	69.77	2.0	69.8	2.5	NE	NE	NE	4.5	67.3	
SS-3	4/10/2014	2.6	71.77	69.17	2.6	69.2	1.6	NE	NE	NE	4.2	67.6	
SS-4	4/10/2014	2.2	71.77	69.57	2.2	69.6	2.4	NE	NE	NE	4.6	67.2	
PP-1	4/11/2014	0.9	71.73	70.83	0.9	70.8	3.7	NE	NE	NE	4.6	67.1	
PP-2	4/11/2014	0.9	71.73	70.83	NE	NE	NE	0.9	70.8	3.3	4.2	67.5	Riprap over the sand.
PP-3	4/11/2014	2.2	71.73	69.53	NE	NE	NE	2.2	69.5	NE	NE	NE	
PP-4	4/11/2014	0.0	71.73	71.73	Point Eliminated								
PP-5	4/11/2014	1.8	71.73	69.93	1.8	69.9	3.0	NE	NE	NE	4.8	67.0	
PP-6	4/11/2014	1.9	71.73	69.88	1.9	69.9	4.2	NE	NE	NE	6.0	65.7	
PP-7	4/11/2014	2.0	71.73	69.73	2.0	69.7	3.0	NE	NE	NE	5.0	66.7	
PP-8	4/11/2014	2.5	71.73	69.23	2.5	69.2	0.3	2.8	68.9	NE	NE	NE	
PP-9	4/11/2014	1.0	71.73	70.73	NE	NE	NE	1.0	70.7	NE	NE	NE	
PP-10	4/11/2014	2.5	71.73	69.23	NE	NE	NE	2.5	69.2	NE	NE	NE	
PP-11	4/11/2014	1.2	71.73	70.53	1.2	70.5	3.3	NE	NE	NE	4.5	67.2	
PP-12	4/11/2014	2.1	71.73	69.63	2.1	69.6	4.6	NE	NE	NE	6.7	65.0	
PP-13	4/11/2014	2.3	71.73	69.43	2.3	69.4	3.5	NE	NE	NE	5.8	65.9	
PP-14	4/11/2014	2.5	71.73	69.23	2.5	69.2	3.4	NE	NE	NE	5.9	65.8	
PP-15	4/11/2014	4.5	71.73	67.23	4.5	67.2	2.5	NE	NE	NE	7.0	64.7	2-ft of gray sand smear on PVC
PP-16	4/11/2014	1.8	71.73	69.93	1.8	69.9	5.0	NE	NE	NE	6.8	64.9	
PP-17	4/11/2014	2.9	71.73	68.83	2.9	68.8	3.7	NE	NE	NE	6.6	65.1	
PP-18	4/11/2014	3.4	71.73	68.33	3.4	68.3	3.3	NE	NE	NE	6.7	65.0	
PP-19	4/11/2014	1.6	71.73	70.13	1.6	70.1	5.0	NE	NE	NE	6.6	65.1	
PP-20	4/11/2014	3.4	71.73	68.33	3.4	68.3	4.8	NE	NE	NE	8.2	63.5	
PP-21	4/11/2014	3.7	71.73	68.03	3.7	68.0	3.6	NE	NE	NE	7.3	64.4	
PP-22	4/11/2014	2.2	71.73	69.53	2.2	69.5	4.6	NE	NE	NE	6.8	64.9	
PP-23	4/11/2014	3.0	71.73	68.73	3.0	68.7	5.4	NE	NE	NE	8.4	63.3	
PP-24	4/11/2014	3.1	71.73	68.63	3.1	68.6	3.8	NE	NE	NE	6.9	64.8	
PP-25	4/11/2014	3.0	71.73	68.73	3.0	68.7	4.3	NE	NE	NE	7.3	64.4	
PP-26	4/11/2014	3.0	71.73	68.73	3.0	68.7	4.1	NE	NE	NE	7.1	64.6	
PP-27	4/11/2014	1.6	71.73	70.13	1.6	70.1	5.1	NE	NE	NE	6.7	65.0	6-in. sand on top of soft sediment
PP-28	4/11/2014	3.5	71.73	68.23	NE	NE	NE	3.5	68.2	NE	NE	NE	
PP-29	4/11/2014	3.5	71.73	68.23	NE	NE	NE	3.5	68.2	NE	NE	NE	
PP-30	4/11/2014	2.5	71.73	69.23	2.5	69.2	4.3	NE	NE	NE	6.8	64.9	
PP-31	4/11/2014	2.0	71.73	69.73	NE	NE	NE	2.0	69.7	NE	NE	NE	
PP-32	4/11/2014	2.7	71.73	69.03	NE	NE	NE	NE	NE	NE	NE	NE	Sand from 2.7 to 4.0, Fabric at 4.0
PP-33	4/11/2014	3.0	71.73	68.73	NE	NE	NE	NE	NE	NE	NE	NE	Sand from 3.0 to 5.6, Fabric at 5.6
PP-34	4/11/2014	2.6	71.73	69.13	2.6	69.1	5.2	NE	NE	NE	7.8	63.9	At edge of rip rap
DC-2	4/9/2014	2.0	71.84	69.84	2.0	69.8	2.5	NE	NE	NE	4.5	67.3	
DC-3	4/9/2014	1.8	71.84	70.09	1.8	70.1	3.7	NE	NE	NE	5.5	66.4	
DC-4	4/9/2014	2.5	71.84	69.34	2.5	69.3	3.5	NE	NE	NE	6.0	65.8	
DC-5	4/10/2014	3.0	71.77	68.77	3.0	68.8	3.0	NE	NE	NE	6.0	65.8	
DC-6	4/10/2014	3.0	71.77	68.77	3.0	68.8	2.8	NE	NE	NE	5.8	66.0	
DC-7	4/10/2014	3.0	71.77	68.77	3.0	68.8	2.5	NE	NE	NE	5.5	66.3	
DC-8	4/10/2014	3.2	71.77	68.57	3.2	68.6	3.8	NE	NE	NE	7.0	64.8	
DC-9	4/9/2014	3.5	71.84	68.34	3.5	68.3	3.5	NE	NE	NE	7.0	64.8	
DC-10	4/9/2014	3.3	71.84	68.59	3.3	68.6	3.3	NE	NE	NE	6.5	65.3	
DC-11	4/9/2014	2.2	71.84	69.64	2.2	69.6	3.0	NE	NE	NE	5.2	66.6	
DC-12	4/9/2014	1.5	71.84	70.34	1.5	70.3	4.5	NE	NE	NE	6.0	65.8	
DC-13	4/9/2014	2.0	71.84	69.84	2.0	69.8	5.0	NE	NE	NE	7.0	64.8	
DC-14	4/10/2014	3.5	71.77	68.27	3.5	68.3	3.0	NE	NE	NE	6.5	65.3	
DC-15	4/10/2014	3.0	71.77	68.77	3.0	68.8	4.0	NE	NE	NE	7.0	64.8	

TABLE X
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION-GROUNDWATER AND SEDIMENT POREWATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	CS-1	CS-1	CS-2	CS-3	MW-104D	MW-104S	MW-105D	MW-105S	MW-106D
Sample ID	0553-FD-001-060112	CS-1-WG-01-060112	CS-2-WG-01-053112	CS-3-WG-01-060112	MW-104D-WG-01-121312	MW-104S-WG-01-121412	MW-105D-WG-01-121312	MW-105S-WG-01-121412	MW-106D-WG-01-121312
Sample Date	6/1/2012 0:00	6/1/2012 10:00	5/31/2012 14:30	6/1/2012 10:30	12/13/2012 11:05	12/14/2012 10:20	12/13/2012 12:05	12/14/2012 10:45	12/13/2012 13:40
Sample Depth	5' - 6'	5' - 6'	4.6' - 5.6'	1' - 2'	11' - 12'	5' - 6'	11' - 12'	5' - 6'	13' - 14'
Lab Sample ID	L1209776-06	L1209776-01	L1209686-05	L1209776-02	L1222658-01	L1222751-01	L1222658-02	L1222751-02	L1222658-03
VOCs (ug/L)									
BENZENE	**10**	**9.7**	**1800**	0.50U	**16**	**28000**	**5.9**	**230000**	3.9
OTHERS (%)									
TOTAL ORGANIC CARBON	-	-	-	-	-	-	-	-	-

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected
3. SP-1, SP-2 and SP-3 are Sediment Porewater

TABLE X
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION-GROUNDWATER AND SEDIMENT POREWATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	MW-106S	MW-107D	MW-107S	PZ-101	PF-1		
Sample ID	MW-106S-WG-01-121412	MW-107D-WG-01-121312	MW-107S-WG-01-121412	PZ-101-WG-01-071411	PF-1-WG-01-060112	PF-1-WG-02-060412	PF-1-WG-03-060412
Sample Date	12/14/2012 11:30	12/13/2012 14:20	12/14/2012 12:15	7/14/2011 11:30	6/1/2012 8:05	6/4/2012 14:15	6/4/2012 15:00
Sample Depth	7' - 8'	11.75' - 12.75'	5.75' - 6.75'	5' - 6'	3' - 4'	4.5' - 5.5'	5.5' - 6.5'
Lab Sample ID	L1222751-03	L1222658-04	L1222751-04	L1110532-02	L1209776-04	L1209866-12	L1209866-13
VOCs (ug/L)							
BENZENE	**61000**	**11**	**390000**	0.54	**35000**	**87000**	**110000**
OTHERS (%)							
TOTAL ORGANIC CARBON	-	-	-	26	-	-	-

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected
3. SP-1, SP-2 and SP-3 are Sediment Porewater

TABLE X
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION-GROUNDWATER AND SEDIMENT POREWATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PF-2			PF-3		
Sample ID	PF-2-WG-01-053012	PF-2-WG-02-053012	PF-2-WG-03-060412	PF-3-WG-01-053012	PF-3-WG-02-053012	PF-3-WG-03-060112
Sample Date	5/30/2012 10:00	5/30/2012 11:40	6/4/2012 13:50	5/30/2012 9:50	5/30/2012 11:05	6/1/2012 7:55
Sample Depth	2' - 3'	3' - 4'	4' - 5'	1.5' - 2.5'	2.5' - 3.5'	3.5' - 4.5'
Lab Sample ID	L1209601-02	L1209601-04	L1209866-11	L1209601-03	L1209601-05	L1209776-03
VOCs (ug/L)						
BENZENE	**12**	**470**	**30000**	0.74	1	**440**
OTHERS (%)						
TOTAL ORGANIC CARBON	-	-	-	-	-	-

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected
3. SP-1, SP-2 and SP-3 are Sediment Porewater

TABLE X
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION-GROUNDWATER AND SEDIMENT POREWATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	SP-1			SP-2		
Sample ID	SP-1-WG-01-101812	SP-1-WG-02-101812	SP-1-WG-03-101812	SP-2-WG-01-101812	SP-2-WG-02-101812	SP-2-WG-03-101812
Sample Date	10/18/2012 12:00	10/18/2012 12:05	10/18/2012 12:13	10/18/2012 12:22	10/18/2012 12:26	10/18/2012 12:30
Sample Depth	0.5' - 1'	1.5' - 2'	2.5' - 3'	0.5' - 1'	1.5' - 2'	2.5' - 3'
Lab Sample ID	L1218834-01	L1218834-02	L1218834-03	L1218834-04	L1218834-05	L1218834-06
VOCs (ug/L)						
BENZENE	**12000**	**38000**	**14000**	**8700**	**82000**	**71000**
OTHERS (%)						
TOTAL ORGANIC CARBON	-	-	-	-	-	-

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected
3. SP-1, SP-2 and SP-3 are Sediment Porewater

TABLE X
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST & EAST HIDE PILE INVESTIGATION-GROUNDWATER AND SEDIMENT POREWATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	SP-3			TD-1	TD-2	TD-3
Sample ID	SP-3-WG-01-101812	SP-3-WG-02-101812	SP-3-WG-03-101812	TD-1-WG-01-053112	TD-2-WG-01-053112	TD-3-WG-01-053112
Sample Date	10/18/2012 12:38	10/18/2012 12:40	10/18/2012 12:45	5/31/2012 13:10	5/31/2012 13:05	5/31/2012 13:15
Sample Depth	0.5' - 1'	1.5' - 2'	2.5' - 3'	1.3'	1.3'	1.3'
Lab Sample ID	L1218834-07	L1218834-08	L1218834-09	L1209686-04	L1209686-02	L1209686-03
VOCs (ug/L)						
BENZENE	0.5U	0.5U	0.5U	**7.6**	**8.4**	0.5U
OTHERS (%)						
TOTAL ORGANIC CARBON	-	-	-	-	-	-

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected
3. SP-1, SP-2 and SP-3 are Sediment Porewater

TABLE XI
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST EAST HIDE PILE INVESTIGATION-SURFACE WATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PZ-101	PZ-102	PZ-103	PZ-104	PZ-105	PZ-106	PZ-107	PZ-108	PZ-109
Sample ID	PZ-101-WS-01-062011	PZ-102-WS-01-061311	PZ-103-WS-01-062011	PZ-104-WS-01-061711	PZ-105-WS-01-061311	PZ-106-WS-01-061711	PZ-107-WS-01-061411	PZ-108-WS-01-061411	PZ-109-WS-01-061611
Sample Date	6/20/2011 11:15	6/13/2011 13:30	6/20/2011 9:55	6/17/2011 12:50	6/13/2011 9:15	6/17/2011 9:05	6/14/2011 8:35	6/14/2011 9:47	6/16/2011 11:58
Sample Depth	0.61'	0.47'	0.25'	1.2'	1.05'	1'	0.2'	0.2'	0.09'
Lab Sample ID	L1108910-02	L1108393-04	L1108910-01	L1108793-03	L1108393-01	L1108793-01	L1108473-01	L1108473-02	L1108682-03
VOCs (ug/L)									
BENZENE	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.38J	0.5U
OTHERS (%)									
TOTAL ORGANIC CARBON	8.9	10	9.3	8.6	9.6	9.8	11	12	9.4

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected

TABLE XI
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST EAST HIDE PILE INVESTIGATION-SURFACE WATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PZ-110	PZ-111	PZ-112	PZ-113	PZ-114
Sample ID	PZ-110-WS-01-061511	PZ-111-WS-01-061611	PZ-112-WS-01-070111	PZ-113-WS-01-061411	PZ-114-WS-01-061511
Sample Date	6/15/2011 13:40	6/16/2011 10:35	7/1/2011 10:45	6/14/2011 13:25	6/15/2011 14:50
Sample Depth	0.57'	0.4'	0.16'	0.2'	0.42'
Lab Sample ID	L1108574-01	L1108682-02	L1109833-02	L1108473-04	L1108574-02
VOCs (ug/L)					
BENZENE	0.5U	0.5U	0.5U	0.5U	0.5U
OTHERS (%)					
TOTAL ORGANIC CARBON	8.9	9.6	13	9.9	9.3

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected

TABLE XI
SUMMARY OF ANALYTICAL DATA
PDI-09 WEST EAST HIDE PILE INVESTIGATION-SURFACE WATER
INDUSTRI-PLEX OU2, WOBURN, MA

Location	PZ-115			PZ-116	PZ-117
Sample ID	PZ-115-WS-01-061611	PZ-115-WS-01-071811	2287-FD-001-071811	PZ-116-WS-01-070811	PZ-117-WS-01-070111
Sample Date	6/16/2011 9:05	7/18/2011 12:25	7/18/2011 0:00	7/8/2011 10:15	7/1/2011 9:50
Sample Depth	0.65'	0.6'	0.6' - 0.6'	1.25'	2.25'
Lab Sample ID	L1108682-01	L1110745-02	L1110745-01	L1110149-02	L1109832-01
VOCs (ug/L)					
BENZENE	0.5U	0.5U	0.5U	0.5U	0.5U
OTHERS (%)					
TOTAL ORGANIC CARBON	9.9	11	11	6.5	5.4

NOTES:
1. Cleanup Standard Exceedances are **BOLD**
2. "-" Indicates Data Not Collected

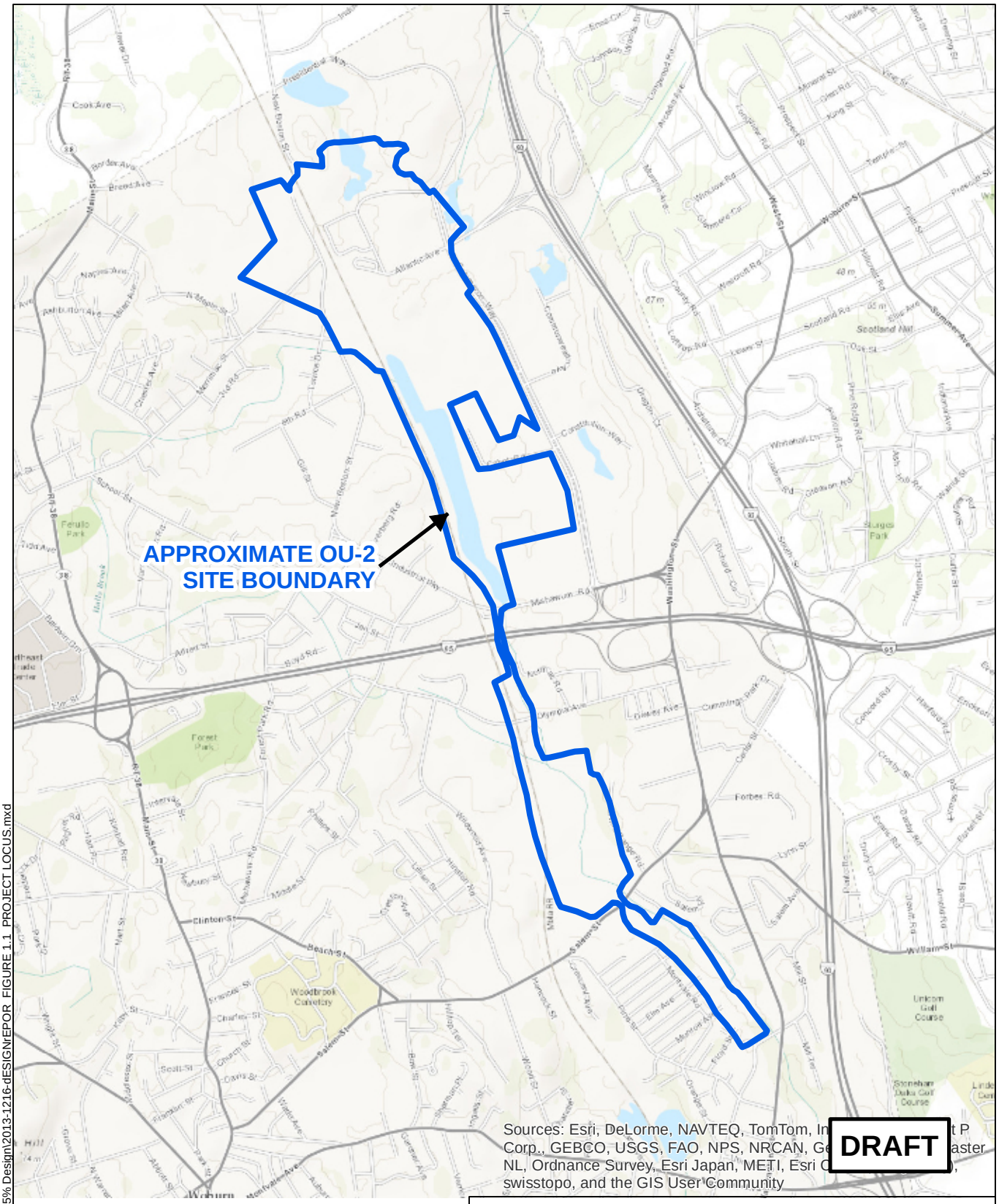
TABLE XII

EVALUATION OF THE PARTITIONING OF BENZENE BETWEEN POREWATER AND SEDIMENT
PDI-09 WEST & EAST HIDE PILE INVESTIGATION- SOIL
INDUSTRI-PLEX OU2, WOBURN, MA

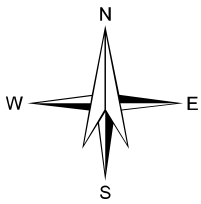
Sample ID	Depth (ft)	Sediment/Soil[1] Benzene (mg/Kg)	Porewater[2]/ Groundwater Benzene (mg/L)	Sediment[1] Foc	Site-Specific:		Literature[5] Based Koc	"Predicted"[6] Sediment Benzene (mg/Kg)	Is porewater at equilibrium with sediment?[7]
					Kd[3]	Koc[4]			
SP-1-01	0.5-1	4.80	12	0.01	0.40	28.57	59	9.91	Yes
SP-1-02	1.5-2	29.00	38	0.03	0.76	30.53	59	56.05	Yes
SP-1-03	2.5-3	28.00	14	0.02	2.00	90.91	59	18.17	Yes
SP-2-01	0.5-1	940.00	8.7	0.18	108.05	590.42	59	93.93	No
SP-2-02	1.5-2	110.00	82	0.02	1.34	84.90	59	76.44	Yes
SP-2-03	2.5-3	460.00	71	0.14	6.48	47.99	59	565.52	Yes
SP-3-01	0.5-1	ND(0.0055)	ND(0.0005)	0.0378	NA	NA	59	NA	NA
SP-3-02	1.5-2	0.18	ND(0.0005)	0.184	NA	NA	59	0.005	No/Uncertain
SP-3-03	2.5-3	0.052	ND(0.0005)	0.141	NA	NA	59	0.004	No/Uncertain
MW-106	7.0-8.0	320	61	0.0195	5.25	269.02	59	70.18	No
	13-14	0.0051	0.0039	0.000205	1.31	6378.99	59	0.0000	No
MW-107	5.5-6.5	510	390	0.08845	1.31	14.78	59	2035.23	No
	11.75-12.75	0.0015	0.011	0.000115	0.14	1185.77	59	0.0000746	No
MW-104	6-7	120	28	0.02065	4.29	207.54	59	34.11	No
	11-12	0.0016	0.016	0.00023	0.10	434.78	59	0.00	No
MW-105	5-6	1400	230	0.01305	6.09	466.43	59	177.09	No
	10.5-11.5	0.0018	0.0059	0.000425	0.31	717.85	59	0.00015	No

Footnotes:

1. Actual sediment benzene and fraction of Total Organic Carbon from analytical lab reports at each location and depth.
2. Porewater benzene was measured indirectly from Passive Diffusion Bags deployed within piezometers immediately adjacent to sediment cores (1). Groundwater samples were colected from wells using low flow techniques
3. The site-specifec benzene partition coefficient, Kd (in L/Kg), was calculated by dividing the bulk sediment benzene concentration by the porewater benzene concentration.
4. The Koc (L/Kg) was calculated by dividing the Kd by the fraction organic carbon (Foc) of the sediment.
5. The literature Koc value was taken from EPA (1996) : Soil Screeening Guidance: Technical Background Document EPA/540/R-95/128
6. The "predicted" value was obtained by back-calculating a nominal sediment benzene using the literature-based Koc and the actual benzene sediment and porewater concentration. For location SP-3 the predicted value was based on the porewater detection limit of 0.0002
7. Equilibrium was assumed if the predicted K_{OC} values were within a factor of 2 relative to the literature value of 59 as decribed in Pankow (1995 pg 244-245 and, EPA, 1996) due to inherent variability in K_{OC} values.



SITE COORDINATES: 42°30'21"N 71°8'12"W



U.S.G.S. QUADRANGLE: WILMINGTON, MA

HALEY & ALDRICH

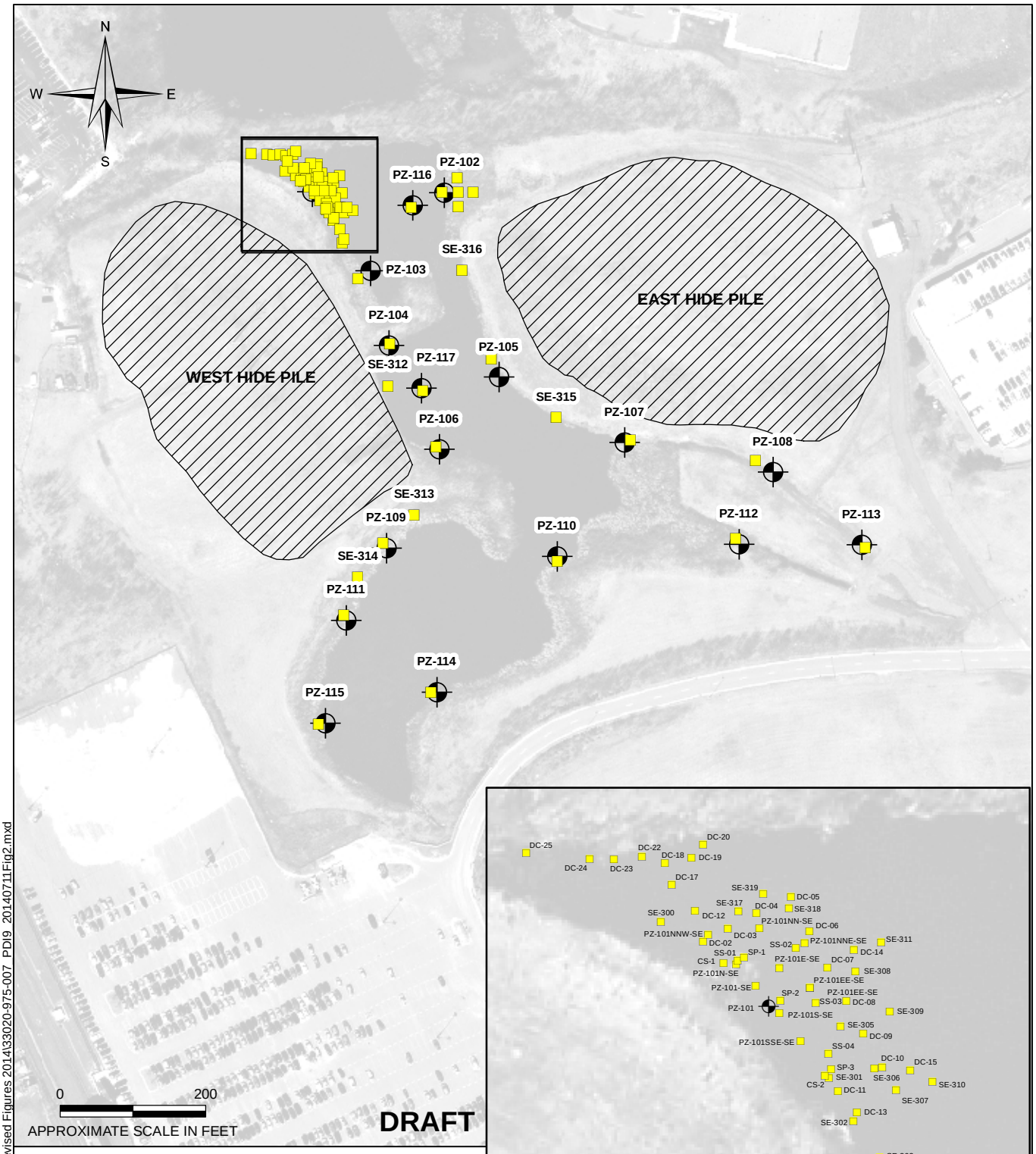
100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

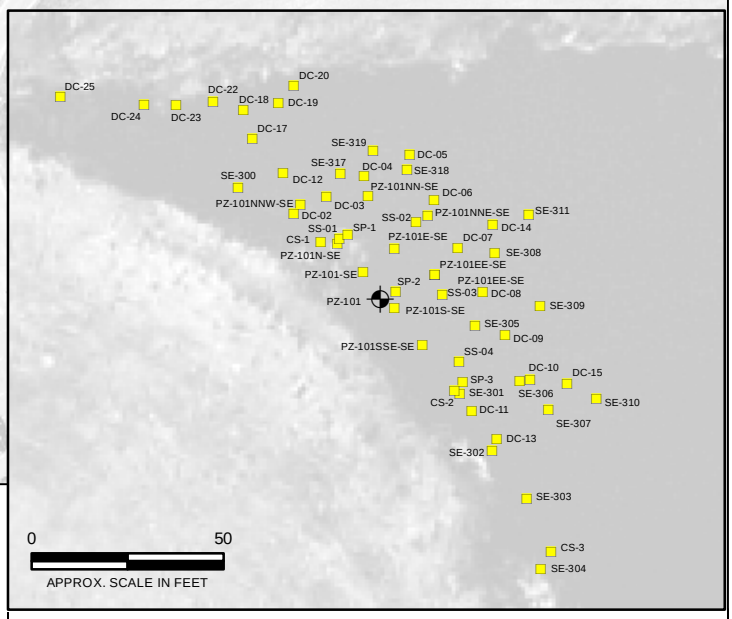
PROJECT LOCUS

SCALE: 1:24,000
JULY 2014

FIGURE 1

G:\33020\GLOBAL\GIS\MapProjects\95% Design\2013-1216-dESIGNREPOR FIGURE 1.1 PROJECT LOCUS.mxd





LEGEND:

PDI-9 GROUNDWATER & SURFACE WATER SAMPLING LOCATION

PDI-9 SEDIMENT SAMPLING LOCATION

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. 2008 30 CENTIMETER RESOLUCTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.
3. WEST HIDE PILE, EAST HIDE PILE APPROXIMATED FROM MSGRP REMEDIAL INVESTIGATION REPORT, RI FIGURE 2-5A SURFACE WATER SAMPLE LOCATIONS - REACH 0.

HALEY & ALDRICH

100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

SEDIMENT SAMPLE LOCATIONS IN LOWER SOUTH POND

SCALE: AS SHOWN
JULY 2014

FIGURE 2

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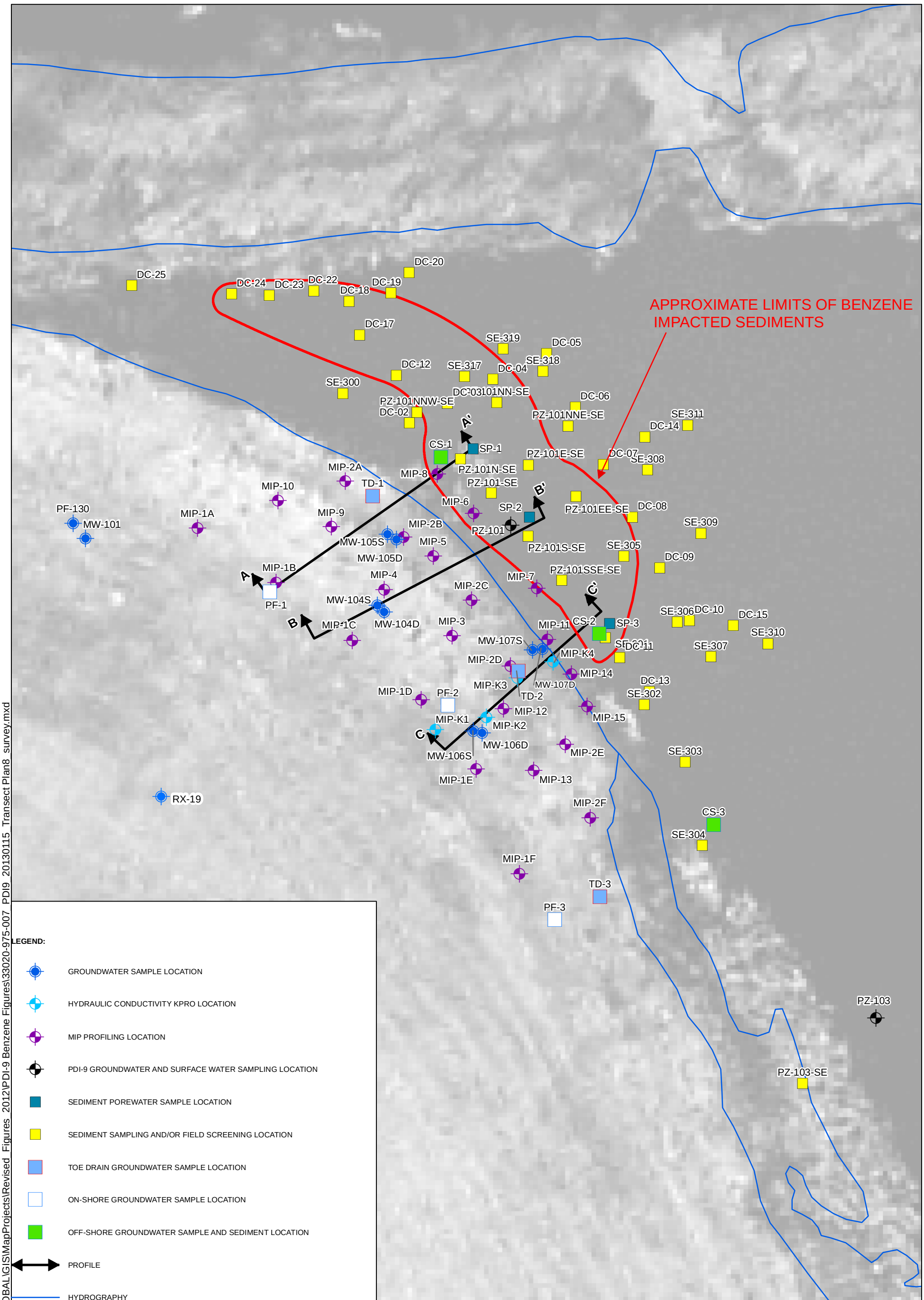

LEGEND:

- GROUNDWATER SAMPLE LOCATION
- HYDRAULIC CONDUCTIVITY KPRO LOCATION
- MIP PROFILING LOCATION
- PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION
- SEDIMENT POREWATER SAMPLE LOCATION
- SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION
- TOE DRAIN GROUNDWATER SAMPLE LOCATION
- ON-SHORE GROUNDWATER SAMPLE LOCATION
- OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION
- PROFILE
- HYDROGRAPHY

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. WELLS RX-18 AND RX-19 SAMPLED BY ROUX 12/2002. ALL OTHER SAMPLES TAKEN BY H&A BETWEEN 4/2011 AND 1/2013.
3. 2008 30 CENTIMETER RESOLUTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.

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HALEY & ALDRICH

100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

MULTI-MEDIA SAMPLE LOCATIONS IN LOWER SOUTH POND AREA OF INTEREST

SCALE: AS SHOWN
JULY 2014

FIGURE 3

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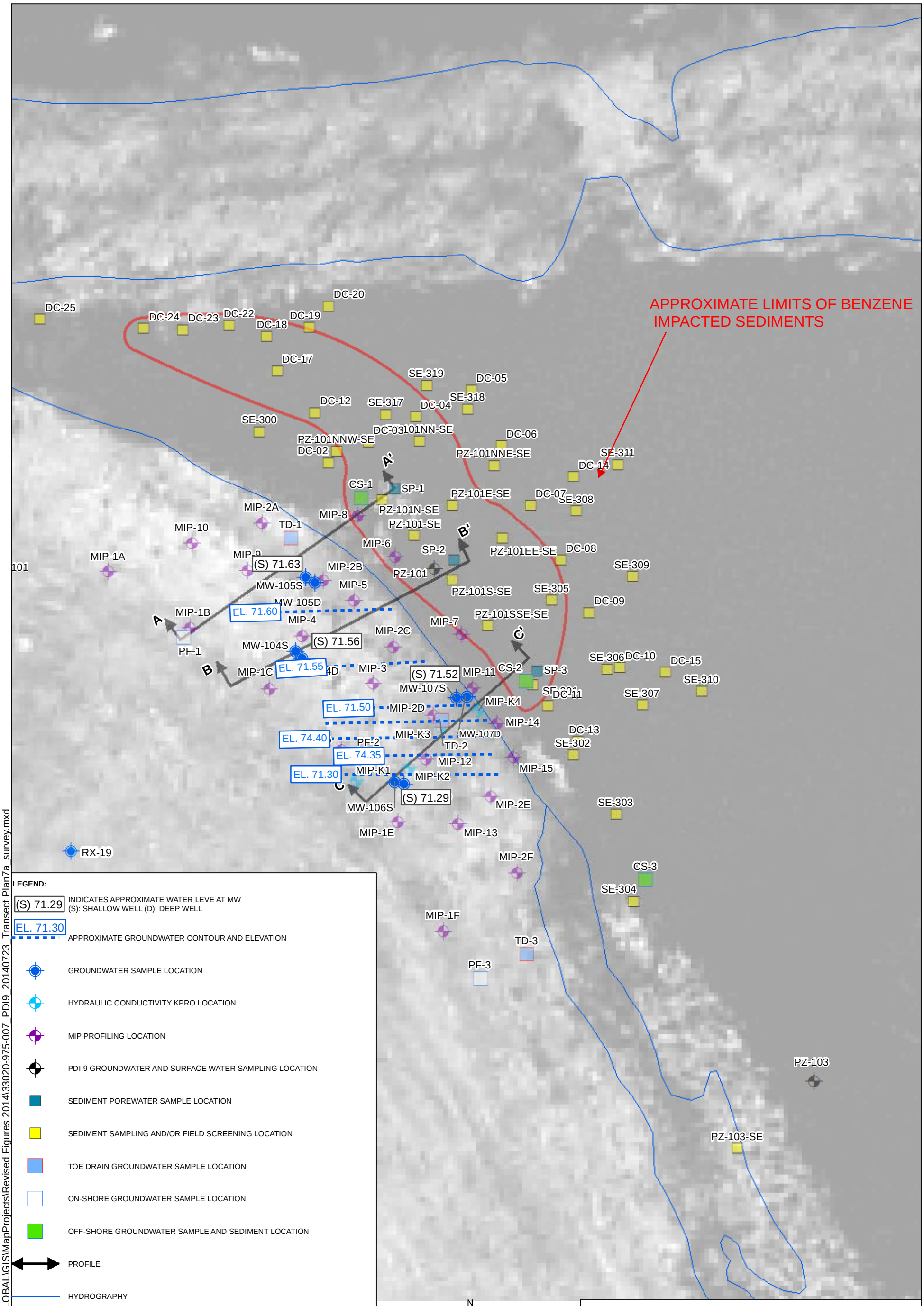

LEGEND:

(S) 71.29 INDICATES APPROXIMATE WATER LEVE AT MW (S): SHALLOW WELL (D): DEEP WELL

EL. 71.30 APPROXIMATE GROUNDWATER CONTOUR AND ELEVATION

GROUNDWATER SAMPLE LOCATION

HYDRAULIC CONDUCTIVITY KPRO LOCATION

MIP PROFILING LOCATION

PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION

SEDIMENT POREWATER SAMPLE LOCATION

SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION

TOE DRAIN GROUNDWATER SAMPLE LOCATION

ON-SHORE GROUNDWATER SAMPLE LOCATION

OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION

PROFILE

HYDROGRAPHY

NOTES:

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HALEY & ALDRICH

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INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE ORGANIC SILT/FILL DEPOSIT ON 4 DECEMBER 2014

SCALE: AS SHOWN
JULY 2014

FIGURE 7A

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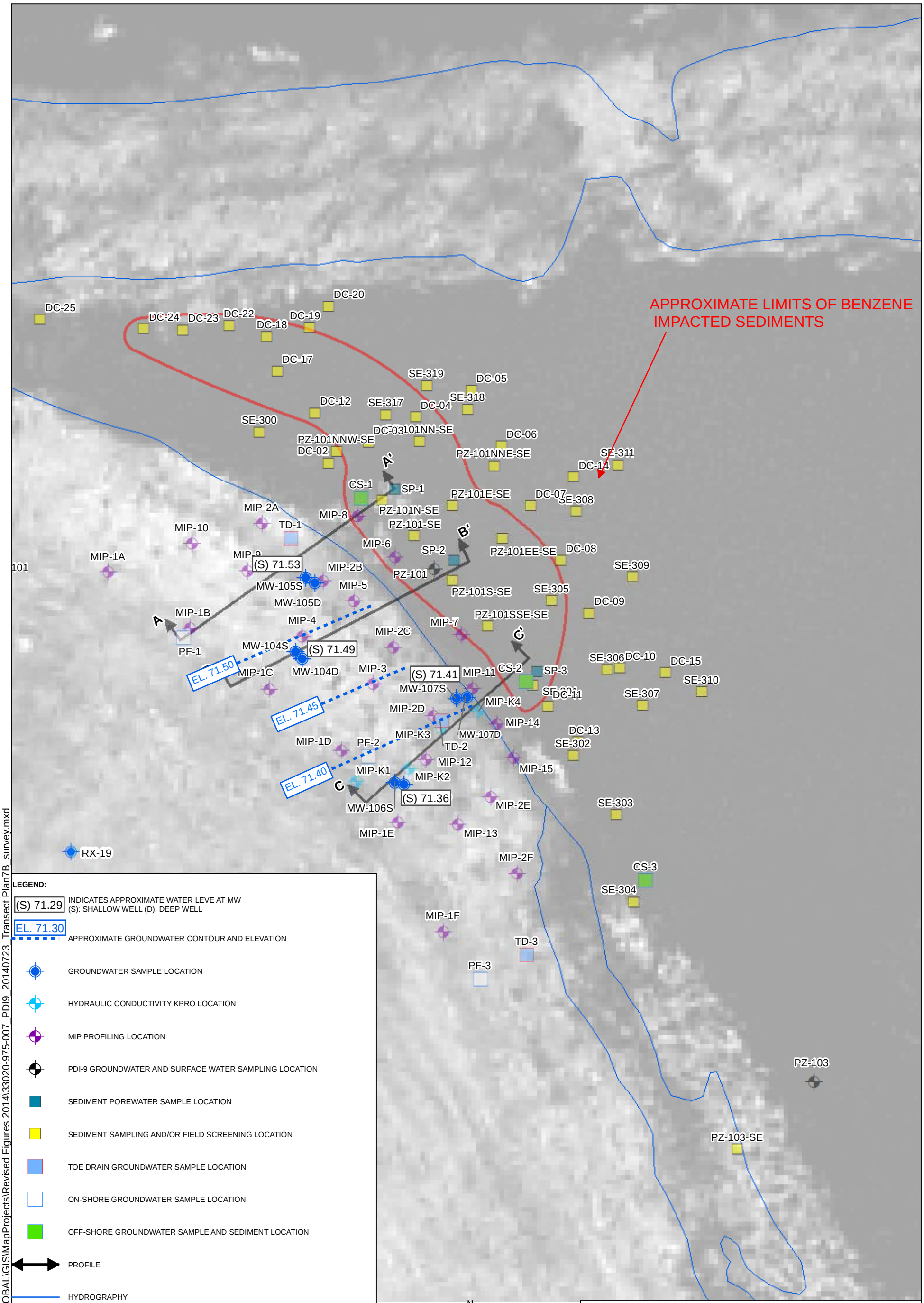

LEGEND:

(S) 71.29 INDICATES APPROXIMATE WATER LEVE AT MW (S): SHALLOW WELL (D): DEEP WELL

EL. 71.30 APPROXIMATE GROUNDWATER CONTOUR AND ELEVATION

GROUNDWATER SAMPLE LOCATION

HYDRAULIC CONDUCTIVITY KPRO LOCATION

MIP PROFILING LOCATION

PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION

SEDIMENT POREWATER SAMPLE LOCATION

SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION

TOE DRAIN GROUNDWATER SAMPLE LOCATION

ON-SHORE GROUNDWATER SAMPLE LOCATION

OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION

PROFILE

HYDROGRAPHY

NOTES:

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HALEY & ALDRICH

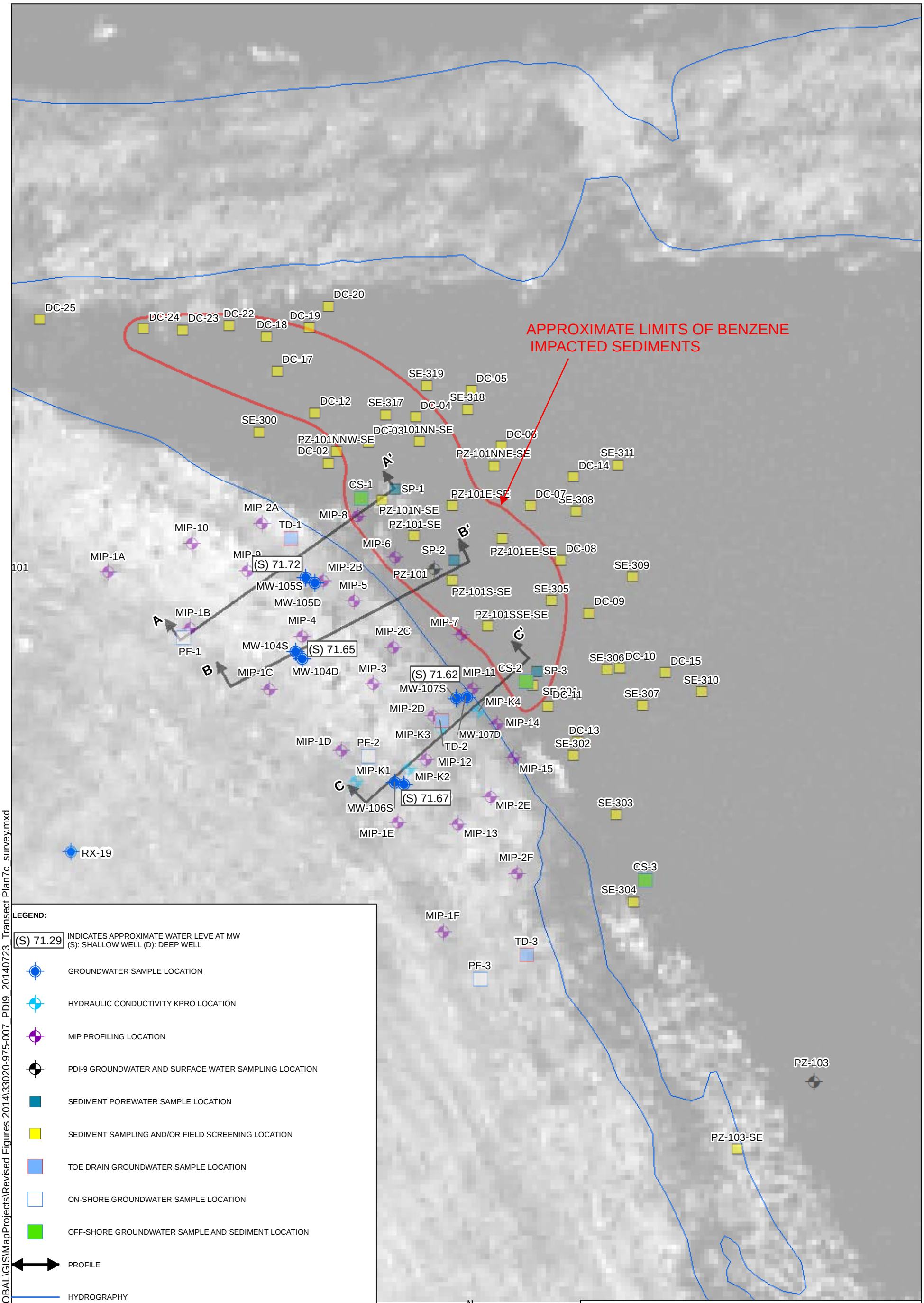
100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE ORGANIC SILT/FILL DEPOSIT ON 6 DECEMBER 2012

SCALE: AS SHOWN
JULY 2014

FIGURE 7B

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2014\33020-975-007_PDI9_20140723_Transect Plan7B_survey.mxd



LEGEND:

(S) 71.29 INDICATES APPROXIMATE WATER LEVE AT MW (S): SHALLOW WELL (D): DEEP WELL

- GROUNDWATER SAMPLE LOCATION
- HYDRAULIC CONDUCTIVITY KPRO LOCATION
- MIP PROFILING LOCATION
- PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION
- SEDIMENT POREWATER SAMPLE LOCATION
- SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION
- TOE DRAIN GROUNDWATER SAMPLE LOCATION
- ON-SHORE GROUNDWATER SAMPLE LOCATION
- OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION
- PROFILE
- HYDROGRAPHY

NOTES:

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HALEY & ALDRICH

100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE ORGANIC SILT/FILL DEPOSIT ON 14 MAY 2013

SCALE: AS SHOWN
JULY 2014

FIGURE 7C

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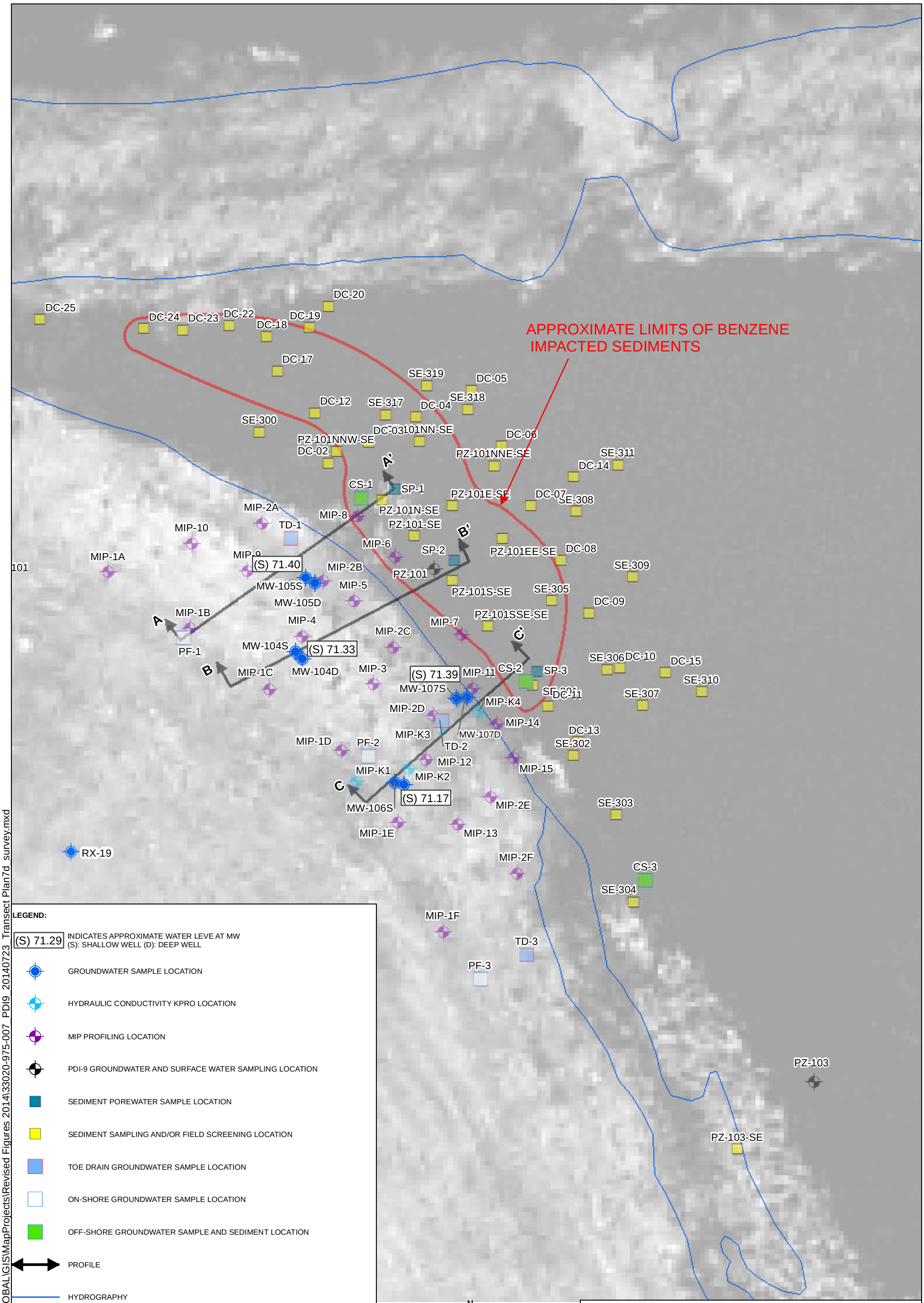

LEGEND:

(S) 71.29 INDICATES APPROXIMATE WATER LEVE AT MW (S): SHALLOW WELL (D): DEEP WELL

GROUNDWATER SAMPLE LOCATION

HYDRAULIC CONDUCTIVITY KPRO LOCATION

MIP PROFILING LOCATION

PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION

SEDIMENT POREWATER SAMPLE LOCATION

SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION

TOE DRAIN GROUNDWATER SAMPLE LOCATION

ON-SHORE GROUNDWATER SAMPLE LOCATION

OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION

PROFILE

HYDROGRAPHY

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
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100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE ORGANIC SILT/FILL DEPOSIT ON 1 NOVEMBER 2013

SCALE: AS SHOWN
JULY 2014

FIGURE 7D

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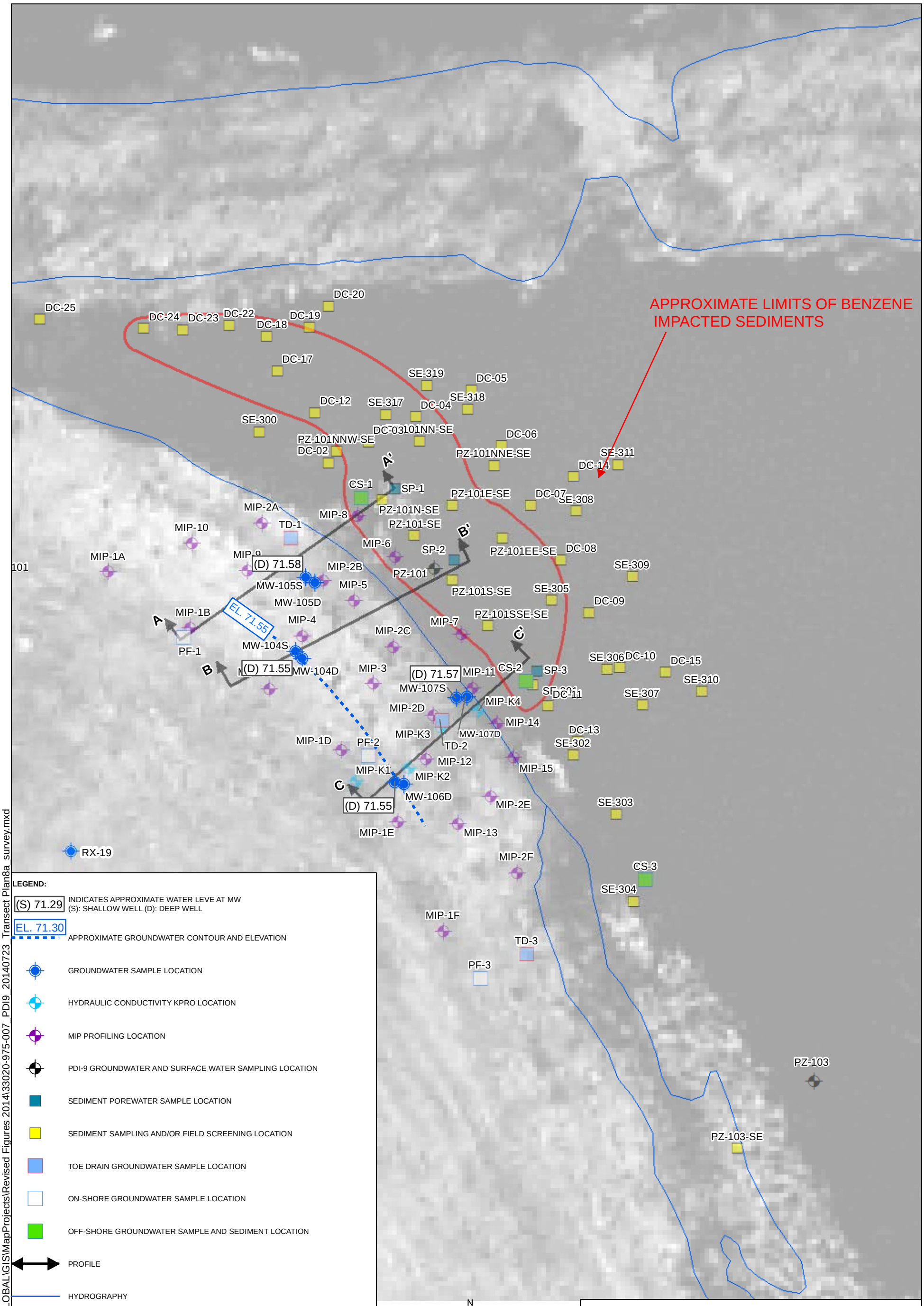

LEGEND:

(S) 71.29 INDICATES APPROXIMATE WATER LEVE AT MW (S): SHALLOW WELL (D): DEEP WELL

EL. 71.30 APPROXIMATE GROUNDWATER CONTOUR AND ELEVATION

GROUNDWATER SAMPLE LOCATION

HYDRAULIC CONDUCTIVITY KPRO LOCATION

MIP PROFILING LOCATION

PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION

SEDIMENT POREWATER SAMPLE LOCATION

SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION

TOE DRAIN GROUNDWATER SAMPLE LOCATION

ON-SHORE GROUNDWATER SAMPLE LOCATION

OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION

PROFILE

HYDROGRAPHY

NOTES:

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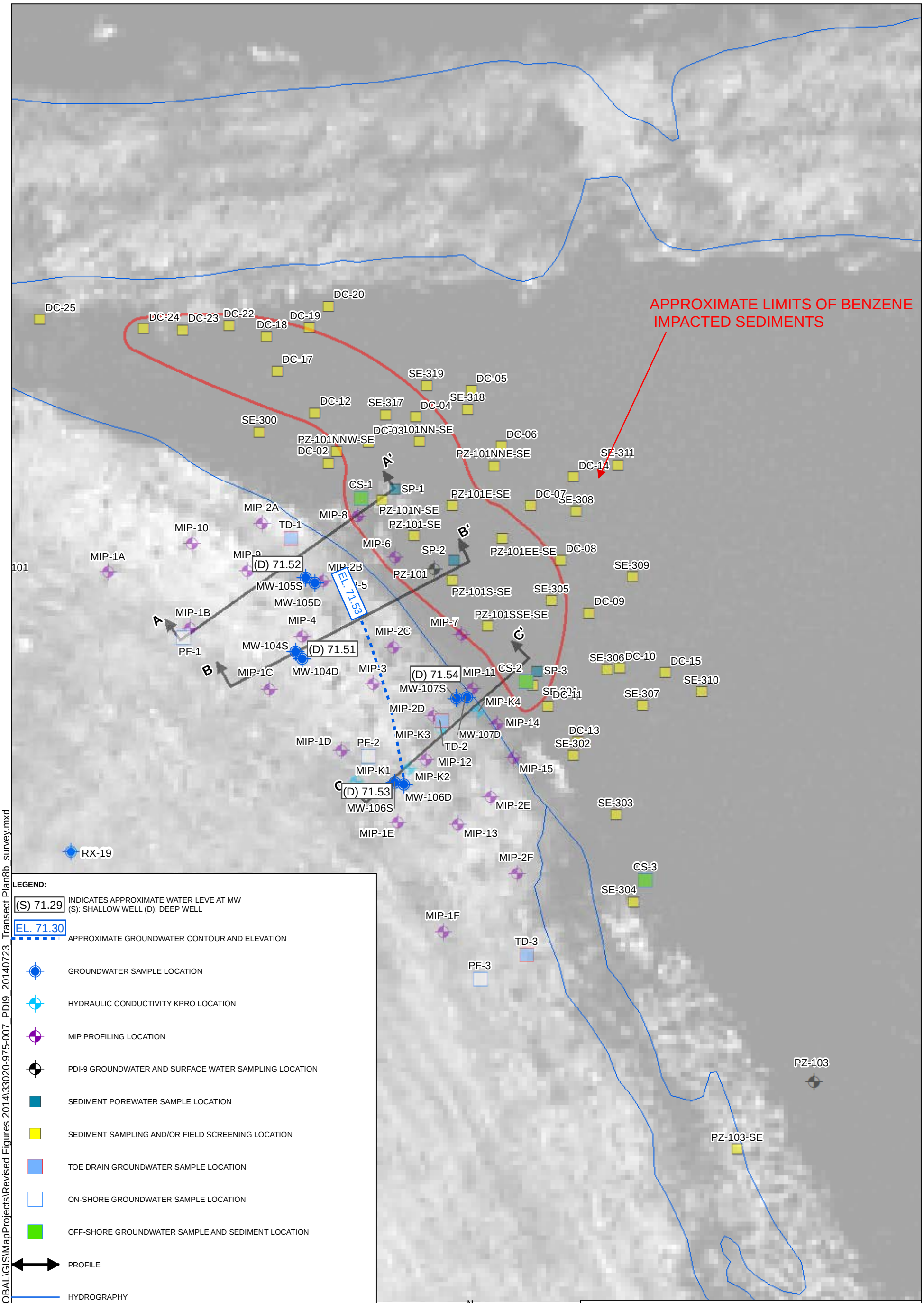
100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE SAND DEPOSIT ON 4 DECEMBER 2012

SCALE: AS SHOWN
JULY 2014

FIGURE 8A

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2014\33020-975-007_PDI9_20140723_Transect Plan8a_survey.mxd



NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. WELLS RX-18 AND RX-19 SAMPLED BY ROUX 12/2002. ALL OTHER SAMPLES TAKEN BY H&A BETWEEN 4/2011 AND 1/2013.
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HALEY & ALDRICH

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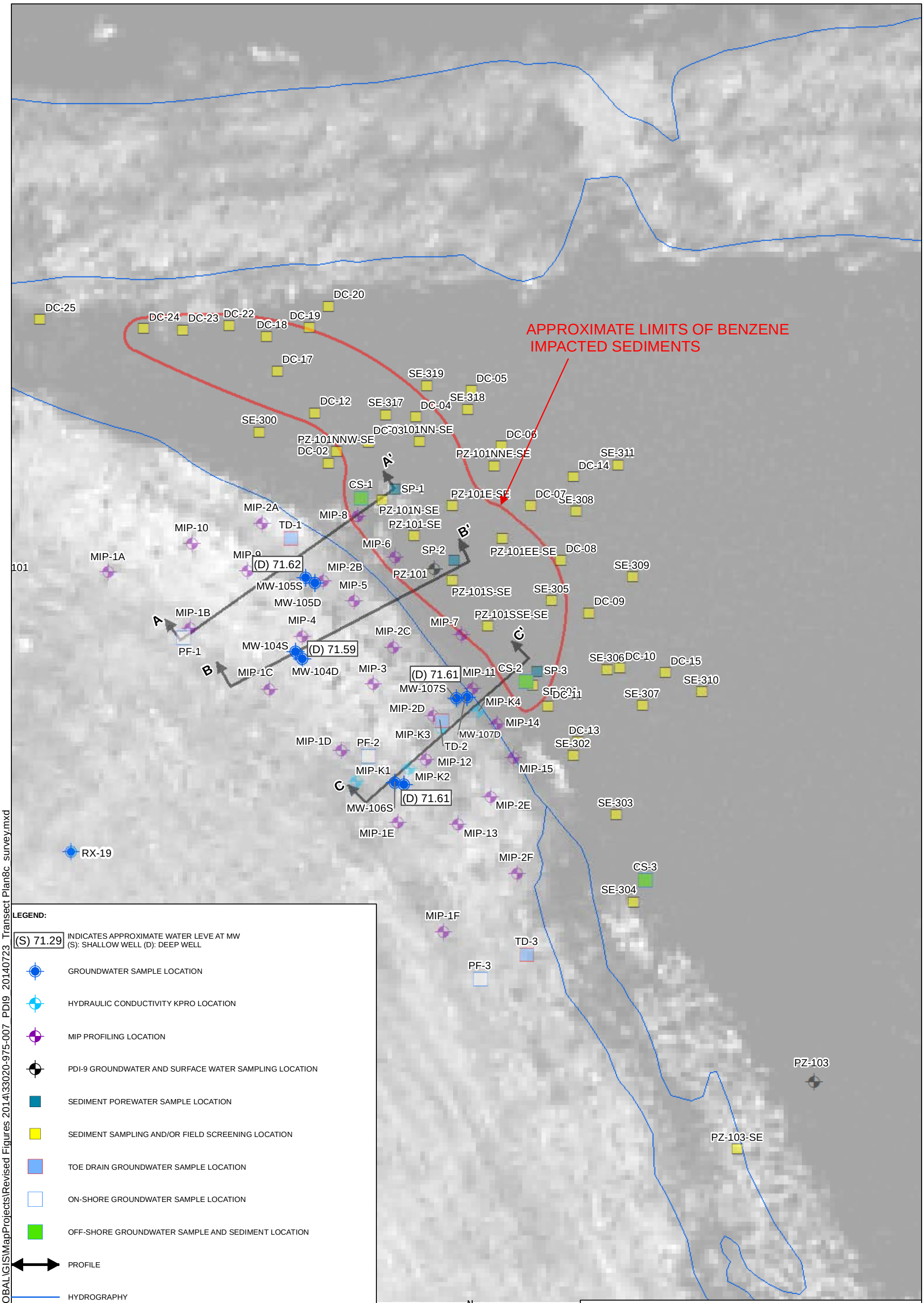
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE SAND DEPOSIT ON 6 DECEMBER 2012

SCALE: AS SHOWN
JULY 2014

FIGURE 8B

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2014\33020-975-007_PDI9_20140723_Transect Plan8b_survey.mxd



LEGEND:

(S) 71.29 INDICATES APPROXIMATE WATER LEVE AT MW
(S): SHALLOW WELL (D): DEEP WELL

- GROUNDWATER SAMPLE LOCATION
- HYDRAULIC CONDUCTIVITY KPRO LOCATION
- MIP PROFILING LOCATION
- PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION
- SEDIMENT POREWATER SAMPLE LOCATION
- SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION
- TOE DRAIN GROUNDWATER SAMPLE LOCATION
- ON-SHORE GROUNDWATER SAMPLE LOCATION
- OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION
- PROFILE
- HYDROGRAPHY

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. WELLS RX-18 AND RX-19 SAMPLED BY ROUX 12/2002. ALL OTHER SAMPLES TAKEN BY H&A BETWEEN 4/2011 AND 1/2013.
3. 2008 30 CENTIMETER RESOLUTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.

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Feet

HALEY & ALDRICH

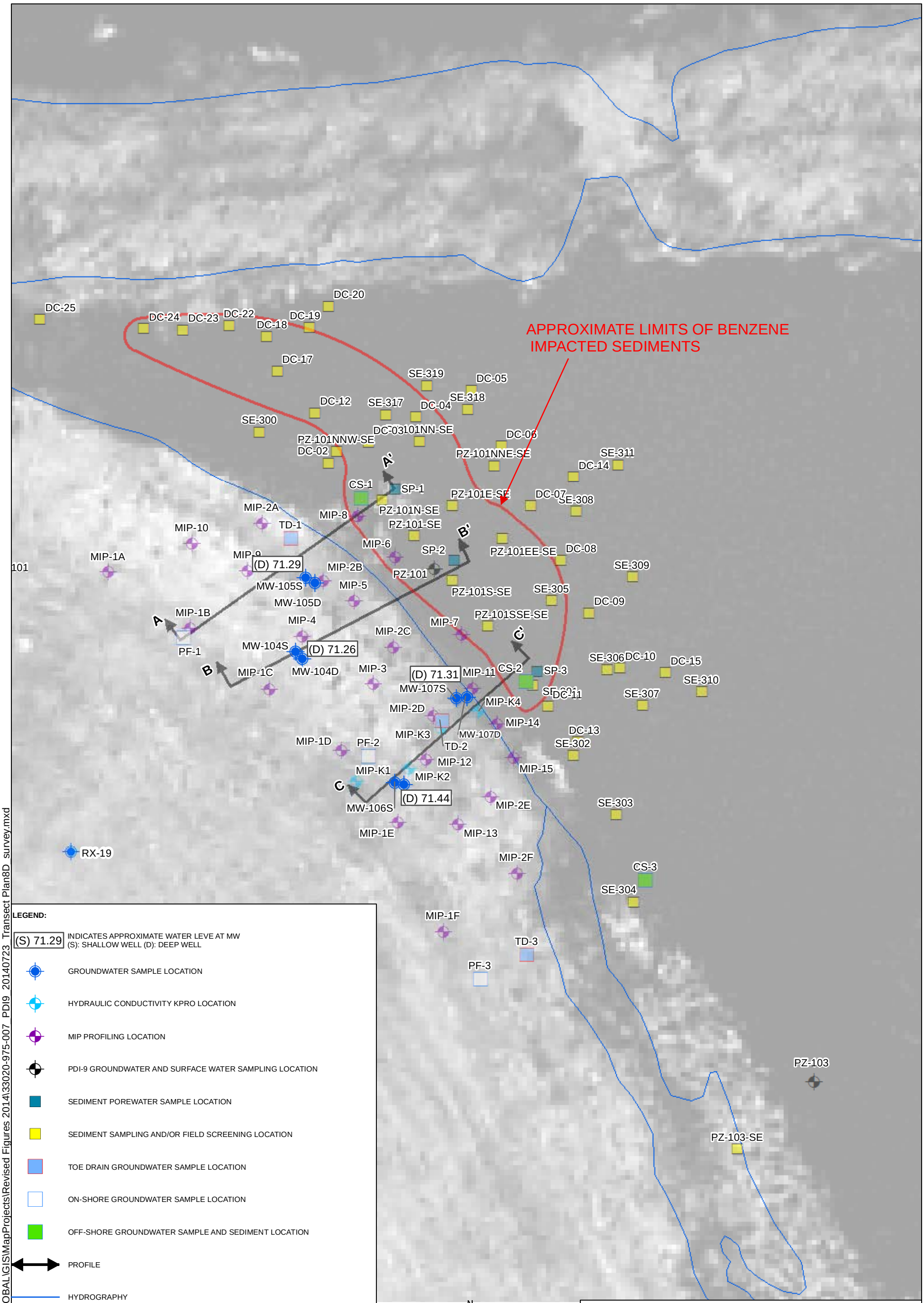
100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE SAND DEPOSIT ON 14 MAY 2013

SCALE: AS SHOWN
JULY 2014

FIGURE 8C

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2014\33020-975-007_PDI9_20140723_Transect Plan8c_survey.mxd



LEGEND:

(S) 71.29 INDICATES APPROXIMATE WATER LEVE AT MW
(S): SHALLOW WELL (D): DEEP WELL

- GROUNDWATER SAMPLE LOCATION
- HYDRAULIC CONDUCTIVITY KPRO LOCATION
- MIP PROFILING LOCATION
- PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION
- SEDIMENT POREWATER SAMPLE LOCATION
- SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION
- TOE DRAIN GROUNDWATER SAMPLE LOCATION
- ON-SHORE GROUNDWATER SAMPLE LOCATION
- OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION
- PROFILE
- HYDROGRAPHY

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. WELLS RX-18 AND RX-19 SAMPLED BY ROUX 12/2002. ALL OTHER SAMPLES TAKEN BY H&A BETWEEN 4/2011 AND 1/2013.
3. 2008 30 CENTIMETER RESOLUTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.

HALEY & ALDRICH

100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

GROUNDWATER ELEVATIONS WITHIN THE SAND DEPOSIT ON 1 NOVEMBER 2013

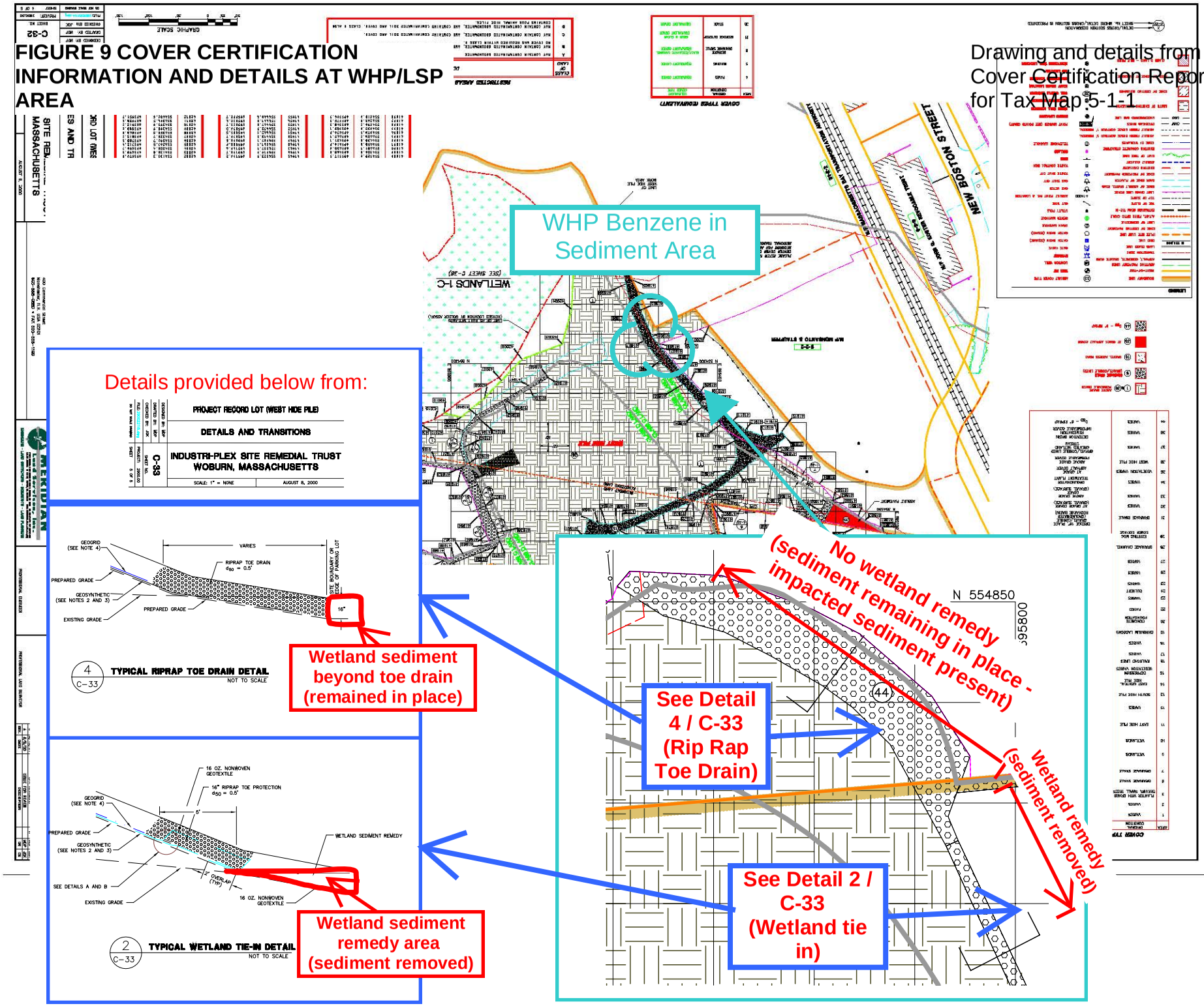
SCALE: AS SHOWN
JULY 2014

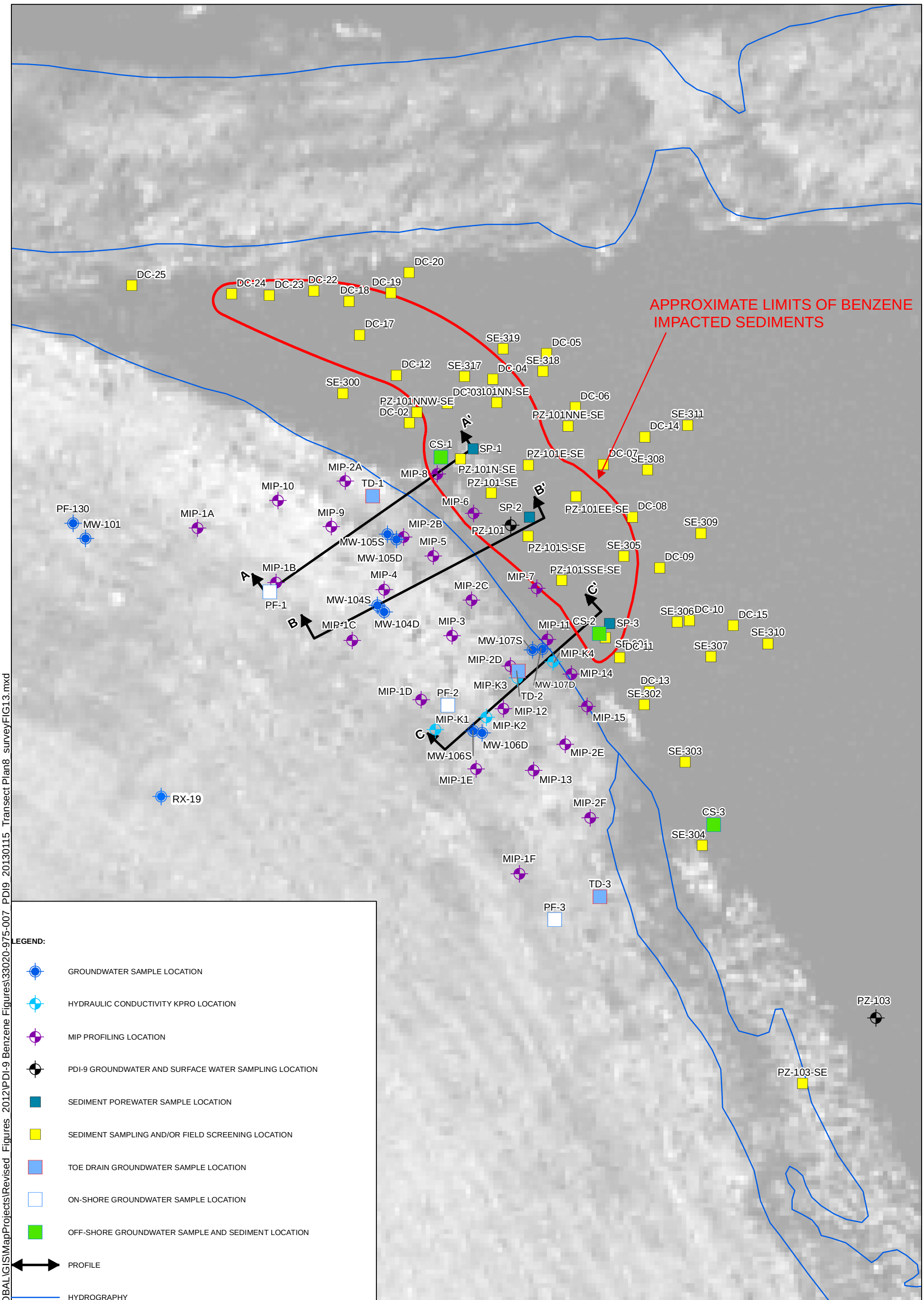
FIGURE 8D

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2014\33020-975-007_PDI9_20140723_Transect Plan8D_survey.mxd

FIGURE 9 COVER CERTIFICATION INFORMATION AND DETAILS AT WHP/LSP AREA

Drawing and details from Cover Certification Reports for Tax Map 5-1-1





LEGEND:

- GROUNDWATER SAMPLE LOCATION
- HYDRAULIC CONDUCTIVITY KPRO LOCATION
- MIP PROFILING LOCATION
- PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION
- SEDIMENT POREWATER SAMPLE LOCATION
- SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION
- TOE DRAIN GROUNDWATER SAMPLE LOCATION
- ON-SHORE GROUNDWATER SAMPLE LOCATION
- OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION
- PROFILE
- HYDROGRAPHY

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. WELLS RX-18 AND RX-19 SAMPLED BY ROUX 12/2002. ALL OTHER SAMPLES TAKEN BY H&A BETWEEN 4/2011 AND 1/2013.
3. 2008 30 CENTIMETER RESOLUTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.

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HALEY & ALDRICH

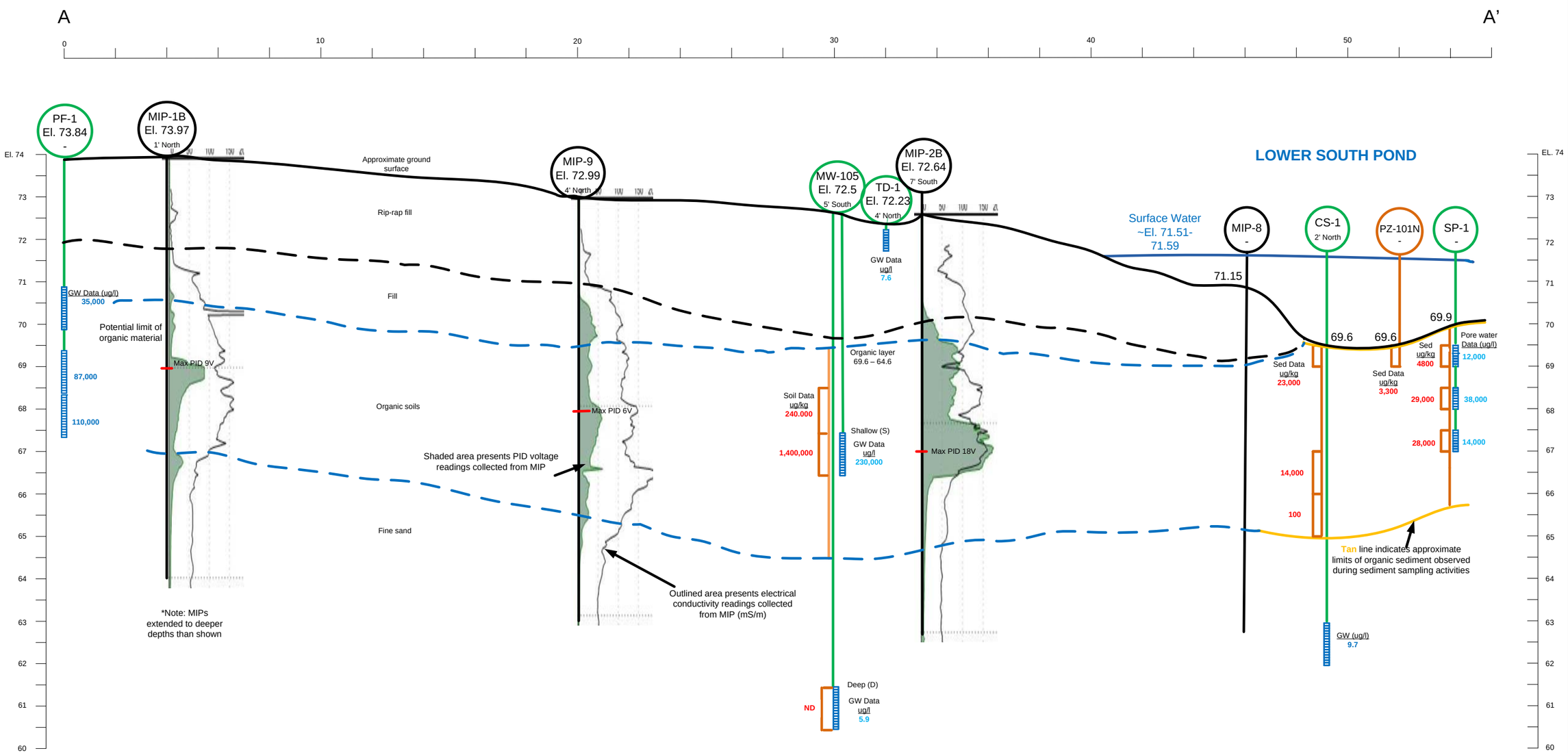
100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PDI 9: CROSS SECTION LOCATIONS
WEST HIDE PILE LOWER SOUTH POND

SCALE: AS SHOWN
JULY 2014

FIGURE 13

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2012\PDI-9 Benzene Figures\33020-975-007 PDI9 20130115 Transect Plan8 surveyFIG13.mxd



NOTES:

1. All locations are approximate
2. Horizontal and vertical scales are approximate
3. **All soil, sediment, groundwater and pore water results shown are for Benzene**
4. Benzene results shown in **Red** representative of SOIL samples. Results shown in **Blue** representative of WATER (groundwater or pore water) samples

LEGEND:

PF-1
El. 73.84
2' North

PF-1	Groundwater profiling (pz) location
MIP-1B	MIP profiling location
MW-105	Monitoring Well couplet location
TD-1	Toe Drain sampling location
CS-1	Sediment core and groundwater (pz) sampling location
SP-1	Sediment core and pore water sampling location (3 well points)
PZ-101N	Surface sediment sampling location

El. 73.84 indicates approximate ground surface elevation (ft.)
1' North indicates offsite distance and direction from transect line (ft.)

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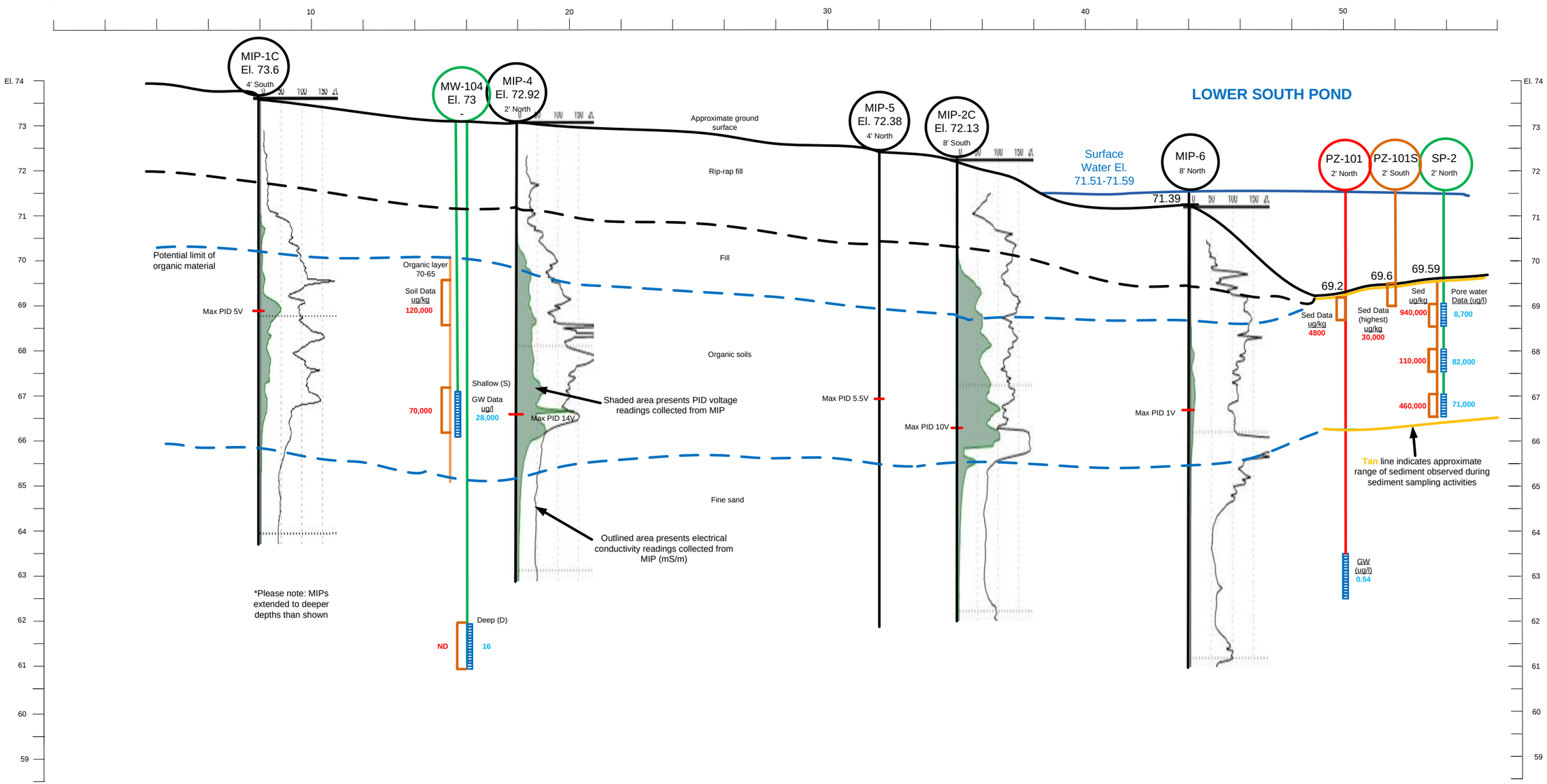
100% REMEDIAL DESIGN - LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PDI-9 WEST HIDE PILE
CROSS SECTION A - A'

SCALE: AS SHOWN
JULY 2014

FIGURE 14

\\ad\Common\33920\04\Octobar 2013 Investigation\PDI-9 Brewerer Summary\Cross section\2013-001213-MIP Program Cross Section A-F.mxd



NOTES:

1. All locations are approximate
2. Horizontal and vertical scales are approximate
3. **All soil, sediment, groundwater and pore water results shown are for Benzene**
4. Benzene results shown in **Red** representative of SOIL samples. Results shown in **Blue** representative of WATER (groundwater or pore water) samples

LEGEND:

MIP-4
El. 73.84
2' North

MIP-1B MIP profiling location
MW-105 Monitoring Well couplet location
PZ-101 Piezometer groundwater and surface sediment sampling location
SP-1 Sediment core and pore water sampling location (3 well points)
PZ-101N Surface sediment sampling location

El. 73.84 indicates approximate ground surface elevation (ft.)
1' North indicates offsite distance and direction from transect line (ft.)

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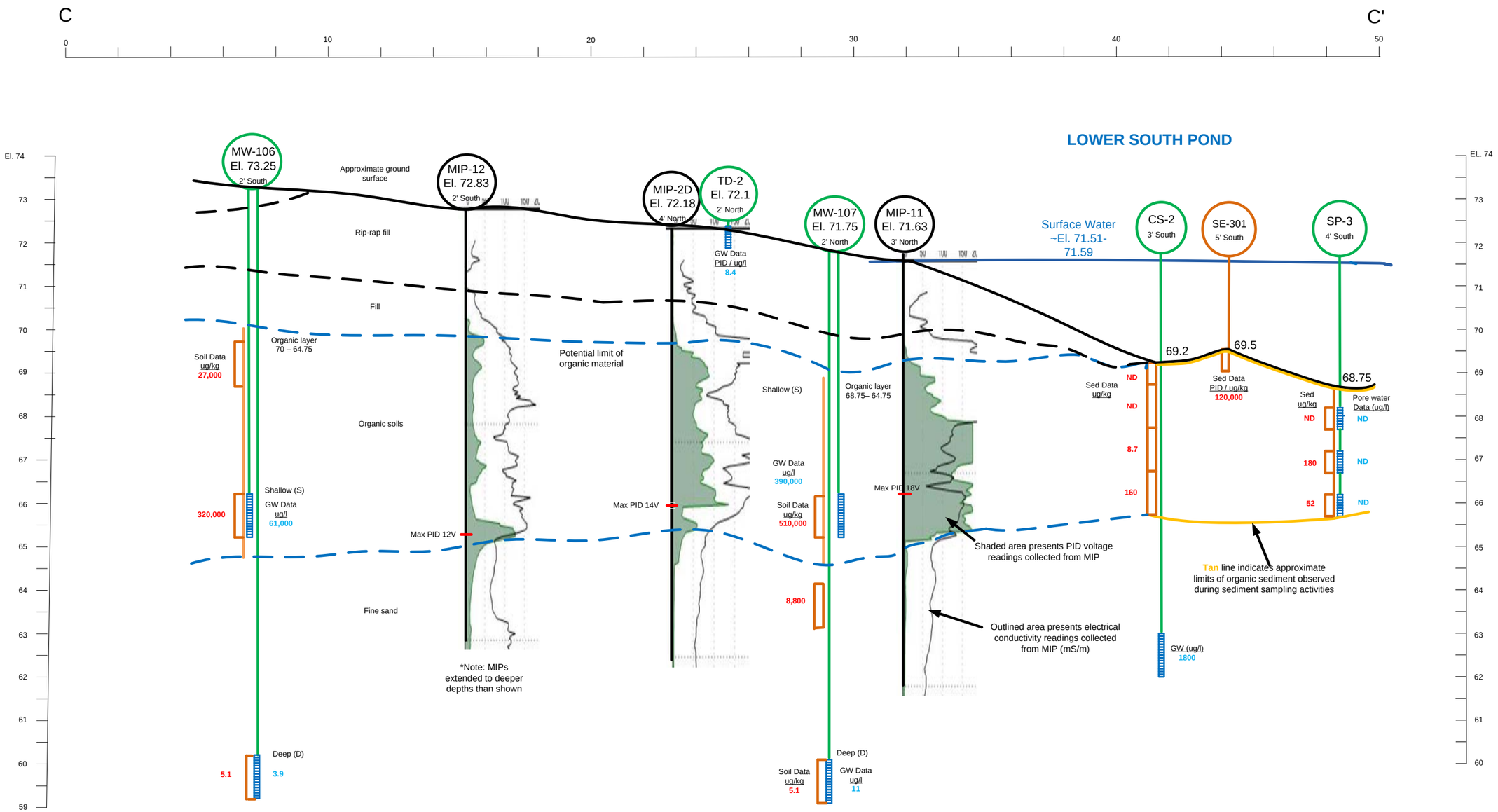
100% REMEDIAL DESIGN - LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PDI-9 WEST HIDE PILE
CROSS SECTION B - B'

SCALE: AS SHOWN
JULY 2014

FIGURE 15

\\BOS\Common\33020\04\9\October 2012 Investigations\PDI-9 Benzene Summary\Cross sections\2013-0124-MIP Program Cross Sections\B-F.vsd



NOTES:

1. All locations are approximate
2. Horizontal and vertical scales are approximate
3. **All soil, sediment, groundwater and pore water results shown are for Benzene**
4. Benzene results shown in **Red** representative of SOIL samples. Results shown in **Blue** representative of WATER (groundwater or pore water) samples

LEGEND:

MIP-1B
El. 73.84
2' North

MIP-1B MIP profiling location
MW-105 Monitoring Well couplet location
TD-1 Toe Drain sampling location
CS-1 Sediment core and groundwater (pz) sampling location
SP-1 Sediment core and pore water sampling location (3 well points)
SE-301 Surface sediment sampling location

El. 73.84 indicates approximate ground surface elevation (ft.)
1' North indicates offsite distance and direction from transect line (ft.)

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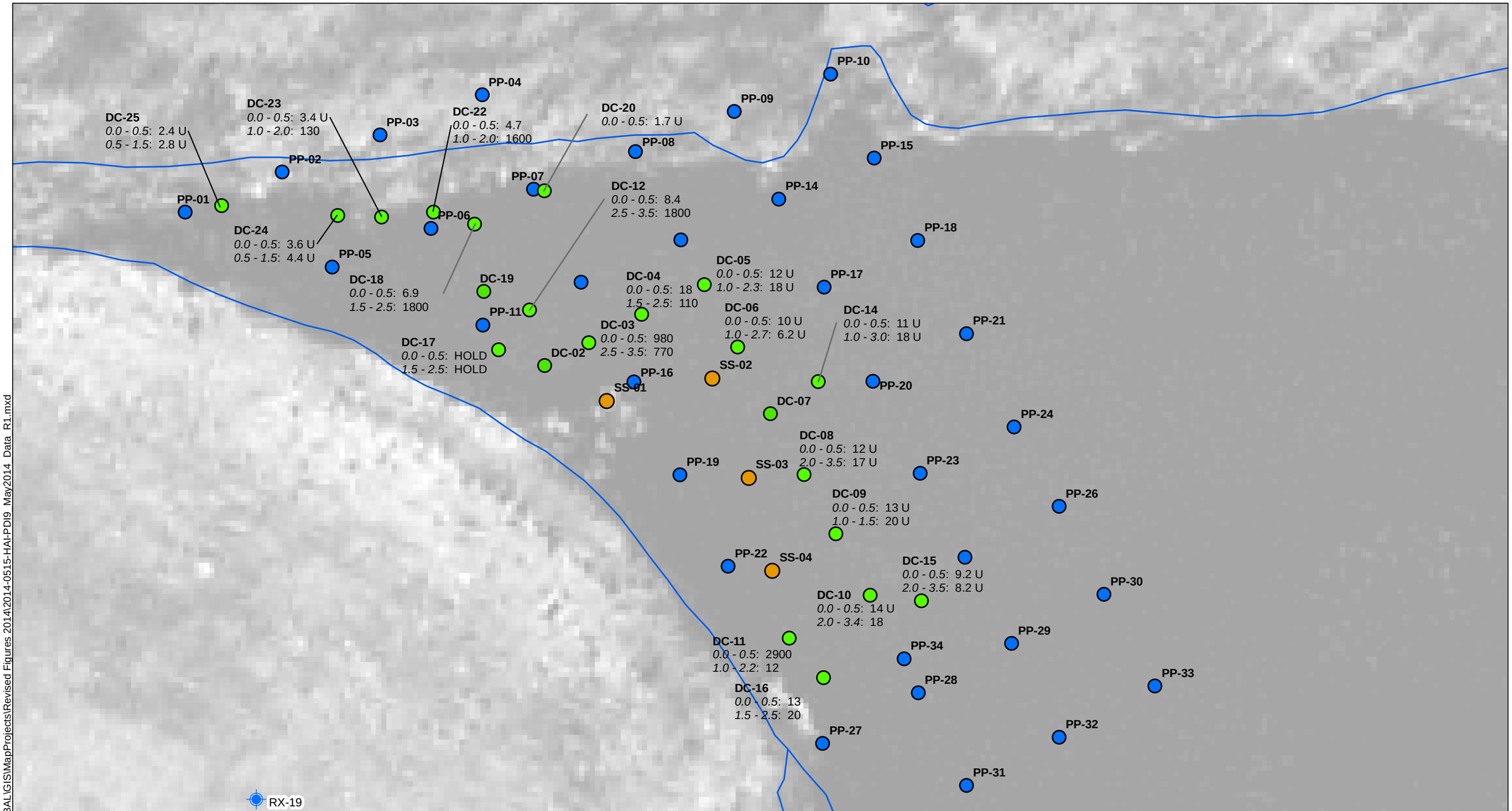
100% REMEDIAL DESIGN - LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PDI-9 WEST HIDE PILE
CROSS SECTION C - C'

SCALE: AS SHOWN
JULY 2014

FIGURE 16

I:\B\Sycamore\130020\04\80\October 2012 Investigation\PDI-9 Benzene Summary\Cross sections\2012-01\PDI-9 MIP Program Cross Sections-C.dwg



LEGEND:

- Delineation Cores
- Peat Probes
- Surface Sediment
- HYDROGRAPHY

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. WELLS RX-18 AND RX-19 SAMPLED BY ROUX 12/2002. ALL OTHER SAMPLES TAKEN BY H&A BETWEEN 4/2011 AND 1/2013.
3. 2008 30 CENTIMETER RESOLUTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.

DRAFT

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HALEY & ALDRICH

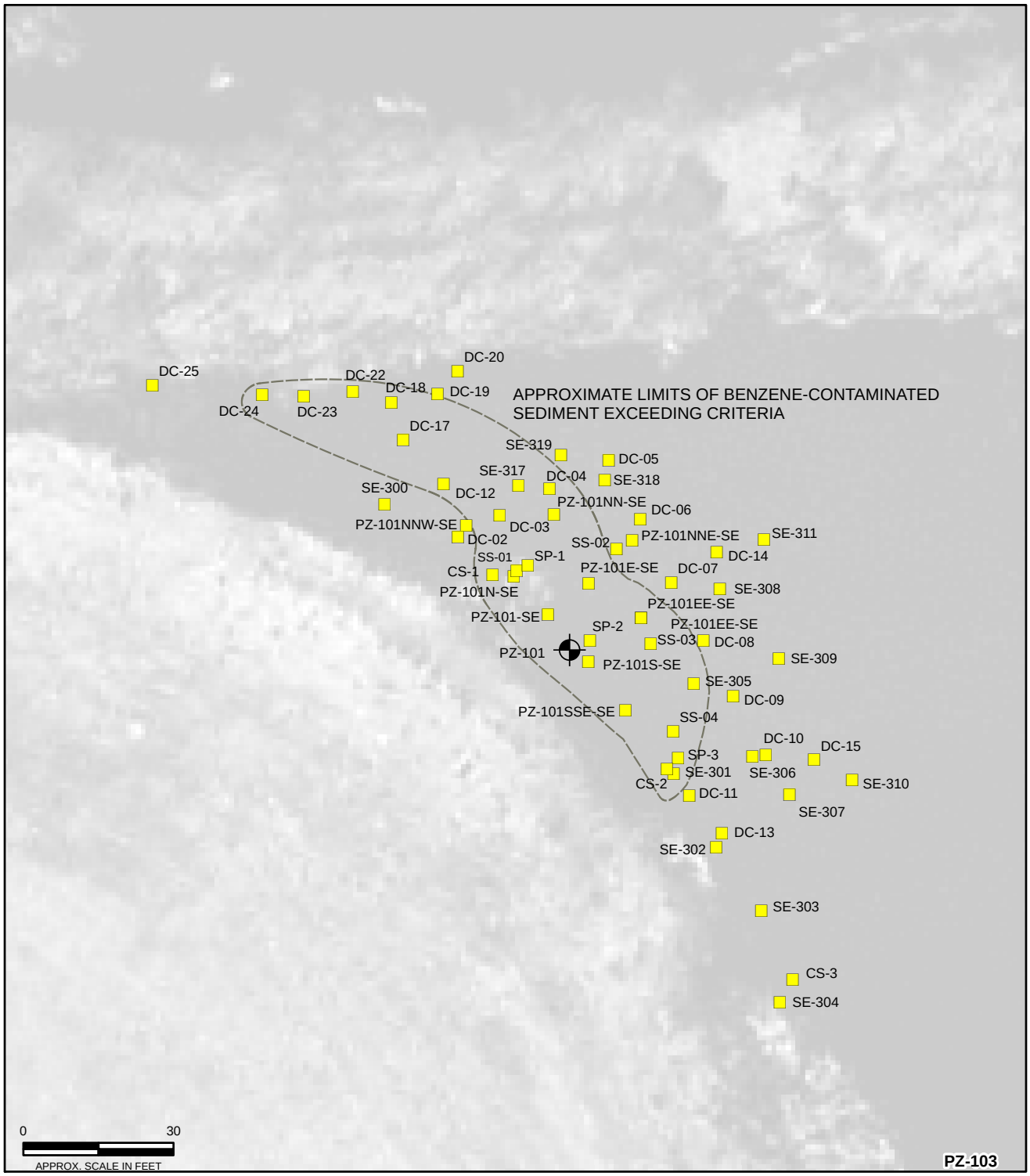
100% REMEDIAL DESIGN - LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PDI 9: ADDITIONAL BENZENE ASSESSMENT WEST HIDE PILE LOWER SOUTH POND

SCALE: AS SHOWN
JULY 2014

FIGURE 17

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2014\2014-0515-HAI-PDI9_May2014_Data_R1.mxd



LEGEND:

PDI-9 GROUNDWATER & SURFACE WATER SAMPLING LOCATION

PDI-9 SEDIMENT SAMPLING LOCATION

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. 2008 30 CENTIMETER RESOLUCTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.
3. WEST HIDE PILE, EAST HIDE PILE APPROXIMATED FROM MSGRP REMEDIAL INVESTIGATION REPORT, RI FIGURE 2-5A SURFACE WATER SAMPLE LOCATIONS - REACH 0.

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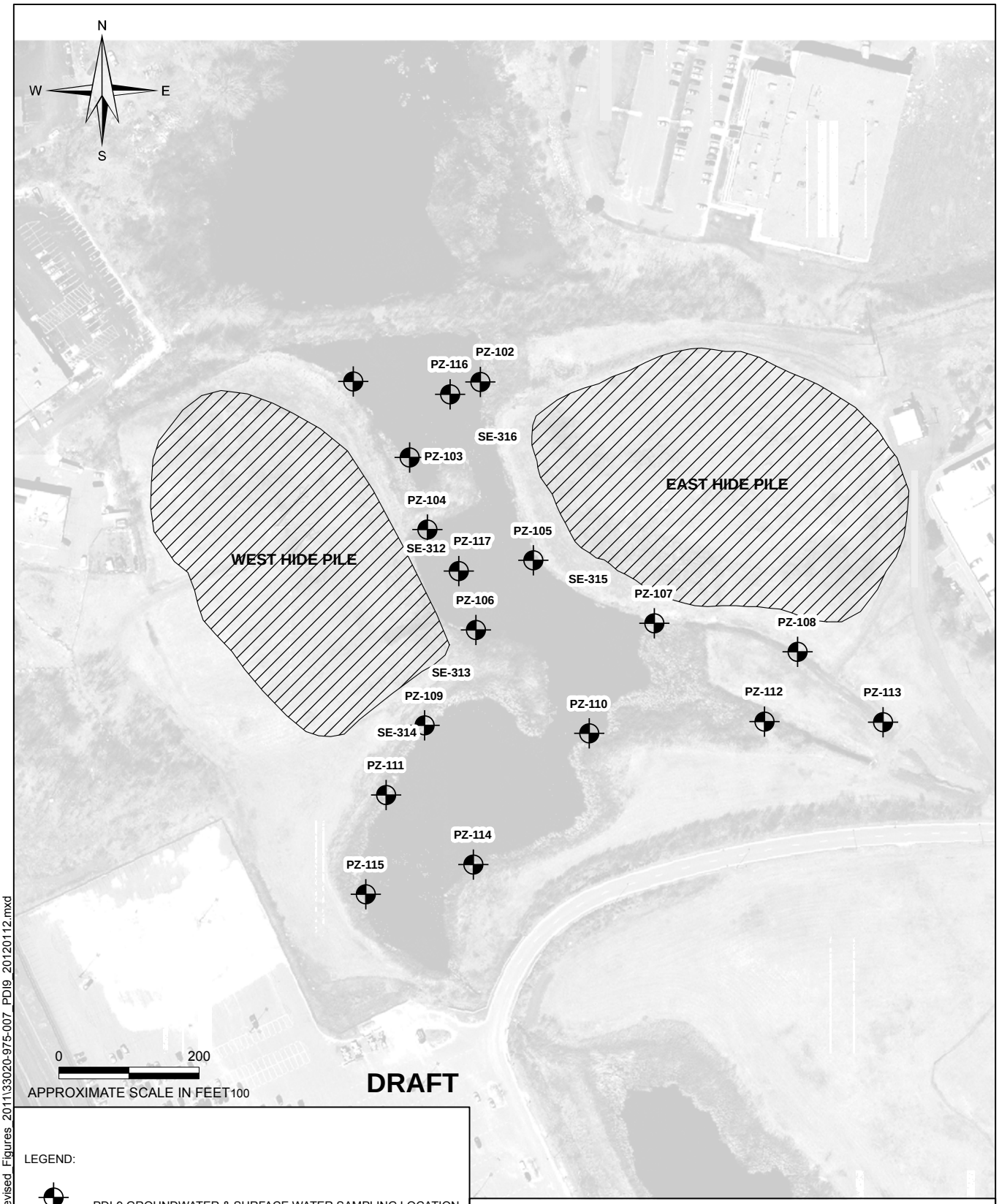
100% REMEDIAL DESIGN - LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

APPROXIMATE AREA OF BENZENE CONTAMINATED SEDIMENT ABOVE THE CLEANUP STANDARD

SCALE: AS SHOWN
JULY 2014

FIGURE 18

Document Path: G:\33020\GLOBAL\GIS\MapProjects\Revised Figures 2014\33020-975-007_PDI9_20140711Fig3.mxd



LEGEND:

PDI-9 GROUNDWATER & SURFACE WATER SAMPLING LOCATION

NOTES:

1. ALL LOCATIONS, DIMENSIONS, AND AREAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
2. 2008 30 CENTIMETER RESOLUCTION COLOR ORTHOIMAGERY OBTAINED FROM THE OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS.
3. WEST HIDE PILE, EAST HIDE PILE APPROXIMATED FROM MSGRP REMEDIAL INVESTIGATION REPORT, RI FIGURE 2-5A SURFACE WATER SAMPLE LOCATIONS - REACH 0.

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100% REMEDIAL DESIGN - LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PDI-9 WEST & EAST HIDE PILE
SURFACE WATER INVESTIGATION
EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
JULY 2014

FIGURE 19

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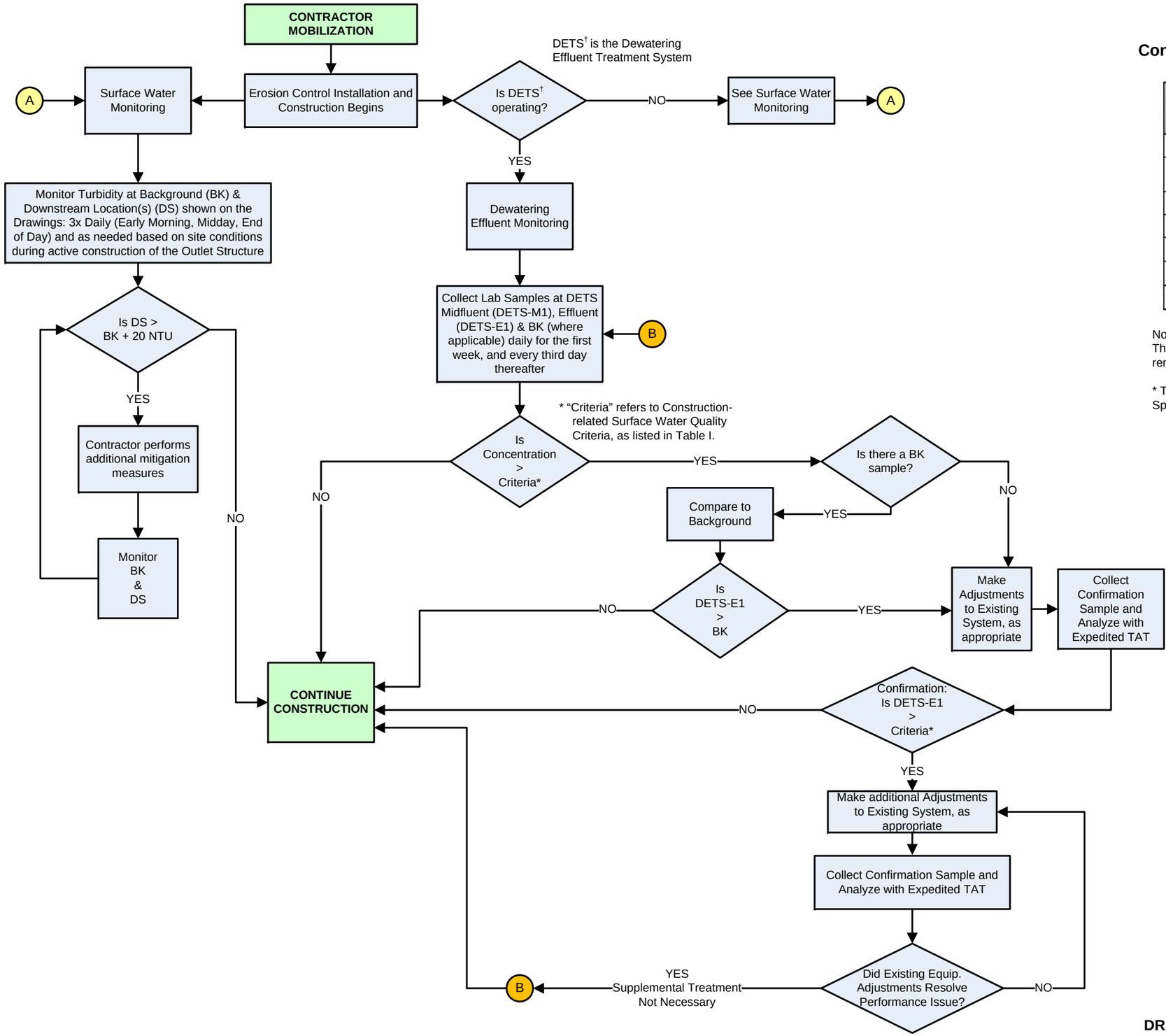

Construction-related Surface Water Quality Criteria

Parameter	Construction-related Surface Water Quality Criteria
Benzene (µg/L)	46
Dissolved Arsenic (µg/L)	150
Total Arsenic (µg/L)	150
Ammonia (mg/L)	NRWQC (Note 1)*
TSS (mg/L)	30
Turbidity (NTU)	Background + 20
Naphthalene (µg/L)	193.5

Notes:
The above list of parameters are specific to the Lower South Pond remediation adjacent to the West Hide Pile only.

* The ammonia NRWQC varies with temperature and pH. See Specification Section 312319 for more details.

Legend:

A Start surface water monitoring program

B Restart dewatering sampling program

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100% REMEDIAL DESIGN – LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

SURFACE WATER AND DEWATERING EFFLUENT MONITORING PLAN

SCALE: NONE
JULY 2014

FIGURE 20

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APPENDIX A

100% Design Drawings, Specifications and Calculations

Lower South Pond (LSP) Sediments Adjacent to West Hide Pile (WHP) Remedial Design – Drawings and Specifications

List of Calculation and Supporting Information

Calculations – IPLEX West Hide Pile Access Road Slope Stability and Backup Data

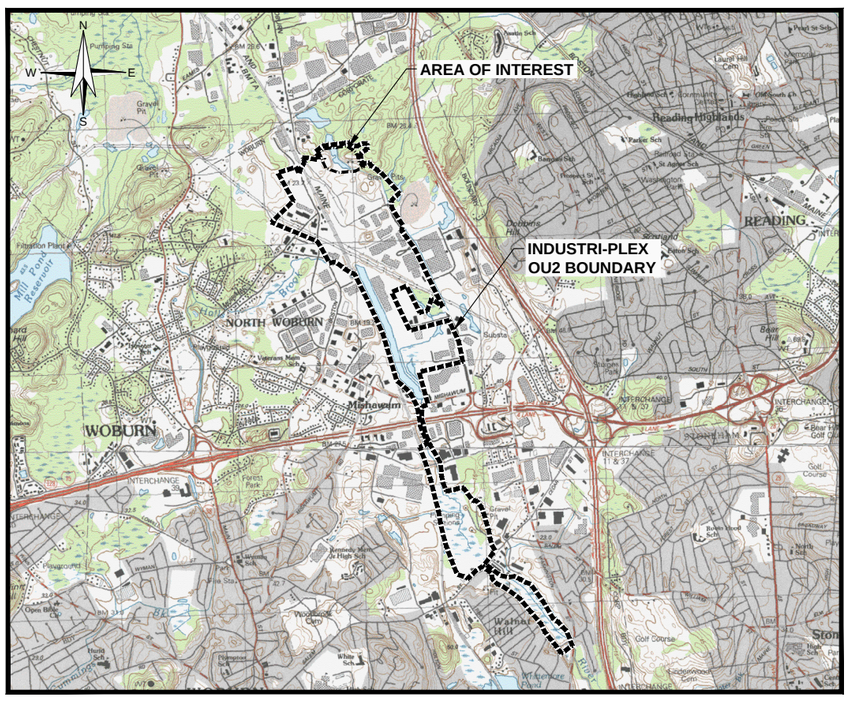
Supporting Information – Solidification Testing Addendum Report

Supporting Information – Aquagate+PAC™ Longevity Estimate

100% REMEDIAL DESIGN

INDUSTRI-PLEX SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

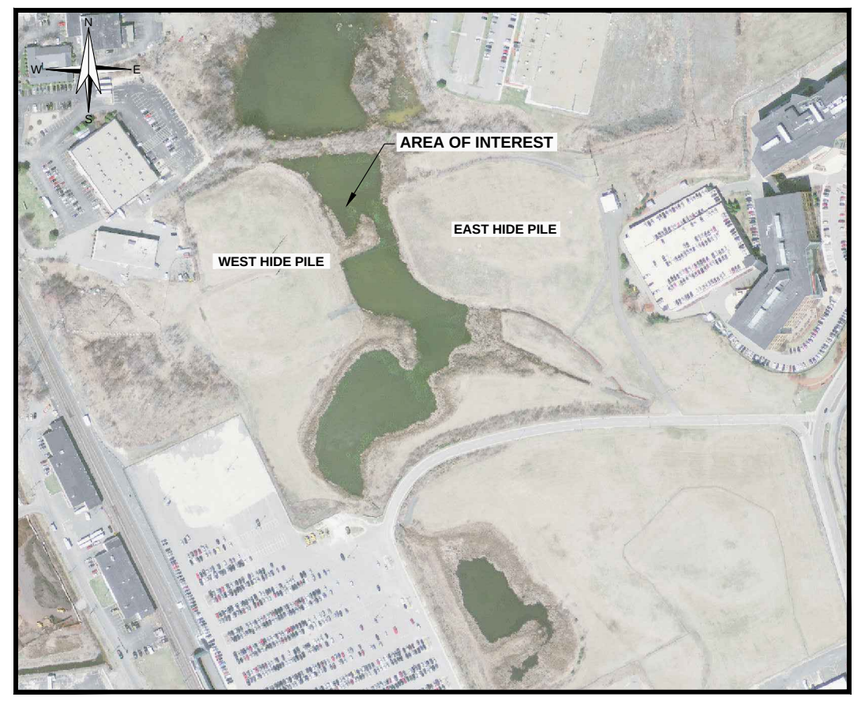
LOWER SOUTH POND (LSP) SEDIMENTS
ADJACENT TO WEST HIDE PILE (WHP)
REMEDIAL DESIGN



SITE LOCUS

TOPO SOURCE: USGS TOPOGRAPHIC MAP, BOSTON NORTH AND READING, MASSACHUSETTS QUADRANGLE (1985).

0 2000 4000 6000
APPROXIMATE SCALE IN FEET



SITE AERIAL

IMAGE, DATED APRIL 10-18, 2008. TAKEN ELECTRONICALLY FROM GOOGLE EARTH PRO.

0 200 400 600
APPROXIMATE SCALE IN FEET

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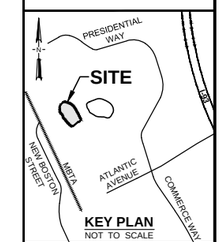
465 Medford Street
Suite 2200
Boston, MA 02129-1400
Tel: 617.886.7400
www.haleyaldrich.com



KEY PLAN
NOT TO SCALE

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
INDUSTRI-PLEX
SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

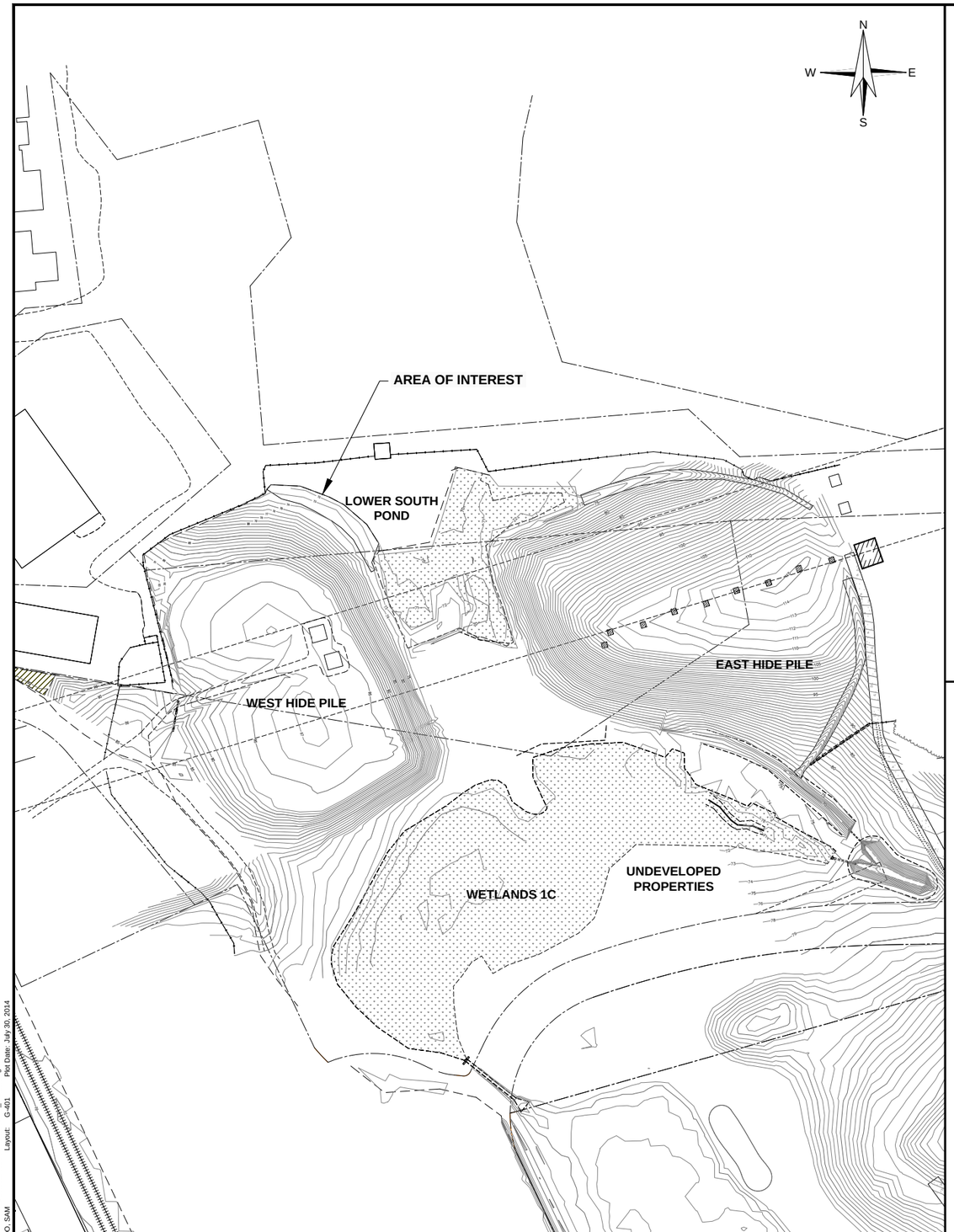
WEST HIDE PILE DESIGN

TITLE SHEET AND SITE LAYOUT

G-400

Sheet: 1 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\West Hide Pile\33020-222_G-400.dwg
Operator Name: LUCIDO, SAM
Layout: G-400 Plot Date: July 30, 2014



SITE LAYOUT

0 100 200 300 400

SCALE IN FEET

100% REMEDIAL DESIGN

INDUSTRI-PLEX SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

LOWER SOUTH POND (LSP) SEDIMENTS ADJACENT TO WEST HIDE PILE (WHP) REMEDIAL DESIGN

SHEET NO.	DRAWING NO.	SHEET TITLE
1	G-400	TITLE SHEET AND SITE LAYOUT
2	G-401	OVERALL SITE PLAN AND DRAWING INDEX
3	G-402	GENERAL NOTES AND LEGEND
4	G-403	SITE AND EXPLORATION LOCATION PLAN
5	G-404	SITE AND BENZENE IMPACTED SEDIMENT LOCATION PLAN
6	C-400	SITE PREPARATION PLAN
7	C-401	SURFACE WATER DIVERSION AND MONITORING PLAN
8	C-402	WELL ABANDONMENT PLAN
9	C-403	SEDIMENT REMOVAL PLAN
10	C-404	SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (1 of 4)
11	C-405	SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (2 of 4)
12	C-406	SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (3 of 4)
13	C-407	SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (4 of 4)
14	C-408	SITE RESTORATION PLAN
15	C-409	SITE RESTORATION DETAILS

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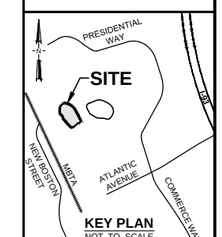
465 Medford Street
Suite 2200
Boston, MA 02129-1400
Tel: 617.886.7400
www.haleyaldrich.com



KEY PLAN
NOT TO SCALE

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
INDUSTRI-PLEX
SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

WEST HIDE PILE DESIGN

OVERALL SITE PLAN AND DRAWING INDEX

G-401

Sheet: 2 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\West Hide Pile\33020-222_G-400.dwg
Operator Name: LUCIDO, SAM
Layout: G-401
Plot Date: July 30, 2014

GENERAL NOTES

1. THE BASEMAP FOR THE WEST HIDE PILE AREA IS DERIVED FROM SEVERAL INDUSTRIPLEX OU1 COVER CERTIFICATION REPORT AS-BUILT DRAWINGS.
2. ELEVATIONS REFER TO NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29) IN US SURVEY FEET. THE HORIZONTAL DATUM IS MASSACHUSETTS STATE PLANE, BASED ON NORTH AMERICAN DATUM OF 1927 (NAD 27) IN US SURVEY FEET.
3. MEANS AND METHODS ARE TO BE SELECTED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER. FINAL CONSTRUCTION SEQUENCE AND ELEMENTS MAY CHANGE IN ACCORDANCE WITH THE CONTRACTOR'S CONSTRUCTION MEANS AND METHODS.
4. AS DEFINED IN THE OU-1 COVER CERTIFICATION REPORTS, CLASS C LAND MAY CONTAIN CONTAMINATED GROUNDWATER, AND CONTAINS CONTAMINATED SOIL AND COVER. CLASS D LAND MAY CONTAIN CONTAMINATED GROUNDWATER, AND CONTAINS CONTAMINATED SOIL AND COVER, AND FOUR ANIMAL HIDE PILES.

GENERAL LINETYPES

- BUILDINGS, BEDROCK, STRATA, CONTOURS, TOPO, HATCH PATTERNS, AND SITE DEVELOPMENT LINES.
- CENTERLINES, GRIDS, SITE GRID LINES, SITE LIMITS, COLUMN LINES, FUTURE WORKS, AND MATCH LINES.
- MOST SITE ENTITIES EXCEPT THOSE SHOWN WITH A CONTINUOUS OR DASHED LINETYPE
- DEMOLISHED/RELOCATED ITEMS, ABANDONED FEATURES, EASEMENTS, RIGHT-OF-WAYS, FOOTINGS, AND INTERPRETIVE CONTOURS.
- UNDERGROUND STRUCTURES, TANKS, PROPOSED EXISTING COLUMNS, FOOTINGS, STRUCTURES BEYOND, HIDDEN OR EXISTING STRUCTURES.

CIVIL FEATURES / SURVEY DATA

- 60 — 10' CONTOUR INTERVAL (UPLAND)
- 58 — 2' CONTOUR INTERVAL (UPLAND)
- 46 — 1' CONTOUR INTERVAL (HBHA POND)
- ACCESS ROAD
- EXISTING BUILDING
- CONCRETE BARRIERS
- FENCE LINE
- TREE LINE
- TREE
- RAILROAD
- LOT / PROPERTY LINE
- EDGE OF PAVEMENT
- GRAVEL ROAD
- EDGE OF WATER
- EDGE OF WATER / WETLANDS
- UG — UNDERGROUND UTILITY
- OH — OVERHEAD UTILITIE
- T — TELEPHONE LINE
- W — WATER LINE
- GAS — GAS LINE
- SAN — SANITARY SEWER LINE
- DRAIN LINE
- BENCHMARK SET / FOUND
- WETLANDS
- SILT CURTAIN
- TEMPORARY COFFERDAM OR OTHER WATER DIVERSION
- STAW WATTTLES
- MONITORING WELL
- SAMPLE LOCATION
- STAFF GUAGE
- PIEZOMETER
- PB — PULLBOX (ELEC.)
- SINGLE POST SIGN
- DOUBLE POST SIGN
- WATER HYDRANT
- W — WATER VALVE
- TALL STAKE
- U — UNIDENTIFIED OBJECT
- R & R SIGNAL
- FOUND/SET GRANITE BOUND
- FOUND IRON PIPE
- S — FOUND SEWER MANHOLE
- D — DRAIN MANHOLE
- T — TELEPHONE
- MH — MANHOLE
- CATCH BASIN (SQUARE)
- CATCH BASIN (ROUND)
- LIGHT
- U — UNIDENTIFIED OBJECT
- 1 — UNIDENTIFIED OBJECT (1) 1" PIPE
- 2 — UNIDENTIFIED OBJECT (2) 1" PIPES
- 3 — UNIDENTIFIED OBJECT (3) 1" PIPES
- 4 — UNIDENTIFIED OBJECT (4) 1" PIPES
- 5 — UNIDENTIFIED OBJECT (5) 1" PIPES
- SHUT-OFF WELL
- GAS VALVE
- NO#S — NO CARRIER NUMBER
- UTILITY POLE

PLAN SHEET DATA

- 1 / C-400 — PROFILE REFERENCE (DETAIL 1 ON PLAN SHEET C-400)
- 1 / C-400 — DETAIL REFERENCE (DETAIL 1 ON PLAN SHEET C-400)

DETAILS

- SAND OR GRANULAR FILL
- NATIVE SOIL
- CONCRETE
- CRUSHED STONE / RIPRAP
- WOOD TIMBERS
- TOPSOIL
- GEOMEMBRANE
- GEOTEXTILE
- EROSION CONTROL BLANKET

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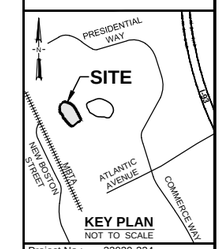


Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

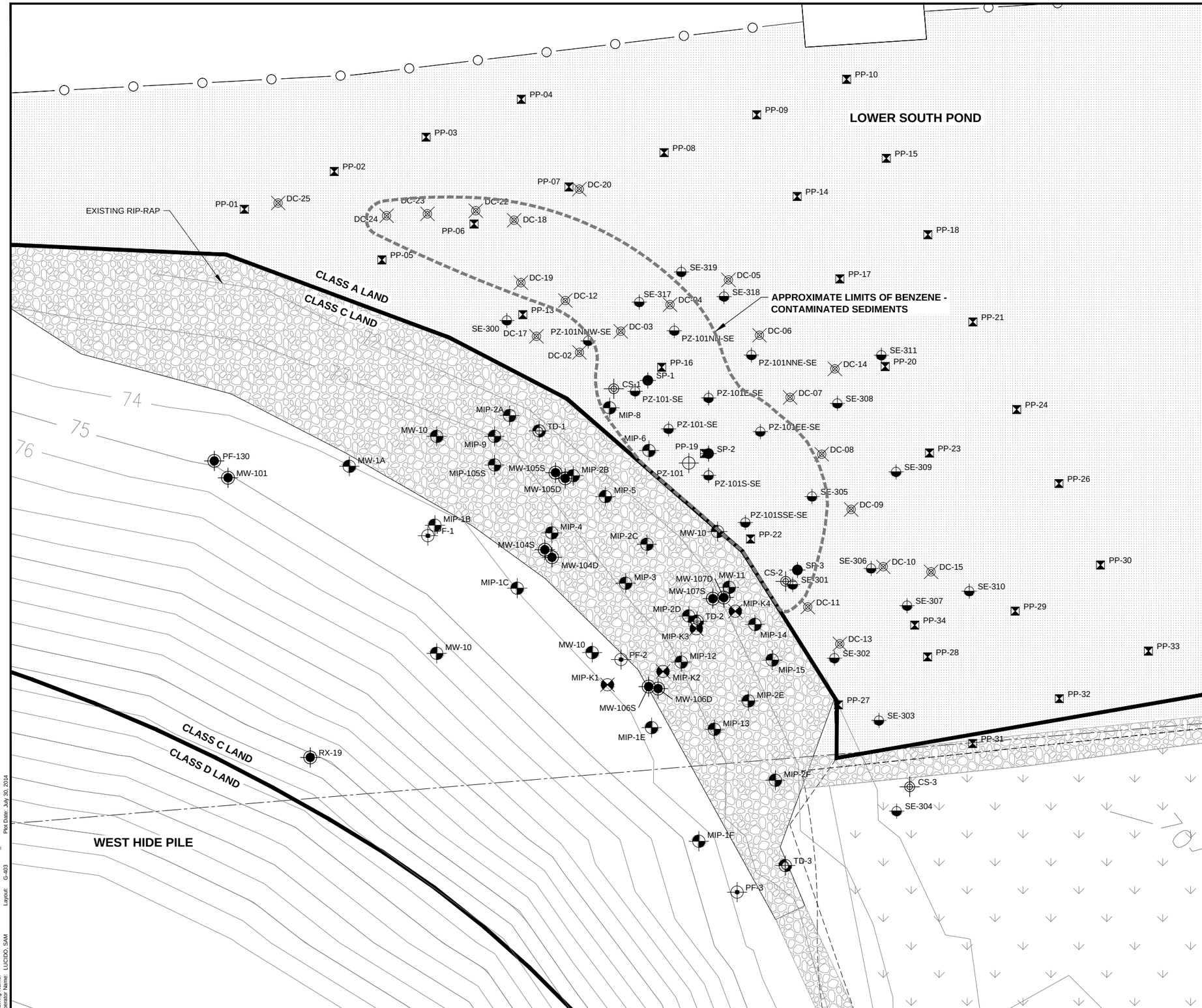
100% REMEDIAL DESIGN
INDUSTRI-PLEX
SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

WEST HIDE PILE DESIGN

GENERAL NOTES AND LEGEND

G-402

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\33020-222_G-402.DWG
Plot Date: July 30, 2014
Operator Name: LUCIDO, SAM
Layout: G-402



LEGEND

- GROUNDWATER SAMPLE LOCATION
- HYDRAULIC CONDUCTIVITY TEST LOCATION
- MEMBRANE INTERFACE PROBE (MIP) PROFILING LOCATION
- PDI-9 GROUNDWATER AND SURFACE WATER SAMPLING LOCATION
- SEDIMENT POREWATER SAMPLE LOCATION
- SEDIMENT SAMPLING AND/OR FIELD SCREENING LOCATION
- ON-SHORE GROUNDWATER SAMPLE LOCATION
- OFF-SHORE GROUNDWATER SAMPLE AND SEDIMENT LOCATION
- TOE DRAIN GROUNDWATER SAMPLE LOCATION
- PEAT PROBE LOCATION
- PRECHARACTERIZATION SAMPLES (MAY - JUNE 2014)

NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G-402.
2. ALL LOCATIONS, DIMENSIONS, AND AERIAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.

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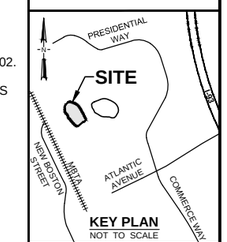

KEY PLAN
NOT TO SCALE

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	MK	06/27/14

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SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

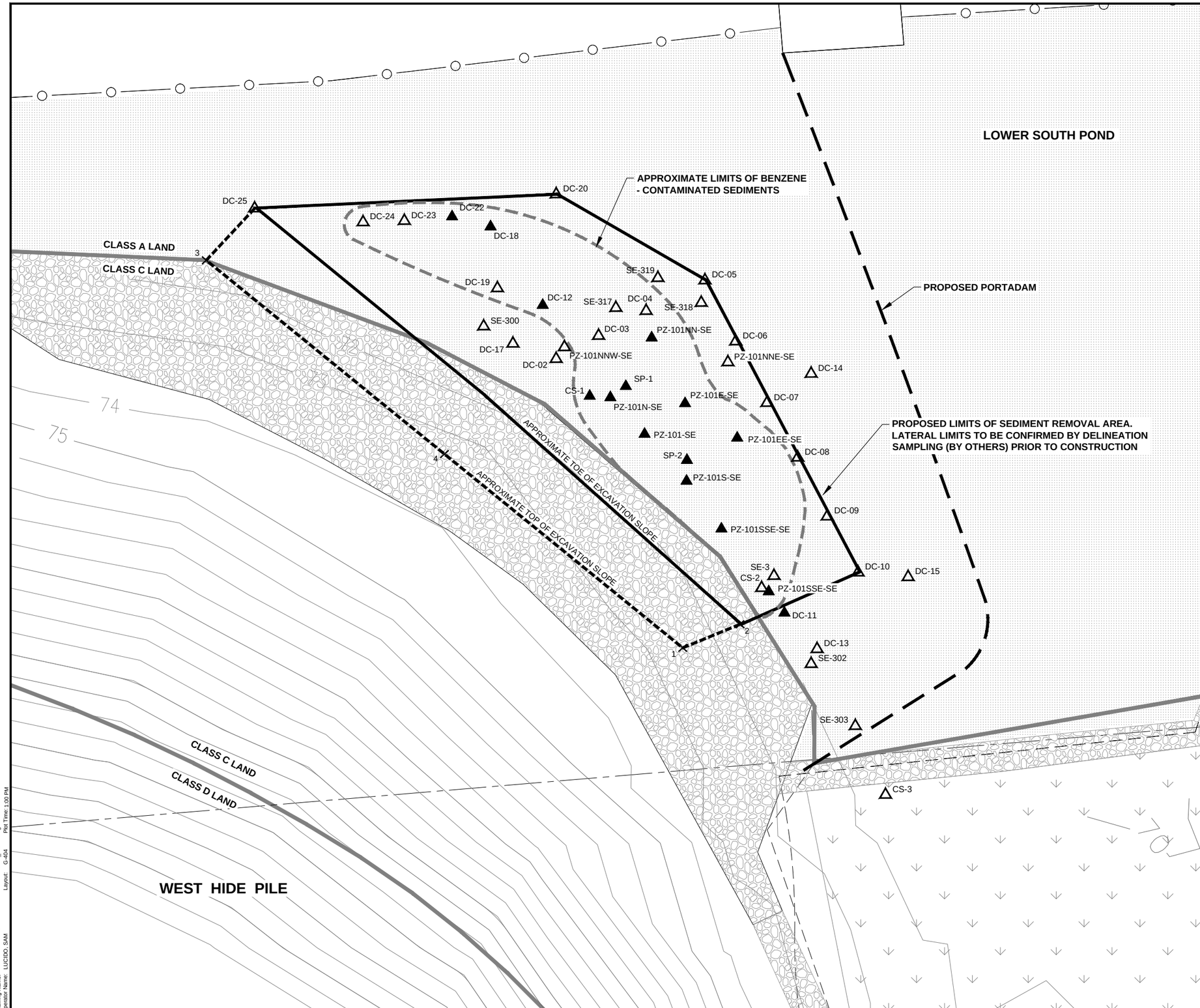
WEST HIDE PILE DESIGN

SITE AND EXPLORATION LOCATION PLAN

G-403

Sheet: 4 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\33020-222_G-403.DWG
Operator Name: LUCIDO, SAM Layout: G-403 Plot Date: July 30, 2014



LEGEND

▲ LOWER SOUTH POND SEDIMENT SAMPLE EXHIBITING BENZENE CONCENTRATIONS IN EXCESS OF EPA SEDIMENT CRITERIA OF 1.472 mg/kg FOR LOWER SOUTH POND

△ SEDIMENT SAMPLE EXHIBITING BENZENE CONCENTRATIONS BELOW EPA SEDIMENT CRITERIA OF 1.472 mg/kg FOR LOWER SOUTH POND

NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G-402.
2. WELL RX-19 SAMPLED BY ROUX DECEMBER 2002. ALL OTHER SAMPLES TAKEN BY H&A BETWEEN APRIL 2011 AND JUNE 2013.
3. ALL LOCATIONS, DIMENSIONS, AND AERIAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.

COORDINATES OF LIMITS OF EXCAVATION		
POINT ID	NORTHING	EASTING
1	554784.6	695751.4
2	554789.4	695763.0
DC-10	554799.9	695786.9
DC-05	554859.1	695755.9
DC-20	554876.5	695725.7
DC-25	554873.6	695664.6
3	554863.1	695654.8
4	554823.9	695703.1

NOTE:
COORDINATES ARE IN NAD 27 MASSACHUSETTS STATE PLANE.

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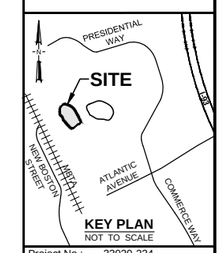

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	MK	06/27/14

100% REMEDIAL DESIGN
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OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

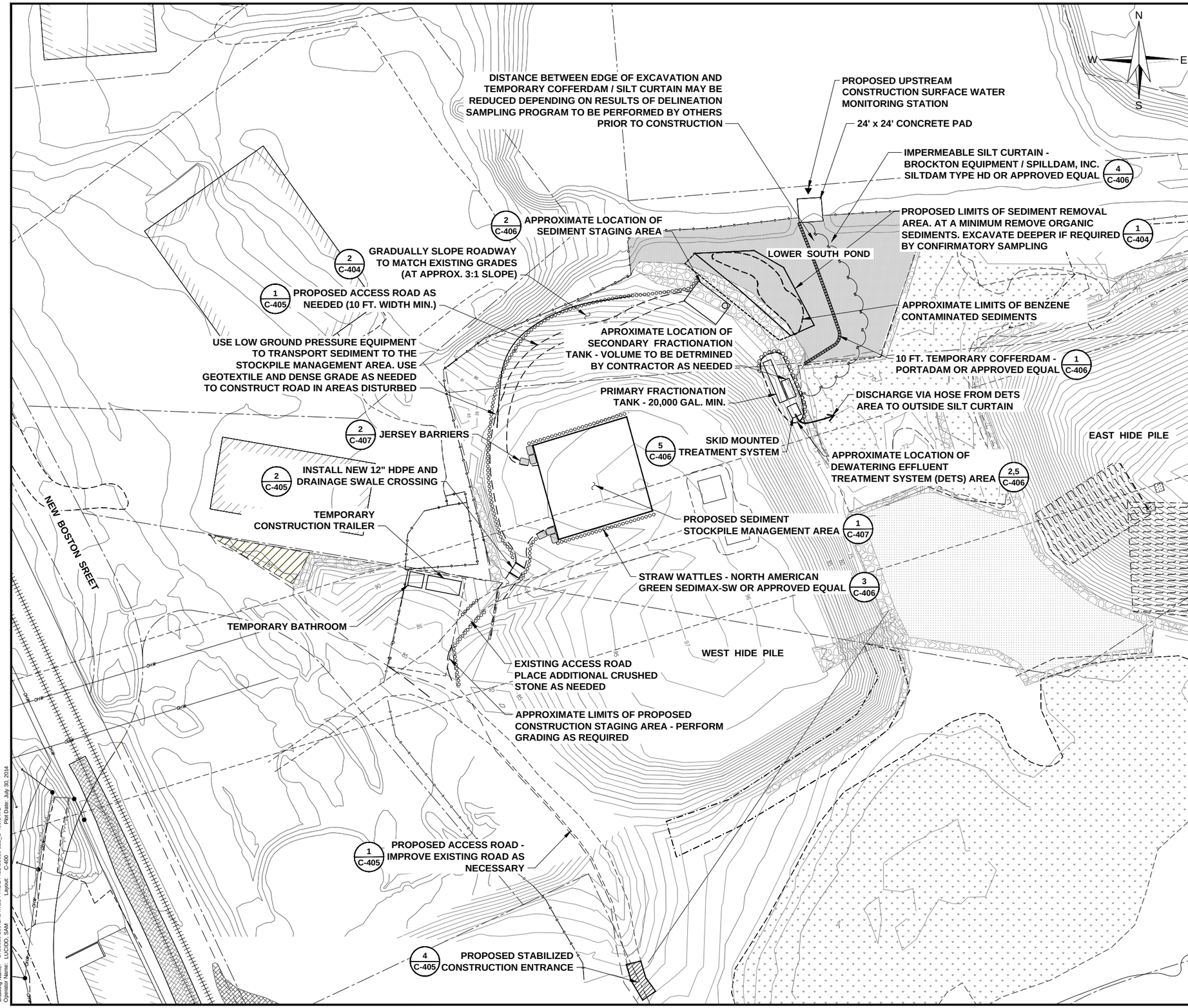
WEST HIDE PILE DESIGN

SITE AND BENZENE IMPACTED SEDIMENT LOCATION PLAN

G-404

Sheet: 5 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\West Hide Pile\33020-222_G-404.dwg
Operator Name: LUCIDO, SAM
Layout: G-404
Plot Time: 1:00 PM



NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G-402.
2. ALL LOCATIONS, DIMENSIONS, AND AERIAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.

PROPOSED CONSTRUCTION SEQUENCE

1. MOBILIZE.
2. PERFORM BASELINE LAND SURVEY OF WORK AREA.
3. ESTABLISH A CONSTRUCTION STAGING AREA IN CLOSE PROXIMITY TO THE WORK AREA AS INDICATED ON THE DRAWINGS.
4. ESTABLISH SURFACE WATER MONITORING STATIONS. INSTALL TEMPORARY HYDRODAMS IN NORTH AND SOUTH SWALES SOUTH OF EAST HIDE PILE.
5. INSTALL EROSION AND SEDIMENTATION CONTROLS IN THE WORK AREA. INSTALL A STABILIZED CONSTRUCTION ENTRANCE.
6. INSTALL A NEW 12∅HDPE PIPE IN THE AREA OF THE DRAINAGE SWALE BENEATH THE PROPOSED TEMPORARY ACCESS ROADWAY.
7. IN THE AREA OF THE PROPOSED TEMPORARY ACCESS ROADWAY, SCARIFY SOILS TO PREPARE THE SUBGRADE TO RECEIVE THE GEOTEXTILE AS NEEDED. CUTTING INTO THE GEOSYNTHETIC PORTION OF THE EXISTING WEST HIDE PILE CAP AND COVER SYSTEM FOR TEMPORARY ACCESS ROADWAY CONSTRUCTION SHALL NOT BE PERMITTED. FILLING WILL BE REQUIRED TO CREATE A LEVEL SURFACE FOR THE TEMPORARY ACCESS ROADWAY. BEST ROUTE OF ROAD TO BE DETERMINED IN THE FIELD.
8. CONSTRUCT A SEDIMENT STOCKPILE MANAGEMENT AREA, DETS AREA, AND SEDIMENT STAGING AREA.
9. INSTALL THE SILT CURTAIN.
10. INSTALL TEMPORARY COFFERDAM. TIE IN UPSLOPE AS NEEDED TO CREATE HYDRAULIC CUTOFF AROUND PERIMETER OF DEWATERED AREA.
11. DEWATER WITHIN THE TEMPORARY COFFERDAM USING PUMPS. INSTALL LOCALIZED SUMPS AS REQUIRED TO ALLOW CONSTRUCTION IN THE DRY. THE NUMBER AND LOCATION OF SUMPS SHALL BE DETERMINED BY THE CONTRACTOR'S MEANS AND METHODS.
12. TREAT DEWATERING EFFLUENT AND DISCHARGE EFFLUENT VIA HOSE BETWEEN THE TEMPORARY COFFERDAM AND SILT CURTAIN. PLACE END OF DEWATERING EFFLUENT DISCHARGE OUTSIDE OF SILT CURTAIN.
13. STRIP EXISTING RIP-RAP LOCATED WITHIN THE PROPOSED SEDIMENT REMOVAL AREA AND STOCKPILE FOR LATER REUSE.
14. ONCE EXCAVATION IS DRY, BEGIN SEDIMENT REMOVAL. SEDIMENT REMOVAL WILL TARGET THE BENZENE CONTAMINATED ORGANIC SEDIMENTS. TOTAL REQUIRED EXCAVATION DEPTHS WILL BE VERIFIED WITH CONFIRMATORY SAMPLING AND TESTING PERFORMED BY THE CONTRACTOR DURING CONSTRUCTION.
15. PLACE EXCAVATED SEDIMENT INTO THE SEDIMENT STOCKPILE MANAGEMENT AREA FOR DEWATERING UNDER SELF-WEIGHT. TREAT DEWATERING EFFLUENT PRIOR TO DISCHARGING CURTAIN INTO RIPRAP APRON.
16. OBTAIN CONFIRMATORY SEDIMENT SAMPLES AT THE BOTTOM OF THE EXCAVATION AND SUBMIT FOR ANALYTICAL TESTING. EXCAVATE DEEPER IF REQUIRED.
17. ONCE ALL BENZENE CONTAMINATED SEDIMENTS HAVE BEEN REMOVED, BACKFILL THE EXCAVATED AREA AS SHOWN ON THE DETAILS.
18. TRANSPORT SEDIMENT FROM THE STAGING AREA TO APPROVED OFFSITE FACILITIES FOR SEDIMENT DISPOSAL.
19. REMOVE ACCESS ROAD, TEMPORARY COFFERDAM, SILT CURTAIN, SEDIMENT STOCKPILE MANAGEMENT AREA, DEWATERING EFFLUENT TREATMENT SYSTEM, ROLLOFF STAGING AREA, AND WHEEL WASH AREA.
20. RESTORE THE AREA AS SHOWN ON THE DRAWINGS.
21. DEMOBILIZE.

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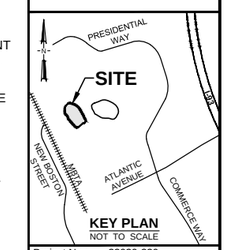


Project No.:	33020-220
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
INDUSTRI-PLEX
SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

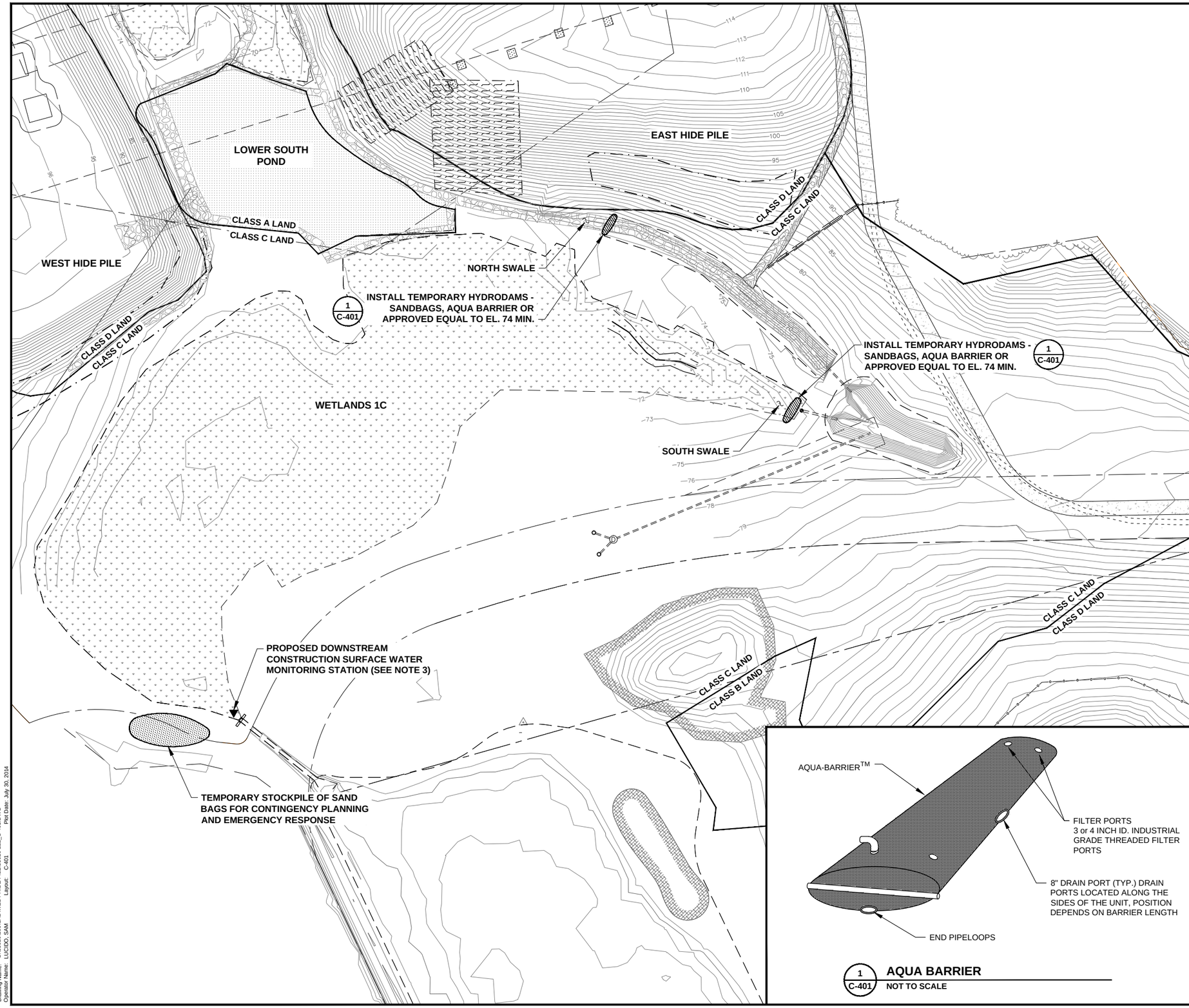
WEST HIDE PILE DESIGN

SITE PREPARATION PLAN

C-400

Sheet: 6 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\33020-222_C-400.DWG
Operator Name: LUCIDO, SAM Layout: C-400 Plot Date: July 30, 2014



1 C-401 **AQUA BARRIER**
NOT TO SCALE

NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G-402.
2. ALL LOCATIONS, DIMENSIONS, AND AERIAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
3. ADDITIONAL DOWNSTREAM SURFACE WATER MONITORING WILL BE CONDUCTED AT THE ATLANTIC AVENUE DRAINWAY (AAD) MONITORING STATION.

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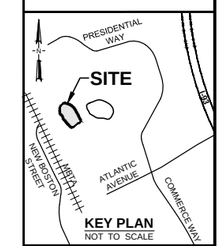

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
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SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

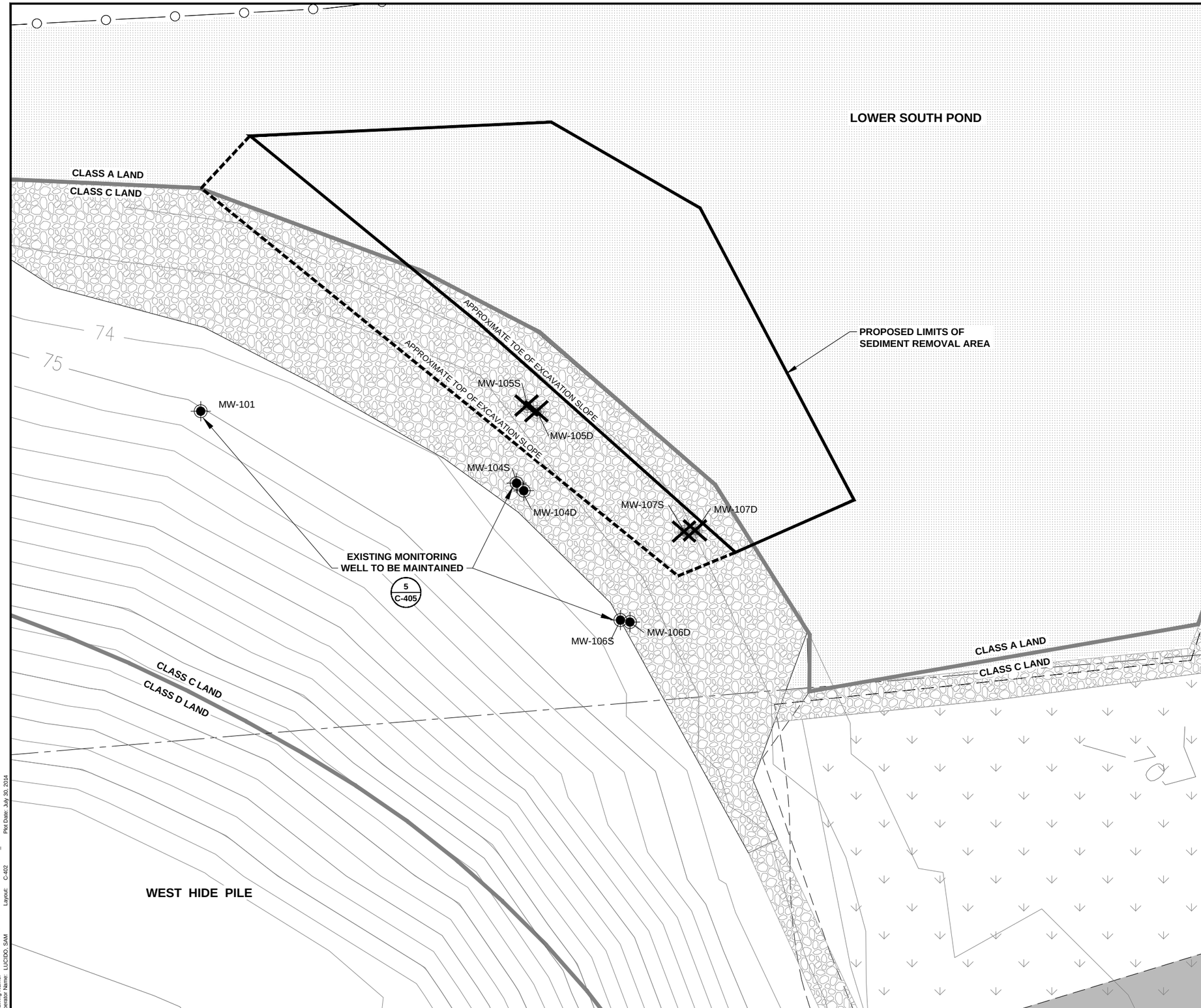
WEST HIDE PILE DESIGN

SURFACE WATER DIVERSION AND MONITORING PLAN

C-401

Sheet: 7 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\33020-222_C-401.DWG
Operator Name: LUCIDO, SAM
Layout: C-401
Plot Date: July 30, 2014



LEGEND

EXISTING MONITORING WELL TO BE DESTROYED BY CONTRACTOR IN ACCORDANCE WITH SPECIFICATION SECTION 332900 - WELL ABANDONMENT

EXISTING MONITORING WELL. THE CONTRACTOR SHALL CUT WELL DOWN TO MATCH EXISTING SURROUNDING GRADES, INSTALL ROADWAY BOX, AND PROTECT WELL DURING CONSTRUCTION.

NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G-402.
2. ALL LOCATIONS, DIMENSIONS, AND AERIAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.

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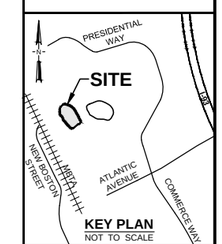

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
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1	REVISED EXCAVATION LIMITS	HA	07/16/14

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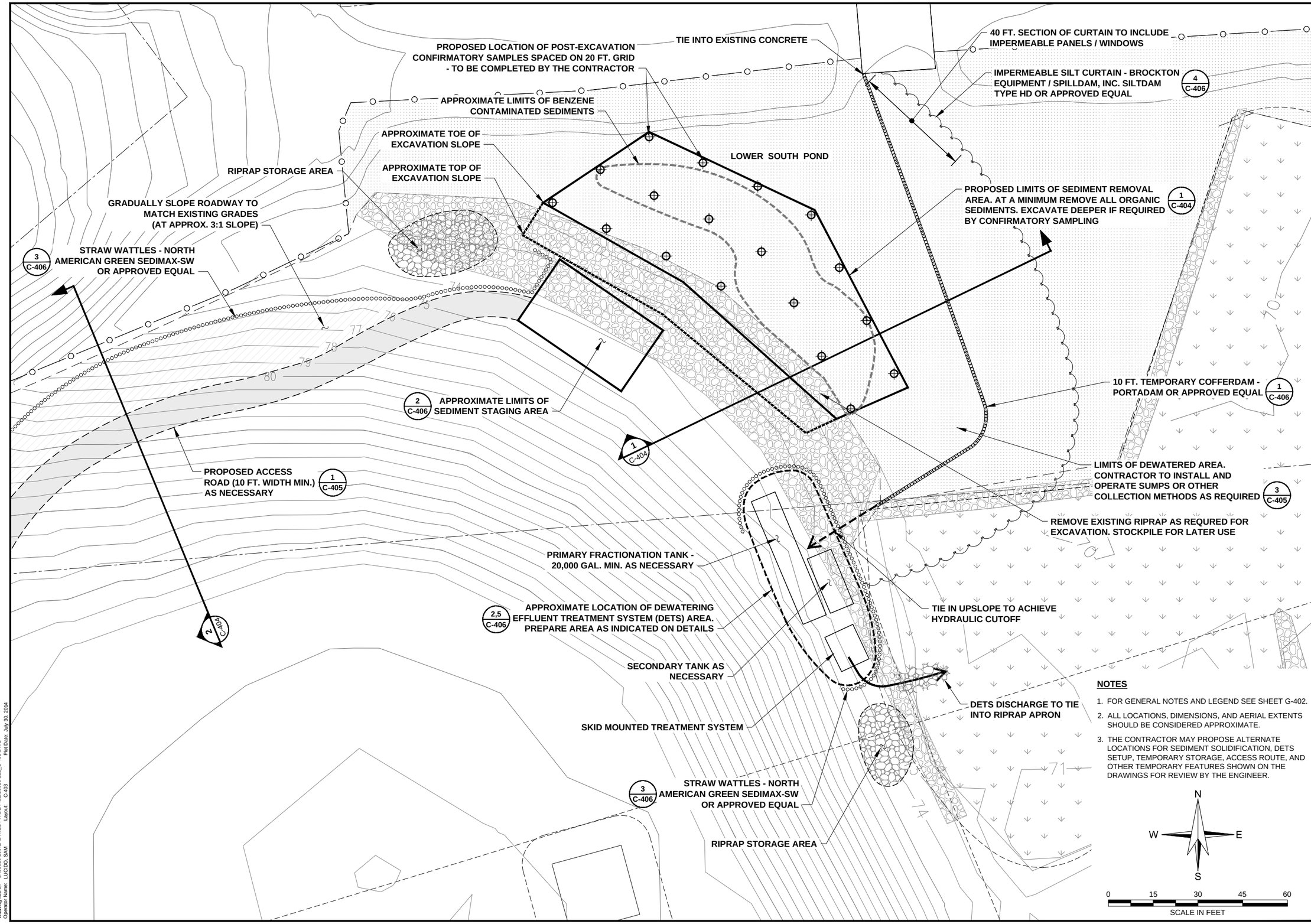
WEST HIDE PILE DESIGN

WELL ABANDONMENT PLAN

C-402

Sheet: 8 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\33020-222_C-402.DWG
Operator Name: LUCIDO, SAM Layout: C-402 Plot Date: July 30, 2014



NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G-402.
2. ALL LOCATIONS, DIMENSIONS, AND AERIAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.
3. THE CONTRACTOR MAY PROPOSE ALTERNATE LOCATIONS FOR SEDIMENT SOLIDIFICATION, DETS SETUP, TEMPORARY STORAGE, ACCESS ROUTE, AND OTHER TEMPORARY FEATURES SHOWN ON THE DRAWINGS FOR REVIEW BY THE ENGINEER.

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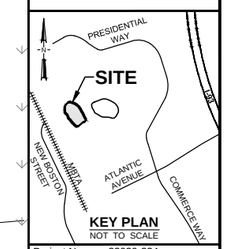

KEY PLAN
NOT TO SCALE

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	MK	06/27/14

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WEST HIDE PILE DESIGN

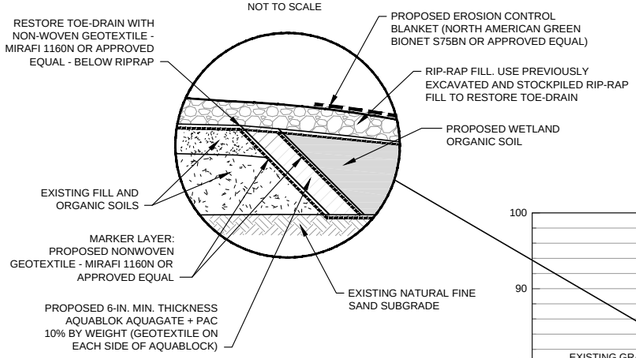
SEDIMENT REMOVAL PLAN

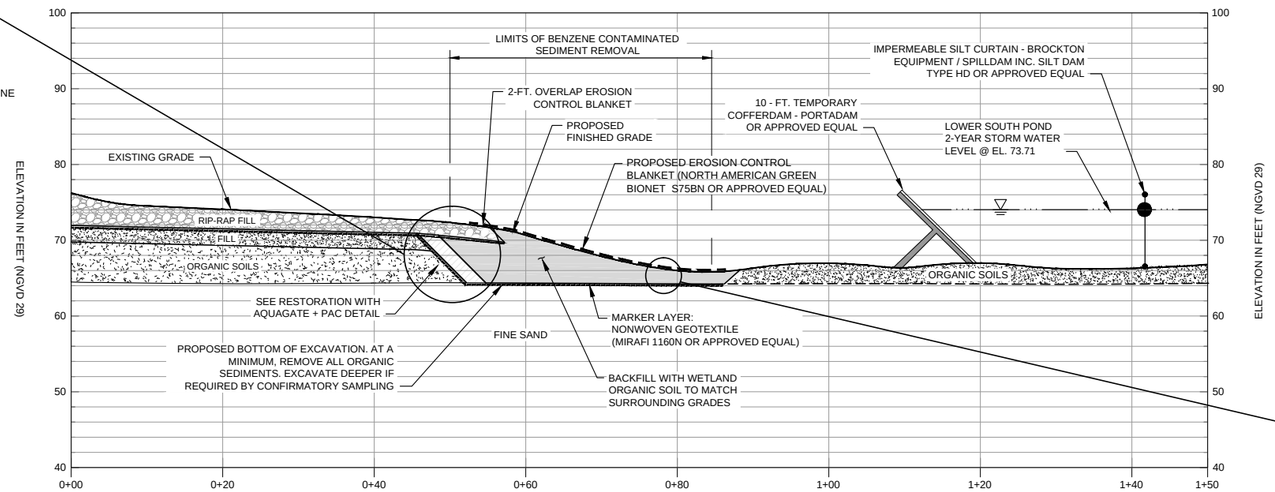
C-403

Sheet: 9 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\33020-222_C-403.DWG
Operator Name: LUCIDO, SAM
Layout: C-403
Plot Date: July 30, 2014

RESTORATION WITH AQUAGATE + PAC DETAIL
NOT TO SCALE

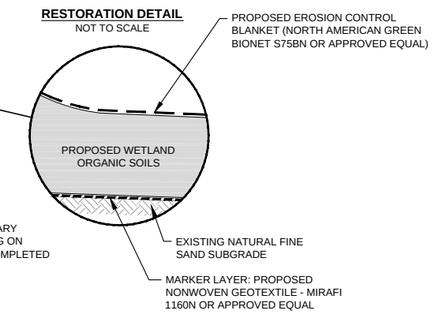


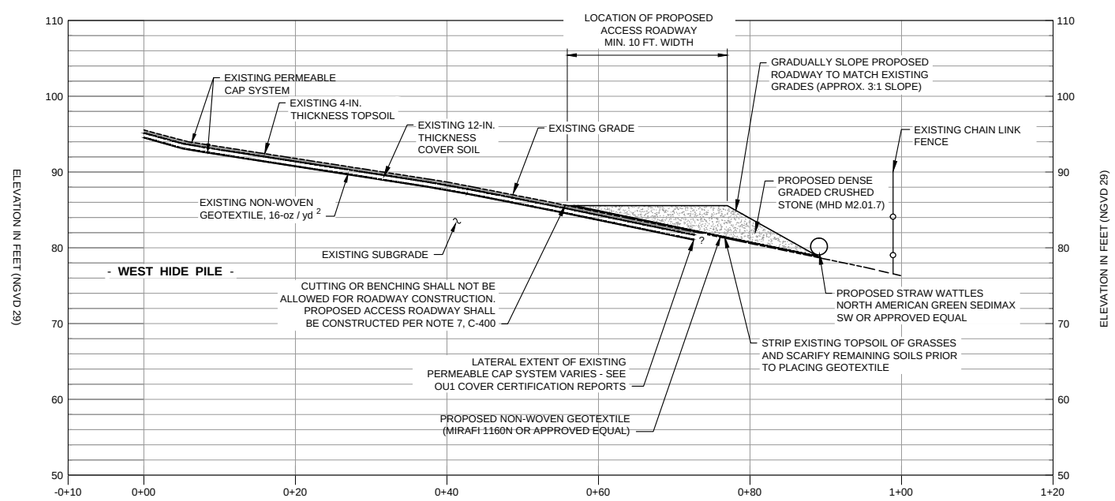


1 **CONTAMINATED SEDIMENT REMOVAL SECTION**
C-400
C-403
SCALE: SHOWN
0 10' 20' HORIZ.
0 10' 20' VERT.

NOTES:
1. DISTANCE BETWEEN EDGE OF EXCAVATION AND TEMPORARY COFFERDAM / SILT CURTAIN MAY BE REDUCED DEPENDING ON RESULTS OF DELINEATION SAMPLING PROGRAM TO BE COMPLETED BY OTHERS PRIOR TO CONSTRUCTION.

RESTORATION DETAIL
NOT TO SCALE





2 **PROPOSED ACCESS ROADWAY ALONG SLOPE**
C-400
C-403
SCALE: SHOWN
0 10' 20' HORIZ.
0 10' 20' VERT.

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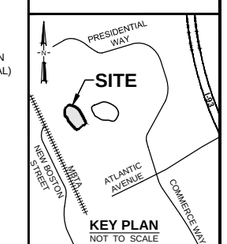

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
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WOBURN, MASSACHUSETTS

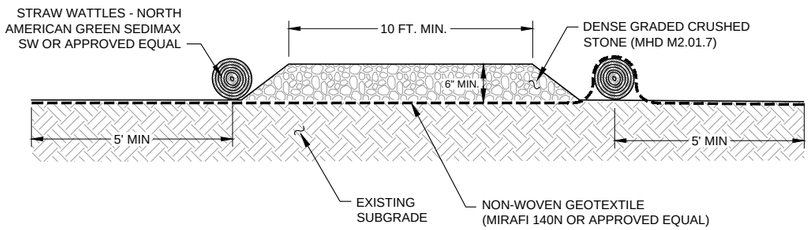
WEST HIDE PILE DESIGN

SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (1 OF 4)

C-404

Sheet: 10 of 15

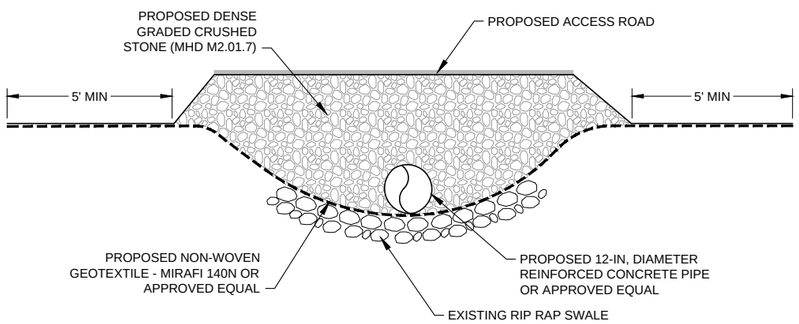
CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\33020-222_C-500.DWG
Operator Name: LUCIDO, SAM Layout: C-404 Plot Date: July 30, 2014



PROPOSED ACCESS ROAD / EXISTING ROAD IMPROVEMENT

1 / C-400, C-403, C-408

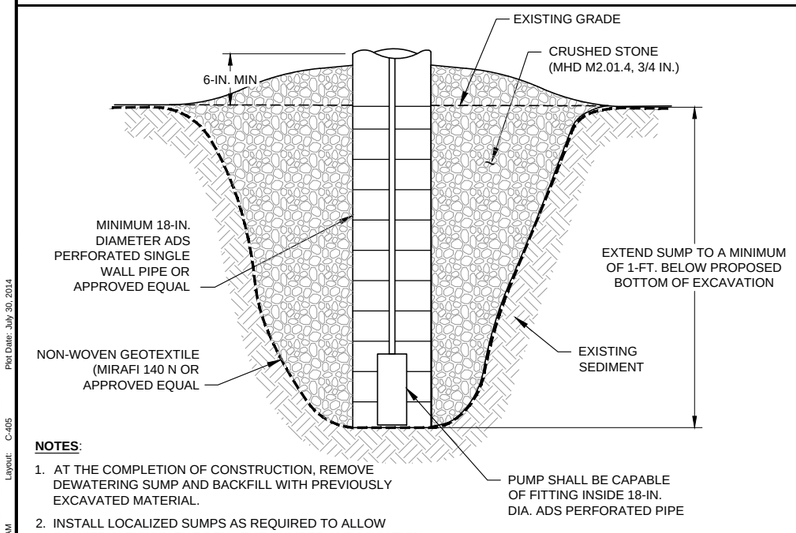
SCALE: AS SHOWN



DRAINAGE SWALE CROSSING

2 / C-400, C-403, C-408

SCALE: AS SHOWN



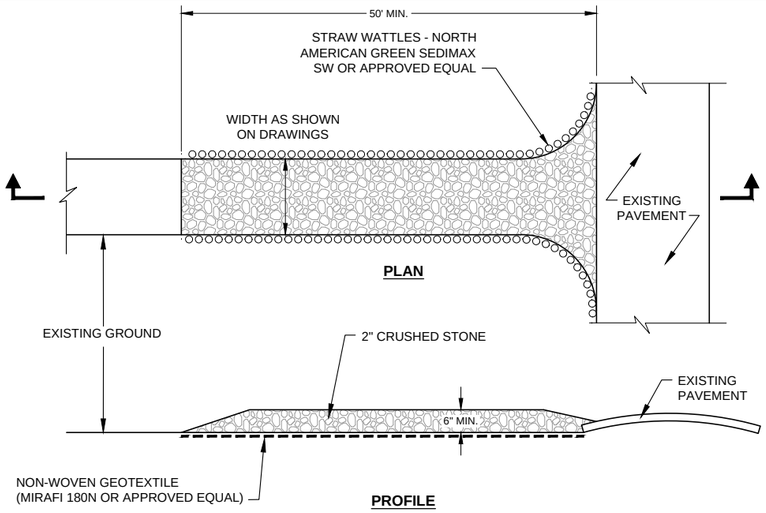
NOTES:

1. AT THE COMPLETION OF CONSTRUCTION, REMOVE DEWATERING SUMP AND BACKFILL WITH PREVIOUSLY EXCAVATED MATERIAL.
2. INSTALL LOCALIZED SUMPS AS REQUIRED TO ALLOW CONSTRUCTION IN THE DRY. THE NUMBER AND LOCATION OF SUMPS SHALL BE DETERMINED BY THE CONTRACTOR'S MEANS AND METHODS.

DEWATERING SUMP

3 / C-403

SCALE: AS SHOWN



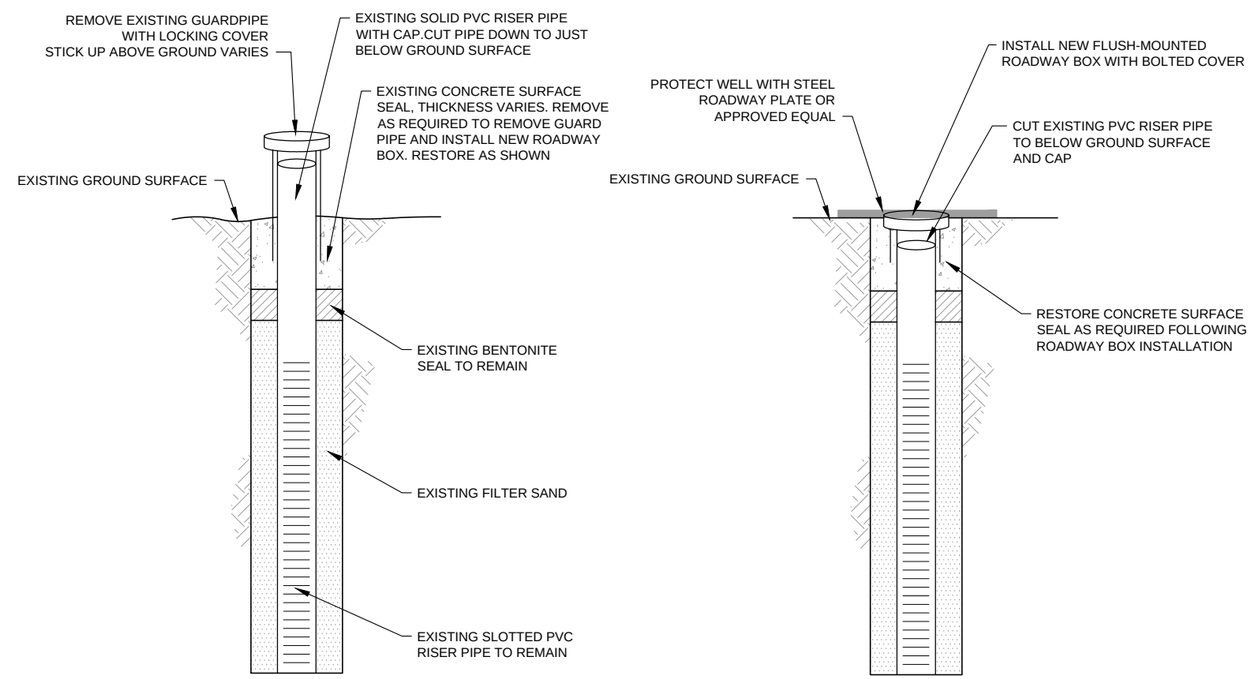
REQUIREMENTS:

1. CRUSHED STONE THICKNESS NOT LESS THAN 6 INCHES.
2. FILTER FABRIC SHALL BE PLACED WITHIN THE LIMITS OF THE STABILIZED CONSTRUCTION ENTRANCE PRIOR TO PLACING CRUSHED STONE.
3. ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL CRUSHED STONE AS CONDITIONS REQUIRE. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY SHALL BE REMOVED IMMEDIATELY.
4. THE CONTRACTOR SHALL PROVIDE PERIODIC INSPECTION AND REQUIRED MAINTENANCE.

TEMPORARY STABILIZED CONSTRUCTION ENTRANCE

4 / C-400

SCALE: AS SHOWN



EXISTING MONITORING WELL TO BE MAINTAINED

5 / C-402

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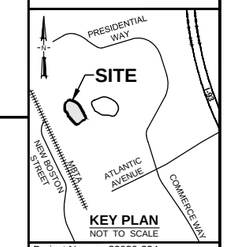


Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
INDUSTRI-PLEX
SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

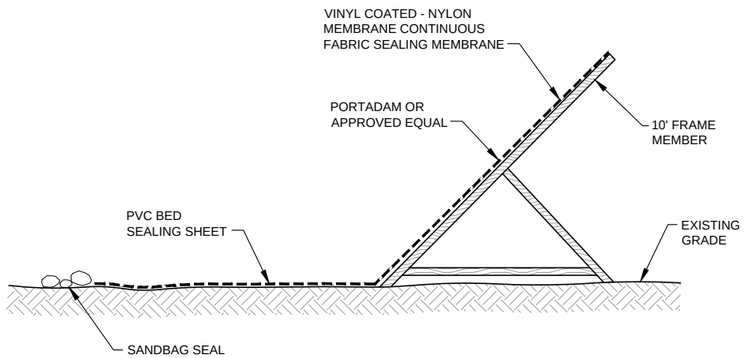
WEST HIDE PILE DESIGN

SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (2 OF 4)

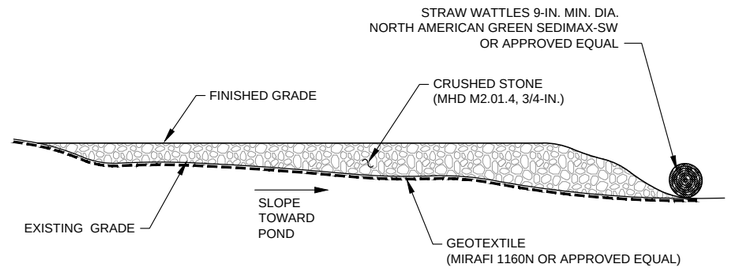
C-405

Sheet: 11 of 15

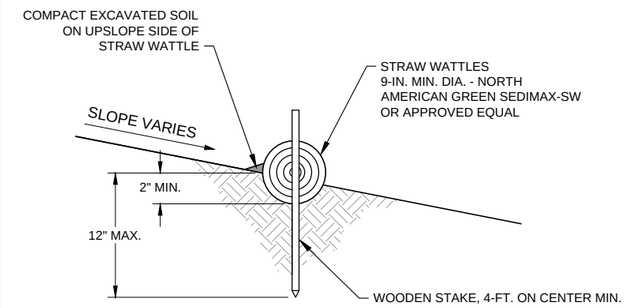
CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\DETAILS\33020-DETAILS.DWG
Layout: C-405 Plot Date: July 30, 2014
Operator Name: LUCIDO, SAM



1 / C-400, C-403, C-404 — TEMPORARY COFFERDAM
NOT TO SCALE



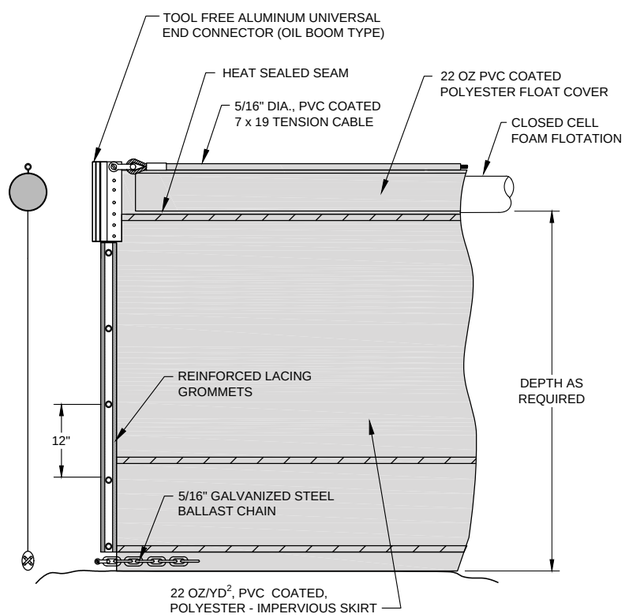
2 / C-400, C-403 — DETS AREA AND SEDIMENT STAGING AREA SITE PREPARATION
NOT TO SCALE



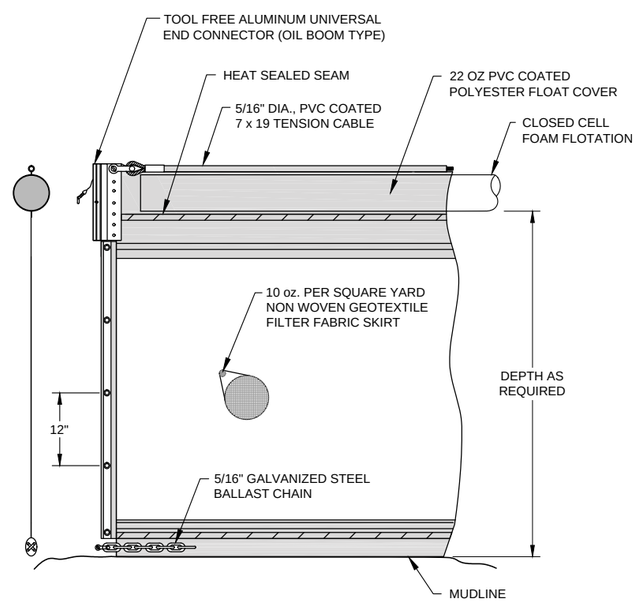
NOTES:

1. NO DISTURBANCE TO THE EXISTING WEST HIDE PILE PERMEABLE CAP SYSTEM SHALL BE PERMITTED DURING STRAW WATTLE INSTALLATION. DRIVE WOODEN STAKES TO MAXIMUM 12-IN. BELOW GROUND SURFACE.

3 / C-400 - C-407 — STRAW WATTLE INSTALLATION
NOT TO SCALE



SILT CURTAIN INSTALLATION - IMPERMEABLE TYPE HD

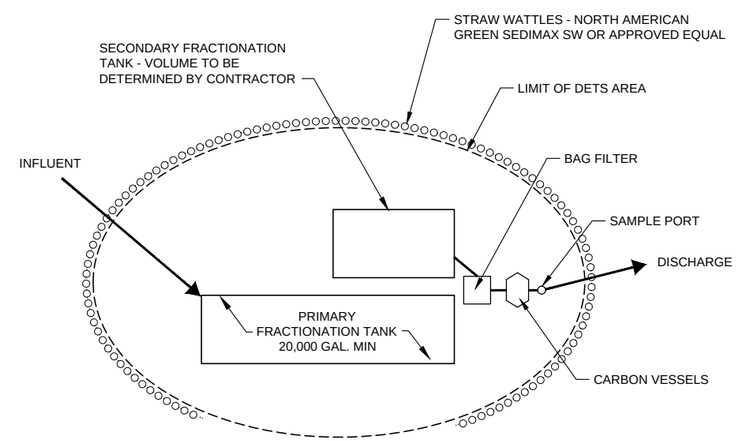


SILT CURTAIN INSTALLATION - PERMEABLE TYPE II

NOTES:

1. SILT CURTAIN SHALL BE AN IMPERMEABLE TYPE HD TURBITITY BARRIER BY BROCKTON EQUIPMENT/SPILLDAM, INC. OR APPROVED EQUAL. THE SILT CURTAIN SHALL BE DESIGNED WITH PERMEABLE PANELS (SILTDAM TYPE II). ASSUME SILT CURTAIN LENGTH WILL BE MAX. 10% PERMEABLE TYPE II.
2. PLACE END OF DEWATERING EFFLUENT TREATMENT HOSE AWAY FROM PERMEABLE PANELS TO PREVENT SYSTEM CLOGGING.

4 / C-400, C-403, C-404 — SILT CURTAIN INSTALLATION
NOT TO SCALE



5 / C-400, C-403 — DEWATERING EFFLUENT TREATMENT SYSTEM (DETS) AREA
NOT TO SCALE

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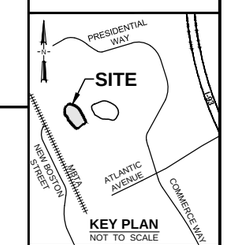


Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
INDUSTRI-PLEX
SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

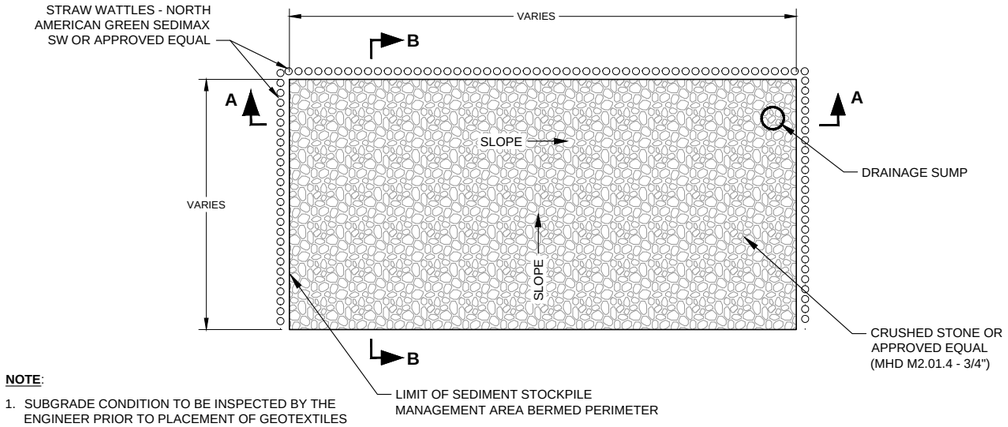
WEST HIDE PILE DESIGN

SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (3 OF 4)

C-406

Sheet: 12 of 15

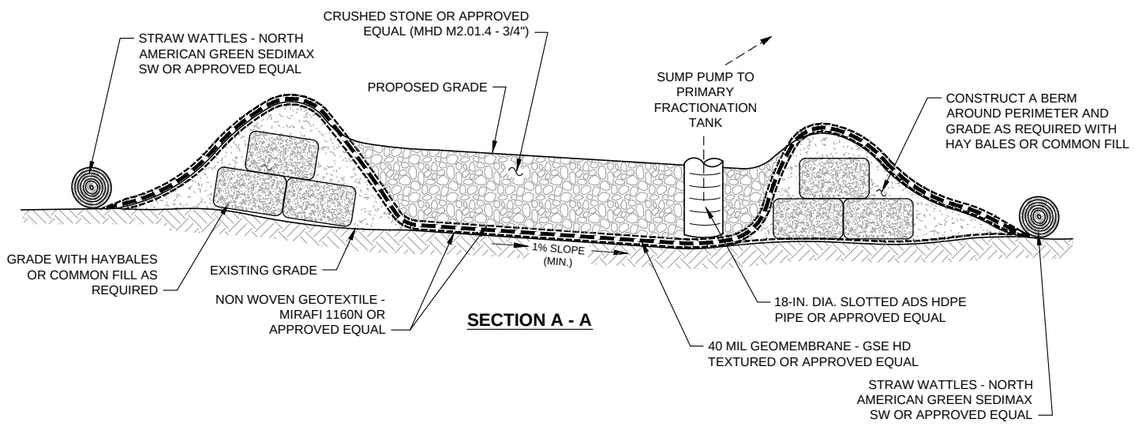
CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\DETAILS\33020-DETAILS.DWG
Operator Name: LUCIDO, SAM
Layout: C-406
Plot Date: July 30, 2014



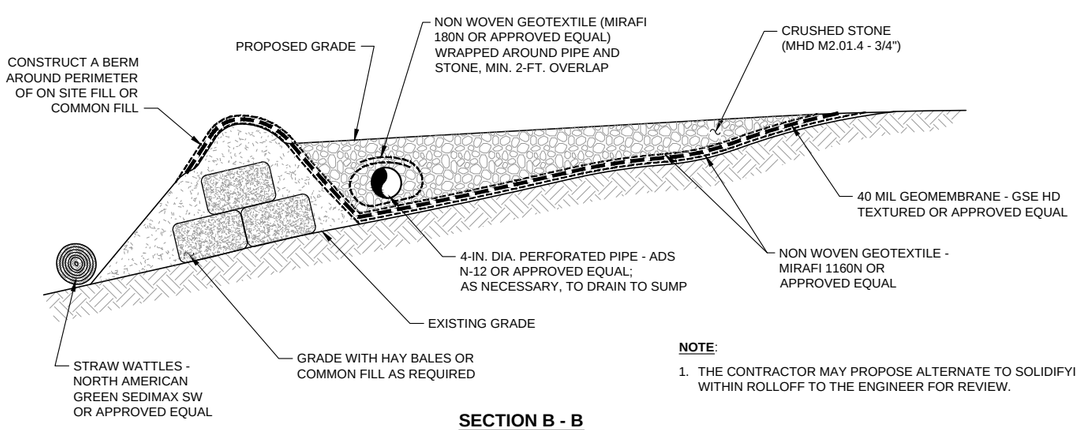
NOTE:

1. SUBGRADE CONDITION TO BE INSPECTED BY THE ENGINEER PRIOR TO PLACEMENT OF GEOTEXTILES AND GEOMEMBRANE. IF SUBGRADE CONDITION IS DETERMINED BY THE ENGINEER TO BE UNSUITABLE, A 4-IN. MIN. SAND LAYER MAY BE REQUIRED BETWEEN THE LOWER GEOTEXTILE AND THE GEOMEMBRANE.

PLAN



SECTION A - A



NOTE:

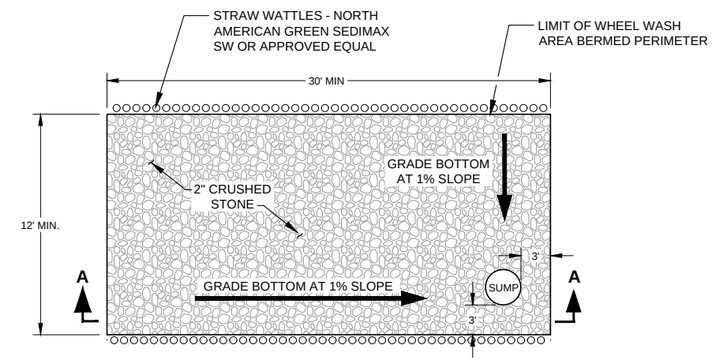
1. THE CONTRACTOR MAY PROPOSE ALTERNATE TO SOLIDIFYING WITHIN ROLLOFF TO THE ENGINEER FOR REVIEW.

SECTION B - B

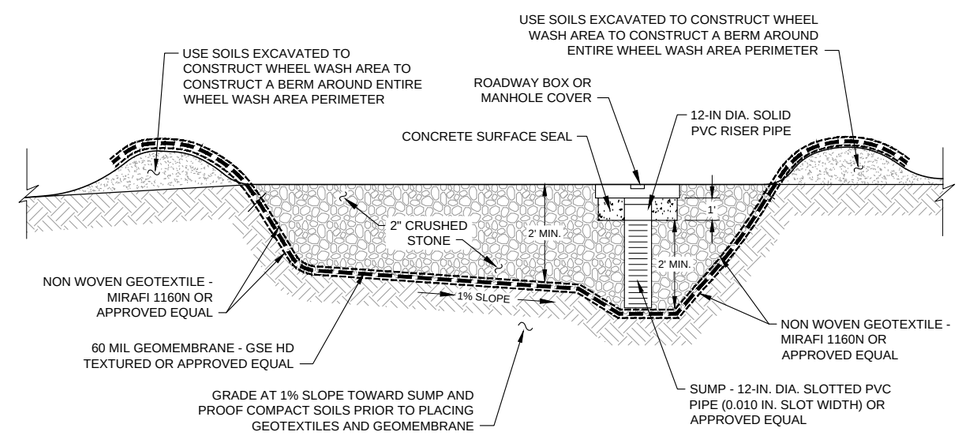
1 / C-400 / C-403 SEDIMENT STOCKPILE MANAGEMENT AREA
NOT TO SCALE

WHEEL WASH AREA NOTES:

1. WATER PUMPED FROM SUMP SHALL BE PUMPED TO THE DETS AREA AND TREATED IN ACCCORDANCE WITH SECTION 312319 CONSTRUCTION DEWATERING AND WATER TREATMENT.
2. AT END OF CONSTRUCTION, ALL MATERIALS FROM THE WHEEL WASH AREA SHALL BE EXCAVATED AND DISPOSED OF IN A MANNER ACCEPTABLE TO THE ENGINEER. THE EXCAVATION SHALL BE BACKFILLED WITH DENSE GRADE TO MATCH THE SURROUNDING ACCESS ROAD.
3. BLEND THE WHEEL WASH AREA WITH THE ADJACENT ROADWAY.
4. CONSTRUCT A BERM AROUND ENTIRE WHEEL WASH AREA AS SHOWN.
5. SUBGRADE CONDITION TO BE INSPECTED BY THE ENGINEER PRIOR TO PLACEMENT OF GEOTEXTILES AND GEOMEMBRANE. IF SUBGRADE CONDITION IS DETERMINED BY THE ENGINEER TO BE UNSUITABLE, A 4-IN. MIN. SAND LAYER MAY BE REQUIRED BETWEEN THE LOWER GEOTEXTILE AND THE GEOMEMBRANE.



PLAN



SECTION A - A

2 / C-400 WHEEL WASH AND DECONTAMINATION PAD
NOT TO SCALE

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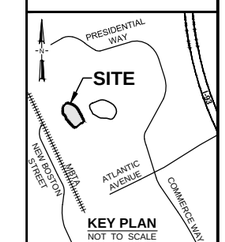


KEY PLAN
NOT TO SCALE

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
INDUSTRI-PLEX
SUPERFUND SITE
OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

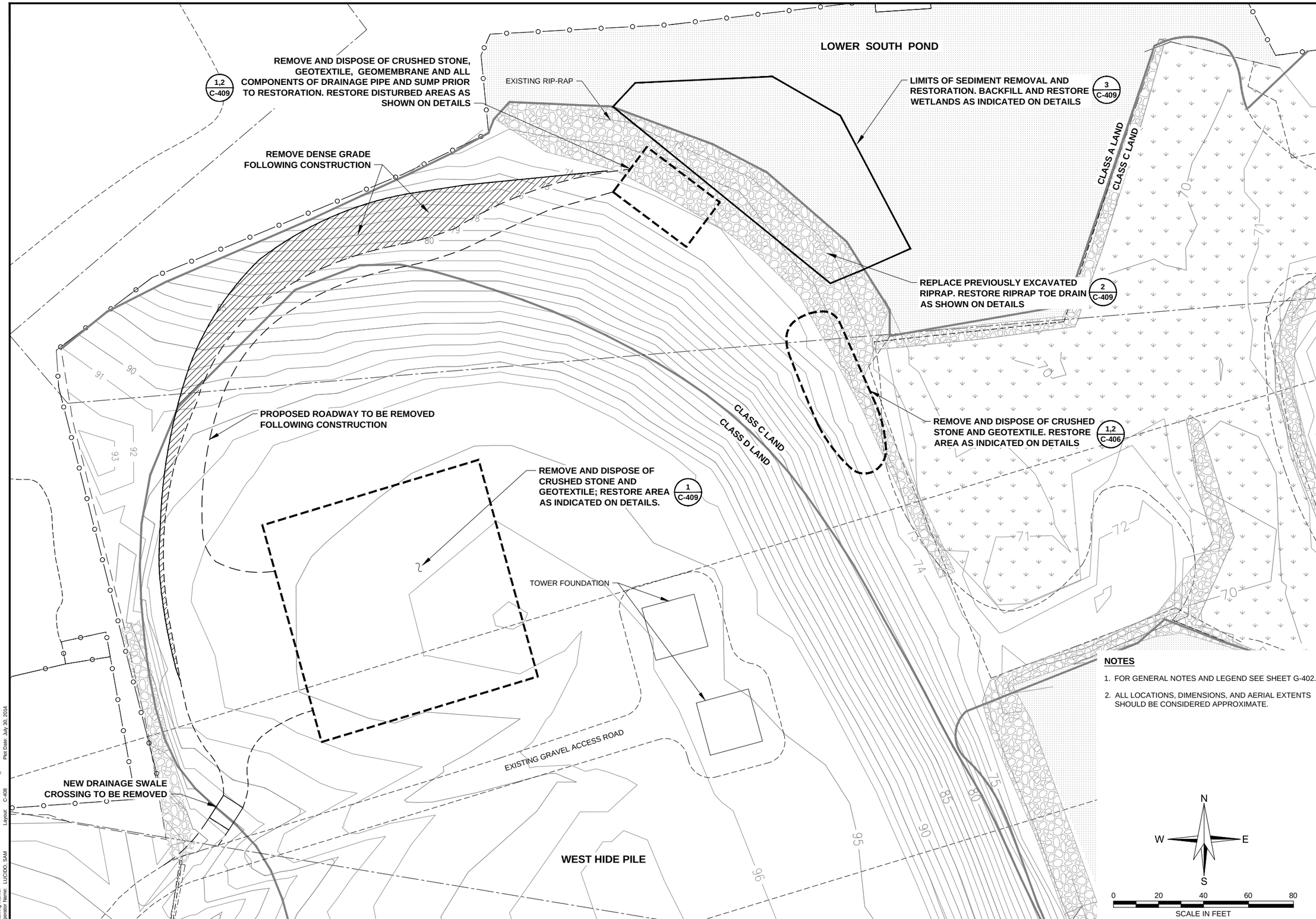
WEST HIDE PILE DESIGN

SITE PREPARATION AND SEDIMENT REMOVAL DETAILS (4 OF 4)

C-407

Sheet: 13 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\DETAILS\33020-DETAILS.DWG
Operator Name: LUCIDO, SAM
Layout: C-407
Plot Date: July 30, 2014



NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G-402.
2. ALL LOCATIONS, DIMENSIONS, AND AERIAL EXTENTS SHOULD BE CONSIDERED APPROXIMATE.

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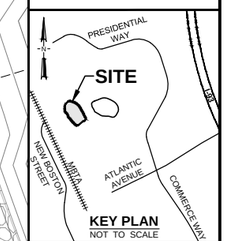

Project No.:	33020-224
Scale:	AS SHOWN
Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
Checked By:	TJH
Approved By:	
Stamp:	

Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

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WOBURN, MASSACHUSETTS

WEST HIDE PILE DESIGN

SITE RESTORATION PLAN

C-408

Sheet: 14 of 15

CADD File Data:
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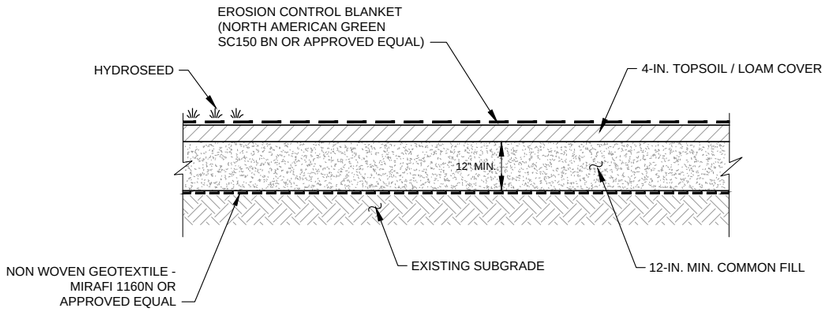
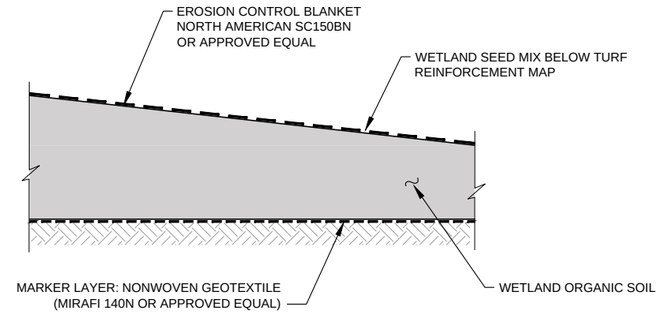
Operator Name: LUCIDO, SAM
Layout: C-408
Plot Date: July 30, 2014



NOTES:

1. THE CONTRACTOR SHALL TAKE MEASURES TO AVOID DISTURBING THE EXISTING PERMEABLE CAP SYSTEM DURING CONSTRUCTION ACTIVITIES. SHOULD CAP BECOME DISTURBED, REPAIR THE CAP TO THE SPECIFICATIONS SHOWN.
2. THIS DETAIL IS DERIVED FROM OPERABLE UNIT 1 AS-BUILT RECORD DRAWING C-33, DETAIL TITLED ïABOVE GRADE ENGINEERED PERMEABLE COVERò PREPARED BY MERIDIAN LAND SERVICES, DATED 8 AUGUST 2000.
3. NONWOVEN GEOTEXTILE PANELS TO BE SEWN AS PER THE TYPICAL DETAIL ON THIS SHEET AND DESCRIBED IN THE SPECIFICATIONS.

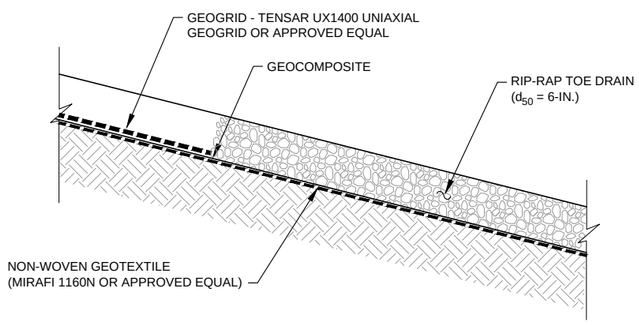
1 / C-408 **EXISTING PERMEABLE CAP SYSTEM REPAIR / RESTORATION**
NOT TO SCALE



NOTES:

1. RESTORE EXCAVATED AND DISTURBED AREAS WITHIN LOWER SOUTH POND TO THE MANNER SHOWN.
2. AREA OF POND TO BE OPEN WATER.

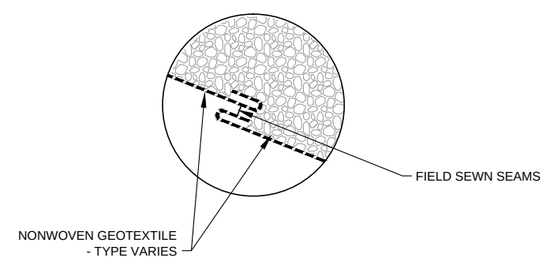
3 / C-408 **CONTAMINATED SEDIMENT REMOVAL AREA RESTORATION**
NOT TO SCALE



NOTES:

1. STOCKPILE EXCAVATED RIPRAP FOR LATER REUSE.
2. RESTORE DISTURBED RIPRAP TOE DRAINS AS SHOWN ON THE DRAWINGS.
3. BASED ON OU-1 COVER CERTIFICATION REPORT, GEOGRIDS WERE PLACED IN AREAS WITH SLOPES STEEPER THAN 33%. IF GEOGRIDS ARE ENCOUNTERED AND DISTURBED DURING CONSTRUCTION, GRIDS SHALL BE RESTORED.
4. THIS DETAIL IS DERIVED FROM OPERABLE UNIT 1 AS-BUILT RECORD DRAWING C-33, DETAIL 4 PREPARED BY MERIDIAN LAND SERVICES, DATED 8 AUGUST 2000.
5. NONWOVEN GEOTEXTILE PANELS TO BE SEWN AS PER THE TYPICAL DETAIL ON THIS SHEET AND DESCRIBED IN THE SPECIFICATIONS.
6. IN THE EVENT THAT A GEOCOMPOSITE IS ENCOUNTERED AND DAMAGED DURING CONSTRUCTION, REPLACE AND RESTORE IN LIKE KIND IN ACCORDANCE WITH THE OU-1 COVER DESIGN

2 / C-408 **EXISTING PERMEABLE CAP SYSTEM RIP-RAP TOE DRAIN REPAIR / RESTORATION**
NOT TO SCALE



4 / C-409 **TYPICAL NONWOVEN GEOTEXTILE PANEL SEWING DETAIL**
SCALE: AS SHOWN

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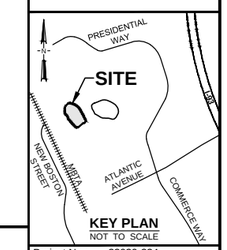

KEY PLAN
NOT TO SCALE

Project No.:	33020-224
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Date:	14-MAR-2014
Drawn By:	SJL
Designed By:	LB,MK
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Rev.	Description	By	Date
1	REVISED EXCAVATION LIMITS	HA	07/16/14

100% REMEDIAL DESIGN
INDUSTRI-PLEX
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OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

WEST HIDE PILE DESIGN

SITE RESTORATION DETAILS

C-409

Sheet: 15 of 15

CADD File Data:
Drawing Name: G:\33020\100\CAD\WEST HIDE PILE\DETAILS\33020-DETAILS.DWG
Operator Name: LUCIDO, SAM
Layout: C-409
Plot Date: July 30, 2014

SECTION 011100

SUMMARY OF WORK

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. General

1. Work is subdivided according to the following general areas (listed in order from upstream to downstream along the Halls Brook and Aberjona River waterways):

a. West Hide Pile (WHP), including the Lower South Pond immediately adjacent to WHP. Sediment removal action in LSP.

b. Permeable Cap System. Located adjacent to the Halls Brook Holding Area (HBHA) Pond.

c. HBHA Pond Remediation System Design, including the following remedy subcomponents:
   1) Energy Dissipation at two inlets to HBHA Pond: the Atlantic Avenue Drainway (AAD) and Boston Edison Company Drainway (a.k.a., Right of Way Number 9 [ROW No. 9] outfall).
   2) Halls Brook Diversion Structure and Stormwater Bypass System.
   3) Primary-Secondary Cell Cofferdam and Weir.
   4) Secondary Treatment Cell Water Treatment System and Related Components.
   5) HBHA Pond Outlet Structure Improvements.

d. Wells G&H and Cranberry Bog Conservation Area (CBCA) Sediment Removal. Located south of HBHA Pond.

e. Wetland Mitigation Site Design. Location to be determined.

2. Work is to be performed and sequenced upstream to downstream unless approved otherwise by the SD Representative.

3. The Halls Brook Holding Area (HBHA) Pond is an approximately 4.6-acre storm water management pond located in Woburn, Massachusetts. Major surface water discharges occur into the HBHA Pond from three main surface water sources: Halls Brook, Atlantic Avenue Drainway (AAD), and Right of Way Number 9 (ROW No. 9) outfall. Water exits the HBHA Pond from one outlet at its south end. South of HBHA Pond is the HBHA Wetland, which covers approximately 10.6 acres. The HBHA Pond and Wetland discharge into the main branch of the Aberjona River just before Mishawum Road.

   Work shall also be performed within the Wells G&H and CBCA areas, which lie south of the HBHA Wetland along the Aberjona River waterway. Together, the Wells G&H and CBCA remediation areas encompass a small portion of the overall wetland area. Finally, work shall be performed in the LSP area adjacent to the WHP, which is located in the northwest portion of Industri-plex Operable Unit 2; the remediation area encompasses less than 0.1 acres in area.

4. These Specification Documents describe work to be performed in all areas of the site described above.

5. The Work described in these Contract Documents is being performed as part of response actions related to the Industri-plex Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; more commonly referred to as Superfund) Site Operable Unit No. 2, which is regulated by the United States Environmental Protection Agency (EPA). These activities are being undertaken by Pharmacia LLC by its attorney-in-fact Monsanto Company, and Stauffer Management Company LLC as litigation agent for Bayer CropScience (collectively the “Settling Defendants or “SDs”), responding parties to a Consent Decree (CD) entered in Civil Action No. 1:08-cv-10325 and the Statement of Work (SOW) appended to the Consent Decree with the EPA and Massachusetts Department of Environmental Protection (MassDEP). The Work described in these contract documents is being conducted by the SDs in accordance with the CD that was lodged on February 27, 2008 with the United States District Court for the District of Massachusetts in connection with the Remedial Design/Remedial Action (RD/RA) Statement of Work (SOW) that is attached as Appendix D to the CD.

6. The Contractor is advised that the HBHA Pond and other waterways adjacent to other work areas have a variable water surface and exhibit periodic flooding.

7. The Contractor is advised that control of erosion is a critical part of the construction work. A large majority of excavation and restoration work will take place within wetlands and the 100-ft buffer zone. The Contractor shall control erosion as specified in Section 312500 - Erosion and Sedimentation Controls and other specification Sections as applicable.

B. Regulatory Requirements

1. Comply with all rules, regulations, laws, and ordinances of the EPA, Commonwealth of Massachusetts, City of Woburn, Occupational Safety and Health Administration (OSHA), and of all other authorities having jurisdiction. All labor, materials, equipment, and services necessary to make Work comply with such requirements shall be provided without additional cost to SDs.

C. Abbreviated Summary of Work

1. The Work of the Contract is indicated by the Contract Documents.

2. The Contract includes coordination of all Work indicated by the Contract Documents.

3. The Contract is unavoidably affected by governmental regulations, weather and natural phenomena, an access agreement with one or more land owners, and other forces and conditions not described in the Contract Documents.

D. Without limitation, the Contract includes the following Major Elements of Work:

1. General items applicable to work areas:

a. Submittal preparation.

b. Where applicable, coordinating work with the railroad, including training staff as required by railroad.

c. Contacting “Dig Safe” and complying with Massachusetts General Laws, Chapter 82, Section 40 and all applicable codes, rules, regulations. Do not begin any excavation or other intrusive work without complying with the law. Ensure that all utilities have been located and marked prior to beginning any excavation or intrusive work.

d. Where applicable, coordinating work with the utility owners.

e. Mobilization.

f. Construction of a material storage and laydown areas.

g. Providing a site office trailer and other temporary facilities for use by Contractor, the Engineer, and the Project Coordinator.

h. Providing site security, such as temporary fencing.

i. Protection of existing utilities, monitoring wells, and other site features.

j. Protection of completed work.

k. Installing and maintaining erosion and sedimentation controls.

l. Dust and odor control.

m. Site clearing and grubbing, including chipping of all above-grade woody plant materials and containerizing for off-site management. Segregate, stockpile, and containerize grubbed root balls for disposal by others.

n. Earthwork, including but not limited to, excavation, material handling, temporary stockpiling, filling, compaction, material procurement (import materials), and other earthwork activities.

o. Coordination of transportation and off-site disposal. Disposal expense by others.

p. Coordination and collection of confirmatory samples as described in the specifications and RD document and shown on the Drawings.

q. General site cleanup.

r. Site restoration, including wetland and upland areas affected by the work.

s. Survey layout, including but not limited to verification of existing benchmarks through a baseline field survey, establishing supplementary survey control benchmarks in the vicinity of the Work, survey layout of proposed construction features, field verification while construction is in progress, setting grade stakes and other controls, and as-built construction documentation and final as-built drawings.

t. Demobilization.

u. And other general items required by the contract documents.

2. West Hide Pile – Lower South Pond Sediment Removal Area

a. Installing temporary fence if necessary. No fencing will be installed below grade within areas of the existing OU-1 cap.

b. Installing and maintaining a stabilized construction entrance and temporary site entrance improvement.

c. Temporary and new access roadway construction.

d. Well abandonment.

e. Well modifications and protection.

f. Installation of a silt curtain and installing and maintaining a temporary surface water diversion (e.g., PORTADAM system), as needed.

g. Construction and operation of sediment and water containment and treatment areas.

h. Mass sediment excavation, dewatering, and coordination of off-site disposal (following sediment dewatering).

i. Treatment of dewatering effluent.

j. Installation of a permeable reactive barrier consisting of activated carbon layer.

k. Earthwork.

l. Site restoration, including wetland and upland restoration, and repair of any damages to the existing permeable cap system.

m. All other work indicated

3. Permeable Cap System

a. Installing and maintaining a stabilized construction entrance and temporary site entrance improvement.

b. Installing and maintaining temporary surface water diversions, as needed.

c. Removal of existing instrumentation platform and removal of associated fencing.

d. Dewatering and treatment of dewatering effluent, as needed.

e. Construction of a permeable cap system.

f. Earthwork.

g. Site restoration, including wetland and upland restoration.

h. All other work indicated.

4. Halls Brook Diversion Structure (Between Halls Brook Inlet and Bypass Stop Log Structure)

a. Construction of temporary access roadways.

b. Installing and maintaining a stabilized construction entrance and temporary site entrance improvement.

c. Temporary water diversion.

d. Installing temporary and permanent steel sheet piles.

e. Removal, size reduction, and containerizing abandoned piping, concrete slab, abandoned concrete manhole, existing instrumentation pad and fencing, steps, and other debris requiring removal to facilitate the work. Coordinate off-site disposal of debris.

f. Installation of seepage cutoff around active sewer, stop log structure, and elsewhere as shown on the Drawings.

g. Protection of existing utilities, including but not limited to sewer.

h. Installation of a permanent “baseflow” conveyance system, including box culvert, manhole, sluice gate, and related items.

i. Construction of a permanent crushed stone berm and sheet pile buttress with rip rap armor.

j. Construction of a permanent, armored diversion channel.

k. Construction of a permanent stop-log system.

l. Installation of armor mattress and other armoring details such as but not limited to reinforced concrete sheetpile facing.

m. Dewatering and treatment of dewatering effluent, as needed.

n. Earthwork.

o. Site restoration, including wetland and upland restoration.

p. All other work indicated.

5. Halls Brook Bypass Structure, Primary-Secondary Cell Cofferdam and Weir, and Energy Dissipation Structures at AAD and BECo Inlets

a. Construction of temporary access roadways.

b. Temporary water diversion.

c. Installing temporary and permanent steel sheet piles.

d. Construction of flow control/energy dissipation structures at Atlantic Avenue Drainway and BECo Inlets.

e. Construction of a permanent, armored bypass channel and energy dissipation structure.

f. Dewatering and treatment of dewatering effluent, as needed.

g. Earthwork.

h. Site restoration, including wetland and upland restoration.

i. All other work indicated.

6. HBHA Pond Outlet Structure

a. Temporary construction access roadways.

b. Temporary culverts.

c. Temporary and permanent water diversion.

d. Removal of silt and debris from existing culvert on west side of limit of work and regrading at culvert outlet.

e. Removal of existing instrumentation platform and removal of associated fencing.

f. Construction and operation of sediment and water containment and treatment areas.

g. Dewatering and treatment of dewatering effluent, as needed.

h. Earthwork.

i. Installing permanent reinforced concrete trapezoidal channel.

j. Installing permanent instrumentation platform and steps.

k. Installing steel sheet pile.

l. Installing steel hand railing.

m. Site restoration, including wetland and upland restoration.

n. All other work indicated.

7. Secondary Treatment Cell Water Treatment System and Related Components.

TO BE PROVIDED IN FUTURE VERSION OF THIS SPECIFICATION)

8. Wells G&H and Cranberry Bog Conservation Area (CBCA) Wetland Areas

a. Construction of temporary access roadways.

b. Construction of temporary sewer crossings.

c. Construction and operation of sediment and water containment and treatment areas.

d. Installing and maintaining temporary surface water diversion, as needed.

e. Site clearing and temporary relocation of City of Woburn materials stored in the vicinity of the Wells G&H remediation area.

f. Mass sediment excavation and coordination of off-site disposal following sediment dewatering.

g. Treatment of dewatering effluent.

h. Earthwork.

i. Wetlands restoration, including wetland and upland areas affected by the work.

j. All other work indicated.

E. Sequencing

1. The Work shall be performed in accordance with the Contractor's Construction Sequence Plan, submitted and reviewed under Section 013000 – Administrative Requirements. The Drawing package includes a conceptual construction sequence that is considered to be a technically feasible approach for performing the Work under this Contract. The Contractor's actual construction sequence shall be in accordance with his Construction Sequence Plan.

2. To the extent practicable, construction shall proceed from upstream to downstream portions of the project to minimize the risk of re-depositing contamination in areas that have been restored.

F. Limit of Work

1. The Limit of Work shown on the Drawings is based on the estimated limits of work to provide access to and construction of the main remediation features. Access road improvements and other work shown on the Drawings located outside the main Limit of Work are included in the Scope of Work.

G. Utilities and Services: The Contract includes full coordination and cooperation with utility companies and service providers.

1. Coordinate the Work of the Contract with all utilities and services.

2. Perform all Work required by utility and service companies to complete the Work of the Contract even if the Work is not clearly itemized in the Contract Documents.

3. Pay all fees and charges assessed by utility and service companies.

H. Wetlands: Because of the proximity of Work of the Contract to water or wetlands, the Contract includes strict compliance with all environmental protection requirements of all authorities having jurisdiction.

I. Access Agreements: The work will take place on property not owned by the SD's. The SDs have negotiated agreements (copies to be provided to Contractor) to access the property included in the Work. The Contractor shall conduct the Work in accordance with the agreements made for the property involved. Requirements generally include, but are not limited to, the following:

1. Working hours for the site are 7:00 AM to 7:00 PM Monday through Friday, and 8:00 AM to 5:00 PM on Saturday and excludes working on Sunday and any Federal Holiday. Work at the site can only be completed during this time frame, unless 1) there are emergency or contingency plan activities necessary; 2) overnight dewatering and dewatering effluent treatment system (DETS) operation requires oversight; or 3) changes are communicated to and approved by the Engineer and the SD Representative twenty four hours (24) in advance of conducting the work.

2. Access to the site will only be accessed in accordance with the access agreement and as noted in the Contract Documents.

J. Work Not In This Contract: The following Work has been or will be assigned by the SD's Representative under separate contracts, or will be provided by the SDs. The Contractor shall

coordinate the following Work with the Work of the Contract and shall include the following Work in the Contract schedule.

1. Laboratory testing of select samples collected in conjunction with the work, as described in the specifications.

2. To the extent excess soil is generated that requires off-site disposal, the Contractor will be responsible for coordinating transportation and disposal as described in the Specifications. The SD's or SD's Representative will provide the name and location of an approved facility to the Contractor.

3. Geotechnical Instrumentation, with the exception of the Utility Monitoring Points (UMPs), will be installed by the Engineer to monitor vibrations and movement of sewer manholes and the existing 36 Cabot Road building in the general vicinity of the sheet pile installation in the HBHA Pond area, as well as manholes located in the Cranberry Bog Conservation Area (CBCA), as described in Section 310913 - Geotechnical Instrumentation.

1.03 RELATED SECTIONS

A. SECTION 013529 – Health & Safety

B. SECTION 020000 – Existing Conditions

C. Drawings

D. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

1.07 SUBMITTALS

A. Contractor shall submit to the Engineer an updated submittal register of all submittals required by this Contract. A draft submittal register has been prepared by the Engineer, and is attached to this specification Section as Table 011100-1 (**Submittal Group 2)**.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 013000

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. This section includes procedures for the preparation and submittal of the Contractor's Construction Sequencing Plan and Progress Schedule, periodic updating of the Contractor's Progress Schedule and Weekly Progress Reports. A preliminary Construction Sequencing plan and Progress Schedule shall be included as a part of the Contractor's proposal. The Contractor's Progress Schedule shall be prepared using a computer system that produces legible, easily updated schedules such as Microsoft Project or approved equivalent.

B. This section contains general information that applies to all work performed under the Contract and is inherently made a part of each specification section.

C. All submittals will be accompanied by the coversheet provided in attachment A of Section 013300-Submittal Procedures.

1.03 RELATED SECTIONS

A. SECTION 001000 – Instructions to Bidders

B. SECTION 003000 – Measurement and Payment

C. SECTION 011000 – Summary of Work

D. SECTION 013300 – Submittal Procedures

E. SECTION 023200 – Sampling, Testing, and Data Evaluation

F. Drawings

G. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

1.07 SUBMITTALS

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. A preliminary Construction Sequencing Plan and Progress Schedule shall be included in Contractor's Proposal **(Submittal Group 1).**

C. A revised Construction Sequencing Plan and Progress Schedule shall be submitted to the Engineer for review **(Submittal Group 2)**. The Contractor's Progress Schedule will be discussed at the Pre-Construction Meeting as such may need to be updated based on the actual date of the Notice to Proceed. Update and submit Progress Schedule at a minimum with each Weekly Progress Report. For purposes of this work the baseline schedule shall start with the actual date from the Notice to Proceed.

D. Format Submittal as Follows

1. The Construction Sequencing Plan should be a narrative employing charts and graphs where appropriate.

2. The Progress Schedule shall be presented in the form of a Gantt (bar) chart that identifies critical path items and task relationships.

3. The project name (INDUSTRI-PLEX SUPERFUND SITE-OPERABLE UNIT 2 REMEDIAL ACTION) shall be identified at the top of the Construction Sequencing Plan and Progress Schedule.

4. Organize the Construction Sequencing Plan and Progress Schedule according to work area, as described below:

   a. West Hide Pile (WHP) – Lower South Pond Sediment Removal.

   b. Permeable Cap System.

   c. HBHA Pond Remediation System Design, including the following remedy subcomponents:
      1) Energy Dissipation at two inlets to HBHA Pond: the Atlantic Avenue Drainway (AAD) and Boston Edison Company Drainway (a.k.a., Right of Way Number 9 [ROW No. 9] outfall).
      2) Halls Brook Diversion Structure, Stormwater Bypass System, Primary-Secondary Cell Cofferdam and Weir.
      3) Secondary Treatment Cell Water Treatment System and Related Components.
      4) HBHA Pond Outlet Structure Improvements.

   d. Wells G&H and Cranberry Bog Conservation Area (CBCA) Sediment Removal.

   e. Wetland Mitigation Site Design (To be submitted in future submission.)

5. Represent each major work task or segment of work by one horizontal bar.

6. Indicate milestone dates for the completion of each phase of the Work.

7. Sequence of Listings: The chronological order of the start of each major operation or segment of work shall determine the vertical location of its bar on the chart.

8. Horizontal Time Scale: Bold Vertical Lines for weeks with the date given for the beginning of each week.

9. Scale and Spacing: The scale and spacing shall allow space for notations and future revisions. The minimum sheet size shall be 11 inches by 17 inches.

E. Content of Submittal as Follows

1. The complete sequence of work by activity shall be shown, with dates for the beginning and completion of each major work segment.

2. The bar representing each major operation or segment of the work shall be identified by Specification number(s) and/or Contract Drawing number(s) coinciding with the described item.

3. A sub schedule bar chart shall be prepared to define critical portions of the major tasks, especially items that require coordination among subcontractors or coordination with the Engineer, SD Representative or Property Owner.

4. Estimated percentage of completion of each work item and estimated total percentage of work complete as of the last day of each week shall be noted at appropriate points on the chart.

F. REVISIONS TO SCHEDULE

1. The progress of each activity to the date of revision submittal, shall be indicated and an estimate given for completion date.

2. Changes that occur since the previous schedule submittal shall be shown and identified as: Changes in scope or quantity, activities modified, revised estimates of progress and completion, or other changes.

3. A narrative report shall be prepared at the Engineer or SD Representative's request to define:

   a. New problem areas, expected delays, and their impact on the schedule;

   b. Corrective action taken or proposed, and their effects;

   c. The effects of changes made or proposed on the functioning of the subcontractors; and

   d. Schedule revisions and date revisions shall be consecutively numbered and dated.

G. DAILY PROGRESS REPORTS **(Submittal Group 4)**

1. Daily Reports: Contractor shall prepare daily reports recording all important information concerning events at the site. Submit daily reports to the SD Representative and the Engineer on the following day. Daily Reports shall include at a minimum.

   a. Date

   b. List of Name of all workers on site.

   c. Total Hours Worked for each on site employee.

   d. Description of Work completed.

   e. List type and quantity of material received including equipment deliveries.

   f. List type and quantity of material sent off-site including equipment.

   g. List of Equipment or Systems operating/in use on site.

   h. Estimate of impact on the schedule, if any.

H. WEEKLY PROGRESS REPORTS **(Submittal Group 4)**

1. The Contractor shall prepare and distribute on Monday of each week, or prior to any scheduled weekly construction progress meeting, a Weekly Progress Report for submittal to the Engineer and SD Representative, which shall include:

   a. A description of all portions of the work completed and other appropriate supporting documentation including photographs, videos, etc.

   b. A description of all work in progress, including all necessary supporting documentation;

   c. Descriptions of all actions, data, and plans that are scheduled for the next week, including information relating to the progress of construction.

   d. General construction photographs of work at various stages of construction. Provide a brief description of each photograph including date, time, description of subject, relevant information, and direction photo faces.

   e. Information regarding the percentage of completion, anticipated delays, and unresolved issues.

I. SPECIAL REPORTS

1. Special Reports: Prepare detailed, written reports recording all information concerning unusual and significant events at the site. Submit to SD Representative within 24 hours after the event. The written report shall include, without limitation:

   a. A summary of the event.

   b. A chronological list of the chain of events.

   c. Names of all persons involved in the event.

   d. The Contractor's actions and response to the event.

   e. The actions and response to the event by affected subcontractors.

   f. The Contractor's evaluation of the results or effects of the event.

   g. Other important and relevant information

J. PROJECT PHOTOGRAPHS

1. Project Photographs: Provide digital photographs. Photographs should be clear and legible.

   a. Preconstruction Photographs: **(Submittal Group 2)** Before beginning work, take sufficient photographs of the existing conditions and the site from different view points to show all significant existing conditions.

b. Wetland Restoration Photographs: **(Submittal Group 4)** In addition to the General Construction Photographs, provide photographs representative of the wetland restoration area taken at the same location at the following stages of construction:
   1) Existing pre-excavation conditions;
   2) Completion of installation of Contractor-designed and contract-required erosion controls;
   3) Completion of final grades; and
   4) Completion of planting.

c. Digital Files: All digital photos shall become the property of the SDs. At the completion of the Contract and before final payment, deliver the digital files to the SDs in a properly labeled CD or other approved media. Organize and label digital photo files by date photo taken and image summary.

K. SCHEDULE, DISTRIBUTION AND REVIEW:

1. Updated schedules and weekly reports shall be distributed in an electronic format to the SD Representative and Engineer on Monday of each week, or prior to any scheduled weekly construction progress meeting.

2. The latest schedule will also be posted at the job site.

3. The Contractor shall resubmit the schedule and/or report within three working days of receipt of the review copy, if required.

L. SAMPLE TRACKING LOG

1. Provide Sample Tracking Log as described in specification Section 023200 – Sampling, Testing, and Data Evaluation.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 013300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in this Section.

B. All submittals will be accompanied by the coversheet provided in Attachment A of this Section.

1.03 RELATED SECTIONS

A. SECTION 011100 – Summary of Work

B. SECTION 013000 – Administrative Requirements

C. Drawings

D. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

1.07 SUBMITTAL PROCEDURES

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. Required Submittals: Submit shop drawings, product data, initial selection samples, verification samples, calculations, coordination drawings, schedules, and all other submittals as specified for each part of the Work.

1. Substitutions: Where a submittal proposes a material or product different than specified and for all “or equal” submittals, comply with requirements and procedures for substitutions in Section 016000 - Product Requirements.

2. Submittals May Affect Payments: No payment will be made for any work requiring a submittal until a submittal has been made and until the submittal has been approved by the Engineer.

3. Submittal Limit: No submittal may be made more than three times. If a submittal is not fully acceptable after its second submission, the Contractor shall take effective action to manage the submittal process and to resolve the problem so the third submission will be acceptable. The Contractor shall be solely responsible for all increased costs including, without limitation, project delays, professional fees, Engineer’s review time, and other costs related to submittals made more than three times.

C. Submittal Schedule: Each required Submittal listed in the individual Specifications has been assigned a Submittal Group classification based on Submittal due date. The Contractor shall issue submittals to the Engineer according to the following schedule, based on assigned Submittal Group.

SUBMITTAL DUE DATE SCHEDULE (UNLESS TIMING INDICATED OTHERWISE)	
Group ID	**Due Date**
Group 1	Due with Bid
Group 2	Due 6 Weeks After Notice of Award
Group 3	Due at Least 3 Weeks Prior to Use
Group 4	Due within 45 days After Completion

D. A draft submittal register has been prepared for the Contractor's use and is included with Section 011100 – Summary of Work. The Contractor shall submit a final submittal register to the Engineer including proposed dates of submittal submission to the Engineer's office and proposed due date to be returned to the Contractor. Schedule at least 2 weeks for reviewing each submission and time for possible required resubmission unless indicated otherwise. (**Submittal Group 2).**

E. Delays: Delays in the work due to improper submittal scheduling or incomplete or improper submission is not justification for an extension of Contract Time.

F. Submittal Reference Numbers:

1. Submittal Reference Numbers: Use Submittal Reference Numbers on Submittal Schedule and actual submittals. Identify each submittal with a unique identification number which is related to the specification section requiring the submittal and the specification paragraph numbers related to the submittal, including a project identifier prefix.

2. Specification References: Clearly identify, refer, and relate each submittal item to the specification paragraph numbers related to the submittal. This is intended to expedite the submittal review process.

3. Example Submittal Reference Number: "Pond Outlet 011100-1.03.A-Rev 01".

G. Revisions: When a submittal is resubmitted with revisions or changes, the Contractor shall highlight and specifically call out all revisions and changes including revisions and changes which are not the result of comments, notes, or exceptions made on the previous submittal by the submittal reviewer. Approval of a submittal with revisions or changes which are not highlighted shall not apply to the revisions or changes which are not highlighted, and the non-highlighted revisions or changes shall be considered "Not Approved."

H. Electronic File type and Filename Convention for Submittals: Contractor to use Adobe Acrobat "PDF" (or approved equal) file format to facilitate submittal review process. Electronic filename shall include project reference, submittal reference number, specification reference, and revision number (if applicable). For example: "Pond Outlet 011100-1.03.A-Rev 01.pdf"

I. The Engineer shall review and return submittals to the Contractor within 5 business days of the stamped received date, except where indicated otherwise. Please note that regulatory agency approval is required for each submittal and the Agency submittal review is expected within three (3) working days following Engineer's review.

J. Resubmittals shall be made within 5 days of the date of the letter returning the material to be modified or corrected, unless within 2 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time. When corrected copies are resubmitted, the Contractor shall work in "Track Changes" mode to direct specific attention to all revisions, and shall list separately any revisions made other than those called for by the Engineer on previous submissions.

K. Use the "Submittal Cover Sheet" included as Attachment A to this Section, leaving open space as shown for Engineer's submittal review stamp and notations. In addition, within the submittal provide clear notes and full description of all qualifications and all deviations from the requirements of the Contract Documents, if any. As applicable, clearly identify the following on each submittal:

1. Name of project.

2. Date of submittal origination or creation.

3. Contractor's name.

4. Subcontractor's name, complete address, contact person, and telephone number.

5. Manufacturer's name, complete address, contact person, and telephone number.

6. Supplier's name, complete address, contact person, and telephone number.

7. Fabricator's name, complete address, contact person, and telephone number.

8. Submittal name and description.

9. Unique and individual Submittal Reference Number as specified above.

10. Clear notes and full description of all qualifications and all deviations from the requirements of the Contract Documents.

11. Contractor's signed and dated review stamp, showing the Contractor's review and approval of each submittal before delivery to Engineer's office. Unstamped, undated, or unsigned submittals will be returned without action by the Engineer.

12. Open space as shown in Attachment A reserved for Engineer's submittal review stamp and notations.

13. Highlight and call out each and every change and revision made to a previously submitted submittal.

L. Submittal mechanics: Send all submittals to the Engineer in electronic format by e-mail (designated recipient to be indentified upon contract award). Do not send submittals directly to the Engineer's consultants.

1. The Engineer will return submittals electronically to designated Contractor's staff.

M. Product Data: Provide electronic copy of manufacturer's literature including, without limitation, manufacturer's standard description of product, materials and construction, recommendations for application and use, certification of compliance with standards, instructions for installation, and special coordination requirements. Collect data into one submittal for each unit of work or system; clearly mark each copy to show which choices and options are applicable to project.

1. Installer Copy: Verify that the Installer has a current copy of the relevant product data, including installation instructions, before permitting installation to begin.

N. Shop Drawings: Provide accurately prepared large scale and detailed shop drawings prepared specifically for this project on reproducible sheets and provided in electronic format. Show adjacent conditions and related work. Show accurate field dimensions and clearly note field conditions. Identify materials and products in the work shown. Note special coordination required.

1. Field Measurements Required: The Contractor and its suppliers and Subcontractors shall jointly take and record in writing accurate field measurements for all built-in materials, products, and fixed equipment. Maintain field measurement record until built-in materials, products, and fixed equipment has been fully installed and accepted by the Engineer. The Contractor shall pay all costs involved in correcting improperly fitting built-in materials, products, and fixed equipment.

2. Maximum Sheet Size: 30 x 54 in.

O. Samples: Provide at least two sample units for each sample submission. Sample units shall be identical to final materials and products installed in the work. Work in the field that falls outside the accepted range shown by the samples will be rejected. Label each sample with description, source, product name or manufacturer's name and model number. Engineer generally will not test samples for compliance with Contract requirements, which shall remain the responsibility of the Contractor.

P. Timing of Submittals: Submit submittals in accordance with the Submittal Due Date Schedule.

1. Testing: Submit samples and materials for testing sufficiently in advance of need for use on project. Allow adequate time for testing and, if necessary, re-testing.

2. Substitutions: Additional submittal review time is required for substitutions. See Section 016000 - Product Requirements

Q. Engineer's Action on Submittals: Engineer will review submittals, stamp with "action stamp," mark action, and return to Contractor. Engineer will review submittals only for conformance with the design concept of the project. The Contractor is responsible for confirming compliance with other Contract requirements, including without limitation, performance requirements, field dimensions, fabrication methods, means, methods, techniques, sequences and procedures of construction, and coordination with other work. The Engineer's review of submittals shall be held to the limitations stated in the Contract Documents. In no case shall acceptance by the Engineer be interpreted as a release of Contractor of its responsibilities to fulfill all of the requirements of the Contract Documents. Engineer will indicate one or more of the following:

1. Reviewed: When so marked, the work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents. Acceptance of the work will be based on that compliance.

2. Reviewed As Noted: When so marked, the work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents and the Engineer's notes and comments. Acceptance of the work will be based on that compliance.

3. Reviewed As Noted, Resubmission Required: When so marked, make corrections or changes to original submittal or prepare a new submittal and resubmit to Engineer for record. Submittals with this action may be used at the project site or elsewhere where work is in progress.

4. Revise and Resubmit: When so marked, the submittal is not acceptable. Do not permit submittals with the action marking to be used at the project site or elsewhere where work is in progress.

5. Distribution: Contractor is required to make prints or copies and distribute to the SD Representative and Subcontractors involved. A total of four hard copies are required to be submitted to the SD Representative within five (5) calendar days after date of Engineer's review noting that no resubmittal or further action is required. Provide and pay for all copies for distribution from the final approved submittal. Maintain one complete set of submittals at the project site in a neat, organized file.

1.08 PROJECT PHOTOGRAPHS

A. Digital Files: All digital photos shall become the property of the SDs. At the completion of the Contract and before final payment, deliver the digital files to the SDs in a properly labeled CD or other approved media. Organize and label digital photo files by date photo taken and image summary.

1.09 OTHER REQUIRED SUBMITTALS

A. Emergency Contacts: The Contractor shall furnish to the SD Representative, the names addresses, telephone numbers, and pager/cellular numbers of its job superintendent and at least two other of its own authorized representatives so they can be contacted at times other than normal working hours in case of emergency. In addition, permanently and conspicuously post Contractor's emergency telephone numbers in a manner to be viewed from outside the field office.

1.10 REQUEST FOR INFORMATION (RFI) PROCEDURE

A. The request for information (RFI) process is a means of communicating deviations from the Contract Documents. At any point during the execution of the Contract Documents following the award of this Work, the Engineer, Contractor or SD Representative may request additional information or clarification of the procedures, methods, or materials that may not be in accordance with the specifications or reviewed submittals and/or questions concerning the applicability or interpretation of a particular section or part of any Contract Documents. All requests for information shall be directed to the SD Representative.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECTUTION

Not Used.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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ATTACHMENT A
INDUSTRI-PLEX SUPERFUND SITE-OPERABLE UNIT 2
HBHA POND OUTLET STRUCTURE
SUBMITTAL COVER SHEET

THE USE OF THIS SUBMITTAL COVER SHEET IS REQUIRED FOR ALL SUBMITTALS.

Contractor: _____

Subcontractor: _____

This Submittal Reference Number: _____
Example: "Pond Outlet 011100-1.03.A-Rev 01"

Submittal Title: _____

Drawing and Detail Reference: _____

Date of Initial Submittal: _____

Date of this Submittal: _____

This Submittal Prepared By: _____

Indicate one of the following:

[ ] This submission is not a proposed substitution or deviation from the Contract Documents.

[ ] This submission includes a proposed deviation from the Contract Documents as clearly identified in this submittal.

[ ] This submission is a proposed substitution or "equal." All requirements of Section 016000 – Product Requirements have been met.

The undersigned attests that the undersigned has examined this submission and that the requirements of the Contract Documents have been met.

By: _____
Signature

_____
Printed or Typed Name

_____
Title

END OF SUBMITTAL COVER SHEET

Reserved for Engineer's Submittal Review Stamp

SECTION 013529

HEALTH AND SAFETY

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

F. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at all times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The Contractor is required to prepare a Health and Safety Plan (HASP) prepared by a qualified health professional as described herein for all workers at the site, including subcontractors, engaged in activity where exposure to contaminated media, including air-borne contaminants, is possible as determined by a qualified health professional retained by the Contractor. It may be necessary that workers who are in close proximity to excavated materials and groundwater be trained in health and safety procedures according to the OSHA requirements and be current in their OSHA refresher course.

B. Opinions of the Engineer or the SD Representative regarding expected site conditions do not relieve the Contractor of his responsibility to protect the health and safety of his employees, all sub-contractor employees, the public welfare, and the environment.

C. The Contractor shall implement health and safety procedures designed to protect health, safety, public welfare, and the environment during the performance of all Work. Such procedures shall include, without limitation, the following:

1. Measures to protect human receptors (the public and workers) from exposure to oil or hazardous material;

2. The institution of air monitoring activities, if necessary, to protect human receptors (the public and workers) from exposure to gases and air-borne particulates;

3. Measures that may be necessary to contain oil and/or hazardous material during the performance of the Work, including:

a. measures to control fugitive dust and other environmental media;

b. measures to control odors;

c. measures to decontaminate vehicles and equipment to minimize the spread of contaminated soil, sediment, or other media from the Work area;

d. measures to secure on-site excavations and temporary stockpiles of contaminated materials; and

e. discontinuance of Work where necessary to protect worker or public health and safety.

D. Provide a health and safety coordination meeting prior to commencement of work at the site to inform each worker of the site conditions and proposed health and safety contingency actions.

E. The scope and detail of the health and safety procedures shall be commensurate with the degree and nature of the risks posed to human (worker and public) and ecological populations by the Work as determined by a qualified health professional retained by the Contractor. Standardized health and safety plans may be appropriate for non-intrusive or routine activities conducted at the site.

F. The Contractor shall appoint an OSHA qualified Health & Safety Supervisor/Coordinator who will be charged with overseeing site health and safety, instrument monitoring, personnel and equipment decontamination, control of equipment check-out and emergency response.

G. The responsibility for providing a site “competent person”, as defined by OSHA, shall rest on the Contractor.

1.03 RELATED SECTIONS

A. SECTION 011100 – Summary of Work

B. SECTION 020000 – Existing Conditions

C. SECTION 026113 – Excavated Soils and Materials Management Plan

D. SECTION 441123 – Construction Dust and Odor Control

E. Drawings

F. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. Refer to Section 020000 – Existing Conditions, the Administrative Record associated with Industri-plex Superfund Site Operable Unit 2, Draft 30%, 95%, and 100% Remedial Design, and the Remedial Action Work Plan (RAWP) for information relevant to environmental and subsurface conditions.

B. Groundwater, sediment, soil, soil gas, and surface water have been sampled and analyzed as part of site investigations to date. These investigations have identified elevated concentration of several constituents or classes of constituent, including metals, volatile organic compounds, ammonia, and others. Main Contaminants of Concern (COCs) in soil, sediment, groundwater, and surface water include, but are not necessarily limited to, ammonia, arsenic, benzene, 1,2-dichloroethane, trichloroethene, naphthalene, and benzo(a)pyrene.

C. Subsurface investigations performed by the Engineer concluded that sandy fill, organic deposits, glaciolacustrine deposits, glacial till and bedrock underlie the site.

D. Levels of personal protection are established in reference standards listed in Section 1.04. It is anticipated that the majority of the work to be performed on this project may be performed at Personnel Protection Level D. The Contractor shall be responsible for determining if a higher level of Personnel Protection is required based on the criteria outlined in the Contractor's HASP. In the event that the Contractor determines that a level of protection higher than Level D is required, the Contractor's personnel shall take the necessary steps outlined in the HASP. Should the level of personal protection be upgraded during the course of the work to Level C or above, the Board of Health for the City of Woburn shall be notified of the upgrade as soon as practicable. If upgrading to Level B (self-contained breathing apparatus) protection is required, the work shall be suspended in the area identified as the "work zone" by the Contractor's Health and Safety Officer until the Contractor is equipped to continue the work.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

B. Ambient Air Monitoring

1. The Contractor shall monitor air quality in the "breathing zone" for the compounds of concern (vapors, gases or particulates) during those activities where exposure to the general public and workers to contaminated air, sediment, soil, groundwater, surface water, or other hazardous conditions are possible, using instruments as described in the

Contractor's HASP. The instruments shall be used in accordance with the procedures outlined in the Contractor's HASP for their employees and subcontractor's employees.

2. The Contractor shall control dust in accordance with the requirements of Section 026113 – Excavated Soil and Materials Management Plan and Section 441123 – Construction Dust and Odor Control. In addition, no visible dust shall be allowed. At the request of the SD Representative, additional dust suppression will be implemented at no additional cost to the Owner.

3. The Engineer will monitor air quality inside the Work Area according to the procedures outlined in the HASP for the Engineer's employees only.

C. Fence-line/Work Area Perimeter Monitoring

1. The Engineer will monitor air quality at the Fence-line/Work Area Perimeter as described in the RAWP applicable to the Work.

1.07 SUBMITTALS

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. A HASP has been prepared by the Engineer and is included in the Project Operations Plan (POP). This POP HASP addresses the Engineer's worker(s) present on site during Remedial Action, as well as establishes minimum requirements of the Contractor's HASP to be prepared by the Contractor as described herein.

C. **(Submittal Group 2)** Submit a HASP prepared by a qualified health professional experienced in working in contaminated environments to the Engineer for review. The HASP shall be prepared by a Certified Industrial Hygienist or environmental health and safety professional familiar with the site conditions and proposed construction activities. The minimum qualifications shall be 5 years of demonstrated experience in preparing similar health and safety plans. No work shall be performed until the Engineer has reviewed the Contractor's HASP. The HASP shall apply to all work to be conducted at the site, including work by the Contractor and all Subcontractors. Training will not be provided by the SDs, SD Representative, or the Engineer. The plan shall include the following information:

1. A list of Contractor's Work tasks that may involve contact with, excavation of, or handling of contaminated soil, sediment, surface water, or groundwater.

2. Compounds of concern and sign/symptoms of exposure.

3. Potential for worker exposure to the compounds of concern for each work task.

4. Requirements for OSHA training for each work task and a record or schedule for training of Contractor's and Subcontractor's workers in the use of personal protective equipment.

5. Work task specific levels of protection and a description of health and safety equipment including protective clothing, respiratory equipment and monitoring instruments.

6. Procedures for in-situ monitoring of particulates, hazardous gases or vapors for each work task and action levels for donning personal protective equipment; description of monitoring instruments.

7. Procedures for containing oil and/or hazardous materials such as decontamination of heavy construction equipment and tools and dust and odor control.

8. Emergency Response Plan describing procedures that will be undertaken to control spills or sudden releases of oil or hazardous material.

9. Dust and Odor Monitoring Program.

D. The HASP will be reviewed by the Engineer before the Contractor conducts the first health and safety coordination meeting relating to possible exposure to contamination at the site. Each health and safety coordination meeting is to be scheduled by the Contractor and held prior to the commencement of work for each new worker. The Contractor shall provide written advance notice of these meetings to all interested parties.

PART 2 - PRODUCTS

2.01 CLOTHING AND EQUIPMENT

A. All clothing and equipment must conform to the OSHA and EPA requirements as indicated in the Reference Standards (Section 1.04). Generally, protective clothing is considered disposable, but respiratory equipment is reusable.

PART 3 - EXECUTION

3.01 HEALTH AND SAFETY PLANNING AND IMPLEMENTATION

A. Prepare and implement a plan which will ensure the health and safety of all workers engaged in work at the site at all times when exposure to contaminated media is possible. Implement the plan throughout the execution of the work.

B. Prepare and implement a plan to protect the health & safety of the public and the environment.

C. Contractor's workers who will be engaged in work at the site which might result in exposure to contaminated soil or groundwater shall review the HASP and attend the health and safety coordination meeting.

D. Provide adequate health and safety training for all personnel who may come in contact with or be exposed to contaminated materials during the execution of the work.

E. Personnel who have not received training, and who are not equipped with the required protective clothing and equipment shall not be permitted access to the site by the Contractor, during execution of work which may result in exposure to contaminated media.

3.02 ACCIDENT REPORTING REQUIREMENTS

A. The Contractor must comply with all accident and or incident reporting requirements, including the following:

1. Should any unforeseen safety-related factor, hazard, or condition become evident during the performance of the Work, the Contractor must immediately take prudent action to establish, maintain, and secure the site and working conditions. This shall be followed by immediate notice to the SD Representative.

2. If serious injury to a person or damage to property, environment, or natural resources results from an incident, the Contractor shall immediately report the incident to the SD Representative. The report shall be followed by a written document describing the incident, what hazards were created by it, and detailed statements of what actions were taken to correct the problem. The Contractor will also include a description of why the actions taken were prudent.

3.03 DECONTAMINATION

A. Decontaminate all equipment and tools which have come in contact with contaminated media in accordance with the approved HASP to prevent the spread of contamination inside and outside the site limits.

B. Provide on-site facilities for Contractor personnel to decontaminate their protective clothing or other equipment.

C. Properly store and dispose of contaminated personal protection equipment and decontamination fluids.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 014000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. This Section includes information on the following items:

1. Quality control and control of installation.

2. Tolerances.

3. References.

4. Labeling.

5. Testing and inspection services.

6. Manufacturers' field services.

7. Examination.

8. Preparation.

1.03 RELATED SECTIONS

A. SECTION 013000 – Administrative Requirements

B. SECTION 013300 – Submittal Procedures

C. SECTION 016000 – Product Requirements

D. SECTION 023200 – Sampling, Testing, and Data Evaluation

E. Drawings

F. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.07 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

D. Conform to tolerances specified in individual specification sections for earthwork, sheet pile installation, concrete placement, and other specification Sections as appropriate.

1.08 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue. Reference standards shall be most current version with respect to date on Contract Documents.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.09 LABELING

A. Attach label from approved agency having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.

1. Model number.

2. Serial number.

3. Performance characteristics.

1.10 TESTING AND INSPECTION SERVICES

A. Excludes chemical testing at the Project Chemical Testing Laboratory, which has been selected and payment for laboratory testing is by others. Refer to specification Section 023200 - Sampling, Testing, and Data Evaluation

B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Engineer.

1. Laboratory: Authorized to operate in State of Massachusetts and on a Superfund site.

2. Laboratory Staff: Maintain full time registered Engineer specialist on staff to review services. Staff working on site where exposure to contaminated media may occur shall be trained in accordance with applicable OSHA Hazwoper and related requirements, adhere to the requirements of Section 013529 - Health and Safety, and follow the Health and Safety Plan.

3. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Engineer or SDs.

D. Reports will be submitted by independent firm to Engineer and Contractor in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

1. Submit final report indicating correction of Work previously reported as non-compliant.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify Engineer and independent firm 24 hours prior to expected time for operations requiring services.

2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Engineer. Payment for re-testing or re-inspection will be at the Contractors expense and no additional cost will be incurred by the SDs.

H. Independent Concrete Testing Laboratories Responsibilities:

1. Test samples of mixes submitted by Contractor.

2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.

3. Perform specified sampling and testing of products in accordance with specified standards.

4. Ascertain compliance of materials and mixes with requirements of Contract Documents.

5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.

6. Perform additional tests required by Engineer.

7. Attend preconstruction meetings and progress meetings.

I. Laboratory Reports: After each test, promptly submit two copies of report to Engineer and Contractor. Provide interpretation of test results and include the following information:

1. Date issued.

2. Project title and number.

3. Name of inspector.

4. Date and time of sampling or inspection.

5. Identification of product and specifications section.

6. Location in Project.

7. Type of inspection or test.

8. Date of test.

9. Results of tests.

10. Conformance with Contract Documents.

J. Limits on Testing Authority:

1. Testing laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

2. Laboratory may not approve or accept any portion of the Work.

3. Laboratory may not assume duties of Contractor.

4. Laboratory has no authority to stop the Work.

1.11 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to Engineer's acceptance.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

1.12 SUBMITTALS

Not Used.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing subgrade is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

SECTION 014200

REFERENCES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. This Section defines terms, abbreviations, and acronyms used elsewhere in the Contract Documents and on the Drawings.

1.03 RELATED SECTIONS

A. SECTION 000110 – Table of Contents

B. SECTION 001000 – Instructions to Bidders

C. SECTION 011100 – Summary of Work

D. SECTION 013000 – Administrative Requirements

E. Drawings

F. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 ABBREVIATIONS AND ACRONYMS

A. AAD: Atlantic Avenue Drainway

B. AASHTO: American Association of State Highway/Transportation Officials, latest edition.

C. ASTM: Specifications of the American Society for Testing and Materials, latest edition

D. BECo: Boston Edison Company

E. CBCA: Cranberry Bog Conservation Area

F. CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act

G. COCs: Contaminants of Concern

H. DEP: Massachusetts Department of Environmental Protection.

I. DETS: Dewatering Effluent Treatment System

J. EPA: Environmental Protection Agency

K. HASP: Health and Safety Plan

L. HBHA: Halls Brook Holding Area

M. LSP: Lower South Pond

N. NCP: National Oil and Hazardous Substances Pollution Contingency Plan

O. NRWQC: National Recommended Water Quality Criteria

P. OSHA: Occupational Safety and Health Administration

Q. QAPP: Quality Assurance Project Plan

R. RAWP: Remedial Action Work Plan

S. RD/RA: Remedial Design/Remedial Action

T. RDWP: Remedial Design Work Plan

U. UMP: Utility Monitoring Point(s)

V. WHP: West Hide Pile

1.05 DEFINITIONS

A. SDs: Hereafter refers to the Settling Defendants; The Settling Defendants ultimately purchasing the work described in these contract documents include Pharmacia Corporation by its Attorney-in-Fact Monsanto Company and Stauffer Management Company LLC, as litigation agent for Bayer CropScience Inc.

B. SD Representative: Hereafter refers to de maximis, inc.

C. Contractor: Hereafter refers to the contractor selected to perform the Work described in the Contract Documents.

D. Subcontractor: Unless otherwise indicated, refers to the Contractor's subcontractor.

E. Engineer: Hereafter refers to Haley & Aldrich, Inc.

F. Project Chemical Testing Laboratory: Hereafter refers to Alpha Analytical, Inc. (Westborough, MA).

G. Project Geotechnical Testing Laboratory: TBD

H. Project Geosynthetic Testing Laboratory: TBD

I. Project Concrete Testing Company and Laboratory: TBD

J. Property Owner: Hereafter refers to property owner of record.

K. Health and Safety Personal Protective Equipment Standards: Hereafter refers to 29 CFR 1910 – Occupational Safety and Health Standards and EPA's Emergency Management Personal Protective Equipment guidance.

L. Horizontal Datum (X, Y): Massachusetts State Plane, NAD27 in US Survey Feet.

M. Vertical Datum (Elevation, Z): National Geodetic Vertical Datum of 1929 (NGVD1929) in US Survey Feet.

N. Pond: Unless otherwise indicated, "Pond" or "pond" refers to the Halls Brook Holding Area Pond.

O. Construction-related Surface Water Quality Criteria: Criteria applicable to discharges to surface water (e.g., dewatering effluent, construction runoff).

P. 30% Remedial Design: Document prepared by Haley & Aldrich, Inc. summarizing the results of Pre-design Investigations completed at the Industri-plex Superfund Site Operable Unit 2.

Q. Administrative Record: Compendium of documents related to investigations of the Industri-plex Superfund Site Operable Unit 2.

R. Contract Document: The following list of documents is included as part of the Contract Document:

1. Terms and Conditions of Agreement, including any special conditions.

2. EPA, 2006. “Record of Decision: Industri-plex Superfund Site Operable Unit-2 (and Including Wells G&H Superfund Site Operable Unit 3) Superfund Site, Dated January 2006.

3. EPA, 2008. “Consent Decree-Appendix D: Final RD/RA Statement of Work, Industri-plex Operable Unit 2 (and Including Wells G&H Superfund Site Operable Unit 3) Superfund Site, Dated 27 February 2008.

4. All Specifications.

5. Drawings.

6. Remedial Action Work Plan (RAWP).

7. Other referenced documents as referenced in the above documents.

1.06 EXISTING CONDITIONS

Not Used.

1.07 QUALITY ASSURANCE

Not Used.

1.08 SUBMITTALS

Not Used.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The Contractor shall furnish and construct all temporary facilities and controls as required to complete the Work as outlined by the Contract Documents and Drawings.

B. The Contractor shall install temporary controls, including but not limited to fences and barricades, to protect people, including workers and the public, from injury resulting from Contract activities.

C. The Contractor is solely responsible for work place safety and safety of the public with respect to Contract activities. The Contractor shall determine the appropriate means, methods, and techniques to be used to ensure safety.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 026113 – Excavated Soil and Materials Management Plan

C. SECTION 310000 – Earthwork

D. SECTION 312500 – Erosion and Sedimentation Controls

E. SECTION 316216 – Steel Sheet Piles

F. SECTION 350140 – Temporary Water Diversions (Operation and Maintenance of Waterway Construction)

G. SECTION 441123 – Construction Dust and Odor Control

H. Drawings

I. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

1.07 TEMPORARY FACILITIES

A. Contractor's Field Offices: The Contractor shall provide the Contractor's own field offices as needed. Maintain Contractor's field offices for the duration of the Contract as determined by the Engineer.

1. Location: Locate field offices as shown on the Drawings.

2. Office Equipment: Provide office equipment needed for efficient administration of the project.

3. Contract Documents at Site: Keep copies of all Contract Documents and project paperwork neatly on file at job site. Maintain all sets of Contract Documents at the site current and up-to-date. In addition to maintaining a separate chronological file of addenda and Contract Modifications, clearly note and paste in all addenda and Contract Modifications on the sheets

and pages that are changed by addenda and modification. Bind, tape edgeband, reinforce, and prepare job site copies of Contract Documents.

B. Storage: Locate storage areas where approved by the SD Representative and authorities having jurisdiction.

C. Toilet Facilities: Provide and maintain clean, well-supplied portable toilet facilities in compliance with municipal ordinances and requirements of authorities having jurisdiction.

1.08 TEMPORARY UTILITY REQUIREMENT

A. Contact “Dig Safe”: Comply with Massachusetts General Laws, Chapter 82, Section 40 and all applicable codes, rules, regulations. Do not begin any excavation without complying with the law. Ensure that all utilities have been located and marked prior to beginning any excavation work.

B. Temporary Water: Provide and maintain safe, code complying, temporary water service during construction, including water for construction, dust control, drinking, and decontamination. Provide all connections and make all arrangements for this service. Provide all piping, hoses, fittings, water barrels, and other temporary facilities needed. The Contractor will pay for water consumed.

1. Payment Responsibility: The Contractor will pay for water consumed.

2. Freezing Weather: Protect temporary and permanent water systems from freezing and damage. Repair damage at no additional cost to the SDs.

3. Drinking Water: Provide clean, cooled drinking water for workers and all subcontractors. Provide disposable paper cups and waste container.

C. Temporary Lighting and Power: Provide and maintain a safe, code complying temporary light and power system for entire project, including temporary offices, temporary construction dewatering system operation, and other equipment requiring power supply. Provide all connections and make all arrangements for temporary light and power service. Provide all feeders, conductors, fuse boxes, fuses, disconnect switches, receptacles, fixtures, bulbs, and other temporary items needed. Provide adequate lighting for proper construction, inspection, safety, and security, including material storage areas.

1. Contractor shall design and install an electrical power supply to support the Work described in these Contract Documents that may either be from a portable generator or from the location of the power supply tie-ins as shown on the Drawings. The existing power supply at HBHA Pond, which is currently being utilized by the Engineer for an ongoing pilot test in the HBHA Pond, consists of a 300 amp, 3-phase, 480 volt service (available temporarily to support construction of the outlet structure) [Note: the actual panel at the power tie-in is rated for 400 amps; 100 amps of which are necessary for the Engineer’s ongoing pilot test]. The Contractor must closely coordinate all work related to tying into and utilizing this power supply with the Engineer to minimize disruption to the Engineer’s ongoing use of this electrical service. This service shall be evaluated by the Contractor’s electrical engineer/contractor for suitability related to the electrical equipment power demand necessary to complete the Work described in the Contract Documents. Payment Responsibility: The Contractor will pay for electricity consumed.

2. Contractor is required to obtain all permits and inspections.

3. All Electrical work shall be designed and installed in accordance with National Electrical Code and shall comply with all applicable rules and regulations of local and state laws and ordinances.

1.09 SUBMITTALS

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. Contractor shall submit in accordance with the General Provisions of the Contract, an electrical supply plan and design, prepared by an appropriately trained, experienced, and licensed electrical engineer/contractor **(HBHA Pond Submittal Group 2)**

C. The Contractor shall provide a submittal outlining the type of chain link fencing used and a map illustrating locations of temporary fencing and gates. **(Submittal Group 3)**

PART 2 - PRODUCTS

2.01 CHAIN LINK FENCING

A. Provide chain link perimeter fencing and locked gates to protect the work, protect materials, prevent injury, and control access as necessary.

2.02 TEMPORARY GUARDS AND BARRIERS

A. Barricades, Warning Tapes: Provide effective barricades to ensure safety. Warning tapes may only be used for very minor hazards or walkway identification.

B. “Jersey” Barriers: Jersey barriers shall be used to protect above grade utilities from truck traffic within the areas of roadway improvement. Wherever pedestrian walkways are positioned within 5 ft of an active roadway, street, or drive lane, provide continuous precast concrete “Jersey” barriers to separate the pedestrian and vehicular zones.

2.03 TEMPORARY ROADWAY AND ENTRANCE IMPROVEMENTS

A. Construct Temporary Access Roadways and Roadway Improvements in accordance with information shown on the Drawings.

B. Construct Temporary Stabilized Construction Entrances in accordance with the information shown on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Minimize disturbance to trees and shrubs during fence installation in areas that otherwise would not be disturbed by construction.

B. Temporary roadway installation shall include placement of geotextile and crushed stone along the temporary roadway, and placement of erosion control blankets along the edge of stone to minimize potential erosion of the existing landscaped areas adjacent to the temporary roadway.

C. Damage to the existing Industri-plex OU1 cap system must be repaired by the Contractor at their sole expense.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 016000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. This Section specifies administrative and procedural requirements governing the selection of products for use in the Project, including:

1. Product list schedules.

2. Substitution requests.

3. Product selection.

4. Product delivery, storage, and handling.

1.03 RELATED SECTIONS

A. SECTION 011100 – Summary of Work

B. SECTION 013000 – Administrative Requirements

C. SECTION 013300 – Submittal Procedures

D. SECTION 014000 – Quality Requirements

E. Drawings

F. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

B. Definitions used in this Section are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.

C. Products: Items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature that is current as of the date of the Contract Documents.

2. "Foreign Products", as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.

D. Materials: Products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

E. Equipment: A product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

F. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor are considered requests for "substitutions." The following are not considered substitutions:

1. Revisions to Contract Documents requested by the SDs, SD Representative, or Engineer.

2. Specified options of products and construction methods included in Contract Documents.

3. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

B. Source Limitations: Provide products of the same kind, from a single source.

1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Engineer for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources that produce products that possess these qualities, to the fullest extent possible.

C. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

D. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:

1. No available domestic product complies with the Contract Documents.

2. Domestic products that comply with Contract Document are only available at prices or terms that are greater than 25 percent higher than foreign products that also comply with the Contract Documents. Cost differential must be documented, submitted, and approved by the SD Representative 7 days prior to procurement of the foreign products.

E. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service connected or power operated equipment. Locate on an easily accessible surface, which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

   a. Name of product and manufacturer.

   b. Model and serial number.

   c. Capacity.

   d. Speed.

   e. Ratings.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

   1. Schedule delivery to minimize long term storage at the site and to prevent overcrowding of construction spaces.

   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

   3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

   4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.

   5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

   6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

   7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

B. All deliveries of material, equipment, etc., shall be made to the Contractor and accepted only by the Contractor during working hours. SD Representative or Engineer personnel will not receive or accept any material or equipment, etc., at any time.

1.08 SUBMITTALS

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. Product List Schedule: **(Submittal Group 2)** Prepare a schedule showing products specified in a tabular form acceptable to the Engineer and SDs. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.

2. Form: Prepare the product-listing schedule with information on each item tabulated under the following column headings:

a. Related Specification Section number.

b. Generic name used in Contract Documents.

c. Proprietary name, model number and similar designations.

d. Manufacturer's name.

e. Installer's name and address.

f. Identification of product as one of the following:
1) Product as specified
2) Proposed Substitution
3) Proposed Equal

3. Submit completed product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

C. Substitution Request Submittal: **(Submittal Group 1)**

1. Submit requests for substitution in accordance Section 013300 – Submittal Procedures.

2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and/or Drawing Numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

a. Product Data, including Drawings and descriptions of products, fabrication, and installation procedures.

b. Samples, where applicable or requested.

c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance, and visual effect.

d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the SDs and separate

Contractors that will become necessary to accommodate the proposed substitution.

e. A statement indicating the substitution effect on the Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

f. Certification by the Contractor that the substitution proposed is equal to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

3. Engineer's Action: Within one week of receipt of the request the Engineer will evaluate the data and send his recommendation of acceptance or rejection of the proposed substitution, with two copies, to the SD Representative and the SD Representative will notify the Contractor. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the original product specified by name.

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.

1. Provide products complete with all accessories, trim, and finish, safety guards and other devices and details needed for a complete installation for the intended use and effect.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.

2. Semi-proprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.

a. Where products or manufacturers are specified by name, accompanied by the term "or equal" or “or equivalent,” comply with the provisions concerning "Substitutions" to obtain approval for use of an unnamed product.

3. Non Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with provisions concerning "substitutions" to obtain approval for use of an unnamed product.

4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade

name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.

   a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.

6. Compliance with Standards, Codes, and Regulations: Where the Specifications only requires compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.

7. Visual Matching: Where Specifications require matching an established Sample, the SDs or SD Representative's decision will be final on whether a proposed product matches satisfactorily.

   a. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.

8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The SDs or SD Representative's or Engineer will select the color, pattern and texture from the product line selected.

2.02 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.

2. Proposed changes are in keeping with the general intent of Contract Documents.

3. The request is timely, fully documented, and properly submitted.

4. The request is directly related to an "or equal" clause or similar language in the Contract Documents.

5. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

7. A substantial advantage is offered the SDs, in terms of cost, time, energy conservation, or other considerations of merit, after deducting offsetting responsibilities the SDs may be required to bear. Additional responsibilities for the SDs may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the SDs or subcontractors, and similar considerations.

8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.

9. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.

10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

11. The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data, or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

PART 3 - EXECUTION

3.01 INSTALLATION OF PRODUCTS:

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located, and aligned with other Work.

B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until time of Substantial Completion

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 017000

PREPARATION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. This section includes information on the following items:

1. Examination and Preparation Procedures

2. Survey layout, including but not limited to verification of existing benchmarks through a baseline field survey, establishing supplementary survey control benchmarks in the vicinity of the Work, survey layout of proposed construction features, field verification while construction is in progress, setting grade stakes and other controls, and as-built construction documentation and final as-built drawings.

3. Closeout procedures.

4. Final cleaning.

5. Protecting installed construction.

6. Project record documents.

7. Manual for materials, equipment, and finishes.

8. Product warranties and product bonds.

1.03 RELATED SECTIONS

A. SECTION 011100 – Summary of Work

B. SECTION 013000 – Administrative Requirements

C. SECTION 013300 – Submittal Requirements

D. SECTION 016000 – Product Requirements

E. Drawings

F. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

1.07 EXAMINATION AND PREPARATION PROCEDURES

A. Review all relevant project documents, including reports containing subsurface information.

B. Review existing survey data and locate previously established benchmarks.

C. Prior to bid, walk site, review conditions and note anything that may affect progress of required work.

1.08 SURVEY AND LAYOUT

A. The Contractor shall be responsible for layout and survey control and establishing all locations and elevations required based on the benchmarks and survey control points indicated on the Drawings or other points acceptable to the Engineer. The Contractor shall be responsible for the maintenance and protection of survey control points and construction location stakes.

B. Submit the resume, including qualifications and experience information, of the Massachusetts Licensed Registered Land Surveyor and Registered Civil Engineer proposed by the Contractor to perform site survey, layout, as-built surveys, and drawings **(Submittal Group 3).** The Registered Land Surveyor or Professional Engineer should be familiar with earthwork construction is subject to the Owner's and Engineer's approval prior to employment.

C. All survey work shall be referenced to the following datum (the "Project Coordinate System"):

1. Horizontal Datum (X, Y): Massachusetts State Plane, NAD27 in US Survey Feet

2. Vertical Datum (Elevation, Z): National Geodetic Vertical Datum of 1929 (NGVD1929) in US Survey Feet

D. Perform baseline land survey in the West Hide Pile/Lower South Pond Work Area prior to beginning work to document existing conditions, including but not limited to, topography, bathymetry, edge of water, above- and below-grade utilities (including ownership of utility), surface type change boundaries (e.g., rip rap - topsoil boundaries), access roads, fences, monitoring wells and piezometers, roadways, paths, drainways and culverts, rights-of-way, tree masses, structures, significant improvements on the land, and other site features located within the area of Work. Contractor shall submit survey drawing in hard copy and electronic form (AutoCAD meeting the requirements described herein and PDF) to the Engineer for review **(Submittal Group 4).**

E. Capture topographic spot elevations and generate ground surface contours. Sufficient field verification and topographic spot elevation measurements shall be obtained to facilitate accurate topographic plans to support as-built documentation requirements. Note regarding contour generation requirements: 2-foot contours in upland areas; 1-foot contour detail in the proposed edge of water/underwater excavation areas.

F. Capture location of edge of water (noting elevation and date/time of measurement).

G. The Contractor's survey benchmarks shall be established in areas that will be unaffected by the placement of new fill or other work.

H. Conduct initial survey control base line layout, including verification of existing survey control benchmarks, establishing additional control benchmarks, and other survey layout to facilitate the Work. All layouts, offsets, checking of all grade and the plumbness of the Work shall be provided by the Contractor's qualified registered land surveyor.

I. Field-locate and mark existing property and easement corners.

J. Layout of Work: Establish and be responsible for all subsequent lines, elevations, and measurements of the work executed under the Contract including without limitation, grading, utilities, culverts, manholes, structures, and other work. Establish all subsequent lines needed to accurately lay out and construct the work.

K. Temporary Working Points: Provide and maintain stakes, lines, bench marks, batter boards, and other temporary working points, lines, and levels. Construct temporary working points to be "permanent" during construction. Remove working points when they are no longer needed after obtaining Engineer's approval of removal prior to removal.

L. Deviations: Do not deviate from indicated lines and grades without the Engineer's written prior approval.

M. Engineer's Review of diversion structure and bypass system layout: After completion of subgrade preparation, and before continuing work, request Engineer's review and obtain Engineer's acceptance of layout.

N. Field Measurements and Discrepancies Between Field Conditions and Contract Documents: Before ordering materials and fabricated components, and before beginning work, verify actual field dimensions and locations. Take field measurements and ensure the complete and proper interface of all work.

1. Notification Required: If there are any discrepancies between the Contract Documents and the actual field conditions, notify the Engineer immediately in writing describing the discrepancy. Do not proceed until the discrepancy is resolved to the satisfaction of the Engineer.

2. Adjustment: If approved by Engineer, adjust work to actual field dimensions and conditions, and adjust work to ensure the complete and proper interface of all work at no change in Contract Amount.

3. Cost of Adjustment: The Contractor shall adjust and correct ill fitting work.

O. Adjustments: Make minor adjustments in layout as requested by the Engineer at no change in Contract Amount.

P. Change of Scope: If, in the Contractor's opinion, the Engineer's field instructions measurably and significantly increases or decreases the scope of work, the Contractor shall notify the SD, SD Representative, and Engineer in writing by a formal "Change Order Request" and obtain the SD's and Engineer's written authorization prior to implementing the field instructions.

Q. The Contractor shall determine the Limits of Work shown on the Drawings by accurate field survey and shall clearly mark the limits using plastic barrier fence per Section 015000 – Temporary Facilities and Controls, or other methods that are acceptable to the Engineer. Notify the Engineer a minimum of one (1) week prior to the start of work to review the marked Limits of Work. Adjust the limits as directed by the Engineer.

R. The Contractor shall be responsible for the correct location in plan and elevation of all excavation and filling, and all other construction indicated on the Drawings and as specified herein.

S. Finished grades, contours, and elevations indicated on the Drawings describe final surface elevations for completed construction unless indicated otherwise. Contractor shall be responsible for documentation of final as well as intermediate excavation grades. Survey after completion of the following construction activities or as otherwise described herein:

1. Final excavation limits in soil/sediment removal areas;

2. Excavation subgrade (i.e., the interface between the existing site soil remaining in place and placed fill) before placing imported fills;

3. Wetland restoration (subgrade elevation and final grading prior to planting);

4. Finish grades and final set elevation of the other structures/features shown on the Drawings.

T. On as-built plans, show all grade lines, constructed features, pre-existing and new utilities, property lines, and other relevant information. Certify that work is located as required by the Contract Documents. Deliver the survey to the SDs through the Engineer as a submittal pursuant to the closeout requirements described herein **(Submittal Group 4).**

U. Electronic Files for Survey Mapping - Survey data will be processed and documented onto an existing condition and as-built site plans by the Contractor. Mapping requirements include:

1. Prepare base map on Project Coordinate System and to scale using CAD software (AutoCAD 2008, or newer) illustrating the features surveyed. Submit the AutoCAD version to verify compatibility **(Submittal Group 3)**.

2. Basic CAD standards and layer naming convention:

a. Nothing shall be placed on layer “0”

b. All entities in the drawing shall be “Color by Layer”.

c. All entities in the drawing shall be “Linetype by Layer”.

d. All drawings shall include a North Arrow.

e. All drawings shall include a bar scale so the scale of the drawing is “graphically represented” when it is printed

f. Any Hatch patterns used in the drawing file shall not be exploded.

g. All drawings shall be to scale on the “Project Coordinate System” and shall include a note referencing the horizontal and vertical datum.

h. Any references files/base maps sent to or from the Engineer will use 0,0 as the insertion point

i. Layers names shall be easily identifiable as to what is on that layer (for example “BLDG” for layers with buildings is easily identifiable but something like “10” would not be). A list of layer names and a description of what is on that layer shall be provided by the Contractor.

j. Create PDFs “To Scale” and include a North arrow and a scale bar on the PDF.

3. Provide x,y,z coordinate file (comma-delimited) for benchmarks and other points.

1.09 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for final review by SD Representative.

B. Provide submittals to SD Representative required by authorities having jurisdiction.

C. Contractor shall survey in process and completed work as described in these specifications and provide submittal with all As-Built Drawings and documentation **(Submittal Group 4)**.

D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due. **(Submittal Group 4)**

1.10 FINAL CLEANING

A. The Contractor will provide final cleaning after final acceptance.

1. Contractor shall clean site; sweep paved areas, rake clean landscaped surfaces.

2. Contractor shall remove waste and surplus materials, rubbish, and construction facilities from site.

1.11 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Prohibit traffic on landscaped areas.

1.12 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.

2. Specifications.

3. Addenda.

4. Change Orders and other modifications to the Contract.

5. Reviewed Shop Drawings, Product Data, and Samples.

6. Manufacturer's instruction for assembly, installation, and adjustment.

B. Ensure entries are complete and accurate, enabling future reference by SD, SD Representative, and Engineer.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, on a daily basis.

E. Specifications: Legibly mark and record a description of actual products installed, including the following:

1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.

3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to ground surface datum and condition of subgrade.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Field changes of dimension and detail.

4. Details not on original Contract drawings.

G. Contractor shall submit documents to SD Representative and Engineer with claim for final Application for Payment **(Submittal Group 4)**.

1.13 MANUAL FOR MATERIALS, EQUIPMENT, AND FINISHES

A. Submit two copies of preliminary draft or proposed formats and outlines of contents. SD Representative will review draft and return one copy with comments. **(Submittal Group 2)**

B. Submit one copy of completed volumes. Draft copy be reviewed and returned after final inspection, with SD Representative comments. Revise content of document sets as required prior to final submission. **(Submittal Group 3)**

C. Submit two sets of revised final volumes in final form. **(Submittal Group 4)**

D. Building Products, Equipment, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom manufactured products.

E. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

F. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

G. Additional Requirements: As specified in individual product specification sections.

H. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.14 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Unless indicated otherwise herein, warranty period shall begin at the date of substantial completion of construction. Where warrantee items are subcomponents integrated into the overall construction shown on the Drawings, the date of substantial completion is the date of substantial completion of the overall construction of the comprehensive remedial component (e.g., the completion of the Halls Brook Diversion Structure, Bypass, and Cofferdam in HBHA Pond).

C. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

D. Verify documents are in proper form, contain full information, and are notarized.

E. Co-execute submittals when required.

F. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.

G. Submit prior to final Application for Payment **(Submittal Group 4)**.

H. Time Of Submittals:

1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 GENERAL

A. All work shall be surveyed by Massachusetts Licensed Registered Land Surveyor or Registered Civil Engineer, to ensure compliance with the specifications and Drawings. As-built drawings prepared by the Contractor shall be signed and stamped by the Contractor's Massachusetts Licensed Registered Civil Engineer.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 020000

EXISTING CONDITIONS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Prior to submitting a bid, the Contractor shall review and understand the information contained in the following documents:

1. 100% Design Submission for Industri-plex Operable Unit 2, dated _____, prepared by Haley & Aldrich, Inc. on behalf of the SDs.

2. 95% Design Submission for Industri-plex Operable Unit 2, dated 14 March 2014, prepared by Haley & Aldrich, Inc. on behalf of the SDs.

3. 30% Design Submission (30% Remedial Design Report, Industri-plex Operable Unit 2 (Including Wells G&H Operable Unit 3) Superfund Site, Woburn, Massachusetts), dated April 2012, prepared by Haley & Aldrich, Inc. on behalf of the SDs.

4. Remedial Design Work Plan, Industri-plex Operable Unit 2 (Including Wells G&H Operable Unit 3) Superfund Site, Woburn, Massachusetts," dated March 2011, prepared by Haley & Aldrich, Inc. on behalf of the SDs.

5. Remedial Design Work Plan for Industri-plex Operable Unit 2, dated April 2011, prepared by Haley & Aldrich, Inc. on behalf of the SDs.

6. Cover Certification Reports, Industri-Plex Operable Unit (OU) 1, Multiple reports on various dates describing, by parcel, the scope of the OU1 remedial action, such as limits of existing cover, source and conformance testing during construction, design changes, quality assurance, record drawings, and other information associated with existing features of the OU1 remedy. Prepared by Roux Associates, Inc. and Meridian Land Services, Inc. on behalf of the Industri-Plex Site Remedial Trust.

7. Draft Final Feasibility Study, dated June 2005, prepared by Tetra Tech NUS, Inc. for the United States Environmental Protection Agency (EPA).

8. Draft Final MSGRP Remedial Investigation Report, dated March 2005, prepared by Tetra Tech NUS, Inc. for the United States Environmental Protection Agency (EPA).

9. Baseline Human Health and Ecological Risk Assessment Report, Wells G&H Superfund Site Aberjona River Study, Operable Unit 3, Woburn, Massachusetts, dated September 2004, prepared by Metcalf & Eddy for the United States Environmental Protection Agency (EPA).

10. Preliminary Multiple Source Groundwater Response Plan Report, Industri-plex Site, Woburn, Massachusetts, dated August 1997, prepared by Haliburton NUS Corporation for United States Environmental Protection Agency.

11. Ground-water/Surface Water Investigation Plan, Phase 2 Remedial Investigation Draft Report dated May 29, 1992, prepared by Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, on behalf of the Industri-Plex Site Remedial Trust.

12. Ground-water/Surface Water Investigation Plan, Phase 1 Remedial Investigation Final Report dated June 7, 1991, prepared by Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, on behalf of the Industri-Plex Site Remedial Trust.

13. Such other documents including subsurface data, results of testing various media, and other relevant information incorporated into the Industri-plex Operable Unit 2 Administrative Record. See attached index for the Administrative Record dated January 31, 2006.

B. Prior to submitting a bid, the Contractor shall also review and understand the information contained in the following regulatory documents. These documents are made available to the Contractor by the SDs.

1. EPA, 2006. "Record of Decision: Industri-plex Superfund Site Operable Unit-2 (and Including Wells G&H Superfund Site Operable Unit-3, Aberjona River Study)," dated January 2006.

2. EPA, 2008. "Consent Decree-Appendix D: Final RD/RA Statement of Work, Industri-plex Operable Unit 2 (Including Wells G&H Operable Unit 3) Superfund Site," dated 27 February 2008.

C. The subsurface and environmental conditions information presented in these documents, as applicable, are for information only and shall not be interpreted as a warranty of subsurface or

environmental conditions whether interpreted from written text, test boring logs, test pits logs, chemical test results, or other data.

1.03 RELATED SECTIONS

A. SECTION 011100 – Summary of Work

B. SECTION 013529 – Health and Safety

C. Drawings

D. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. The Contractor shall expect to encounter existing and remnant utilities, foundations, granite blocks, brick and granite walls, boulders and other oversized materials, wood piles, and other buried structures during excavation.

B. The Contractor shall be aware that the Work described in the Contract Documents for Industri-plex OU2 overlaps portions of Industri-plex OU1. The Remedial Action for Industri-plex OU1 is complete. Industri-plex OU1 Cover Certification Reports referenced above indicate the limits of caps, covers, and other features constructed as part of the OU1 remedy. Any damage to existing OU1 remedy features shall by repaired at Contractor's sole expense.

C. Refer to Related Sections for conditions applicable to the scope of work outlined in those Sections.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

1.07 QUALIFICATIONS

A. The subsurface data are provided to the Contractor for information. The Contractor shall interpret said data according to the Contractor's own judgment and shall understand that subsurface conditions may differ from those recorded in the reports or as shown on the test boring logs, test pit logs, or other subsurface explorations. The subsurface data represents the conditions at the sampling location at the time of exploration only. SDs, SD Representative, or the Engineer shall not be liable for any error or discrepancy in the information provided.

1.08 SUBMITTALS

Not Used.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 023200

SAMPLING, TESTING, AND DATA EVALUATION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections of Division I - GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

G. The provisions specified in this Section may be subject to alterations by the Engineer or SD Representative based on actual field conditions encountered during the Work.

1.02 DESCRIPTION OF WORK

A. This Section provides procedures and requirements for sampling activities to be conducted by the Contractor during remediation.

B. The Contractor shall manage contaminated materials while sampling in a manner that ensures the protection of health, safety, public welfare, and the environment.

C. Unused samples shall be handled and disposed in accordance with the provisions of CERCLA and other applicable state and federal laws, as well as requirements imposed by approved transportation and disposal facilities.

D. The Contractor shall undertake the following work:

1. Preparing submittals.

2. Notifying Engineer and SD Representative when the Contractor is ready to collect samples.

3. Collecting samples, such as but not limited to surface water samples, dewatering system samples, sediment samples, soil samples, and proposed borrow source material samples.

4. Preparing paperwork such as but not limited to the Chain of Custody, Sample Tracking Log, and sampling record.

5. Transporting samples to laboratories for analysis. In cases where the Project Laboratory provides a courier service, arranging transportation and analysis of samples with said laboratory.

6. Obtaining and distributing sample results for review by the SD Representative and Engineer.

7. Such other ancillary activities in support of sampling performed to facilitate the Work.

1.03 RELATED SECTIONS

A. SECTION 013529 – Health & Safety

B. SECTION 020000 – Existing Conditions

C. SECTION 026113 – Excavated Soil and Materials and Management Plan

D. SECTION 310000 – Earthwork

E. SECTION 311100 – Site Clearing

F. SECTION 312319 – Construction Dewatering and Water Treatment

G. SECTION 312500 – Erosion and Sedimentation Controls

H. SECTION 327100 – Wetlands Restoration

I. Drawings

J. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. Refer to Section 020000 – Existing Conditions for information regarding site conditions.

B. The site is a Superfund site and is regulated by the United States Environmental Protection Agency (EPA) under CERCLA and by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Soil, sediment, and other media chemical data has been collected; onsite fill and natural soils are likely contaminated.

C. Available groundwater, surface water, soil, sediment and other chemical test data proximate to the Work Area are provided in the documents listed in specification Section 020000 – Existing Conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

B. Applicable quality assurance requirements associated with sample collection, handling, preservation, and analysis are described in the FSP, QAPP, and other RD and RAWP related documents incorporated by reference.

C. The Engineer or SD Representative will observe the Contractor's activities associated with the Work of this Section. The Engineer and SD Representative reserve the right to collect split or duplicate samples to verify results associated with samples collected by the Contractor. In the event of a discrepancy, the Engineer and SD Representative shall determine which test result prevails for decision-making purposes.

D. Additional samples shall be collected by the Contractor to satisfy the sample quality control and assurance requirements as described in the QAPP and FSP. Where field duplicates are collected to satisfy these requirements, the most conservative result shall prevail for decision-making purposes unless quality control information indicate one sample is more representative than the other, as determined by the Engineer or SD Representative.

E. Name samples in accordance with the sample naming nomenclature found in the QAPP.

1.07 SUBMITTALS

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. Sample Tracking Log. **(Submittal Group 3)** Prepare and update a comprehensive Sample Tracking Log for all samples collected during the Work. The Sample Tracking Log shall:

1. Be organized according to Work Area, media type, and other categories as determined by the Engineer and SD Representative to facilitate ease of review.

2. Utilize Microsoft Excel or other software approved by the Engineer or SD Representative to facilitate information exchange electronically.

3. Include at a minimum the following information: Work Area, sample location name, location coordinates relative to the project coordinate system, sample designation, sample matrix, sample description, sample type and purpose, test status, a “pass” or “fail” indication and decision made relative to the result, and other information deemed necessary to track progress as determined by the Engineer or SD Representative.

4. Be prepared and submitted by the Contractor in template form for the Engineers review. Once work generating samples begins, the Sample Tracking Log shall be updated daily and distributed to the Engineer and SD Representative for review.

C. Results Summary for Field Testing. **(Submittal Group 4)** For testing performed in the field by the Contractor using screening or other analytical tools, provide results in electronic format in accordance with the forms incorporated into the FSP and QAPP, or in another format acceptable to the Engineer. Provide results in a timely manner to facilitate decision making and progress.

D. General Sampling Information. **(Submittal Group 3)** Submit general sampling information to the Engineer for review.

1. Qualifications and experience of field personnel to be used on the project to collect samples.

2. Acknowledgement the Contractor has read and understands the requirements of this specification, including the documents incorporated by reference, such as but not limited to the FSP, QAPP, and other portions of the RAWP.

E. Final Documentation. **(Submittal Group 4)** At the conclusion of the Work, submit the final Sample Tracking Log and a complete set of laboratory data packages and reports consolidated into a single comprehensive submittal in accordance with project closeout procedures described in the specifications.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Provide personnel with personal protective equipment and clothing for sampling as described in the Contractor's Health and Safety Plan.

B. Sample collection equipment.

C. Decontamination equipment and materials to properly clean sample equipment.

D. Containers to collect decontamination materials for proper handling and disposition.

E. Sample Containers:

1. Order sample containers for testing at the Project Chemical Testing Laboratory, which will be supplied by the laboratory. Sample container orders must be placed through Project Chemical Testing Laboratory by submitting a list of sample parameters and matrices (Project Chemical Testing Laboratory will determine the appropriate sample containers based on information provided). All orders need to be placed prior to the day of sampling; small bottle orders (less than 30 samples) must be placed a minimum of

24 hours prior to expected delivery and large orders (more than 30 samples with two or more tests per sample) must be submitted a minimum of 72 hours prior to expected delivery.

2. Furnish appropriate sample containers for testing at laboratories other than the Project Chemical Testing Laboratory. Utilize containers acceptable to the testing laboratory for given test type.

F. Coolers, ice, and other equipment or materials needed to preserve sample integrity and representativeness.

PART 3 - EXECUTION

3.01 SAMPLE COLLECTION

A. Coordinate all work with the Engineer and SD Representative. The Contractor is responsible for sampling described herein. The Engineer and SD Representative retains the right to witness the work and perform additional sampling as needed.

B. Collect and submit for testing the following sample types:

1. Surface Water Samples: Surface water samples to be collected for chemical testing upstream and downstream of construction work areas to monitor water quality. Sample locations are shown on the Drawings. Refer to specification Section 312500-Erosion and Sedimentation Controls for parameters, test frequency, action levels, and mitigation requirements applicable to such surface water samples.

2. Construction Dewatering System Water Samples: Construction Dewatering and Water treatment samples to be collected for chemical testing to assess water quality and treatment effectiveness as outlined in Section 312319-Construction Dewatering and Water Treatment. Refer to Section 312319-Construction Dewatering and Water Treatment for locations, parameters, test frequency action levels, and mitigation requirements applicable to such samples.

3. Soil/Sediment Delineation and Post-excavation Verification Samples: Sediment delineation samples to be collected for chemical testing to confirm designated boundaries of excavations (shown on Drawings) are achieved and, in the event that excavation boundaries shown on Drawings expand based on the results of testing, that the final horizontal and vertical boundaries established through execution of the Work satisfy the Performance Standards (numerical cleanup criteria). Sample locations for the first round of post-excavation verification sampling are shown on the Drawings. Additional “step-out” verification samples may be necessary for further horizontal and/or vertical boundary delineation pending the results of the first round of verification sampling in a given excavation area. Refer to specification Section 026113 - Excavated Soil and Materials Management Plan for parameters and test frequency. Upon receipt of a “failing” test result for an excavation boundary and before additional soil/sediment removal is performed in the area, the Contractor shall consult with the Engineer and/or SD Representative to define an appropriate excavation step-out boundary and verification sample location that is acceptable to the Engineer and SD Representative.

4. Stockpile Testing: Samples to be collected for chemical testing of excavated materials in stockpiles or similar temporary storage, such as but not limited to roll-off containers, to

facilitate proper off-site disposal (for selecting and gaining acceptance at approved disposal facility). The samples will be collected at a frequency that will meet requirements of the potential disposal facility. Refer to specification Section 026113 - Excavated Soil and Materials Management Plan for parameters and test frequency.

5. Post-solidification Waste Characterization Samples: Soil/sediment samples to be collected for chemical testing to confirm stabilization of wet sediment or soil to achieve transportation and disposal facility requirements prior to shipment off site. Refer to specification Section 026113 - Excavated Soil and Materials Management Plan for parameters, test frequency, and solidification requirements applicable to such samples.

6. Borrow Source Pre-qualification: Samples of material for use as import fill must be sampled to pre-qualify the borrow source. Refer to Section 310000 Earthwork for parameters and test frequency, and other submittal requirements associated with materials to be imported to the site.

C. Follow requirements outlined in this and other specifications, Drawings, the FSP, the QAPP, the RAWP, and other related documents describing sampling.

3.02 SAMPLE TRANSPORTATION

A. Arrange a lab courier service at least 24 hours prior to sampling. Same day pick-up requests are not guaranteed. In the event the courier service is not available or other issues arise that affect sample shipment and delivery, the Contractor retains the sole responsibility for ensuring samples are delivered to the lab in acceptable condition prior to the expiration of any hold times.

B. Complete, review, and sign the Chain of Custody prior to samples leaving the site.

C. Complete Sample Tracking Log and other submittals as described herein.

3.03 SAMPLE ANALYSIS

A. Samples for chemical testing will be submitted to the Project Chemical Testing Laboratory, Alpha Analytical (Westborough, MA), for analysis. Payment will be appropriated by the Engineer or SD Representative for planned lab analyses and the cost for analytical testing is not to be carried by the Contractor.

B. The following On Time Performance (OTP) information for analyses performed by the Project Chemical Testing Laboratory is provided to the Contractor to forecast the lag time between sample collection and obtaining the results, as well as other uncertainties and considerations the Contractor must consider in planning execution of the Work. A Rush Turn Around Time (TAT) is NOT guaranteed. On Time Performance (OTP) for routine (i.e. “standard”) or rush sample results can be expected from the laboratory by 11:30 pm on the expected due date 80 percent of the time. The following should be considered when selecting a Turn Around Time (TAT):

1. TAT is expressed in normal business days (weekends and holidays are not considered business days).

2. Complex matrices, such as sediment, may require special preparation and cleanup procedures which may affect the expected TAT.

3. Non-aqueous samples with low percent solids may require freeze-drying prior to analysis. In cases where freeze-drying is necessary, the TAT may extend beyond the normal OTP expectation by at least one week.

    a. Freeze drying is to be completed through Alpha Analytical. The contractor should be aware that freeze drying is done in batches of 20 or 40 (depending on 4 oz vs 8oz jars) at a fixed price per batch. As such, the samples should be scheduled to maximize batch space without holding up the construction schedule.

    b. Percent total solids (TS) shall be analyzed prior to the COCs in order to inform the Contractor if sample COC results have the possibility of being rejected without freeze drying the sample first. If a sample has TS<30%, ND results will be rejected. If a sample has TS<10%, all results will be rejected. The Contractor will coordinate with the lab as needed so that COC analysis are completed either after initial TS results are found to be greater than 30% or after the samples are freeze dried.

4. Situations can arise in the processing of samples where specific quality control guidelines for processing analytical methods in Massachusetts dictate a re-extraction or re-analysis must be done. In cases where the re-extraction or re-analysis is required, the TAT may extend beyond the normal OTP expectation.

5. A Rush TAT must be preapproved by the lab prior to the samples arriving at the lab. If the lab is not notified of Rush TAT 24 hours (minimum) prior to sample arrival, the lab cannot guarantee compliance with the OTP expectation. Additionally, there are some methods that require significant preparation steps prior to analysis and therefore may not be available for accelerated (Rush) TAT, including but not limited to:

    a. Toxicity Characteristic Leaching Procedure (TCLP) or Synthetic Precipitation Leaching Procedure (SPLP) extraction for any method cannot be processed on 24 hour TAT

    b. Any analytical method/matrix requiring Soxhlet extraction cannot be processed in 24 hour TAT.

    c. Herbicides (method 8151) minimum TAT is 5 business days

C. Except where the method or other considerations described herein dictate otherwise, Rush TAT is considered one business day. Rush (one day) TAT is eligible for the following sample types described herein:

1. Surface Water Samples.

2. Construction Dewatering System Water Samples.

3. Soil/Sediment Delineation and Post-excavation Verification.

D. Standard TAT is ten business days. Since they typically can be planned for in advance, the following sample types described herein should be assigned standard TAT:

1. Stockpile Testing.

2. Post-solidification Waste Characterization Samples.

3. Borrow Source Pre-qualification.

The Contractor may request approval from the SD Representative to expedite TAT on the standard TAT sample types. If approved, the premium cost (the excess over the cost for standard TAT) for Rush TAT will at the Contractor's sole expense.

3.04 SAMPLE RESULTS AND DATA EVALUATION

A. Upon receipt of the test results, the Contractor shall update and distribute the Sample Tracking Log and provide test results to the SD Representative and Engineer for review. One of three potential outcomes, as determined by the Engineer, are anticipated:

1. Pass: The result is less than applicable criteria and no mitigation action related to that specific test result is needed.

2. Fail: The result exceeds a threshold and some additional measures are needed to address the exceedance.

3. Re-sample: in the event the sample integrity is compromised or the analytical test is invalid or rejected, additional sampling is needed.

B. The Engineer or SD Representative will notify the Contractor of the data evaluation outcome.

C. The Contractor is responsible for ensuring both the SD Representative and the Engineer receive copies of the laboratory data reports.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 026113

EXCAVATED SOIL AND MATERIALS MANAGEMENT PLAN

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections of Division I - GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or effected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall be aware that reportable concentrations of chemical constituents are present in the fill and natural soils at the site. The site is currently regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Management of contaminated soils and other media shall be conducted in accordance with the requirements herein and with a Remedial Action Work Plan to be submitted by the Engineer.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

H. Remediation derived waste and other excess soil, sediment, and other wastes to be disposed off-site will require the collection and analysis of adequate chemical testing data to satisfy disposal facilities testing requirements (analytes, frequency of testing, etc.). During the 30%, 95%, and/or 100% Remedial Design (RD) phases, samples were collected and analyzed to establish a preliminary determination whether certain materials may be hazardous waste or non-hazardous waste, as defined in Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Refer to the documents referenced in specification Section 020000 – Existing Conditions for available data. Such testing may need to be supplemented to facilitate a final waste characterization and profile approval at a designated hazardous or non-hazardous disposal facility. The SD Representative or Engineer will identify the list of parameters and test frequency necessary for a given disposal facility. The Contractor shall collect the waste characterization samples, submit samples to the Project Chemical Testing Laboratory for the analyses indicated by the SD Representative or Engineer, and provide results to the SD Representative and Engineer, as described in specification Section - 023200 Sampling, Testing, and Data Evaluation.

The SD Representative shall utilize this data to obtain acceptance of materials for disposal at receiving facilities.

I. Off-site waste disposal for material generated during Superfund site remediation under CERCLA (i.e., Industri-plex OU2) requires EPA "pre-approval" of the proposed disposal facility prior to off-site shipment in accordance with EPA's "off-site rule".

J. In addition to EPA, The SDs have "pre-approved" select disposal facilities for the waste destined for off-site disposal related to the Work described in the Contract Documents. The SD Representative will complete the appropriate waste profile paperwork on behalf of the SDs. The following are the pre-approved disposal facilities by waste type:

1. Non-hazardous Waste (Subtitle D Disposal): Turnkey Recycling and Environmental Enterprise (Waste Management of New Hampshire, Inc., TLR-III Refuse Disposal Facility) located in Rochester, New York. Contact information for coordinating transportation and disposal, as well as the minimum testing requirements are as follows:

   a. Contact Information: John Nadeau, Jr. District Manager, 603-330-2122
   Bill Howard, P.E., District Engineer, 603-330-2105
   Ellen Bellio, Technical Manager, 603- 330-2170

   30 Rochester Neck Road
   Rochester, NH

   Soil, sediment, debris, and other media: 1 sample per 250 tons or 1 sample per 500 tons with a minimum of 4 complete sample sets

   Soil, sediment, debris, and other media: Total RCRA-8 Metals, Total SVOCs, Total VOCs, Total PCBs, Total Pesticides/Herbicides, Reactivity, Corrosivity, Ignitability, and TCLP analysis is required for any results that exceed 20x the RCRA regulatory limit

2. Hazardous waste (Subtitle C Disposal): *(to be determined in subsequent submittals)*, located in *(to be determined in subsequent submittals)*. Contact information for coordinating transportation and disposal, as well as the minimum testing requirements are as follows:

   a. Contact Information: (*to be determined in subsequent submittals*

   Soil, sediment, and other media: Test Frequency (*to be determined in subsequent submittals)*

   Soil, sediment, and other media: Test Analytes (*to be determined in subsequent submittals)*

   Debris: Test Frequency (*to be determined in subsequent submittals)*

   Debris: Test Analytes (*to be determined in subsequent submittals)*

K. The provisions specified in this Section may be subject to alterations by the Engineer or SD Representative based on actual field conditions encountered during excavation activities.

1.02 DESCRIPTION OF WORK

A. This section provides procedures and requirements for excavated soil management activities to be conducted during excavation for the remedy components shown on the Drawings and summarized generally in specification Section 011100 – Summary of Work. This specification Section provides

procedures and requirements for excavated soil and material management. Material classification, stockpiling, on-site reuse, off-site transportation and disposal coordination, dust and odor control measures and contingencies are also included. The following Work shall be undertaken by the Contractor.

B. The following areas of the site and remediation-derived materials involve off-site disposal as described in the 100% Remedial Design:

1. West Hide Pile – Lower South Pond: Sediment in Lower South Pond exceeding the benzene cleanup standard.

2. Permeable Cap: Excess soil from permeable cap construction that cannot be reused on site to reach final lines and grades shown on the Drawings.

3. HBHA Pond (Surface Water Diversion/Management Structures): Sediment removed from the HBHA Pond to facilitate construction of the Halls Brook diversion and bypass structure and energy dissipation structures at the Atlantic Avenue Drainway (AAD) and Boston Edison Company (BECo) Drainway inlets to HBHA Pond.

4. HBHA Pond (Dredging): Sediment dredged from the HBHA Pond.

5. HBHA Pond (Secondary Treatment Cell Treatment System): TBD

6. HBHA Pond Outlet Structure

7. Wells G&H and Cranberry Bog Conservation Area (CBCA): Sediment in wetlands exceeding the arsenic and/or benzo(a)pyrene cleanup standard.

8. Excavated soil, sediment, and other media deemed unsuitable by the Engineer for on-site reuse during construction from all Work Areas.

9. Debris, including but not limited to, piping, asphalt, brick, and concrete (ABC) rubble, stumps, and vegetation, as well as solid wastes accumulated during the Work.

C. Excavation and coordinating legal off-site disposal/recycling of excess excavated material or material judged to be unsuitable for on-site reuse.

D. Temporary on-site storage of excavated materials is required and the material shall be stockpiled and covered in designated stockpile areas according to the procedures presented in this Section, on the Drawings, and as indicated by the SD's Representative and Engineer.

E. Manage contaminated materials encountered in the excavation in a manner that ensures the protection of health, safety, public welfare, and the environment.

F. Provide temporary lighting as needed to comply with state, federal, and local regulations.

G. Stockpile excess material generated by excavation within rolloffs or stockpiles acceptable to the Engineer.

H. The Contractor shall be prepared to segregate excavated materials as requested by the Engineer based on conditions observed during construction.

I. Take measures to suppress dust and odors, and to ensure that the stockpile does not create a public or environmental health hazard. Perform dust and odor control in accordance with Section 441123 – Construction Dust and Odor Control.

J. Perform soil sampling to facilitate chemical testing for waste characterization purposes as described in specification Section 023200 - Sampling, Testing, and Data Evaluation and described herein.

K. On-site treatment by solidification of wet material which fails the paint filter test, where required to facilitate legal off-site transportation and disposal and conform to receiving facility requirements.

L. Except where indicated otherwise on the Drawings, Specifications, or in the 100% Remedial Design, excavated material shall be stored on site and reused where possible. Main scenarios include:

1. Soils/Sediment/Debris Destined for Off-site Disposal – Materials exhibiting contaminant concentrations above the site cleanup standards where the remedy design involves excavation will be removed and disposed off-site as described in the Contract Documents and 100% Remedial Design.

2. Unsuitable for On-site Reuse - The Engineer will judge the acceptance of material for reuse on site. If materials cannot be reused, the Contractor will be informed of the need to stockpile, sample, and test material to gain acceptance at one or more of the pre-approved off-site disposal facilities. Segregate, stockpile, and crush/mechanically screen/process debris and rubble as needed to size material for facility acceptance.

3. Suitable for On-site Reuse - The Engineer will judge the acceptance of material for reuse on site. Segregate, stockpile, and mechanically screen/process for on-site reuse: existing fill, organic soils, and native soils where generated by site activities, including but not limited to: stripping of topsoil (uncontaminated areas only); pre-excavation/pre-clearing for ground improvement or foundations; and general earthwork activities for proposed buildings, structures, and utilities, to the extent practical and within the guidelines provided by this Section and Section 310 000 - Earthwork. Specific zones of reuse will also be dependent on geotechnical characteristics of the material described in the specifications and as shown on the Drawings. If soil reuse is not possible in the vicinity or at the time the excess material is produced, and the material is otherwise suitable for reuse in future on-site construction, soils must be temporarily stockpiled onsite in one or more lined and covered stockpiles, as deemed acceptable by the Engineer.

4. Additional information and requirements associated with on-site reuse is provided below.

M. Once the SD Representative has selected and gained acceptance of the waste from a “pre-approved” disposal facility, the SD Representative will provide the Contractor with the facility name and location, and confirm the contact information for the approved disposal facility. The Contractor will then be responsible for coordinating all pickups and deliveries of roll-off and other waste containers, and will be responsible for ensuring that soils/sediment and other wastes are properly prepared and loaded for offsite disposal.

N. Coordinate off-site transportation and disposal with the SD Representative, Engineer, and transportation and receiving facilities.

O. SD Representative will complete bills of lading, and review hazardous waste manifests for the SDs.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 033000 – Cast-In-Place Concrete

C. SECTION 310000 – Earthwork

D. SECTION 310519.13 – Non-Woven Geotextile

E. SECTION 310519.16 – Geomembrane

F. SECTION 310913 – Geotechnical Instrumentation

G. SECTION 312319 – Construction Dewatering and Water Treatment

H. SECTION 312500 – Erosion and Sedimentation Controls

I. SECTION 316216 – Steel Sheet Piles

J. SECTION 327100 – Wetland and Upland Restoration

K. SECTION 441123 – Construction Dust and Odor Control

L. Drawings

M. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

B. DEP: Commonwealth of Massachusetts Department of Environmental Protection.

C. EPA: United States Environmental Protection Agency

D. Health and Safety Procedures: 310 CMR 40.0018.

E. HAZWOPER: Hazardous Waste Operations and Emergency Response: OSHA Regulation 29 CFR 1910.120.

F. RCRA: Resource Conservation and Recovery Act

1.05 EXISTING CONDITIONS

A. Refer to Section 020000 – Existing Conditions for information regarding site conditions.

B. The site is a Superfund site and is regulated by the United States Environmental Protection Agency (EPA) under CERCLA and by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Soil, sediment, and other media chemical data has been collected onsite; onsite fill and natural soils are likely contaminated.

C. Site groundwater will require treatment prior to discharge as described in Section 312319 - Construction Dewatering and Water Treatment.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

B. The Engineer will observe the Contractor's activities associated with the Work of this Section. This observation will include, but not be limited to classifying soils for possible on-site reuse, stockpiling and handling of the excavated soils/sediments/debris to ensure public and environmental safety and proper off-site disposition.

C. The classification of excavated materials will be based on geotechnical and analytical data developed prior to construction; field observations during excavation and soil management activities; and supplemental field/laboratory analytical testing/screening conducted during construction by the Contractor, Engineer, or SD Representative.

D. The Contractor shall perform the excavation so as to segregate materials according to their classification. The Contractor shall be responsible for any cross-contamination and/or mixing of materials caused by the Contractor which requires additional segregation, stockpiling, material re-handling, testing, on-site treatment, off-site disposal, or other costs to the project. The Contractor shall perform activities to remediate the cross-contamination, to the satisfaction of the SD Representative, without cost or delay to the project.

1.07 SUBMITTALS

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. Review by the SDs Representative and Engineer shall not relieve the Contractor of the responsibility to conform to the requirement of this Section or satisfactory performance of sequences, treatment systems, or other details of the Work.

C. The Contractor is responsible for scheduling the submission of the required submittals and re-submittals to prevent delays in the Work.

D. The following materials must be submitted for approval by the SD's Representative and Engineer in draft form as **Submittal Group 1**:

1. A draft detailed narrative describing the construction sequence of the following: surveying and laying out limits and locations of Work and of the various materials, sequence for excavating and handling each material type, stockpiling procedures and plans, and reuse procedures.

2. A draft plan or plans supplementing the proposed construction sequences described in the narrative, including but not limited to, proposed stockpile locations of each material type, staging areas, reuse areas, etc.

E. The following materials must be submitted for approval by the SD's Representative and Engineer as **Submittal Group 2:**

1. A revised detailed narrative describing the construction sequence of the following: surveying and laying out limits and locations of Work and of the various materials, sequence for excavating and handling each material type, stockpiling procedures and plans, and reuse procedures.

2. A revised plan or plans supplementing the proposed construction sequences described in the narrative, including but not limited to, proposed stockpile locations of each material type, staging areas, reuse areas, etc.

3. The approach to relocate material to the soil stockpile management areas. In the event alternate means and methods from those shown on the Drawings and described in the Contract Documents are proposed, the Contractor shall submit a detailed description with drawings as needed indicating the components of the proposed material handling, stockpiling, and excavated soil dewatering system.

4. Estimated production rates by Work Area

F. The following materials must be submitted for approval by the SD's Representative and Engineer as **Submittal Group 3:**

1. The means and methods for blending cement or other solidification agents with wet sediment to ready the materials for loading and off-site disposal.

2. Plan for collecting supplemental waste characterization samples and temporary storage while awaiting results and final facility acceptance for the materials.

3. Name and qualifications of Contractor's personnel who will perform the on-site solidification, as well as coordinate off-site disposal with various disposal facilities and coordination of additional sampling and testing if required.

4. Mitigation measures to control site dust and odors should monitoring results exceed the specified Action Levels as stipulated in Specification Section 441123 – Construction Dust and Odor Control.

G. The Contractor shall submit all documentation, including, but not limited to, original s of completed Material Shipping Record & Log, Bills-of-Lading, or Uniform Hazardous Waste Manifests documenting transportation of contaminated media. The submittal shall also include weight slips for each load transported from the site to the disposal facility. **(Submittal Group 4)**

H. Completed, signed Bill of Lading Records (BWSC-012A and BWSC-012C) are required to be submitted to the DEP within 30 days of the last shipment of material to the receiving facility. The Contractor is responsible for providing completed forms with original signatures to the Owner's Representative for submittal to the DEP. Completed forms shall be provided to the Owner's Representative within 15 days after last shipment of material to designated receiving facility. **(Submittal Group 4)**

PART 2 - PRODUCTS

2.01 PERSONAL PROTECTIVE EQUIPMENT (PPE)

A. Provide personnel with personal protective equipment and clothing as described in the Contractor's Health and Safety Plan.

2.02 STOCKPILE/ROLLOFF/CONTAINMENT MATERIALS

A. Metal Rolloff – with a valved drain outlet and cover.

B. 16 oz/sq. yd. geotextile shall be Mirafi 1160N non-woven, needle-punched polyester or polypropylene product, as manufactured by TC Mirafi of Pendergrass, Georgia or approved equal. The physical properties of the geotextile shall meet the minimum requirements in Section 310519.13 – Non-Woven Geotextile.

C. 40 mil geomembrane shall be seam welded High Density Polyethylene (HDPE) to provide a continuous barrier, as described in specification Section 310519.16 - Geomembrane.

D. Stone and other materials as shown on the Drawings, in accordance with Section 310000 – Earthwork

E. Covers for stockpiles, including uncontainerized as well as stockpiles in rolloffs, shall be 20 mil (minimum) polyethylene.

F. Jersey Barriers for definition of work area and stockpile perimeter.

2.03 DUST CONTROL

A. See Specification Section 441123 – Construction Dust and Odor Control.

2.04 ODOR SUPPRESSANT

A. See Specification Section 441123 – Construction Dust and Odor Control.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to start of excavation, the Contractor shall identify, survey, and lay out approved stockpiling locations, excavation limits, the property limits adjacent to the work, and other features critical to performing the work.

B. The Contractor shall prepare and stage the stockpile/containment materials prior to performing excavation.

3.02 EXCAVATION

A. See Specification Section 310000 – Earthwork.

B. The Contractor shall excavate materials in a controlled manner by methods which will permit observation of exposed subsurface soils to identify, test, and segregate any soils/wastes and to eliminate the potential for mixing identified soil strata and/or contaminated soils with soils with less contaminated soils.

C. Conduct excavation to prevent cross-contamination.

D. Topsoil, various fills, organic deposits and naturally deposited inorganic soils shall be segregated from each other. Chemical group classifications shall be kept segregated from each other.

E. The Contractor shall excavate beyond the limits of the excavation, when directed by the Engineer, to remove localized areas of stained soil which indicate visual, olfactory or field screening evidence of contamination as judged by the SD's Representative or Engineer.

F. Segregate oversized and/or other deleterious materials from excavated soils prior to reuse, processing, or off-site removal as necessary to meet disposal facility acceptance criteria or as directed by the SD's Representative or Engineer. Segregation may consist of hand labor, mechanical screeners, or other methods.

G. Coordinate all work with the Engineer. Excavated soils will be monitored by the Engineer during the excavation. Soils will be monitored by the Engineer for visual and olfactory evidence of contamination, based on observed discoloration, texture, and odor. In addition, excavated material will be monitored with a photo ionization detector (PID) to screen for the relative concentration of volatile organic compounds (VOCs). Screening will occur in the excavation area (ambient) and will be periodically performed in the headspace of jar samples. Ambient PID readings will be periodically performed in the work zone and within 6 inches of the excavated material. The Contractor shall be prepared to segregate materials at any time during construction at the request of the Engineer.

3.03 TEMPORARY STOCKPILING OF EXCAVATED MATERIAL

A. Excavated soils shall be loaded into roll-offs on site or placed in designated soil stockpile areas for temporary stockpiling. The Contractor shall be prepared to segregate excavated materials at any time at the request of the Engineer.

B. Operate trucks, containers, and other equipment used for material handling on site with sufficient freeboard to avoid spillage during handling and transport to or from temporary stockpiling areas.

C. Roll-off containers shall be water tight (with an operating valved drain) and provided with a cover. Roll-off containers shall be water tight (with drain valve closed) for on-site handling and relocation to the stockpiling area. Sufficient freeboard shall be maintained inside the roll-off containers to avoid spillage during handling and transport. Roll-offs shall be water tight and covered for off-site transport purposes. Configure rolloff containers and other stockpiles to facilitate dewatering as shown on the Drawings or otherwise approved by the Engineer.

D. Stockpiles and roll off containers shall be securely covered at the end of each workday to prevent erosion or the emission of fugitive dust, odors, and gases.

E. Stockpiled soils, sediment, and other wastes to be disposed off site shall be sampled for waste characterization and facility approval purposes. Such sampling by the Contractor is described in specification Section 0 23200 - Sampling, Testing, and Data Evaluation and described herein. Coordinate with the SD Representative and Engineer regarding offsite disposal of waste generated during the Work.

F. Excavated material that requires additional chemical characterization for classification and offsite disposal shall be temporarily stockpiled separately. Stockpiles shall be separated by material type. Intermediate stockpiles shall be no larger than 250 cu yd.

G. The intermediate stockpiles shall be located away from the ongoing earthwork activity, pending the results of the laboratory analyses. Once the material is classified based on the results of the testing, the materials shall be moved directly into the earthwork area if suitable for on-site reuse or temporarily stored in stockpiles for future treatment (solidification) and off-site disposal. The Contractor shall coordinate his operations to avoid delays in the Work due to laboratory testing turnaround and review by

the SD's Representative. Stockpiled soils shall remain in intermediate stockpiles until the results of off-site laboratory analyses are reviewed by the SD's Representative.

H. Temporary stockpiles shall be placed on polyethylene sheeting, bermed, and securely covered with polyethylene sheeting. Stockpiles shall be shaped and graded to facilitate surface drainage. The Contractor shall take appropriate measures to control dust, odor, run-on, and run-off from stockpiles. Excavated material that requires additional chemical characterization for classification and offsite disposal shall be temporarily stockpiled. Stockpiles shall be separated by type.

I. All soil stockpiles shall be located as shown on Drawings or otherwise approved by the Engineer.

3.04 ON-SITE SOIL/SEDIMENT REUSE

A. In general, excavated soil or sediment that satisfies the following criteria can be reused onsite, subject to the Engineer's pre-approval:

1. The material is not the specific target of the remedial action (i.e., it is not part of a remediation area where excavation and off-site disposal is the selected remedy as designed).

2. Soil/sediment quality is suitable for the proposed destination, confirmed through additional sampling and analysis as necessary.

3. Such reuse will not harm the overall remedy effectiveness or integrity.

4. The material satisfies the geotechnical and other requirements of specification Section 312000 – Earthwork, Drawings, and other contract document requirements for the proposed destination and purpose.

B. It is anticipated that a relatively small amount of the total volume of excavated soils will be reused on site. The suitability for reuse will depend on physical characteristics as well as compliance with criteria and guidelines presented herein. The following lists candidate areas that may produce excess material for possible testing and on-site re-use, as well as supplemental conditions controlling reuse.

1. Clean stone imported to the site for use as temporary access roadway(s) that is removed as part of site restoration in a work area, provided the material is tested to ensure it was not contaminated by the work and otherwise satisfies the requirements described herein. Such material may be reused, stockpiled on-site for future use subject to the limitations described herein.

2. Excess material produced while excavating in the Halls Brook Diversion, Halls Brook Bypass Structure, and Halls Brook Holding Area (HBHA) Pond Outlet Structure to reach suitable subgrade in a given area or otherwise excavated to reach design subgrade elevations. Subject to the Engineer's pre-approval, such material could be placed below the armoring layer in a portion of the Halls Brook bypass as indicated on the Contract Drawings subject to the limitations described herein, and provided the materials meets all the applicable criteria described in these Contract Documents.

3. Soil excavated in the Permeable Cap area to reach design subgrade elevations for cap placement provided the excavated material is relocated to an area and placed beneath the permeable cap. These materials will not require testing (unless visual or olfactory evidence of contamination suggests the material differs from the anticipated contamination) since the material must be placed below the permeable cap.

4. These on-site re-use guidelines are based on the provisions that the materials do not exhibit obvious visual/olfactory evidence of contamination such as unusual odors or staining, or other field screening or laboratory testing evidence of contamination.

5. If materials are encountered that are potentially more significantly impacted, based on visual or olfactory observation, the Engineer will assess the conditions, determine if additional testing is needed, and judge acceptability for on-site reuse or off-site disposal. All materials considered for reuse must be able to be adequately compacted to meet geotechnical requirements.

C. Temporary stockpiles of material to be reused on site in the vicinity of the excavation ("active stockpiles") may be placed directly on the ground and covered with polyethylene at the end of each work day. Stockpiles shall be shaped and graded to facilitate surface drainage. The Contractor shall take appropriate measures to control dust, odor, run-on, and run-off from stockpiles. Additional erosion and sedimentation controls may be necessary. Stockpiles shall be separated by type.

D. Material temporarily stored on site for future reuse in another Work Area or stockpiled for an extended timeframe (e.g., "inactive stockpiles" staged for 5 days before material reuse), shall be placed on polyethylene sheeting, bermed, and securely covered with polyethylene sheeting. Stockpiles shall be shaped and graded to facilitate surface drainage. The Contractor shall take appropriate measures to control dust, odor, run-on, and run-off from stockpiles. Stockpiles shall be separated by type.

E. Material Prohibited from On-site Reuse, includes but is not limited to, the following:

1. The material derives from a remediation area where excavation and off-site disposal is the selected remedy as designed.

2. Hazardous waste, as defined in RCRA 40 CFR 261.

3. Solid wastes.

4. Plant waste.

5. Debris.

3.05 PRE-TREATMENT PRIOR TO OFFSITE DISPOSAL

A. Solidification: Solidification to Dewater/Improve Handling Characteristics

1. Wet sediment and other material excavated may require solidification to improve its handling characteristics and satisfy facility requirements prior to off-site transportation and disposal.

2. Refer to the 30%, 95%, 100% Remedial Design, Remedial Action Work Plan, the Drawings and specifications for additional information on existing bench-scale testing data to facilitate the Contractor's material dewatering plan, including but not limited to decanting needs, reagent dosing, and other relevant material handling and solidification information.

B. Onsite Treatment of Material Exhibiting the Toxicity Characteristic

1. Not Used.

3.06 COORDINATION OF TRANSPORTATION OF MATERIAL FOR OFFSITE DISPOSAL

A. The Contractor will be responsible for properly loading and preparing the waste container for offsite transport. Soils, sediments, and other wastes must be properly dewatered prior to shipping offsite. The Contractor shall be aware that soils must be sufficiently dewatered so as to pass the Paint Filter Test and any additional requirement specified by the transportation and receiving disposal facility.

B. The SD Representative shall provide the Contractor with the names and contact information for approved disposal facilities. It should be noted that EPA is required to pre-approve the proposed disposal facility prior to off-site shipment in accordance with EPA's "off-site rule". Once the waste is approved at a designated disposal facility, the Contractor shall be responsible for coordinating directly with the disposal facility to ensure timely pickups and deliveries of rolloff or other shipping containers. The Contractor shall notify the Engineer and SD Representative prior to offsite soil transport so that appropriate disposal paperwork is completed and filed in advance.

C. Materials removed from the site shall be loaded within the site limits. All trucks leaving the site shall be covered and cleaned of spilled debris that might fall from the trucks during transport. Soil and other material shall be removed from truck tires within a designated decontamination area prior to leaving the site. Every attempt shall be made to prevent debris from being spilled from trucks or tracked from the site onto local streets. Each workday the Contractor shall clean driveways, sidewalks, and local streets which contain site debris.

3.07 DUST, ODOR, AND GAS CONTROL AND MONITORING

A. The Contractor shall employ measures to minimize fugitive dust, odors, and gases during the demolition and construction. Dust and odor control measures shall be undertaken in accordance with Section 441123 – Construction Dust and Odor Control.

3.08 SITE AREA CONTROL

A. Operate trucks and heavy equipment to limit the tracking of site soils onto city streets and other public roadways.

B. Sweep streets in the vicinity of the site on a daily basis, or more frequently as necessary, during excavation activities.

C. Operate trucks and heavy equipment utilized for on site material handling to avoid spillage and cross-contamination from contaminated to clean areas. To the extent such spillage or cross-contamination occurs, the impacted materials will be remediated at the Contractor's sole expense.

D. At the determination of the SD Representative or Engineer, in the event that soils are tracked from the site, the Contractor shall install additional mud stops (gravel) and wheel washes at site exit locations.

3.09 CONTINGENCIES

A. If during the work, the presence of potentially hazardous conditions is evident, work in the area shall be terminated. These conditions include, but are not limited to, encountering buried containers, tanks, or drums.

B. The area shall be secured to prevent the existence of a health risk or release into the environment. The sources of the event causing the material to be considered suspect will be evaluated by the SD

Representative or Engineer. In the event that buried containers, drums or tanks are encountered or if a release of oil or potentially hazardous materials has occurred, the Contractor shall notify the SD Representative immediately. The SD Representative will notify the EPA RPM and Environmental Emergency hotline within the required reporting time period (EPA Region 1 Environmental Emergency Number: 1-800-424-8802). The Contractor shall notify the City of Woburn Fire Department and state Fire Marshal's office upon discovery of the tank or buried container. The Contractor shall also obtain permission for removal of buried storage tanks and coordinate with Fire Department inspectors.

C. While not currently identified as being present within the area of work, if asbestos containing materials (ACM) is encountered, the Contractor shall engage the services of a qualified asbestos abatement contractor to abate the asbestos containing materials (ACM) encountered by soil excavation. ACM building/facility components or source materials shall not be disturbed, removed, stockpiled, broken, or dismantled, except by the qualified asbestos abatement contractor. Handling and management of ACM shall be performed in accordance with Massachusetts Department of Environmental Protection's (MassDEP's) latest Asbestos in Soil policy and Bureau of Waste Prevention regulations.

D. The impact on the work should be evaluated and, if necessary, the Health and Safety Program implemented at the site (Section 013529 – Health and Safety) should be revised in response to the unforeseen conditions.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 310000

EARTHWORK

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Abbreviated Summary of Work

1. The Work of the Contract is indicated by the Contract Documents.

2. The Contract includes coordination of all Work indicated by the Contract Documents.

3. The Contract is unavoidably affected by governmental regulations, weather and natural phenomena, an access agreement with one or more land owners, and other forces and conditions not described in the Contract Documents.

B. General for All Work Areas

1. Contact “Dig Safe”: Comply with Massachusetts General Laws, Chapter 82, Section 40 and all applicable codes, rules, regulations. Do not begin any excavation without complying with the law. Ensure that all utilities have been located and marked prior to beginning any excavation work.

2. Submittal preparation.

3. Where applicable, coordinating work with the railroad, including training staff as required by railroad.

4. Where applicable, coordinating work with utility owners.

5. Site clearing and grubbing, including chipping of all above-grade woody plant materials and containerizing for off-site management. Segregate, stockpile, and containerize grubbed root balls for disposal by others.

6. Performing the required excavation and grading to establish access and material staging areas in the various Work Areas. Rough grading of onsite fill may be required.

7. Perform excavation, temporary filling, grading, and compaction as required to construct the temporary access roadways as indicated on the Drawings and as needed to facilitate material handling. Maintain access roads throughout the work. Remove earth materials placed for temporary access roadways when work is complete unless indicated otherwise.

8. Excavating material unsuitable as a bearing surface for the overlying or adjacent construction, to lines and grades determined in the field and acceptable to the Engineer.

9. Performing localized dewatering as required.

10. On-site material handling to and from temporary stockpiles.

11. Loading material into trucks and other suitable containers for off-site disposition.

12. Compacting fill as described herein and shown on the Drawings.

13. Excavating, stockpiling, and backfilling with onsite soils, as required during construction.

14. Placing fill soils, previously excavated soils, aggregate, riprap, erosion control blankets, geotextiles and other materials as shown on the Drawings.

15. Providing approved fill, as necessary, from off-site sources.

16. Installing and maintaining erosion and sedimentation controls.

17. Dust and odor control.

18. Performing final grading as required to achieve the elevations and lines indicated on the Drawings.

19. Protection of existing utilities, monitoring wells, and other site features.

20. Protection of completed work.

21. Performing other earthwork operations that are incidental to the Work and general items required by the Contract Documents.

C. West Hide Pile – Lower South Pond Sediment Removal Area

1. General items.

2. Installing and maintaining a stabilized construction entrance, a wheel wash decontamination pad, and new access roadway construction.

3. Earthwork needed to facilitate installation of a silt curtain and install and maintain temporary surface cofferdam (e.g., PORTADAM system), as needed.

4. Constructing a temporary Dewatering Effluent Treatment System (DETS) area. Removing earth materials placed for the temporary DETS when work is complete.

5. Constructing a temporary sediment stockpile management area. Removing earth materials placed for the temporary sediment stockpile management area when work is complete.

6. Mass sediment excavation, solidification (dewatering) of excavated sediments, and coordination of off-site disposal (following sediment dewatering).

7. Installing non-woven geotextile.

8. Backfilling excavation with clean import soil to pre-remediation grades and bathymetry.

9. Installation of a permeable reactive barrier consisting of activated carbon layer.

10. Site restoration, including wetland planting and upland restoration to restore the West Hide Pile cap system.

11. All other work indicated.

D. Permeable Cap System

1. General items.

2. Installing and maintaining a stabilized construction entrance and existing site entrance improvement, and a wheel wash decontamination pad. Construction of existing access road improvements.

3. Earthwork to facilitate installing and maintaining temporary surface water diversions (e.g. PORTADAM system and filter roll check dam), as needed.

4. Construction of a temporary excavated soil stockpile and water treatment area, and grubbed material stockpile area. Removing earth materials placed for the areas when work is complete.

5. Construction of a permeable cap system, including but not limited to, site clearing and grubbing, excavation to reach subgrade elevations, on-site material handling, temporary stockpiling as needed, placement and compaction of excavated and suitable on-site fill (below the cap), placement and compaction of clean import soil to construct the cap to the lines and grades shown on the Drawings.

6. Finish grading to facilitate site restoration.

7. All other work indicated.

E. Halls Brook Diversion Structure (Between Halls Brook Inlet and Bypass Stop Log Structure)

1. General items.

2. Construction of temporary access roadways.

3. Earthwork for temporary water diversion.

4. Performing local excavation as required for the installation of steel sheetpiling.

5. Earthwork to facilitate removal of abandoned piping, concrete slab, abandoned concrete manhole, existing instrumentation pad and fencing, steps, and other debris requiring removal to facilitate the Work.

6. Excavation to reach subgrades and installation of seepage cutoff around active sewer, stop log structure, and elsewhere as shown on the Drawings.

7. Excavation, fill placement and compaction to construct a permanent “baseflow” conveyance system, including box culvert, manhole, sluice gate, and related items.

8. Construction of a permanent, armored diversion channel, including but not limited to site clearing and grubbing, excavation to reach subgrade elevations, on-site material handling, temporary stockpiling as needed, geotextile installation, placement of excavated and suitable on-site fill, placement and compaction of clean import soil, installation or armor stone, mattress layers, and gabions to the lines and grades shown on the Drawings.

9. Excavation to facilitate concrete placement as shown on the Drawings.

10. Construction of a permanent crushed stone berm and sheet pile buttress with rip rap armor.

11. Finish grading for site restoration.

12. All other work indicated.

F. Halls Brook Bypass Structure, Primary-Secondary Cell Cofferdam and Weir, and Energy Dissipation Structures at AAD and BECo Inlets

1. General items.

2. Construction of temporary access roadways.

3. Earthwork needed for temporary water diversion.

4. Performing local excavation as required for the installation of steel sheetpiling.

5. Excavation of HBHA Pond sediment to construct flow control/energy dissipation structures at Atlantic Avenue Drainway and BECo Inlets. Stockpile and solidify wet sediments as needed to prepare the material for off-site disposal.

6. Excavation to facilitate concrete placement as shown on the Drawings.

7. Construction of a permanent, armored bypass channel, including but not limited to site clearing and grubbing, excavation to reach subgrade elevations, on-site material handling, temporary stockpiling as needed, geotextile installation, placement of excavated and suitable on-site fill, placement and compaction of clean import soil, installation or armor stone, mattress layers, and gabions to the lines and grades shown on the Drawings.

8. Placing geotextile and armor stone.

9. Finish grading for site restoration.

10. All other work indicated.

G. HBHA Pond Outlet Structure

1. General items.

2. Excavation and construction of a temporary outlet diversion channel. Performing localized dewatering as required. Installing temporary diversion pipes as a temporary HBHA Pond outlet where indicated and backfill as indicated on the Drawings.

3. Performing local excavation as required for the installation of steel sheetpiling.

4. Placing geotextile and imported material along the new steel sheetpiling as indicated on the Drawings.

5. Excavating, dewatering, and constructing a new trapezoidal outlet channel as indicated on the Drawings.

6. Removal of silt and debris from existing culvert on west side of limit of work and regrading at culvert outlet.

7. Excavating footings for permanent instrumentation platform and step installation.

8. Finish grading for site restoration.

9. All other work indicated.

H. Secondary Treatment Cell Water Treatment System and Related Components.

1. General items.

TO BE PROVIDED IN FUTURE VERSION OF THIS SPECIFICATION

I. Wells G&H and Cranberry Bog Conservation Area (CBCA) Wetland Areas

1. General items.

2. Installing and maintaining a stabilized construction entrance and temporary access roadway improvements. Temporary access roadway construction.

3. Earthwork needed to facilitate and install, and maintain temporary surface water diversion (e.g., PORTADAM system), as needed.

4. Constructing a temporary excavated soil stockpile and water treatment area. Removing earth materials placed for the temporary excavated soil stockpile and water treatment area when work is complete.

5. Constructing temporary sediment dewatering area. Removing earth materials placed for the temporary sediment dewatering area when work is complete.

6. Mass sediment excavation, solidification (dewatering) of excavated sediments, and coordination of off-site disposal (following sediment dewatering).

7. Installing non-woven geotextile.

8. Backfilling excavation with clean import soil.

9. Site restoration, including wetland planting and upland restoration to restore the areas impacted by the Work.

10. All other work indicated.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 026113 – Excavated Soil and Materials Management Plan

C. SECTION 033000 – Cast-In-Place Concrete

D. SECTION 310519.13 – Non-Woven Geotextile

E. SECTION 310519.16 – Geomembrane

F. SECTION 310913 – Geotechnical Instrumentation

G. SECTION 312319 – Construction Dewatering and Water Treatment

H. SECTION 312500 – Erosion and Sedimentation Controls

I. SECTION 312500 – Steel Sheet Piles

J. SECTION 313619 – Armor Mattress

K. SECTION 327100 – Wetland and Upland Restoration

L. SECTION 329000 – Planting, Turfs, and Grasses

M. SECTION 350140 – Temporary Water Diversions

N. SECTION 441123 – Construction Dust and Odor Control

O. Drawings

P. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See specification Section 014200 – References for acronyms and definitions applicable to this Section.

B. ASTM C127-12 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

C. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

D. ASTM D421-85(2007) – Standard practice for Dry Preparation of Soil Samples by Particle-Size Analysis and Determination of Soil Constants

E. ASTM D422-63(2007) – Standard Test Method for Particle-Size Analysis

F. ASTM D1140-00(2006) – Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-um) Sieve

G. ASTM D1556-07 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

H. ASTM D1557-12 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbf/ft^3 (2,700 $kN\text{-}m/m^3$))

I. ASTM D6938-10 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

J. Method 8260B – Volatile Organic Compounds by Gas Chromotography / Mass Spectrometry (CG/MS)

K. Method 8270C – Semivolatile Organic Compounds by Gas Chromotography / Mass Spectrometry (GC/MS)

L. Method 8081A – Organochlorine Pesticides by Gas Chromotography

M. Method 8082 – Polychlorinated Biphenyls (PCBs) by Gas Chromotography

N. Method 6010B – Inductively Coupled Plasma-Atomic Emission Spectrometry

O. Method 7470A – Mercury in Liquid Waste (Manual Cold-Vapor Technique)

P. Method 7471B – Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)

Q. Massachusetts Department of Transportation – Highway Division, “Supplemental Specifications to the Standard Specifications for Highways and Bridges”, 15 June 2012.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

B. Below-grade debris and obstructions may be present onsite. Debris and obstructions may include bricks, metal scraps, piping, tools, concrete, wood, and boulders.

C. Contaminated soils exist on site. The Contractor shall be responsible for the health and safety of all workers engaged in excavation, backfilling, grading, and other associated operations. Work shall be performed in accordance with the Contractor's Health and Safety Plan. See Section 013529 – Health and Safety for Contractor health and safety requirements.

D. Contractor shall conduct the Work in a manner that is protective of public health and safety. The Contractor shall control public access to the Work Areas and shall control the concentration of dust and odors at the Limit of Work perimeter. See Sections 015000 – Temporary Facilities and Controls and 441123 – Construction Dust and Odor Control for more information.

E. Contractor shall conduct the Work in a manner that is protective of surface water quality and wetlands. Contractor shall control erosion as specified in Section 312500 – Erosion and Sedimentation Controls.

F. The Contractor is advised that flow rates and water levels in Lower South Pond, Halls Brook, Halls Brook Holding Area (HBHA) Pond, HBHA Wetland, Atlantic Avenue Drainway (AAD), Boston Edison Company (BECo) Drainway, Aberjona River, and other waterbodies adjacent to the Work can vary widely over short periods of time in response to precipitation events and seasonal variations (prone to flash flooding conditions).

G. The Contractor is advised that much of the earthwork will take place in and adjacent to water bodies and wetland areas. These soils could exhibit poor trafficability and handling characteristics. The Contractor shall use specialized equipment and/or methods to perform the Work, as required.

1.06 QUALITY ASSURANCE

A. The Contractor’s quality control of earthwork operations will be monitored by the Engineer. During final stages of excavation, foundation construction, subgrade preparation, placement of working mats, and controlled filling operations, the Contractor shall provide sufficient notice to the Engineer prior to work and shall cooperate with the Engineer in all respects to facilitate any testing or observations required. The Contractor shall not place a layer of fill or foundations until the Engineer has approved the underlying subgrade surface (and underlying geotextile, where required). The Engineer will make such tests, in accordance with the methods specified below, as are deemed necessary to determine compliance with these Specifications. The Engineer will determine the suitability of earth materials for use in backfill.

1. Methods of Testing

   a. Moisture-Density Relationship: ASTM D1557

   b. In-Place Density: ASTM D1556 or D6938.

   c. Sieve Analysis: ASTM D421 or D422

d. Percent Passing No. 200 Sieve: ASTM D1140

e. Topsoil shall have soil fertility test performed (UMASS Agriculture Fertility Test).

2. Tolerances

a. For subgrades below proposed concrete structures, including the base flow culvert structure, armor mattress and sewer connection, base flow conduit inlet structure, sluice gate and manhole, stop log system and concrete gravity wall, and pond outlet structure trapezoidal channel, construct finished soil and backfill surfaces to plus or minus ½ inch of the elevations indicated on the Drawings.

b. For the Permeable Soil Cap Work Area where a cap is being constructed and other areas where the existing OU1 cap is present, disturbed during construction, and repaired, the minimum allowable thickness of the clean soil cover is 16 inches. In such areas, the tolerance on finished soil and backfill surfaces is plus two inches (2 in.) or minus zero inches (0 in.) of the elevations indicated on the Drawings.

c. For grading in areas not included in (a) and (b), construct soil and backfill surfaces to plus or minus 1/10-ft of the elevations indicated on the Drawings, unless otherwise indicated.

d. Maintain the moisture content of fill material as it is being placed within plus or minus two percent of the optimum moisture content of the material determined by the laboratory tests specified herein.

B. The Engineer will observe other aspects of construction including dewatering, installation of the temporary diversion structures, wetlands restoration, and erosion control.

C. All costs related to testing or replacement of non-conforming materials shall be paid for by the Contractor at no additional cost to the SDs, and the costs thereof will be deducted by the SDs from that due the Contractor.

D. All Work shall conform to the Drawings and Specifications and shall comply with applicable codes and regulations.

1.07 COORDINATION

A. As construction proceeds, the Contractor shall be responsible for notifying the Engineer at least three working days prior to the start of earthwork operations requiring monitoring and/or testing.

B. Contractor shall cooperate with the Engineer in obtaining field samples and conducting field testing. Furnish incidental labor, if necessary, in connection with the required sampling and testing.

C. Contractor shall control dust and odors such that perimeter air action levels are not exceeded (see Section 441123 - Construction Dust and Odor Control). Contractor shall modify Work practices, including (if necessary) stopping dust- or odor-producing activities, to control dust/odors and ensure air action levels are not exceeded at the request of the Engineer.

1.08 LINES AND GRADES

A. The Contractor shall be responsible for layout and survey control and establishing all elevations required based on the benchmarks indicated on the Drawings or other points acceptable to the Engineer. Layout and survey control requirements associated with the Work, as shown on the Drawings and described in these specifications, is described in Section 017000 – Preparation and Closeout Requirements.

1.09 SUBMITTALS

A. Submit to the Engineer the following information on the proposed source of imported fill materials (excluding AquaGate+PAC™): **(Submittal Group 2)**

1. Location of the borrow source site. Include street (if applicable), city, state, and contact telephone number for source site information.

2. Present and past usage of source site and material;

3. Any existing site assessment reports evaluating the presence of oil and hazardous material at the source site.

4. Any change in source throughout the Work requires prior approval by the Engineer.

5. Contractor shall sample and submit for chemical testing at the Project Chemical Testing Laboratory the suite of chemical tests listed in this section on all proposed fill materials from off-site sources, with the exception of stone, riprap, and AquaGate+PAC™, and submit results at least two weeks prior to delivery to the site to confirm the borrow source is acceptable. The cost for sampling is at the Contractor's expense (see specification Section 023200 – Sample, Testing, and Data Evaluation). The cost for testing one candidate borrow source by material type at the Project Chemical Testing Laboratory shall be by the SDs. In the event test results for the first borrow source fails to meet the project requirements or additional borrow sources for a particular material type are needed, the cost of additional sampling as well as testing source quality will be by the Contractor. The Contractor shall provide the Project Chemical Testing Laboratory's final reports to the Engineer for review. At a minimum, laboratory reports/deliverables shall include sample chain of custody forms, analytical results, QC summaries and supporting raw data from instrument printouts sufficient to support validation of the analytical data as described in the Quality Assurance Project Plan (QAPP) included with the Remedial Action Work Plan (RAWP) and 100% Remedial Design. The testing suite shall consist of the following:

a. Volatile Organic Compounds SW-846 Method 8260B;

b. Semi-Volatile Organic Compounds SW-846 Method 8270C;

c. MADEP Extractable Petroleum Hydrocarbons (EPH), (adjusted carbon ranges only);

d. Pesticides SW-846 Method 8081A;

e. Polychlorinated Biphenyls (PCBs) SW-846 Method 8082;

f. Trace Metals SW-846 Method 6010B; and

g. Mercury SW-846 Methods 7470/7471.

For each type of off-site soil material, one suite of the above tests with Massachusetts RCS-1 reporting limits shall be performed at least two weeks prior to delivery to the site, and thereafter for each 5,000 cubic yards of the material imported to the site.

B. For each type and source of proposed imported fill or crushed stone, the Contractor shall deliver to the Engineer one 5-gallon pail with secured lid - sample for quality control testing. For each type and source of riprap, the Contractor shall deliver to the Site an approximate 150-lb sample. All samples shall be clearly labeled as to the project, source of the material, intended use and date of sample delivery. **(Submittal Group 3)**

C. Record Drawings **(Submittal Group 4)**

1. The Contractor shall submit to the SD Representative a set of as-built drawings in accordance with Section 017000 – Preparation and Closeout Requirements.

D. Product Information **(Submittal Group 3)**

1. For Specialty Material AquaGate+PAC™, provide manufacturer cut sheet, handling, installation, manufacturer certification of the material as defined herein, and related product information.

PART 2 - PRODUCTS

2.01 EARTH MATERIALS

A. Common Fill: Common Fill shall be naturally occurring mineral soil, well-graded and free of trash and all organic soils and materials, weak, compressible, and frozen materials. It shall be of such nature and character that it can be readily spread and compacted and shall be free of expansive materials (such as highly plastic clays), and of materials subject to decay, decomposition, or dissolution. Common fill shall contain no stone larger than three (3) in. in maximum dimension.

B. Onsite Fill: Onsite Fill shall be existing onsite fill including rubble and topsoil, organic soil, and miscellaneous material.

C. Processed Gravel (MHD M1.03.1): Processed gravel shall consist of inert material that is hard durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials. The material shall be the result of processing by mechanical means and shall be stockpiled in such a manner to minimize segregation of particle sizes. All processed gravel shall come from approved stockpiles. The gradation shall meet the following requirements:

Sieve Designation	Percent Passing
3 in.	100
1-1/2 in.	70 - 100
3/4 in.	50 - 85
No. 4	30 - 60
No. 200	0 - 10

D. Granular Fill: shall consist of clean, gravelly sand or sandy gravel free of organic material, loam, trash, snow, ice, frozen soil or other objectionable material. This material should be well graded within the following limits:

Sieve Size	Percent Finer by Weight
6 in.	100
No. 4	30 - 80
No. 40	10 - 50
No. 200	0 - 8

E. Dense-graded Crushed Stone: Dense-graded crushed stone shall conform to MHD M2.01.7. Dense-graded Crushed Stone shall consist of a well-graded material produced by combining crusher run coarse aggregate and fine aggregate consisting of natural or crushed sand. The coarse aggregate shall consist of angular fragments of hard, durable stone, produced by crushing solid or shattered rock. The composite material shall be free from clay, loam, and other deleterious materials, and shall conform to the following requirements:

Sieve Designation	Percent Passing
2 in.	100
1-1/2 in.	70 - 100
3/4 in.	50 - 85
No. 4	30 - 55
No. 50	8 - 24
No. 200	3 - 10

F. Sand Borrow shall be as specified in MHD M1.04.0, Type a. Sand Borrow shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay, surface coatings, fly ash, and deleterious materials. The allowable amount of material passing the No. 200 sieve as determined by ASTM D422 shall not exceed 10 percent by weight. The maximum particle size for Sand Borrow shall be 1/4 inch.

G. Crushed Stone: Crushed Stone shall consist of one or the other of the following materials:

1. Durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock, and free from a detrimental quantity of thin, flat, elongated or other objectionable pieces. A detrimental quantity will be considered as any amount in excess of 15 percent of the total weight.

2. Durable crushed gravel stone obtained by artificial crushing of boulders or fieldstone with a minimum diameter before crushing of 8 in.

The Crushed Stone shall be reasonably free from clay, loam and deleterious material. Not more than 1.0 percent of satisfactory material passing a No. 200 sieve will be allowed to adhere to the Crushed Stone. The Crushed Stone shall be uniformly blended according to the grading requirements for the respective stone sizes shown in the following table:

	2-in. Crushed Stone (No MHD spec)	**3/4-in. Crushed Stone (MHD M2.01.4)**	**1/2-in. Crushed Stone (MHD M2.01.5)**	**1/4-in. Crushed Stone (MHD M2.01.5)**
Sieve Designation	Percent Passing			
2-1/2 in.	100			
2 in.	95 - 100			
1-1/2 in.	35 - 70			
1 in.	0 - 25	100		
¾ in.	0 - 5	90 - 100		
5/8 in.			100	
1/2 in.		10 - 50	85 - 100	100
3/8 in.		0 - 20	15 - 45	85 - 100
No. 4		0 - 5	0 - 15	20 - 50
No. 8			0 - 5	0 - 15
No. 16			0 - 5	0 - 5

H. Riprap: Riprap shall be hard, durable, angular shaped stones that are the product of crushing, blasting, or ripping. Rounded stone, boulders, sandstone and similar soft stone or thin slabs are not acceptable. Riprap shall be free of soil, organics and other deleterious materials, and shall have a minimum specific gravity of 2.60 as determined by ASTM C 127. Riprap shall have a maximum of 50 percent abrasion loss as determined by the methods of ASTM C 131.

1. Light Riprap shall consist of MHD M2.02.4, Modified Rockfill and shall be graded within the following limits:

Size of Stone	Percent Finer by Weight
8 in.	95 - 100
4 in.	0 - 25
2-1/2 in.	0 - 5

2. Medium Riprap shall consist of MHD M2.02.3, Stone for Pipe Ends. Each stone shall weigh not less than 50 pounds, not more than 125 pounds, and at least 75 percent of the volume shall consist of stones weighing not less than 75 pounds each. The remainder of the stones shall be so graded that, when placed with the larger stones, the entire mass will be compact.

3. Heavy Riprap shall consist of MHD M2.02.2, Dumped Riprap and shall be graded within the following limits:

Size of Stone	Percent Finer by Weight
400 lb	100
300 lb	80
200 lb	50
25 lb*	10

* No more than 5 percent by weight shall pass a 2-in. sieve.

I. Stone Riprap for Filter Mattress Armoring. Stone for filling Filter Mattresses may be crushed stone. The stone shall be durable and of suitable quality to ensure suitable performance in the Mattresses and the climate at the work site. Stone shall be free from cracks, seams, and other defects that would tend to increase its deterioration in the Mattresses. The inclusion of objectionable quantities of dirt, sand, clay, and rock fines shall not be permitted. Stone for filling Filter Mattresses shall be a well-graded mixture with the following gradation:

Sieve Designation	Percent Finer by Weight
3 in.	100
2-1/2 in.	90 - 100
2 in.	35 - 70
1-1/2 in.	0 - 15
¾ in.	0 - 5

J. Sand and Gravel Stream Liner: Stream Liner shall consist of a mixture of gravel and coarse sand. The gravel shall be hard, durable, rounded or sub-rounded in shape and resistant to weathering. Angular shaped stones or crushed material will not be accepted. Sand and Gravel Stream Liner shall meet the gradation shown below. It is anticipated that MHD Gravel Borrow with the minus No. 10 material removed will meet the gradation for Sand and Gravel Stream Liner.

Sieve Designation	Percent Passing
3 in.	100
2 in.	50 - 100
1 in.	40 - 100
½ in.	28 - 65
No. 4	14 - 40
No. 10	0 - 5

K. Topsoil/Loam Borrow: Topsoil/Loam Borrow shall be as specified in MHD M1.05.0, and shall also have a pH between 5.8 and 7.0. Loam Borrow shall consist of a fertile, friable, natural topsoil, without admixture of subsoil, refuse, or other foreign materials, and shall be obtained from a well-drained arable site.

L. Wetland Organic Soil: Wetland Organic Soil shall consist of a highly decomposed organic material containing at least 12 percent organic carbon content by weight. To meet this standard, wetland soils shall be produced by amending natural loam with leaf mold at a ratio of 50 percent soil to 50 percent organic material by volume, or equal. The resulting soil mix shall be free of stones, stumps, large sticks, shrubs, the seeds and roots of exotic/invasive plants, or other litter. The Wetland Organic Soil mix shall be tested to confirm that it meets the minimum 12 percent organic carbon content. Earth materials used for wetland restoration, including but not limited to, wetland organic soil, loam, leaf mold, shall not be harvested from an area that contained invasive species plant parts (seed, rhizomes, etc.) or contain any materials with invasive plant parts present. To the extent on-site wetland organic soil is re-used on site for restoration, such on-site re-use of material shall require conformance with the composition requirements described herein.

M. Specialty Material: AquaGate+PAC™: Aquagate+PAC™ is a composite-aggregate technology resembling small stones comprised of a dense aggregate core, clay or clay-sized materials, polymers, and fine-grained activated carbon additives as manufactured by AquaBlok, Ltd., 3401 Glendale Avenue Suite 300, Toledo, OH 43614, Tel. 800-688-2649.

1. Aggregate – Nominal AASHTO #8 (1/4-3/8”)

2. Clay – Bentonite or montmorillinite derivative

3. Powdered Activated Carbon (PAC):

   a. 10% by weight addition/formulation

   b. Iodine Number 800 mg/g (minimum)

   c. Gradation
      1) 99% (minimum) through 100 mesh sieve
      2) 98% (minimum) through 200 mesh sieve
      3) 90% (minimum) through 325 mesh sieve

4. Binder – Cellulosic polymer

5. Permeability – $1x10^{-1}$ to $1x10^{-2}$ cm/sec.

6. Dry bulk density – 70-90 lbs/ft^3

2.02 GEOTEXTILE, GEOMEMBRANE, AND EROSION CONTROL BLANKET

A. Geotextile and erosion control blanket shall be placed within the limits indicated on Drawings or as directed by the Engineer. The limits indicated on the Drawings will be adjusted in the field by the Engineer, depending on the actual limits of excavation during construction and other field conditions.

B. Geotextile and erosion control blanket shall consist of the type and grade indicated on the Drawings, or equal products approved by the Engineer. Geotextiles shall be placed in accordance with Section 310519.13 – Non-Woven Geotextile. Erosion control blanket shall be placed in accordance with Section 312500 – Erosion and Sedimentation Controls

C. Geomembranes shall be furnished and installed where shown on the Drawings or otherwise specified in the Contract Documents in accordance with Section 310519.16 – Geomembrane.

D. Geotextiles shall consist of the following (see Drawings for limits of each material).

   1. Mirafi 140N or approved equal

   2. Mirafi 180N or approved equal

   3. Mirafi 1160N or approved equal

E. Erosion control blankets shall consist of the following (see Drawings for limits of each material):

   1. North American Green Bionet C125BN or approved equal

   2. North American Green Bionet SC150BN or approved equal

   3. North American Green Bionet S75BN or approved equal

F. Geomembrane shall consist of the following (see Drawings for limits of each material):

1. GSE Lining Technology Inc., High Performance GSE HD Textured 40 mil or approved equal

2. GSE Lining Technology Inc., High Performance GSE HD Textured 60 mil or approved equal

G. Sediment control filtration rolls shall consist of the following (see drawings for limits):

1. North American Green SediMax-FR (Filtration Rolls) or approved equal

2. North American Green Coir Rolls or approved equal

3. North American Green SediMax-SW (Straw Wattles) or approved equal

PART 3 - EXECUTION

3.01 EXCAVATION

A. General Requirements

1. The Contractor shall excavate soil in accordance with the sequence of work outlined in Section 011100 – Summary of Work and Section 013000 - Administrative Requirements (describing the Contractor's Construction Sequencing Plan as accepted and reviewed by the Engineer).

2. Excavation shall include the removal of all materials encountered including earth, organic soils, boulders, pavement, slabs, demolition debris, walls, foundations, incidental structures, and other materials.

3. Excavation of rock, as defined previously, is not anticipated to be necessary. Boulders shall be classified as rock when in excess of 3 cubic yards in general excavation, but only when removed through the use of explosives. It does not include materials that can be removed by means other than drilling and blasting or drilling and wedging, but which, for reasons of economy in excavation, the contractor prefers to remove with explosives.

4. Excavated material shall be stockpiled onsite and dewatered in accordance with Section 026113 – Excavated Soil and Materials Management Plan.

5. The Contractor shall control the grading such that ground is pitched to prevent water from running to excavated areas, damaging structures or leaving the work area. The Contractor shall ensure that grading is undertaken such that abutting properties are protected from flooding.

6. Construction dewatering shall be undertaken in accordance with Section 312319 – Construction Dewatering and Water Treatment.

7. Where soil has been softened, eroded by flooding, or placement during unfavorable weather, frozen, or otherwise disturbed, it shall be removed and replaced with suitable material at no additional cost to the SDs.

8. Exercise care to preserve materials below and beyond the lines of excavation. Where excavation is carried out, through Contractor error, below indicated grade or beyond the lines of excavation or as directed by the Engineer, backfill to the indicated grade and compact with acceptable material at no additional cost to the SDs, and at the direction of the Engineer.

9. The Contractor shall shore, brace and/or slope excavations in compliance with OSHA requirements. The Contractor shall be solely responsible for maintaining Site safety in accordance with OSHA and other applicable regulations, including Massachusetts 520 CMR 14.00 and "Jackie's Law"

10. The responsibility for providing a site and excavation "competent person", as defined by OSHA, shall rest on the Contractor.

11. Restore any altered wetland resource areas impacted by erosion from Contractor's work to prior conditions at no cost to SDs.

3.02 HAULING WITHIN LIMITS OF WORK

A. Equipment

1. Trucks transporting saturated material shall be designed to contain the material and not allow the release of materials to roadways. Truck bodies shall be as watertight as practicable by initial design or supplement modifications, such as gasketing of tail gates.

2. Trucks transporting soil, rock, or sediment shall be equipped with covers that are secured at multiple points to the vehicle body to prevent contents from becoming airborne or otherwise leaving the truck during transport.

B. Routing

1. Vehicles leaving the limits of work shall be cleaned of soil, and public roadways shall be maintained as required by Section 441123 – Construction Dust and Odor Control.

3.03 FILL PLACEMENT AND COMPACTION

A. Requirements

1. Place and compact fill to the limits, of the material types, and in the manner as specified herein and shown on the Drawings. Unless otherwise specified or directed by the Engineer, material used for fill and backfill shall meet the material requirements specified under Part 2 – PRODUCTS.

2. Protect functioning utilities, structures and pipes from damage during backfilling operations. If damaged, repair at no additional cost to the SDs.

3. The Contractor shall maintain and protect all overhead, surface, and subsurface utilities during construction activity.

4. The Contractor shall maintain and protect all structures, pavements and fences during construction activity.

5. If excessive weaving or instability is observed during compaction, as judged by the Engineer, compaction efforts shall be discontinued until the subgrade is stabilized.

6. Compaction by puddling or jetting is prohibited.

7. Control groundwater and surface run-off to minimize disturbance of material being placed. Slope fill surfaces at the end of each day to provide for free surface drainage.

8. Placement of fill shall not begin before observation and approval of subgrade conditions by the Engineer.

9. All materials shall be placed in-the-dry on subgrades acceptable to the Engineer. The Contractor shall dewater excavated areas as required to perform the work in such a manner as to preserve the undisturbed state of the approved subgrade and maintain proper moisture content of the fill soils.

10. Do not place fill on frozen ground unless approved by the Engineer.

11. Do not place frozen fill unless approved by the Engineer.

12. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of a day's operations.

B. Compaction Equipment and Lift Thickness

1. Compaction equipment used in open areas where space permits shall consist of single or double drum vibratory rollers weighing at least 14,000 pounds, or similar equipment approved by the Engineer. Place fill in loose lifts not exceeding 12 in. when using vibratory drum compactors. The Contractor will be given the option of demonstrating to the satisfaction of the Engineer in the field the ability to compact lift thickness up to 18 inches, loose measure.

2. In confined areas, compaction equipment shall consist of hand-guided equipment such as vibratory plate or vibratory drum compactors. Place fill in loose lifts not exceeding 6 in. when using hand guided equipment.

3. A minimum of four (4) systematic passes of the approved compaction equipment is required, unless otherwise indicated herein.

4. If the required compaction is not achieved, the Contractor shall apply additional passes, use heavier equipment, reduce lift thickness, and/or adjust moisture content as needed to achieve the minimum specified compaction.

5. The Engineer reserves the right to disapprove compaction equipment being used if it is judged to be unsuited or inadequate to compact materials to the specified densities and within a reasonable length of time.

C. Compaction Requirements:

1. All compaction requirements are based on ASTM D1557.

2. Additional compaction requirements for specific areas are as follows:

Area	Materials	Minimum Number of Coverages	Minimum Percent Compaction
Subgrade for Concrete Outlet Channel, Stop-Log Structure, Box Culvert, Sluice Gate Manhole, and any other structure	Granular Fill, Dense Graded Crushed Stone, or Existing Soils if Suitable	5	98%
Stone backfill surrounding temporary diversion structure or for bedding layers at Sediment Management Areas and Construction Entrances	Crushed Stone	4	95%
Along steel sheet piles	Light Riprap	No compaction required	---
Wetland restoration areas, other loamed areas	Wetland organic soil, loam borrow	No compaction required	---
Permeable Cover	Common Fill	4	95%
Existing Access Road Improvement and Temporary Access Roads	Dense Graded Crushed Stone	4	95%

If not otherwise indicated on the Drawings or in the Specifications, the minimum percent compaction shall be 92 percent of ASTM D1557 with a minimum of four (4) coverages, unless otherwise required by the Engineer.

3. Moisture Control

a. If the fill is too dry for proper compaction, water shall be added to increase the moisture content, as necessary for proper compaction. If the fill is too wet for proper compaction, the material shall be processed or conditioned so that it can be compacted.

b. No fill material shall be placed, spread or rolled during weather conditions that prevent the Contractor from maintaining the moisture content of the fill such that the minimum compaction requirements are achieved.

c. All corrective work or operations necessary to achieve and maintain proper moisture control of fill materials shall be at the sole expense of the Contractor.

4. Protection of Fill

a. The Contractor shall take the steps necessary to avoid disturbing subgrade soils and previously placed fill during excavation and filling operations. Methods of excavation and filling operations shall be revised as necessary to avoid disturbing of subgrade and previously placed fill, including restricting the use of certain types

of construction equipment and their movement over sensitive or unstable materials, dewatering, and other acceptable control measures.

b. All excavated or filled areas distorted during construction, all loose or saturated soil, and other areas that do not meet compaction requirements as specified herein shall be removed and replaced with suitable materials. Costs of removal of these materials and replacement shall be borne by the Contractor.

D. Excavation, Trenching, Pipe Bedding, and Backfill

1. The Contractor shall provide temporary support to existing subsurface utilities as approved by the respective utility companies and to other facilities adjacent to or crossing through excavation at no additional cost to the SDs.

2. Trenches shall be of sufficient width for installation of pipe and utilities, and compaction of backfill materials.

3. The bottoms of trenches shall be shaped to provide uniform bearing and support of pipes and utilities.

4. Install dewatering systems, as necessary, such that the trench is continually and effectively drained.

5. Loose, saturated or otherwise unsuitable material in the bottom of the trench shall be removed and replaced with suitable fill if required by the Engineer.

6. Open trenches shall advance no more than 50 ft ahead of installed pipe. All open trenches shall be backfilled at the end of each working day.

7. Place all bedding, filter fabric and backfill in accordance with the Drawings and these Specifications. Compact all bedding and trench backfill materials to the specified density. All pipe bedding and backfill shall be placed in dry conditions.

8. Do not backfill trenches until tests and observations have been made and backfilling authorized by the Engineer. Use care in backfilling to avoid damage or displacement of pipe system.

E. Wetland Restoration/Replacement Areas

1. Wetland Organic Soil shall be placed within the wetlands restoration areas to the lines and grades shown on the Drawings or as determined by the Engineer during construction in accordance with Section 327100 – Wetlands Restoration.

F. Riprap Installation

1. Place riprap on filter fabric using methods that will not damage the fabric.

2. Dumping of the riprap at the top of the slopes and rolling or pushing into place, or other means of placement which may result in damage to the filter fabric or segregation of the various sizes of stone, will not be permitted.

3. Should damage occur to the fabric during Riprap placement, carefully remove the Riprap and make repairs to the fabric in accordance with the manufacturer's recommendations. Make such repairs at no additional cost to the SDs.

4. Large stones shall be well distributed and the entire mass of stones in their final position shall be roughly graded to conform to the gradation specified. Finished riprap shall be free from pockets of small stones and clusters of larger stones.

G. Armor Mattress and Gabion Installation

1. Refer to specification Section 313600 – Armor Mattress, Gabions, and Specialty Armoring.

3.04 DECONSTRUCTION OF TEMPORARY STRUCTURES

A. Unless otherwise indicated, at the conclusion of the Project, deconstruct the temporary access roadways, sediment dewatering areas, and temporary Dewatering Effluent Treatment System (DETS) areas. Remove fill soils and temporary structures as shown on the Drawings and in accordance with Section 015000 – Temporary Facilities and Controls. Place and compact previously excavated soils or imported fills in order to achieve finished grades as indicated on the Drawings or to restore the area to pre-construction grades for site restoration (where applicable).

3.05 STOCKPILE MANAGEMENT

A. Soils shall be stockpiled and dewatered in accordance with Section 026113 – Excavated Soil and Materials Management Plan.

3.06 MANAGEMENT OF CONSTRUCTION EQUIPMENT

A. Construction equipment shall be removed from Work Areas that are adjacent to or formerly were resource areas at the end of each workday. Equipment shall be staged at the location indicated on the Drawings.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 310519.13

NON-WOVEN GEOTEXTILE

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The Contractor shall install all geotextiles, utilizing personnel or subcontractor thoroughly qualified and experienced in the installation of geotextiles.

B. The work of this section shall include, but not be limited to, placement of the geotextile in areas identified on the Drawings.

1.03 RELATED SECTIONS

A. SECTION 015000 – Temporary Facilities and Controls

B. SECTION 020000 – Existing Conditions

C. SECTION 033000 – Cast-In-Place Concrete

D. SECTION 310519.16 – Geomembrane

E. SECTION 310000 – Earthwork

F. SECTION 313613 – Gabions

G. SECTION 313619 – Armor Mattress

H. SECTION 327100 – Wetland and Upland Restoration

I. Drawings

J. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

B. FHWA – Federal Highway Administration

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

B. Responsibilities and Qualifications:

1. Manufacturer: Responsible for the production of geotextile rolls and will be a well-established firm with more than 2 years experience in the manufacture of geotextiles. Submit a statement listing certified minimum average roll values of the proposed geotextile and the tests used to determine those properties as described herein.

2. Installer: Responsible for field handling, storing, deploying, seaming or connecting, anchoring, and other site aspects of the geotextile installation.

C. Quality Assurance Program: Agree to participate in and conform with all items and requirements of the quality assurance program as outlined in this Specification.

D. General Requirements: Geotextile rolls will be tested and evaluated prior to acceptance. Manufacturing Quality Control (MQC) testing of the geotextile will be conducted by Manufacturer. The Engineer or a designated, independent geosynthetics testing laboratory will perform additional Conformance Testing to verify that the geotextile meets the specifications.

E. Manufacturing Quality Control (MQC)

1. Sampling and testing of the geotextile material will be conducted by Manufacturer to demonstrate that the material conforms to the requirements in Part 2 – Products of this Section.

2. Collect samples on sacrificial portions of the material, such that repair of the material is not required.

3. Samples that do not meet the specified properties shall result in rejection of the applicable rolls.

4. At Manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify the noncomplying rolls and/or to qualify individual rolls.

1.07 SUBMITTALS

A. Requested information shall be submitted to the Engineer in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. Manufacturer's Certification. **(Submittal Group 3)** On the basis of the results of the tests performed by either the Manufacturer's laboratory or another outside laboratory with which Manufacturer has contracted at its sole cost and expense, Manufacturer will provide a written certification that the supplied geotextile meets the requirements outlined in this Specification.

C. The Contractor shall obtain from the Geotextile Manufacturer, submit to Engineer, and have available the Geosynthetics Installer's inspection, the following documentation on the geotextile production: **(Submittal Group 3)**

1. Manufacturing quality control certificates for each batch of resin and each shift's production. The certificates shall identify the origin of the resin and the manufacturer of the resin. The certificates shall be signed by responsible parties, such as the production manager employed by the manufacturer.

2. The quality control certificate shall include:

   a. roll numbers and identification;

   b. sampling procedures; and,

   c. results of quality control tests, including a description of the test methods used.

3. Geotextile Manufacturer's quality control tests to be performed as outlined in this Section.

4. Geotextile Supplier's certification that the material properties meet or exceed the values specified in Table 310519.13-1 and that the geotextile products will (a) retain their structure during handling, placement, and long-term service and (b) be capable of withstanding direct exposure to sunlight for a minimum of 14 days for polypropylene (PP) geotextiles, or 28 days for polyester (PET) geotextiles, and yet retain 70 percent of specified strength properties.

5. Geotextile Supplier's certification that the geotextiles are needle free.

D. A minimum of 21 days prior to shipping any geotextile to the site, the Contractor shall obtain from the Geotextile Manufacturer, submit to Engineer or Engineer's independent geosynthetics testing laboratory for conformance testing, samples of material for conformance testing as described herein. **(Submittal Group 3)**

E. The Contractor shall obtain from the manufacturer and the Geotextile installer, and provide the same to the SD Representative, a written 20-year warranty to the benefit of the SDs, against defects in the material, in-ground durability, and in the workmanship of the installed geotextile. **(Submittal Group 4)**

F. Should the Contractor select a geotextile not specified below in Part 2 – Products, or specified on the Drawings, the Contractor shall submit all manufacturers product specifications and test results for the chosen geotextiles to the Engineer at least 21 days prior to the time the geotextile will be required on site. **(Submittal Group 3)**

PART 2 - PRODUCTS

2.01 GEOTEXTILE PROPERTIES

A. The Contractor shall furnish materials whose "Minimum Average Roll Values", as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria specified in Table 310519.13-1.

B. The products shall be nonwoven geotextiles manufactured from continuous filaments or staple fibers. Products shall be needle punched. All needles shall be removed from the product.

2.02 PACKING AND LABELING

A. Geotextiles shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.

B. Each geotextile roll shall be marked or tagged with the following information:

1. Manufacturer's name;
2. Product identification;
3. Lot number;
4. Roll number; and,
5. Roll dimensions

2.03 TRANSPORTATION

A. In accordance with Section 310519.13, Part 3.1.

B. Geotextile material shall be delivered to the site at least 7 days before planned date of deployment.

2.04 HANDLING AND STORAGE

A. In accordance with Section 310519.13, Part 3.1

B. Geotextile shall not be dragged along the ground. The Contractor shall use slings, or a pole which extends a minimum of 1 foot beyond each end of the roll, to handle each roll. Geotextile rolls shall be stored off the ground and protected from ultraviolet exposure and weather conditions.

2.05 CONFORMANCE TESTING

A. Geotextile performance requirements are listed on Table 310519.13-1.

B. As a minimum, the following conformance tests will be performed for each geotextile product: mass per unit area, grab strength, tear strength; puncture strength, burst strength, apparent opening-size, porosity, and flow-rate tests.

C. Any geotextiles that are not certified in accordance with this Section, or that conformance testing indicates do not comply with this Section, will be rejected by the Engineer. Replacement of the rejected material shall be made with materials which comply with project requirements, at no additional cost to the SDs.

2.06 PRODUCTS

A. 4 oz./sq. yd. geotextile shall be Mirafi 140N non-woven, needle-punched polyester or polypropylene product, as manufactured by TC Mirafi of Pendergrass, Georgia, or equal. The physical properties of the geotextile shall meet the minimum requirements of Table 310519.13-1.

All geotextile properties are minimum average roll values (i.e., the test results for any sampled roll in a lot shall meet or exceed the minimum values in the table).

B. 8 oz./sq. yd. geotextile shall be Mirafi 180N non-woven, needle-punched polyester or polypropylene product, as manufactured by TC Mirafi of Pendergrass, Georgia or approved equal. The physical properties of the geotextile shall meet the minimum requirements of Table 310519.13-1.

All geotextile properties are minimum average roll values (i.e., the test results for any sampled roll in a lot shall meet or exceed the minimum values in the table).

C. 16 oz./sq. yd. geotextile shall be Mirafi 1160N non-woven, needle-punched polyester or polypropylene product, as manufactured by TC Mirafi of Pendergrass, Georgia or approved equal. The physical properties of the geotextile shall meet the minimum requirements of Table 310519.13-1.

All geotextile properties are minimum average roll values (i.e., the test results for any sampled roll in a lot shall meet or exceed the minimum values in the table).

D. Geotextile Properties

Table 310519.13-1
Geotextile Specifications(1)

Geotextile Property	Test Method	Property Required		
Mass per unit area	ASTM D5261	4 oz./sq. yd.	8 oz./sq. yd.	16 oz./sq. yd.
Apparent Opening Size (U.S. Sieve)	ASTM D4751	No. 70 or larger	No. 80 or larger	No. 100 or larger
Permittivity (1/second)	ASTM D4491	1.8 minimum	1.2 minimum	0.7 minimum
Grab Tensile Strength (lb.)	ASTM D4632	120 minimum	205 minimum	380 minimum
CBR Puncture Strength (lb.)	ASTM D6241	310 minimum	500 minimum	1,025 minimum
Trapezoid Tear (lb.)	ASTM D4533	50 minimum	80 minimum	140 minimum
UV Stability (4)	ASTM D4355	70% after 500 hrs. exposure	70% after 500 hrs. exposure	70% after 500 hrs. exposure
Seam Strength (lb./in.)	ASTM D4884	N/A	N/A	N/A

NOTES:
1. All values represent minimum average roll values (i.e., the average test results from any roll in a lot should meet or exceed the values in this table with the exception of AOS which is a maximum average roll value).
2. One per production lot, or not more than 100,000 ft^2, whichever is smaller.
3. One per 100,000 ft^2 lot for conformance testing.
4. Provide certification and test results of UV stability on geotextiles made from polymer of same formulation.
5. Except as noted: Manufacturer's quality control per Note 2 and conformance testing per Note 3.
6. Test all factory, fabrication, and/or field seams at one per 1,000 lineal feet of seam.

PART 3 - EXECUTION

3.01 HANDLING AND PLACEMENT

A. In accordance with this section, all geotextiles shall be handled in a manner intended to prevent damage to the geotextile. The Contractor shall be liable for all damages to the materials incurred prior to the final acceptance of the system by the SD Representative.

B. Precautions shall be taken to prevent damage to underlying layers during placement of the geotextile.

C. After unwrapping the geotextile from its opaque cover, the geotextile shall not be left exposed for a period in excess of 14 days for PP geotextile or 28 days for PET geotextile. Materials uncovered more than 15 days shall be tested for strength within 2 days prior to covering. The results of the tests will be evaluated by the Engineer prior to covering. Non-conforming materials will be removed and replaced at no cost to the SDs.

D. If white colored geotextile is used, precautions shall be taken against "snowblindness" of personnel.

E. Care shall be taken not to entrap stones, excessive dust, or moisture in the geotextile during placement.

F. All geotextiles shall be anchored with ballast during windy conditions. Such ballast shall be installed during placement and shall remain until the geotextiles are suitably weighted with other components of the liner system.

G. The Contractor or Geosynthetics Installer (whichever installs the geotextile) shall examine the surface to be covered with geotextile to ensure that no potentially harmful foreign objects are present below the geotextile. Surface shall be smooth, compacted, and free of stones greater than ½ inch dimension. Following deployment of the geotextile, the deployed surface shall be examined to ensure that no potentially harmful foreign objects are present in the geotextile. Foreign objects shall be removed and damaged geotextile shall be replaced at no additional cost to the SDs.

3.02 SEAMS AND OVERLAPS

A. For geotextiles installed in channels or other waterways subject to flowing water lay geotextile panels in a “shingled” pattern or pattern otherwise acceptable to the Engineer.

B. Permeable Cap and Repairs to Existing Operable Unit 1 Cap System

1. All geotextile seams for the Permeable Cap construction, as well as repairs to existing Operable Unit 1 Cap System where existing seams are sewn, shall be continuously sewn whenever possible, overlapping of seems may be allowed only with the Engineers approval. The overlap shall extend 3-feet in all directions from the tear, edge, hole or opening being covered to maintain the continuity of the cover. Spot sewing is not allowed. Seams shall be prayer or flat seams. All seams shall be formed by mating the edges of the geotextile panels and sewing them together with continuous stitches located a minimum of three inches from the edges. Seams shall be located up and down (not across) slopes.

2. Polymeric thread, with chemical resistance properties equal to or exceeding those of geotextile, shall be used for all sewing. The seam type shall be a two-threaded, type 401k double-lock. The Contractor shall demonstrate the seam efficiency meets the project specification. The thread shall have a distinctly different color from that of the geotextile.

C. Other Non-Woven Geotextile Applications Across the Site

1. Overlap adjacent geotextile panels a minimum of 12 inches.

3.03 GEOTEXTILE RUN-OUT ON SLOPES

A. At the tops of slopes, the Contractor shall install the geotextile with at least a 10-ft run-out laterally beyond the top of the slope, unless otherwise approved by the Engineer. The geotextile shall be installed such that no panel end seams are included in the run-out length.

3.04 REPAIR

A. Any holes or tears in the geotextile shall be repaired as follows:

1. On slopes steeper than 10 horizontal to 1 vertical, a patch made from the same geotextile shall be double seamed into place with each seam 0.5 in apart and no closer than 1 in. from any edge. Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced with new material.

2. On slopes flatter than 10 horizontal to 1 vertical, a patch made from the same geotextile shall be continuously sewn in place with a minimum of 2 foot overlap in all directions.

B. Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile.

3.05 PLACEMENT OF OVERLYING MATERIALS

A. The Contractor shall place all materials overlying the geotextile, starting from the bottom of the slope and proceeding to the top of the slope, in a manner such that:

1. The geotextile and underlying materials are not damaged;

2. Minimum slippage occurs between the geotextile filter and underlying layers during placement; and,

3. Excess stresses are not induced in the geotextile.

B. Equipment shall not be driven directly on the geotextile. Care shall be taken to prevent sudden stops or changes in direction which could stress or damage the geotextile or other work. Unless otherwise specified by the Engineer, all equipment operating on material overlying the geotextile shall comply with the requirements defined in Table 310519-2.

TABLE 310519.13-2
Equipment Ground Pressure and Clearance Requirements

Allowable Equipment Ground Pressure (psi)	**Thickness of Overlying Compacted Fill (ft)**
<5	0.5
5 to 10	1.5
10 to 20	2.0
>20	3.0

3.06 PRODUCT PROTECTION

A. The Contractor shall use all means necessary to protect all prior work and materials and completed work of other Sections of the Specifications.

B. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary, to the approval of the Engineer, at no additional cost to the SDs.

3.07 FIELD QUALITY CONTROL

A. The Engineer will perform onsite observation of non-woven geotextile placement. The Contractor shall provide sufficient notice to the Engineer prior to the planned Work to allow the Engineer to be present at the location of the Work.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 310519.16

GEOMEMBRANE

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The CONTRACTOR is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The ENGINEER should be notified of the presence of potentially hazardous conditions, if encountered.

F. The CONTRACTOR shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The CONTRACTOR shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Furnish and install High Density Polyethylene (HDPE) geomembrane as specified herein, as shown on Contract Drawings, and in accordance with MANUFACTURER's recommendations.

1.03 RELATED SECTIONS

A. SECTION 015000 – Temporary Facilities and Controls

B. SECTION 020000 – Existing Conditions

C. SECTION 310519.13 – Non-woven Geotextile

D. SECTION 310000 – Earthwork

E. Drawings

F. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

B. Definitions

1. Lot: A quantity of resin (usually the capacity of one rail car) used in the manufacture of geomembranes. Finished geomembrane roll will be identified by a roll number traceable to the resin lot used.

2. The Remedial Design Engineer (ENGINEER): The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

3. Geomembrane Manufacturer (MANUFACTURER): The party responsible for manufacturing the geomembrane rolls.

4. Geosynthetic Quality Assurance Testing Laboratory (GEOSYNTHETICS TESTING LABORATORY): Accredited by Geosynthetic Accreditation Institute's-Laboratory Accreditation Program (GAI-LAP). Party, independent from the OWNER (SETTLING DEFENDANTS), ENGINEER, CONTRACTOR, MANUFACTURER**, and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing. There may be multiple GEOSYNTHETICS TESTING LABORATORIES involved in geosynthetic testing in support of the Work; in such cases the party to whom is responsible for hiring or arranging for the testing will be provided as a prefix (e.g., "MANUFACTURER's" GEOSYNTHETICS TESTING LABORATORY, "OWNER's" GEOSYNTHETICS TESTING LABORATORY, etc.)

   NOTE** If the MANUFACTURER has an in-house geosynthetic testing laboratory accredited by Geosynthetic Accreditation Institute's-Laboratory Accreditation Program (GAI-LAP) they intend to use for manufacturer's quality control testing performed in accordance with this specification, the MANUFACTURER and CONTRACTOR shall submit documentation of intent and accreditation in writing to the ENGINEER as part of the submittal process.

5. INSTALLER: Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.

6. OIT: Oxidative Induction Time

7. Panel: Unit area of a geomembrane that will be seamed in the field that is larger than 100 sq. ft.

8. Patch: Unit area of a geomembrane that will be seamed in the field that is less than 100 sq. ft.

9. Subgrade Surface: Soil layer surface which immediately underlies the geosynthetic material(s).

10. SETTLING DEFENDANTs (SDs): The parties defined elsewhere in the specifications who are the OWNER. The SDs have secured the services of a Project Coordinator, who act as the SD's REPRESENTATIVE.

C. American Society for Testing and Materials (ASTM)

1. D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting

2. D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

3. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique

4. D 1603 Test Method for Carbon Black in Olefin Plastics

5. D 3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry

6. D 4218 Standard Test Method for Determination of Carbon Black in Polyethylene Compounds

7. D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

8. D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

9. D 5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

10. D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

11. D 5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes

12. D 6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

13. D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

14. D 7240 Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)

D. Geosynthetic Research Institute

1. GRI GM 13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. See Specification Section 014000 – Quality Requirements for information regarding Quality Assurance.

B. Responsibilities and Qualifications:

1. CONTRACTOR

a. Prepares submittals.

b. Subcontracts with the INSTALLER, unless the CONTRACTOR has sufficient experience and qualifications to self-perform geomembrane installation pursuant to the specifications.

c. Purchases materials from MANUFACTURER.

d. Other tasks necessary for successful geomembrane installation.

2. MANUFACTURER

a. Geomembrane shall be manufactured by the following:
1) GSE Lining Technology, LLC
2) Approved equal

b. Shall have a minimum of five (5) years continuous experience in the manufacture of HDPE geomembranes.

c. MANUFACTURER shall have manufactured a minimum of 5,000,000 square feet of polyethylene geomembrane during the last year.

d. Certify minimum average roll values of the proposed geomembranes and provide the test results by laboratory used to determine those properties as described herein.

e. Supply geomembrane to the project.

3. INSTALLER

a. Installation shall be performed by one of the following installation companies (or approved equal)
1) GSE Lining Technology, LLC
2) GSE Approved Installers

b. INSTALLER shall have a minimum of five (5) years continuous experience in the installation of HDPE geomembranes including at least 500,000 square feet of similar installations.

c. Responsible for field handling, storing, deploying, seaming or connecting, anchoring, and other site aspects of the geomembrane installation.

d. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

e. The INSTALLER shall provide a minimum of one Master Seamer for work on the project. Must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for the use on this Project.

1.07 SUBMITTALS

A. Requested information shall be submitted to the ENGINEER in accordance with the information outlined in Specification Section 013300 – Submittal Procedures.

B. MANUFACTURER's and INSTALLER's documentation of experience. **(Submittal Group 3)** Submit evidence and references for at least two similar projects of equal or greater square footage construction within the last five (5) years. Demonstrate that personnel (including Master Seamer) have experience and competency to perform the work.

C. Documentation of GEOSYNTHETICS TESTING LABOTRATORY accreditation (GAI-LAP). **(Submittal Group 3)**

D. Submit Warranty. **(Submittal Group 4)**

1. Material shall be warranted, on a pro-rata basis against MANUFACTURER's defects for a period of five (5) years from the date of geomembrane installation.

2. Installation shall be warranted against defects in workmanship for a period of one (1) year from the date of geomembrane completion.

E. MANUFACTURER's Certifications - **(Submittal Group 3)** On the basis of the results of the tests performed by either the MANUFACTURER's GEOSYNTHETICS TESTING LABORATORY or another outside GEOSYNTHETICS TESTING LABORATORY with which MANUFACTURER has contracted at its sole cost and expense, submit the following for each.

1. Resin - Certification and test results signed by an authorized representative of the MANUFACTURER, showing the resin specifications and results of required quality control tests on the material furnished to the project. Resin used in geomembrane furnished to the project must meet the required resin material test values indicated in Part 2 of this Section. Certificate shall include:

a. name of accredited GEOSYNTHETICS TESTING LABORATORY;

b. sampling procedures;

c. results of quality control tests, including descriptions of the test methods used; and

d. Statement certifying no recycled polymer and no more than 10 percent rework of the same type of material is added to the resin (product run may be recycled).

2. Geomembrane Rolls - Certification and test results signed by an authorized representative of the MANUFACTURER, showing that geomembranes furnished to the project meet the minimum required material test values indicated in Table 310519.16-1. Certificate shall include:

a. name of accredited GEOSYNTHETICS TESTING LABORATORY;

b. roll numbers and identification;

c. sampling procedures; and

d. results of quality control tests, including descriptions of the test methods used.

F. Submit MANUFACTURER's installation recommendations. **(Submittal Group 3)**

G. The INSTALLER shall furnish the following information to the ENGINEER **(Submittal Group 3)**:

1. Installation layout drawings.

a. Must show proposed panel layout including field seams and details.

b. Must be approved prior to installing the geomembrane.

2. Approved drawings will be for concept only and actual panel placement will be determined by site conditions.

3. INSTALLER's Geosynthetic Field Installation Quality Assurance Plan.

H. The INSTALLER or CONTRACTOR will submit the following to the ENGINEER upon completion of installation: **(Submittal Group 4)**

1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents.

2. Material and installation warranties.

3. As-built drawings showing actual geomembrane placement and seams including typical anchor trench detail.

I. During the installation, the CONTRACTOR shall be responsible for daily submission to the ENGINEER of:

1. Daily reports of previous day's inspection findings and field test results of geosynthetic materials placed, including all non-destructive and destructive membrane seam tests and locations of all tests. **(Submittal Group 4)**

2. During installation, submit seam samples and test results to ENGINEER as specified in Part 3 of this specification.

1.08 MATERIAL LABELING, SHIPPING, DELIVERY, STORAGE AND HANDLING

A. Labeling - Each roll of geomembrane delivered to the site shall be labeled by the MANUFACTURER. The label will identify:

1. MANUFACTURER's name.

2. Product identification.

3. Thickness.

4. Length.

5. Width.

6. Roll number.

B. Shipping - The geomembrane rolls shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the INSTALLER.

C. Delivery - Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

D. Storage - The on-site storage location for geomembrane material, provided by the CONTRACTOR to protect the geomembrane from punctures, abrasions and excessive dirt and moisture must have the following characteristics:

1. Level (no wooden pallets).

2. Smooth.

3. Dry.

4. Protected from theft, vandalism, puncture, cutting, or other damaging or deleterious conditions.

5. Adjacent to the area being lined, where possible.

6. In accordance with any additional requirements of the MANUFACTURER.

E. Handling - Materials are to be handled so as to prevent damage.

PART 2 - PRODUCTS

2.01 GEOMEMBRANE

A. Resin

1. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.

2. Reclaimed/recycled polymer shall not be added to the resin. However, the use of re-worked polymer during the manufacturing process shall be permitted if performed with appropriate cleanliness, and if the recycled polymer does not exceed 10 percent by weight of the total polymer weight.

3. Natural resin (without carbon black) shall meet the following requirements:

a. Specific Gravity: ≥0.932 (ASTM D1505).

b. Melt Index: ≤1.0 g/10 minute, maximum (ASTM D1238 190/2.16).

c. Oxidative Induction Time (OIT): ≥100 minutes (ASTM D 3895 1 atm/200°C).

B. Geomembrane Rolls

1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.

2. Geomembrane shall be free of striations, roughness (except in the case of textured geomembranes where a roughened surface is characteristic), holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

3. Geomembrane shall be manufactured in a single layer (thinner layers shall not be welded together to produce the final required thickness).

4. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating MANUFACTURER's name, product identification, thickness, length, width, and roll number.

5. Geomembrane material shall be shipped free of any factory seams.

6. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Table 310519.16-1 and be tested by an acceptable method of inspecting for pinholes.

C. Geomembrane Types:

1. HDPE membrane shall be textured on both sides.

a. GSE Lining Technology Inc., GSE HD Textured 40 mil or approved equal

b. GSE Lining Technology Inc., GSE HD Textured 60 mil or approved equal

D. Geomembrane Properties:

Table 310519.16-1
Geomembrane Specifications

Tested Property	Test Method	Frequency	Minimum Average Values				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, mil Lowest individual reading	ASTM D 5994	every roll	[redacted]	40 36	60 54	[redacted]	[redacted]
Density, g/cm^3, (min.)	ASTM D 1505	200,000 lbs	[redacted]	0.940	0.940	[redacted]	[redacted]
Tensile Properties (each direction) Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, %	ASTM D 6693, Type IV Dumbbell, 2 ipm G.L. 2.0 in G.L. 1.3 in	20,000 lbs	[redacted]	 60 84 100 12	 90 126 100 12	[redacted]	[redacted]
Tear Resistance, lb	ASTM D 1004	45,000 lbs	[redacted]	28	42	[redacted]	[redacted]
Puncture Resistance, lb	ASTM D 4833	45,000 lbs	[redacted]	60	90	[redacted]	[redacted]
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lbs	[redacted]	2.0 - 3.0	2.0 - 3.0	[redacted]	[redacted]
Carbon Black Dispersion	ASTM D 5596	45,000 lbs	[redacted]	Note(1)	Note(1)	[redacted]	[redacted]
Asperity Height, mil	ASTM D 7466	second roll	[redacted]	18	18	[redacted]	[redacted]
Notch Constant Tensile Load(2), hr	ASTM D 5397, Appendix	200,000 lbs	[redacted]	300	300	[redacted]	[redacted]
Oxidative Induction Time, min	ASTM D 3895, 200°C; O_2, 1 atm	200,000 lbs	[redacted]	>100	>100	[redacted]	[redacted]
Typical Roll Dimensions							
Roll Length(3), ft	Double-Sided Textured [redacted]		[redacted]	700 [redacted]	520 [redacted]	[redacted]	[redacted]
Roll Width(3), ft			[redacted]	22.5	22.5	[redacted]	[redacted]
Roll Area, ft(2)	Double-Sided Textured [redacted]		[redacted]	15,750 [redacted]	11,700 [redacted]	[redacted]	[redacted]

NOTES:

- (1)Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- (2)NCTL for GSE HD Textured is conducted on representative smooth geomembrane samples.
- (3)Roll lengths and widths have a tolerance of ± 1%.
- GSE HD Textured is available in rolls weighing approximately 4,000 lbs.
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.

E. Extrudate Rod or Bead

1. Of the type recommended by the MANUFACTURER for the geomembrane specified.

2. Extrudate material shall be made from same type resin as the geomembrane.

3. Additives shall be thoroughly dispersed.

4. Materials shall be free of contamination by moisture or foreign matter.

2.02 MANUFACTURING QUALITY CONTROL

A. Resin - MANUFACTURER shall test each batch of base HDPE resin to ensure consistency and quality of the raw material. Tests shall include at a minimum Density, Melt Flow Index, and Oxidative Induction Time (OIT).

B. Geomembrane Roll - The Manufacturing Quality Control tests and test frequency are to be as indicated in Table 310519.16-1.

C. Any geomembrane that is not certified by the MANUFACTURER in accordance with this Section, or that testing indicates does not comply with this Section, will be rejected by the ENGINEER. Replacement of the rejected material shall be made with materials which comply with project requirements, at no additional cost to the OWNER (SDs).

2.03 CONFORMANCE TESTING (SUPPLEMENTAL PROJECT-SPECIFIC TESTING)

A. The ENGINEER may elect to perform supplemental, project-specific Conformance Testing to verify the MANUFACTURER's quality control testing and certifications supplied in the Submittal process described herein.

PART 3 - EXECUTION

3.01 PREPARATION

A. Transport, store, and handle as described in these specifications to prevent damage to the geomembrane.

B. Surface Preparation

1. Surfaces to receive geomembrane shall be smooth and free of debris, roots, and stones larger than 1/2 in. dimension, or other materials that could damage the geomembrane.

2. Subgrade shall consist of a minimum 6-in. thick layer of Sand Borrow (unless shown differently on the Drawings) and shall be compacted as specified in the Earthwork specification. Subgrade shall have no sharp sudden changes in grade or ruts.

3. Subgrade shall not contain areas softened by precipitation, cracked due to desiccation, or swelling or heaving. Any such disturbed areas shall be replaced or reworked.

4. Excavate anchor trenches and prevent from sloughing.

5. Provide a written statement from the INSTALLER that he has examined the prepared subgrade and provides his acceptance thereof.

3.02 DEPLOYMENT

A. Layout Drawings: Provide drawings showing the general panel configuration for the geomembrane. Lay out panels to minimize the number of field seams. Field seams shall be oriented up or down slope and not across slope.

B. Each field panel must be given an identification code (number or letter number). The field panel identification code shall be related, through a table or chart, to the original resin, and the constituent rolls and factory panels.

C. Placement Conditions:

1. Field panels shall be placed one at a time, and each field panel shall be seamed to adjacent panels the same day that it is placed. Install geomembranes in a relaxed condition and free of tension or stress. Stretching of geomembranes is prohibited.

2. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).

3. Geomembranes shall not be placed when the ambient temperature is below 32°F unless INSTALLER can demonstrate to the ENGINEER the geomembrane installation will not be adversely affected.

4. Geomembranes shall not be placed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of winds exceeding 20 miles per hour.

5. No vehicular traffic shall be allowed on the geomembrane.

6. Equipment used shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.

7. Personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.

8. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

9. Minimize wrinkles (especially differential wrinkles between adjacent panels).

10. Temporary loads and/or anchors (e.g., sand bags, tires) not likely to damage the geomembrane should be placed on the geomembrane to prevent uplift by wind. In high wind conditions, continuous loading along the edge of panels is recommended.

11. Any field panel or portion thereof which becomes damaged (torn, twisted, or crimped) shall be replaced with new material at no cost to the OWNER (SDs). Less serious damage may be repaired at the ENGINEER's sole discretion and at no cost to the OWNER (SDs). Damaged panels or portions of damaged panels that have been rejected shall be removed from the work area.

D. Ultraviolet Light (UV) Exposure:

1. All geomembranes shall be covered within 14 days. If a geomembrane will be left exposed for more than 14 days, the MANUFACTURER shall provide field UV test data and written recommendations for the maximum time of UV exposure prior to material shipment.

2. Geomembrane left exposed for more than 14 days may be sampled and tensile strength tests performed every 4 weeks. Sample areas shall be immediately repaired. If the tensile strength of the geomembrane falls below 90 percent of the original values within the recommended exposure period, the MANUFACTURER or CONTRACTOR will replace the defective material at no cost to the OWNER (SDs).

E. Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.

3.03 FIELD SEAMING

A. Seam Layout:

1. To the maximum extent possible, orient seams parallel to the line of maximum slope; i.e., oriented up-down, not across, the slope.

2. Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area.

3. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.

4. No horizontal seam shall be made on or within 10 ft of any top of the slope, except where approved by the ENGINEER.

5. No seams shall be located in an area of potential stress concentration, as defined by the ENGINEER.

6. No bare T seam shall be closer than 5 ft. from the toe of the slope.

7. Seams shall be aligned with the least number of wrinkles and “fishmouths.” If a wrinkle or fishmouth is found, it shall be relieved or capstripped.

B. Personnel: All personnel performing seaming operations shall be qualified and trained in the operation of the specific seaming equipment being used. Provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

C. Weather Conditions for Seaming

1. Seaming shall not be attempted at ambient temperatures below 32°F, above 104°F, or when wind velocity exceeds 20 miles per hour. At ambient temperatures between 32°F and 50°F, seaming shall be allowed if the geomembrane is preheated by either the sun or a hot air device, and if there is no excessive cooling from wind. At ambient temperatures above 50°F, no preheating will be required. In all cases, the geomembrane shall be dry and protected from excessive wind.

2. If the INSTALLER wishes to use methods which may allow seaming at ambient temperatures below 32°F or above 104°F, he shall demonstrate that the seam so produced is equivalent to those produced under normally approved conditions, and that the overall quality of the geomembrane is not adversely affected. It is specifically required that the seaming procedure does not cause any physical or chemical modification to the geomembrane that will generate any short or long-term damage to the geomembrane.

3. If the geomembrane must be seamed in the middle of a sunny day, the INSTALLER shall ensure that the panels to be seamed are at the same temperature and that there is sufficient slack in the geomembrane to prevent the generation of excessive stresses or trampolining when the geomembrane contracts as cooler temperatures prevail. The required amount of slack shall be determined by the INSTALLER and it should not be so much so as to cause wrinkling of the geomembrane. If trampolining of the geomembrane is observed, the INSTALLER will be required to make repairs so that the problem is eliminated.

4. Ambient temperatures shall be measured 6 in. above the geomembrane surface.

D. Overlapping and Temporary Bonding:

1. Align seam overlaps consistent with the requirements of the welding equipment being used. A 6-inch overlap is commonly suggested. Sufficient overlap shall be provided to allow peel tests to be performed on the seam.

E. Seam Preparation:

1. Prior to seaming, the seam area shall be cleaned and made free of moisture, dust, dirt, debris of any kind, and foreign material.

2. If seam overlap grinding is required, the process shall be completed according to the manufacturer's instructions within 1 hour of the seaming operation and in a manner that does not damage the geomembrane. The grind depth shall not exceed 10 percent of the geomembrane thickness. Grinding marks shall not appear beyond 0.25 in. of the extrudate after it is placed.

3. Seams shall be aligned with the fewest possible number of wrinkles and fishmouths.

F. General Seaming Requirements

1. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

2. If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

3. If seaming operations are carried out at night, adequate illumination shall be provided by the INSTALLER for performing seaming activities and for quality control and quality assurance activities.

4. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed where possible; any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane that extends a minimum of 6 in. beyond the cut in all directions.

G. Seaming Process

1. Approved processes for field seaming are extrusion welding and double fusion welding. Double fusion welding shall be the primary welding procedure. Extrusion welding shall be used only for repairs and detail work.

   Seaming equipment shall be operated in a manner that does not cause damage to the geomembrane. Only apparatus that the ENGINEER has specifically approved by make and model shall be used. Proposed alternate seaming processes shall be documented and submitted to the ENGINEER for review.

2. Extrusion Equipment and Procedures:

   a. The INSTALLER shall provide documentation regarding the extrudate to the ENGINEER and shall certify that the extrudate is compatible with the specifications and consists of the same resins as the geomembrane.

   b. The INSTALLER shall maintain at least one spare operable extrusion seaming apparatus on site at all times.

   c. Extrusion welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the nozzle.

   d. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.

   e. Clean geomembrane surfaces by disc grinder or equivalent.

   f. Prior to beginning a seam, the extruder shall be purged until all heat degraded extrudate has been removed from the barrel. Whenever the extruder is stopped, the barrel shall be purged of all heat-degraded extrudate.

   g. The electric generator used for power supply to the welding machines shall be placed outside the area to be lined or mounted on soft tires such that no damage occurs to the geomembrane. The electric generator shall be equipped with a grounding rod that is driven into the ground outside the lined area. Power source must be capable of providing constant voltage under combined line load. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

3. Fusion Equipment and Procedures:

   a. The INSTALLER shall maintain at least one spare operable seaming apparatus on site at all times.

   b. Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.

   c. Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.

   d. The edges of cross seams shall be abraded to a smooth incline (top and bottom) prior to welding.

e. Protect against moisture build-up between sheets. A movable protective layer may be used directly below each geomembrane overlap to be seamed to prevent the buildup of moisture between the sheets.

f. The electric generator used for power supply to the welding machines shall be placed outside the area to be lined or mounted on soft tires such that no damage occurs to the geomembrane. Power source must be capable of providing constant voltage under combined line load. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

H. Trial Seams/Welds

1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly. Trial seams shall be made prior to production seaming by all seamers and by all equipment to be used during production seaming. The trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate.

2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature. The trial seam sample shall be at least 5 ft long by 1 ft wide (after seaming) with the seam centered lengthwise.

3. Such trial seams shall be made at the beginning of each seaming period, and at least once every 5 hours, for each seaming apparatus used that day. Also, each seamer shall make at least one trial seam each day.

4. Two adjoining specimens, each 1.0 in. wide, shall be cut from the trial seam sample by the INSTALLER. The specimens shall be tested in shear and peel, respectively, using a field tensiometer, and the specimen shall fail by film tear bond rather than in the seam. Trial weld specimens shall pass when:

a. The results shown in the Table 310519.16-2 for HDPE geomembranes are achieved in both peel and shear test.

b. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).

c. The break is ductile.

Table 310519.16-2
Minimum Weld Values for HDPE Geomembranes

		Nominal Geomembrane Thickness (mils)					
Property	**Test Method**	**30**	**40**	**60**	**80**	**100**	**120**
Peel Strength (fusion), lbs/inch	ASTM D 6392		65	98			
Peel Strength (extrusion), lbs/inch	ASTM D 6392		52	78			
Shear Strength (fusion & ext.), lbs/inch	ASTM D 6392		81	121			

5. Trial seams shall also be rejected for excess crystallinity as indicated by cracking during bending or cutting. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.

6. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.

7. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.

8. After completion of the above-described tests, the remaining portion of the trial seam sample can be discarded. If a trial seam sample fails a test, then a sample of the seam for Destructive Testing (as described below) shall be taken from the seams completed by the seamer during the shift related to the considered trial seam. These samples shall be tested in the field with the field tensiometer, and a separate sample from the destructive test location forwarded to the ENGINEER for laboratory testing (at the ENGINEER's request), and if they fail either of these tests, the repair procedure indicated in Part 3.03.J of this Section shall apply.

9. Destructive Testing: Samples shall be cut by the INSTALLER at the locations designated by the ENGINEER as the seaming progresses in order to obtain field tensiometer tests (and at the discretion of the ENGINEER) laboratory tests at the ENGINEER'S GEOSYNTHYETICS TESTING LABORATORY. Satisfactory test results must be obtained before the geomembrane is covered by another material. All holes in the geomembrane resulting from the destructive seam sampling shall be immediately repaired in accordance with the repair procedures described in Part 3.03.J of this Section. The continuity of the new seams in the repaired areas shall be tested according to Part 3.03.I of this Section.

10. Destructive Test Failure. The following procedures shall apply whenever a sample fails a destructive test, whether the test is conducted by the ENGINEER's laboratory, the INSTALLER's or CONTRACTOR's laboratory, or by a field tensiometer. The INSTALLER shall have two options, as described in a. and b., below.

    a. The INSTALLER can reconstruct the seam (e.g., remove the old seam and reseat) between any two passed test locations.

    b. The INSTALLER can trace the welding path to an intermediate location, a minimum of 10 ft from the location of the failed test (in each direction) and take a small sample for an additional field test at each location. If these additional samples pass the tests, then full laboratory samples shall be taken. If these laboratory samples pass the tests, then the seam shall be reconstructed between these locations. If either sample fails, then the process shall be repeated to establish the zone in which the seam should be reconstructed. In any case, all acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases where the length of reconstructed seam exceeds 150 ft, a destructive sample taken from within the reconstructed zone must pass destructive testing. Whenever a sample fails, the ENGINEER may require additional tests for seams that were formed by the same seamer and/or seaming apparatus or seamed during the same time shift.

I. Nondestructive Seam Continuity Testing:

1. The INSTALLER shall nondestructively test all field seams over their full length using air pressure test (for double fusion seams only), or other approved method. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. The INSTALLER shall complete any required repairs in accordance with Part 3.03.J of this Section. The following procedures shall apply to locations where seams cannot be nondestructively tested:

   a. If the seam is accessible to testing equipment prior to final installation, the seam shall be nondestructively tested prior to final installation.

   b. If the seam cannot be tested prior to final installation, the seaming operations must be observed in their entirety by the ENGINEER for uniformity and completeness.

2. Vacuum Chamber Testing (if approved):

   a. Shall be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.

   b. All areas where test results indicate failure (bubbles appear after sufficient dwell time) shall be marked with a marker that will not damage the geomembrane and repaired in accordance with Part 3.03.J of this Section.

3. Air Pressure Testing (For Double Fusion Seams Only):

   a. The following procedures are applicable to those processes, which produce a double seam with an enclosed space.

   b. Shall be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

   c. Insert a protective cushion between the air pump and the geomembrane.

   d. Energize the air pump to a pressure between 25 and 30 psi, close valve, allow two (2) minutes for pressure to stabilize, and sustain the pressure for not less than five (5) minutes.

   e. If loss of pressure exceeds 2 psi, or if the pressure does not stabilize, locate faulty area and repair in accordance with Part 3.03.J of this Section.

   f. Cut opposite end to verify continuity of seam, remove needle, or other approved pressure feed device, and seal repair in accordance with Part 3.03.J of this Section.

J. Defects and Repairs:

1. All seams and non-seam areas of the geomembrane will be examined by the ENGINEER for evidence of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be swept or washed by the INSTALLER if surface contamination inhibits examination. The INSTALLER shall ensure that this examination of the geomembrane precedes any seaming of that section.

2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

3. Each suspect location, both in seam and non-seam areas, shall be nondestructively tested using the methods described Part 3.03.I of this Section, as appropriate. Each location that fails nondestructive testing shall be marked by the ENGINEER and repaired by the INSTALLER. Work shall not proceed with any materials that will cover repaired locations until laboratory test results with passing values are available.

4. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the ENGINEER shall identify all excessive geomembrane wrinkles. The INSTALLER shall cut and reseam all wrinkles so identified. The seams thus produced shall be tested as any other seams.

5. Repair Procedures:

   a. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the INSTALLER. Several repair procedures are specified below. The final decision as to the appropriate repair procedure shall be agreed upon between the ENGINEER and the INSTALLER. The procedures available include:
      1) patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
      2) abrading and reseaming, used to repair small sections of extruded seams;
      3) spot seaming, used to repair small tears or other minor, localized flaws;
      4) spot welding, used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced;
      5) capping, used to repair long lengths of failed seams;
      6) removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams);
      7) flap welding, used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap; and
      8) Remove the unacceptable seam and replace with new material.

   b. In addition, the following shall be satisfied:
      1) surfaces of the geomembrane which are to be repaired shall be lightly abraded to assure cleanliness no more than 1 hour prior to the repair;
      2) all surfaces must be clean and dry at the time of repair;
      3) all seaming equipment used in repair procedures must be approved by the ENGINEER;
      4) the repair procedures, materials, and techniques shall be approved in advance, for the specific repair, by the ENGINEER and INSTALLER;
      5) Extend patches or caps at least 6 inches for extrusion welds and 4 inches for wedge welds beyond the edge of the defect, and around all corners of patch material; and
      6) the geomembrane below large patches or caps shall be appropriately cut to avoid water or gas collection between the two sheets.

6. Each repair shall be numbered and logged and shall be nondestructively tested using the methods described in Part 3.03.I of this Section, as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests will require the repair to be redone and retested until a passing test result is achieved. At the discretion of the ENGINEER, destructive testing may be required on large caps.

3.04 MATERIALS IN CONTACT WITH GEOMEMBRANE

A. The INSTALLER shall take all necessary precautions to ensure that the geomembrane is not damaged during its installation, during the installation of other components of the lined cap system, or by other construction activities. If approved by the ENGINEER, additional loosely placed geotextile sections may be used by the INSTALLER to protect the geomembrane.

B. The geomembrane shall not be placed directly on crushed stone. A geotextile cushion shall be installed between crushed stone and the geomembrane.

C. Equipment shall not be driven directly on the geomembrane. Unless otherwise specified by the OWNER (SDs), all equipment operating on materials overlying the geomembrane shall comply with the following (see Table 310519.16-3):

TABLE 310519.16-3
Equipment Ground Pressure and Clearance Requirements

Allowable Equipment Ground Pressure (psi)	Thickness of Overlying Compacted Fill (ft)
<5	0.5
5 to 10	1.5
10 to 20	2.0
>20	3.0

D. In heavily trafficked areas such as access ramps, and in areas trafficked by rubber tire vehicles, the thickness of overlying compacted fill shall be at least 2.5 ft.

3.05 GEOMEMBRANE ACCEPTANCE

A. The CONTRACTOR shall retain all ownership and responsibility for the geomembrane until accepted by the PWNER (SDs).

B. The geomembrane will not be accepted by the OWNER (SDs) until all of the following conditions are met:

1. the installation of all the geosynthetic materials and overlying fill layers are finished;

2. all documentation of installation is completed including the final reports summarizing quality assurance testing;

3. verification of the adequacy of all field seams and repairs, including associated testing, is complete;

4. the warranties required by Part 1 are accepted by the OWNER (SDs); and

5. all documentation of the associated geosynthetic materials, written certification documents, including CONTRACTOR's as-built record drawings, sealed by the CONTRACTOR's Surveyor have been received and accepted by the OWNER (SDs).

3.06 PRODUCT PROTECTION

A. The CONTRACTOR shall use all means necessary to protect all prior work and all materials and completed work of other Sections.

B. In the event of damage, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the ENGINEER and at no additional cost to the OWNER (SDs).

3.07 FIELD QUALITY CONTROL

A. MANUFACTURER and INSTALLER shall participate in and conform to all terms and requirements of the OWNER's (SDs) quality assurance program. CONTRACTOR shall be responsible for assuring this participation.

B. Quality assurance requirements are as specified in this Section and in the Field Installation Quality Assurance Manual if it is included in the contract.

C. The handling and installation of the geomembranes materials shall be inspected and tested as outlined in the specifications. CONTRACTOR shall provide full-time inspection of INSTALLER during all geomembrane handling and installation activities. The CONTRACTOR shall make and record observations and tests of the handling and installation of geomembrane materials and shall submit written reports of such observations and tests to the ENGINEER no later than the workday following the observations and tests.

D. The CONTRACTOR and the INSTALLER shall be aware of the required Quality Control and Quality Assurance activities in the Specifications and shall account for these activities in the installation schedule.

E. OWNER's (SDs) ENGINEER will perform quality assurance tests as required, observe the plant and field operations, and review quality control data provided by the CONTRACTOR as deemed necessary to evaluate the effectiveness of CONTRACTOR's Quality Control activities. The results of such tests and observations will be provided to CONTRACTOR, but may not be used by CONTRACTOR in substitution for the Quality Control Testing and inspection required herein.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 310913

GEOTECHNICAL INSTRUMENTATION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The Engineer shall be responsible for the following instrumentation installations and monitoring:

1. The Contractor shall provide and install Utility Monitoring Points (UMPs), on the sanitary sewer along the west edge of the HBHA Pond and along the Cranberry Bog Conservation Area. The Engineer will maintain and monitor the UMP. The Contractor shall protect all UMPs from damage during the duration of the Work of this Contract.

2. The Engineer shall provide engineering seismographs for monitoring of vibrations on the existing sanitary sewers and at the existing 36 Cabot Rd building during excavation activities, sheet pile installation, and as otherwise required. The Contractor shall protect all engineering seismographs from damage during the duration of the Work of this Contract.

3. The Engineer shall provide noise monitoring at the existing 36 Cabot Rd building and elsewhere as shown on the Drawings, as required. The Contractor shall protect all noise monitoring equipment from damage during the duration of the Work of this Contract.

4. Data acquired by the Engineer will be made available to the Contractor in a timely manner. The Contractor may observe the Engineer's acquisition of instrumentation data at any time or make supplementary readings at no additional cost to the SDs.

5. Monitor and reduce instrumentation data during construction. The Contractor shall make independent interpretations of all data as it relates to contractual performance and job safety requirements of the Work.

1.03 RELATED SECTIONS

A. SECTION 014000 – Quality Requirements

B. SECTION 026113 – Excavated Soil and Materials Management Plan

C. SECTION 310000 – Earthwork

D. SECTION 312319 – Construction Dewatering and Water Treatment

E. SECTION 316216 – Steel Sheet Piles

F. SECTION 441123 – Construction Dust and Odor Control

G. Drawings

H. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

B. Noise Control Ordinance: City of Woburn Title 9 (Public Peace, Morals, and Welfare), Article I (Offenses Against Public Peace), Section 9-2 (Noise Control).

C. 29CFR1910.95(c)(2) - OSHA action level for hearing protection.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. The Engineer will review, record and plot the instrumentation data monitored by the Engineer. This Work does not relieve the Contractor of the responsibility to complete the Work in accordance with the Contract Documents.

B. Data acquired by the Engineer will be made available to the Contractor in a timely manner. The Contractor may observe the Engineer's acquisition of instrumentation data at any time or may take supplementary readings at no additional cost to the SDs. The Contractor shall make independent interpretations of all data as it relates to contractual performance and job safety aspects of the Work.

C. Pre- and Post-Construction Conditions Survey

1. The Engineer will perform a pre-construction survey of ambient vibrations adjacent to 36 Cabot Road and the sewer lines running along the railroad tracks.

2. The Engineer shall hire an independent subcontractor to conduct video and still shot photography surveys of the adjacent 36 Cabot Road building and the existing sanitary sewers along the west edge of the HBHA Pond and Cranberry Bog Conservation Area. Such survey will be performed both before and after construction.

3. The Contractor may elect to conduct supplemental pre- or post-construction condition surveys at no cost to the SDs.

1.07 SUBMITTALS

Not Used.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Instrumentation monitored by the Engineer will be on a schedule based on the location and extent of construction activities. The Contractor shall cooperate in every way with the Engineer to accomplish instrumentation monitoring. Data acquired by the Engineer will be made available to the Contractor in a timely manner. Provide and maintain lighting and safe means of access to all instrumentation locations as required for data collection by the Engineer for the duration of the project.

B. The Contractor shall exercise caution during the progress of Work and shall prevent damage to all instrumentation devices. Any damage or loss of function caused by the Contractor's operations, or by any other cause, to new or existing instrumentation shall be repaired or the equipment replaced within 24 hours of the Contractor being notified of the instrument malfunction at no additional cost to the SDs.

3.02 IMPLEMENTATION OF MITIGATION MEASURES

A. Performance Criteria Threshold and Limiting Values and Mitigation measures associated with these Values are defined in Table 310913-1 below. The criteria presented in Table I below are

intended to establish a minimum basis for the Contractor's procedures, and in no way relieve the Contractor of its sole responsibility for preventing detrimental movements and damage to adjacent existing and new facilities, utilities, structures, and other features. Mitigating measures are subject to adjustment by the Engineer based on observed conditions during construction.

Table 310913-1 - Performance Criteria

Instrumentation Type / Location	Instrument Performance Criteria Values (Note: Subject to judgment by the Engineer as being potentially attributable to the Contractor's Work.)	
	Threshold	Limiting
A. Utility Monitoring Points (UMPs)	0.25 in. vertical	0.5 in. vertical
B. Noise Monitoring	100 decibels at point of monitoring	120 decibels 20 feet from source
C. Vibration Monitoring	Frequencies less than 40 Hz: Max ppv = 0.5 ips Frequencies greater than 40 Hz: Max ppv = 0.7 ips	Frequencies less than 40 Hz: Max ppv = 0.7 ips Frequencies greater than 40 Hz: Max ppv = 1.0 ips

B. If the Engineer indicates to the Contractor that a Performance Criteria Threshold Value is being approached, the Contractor shall:

1. Meet with the Engineer to discuss the status of Work activities, observations made, and need for mitigating measures to prevent exceedances of Threshold Values if it is judged by the Engineer to be attributed to the Work by the Contractor.

2. If directed by Engineer that mitigating measures are needed, submit for review by the Engineer a detailed plan of action to prevent exceedances of Threshold Values.

3. If authorized or directed by the Engineer, implement mitigation measures within 24 hours of receiving said notice by the Engineer so that the Performance Criteria Limiting Values are not approached.

C. If the Engineer indicates to the Contractor that a Performance Criteria Limiting Value is being approached, the Contractor shall take all actions necessary to prevent exceedances of the Limiting Value including, but not limited to, the following:

1. Meet with the SD Representative and Engineer within 2 hours to discuss exceedances and additional mitigation measures needed to prevent further exceedance.

2. If determined necessary by the Engineer, and approved by the SD Representative, immediately implement additional mitigating measures agreed to by the Engineer and the Contractor to prevent further exceedances, including but not limited to:

   a. terminate further Work activity determined to be causing the exceedance.

   b. work continuously (24 hours per day/7 days per week) to prevent further exceedances.

3. If exceedances continue, and if so directed by the Engineer, implement other measures determined necessary by the Engineer to halt the exceedances.

4. Install additional instrumentation and increase monitoring frequency if directed by the Engineer, at no additional cost to the SDs.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 311100

SITE CLEARING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Abbreviated Summary of Work

1. The Work of the Contract is indicated by the Contract Documents.

2. The Contract includes coordination of all Work indicated by the Contract Documents.

3. The Contract is unavoidably affected by governmental regulations, weather and natural phenomena, an access agreement with one or more land owners, and other forces and conditions not described in the Contract Documents.

B. General description of work for All Work Areas

1. Contact "Dig Safe": Comply with Massachusetts General Laws, Chapter 82, Section 40 and all applicable codes, rules, regulations. Do not begin any clearing, grubbing, or other intrusive activities without complying with the law. Ensure that all utilities have been located and marked prior to beginning work.

2. Submittal preparation.

3. Where applicable, coordinating work with the railroad, including training staff as required by railroad.

4. Where applicable, coordinating work with utility owners.

5. Removing and sizing debris encountered in the Work Area or otherwise shown on the Drawings.

6. Removing and grubbing trees, shrubs, and other plant life in designated areas.

7. Separating uncontaminated above-grade portions of organic/plant material from potentially contaminated below-grade organic/plant material with soil/sediment attached (e.g., root balls).

8. Protecting trees outside the limits of clearing and select trees in areas where selective clearing will be performed, as necessary.

9. Handling and containerizing cleared debris and organic plant/tree waste (including root balls and similar soil-containing debris) for proper off-site disposition.

10. Limits of clearing and grubbing shown on the Drawings are approximate only. Actual limits of clearing and grubbing shall be marked in the field by the Contractor and reviewed by the SD Representative and Engineer before clearing can begin.

1.03 RELATED SECTIONS

A. SECTION 011100 – Summary of Work

B. SECTION 013529 – Health & Safety

C. SECTION 015000 – Temporary Facilities and Controls

D. SECTION 020000 – Existing Conditions

E. SECTION 026113 – Excavated Soil and Materials Management Plan

F. SECTION 312500 – Erosion and Sedimentation Controls

G. SECTION 441123 – Construction Dust and Odor Control

H. Drawings

I. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 ABBREVIATIONS AND ACRONYMS

Note Used.

1.05 DEFINITIONS

A. Soil – Soil means unconsolidated earth material composing the superficial geologic strata (material overlying bedrock), consisting of clay, silt, sand, or gravel size particles or a mixture of such materials with liquids, sludges or solids which is inseparable by simple mechanical removal processes and is made up primarily of soil by volume based on visual inspection.

B. Debris - Debris means solid material exceeding a 60 mm particle size that is a manufactured object or plant/animal matter.

1.06 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

B. Below-grade debris and obstructions may be present onsite. Debris and obstructions may include bricks, metal scraps, piping, tools, concrete, wood, and boulders.

C. Contaminated soils and sediments exist on site. Elevated concentrations of site-related contaminants of concerns (COCs) are present in soil and/or sediments. The Contractor shall be responsible for the health and safety of all workers engaged in clearing, grubbing, and other associated operations. Clearing and grubbing in contaminated soils and sediments depicted on the Drawings must be conducted by workers who have completed an OSHA 40 hour Health and Safety training course (and any subsequent 8-hr refresher training courses as required) in compliance with the OSHA Hazardous Waste Operations Regulation, 29 CFR 1910.120. Work shall be performed in accordance with the Contractor's Health and Safety Plan (See Section 013529 – Health & Safety for Contractor health and safety requirements).

D. Conduct the Work in a manner that is protective of public health and safety. The Contractor shall control public access to the Work Areas and shall control the concentration of dust and odors at the Limit of Work perimeter. See Sections 015000 – Temporary Facilities and Controls and 441123 – Construction Dust and Odor Control for more information.

E. Conduct the Work in a manner that is protective of surface water quality and wetlands. Contractor shall control erosion as specified in Section 312500 – Erosion and Sedimentation Controls.

1.07 QUALITY ASSURANCE

Not Used.

1.08 SUBMITTALS

A. Submit a site clearing plan to Engineer and SD Representative for review. Clearing plan shall describe clearing sequence, clearing and grubbing methods and equipment, coordination with rail road (where applicable), handling of cleared material, salvage areas for temporary storage, and proposed reuse facility/site for cleared, uncontaminated above-grade portions of vegetation. **(Submittal Group 3)**

1.09 SPECIAL SITE CONDITIONS

A. Contract includes clearing in and adjacent to wetlands. The wetlands are typically composed of organic soils/sediment of low strength and therefore may present unstable conditions. Contractor shall protect workers and equipment accordingly.

B. Use of herbicides is prohibited.

PART 2 - PRODUCTS

2.01 FENCING

A. High visibility snow fence 4 feet high minimum to demarcate limits of clearing. Posts shall be spaced 10 feet (max) on center.

B. High visibility tape to flag individual trees to be protected in place.

PART 3 - EXECUTION

3.01 PREPARATION

A. Properly install all erosion and sediment control measures prior to clearing.

B. Identify salvage areas for placing removed materials. Submit plan depicting proposed salvage areas for Engineer's approval.

1. "Below-grade" Contaminated Plant Material - Locate salvage area for tree stumps and other below-grade vegetation from contaminated areas shown on the Drawings removed during clearing and grubbing activities within the contaminated area to the extent possible. If not possible or if temporary storage is needed for longer than 24 hours, manage the contaminated material in stockpiles constructed in accordance with the specification Section 026113 – Excavated Soil and Materials Management Plan for proper off-site disposal.

2. "Below-grade" Uncontaminated Plant Material - Locate salvage area for tree stumps and other below-grade vegetation from uncontaminated areas outside the limits of the contaminated area. Segregate material in stockpiles for proper chipping, composting, or other approved management.

3. "Above-grade" Uncontaminated Tree/Plant Material - Locate salvage area for tree trunks and limbs and shrubs/undergrowth (i.e., the clean, above-grade portions of cleared vegetation), regardless of the portion of the site (contaminated and uncontaminated areas) from which they were cleared, outside the limits of the contaminated area. Segregate material for proper salvage or productive reuse (large trees/limbs), chipping/composting (undergrowth/shrubs/small trees/limbs), or other approved management.

4. Debris - manage debris in stockpiles constructed in accordance with the specification Section 026113 – Excavated Soil and Materials Management Plan for proper off-site disposal.

3.02 EXAMINATION

A. Verify existing plant life designated to remain is tagged or identified.

3.03 PROTECTION

A. Before clearing begins, protect areas to remain uncleared with snow fencing to the approximate diameter of foliage to prevent damage to the trunk, foliage and root systems by construction equipment and procedures. Fencing shall be maintained by the Contractor.

B. Protect other plant growth and features designated to remain.

C. Repair or replace immediately any damage to existing trees or root systems that are to remain, at no additional cost to the SDs (Owner). The Contractor shall hire a licensed arborist to determine the repair and replacement needs and methods.

D. Replace damaged trees and shrubs designated to remain with the same size and species.

E. The Contractor shall mark the limits of clearing shown on the Contract Drawings by accurate field survey and shall meet with the Engineer and SD Representative prior to cutting. Notify Engineer and SD Representative a minimum of five (5) working days prior to cutting for review of flagged limits. Adjust the limits as directed by the Engineer or SD Representative.

3.04 CLEARING

A. Clear areas required for access to site and execution of work.

B. Follow clearing sequence as shown on the Drawings. Clearing and grubbing shall be phased to minimize the area exposed to potential erosion.

C. Remove trees and shrubs. Protect areas shown on the Drawings. Remove stumps, main root ball and root system.

D. Shake out soil attached to stumps and roots removed during clearing and grubbing. Leave resultant soil within its area of origin. Do not move contaminated soil to areas outside of the contaminated area as shown on the Drawings.

E. Clear undergrowth and deadwood, without disturbing subsoil.

F. Prevent trunk, limbs and foliage of trees (i.e., the clean, above-grade portions) in contaminated areas shown on the Drawings from becoming contaminated during clearing and handling process.

3.05 DEBRIS SIZING REQUIREMENTS

A. Removed and size debris to facilitate off-site transportation and disposal.

B. Maximum size of debris shall conform to the requirements of the disposal facility.

3.06 REMOVAL

A. Clean trunks and limbs of cleared trees shall be salvaged for productive reuse.

B. Stump and undergrowth disposal:

1. Stumps and undergrowth removed from contaminated areas as shown on the Contract Drawings shall be disposed off-site.

2. Stumps and undergrowth removed from outside the limits of the contaminated areas shall be disposed off-site.

C. Debris - remove, size, containerize, and stage for off-site disposal.

D. Coordinate off-site management and disposal of materials.

E. Do not burn materials on site.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 312319

CONSTRUCTION DEWATERING AND WATER TREATMENT

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the Work of this Section.

C. Coordinate work with that of all other trades affecting or affected by Work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, material, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The Contractor shall be responsible for construction dewatering. Dewatering shall be performed as required to conduct Work in-the-dry, unless indicated otherwise. Groundwater levels shall be lowered to a minimum of 1-foot below the lowest excavation level in areas without proposed structures and 2-feet below the subgrade elevation in areas with proposed structures.

B. Construct temporary cofferdams, including steel sheet piles and Portadams, at the locations and to the elevations indicated on the Contract Drawings and in applicable Specification Sections.

C. The methods of controlling groundwater and surface water runoff in excavations, including but not limited to, the temporary surface water diversion, are to be constructed in accordance with Contract Drawings and applicable specifications.

D. Repair damage, disruption, or interference to any facility resulting directly or indirectly from dewatering/groundwater recharging activities, including inadequate performance of such systems.

E. Manage contaminated groundwater and surface water that is collected, treated, recycled, or discharged at the site as part of construction in compliance with all applicable provisions of the federal, state or local laws, regulations or bylaws, and in accordance with this specification Section and other applicable specifications.

F. Following completion of the HBHA Pond outlet structure construction (including appropriate concrete curing) as per Section 0330003 - Cast-in-Place Concrete and sump pump removal, temporary dewatering sumps are to be backfilled and sealed with cement grout.

G. Remove dewatering sump materials and equipment upon completion of dewatering activities to facilitate site restoration.

H. The Contractor shall collect and dispose of construction dewatering effluent from all systems in accordance with federal, state, and local codes, ordinances, regulations these Contract Documents, and the Remedial Action Work Plan governing this Work. Water will be discharged downstream of the temporary cofferdam following treatment specified in this Section.

I. The Contractor's Base Dewatering Effluent Treatment System (DETS) shall include, for each Work Area, a minimum of the components as specified on the related Work Area Drawings. The System shall also include all equipment associated with groundwater treatment and be capable of extracting and treating water at whatever flow rates enter the dewatered excavation area to maintain excavation in-the-dry.

J. The Contractor will monitor water quality in accordance with specification Section 023200 - Sampling, Testing, and Data Evaluation (Construction Dewatering System Water Samples) to ensure compliance with the criteria presented in Table 3123019-1, at the frequency outlined in this specification. Contractor will provide access to sampling port(s) in the DETS to allow the Engineer to sample if needed. The Contractor may conduct water quality sampling and analysis more frequently to assess the efficiency of their treatment system at their own discretion, and at no additional cost to the SDs.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 023200 – Sampling, Testing, and Data Evaluation

C. SECTION 026113 – Excavated Soil and Materials Management Plan

D. SECTION 033000 – Cast-In-Place Concrete

E. SECTION 310000 – Earthwork

F. SECTION 316216 – Steel Sheet Piles

G. SECTION 312500 – Erosion and Sedimentation Controls

H. SECTION 327100 – Wetland and Upland Restoration

I. SECTION 350140 – Temporary Water Diversions (Operation and Maintenance of Waterway Construction)

J. SECTION 441123 – Construction Dust and Odor Controls

K. Drawings

L. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. Refer to Section 020000 – Existing Conditions for information regarding site conditions.

B. Available groundwater and surface water chemical test data proximate to the Work Area are provided in the documents referenced in specification Section 020000 – Existing Conditions. A summary of historic data for key parameters is provided in Table I. Of the parameters monitored, ammonia has been observed at concentration in surface water at or near the Pond outlet at concentrations exceeding the applicable ammonia National Recommended Water Quality Criteria (NRWQC).

1.06 QUALITY ASSURANCE

A. Design and Performance Criteria

1. The Contractor is responsible for providing and operating pumps and all associated equipment required for the operation of the DETS such that water inside the excavation is maintained a minimum of 1-foot below subgrade elevation in areas without proposed structures and 2-feet below the subgrade elevation in areas with proposed structures. Unless indicated otherwise, dewater such that all construction operations are conducted in-the-dry.

2. Construct and maintain dewatering and drainage sumps in accordance with Drawings or as per Contractor's approved means and methods.

3. Where Sheetpile is indicated on Drawings as the dewatering cofferdam style, the Contractor's steel sheet pile cofferdam shall be watertight, as described in Section 316216 – Steel Sheet Piles.

4. Take measures to prevent damage to properties, buildings or structures, sewers and other utility installations, pavements, sidewalks, and other work.

5. Repair damage, disruption or interference to any facility resulting directly or indirectly from dewatering activities, including inadequate performance of such equipment, at no additional cost to the SDs.

6. As necessary, and in addition to providing the primary power source in accordance with Section 015000 – Temporary Facilities and Controls, Contractor shall provide backup power generation and dewatering system components and devise emergency procedures for maintaining continuous, uninterrupted dewatering operations.

7. Performance of treatment systems shall meet the following numeric Performance Criteria (Construction-related Surface Water Quality Criteria).

Table 312319-1
Construction-related Surface Water Quality Criteria

Parameter	Construction-related Surface Water Quality Criteria
Benzene (µg/L)	46
Dissolved Arsenic (µg/L)	150
Total Arsenic (µg/L)	150
Ammonia (mg/L)	NRWQC (Note 1)*
TSS (mg/L)	30
Turbidity (NTU)	Background + 20
1,2-Dichloroethane (µg/L)	910 (Note 2)
Trichloroethene (µg/L)	47 (Note 2)
Naphthalene (µg/L)	193.5

Notes:
1. The ammonia NRWQC varies with temperature and pH. As such, temperature and pH must be measured along with sampling for other parameters with defined Construction-related Surface Water Quality Criteria. Given that ammonia is observed in the HBHA Pond at concentrations that may exceed the ammonia NRWQC (absent any construction activities), the concentrations of ammonia and other parameters obtained from dewatering effluent and other surface water monitoring locations must be compared to the upstream background location and consider other factors. In the event that ammonia concentrations have been determined by the Engineer to exceed or likely exceed the NRWQC criteria, the Contractor will be informed of the need for and amount of ammonia treatment. For purposes of preparing the Contractor's bid, the Contractor shall assume that 4 mg/L ammonia removal from the DETS is necessary. Similarly, in the event that benzene (or other VOCs) concentrations have been determined by the Engineer to exceed the criteria, the Contractor will be informed of the need for and amount of benzene (or other VOCs) treatment.
2. The compounds including 1,2-Dichlorothethane and Trichloroethene are not required to be tested at the Lower South Pond as part of the removal of sediments adjacent to the West Hide Pile.

B. Sampling and Analysis

1. Sampling performed by the Contractor.

2. Analysis at the designated Project Chemical Testing Laboratory. Except where noted otherwise in this and other specifications, the cost for analytical testing will not be borne by the Contractor.

3. Sample Locations: Given the ammonia and other constituents in surface water (absent construction activities), it is necessary to compare testing results to background values established upstream of the various Work Areas. Therefore, sampling and testing will be conducted at two locations proximate to the construction area to monitor construction

activities and the effectiveness of the DETS: 1) upstream of the work area as a "background" location relative to the work area; and 2) the DETS effluent. The Contractor may at their discretion collect additional samples at other locations and frequencies at the Contractor's own expense to assess treatment performance. The upstream (i.e. background) sample location is shown on the drawings.

4. Performance/Breakthrough Monitoring: The Contractor shall collect additional samples to monitor the system performance and expected capacity of the active treatment media based on expected flow rates, treatment COC concentrations and time to breakthrough of the media. Performance/breakthrough monitoring shall include sampling between the carbon vessels (midfluent).

5. Sample Frequency: The sampling events at the upstream background and DETS effluent location include chemical testing daily during the fires 7-days of dewatering, and every third day thereafter (per Remediation General Permit (RGP) guidelines) followed by weekly testing to be conducted through the end of the scheduled DETS operation and discharge. It should be noted that adding or removing treatment equipment or making material changes to the treatment process would constitute a change that would re-set the above sampling frequency. Laboratory turnaround time (TAT) shall be rush/24 hour TAT.

6. Parameters: Listed in Table 312319-1.

7. Additional confirmatory sampling may be performed by the Engineer to verify treatment system performance as describe in specification Section 023200 – Sampling, Testing, and Data Evaluation.

1.07 SUBMITTALS

A. The DETS Submittal shall be prepared and stamped by an experienced registered Professional Engineer licensed in the Commonwealth of Massachusetts. **(Submittal Group 2)** The DETS Submittal shall include, at a minimum:

1. Specifications of all pumps used for transmitting water from the excavation and pumps required to meet the specifications of the Base DETS.

2. Shop drawings showing proposed types and details of dewatering systems to be used for the Base DETS.

3. Specifications and shop drawings showing proposed types and details of treatment systems to be used for benzene (and other VOCs), ammonia, TSS (and turbidity/total metals), and dissolved arsenic removal if modification to the Base DETS is necessary to address any of these constituents. The Contractor shall submit calculations supporting the proposed system components, including flow rates, design concentrations to be treated, estimated breakthrough times for each media, and the proposed media vessel size and capacity.

4. Given the need for dewatering and water treatment in multiple Work Areas, organize the description of dewatering activities by Work Area (West Hide Pile, Permeable Cap System, Halls Brook Bypass, etc.).

5. The arrangements and locations of the proposed systems.

6. A complete description of equipment and materials to be used.

7. Procedure to be followed for installation, primary power source connection, system operation, maintenance, and system removal at the completion of the Work, including a discussion of the relationship to the Contractor's Construction Sequencing Plan prepared as per Section 013000 – Administrative Requirements.

8. The standby equipment and standby power supply.

9. A contingency plan in the event water treatment performance standards are not achieved, including at a minimum a description of standby equipment, temporary storage equipment, turnaround time on mobilization of additional equipment, and related contingency measures to be undertaken by the Contractor to maintain site operations and avoid dewatering stoppage.

10. Proposed locations of points of discharge of water and their relationship to sediment controls and systems.

11. Details regarding schedule, frequency, and procedure for cleaning fractionation tanks and bag filters, as well as other operating parameters for the Contractor's proposed equipment.

12. Methods and information about the handling, storing, recycling, and disposal of sediment in the fractionation tanks, bag filters and any other materials used in conjunction with the DETS.

13. Name and qualifications of Contractor's certified treatment system operator.

B. The Contractor is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the Work.

PART 2 - PRODUCTS

2.01 GENERAL (BASE SYSTEM)

A. Materials and equipment shall be of suitable size, capacity, and type to dewater site soils; maintain dry and stable working surfaces; and to pump, store, manage, treat, and discharge dewatering effluent.

B. All materials and equipment shall be of appropriate type and maintained in proper operating condition at all times during the course of the Work. Any leaks or spills shall be immediately fixed or cleaned.

C. Fractionation tanks and bag filters shall be of sufficient size and capacity to handle the dewatering flows, and to reduce suspended materials in the dewatering effluent to achieve the Construction-related Surface Water Quality Criteria (Table I). The tank shall contain baffles to reduce velocities and allow sediment to settle inside the tank.

D. The Contractor shall maintain and employ adequate back-up equipment in the case of equipment break-down and power supply interruption. Contractor shall provide backup power

generation and dewatering system components and devise emergency procedures for maintaining continuous, uninterrupted dewatering operations.

E. The Contractor will obtain samples, submit for testing, and report results in conjunction with monitoring DETS attainment of the applicable Construction-related Surface Water Quality Criteria described herein as per specification Section 023200 - Sampling, Testing, and Data Evaluation. Contractor shall provide (and allow Engineer access to) sampling ports at the influent and effluent of each major treatment system component. The Contractor may at their discretion collect additional samples at the Contractor's own expense to assess treatment performance.

2.02 ADDITIONAL TREATMENT SYSTEMS (IF REQUIRED)

A. Treatment systems shall be implemented only if required to meet Construction-related Surface Water Quality Criteria described herein, as determined and requested by the Engineer or SD Representative. If required, supplemental treatment components shall be of sufficient size and capacity to handle the anticipated dewatering effluent flows, and to reduce contaminant concentrations to Construction-related Surface Water Quality Criteria and other Performance Criteria established for the Work, as described herein.

B. Additional treatment systems may consist of other types of materials and equipment required for treating the dewatering effluent to meet the Construction-related Surface Water Quality Criteria and other Performance Criteria.

C. If supplemental treatment unit operations to address COCs are brought online after the initial base DETS, an additional set of start-up samples will be collected per the start-up sampling procedures outlined herein to ensure the DETS system is properly treating the effluent in the modified configuration.

D. If groundwater treatment for dissolved arsenic (beyond sediment and particulate arsenic removal provided for in the Base DETS) is required, Contractor shall provide additional cost estimate with the Contractor's bid, including mobilization, demobilization, and daily operation costs, as described herein. This cost estimate shall be provided as a separate cost from the Base DETS. A submission of the Contractor's proposed approach to mitigate dissolved arsenic in the effluent is due with the Contractor's bid, with full design due with DETS Submittal. The Contractor will be notified by the Engineer of an exceedance requiring dissolved arsenic treatment. At that time, the Contractor will be required to mobilize the approved system to the site within 48 hours. The Contractor will not mobilize any additional treatment equipment other than what is in the base DETS to the site until notified by the Engineer.

E. If groundwater treatment for benzene or other VOCs (beyond sediment and arsenic removal provided for in the Base DETS) is required, Contractor shall provide additional cost estimate with the Contractor's bid, including mobilization, demobilization, and daily operation costs, as described herein. This cost estimate shall be provided as a separate cost from the Base DETS. A submission of the Contractor's proposed approach to mitigate benzene or other VOCs in the effluent is due with the Contractor's bid, with full design due with DETS Submittal. The Contractor will be notified by the Engineer of an exceedance requiring benzene or other VOC treatment. At that time, the Contractor will be required to mobilize the approved system to the site within 48 hours. The Contractor will not mobilize any additional treatment equipment other than what is in the base DETS to the site until notified by the Engineer.

F. If groundwater treatment for ammonia (beyond sediment and arsenic removal provided for in the Base DETS) is required, Contractor shall provide additional cost estimate with the

Contractor's bid, including mobilization, demobilization, and daily operation costs, as described herein. This cost estimate shall be provided as a separate cost from the Base DETS. A submission of the Contractor's proposed approach to mitigate ammonia in the effluent is due with the Contractor's bid, with full design due with DETS Submittal. The Contractor will be notified by the Engineer of an exceedance requiring ammonia treatment. At that time, the Contractor will be required to mobilize the approved system to the site within 48 hours. The Contractor will not mobilize any additional treatment equipment other than what is in the base DETS to the site until notified by the Engineer.

G. The Contractor shall incorporate any non-productive time due to interruptions in dewatering associated with mobilizing and installing additional treatment system components beyond the base DETS into the schedule and costs for mobilizing each additional treatment system for ammonia, benzene, or other contaminants of concern.

PART 3 - EXECUTION

3.01 DEWATERING SYSTEM

A. Install the dewatering system(s) for excavations in accordance with accepted shop drawings.

B. Provide all collection, pumping, and sedimentation control including fractionation tanks and bag filters to reduce suspended solids in effluent prior to discharge.

C. Control the inflow of water, including surface water and seepage, into the excavation at all times during construction and to permit all work to be performed in the dry.

D. Continuously operate the dewatering system(s) to:

1. Result in no damage to adjacent buildings, properties, structures, utilities, and completed work.

2. Prevent and remove any water accumulating in the excavation.

3. Meet the Construction-related Surface Water Quality Criteria and other Performance Criteria.

4. Collect, treat and legally discharge surface water, precipitation, seepage, groundwater and other water which may enter excavations.

5. Maintain dry undisturbed excavation subgrades for execution of subsequent construction operations in the dry.

6. Maintain and control the water level within the excavation to a minimum of 2-ft below subgrade during all excavation, construction, and backfilling operations beneath proposed structures. In other areas without proposed structures, maintain and control the water level within the excavation to a minimum of 1-ft below subgrade during all excavation, construction, and backfilling operations.

E. Perform sampling to verify compliance with treatment requirements specified herein.

F. Inform the SD Representative and Engineer in writing of any changes made to the system(s) to accommodate field conditions. Notification shall be provided no less than 24 hours prior to implementing the changes.

G. Provide, install, maintain, and operate pumps, wells, and related equipment, including standby equipment, in accordance with system/equipment manufacturer's recommendations and of sufficient capacity to adequately dewater excavations until the required construction, installation, backfilling, and other elements are completed.

H. Modify dewatering procedures which cause or may cause, in the opinion of the Engineer, damage to new or existing facilities, utilities, or other site features. Modifications to dewatering system(s) shall be made at no additional cost to the SDs.

I. Maintain continuous and complete effectiveness of all systems throughout the conduct of the Work.

J. Permanent utilities and piping shall not be used as part of dewatering system(s).

K. Following completion of the HBHA Pond outlet structure construction (including appropriate concrete curing) as per Section 033300 - Cast-in-Place Concrete, and sump pump removal, temporary dewatering sumps are to be backfilled and sealed with cement grout.

L. Remove dewatering sump materials and equipment upon completion of dewatering activities to facilitate site restoration.

3.02 ADDITIONAL CONSIDERATIONS FOR WEST HIDE PILE – LOWER SOUTH POND

A. The mechanical excavation of benzene-impacted sediments from the Lower South Pond will take place under dry conditions. To achieve dry conditions, a temporary 10 ft cofferdam structure (Port-a-Dam or similar) and an impermeable silt curtain (a portion of which will have permeable panels) will be installed within Lower South Pond as shown on the Drawings. Surface water will then be pumped out of the area enclosed by the temporary cofferdam. Additional localized sumps will be installed as required to allow construction in the dry.

B. In addition to the standard "Base" DETS treatment equipment outlined above, the Contractor is expected to have granular activated carbon (GAC) vessels on site capable of treating benzene and other VOCs amenable to treatment with GAC.

C. If the GAC vessels (or other treatment unit operations to address COCs identified in the treated effluent) are brought online after the initial DETS, an additional set of start-up samples will be collected per the start-up sampling procedures outlined herein to ensure the DETS system is properly treating the effluent in the modified configuration.

D. Treated water will be discharged via hose into the Lower South Pond, between the temporary cofferdam and silt curtain. If effluent results indicate system adjustments are necessary, discharge will be stopped and the addition (or subtraction via DETS influent sampling) of treatment processes will be performed as needed.

E. Prior to and during operation of the DETs at Lower South Pond, groundwater levels in monitoring wells remaining shall be monitored daily. These monitoring wells include MW-101, MW-104S, MW-10, and MW-106S).

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 312500

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work on the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Work is subdivided according to the following general areas (listed in order from upstream to downstream along the Halls Brook and Aberjona River waterways):

1. West Hide Pile (WHP), including the Lower South Pond immediately adjacent to WHP. Sediment removal action in LSP.

2. Permeable Cap System. Located adjacent to the Halls Brook Holding Area (HBHA) Pond.

3. HBHA Pond Remediation System Design, including the following remedy subcomponents:

   a. Energy Dissipation at two inlets to HBHA Pond: the Atlantic Avenue Drainway (AAD) and Boston Edison Company Drainway (a.k.a., Right of Way Number 9 [ROW No. 9] outfall).

   b. Halls Brook Diversion Structure and Stormwater Bypass System.

   c. Primary-Secondary Cell Cofferdam and Weir.

   d. Secondary Treatment Cell Water Treatment System and Related Components (Future Submission).

   e. HBHA Pond Outlet Structure Improvements.

4. Wells G&H and Cranberry Bog Conservation Area (CBCA) Sediment Removal. Located south of HBHA Pond.

5. Wetland Mitigation Site Design. Location to be determined, and submitted with future submission.

B. The resources within and downstream of the Work Areas cannot be further degraded by erosion resulting from this construction. The contract required erosion control measures involve a multi-tier approach. This approach includes, but is not limited to:

1. Construction of temporary access to the work area will require some placement of crushed stone and timber matting. Rough grading of the existing OU-1 cap is not allowed.

2. Delaying grubbing and exposing erosion susceptible materials in small increments during the workday.

3. Placement of fills at the site in a controlled fashion and construction of final surface covers on a piecemeal basis.

4. Management of the locations and protection systems for active and inactive stockpiles of materials, mitigating run-on and run-off.

5. Use of conventional straw bales, silt fences, straw wattles, coir rolls, and supplemental measures as needed strategically placed at locations shown on the Drawings, chosen by the Engineer, or chosen by Contractor based on work area location, work sequencing, and work to be performed.

C. Contractor shall design and construct erosion control systems to prevent erosional movement of soil from the following:

1. Work Areas to resource areas outside Limit of Work.

2. Work Areas and drainage channels containing surface waters.

D. The Contractor will monitor effectiveness of erosion and sedimentation controls by performing water quality sampling upstream and downstream of the Work Areas as work progresses in

accordance with specification Section 023200 - Sampling, Testing, and Data Evaluation (Surface Water Samples) to ensure compliance with the criteria presented herein, at the frequency outlined in this specification. Contractor will provide access to sampling location to allow the Engineer to sample if needed. The Contractor may conduct water quality sampling and analysis more frequently at their own discretion, and at no additional cost to the SDs.

E. The Work of this Section includes, but is not limited to:

1. Furnishing, installing, and maintaining erosion control materials in accordance with the Drawings and Specifications. Erosion control includes, but is not limited to, perimeter erosion control, intermediate erosion control in excavation, and erosion controls to protect downstream wetland resources.

2. Preventing and controlling soil erosion such that there is no impact to resource areas.

3. Managing stormwater during construction.

4. Sampling to document conformance with the specifications.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 023200 – Sampling, Testing, and Data Evaluation

C. SECTION 026113 – Excavated Soil and Materials Management Plan

D. SECTION 310000 – Earthwork

E. SECTION 310519 – Non-Woven Geotextile

F. SECTION 311100 – Site Clearing

G. SECTION 312319 – Construction Dewatering and Water Treatment

H. SECTION 316216 – Steel Sheet Piles

I. SECTION 327100 – Wetland and Upland Restoration

J. SECTION 350140 – Temporary Water Diversions (Operation and Maintenance of Waterway Construction)

K. SECTION 441123 – Construction Dust and Odor Control

L. Drawings

M. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. Inspect erosion controls daily. Remove collected sediment on an as-needed basis.

B. Maintain erosion controls in good repair until all disturbed areas have been fully stabilized with vegetation or other means.

C. Contractor shall attend a pre-construction meeting with the SD's Representative, EPA, and Engineer to ensure that the necessary erosion controls and site management is understood by the Contractor.

D. Sampling and Analysis

1. Sampling performed by the Contractor.

2. Analysis in the field by the Contractor with turbidimeter using instrument approved by the Engineer and otherwise in conformance with the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP).

3. Sample Locations: Upstream "background" and downstream locations established at the various Work Areas. See Drawings. If not shown on Drawings, assume one upstream and one downstream of each Work Area. In the event multiple Work Areas in the same vicinity (e.g., HBHA Pond) are occurring concurrently, the upstream and downstream locations will be modified as needed and approved by the Engineer. The Contractor may at their discretion collect additional samples at other locations and frequencies at the Contractor's own expense to assess performance, evaluate potential areas of erosion concern, or to otherwise improve erosion control.

4. Sample Frequency: Minimum of three times daily (Early Morning, Midday, End of Day), and as needed based on site conditions during construction as directed by the Engineer.

5. Parameter: Turbidity. Performance of erosion and sedimentation control systems shall meet at the downstream location the following numeric Performance Criteria (Construction-related Surface Water Quality Criteria): 20 Nephalometric Turbidity Units (NTUs) above the background value established at the upstream location.

6. Additional confirmatory sampling and testing may be performed by the Engineer to verify erosion and sedimentation control system performance as describe in specification Section 023200 – Sampling, Testing, and Data Evaluation.

1.07 SPECIAL SITE CONDITIONS

A. Flow of soil-laden water into resource areas shall be prevented during construction. If erosion is observed, causing movement of soil into resource areas or gullying of surface areas, the Contractor shall undertake measures to arrest the erosion and restore impacted resource areas to prior conditions.

B. Temporary seeding and mulching, and redirection of surface water flow shall be utilized when necessary. All erosion control measures are to be implemented as required prior to starting, during, and after construction activities.

C. Loaming and seeding of all areas requiring the same shall be scheduled to have that Work done as soon as is practical to minimize erosion. Prepare and plant in accordance with Section 327100 – Wetland and Upland Restoration, unless otherwise approved by the Engineer.

1.08 COORDINATION

A. Coordinate Erosion and Sedimentation Control Plan with Construction Sequence Plan.

B. Coordinate installation of wetland replacement area erosion controls with wetlands restoration schedule.

C. Contractor shall cooperate to allow EPA, SD's Representative, and Engineer to inspect erosion control measures.

1.09 SUBMITTALS

A. Submit to the Engineer for review product literature for all commercial products to be used. Plans and details shall conform to the intent of Drawings and specifications. **(Submittal Group 3)**

B. Notify Engineer when installation of initial work area perimeter erosion controls is complete. **(Submittal Group 4)**

PART 2 - PRODUCTS

2.01 MATERIALS

A. Straw Bales: Securely tied baled straw at least 14 in. by 18 in. by 30 in. long. Secure with #2 re-bar steel pickets or 1-in. by 1-in. oak stakes, at least 3.0 ft in length. Clean straw bales shall be free of reproductive plant parts (e.g., seed heads, etc.) from the harvested plants that can contribute to invasive species development.

B. Erosion control materials used at the site shall not contain plant parts capable of reproducing (e.g., seed, rhizomes, etc.). Straw bales and other erosion control materials delivered to the site may be rejected by the Engineer or SD Representative for use if they contain reproductive plant parts.

C. Temporary Seed Mixture: Temporary seed is only to be required when or if it is impractical to establish permanent protective vegetation on disturbed earth by October 15. Use "Conservation Mix" or seed mixture approved by the Engineer and application rates acceptable to the Engineer.

D. Permanent Seed Mixture: See specification Section 327100 – Wetland and Upland Restoration.

E. Permanent Seed Mixture: In areas that require seeding, the following seed mix shall be used: Seed shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable state seed laws. Seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than 90, a percentage of purity not less than 85 and shall have not more than one percent (1 %) weed content and contain no noxious weeds. The mixtures shall consist of seed proportioned by weight.

1. Seed for all areas shall be as follows:

40%	Clemfine, Rebel 11 or Tribute Tall Fescue
15%	Palmer II Perennial Ryegrass
10%	Jamestown Chewings Fescue
10%	Reliant Hard Fescue
10%	Birdsfoot Trefoil (Arvenis variety)
5%	Switchgrass
5%	White Clover
5%	Redtop (Streaker variety)

2. The seeding rate shall be 5 pounds per 1000 square feet.

F. Wetland Seed: See Section 327100 – Wetland and Upland Restoration.

G. Tackifier: Tackifier shall consist of naturally based material (i.e., wood cellulose, paper, or other plant products) or polymer-based product acceptable to the Engineer used to contain seed and provide stability on shallow slopes. Asphalt based materials shall not be used.

H. Straw Wattles shall consist of North American Green Sedimax-SW (Straw Wattles).

I. Floc Logs shall consist of Applied Polymer Systems (APS) 700 Series Floc Logs.

J. Coir Logs and Filtration Rolls shall consist of North American Green Sedimax-FR (Filtration Rolls) that are 100% biodegradable, made of straw and coconut fiber. The netting shall be biodegradable jute netting.

K. Crushed Stone: ¾-in. Crushed Stone (MHD M2.01.4) as specified in Section 310000 – Earthwork.

L. Erosion Control Blankets: Erosion control blankets shall consist of biodegradable natural fiber materials. The matting matrix shall consist of agricultural straw, coconut fibers, or a mixture of the two, depending on the matting type indicated on the Drawings. Erosion control blankets shall be as specified in Section 310000 – Earthwork.

M. Silt Fence: The filter fabric shall be a material suitable for erosion control applications and shall be one of those included on the Massachusetts Highway Department's List of Approved Materials and Supplies. Wood posts shall be oak, 2-in. by 2-in. in section, and at least 4.5 ft in

length. Support netting shall be heavy-duty plastic mesh. For prefabricated silt fence, 1 in. by 1-in. wood posts will be permitted.

N. Welded Wire Fabric: 14-gauge, galvanized steel, 6 in. by 6 in. welded wire mesh extending from ground surface to 6 in. above top of silt fence.

O. Silt Curtain: Consisting of the following:

1. Skirt: Main panel skirt made from 10 oz/sq yd non-woven geotextile filter fabric skirt.

2. Boom: 12" dia. flotation boom (50 lbs/ft buoyancy), with 22 oz PVC coated polyester float cover.

3. Tension Cable: 5/16" dia., PVC Coated, 7x19, galvanized steel top tension cable (9,800 lb break).

4. Bottom Ballast: Double, 5/16" dia., galvanized steel ballast chain enclosed within 22 oz PVC coated polyester pocket.

5. Skirt reefing lines.

6. Suitable anchorage.

PART 3 - EXECUTION

3.01 INSTALLATION OF EROSION CONTROLS FOR TEMPORARY DIVERSION STRUCTURE

A. Before installing the Temporary Diversion Piping, the grading at the pipe outlets shall be conducted to set the Erosion Control blankets and stone at lines and grades shown on the Drawings. If water levels in the wetland are elevated above El. 52 the Contractor and Engineer may need to adjust the elevations of the proposed erosion control and rip rap apron at the pipe outlet.

B. Seed areas in the upland if areas are disturbed.

3.02 STRAW WATTLES, STRAW BALES, AND SILT FENCE

A. The straw wattles shall be placed and anchored as shown on the drawings. To prevent damage to the underlying OU-1 cap geosynthetic materials, in Class C and Class D Land, stakes shall not be driven to a depth greater than 12-inches.

B. Embed straw bales into soil and anchor in place with stakes. Where used, bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. All straw bales and silt fence shall be entrenched 4 in. below ground surface to prevent runoff from passing below the straw bales.

C. The erosion check bales shall be entrenched and backfilled. The trench shall be excavated the width of the bale and the length of the check to a minimum depth of 4 in. After the bales are staked and chinked, the excavated soil shall be backfilled against the check bales.

D. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together.

E. Straw bales shall be replaced when they become clogged with soil particles or as directed by the Engineer.

F. Erect silt fence as shown on the Drawings and maintain or replace as necessary or as directed by the Engineer.

G. A minimum 6-in. deep by 6-in. wide trench shall be dug where the silt fence is to be installed. This shall not exceed 12-inches to prevent damage to the underlying OU-1 cap.

H. The silt fence shall be positioned in the trench with the fence posts set at 8 ft on center (maximum). The trench shall be backfilled and the soil compacted over the silt fence fabric. Posts shall not be driven more than 12-inches in areas of the OU-1 cap.

I. The silt fence shall be stapled to each post. When joints are necessary, silt fence shall be spliced together only at support posts. Splices shall consist of a 6-in. overlap, and shall be securely sealed.

J. The installed height of the fence shall be 2.5 ft (minimum). However, height shall not exceed 36 in. since higher barriers may impound volumes of water sufficient to cause failure of the fence structure.

3.03 FILTER ROLL CHECK DAMS AND FLOC LOGS

A. The Filter Roll Check Dams are to be installed downstream of the sediment excavations at the Wells G&H Wetland Areas and the CBCA Wetland Areas as shown on the Drawings.

B. The APS 700 Series Floc Logs shall be placed within the Check Dams before the excavation of sediment is started adjacent to the Check Dam.

3.04 CRUSHED STONE

A. Crushed stone shall be placed in accordance with the Drawings and Section 310000 – Earthwork, and at the direction of the Engineer.

3.05 SILT CURTAIN

A. Silt curtain shall be installed in accordance with the manufacturer's recommendations. At a minimum, silt curtain shall be secured at the edges, at bends shown on the Drawings, and the channel centerline (in addition to the continuous ballast chain as shown on the Drawings).

B. Curtain height and anchoring approach shall allow rise and fall of the water surface while remaining anchored to the bottom. Contractor shall provide sufficient curtain length and area to facilitate flow of water through the curtain without dislodging the curtain from its anchorage at the edge of water and along the bottom of the curtain.

C. The Contractor shall replace silt curtain with new curtain if it becomes clogged, as identified by the Engineer, during conduct of the Work at no additional cost to the SDs.

3.06 EROSION CONTROL BLANKETS

A. Erosion control blankets shall be installed in accordance with the manufacturer's recommendations. At a minimum, matting shall be secured to the soil surface by placing staples or stakes at 18 in. by 24 in. centers with smaller dimension oriented across slope. The edges of parallel matting shall be staked with a 4 in. overlap.

B. Refer to Section 310000 – Earthwork for erosion control blanket material specifications.

C. Place seed in accordance with Section 327100 – Wetland and Upland Restoration. .

3.07 MAINTENANCE AND COMPLIANCE

A. The Engineer has the authority to verify, enforce, and to specify maintenance activities and to require that erosion controls have been properly maintained. Erosion controls shall be maintained by the Contractor to the satisfaction of the SD Representative.

B. Erosion and pollution controls must be able to prevent both the movement of soil materials and the intrusion of sediment-laden discharges into undisturbed resource areas and other environmentally sensitive areas.

C. Erosion and sedimentation controls shall be routinely inspected and maintained by the Contractor. At a minimum, erosion controls shall be visually inspected at the start of day, mid-day, at the end of the day, following storm event, and as requested by Engineer. The Contractor shall conduct inspections of the erosion and sedimentation controls promptly after rain events or when directed by the Engineer. Impacted resource areas shall be restored to prior conditions.

D. The Contractor shall aggressively and expeditiously perform cleaning and maintenance work to remedy identified problems to the satisfaction of the Engineer. Damaged controls shall be repaired or replaced after each storm events or as directed by the Engineer.

E. At a minimum, erosion and sedimentation controls will be cleaned when sediment deposits reach 6 in. in height adjacent to the straw bales, silt fences, or coir logs.

F. The Contractor shall be advised that the Engineer will monitor upstream background and downstream water quality to confirm Contractors compliance with Erosion Control Requirements described herein. The performance criterion is included in the RAWP, as amended and updated (see most current version). Should additional erosion controls be necessary, as determined by the Engineer, the Contractor will be responsible to install and implement additional erosion mitigation measures at no additional cost to the SDs.

3.08 DAMAGE, REPAIR, AND REMOVAL

A. Repair all damages caused by soil erosion or construction equipment at or before the end of each working day.

B. Contractor shall maintain a supply of extra erosion control materials under cover on the Site in order to make emergency repairs to erosion controls. Store the following minimum quantities of materials at the Site:

1. 50 straw bales (under cover)

2. 100 stakes

3. 200 linear ft of silt fencing

4. 60 linear ft of silt curtain

5. 200 linear ft of erosion control blanket, North American Green C125BN or approved equivalent (under cover)

6. 20 cy of ¾-in. crushed stone

C. Straw bales, silt fences, and other erosion protection systems shall be maintained by the Contractor and will be removed only when the adjacent exposed area is stabilized; i.e., the area meets the acceptance criteria in Section 327100 – Wetland Restoration or has established stone cover and is free from future uncontrolled discharges. Contractor shall not remove any erosion control elements without prior approval from the SD Representative.

D. Before controls are removed, all accumulated sediment shall be removed and placed within a roll-off in the designated Soil Stockpile Management Area.

3.09 STORMWATER MANAGEMENT AND EROSION CONTROL

A. Temporary erosion controls shall be installed until vegetation has been permanently stabilized. Temporary erosion controls may include supplemental staked straw bales, silt fence, silt curtain, seeding, tackifier or crushed stone.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 313619

ARMOR MATTRESS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section contains general information that applies to all Work performed under the Contract and is inherently made a part of each Specification Section.

B. Attention is directed to the CONTRACT AND GENERAL REQUIREMENTS and all other sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

D. Coordinate work with that of all other trades affecting or effected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

E. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

F. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

G. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Abbreviated Summary of Work

1. The Work of the Contract is indicated by the Contract Documents.

2. The Contract includes coordination of all Work indicated by the Contract Documents.

3. The Contract is unavoidably affected by governmental regulations, weather and natural phenomena, an access agreement with one or more land owners, and other forces and conditions not described in the Contract Documents.

B. General Description

1. Contact "Dig Safe": Comply with Massachusetts General Laws, Chapter 82, Section 40 and all applicable codes, rules, regulations. Do not begin any intrusive activities without complying with the law. Ensure that all utilities have been located and marked prior to beginning work.

2. Submittal preparation.

3. Where applicable, coordinating work with the railroad, including training staff as required by railroad.

4. Where applicable, coordinating work with utility owners.

5. The work covered by this section consists of furnishing all labor, materials, plant and equipment and performing all operations required to provide Armor Mattresses. The compartmental rectangular Mattresses shall be filled with stone. The required width and depth of the Mattress units shall be as shown on the drawings. The Mattress units may be fabricated and filled off-site or on-site, for lifting into place.

6. NOTE: Mattresses, larger (but not thicker) than shown on the Drawings, may be utilized, if approved by the Engineer and SD Representative. The Contractor shall have the proper lifting equipment (including spreader bar) to lift and place the larger mattresses. The final approval for the use of larger Mattresses shall be obtained from the Engineer and SD Representative.

1.03 RELATED SECTIONS

A. SECTION 011100 – Summary of Work

B. SECTION 013529 – Health & Safety

C. SECTION 015000 – Temporary Facilities and Controls

D. SECTION 020000 – Existing Conditions

E. SECTION 310000 – Earthwork

F. SECTION 310519.13 – Non-woven Geotextile

G. SECTION 026113 – Excavated Soil and Materials Management Plan

H. SECTION 312500 – Erosion and Sedimentation Controls

I. SECTION 441123 – Construction Dust and Odor Control

J. Drawings

K. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. American Association of State Highway and Transportation Officials (AASHTO)

   a. Standard Specification for Highway Bridges (1997 Interim).

2. American Society for Testing and Materials (ASTM):

   a. D 1388 Standard Test Method for Stiffness of Fabrics (Option A).

   b. D 4355 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus.

   c. D 4439 Standard Terminology for Geosynthetics

   d. D 4759 Standard Practice for Determining the Specification Conformance of Geosynthetics.

   e. D 5732 Standard Test Method for Stiffness of Nonwoven Fabrics Using the Cantilever Test

   f. D 5818 Standard Practice for Exposure and Retrieval of Samples to Evaluate installation Damage of Geosynthetics.

   g. D 6637 Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method

3. Geosynthetic Institute:

   a. GG2-87 Standard Test Method for Individual Geogrid Junction Strength.

4. U. S. Environmental Protection Agency

   a. EPA9090 Compatibility Test for Wastes and Membrane Liners.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

B. Below-grade debris and obstructions may be present onsite. Debris and obstructions may include bricks, metal scraps, piping, tools, concrete, wood, and boulders.

C. Contaminated soils and sediments exist on site. Elevated concentrations of site-related contaminants of concerns (COCs) are present in soil and/or sediments. The Contractor shall be responsible for the health and safety of all workers engaged in construction activities. Work shall be performed in accordance with the Contractor's Health and Safety Plan (See Section 013529 – Health & Safety for Contractor health and safety requirements).

D. Conduct the Work in a manner that is protective of public health and safety. The Contractor shall control public access to the Work Areas and shall control the concentration of dust and odors at the Limit of Work perimeter. See Sections 015000 – Temporary Facilities and Controls and 441123 – Construction Dust and Odor Control for more information.

E. Conduct the Work in a manner that is protective of surface water quality and wetlands. Contractor shall control erosion as specified in Section 312500 – Erosion and Sedimentation Controls.

1.06 QUALITY ASSURANCE

A. Qualifications of Contractor

1. The Contractor conducting the Armor Mattress placement work shall possess a minimum of 10 years experience in the construction of underwater structures.

B. On-Site Technical Assistance

1. The Contractor shall coordinate for a qualified representative of the Armor Mattress supplier to be present at the job site during the first week of installation to provide technical assistance as needed. The Contractor shall remain solely responsible for the quality of installation.

1.07 SUBMITTALS

A. The following shall be submitted in accordance with Section 013300 - Submittal Procedures.

B. Samples - **(Submittal Group 3)** The Contractor shall furnish physical examples of the Mattress material, stone for filling Mattresses, and connectors that are physically identical to the materials to be used in the contract work.

C. Shop Drawings - **(Submittal Group 2)** Contractor shall provide shop drawings, specifically for this contract, depicting the fabrication of the Armor Mattresses including all connections.

D. The Contractor shall furnish the SD's Representative and Engineer, in duplicate, a manufacturer's certificate or affidavit signed by a legally authorized official from the company manufacturing the Armor Mattresses that all materials contained within that shipment meet the composition, physical, and manufacturing requirements stated in this specification (see also Table 313613-1). Certificate of Compliance shall be submitted for the Armor Mattresses prior to delivery to the work site. A copy of all test results performed by the Contractor or his supplier which are necessary to assure compliance with the Drawings and specifications shall also be furnished to the Engineer. Acceptance of furnished material will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the Engineer. **(Submittal Group 3)**

E. Sieve Curve - **(Submittal Group 3)** The Contractor shall submit a sample for sieve testing for the stone proposed for filling the Armor Mattresses as per specification Section 310000 - Earthwork.

F. Contractor shall provide manufacturer's recommendations for fabrication, lining with geotextile, filling, installation and repair of the Armor Mattresses. **(Submittal Group 3)**

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall check the geogrid upon delivery to ensure that the proper material has been received, and is free from defects that may impair its strength and durability.

B. Storage and Protection:

1. Prevent excessive mud, wet concrete, epoxy, or other deleterious materials from coming in contact with and affixing to mattress materials.

2. Store at temperatures above -20 ºF (-29 ºC) and not greater than 140 ºF (60 ºC).

3. Rolled materials may be laid flat or stood on end.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. An approved source of geogrid is Tensar International Corporation, Inc., Atlanta, GA or their designated representative.

B. Substitutions – See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Geogrids

1. Tensar International Corporation integrally formed Biaxial Geogrid BX1500.

2. The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant polypropylene or high density polyethylene material with molecular weight and molecular characteristics which impart high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation and/or long-term environmental stress.

3. The Armor Mattresses shall be constructed of structural geogrid conforming to the following material properties.

4. Armor Mattress Geogrid Properties:

Table 313619-1
Geogrid Specifications

Properties	Units	Machine Direction (MD)[1]	Cross Machine Direction (XMD)[1]
Index Properties			
Aperture Dimensions[2]	inch	1.0	1.2
Minimum Rib Thickness[2]	inch	0.07	0.07
Load Capacity			
True 1% Tensile Strength in Use[3]	lb/ft	24,000	28,400
Structural Integrity			
Junction Strength[4]	lb/ft	1,665	1,911
Flexural Stiffness[5]	mg-cm	2,000,000	2,000,000
Durability			
Resistance to Long Term Degradation[6]	%	100	100
Resistance to UV Degradation[7]	%	98	98
Dimensions and Delivery - The biaxial geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 4.0 meters (13.1 ft) in width and 50.0 meters (164 ft) in length. A typical truckload quantity is 180 rolls.			

Notes:
1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D4759-02. Brief descriptions of test procedures are given in the following notes.
2. Nominal dimensions.
3. True resistance to elongation when initially subjected to a load determined in accordance with ASTM D6637-01 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
4. Load transfer capability determined in accordance with ASTM D7737-11.
5. Resistance to bending force determined in accordance with ASTM D5732-01, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a “ladder”), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of MD and XMD Flexural Stiffness values.
6. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.
7. Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultraviolet light and aggressive weathering in accordance with ASTM D4355-05.

5. Prior to construction the manufacturer shall provide certification that the geogrid materials proposed conform to these requirements. The Contractor, or the supplier as his agent, shall furnish to the Engineer a Certificate of Compliance certifying that the structural geogrid materials comply with the applicable sections of these specifications. A copy of all test results performed by the Contractor or his supplier which are necessary to assure compliance with the Drawings and specifications shall also be furnished to the Engineer. Acceptance of furnished material will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the Engineer.

B. Braid

1. The braid material shall be a hollow-core polyethylene braid and shall have a minimum diameter of 3/16 inch (nominal) with a breaking strength of not less than 400 lb load on a test specimen 36 inches in length. For UV stability, the braid material shall have a minimum carbon black content of 2.0% throughout.

C. Stone for Filling Armor Mattress

1. Refer to specification Section 310000 – Earthwork for gradation requirements.

D. Non-woven Geotextile

1. Refer to Drawings and specification Section 310519.13 – Non-woven Geotextile.

E. Extensions on Armor Mattresses

1. Extensions on Mattresses shall be constructed of the same material as the Armor Mattress.

PART 3 - EXECUTION

3.01 ASSEMBLY

A. General - Empty Mattress units shall be assembled as recommended by the manufacturer and as indicated on the Drawings. The joints where the ends and baffles of each unit join the top or bottom of the unit shall be made with a mechanical connection.

B. Braids - All cut ends of braid material shall be knotted within 1 inch to 2 inch of the end to prevent raveling of the braid material. The braid material shall be securely knotted to the geogrid at all ends of all stitched seams, and at a spacing not to exceed 6 feet along any stitched seam. Pieces of braid material may be spliced end to end by securely knotting. The stitches along each seam shall be sufficiently tight to close the gap between the adjacent pieces of geogrid. The braid material shall be stitched through each pair of apertures along each seam at least once. The spacing of stitches shall be reasonably uniform at approximately 6 (minimum) stitches per foot along the entire length of each seam.

C. Filling with Stone - Stone filling operations shall carefully proceed with placement by hand or machine so as not to damage the geogrid, to assure a minimum of voids between the matstones, and to avoid deformation throughout the filling process. Undue bulging of the Mattress material shall be avoided. The maximum height from which the stone may be dropped into the basket units shall be 1 foot. The stone shall be leveled with the top of the Mattress to allow for proper closing of the lid. The Mattresses shall be closed over the stone as recommended by the manufacturer.

3.02 PREPARATION

A. Perform clearing and grubbing.

B. Divert surface water to maintain Halls Brook flow into Halls Brook Holding Area (HBHA) Pond and construct other temporary water control structures to facilitate excavation in the dry.

C. Remove, size, and containerize debris as shown on the Drawings and described in the specifications.

D. Excavate to reach suitable subgrade layer, as determined in the field by the Engineer based on field conditions as described in specification Section 310000 – Earthwork. Remove debris, plant material, large stones, soils unsuitable as a bearing surface, and other deleterious material.

E. Place and compact fill soils acting as the Armor Mattress subgrade to lines, grades and tolerances shown on the Drawings and specified in the specifications. Unless otherwise directed by the Engineer, the Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations. The Contractor shall not proceed until all unsatisfactory conditions have been remedied. No mattress units shall be placed on the subgrade until the prepared area has been approved by the Engineer.

F. Compact/proof-roll subgrade surface.

G. Place concrete seepage keyway and other concrete work as shown on the Drawings and described in the specifications.

H. Where applicable, perimeter trenches shall be excavated as shown on the Drawings or as directed by the Engineer; excavated material shall be temporarily stockpiled for use in re-filling the perimeter anchor trenches unless indicated otherwise.

I. Install non-woven geotextile layer on the prepared subgrade and in the anchor trenches as shown on the Drawings and specified in Section 310519.13 – Non-woven Geotextile, and as follows:

1. Geotextile shall be placed in intimate contact with the subgrade and shall be free of tension. Some wrinkling of the geotextile is desirable in order to reduce the potential for tensile stresses developing in the geotextile. Where applicable, the geotextile shall extend into the perimeter trenches. Unless otherwise called for on the Drawings or approved by the Engineer, the geotextile shall be lapped a minimum of 12 inches at ends and sides of adjoining panels. Where applicable, the upstream or upslope panel of geotextile shall be placed on top of the downstream or downslope panel of geotextile at the overlap. Geotextile shall be cut to fit snugly against abutting structures. Staples may be used to temporarily secure the geotextile prior to installation of the mattress units.

2. All fabric that is torn or punctured shall be repaired or replaced by the Contractor at no additional cost to the SDs (Owners). Unless otherwise approved by the Engineer, the repair shall consist of a patch of the same geotextile material placed over the ruptured area and lapped a minimum of 36 inches beyond the edge of any part of the rupture. No vehicular traffic shall be permitted to operate directly on the geotextile.

3.03 INSTALLATION

A. Mattresses shall be set to the required lines and grades as shown on the Drawings. Adjacent Mattresses shall abut each other along the entire perimeter of their contact surfaces, to obtain a monolithic structure. The allowable tolerance on the space between adjacent Mattresses shall not be greater than 4 inches.

B. The procedure used in placement of the units shall be in accordance with the recommendations of the system supplier and as approved by the SD's Representative and Engineer.

3.04 REPAIRS

A. Damaged Mattresses shall be replaced or repaired in a manner approved by the SD's Representative and Engineer. Damaged braid shall be repaired by installing a new braided seam in accordance with the project specifications, and extending at least one foot in either direction beyond the location of the damaged braid.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 327100

WETLAND AND UPLAND RESTORATION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to:

1. Furnishing and installing new wetland and upland areas including, without limitation: fabric materials, stones, soils, grading, plantings, erosion control measures, seeding, and structural habitat features.

2. Protection, maintenance, replacement of defective work, and certification and approval of finished products.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 026113 – Excavated Soil and Materials Management Plan

C. SECTION 310000 – Earthwork

D. SECTION 312319 – Construction Dewatering and Water Treatment

E. SECTION 312500 – Erosion and Sedimentation Controls

F. SECTION 310519.13 – Non-woven Geotextile

G. SECTION 441123 – Construction Dust and Odor Control

H. Drawings

I. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 COORDINATION

A. Coordinate earthwork and erosion controls to determine when wetland replacement and restoration, as described in the section, may proceed.

B. Assure erosion control measures are in place as described in Section 312500 - Erosion and Sedimentation Controls, prior to commencing work.

C. The timing and sequence of seeding is dependent on a number of factors, including the type of seed, hydrologic regime, and the construction schedule, as described in Section 1.08.C, below.

1.08 CONSTRUCTION SEQUENCE

A. Place erosion control measures around the wetland and upland work area to be reconstructed, as required.

B. Follow the construction sequencing in the Contractor's approved Construction Sequence Plan. In general, construction will proceed from upstream to downstream for the project Work Areas.

C. Each Work Area has its own construction sequence and the scope of wetland and upland restoration varies as shown on the Drawings.

D. The window of time available for wetland seeding is dependent on the type of seed, hydrologic conditions such as the elevation of the water in wetlands adjacent to the Work Areas, and the construction schedule. Preferred and alternate seeding times are provided in these Specifications and/or the Drawings. These planting seasons are subject to modifications, based on the construction schedule and/or hydrologic conditions. Therefore, the Contractor shall coordinate with the Engineer and SD Representative to determine if seeding is done following construction or the following spring season.

E. The Contractor's construction sequence shall eliminate the need to travel (by pedestrian, vehicle, and equipment) across the finish surface materials of the seeded sections of wetland, except for hand tools and personnel as may be necessary for seeding purposes, repair and maintenance.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Materials:

1. Deliver packaged materials to the site in original, unopened containers, showing weight, manufacturer's name and guaranteed analysis.

2. Store materials in a manner that their effectiveness and usability will not be diminished or destroyed. Materials shall remain uniform in composition, dry, unfrozen and free flowing. Any material that has become caked or otherwise damaged or does not meet the specified requirements will be rejected.

B. Plants:

1. The plants required for specific locations are shown on the Drawings.

1.10 SUBMITTALS

A. Submit results of tests verifying that the Wetland Soil Mixture contains at least 12 percent by weight of organic material and other tests and submittals required for earth materials as per Section 310000 - Earthwork. **(Submittal Group 3)**

B. Submit manufacturers' material specifications for seed, fertilizer, and hydroseed mixture as appropriate. **(Submittal Group 3)**

C. Certificates of Compliance: **(Submittal Group 3)**

1. Submit manufacturer's Certificate of Compliance to the specifications with each shipment of each type of seed. The certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. Seed shall not be sown prior to submittal of the certificates.

2. Submit a certified statement for the hydroseed mix to be used to include the amounts of seed and processed fiber per 100 gallons of water. The statement shall also include the amounts and type of seed mixture used.

PART 2 - PRODUCTS

2.01 EARTH MATERIALS.

A. Wetland Organic Soils: As defined in Section 310000 - Earthwork.

B. Loam: As defined in Section 310000 - Earthwork.

C. Leaf Mold: Leaf mold shall be a highly organic dark brown to black spongy residue resulting from the well aerated composting of deciduous tree parts, free of plants and their roots, debris or other extraneous matter and shall be uncontaminated by foreign matter and substances harmful to plant growth. The organic matter shall not be less than 85 percent by weight.

D. Earth materials used for wetland restoration, including but not limited to, wetland organic soil, loam, leaf mold, shall not be harvested from an area that contained invasive species plant parts (seed, rhizomes, etc.) or contain any materials with invasive plant parts present.

2.02 FERTILIZER

A. Fertilizer may be used for mixing with wetland seed to provide bulk to this very fine seed mixture and achieve the application rate. Fertilizer used for wetland seeding shall contain the following percentage of available plant food by weight: 12 percent nitrogen, 6 percent potash, or similar concentrations as approved.

B. For all fertilizers, at least 50 percent of available nitrogen shall be in a slow-release form as is found in certain urea-formed products, or natural organic forms, or a combination of both. Exact percentages of the fertilizer components may vary in accordance with the soil test report.

2.03 FABRIC MATERIALS AND STAKES

A. Coir Logs shall be North American Green Sedimax – FR (Filter Rolls) as described in Section 312500 - Erosion and Sedimentation Controls.

B. Wood stakes. Pine, oak or fir, 1 in. by 1 in. by 3 ft long, used for marking limits of planting areas.

2.04 PLANT MATERIALS

A. Wetland Seed Mix:

1. The Wetland Seed Mix shall conform to the New England Wetland Plants, Inc. New England Wetmix (Wetland Seed Mix), and in shall be applied at an Application Rate of 18 lbs per Acre, as recommended by New England Wetland Plants Inc. of Amherst, Massachusetts.

2. Seed mix shall be fresh, clean, dry, new-crop seed. Weed seed content shall not exceed 1 percent.

B. Upland Seed Mix:

1. Seed mix shall conform to seed mix shown on Drawings.

C. Plantings

1. Provide plant, shrub, tree, and other vegetation types as listed on the Drawings.

2. Substitutions for species described on the Drawings must have Engineer's approval.

PART 3 - EXECUTION.

3.01 SUBGRADE ELEVATIONS

A. After subgrade has been prepared as specified under Section 310000 – Earthwork, inspect subgrade to assure compliance with final grading conditions.

B. Employ surveyor to determine subgrade elevations.

3.02 EQUIPMENT

A. Equipment to be used shall be in clean condition prior to entering the work area such that no mud containing invasive seeds or other plant parts capable of reproducing are inadvertently brought onto the site.

3.03 PLACEMENT OF COIR ROLLS

A. Following earthwork activities, place and anchor Coir (Coconut fiber) Rolls as shown on Drawings and in accordance with manufacturer's recommendations.

B. Where indicated on the Drawings, backfill areas upslope of the Coir Rolls with Wetland Organic Soil.

3.04 APPLY WETLAND ORGANIC SOIL TO SUBGRADE.

A. Wetland Organic Soil. Apply Wetland Organic Soil to subgrade in thickness as shown on the Drawings.

1. Preserve any "pit and mound" topography of the subgrade into the finish grade of the Wetland Organic Soil.

2. Lightly spread the soil mixture into place, but do not compact.

3. Once placed, do not traverse the soil with equipment or vehicles.

4. Place the Wetland Organic Soil on the slopes to the lines shown on the Drawings, preserving the subgrade elevations between the various wetland sections identified on the Drawings.

3.05 APPLY LOAM TO SUBGRADE IN UPLAND AREAS.

A. Apply loam to subgrade in a thickness as per the Drawings.

3.06 STRAW WATTLES AND BALES

A. Straw wattles and bales shall be in accordance with Section 312500 - Erosion and Sedimentation Controls.

3.07 SEEDING

A. Wetland areas specified on Drawings shall be seeded after initial planting. Seeding shall be performed between April 15 and May 31, or August 31 and October 15. No seeding is permitted when flooded or inundated conditions exist.

B. Where the seedbed has become compacted, it shall be scarified to a depth of 3 in. prior to fine raking. No seeding will be permitted on areas where the seedbed has not been properly prepared or where the soil is compacted.

C. Seed mixture shall be spread directly on the surface of the Wetland Organic Soil prior to placement of erosion control blankets, using the methods described below.

D. The application rate shall conform to the recommended guidelines published by the manufacturer (or as provided in the Drawings). Because the wetland seed is very fine, a bulking material such as vermiculite or a granular fertilizer may be mixed with this seed to achieve the application rate. A Culti-packer or approved equal equipment may be used to cover the seed and to form the seedbed in one operation. Otherwise, seed shall be lightly raked into the soil to a depth of between 1/8 in. to 1/4 in., and the entire seeded area shall be rolled with a light roller. In upland areas having slopes of 3:1 or steeper, and in drainage swales, the Contractor shall overseed immediately after sowing the specified seed mix. Overseeding shall be sown at the rate of 3 pounds per 1,000 sq. ft.

E. Hydroseeding slurry shall contain seed at the recommended application rates published by the manufacturer, or as provided in the Drawings. Wood cellulose fiber mulch shall be included in the hydroseeding slurry to achieve an application rate of 2 tons per acre. The hydroseeding slurry for upland seeding shall contain fertilizer at a rate of 850 pounds per acre. The slurry shall be mixed and kept in an agitated state so the materials are uniformly suspended in the water. The slurry shall be applied evenly over the area to be seeded by an operator thoroughly familiar with this type of seeding operation.

3.08 PLANTING

A. Planting materials in each area shall be as shown on the Drawings.

B. Prior to commencing plantings, provide plant materials to Engineer or SD Representative for inspection and approval.

C. Planting Season:

1. Between May 1 and June 15; or

2. Between September 1and October 15.

D. Planting Holes.

1. Holes shall be of sufficient width and depth to allow easy placement of the plant at a depth that is one inch deeper into the soil than it was grown at the nursery.

2. If the root system is container bound, the roots shall be carefully freed, separated, and spread out such that the roots can grow without further constriction.

3. Backfill the plant hole with the excavated soil by layer type and tamp firmly to remove large air pockets and soil voids.

4. If a soil depression is formed up slope of or adjacent to the planting, slough and tamp enough soil from the surrounding area into the depression to leave a level surface with the surrounding area.

3.09 MAINTENANCE

A. Begin maintenance immediately after planting is completed.

B. Maintenance shall include, but may not be limited to, watering, weeding, re-seeding, pruning, disease and pest control, protection from herbivory, re-mulching, removal of dead and dying plantings, resetting to proper grades and upright positions, repair of erosion damage, repairing structural habitat features, replacing unacceptably growing plants, and any other procedures consistent with good horticultural practice required to ensure normal, vigorous, and healthy growth of wetland plantings.

C. Wetland restoration areas shall be protected at all times against trespassing and damage of all kinds for the duration of the maintenance period. If any plants become damaged or injured, they shall be treated or replaced as directed at no additional cost to the SDs.

D. Replace damaged and non-growing plantings as soon as they are discovered, provided it is within the planting season.

E. Water plantings as needed to promote growth and vitality.

F. Maintenance period shall be a minimum of sixty (60) days from date of completion of all plantings, or until conditional approval of all plants, whichever is greater.

3.10 FINAL WETLAND RESTORATION APPROVAL AND ACCEPTANCE

A. Final acceptance criteria for wetland restoration areas are a minimum 75 percent overall vegetative growth coverage within two (2) years. This vegetative coverage may be achieved as a result of seeding installed under this section of the specifications.

B. As-built plans shall be generated by the Contractor following the completion of the construction of the wetland. These plans must show any construction modifications that were approved by the Engineer or Wetland Scientist. If there were no such modifications, then original plans and specifications should be labeled “AS-BUILT – NO MODIFICATIONS – CONSTRUCTED AS DESIGNED AND SPECIFIED.”

C. The Contractor shall not request a final inspection of the wetland replacement and restoration activities before one (1) year from the date of conditional approval. The request shall be made in writing at least ten (10) days prior to the anticipated date.

D. After inspection, the Contractor will be notified in writing of any deficiencies of the requirements for completion of the work. If any plant materials are found dead or not in a healthy flourishing condition, they shall be replaced at no additional cost to the SDs. Plants shall be replaced at no additional cost to the SDs. Plants shall be replaced during the normal planting season. Replacement plant materials shall be of the same size and species. The Wetland Scientist shall be given sufficient notice of the installation of the replacement plants to allow an inspection of the plant material.

E. If additional seeding is required, the Contractor will be notified in writing of the nature and location of the deficiency. Acceptance shall be given for the entire portion of the seeded areas; no partial acceptance will be given. Seeded areas shall exhibit a uniform, thick, well-developed stand of herbaceous cover. Bare spots shall not exceed 4 in. in diameter, or comprise more than 2 percent of the total area of the planting zone. Seeded areas shall not exhibit signs of damage from erosion, washouts, gullies, or other causes. Unacceptable areas shall be reseeded at no additional cost to the SDs. Reseeding shall be performed during the normal seeding season (as specified herein). Replacement seed mixtures shall be of the same size and species.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 332900

WELL ABANDONMENT

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, of all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. Decommission or abandon groundwater monitoring wells to permanently decommission the subsurface monitoring device.

B. The work shall consist of abandoning select site groundwater monitoring wells. The work generally includes:

1. Preparing submittals.

2. Removing protective casing and existing surface seal.

3. Pulling well casing material where possible.

4. Tremie pressure grouting well borehole.

5. Installing cement-bentonite surface seal.

6. Containerizing debris from abandonment activities.

7. Coordinating disposal of debris.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 026113 – Excavated Soil and Materials Management Plan

C. Drawings

D. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

B. The term “monitoring well” or “well” in the specification is used to denote groundwater monitoring wells, groundwater observation wells, piezometers, gasmonitoring wells, lysimeters or other devices constructed in similar manner to a well.

C. American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5299-99(2012)e1, “Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.”

D. Commonwealth of Massachusetts, Department of Environmental Protection, Standard References for Monitoring Wells, January 1991.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

B. See well construction logs (where available) attached to this specification.

1.06 QUALITY ASSURANCE

A. Not Used.

1.07 SUBMITTALS

A. The following Items are to be submitted. **(Submittal Group 2)**

1. Well decommissioning shall be performed by a registered well driller in Massachusetts or a person knowledgeable with the installation of wells. Submit the name and experience of

qualified well abandonment subcontractor or, if self-performed by the Contractor, the personnel, qualifications, and description of their prior well abandonment experience.

2. Schedule for completing the work described in this specification. Schedule must indicate the timing in relation to other construction activities planned in the work area.

B. Documentation in the form of purchase records or similar for the materials, including but not limited to cement, bentonite, admixtures, used in well abandonment. **(Submittal Group 2)**

C. Submit complete well abandonment/decommissioning records in the template form provided in the Commonwealth of Massachusetts, Department of Environmental Protection (MassDEP), Standard References for Monitoring Wells (January, 1991, incorporated by reference). **(Submittal Group 4)**

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement-Bentonite Grout (smooth cement/bentonite/water mixture). Mixture must be free from lumps and uniform throughout. A thick viscous mix consisting of 5 to 7.5 gallons of water per 94-lb bag Type I Portland cement and 2% to 10% powdered bentonite (percent addition based on dry weight of cement). The use of potentially hazardous materials to decrease or increase grout viscosity (e.g., kerosene) is prohibited.

B. Portland Cement (Type I).

C. Powdered Bentonite (Pulverized bentonite sized to 200-mesh screen).

D. Water, potable.

E. Concrete for surface seal.

PART 3 - EXECUTION

3.01 GENERAL

A. Scope consists of abandoning the following groundwater monitoring wells.

Table 332900-1: Wells to be Abandoned

Well Designation	Area	Surface Completion	Total Depth (ft bgs)	Casing/Riser Dia. (in.)	Casing/Riser Material	Abandonment Method
MW-105S	WHP	Stl/Stickup	6	1.5	PVC	Described herein
MW-105D	WHP	Stl/Stickup	12	1.5	PVC	Described herein
MW-107S	WHP	Stl/Stickup	6.75	1.5	PVC	Described herein
MW-107D	WHP	Stl/Stickup	12.75	1.5	PVC	Described herein

Notes:
WHP = West Hide Pile Area
Stl/Stickup = Protective casing made of steel in stickup (above grade) configuration
bgs = below ground surface
1. Refer to attached well construction logs for additional information.
2. Monitoring wells MW-104S and MW-106S (both located in the West Hide Pile vicinity) to be modified from stickup to flush-mounted roadway box configuration and protected from damage during the Work by the Contractor (see Drawings for well modification details). Other wells present in other work areas at the OU2 site may require special handling (e.g., protection from damage); refer to Drawings.

B. In the event that construction activities are planned in the work area vicinity where well abandonment is necessary, either:

1. Protect the wells in place pending mobilization and execution of well abandonment (to prevent loss or damage of well prior to proper abandonment as described herein), or

2. Complete well abandonment in advance of other adjacent construction activities.

3.02 EQUIPMENT

A. Drill rig equipped with pump, grout tub, various hand tools, hoses, tremie wands etc.

B. Mixer, cement or grout plant

C. Ruler, engineer's 6 ft folding

D. Scale, engineer's

E. Graduated Tape, 100 ft length, with weighted end

F. Water Level Indicator, Sinco or equivalent

G. Logs & Forms

H. Site Plan Drawing(s), Maps, Boring and Well Installation Logs

I. Calculator

J. Sample jars and labels

3.03 PROCEDURE

A. Locate Well. Locate the subject well in the field, using Drawings, sketches, fixed references or other available documentation. Verify well designation, particularly individual wells located in closely spaced well clusters or well nests. If necessary, verify and document the location of the well to be decommissioned, referenced by taped distance to three fixed features, or acquire coordinates using global positioning system (GPS) methods or by instrument survey.

B. Evaluate Well Integrity and Construction.

1. Evaluate and document condition of protective well casing and surface seal (padlock missing/broken, well cap missing, staining on well riser observed, concrete surface seal cracked, surface runoff entering well, etc.). Record well construction material (stainless steel, PVC, fiberglass, galvanized steel, black carbon steel, etc.). Measure well diameter, depth to water, and depth to bottom of well using water level indicator and a weighted graduated tape (the water-level indicator should not be used to sound the depth of the well as the electric probe can be damaged over time if it is repeatedly submerged). Verify information on the respective well record, if available, and note any discrepancies. If well logs are not available, determine screen length and depth, if possible, to determine whether the well construction will provide useful data.

2. Evaluate obstructions present within the well or material accumulated in bottom of well. The presence of an obstruction or a significant amount (0.5 ft or greater) of accumulated materials (i.e., silt) in bottom of well shall be removed prior to sealing or over-drilling to remove the obstruction and well materials.

3. Remove and discard any dedicated groundwater sampling devices, including dedicated pump tubing and foot valves, if present.

C. Calculate Volume of Cement-Bentonite Grout Needed. To assure the well is properly plugged and sealed, calculate the estimated volume of cement-bentonite grout required to fill or exceed the volume of hole to be plugged.

D. Remove Protective Casing. Remove and either properly dispose protective casing or set aside for re-use (where applicable).

E. Remove Riser and Screen. Attempt to remove well screens and risers by pulling. If not possible, tremie grout the well from the bottom up according the procedure below.

F. Tremie Pressure Grouting

1. Prepare smooth cement/bentonite/water mixture (Cement-Bentonite Grout).

2. Obtain a representative sample of the cement-bentonite grout mix. Label sample container appropriately, indicating date, project number, work area, boring/well designation, water/cement ratio and additives. Provide grout sample to Engineer or SD Representative.

3. Visually inspect grout tremie hose and ensure it is equipped with a side discharge endpipe (tremie "wand"). Overly flexible hoses that kink, are unable to reach the bottom of the well, or constrict grout flow are not acceptable.

4. Lower grout pipe or tremie hose into the well riser until the bottom is reached, and pump the grout mix down into the well. Continue to pump grout mix into the borehole until the water present in the well riser is evacuated and the groutmix is flowing out at the ground surface. In no circumstances is the grout to be placed by pouring or dumping down the well riser or open borehole (i.e., in cases where the well materials can be pulled from the borehole).

5. Groundwater displaced from the borehole requires containment due to its water quality. If an on-site water treatment system capable of treating the extracted groundwater is available or otherwise part of the Contractor's work scope, containerize and treat groundwater in the on-site treatment system unless indicated otherwise by the Engineer or SD Representative. If no on-site treatment system is available or as directed by the Engineer or SD Representative, containerize the water for proper off-site disposal.

6. If the well screen and riser was not pulled (or over-drilled, if applicable), expose and remove the upper part of well riser at the ground surface, and remove well riser no further than the depth of the underlying geosynthetics used for the existing cap. Remove existing protective casings or guard pipes and concrete surface seal, if not previously removed.

7. Additional grout batches may be required. Each additional batch shall be consistent with the original grout batch. Document total quantity of grout used in decommissioning.

8. Remove the grout pipe (or the tremie hose). Immediately top off the borehole or split well screen and riser with additional grout to approximately 2 ft below ground surface.

9. Clean and flush all equipment used in the grouting/sealing procedure with clean water, including grout mixer, grout tub, pump, hoses, tremie wand, hollow stem augers or other drilling tools.

10. Top off decommissioned well borehole with a minimum of a two (2) ft thick concrete plug installed and tamped at least 6-inches below ground surface. The grout plug shall be terminated at least 6-inches below existing grade. Establish finished grade with clean fill or sand and compact to minimize subsidence in accordance with MassDEP standard reference. Grade disturbed soils to promote rainwater runoff away from decommissioned well location.

11. Check the grouted borehole during the subsequent 24-hour period for signs of settlement, and top off with additional cement to ground surface.

12. Restore surface.

13. Complete documentation, including but not limited to well decommissioning records.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 350140

TEMPORARY WATER DIVERSIONS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections of Division 1 – GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by the Work of this Section. Cooperate with such trades to assure the steady progress of work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the Work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to:

1. Furnishing and installing temporary culverts, Portadams, Aquabarriers, filter rolls, or temporary sheeting for purposes of diverting water to access the proposed removal or filling activities.

2. Protection, maintenance, replacement of defective work, and certification and approval of finished products for the temporary diversion of water.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 026113 – Excavated Soil and Materials Management Plan

C. SECTION 310000 – Earthwork

D. SECTION 312319 – Construction Dewatering and Water Treatment

E. SECTION 312500 – Erosion and Sedimentation Controls

F. SECTION 310519.13 – Non-woven Geotextile

G. SECTION 316216 – Steel Piles

H. SECTION 441123 – Construction Dust and Odor Control

I. Drawings

J. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See Specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. The Engineer will perform on-site observation during construction including, but not limited to the following:

1. Observation of the installation of each water diversion system.

2. Observation of the performance of the diversion system and observations of the dewatering if necessary or sealing of the diversion system to adequately access the sediment to be removed or the toe of the slope to be graded and filled according.

1.07 COORDINATION

A. As construction proceeds, the Contractor shall be responsible for notifying the Engineer at least three (3) working days prior to the start of the water diversion operations requiring monitoring. Adjustment to schedule due to weather such as significant rain events may be necessary.

B. Coordinate earthwork and erosion controls to determine when wetland excavation, grading and other construction activities that require water diversion as described in the section, may proceed.

C. Assure erosion control measures are in place as described in Section 312500 - Erosion and Sedimentation Controls, prior to commencing work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Temporary Culverts and Sheeting:

1. Deliver culverts and sheeting to the site undamaged and ready for unloading to a designated material lay-down area.

2. Store materials in a manner that their effectiveness and usability will not be diminished or destroyed. Any material that has become caked or otherwise damaged or does not meet the specified requirements will be rejected.

B. Portadam and Aquabarriers:

1. The Portadam materials and the Aquabarriers shall be clean and free of debris when delivered to the site.

2. The materials for construction of the Portadam and/or Aquabarriers shall be in suitable condition for immediate placement and if damaged during delivery, replacement materials shall be delivered within 24 hours.

1.09 SUBMITTALS

A. Submit cut-sheets from the manufacturer for each diversion system proposed to be utilized on the site. **(Submittal Group 2)**

PART 2 - PRODUCTS

2.01 EARTH MATERIALS.

A. Wetland Organic Soils: As defined in Section 310000 - Earthwork.

B. Crushed Stone or Dense Grade Crushed Stone: As defined in Section 310000 - Earthwork.

C. Earth materials used for wetland restoration, including but not limited to, wetland organic soil, loam, leaf mold, shall not be harvested from an area that contained invasive species plant parts (seed, rhizomes, etc.) or contain any materials with invasive plant parts present.

2.02 PIPE

A. High Density Polyethylene (HDPE) pipe shall be used for Temporary Diversion of Halls Brook during construction of the Halls Brook Diversion Structure, and for Temporary Diversion of flow from the Pond Outlet during construction of the Pond Outlet.

2.03 SHEETING

A. Steel Sheeting shall be either new or used and shall conform to the Steel Pile Specification, 316216. The Sheet piling shall be hot-rolled steel sections conforming as a minimum to ASTM A 328. The interlocks of steel sheet piling shall be free-sliding, provide a swing suitable for the intended installation and maintain continuous interlocking when installed.

2.04 DIVERSION SYSTEMS

A. Portadam:

1. The Portadam systems shall be the 7 ft or 10 ft high Portadam as shown on the drawings. The 10 ft system is to be used at the HBHA Pond and West Hide Pile areas, and the 7 ft high system shall be used at the West side of Wells G&H Wetland Areas, as shown on the Drawings.

B. Aquabarrier:

1. The Aquabarrier shall be a minimum of 5 ft high when inflated with water.

2. The Aquabarrier may be inflated with water from the Aberjona River if allowed by the Company that owns the Aquabarrier, otherwise potable water shall be used for inflating the Aquabarrier.

PART 3 - EXECUTION.

3.01 GENERAL REQUIREMENTS

A. Water diversion structures shall not be installed until all erosion control measures are in place.

B. Perform all work in accordance with reviewed shop Drawings.

3.02 WEST HIDE PILE

A. Equipment to be used shall be in clean condition prior to entering the work area such that no mud containing invasive seeds or other plant parts capable of reproducing are inadvertently brought onto the site.

B. Following installation of the erosion control measures, including the silt curtain, the Portadam can begin to be installed at the location shown on the Drawings. The Aquabarrier for the West Hide Pile water diversion is 10 ft high frame Portadam.

C. All Portadam manufacturer means and methods of installation shall be followed for the installation of the Portadam system.

3.03 HALLS BROOK DIVERSION STRUCTURE

A. The Halls Brook Diversion structure requires a combination of Sheet Pile and Temporary Culverts for diverting the flow of Halls Brook in order to construct the Halls Brook Diversion and Bypass Structures.

B. Following the installation of the northern sections of sheet pile to form the Diversion Structure the Halls Brook northern side slope and channel base can be rough graded to establish the lines and grades of the Temporary Culvert Diversion. A Temporary bedding layer for the culverts will be necessary.

C. The Temporary Culverts shall be dual 36-inch diameter HDPE pipes laid at a 1% Slope. Temporary headwall structure consisting of Gabions and Sand Bags will be required to direct the water flowing through the existing Box Culvert to the Temporary HDPE pipes.

3.04 HBHA POND OUTLET

A. The Pond Outlet Diversion consists of HDPE culverts on the East side of the Pond Outlet Berm. Proposed culverts include (4) 24-inch diameter HDPE pipes.

3.05 WEST SIDE OF WELLS G&H WETLANDS

A. The west side of Wells G&H wetlands requires 7 ft high Portadams and a 5 ft high, when inflated, Aquabarrier to maintain the diversion of the Aberjona River around the sediment removal area.

B. The northern section of Portadam shall be installed, followed by the Aquabarrier and the southern section of a Portadam to provide the necessary water diversion.

3.06 CBCA WETLANDS

A. Sheeting will be used to divert the Aberjona River around the sediment removal area, and a 7 ft high Portadam connecting into the sheeting shall be installed to minimize water inundation into the northern most sediment removal area.

B. Filter Roll check dams will provide erosion control between the CBCA channels and the Aberjona River as well as provide some water diversion capability.

3.07 MAINTENANCE

A. Maintenance of the Diversion structures by the Contractor is required during the construction activities.

B. Maintenance shall include, but may not be limited to, removal of debris, adjusting frames and membranes of the Portadam, and periodic inflation of the Aquabarrier by adding more water in the event of minor leakage. More significant maintenance may be required following rain events.

C. Maintenance period shall be a minimum of sixty (60) days from date of completion of all wetland restoration plantings, or until conditional approval of the wetland and stream restoration work, whichever is greater.

3.08 DIVERSION STRUCTURE REMOVAL

A. Final inspection of the wetland restoration and stream restoration work will be conducted by the Owner and Engineer before the removal of the water diversion structures.

B. After inspection, the Contractor will be notified by the Engineer of how to stage the removal of the Water Diversion structure(s).

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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SECTION 441123

CONSTRUCTION DUST AND ODOR CONTROL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections of Division I - GENERAL REQUIREMENTS, which are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work in this Section.

C. Coordinate work with that of all other trades affecting or affected by the Work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

E. The Work described in these Contract Documents will be performed at a Superfund site. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soil, sediment, surface water, groundwater, and other media (contaminated media). The Engineer should be notified of the presence of potentially hazardous conditions, if encountered.

F. The Contractor shall at times be solely responsible for exercising reasonable precaution to protect the health, safety, public welfare, and all on-site personnel, and the environment during performance of the Work described in these Contract Documents. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

1.02 DESCRIPTION OF WORK

A. The work of this Section includes, but is not limited to, furnishing all plant, labor, equipment, appliances, material, and performing all operations in connection with construction dust and odor control.

B. The Contractor is responsible for control of dust and odors at all times during Work of this Contract, 24 hours per day, 7 days per week, including non-working hours, weekends, and holidays.

1.03 RELATED SECTIONS

A. SECTION 020000 – Existing Conditions

B. SECTION 026113 – Excavated Soil and Materials Management Plan

C. SECTION 310000 – Earthwork

D. SECTION 310913 – Geotechnical Instrumentation

E. SECTION 312319 – Construction Dewatering and Water Treatment

F. SECTION 312500 – Erosion and Sedimentation Controls

G. SECTION 327100 – Wetland and Upland Restoration

H. Drawings

I. Other Sections of the Specifications, not referenced above, shall also apply to the extent required for the proper performance of the Work.

1.04 DEFINITIONS AND REFERENCE STANDARDS

A. See specification Section 014200 – References for acronyms and definitions applicable to this Section.

1.05 EXISTING CONDITIONS

A. See Specification Section 020000 – Existing Conditions for information regarding site conditions.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Product literature, including manufacturer's application recommendations, Material Safety Data Sheets, and other information as appropriate for odor suppression and control products. **(Submittal Group 2)**

PART 2 - PRODUCTS

2.01 COVERS

A. Covers for stockpiles, if necessary, shall be 20 mil polyethylene as described in Section 026113 – Excavated Soil and Materials Management Plan.

B. Roll-offs shall be covered daily with secure fitting covers.

2.02 WATER

A. Water shall be furnished and applied as needed by the Contractor to control dust during the Work.

2.03 HYDROSEEDING

A. Hydroseeding for permanent dust control shall be used for control as required or as directed by the Engineer. The Contractor shall conduct soil tests as necessary to enable the Contractor to determine the materials and methods necessary for the Contractor to satisfactorily produce a stand of grass that will effectively control dust. Hydroseeding shall be conducted in accordance with Section 327100 – Wetland and Upland Restoration.

2.04 ODOR CONTROL FOAMS

A. Short-term Controls (less than a day, such as active excavations): Rusmar Incorprated AC-645 or approved equal, applied per the manufacturers recommendations. Color_____; Scent _____.

B. Medium Term Controls (up to 15 to 30 days): Rusmar Incorprated AC-904 or approved equal, applied per the manufacturers recommendations. Color_____; Scent _____.

C. Long-term Controls (longer than 30 days): Rusmar Incorprated AC-912, AC-920, or approved equal, applied per the manufacturers recommendations. Color_____; Scent _____.

PART 3 - EXECUTION

3.01 CONSTRUCTION SITE DUST CONTROL - GENERAL

A. Wet suppression shall be used to provide temporary control of dust. Several applications per day may be necessary to control dust, depending upon meteorological conditions and work activity. The Contractor shall apply wet suppression on a routine basis, as necessary, or directed by the Engineer, to control dust.

1. Wet suppression consists of the application of water. Water shall be applied in a manner that does not cause erosion.

2. Wet suppression equipment shall consist of sprinkler pipelines, tanks, tank trucks, or other devices capable of providing regulated flow, uniform spray, and positive shut-off.

B. Calcium chloride shall be used to control dust instead of wet suppression when freezing conditions exist.

C. The use of petroleum products for dust suppression or any other products not submitted to and accepted by the Engineer for review is prohibited in this Contract.

D. During Hydroseeding, furnish to the Engineer all container labels or empty containers from all materials used. Do not hydroseed without acceptance of the Engineer.

E. To minimize the potential for tracking mud and dust off site, the Contractor's employees shall park personal vehicles in a designated parking area (to the extent practical) constructed of gravel, asphalt, or other suitable materials that minimizes generation of mud and dust. Dust control in the parking areas shall be performed by the Contractor in accordance with this Section.

F. The Contractor shall perform all Work specified under this Section in compliance with the Code of Massachusetts Regulations (CMR) 310 CMR 7.00, "Air Pollution Control Regulations," specifically, 310 CMR 7.09, "Dust, Odor, Construction and Demolition."

G. Dust and VOC levels shall not exceed those levels determined under Section 013529 – Health and Safety to be protective of worker and public health.

H. The Engineer will conduct perimeter dust monitoring onsite. Basic components of the perimeter dust monitoring program include and upwind and downwind dust monitoring stations. Refer to Section 013529 – Health and Safety and the Remedial Action Work Plan (RAWP) associated with the Work for more information on the Engineer's perimeter dust monitoring program.

I. In no instance shall the airborne dust levels at any location on the perimeter surrounding the Limits of Work exceed the lower of 150 µg/cubic meter (µg/m^3) measured as PM-10, as defined by 310 CMR 6.04 and the values provided in Table 441123-1 (presented by Work Area). It is anticipated that MIE Data RAM Portable Real-Time Aerosol Monitors or equivalent instruments will be used by the Engineer for perimeter air monitoring to determine dust levels. Contractor responsible for performing dust monitoring for worker protection in accordance with Section 013529 – Health and Safety.

Table 441123-1
Perimeter Dust Thresholds by Work Area

Work Area	Dust*
Wells G&H (East and West Sides) HBHA Pond Sediment	75 µg/m^3
Cranberry Bog Conservation Area (CBCA) HBHA Pond – Bypass HBHA Pond – BECo Area HBHA Pond – Permeable Cap West Hide Pile (WHP)	150 µg/m^{3**}

Notes:

*Dust levels at the downwind location are "corrected" by subtracting the upwind dust levels, which represents background ambient air quality, with comparison to the noted criteria.

The Contractor shall implement active dust control measures before the dust action level in this table is exceeded. The value in this table represents a stop work threshold that, once exceeded, dust generating activities must stop pending the Contractor's resolution of work practices and dust control measures. Work may continue when the work practices and dust control is corrected to the satisfaction of the SD Representative and Engineer.

**This value represents USEPA's National Ambient Air Quality Standard (NAAQS) for particulates (PM_{10}) and, consequently, dust levels cannot exceed this value during the remedial activities (i.e., the 150 µg/m^3 value is a ceiling dust concentration).

J. The SD's Representative or Engineer will conduct continuous quantitative dust monitoring at selected upwind and downwind locations (total of two) to monitor effectiveness of the Contractor's dust control measures for the duration of earthwork operations. Such quantitative dust monitoring will be conducted during the normal 8-hr. work day, except during wet weather, moist ground conditions, or when construction activities and traffic on exposed ground surfaces are limited such that visible nuisance dust conditions are not evident. The location of the dust monitoring stations will be coordinated with the Contractor. Additional dust monitoring may be required in connection with the Contractor's Health & Safety Plan.

3.02 PUBLIC ROADWAY DUST CONTROL

A. Where required by the Engineer, the Contractor shall establish wheel wash stations at the entrance/exit of the site to eliminate mud and dirt from vehicle bodies and wheels of vehicles leaving the construction site.

B. Haul truck cargo areas shall be securely covered during material transport on public roadways.

C. Vehicle mud and dirt carryout, material spills, and soil wash-out onto public roadways and walkways, and other paved areas, shall be cleaned up immediately.

3.03 CONTROL OF EARTHWORK DUST

A. During batch drop operations (i.e., earthwork with front-end loader, clamshell bucket, or backhoe) the free drop height of excavated or aggregate material shall be reduced at the request of the Engineer to minimize the generation of dust.

B. To prevent spills and dust generation during transport, cargo shall be leveled, and freeboard space shall be maintained between the material load and the top of the truck cargo bed rail.

C. Wet suppression of cargo loads may be necessary to control dust emissions during on-site transport of materials.

D. Wet suppression may be necessary, part-time or on a continuous round-the-clock basis, to control dust during active earthmoving activities.

3.04 CONTROL OF STOCKPILE DUST

A. The Contractor shall use the following methods to control dust and wind erosion of active and inactive stockpiles, including, where applicable, materials stored in rolloff containers:

1. Suppression with wetting agent during active stockpile load-in, load-out, and maintenance activities.

2. Plastic tarps on stockpiles and containers, secured with sandbags or an equivalent method to prevent the cover from being dislodged by the wind. The Contractor shall repair or replace covers immediately whenever damaged or dislodged.

3. Seeding of inactive stockpiles if stockpiles are generated and acceptable to the Engineer and SD Representative.

4. Other measures as needed or appropriate.

3.05 ODOR MONITORING, CONTROL, AND SUPPRESSION

A. Odors may emanate from the site soils, sediments, and other media during construction. The Contractor shall have a minimum of four unused drums of odor suppressant foam on standby at all times during the mass excavation to use as an odor suppressant when deemed necessary by the SD Representative and the Engineer. Perimeter exposure limit and action level for odor suppression at the fenceline of the work area is 100 parts per billion for hydrogen sulfide and 5 ppmv for petroleum as volatiles.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. See Section 003000 – Measurement and Payment for relevant information.

END OF SECTION

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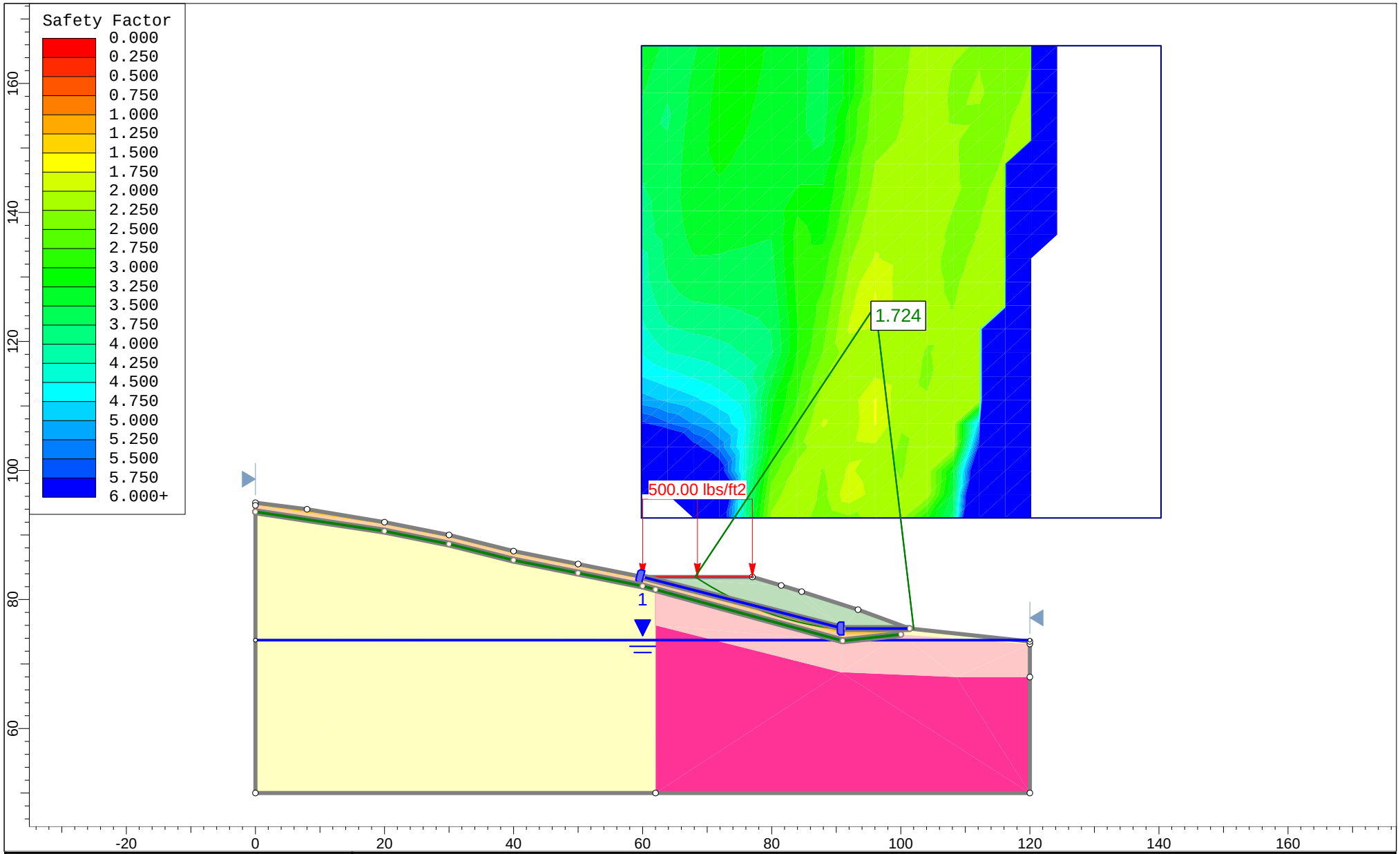

Project	IPLEX West Hide Pile Design		
Analysis Description	New Access Roadway		
Drawn By: L. Buchanan	Scale: 1:246.6	Company: Haley & Aldrich	
Date: 3/13/2014 1:30 PM		File Name: 2014_0313_HAI_WHP New Roadway Slope CC_R10.slim	

SLIDEINTERPRET 6.005

Slide Analysis Information

IPLEX West Hide Pile Design

Project Summary

File Name: 2014_0313_HAI_WHP New Roadway Slope CC_R10.slim
Last saved with Slide version: 6.005
Project Title: IPLEX West Hide Pile Design
Analysis: New Access Roadway
Author: L. Buchanan
Company: Haley & Aldrich
Date Created: 3/13/2014 1:30 PM
Comments:

33020-224
de maximis

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

1 Distributed Load present

Distributed Load 1

Distribution: Constant
Magnitude [lbs/ft2]: 500
Orientation: Normal to boundary

Material Properties

Property	Hide Pile	Dense Grade	Granular Backfill	Topsoil	Fill Sands	Natural Sand
Color						
Strength Type	Undrained	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	90	133	125	95	110	125
Cohesion [psf]		0	0	0	0	0
Friction Angle [deg]		37	38	22	30	35
Cohesion Type	300					
Water Surface	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value		1	1	1	0	1
Ru Value	0					

Support Properties

Non-Woven GTX Mirafi 140N

Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent

Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 167 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Non-Woven GTX Mirafi 1160N

Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: None
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 529 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 20 degrees

List Of Coordinates

Piezoline

X	Y
0	73.71
120	73.71

Line Load

X	Y
77	83.5
60	83.5

Bolt

X	Y
60	83.5
91.073	75.496

Bolt

X	Y
0	93.6
20	90.6

Bolt

X	Y
20	90.6

TENCATE Mirafi®

Drainage Separation

Mirafi® 1160N

Mirafi® 1160N is a needlepunched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® 1160N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D4632	lbs (N)	380 (1691)	380 (1691)
Grab Tensile Elongation	ASTM D4632	%	50	50
Trapezoid Tear Strength	ASTM D4533	lbs (N)	140 (623)	140 623)
CBR Puncture Strength	ASTM D6241	lbs (N)	1025 (4561)	
Apparent Opening Size (AOS)[1]	ASTM D4751	U.S. Sieve (mm)	100 (0.15)	
Permittivity	ASTM D4491	sec^{-1}	0.7	
Flow Rate	ASTM D4491	$gal/min/ft^2$ ($l/min/m^2$)	50 (2037)	
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	70	

[1] ASTM D4751: AOS is a Maximum Opening Diameter Value

Physical Properties	Unit	Typical Value
Roll Dimensions (width x length)	ft (m)	15 x 150 (4.5 x 46)
Roll Area	yd^2 (m^2)	250 (209)
Estimated Roll Weight	lb (kg)	232 (105)

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ETQR29

TENCATE Mirafi®

Drainage Separation

Mirafi® 140N

Mirafi® 140N is a needlepunched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® 140N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Mirafi® 140N meets Aashto M288-06 Class 3 for elongation > 50%.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D4632	lbs (N)	120 (534)	120 (534)
Grab Tensile Elongation	ASTM D4632	%	50	50
Trapezoid Tear Strength	ASTM D4533	lbs (N)	50 (223)	50 (223)
CBR Puncture Strength	ASTM D6241	lbs (N)	310 (1380)	
Apparent Opening Size (AOS)[1]	ASTM D4751	U.S. Sieve (mm)	70 (0.212)	
Permittivity	ASTM D4491	sec^{-1}	1.7	
Flow Rate	ASTM D4491	$gal/min/ft^2$ ($l/min/m^2$)	135 (5500)	
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	70	

[1] ASTM D4751: AOS is a Maximum Opening Diameter Value

Physical Properties	Unit	Typical Value	
Roll Dimensions (width x length)	ft (m)	12.5 x 360 (3.8 x 110)	15 x 360 (4.5 x 110)
Roll Area	yd^2 (m^2)	500 (418)	600 (502)
Estimated Roll Weight	lb (kg)	133 (60)	160 (72)

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TENCATE™ materials that make a difference

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VIA EMAIL

May 2, 2014

Mr. Mark D. Kelley, P.E.
Haley & Aldrich, Inc.
465 Medford Street, Suite 2200
Boston, MA 02129

Re: Solidification Testing – Addendum Report
Sediment from Lower South Pond
Adjacent to West Hide Pile
Industri-Plex Operable Unit 2

Dear Mr. Kelly,

Hard Hat Services, LLC (HHS) reports the results of bench scale solidification tests run on sediment from the Lower South Pond. The sample was received on April 16, 2014 and is an organic silt sample containing vegetative residue and an occasional gravel. The sample as received contained approximately one inch of free water over the sediment. The free water was removed prior to homogenizing the sediment in preparation for testing.

Test Procedure

The bench scale test procedure using plastic cups nested in Styrofoam cups for heat loss control is:

1. A quantity of sediment adequate for the production of the test cups of mix is removed from the bulk sediment sample and blended.
2. Water content samples are recovered from the blended sediment prior to solidification.
3. A quantity of the sample that is larger than required to fill one test cup is weighed and placed in the mixing bowl of a Kitchen Aid mixer.
4. The appropriate weight of solidification agent is added to the bowl and is mixed for 30 to 60-seconds.
5. The mixed sediment is then placed into a 16-oz plastic cup and weighed to determine the starting weight of the solidified sediment.
6. The plastic cup is nested in a Styrofoam cup to limit heat loss from the sides of the cup, covered with plastic wrap and a towel to limit evaporation.
7. Twenty-four hours later the weight of the solidified sediment is taken again and the shear strength of the mixture is measured using a pocket torvane.
8. After the torvane test, a water content sample is taken and the remainder of the sample is subjected to a paint filter test.

9. During the paint filter test the tabletop on which the samples sits is vibrated for 30-minutes to simulate the effects of transportation in a truck.
10. If the sample loses water from the paint filter, the sample is recorded to have failed the paint filter test.

Test Results

The average sediment water content prior to a first round of testing was 190% (35% dry solids). The following day the homogenized sediment again contained some free water indicating the sediment without some solidification would fail to pass the paint filter test. Previous experience with other wetland shallow pond sediment at the Industri-Plex site, suggested that solidification mixtures containing 7.5%, 10% and 12.5% by wet weight could be appropriate for the sediment. A cup test using the solidification agent high calcium lime and Type I Portland Cement was run using these solidification ratios with the results shown on Table 1.

The three ratios using Portland Cement all produced a solidified mixture with appreciable strength (greater than 1 TSF shear strength) and dry solids that easily passed the paint filter test. The results using lime resulted in lower strengths with the sample at 7.5% by wet weight failing the paint filter test after 30 minutes of vibration and 24 hours of sitting. The free water did not separate from the 7.5% lime test after the vibration stage of the paint filter test but only 24-hours later was drained water observed.

As a result of the high strengths and dryness of the Portland Cement samples two additional tests using Portland Cement were made at 5% and 2.5% by wet weight to determine a breakpoint for solidification additive. The results were taken from a new composite of the bulk sample with initial water content of 179% and show that the 5% addition shows good drying and strength gain and easily passed the paint filter test. The 2.5% addition rate shows little drying or strength gain but does pass the paint filter test. Based on the observation of the sample it is obvious that the 2.5% sample may have failed the paint filter test if it started with a 190% water content unsolidified sediment and 5% is considered the lowest successful solidification rate.

Preparation of Sample for Analytical Testing

A sample of the sediment was solidified with 5% by wet weight Type I Portland Cement on April 30, 2014 and placed into jars provided by Alpha Analytical for chemical analysis. An additional volume was retained in a plastic cup for using in preparing samples for volatile analysis. The filled jars and the extra sample were both covered to prevent direct surface desiccation but allowed to remain exposed to air as would occur in a solidified soil pile. After 24 hours the sample jars were sealed and the volatile analysis prepared with the samples place on ice and shipped for overnight delivery to Alpha Analytical.

The test results indicate that Portland Cement is an appropriate agent for solidification of the Lower South Pond sediment. The reason for the performance difference between Portland Cement and High Calcium Lime is not discernable based on the appearance of the sediment.

If you have any questions, please call or e-mail (t.harrington@harrington-engineering.com).

Respectfully,

Timothy J. Harrington, PE

Mark W. Loerop, PE

cc: Tom Holden PE, Haley and Aldrich
Maris Mann-Stadt, Haley and Aldrich

TJH/tjh/MWL
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Table 1
Solidification Testing
Lower South Pond Sediment
Adjacent to West Hide Pile

QUICK LIME TEST

Mixing Stage								Test Cup				
Sample No.	% Additive	Description	Starting w_c (%)	Weight Sediment (grams)	Weight Additive (grams)	% Additive by Wet Weight		Start Wt (grams)	End Wt (grams)	Final Dry Solids(%)	Torvane (tsf)	Paint Filter (pass/fail)[1]
1QL	7.5		190.0%	857	64	7.5%		646	646	43%	0.5	F
2QL	10		190.0%	988	99	10.0%		669	667	45%	0.7	P
3QL	12.5		190.0%	975	123	12.6%		667	667	50%	1.1	P
Starting Water Content								Final Water Content				
	Tare	Wet Weight	Dry Weight	w_c (%)	Dry Solids				Tare	Wet Weight	Dry Weight	w_c (%)
I	0.9	31.7	11.5	190.6%	34.4%			D	1.3	33.9	15.4	131%
II	1	32.3	11.4	201.0%	33.2%			E	1.3	30.9	14.6	123%
III	1.2	32.1	12.3	178.4%	35.9%			F	1.4	32.4	16.9	100%
Average				190.0%	34.5%							

PORTLAND CEMENT TEST

Mixing Stage								Test Cup				
Sample No.	% Additive	Description	Starting w_c (%)	Weight Sediment (grams)	Weight Additive (grams)	% Additive by Wet Weight		Start Wt (grams)	End Wt (grams)	Final Dry Solids (%)	Torvane (tsf)	Paint Filter (pass/fail)[1]
1PC	7.5		190.0%	608	46	7.6%		612	610	40%	1	P
2PC	10		190.0%	807	81	10.0%		608	603	43%	1.5	P
3PC	12.5		190.0%	989	123	12.4%		621	624	45%	2.5	P
4PC	2.5		178.7%	866	22.6	2.6%		662	660	38%	0.45	P
5PC	5		178.7%	996	49.2	4.9%		658	658	42%	0.6	P
Starting Water Content (4PC & 5PC)								Final Water Content				
	Tare	Wet Weight	Dry Weight	w_c (%)	Dry Solids				Tare	Wet Weight	Dry Weight	w_c (%)
I	1.35	32.3	12.3	182.6%	35.4%			A	1.7	22.8	10.2	148%
II	1.25	38.2	14.7	174.7%	36.4%			B	1.3	26.2	12.1	131%
III								C	1.4	32.2	15.2	123%
								A4C	1.5	30.2	12.4	163%
								A5C	1.5	27.1	12.25	138%
Average				178.7%	35.9%							

1. Control Sample 35% dry solids without additive fails the paint filter test

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HALEY & ALDRICH

TECHNICAL MEMORANDUM

Revised 23 July 2014
10 March 2014
File No. 33020-224

TO: File
File

FROM: Haley & Aldrich, Inc.
Thomas J. Holden, P.E.

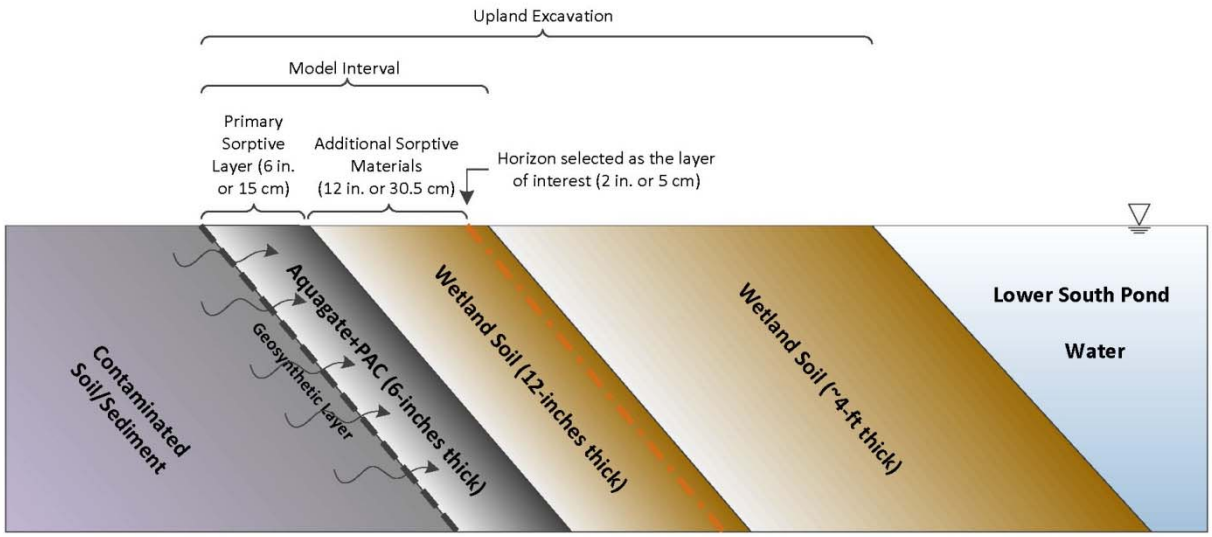
SUBJECT: Aquagate+PAC™ Longevity Estimate (West Hide Pile-Lower South Pond Area)
Industri-plex Operable Unit No. 2
Woburn, Massachusetts

As shown on Drawing C-404, a 6-inch thickness of the Aquagate+PAC™, which is a composite particle system consisting of gravel coated with powdered activated carbon (PAC), is incorporated along the edge of the excavation area running along the WHP. The product is manufactured by AquaBlok® in two formulations: 5% and 10% by weight PAC. The 10% by weight PAC formulation is specified for this application to increase longevity. Breakthrough time for the Aquagate+PAC™ was estimated using the model created by Lambert & Reible (2008) with the Capsim 2.6 model code. The estimated design life of this layer when 6 inches thick exceeds 100 years. Following is a description of how this estimate was developed.

MODEL ASSUMPTIONS AND INPUT PARAMETER VALUES

This section presents an overview of the assumptions made in developing the model and the input values used to run the simulations. The following are some general assumptions on which the model is based:

- Number of layers simulated: 2, as shown in the inset figure for the baseline case.



- Bottom (left) boundary condition assumes constant contaminant concentrations in pore water, which is a conservative assumption.
- In this configuration, bioturbation does not occur, thus it was excluded from the model scenario.
- Biodegradation of benzene, to the extent it occurs, is excluded (a conservative model assumption).
- Sediment deposition on top of the cap is ignored (a conservative model assumption).

Capping System Components

A. Layer Properties

The following are the properties that must be defined for each layer in the model.

Thickness (cm) represents the thickness of the layer in the model. Base model scenario modeled as two layers:

- Layer 1 - Wetland Soil: 12-inch thickness (~30 cm) as a conservative estimate given the approximately five feet of wetland organic soil backfill, which also sorbs and retards migration of benzene, for the additional buffer created in the upland before the edge of water (see Drawing C-402).

- Layer 2 - Aquagate+PAC™: Six-inch (~15 cm) thickness of the Aquagate+PAC™, 10 percent by weight PAC formulation. A thinner and thicker scenario was modeled as a sensitivity analysis, the results of which are summarized below.

Porosity, Φ, is the void fraction in the layer.

- Layer 1 - Wetland Soil: 0.55. Midpoint between published range of porosity for organic silt in Table 6 from Naval Facilities Engineering Command Soil Mechanics Design Manual 7.01 dated 1 Sept 1986.
- Layer 2 - Aquagate+PAC™: 0.66. Based on the pore space estimate for the PAC provided by Calgon.

Bulk Density, ρ (g/cm^3) is the density of the porous media considering solids and air and water-filled pore space. In the CapSim model, the bulk density value listed for each layer represents the mass of the modeled sorbent material per unit volume in the layer. For the composite Aquagate+PAC™ layer, this value would be the mass of PAC per unit volume of the composite particle, and for the wetland soil layer, it would simply be the bulk density of the material.

- Layer 1 - Wetland Soil: 1.20 g/cm^3, which translates to approximately 75 lb/ft^3. On the low end of the range (conservative assumption) for clayey organic silts found in Table 5 from Naval Facilities Engineering Command Soil Mechanics Design Manual 7.01 dated 1 Sept 1986.
- Layer 2 - Aquagate+PAC™: 0.13 g/cm^3. Derived based on the bulk density of the composite particle 80 lb/ft^3, 10% by weight addition rate for PAC in the specified product, which yields 8 lbs/ft^3 of PAC which equals 0.13 g of PAC/cm^3 of the composite particle layer material.

Hydrodynamic dispersivity is the tendency for a solute to spread out from the path it would be expected to follow according to the advective hydraulics of the flow system. Hydrodynamic dispersion causes dilution of the solute. Hydrodynamic dispersion occurs because of mechanical mixing during fluid advection and because of molecular diffusion due to the thermal-kinetic energy of the solute particles. The hydrodynamic dispersivity is a scale of the heterogeneities in an individual layer. In typical soils it is 5-10% of travel distance while in uniform media it is typically of the order of the particle size. The grain size distribution of the proposed cap material is relatively uniform, but a conservative default value of 1 cm was employed for each layer.

B. Layer Model Properties

The **tortuosity correction** is modeled based on the model defaults for sediment and activated carbon layers. Specifically Boudreau for sediment (Layer 1 wetland soil) and Millington & Quirk for the activated carbon layer (Layer 2)[1]. $D_{diff} = \varepsilon_1^{4/3} D_w$

[1] Millington, R.J., and Quirk, J.M. (1961) "Permeability of Porous Solids," Transactions of the Faraday Society, 57:1200-1207.

The **sorption isotherm** is modeled as linear: K_d is specified for the wetland soil (Layer 1). The Freundlich isotherm was used for active carbon layer (Layer 2).

Decay, λ (yr^{-1}), no biodegradation within the layers was assumed (conservative assumption).

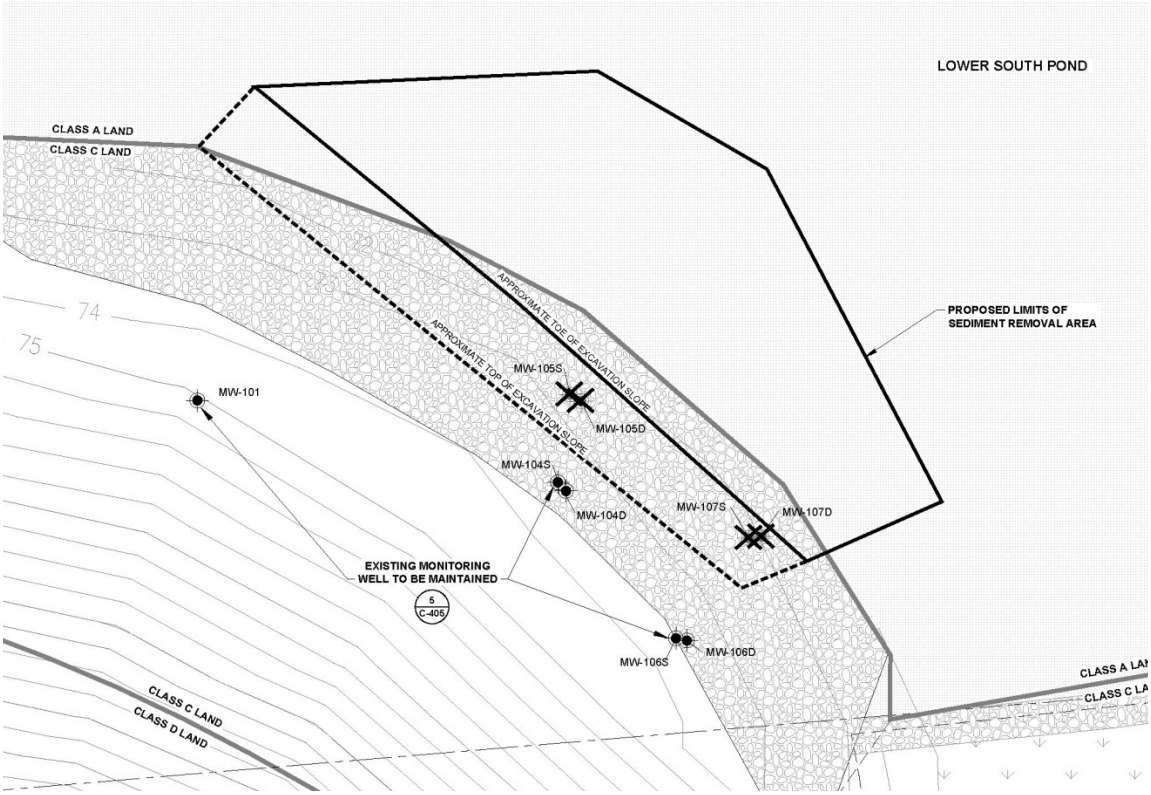
C. Layer Chemical Properties

The chemical properties that must be defined in the model are listed below, along with details and assumptions made in deriving the values used in the model.

The **concentration** of the modeled constituent in the **water "overlying" the layer** was set at zero (0 μg/L).

The **initial concentration** in each cap layer is set to zero (0 μg/L) because it is assumed there is no contamination in the material at the time the model is initiated (time zero [t_0]).

The **underlying sediment pore water concentration,** (μg/L) is based on measured groundwater concentration. Initial porewater concentration (behind/below or on the concentrated side of sorptive layer): Maximum benzene concentration of two shallow screened wells immediately adjacent to the proposed sorptive layer (MW-106S: 61,000 μg/L benzene, sampled 12/13-14/2012; for reference, MW-104S exhibits a concentration of 28,000 μg/L). Note: monitoring wells MW-105S and MW-107S are located within the limits of the sediment removal so the groundwater results from these wells were excluded from the analysis. See inset below for well locations.

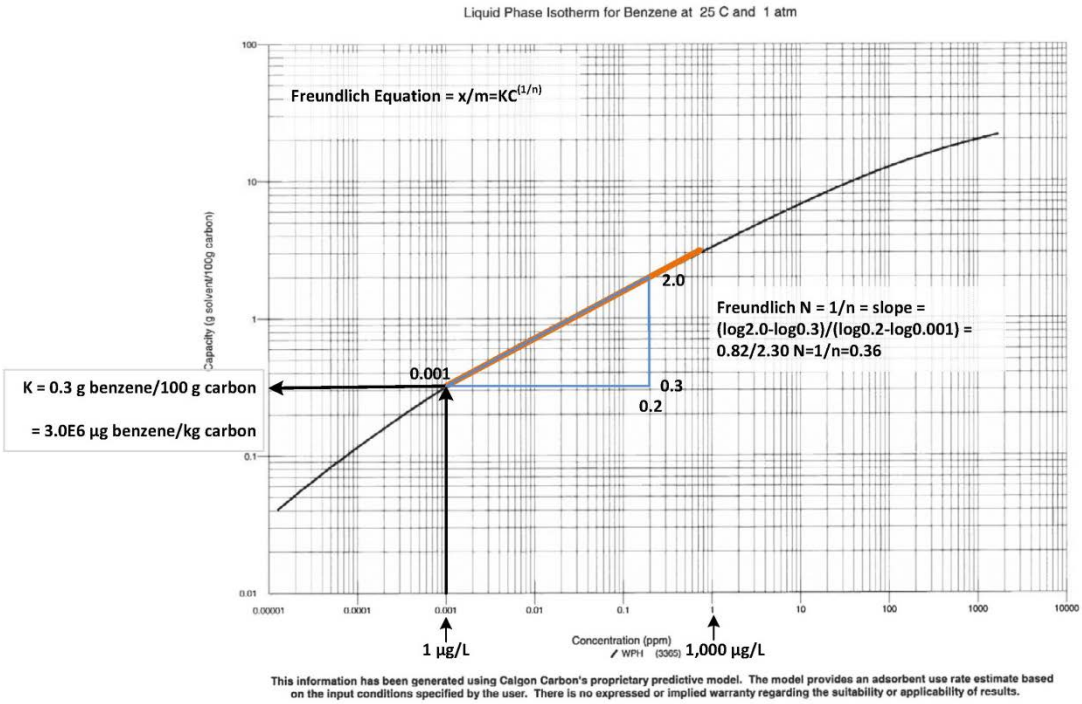


The **sorption isotherm** for the **wetland soil layer** (Layer 1) was calculated within the model using the modeling programs built-in linear-K_d estimation. The values estimated by the model for the Wetland Soil (Layer 1) are based on the following:

- Organic carbon-water partitioning coefficient: Benzene: 59 L/kg (1.77 log L/kg).[2]
- Fraction of organic carbon (f_{oc}) of 3% (0.03), which is conservative as the wetland soil described in specification Section 310000 (Earthwork) calls for 12% organic carbon content.

The **sorption isotherm** for Aquagate+PAC™ active carbon layer (Layer 2) is the Freundlich isotherm (K_f). The Freundlich isotherm is a mathematical approach for fitting experimentally determined sorption data using minimum adjustable parameters for an empirical relationship. This relationship was obtained from the Calgon isotherm for benzene for the activated carbon supplied to AquaBlok® for this product. The value for K_f in terms of $(ug/kg)/(ug/L)^{1/n}$ is estimated to be approximately 3.0E6 μg benzene per kg activated carbon, with a Freundlich N (1/n) value of 0.36 (note, the value used in the prior version of this memorandum was 0.38, which was reduced to 0.36 based on further review, plotting, and calculation). See following inset image for the basis of these values.

[2] App K EPA (1996): Soil Screening Guidance: Technical Background Document EPA/540/R-95/128



Adapted from Isotherm supplied by Calgon Carbon for the carbon supplied to AquaBlok for the Aquagate+PAC product

D. Physical and Chemical Parameters

The following physical and chemical properties must be defined in the model.

Molecular diffusion coefficient (diffusivity) in H_20, D_w (cm^2/s) is the net flux of molecules from a region of higher concentration to one of lower concentration. This quantity (8.06E-6 cm^2/s) is calculated within the model from the Hayduk and Laudie formula[3] specific to benzene using its physical properties and at 15 degrees C.

Organic carbon partition coefficient, logK_{oc} (log(L/kg)) is used to estimate the sediment-water partition coefficient. This quantity is literature-based K_{oc} of 59 L/kg (1.77 log(L/kg))[4].

Dissolved organic carbon partition coefficient, log K_{DOC} (log(L/kg)) is the affinity of organics to sorb to soil or sediment particles. Dissolved organic matter can increase the mobile fraction of contaminant. This quantity is calculated within the model from the formula[5]

[3] Hayduk W, Laudie H. 1974. Prediction of diffusion coefficients for nonelectrolytes in dilute1269 aqueous solutions. AIChE J 20:611–615.
[4] App K EPA (1996): Soil Screening Guidance: Technical Background Document EPA/540/R-95/128
[5] Burkhard LP. 2000. Estimating dissolved organic carbon partition coefficients for nonionic organic chemicals. Environ Sci Technol 34:4663-4668.

$\log K_{doc} = \log K_{ow} - 0.58$ specific to each compound modeled using the compounds physical properties, which for benzene is a log K_{doc} of 1.55 based on a log K_{ow} of 2.13[6].

Dissolved organic matter concentration, r_{DOC} (mg/L) is measured through lab analysis of pore water samples collected in the field. The dissolved organic carbon concentration was derived from GSIP data from OW-31 for dissolved organic carbon (DOC). Concentration at this location on 11/23/1991 was 194 mg/L.

Darcy velocity, (cm/yr) is the rate of groundwater/porewater flow through the layer(s) of interest. This parameter was estimated to be 2.54 cm/year (i.e., 1 inch per year) in the organic silt layer at the LSP-WPH site (see Section 2 of the WHP-LSP 100% Remedial Design for the derivation of this value).

Bioturbation depth, (cm) is the thickness of the biologically active layer that will develop below the surface of a sediment cap. For this modeling and configuration bioturbation was excluded.

Benthic boundary layer mass transfer coefficient, (cm/hr). This is the mass transfer coefficient within the specified benthic boundary layer at the top of a typical sediment cap. This coefficient is typically of the order of 1.0 cm/hr but is dependent upon flow conditions. The modeling is insensitive to this value so a default of 1.0 cm/hr was employed in the updated modeling included herein.

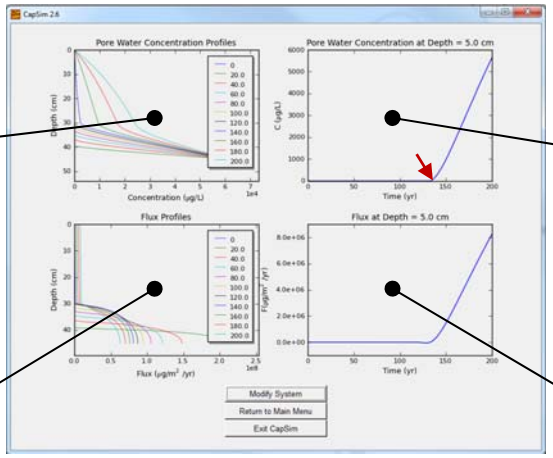
[6] App K EPA (1996): Soil Screening Guidance: Technical Background Document EPA/540/R-95/128

MODEL RESULTS

The Capsim model produces graphical output summarizing the results. Following is a brief description of the four graphs to facilitate a discussion of the test results below.

Porewater concentration at differing time steps in years (0, 20yrs, 40yrs…) relative to depth below the top of the model interval, i.e., the combined ~18 inches (45 cm) of the two layers, for the baseline case

Similar to above graph, but a measure of the contaminant flux rate



Porewater concentration at an assumed depth of interest (in this case 5 cm below the top of the model interval for the two layers). Illustrates when the breakthrough is estimated to occur in years at this horizon (see arrow).

Similar to above graph, but a measure of the contaminant flux rate

Three scenarios were developed to assess the sensitivity of the longevity to thickness of the 10% by weight Aquagate+PAC™ as follows

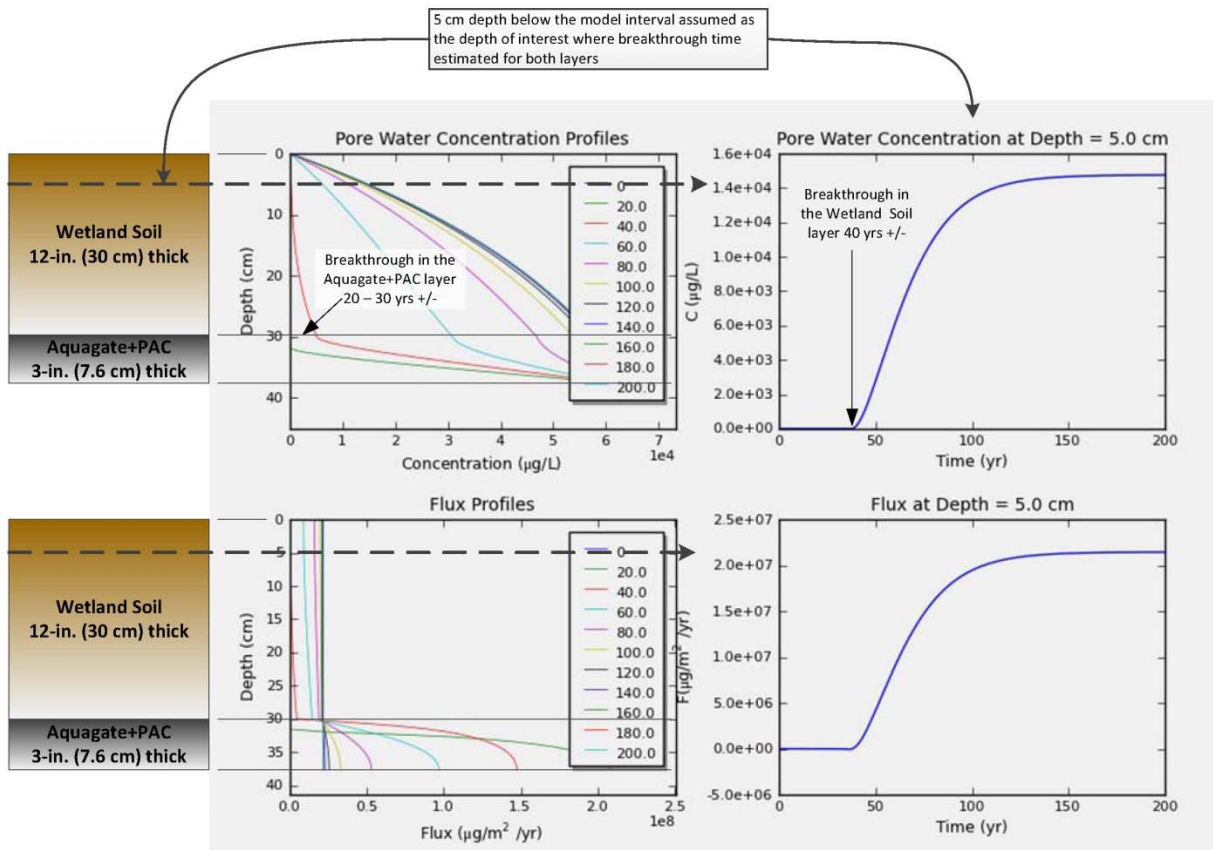
- **Thinner Layer – 3 inches (7.5 cm)** of 10% by weight Aquagate+PAC™ plus 12 in. (30 cm) of Wetland Soil
- **Baseline as per the Drawings - 6 inches (15 cm)** of 10% by weight Aquagate+PAC™ plus 12 in. (30 cm) of Wetland Soil
- **Thicker Layer – 12 inches (30 cm)** of 10% by weight Aquagate+PAC™ plus 12 in. (30 cm) of Wetland Soil

Thickness of the Aquagate+PAC™ activated carbon layer (Layer 2 in the model) was the only variable altered in these three runs, thus the remaining inputs described above were held constant.

For the input values described above, the model run produced an estimated longevity of approximately 100+ year service life before breakthrough is forecast for the baseline case with 6 inches (15 cm) of 10% by weight Aquagate+PAC™ plus 12 in. (30 cm) of Wetland Soil. Following is a table summarizing the graphical output and results for these three model scenarios. Model input and output files are attached.

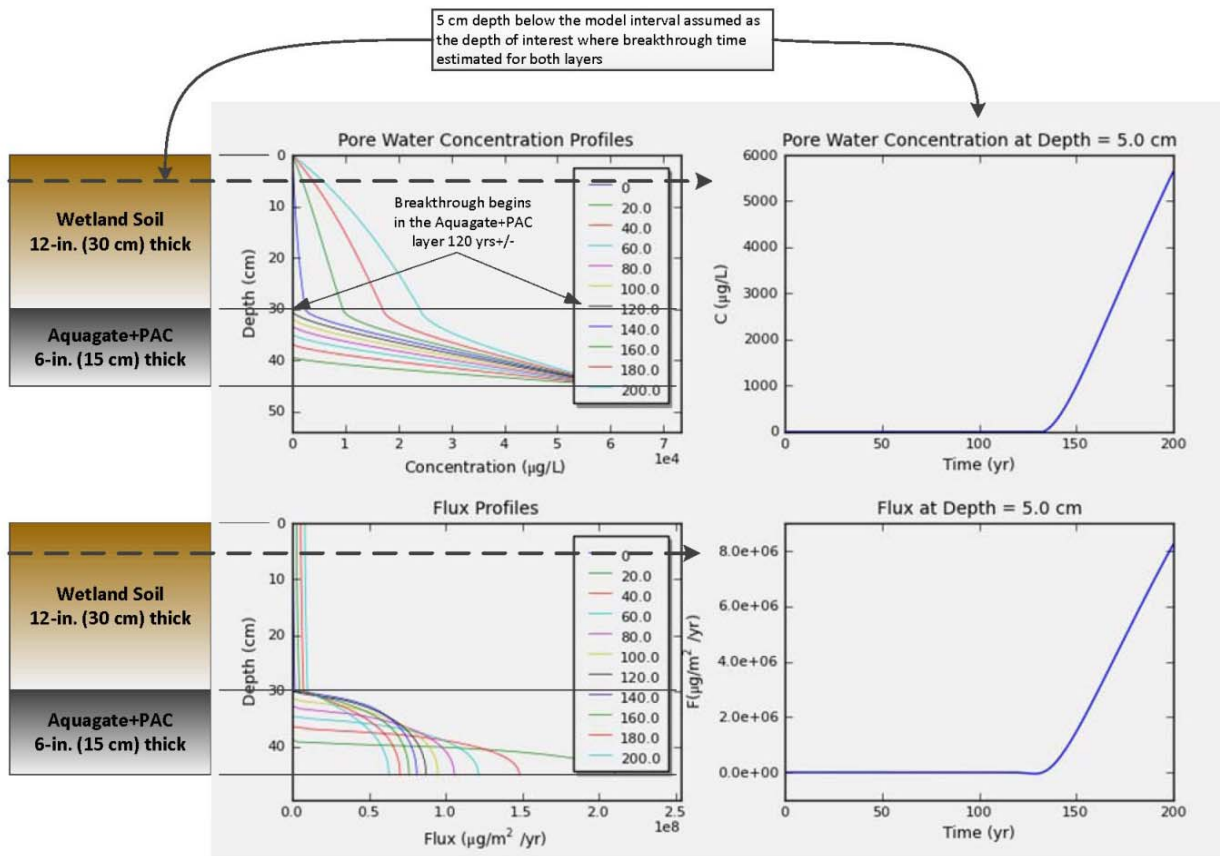
Thinner Aquagate+PAC Case

(Aquagate+PAC Layer Consumed in 20-30 yrs)



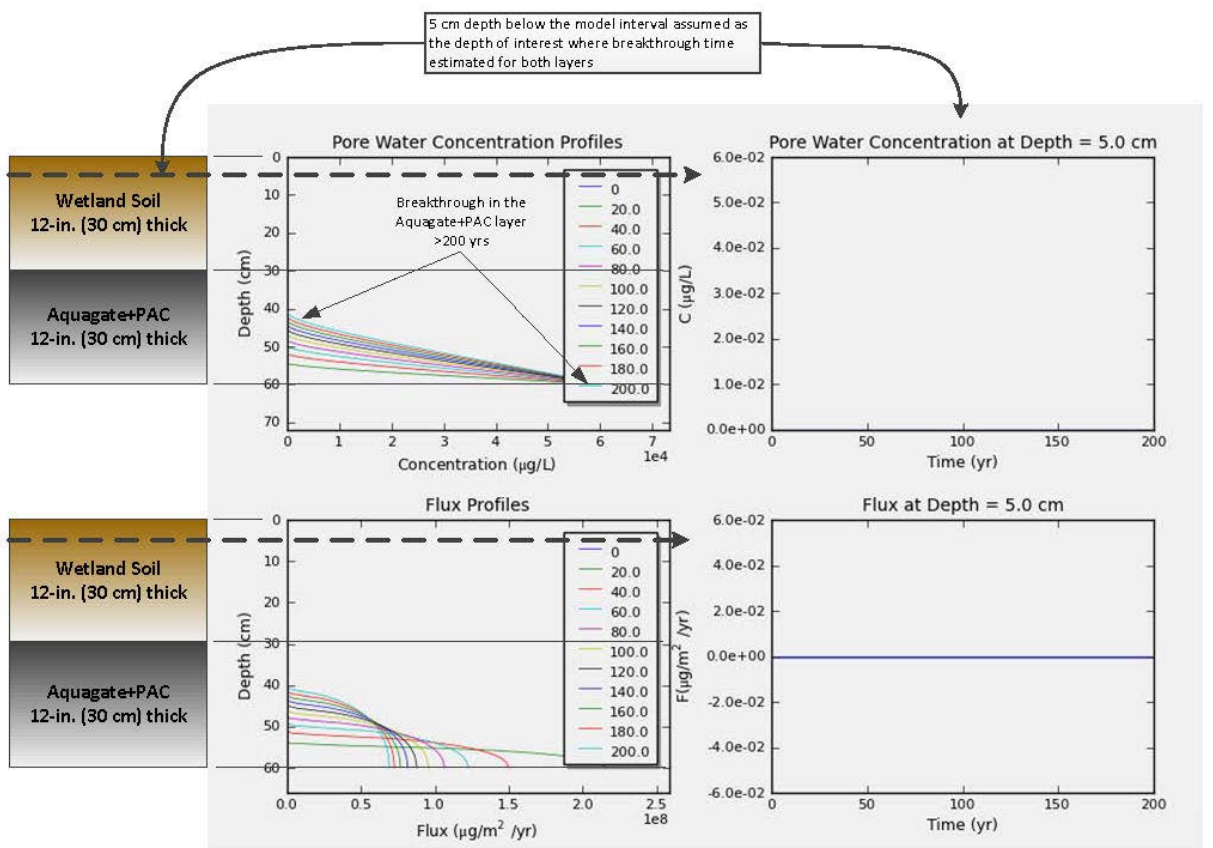
Baseline Case

(Aquagate+PAC Layer Consumed in 120 yrs+/-)



Thicker Aquagate+PAC Case

(Aquagate+PAC Layer Consumed in >200 yrs+/-)



The baseline case is justified on cost-benefit terms. The present value of installing a thicker Aquagate+PAC™ layer than the baseline case, which last over 100 years, is not supported. For example, for the approximate cost of a truckload (22 Tons) of the material ($15,000 in present value terms) would only require a set-aside of ~$450 in net present value terms to expend this in 120 years (the estimated time when the 6-in. layer may become exhausted, i.e., breakthrough) assuming a discount rate of 3% net of inflation.

ATTACHMENTS

AquaBlok cut sheet for Aquagate+PAC™

Model output for Thinner Layer – 3 inches (7.5 cm) of 10% by weight Aquagate+PAC™ plus 12 in. (30 cm) of Wetland Soil

Model output for Baseline as per the Drawings - 6 inches (15 cm) of 10% by weight Aquagate+PAC™ plus 12 in. (30 cm) of Wetland Soil

Model output Thicker Layer – 12 inches (30 cm) of 10% by weight Aquagate+PAC™ plus 12 in. (30 cm) of Wetland Soil

AquaGate+PAC

AquaGate+PAC™

Background

AquaGate+PAC (Powdered Activated Carbon) is a patented, composite-aggregate technology resembling small stones typically comprised of a dense aggregate core, clay or clay-sized materials, polymers, and fine-grained activated carbon additives.

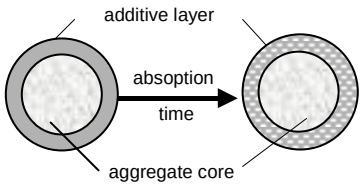


Figure 1. Configuration of PAC-coated particle.

AquaGate+PAC serves as a delivery mechanism to reliably place reactive capping materials into aquatic environments.

Product Specifications

Aggregate:	Nominal AASHTO #8 (1/4-3/8") or custom-sized to meet project-specific need * Limestone or non-calcareous substitute, as deemed project-appropriate
Clay:	Bentonite (or montmorillonite derivative) ** Typically 5 – 10% by weight*
Activated Carbon:	Powdered – Iodine Number 800 mg/g (minimum) ⊙ 99% (minimum) through 100 mesh sieve ⊙ 95% (minimum) through 200 mesh sieve ⊙ 90% (minimum) through 325 mesh sieve ** Typically 2 – 5% by weight*
Binder:	Cellulosic polymer
Permeability:	1×10^{-1} to 1×10^{-2} cm/sec
Dry Bulk Density:	70 – 90 lbs/ft^3

AquaBlok®
Composite Particle System

For more information, Contact AquaBlok, Ltd. at:

Phone: (800) 688-2649
Email: services@aquablokinfo.com visit us at our
Web: www.aquablokinfo.com

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Last Revised: January 1, 2010

Model Run Report for "Aqugate_Soil_Barrier_Rev_2014-0724_3inchAGPAC.cpsm"

Version: CapSim 2.6

Date and Time: 2014-07-24 15:41:10

Model setup:

Model the underlying sediment using a constant concentration boundary condition
Ignore bioturbation at the top of the system
Ignore consolidation of the underlying sediment
Ignore deposition of fresh sediment on the cap
Model a 2 layer system

Layer Parameters:

Overlying water concentration:	0.000e+00 µg/L

Layer 1: Sediment

initial concentration:	0.000e+00 µg/L
depth:	30.0 cm
porosity:	0.55
bulk density:	1.20 g/cm³
sorption isotherm:	Linear--Kocfoc
organic carbon fraction	0.030
Kd	1.767e+00 L/kg
retardation factor:	5.503e-01
tortuosity correction:	Boudreau
hydrodynamic dispersivity:	1.00 cm
effection diffusion coefficient:	6.621e+01 cm²/yr
decay rate:	None

Layer 2: Activated Carbon

initial concentration:	0.000e+00 µg/L
depth:	7.6 cm
porosity:	0.66
bulk density:	0.13 g/cm³
sorption isotherm:	Freundlich
Freundlich Kf:	3.00e+06 µg/kg/(µg/L)^(1/n)
Freundlich 1/n:	0.36
retardation factor:	Variable but > 6.774e-01
tortuosity correction:	Millington & Quirk
hydrodynamic dispersivity:	1.00 cm
effection diffusion coefficient:	1.486e+02 cm²/yr
decay rate:	None

Underlying pore water concentration: 6.100e+04 µg/L

Flow and System Parameters:

Chemical name:	benzene-15C
Temperature:	15.0°C
Darcy velocity:	2.54 cm/yr
Molecular diffusivity:	8.06e-06 cm²/s
Organic carbon partition coefficient:	1.77 log(L/kg)
Dissolved organic carbon partition coefficient:	1.55 log(L/kg)
Dissolved organic matter concentration:	194.0 μg/L
Benthic boundary layer mass transfer coefficient:	1.0 cm/hr

Model output:

Depth of interest: 5.0 cm

Time (yrs)	C (μg/L)	F (μg/m²/yr)	q (μg/kg)	W(μg/L)
0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.052e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.104e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.156e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.208e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.026e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.231e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.436e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.642e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.847e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.052e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.257e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.462e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.668e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.873e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.078e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.283e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.488e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.694e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.899e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.104e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.309e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.514e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.720e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.925e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.130e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.335e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.540e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.746e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.951e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.156e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.361e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.566e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.772e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.977e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.182e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.387e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.592e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.798e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00

8.003e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.208e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.413e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.618e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.824e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.029e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.234e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.439e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.644e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.850e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.005e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.026e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.047e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.067e+01	0.000e+00	-1.539e-20	0.000e+00	0.000e+00
1.088e+01	0.000e+00	-3.180e-20	0.000e+00	0.000e+00
1.108e+01	0.000e+00	-6.374e-20	0.000e+00	0.000e+00
1.129e+01	0.000e+00	-1.248e-19	0.000e+00	0.000e+00
1.149e+01	0.000e+00	-2.378e-19	0.000e+00	0.000e+00
1.170e+01	0.000e+00	-4.342e-19	0.000e+00	0.000e+00
1.190e+01	0.000e+00	-7.353e-19	0.000e+00	0.000e+00
1.211e+01	0.000e+00	-1.089e-18	0.000e+00	0.000e+00
1.231e+01	0.000e+00	-1.216e-18	0.000e+00	0.000e+00
1.252e+01	0.000e+00	-3.147e-19	0.000e+00	0.000e+00
1.272e+01	0.000e+00	3.496e-18	0.000e+00	0.000e+00
1.293e+01	0.000e+00	1.429e-17	1.048e-20	0.000e+00
1.313e+01	1.287e-20	4.090e-17	3.437e-20	2.274e-20
1.334e+01	3.445e-20	1.031e-16	9.196e-20	6.085e-20
1.354e+01	8.464e-20	2.461e-16	2.260e-19	1.495e-19
1.375e+01	1.993e-19	5.703e-16	5.321e-19	3.521e-19
1.395e+01	4.556e-19	1.288e-15	1.216e-18	8.048e-19
1.416e+01	1.011e-18	2.819e-15	2.699e-18	1.786e-18
1.436e+01	2.172e-18	5.964e-15	5.798e-18	3.836e-18
1.457e+01	4.515e-18	1.221e-14	1.205e-17	7.976e-18
1.477e+01	9.129e-18	2.435e-14	2.437e-17	1.613e-17
1.498e+01	1.810e-17	4.781e-14	4.832e-17	3.197e-17
1.518e+01	3.547e-17	9.322e-14	9.470e-17	6.266e-17
1.539e+01	6.910e-17	1.811e-13	1.845e-16	1.221e-16
1.560e+01	1.337e-16	3.492e-13	3.571e-16	2.363e-16
1.580e+01	2.559e-16	6.635e-13	6.831e-16	4.520e-16
1.601e+01	4.799e-16	1.230e-12	1.281e-15	8.477e-16
1.621e+01	8.753e-16	2.207e-12	2.337e-15	1.546e-15
1.642e+01	1.544e-15	3.816e-12	4.123e-15	2.728e-15
1.662e+01	2.631e-15	6.362e-12	7.024e-15	4.648e-15
1.683e+01	4.344e-15	1.030e-11	1.160e-14	7.673e-15
1.703e+01	7.006e-15	1.637e-11	1.871e-14	1.238e-14
1.724e+01	1.116e-14	2.590e-11	2.980e-14	1.972e-14
1.744e+01	1.774e-14	4.112e-11	4.736e-14	3.134e-14
1.765e+01	2.818e-14	6.530e-11	7.524e-14	4.978e-14
1.785e+01	4.437e-14	1.020e-10	1.185e-13	7.838e-14
1.806e+01	6.784e-14	1.523e-10	1.811e-13	1.198e-13
1.826e+01	9.767e-14	2.084e-10	2.608e-13	1.725e-13
1.847e+01	1.262e-13	2.425e-10	3.369e-13	2.229e-13
1.867e+01	1.323e-13	1.922e-10	3.533e-13	2.338e-13
1.888e+01	7.301e-14	-5.659e-11	1.949e-13	1.290e-13
1.908e+01	0.000e+00	-6.918e-10	0.000e+00	0.000e+00
1.929e+01	0.000e+00	-2.022e-09	0.000e+00	0.000e+00

1.949e+01	0.000e+00	-4.603e-09	0.000e+00	0.000e+00
1.970e+01	0.000e+00	-9.551e-09	0.000e+00	0.000e+00
1.990e+01	0.000e+00	-1.924e-08	0.000e+00	0.000e+00
2.011e+01	0.000e+00	-3.863e-08	0.000e+00	0.000e+00
2.031e+01	0.000e+00	-7.769e-08	0.000e+00	0.000e+00
2.052e+01	0.000e+00	-1.552e-07	0.000e+00	0.000e+00
2.073e+01	0.000e+00	-3.042e-07	0.000e+00	0.000e+00
2.093e+01	0.000e+00	-5.796e-07	0.000e+00	0.000e+00
2.114e+01	0.000e+00	-1.068e-06	0.000e+00	0.000e+00
2.134e+01	0.000e+00	-1.903e-06	0.000e+00	0.000e+00
2.155e+01	0.000e+00	-3.300e-06	0.000e+00	0.000e+00
2.175e+01	0.000e+00	-5.618e-06	0.000e+00	0.000e+00
2.196e+01	0.000e+00	-9.490e-06	0.000e+00	0.000e+00
2.216e+01	0.000e+00	-1.604e-05	0.000e+00	0.000e+00
2.237e+01	0.000e+00	-2.723e-05	0.000e+00	0.000e+00
2.257e+01	0.000e+00	-4.641e-05	0.000e+00	0.000e+00
2.278e+01	0.000e+00	-7.909e-05	0.000e+00	0.000e+00
2.298e+01	0.000e+00	-1.340e-04	0.000e+00	0.000e+00
2.319e+01	0.000e+00	-2.245e-04	0.000e+00	0.000e+00
2.339e+01	0.000e+00	-3.710e-04	0.000e+00	0.000e+00
2.360e+01	0.000e+00	-6.053e-04	0.000e+00	0.000e+00
2.380e+01	0.000e+00	-9.788e-04	0.000e+00	0.000e+00
2.401e+01	0.000e+00	-1.578e-03	0.000e+00	0.000e+00
2.421e+01	0.000e+00	-2.551e-03	0.000e+00	0.000e+00
2.442e+01	0.000e+00	-4.146e-03	0.000e+00	0.000e+00
2.462e+01	0.000e+00	-6.763e-03	0.000e+00	0.000e+00
2.483e+01	0.000e+00	-1.104e-02	0.000e+00	0.000e+00
2.503e+01	0.000e+00	-1.792e-02	0.000e+00	0.000e+00
2.524e+01	0.000e+00	-2.879e-02	0.000e+00	0.000e+00
2.544e+01	0.000e+00	-4.562e-02	0.000e+00	0.000e+00
2.565e+01	0.000e+00	-7.110e-02	0.000e+00	0.000e+00
2.586e+01	0.000e+00	-1.089e-01	0.000e+00	0.000e+00
2.606e+01	0.000e+00	-1.641e-01	0.000e+00	0.000e+00
2.627e+01	0.000e+00	-2.450e-01	0.000e+00	0.000e+00
2.647e+01	0.000e+00	-3.652e-01	0.000e+00	0.000e+00
2.668e+01	0.000e+00	-5.481e-01	0.000e+00	0.000e+00
2.688e+01	0.000e+00	-8.330e-01	0.000e+00	0.000e+00
2.709e+01	0.000e+00	-1.282e+00	0.000e+00	0.000e+00
2.729e+01	0.000e+00	-1.988e+00	0.000e+00	0.000e+00
2.750e+01	0.000e+00	-3.084e+00	0.000e+00	0.000e+00
2.770e+01	0.000e+00	-4.754e+00	0.000e+00	0.000e+00
2.791e+01	0.000e+00	-7.237e+00	0.000e+00	0.000e+00
2.811e+01	0.000e+00	-1.084e+01	0.000e+00	0.000e+00
2.832e+01	0.000e+00	-1.594e+01	0.000e+00	0.000e+00
2.852e+01	0.000e+00	-2.301e+01	0.000e+00	0.000e+00
2.873e+01	0.000e+00	-3.264e+01	0.000e+00	0.000e+00
2.893e+01	0.000e+00	-4.584e+01	0.000e+00	0.000e+00
2.914e+01	0.000e+00	-6.444e+01	0.000e+00	0.000e+00
2.934e+01	0.000e+00	-9.185e+01	0.000e+00	0.000e+00
2.955e+01	0.000e+00	-1.338e+02	0.000e+00	0.000e+00
2.975e+01	0.000e+00	-1.987e+02	0.000e+00	0.000e+00
2.996e+01	0.000e+00	-2.988e+02	0.000e+00	0.000e+00
3.016e+01	0.000e+00	-4.497e+02	0.000e+00	0.000e+00
3.037e+01	0.000e+00	-6.714e+02	0.000e+00	0.000e+00
3.057e+01	0.000e+00	-9.884e+02	0.000e+00	0.000e+00
3.078e+01	0.000e+00	-1.429e+03	0.000e+00	0.000e+00

3.099e+01	0.000e+00	-2.024e+03	0.000e+00	0.000e+00
3.119e+01	0.000e+00	-2.808e+03	0.000e+00	0.000e+00
3.140e+01	0.000e+00	-3.814e+03	0.000e+00	0.000e+00
3.160e+01	0.000e+00	-5.076e+03	0.000e+00	0.000e+00
3.181e+01	0.000e+00	-6.624e+03	0.000e+00	0.000e+00
3.201e+01	0.000e+00	-8.483e+03	0.000e+00	0.000e+00
3.222e+01	0.000e+00	-1.067e+04	0.000e+00	0.000e+00
3.242e+01	0.000e+00	-1.321e+04	0.000e+00	0.000e+00
3.263e+01	0.000e+00	-1.609e+04	0.000e+00	0.000e+00
3.283e+01	0.000e+00	-1.930e+04	0.000e+00	0.000e+00
3.304e+01	0.000e+00	-2.284e+04	0.000e+00	0.000e+00
3.324e+01	0.000e+00	-2.666e+04	0.000e+00	0.000e+00
3.345e+01	0.000e+00	-3.073e+04	0.000e+00	0.000e+00
3.365e+01	0.000e+00	-3.499e+04	0.000e+00	0.000e+00
3.386e+01	0.000e+00	-3.938e+04	0.000e+00	0.000e+00
3.406e+01	0.000e+00	-4.382e+04	0.000e+00	0.000e+00
3.427e+01	0.000e+00	-4.822e+04	0.000e+00	0.000e+00
3.447e+01	0.000e+00	-5.248e+04	0.000e+00	0.000e+00
3.468e+01	0.000e+00	-5.651e+04	0.000e+00	0.000e+00
3.488e+01	0.000e+00	-6.019e+04	0.000e+00	0.000e+00
3.509e+01	0.000e+00	-6.338e+04	0.000e+00	0.000e+00
3.529e+01	0.000e+00	-6.596e+04	0.000e+00	0.000e+00
3.550e+01	0.000e+00	-6.779e+04	0.000e+00	0.000e+00
3.570e+01	0.000e+00	-6.872e+04	0.000e+00	0.000e+00
3.591e+01	0.000e+00	-6.861e+04	0.000e+00	0.000e+00
3.612e+01	0.000e+00	-6.732e+04	0.000e+00	0.000e+00
3.632e+01	0.000e+00	-6.470e+04	0.000e+00	0.000e+00
3.653e+01	0.000e+00	-6.060e+04	0.000e+00	0.000e+00
3.673e+01	0.000e+00	-5.489e+04	0.000e+00	0.000e+00
3.694e+01	0.000e+00	-4.745e+04	0.000e+00	0.000e+00
3.714e+01	0.000e+00	-3.814e+04	0.000e+00	0.000e+00
3.735e+01	0.000e+00	-2.687e+04	0.000e+00	0.000e+00
3.755e+01	0.000e+00	-1.353e+04	0.000e+00	0.000e+00
3.776e+01	0.000e+00	1.976e+03	0.000e+00	0.000e+00
3.796e+01	0.000e+00	1.971e+04	0.000e+00	0.000e+00
3.817e+01	9.781e+00	3.975e+04	2.611e+01	1.728e+01
3.837e+01	2.287e+01	6.213e+04	6.105e+01	4.040e+01
3.858e+01	3.754e+01	8.690e+04	1.002e+02	6.632e+01
3.878e+01	5.383e+01	1.141e+05	1.437e+02	9.510e+01
3.899e+01	7.177e+01	1.437e+05	1.916e+02	1.268e+02
3.919e+01	9.136e+01	1.758e+05	2.439e+02	1.614e+02
3.940e+01	1.126e+02	2.103e+05	3.007e+02	1.990e+02
3.960e+01	1.356e+02	2.473e+05	3.619e+02	2.395e+02
3.981e+01	1.602e+02	2.866e+05	4.276e+02	2.829e+02
4.001e+01	1.864e+02	3.284e+05	4.977e+02	3.293e+02
4.022e+01	2.143e+02	3.725e+05	5.722e+02	3.786e+02
4.042e+01	2.439e+02	4.189e+05	6.511e+02	4.308e+02
4.063e+01	2.750e+02	4.677e+05	7.343e+02	4.858e+02
4.083e+01	3.077e+02	5.186e+05	8.216e+02	5.436e+02
4.104e+01	3.420e+02	5.718e+05	9.132e+02	6.042e+02
4.125e+01	3.778e+02	6.271e+05	1.009e+03	6.675e+02
4.145e+01	4.151e+02	6.846e+05	1.108e+03	7.333e+02
4.166e+01	4.539e+02	7.440e+05	1.212e+03	8.018e+02
4.186e+01	4.940e+02	8.054e+05	1.319e+03	8.727e+02
4.207e+01	5.356e+02	8.688e+05	1.430e+03	9.461e+02
4.227e+01	5.785e+02	9.340e+05	1.544e+03	1.022e+03

4.248e+01	6.227e+02	1.001e+06	1.662e+03	1.100e+03
4.268e+01	6.681e+02	1.070e+06	1.784e+03	1.180e+03
4.289e+01	7.148e+02	1.140e+06	1.908e+03	1.263e+03
4.309e+01	7.627e+02	1.212e+06	2.036e+03	1.347e+03
4.330e+01	8.117e+02	1.286e+06	2.167e+03	1.434e+03
4.350e+01	8.619e+02	1.361e+06	2.301e+03	1.522e+03
4.371e+01	9.130e+02	1.438e+06	2.438e+03	1.613e+03
4.391e+01	9.653e+02	1.516e+06	2.577e+03	1.705e+03
4.412e+01	1.018e+03	1.596e+06	2.719e+03	1.799e+03
4.432e+01	1.073e+03	1.676e+06	2.864e+03	1.895e+03
4.453e+01	1.128e+03	1.758e+06	3.011e+03	1.992e+03
4.473e+01	1.184e+03	1.842e+06	3.160e+03	2.091e+03
4.494e+01	1.240e+03	1.926e+06	3.312e+03	2.191e+03
4.514e+01	1.298e+03	2.011e+06	3.466e+03	2.293e+03
4.535e+01	1.356e+03	2.098e+06	3.621e+03	2.396e+03
4.555e+01	1.415e+03	2.185e+06	3.779e+03	2.500e+03
4.576e+01	1.475e+03	2.274e+06	3.939e+03	2.606e+03
4.596e+01	1.536e+03	2.363e+06	4.100e+03	2.713e+03
4.617e+01	1.597e+03	2.453e+06	4.263e+03	2.821e+03
4.638e+01	1.659e+03	2.544e+06	4.428e+03	2.930e+03
4.658e+01	1.721e+03	2.636e+06	4.594e+03	3.040e+03
4.679e+01	1.784e+03	2.729e+06	4.762e+03	3.151e+03
4.699e+01	1.847e+03	2.822e+06	4.931e+03	3.263e+03
4.720e+01	1.911e+03	2.916e+06	5.102e+03	3.376e+03
4.740e+01	1.975e+03	3.010e+06	5.274e+03	3.489e+03
4.761e+01	2.040e+03	3.105e+06	5.447e+03	3.604e+03
4.781e+01	2.105e+03	3.201e+06	5.621e+03	3.719e+03
4.802e+01	2.171e+03	3.297e+06	5.796e+03	3.835e+03
4.822e+01	2.237e+03	3.394e+06	5.972e+03	3.951e+03
4.843e+01	2.303e+03	3.491e+06	6.149e+03	4.068e+03
4.863e+01	2.370e+03	3.588e+06	6.327e+03	4.186e+03
4.884e+01	2.437e+03	3.686e+06	6.505e+03	4.304e+03
4.904e+01	2.504e+03	3.784e+06	6.685e+03	4.423e+03
4.925e+01	2.571e+03	3.883e+06	6.865e+03	4.542e+03
4.945e+01	2.639e+03	3.982e+06	7.046e+03	4.662e+03
4.966e+01	2.707e+03	4.081e+06	7.227e+03	4.782e+03
4.986e+01	2.775e+03	4.181e+06	7.409e+03	4.902e+03
5.007e+01	2.843e+03	4.280e+06	7.591e+03	5.023e+03
5.027e+01	2.912e+03	4.380e+06	7.774e+03	5.144e+03
5.048e+01	2.981e+03	4.480e+06	7.957e+03	5.265e+03
5.068e+01	3.049e+03	4.581e+06	8.141e+03	5.387e+03
5.089e+01	3.118e+03	4.681e+06	8.325e+03	5.508e+03
5.109e+01	3.187e+03	4.782e+06	8.509e+03	5.630e+03
5.130e+01	3.256e+03	4.882e+06	8.694e+03	5.752e+03
5.151e+01	3.326e+03	4.983e+06	8.879e+03	5.875e+03
5.171e+01	3.395e+03	5.084e+06	9.063e+03	5.997e+03
5.192e+01	3.464e+03	5.185e+06	9.249e+03	6.119e+03
5.212e+01	3.533e+03	5.285e+06	9.434e+03	6.242e+03
5.233e+01	3.603e+03	5.386e+06	9.619e+03	6.364e+03
5.253e+01	3.672e+03	5.487e+06	9.804e+03	6.487e+03
5.274e+01	3.742e+03	5.588e+06	9.989e+03	6.610e+03
5.294e+01	3.811e+03	5.689e+06	1.017e+04	6.732e+03
5.315e+01	3.880e+03	5.790e+06	1.036e+04	6.855e+03
5.335e+01	3.950e+03	5.891e+06	1.055e+04	6.977e+03
5.356e+01	4.019e+03	5.991e+06	1.073e+04	7.100e+03
5.376e+01	4.088e+03	6.092e+06	1.092e+04	7.222e+03

5.397e+01	4.158e+03	6.192e+06	1.110e+04	7.344e+03
5.417e+01	4.227e+03	6.293e+06	1.128e+04	7.467e+03
5.438e+01	4.296e+03	6.393e+06	1.147e+04	7.589e+03
5.458e+01	4.365e+03	6.493e+06	1.165e+04	7.711e+03
5.479e+01	4.434e+03	6.593e+06	1.184e+04	7.832e+03
5.499e+01	4.503e+03	6.693e+06	1.202e+04	7.954e+03
5.520e+01	4.571e+03	6.793e+06	1.220e+04	8.075e+03
5.540e+01	4.640e+03	6.892e+06	1.239e+04	8.197e+03
5.561e+01	4.708e+03	6.991e+06	1.257e+04	8.318e+03
5.581e+01	4.777e+03	7.090e+06	1.275e+04	8.438e+03
5.602e+01	4.845e+03	7.189e+06	1.294e+04	8.559e+03
5.622e+01	4.913e+03	7.288e+06	1.312e+04	8.679e+03
5.643e+01	4.981e+03	7.387e+06	1.330e+04	8.799e+03
5.664e+01	5.049e+03	7.485e+06	1.348e+04	8.919e+03
5.684e+01	5.117e+03	7.583e+06	1.366e+04	9.039e+03
5.705e+01	5.184e+03	7.680e+06	1.384e+04	9.158e+03
5.725e+01	5.251e+03	7.778e+06	1.402e+04	9.277e+03
5.746e+01	5.319e+03	7.875e+06	1.420e+04	9.395e+03
5.766e+01	5.386e+03	7.972e+06	1.438e+04	9.514e+03
5.787e+01	5.452e+03	8.069e+06	1.456e+04	9.632e+03
5.807e+01	5.519e+03	8.165e+06	1.473e+04	9.749e+03
5.828e+01	5.585e+03	8.261e+06	1.491e+04	9.867e+03
5.848e+01	5.652e+03	8.357e+06	1.509e+04	9.984e+03
5.869e+01	5.718e+03	8.453e+06	1.526e+04	1.010e+04
5.889e+01	5.783e+03	8.548e+06	1.544e+04	1.022e+04
5.910e+01	5.849e+03	8.643e+06	1.562e+04	1.033e+04
5.930e+01	5.914e+03	8.737e+06	1.579e+04	1.045e+04
5.951e+01	5.980e+03	8.832e+06	1.596e+04	1.056e+04
5.971e+01	6.044e+03	8.925e+06	1.614e+04	1.068e+04
5.992e+01	6.109e+03	9.019e+06	1.631e+04	1.079e+04
6.012e+01	6.174e+03	9.112e+06	1.648e+04	1.091e+04
6.033e+01	6.238e+03	9.205e+06	1.665e+04	1.102e+04
6.053e+01	6.302e+03	9.298e+06	1.683e+04	1.113e+04
6.074e+01	6.366e+03	9.390e+06	1.700e+04	1.125e+04
6.094e+01	6.429e+03	9.482e+06	1.716e+04	1.136e+04
6.115e+01	6.492e+03	9.573e+06	1.733e+04	1.147e+04
6.135e+01	6.556e+03	9.664e+06	1.750e+04	1.158e+04
6.156e+01	6.618e+03	9.755e+06	1.767e+04	1.169e+04
6.177e+01	6.681e+03	9.845e+06	1.784e+04	1.180e+04
6.197e+01	6.743e+03	9.935e+06	1.800e+04	1.191e+04
6.218e+01	6.805e+03	1.002e+07	1.817e+04	1.202e+04
6.238e+01	6.867e+03	1.011e+07	1.833e+04	1.213e+04
6.259e+01	6.928e+03	1.020e+07	1.850e+04	1.224e+04
6.279e+01	6.990e+03	1.029e+07	1.866e+04	1.235e+04
6.300e+01	7.050e+03	1.038e+07	1.882e+04	1.245e+04
6.320e+01	7.111e+03	1.047e+07	1.899e+04	1.256e+04
6.341e+01	7.171e+03	1.055e+07	1.915e+04	1.267e+04
6.361e+01	7.232e+03	1.064e+07	1.931e+04	1.277e+04
6.382e+01	7.291e+03	1.073e+07	1.947e+04	1.288e+04
6.402e+01	7.351e+03	1.081e+07	1.963e+04	1.299e+04
6.423e+01	7.410e+03	1.090e+07	1.978e+04	1.309e+04
6.443e+01	7.469e+03	1.098e+07	1.994e+04	1.319e+04
6.464e+01	7.528e+03	1.107e+07	2.010e+04	1.330e+04
6.484e+01	7.586e+03	1.115e+07	2.025e+04	1.340e+04
6.505e+01	7.644e+03	1.124e+07	2.041e+04	1.350e+04
6.525e+01	7.702e+03	1.132e+07	2.056e+04	1.361e+04

6.546e+01	7.760e+03	1.140e+07	2.072e+04	1.371e+04
6.566e+01	7.817e+03	1.148e+07	2.087e+04	1.381e+04
6.587e+01	7.874e+03	1.157e+07	2.102e+04	1.391e+04
6.607e+01	7.930e+03	1.165e+07	2.117e+04	1.401e+04
6.628e+01	7.987e+03	1.173e+07	2.132e+04	1.411e+04
6.648e+01	8.043e+03	1.181e+07	2.147e+04	1.421e+04
6.669e+01	8.098e+03	1.189e+07	2.162e+04	1.431e+04
6.690e+01	8.154e+03	1.197e+07	2.177e+04	1.440e+04
6.710e+01	8.209e+03	1.205e+07	2.192e+04	1.450e+04
6.731e+01	8.264e+03	1.213e+07	2.206e+04	1.460e+04
6.751e+01	8.318e+03	1.221e+07	2.221e+04	1.469e+04
6.772e+01	8.372e+03	1.229e+07	2.235e+04	1.479e+04
6.792e+01	8.426e+03	1.236e+07	2.250e+04	1.489e+04
6.813e+01	8.480e+03	1.244e+07	2.264e+04	1.498e+04
6.833e+01	8.533e+03	1.252e+07	2.278e+04	1.507e+04
6.854e+01	8.586e+03	1.259e+07	2.292e+04	1.517e+04
6.874e+01	8.639e+03	1.267e+07	2.306e+04	1.526e+04
6.895e+01	8.691e+03	1.274e+07	2.320e+04	1.535e+04
6.915e+01	8.743e+03	1.282e+07	2.334e+04	1.544e+04
6.936e+01	8.795e+03	1.289e+07	2.348e+04	1.554e+04
6.956e+01	8.846e+03	1.297e+07	2.362e+04	1.563e+04
6.977e+01	8.897e+03	1.304e+07	2.375e+04	1.572e+04
6.997e+01	8.948e+03	1.311e+07	2.389e+04	1.581e+04
7.018e+01	8.998e+03	1.319e+07	2.402e+04	1.590e+04
7.038e+01	9.048e+03	1.326e+07	2.416e+04	1.598e+04
7.059e+01	9.098e+03	1.333e+07	2.429e+04	1.607e+04
7.079e+01	9.147e+03	1.340e+07	2.442e+04	1.616e+04
7.100e+01	9.197e+03	1.347e+07	2.455e+04	1.625e+04
7.120e+01	9.245e+03	1.354e+07	2.468e+04	1.633e+04
7.141e+01	9.294e+03	1.361e+07	2.481e+04	1.642e+04
7.161e+01	9.342e+03	1.368e+07	2.494e+04	1.650e+04
7.182e+01	9.390e+03	1.375e+07	2.507e+04	1.659e+04
7.203e+01	9.438e+03	1.382e+07	2.520e+04	1.667e+04
7.223e+01	9.485e+03	1.389e+07	2.532e+04	1.676e+04
7.244e+01	9.532e+03	1.396e+07	2.545e+04	1.684e+04
7.264e+01	9.578e+03	1.402e+07	2.557e+04	1.692e+04
7.285e+01	9.625e+03	1.409e+07	2.570e+04	1.700e+04
7.305e+01	9.671e+03	1.415e+07	2.582e+04	1.708e+04
7.326e+01	9.716e+03	1.422e+07	2.594e+04	1.716e+04
7.346e+01	9.762e+03	1.429e+07	2.606e+04	1.724e+04
7.367e+01	9.807e+03	1.435e+07	2.618e+04	1.732e+04
7.387e+01	9.852e+03	1.441e+07	2.630e+04	1.740e+04
7.408e+01	9.896e+03	1.448e+07	2.642e+04	1.748e+04
7.428e+01	9.940e+03	1.454e+07	2.654e+04	1.756e+04
7.449e+01	9.984e+03	1.461e+07	2.666e+04	1.764e+04
7.469e+01	1.003e+04	1.467e+07	2.677e+04	1.771e+04
7.490e+01	1.007e+04	1.473e+07	2.689e+04	1.779e+04
7.510e+01	1.011e+04	1.479e+07	2.700e+04	1.787e+04
7.531e+01	1.016e+04	1.485e+07	2.711e+04	1.794e+04
7.551e+01	1.020e+04	1.491e+07	2.723e+04	1.802e+04
7.572e+01	1.024e+04	1.497e+07	2.734e+04	1.809e+04
7.592e+01	1.028e+04	1.503e+07	2.745e+04	1.816e+04
7.613e+01	1.032e+04	1.509e+07	2.756e+04	1.824e+04
7.633e+01	1.036e+04	1.515e+07	2.767e+04	1.831e+04
7.654e+01	1.040e+04	1.521e+07	2.778e+04	1.838e+04
7.674e+01	1.045e+04	1.527e+07	2.789e+04	1.845e+04

7.695e+01	1.049e+04	1.533e+07	2.799e+04	1.852e+04
7.716e+01	1.053e+04	1.538e+07	2.810e+04	1.859e+04
7.736e+01	1.056e+04	1.544e+07	2.821e+04	1.866e+04
7.757e+01	1.060e+04	1.550e+07	2.831e+04	1.873e+04
7.777e+01	1.064e+04	1.555e+07	2.841e+04	1.880e+04
7.798e+01	1.068e+04	1.561e+07	2.852e+04	1.887e+04
7.818e+01	1.072e+04	1.566e+07	2.862e+04	1.894e+04
7.839e+01	1.076e+04	1.572e+07	2.872e+04	1.900e+04
7.859e+01	1.080e+04	1.577e+07	2.882e+04	1.907e+04
7.880e+01	1.083e+04	1.582e+07	2.892e+04	1.914e+04
7.900e+01	1.087e+04	1.588e+07	2.902e+04	1.920e+04
7.921e+01	1.091e+04	1.593e+07	2.912e+04	1.927e+04
7.941e+01	1.094e+04	1.598e+07	2.922e+04	1.933e+04
7.962e+01	1.098e+04	1.604e+07	2.931e+04	1.940e+04
7.982e+01	1.102e+04	1.609e+07	2.941e+04	1.946e+04
8.003e+01	1.105e+04	1.614e+07	2.950e+04	1.952e+04
8.023e+01	1.109e+04	1.619e+07	2.960e+04	1.958e+04
8.044e+01	1.112e+04	1.624e+07	2.969e+04	1.965e+04
8.064e+01	1.116e+04	1.629e+07	2.979e+04	1.971e+04
8.085e+01	1.119e+04	1.634e+07	2.988e+04	1.977e+04
8.105e+01	1.122e+04	1.639e+07	2.997e+04	1.983e+04
8.126e+01	1.126e+04	1.644e+07	3.006e+04	1.989e+04
8.146e+01	1.129e+04	1.649e+07	3.015e+04	1.995e+04
8.167e+01	1.133e+04	1.653e+07	3.024e+04	2.001e+04
8.187e+01	1.136e+04	1.658e+07	3.033e+04	2.007e+04
8.208e+01	1.139e+04	1.663e+07	3.041e+04	2.012e+04
8.229e+01	1.142e+04	1.667e+07	3.050e+04	2.018e+04
8.249e+01	1.146e+04	1.672e+07	3.059e+04	2.024e+04
8.270e+01	1.149e+04	1.677e+07	3.067e+04	2.030e+04
8.290e+01	1.152e+04	1.681e+07	3.076e+04	2.035e+04
8.311e+01	1.155e+04	1.686e+07	3.084e+04	2.041e+04
8.331e+01	1.158e+04	1.690e+07	3.093e+04	2.046e+04
8.352e+01	1.161e+04	1.695e+07	3.101e+04	2.052e+04
8.372e+01	1.165e+04	1.699e+07	3.109e+04	2.057e+04
8.393e+01	1.168e+04	1.704e+07	3.117e+04	2.063e+04
8.413e+01	1.171e+04	1.708e+07	3.125e+04	2.068e+04
8.434e+01	1.174e+04	1.712e+07	3.133e+04	2.073e+04
8.454e+01	1.177e+04	1.716e+07	3.141e+04	2.078e+04
8.475e+01	1.179e+04	1.721e+07	3.149e+04	2.084e+04
8.495e+01	1.182e+04	1.725e+07	3.157e+04	2.089e+04
8.516e+01	1.185e+04	1.729e+07	3.164e+04	2.094e+04
8.536e+01	1.188e+04	1.733e+07	3.172e+04	2.099e+04
8.557e+01	1.191e+04	1.737e+07	3.180e+04	2.104e+04
8.577e+01	1.194e+04	1.741e+07	3.187e+04	2.109e+04
8.598e+01	1.197e+04	1.745e+07	3.195e+04	2.114e+04
8.618e+01	1.199e+04	1.749e+07	3.202e+04	2.119e+04
8.639e+01	1.202e+04	1.753e+07	3.209e+04	2.124e+04
8.659e+01	1.205e+04	1.757e+07	3.217e+04	2.128e+04
8.680e+01	1.208e+04	1.761e+07	3.224e+04	2.133e+04
8.700e+01	1.210e+04	1.765e+07	3.231e+04	2.138e+04
8.721e+01	1.213e+04	1.768e+07	3.238e+04	2.143e+04
8.742e+01	1.215e+04	1.772e+07	3.245e+04	2.147e+04
8.762e+01	1.218e+04	1.776e+07	3.252e+04	2.152e+04
8.783e+01	1.221e+04	1.780e+07	3.259e+04	2.156e+04
8.803e+01	1.223e+04	1.783e+07	3.266e+04	2.161e+04
8.824e+01	1.226e+04	1.787e+07	3.272e+04	2.165e+04

8.844e+01	1.228e+04	1.791e+07	3.279e+04	2.170e+04
8.865e+01	1.231e+04	1.794e+07	3.286e+04	2.174e+04
8.885e+01	1.233e+04	1.798e+07	3.292e+04	2.178e+04
8.906e+01	1.236e+04	1.801e+07	3.299e+04	2.183e+04
8.926e+01	1.238e+04	1.805e+07	3.305e+04	2.187e+04
8.947e+01	1.240e+04	1.808e+07	3.312e+04	2.191e+04
8.967e+01	1.243e+04	1.811e+07	3.318e+04	2.195e+04
8.988e+01	1.245e+04	1.815e+07	3.324e+04	2.200e+04
9.008e+01	1.247e+04	1.818e+07	3.331e+04	2.204e+04
9.029e+01	1.250e+04	1.821e+07	3.337e+04	2.208e+04
9.049e+01	1.252e+04	1.825e+07	3.343e+04	2.212e+04
9.070e+01	1.254e+04	1.828e+07	3.349e+04	2.216e+04
9.090e+01	1.257e+04	1.831e+07	3.355e+04	2.220e+04
9.111e+01	1.259e+04	1.834e+07	3.361e+04	2.224e+04
9.131e+01	1.261e+04	1.838e+07	3.367e+04	2.228e+04
9.152e+01	1.263e+04	1.841e+07	3.373e+04	2.231e+04
9.172e+01	1.265e+04	1.844e+07	3.378e+04	2.235e+04
9.193e+01	1.267e+04	1.847e+07	3.384e+04	2.239e+04
9.213e+01	1.270e+04	1.850e+07	3.390e+04	2.243e+04
9.234e+01	1.272e+04	1.853e+07	3.395e+04	2.247e+04
9.255e+01	1.274e+04	1.856e+07	3.401e+04	2.250e+04
9.275e+01	1.276e+04	1.859e+07	3.406e+04	2.254e+04
9.296e+01	1.278e+04	1.862e+07	3.412e+04	2.257e+04
9.316e+01	1.280e+04	1.865e+07	3.417e+04	2.261e+04
9.337e+01	1.282e+04	1.868e+07	3.423e+04	2.265e+04
9.357e+01	1.284e+04	1.870e+07	3.428e+04	2.268e+04
9.378e+01	1.286e+04	1.873e+07	3.433e+04	2.272e+04
9.398e+01	1.288e+04	1.876e+07	3.438e+04	2.275e+04
9.419e+01	1.290e+04	1.879e+07	3.443e+04	2.278e+04
9.439e+01	1.292e+04	1.881e+07	3.449e+04	2.282e+04
9.460e+01	1.294e+04	1.884e+07	3.454e+04	2.285e+04
9.480e+01	1.295e+04	1.887e+07	3.459e+04	2.288e+04
9.501e+01	1.297e+04	1.890e+07	3.464e+04	2.292e+04
9.521e+01	1.299e+04	1.892e+07	3.469e+04	2.295e+04
9.542e+01	1.301e+04	1.895e+07	3.473e+04	2.298e+04
9.562e+01	1.303e+04	1.897e+07	3.478e+04	2.301e+04
9.583e+01	1.305e+04	1.900e+07	3.483e+04	2.305e+04
9.603e+01	1.306e+04	1.902e+07	3.488e+04	2.308e+04
9.624e+01	1.308e+04	1.905e+07	3.492e+04	2.311e+04
9.644e+01	1.310e+04	1.907e+07	3.497e+04	2.314e+04
9.665e+01	1.312e+04	1.910e+07	3.502e+04	2.317e+04
9.685e+01	1.313e+04	1.912e+07	3.506e+04	2.320e+04
9.706e+01	1.315e+04	1.915e+07	3.511e+04	2.323e+04
9.726e+01	1.317e+04	1.917e+07	3.515e+04	2.326e+04
9.747e+01	1.318e+04	1.920e+07	3.520e+04	2.329e+04
9.768e+01	1.320e+04	1.922e+07	3.524e+04	2.332e+04
9.788e+01	1.322e+04	1.924e+07	3.528e+04	2.335e+04
9.809e+01	1.323e+04	1.927e+07	3.533e+04	2.337e+04
9.829e+01	1.325e+04	1.929e+07	3.537e+04	2.340e+04
9.850e+01	1.326e+04	1.931e+07	3.541e+04	2.343e+04
9.870e+01	1.328e+04	1.933e+07	3.545e+04	2.346e+04
9.891e+01	1.329e+04	1.935e+07	3.549e+04	2.348e+04
9.911e+01	1.331e+04	1.938e+07	3.553e+04	2.351e+04
9.932e+01	1.332e+04	1.940e+07	3.557e+04	2.354e+04
9.952e+01	1.334e+04	1.942e+07	3.561e+04	2.356e+04
9.973e+01	1.335e+04	1.944e+07	3.565e+04	2.359e+04

9.993e+01	1.337e+04	1.946e+07	3.569e+04	2.362e+04
1.001e+02	1.338e+04	1.948e+07	3.573e+04	2.364e+04
1.003e+02	1.340e+04	1.950e+07	3.577e+04	2.367e+04
1.005e+02	1.341e+04	1.952e+07	3.581e+04	2.369e+04
1.008e+02	1.343e+04	1.954e+07	3.585e+04	2.372e+04
1.010e+02	1.344e+04	1.956e+07	3.588e+04	2.374e+04
1.012e+02	1.345e+04	1.958e+07	3.592e+04	2.377e+04
1.014e+02	1.347e+04	1.960e+07	3.596e+04	2.379e+04
1.016e+02	1.348e+04	1.962e+07	3.599e+04	2.381e+04
1.018e+02	1.349e+04	1.964e+07	3.603e+04	2.384e+04
1.020e+02	1.351e+04	1.966e+07	3.606e+04	2.386e+04
1.022e+02	1.352e+04	1.968e+07	3.610e+04	2.389e+04
1.024e+02	1.353e+04	1.970e+07	3.613e+04	2.391e+04
1.026e+02	1.355e+04	1.972e+07	3.617e+04	2.393e+04
1.028e+02	1.356e+04	1.974e+07	3.620e+04	2.395e+04
1.030e+02	1.357e+04	1.975e+07	3.624e+04	2.398e+04
1.032e+02	1.358e+04	1.977e+07	3.627e+04	2.400e+04
1.034e+02	1.360e+04	1.979e+07	3.630e+04	2.402e+04
1.036e+02	1.361e+04	1.981e+07	3.633e+04	2.404e+04
1.038e+02	1.362e+04	1.982e+07	3.637e+04	2.406e+04
1.040e+02	1.363e+04	1.984e+07	3.640e+04	2.408e+04
1.042e+02	1.365e+04	1.986e+07	3.643e+04	2.411e+04
1.044e+02	1.366e+04	1.987e+07	3.646e+04	2.413e+04
1.047e+02	1.367e+04	1.989e+07	3.649e+04	2.415e+04
1.049e+02	1.368e+04	1.991e+07	3.652e+04	2.417e+04
1.051e+02	1.369e+04	1.992e+07	3.655e+04	2.419e+04
1.053e+02	1.370e+04	1.994e+07	3.659e+04	2.421e+04
1.055e+02	1.371e+04	1.996e+07	3.661e+04	2.423e+04
1.057e+02	1.373e+04	1.997e+07	3.664e+04	2.425e+04
1.059e+02	1.374e+04	1.999e+07	3.667e+04	2.427e+04
1.061e+02	1.375e+04	2.000e+07	3.670e+04	2.428e+04
1.063e+02	1.376e+04	2.002e+07	3.673e+04	2.430e+04
1.065e+02	1.377e+04	2.003e+07	3.676e+04	2.432e+04
1.067e+02	1.378e+04	2.005e+07	3.679e+04	2.434e+04
1.069e+02	1.379e+04	2.006e+07	3.682e+04	2.436e+04
1.071e+02	1.380e+04	2.008e+07	3.684e+04	2.438e+04
1.073e+02	1.381e+04	2.009e+07	3.687e+04	2.440e+04
1.075e+02	1.382e+04	2.011e+07	3.690e+04	2.441e+04
1.077e+02	1.383e+04	2.012e+07	3.692e+04	2.443e+04
1.079e+02	1.384e+04	2.014e+07	3.695e+04	2.445e+04
1.081e+02	1.385e+04	2.015e+07	3.698e+04	2.447e+04
1.083e+02	1.386e+04	2.016e+07	3.700e+04	2.448e+04
1.086e+02	1.387e+04	2.018e+07	3.703e+04	2.450e+04
1.088e+02	1.388e+04	2.019e+07	3.705e+04	2.452e+04
1.090e+02	1.389e+04	2.020e+07	3.708e+04	2.453e+04
1.092e+02	1.390e+04	2.022e+07	3.710e+04	2.455e+04
1.094e+02	1.391e+04	2.023e+07	3.713e+04	2.457e+04
1.096e+02	1.392e+04	2.024e+07	3.715e+04	2.458e+04
1.098e+02	1.392e+04	2.026e+07	3.718e+04	2.460e+04
1.100e+02	1.393e+04	2.027e+07	3.720e+04	2.461e+04
1.102e+02	1.394e+04	2.028e+07	3.722e+04	2.463e+04
1.104e+02	1.395e+04	2.030e+07	3.725e+04	2.464e+04
1.106e+02	1.396e+04	2.031e+07	3.727e+04	2.466e+04
1.108e+02	1.397e+04	2.032e+07	3.729e+04	2.467e+04
1.110e+02	1.398e+04	2.033e+07	3.731e+04	2.469e+04
1.112e+02	1.398e+04	2.034e+07	3.734e+04	2.470e+04

1.114e+02	1.399e+04	2.036e+07	3.736e+04	2.472e+04
1.116e+02	1.400e+04	2.037e+07	3.738e+04	2.473e+04
1.118e+02	1.401e+04	2.038e+07	3.740e+04	2.475e+04
1.120e+02	1.402e+04	2.039e+07	3.742e+04	2.476e+04
1.122e+02	1.403e+04	2.040e+07	3.745e+04	2.478e+04
1.124e+02	1.403e+04	2.041e+07	3.747e+04	2.479e+04
1.127e+02	1.404e+04	2.042e+07	3.749e+04	2.480e+04
1.129e+02	1.405e+04	2.044e+07	3.751e+04	2.482e+04
1.131e+02	1.406e+04	2.045e+07	3.753e+04	2.483e+04
1.133e+02	1.406e+04	2.046e+07	3.755e+04	2.484e+04
1.135e+02	1.407e+04	2.047e+07	3.757e+04	2.486e+04
1.137e+02	1.408e+04	2.048e+07	3.759e+04	2.487e+04
1.139e+02	1.409e+04	2.049e+07	3.761e+04	2.488e+04
1.141e+02	1.409e+04	2.050e+07	3.763e+04	2.490e+04
1.143e+02	1.410e+04	2.051e+07	3.765e+04	2.491e+04
1.145e+02	1.411e+04	2.052e+07	3.766e+04	2.492e+04
1.147e+02	1.411e+04	2.053e+07	3.768e+04	2.493e+04
1.149e+02	1.412e+04	2.054e+07	3.770e+04	2.495e+04
1.151e+02	1.413e+04	2.055e+07	3.772e+04	2.496e+04
1.153e+02	1.414e+04	2.056e+07	3.774e+04	2.497e+04
1.155e+02	1.414e+04	2.057e+07	3.776e+04	2.498e+04
1.157e+02	1.415e+04	2.058e+07	3.777e+04	2.499e+04
1.159e+02	1.415e+04	2.059e+07	3.779e+04	2.501e+04
1.161e+02	1.416e+04	2.060e+07	3.781e+04	2.502e+04
1.163e+02	1.417e+04	2.061e+07	3.783e+04	2.503e+04
1.166e+02	1.417e+04	2.061e+07	3.784e+04	2.504e+04
1.168e+02	1.418e+04	2.062e+07	3.786e+04	2.505e+04
1.170e+02	1.419e+04	2.063e+07	3.788e+04	2.506e+04
1.172e+02	1.419e+04	2.064e+07	3.789e+04	2.507e+04
1.174e+02	1.420e+04	2.065e+07	3.791e+04	2.508e+04
1.176e+02	1.421e+04	2.066e+07	3.793e+04	2.509e+04
1.178e+02	1.421e+04	2.067e+07	3.794e+04	2.510e+04
1.180e+02	1.422e+04	2.068e+07	3.796e+04	2.511e+04
1.182e+02	1.422e+04	2.068e+07	3.797e+04	2.513e+04
1.184e+02	1.423e+04	2.069e+07	3.799e+04	2.514e+04
1.186e+02	1.423e+04	2.070e+07	3.800e+04	2.515e+04
1.188e+02	1.424e+04	2.071e+07	3.802e+04	2.516e+04
1.190e+02	1.425e+04	2.072e+07	3.803e+04	2.517e+04
1.192e+02	1.425e+04	2.072e+07	3.805e+04	2.518e+04
1.194e+02	1.426e+04	2.073e+07	3.806e+04	2.518e+04
1.196e+02	1.426e+04	2.074e+07	3.808e+04	2.519e+04
1.198e+02	1.427e+04	2.075e+07	3.809e+04	2.520e+04
1.200e+02	1.427e+04	2.076e+07	3.811e+04	2.521e+04
1.202e+02	1.428e+04	2.076e+07	3.812e+04	2.522e+04
1.205e+02	1.428e+04	2.077e+07	3.813e+04	2.523e+04
1.207e+02	1.429e+04	2.078e+07	3.815e+04	2.524e+04
1.209e+02	1.429e+04	2.079e+07	3.816e+04	2.525e+04
1.211e+02	1.430e+04	2.079e+07	3.817e+04	2.526e+04
1.213e+02	1.430e+04	2.080e+07	3.819e+04	2.527e+04
1.215e+02	1.431e+04	2.081e+07	3.820e+04	2.528e+04
1.217e+02	1.431e+04	2.081e+07	3.821e+04	2.529e+04
1.219e+02	1.432e+04	2.082e+07	3.823e+04	2.529e+04
1.221e+02	1.432e+04	2.083e+07	3.824e+04	2.530e+04
1.223e+02	1.433e+04	2.083e+07	3.825e+04	2.531e+04
1.225e+02	1.433e+04	2.084e+07	3.827e+04	2.532e+04
1.227e+02	1.434e+04	2.085e+07	3.828e+04	2.533e+04

1.229e+02	1.434e+04	2.085e+07	3.829e+04	2.533e+04
1.231e+02	1.435e+04	2.086e+07	3.830e+04	2.534e+04
1.233e+02	1.435e+04	2.087e+07	3.831e+04	2.535e+04
1.235e+02	1.436e+04	2.087e+07	3.833e+04	2.536e+04
1.237e+02	1.436e+04	2.088e+07	3.834e+04	2.537e+04
1.239e+02	1.436e+04	2.089e+07	3.835e+04	2.537e+04
1.241e+02	1.437e+04	2.089e+07	3.836e+04	2.538e+04
1.244e+02	1.437e+04	2.090e+07	3.837e+04	2.539e+04
1.246e+02	1.438e+04	2.090e+07	3.838e+04	2.540e+04
1.248e+02	1.438e+04	2.091e+07	3.839e+04	2.540e+04
1.250e+02	1.438e+04	2.092e+07	3.840e+04	2.541e+04
1.252e+02	1.439e+04	2.092e+07	3.842e+04	2.542e+04
1.254e+02	1.439e+04	2.093e+07	3.843e+04	2.543e+04
1.256e+02	1.440e+04	2.093e+07	3.844e+04	2.543e+04
1.258e+02	1.440e+04	2.094e+07	3.845e+04	2.544e+04
1.260e+02	1.440e+04	2.094e+07	3.846e+04	2.545e+04
1.262e+02	1.441e+04	2.095e+07	3.847e+04	2.545e+04
1.264e+02	1.441e+04	2.096e+07	3.848e+04	2.546e+04
1.266e+02	1.442e+04	2.096e+07	3.849e+04	2.547e+04
1.268e+02	1.442e+04	2.097e+07	3.850e+04	2.547e+04
1.270e+02	1.442e+04	2.097e+07	3.851e+04	2.548e+04
1.272e+02	1.443e+04	2.098e+07	3.852e+04	2.549e+04
1.274e+02	1.443e+04	2.098e+07	3.853e+04	2.549e+04
1.276e+02	1.443e+04	2.099e+07	3.854e+04	2.550e+04
1.278e+02	1.444e+04	2.099e+07	3.855e+04	2.550e+04
1.280e+02	1.444e+04	2.100e+07	3.856e+04	2.551e+04
1.282e+02	1.444e+04	2.100e+07	3.857e+04	2.552e+04
1.285e+02	1.445e+04	2.101e+07	3.857e+04	2.552e+04
1.287e+02	1.445e+04	2.101e+07	3.858e+04	2.553e+04
1.289e+02	1.446e+04	2.102e+07	3.859e+04	2.554e+04
1.291e+02	1.446e+04	2.102e+07	3.860e+04	2.554e+04
1.293e+02	1.446e+04	2.103e+07	3.861e+04	2.555e+04
1.295e+02	1.446e+04	2.103e+07	3.862e+04	2.555e+04
1.297e+02	1.447e+04	2.104e+07	3.863e+04	2.556e+04
1.299e+02	1.447e+04	2.104e+07	3.864e+04	2.556e+04
1.301e+02	1.447e+04	2.104e+07	3.864e+04	2.557e+04
1.303e+02	1.448e+04	2.105e+07	3.865e+04	2.557e+04
1.305e+02	1.448e+04	2.105e+07	3.866e+04	2.558e+04
1.307e+02	1.448e+04	2.106e+07	3.867e+04	2.559e+04
1.309e+02	1.449e+04	2.106e+07	3.868e+04	2.559e+04
1.311e+02	1.449e+04	2.107e+07	3.868e+04	2.560e+04
1.313e+02	1.449e+04	2.107e+07	3.869e+04	2.560e+04
1.315e+02	1.450e+04	2.107e+07	3.870e+04	2.561e+04
1.317e+02	1.450e+04	2.108e+07	3.871e+04	2.561e+04
1.319e+02	1.450e+04	2.108e+07	3.872e+04	2.562e+04
1.321e+02	1.450e+04	2.109e+07	3.872e+04	2.562e+04
1.324e+02	1.451e+04	2.109e+07	3.873e+04	2.563e+04
1.326e+02	1.451e+04	2.109e+07	3.874e+04	2.563e+04
1.328e+02	1.451e+04	2.110e+07	3.875e+04	2.564e+04
1.330e+02	1.451e+04	2.110e+07	3.875e+04	2.564e+04
1.332e+02	1.452e+04	2.111e+07	3.876e+04	2.565e+04
1.334e+02	1.452e+04	2.111e+07	3.877e+04	2.565e+04
1.336e+02	1.452e+04	2.111e+07	3.877e+04	2.566e+04
1.338e+02	1.453e+04	2.112e+07	3.878e+04	2.566e+04
1.340e+02	1.453e+04	2.112e+07	3.879e+04	2.566e+04
1.342e+02	1.453e+04	2.112e+07	3.879e+04	2.567e+04

1.344e+02	1.453e+04	2.113e+07	3.880e+04	2.567e+04
1.346e+02	1.454e+04	2.113e+07	3.881e+04	2.568e+04
1.348e+02	1.454e+04	2.113e+07	3.881e+04	2.568e+04
1.350e+02	1.454e+04	2.114e+07	3.882e+04	2.569e+04
1.352e+02	1.454e+04	2.114e+07	3.883e+04	2.569e+04
1.354e+02	1.455e+04	2.115e+07	3.883e+04	2.569e+04
1.356e+02	1.455e+04	2.115e+07	3.884e+04	2.570e+04
1.358e+02	1.455e+04	2.115e+07	3.885e+04	2.570e+04
1.360e+02	1.455e+04	2.116e+07	3.885e+04	2.571e+04
1.363e+02	1.455e+04	2.116e+07	3.886e+04	2.571e+04
1.365e+02	1.456e+04	2.116e+07	3.886e+04	2.571e+04
1.367e+02	1.456e+04	2.116e+07	3.887e+04	2.572e+04
1.369e+02	1.456e+04	2.117e+07	3.888e+04	2.572e+04
1.371e+02	1.456e+04	2.117e+07	3.888e+04	2.573e+04
1.373e+02	1.457e+04	2.117e+07	3.889e+04	2.573e+04
1.375e+02	1.457e+04	2.118e+07	3.889e+04	2.573e+04
1.377e+02	1.457e+04	2.118e+07	3.890e+04	2.574e+04
1.379e+02	1.457e+04	2.118e+07	3.890e+04	2.574e+04
1.381e+02	1.457e+04	2.119e+07	3.891e+04	2.574e+04
1.383e+02	1.458e+04	2.119e+07	3.891e+04	2.575e+04
1.385e+02	1.458e+04	2.119e+07	3.892e+04	2.575e+04
1.387e+02	1.458e+04	2.119e+07	3.893e+04	2.576e+04
1.389e+02	1.458e+04	2.120e+07	3.893e+04	2.576e+04
1.391e+02	1.458e+04	2.120e+07	3.894e+04	2.576e+04
1.393e+02	1.459e+04	2.120e+07	3.894e+04	2.577e+04
1.395e+02	1.459e+04	2.121e+07	3.895e+04	2.577e+04
1.397e+02	1.459e+04	2.121e+07	3.895e+04	2.577e+04
1.399e+02	1.459e+04	2.121e+07	3.896e+04	2.578e+04
1.402e+02	1.459e+04	2.121e+07	3.896e+04	2.578e+04
1.404e+02	1.459e+04	2.122e+07	3.897e+04	2.578e+04
1.406e+02	1.460e+04	2.122e+07	3.897e+04	2.579e+04
1.408e+02	1.460e+04	2.122e+07	3.898e+04	2.579e+04
1.410e+02	1.460e+04	2.122e+07	3.898e+04	2.579e+04
1.412e+02	1.460e+04	2.123e+07	3.898e+04	2.579e+04
1.414e+02	1.460e+04	2.123e+07	3.899e+04	2.580e+04
1.416e+02	1.461e+04	2.123e+07	3.899e+04	2.580e+04
1.418e+02	1.461e+04	2.123e+07	3.900e+04	2.580e+04
1.420e+02	1.461e+04	2.124e+07	3.900e+04	2.581e+04
1.422e+02	1.461e+04	2.124e+07	3.901e+04	2.581e+04
1.424e+02	1.461e+04	2.124e+07	3.901e+04	2.581e+04
1.426e+02	1.461e+04	2.124e+07	3.902e+04	2.582e+04
1.428e+02	1.462e+04	2.125e+07	3.902e+04	2.582e+04
1.430e+02	1.462e+04	2.125e+07	3.902e+04	2.582e+04
1.432e+02	1.462e+04	2.125e+07	3.903e+04	2.582e+04
1.434e+02	1.462e+04	2.125e+07	3.903e+04	2.583e+04
1.436e+02	1.462e+04	2.125e+07	3.904e+04	2.583e+04
1.438e+02	1.462e+04	2.126e+07	3.904e+04	2.583e+04
1.441e+02	1.462e+04	2.126e+07	3.904e+04	2.583e+04
1.443e+02	1.463e+04	2.126e+07	3.905e+04	2.584e+04
1.445e+02	1.463e+04	2.126e+07	3.905e+04	2.584e+04
1.447e+02	1.463e+04	2.126e+07	3.906e+04	2.584e+04
1.449e+02	1.463e+04	2.127e+07	3.906e+04	2.584e+04
1.451e+02	1.463e+04	2.127e+07	3.906e+04	2.585e+04
1.453e+02	1.463e+04	2.127e+07	3.907e+04	2.585e+04
1.455e+02	1.463e+04	2.127e+07	3.907e+04	2.585e+04
1.457e+02	1.464e+04	2.127e+07	3.908e+04	2.585e+04

1.459e+02	1.464e+04	2.128e+07	3.908e+04	2.586e+04
1.461e+02	1.464e+04	2.128e+07	3.908e+04	2.586e+04
1.463e+02	1.464e+04	2.128e+07	3.909e+04	2.586e+04
1.465e+02	1.464e+04	2.128e+07	3.909e+04	2.586e+04
1.467e+02	1.464e+04	2.128e+07	3.909e+04	2.587e+04
1.469e+02	1.464e+04	2.129e+07	3.910e+04	2.587e+04
1.471e+02	1.465e+04	2.129e+07	3.910e+04	2.587e+04
1.473e+02	1.465e+04	2.129e+07	3.910e+04	2.587e+04
1.475e+02	1.465e+04	2.129e+07	3.911e+04	2.588e+04
1.477e+02	1.465e+04	2.129e+07	3.911e+04	2.588e+04
1.479e+02	1.465e+04	2.130e+07	3.911e+04	2.588e+04
1.482e+02	1.465e+04	2.130e+07	3.912e+04	2.588e+04
1.484e+02	1.465e+04	2.130e+07	3.912e+04	2.588e+04
1.486e+02	1.465e+04	2.130e+07	3.912e+04	2.589e+04
1.488e+02	1.465e+04	2.130e+07	3.913e+04	2.589e+04
1.490e+02	1.466e+04	2.130e+07	3.913e+04	2.589e+04
1.492e+02	1.466e+04	2.131e+07	3.913e+04	2.589e+04
1.494e+02	1.466e+04	2.131e+07	3.913e+04	2.589e+04
1.496e+02	1.466e+04	2.131e+07	3.914e+04	2.590e+04
1.498e+02	1.466e+04	2.131e+07	3.914e+04	2.590e+04
1.500e+02	1.466e+04	2.131e+07	3.914e+04	2.590e+04
1.502e+02	1.466e+04	2.131e+07	3.915e+04	2.590e+04
1.504e+02	1.466e+04	2.131e+07	3.915e+04	2.590e+04
1.506e+02	1.466e+04	2.132e+07	3.915e+04	2.591e+04
1.508e+02	1.467e+04	2.132e+07	3.916e+04	2.591e+04
1.510e+02	1.467e+04	2.132e+07	3.916e+04	2.591e+04
1.512e+02	1.467e+04	2.132e+07	3.916e+04	2.591e+04
1.514e+02	1.467e+04	2.132e+07	3.916e+04	2.591e+04
1.516e+02	1.467e+04	2.132e+07	3.917e+04	2.591e+04
1.518e+02	1.467e+04	2.132e+07	3.917e+04	2.592e+04
1.521e+02	1.467e+04	2.133e+07	3.917e+04	2.592e+04
1.523e+02	1.467e+04	2.133e+07	3.917e+04	2.592e+04
1.525e+02	1.467e+04	2.133e+07	3.918e+04	2.592e+04
1.527e+02	1.467e+04	2.133e+07	3.918e+04	2.592e+04
1.529e+02	1.468e+04	2.133e+07	3.918e+04	2.592e+04
1.531e+02	1.468e+04	2.133e+07	3.918e+04	2.593e+04
1.533e+02	1.468e+04	2.133e+07	3.919e+04	2.593e+04
1.535e+02	1.468e+04	2.134e+07	3.919e+04	2.593e+04
1.537e+02	1.468e+04	2.134e+07	3.919e+04	2.593e+04
1.539e+02	1.468e+04	2.134e+07	3.919e+04	2.593e+04
1.541e+02	1.468e+04	2.134e+07	3.920e+04	2.593e+04
1.543e+02	1.468e+04	2.134e+07	3.920e+04	2.594e+04
1.545e+02	1.468e+04	2.134e+07	3.920e+04	2.594e+04
1.547e+02	1.468e+04	2.134e+07	3.920e+04	2.594e+04
1.549e+02	1.468e+04	2.134e+07	3.920e+04	2.594e+04
1.551e+02	1.469e+04	2.135e+07	3.921e+04	2.594e+04
1.553e+02	1.469e+04	2.135e+07	3.921e+04	2.594e+04
1.555e+02	1.469e+04	2.135e+07	3.921e+04	2.594e+04
1.557e+02	1.469e+04	2.135e+07	3.921e+04	2.595e+04
1.560e+02	1.469e+04	2.135e+07	3.922e+04	2.595e+04
1.562e+02	1.469e+04	2.135e+07	3.922e+04	2.595e+04
1.564e+02	1.469e+04	2.135e+07	3.922e+04	2.595e+04
1.566e+02	1.469e+04	2.135e+07	3.922e+04	2.595e+04
1.568e+02	1.469e+04	2.135e+07	3.922e+04	2.595e+04
1.570e+02	1.469e+04	2.136e+07	3.923e+04	2.595e+04
1.572e+02	1.469e+04	2.136e+07	3.923e+04	2.596e+04

1.574e+02	1.469e+04	2.136e+07	3.923e+04	2.596e+04
1.576e+02	1.469e+04	2.136e+07	3.923e+04	2.596e+04
1.578e+02	1.470e+04	2.136e+07	3.923e+04	2.596e+04
1.580e+02	1.470e+04	2.136e+07	3.924e+04	2.596e+04
1.582e+02	1.470e+04	2.136e+07	3.924e+04	2.596e+04
1.584e+02	1.470e+04	2.136e+07	3.924e+04	2.596e+04
1.586e+02	1.470e+04	2.136e+07	3.924e+04	2.596e+04
1.588e+02	1.470e+04	2.136e+07	3.924e+04	2.597e+04
1.590e+02	1.470e+04	2.137e+07	3.924e+04	2.597e+04
1.592e+02	1.470e+04	2.137e+07	3.925e+04	2.597e+04
1.594e+02	1.470e+04	2.137e+07	3.925e+04	2.597e+04
1.596e+02	1.470e+04	2.137e+07	3.925e+04	2.597e+04
1.599e+02	1.470e+04	2.137e+07	3.925e+04	2.597e+04
1.601e+02	1.470e+04	2.137e+07	3.925e+04	2.597e+04
1.603e+02	1.470e+04	2.137e+07	3.926e+04	2.597e+04
1.605e+02	1.470e+04	2.137e+07	3.926e+04	2.597e+04
1.607e+02	1.470e+04	2.137e+07	3.926e+04	2.598e+04
1.609e+02	1.471e+04	2.137e+07	3.926e+04	2.598e+04
1.611e+02	1.471e+04	2.137e+07	3.926e+04	2.598e+04
1.613e+02	1.471e+04	2.138e+07	3.926e+04	2.598e+04
1.615e+02	1.471e+04	2.138e+07	3.926e+04	2.598e+04
1.617e+02	1.471e+04	2.138e+07	3.927e+04	2.598e+04
1.619e+02	1.471e+04	2.138e+07	3.927e+04	2.598e+04
1.621e+02	1.471e+04	2.138e+07	3.927e+04	2.598e+04
1.623e+02	1.471e+04	2.138e+07	3.927e+04	2.598e+04
1.625e+02	1.471e+04	2.138e+07	3.927e+04	2.599e+04
1.627e+02	1.471e+04	2.138e+07	3.927e+04	2.599e+04
1.629e+02	1.471e+04	2.138e+07	3.928e+04	2.599e+04
1.631e+02	1.471e+04	2.138e+07	3.928e+04	2.599e+04
1.633e+02	1.471e+04	2.138e+07	3.928e+04	2.599e+04
1.635e+02	1.471e+04	2.138e+07	3.928e+04	2.599e+04
1.637e+02	1.471e+04	2.139e+07	3.928e+04	2.599e+04
1.640e+02	1.471e+04	2.139e+07	3.928e+04	2.599e+04
1.642e+02	1.471e+04	2.139e+07	3.928e+04	2.599e+04
1.644e+02	1.471e+04	2.139e+07	3.929e+04	2.599e+04
1.646e+02	1.471e+04	2.139e+07	3.929e+04	2.599e+04
1.648e+02	1.472e+04	2.139e+07	3.929e+04	2.600e+04
1.650e+02	1.472e+04	2.139e+07	3.929e+04	2.600e+04
1.652e+02	1.472e+04	2.139e+07	3.929e+04	2.600e+04
1.654e+02	1.472e+04	2.139e+07	3.929e+04	2.600e+04
1.656e+02	1.472e+04	2.139e+07	3.929e+04	2.600e+04
1.658e+02	1.472e+04	2.139e+07	3.929e+04	2.600e+04
1.660e+02	1.472e+04	2.139e+07	3.930e+04	2.600e+04
1.662e+02	1.472e+04	2.139e+07	3.930e+04	2.600e+04
1.664e+02	1.472e+04	2.139e+07	3.930e+04	2.600e+04
1.666e+02	1.472e+04	2.139e+07	3.930e+04	2.600e+04
1.668e+02	1.472e+04	2.140e+07	3.930e+04	2.600e+04
1.670e+02	1.472e+04	2.140e+07	3.930e+04	2.600e+04
1.672e+02	1.472e+04	2.140e+07	3.930e+04	2.601e+04
1.674e+02	1.472e+04	2.140e+07	3.930e+04	2.601e+04
1.676e+02	1.472e+04	2.140e+07	3.930e+04	2.601e+04
1.679e+02	1.472e+04	2.140e+07	3.931e+04	2.601e+04
1.681e+02	1.472e+04	2.140e+07	3.931e+04	2.601e+04
1.683e+02	1.472e+04	2.140e+07	3.931e+04	2.601e+04
1.685e+02	1.472e+04	2.140e+07	3.931e+04	2.601e+04
1.687e+02	1.472e+04	2.140e+07	3.931e+04	2.601e+04

1.689e+02	1.472e+04	2.140e+07	3.931e+04	2.601e+04
1.691e+02	1.472e+04	2.140e+07	3.931e+04	2.601e+04
1.693e+02	1.473e+04	2.140e+07	3.931e+04	2.601e+04
1.695e+02	1.473e+04	2.140e+07	3.931e+04	2.601e+04
1.697e+02	1.473e+04	2.140e+07	3.932e+04	2.601e+04
1.699e+02	1.473e+04	2.140e+07	3.932e+04	2.601e+04
1.701e+02	1.473e+04	2.140e+07	3.932e+04	2.601e+04
1.703e+02	1.473e+04	2.141e+07	3.932e+04	2.602e+04
1.705e+02	1.473e+04	2.141e+07	3.932e+04	2.602e+04
1.707e+02	1.473e+04	2.141e+07	3.932e+04	2.602e+04
1.709e+02	1.473e+04	2.141e+07	3.932e+04	2.602e+04
1.711e+02	1.473e+04	2.141e+07	3.932e+04	2.602e+04
1.713e+02	1.473e+04	2.141e+07	3.932e+04	2.602e+04
1.715e+02	1.473e+04	2.141e+07	3.932e+04	2.602e+04
1.718e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.720e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.722e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.724e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.726e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.728e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.730e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.732e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.734e+02	1.473e+04	2.141e+07	3.933e+04	2.602e+04
1.736e+02	1.473e+04	2.141e+07	3.933e+04	2.603e+04
1.738e+02	1.473e+04	2.141e+07	3.933e+04	2.603e+04
1.740e+02	1.473e+04	2.141e+07	3.933e+04	2.603e+04
1.742e+02	1.473e+04	2.141e+07	3.934e+04	2.603e+04
1.744e+02	1.473e+04	2.141e+07	3.934e+04	2.603e+04
1.746e+02	1.473e+04	2.141e+07	3.934e+04	2.603e+04
1.748e+02	1.473e+04	2.142e+07	3.934e+04	2.603e+04
1.750e+02	1.473e+04	2.142e+07	3.934e+04	2.603e+04
1.752e+02	1.473e+04	2.142e+07	3.934e+04	2.603e+04
1.754e+02	1.473e+04	2.142e+07	3.934e+04	2.603e+04
1.757e+02	1.474e+04	2.142e+07	3.934e+04	2.603e+04
1.759e+02	1.474e+04	2.142e+07	3.934e+04	2.603e+04
1.761e+02	1.474e+04	2.142e+07	3.934e+04	2.603e+04
1.763e+02	1.474e+04	2.142e+07	3.934e+04	2.603e+04
1.765e+02	1.474e+04	2.142e+07	3.934e+04	2.603e+04
1.767e+02	1.474e+04	2.142e+07	3.934e+04	2.603e+04
1.769e+02	1.474e+04	2.142e+07	3.934e+04	2.603e+04
1.771e+02	1.474e+04	2.142e+07	3.935e+04	2.603e+04
1.773e+02	1.474e+04	2.142e+07	3.935e+04	2.603e+04
1.775e+02	1.474e+04	2.142e+07	3.935e+04	2.603e+04
1.777e+02	1.474e+04	2.142e+07	3.935e+04	2.603e+04
1.779e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.781e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.783e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.785e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.787e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.789e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.791e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.793e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.795e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.798e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.800e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04
1.802e+02	1.474e+04	2.142e+07	3.935e+04	2.604e+04

1.804e+02	1.474e+04	2.142e+07	3.936e+04	2.604e+04
1.806e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.808e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.810e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.812e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.814e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.816e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.818e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.820e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.822e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.824e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.826e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.828e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.830e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.832e+02	1.474e+04	2.143e+07	3.936e+04	2.604e+04
1.834e+02	1.474e+04	2.143e+07	3.936e+04	2.605e+04
1.837e+02	1.474e+04	2.143e+07	3.936e+04	2.605e+04
1.839e+02	1.474e+04	2.143e+07	3.936e+04	2.605e+04
1.841e+02	1.474e+04	2.143e+07	3.936e+04	2.605e+04
1.843e+02	1.474e+04	2.143e+07	3.937e+04	2.605e+04
1.845e+02	1.474e+04	2.143e+07	3.937e+04	2.605e+04
1.847e+02	1.474e+04	2.143e+07	3.937e+04	2.605e+04
1.849e+02	1.474e+04	2.143e+07	3.937e+04	2.605e+04
1.851e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.853e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.855e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.857e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.859e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.861e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.863e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.865e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.867e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.869e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.871e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.873e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.876e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.878e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.880e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.882e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.884e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.886e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.888e+02	1.475e+04	2.143e+07	3.937e+04	2.605e+04
1.890e+02	1.475e+04	2.144e+07	3.937e+04	2.605e+04
1.892e+02	1.475e+04	2.144e+07	3.937e+04	2.605e+04
1.894e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.896e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.898e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.900e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.902e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.904e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.906e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.908e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.910e+02	1.475e+04	2.144e+07	3.938e+04	2.605e+04
1.912e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.915e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.917e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04

1.919e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.921e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.923e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.925e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.927e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.929e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.931e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.933e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.935e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.937e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.939e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.941e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.943e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.945e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.947e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.949e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.951e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.954e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.956e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.958e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.960e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.962e+02	1.475e+04	2.144e+07	3.938e+04	2.606e+04
1.964e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.966e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.968e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.970e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.972e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.974e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.976e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.978e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.980e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.982e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.984e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.986e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.988e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.990e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.992e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.995e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.997e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04
1.999e+02	1.475e+04	2.144e+07	3.939e+04	2.606e+04

Pore Water Concentration Profiles at Various Times

Time (yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)		Pore Water Concentrations (μg/L)			
0.000e+00	0.000e+00	1.045e-14	2.705e-01	1.009e+01	1.827e+01
3.797e-01	0.000e+00	5.371e-13	1.379e+01	5.133e+02	9.297e+02
7.595e-01	0.000e+00	1.067e-12	2.718e+01	1.009e+03	1.828e+03
1.139e+00	0.000e+00	1.609e-12	4.050e+01	1.499e+03	2.714e+03
1.519e+00	0.000e+00	2.175e-12	5.380e+01	1.981e+03	3.586e+03
1.899e+00	0.000e+00	2.774e-12	6.714e+01	2.457e+03	4.447e+03
2.278e+00	0.000e+00	3.418e-12	8.058e+01	2.927e+03	5.296e+03
2.658e+00	0.000e+00	4.119e-12	9.417e+01	3.391e+03	6.133e+03
3.038e+00	0.000e+00	4.888e-12	1.080e+02	3.850e+03	6.958e+03
3.418e+00	0.000e+00	5.740e-12	1.220e+02	4.303e+03	7.772e+03

3.797e+00	0.000e+00	6.690e-12	1.364e+02	4.750e+03	8.575e+03
4.177e+00	0.000e+00	7.753e-12	1.512e+02	5.193e+03	9.367e+03
4.557e+00	0.000e+00	8.949e-12	1.663e+02	5.630e+03	1.015e+04
4.937e+00	0.000e+00	1.030e-11	1.819e+02	6.063e+03	1.092e+04
5.316e+00	0.000e+00	1.182e-11	1.981e+02	6.492e+03	1.168e+04
5.696e+00	0.000e+00	1.355e-11	2.148e+02	6.916e+03	1.243e+04
6.076e+00	0.000e+00	1.551e-11	2.322e+02	7.336e+03	1.317e+04
6.456e+00	0.000e+00	1.773e-11	2.502e+02	7.753e+03	1.390e+04
6.835e+00	0.000e+00	2.025e-11	2.689e+02	8.165e+03	1.463e+04
7.215e+00	0.000e+00	2.312e-11	2.884e+02	8.574e+03	1.534e+04
7.595e+00	0.000e+00	2.639e-11	3.087e+02	8.979e+03	1.604e+04
7.975e+00	0.000e+00	3.010e-11	3.299e+02	9.381e+03	1.674e+04
8.354e+00	0.000e+00	3.432e-11	3.520e+02	9.780e+03	1.743e+04
8.734e+00	0.000e+00	3.913e-11	3.751e+02	1.018e+04	1.810e+04
9.114e+00	0.000e+00	4.461e-11	3.992e+02	1.057e+04	1.877e+04
9.494e+00	0.000e+00	5.085e-11	4.244e+02	1.096e+04	1.944e+04
9.873e+00	0.000e+00	5.795e-11	4.507e+02	1.135e+04	2.009e+04
1.025e+01	0.000e+00	6.604e-11	4.781e+02	1.173e+04	2.074e+04
1.063e+01	0.000e+00	7.525e-11	5.068e+02	1.212e+04	2.138e+04
1.101e+01	0.000e+00	8.575e-11	5.368e+02	1.250e+04	2.201e+04
1.139e+01	0.000e+00	9.771e-11	5.682e+02	1.288e+04	2.263e+04
1.177e+01	0.000e+00	1.113e-10	6.009e+02	1.326e+04	2.325e+04
1.215e+01	0.000e+00	1.269e-10	6.351e+02	1.363e+04	2.386e+04
1.253e+01	0.000e+00	1.446e-10	6.707e+02	1.401e+04	2.447e+04
1.291e+01	0.000e+00	1.648e-10	7.080e+02	1.438e+04	2.506e+04
1.329e+01	0.000e+00	1.878e-10	7.468e+02	1.475e+04	2.565e+04
1.367e+01	0.000e+00	2.140e-10	7.874e+02	1.512e+04	2.624e+04
1.405e+01	0.000e+00	2.439e-10	8.296e+02	1.549e+04	2.682e+04
1.443e+01	0.000e+00	2.779e-10	8.737e+02	1.586e+04	2.739e+04
1.481e+01	0.000e+00	3.168e-10	9.196e+02	1.622e+04	2.795e+04
1.519e+01	0.000e+00	3.610e-10	9.675e+02	1.659e+04	2.851e+04
1.557e+01	0.000e+00	4.115e-10	1.017e+03	1.695e+04	2.907e+04
1.595e+01	0.000e+00	4.690e-10	1.069e+03	1.732e+04	2.962e+04
1.633e+01	0.000e+00	5.346e-10	1.123e+03	1.768e+04	3.016e+04
1.671e+01	0.000e+00	6.093e-10	1.179e+03	1.804e+04	3.070e+04
1.709e+01	0.000e+00	6.944e-10	1.238e+03	1.841e+04	3.123e+04
1.747e+01	0.000e+00	7.915e-10	1.298e+03	1.877e+04	3.176e+04
1.785e+01	0.000e+00	9.021e-10	1.361e+03	1.913e+04	3.228e+04
1.823e+01	0.000e+00	1.028e-09	1.427e+03	1.949e+04	3.280e+04
1.861e+01	0.000e+00	1.172e-09	1.495e+03	1.985e+04	3.331e+04
1.899e+01	0.000e+00	1.335e-09	1.565e+03	2.021e+04	3.382e+04
1.937e+01	0.000e+00	1.521e-09	1.638e+03	2.057e+04	3.432e+04
1.975e+01	0.000e+00	1.733e-09	1.714e+03	2.093e+04	3.482e+04
2.013e+01	0.000e+00	1.974e-09	1.793e+03	2.129e+04	3.532e+04
2.051e+01	0.000e+00	2.249e-09	1.875e+03	2.165e+04	3.581e+04
2.089e+01	0.000e+00	2.561e-09	1.959e+03	2.202e+04	3.629e+04
2.127e+01	0.000e+00	2.916e-09	2.046e+03	2.238e+04	3.677e+04
2.165e+01	0.000e+00	3.320e-09	2.137e+03	2.274e+04	3.725e+04
2.203e+01	0.000e+00	3.779e-09	2.231e+03	2.310e+04	3.772e+04
2.241e+01	0.000e+00	4.301e-09	2.327e+03	2.346e+04	3.819e+04
2.278e+01	0.000e+00	4.894e-09	2.428e+03	2.382e+04	3.866e+04
2.316e+01	0.000e+00	5.567e-09	2.531e+03	2.419e+04	3.912e+04
2.354e+01	0.000e+00	6.331e-09	2.638e+03	2.455e+04	3.958e+04
2.392e+01	0.000e+00	7.199e-09	2.748e+03	2.491e+04	4.003e+04
2.430e+01	0.000e+00	8.183e-09	2.862e+03	2.528e+04	4.048e+04
2.468e+01	0.000e+00	9.298e-09	2.980e+03	2.564e+04	4.093e+04

2.506e+01	0.000e+00	1.056e-08	3.102e+03	2.601e+04	4.137e+04
2.544e+01	0.000e+00	1.200e-08	3.227e+03	2.637e+04	4.181e+04
2.582e+01	0.000e+00	1.362e-08	3.356e+03	2.674e+04	4.225e+04
2.620e+01	0.000e+00	1.545e-08	3.489e+03	2.711e+04	4.268e+04
2.658e+01	0.000e+00	1.753e-08	3.626e+03	2.748e+04	4.311e+04
2.696e+01	0.000e+00	1.988e-08	3.767e+03	2.784e+04	4.354e+04
2.734e+01	0.000e+00	2.254e-08	3.912e+03	2.821e+04	4.396e+04
2.772e+01	0.000e+00	2.554e-08	4.062e+03	2.858e+04	4.438e+04
2.810e+01	0.000e+00	2.892e-08	4.216e+03	2.896e+04	4.480e+04
2.848e+01	0.000e+00	3.274e-08	4.374e+03	2.933e+04	4.521e+04
2.886e+01	0.000e+00	3.705e-08	4.537e+03	2.970e+04	4.563e+04
2.924e+01	0.000e+00	4.190e-08	4.704e+03	3.007e+04	4.604e+04
2.962e+01	0.000e+00	4.737e-08	4.876e+03	3.045e+04	4.644e+04
3.000e+01	0.000e+00	5.351e-08	5.053e+03	3.082e+04	4.684e+04
3.038e+01	0.000e+00	1.496e-11	5.467e+03	3.109e+04	4.706e+04
3.076e+01	0.000e+00	1.663e-07	6.551e+03	3.154e+04	4.734e+04
3.114e+01	0.000e+00	8.882e-05	8.185e+03	3.218e+04	4.770e+04
3.152e+01	0.000e+00	3.263e-02	1.024e+04	3.301e+04	4.812e+04
3.190e+01	0.000e+00	9.237e+00	1.263e+04	3.400e+04	4.861e+04
3.228e+01	0.000e+00	1.073e+03	1.525e+04	3.515e+04	4.916e+04
3.266e+01	0.000e+00	3.363e+03	1.807e+04	3.645e+04	4.976e+04
3.304e+01	0.000e+00	6.347e+03	2.104e+04	3.788e+04	5.043e+04
3.342e+01	0.000e+00	9.823e+03	2.412e+04	3.944e+04	5.114e+04
3.380e+01	0.000e+00	1.367e+04	2.730e+04	4.111e+04	5.190e+04
3.418e+01	0.000e+00	1.782e+04	3.055e+04	4.287e+04	5.270e+04
3.456e+01	0.000e+00	2.221e+04	3.385e+04	4.471e+04	5.354e+04
3.494e+01	0.000e+00	2.677e+04	3.720e+04	4.662e+04	5.441e+04
3.532e+01	0.000e+00	3.148e+04	4.058e+04	4.859e+04	5.531e+04
3.570e+01	0.000e+00	3.630e+04	4.398e+04	5.061e+04	5.623e+04
3.608e+01	0.000e+00	4.119e+04	4.739e+04	5.266e+04	5.717e+04
3.646e+01	0.000e+00	4.612e+04	5.080e+04	5.473e+04	5.812e+04
3.684e+01	0.000e+00	5.109e+04	5.421e+04	5.682e+04	5.908e+04
3.722e+01	0.000e+00	5.605e+04	5.762e+04	5.891e+04	6.004e+04
3.760e+01	0.000e+00	6.100e+04	6.100e+04	6.100e+04	6.100e+04

Time (yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)		Pore Water Concentrations (μg/L)			
0.000e+00	2.216e+01	2.366e+01	2.420e+01	2.438e+01	2.445e+01
3.797e-01	1.128e+03	1.204e+03	1.231e+03	1.241e+03	1.244e+03
7.595e-01	2.217e+03	2.367e+03	2.421e+03	2.439e+03	2.446e+03
1.139e+00	3.291e+03	3.514e+03	3.593e+03	3.621e+03	3.630e+03
1.519e+00	4.349e+03	4.644e+03	4.749e+03	4.785e+03	4.797e+03
1.899e+00	5.392e+03	5.757e+03	5.887e+03	5.932e+03	5.948e+03
2.278e+00	6.421e+03	6.855e+03	7.010e+03	7.063e+03	7.082e+03
2.658e+00	7.434e+03	7.937e+03	8.116e+03	8.178e+03	8.199e+03
3.038e+00	8.433e+03	9.003e+03	9.206e+03	9.276e+03	9.300e+03
3.418e+00	9.418e+03	1.005e+04	1.028e+04	1.036e+04	1.039e+04
3.797e+00	1.039e+04	1.109e+04	1.134e+04	1.143e+04	1.146e+04
4.177e+00	1.135e+04	1.211e+04	1.238e+04	1.248e+04	1.251e+04
4.557e+00	1.229e+04	1.312e+04	1.341e+04	1.351e+04	1.355e+04
4.937e+00	1.322e+04	1.411e+04	1.443e+04	1.453e+04	1.457e+04
5.316e+00	1.414e+04	1.509e+04	1.542e+04	1.554e+04	1.558e+04
5.696e+00	1.504e+04	1.605e+04	1.641e+04	1.653e+04	1.658e+04
6.076e+00	1.593e+04	1.700e+04	1.738e+04	1.751e+04	1.756e+04
6.456e+00	1.681e+04	1.794e+04	1.834e+04	1.847e+04	1.852e+04

6.835e+00	1.768e+04	1.886e+04	1.928e+04	1.942e+04	1.947e+04
7.215e+00	1.854e+04	1.977e+04	2.021e+04	2.036e+04	2.041e+04
7.595e+00	1.938e+04	2.067e+04	2.112e+04	2.128e+04	2.134e+04
7.975e+00	2.021e+04	2.155e+04	2.203e+04	2.219e+04	2.225e+04
8.354e+00	2.103e+04	2.242e+04	2.292e+04	2.309e+04	2.315e+04
8.734e+00	2.184e+04	2.328e+04	2.379e+04	2.397e+04	2.403e+04
9.114e+00	2.264e+04	2.413e+04	2.466e+04	2.484e+04	2.490e+04
9.494e+00	2.343e+04	2.496e+04	2.551e+04	2.570e+04	2.576e+04
9.873e+00	2.420e+04	2.579e+04	2.635e+04	2.654e+04	2.661e+04
1.025e+01	2.497e+04	2.660e+04	2.718e+04	2.738e+04	2.745e+04
1.063e+01	2.573e+04	2.740e+04	2.799e+04	2.820e+04	2.827e+04
1.101e+01	2.647e+04	2.819e+04	2.880e+04	2.901e+04	2.908e+04
1.139e+01	2.721e+04	2.896e+04	2.959e+04	2.981e+04	2.988e+04
1.177e+01	2.793e+04	2.973e+04	3.037e+04	3.059e+04	3.067e+04
1.215e+01	2.865e+04	3.049e+04	3.114e+04	3.137e+04	3.144e+04
1.253e+01	2.936e+04	3.123e+04	3.190e+04	3.213e+04	3.221e+04
1.291e+01	3.005e+04	3.197e+04	3.265e+04	3.288e+04	3.296e+04
1.329e+01	3.074e+04	3.269e+04	3.338e+04	3.362e+04	3.371e+04
1.367e+01	3.142e+04	3.341e+04	3.411e+04	3.436e+04	3.444e+04
1.405e+01	3.209e+04	3.411e+04	3.483e+04	3.508e+04	3.516e+04
1.443e+01	3.275e+04	3.480e+04	3.553e+04	3.579e+04	3.587e+04
1.481e+01	3.340e+04	3.549e+04	3.623e+04	3.649e+04	3.657e+04
1.519e+01	3.405e+04	3.616e+04	3.692e+04	3.718e+04	3.727e+04
1.557e+01	3.468e+04	3.683e+04	3.759e+04	3.786e+04	3.795e+04
1.595e+01	3.531e+04	3.749e+04	3.826e+04	3.853e+04	3.862e+04
1.633e+01	3.593e+04	3.813e+04	3.892e+04	3.919e+04	3.928e+04
1.671e+01	3.654e+04	3.877e+04	3.956e+04	3.984e+04	3.993e+04
1.709e+01	3.715e+04	3.940e+04	4.020e+04	4.048e+04	4.057e+04
1.747e+01	3.774e+04	4.002e+04	4.083e+04	4.111e+04	4.121e+04
1.785e+01	3.833e+04	4.064e+04	4.145e+04	4.174e+04	4.183e+04
1.823e+01	3.891e+04	4.124e+04	4.206e+04	4.235e+04	4.245e+04
1.861e+01	3.948e+04	4.183e+04	4.267e+04	4.296e+04	4.305e+04
1.899e+01	4.005e+04	4.242e+04	4.326e+04	4.355e+04	4.365e+04
1.937e+01	4.061e+04	4.300e+04	4.385e+04	4.414e+04	4.424e+04
1.975e+01	4.116e+04	4.357e+04	4.443e+04	4.472e+04	4.482e+04
2.013e+01	4.171e+04	4.414e+04	4.499e+04	4.529e+04	4.539e+04
2.051e+01	4.225e+04	4.469e+04	4.556e+04	4.585e+04	4.596e+04
2.089e+01	4.278e+04	4.524e+04	4.611e+04	4.641e+04	4.651e+04
2.127e+01	4.330e+04	4.578e+04	4.665e+04	4.696e+04	4.706e+04
2.165e+01	4.382e+04	4.631e+04	4.719e+04	4.750e+04	4.760e+04
2.203e+01	4.434e+04	4.684e+04	4.772e+04	4.803e+04	4.813e+04
2.241e+01	4.484e+04	4.736e+04	4.824e+04	4.855e+04	4.866e+04
2.278e+01	4.534e+04	4.787e+04	4.876e+04	4.907e+04	4.917e+04
2.316e+01	4.584e+04	4.837e+04	4.927e+04	4.958e+04	4.968e+04
2.354e+01	4.632e+04	4.887e+04	4.977e+04	5.008e+04	5.018e+04
2.392e+01	4.681e+04	4.936e+04	5.026e+04	5.057e+04	5.068e+04
2.430e+01	4.728e+04	4.984e+04	5.075e+04	5.106e+04	5.117e+04
2.468e+01	4.775e+04	5.032e+04	5.123e+04	5.154e+04	5.165e+04
2.506e+01	4.822e+04	5.079e+04	5.170e+04	5.201e+04	5.212e+04
2.544e+01	4.868e+04	5.126e+04	5.217e+04	5.248e+04	5.259e+04
2.582e+01	4.913e+04	5.171e+04	5.263e+04	5.294e+04	5.305e+04
2.620e+01	4.958e+04	5.217e+04	5.308e+04	5.339e+04	5.350e+04
2.658e+01	5.002e+04	5.261e+04	5.353e+04	5.384e+04	5.395e+04
2.696e+01	5.046e+04	5.305e+04	5.397e+04	5.428e+04	5.439e+04
2.734e+01	5.089e+04	5.349e+04	5.440e+04	5.471e+04	5.482e+04
2.772e+01	5.132e+04	5.391e+04	5.483e+04	5.514e+04	5.525e+04

2.810e+01	5.174e+04	5.434e+04	5.525e+04	5.556e+04	5.567e+04
2.848e+01	5.216e+04	5.475e+04	5.567e+04	5.598e+04	5.609e+04
2.886e+01	5.257e+04	5.516e+04	5.608e+04	5.639e+04	5.650e+04
2.924e+01	5.298e+04	5.557e+04	5.648e+04	5.679e+04	5.690e+04
2.962e+01	5.339e+04	5.597e+04	5.688e+04	5.719e+04	5.730e+04
3.000e+01	5.379e+04	5.637e+04	5.727e+04	5.758e+04	5.769e+04
3.038e+01	5.397e+04	5.654e+04	5.745e+04	5.776e+04	5.786e+04
3.076e+01	5.419e+04	5.673e+04	5.762e+04	5.793e+04	5.804e+04
3.114e+01	5.443e+04	5.692e+04	5.780e+04	5.810e+04	5.821e+04
3.152e+01	5.469e+04	5.713e+04	5.798e+04	5.828e+04	5.838e+04
3.190e+01	5.497e+04	5.733e+04	5.816e+04	5.845e+04	5.855e+04
3.228e+01	5.527e+04	5.755e+04	5.835e+04	5.862e+04	5.872e+04
3.266e+01	5.560e+04	5.777e+04	5.853e+04	5.880e+04	5.889e+04
3.304e+01	5.594e+04	5.800e+04	5.872e+04	5.897e+04	5.905e+04
3.342e+01	5.631e+04	5.823e+04	5.891e+04	5.914e+04	5.922e+04
3.380e+01	5.668e+04	5.847e+04	5.910e+04	5.931e+04	5.939e+04
3.418e+01	5.708e+04	5.871e+04	5.929e+04	5.948e+04	5.955e+04
3.456e+01	5.748e+04	5.896e+04	5.948e+04	5.966e+04	5.972e+04
3.494e+01	5.790e+04	5.921e+04	5.967e+04	5.983e+04	5.988e+04
3.532e+01	5.833e+04	5.946e+04	5.986e+04	6.000e+04	6.004e+04
3.570e+01	5.877e+04	5.972e+04	6.005e+04	6.017e+04	6.021e+04
3.608e+01	5.921e+04	5.997e+04	6.024e+04	6.033e+04	6.037e+04
3.646e+01	5.965e+04	6.023e+04	6.043e+04	6.050e+04	6.053e+04
3.684e+01	6.010e+04	6.049e+04	6.062e+04	6.067e+04	6.068e+04
3.722e+01	6.055e+04	6.074e+04	6.081e+04	6.083e+04	6.084e+04
3.760e+01	6.100e+04	6.100e+04	6.100e+04	6.100e+04	6.100e+04

Time (yr) 2.000e+02

Depth (cm)	Pore Water Concentrations (μg/L)
0.000e+00	2.447e+01
3.797e-01	1.245e+03
7.595e-01	2.448e+03
1.139e+00	3.633e+03
1.519e+00	4.802e+03
1.899e+00	5.953e+03
2.278e+00	7.088e+03
2.658e+00	8.206e+03
3.038e+00	9.308e+03
3.418e+00	1.039e+04
3.797e+00	1.147e+04
4.177e+00	1.252e+04
4.557e+00	1.356e+04
4.937e+00	1.458e+04
5.316e+00	1.559e+04
5.696e+00	1.659e+04
6.076e+00	1.757e+04
6.456e+00	1.854e+04
6.835e+00	1.949e+04
7.215e+00	2.043e+04
7.595e+00	2.136e+04
7.975e+00	2.227e+04
8.354e+00	2.317e+04
8.734e+00	2.405e+04
9.114e+00	2.493e+04
9.494e+00	2.579e+04

9.873e+00	2.663e+04
1.025e+01	2.747e+04
1.063e+01	2.829e+04
1.101e+01	2.910e+04
1.139e+01	2.990e+04
1.177e+01	3.069e+04
1.215e+01	3.147e+04
1.253e+01	3.224e+04
1.291e+01	3.299e+04
1.329e+01	3.373e+04
1.367e+01	3.447e+04
1.405e+01	3.519e+04
1.443e+01	3.590e+04
1.481e+01	3.660e+04
1.519e+01	3.730e+04
1.557e+01	3.798e+04
1.595e+01	3.865e+04
1.633e+01	3.931e+04
1.671e+01	3.996e+04
1.709e+01	4.061e+04
1.747e+01	4.124e+04
1.785e+01	4.187e+04
1.823e+01	4.248e+04
1.861e+01	4.309e+04
1.899e+01	4.369e+04
1.937e+01	4.427e+04
1.975e+01	4.486e+04
2.013e+01	4.543e+04
2.051e+01	4.599e+04
2.089e+01	4.655e+04
2.127e+01	4.710e+04
2.165e+01	4.764e+04
2.203e+01	4.817e+04
2.241e+01	4.869e+04
2.278e+01	4.921e+04
2.316e+01	4.972e+04
2.354e+01	5.022e+04
2.392e+01	5.072e+04
2.430e+01	5.120e+04
2.468e+01	5.168e+04
2.506e+01	5.216e+04
2.544e+01	5.262e+04
2.582e+01	5.308e+04
2.620e+01	5.354e+04
2.658e+01	5.398e+04
2.696e+01	5.442e+04
2.734e+01	5.486e+04
2.772e+01	5.529e+04
2.810e+01	5.571e+04
2.848e+01	5.612e+04
2.886e+01	5.653e+04
2.924e+01	5.694e+04
2.962e+01	5.733e+04
3.000e+01	5.773e+04
3.038e+01	5.790e+04
3.076e+01	5.807e+04

3.114e+01	5.824e+04
3.152e+01	5.841e+04
3.190e+01	5.858e+04
3.228e+01	5.875e+04
3.266e+01	5.892e+04
3.304e+01	5.908e+04
3.342e+01	5.925e+04
3.380e+01	5.941e+04
3.418e+01	5.958e+04
3.456e+01	5.974e+04
3.494e+01	5.990e+04
3.532e+01	6.006e+04
3.570e+01	6.022e+04
3.608e+01	6.038e+04
3.646e+01	6.053e+04
3.684e+01	6.069e+04
3.722e+01	6.085e+04
3.760e+01	6.100e+04

Flux Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)			Flux (μg/m²/yr)		
0.000e+00	0.000e+00	-9.161e-09	2.370e+05	8.838e+06	1.601e+07
3.797e-01	0.000e+00	-9.343e-09	2.381e+05	8.841e+06	1.601e+07
7.595e-01	0.000e+00	-9.615e-09	2.397e+05	8.845e+06	1.602e+07
1.139e+00	0.000e+00	-1.007e-08	2.423e+05	8.852e+06	1.602e+07
1.519e+00	0.000e+00	-1.071e-08	2.459e+05	8.861e+06	1.602e+07
1.899e+00	0.000e+00	-1.155e-08	2.505e+05	8.873e+06	1.603e+07
2.278e+00	0.000e+00	-1.259e-08	2.561e+05	8.887e+06	1.604e+07
2.658e+00	0.000e+00	-1.386e-08	2.627e+05	8.903e+06	1.605e+07
3.038e+00	0.000e+00	-1.538e-08	2.703e+05	8.922e+06	1.606e+07
3.418e+00	0.000e+00	-1.716e-08	2.789e+05	8.943e+06	1.607e+07
3.797e+00	0.000e+00	-1.925e-08	2.885e+05	8.967e+06	1.608e+07
4.177e+00	0.000e+00	-2.166e-08	2.991e+05	8.992e+06	1.610e+07
4.557e+00	0.000e+00	-2.445e-08	3.107e+05	9.020e+06	1.611e+07
4.937e+00	0.000e+00	-2.766e-08	3.233e+05	9.051e+06	1.613e+07
5.316e+00	0.000e+00	-3.134e-08	3.369e+05	9.083e+06	1.615e+07
5.696e+00	0.000e+00	-3.556e-08	3.515e+05	9.118e+06	1.617e+07
6.076e+00	0.000e+00	-4.038e-08	3.671e+05	9.154e+06	1.619e+07
6.456e+00	0.000e+00	-4.588e-08	3.838e+05	9.193e+06	1.621e+07
6.835e+00	0.000e+00	-5.217e-08	4.015e+05	9.234e+06	1.623e+07
7.215e+00	0.000e+00	-5.934e-08	4.204e+05	9.277e+06	1.625e+07
7.595e+00	0.000e+00	-6.752e-08	4.402e+05	9.321e+06	1.628e+07
7.975e+00	0.000e+00	-7.685e-08	4.612e+05	9.368e+06	1.630e+07
8.354e+00	0.000e+00	-8.749e-08	4.833e+05	9.417e+06	1.633e+07
8.734e+00	0.000e+00	-9.961e-08	5.066e+05	9.467e+06	1.636e+07
9.114e+00	0.000e+00	-1.134e-07	5.310e+05	9.519e+06	1.639e+07
9.494e+00	0.000e+00	-1.292e-07	5.565e+05	9.573e+06	1.642e+07
9.873e+00	0.000e+00	-1.472e-07	5.833e+05	9.629e+06	1.645e+07
1.025e+01	0.000e+00	-1.676e-07	6.113e+05	9.687e+06	1.648e+07
1.063e+01	0.000e+00	-1.910e-07	6.405e+05	9.746e+06	1.651e+07
1.101e+01	0.000e+00	-2.176e-07	6.710e+05	9.807e+06	1.654e+07
1.139e+01	0.000e+00	-2.479e-07	7.027e+05	9.870e+06	1.658e+07
1.177e+01	0.000e+00	-2.825e-07	7.358e+05	9.934e+06	1.661e+07

1.215e+01	0.000e+00	-3.220e-07	7.702e+05	1.000e+07	1.665e+07
1.253e+01	0.000e+00	-3.670e-07	8.060e+05	1.007e+07	1.668e+07
1.291e+01	0.000e+00	-4.183e-07	8.432e+05	1.014e+07	1.672e+07
1.329e+01	0.000e+00	-4.768e-07	8.818e+05	1.021e+07	1.676e+07
1.367e+01	0.000e+00	-5.434e-07	9.218e+05	1.028e+07	1.680e+07
1.405e+01	0.000e+00	-6.194e-07	9.633e+05	1.035e+07	1.684e+07
1.443e+01	0.000e+00	-7.061e-07	1.006e+06	1.043e+07	1.688e+07
1.481e+01	0.000e+00	-8.049e-07	1.051e+06	1.050e+07	1.692e+07
1.519e+01	0.000e+00	-9.175e-07	1.097e+06	1.058e+07	1.696e+07
1.557e+01	0.000e+00	-1.046e-06	1.145e+06	1.066e+07	1.700e+07
1.595e+01	0.000e+00	-1.192e-06	1.194e+06	1.074e+07	1.704e+07
1.633e+01	0.000e+00	-1.359e-06	1.245e+06	1.082e+07	1.709e+07
1.671e+01	0.000e+00	-1.549e-06	1.298e+06	1.090e+07	1.713e+07
1.709e+01	0.000e+00	-1.765e-06	1.352e+06	1.099e+07	1.718e+07
1.747e+01	0.000e+00	-2.011e-06	1.408e+06	1.107e+07	1.722e+07
1.785e+01	0.000e+00	-2.291e-06	1.466e+06	1.116e+07	1.727e+07
1.823e+01	0.000e+00	-2.610e-06	1.526e+06	1.125e+07	1.731e+07
1.861e+01	0.000e+00	-2.973e-06	1.587e+06	1.133e+07	1.736e+07
1.899e+01	0.000e+00	-3.386e-06	1.650e+06	1.142e+07	1.741e+07
1.937e+01	0.000e+00	-3.856e-06	1.716e+06	1.151e+07	1.745e+07
1.975e+01	0.000e+00	-4.390e-06	1.783e+06	1.161e+07	1.750e+07
2.013e+01	0.000e+00	-4.997e-06	1.852e+06	1.170e+07	1.755e+07
2.051e+01	0.000e+00	-5.686e-06	1.923e+06	1.179e+07	1.760e+07
2.089e+01	0.000e+00	-6.469e-06	1.996e+06	1.189e+07	1.765e+07
2.127e+01	0.000e+00	-7.358e-06	2.071e+06	1.198e+07	1.770e+07
2.165e+01	0.000e+00	-8.367e-06	2.148e+06	1.208e+07	1.775e+07
2.203e+01	0.000e+00	-9.512e-06	2.227e+06	1.218e+07	1.780e+07
2.241e+01	0.000e+00	-1.081e-05	2.309e+06	1.227e+07	1.785e+07
2.278e+01	0.000e+00	-1.228e-05	2.392e+06	1.237e+07	1.790e+07
2.316e+01	0.000e+00	-1.395e-05	2.477e+06	1.247e+07	1.795e+07
2.354e+01	0.000e+00	-1.583e-05	2.565e+06	1.257e+07	1.800e+07
2.392e+01	0.000e+00	-1.797e-05	2.655e+06	1.267e+07	1.805e+07
2.430e+01	0.000e+00	-2.038e-05	2.747e+06	1.278e+07	1.810e+07
2.468e+01	0.000e+00	-2.311e-05	2.841e+06	1.288e+07	1.816e+07
2.506e+01	0.000e+00	-2.620e-05	2.938e+06	1.298e+07	1.821e+07
2.544e+01	0.000e+00	-2.968e-05	3.037e+06	1.309e+07	1.826e+07
2.582e+01	0.000e+00	-3.361e-05	3.138e+06	1.319e+07	1.831e+07
2.620e+01	0.000e+00	-3.805e-05	3.241e+06	1.330e+07	1.837e+07
2.658e+01	0.000e+00	-4.305e-05	3.347e+06	1.340e+07	1.842e+07
2.696e+01	0.000e+00	-4.868e-05	3.454e+06	1.351e+07	1.847e+07
2.734e+01	0.000e+00	-5.502e-05	3.565e+06	1.361e+07	1.853e+07
2.772e+01	0.000e+00	-6.215e-05	3.677e+06	1.372e+07	1.858e+07
2.810e+01	0.000e+00	-7.017e-05	3.792e+06	1.383e+07	1.863e+07
2.848e+01	0.000e+00	-7.917e-05	3.910e+06	1.394e+07	1.869e+07
2.886e+01	0.000e+00	-8.927e-05	4.029e+06	1.405e+07	1.874e+07
2.924e+01	0.000e+00	-1.006e-04	4.151e+06	1.416e+07	1.879e+07
2.962e+01	0.000e+00	-1.132e-04	4.275e+06	1.427e+07	1.885e+07
3.000e+01	0.000e+00	-1.266e-04	4.401e+06	1.438e+07	1.890e+07
3.038e+01	0.000e+00	4.297e-03	3.069e+07	2.196e+07	2.173e+07
3.076e+01	0.000e+00	1.737e+00	5.481e+07	2.948e+07	2.454e+07
3.114e+01	0.000e+00	6.379e+02	7.428e+07	3.681e+07	2.731e+07
3.152e+01	0.000e+00	1.806e+05	8.942e+07	4.386e+07	3.000e+07
3.190e+01	0.000e+00	2.099e+07	1.012e+08	5.056e+07	3.261e+07
3.228e+01	0.000e+00	6.585e+07	1.104e+08	5.686e+07	3.510e+07
3.266e+01	0.000e+00	1.040e+08	1.177e+08	6.272e+07	3.747e+07
3.304e+01	0.000e+00	1.279e+08	1.236e+08	6.811e+07	3.971e+07

3.342e+01	0.000e+00	1.458e+08	1.285e+08	7.301e+07	4.179e+07
3.380e+01	0.000e+00	1.599e+08	1.326e+08	7.743e+07	4.371e+07
3.418e+01	0.000e+00	1.713e+08	1.359e+08	8.135e+07	4.546e+07
3.456e+01	0.000e+00	1.806e+08	1.387e+08	8.479e+07	4.703e+07
3.494e+01	0.000e+00	1.882e+08	1.410e+08	8.777e+07	4.842e+07
3.532e+01	0.000e+00	1.942e+08	1.428e+08	9.028e+07	4.962e+07
3.570e+01	0.000e+00	1.990e+08	1.443e+08	9.236e+07	5.063e+07
3.608e+01	0.000e+00	2.026e+08	1.455e+08	9.402e+07	5.146e+07
3.646e+01	0.000e+00	2.053e+08	1.464e+08	9.528e+07	5.210e+07
3.684e+01	0.000e+00	2.071e+08	1.470e+08	9.616e+07	5.255e+07
3.722e+01	0.000e+00	2.081e+08	1.473e+08	9.667e+07	5.282e+07
3.760e+01	0.000e+00	2.087e+08	1.475e+08	9.701e+07	5.300e+07

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)			Flux (μg/m²/yr)		
0.000e+00	1.942e+07	2.073e+07	2.120e+07	2.137e+07	2.142e+07
3.797e-01	1.942e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
7.595e-01	1.942e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
1.139e+00	1.942e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
1.519e+00	1.942e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
1.899e+00	1.943e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
2.278e+00	1.943e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
2.658e+00	1.943e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
3.038e+00	1.944e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
3.418e+00	1.944e+07	2.074e+07	2.121e+07	2.137e+07	2.142e+07
3.797e+00	1.945e+07	2.075e+07	2.121e+07	2.137e+07	2.142e+07
4.177e+00	1.945e+07	2.075e+07	2.121e+07	2.137e+07	2.142e+07
4.557e+00	1.946e+07	2.075e+07	2.121e+07	2.137e+07	2.142e+07
4.937e+00	1.947e+07	2.075e+07	2.121e+07	2.137e+07	2.142e+07
5.316e+00	1.948e+07	2.076e+07	2.121e+07	2.137e+07	2.142e+07
5.696e+00	1.948e+07	2.076e+07	2.121e+07	2.137e+07	2.142e+07
6.076e+00	1.949e+07	2.076e+07	2.121e+07	2.137e+07	2.142e+07
6.456e+00	1.950e+07	2.077e+07	2.122e+07	2.137e+07	2.142e+07
6.835e+00	1.951e+07	2.077e+07	2.122e+07	2.137e+07	2.142e+07
7.215e+00	1.952e+07	2.077e+07	2.122e+07	2.137e+07	2.143e+07
7.595e+00	1.953e+07	2.078e+07	2.122e+07	2.137e+07	2.143e+07
7.975e+00	1.954e+07	2.078e+07	2.122e+07	2.137e+07	2.143e+07
8.354e+00	1.955e+07	2.078e+07	2.122e+07	2.137e+07	2.143e+07
8.734e+00	1.956e+07	2.079e+07	2.122e+07	2.137e+07	2.143e+07
9.114e+00	1.957e+07	2.079e+07	2.122e+07	2.137e+07	2.143e+07
9.494e+00	1.958e+07	2.080e+07	2.123e+07	2.138e+07	2.143e+07
9.873e+00	1.960e+07	2.080e+07	2.123e+07	2.138e+07	2.143e+07
1.025e+01	1.961e+07	2.081e+07	2.123e+07	2.138e+07	2.143e+07
1.063e+01	1.962e+07	2.081e+07	2.123e+07	2.138e+07	2.143e+07
1.101e+01	1.964e+07	2.082e+07	2.123e+07	2.138e+07	2.143e+07
1.139e+01	1.965e+07	2.082e+07	2.123e+07	2.138e+07	2.143e+07
1.177e+01	1.966e+07	2.083e+07	2.124e+07	2.138e+07	2.143e+07
1.215e+01	1.968e+07	2.083e+07	2.124e+07	2.138e+07	2.143e+07
1.253e+01	1.969e+07	2.084e+07	2.124e+07	2.138e+07	2.143e+07
1.291e+01	1.971e+07	2.084e+07	2.124e+07	2.138e+07	2.143e+07
1.329e+01	1.972e+07	2.085e+07	2.124e+07	2.138e+07	2.143e+07
1.367e+01	1.974e+07	2.085e+07	2.125e+07	2.138e+07	2.143e+07
1.405e+01	1.976e+07	2.086e+07	2.125e+07	2.138e+07	2.143e+07
1.443e+01	1.977e+07	2.086e+07	2.125e+07	2.138e+07	2.143e+07
1.481e+01	1.979e+07	2.087e+07	2.125e+07	2.138e+07	2.143e+07

1.519e+01	1.981e+07	2.088e+07	2.125e+07	2.138e+07	2.143e+07
1.557e+01	1.982e+07	2.088e+07	2.126e+07	2.139e+07	2.143e+07
1.595e+01	1.984e+07	2.089e+07	2.126e+07	2.139e+07	2.143e+07
1.633e+01	1.986e+07	2.090e+07	2.126e+07	2.139e+07	2.143e+07
1.671e+01	1.988e+07	2.090e+07	2.126e+07	2.139e+07	2.143e+07
1.709e+01	1.989e+07	2.091e+07	2.127e+07	2.139e+07	2.143e+07
1.747e+01	1.991e+07	2.091e+07	2.127e+07	2.139e+07	2.143e+07
1.785e+01	1.993e+07	2.092e+07	2.127e+07	2.139e+07	2.143e+07
1.823e+01	1.995e+07	2.093e+07	2.127e+07	2.139e+07	2.143e+07
1.861e+01	1.997e+07	2.093e+07	2.127e+07	2.139e+07	2.143e+07
1.899e+01	1.999e+07	2.094e+07	2.128e+07	2.139e+07	2.143e+07
1.937e+01	2.000e+07	2.095e+07	2.128e+07	2.139e+07	2.143e+07
1.975e+01	2.002e+07	2.096e+07	2.128e+07	2.139e+07	2.143e+07
2.013e+01	2.004e+07	2.096e+07	2.128e+07	2.139e+07	2.143e+07
2.051e+01	2.006e+07	2.097e+07	2.129e+07	2.140e+07	2.143e+07
2.089e+01	2.008e+07	2.098e+07	2.129e+07	2.140e+07	2.143e+07
2.127e+01	2.010e+07	2.098e+07	2.129e+07	2.140e+07	2.143e+07
2.165e+01	2.012e+07	2.099e+07	2.129e+07	2.140e+07	2.143e+07
2.203e+01	2.014e+07	2.100e+07	2.130e+07	2.140e+07	2.143e+07
2.241e+01	2.016e+07	2.101e+07	2.130e+07	2.140e+07	2.143e+07
2.278e+01	2.018e+07	2.101e+07	2.130e+07	2.140e+07	2.143e+07
2.316e+01	2.020e+07	2.102e+07	2.130e+07	2.140e+07	2.144e+07
2.354e+01	2.022e+07	2.103e+07	2.131e+07	2.140e+07	2.144e+07
2.392e+01	2.024e+07	2.103e+07	2.131e+07	2.140e+07	2.144e+07
2.430e+01	2.026e+07	2.104e+07	2.131e+07	2.140e+07	2.144e+07
2.468e+01	2.028e+07	2.105e+07	2.131e+07	2.141e+07	2.144e+07
2.506e+01	2.031e+07	2.106e+07	2.132e+07	2.141e+07	2.144e+07
2.544e+01	2.033e+07	2.106e+07	2.132e+07	2.141e+07	2.144e+07
2.582e+01	2.035e+07	2.107e+07	2.132e+07	2.141e+07	2.144e+07
2.620e+01	2.037e+07	2.108e+07	2.132e+07	2.141e+07	2.144e+07
2.658e+01	2.039e+07	2.109e+07	2.133e+07	2.141e+07	2.144e+07
2.696e+01	2.041e+07	2.109e+07	2.133e+07	2.141e+07	2.144e+07
2.734e+01	2.043e+07	2.110e+07	2.133e+07	2.141e+07	2.144e+07
2.772e+01	2.045e+07	2.111e+07	2.133e+07	2.141e+07	2.144e+07
2.810e+01	2.047e+07	2.112e+07	2.134e+07	2.141e+07	2.144e+07
2.848e+01	2.049e+07	2.112e+07	2.134e+07	2.141e+07	2.144e+07
2.886e+01	2.051e+07	2.113e+07	2.134e+07	2.141e+07	2.144e+07
2.924e+01	2.053e+07	2.114e+07	2.135e+07	2.142e+07	2.144e+07
2.962e+01	2.056e+07	2.115e+07	2.135e+07	2.142e+07	2.144e+07
3.000e+01	2.058e+07	2.115e+07	2.135e+07	2.142e+07	2.144e+07
3.038e+01	2.158e+07	2.150e+07	2.147e+07	2.146e+07	2.145e+07
3.076e+01	2.258e+07	2.185e+07	2.159e+07	2.150e+07	2.147e+07
3.114e+01	2.356e+07	2.219e+07	2.171e+07	2.154e+07	2.148e+07
3.152e+01	2.453e+07	2.252e+07	2.182e+07	2.158e+07	2.150e+07
3.190e+01	2.546e+07	2.284e+07	2.193e+07	2.162e+07	2.151e+07
3.228e+01	2.636e+07	2.316e+07	2.204e+07	2.165e+07	2.152e+07
3.266e+01	2.721e+07	2.345e+07	2.214e+07	2.169e+07	2.153e+07
3.304e+01	2.802e+07	2.374e+07	2.224e+07	2.172e+07	2.154e+07
3.342e+01	2.878e+07	2.400e+07	2.233e+07	2.175e+07	2.155e+07
3.380e+01	2.949e+07	2.425e+07	2.241e+07	2.178e+07	2.156e+07
3.418e+01	3.014e+07	2.448e+07	2.249e+07	2.181e+07	2.157e+07
3.456e+01	3.072e+07	2.468e+07	2.256e+07	2.183e+07	2.158e+07
3.494e+01	3.124e+07	2.487e+07	2.263e+07	2.185e+07	2.159e+07
3.532e+01	3.170e+07	2.503e+07	2.268e+07	2.187e+07	2.160e+07
3.570e+01	3.209e+07	2.516e+07	2.273e+07	2.189e+07	2.160e+07
3.608e+01	3.240e+07	2.527e+07	2.277e+07	2.190e+07	2.161e+07

3.646e+01	3.265e+07	2.536e+07	2.280e+07	2.191e+07	2.161e+07
3.684e+01	3.283e+07	2.543e+07	2.282e+07	2.192e+07	2.161e+07
3.722e+01	3.293e+07	2.546e+07	2.283e+07	2.192e+07	2.161e+07
3.760e+01	3.300e+07	2.549e+07	2.284e+07	2.193e+07	2.161e+07

Time(yr) 2.000e+02

Depth (cm)	Flux (μg/m²/yr)
0.000e+00	2.144e+07
3.797e-01	2.144e+07
7.595e-01	2.144e+07
1.139e+00	2.144e+07
1.519e+00	2.144e+07
1.899e+00	2.144e+07
2.278e+00	2.144e+07
2.658e+00	2.144e+07
3.038e+00	2.144e+07
3.418e+00	2.144e+07
3.797e+00	2.144e+07
4.177e+00	2.144e+07
4.557e+00	2.144e+07
4.937e+00	2.144e+07
5.316e+00	2.144e+07
5.696e+00	2.144e+07
6.076e+00	2.144e+07
6.456e+00	2.144e+07
6.835e+00	2.144e+07
7.215e+00	2.144e+07
7.595e+00	2.144e+07
7.975e+00	2.144e+07
8.354e+00	2.144e+07
8.734e+00	2.144e+07
9.114e+00	2.144e+07
9.494e+00	2.144e+07
9.873e+00	2.144e+07
1.025e+01	2.144e+07
1.063e+01	2.144e+07
1.101e+01	2.144e+07
1.139e+01	2.144e+07
1.177e+01	2.144e+07
1.215e+01	2.144e+07
1.253e+01	2.144e+07
1.291e+01	2.144e+07
1.329e+01	2.144e+07
1.367e+01	2.144e+07
1.405e+01	2.144e+07
1.443e+01	2.144e+07
1.481e+01	2.144e+07
1.519e+01	2.144e+07
1.557e+01	2.144e+07
1.595e+01	2.144e+07
1.633e+01	2.144e+07
1.671e+01	2.144e+07
1.709e+01	2.144e+07
1.747e+01	2.144e+07
1.785e+01	2.145e+07

1.823e+01	2.145e+07
1.861e+01	2.145e+07
1.899e+01	2.145e+07
1.937e+01	2.145e+07
1.975e+01	2.145e+07
2.013e+01	2.145e+07
2.051e+01	2.145e+07
2.089e+01	2.145e+07
2.127e+01	2.145e+07
2.165e+01	2.145e+07
2.203e+01	2.145e+07
2.241e+01	2.145e+07
2.278e+01	2.145e+07
2.316e+01	2.145e+07
2.354e+01	2.145e+07
2.392e+01	2.145e+07
2.430e+01	2.145e+07
2.468e+01	2.145e+07
2.506e+01	2.145e+07
2.544e+01	2.145e+07
2.582e+01	2.145e+07
2.620e+01	2.145e+07
2.658e+01	2.145e+07
2.696e+01	2.145e+07
2.734e+01	2.145e+07
2.772e+01	2.145e+07
2.810e+01	2.145e+07
2.848e+01	2.145e+07
2.886e+01	2.145e+07
2.924e+01	2.145e+07
2.962e+01	2.145e+07
3.000e+01	2.145e+07
3.038e+01	2.145e+07
3.076e+01	2.146e+07
3.114e+01	2.146e+07
3.152e+01	2.147e+07
3.190e+01	2.147e+07
3.228e+01	2.148e+07
3.266e+01	2.148e+07
3.304e+01	2.148e+07
3.342e+01	2.149e+07
3.380e+01	2.149e+07
3.418e+01	2.149e+07
3.456e+01	2.150e+07
3.494e+01	2.150e+07
3.532e+01	2.150e+07
3.570e+01	2.150e+07
3.608e+01	2.151e+07
3.646e+01	2.151e+07
3.684e+01	2.151e+07
3.722e+01	2.151e+07
3.760e+01	2.151e+07

Solid Concentration Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01

Depth (cm)	Solid Concentrations (μg/kg)				
0.000e+00	0.000e+00	1.847e-14	4.779e-01	1.782e+01	3.228e+01
3.797e-01	0.000e+00	9.489e-13	2.437e+01	9.067e+02	1.642e+03
7.595e-01	0.000e+00	1.884e-12	4.802e+01	1.783e+03	3.229e+03
1.139e+00	0.000e+00	2.842e-12	7.154e+01	2.647e+03	4.794e+03
1.519e+00	0.000e+00	3.842e-12	9.503e+01	3.500e+03	6.336e+03
1.899e+00	0.000e+00	4.901e-12	1.186e+02	4.341e+03	7.856e+03
2.278e+00	0.000e+00	6.038e-12	1.423e+02	5.171e+03	9.355e+03
2.658e+00	0.000e+00	7.276e-12	1.664e+02	5.991e+03	1.083e+04
3.038e+00	0.000e+00	8.635e-12	1.907e+02	6.801e+03	1.229e+04
3.418e+00	0.000e+00	1.014e-11	2.156e+02	7.601e+03	1.373e+04
3.797e+00	0.000e+00	1.182e-11	2.410e+02	8.391e+03	1.515e+04
4.177e+00	0.000e+00	1.370e-11	2.670e+02	9.173e+03	1.655e+04
4.557e+00	0.000e+00	1.581e-11	2.938e+02	9.946e+03	1.793e+04
4.937e+00	0.000e+00	1.819e-11	3.214e+02	1.071e+04	1.929e+04
5.316e+00	0.000e+00	2.088e-11	3.499e+02	1.147e+04	2.063e+04
5.696e+00	0.000e+00	2.393e-11	3.795e+02	1.222e+04	2.196e+04
6.076e+00	0.000e+00	2.739e-11	4.101e+02	1.296e+04	2.327e+04
6.456e+00	0.000e+00	3.132e-11	4.419e+02	1.370e+04	2.456e+04
6.835e+00	0.000e+00	3.578e-11	4.750e+02	1.442e+04	2.584e+04
7.215e+00	0.000e+00	4.085e-11	5.095e+02	1.515e+04	2.710e+04
7.595e+00	0.000e+00	4.661e-11	5.453e+02	1.586e+04	2.834e+04
7.975e+00	0.000e+00	5.317e-11	5.828e+02	1.657e+04	2.957e+04
8.354e+00	0.000e+00	6.063e-11	6.218e+02	1.728e+04	3.078e+04
8.734e+00	0.000e+00	6.913e-11	6.626e+02	1.798e+04	3.198e+04
9.114e+00	0.000e+00	7.880e-11	7.052e+02	1.867e+04	3.317e+04
9.494e+00	0.000e+00	8.982e-11	7.496e+02	1.936e+04	3.434e+04
9.873e+00	0.000e+00	1.024e-10	7.961e+02	2.005e+04	3.549e+04
1.025e+01	0.000e+00	1.167e-10	8.446e+02	2.073e+04	3.663e+04
1.063e+01	0.000e+00	1.329e-10	8.954e+02	2.141e+04	3.776e+04
1.101e+01	0.000e+00	1.515e-10	9.483e+02	2.208e+04	3.888e+04
1.139e+01	0.000e+00	1.726e-10	1.004e+03	2.275e+04	3.998e+04
1.177e+01	0.000e+00	1.967e-10	1.061e+03	2.342e+04	4.107e+04
1.215e+01	0.000e+00	2.241e-10	1.122e+03	2.408e+04	4.215e+04
1.253e+01	0.000e+00	2.554e-10	1.185e+03	2.474e+04	4.322e+04
1.291e+01	0.000e+00	2.911e-10	1.251e+03	2.540e+04	4.427e+04
1.329e+01	0.000e+00	3.317e-10	1.319e+03	2.606e+04	4.532e+04
1.367e+01	0.000e+00	3.780e-10	1.391e+03	2.671e+04	4.635e+04
1.405e+01	0.000e+00	4.308e-10	1.466e+03	2.736e+04	4.737e+04
1.443e+01	0.000e+00	4.910e-10	1.543e+03	2.801e+04	4.838e+04
1.481e+01	0.000e+00	5.596e-10	1.625e+03	2.866e+04	4.938e+04
1.519e+01	0.000e+00	6.378e-10	1.709e+03	2.930e+04	5.037e+04
1.557e+01	0.000e+00	7.269e-10	1.797e+03	2.995e+04	5.135e+04
1.595e+01	0.000e+00	8.285e-10	1.889e+03	3.059e+04	5.232e+04
1.633e+01	0.000e+00	9.443e-10	1.984e+03	3.123e+04	5.328e+04
1.671e+01	0.000e+00	1.076e-09	2.083e+03	3.187e+04	5.423e+04
1.709e+01	0.000e+00	1.227e-09	2.186e+03	3.251e+04	5.517e+04
1.747e+01	0.000e+00	1.398e-09	2.293e+03	3.315e+04	5.610e+04
1.785e+01	0.000e+00	1.594e-09	2.405e+03	3.379e+04	5.703e+04
1.823e+01	0.000e+00	1.816e-09	2.520e+03	3.443e+04	5.794e+04
1.861e+01	0.000e+00	2.070e-09	2.640e+03	3.507e+04	5.885e+04
1.899e+01	0.000e+00	2.358e-09	2.765e+03	3.570e+04	5.974e+04
1.937e+01	0.000e+00	2.687e-09	2.894e+03	3.634e+04	6.063e+04
1.975e+01	0.000e+00	3.061e-09	3.028e+03	3.698e+04	6.151e+04
2.013e+01	0.000e+00	3.487e-09	3.167e+03	3.762e+04	6.239e+04

2.051e+01	0.000e+00	3.972e-09	3.311e+03	3.825e+04	6.325e+04
2.089e+01	0.000e+00	4.524e-09	3.461e+03	3.889e+04	6.411e+04
2.127e+01	0.000e+00	5.151e-09	3.615e+03	3.953e+04	6.496e+04
2.165e+01	0.000e+00	5.865e-09	3.775e+03	4.017e+04	6.580e+04
2.203e+01	0.000e+00	6.676e-09	3.940e+03	4.081e+04	6.664e+04
2.241e+01	0.000e+00	7.598e-09	4.111e+03	4.145e+04	6.747e+04
2.278e+01	0.000e+00	8.645e-09	4.288e+03	4.209e+04	6.829e+04
2.316e+01	0.000e+00	9.834e-09	4.471e+03	4.273e+04	6.911e+04
2.354e+01	0.000e+00	1.118e-08	4.660e+03	4.337e+04	6.991e+04
2.392e+01	0.000e+00	1.272e-08	4.855e+03	4.401e+04	7.072e+04
2.430e+01	0.000e+00	1.445e-08	5.057e+03	4.465e+04	7.151e+04
2.468e+01	0.000e+00	1.643e-08	5.265e+03	4.530e+04	7.230e+04
2.506e+01	0.000e+00	1.866e-08	5.479e+03	4.594e+04	7.308e+04
2.544e+01	0.000e+00	2.119e-08	5.700e+03	4.659e+04	7.386e+04
2.582e+01	0.000e+00	2.406e-08	5.928e+03	4.724e+04	7.463e+04
2.620e+01	0.000e+00	2.730e-08	6.163e+03	4.789e+04	7.540e+04
2.658e+01	0.000e+00	3.097e-08	6.405e+03	4.854e+04	7.616e+04
2.696e+01	0.000e+00	3.512e-08	6.655e+03	4.919e+04	7.691e+04
2.734e+01	0.000e+00	3.981e-08	6.911e+03	4.984e+04	7.766e+04
2.772e+01	0.000e+00	4.511e-08	7.176e+03	5.049e+04	7.840e+04
2.810e+01	0.000e+00	5.109e-08	7.448e+03	5.115e+04	7.914e+04
2.848e+01	0.000e+00	5.784e-08	7.727e+03	5.181e+04	7.987e+04
2.886e+01	0.000e+00	6.545e-08	8.015e+03	5.246e+04	8.060e+04
2.924e+01	0.000e+00	7.402e-08	8.310e+03	5.312e+04	8.132e+04
2.962e+01	0.000e+00	8.368e-08	8.614e+03	5.379e+04	8.204e+04
3.000e+01	0.000e+00	nan	6.462e+07	1.239e+08	1.441e+08
3.038e+01	0.000e+00	nan	6.648e+07	1.243e+08	1.443e+08
3.076e+01	nan	1.088e+04	7.096e+07	1.249e+08	1.446e+08
3.114e+01	nan	1.044e+05	7.688e+07	1.259e+08	1.450e+08
3.152e+01	nan	8.750e+05	8.335e+07	1.270e+08	1.455e+08
3.190e+01	0.000e+00	6.679e+06	8.986e+07	1.284e+08	1.460e+08
3.228e+01	0.000e+00	3.700e+07	9.619e+07	1.299e+08	1.466e+08
3.266e+01	0.000e+00	5.581e+07	1.022e+08	1.316e+08	1.472e+08
3.304e+01	nan	7.015e+07	1.080e+08	1.335e+08	1.479e+08
3.342e+01	nan	8.210e+07	1.134e+08	1.354e+08	1.487e+08
3.380e+01	nan	9.248e+07	1.186e+08	1.374e+08	1.495e+08
3.418e+01	0.000e+00	1.017e+08	1.235e+08	1.395e+08	1.503e+08
3.456e+01	0.000e+00	1.101e+08	1.282e+08	1.417e+08	1.512e+08
3.494e+01	0.000e+00	1.178e+08	1.326e+08	1.438e+08	1.520e+08
3.532e+01	nan	1.249e+08	1.368e+08	1.460e+08	1.529e+08
3.570e+01	nan	1.314e+08	1.408e+08	1.481e+08	1.539e+08
3.608e+01	nan	1.375e+08	1.447e+08	1.503e+08	1.548e+08
3.646e+01	0.000e+00	1.433e+08	1.483e+08	1.524e+08	1.557e+08
3.684e+01	0.000e+00	1.486e+08	1.518e+08	1.544e+08	1.566e+08
3.722e+01	0.000e+00	1.537e+08	1.552e+08	1.565e+08	1.575e+08
3.760e+01	0.000e+00	1.584e+08	1.584e+08	1.584e+08	1.584e+08

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02

Depth (cm)	Solid Concentrations (μg/kg)				
0.000e+00	3.915e+01	4.180e+01	4.275e+01	4.307e+01	4.319e+01
3.797e-01	1.992e+03	2.127e+03	2.175e+03	2.192e+03	2.197e+03
7.595e-01	3.916e+03	4.182e+03	4.276e+03	4.309e+03	4.320e+03
1.139e+00	5.813e+03	6.207e+03	6.347e+03	6.396e+03	6.413e+03
1.519e+00	7.683e+03	8.203e+03	8.389e+03	8.453e+03	8.475e+03
1.899e+00	9.526e+03	1.017e+04	1.040e+04	1.048e+04	1.051e+04

2.278e+00	1.134e+04	1.211e+04	1.238e+04	1.248e+04	1.251e+04
2.658e+00	1.313e+04	1.402e+04	1.434e+04	1.445e+04	1.448e+04
3.038e+00	1.490e+04	1.590e+04	1.626e+04	1.639e+04	1.643e+04
3.418e+00	1.664e+04	1.776e+04	1.816e+04	1.830e+04	1.835e+04
3.797e+00	1.835e+04	1.959e+04	2.003e+04	2.018e+04	2.024e+04
4.177e+00	2.004e+04	2.139e+04	2.187e+04	2.204e+04	2.210e+04
4.557e+00	2.171e+04	2.317e+04	2.369e+04	2.387e+04	2.393e+04
4.937e+00	2.335e+04	2.492e+04	2.548e+04	2.568e+04	2.574e+04
5.316e+00	2.498e+04	2.665e+04	2.725e+04	2.745e+04	2.752e+04
5.696e+00	2.657e+04	2.835e+04	2.899e+04	2.921e+04	2.928e+04
6.076e+00	2.815e+04	3.003e+04	3.070e+04	3.093e+04	3.101e+04
6.456e+00	2.970e+04	3.169e+04	3.239e+04	3.264e+04	3.272e+04
6.835e+00	3.124e+04	3.332e+04	3.406e+04	3.431e+04	3.440e+04
7.215e+00	3.275e+04	3.492e+04	3.570e+04	3.597e+04	3.606e+04
7.595e+00	3.424e+04	3.651e+04	3.732e+04	3.760e+04	3.769e+04
7.975e+00	3.571e+04	3.807e+04	3.891e+04	3.920e+04	3.930e+04
8.354e+00	3.716e+04	3.961e+04	4.048e+04	4.078e+04	4.089e+04
8.734e+00	3.858e+04	4.113e+04	4.203e+04	4.234e+04	4.245e+04
9.114e+00	3.999e+04	4.262e+04	4.356e+04	4.388e+04	4.399e+04
9.494e+00	4.139e+04	4.410e+04	4.506e+04	4.540e+04	4.551e+04
9.873e+00	4.276e+04	4.555e+04	4.655e+04	4.689e+04	4.701e+04
1.025e+01	4.411e+04	4.699e+04	4.801e+04	4.836e+04	4.848e+04
1.063e+01	4.545e+04	4.840e+04	4.945e+04	4.981e+04	4.994e+04
1.101e+01	4.676e+04	4.979e+04	5.087e+04	5.124e+04	5.137e+04
1.139e+01	4.806e+04	5.117e+04	5.227e+04	5.265e+04	5.278e+04
1.177e+01	4.934e+04	5.252e+04	5.365e+04	5.404e+04	5.418e+04
1.215e+01	5.061e+04	5.386e+04	5.501e+04	5.541e+04	5.555e+04
1.253e+01	5.186e+04	5.517e+04	5.635e+04	5.676e+04	5.690e+04
1.291e+01	5.309e+04	5.647e+04	5.767e+04	5.809e+04	5.823e+04
1.329e+01	5.431e+04	5.775e+04	5.898e+04	5.940e+04	5.954e+04
1.367e+01	5.550e+04	5.901e+04	6.026e+04	6.069e+04	6.084e+04
1.405e+01	5.669e+04	6.026e+04	6.152e+04	6.196e+04	6.211e+04
1.443e+01	5.786e+04	6.148e+04	6.277e+04	6.322e+04	6.337e+04
1.481e+01	5.901e+04	6.269e+04	6.400e+04	6.445e+04	6.461e+04
1.519e+01	6.015e+04	6.389e+04	6.521e+04	6.567e+04	6.583e+04
1.557e+01	6.127e+04	6.506e+04	6.641e+04	6.687e+04	6.703e+04
1.595e+01	6.238e+04	6.622e+04	6.759e+04	6.806e+04	6.822e+04
1.633e+01	6.347e+04	6.737e+04	6.875e+04	6.923e+04	6.939e+04
1.671e+01	6.455e+04	6.849e+04	6.989e+04	7.038e+04	7.054e+04
1.709e+01	6.562e+04	6.961e+04	7.102e+04	7.151e+04	7.168e+04
1.747e+01	6.667e+04	7.070e+04	7.213e+04	7.263e+04	7.279e+04
1.785e+01	6.771e+04	7.178e+04	7.323e+04	7.373e+04	7.390e+04
1.823e+01	6.874e+04	7.285e+04	7.431e+04	7.481e+04	7.498e+04
1.861e+01	6.975e+04	7.390e+04	7.537e+04	7.588e+04	7.606e+04
1.899e+01	7.075e+04	7.494e+04	7.642e+04	7.694e+04	7.711e+04
1.937e+01	7.174e+04	7.596e+04	7.746e+04	7.797e+04	7.815e+04
1.975e+01	7.272e+04	7.697e+04	7.848e+04	7.900e+04	7.918e+04
2.013e+01	7.368e+04	7.797e+04	7.948e+04	8.001e+04	8.019e+04
2.051e+01	7.463e+04	7.895e+04	8.048e+04	8.100e+04	8.118e+04
2.089e+01	7.557e+04	7.991e+04	8.145e+04	8.198e+04	8.217e+04
2.127e+01	7.650e+04	8.087e+04	8.242e+04	8.295e+04	8.313e+04
2.165e+01	7.741e+04	8.181e+04	8.337e+04	8.390e+04	8.409e+04
2.203e+01	7.832e+04	8.274e+04	8.430e+04	8.484e+04	8.503e+04
2.241e+01	7.921e+04	8.366e+04	8.523e+04	8.577e+04	8.595e+04
2.278e+01	8.010e+04	8.456e+04	8.613e+04	8.668e+04	8.687e+04
2.316e+01	8.097e+04	8.545e+04	8.703e+04	8.758e+04	8.777e+04

2.354e+01	8.183e+04	8.633e+04	8.792e+04	8.846e+04	8.865e+04
2.392e+01	8.268e+04	8.719e+04	8.879e+04	8.934e+04	8.953e+04
2.430e+01	8.353e+04	8.805e+04	8.965e+04	9.020e+04	9.039e+04
2.468e+01	8.436e+04	8.889e+04	9.049e+04	9.105e+04	9.124e+04
2.506e+01	8.518e+04	8.973e+04	9.133e+04	9.188e+04	9.207e+04
2.544e+01	8.599e+04	9.055e+04	9.215e+04	9.271e+04	9.290e+04
2.582e+01	8.679e+04	9.136e+04	9.296e+04	9.352e+04	9.371e+04
2.620e+01	8.758e+04	9.215e+04	9.377e+04	9.432e+04	9.451e+04
2.658e+01	8.837e+04	9.294e+04	9.455e+04	9.511e+04	9.530e+04
2.696e+01	8.914e+04	9.372e+04	9.533e+04	9.589e+04	9.608e+04
2.734e+01	8.990e+04	9.449e+04	9.610e+04	9.665e+04	9.685e+04
2.772e+01	9.066e+04	9.524e+04	9.685e+04	9.741e+04	9.760e+04
2.810e+01	9.141e+04	9.599e+04	9.760e+04	9.816e+04	9.835e+04
2.848e+01	9.215e+04	9.672e+04	9.833e+04	9.889e+04	9.908e+04
2.886e+01	9.288e+04	9.745e+04	9.906e+04	9.961e+04	9.980e+04
2.924e+01	9.360e+04	9.817e+04	9.977e+04	1.003e+05	1.005e+05
2.962e+01	9.431e+04	9.887e+04	1.005e+05	1.010e+05	1.012e+05
3.000e+01	1.514e+08	1.540e+08	1.549e+08	1.552e+08	1.553e+08
3.038e+01	1.516e+08	1.542e+08	1.550e+08	1.553e+08	1.554e+08
3.076e+01	1.518e+08	1.543e+08	1.552e+08	1.555e+08	1.556e+08
3.114e+01	1.521e+08	1.545e+08	1.554e+08	1.557e+08	1.558e+08
3.152e+01	1.523e+08	1.547e+08	1.556e+08	1.558e+08	1.559e+08
3.190e+01	1.526e+08	1.549e+08	1.557e+08	1.560e+08	1.561e+08
3.228e+01	1.529e+08	1.551e+08	1.559e+08	1.562e+08	1.563e+08
3.266e+01	1.532e+08	1.554e+08	1.561e+08	1.563e+08	1.564e+08
3.304e+01	1.536e+08	1.556e+08	1.563e+08	1.565e+08	1.566e+08
3.342e+01	1.539e+08	1.558e+08	1.565e+08	1.567e+08	1.568e+08
3.380e+01	1.543e+08	1.560e+08	1.566e+08	1.568e+08	1.569e+08
3.418e+01	1.547e+08	1.563e+08	1.568e+08	1.570e+08	1.571e+08
3.456e+01	1.551e+08	1.565e+08	1.570e+08	1.572e+08	1.572e+08
3.494e+01	1.555e+08	1.567e+08	1.572e+08	1.573e+08	1.574e+08
3.532e+01	1.559e+08	1.570e+08	1.574e+08	1.575e+08	1.575e+08
3.570e+01	1.563e+08	1.572e+08	1.575e+08	1.576e+08	1.577e+08
3.608e+01	1.567e+08	1.575e+08	1.577e+08	1.578e+08	1.578e+08
3.646e+01	1.572e+08	1.577e+08	1.579e+08	1.580e+08	1.580e+08
3.684e+01	1.576e+08	1.579e+08	1.581e+08	1.581e+08	1.581e+08
3.722e+01	1.580e+08	1.582e+08	1.583e+08	1.583e+08	1.583e+08
3.760e+01	1.584e+08	1.584e+08	1.584e+08	1.584e+08	1.584e+08

Time(yr) 2.000e+02

Depth (cm)	Solid Concentrations (μg/kg)
0.000e+00	4.322e+01
3.797e-01	2.199e+03
7.595e-01	4.324e+03
1.139e+00	6.418e+03
1.519e+00	8.482e+03
1.899e+00	1.052e+04
2.278e+00	1.252e+04
2.658e+00	1.450e+04
3.038e+00	1.644e+04
3.418e+00	1.836e+04
3.797e+00	2.025e+04
4.177e+00	2.212e+04
4.557e+00	2.395e+04
4.937e+00	2.576e+04

5.316e+00	2.755e+04
5.696e+00	2.931e+04
6.076e+00	3.104e+04
6.456e+00	3.275e+04
6.835e+00	3.443e+04
7.215e+00	3.609e+04
7.595e+00	3.772e+04
7.975e+00	3.934e+04
8.354e+00	4.092e+04
8.734e+00	4.249e+04
9.114e+00	4.403e+04
9.494e+00	4.555e+04
9.873e+00	4.705e+04
1.025e+01	4.853e+04
1.063e+01	4.998e+04
1.101e+01	5.141e+04
1.139e+01	5.283e+04
1.177e+01	5.422e+04
1.215e+01	5.559e+04
1.253e+01	5.695e+04
1.291e+01	5.828e+04
1.329e+01	5.959e+04
1.367e+01	6.089e+04
1.405e+01	6.216e+04
1.443e+01	6.342e+04
1.481e+01	6.466e+04
1.519e+01	6.588e+04
1.557e+01	6.709e+04
1.595e+01	6.827e+04
1.633e+01	6.944e+04
1.671e+01	7.060e+04
1.709e+01	7.173e+04
1.747e+01	7.285e+04
1.785e+01	7.396e+04
1.823e+01	7.504e+04
1.861e+01	7.612e+04
1.899e+01	7.717e+04
1.937e+01	7.821e+04
1.975e+01	7.924e+04
2.013e+01	8.025e+04
2.051e+01	8.125e+04
2.089e+01	8.223e+04
2.127e+01	8.320e+04
2.165e+01	8.415e+04
2.203e+01	8.509e+04
2.241e+01	8.602e+04
2.278e+01	8.693e+04
2.316e+01	8.783e+04
2.354e+01	8.872e+04
2.392e+01	8.959e+04
2.430e+01	9.045e+04
2.468e+01	9.130e+04
2.506e+01	9.214e+04
2.544e+01	9.296e+04
2.582e+01	9.377e+04
2.620e+01	9.458e+04

2.658e+01	9.537e+04
2.696e+01	9.614e+04
2.734e+01	9.691e+04
2.772e+01	9.767e+04
2.810e+01	9.841e+04
2.848e+01	9.914e+04
2.886e+01	9.987e+04
2.924e+01	1.006e+05
2.962e+01	1.013e+05
3.000e+01	1.553e+08
3.038e+01	1.555e+08
3.076e+01	1.556e+08
3.114e+01	1.558e+08
3.152e+01	1.560e+08
3.190e+01	1.561e+08
3.228e+01	1.563e+08
3.266e+01	1.565e+08
3.304e+01	1.566e+08
3.342e+01	1.568e+08
3.380e+01	1.569e+08
3.418e+01	1.571e+08
3.456e+01	1.572e+08
3.494e+01	1.574e+08
3.532e+01	1.575e+08
3.570e+01	1.577e+08
3.608e+01	1.578e+08
3.646e+01	1.580e+08
3.684e+01	1.581e+08
3.722e+01	1.583e+08
3.760e+01	1.584e+08

Total Concentration Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)	Total Concentrations (μg/L)				
0.000e+00	0.000e+00	2.791e-14	7.222e-01	2.693e+01	4.878e+01
3.797e-01	0.000e+00	1.434e-12	3.683e+01	1.370e+03	2.482e+03
7.595e-01	0.000e+00	2.848e-12	7.257e+01	2.695e+03	4.881e+03
1.139e+00	0.000e+00	4.296e-12	1.081e+02	4.001e+03	7.245e+03
1.519e+00	0.000e+00	5.806e-12	1.436e+02	5.289e+03	9.575e+03
1.899e+00	0.000e+00	7.406e-12	1.792e+02	6.560e+03	1.187e+04
2.278e+00	0.000e+00	9.126e-12	2.151e+02	7.815e+03	1.414e+04
2.658e+00	0.000e+00	1.100e-11	2.514e+02	9.054e+03	1.637e+04
3.038e+00	0.000e+00	1.305e-11	2.883e+02	1.028e+04	1.858e+04
3.418e+00	0.000e+00	1.533e-11	3.258e+02	1.149e+04	2.075e+04
3.797e+00	0.000e+00	1.786e-11	3.642e+02	1.268e+04	2.289e+04
4.177e+00	0.000e+00	2.070e-11	4.036e+02	1.386e+04	2.501e+04
4.557e+00	0.000e+00	2.389e-11	4.440e+02	1.503e+04	2.709e+04
4.937e+00	0.000e+00	2.749e-11	4.858e+02	1.619e+04	2.915e+04
5.316e+00	0.000e+00	3.156e-11	5.289e+02	1.733e+04	3.118e+04
5.696e+00	0.000e+00	3.617e-11	5.735e+02	1.847e+04	3.319e+04
6.076e+00	0.000e+00	4.140e-11	6.198e+02	1.959e+04	3.517e+04
6.456e+00	0.000e+00	4.733e-11	6.679e+02	2.070e+04	3.712e+04
6.835e+00	0.000e+00	5.407e-11	7.179e+02	2.180e+04	3.905e+04
7.215e+00	0.000e+00	6.173e-11	7.700e+02	2.289e+04	4.095e+04

7.595e+00	0.000e+00	7.044e-11	8.242e+02	2.397e+04	4.283e+04
7.975e+00	0.000e+00	8.036e-11	8.808e+02	2.505e+04	4.469e+04
8.354e+00	0.000e+00	9.164e-11	9.398e+02	2.611e+04	4.652e+04
8.734e+00	0.000e+00	1.045e-10	1.001e+03	2.717e+04	4.834e+04
9.114e+00	0.000e+00	1.191e-10	1.066e+03	2.822e+04	5.013e+04
9.494e+00	0.000e+00	1.357e-10	1.133e+03	2.926e+04	5.189e+04
9.873e+00	0.000e+00	1.547e-10	1.203e+03	3.030e+04	5.364e+04
1.025e+01	0.000e+00	1.763e-10	1.277e+03	3.133e+04	5.537e+04
1.063e+01	0.000e+00	2.009e-10	1.353e+03	3.235e+04	5.707e+04
1.101e+01	0.000e+00	2.289e-10	1.433e+03	3.337e+04	5.876e+04
1.139e+01	0.000e+00	2.609e-10	1.517e+03	3.438e+04	6.043e+04
1.177e+01	0.000e+00	2.973e-10	1.604e+03	3.539e+04	6.208e+04
1.215e+01	0.000e+00	3.388e-10	1.696e+03	3.640e+04	6.371e+04
1.253e+01	0.000e+00	3.860e-10	1.791e+03	3.739e+04	6.532e+04
1.291e+01	0.000e+00	4.399e-10	1.890e+03	3.839e+04	6.691e+04
1.329e+01	0.000e+00	5.013e-10	1.994e+03	3.938e+04	6.849e+04
1.367e+01	0.000e+00	5.713e-10	2.102e+03	4.037e+04	7.005e+04
1.405e+01	0.000e+00	6.511e-10	2.215e+03	4.135e+04	7.159e+04
1.443e+01	0.000e+00	7.420e-10	2.333e+03	4.233e+04	7.312e+04
1.481e+01	0.000e+00	8.457e-10	2.455e+03	4.331e+04	7.463e+04
1.519e+01	0.000e+00	9.639e-10	2.583e+03	4.429e+04	7.613e+04
1.557e+01	0.000e+00	1.099e-09	2.716e+03	4.526e+04	7.761e+04
1.595e+01	0.000e+00	1.252e-09	2.854e+03	4.623e+04	7.907e+04
1.633e+01	0.000e+00	1.427e-09	2.998e+03	4.720e+04	8.052e+04
1.671e+01	0.000e+00	1.627e-09	3.148e+03	4.817e+04	8.196e+04
1.709e+01	0.000e+00	1.854e-09	3.304e+03	4.914e+04	8.338e+04
1.747e+01	0.000e+00	2.113e-09	3.466e+03	5.010e+04	8.479e+04
1.785e+01	0.000e+00	2.408e-09	3.634e+03	5.107e+04	8.619e+04
1.823e+01	0.000e+00	2.745e-09	3.809e+03	5.203e+04	8.757e+04
1.861e+01	0.000e+00	3.128e-09	3.991e+03	5.300e+04	8.894e+04
1.899e+01	0.000e+00	3.564e-09	4.179e+03	5.396e+04	9.029e+04
1.937e+01	0.000e+00	4.061e-09	4.374e+03	5.492e+04	9.164e+04
1.975e+01	0.000e+00	4.627e-09	4.577e+03	5.589e+04	9.297e+04
2.013e+01	0.000e+00	5.271e-09	4.787e+03	5.685e+04	9.429e+04
2.051e+01	0.000e+00	6.003e-09	5.005e+03	5.781e+04	9.560e+04
2.089e+01	0.000e+00	6.837e-09	5.230e+03	5.878e+04	9.689e+04
2.127e+01	0.000e+00	7.785e-09	5.464e+03	5.974e+04	9.818e+04
2.165e+01	0.000e+00	8.864e-09	5.705e+03	6.071e+04	9.945e+04
2.203e+01	0.000e+00	1.009e-08	5.955e+03	6.167e+04	1.007e+05
2.241e+01	0.000e+00	1.148e-08	6.214e+03	6.264e+04	1.020e+05
2.278e+01	0.000e+00	1.307e-08	6.481e+03	6.361e+04	1.032e+05
2.316e+01	0.000e+00	1.486e-08	6.758e+03	6.457e+04	1.044e+05
2.354e+01	0.000e+00	1.690e-08	7.043e+03	6.554e+04	1.057e+05
2.392e+01	0.000e+00	1.922e-08	7.338e+03	6.651e+04	1.069e+05
2.430e+01	0.000e+00	2.185e-08	7.642e+03	6.749e+04	1.081e+05
2.468e+01	0.000e+00	2.483e-08	7.956e+03	6.846e+04	1.093e+05
2.506e+01	0.000e+00	2.820e-08	8.281e+03	6.944e+04	1.105e+05
2.544e+01	0.000e+00	3.203e-08	8.615e+03	7.041e+04	1.116e+05
2.582e+01	0.000e+00	3.636e-08	8.960e+03	7.139e+04	1.128e+05
2.620e+01	0.000e+00	4.126e-08	9.315e+03	7.237e+04	1.140e+05
2.658e+01	0.000e+00	4.681e-08	9.681e+03	7.336e+04	1.151e+05
2.696e+01	0.000e+00	5.308e-08	1.006e+04	7.434e+04	1.162e+05
2.734e+01	0.000e+00	6.017e-08	1.045e+04	7.533e+04	1.174e+05
2.772e+01	0.000e+00	6.818e-08	1.085e+04	7.631e+04	1.185e+05
2.810e+01	0.000e+00	7.722e-08	1.126e+04	7.731e+04	1.196e+05
2.848e+01	0.000e+00	8.742e-08	1.168e+04	7.830e+04	1.207e+05

2.886e+01	0.000e+00	9.892e-08	1.211e+04	7.929e+04	1.218e+05
2.924e+01	0.000e+00	1.119e-07	1.256e+04	8.029e+04	1.229e+05
2.962e+01	0.000e+00	1.265e-07	1.302e+04	8.129e+04	1.240e+05
3.000e+01	0.000e+00	nan	8.275e+06	1.588e+07	1.847e+07
3.038e+01	0.000e+00	nan	8.513e+06	1.593e+07	1.850e+07
3.076e+01	nan	1.393e+03	9.087e+06	1.601e+07	1.854e+07
3.114e+01	nan	1.336e+04	9.846e+06	1.613e+07	1.859e+07
3.152e+01	nan	1.120e+05	1.068e+07	1.628e+07	1.865e+07
3.190e+01	0.000e+00	8.549e+05	1.151e+07	1.645e+07	1.872e+07
3.228e+01	0.000e+00	4.736e+06	1.232e+07	1.665e+07	1.880e+07
3.266e+01	0.000e+00	7.146e+06	1.310e+07	1.687e+07	1.888e+07
3.304e+01	nan	8.984e+06	1.384e+07	1.711e+07	1.897e+07
3.342e+01	nan	1.051e+07	1.454e+07	1.736e+07	1.907e+07
3.380e+01	nan	1.185e+07	1.520e+07	1.762e+07	1.917e+07
3.418e+01	0.000e+00	1.303e+07	1.583e+07	1.789e+07	1.927e+07
3.456e+01	0.000e+00	1.411e+07	1.643e+07	1.816e+07	1.938e+07
3.494e+01	0.000e+00	1.509e+07	1.700e+07	1.844e+07	1.950e+07
3.532e+01	nan	1.600e+07	1.754e+07	1.872e+07	1.961e+07
3.570e+01	nan	1.685e+07	1.805e+07	1.899e+07	1.973e+07
3.608e+01	nan	1.763e+07	1.855e+07	1.927e+07	1.985e+07
3.646e+01	0.000e+00	1.837e+07	1.902e+07	1.954e+07	1.997e+07
3.684e+01	0.000e+00	1.906e+07	1.947e+07	1.981e+07	2.009e+07
3.722e+01	0.000e+00	1.971e+07	1.990e+07	2.007e+07	2.020e+07
3.760e+01	0.000e+00	2.032e+07	2.032e+07	2.032e+07	2.032e+07

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)			Total Concentrations (μg/L)		
0.000e+00	5.916e+01	6.317e+01	6.460e+01	6.510e+01	6.527e+01
3.797e-01	3.010e+03	3.214e+03	3.287e+03	3.312e+03	3.321e+03
7.595e-01	5.919e+03	6.320e+03	6.463e+03	6.513e+03	6.530e+03
1.139e+00	8.786e+03	9.381e+03	9.593e+03	9.667e+03	9.692e+03
1.519e+00	1.161e+04	1.240e+04	1.268e+04	1.278e+04	1.281e+04
1.899e+00	1.440e+04	1.537e+04	1.572e+04	1.584e+04	1.588e+04
2.278e+00	1.714e+04	1.830e+04	1.871e+04	1.886e+04	1.891e+04
2.658e+00	1.985e+04	2.119e+04	2.167e+04	2.183e+04	2.189e+04
3.038e+00	2.252e+04	2.404e+04	2.458e+04	2.477e+04	2.483e+04
3.418e+00	2.514e+04	2.684e+04	2.745e+04	2.766e+04	2.773e+04
3.797e+00	2.774e+04	2.961e+04	3.027e+04	3.050e+04	3.058e+04
4.177e+00	3.029e+04	3.233e+04	3.306e+04	3.331e+04	3.340e+04
4.557e+00	3.281e+04	3.502e+04	3.581e+04	3.608e+04	3.617e+04
4.937e+00	3.530e+04	3.767e+04	3.851e+04	3.881e+04	3.891e+04
5.316e+00	3.775e+04	4.028e+04	4.118e+04	4.149e+04	4.160e+04
5.696e+00	4.016e+04	4.285e+04	4.381e+04	4.414e+04	4.425e+04
6.076e+00	4.254e+04	4.539e+04	4.640e+04	4.675e+04	4.687e+04
6.456e+00	4.489e+04	4.789e+04	4.895e+04	4.932e+04	4.945e+04
6.835e+00	4.721e+04	5.035e+04	5.147e+04	5.186e+04	5.199e+04
7.215e+00	4.949e+04	5.278e+04	5.395e+04	5.436e+04	5.450e+04
7.595e+00	5.174e+04	5.518e+04	5.640e+04	5.682e+04	5.697e+04
7.975e+00	5.396e+04	5.754e+04	5.881e+04	5.925e+04	5.940e+04
8.354e+00	5.615e+04	5.986e+04	6.118e+04	6.164e+04	6.180e+04
8.734e+00	5.831e+04	6.216e+04	6.352e+04	6.400e+04	6.416e+04
9.114e+00	6.045e+04	6.442e+04	6.583e+04	6.632e+04	6.649e+04
9.494e+00	6.255e+04	6.665e+04	6.811e+04	6.861e+04	6.878e+04
9.873e+00	6.462e+04	6.885e+04	7.035e+04	7.087e+04	7.105e+04
1.025e+01	6.667e+04	7.101e+04	7.256e+04	7.309e+04	7.328e+04

1.063e+01	6.868e+04	7.315e+04	7.474e+04	7.529e+04	7.547e+04
1.101e+01	7.068e+04	7.525e+04	7.688e+04	7.745e+04	7.764e+04
1.139e+01	7.264e+04	7.733e+04	7.900e+04	7.958e+04	7.977e+04
1.177e+01	7.458e+04	7.938e+04	8.108e+04	8.167e+04	8.188e+04
1.215e+01	7.649e+04	8.140e+04	8.314e+04	8.374e+04	8.395e+04
1.253e+01	7.838e+04	8.339e+04	8.517e+04	8.578e+04	8.599e+04
1.291e+01	8.024e+04	8.535e+04	8.716e+04	8.779e+04	8.801e+04
1.329e+01	8.207e+04	8.728e+04	8.913e+04	8.977e+04	8.999e+04
1.367e+01	8.389e+04	8.919e+04	9.107e+04	9.172e+04	9.195e+04
1.405e+01	8.568e+04	9.107e+04	9.299e+04	9.365e+04	9.388e+04
1.443e+01	8.744e+04	9.292e+04	9.487e+04	9.554e+04	9.577e+04
1.481e+01	8.918e+04	9.475e+04	9.673e+04	9.741e+04	9.765e+04
1.519e+01	9.090e+04	9.655e+04	9.856e+04	9.925e+04	9.949e+04
1.557e+01	9.260e+04	9.833e+04	1.004e+05	1.011e+05	1.013e+05
1.595e+01	9.428e+04	1.001e+05	1.021e+05	1.029e+05	1.031e+05
1.633e+01	9.593e+04	1.018e+05	1.039e+05	1.046e+05	1.049e+05
1.671e+01	9.756e+04	1.035e+05	1.056e+05	1.064e+05	1.066e+05
1.709e+01	9.917e+04	1.052e+05	1.073e+05	1.081e+05	1.083e+05
1.747e+01	1.008e+05	1.069e+05	1.090e+05	1.098e+05	1.100e+05
1.785e+01	1.023e+05	1.085e+05	1.107e+05	1.114e+05	1.117e+05
1.823e+01	1.039e+05	1.101e+05	1.123e+05	1.131e+05	1.133e+05
1.861e+01	1.054e+05	1.117e+05	1.139e+05	1.147e+05	1.149e+05
1.899e+01	1.069e+05	1.133e+05	1.155e+05	1.163e+05	1.165e+05
1.937e+01	1.084e+05	1.148e+05	1.171e+05	1.178e+05	1.181e+05
1.975e+01	1.099e+05	1.163e+05	1.186e+05	1.194e+05	1.197e+05
2.013e+01	1.114e+05	1.178e+05	1.201e+05	1.209e+05	1.212e+05
2.051e+01	1.128e+05	1.193e+05	1.216e+05	1.224e+05	1.227e+05
2.089e+01	1.142e+05	1.208e+05	1.231e+05	1.239e+05	1.242e+05
2.127e+01	1.156e+05	1.222e+05	1.246e+05	1.254e+05	1.256e+05
2.165e+01	1.170e+05	1.236e+05	1.260e+05	1.268e+05	1.271e+05
2.203e+01	1.184e+05	1.250e+05	1.274e+05	1.282e+05	1.285e+05
2.241e+01	1.197e+05	1.264e+05	1.288e+05	1.296e+05	1.299e+05
2.278e+01	1.211e+05	1.278e+05	1.302e+05	1.310e+05	1.313e+05
2.316e+01	1.224e+05	1.291e+05	1.315e+05	1.324e+05	1.326e+05
2.354e+01	1.237e+05	1.305e+05	1.329e+05	1.337e+05	1.340e+05
2.392e+01	1.250e+05	1.318e+05	1.342e+05	1.350e+05	1.353e+05
2.430e+01	1.262e+05	1.331e+05	1.355e+05	1.363e+05	1.366e+05
2.468e+01	1.275e+05	1.343e+05	1.368e+05	1.376e+05	1.379e+05
2.506e+01	1.287e+05	1.356e+05	1.380e+05	1.389e+05	1.392e+05
2.544e+01	1.300e+05	1.368e+05	1.393e+05	1.401e+05	1.404e+05
2.582e+01	1.312e+05	1.381e+05	1.405e+05	1.413e+05	1.416e+05
2.620e+01	1.324e+05	1.393e+05	1.417e+05	1.426e+05	1.428e+05
2.658e+01	1.336e+05	1.405e+05	1.429e+05	1.437e+05	1.440e+05
2.696e+01	1.347e+05	1.416e+05	1.441e+05	1.449e+05	1.452e+05
2.734e+01	1.359e+05	1.428e+05	1.452e+05	1.461e+05	1.464e+05
2.772e+01	1.370e+05	1.439e+05	1.464e+05	1.472e+05	1.475e+05
2.810e+01	1.381e+05	1.451e+05	1.475e+05	1.483e+05	1.486e+05
2.848e+01	1.393e+05	1.462e+05	1.486e+05	1.495e+05	1.497e+05
2.886e+01	1.404e+05	1.473e+05	1.497e+05	1.506e+05	1.508e+05
2.924e+01	1.415e+05	1.484e+05	1.508e+05	1.516e+05	1.519e+05
2.962e+01	1.425e+05	1.494e+05	1.519e+05	1.527e+05	1.530e+05
3.000e+01	1.942e+07	1.975e+07	1.986e+07	1.990e+07	1.991e+07
3.038e+01	1.944e+07	1.977e+07	1.988e+07	1.992e+07	1.994e+07
3.076e+01	1.947e+07	1.979e+07	1.991e+07	1.994e+07	1.996e+07
3.114e+01	1.950e+07	1.982e+07	1.993e+07	1.997e+07	1.998e+07
3.152e+01	1.953e+07	1.984e+07	1.995e+07	1.999e+07	2.000e+07

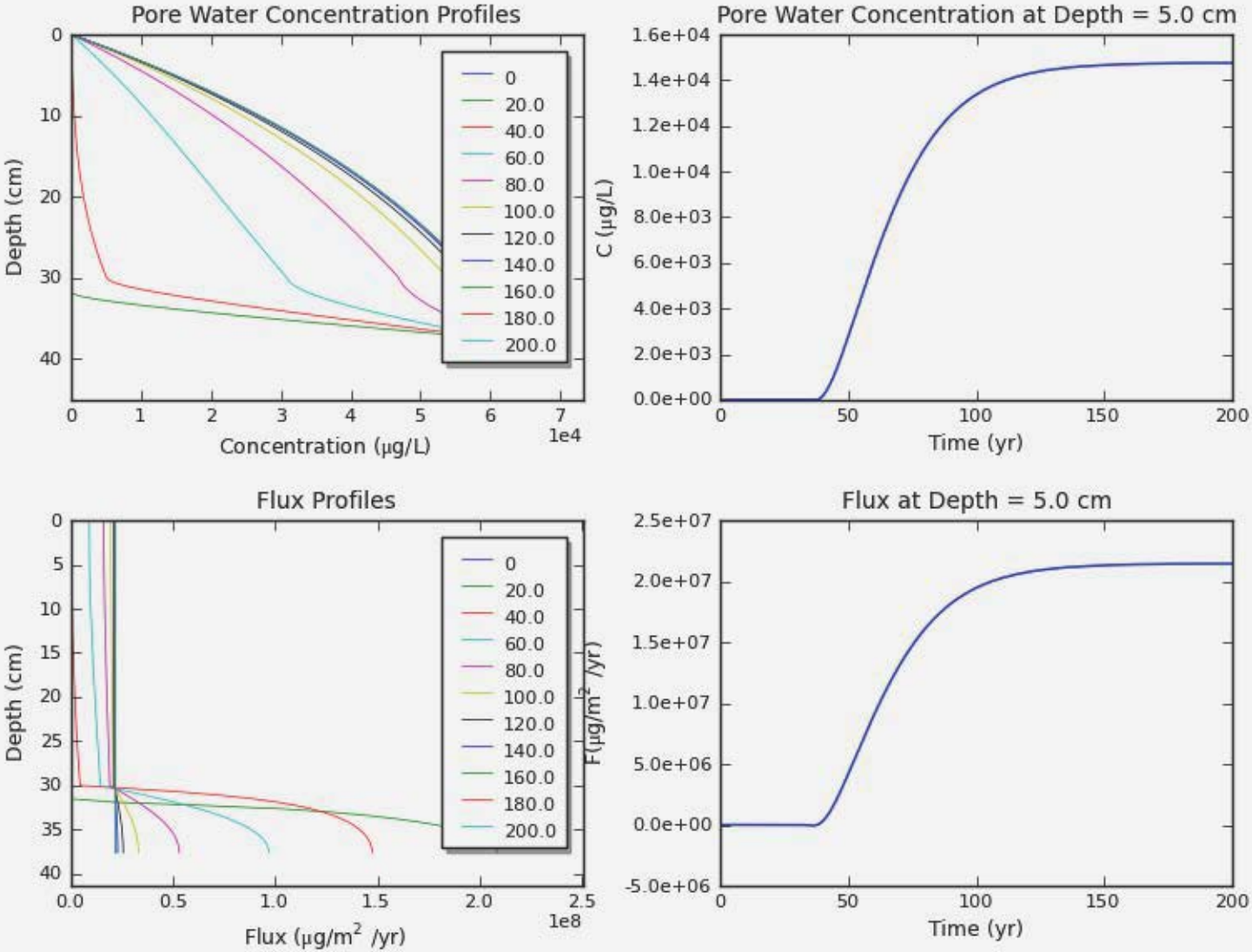
3.190e+01	1.957e+07	1.987e+07	1.997e+07	2.001e+07	2.002e+07
3.228e+01	1.961e+07	1.990e+07	2.000e+07	2.003e+07	2.004e+07
3.266e+01	1.965e+07	1.992e+07	2.002e+07	2.005e+07	2.006e+07
3.304e+01	1.969e+07	1.995e+07	2.004e+07	2.007e+07	2.008e+07
3.342e+01	1.974e+07	1.998e+07	2.006e+07	2.009e+07	2.010e+07
3.380e+01	1.979e+07	2.001e+07	2.009e+07	2.011e+07	2.012e+07
3.418e+01	1.984e+07	2.004e+07	2.011e+07	2.014e+07	2.014e+07
3.456e+01	1.989e+07	2.007e+07	2.013e+07	2.016e+07	2.016e+07
3.494e+01	1.994e+07	2.010e+07	2.016e+07	2.018e+07	2.018e+07
3.532e+01	1.999e+07	2.013e+07	2.018e+07	2.020e+07	2.020e+07
3.570e+01	2.005e+07	2.016e+07	2.020e+07	2.022e+07	2.022e+07
3.608e+01	2.010e+07	2.020e+07	2.023e+07	2.024e+07	2.024e+07
3.646e+01	2.016e+07	2.023e+07	2.025e+07	2.026e+07	2.026e+07
3.684e+01	2.021e+07	2.026e+07	2.027e+07	2.028e+07	2.028e+07
3.722e+01	2.027e+07	2.029e+07	2.030e+07	2.030e+07	2.030e+07
3.760e+01	2.032e+07	2.032e+07	2.032e+07	2.032e+07	2.032e+07

Time(yr) 2.000e+02

Depth (cm)	Total Concentrations (μg/L)
0.000e+00	6.533e+01
3.797e-01	3.324e+03
7.595e-01	6.535e+03
1.139e+00	9.700e+03
1.519e+00	1.282e+04
1.899e+00	1.589e+04
2.278e+00	1.892e+04
2.658e+00	2.191e+04
3.038e+00	2.485e+04
3.418e+00	2.775e+04
3.797e+00	3.061e+04
4.177e+00	3.343e+04
4.557e+00	3.620e+04
4.937e+00	3.894e+04
5.316e+00	4.164e+04
5.696e+00	4.429e+04
6.076e+00	4.691e+04
6.456e+00	4.949e+04
6.835e+00	5.204e+04
7.215e+00	5.454e+04
7.595e+00	5.702e+04
7.975e+00	5.945e+04
8.354e+00	6.185e+04
8.734e+00	6.422e+04
9.114e+00	6.655e+04
9.494e+00	6.884e+04
9.873e+00	7.111e+04
1.025e+01	7.334e+04
1.063e+01	7.554e+04
1.101e+01	7.771e+04
1.139e+01	7.984e+04
1.177e+01	8.195e+04
1.215e+01	8.402e+04
1.253e+01	8.607e+04
1.291e+01	8.808e+04
1.329e+01	9.007e+04

1.367e+01	9.202e+04
1.405e+01	9.395e+04
1.443e+01	9.585e+04
1.481e+01	9.773e+04
1.519e+01	9.957e+04
1.557e+01	1.014e+05
1.595e+01	1.032e+05
1.633e+01	1.050e+05
1.671e+01	1.067e+05
1.709e+01	1.084e+05
1.747e+01	1.101e+05
1.785e+01	1.118e+05
1.823e+01	1.134e+05
1.861e+01	1.150e+05
1.899e+01	1.166e+05
1.937e+01	1.182e+05
1.975e+01	1.198e+05
2.013e+01	1.213e+05
2.051e+01	1.228e+05
2.089e+01	1.243e+05
2.127e+01	1.257e+05
2.165e+01	1.272e+05
2.203e+01	1.286e+05
2.241e+01	1.300e+05
2.278e+01	1.314e+05
2.316e+01	1.327e+05
2.354e+01	1.341e+05
2.392e+01	1.354e+05
2.430e+01	1.367e+05
2.468e+01	1.380e+05
2.506e+01	1.393e+05
2.544e+01	1.405e+05
2.582e+01	1.417e+05
2.620e+01	1.429e+05
2.658e+01	1.441e+05
2.696e+01	1.453e+05
2.734e+01	1.465e+05
2.772e+01	1.476e+05
2.810e+01	1.487e+05
2.848e+01	1.498e+05
2.886e+01	1.509e+05
2.924e+01	1.520e+05
2.962e+01	1.531e+05
3.000e+01	1.992e+07
3.038e+01	1.994e+07
3.076e+01	1.996e+07
3.114e+01	1.998e+07
3.152e+01	2.000e+07
3.190e+01	2.002e+07
3.228e+01	2.005e+07
3.266e+01	2.007e+07
3.304e+01	2.009e+07
3.342e+01	2.011e+07
3.380e+01	2.013e+07
3.418e+01	2.015e+07
3.456e+01	2.017e+07

3.494e+01	2.019e+07
3.532e+01	2.021e+07
3.570e+01	2.023e+07
3.608e+01	2.024e+07
3.646e+01	2.026e+07
3.684e+01	2.028e+07
3.722e+01	2.030e+07
3.760e+01	2.032e+07


Pore Water Concentration Profiles
Depth (cm)
Concentration (μg/L)
1e4
0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
Pore Water Concentration at Depth = 5.0 cm
C (μg/L)
Time (yr)
Flux Profiles
Depth (cm)
Flux (μg/m² /yr)
1e8
F(μg/m² /yr)
Flux at Depth = 5.0 cm
Time (yr)

Model Run Report for "Aqugate_Soil_Barrier_Rev_2014-0724.cpsm"

Version: CapSim 2.6

Date and Time: 2014-07-24 14:42:24

Model setup:

Model the underlying sediment using a constant concentration boundary condition
Ignore bioturbation at the top of the system
Ignore consolidation of the underlying sediment
Ignore deposition of fresh sediment on the cap
Model a 2 layer system

Layer Parameters:

Overlying water concentration:	0.000e+00 µg/L

Layer 1: Sediment

initial concentration:	0.000e+00 µg/L
depth:	30.0 cm
porosity:	0.55
bulk density:	1.20 g/cm³
sorption isotherm:	Linear--Kocfoc
organic carbon fraction	0.030
Kd	1.767e+00 L/kg
retardation factor:	5.503e-01
tortuosity correction:	Boudreau
hydrodynamic dispersivity:	1.00 cm
effection diffusion coefficient:	6.621e+01 cm²/yr
decay rate:	None

Layer 2: Activated Carbon

initial concentration:	0.000e+00 µg/L
depth:	15.0 cm
porosity:	0.66
bulk density:	0.13 g/cm³
sorption isotherm:	Freundlich
Freundlich Kf:	3.00e+06 µg/kg/(µg/L)^(1/n)
Freundlich 1/n:	0.36
retardation factor:	Variable but > 6.774e-01
tortuosity correction:	Millington & Quirk
hydrodynamic dispersivity:	1.00 cm
effection diffusion coefficient:	1.486e+02 cm²/yr
decay rate:	None

Underlying pore water concentration: 6.100e+04 µg/L

Flow and System Parameters:

Chemical name:	benzene-15C
Temperature:	15.0°C
Darcy velocity:	2.54 cm/yr
Molecular diffusivity:	8.06e-06 cm²/s
Organic carbon partition coefficient:	1.77 log(L/kg)
Dissolved organic carbon partition coefficient:	1.55 log(L/kg)
Dissolved organic matter concentration:	194.0 μg/L
Benthic boundary layer mass transfer coefficient:	1.0 cm/hr

Model output:

Depth of interest: 5.0 cm

Time (yrs)	C (μg/L)	F (μg/m²/yr)	q (μg/kg)	W(μg/L)
0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.938e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.876e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.814e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.175e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.469e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.763e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.057e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.350e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.644e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.938e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.232e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.526e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.819e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.113e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.407e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.701e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.995e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.288e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.582e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.876e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.170e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.464e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.757e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.051e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.345e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.639e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.933e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.226e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.520e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.814e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.108e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.402e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.695e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.989e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.028e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.058e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.087e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.116e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00

1.146e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.175e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.205e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.234e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.263e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.293e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.322e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.351e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.381e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.410e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.440e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.469e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.498e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.528e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.557e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.587e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.616e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.645e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.675e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.704e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.733e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.763e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.792e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.822e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.851e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.880e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.910e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.939e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.968e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.998e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.027e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.057e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.086e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.115e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.145e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.174e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.204e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.233e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.262e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.292e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.321e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.350e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.380e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.409e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.439e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.468e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.497e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.527e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.556e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.585e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.615e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.644e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.674e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.703e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.732e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.762e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00

2.791e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.820e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.850e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.879e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.909e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.938e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.967e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.997e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.026e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.056e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.085e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.114e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.144e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.173e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.202e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.232e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.261e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.291e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.320e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.349e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.379e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.408e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.437e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.467e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.496e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.526e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.555e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.584e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.614e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.643e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.673e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.702e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.731e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.761e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.790e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.819e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.849e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.878e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.908e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.937e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.966e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.996e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.025e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.054e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.084e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.113e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.143e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.172e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.201e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.231e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.260e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.289e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.319e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.348e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.378e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.407e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00

4.436e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.466e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.495e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.525e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.554e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.583e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.613e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.642e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.671e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.701e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.730e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.760e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.789e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.818e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.848e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.877e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.906e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.936e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.965e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.995e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.024e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.053e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.083e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.112e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.142e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.171e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.200e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.230e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.259e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.288e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.318e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.347e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.377e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.406e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.435e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.465e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.494e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.523e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.553e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.582e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.612e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.641e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.670e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.700e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.729e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.759e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.788e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.817e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.847e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.876e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.905e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.935e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.964e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.994e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.023e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.052e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00

6.082e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.111e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.140e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.170e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.199e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.229e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.258e+01	0.000e+00	-2.002e-20	0.000e+00	0.000e+00
6.287e+01	0.000e+00	-3.711e-20	0.000e+00	0.000e+00
6.317e+01	0.000e+00	-6.559e-20	0.000e+00	0.000e+00
6.346e+01	0.000e+00	-1.133e-19	0.000e+00	0.000e+00
6.375e+01	0.000e+00	-1.932e-19	0.000e+00	0.000e+00
6.405e+01	0.000e+00	-3.255e-19	0.000e+00	0.000e+00
6.434e+01	0.000e+00	-5.413e-19	0.000e+00	0.000e+00
6.464e+01	0.000e+00	-8.866e-19	0.000e+00	0.000e+00
6.493e+01	0.000e+00	-1.428e-18	0.000e+00	0.000e+00
6.522e+01	0.000e+00	-2.259e-18	0.000e+00	0.000e+00
6.552e+01	0.000e+00	-3.511e-18	0.000e+00	0.000e+00
6.581e+01	0.000e+00	-5.366e-18	0.000e+00	0.000e+00
6.611e+01	0.000e+00	-8.077e-18	0.000e+00	0.000e+00
6.640e+01	0.000e+00	-1.200e-17	0.000e+00	0.000e+00
6.669e+01	0.000e+00	-1.764e-17	0.000e+00	0.000e+00
6.699e+01	0.000e+00	-2.575e-17	0.000e+00	0.000e+00
6.728e+01	0.000e+00	-3.741e-17	0.000e+00	0.000e+00
6.757e+01	0.000e+00	-5.426e-17	0.000e+00	0.000e+00
6.787e+01	0.000e+00	-7.873e-17	0.000e+00	0.000e+00
6.816e+01	0.000e+00	-1.144e-16	0.000e+00	0.000e+00
6.846e+01	0.000e+00	-1.665e-16	0.000e+00	0.000e+00
6.875e+01	0.000e+00	-2.425e-16	0.000e+00	0.000e+00
6.904e+01	0.000e+00	-3.530e-16	0.000e+00	0.000e+00
6.934e+01	0.000e+00	-5.127e-16	0.000e+00	0.000e+00
6.963e+01	0.000e+00	-7.420e-16	0.000e+00	0.000e+00
6.992e+01	0.000e+00	-1.068e-15	0.000e+00	0.000e+00
7.022e+01	0.000e+00	-1.529e-15	0.000e+00	0.000e+00
7.051e+01	0.000e+00	-2.175e-15	0.000e+00	0.000e+00
7.081e+01	0.000e+00	-3.075e-15	0.000e+00	0.000e+00
7.110e+01	0.000e+00	-4.323e-15	0.000e+00	0.000e+00
7.139e+01	0.000e+00	-6.047e-15	0.000e+00	0.000e+00
7.169e+01	0.000e+00	-8.428e-15	0.000e+00	0.000e+00
7.198e+01	0.000e+00	-1.172e-14	0.000e+00	0.000e+00
7.228e+01	0.000e+00	-1.628e-14	0.000e+00	0.000e+00
7.257e+01	0.000e+00	-2.261e-14	0.000e+00	0.000e+00
7.286e+01	0.000e+00	-3.143e-14	0.000e+00	0.000e+00
7.316e+01	0.000e+00	-4.373e-14	0.000e+00	0.000e+00
7.345e+01	0.000e+00	-6.088e-14	0.000e+00	0.000e+00
7.374e+01	0.000e+00	-8.478e-14	0.000e+00	0.000e+00
7.404e+01	0.000e+00	-1.180e-13	0.000e+00	0.000e+00
7.433e+01	0.000e+00	-1.638e-13	0.000e+00	0.000e+00
7.463e+01	0.000e+00	-2.269e-13	0.000e+00	0.000e+00
7.492e+01	0.000e+00	-3.131e-13	0.000e+00	0.000e+00
7.521e+01	0.000e+00	-4.304e-13	0.000e+00	0.000e+00
7.551e+01	0.000e+00	-5.890e-13	0.000e+00	0.000e+00
7.580e+01	0.000e+00	-8.029e-13	0.000e+00	0.000e+00
7.609e+01	0.000e+00	-1.090e-12	0.000e+00	0.000e+00
7.639e+01	0.000e+00	-1.476e-12	0.000e+00	0.000e+00
7.668e+01	0.000e+00	-1.994e-12	0.000e+00	0.000e+00
7.698e+01	0.000e+00	-2.691e-12	0.000e+00	0.000e+00

7.727e+01	0.000e+00	-3.628e-12	0.000e+00	0.000e+00
7.756e+01	0.000e+00	-4.893e-12	0.000e+00	0.000e+00
7.786e+01	0.000e+00	-6.603e-12	0.000e+00	0.000e+00
7.815e+01	0.000e+00	-8.916e-12	0.000e+00	0.000e+00
7.844e+01	0.000e+00	-1.204e-11	0.000e+00	0.000e+00
7.874e+01	0.000e+00	-1.627e-11	0.000e+00	0.000e+00
7.903e+01	0.000e+00	-2.195e-11	0.000e+00	0.000e+00
7.933e+01	0.000e+00	-2.957e-11	0.000e+00	0.000e+00
7.962e+01	0.000e+00	-3.975e-11	0.000e+00	0.000e+00
7.991e+01	0.000e+00	-5.329e-11	0.000e+00	0.000e+00
8.021e+01	0.000e+00	-7.122e-11	0.000e+00	0.000e+00
8.050e+01	0.000e+00	-9.492e-11	0.000e+00	0.000e+00
8.080e+01	0.000e+00	-1.262e-10	0.000e+00	0.000e+00
8.109e+01	0.000e+00	-1.674e-10	0.000e+00	0.000e+00
8.138e+01	0.000e+00	-2.217e-10	0.000e+00	0.000e+00
8.168e+01	0.000e+00	-2.934e-10	0.000e+00	0.000e+00
8.197e+01	0.000e+00	-3.883e-10	0.000e+00	0.000e+00
8.226e+01	0.000e+00	-5.142e-10	0.000e+00	0.000e+00
8.256e+01	0.000e+00	-6.817e-10	0.000e+00	0.000e+00
8.285e+01	0.000e+00	-9.049e-10	0.000e+00	0.000e+00
8.315e+01	0.000e+00	-1.202e-09	0.000e+00	0.000e+00
8.344e+01	0.000e+00	-1.599e-09	0.000e+00	0.000e+00
8.373e+01	0.000e+00	-2.127e-09	0.000e+00	0.000e+00
8.403e+01	0.000e+00	-2.828e-09	0.000e+00	0.000e+00
8.432e+01	0.000e+00	-3.753e-09	0.000e+00	0.000e+00
8.461e+01	0.000e+00	-4.970e-09	0.000e+00	0.000e+00
8.491e+01	0.000e+00	-6.564e-09	0.000e+00	0.000e+00
8.520e+01	0.000e+00	-8.643e-09	0.000e+00	0.000e+00
8.550e+01	0.000e+00	-1.135e-08	0.000e+00	0.000e+00
8.579e+01	0.000e+00	-1.485e-08	0.000e+00	0.000e+00
8.608e+01	0.000e+00	-1.940e-08	0.000e+00	0.000e+00
8.638e+01	0.000e+00	-2.530e-08	0.000e+00	0.000e+00
8.667e+01	0.000e+00	-3.296e-08	0.000e+00	0.000e+00
8.697e+01	0.000e+00	-4.294e-08	0.000e+00	0.000e+00
8.726e+01	0.000e+00	-5.597e-08	0.000e+00	0.000e+00
8.755e+01	0.000e+00	-7.303e-08	0.000e+00	0.000e+00
8.785e+01	0.000e+00	-9.539e-08	0.000e+00	0.000e+00
8.814e+01	0.000e+00	-1.248e-07	0.000e+00	0.000e+00
8.843e+01	0.000e+00	-1.633e-07	0.000e+00	0.000e+00
8.873e+01	0.000e+00	-2.139e-07	0.000e+00	0.000e+00
8.902e+01	0.000e+00	-2.802e-07	0.000e+00	0.000e+00
8.932e+01	0.000e+00	-3.667e-07	0.000e+00	0.000e+00
8.961e+01	0.000e+00	-4.790e-07	0.000e+00	0.000e+00
8.990e+01	0.000e+00	-6.241e-07	0.000e+00	0.000e+00
9.020e+01	0.000e+00	-8.107e-07	0.000e+00	0.000e+00
9.049e+01	0.000e+00	-1.049e-06	0.000e+00	0.000e+00
9.078e+01	0.000e+00	-1.354e-06	0.000e+00	0.000e+00
9.108e+01	0.000e+00	-1.742e-06	0.000e+00	0.000e+00
9.137e+01	0.000e+00	-2.236e-06	0.000e+00	0.000e+00
9.167e+01	0.000e+00	-2.866e-06	0.000e+00	0.000e+00
9.196e+01	0.000e+00	-3.670e-06	0.000e+00	0.000e+00
9.225e+01	0.000e+00	-4.700e-06	0.000e+00	0.000e+00
9.255e+01	0.000e+00	-6.023e-06	0.000e+00	0.000e+00
9.284e+01	0.000e+00	-7.730e-06	0.000e+00	0.000e+00
9.314e+01	0.000e+00	-9.936e-06	0.000e+00	0.000e+00
9.343e+01	0.000e+00	-1.279e-05	0.000e+00	0.000e+00

9.372e+01	0.000e+00	-1.648e-05	0.000e+00	0.000e+00
9.402e+01	0.000e+00	-2.126e-05	0.000e+00	0.000e+00
9.431e+01	0.000e+00	-2.744e-05	0.000e+00	0.000e+00
9.460e+01	0.000e+00	-3.538e-05	0.000e+00	0.000e+00
9.490e+01	0.000e+00	-4.557e-05	0.000e+00	0.000e+00
9.519e+01	0.000e+00	-5.856e-05	0.000e+00	0.000e+00
9.549e+01	0.000e+00	-7.504e-05	0.000e+00	0.000e+00
9.578e+01	0.000e+00	-9.582e-05	0.000e+00	0.000e+00
9.607e+01	0.000e+00	-1.219e-04	0.000e+00	0.000e+00
9.637e+01	0.000e+00	-1.545e-04	0.000e+00	0.000e+00
9.666e+01	0.000e+00	-1.952e-04	0.000e+00	0.000e+00
9.695e+01	0.000e+00	-2.460e-04	0.000e+00	0.000e+00
9.725e+01	0.000e+00	-3.097e-04	0.000e+00	0.000e+00
9.754e+01	0.000e+00	-3.898e-04	0.000e+00	0.000e+00
9.784e+01	0.000e+00	-4.909e-04	0.000e+00	0.000e+00
9.813e+01	0.000e+00	-6.192e-04	0.000e+00	0.000e+00
9.842e+01	0.000e+00	-7.828e-04	0.000e+00	0.000e+00
9.872e+01	0.000e+00	-9.918e-04	0.000e+00	0.000e+00
9.901e+01	0.000e+00	-1.259e-03	0.000e+00	0.000e+00
9.930e+01	0.000e+00	-1.602e-03	0.000e+00	0.000e+00
9.960e+01	0.000e+00	-2.040e-03	0.000e+00	0.000e+00
9.989e+01	0.000e+00	-2.598e-03	0.000e+00	0.000e+00
1.002e+02	0.000e+00	-3.306e-03	0.000e+00	0.000e+00
1.005e+02	0.000e+00	-4.202e-03	0.000e+00	0.000e+00
1.008e+02	0.000e+00	-5.328e-03	0.000e+00	0.000e+00
1.011e+02	0.000e+00	-6.735e-03	0.000e+00	0.000e+00
1.014e+02	0.000e+00	-8.483e-03	0.000e+00	0.000e+00
1.017e+02	0.000e+00	-1.064e-02	0.000e+00	0.000e+00
1.019e+02	0.000e+00	-1.330e-02	0.000e+00	0.000e+00
1.022e+02	0.000e+00	-1.656e-02	0.000e+00	0.000e+00
1.025e+02	0.000e+00	-2.059e-02	0.000e+00	0.000e+00
1.028e+02	0.000e+00	-2.557e-02	0.000e+00	0.000e+00
1.031e+02	0.000e+00	-3.180e-02	0.000e+00	0.000e+00
1.034e+02	0.000e+00	-3.963e-02	0.000e+00	0.000e+00
1.037e+02	0.000e+00	-4.955e-02	0.000e+00	0.000e+00
1.040e+02	0.000e+00	-6.218e-02	0.000e+00	0.000e+00
1.043e+02	0.000e+00	-7.830e-02	0.000e+00	0.000e+00
1.046e+02	0.000e+00	-9.891e-02	0.000e+00	0.000e+00
1.049e+02	0.000e+00	-1.252e-01	0.000e+00	0.000e+00
1.052e+02	0.000e+00	-1.587e-01	0.000e+00	0.000e+00
1.055e+02	0.000e+00	-2.010e-01	0.000e+00	0.000e+00
1.058e+02	0.000e+00	-2.543e-01	0.000e+00	0.000e+00
1.061e+02	0.000e+00	-3.209e-01	0.000e+00	0.000e+00
1.064e+02	0.000e+00	-4.037e-01	0.000e+00	0.000e+00
1.066e+02	0.000e+00	-5.057e-01	0.000e+00	0.000e+00
1.069e+02	0.000e+00	-6.305e-01	0.000e+00	0.000e+00
1.072e+02	0.000e+00	-7.820e-01	0.000e+00	0.000e+00
1.075e+02	0.000e+00	-9.647e-01	0.000e+00	0.000e+00
1.078e+02	0.000e+00	-1.184e+00	0.000e+00	0.000e+00
1.081e+02	0.000e+00	-1.445e+00	0.000e+00	0.000e+00
1.084e+02	0.000e+00	-1.760e+00	0.000e+00	0.000e+00
1.087e+02	0.000e+00	-2.143e+00	0.000e+00	0.000e+00
1.090e+02	0.000e+00	-2.616e+00	0.000e+00	0.000e+00
1.093e+02	0.000e+00	-3.210e+00	0.000e+00	0.000e+00
1.096e+02	0.000e+00	-3.965e+00	0.000e+00	0.000e+00
1.099e+02	0.000e+00	-4.932e+00	0.000e+00	0.000e+00

1.102e+02	0.000e+00	-6.175e+00	0.000e+00	0.000e+00
1.105e+02	0.000e+00	-7.768e+00	0.000e+00	0.000e+00
1.108e+02	0.000e+00	-9.801e+00	0.000e+00	0.000e+00
1.111e+02	0.000e+00	-1.238e+01	0.000e+00	0.000e+00
1.114e+02	0.000e+00	-1.562e+01	0.000e+00	0.000e+00
1.116e+02	0.000e+00	-1.966e+01	0.000e+00	0.000e+00
1.119e+02	0.000e+00	-2.464e+01	0.000e+00	0.000e+00
1.122e+02	0.000e+00	-3.074e+01	0.000e+00	0.000e+00
1.125e+02	0.000e+00	-3.813e+01	0.000e+00	0.000e+00
1.128e+02	0.000e+00	-4.699e+01	0.000e+00	0.000e+00
1.131e+02	0.000e+00	-5.754e+01	0.000e+00	0.000e+00
1.134e+02	0.000e+00	-6.997e+01	0.000e+00	0.000e+00
1.137e+02	0.000e+00	-8.449e+01	0.000e+00	0.000e+00
1.140e+02	0.000e+00	-1.013e+02	0.000e+00	0.000e+00
1.143e+02	0.000e+00	-1.207e+02	0.000e+00	0.000e+00
1.146e+02	0.000e+00	-1.429e+02	0.000e+00	0.000e+00
1.149e+02	0.000e+00	-1.684e+02	0.000e+00	0.000e+00
1.152e+02	0.000e+00	-1.984e+02	0.000e+00	0.000e+00
1.155e+02	0.000e+00	-2.352e+02	0.000e+00	0.000e+00
1.158e+02	0.000e+00	-2.823e+02	0.000e+00	0.000e+00
1.161e+02	0.000e+00	-3.440e+02	0.000e+00	0.000e+00
1.163e+02	0.000e+00	-4.251e+02	0.000e+00	0.000e+00
1.166e+02	0.000e+00	-5.310e+02	0.000e+00	0.000e+00
1.169e+02	0.000e+00	-6.675e+02	0.000e+00	0.000e+00
1.172e+02	0.000e+00	-8.411e+02	0.000e+00	0.000e+00
1.175e+02	0.000e+00	-1.059e+03	0.000e+00	0.000e+00
1.178e+02	0.000e+00	-1.328e+03	0.000e+00	0.000e+00
1.181e+02	0.000e+00	-1.656e+03	0.000e+00	0.000e+00
1.184e+02	0.000e+00	-2.051e+03	0.000e+00	0.000e+00
1.187e+02	0.000e+00	-2.521e+03	0.000e+00	0.000e+00
1.190e+02	0.000e+00	-3.074e+03	0.000e+00	0.000e+00
1.193e+02	0.000e+00	-3.717e+03	0.000e+00	0.000e+00
1.196e+02	0.000e+00	-4.457e+03	0.000e+00	0.000e+00
1.199e+02	0.000e+00	-5.299e+03	0.000e+00	0.000e+00
1.202e+02	0.000e+00	-6.248e+03	0.000e+00	0.000e+00
1.205e+02	0.000e+00	-7.309e+03	0.000e+00	0.000e+00
1.208e+02	0.000e+00	-8.482e+03	0.000e+00	0.000e+00
1.210e+02	0.000e+00	-9.770e+03	0.000e+00	0.000e+00
1.213e+02	0.000e+00	-1.117e+04	0.000e+00	0.000e+00
1.216e+02	0.000e+00	-1.268e+04	0.000e+00	0.000e+00
1.219e+02	0.000e+00	-1.431e+04	0.000e+00	0.000e+00
1.222e+02	0.000e+00	-1.603e+04	0.000e+00	0.000e+00
1.225e+02	0.000e+00	-1.786e+04	0.000e+00	0.000e+00
1.228e+02	0.000e+00	-1.977e+04	0.000e+00	0.000e+00
1.231e+02	0.000e+00	-2.178e+04	0.000e+00	0.000e+00
1.234e+02	0.000e+00	-2.385e+04	0.000e+00	0.000e+00
1.237e+02	0.000e+00	-2.599e+04	0.000e+00	0.000e+00
1.240e+02	0.000e+00	-2.817e+04	0.000e+00	0.000e+00
1.243e+02	0.000e+00	-3.037e+04	0.000e+00	0.000e+00
1.246e+02	0.000e+00	-3.258e+04	0.000e+00	0.000e+00
1.249e+02	0.000e+00	-3.477e+04	0.000e+00	0.000e+00
1.252e+02	0.000e+00	-3.692e+04	0.000e+00	0.000e+00
1.255e+02	0.000e+00	-3.902e+04	0.000e+00	0.000e+00
1.257e+02	0.000e+00	-4.102e+04	0.000e+00	0.000e+00
1.260e+02	0.000e+00	-4.293e+04	0.000e+00	0.000e+00
1.263e+02	0.000e+00	-4.470e+04	0.000e+00	0.000e+00

1.266e+02	0.000e+00	-4.632e+04	0.000e+00	0.000e+00
1.269e+02	0.000e+00	-4.775e+04	0.000e+00	0.000e+00
1.272e+02	0.000e+00	-4.898e+04	0.000e+00	0.000e+00
1.275e+02	0.000e+00	-4.996e+04	0.000e+00	0.000e+00
1.278e+02	0.000e+00	-5.068e+04	0.000e+00	0.000e+00
1.281e+02	0.000e+00	-5.111e+04	0.000e+00	0.000e+00
1.284e+02	0.000e+00	-5.121e+04	0.000e+00	0.000e+00
1.287e+02	0.000e+00	-5.096e+04	0.000e+00	0.000e+00
1.290e+02	0.000e+00	-5.033e+04	0.000e+00	0.000e+00
1.293e+02	0.000e+00	-4.928e+04	0.000e+00	0.000e+00
1.296e+02	0.000e+00	-4.779e+04	0.000e+00	0.000e+00
1.299e+02	0.000e+00	-4.584e+04	0.000e+00	0.000e+00
1.302e+02	0.000e+00	-4.338e+04	0.000e+00	0.000e+00
1.304e+02	0.000e+00	-4.040e+04	0.000e+00	0.000e+00
1.307e+02	0.000e+00	-3.688e+04	0.000e+00	0.000e+00
1.310e+02	0.000e+00	-3.278e+04	0.000e+00	0.000e+00
1.313e+02	0.000e+00	-2.809e+04	0.000e+00	0.000e+00
1.316e+02	0.000e+00	-2.278e+04	0.000e+00	0.000e+00
1.319e+02	0.000e+00	-1.685e+04	0.000e+00	0.000e+00
1.322e+02	0.000e+00	-1.026e+04	0.000e+00	0.000e+00
1.325e+02	0.000e+00	-3.005e+03	0.000e+00	0.000e+00
1.328e+02	0.000e+00	4.924e+03	0.000e+00	0.000e+00
1.331e+02	3.521e+00	1.354e+04	9.400e+00	6.220e+00
1.334e+02	9.436e+00	2.285e+04	2.519e+01	1.667e+01
1.337e+02	1.583e+01	3.287e+04	4.226e+01	2.796e+01
1.340e+02	2.270e+01	4.359e+04	6.062e+01	4.011e+01
1.343e+02	3.006e+01	5.502e+04	8.027e+01	5.311e+01
1.346e+02	3.791e+01	6.716e+04	1.012e+02	6.697e+01
1.349e+02	4.625e+01	8.001e+04	1.235e+02	8.170e+01
1.351e+02	5.507e+01	9.357e+04	1.470e+02	9.728e+01
1.354e+02	6.438e+01	1.078e+05	1.719e+02	1.137e+02
1.357e+02	7.417e+01	1.228e+05	1.980e+02	1.310e+02
1.360e+02	8.444e+01	1.384e+05	2.254e+02	1.492e+02
1.363e+02	9.518e+01	1.548e+05	2.541e+02	1.681e+02
1.366e+02	1.064e+02	1.718e+05	2.841e+02	1.880e+02
1.369e+02	1.181e+02	1.895e+05	3.153e+02	2.086e+02
1.372e+02	1.302e+02	2.078e+05	3.477e+02	2.300e+02
1.375e+02	1.428e+02	2.268e+05	3.813e+02	2.523e+02
1.378e+02	1.558e+02	2.464e+05	4.161e+02	2.753e+02
1.381e+02	1.693e+02	2.666e+05	4.520e+02	2.991e+02
1.384e+02	1.832e+02	2.874e+05	4.891e+02	3.236e+02
1.387e+02	1.975e+02	3.089e+05	5.273e+02	3.489e+02
1.390e+02	2.122e+02	3.309e+05	5.667e+02	3.749e+02
1.393e+02	2.274e+02	3.535e+05	6.071e+02	4.017e+02
1.396e+02	2.429e+02	3.766e+05	6.485e+02	4.291e+02
1.398e+02	2.588e+02	4.003e+05	6.910e+02	4.572e+02
1.401e+02	2.751e+02	4.246e+05	7.345e+02	4.860e+02
1.404e+02	2.917e+02	4.493e+05	7.789e+02	5.154e+02
1.407e+02	3.088e+02	4.746e+05	8.243e+02	5.454e+02
1.410e+02	3.261e+02	5.003e+05	8.707e+02	5.761e+02
1.413e+02	3.438e+02	5.266e+05	9.179e+02	6.074e+02
1.416e+02	3.618e+02	5.533e+05	9.661e+02	6.392e+02
1.419e+02	3.802e+02	5.804e+05	1.015e+03	6.716e+02
1.422e+02	3.989e+02	6.081e+05	1.065e+03	7.046e+02
1.425e+02	4.179e+02	6.361e+05	1.116e+03	7.382e+02
1.428e+02	4.371e+02	6.646e+05	1.167e+03	7.722e+02

1.431e+02	4.567e+02	6.934e+05	1.219e+03	8.068e+02
1.434e+02	4.766e+02	7.227e+05	1.272e+03	8.419e+02
1.437e+02	4.967e+02	7.524e+05	1.326e+03	8.774e+02
1.440e+02	5.171e+02	7.824e+05	1.381e+03	9.134e+02
1.443e+02	5.377e+02	8.129e+05	1.436e+03	9.499e+02
1.446e+02	5.587e+02	8.436e+05	1.492e+03	9.869e+02
1.448e+02	5.798e+02	8.748e+05	1.548e+03	1.024e+03
1.451e+02	6.012e+02	9.062e+05	1.605e+03	1.062e+03
1.454e+02	6.229e+02	9.380e+05	1.663e+03	1.100e+03
1.457e+02	6.447e+02	9.701e+05	1.721e+03	1.139e+03
1.460e+02	6.668e+02	1.003e+06	1.780e+03	1.178e+03
1.463e+02	6.891e+02	1.035e+06	1.840e+03	1.217e+03
1.466e+02	7.116e+02	1.068e+06	1.900e+03	1.257e+03
1.469e+02	7.343e+02	1.102e+06	1.961e+03	1.297e+03
1.472e+02	7.572e+02	1.135e+06	2.022e+03	1.338e+03
1.475e+02	7.803e+02	1.169e+06	2.083e+03	1.378e+03
1.478e+02	8.036e+02	1.203e+06	2.145e+03	1.420e+03
1.481e+02	8.271e+02	1.238e+06	2.208e+03	1.461e+03
1.484e+02	8.507e+02	1.272e+06	2.271e+03	1.503e+03
1.487e+02	8.745e+02	1.307e+06	2.335e+03	1.545e+03
1.490e+02	8.985e+02	1.342e+06	2.399e+03	1.587e+03
1.493e+02	9.226e+02	1.377e+06	2.463e+03	1.630e+03
1.495e+02	9.469e+02	1.413e+06	2.528e+03	1.673e+03
1.498e+02	9.714e+02	1.449e+06	2.593e+03	1.716e+03
1.501e+02	9.960e+02	1.485e+06	2.659e+03	1.759e+03
1.504e+02	1.021e+03	1.521e+06	2.725e+03	1.803e+03
1.507e+02	1.046e+03	1.557e+06	2.792e+03	1.847e+03
1.510e+02	1.071e+03	1.594e+06	2.858e+03	1.891e+03
1.513e+02	1.096e+03	1.631e+06	2.925e+03	1.936e+03
1.516e+02	1.121e+03	1.667e+06	2.993e+03	1.980e+03
1.519e+02	1.146e+03	1.705e+06	3.061e+03	2.025e+03
1.522e+02	1.172e+03	1.742e+06	3.129e+03	2.070e+03
1.525e+02	1.198e+03	1.779e+06	3.197e+03	2.116e+03
1.528e+02	1.223e+03	1.817e+06	3.266e+03	2.161e+03
1.531e+02	1.249e+03	1.855e+06	3.335e+03	2.207e+03
1.534e+02	1.275e+03	1.892e+06	3.404e+03	2.253e+03
1.537e+02	1.301e+03	1.930e+06	3.474e+03	2.299e+03
1.540e+02	1.327e+03	1.969e+06	3.544e+03	2.345e+03
1.542e+02	1.354e+03	2.007e+06	3.614e+03	2.391e+03
1.545e+02	1.380e+03	2.045e+06	3.684e+03	2.438e+03
1.548e+02	1.406e+03	2.084e+06	3.755e+03	2.484e+03
1.551e+02	1.433e+03	2.123e+06	3.826e+03	2.531e+03
1.554e+02	1.460e+03	2.161e+06	3.897e+03	2.578e+03
1.557e+02	1.486e+03	2.200e+06	3.968e+03	2.625e+03
1.560e+02	1.513e+03	2.239e+06	4.040e+03	2.673e+03
1.563e+02	1.540e+03	2.279e+06	4.111e+03	2.720e+03
1.566e+02	1.567e+03	2.318e+06	4.183e+03	2.768e+03
1.569e+02	1.594e+03	2.357e+06	4.255e+03	2.815e+03
1.572e+02	1.621e+03	2.397e+06	4.327e+03	2.863e+03
1.575e+02	1.648e+03	2.436e+06	4.400e+03	2.911e+03
1.578e+02	1.675e+03	2.476e+06	4.473e+03	2.959e+03
1.581e+02	1.702e+03	2.516e+06	4.545e+03	3.007e+03
1.584e+02	1.730e+03	2.555e+06	4.618e+03	3.056e+03
1.587e+02	1.757e+03	2.595e+06	4.691e+03	3.104e+03
1.589e+02	1.785e+03	2.635e+06	4.765e+03	3.153e+03
1.592e+02	1.812e+03	2.675e+06	4.838e+03	3.201e+03

1.595e+02	1.840e+03	2.715e+06	4.912e+03	3.250e+03
1.598e+02	1.867e+03	2.756e+06	4.985e+03	3.299e+03
1.601e+02	1.895e+03	2.796e+06	5.059e+03	3.347e+03
1.604e+02	1.923e+03	2.836e+06	5.133e+03	3.396e+03
1.607e+02	1.950e+03	2.876e+06	5.207e+03	3.445e+03
1.610e+02	1.978e+03	2.917e+06	5.281e+03	3.494e+03
1.613e+02	2.006e+03	2.957e+06	5.356e+03	3.544e+03
1.616e+02	2.034e+03	2.998e+06	5.430e+03	3.593e+03
1.619e+02	2.062e+03	3.039e+06	5.505e+03	3.642e+03
1.622e+02	2.090e+03	3.079e+06	5.579e+03	3.691e+03
1.625e+02	2.118e+03	3.120e+06	5.654e+03	3.741e+03
1.628e+02	2.146e+03	3.161e+06	5.729e+03	3.790e+03
1.631e+02	2.174e+03	3.201e+06	5.803e+03	3.840e+03
1.634e+02	2.202e+03	3.242e+06	5.878e+03	3.889e+03
1.636e+02	2.230e+03	3.283e+06	5.953e+03	3.939e+03
1.639e+02	2.258e+03	3.324e+06	6.028e+03	3.989e+03
1.642e+02	2.286e+03	3.365e+06	6.104e+03	4.039e+03
1.645e+02	2.314e+03	3.406e+06	6.179e+03	4.088e+03
1.648e+02	2.342e+03	3.447e+06	6.254e+03	4.138e+03
1.651e+02	2.371e+03	3.488e+06	6.329e+03	4.188e+03
1.654e+02	2.399e+03	3.529e+06	6.405e+03	4.238e+03
1.657e+02	2.427e+03	3.570e+06	6.480e+03	4.288e+03
1.660e+02	2.455e+03	3.611e+06	6.556e+03	4.338e+03
1.663e+02	2.484e+03	3.653e+06	6.631e+03	4.388e+03
1.666e+02	2.512e+03	3.694e+06	6.707e+03	4.438e+03
1.669e+02	2.540e+03	3.735e+06	6.782e+03	4.488e+03
1.672e+02	2.569e+03	3.776e+06	6.858e+03	4.538e+03
1.675e+02	2.597e+03	3.817e+06	6.934e+03	4.588e+03
1.678e+02	2.625e+03	3.859e+06	7.009e+03	4.638e+03
1.681e+02	2.654e+03	3.900e+06	7.085e+03	4.688e+03
1.683e+02	2.682e+03	3.941e+06	7.161e+03	4.738e+03
1.686e+02	2.711e+03	3.982e+06	7.237e+03	4.788e+03
1.689e+02	2.739e+03	4.024e+06	7.313e+03	4.838e+03
1.692e+02	2.767e+03	4.065e+06	7.388e+03	4.889e+03
1.695e+02	2.796e+03	4.106e+06	7.464e+03	4.939e+03
1.698e+02	2.824e+03	4.147e+06	7.540e+03	4.989e+03
1.701e+02	2.853e+03	4.189e+06	7.616e+03	5.039e+03
1.704e+02	2.881e+03	4.230e+06	7.692e+03	5.089e+03
1.707e+02	2.909e+03	4.271e+06	7.768e+03	5.140e+03
1.710e+02	2.938e+03	4.313e+06	7.843e+03	5.190e+03
1.713e+02	2.966e+03	4.354e+06	7.919e+03	5.240e+03
1.716e+02	2.995e+03	4.395e+06	7.995e+03	5.290e+03
1.719e+02	3.023e+03	4.436e+06	8.071e+03	5.340e+03
1.722e+02	3.051e+03	4.478e+06	8.147e+03	5.390e+03
1.725e+02	3.080e+03	4.519e+06	8.223e+03	5.441e+03
1.728e+02	3.108e+03	4.560e+06	8.298e+03	5.491e+03
1.730e+02	3.137e+03	4.601e+06	8.374e+03	5.541e+03
1.733e+02	3.165e+03	4.643e+06	8.450e+03	5.591e+03
1.736e+02	3.193e+03	4.684e+06	8.526e+03	5.641e+03
1.739e+02	3.222e+03	4.725e+06	8.601e+03	5.691e+03
1.742e+02	3.250e+03	4.766e+06	8.677e+03	5.741e+03
1.745e+02	3.278e+03	4.808e+06	8.753e+03	5.791e+03
1.748e+02	3.307e+03	4.849e+06	8.829e+03	5.842e+03
1.751e+02	3.335e+03	4.890e+06	8.904e+03	5.892e+03
1.754e+02	3.363e+03	4.931e+06	8.980e+03	5.942e+03
1.757e+02	3.392e+03	4.972e+06	9.055e+03	5.992e+03

1.760e+02	3.420e+03	5.013e+06	9.131e+03	6.042e+03
1.763e+02	3.448e+03	5.054e+06	9.206e+03	6.092e+03
1.766e+02	3.477e+03	5.095e+06	9.282e+03	6.141e+03
1.769e+02	3.505e+03	5.136e+06	9.357e+03	6.191e+03
1.772e+02	3.533e+03	5.177e+06	9.433e+03	6.241e+03
1.775e+02	3.561e+03	5.218e+06	9.508e+03	6.291e+03
1.777e+02	3.589e+03	5.259e+06	9.583e+03	6.341e+03
1.780e+02	3.618e+03	5.300e+06	9.659e+03	6.391e+03
1.783e+02	3.646e+03	5.341e+06	9.734e+03	6.440e+03
1.786e+02	3.674e+03	5.382e+06	9.809e+03	6.490e+03
1.789e+02	3.702e+03	5.423e+06	9.884e+03	6.540e+03
1.792e+02	3.730e+03	5.464e+06	9.959e+03	6.590e+03
1.795e+02	3.758e+03	5.505e+06	1.003e+04	6.639e+03
1.798e+02	3.786e+03	5.545e+06	1.011e+04	6.689e+03
1.801e+02	3.814e+03	5.586e+06	1.018e+04	6.738e+03
1.804e+02	3.842e+03	5.627e+06	1.026e+04	6.788e+03
1.807e+02	3.870e+03	5.667e+06	1.033e+04	6.837e+03
1.810e+02	3.898e+03	5.708e+06	1.041e+04	6.887e+03
1.813e+02	3.926e+03	5.749e+06	1.048e+04	6.936e+03
1.816e+02	3.954e+03	5.789e+06	1.056e+04	6.986e+03
1.819e+02	3.982e+03	5.830e+06	1.063e+04	7.035e+03
1.822e+02	4.010e+03	5.870e+06	1.071e+04	7.084e+03
1.825e+02	4.038e+03	5.911e+06	1.078e+04	7.133e+03
1.827e+02	4.066e+03	5.951e+06	1.086e+04	7.183e+03
1.830e+02	4.094e+03	5.992e+06	1.093e+04	7.232e+03
1.833e+02	4.122e+03	6.032e+06	1.100e+04	7.281e+03
1.836e+02	4.149e+03	6.072e+06	1.108e+04	7.330e+03
1.839e+02	4.177e+03	6.113e+06	1.115e+04	7.379e+03
1.842e+02	4.205e+03	6.153e+06	1.123e+04	7.428e+03
1.845e+02	4.233e+03	6.193e+06	1.130e+04	7.477e+03
1.848e+02	4.260e+03	6.233e+06	1.137e+04	7.526e+03
1.851e+02	4.288e+03	6.273e+06	1.145e+04	7.575e+03
1.854e+02	4.315e+03	6.313e+06	1.152e+04	7.623e+03
1.857e+02	4.343e+03	6.354e+06	1.160e+04	7.672e+03
1.860e+02	4.371e+03	6.394e+06	1.167e+04	7.721e+03
1.863e+02	4.398e+03	6.433e+06	1.174e+04	7.769e+03
1.866e+02	4.426e+03	6.473e+06	1.182e+04	7.818e+03
1.869e+02	4.453e+03	6.513e+06	1.189e+04	7.866e+03
1.872e+02	4.480e+03	6.553e+06	1.196e+04	7.915e+03
1.874e+02	4.508e+03	6.593e+06	1.204e+04	7.963e+03
1.877e+02	4.535e+03	6.633e+06	1.211e+04	8.012e+03
1.880e+02	4.563e+03	6.672e+06	1.218e+04	8.060e+03
1.883e+02	4.590e+03	6.712e+06	1.225e+04	8.108e+03
1.886e+02	4.617e+03	6.752e+06	1.233e+04	8.156e+03
1.889e+02	4.644e+03	6.791e+06	1.240e+04	8.205e+03
1.892e+02	4.672e+03	6.831e+06	1.247e+04	8.253e+03
1.895e+02	4.699e+03	6.870e+06	1.255e+04	8.301e+03
1.898e+02	4.726e+03	6.909e+06	1.262e+04	8.349e+03
1.901e+02	4.753e+03	6.949e+06	1.269e+04	8.397e+03
1.904e+02	4.780e+03	6.988e+06	1.276e+04	8.444e+03
1.907e+02	4.807e+03	7.027e+06	1.283e+04	8.492e+03
1.910e+02	4.834e+03	7.067e+06	1.291e+04	8.540e+03
1.913e+02	4.861e+03	7.106e+06	1.298e+04	8.588e+03
1.916e+02	4.888e+03	7.145e+06	1.305e+04	8.635e+03
1.919e+02	4.915e+03	7.184e+06	1.312e+04	8.683e+03
1.921e+02	4.942e+03	7.223e+06	1.319e+04	8.730e+03

1.924e+02	4.969e+03	7.262e+06	1.327e+04	8.778e+03
1.927e+02	4.996e+03	7.301e+06	1.334e+04	8.825e+03
1.930e+02	5.022e+03	7.340e+06	1.341e+04	8.872e+03
1.933e+02	5.049e+03	7.378e+06	1.348e+04	8.919e+03
1.936e+02	5.076e+03	7.417e+06	1.355e+04	8.967e+03
1.939e+02	5.103e+03	7.456e+06	1.362e+04	9.014e+03
1.942e+02	5.129e+03	7.495e+06	1.369e+04	9.061e+03
1.945e+02	5.156e+03	7.533e+06	1.376e+04	9.108e+03
1.948e+02	5.182e+03	7.572e+06	1.384e+04	9.155e+03
1.951e+02	5.209e+03	7.610e+06	1.391e+04	9.201e+03
1.954e+02	5.235e+03	7.649e+06	1.398e+04	9.248e+03
1.957e+02	5.262e+03	7.687e+06	1.405e+04	9.295e+03
1.960e+02	5.288e+03	7.725e+06	1.412e+04	9.342e+03
1.963e+02	5.314e+03	7.764e+06	1.419e+04	9.388e+03
1.966e+02	5.341e+03	7.802e+06	1.426e+04	9.435e+03
1.968e+02	5.367e+03	7.840e+06	1.433e+04	9.481e+03
1.971e+02	5.393e+03	7.878e+06	1.440e+04	9.527e+03
1.974e+02	5.420e+03	7.916e+06	1.447e+04	9.574e+03
1.977e+02	5.446e+03	7.954e+06	1.454e+04	9.620e+03
1.980e+02	5.472e+03	7.992e+06	1.461e+04	9.666e+03
1.983e+02	5.498e+03	8.030e+06	1.468e+04	9.712e+03
1.986e+02	5.524e+03	8.068e+06	1.475e+04	9.758e+03
1.989e+02	5.550e+03	8.105e+06	1.482e+04	9.804e+03
1.992e+02	5.576e+03	8.143e+06	1.489e+04	9.850e+03
1.995e+02	5.602e+03	8.181e+06	1.496e+04	9.896e+03
1.998e+02	5.628e+03	8.218e+06	1.503e+04	9.942e+03

Pore Water Concentration Profiles at Various Times

Time (yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)		Pore Water Concentrations (μg/L)			
0.000e+00	0.000e+00	4.281e-56	2.418e-39	2.242e-27	4.414e-17
4.545e-01	0.000e+00	2.625e-54	1.478e-37	1.364e-25	2.687e-15
9.091e-01	0.000e+00	5.221e-54	2.929e-37	2.690e-25	5.306e-15
1.364e+00	0.000e+00	7.890e-54	4.402e-37	4.011e-25	7.923e-15
1.818e+00	0.000e+00	1.069e-53	5.919e-37	5.335e-25	1.056e-14
2.273e+00	0.000e+00	1.368e-53	7.503e-37	6.670e-25	1.324e-14
2.727e+00	0.000e+00	1.692e-53	9.177e-37	8.024e-25	1.598e-14
3.182e+00	0.000e+00	2.049e-53	1.097e-36	9.404e-25	1.880e-14
3.636e+00	0.000e+00	2.445e-53	1.290e-36	1.082e-24	2.172e-14
4.091e+00	0.000e+00	2.888e-53	1.499e-36	1.228e-24	2.478e-14
4.545e+00	0.000e+00	3.387e-53	1.728e-36	1.378e-24	2.798e-14
5.000e+00	0.000e+00	3.952e-53	1.981e-36	1.535e-24	3.135e-14
5.455e+00	0.000e+00	4.594e-53	2.259e-36	1.697e-24	3.492e-14
5.909e+00	0.000e+00	5.325e-53	2.567e-36	1.867e-24	3.872e-14
6.364e+00	0.000e+00	6.159e-53	2.909e-36	2.045e-24	4.276e-14
6.818e+00	0.000e+00	7.111e-53	3.289e-36	2.231e-24	4.707e-14
7.273e+00	0.000e+00	8.200e-53	3.712e-36	2.426e-24	5.170e-14
7.727e+00	0.000e+00	9.446e-53	4.184e-36	2.631e-24	5.666e-14
8.182e+00	0.000e+00	1.087e-52	4.711e-36	2.846e-24	6.200e-14
8.636e+00	0.000e+00	1.250e-52	5.299e-36	3.073e-24	6.774e-14
9.091e+00	0.000e+00	1.437e-52	5.956e-36	3.310e-24	7.393e-14
9.545e+00	0.000e+00	1.651e-52	6.690e-36	3.560e-24	8.060e-14
1.000e+01	0.000e+00	1.895e-52	7.511e-36	3.821e-24	8.781e-14
1.045e+01	0.000e+00	2.175e-52	8.428e-36	4.096e-24	9.560e-14

1.091e+01	0.000e+00	2.495e-52	9.453e-36	4.383e-24	1.040e-13
1.136e+01	0.000e+00	2.861e-52	1.060e-35	4.683e-24	1.131e-13
1.182e+01	0.000e+00	3.279e-52	1.188e-35	4.996e-24	1.230e-13
1.227e+01	0.000e+00	3.757e-52	1.331e-35	5.323e-24	1.337e-13
1.273e+01	0.000e+00	4.303e-52	1.491e-35	5.661e-24	1.452e-13
1.318e+01	0.000e+00	4.926e-52	1.670e-35	6.012e-24	1.577e-13
1.364e+01	0.000e+00	5.637e-52	1.870e-35	6.375e-24	1.713e-13
1.409e+01	0.000e+00	6.449e-52	2.094e-35	6.748e-24	1.859e-13
1.455e+01	0.000e+00	7.374e-52	2.344e-35	7.131e-24	2.018e-13
1.500e+01	0.000e+00	8.429e-52	2.623e-35	7.521e-24	2.190e-13
1.545e+01	0.000e+00	9.632e-52	2.935e-35	7.917e-24	2.377e-13
1.591e+01	0.000e+00	1.100e-51	3.284e-35	8.316e-24	2.578e-13
1.636e+01	0.000e+00	1.256e-51	3.675e-35	8.716e-24	2.797e-13
1.682e+01	0.000e+00	1.434e-51	4.111e-35	9.114e-24	3.034e-13
1.727e+01	0.000e+00	1.636e-51	4.598e-35	9.504e-24	3.291e-13
1.773e+01	0.000e+00	1.865e-51	5.142e-35	9.883e-24	3.569e-13
1.818e+01	0.000e+00	2.127e-51	5.751e-35	1.024e-23	3.870e-13
1.864e+01	0.000e+00	2.424e-51	6.431e-35	1.058e-23	4.196e-13
1.909e+01	0.000e+00	2.761e-51	7.192e-35	1.089e-23	4.550e-13
1.955e+01	0.000e+00	3.144e-51	8.041e-35	1.116e-23	4.932e-13
2.000e+01	0.000e+00	3.578e-51	8.991e-35	1.138e-23	5.347e-13
2.045e+01	0.000e+00	4.071e-51	1.005e-34	1.153e-23	5.796e-13
2.091e+01	0.000e+00	4.630e-51	1.124e-34	1.162e-23	6.282e-13
2.136e+01	0.000e+00	5.264e-51	1.256e-34	1.162e-23	6.809e-13
2.182e+01	0.000e+00	5.983e-51	1.405e-34	1.151e-23	7.379e-13
2.227e+01	0.000e+00	6.796e-51	1.570e-34	1.129e-23	7.996e-13
2.273e+01	0.000e+00	7.717e-51	1.755e-34	1.092e-23	8.665e-13
2.318e+01	0.000e+00	8.759e-51	1.962e-34	1.038e-23	9.389e-13
2.364e+01	0.000e+00	9.938e-51	2.193e-34	9.660e-24	1.017e-12
2.409e+01	0.000e+00	1.127e-50	2.451e-34	8.718e-24	1.102e-12
2.455e+01	0.000e+00	1.278e-50	2.740e-34	7.524e-24	1.194e-12
2.500e+01	0.000e+00	1.448e-50	3.062e-34	6.044e-24	1.294e-12
2.545e+01	0.000e+00	1.640e-50	3.422e-34	4.238e-24	1.401e-12
2.591e+01	0.000e+00	1.857e-50	3.825e-34	2.062e-24	1.518e-12
2.636e+01	0.000e+00	2.102e-50	4.274e-34	5.307e-25	1.644e-12
2.682e+01	0.000e+00	2.378e-50	4.776e-34	3.595e-24	1.781e-12
2.727e+01	0.000e+00	2.689e-50	5.337e-34	7.189e-24	1.929e-12
2.773e+01	0.000e+00	3.040e-50	5.962e-34	1.138e-23	2.089e-12
2.818e+01	0.000e+00	3.435e-50	6.661e-34	1.623e-23	2.263e-12
2.864e+01	0.000e+00	3.880e-50	7.441e-34	2.183e-23	2.451e-12
2.909e+01	0.000e+00	4.381e-50	8.311e-34	2.826e-23	2.654e-12
2.955e+01	0.000e+00	4.944e-50	9.282e-34	3.562e-23	2.875e-12
3.000e+01	0.000e+00	5.577e-50	1.036e-33	4.399e-23	3.113e-12
3.045e+01	0.000e+00	1.947e-52	1.056e-36	1.951e-24	2.406e-14
3.091e+01	0.000e+00	1.740e-49	3.215e-33	1.321e-22	9.655e-12
3.136e+01	0.000e+00	2.136e-47	1.275e-30	2.529e-19	2.120e-09
3.182e+01	0.000e+00	2.744e-44	2.890e-28	1.350e-16	4.731e-07
3.227e+01	0.000e+00	2.183e-41	4.104e-27	6.122e-14	1.031e-04
3.273e+01	0.000e+00	7.224e-39	3.795e-23	2.457e-11	1.997e-02
3.318e+01	0.000e+00	6.538e-37	2.220e-20	8.255e-09	3.095e+00
3.364e+01	0.000e+00	2.194e-33	9.469e-18	2.306e-06	3.273e+02
3.409e+01	0.000e+00	1.242e-30	3.173e-15	5.803e-04	1.303e+03
3.455e+01	0.000e+00	2.493e-28	5.800e-13	1.460e-01	2.620e+03
3.500e+01	0.000e+00	1.406e-25	1.630e-10	3.142e+01	4.194e+03
3.545e+01	0.000e+00	1.437e-22	1.945e-07	8.656e+02	5.976e+03
3.591e+01	0.000e+00	5.714e-20	9.206e-05	2.242e+03	7.934e+03

3.636e+01	0.000e+00	4.543e-18	2.862e-02	4.003e+03	1.004e+04
3.682e+01	0.000e+00	9.638e-15	6.302e+00	6.057e+03	1.227e+04
3.727e+01	0.000e+00	7.697e-12	7.619e+02	8.346e+03	1.461e+04
3.773e+01	0.000e+00	3.107e-09	2.500e+03	1.083e+04	1.705e+04
3.818e+01	0.000e+00	2.069e-07	4.792e+03	1.347e+04	1.956e+04
3.864e+01	0.000e+00	6.850e-04	7.483e+03	1.625e+04	2.215e+04
3.909e+01	0.000e+00	5.218e-01	1.049e+04	1.915e+04	2.479e+04
3.955e+01	0.000e+00	1.819e+02	1.374e+04	2.214e+04	2.747e+04
4.000e+01	0.000e+00	2.571e+03	1.721e+04	2.521e+04	3.020e+04
4.045e+01	0.000e+00	6.011e+03	2.084e+04	2.834e+04	3.296e+04
4.091e+01	0.000e+00	1.020e+04	2.460e+04	3.153e+04	3.574e+04
4.136e+01	0.000e+00	1.495e+04	2.848e+04	3.476e+04	3.855e+04
4.182e+01	0.000e+00	2.010e+04	3.243e+04	3.802e+04	4.136e+04
4.227e+01	0.000e+00	2.556e+04	3.645e+04	4.130e+04	4.418e+04
4.273e+01	0.000e+00	3.124e+04	4.052e+04	4.459e+04	4.701e+04
4.318e+01	0.000e+00	3.707e+04	4.461e+04	4.789e+04	4.983e+04
4.364e+01	0.000e+00	4.301e+04	4.872e+04	5.119e+04	5.264e+04
4.409e+01	0.000e+00	4.900e+04	5.283e+04	5.447e+04	5.544e+04
4.455e+01	0.000e+00	5.501e+04	5.693e+04	5.775e+04	5.823e+04
4.500e+01	0.000e+00	6.100e+04	6.100e+04	6.100e+04	6.100e+04

Time (yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)		Pore Water Concentrations (μg/L)			
0.000e+00	2.300e-09	5.032e-03	4.275e-01	3.097e+00	6.283e+00
4.545e-01	1.399e-07	3.058e-01	2.594e+01	1.878e+02	3.809e+02
9.091e-01	2.761e-07	6.029e-01	5.106e+01	3.694e+02	7.492e+02
1.364e+00	4.118e-07	8.978e-01	7.583e+01	5.479e+02	1.111e+03
1.818e+00	5.479e-07	1.192e+00	1.003e+02	7.237e+02	1.467e+03
2.273e+00	6.854e-07	1.487e+00	1.245e+02	8.966e+02	1.817e+03
2.727e+00	8.251e-07	1.784e+00	1.486e+02	1.067e+03	2.162e+03
3.182e+00	9.679e-07	2.085e+00	1.724e+02	1.235e+03	2.501e+03
3.636e+00	1.115e-06	2.391e+00	1.962e+02	1.400e+03	2.834e+03
4.091e+00	1.267e-06	2.703e+00	2.199e+02	1.564e+03	3.163e+03
4.545e+00	1.424e-06	3.022e+00	2.435e+02	1.725e+03	3.486e+03
5.000e+00	1.589e-06	3.351e+00	2.672e+02	1.883e+03	3.805e+03
5.455e+00	1.761e-06	3.690e+00	2.909e+02	2.040e+03	4.119e+03
5.909e+00	1.942e-06	4.041e+00	3.146e+02	2.196e+03	4.428e+03
6.364e+00	2.133e-06	4.405e+00	3.385e+02	2.349e+03	4.733e+03
6.818e+00	2.336e-06	4.784e+00	3.626e+02	2.500e+03	5.033e+03
7.273e+00	2.550e-06	5.179e+00	3.869e+02	2.650e+03	5.330e+03
7.727e+00	2.778e-06	5.590e+00	4.113e+02	2.799e+03	5.622e+03
8.182e+00	3.020e-06	6.021e+00	4.361e+02	2.946e+03	5.910e+03
8.636e+00	3.279e-06	6.472e+00	4.611e+02	3.092e+03	6.195e+03
9.091e+00	3.555e-06	6.945e+00	4.865e+02	3.236e+03	6.476e+03
9.545e+00	3.850e-06	7.441e+00	5.122e+02	3.379e+03	6.754e+03
1.000e+01	4.166e-06	7.963e+00	5.382e+02	3.522e+03	7.028e+03
1.045e+01	4.504e-06	8.510e+00	5.647e+02	3.663e+03	7.298e+03
1.091e+01	4.867e-06	9.087e+00	5.917e+02	3.803e+03	7.566e+03
1.136e+01	5.256e-06	9.693e+00	6.191e+02	3.942e+03	7.830e+03
1.182e+01	5.673e-06	1.033e+01	6.470e+02	4.080e+03	8.092e+03
1.227e+01	6.121e-06	1.100e+01	6.754e+02	4.218e+03	8.350e+03
1.273e+01	6.603e-06	1.171e+01	7.044e+02	4.355e+03	8.606e+03
1.318e+01	7.119e-06	1.245e+01	7.339e+02	4.491e+03	8.859e+03
1.364e+01	7.675e-06	1.324e+01	7.641e+02	4.627e+03	9.110e+03
1.409e+01	8.272e-06	1.406e+01	7.949e+02	4.762e+03	9.358e+03

1.455e+01	8.913e-06	1.493e+01	8.263e+02	4.897e+03	9.603e+03
1.500e+01	9.603e-06	1.585e+01	8.584e+02	5.031e+03	9.847e+03
1.545e+01	1.034e-05	1.681e+01	8.912e+02	5.165e+03	1.009e+04
1.591e+01	1.114e-05	1.783e+01	9.248e+02	5.298e+03	1.033e+04
1.636e+01	1.200e-05	1.889e+01	9.590e+02	5.432e+03	1.056e+04
1.682e+01	1.292e-05	2.002e+01	9.941e+02	5.565e+03	1.080e+04
1.727e+01	1.391e-05	2.120e+01	1.030e+03	5.698e+03	1.103e+04
1.773e+01	1.498e-05	2.244e+01	1.067e+03	5.830e+03	1.126e+04
1.818e+01	1.612e-05	2.374e+01	1.104e+03	5.963e+03	1.149e+04
1.864e+01	1.735e-05	2.511e+01	1.142e+03	6.096e+03	1.172e+04
1.909e+01	1.867e-05	2.655e+01	1.182e+03	6.228e+03	1.194e+04
1.955e+01	2.009e-05	2.806e+01	1.222e+03	6.361e+03	1.217e+04
2.000e+01	2.162e-05	2.965e+01	1.263e+03	6.494e+03	1.239e+04
2.045e+01	2.326e-05	3.131e+01	1.305e+03	6.626e+03	1.261e+04
2.091e+01	2.503e-05	3.306e+01	1.348e+03	6.759e+03	1.283e+04
2.136e+01	2.692e-05	3.489e+01	1.392e+03	6.893e+03	1.305e+04
2.182e+01	2.896e-05	3.680e+01	1.437e+03	7.026e+03	1.327e+04
2.227e+01	3.114e-05	3.881e+01	1.483e+03	7.160e+03	1.348e+04
2.273e+01	3.349e-05	4.091e+01	1.530e+03	7.293e+03	1.370e+04
2.318e+01	3.601e-05	4.311e+01	1.578e+03	7.428e+03	1.391e+04
2.364e+01	3.871e-05	4.541e+01	1.627e+03	7.562e+03	1.412e+04
2.409e+01	4.162e-05	4.782e+01	1.677e+03	7.697e+03	1.434e+04
2.455e+01	4.473e-05	5.033e+01	1.728e+03	7.832e+03	1.455e+04
2.500e+01	4.808e-05	5.296e+01	1.781e+03	7.968e+03	1.476e+04
2.545e+01	5.166e-05	5.570e+01	1.834e+03	8.104e+03	1.496e+04
2.591e+01	5.551e-05	5.856e+01	1.889e+03	8.241e+03	1.517e+04
2.636e+01	5.964e-05	6.154e+01	1.945e+03	8.378e+03	1.538e+04
2.682e+01	6.407e-05	6.465e+01	2.002e+03	8.515e+03	1.559e+04
2.727e+01	6.881e-05	6.789e+01	2.061e+03	8.653e+03	1.579e+04
2.773e+01	7.389e-05	7.127e+01	2.120e+03	8.792e+03	1.600e+04
2.818e+01	7.934e-05	7.478e+01	2.181e+03	8.931e+03	1.620e+04
2.864e+01	8.518e-05	7.844e+01	2.243e+03	9.071e+03	1.641e+04
2.909e+01	9.144e-05	8.224e+01	2.307e+03	9.211e+03	1.661e+04
2.955e+01	9.814e-05	8.620e+01	2.371e+03	9.352e+03	1.681e+04
3.000e+01	1.053e-04	9.030e+01	2.437e+03	9.494e+03	1.701e+04
3.045e+01	1.184e-06	2.412e+00	2.648e+03	9.658e+03	1.717e+04
3.091e+01	3.273e-04	2.843e+02	3.219e+03	1.002e+04	1.746e+04
3.136e+01	4.698e-02	1.017e+03	4.085e+03	1.058e+04	1.789e+04
3.182e+01	5.342e+00	2.003e+03	5.181e+03	1.131e+04	1.844e+04
3.227e+01	4.136e+02	3.181e+03	6.454e+03	1.221e+04	1.911e+04
3.273e+01	1.284e+03	4.517e+03	7.867e+03	1.326e+04	1.990e+04
3.318e+01	2.440e+03	5.988e+03	9.392e+03	1.444e+04	2.080e+04
3.364e+01	3.810e+03	7.574e+03	1.101e+04	1.573e+04	2.179e+04
3.409e+01	5.355e+03	9.261e+03	1.270e+04	1.713e+04	2.288e+04
3.455e+01	7.047e+03	1.104e+04	1.446e+04	1.861e+04	2.405e+04
3.500e+01	8.866e+03	1.289e+04	1.627e+04	2.017e+04	2.530e+04
3.545e+01	1.080e+04	1.481e+04	1.814e+04	2.179e+04	2.662e+04
3.591e+01	1.282e+04	1.679e+04	2.004e+04	2.347e+04	2.800e+04
3.636e+01	1.493e+04	1.882e+04	2.198e+04	2.520e+04	2.943e+04
3.682e+01	1.710e+04	2.090e+04	2.395e+04	2.697e+04	3.092e+04
3.727e+01	1.934e+04	2.302e+04	2.595e+04	2.878e+04	3.244e+04
3.773e+01	2.164e+04	2.517e+04	2.797e+04	3.061e+04	3.401e+04
3.818e+01	2.398e+04	2.735e+04	3.001e+04	3.247e+04	3.561e+04
3.864e+01	2.636e+04	2.955e+04	3.207e+04	3.435e+04	3.723e+04
3.909e+01	2.877e+04	3.177e+04	3.413e+04	3.624e+04	3.888e+04
3.955e+01	3.121e+04	3.401e+04	3.621e+04	3.815e+04	4.055e+04

4.000e+01	3.367e+04	3.627e+04	3.829e+04	4.006e+04	4.224e+04
4.045e+01	3.615e+04	3.853e+04	4.038e+04	4.198e+04	4.394e+04
4.091e+01	3.864e+04	4.079e+04	4.246e+04	4.390e+04	4.564e+04
4.136e+01	4.114e+04	4.306e+04	4.455e+04	4.583e+04	4.736e+04
4.182e+01	4.364e+04	4.533e+04	4.664e+04	4.775e+04	4.908e+04
4.227e+01	4.615e+04	4.759e+04	4.872e+04	4.967e+04	5.079e+04
4.273e+01	4.865e+04	4.985e+04	5.079e+04	5.158e+04	5.251e+04
4.318e+01	5.114e+04	5.211e+04	5.285e+04	5.348e+04	5.422e+04
4.364e+01	5.363e+04	5.435e+04	5.491e+04	5.538e+04	5.593e+04
4.409e+01	5.610e+04	5.658e+04	5.695e+04	5.727e+04	5.763e+04
4.455e+01	5.856e+04	5.880e+04	5.898e+04	5.914e+04	5.932e+04
4.500e+01	6.100e+04	6.100e+04	6.100e+04	6.100e+04	6.100e+04

Time (yr) 2.000e+02

Depth (cm)	Pore Water Concentrations (μg/L)
0.000e+00	9.339e+00
4.545e-01	5.662e+02
9.091e-01	1.114e+03
1.364e+00	1.652e+03
1.818e+00	2.180e+03
2.273e+00	2.701e+03
2.727e+00	3.212e+03
3.182e+00	3.715e+03
3.636e+00	4.210e+03
4.091e+00	4.696e+03
4.545e+00	5.175e+03
5.000e+00	5.647e+03
5.455e+00	6.111e+03
5.909e+00	6.567e+03
6.364e+00	7.017e+03
6.818e+00	7.460e+03
7.273e+00	7.896e+03
7.727e+00	8.325e+03
8.182e+00	8.748e+03
8.636e+00	9.165e+03
9.091e+00	9.576e+03
9.545e+00	9.981e+03
1.000e+01	1.038e+04
1.045e+01	1.077e+04
1.091e+01	1.116e+04
1.136e+01	1.155e+04
1.182e+01	1.192e+04
1.227e+01	1.230e+04
1.273e+01	1.266e+04
1.318e+01	1.303e+04
1.364e+01	1.338e+04
1.409e+01	1.374e+04
1.455e+01	1.409e+04
1.500e+01	1.443e+04
1.545e+01	1.477e+04
1.591e+01	1.511e+04
1.636e+01	1.544e+04
1.682e+01	1.577e+04
1.727e+01	1.610e+04
1.773e+01	1.642e+04

1.818e+01	1.674e+04
1.864e+01	1.705e+04
1.909e+01	1.737e+04
1.955e+01	1.767e+04
2.000e+01	1.798e+04
2.045e+01	1.828e+04
2.091e+01	1.858e+04
2.136e+01	1.888e+04
2.182e+01	1.917e+04
2.227e+01	1.946e+04
2.273e+01	1.975e+04
2.318e+01	2.003e+04
2.364e+01	2.031e+04
2.409e+01	2.059e+04
2.455e+01	2.087e+04
2.500e+01	2.115e+04
2.545e+01	2.142e+04
2.591e+01	2.169e+04
2.636e+01	2.196e+04
2.682e+01	2.223e+04
2.727e+01	2.249e+04
2.773e+01	2.275e+04
2.818e+01	2.302e+04
2.864e+01	2.327e+04
2.909e+01	2.353e+04
2.955e+01	2.379e+04
3.000e+01	2.404e+04
3.045e+01	2.420e+04
3.091e+01	2.446e+04
3.136e+01	2.482e+04
3.182e+01	2.527e+04
3.227e+01	2.581e+04
3.273e+01	2.644e+04
3.318e+01	2.715e+04
3.364e+01	2.795e+04
3.409e+01	2.881e+04
3.455e+01	2.975e+04
3.500e+01	3.076e+04
3.545e+01	3.182e+04
3.591e+01	3.294e+04
3.636e+01	3.411e+04
3.682e+01	3.533e+04
3.727e+01	3.659e+04
3.773e+01	3.789e+04
3.818e+01	3.923e+04
3.864e+01	4.059e+04
3.909e+01	4.198e+04
3.955e+01	4.340e+04
4.000e+01	4.483e+04
4.045e+01	4.628e+04
4.091e+01	4.774e+04
4.136e+01	4.921e+04
4.182e+01	5.068e+04
4.227e+01	5.216e+04
4.273e+01	5.365e+04
4.318e+01	5.513e+04

4.364e+01	5.661e+04
4.409e+01	5.808e+04
4.455e+01	5.954e+04
4.500e+01	6.100e+04

Flux Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)			Flux (μg/m²/yr)		
0.000e+00	0.000e+00	3.752e-50	-2.119e-33	1.965e-21	-3.868e-11
4.545e-01	0.000e+00	3.838e-50	-2.153e-33	1.978e-21	-3.900e-11
9.091e-01	0.000e+00	3.967e-50	-2.204e-33	1.997e-21	-3.948e-11
1.364e+00	0.000e+00	4.183e-50	-2.289e-33	2.028e-21	-4.028e-11
1.818e+00	0.000e+00	4.488e-50	-2.409e-33	2.072e-21	-4.138e-11
2.273e+00	0.000e+00	4.888e-50	-2.563e-33	2.127e-21	-4.281e-11
2.727e+00	0.000e+00	5.389e-50	-2.755e-33	2.195e-21	-4.456e-11
3.182e+00	0.000e+00	6.000e-50	-2.987e-33	2.275e-21	-4.664e-11
3.636e+00	0.000e+00	6.731e-50	-3.260e-33	2.367e-21	-4.907e-11
4.091e+00	0.000e+00	7.597e-50	-3.578e-33	2.471e-21	-5.185e-11
4.545e+00	0.000e+00	8.611e-50	-3.945e-33	2.586e-21	-5.500e-11
5.000e+00	0.000e+00	9.793e-50	-4.365e-33	2.714e-21	-5.854e-11
5.455e+00	0.000e+00	1.116e-49	-4.843e-33	2.854e-21	-6.250e-11
5.909e+00	0.000e+00	1.275e-49	-5.385e-33	3.005e-21	-6.689e-11
6.364e+00	0.000e+00	1.457e-49	-5.998e-33	3.169e-21	-7.174e-11
6.818e+00	0.000e+00	1.668e-49	-6.688e-33	3.344e-21	-7.708e-11
7.273e+00	0.000e+00	1.909e-49	-7.465e-33	3.530e-21	-8.295e-11
7.727e+00	0.000e+00	2.186e-49	-8.338e-33	3.729e-21	-8.938e-11
8.182e+00	0.000e+00	2.503e-49	-9.317e-33	3.938e-21	-9.642e-11
8.636e+00	0.000e+00	2.866e-49	-1.041e-32	4.158e-21	-1.041e-10
9.091e+00	0.000e+00	3.282e-49	-1.164e-32	4.388e-21	-1.125e-10
9.545e+00	0.000e+00	3.757e-49	-1.302e-32	4.627e-21	-1.216e-10
1.000e+01	0.000e+00	4.300e-49	-1.456e-32	4.875e-21	-1.315e-10
1.045e+01	0.000e+00	4.921e-49	-1.628e-32	5.130e-21	-1.424e-10
1.091e+01	0.000e+00	5.629e-49	-1.821e-32	5.392e-21	-1.541e-10
1.136e+01	0.000e+00	6.437e-49	-2.037e-32	5.658e-21	-1.669e-10
1.182e+01	0.000e+00	7.358e-49	-2.278e-32	5.926e-21	-1.807e-10
1.227e+01	0.000e+00	8.409e-49	-2.547e-32	6.196e-21	-1.957e-10
1.273e+01	0.000e+00	9.606e-49	-2.848e-32	6.463e-21	-2.121e-10
1.318e+01	0.000e+00	1.097e-48	-3.184e-32	6.724e-21	-2.298e-10
1.364e+01	0.000e+00	1.252e-48	-3.561e-32	6.977e-21	-2.489e-10
1.409e+01	0.000e+00	1.429e-48	-3.981e-32	7.217e-21	-2.697e-10
1.455e+01	0.000e+00	1.630e-48	-4.450e-32	7.438e-21	-2.923e-10
1.500e+01	0.000e+00	1.858e-48	-4.975e-32	7.637e-21	-3.167e-10
1.545e+01	0.000e+00	2.118e-48	-5.562e-32	7.805e-21	-3.432e-10
1.591e+01	0.000e+00	2.413e-48	-6.217e-32	7.936e-21	-3.719e-10
1.636e+01	0.000e+00	2.748e-48	-6.950e-32	8.021e-21	-4.029e-10
1.682e+01	0.000e+00	3.129e-48	-7.768e-32	8.051e-21	-4.366e-10
1.727e+01	0.000e+00	3.560e-48	-8.683e-32	8.016e-21	-4.731e-10
1.773e+01	0.000e+00	4.050e-48	-9.706e-32	7.903e-21	-5.125e-10
1.818e+01	0.000e+00	4.605e-48	-1.085e-31	7.698e-21	-5.553e-10
1.864e+01	0.000e+00	5.234e-48	-1.213e-31	7.387e-21	-6.016e-10
1.909e+01	0.000e+00	5.946e-48	-1.355e-31	6.952e-21	-6.517e-10
1.955e+01	0.000e+00	6.752e-48	-1.515e-31	6.375e-21	-7.059e-10
2.000e+01	0.000e+00	7.665e-48	-1.693e-31	5.633e-21	-7.647e-10
2.045e+01	0.000e+00	8.698e-48	-1.892e-31	4.703e-21	-8.283e-10

2.091e+01	0.000e+00	9.865e-48	-2.115e-31	3.560e-21	-8.971e-10
2.136e+01	0.000e+00	1.118e-47	-2.364e-31	2.172e-21	-9.717e-10
2.182e+01	0.000e+00	1.268e-47	-2.642e-31	5.085e-22	-1.052e-09
2.227e+01	0.000e+00	1.436e-47	-2.953e-31	-1.467e-21	-1.140e-09
2.273e+01	0.000e+00	1.626e-47	-3.300e-31	-3.794e-21	-1.234e-09
2.318e+01	0.000e+00	1.840e-47	-3.688e-31	-6.517e-21	-1.337e-09
2.364e+01	0.000e+00	2.082e-47	-4.121e-31	-9.683e-21	-1.447e-09
2.409e+01	0.000e+00	2.354e-47	-4.605e-31	-1.335e-20	-1.567e-09
2.455e+01	0.000e+00	2.662e-47	-5.145e-31	-1.756e-20	-1.697e-09
2.500e+01	0.000e+00	3.007e-47	-5.749e-31	-2.240e-20	-1.838e-09
2.545e+01	0.000e+00	3.397e-47	-6.422e-31	-2.792e-20	-1.990e-09
2.591e+01	0.000e+00	3.835e-47	-7.174e-31	-3.421e-20	-2.155e-09
2.636e+01	0.000e+00	4.328e-47	-8.014e-31	-4.134e-20	-2.333e-09
2.682e+01	0.000e+00	4.882e-47	-8.950e-31	-4.941e-20	-2.526e-09
2.727e+01	0.000e+00	5.504e-47	-9.995e-31	-5.852e-20	-2.736e-09
2.773e+01	0.000e+00	6.204e-47	-1.116e-30	-6.876e-20	-2.962e-09
2.818e+01	0.000e+00	6.989e-47	-1.246e-30	-8.027e-20	-3.207e-09
2.864e+01	0.000e+00	7.871e-47	-1.391e-30	-9.316e-20	-3.473e-09
2.909e+01	0.000e+00	8.861e-47	-1.552e-30	-1.076e-19	-3.761e-09
2.955e+01	0.000e+00	9.966e-47	-1.731e-30	-1.236e-19	-4.071e-09
3.000e+01	0.000e+00	1.114e-46	-1.921e-30	-1.406e-19	-4.395e-09
3.045e+01	0.000e+00	-3.756e-45	6.949e-29	2.878e-18	2.087e-07
3.091e+01	0.000e+00	-3.492e-43	2.084e-26	4.133e-15	3.465e-05
3.136e+01	0.000e+00	4.486e-40	4.724e-24	2.207e-12	7.734e-03
3.182e+01	0.000e+00	3.568e-37	-6.702e-23	1.001e-09	1.686e+00
3.227e+01	0.000e+00	1.181e-34	-6.203e-19	4.016e-07	3.264e+02
3.273e+01	0.000e+00	-1.069e-32	-3.629e-16	1.349e-04	5.060e+04
3.318e+01	0.000e+00	-3.586e-29	-1.548e-13	3.770e-02	5.350e+06
3.364e+01	0.000e+00	-2.031e-26	-5.186e-11	9.486e+00	2.132e+07
3.409e+01	0.000e+00	-4.075e-24	-9.482e-09	2.386e+03	3.781e+07
3.455e+01	0.000e+00	2.299e-21	2.665e-06	5.137e+05	4.793e+07
3.500e+01	0.000e+00	2.349e-18	3.179e-03	1.415e+07	5.593e+07
3.545e+01	0.000e+00	9.340e-16	1.505e+00	3.636e+07	6.265e+07
3.591e+01	0.000e+00	7.427e-14	4.678e+02	5.185e+07	6.843e+07
3.636e+01	0.000e+00	-1.575e-10	1.030e+05	6.337e+07	7.346e+07
3.682e+01	0.000e+00	-1.258e-07	1.245e+07	7.253e+07	7.788e+07
3.727e+01	0.000e+00	-5.079e-05	4.096e+07	8.011e+07	8.178e+07
3.773e+01	0.000e+00	-3.383e-03	6.651e+07	8.655e+07	8.523e+07

3.818e+01	0.000e+00	1.120e+01	8.267e+07	9.209e+07	8.829e+07
3.864e+01	0.000e+00	8.529e+03	9.500e+07	9.689e+07	9.100e+07
3.909e+01	0.000e+00	2.973e+06	1.050e+08	1.011e+08	9.339e+07
3.955e+01	0.000e+00	4.206e+07	1.133e+08	1.047e+08	9.551e+07
4.000e+01	0.000e+00	9.594e+07	1.203e+08	1.078e+08	9.736e+07
4.045e+01	0.000e+00	1.263e+08	1.262e+08	1.106e+08	9.899e+07
4.091e+01	0.000e+00	1.487e+08	1.311e+08	1.129e+08	1.004e+08
4.136e+01	0.000e+00	1.656e+08	1.352e+08	1.149e+08	1.016e+08
4.182e+01	0.000e+00	1.785e+08	1.386e+08	1.166e+08	1.026e+08
4.227e+01	0.000e+00	1.885e+08	1.414e+08	1.179e+08	1.035e+08
4.273e+01	0.000e+00	1.961e+08	1.437e+08	1.191e+08	1.042e+08
4.318e+01	0.000e+00	2.018e+08	1.454e+08	1.200e+08	1.048e+08
4.364e+01	0.000e+00	2.059e+08	1.467e+08	1.206e+08	1.052e+08
4.409e+01	0.000e+00	2.086e+08	1.475e+08	1.211e+08	1.055e+08
4.455e+01	0.000e+00	2.101e+08	1.480e+08	1.213e+08	1.056e+08
4.500e+01	0.000e+00	2.111e+08	1.484e+08	1.215e+08	1.057e+08

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)			Flux (μg/m²/yr)		
0.000e+00	-2.016e-03	-4.409e+03	3.746e+05	2.714e+06	5.505e+06
4.545e-01	-2.030e-03	-4.432e+03	3.753e+05	2.715e+06	5.507e+06
9.091e-01	-2.050e-03	-4.465e+03	3.763e+05	2.717e+06	5.509e+06
1.364e+00	-2.084e-03	-4.519e+03	3.779e+05	2.720e+06	5.512e+06
1.818e+00	-2.132e-03	-4.594e+03	3.802e+05	2.724e+06	5.516e+06
2.273e+00	-2.192e-03	-4.690e+03	3.831e+05	2.728e+06	5.521e+06
2.727e+00	-2.267e-03	-4.808e+03	3.865e+05	2.734e+06	5.527e+06
3.182e+00	-2.355e-03	-4.947e+03	3.906e+05	2.741e+06	5.534e+06
3.636e+00	-2.458e-03	-5.106e+03	3.953e+05	2.749e+06	5.542e+06
4.091e+00	-2.576e-03	-5.288e+03	4.005e+05	2.758e+06	5.551e+06
4.545e+00	-2.708e-03	-5.491e+03	4.064e+05	2.768e+06	5.561e+06
5.000e+00	-2.857e-03	-5.716e+03	4.128e+05	2.779e+06	5.572e+06
5.455e+00	-3.022e-03	-5.964e+03	4.197e+05	2.791e+06	5.584e+06
5.909e+00	-3.205e-03	-6.234e+03	4.273e+05	2.804e+06	5.597e+06
6.364e+00	-3.406e-03	-6.528e+03	4.354e+05	2.817e+06	5.611e+06
6.818e+00	-3.627e-03	-6.846e+03	4.440e+05	2.832e+06	5.626e+06
7.273e+00	-3.868e-03	-7.189e+03	4.532e+05	2.847e+06	5.641e+06
7.727e+00	-4.130e-03	-7.557e+03	4.629e+05	2.864e+06	5.658e+06
8.182e+00	-4.416e-03	-7.952e+03	4.732e+05	2.881e+06	5.675e+06
8.636e+00	-4.727e-03	-8.373e+03	4.840e+05	2.899e+06	5.693e+06
9.091e+00	-5.064e-03	-8.822e+03	4.954e+05	2.917e+06	5.712e+06
9.545e+00	-5.428e-03	-9.301e+03	5.072e+05	2.937e+06	5.732e+06
1.000e+01	-5.823e-03	-9.809e+03	5.197e+05	2.957e+06	5.753e+06
1.045e+01	-6.249e-03	-1.035e+04	5.326e+05	2.979e+06	5.774e+06
1.091e+01	-6.710e-03	-1.092e+04	5.461e+05	3.001e+06	5.796e+06
1.136e+01	-7.208e-03	-1.152e+04	5.601e+05	3.023e+06	5.819e+06
1.182e+01	-7.744e-03	-1.216e+04	5.746e+05	3.047e+06	5.843e+06
1.227e+01	-8.323e-03	-1.284e+04	5.896e+05	3.071e+06	5.867e+06
1.273e+01	-8.947e-03	-1.355e+04	6.052e+05	3.096e+06	5.892e+06
1.318e+01	-9.619e-03	-1.430e+04	6.213e+05	3.121e+06	5.918e+06
1.364e+01	-1.034e-02	-1.509e+04	6.379e+05	3.148e+06	5.944e+06
1.409e+01	-1.112e-02	-1.592e+04	6.550e+05	3.175e+06	5.972e+06
1.455e+01	-1.196e-02	-1.679e+04	6.727e+05	3.202e+06	5.999e+06
1.500e+01	-1.286e-02	-1.771e+04	6.909e+05	3.231e+06	6.028e+06
1.545e+01	-1.383e-02	-1.867e+04	7.096e+05	3.260e+06	6.057e+06
1.591e+01	-1.488e-02	-1.968e+04	7.288e+05	3.289e+06	6.087e+06

1.636e+01	-1.600e-02	-2.075e+04	7.485e+05	3.319e+06	6.117e+06
1.682e+01	-1.721e-02	-2.186e+04	7.688e+05	3.350e+06	6.148e+06
1.727e+01	-1.850e-02	-2.302e+04	7.896e+05	3.382e+06	6.179e+06
1.773e+01	-1.990e-02	-2.424e+04	8.110e+05	3.414e+06	6.211e+06
1.818e+01	-2.139e-02	-2.551e+04	8.328e+05	3.447e+06	6.244e+06
1.864e+01	-2.300e-02	-2.684e+04	8.552e+05	3.480e+06	6.277e+06
1.909e+01	-2.473e-02	-2.823e+04	8.781e+05	3.514e+06	6.311e+06
1.955e+01	-2.658e-02	-2.968e+04	9.016e+05	3.548e+06	6.345e+06
2.000e+01	-2.857e-02	-3.120e+04	9.256e+05	3.583e+06	6.380e+06
2.045e+01	-3.071e-02	-3.278e+04	9.501e+05	3.619e+06	6.415e+06
2.091e+01	-3.300e-02	-3.443e+04	9.751e+05	3.655e+06	6.451e+06
2.136e+01	-3.546e-02	-3.614e+04	1.001e+06	3.692e+06	6.488e+06
2.182e+01	-3.809e-02	-3.793e+04	1.027e+06	3.729e+06	6.525e+06
2.227e+01	-4.092e-02	-3.978e+04	1.054e+06	3.767e+06	6.562e+06
2.273e+01	-4.395e-02	-4.172e+04	1.081e+06	3.805e+06	6.600e+06
2.318e+01	-4.720e-02	-4.372e+04	1.108e+06	3.843e+06	6.638e+06
2.364e+01	-5.068e-02	-4.581e+04	1.137e+06	3.883e+06	6.677e+06
2.409e+01	-5.441e-02	-4.797e+04	1.166e+06	3.922e+06	6.716e+06
2.455e+01	-5.841e-02	-5.021e+04	1.195e+06	3.962e+06	6.755e+06
2.500e+01	-6.269e-02	-5.254e+04	1.225e+06	4.003e+06	6.795e+06
2.545e+01	-6.728e-02	-5.495e+04	1.255e+06	4.044e+06	6.836e+06
2.591e+01	-7.218e-02	-5.744e+04	1.286e+06	4.086e+06	6.877e+06
2.636e+01	-7.744e-02	-6.002e+04	1.318e+06	4.128e+06	6.918e+06
2.682e+01	-8.306e-02	-6.269e+04	1.350e+06	4.170e+06	6.960e+06
2.727e+01	-8.907e-02	-6.544e+04	1.383e+06	4.213e+06	7.002e+06
2.773e+01	-9.550e-02	-6.829e+04	1.416e+06	4.257e+06	7.044e+06
2.818e+01	-1.024e-01	-7.122e+04	1.450e+06	4.300e+06	7.087e+06
2.864e+01	-1.097e-01	-7.425e+04	1.484e+06	4.345e+06	7.130e+06
2.909e+01	-1.176e-01	-7.736e+04	1.519e+06	4.389e+06	7.173e+06
2.955e+01	-1.259e-01	-8.056e+04	1.554e+06	4.434e+06	7.217e+06
3.000e+01	-1.346e-01	-8.381e+04	1.590e+06	4.479e+06	7.261e+06
3.045e+01	7.071e+00	6.123e+06	1.344e+07	1.109e+07	1.172e+07
3.091e+01	7.680e+02	1.665e+07	2.432e+07	1.761e+07	1.617e+07
3.136e+01	8.733e+04	2.835e+07	3.312e+07	2.381e+07	2.051e+07
3.182e+01	6.761e+06	3.589e+07	4.004e+07	2.959e+07	2.472e+07
3.227e+01	2.101e+07	4.191e+07	4.554e+07	3.491e+07	2.875e+07
3.273e+01	3.345e+07	4.702e+07	5.001e+07	3.973e+07	3.258e+07
3.318e+01	4.190e+07	5.148e+07	5.373e+07	4.406e+07	3.619e+07
3.364e+01	4.861e+07	5.543e+07	5.690e+07	4.793e+07	3.958e+07
3.409e+01	5.428e+07	5.895e+07	5.966e+07	5.138e+07	4.274e+07
3.455e+01	5.919e+07	6.210e+07	6.208e+07	5.444e+07	4.566e+07
3.500e+01	6.351e+07	6.495e+07	6.424e+07	5.716e+07	4.836e+07
3.545e+01	6.735e+07	6.752e+07	6.619e+07	5.957e+07	5.084e+07
3.591e+01	7.077e+07	6.985e+07	6.794e+07	6.171e+07	5.312e+07
3.636e+01	7.384e+07	7.196e+07	6.952e+07	6.361e+07	5.519e+07
3.682e+01	7.659e+07	7.387e+07	7.096e+07	6.530e+07	5.708e+07
3.727e+01	7.905e+07	7.561e+07	7.227e+07	6.680e+07	5.880e+07
3.773e+01	8.127e+07	7.718e+07	7.346e+07	6.814e+07	6.035e+07
3.818e+01	8.326e+07	7.860e+07	7.453e+07	6.932e+07	6.175e+07
3.864e+01	8.504e+07	7.988e+07	7.551e+07	7.037e+07	6.302e+07
3.909e+01	8.663e+07	8.103e+07	7.638e+07	7.130e+07	6.414e+07
3.955e+01	8.805e+07	8.205e+07	7.717e+07	7.212e+07	6.515e+07
4.000e+01	8.930e+07	8.297e+07	7.787e+07	7.284e+07	6.604e+07
4.045e+01	9.040e+07	8.377e+07	7.849e+07	7.347e+07	6.683e+07
4.091e+01	9.136e+07	8.448e+07	7.904e+07	7.402e+07	6.752e+07
4.136e+01	9.219e+07	8.510e+07	7.951e+07	7.449e+07	6.812e+07

4.182e+01	9.290e+07	8.562e+07	7.992e+07	7.489e+07	6.862e+07
4.227e+01	9.350e+07	8.606e+07	8.026e+07	7.522e+07	6.905e+07
4.273e+01	9.399e+07	8.643e+07	8.055e+07	7.550e+07	6.941e+07
4.318e+01	9.437e+07	8.672e+07	8.077e+07	7.572e+07	6.969e+07
4.364e+01	9.466e+07	8.693e+07	8.094e+07	7.588e+07	6.990e+07
4.409e+01	9.487e+07	8.709e+07	8.106e+07	7.600e+07	7.005e+07
4.455e+01	9.499e+07	8.718e+07	8.113e+07	7.607e+07	7.013e+07
4.500e+01	9.506e+07	8.723e+07	8.118e+07	7.611e+07	7.019e+07

Time(yr) 2.000e+02

Depth (cm)	Flux (μg/m²/yr)
0.000e+00	8.184e+06
4.545e-01	8.186e+06
9.091e-01	8.187e+06
1.364e+00	8.190e+06
1.818e+00	8.194e+06
2.273e+00	8.198e+06
2.727e+00	8.204e+06
3.182e+00	8.210e+06
3.636e+00	8.218e+06
4.091e+00	8.226e+06
4.545e+00	8.235e+06
5.000e+00	8.246e+06
5.455e+00	8.257e+06
5.909e+00	8.269e+06
6.364e+00	8.281e+06
6.818e+00	8.295e+06
7.273e+00	8.309e+06
7.727e+00	8.324e+06
8.182e+00	8.340e+06
8.636e+00	8.357e+06
9.091e+00	8.375e+06
9.545e+00	8.393e+06
1.000e+01	8.412e+06
1.045e+01	8.431e+06
1.091e+01	8.452e+06
1.136e+01	8.473e+06
1.182e+01	8.494e+06
1.227e+01	8.517e+06
1.273e+01	8.540e+06
1.318e+01	8.564e+06
1.364e+01	8.588e+06
1.409e+01	8.613e+06
1.455e+01	8.638e+06
1.500e+01	8.664e+06
1.545e+01	8.691e+06
1.591e+01	8.718e+06
1.636e+01	8.746e+06
1.682e+01	8.774e+06
1.727e+01	8.803e+06
1.773e+01	8.833e+06
1.818e+01	8.863e+06
1.864e+01	8.893e+06
1.909e+01	8.924e+06
1.955e+01	8.955e+06

2.000e+01	8.987e+06
2.045e+01	9.020e+06
2.091e+01	9.052e+06
2.136e+01	9.086e+06
2.182e+01	9.119e+06
2.227e+01	9.153e+06
2.273e+01	9.188e+06
2.318e+01	9.223e+06
2.364e+01	9.258e+06
2.409e+01	9.294e+06
2.455e+01	9.330e+06
2.500e+01	9.366e+06
2.545e+01	9.403e+06
2.591e+01	9.440e+06
2.636e+01	9.478e+06
2.682e+01	9.516e+06
2.727e+01	9.554e+06
2.773e+01	9.592e+06
2.818e+01	9.631e+06
2.864e+01	9.671e+06
2.909e+01	9.710e+06
2.955e+01	9.750e+06
3.000e+01	9.790e+06
3.045e+01	1.304e+07
3.091e+01	1.629e+07
3.136e+01	1.950e+07
3.182e+01	2.264e+07
3.227e+01	2.569e+07
3.273e+01	2.866e+07
3.318e+01	3.150e+07
3.364e+01	3.423e+07
3.409e+01	3.683e+07
3.455e+01	3.930e+07
3.500e+01	4.162e+07
3.545e+01	4.381e+07
3.591e+01	4.585e+07
3.636e+01	4.776e+07
3.682e+01	4.953e+07
3.727e+01	5.117e+07
3.773e+01	5.268e+07
3.818e+01	5.407e+07
3.864e+01	5.533e+07
3.909e+01	5.648e+07
3.955e+01	5.752e+07
4.000e+01	5.846e+07
4.045e+01	5.929e+07
4.091e+01	6.002e+07
4.136e+01	6.066e+07
4.182e+01	6.122e+07
4.227e+01	6.169e+07
4.273e+01	6.207e+07
4.318e+01	6.239e+07
4.364e+01	6.262e+07
4.409e+01	6.279e+07
4.455e+01	6.289e+07
4.500e+01	6.295e+07

Solid Concentration Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)	Solid Concentrations (μg/kg)				
0.000e+00	0.000e+00	7.563e-56	4.272e-39	3.961e-27	7.798e-17
4.545e-01	0.000e+00	4.637e-54	2.610e-37	2.409e-25	4.746e-15
9.091e-01	0.000e+00	9.223e-54	5.174e-37	4.753e-25	9.373e-15
1.364e+00	0.000e+00	1.394e-53	7.776e-37	7.086e-25	1.400e-14
1.818e+00	0.000e+00	1.888e-53	1.046e-36	9.425e-25	1.865e-14
2.273e+00	0.000e+00	2.417e-53	1.325e-36	1.178e-24	2.338e-14
2.727e+00	0.000e+00	2.990e-53	1.621e-36	1.417e-24	2.822e-14
3.182e+00	0.000e+00	3.619e-53	1.937e-36	1.661e-24	3.321e-14
3.636e+00	0.000e+00	4.319e-53	2.278e-36	1.911e-24	3.838e-14
4.091e+00	0.000e+00	5.102e-53	2.648e-36	2.169e-24	4.377e-14
4.545e+00	0.000e+00	5.983e-53	3.053e-36	2.435e-24	4.943e-14
5.000e+00	0.000e+00	6.982e-53	3.499e-36	2.711e-24	5.539e-14
5.455e+00	0.000e+00	8.115e-53	3.990e-36	2.999e-24	6.169e-14
5.909e+00	0.000e+00	9.406e-53	4.534e-36	3.299e-24	6.839e-14
6.364e+00	0.000e+00	1.088e-52	5.138e-36	3.612e-24	7.553e-14
6.818e+00	0.000e+00	1.256e-52	5.810e-36	3.941e-24	8.316e-14
7.273e+00	0.000e+00	1.449e-52	6.558e-36	4.286e-24	9.133e-14
7.727e+00	0.000e+00	1.669e-52	7.392e-36	4.648e-24	1.001e-13
8.182e+00	0.000e+00	1.921e-52	8.322e-36	5.028e-24	1.095e-13
8.636e+00	0.000e+00	2.209e-52	9.361e-36	5.428e-24	1.197e-13
9.091e+00	0.000e+00	2.539e-52	1.052e-35	5.847e-24	1.306e-13
9.545e+00	0.000e+00	2.916e-52	1.182e-35	6.288e-24	1.424e-13
1.000e+01	0.000e+00	3.348e-52	1.327e-35	6.750e-24	1.551e-13
1.045e+01	0.000e+00	3.843e-52	1.489e-35	7.235e-24	1.689e-13
1.091e+01	0.000e+00	4.408e-52	1.670e-35	7.742e-24	1.838e-13
1.136e+01	0.000e+00	5.054e-52	1.872e-35	8.273e-24	1.999e-13
1.182e+01	0.000e+00	5.793e-52	2.099e-35	8.826e-24	2.173e-13
1.227e+01	0.000e+00	6.637e-52	2.352e-35	9.402e-24	2.361e-13
1.273e+01	0.000e+00	7.601e-52	2.634e-35	1.000e-23	2.565e-13
1.318e+01	0.000e+00	8.702e-52	2.950e-35	1.062e-23	2.786e-13
1.364e+01	0.000e+00	9.958e-52	3.304e-35	1.126e-23	3.025e-13
1.409e+01	0.000e+00	1.139e-51	3.699e-35	1.192e-23	3.284e-13
1.455e+01	0.000e+00	1.303e-51	4.140e-35	1.260e-23	3.565e-13
1.500e+01	0.000e+00	1.489e-51	4.634e-35	1.329e-23	3.869e-13
1.545e+01	0.000e+00	1.701e-51	5.186e-35	1.399e-23	4.198e-13
1.591e+01	0.000e+00	1.943e-51	5.802e-35	1.469e-23	4.555e-13
1.636e+01	0.000e+00	2.219e-51	6.491e-35	1.540e-23	4.941e-13
1.682e+01	0.000e+00	2.533e-51	7.261e-35	1.610e-23	5.360e-13
1.727e+01	0.000e+00	2.889e-51	8.122e-35	1.679e-23	5.813e-13
1.773e+01	0.000e+00	3.295e-51	9.084e-35	1.746e-23	6.305e-13
1.818e+01	0.000e+00	3.757e-51	1.016e-34	1.810e-23	6.837e-13
1.864e+01	0.000e+00	4.281e-51	1.136e-34	1.869e-23	7.413e-13
1.909e+01	0.000e+00	4.877e-51	1.270e-34	1.924e-23	8.037e-13
1.955e+01	0.000e+00	5.553e-51	1.421e-34	1.971e-23	8.713e-13
2.000e+01	0.000e+00	6.321e-51	1.588e-34	2.010e-23	9.446e-13
2.045e+01	0.000e+00	7.192e-51	1.776e-34	2.038e-23	1.024e-12
2.091e+01	0.000e+00	8.180e-51	1.985e-34	2.053e-23	1.110e-12
2.136e+01	0.000e+00	9.300e-51	2.220e-34	2.052e-23	1.203e-12
2.182e+01	0.000e+00	1.057e-50	2.481e-34	2.034e-23	1.303e-12
2.227e+01	0.000e+00	1.201e-50	2.774e-34	1.994e-23	1.413e-12

2.273e+01	0.000e+00	1.363e-50	3.101e-34	1.929e-23	1.531e-12
2.318e+01	0.000e+00	1.547e-50	3.466e-34	1.834e-23	1.659e-12
2.364e+01	0.000e+00	1.756e-50	3.874e-34	1.707e-23	1.797e-12
2.409e+01	0.000e+00	1.991e-50	4.331e-34	1.540e-23	1.947e-12
2.455e+01	0.000e+00	2.257e-50	4.840e-34	1.329e-23	2.109e-12
2.500e+01	0.000e+00	2.558e-50	5.410e-34	1.068e-23	2.285e-12
2.545e+01	0.000e+00	2.897e-50	6.046e-34	7.486e-24	2.475e-12
2.591e+01	0.000e+00	3.281e-50	6.757e-34	3.643e-24	2.681e-12
2.636e+01	0.000e+00	3.713e-50	7.550e-34	9.375e-25	2.905e-12
2.682e+01	0.000e+00	4.201e-50	8.437e-34	6.351e-24	3.146e-12
2.727e+01	0.000e+00	4.751e-50	9.427e-34	1.270e-23	3.408e-12
2.773e+01	0.000e+00	5.370e-50	1.053e-33	2.010e-23	3.691e-12
2.818e+01	0.000e+00	6.068e-50	1.177e-33	2.868e-23	3.997e-12
2.864e+01	0.000e+00	6.854e-50	1.314e-33	3.857e-23	4.329e-12
2.909e+01	0.000e+00	7.738e-50	1.468e-33	4.993e-23	4.689e-12
2.955e+01	0.000e+00	8.733e-50	1.640e-33	6.292e-23	5.078e-12
3.000e+01	0.000e+00	5.569e-12	nan	nan	nan
3.045e+01	nan	nan	nan	nan	3.753e+01
3.091e+01	nan	nan	6.021e-06	nan	3.248e+02
3.136e+01	0.000e+00	nan	5.189e-05	6.056e-01	2.262e+03
3.182e+01	0.000e+00	6.237e-10	3.656e-04	5.809e+00	1.585e+04
3.227e+01	nan	6.905e-09	nan	5.253e+01	1.101e+05
3.273e+01	nan	5.575e-08	nan	4.546e+02	7.332e+05
3.318e+01	nan	nan	nan	3.691e+03	4.506e+06
3.364e+01	0.000e+00	nan	nan	2.804e+04	2.413e+07
3.409e+01	0.000e+00	nan	nan	2.051e+05	3.967e+07
3.455e+01	0.000e+00	nan	nan	1.501e+06	5.102e+07
3.500e+01	nan	3.392e-03	8.986e+02	1.038e+07	6.043e+07
3.545e+01	nan	4.110e-02	1.151e+04	3.424e+07	6.865e+07
3.591e+01	nan	3.545e-01	1.057e+05	4.823e+07	7.602e+07
3.636e+01	0.000e+00	1.713e+00	8.346e+05	5.943e+07	8.274e+07
3.682e+01	0.000e+00	nan	5.820e+06	6.898e+07	8.895e+07
3.727e+01	nan	nan	3.270e+07	7.742e+07	9.472e+07
3.773e+01	nan	nan	5.016e+07	8.503e+07	1.001e+08
3.818e+01	nan	nan	6.340e+07	9.199e+07	1.052e+08
3.864e+01	0.000e+00	2.178e+05	7.444e+07	9.841e+07	1.100e+08
3.909e+01	0.000e+00	2.374e+06	8.405e+07	1.044e+08	1.146e+08
3.955e+01	0.000e+00	1.953e+07	9.265e+07	1.100e+08	1.189e+08
4.000e+01	nan	5.067e+07	1.005e+08	1.153e+08	1.230e+08
4.045e+01	nan	6.879e+07	1.076e+08	1.202e+08	1.269e+08
4.091e+01	nan	8.323e+07	1.143e+08	1.249e+08	1.307e+08
4.136e+01	0.000e+00	9.549e+07	1.204e+08	1.294e+08	1.343e+08
4.182e+01	0.000e+00	1.062e+08	1.262e+08	1.336e+08	1.378e+08
4.227e+01	nan	1.158e+08	1.316e+08	1.377e+08	1.411e+08
4.273e+01	nan	1.245e+08	1.367e+08	1.415e+08	1.442e+08
4.318e+01	nan	1.324e+08	1.416e+08	1.452e+08	1.473e+08
4.364e+01	0.000e+00	1.397e+08	1.461e+08	1.487e+08	1.502e+08
4.409e+01	0.000e+00	1.464e+08	1.504e+08	1.521e+08	1.531e+08
4.455e+01	0.000e+00	1.526e+08	1.545e+08	1.553e+08	1.558e+08
4.500e+01	0.000e+00	1.584e+08	1.584e+08	1.584e+08	1.584e+08

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02

Depth (cm)	Solid Concentrations (μg/kg)				
0.000e+00	4.064e-09	8.889e-03	7.552e-01	5.471e+00	1.110e+01
4.545e-01	2.472e-07	5.402e-01	4.582e+01	3.317e+02	6.729e+02

9.091e-01	4.878e-07	1.065e+00	9.019e+01	6.525e+02	1.323e+03
1.364e+00	7.275e-07	1.586e+00	1.340e+02	9.680e+02	1.963e+03
1.818e+00	9.679e-07	2.106e+00	1.772e+02	1.278e+03	2.592e+03
2.273e+00	1.211e-06	2.627e+00	2.200e+02	1.584e+03	3.210e+03
2.727e+00	1.457e-06	3.152e+00	2.624e+02	1.885e+03	3.819e+03
3.182e+00	1.710e-06	3.683e+00	3.046e+02	2.181e+03	4.418e+03
3.636e+00	1.969e-06	4.223e+00	3.465e+02	2.474e+03	5.007e+03
4.091e+00	2.237e-06	4.774e+00	3.884e+02	2.762e+03	5.587e+03
4.545e+00	2.516e-06	5.339e+00	4.301e+02	3.046e+03	6.159e+03
5.000e+00	2.807e-06	5.920e+00	4.719e+02	3.327e+03	6.721e+03
5.455e+00	3.111e-06	6.519e+00	5.138e+02	3.604e+03	7.276e+03
5.909e+00	3.431e-06	7.139e+00	5.558e+02	3.878e+03	7.822e+03
6.364e+00	3.769e-06	7.782e+00	5.981e+02	4.149e+03	8.361e+03
6.818e+00	4.126e-06	8.451e+00	6.406e+02	4.417e+03	8.892e+03
7.273e+00	4.505e-06	9.148e+00	6.834e+02	4.682e+03	9.415e+03
7.727e+00	4.907e-06	9.876e+00	7.267e+02	4.944e+03	9.931e+03
8.182e+00	5.335e-06	1.064e+01	7.704e+02	5.204e+03	1.044e+04
8.636e+00	5.792e-06	1.143e+01	8.146e+02	5.462e+03	1.094e+04
9.091e+00	6.280e-06	1.227e+01	8.593e+02	5.717e+03	1.144e+04
9.545e+00	6.801e-06	1.315e+01	9.047e+02	5.970e+03	1.193e+04
1.000e+01	7.359e-06	1.407e+01	9.508e+02	6.221e+03	1.241e+04
1.045e+01	7.957e-06	1.503e+01	9.976e+02	6.470e+03	1.289e+04
1.091e+01	8.597e-06	1.605e+01	1.045e+03	6.718e+03	1.337e+04
1.136e+01	9.285e-06	1.712e+01	1.094e+03	6.964e+03	1.383e+04
1.182e+01	1.002e-05	1.825e+01	1.143e+03	7.208e+03	1.429e+04
1.227e+01	1.081e-05	1.944e+01	1.193e+03	7.451e+03	1.475e+04
1.273e+01	1.166e-05	2.069e+01	1.244e+03	7.693e+03	1.520e+04
1.318e+01	1.258e-05	2.200e+01	1.297e+03	7.934e+03	1.565e+04
1.364e+01	1.356e-05	2.339e+01	1.350e+03	8.174e+03	1.609e+04
1.409e+01	1.461e-05	2.485e+01	1.404e+03	8.412e+03	1.653e+04
1.455e+01	1.575e-05	2.638e+01	1.460e+03	8.650e+03	1.696e+04
1.500e+01	1.696e-05	2.800e+01	1.516e+03	8.887e+03	1.739e+04
1.545e+01	1.827e-05	2.970e+01	1.574e+03	9.124e+03	1.782e+04
1.591e+01	1.968e-05	3.149e+01	1.634e+03	9.360e+03	1.824e+04
1.636e+01	2.120e-05	3.338e+01	1.694e+03	9.595e+03	1.866e+04
1.682e+01	2.282e-05	3.536e+01	1.756e+03	9.830e+03	1.907e+04
1.727e+01	2.457e-05	3.744e+01	1.819e+03	1.007e+04	1.949e+04
1.773e+01	2.645e-05	3.964e+01	1.884e+03	1.030e+04	1.989e+04
1.818e+01	2.848e-05	4.194e+01	1.950e+03	1.053e+04	2.030e+04
1.864e+01	3.065e-05	4.436e+01	2.018e+03	1.077e+04	2.070e+04
1.909e+01	3.299e-05	4.690e+01	2.087e+03	1.100e+04	2.110e+04
1.955e+01	3.550e-05	4.957e+01	2.158e+03	1.124e+04	2.150e+04
2.000e+01	3.820e-05	5.238e+01	2.231e+03	1.147e+04	2.189e+04
2.045e+01	4.109e-05	5.531e+01	2.305e+03	1.171e+04	2.228e+04
2.091e+01	4.421e-05	5.840e+01	2.381e+03	1.194e+04	2.267e+04
2.136e+01	4.756e-05	6.163e+01	2.459e+03	1.218e+04	2.305e+04
2.182e+01	5.115e-05	6.501e+01	2.538e+03	1.241e+04	2.344e+04
2.227e+01	5.501e-05	6.856e+01	2.619e+03	1.265e+04	2.382e+04
2.273e+01	5.916e-05	7.227e+01	2.702e+03	1.288e+04	2.420e+04
2.318e+01	6.361e-05	7.616e+01	2.787e+03	1.312e+04	2.458e+04
2.364e+01	6.839e-05	8.022e+01	2.874e+03	1.336e+04	2.495e+04
2.409e+01	7.352e-05	8.447e+01	2.962e+03	1.360e+04	2.532e+04
2.455e+01	7.902e-05	8.891e+01	3.053e+03	1.384e+04	2.570e+04
2.500e+01	8.493e-05	9.355e+01	3.146e+03	1.408e+04	2.607e+04
2.545e+01	9.127e-05	9.839e+01	3.241e+03	1.432e+04	2.644e+04
2.591e+01	9.806e-05	1.034e+02	3.337e+03	1.456e+04	2.680e+04

2.636e+01	1.054e-04	1.087e+02	3.436e+03	1.480e+04	2.717e+04
2.682e+01	1.132e-04	1.142e+02	3.537e+03	1.504e+04	2.753e+04
2.727e+01	1.216e-04	1.199e+02	3.640e+03	1.529e+04	2.790e+04
2.773e+01	1.305e-04	1.259e+02	3.746e+03	1.553e+04	2.826e+04
2.818e+01	1.402e-04	1.321e+02	3.853e+03	1.578e+04	2.862e+04
2.864e+01	1.505e-04	1.386e+02	3.963e+03	1.602e+04	2.898e+04
2.909e+01	1.615e-04	1.453e+02	4.075e+03	1.627e+04	2.934e+04
2.955e+01	1.734e-04	1.523e+02	4.189e+03	1.652e+04	2.970e+04
3.000e+01	nan nan	4.971e+07	8.110e+07	1.000e+08	
3.045e+01	2.206e+04	4.119e+06	5.121e+07	8.160e+07	1.004e+08
3.091e+01	1.669e+05	2.293e+07	5.494e+07	8.269e+07	1.010e+08
3.136e+01	9.977e+05	3.628e+07	5.986e+07	8.432e+07	1.019e+08
3.182e+01	5.484e+06	4.631e+07	6.521e+07	8.638e+07	1.030e+08
3.227e+01	2.625e+07	5.471e+07	7.058e+07	8.879e+07	1.043e+08
3.273e+01	3.947e+07	6.207e+07	7.579e+07	9.146e+07	1.059e+08
3.318e+01	4.973e+07	6.870e+07	8.078e+07	9.431e+07	1.075e+08
3.364e+01	5.838e+07	7.476e+07	8.553e+07	9.726e+07	1.094e+08
3.409e+01	6.599e+07	8.037e+07	9.006e+07	1.003e+08	1.113e+08
3.455e+01	7.285e+07	8.561e+07	9.436e+07	1.033e+08	1.133e+08
3.500e+01	7.912e+07	9.053e+07	9.846e+07	1.064e+08	1.154e+08
3.545e+01	8.493e+07	9.517e+07	1.024e+08	1.094e+08	1.175e+08
3.591e+01	9.035e+07	9.957e+07	1.061e+08	1.123e+08	1.197e+08
3.636e+01	9.544e+07	1.038e+08	1.097e+08	1.152e+08	1.219e+08
3.682e+01	1.002e+08	1.077e+08	1.132e+08	1.181e+08	1.240e+08
3.727e+01	1.048e+08	1.115e+08	1.165e+08	1.209e+08	1.262e+08
3.773e+01	1.091e+08	1.152e+08	1.197e+08	1.236e+08	1.284e+08
3.818e+01	1.132e+08	1.187e+08	1.227e+08	1.263e+08	1.305e+08
3.864e+01	1.171e+08	1.220e+08	1.257e+08	1.288e+08	1.326e+08
3.909e+01	1.209e+08	1.253e+08	1.285e+08	1.314e+08	1.347e+08
3.955e+01	1.245e+08	1.284e+08	1.313e+08	1.338e+08	1.368e+08
4.000e+01	1.279e+08	1.314e+08	1.340e+08	1.362e+08	1.388e+08
4.045e+01	1.312e+08	1.343e+08	1.366e+08	1.385e+08	1.408e+08
4.091e+01	1.344e+08	1.371e+08	1.391e+08	1.407e+08	1.427e+08
4.136e+01	1.375e+08	1.398e+08	1.415e+08	1.429e+08	1.446e+08
4.182e+01	1.404e+08	1.424e+08	1.438e+08	1.451e+08	1.465e+08
4.227e+01	1.433e+08	1.449e+08	1.461e+08	1.471e+08	1.483e+08
4.273e+01	1.460e+08	1.473e+08	1.483e+08	1.491e+08	1.501e+08
4.318e+01	1.487e+08	1.497e+08	1.505e+08	1.511e+08	1.519e+08
4.364e+01	1.513e+08	1.520e+08	1.525e+08	1.530e+08	1.536e+08
4.409e+01	1.537e+08	1.542e+08	1.546e+08	1.549e+08	1.552e+08
4.455e+01	1.561e+08	1.563e+08	1.565e+08	1.567e+08	1.568e+08
4.500e+01	1.584e+08	1.584e+08	1.584e+08	1.584e+08	1.584e+08

Time(yr) 2.000e+02

Depth (cm)	Solid Concentrations (μg/kg)
0.000e+00	1.650e+01
4.545e-01	1.000e+03
9.091e-01	1.967e+03
1.364e+00	2.917e+03
1.818e+00	3.852e+03
2.273e+00	4.771e+03
2.727e+00	5.674e+03
3.182e+00	6.562e+03
3.636e+00	7.436e+03
4.091e+00	8.296e+03

4.545e+00	9.142e+03
5.000e+00	9.975e+03
5.455e+00	1.079e+04
5.909e+00	1.160e+04
6.364e+00	1.240e+04
6.818e+00	1.318e+04
7.273e+00	1.395e+04
7.727e+00	1.471e+04
8.182e+00	1.545e+04
8.636e+00	1.619e+04
9.091e+00	1.692e+04
9.545e+00	1.763e+04
1.000e+01	1.834e+04
1.045e+01	1.903e+04
1.091e+01	1.972e+04
1.136e+01	2.039e+04
1.182e+01	2.106e+04
1.227e+01	2.172e+04
1.273e+01	2.237e+04
1.318e+01	2.301e+04
1.364e+01	2.364e+04
1.409e+01	2.427e+04
1.455e+01	2.489e+04
1.500e+01	2.550e+04
1.545e+01	2.610e+04
1.591e+01	2.670e+04
1.636e+01	2.728e+04
1.682e+01	2.787e+04
1.727e+01	2.844e+04
1.773e+01	2.901e+04
1.818e+01	2.957e+04
1.864e+01	3.013e+04
1.909e+01	3.068e+04
1.955e+01	3.122e+04
2.000e+01	3.176e+04
2.045e+01	3.229e+04
2.091e+01	3.282e+04
2.136e+01	3.334e+04
2.182e+01	3.386e+04
2.227e+01	3.438e+04
2.273e+01	3.488e+04
2.318e+01	3.539e+04
2.364e+01	3.589e+04
2.409e+01	3.638e+04
2.455e+01	3.687e+04
2.500e+01	3.736e+04
2.545e+01	3.784e+04
2.591e+01	3.832e+04
2.636e+01	3.879e+04
2.682e+01	3.927e+04
2.727e+01	3.973e+04
2.773e+01	4.020e+04
2.818e+01	4.066e+04
2.864e+01	4.112e+04
2.909e+01	4.157e+04
2.955e+01	4.202e+04

3.000e+01	1.133e+08
3.045e+01	1.136e+08
3.091e+01	1.140e+08
3.136e+01	1.146e+08
3.182e+01	1.154e+08
3.227e+01	1.162e+08
3.273e+01	1.173e+08
3.318e+01	1.184e+08
3.364e+01	1.196e+08
3.409e+01	1.209e+08
3.455e+01	1.223e+08
3.500e+01	1.238e+08
3.545e+01	1.253e+08
3.591e+01	1.269e+08
3.636e+01	1.285e+08
3.682e+01	1.302e+08
3.727e+01	1.318e+08
3.773e+01	1.335e+08
3.818e+01	1.352e+08
3.864e+01	1.368e+08
3.909e+01	1.385e+08
3.955e+01	1.402e+08
4.000e+01	1.418e+08
4.045e+01	1.434e+08
4.091e+01	1.450e+08
4.136e+01	1.466e+08
4.182e+01	1.482e+08
4.227e+01	1.498e+08
4.273e+01	1.513e+08
4.318e+01	1.528e+08
4.364e+01	1.542e+08
4.409e+01	1.557e+08
4.455e+01	1.571e+08
4.500e+01	1.584e+08

Total Concentration Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)	Total Concentrations (μg/L)				
0.000e+00	0.000e+00	1.143e-55	6.456e-39	5.986e-27	1.178e-16
4.545e-01	0.000e+00	7.008e-54	3.945e-37	3.641e-25	7.174e-15
9.091e-01	0.000e+00	1.394e-53	7.820e-37	7.183e-25	1.417e-14
1.364e+00	0.000e+00	2.107e-53	1.175e-36	1.071e-24	2.115e-14
1.818e+00	0.000e+00	2.854e-53	1.580e-36	1.424e-24	2.819e-14
2.273e+00	0.000e+00	3.652e-53	2.003e-36	1.781e-24	3.534e-14
2.727e+00	0.000e+00	4.518e-53	2.450e-36	2.142e-24	4.265e-14
3.182e+00	0.000e+00	5.470e-53	2.928e-36	2.511e-24	5.019e-14
3.636e+00	0.000e+00	6.527e-53	3.443e-36	2.889e-24	5.800e-14
4.091e+00	0.000e+00	7.710e-53	4.003e-36	3.278e-24	6.615e-14
4.545e+00	0.000e+00	9.043e-53	4.615e-36	3.680e-24	7.470e-14
5.000e+00	0.000e+00	1.055e-52	5.288e-36	4.097e-24	8.371e-14
5.455e+00	0.000e+00	1.226e-52	6.030e-36	4.532e-24	9.324e-14
5.909e+00	0.000e+00	1.422e-52	6.853e-36	4.985e-24	1.034e-13
6.364e+00	0.000e+00	1.644e-52	7.766e-36	5.460e-24	1.142e-13
6.818e+00	0.000e+00	1.899e-52	8.781e-36	5.957e-24	1.257e-13

7.273e+00	0.000e+00	2.189e-52	9.911e-36	6.478e-24	1.380e-13
7.727e+00	0.000e+00	2.522e-52	1.117e-35	7.025e-24	1.513e-13
8.182e+00	0.000e+00	2.903e-52	1.258e-35	7.600e-24	1.655e-13
8.636e+00	0.000e+00	3.338e-52	1.415e-35	8.203e-24	1.808e-13
9.091e+00	0.000e+00	3.837e-52	1.590e-35	8.838e-24	1.974e-13
9.545e+00	0.000e+00	4.408e-52	1.786e-35	9.504e-24	2.152e-13
1.000e+01	0.000e+00	5.061e-52	2.005e-35	1.020e-23	2.344e-13
1.045e+01	0.000e+00	5.808e-52	2.250e-35	1.093e-23	2.552e-13
1.091e+01	0.000e+00	6.662e-52	2.524e-35	1.170e-23	2.777e-13
1.136e+01	0.000e+00	7.639e-52	2.830e-35	1.250e-23	3.021e-13
1.182e+01	0.000e+00	8.755e-52	3.172e-35	1.334e-23	3.284e-13
1.227e+01	0.000e+00	1.003e-51	3.554e-35	1.421e-23	3.568e-13
1.273e+01	0.000e+00	1.149e-51	3.981e-35	1.511e-23	3.877e-13
1.318e+01	0.000e+00	1.315e-51	4.459e-35	1.605e-23	4.211e-13
1.364e+01	0.000e+00	1.505e-51	4.993e-35	1.702e-23	4.572e-13
1.409e+01	0.000e+00	1.722e-51	5.590e-35	1.802e-23	4.964e-13
1.455e+01	0.000e+00	1.969e-51	6.258e-35	1.904e-23	5.388e-13
1.500e+01	0.000e+00	2.250e-51	7.003e-35	2.008e-23	5.847e-13
1.545e+01	0.000e+00	2.571e-51	7.837e-35	2.114e-23	6.345e-13
1.591e+01	0.000e+00	2.937e-51	8.769e-35	2.220e-23	6.884e-13
1.636e+01	0.000e+00	3.354e-51	9.810e-35	2.327e-23	7.468e-13
1.682e+01	0.000e+00	3.828e-51	1.097e-34	2.433e-23	8.101e-13
1.727e+01	0.000e+00	4.367e-51	1.228e-34	2.537e-23	8.786e-13
1.773e+01	0.000e+00	4.980e-51	1.373e-34	2.639e-23	9.528e-13
1.818e+01	0.000e+00	5.678e-51	1.535e-34	2.735e-23	1.033e-12
1.864e+01	0.000e+00	6.470e-51	1.717e-34	2.825e-23	1.120e-12
1.909e+01	0.000e+00	7.371e-51	1.920e-34	2.907e-23	1.215e-12
1.955e+01	0.000e+00	8.393e-51	2.147e-34	2.979e-23	1.317e-12
2.000e+01	0.000e+00	9.553e-51	2.401e-34	3.037e-23	1.428e-12
2.045e+01	0.000e+00	1.087e-50	2.684e-34	3.079e-23	1.547e-12
2.091e+01	0.000e+00	1.236e-50	3.001e-34	3.102e-23	1.677e-12
2.136e+01	0.000e+00	1.405e-50	3.355e-34	3.102e-23	1.818e-12
2.182e+01	0.000e+00	1.597e-50	3.750e-34	3.074e-23	1.970e-12
2.227e+01	0.000e+00	1.814e-50	4.192e-34	3.013e-23	2.135e-12
2.273e+01	0.000e+00	2.060e-50	4.686e-34	2.915e-23	2.313e-12
2.318e+01	0.000e+00	2.339e-50	5.239e-34	2.772e-23	2.507e-12
2.364e+01	0.000e+00	2.653e-50	5.855e-34	2.579e-23	2.716e-12
2.409e+01	0.000e+00	3.009e-50	6.545e-34	2.327e-23	2.943e-12
2.455e+01	0.000e+00	3.412e-50	7.315e-34	2.009e-23	3.188e-12
2.500e+01	0.000e+00	3.866e-50	8.176e-34	1.614e-23	3.454e-12
2.545e+01	0.000e+00	4.379e-50	9.137e-34	1.131e-23	3.741e-12
2.591e+01	0.000e+00	4.958e-50	1.021e-33	5.506e-24	4.053e-12
2.636e+01	0.000e+00	5.612e-50	1.141e-33	1.417e-24	4.390e-12
2.682e+01	0.000e+00	6.349e-50	1.275e-33	9.598e-24	4.755e-12
2.727e+01	0.000e+00	7.180e-50	1.425e-33	1.919e-23	5.150e-12
2.773e+01	0.000e+00	8.116e-50	1.592e-33	3.038e-23	5.578e-12
2.818e+01	0.000e+00	9.171e-50	1.778e-33	4.334e-23	6.041e-12
2.864e+01	0.000e+00	1.036e-49	1.987e-33	5.829e-23	6.543e-12
2.909e+01	0.000e+00	1.170e-49	2.219e-33	7.546e-23	7.086e-12
2.955e+01	0.000e+00	1.320e-49	2.478e-33	9.510e-23	7.674e-12
3.000e+01	0.000e+00	7.129e-13	nan	nan	nan
3.045e+01	nan	nan	nan	nan	4.804e+00
3.091e+01	nan	nan	7.707e-07	nan	4.158e+01
3.136e+01	0.000e+00	nan	6.642e-06	7.751e-02	2.896e+02
3.182e+01	0.000e+00	7.983e-11	4.680e-05	7.435e-01	2.029e+03
3.227e+01	nan	8.839e-10	nan	6.724e+00	1.410e+04

3.273e+01	nan	7.136e-09	nan	5.819e+01	9.386e+04
3.318e+01	nan	nan	nan	4.724e+02	5.768e+05
3.364e+01	0.000e+00	nan	nan	3.589e+03	3.088e+06
3.409e+01	0.000e+00	nan	nan	2.626e+04	5.078e+06
3.455e+01	0.000e+00	nan	nan	1.921e+05	6.532e+06
3.500e+01	nan	4.341e-04	1.150e+02	1.328e+06	7.738e+06
3.545e+01	nan	5.260e-03	1.473e+03	4.383e+06	8.791e+06
3.591e+01	nan	4.538e-02	1.353e+04	6.176e+06	9.736e+06
3.636e+01	0.000e+00	2.193e-01	1.068e+05	7.609e+06	1.060e+07
3.682e+01	0.000e+00	nan	7.450e+05	8.834e+06	1.139e+07
3.727e+01	nan	nan	4.187e+06	9.915e+06	1.213e+07
3.773e+01	nan	nan	6.422e+06	1.089e+07	1.283e+07
3.818e+01	nan	nan	8.119e+06	1.178e+07	1.348e+07
3.864e+01	0.000e+00	2.787e+04	9.533e+06	1.261e+07	1.410e+07
3.909e+01	0.000e+00	3.038e+05	1.077e+07	1.338e+07	1.468e+07
3.955e+01	0.000e+00	2.500e+06	1.187e+07	1.409e+07	1.524e+07
4.000e+01	nan	6.488e+06	1.287e+07	1.477e+07	1.576e+07
4.045e+01	nan	8.810e+06	1.379e+07	1.541e+07	1.627e+07
4.091e+01	nan	1.066e+07	1.464e+07	1.601e+07	1.675e+07
4.136e+01	0.000e+00	1.223e+07	1.543e+07	1.659e+07	1.722e+07
4.182e+01	0.000e+00	1.361e+07	1.618e+07	1.713e+07	1.766e+07
4.227e+01	nan	1.484e+07	1.687e+07	1.765e+07	1.809e+07
4.273e+01	nan	1.596e+07	1.753e+07	1.815e+07	1.849e+07
4.318e+01	nan	1.697e+07	1.815e+07	1.862e+07	1.889e+07
4.364e+01	0.000e+00	1.791e+07	1.873e+07	1.907e+07	1.927e+07
4.409e+01	0.000e+00	1.877e+07	1.929e+07	1.951e+07	1.963e+07
4.455e+01	0.000e+00	1.957e+07	1.982e+07	1.992e+07	1.998e+07
4.500e+01	0.000e+00	2.032e+07	2.032e+07	2.032e+07	2.032e+07

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02

Depth (cm)	Total Concentrations (μg/L)				
0.000e+00	6.142e-09	1.343e-02	1.141e+00	8.268e+00	1.677e+01
4.545e-01	3.736e-07	8.164e-01	6.926e+01	5.013e+02	1.017e+03
9.091e-01	7.372e-07	1.610e+00	1.363e+02	9.861e+02	2.000e+03
1.364e+00	1.099e-06	2.397e+00	2.025e+02	1.463e+03	2.967e+03
1.818e+00	1.463e-06	3.182e+00	2.678e+02	1.932e+03	3.917e+03
2.273e+00	1.830e-06	3.970e+00	3.325e+02	2.394e+03	4.852e+03
2.727e+00	2.203e-06	4.763e+00	3.966e+02	2.849e+03	5.772e+03
3.182e+00	2.584e-06	5.566e+00	4.603e+02	3.297e+03	6.677e+03
3.636e+00	2.976e-06	6.383e+00	5.238e+02	3.739e+03	7.568e+03
4.091e+00	3.381e-06	7.216e+00	5.870e+02	4.174e+03	8.444e+03
4.545e+00	3.802e-06	8.069e+00	6.501e+02	4.604e+03	9.308e+03
5.000e+00	4.242e-06	8.947e+00	7.133e+02	5.029e+03	1.016e+04
5.455e+00	4.702e-06	9.853e+00	7.765e+02	5.448e+03	1.100e+04
5.909e+00	5.186e-06	1.079e+01	8.400e+02	5.862e+03	1.182e+04
6.364e+00	5.696e-06	1.176e+01	9.039e+02	6.271e+03	1.264e+04
6.818e+00	6.236e-06	1.277e+01	9.681e+02	6.676e+03	1.344e+04
7.273e+00	6.808e-06	1.383e+01	1.033e+03	7.076e+03	1.423e+04
7.727e+00	7.416e-06	1.493e+01	1.098e+03	7.473e+03	1.501e+04
8.182e+00	8.063e-06	1.608e+01	1.164e+03	7.865e+03	1.578e+04
8.636e+00	8.754e-06	1.728e+01	1.231e+03	8.254e+03	1.654e+04
9.091e+00	9.491e-06	1.854e+01	1.299e+03	8.640e+03	1.729e+04
9.545e+00	1.028e-05	1.987e+01	1.367e+03	9.023e+03	1.803e+04
1.000e+01	1.112e-05	2.126e+01	1.437e+03	9.402e+03	1.876e+04
1.045e+01	1.203e-05	2.272e+01	1.508e+03	9.779e+03	1.949e+04

1.091e+01	1.299e-05	2.426e+01	1.580e+03	1.015e+04	2.020e+04
1.136e+01	1.403e-05	2.588e+01	1.653e+03	1.052e+04	2.091e+04
1.182e+01	1.515e-05	2.758e+01	1.727e+03	1.089e+04	2.160e+04
1.227e+01	1.634e-05	2.937e+01	1.803e+03	1.126e+04	2.229e+04
1.273e+01	1.763e-05	3.126e+01	1.881e+03	1.163e+04	2.298e+04
1.318e+01	1.901e-05	3.325e+01	1.959e+03	1.199e+04	2.365e+04
1.364e+01	2.049e-05	3.534e+01	2.040e+03	1.235e+04	2.432e+04
1.409e+01	2.208e-05	3.755e+01	2.122e+03	1.271e+04	2.498e+04
1.455e+01	2.380e-05	3.987e+01	2.206e+03	1.307e+04	2.564e+04
1.500e+01	2.564e-05	4.231e+01	2.292e+03	1.343e+04	2.629e+04
1.545e+01	2.762e-05	4.489e+01	2.379e+03	1.379e+04	2.693e+04
1.591e+01	2.975e-05	4.759e+01	2.469e+03	1.415e+04	2.757e+04
1.636e+01	3.203e-05	5.044e+01	2.560e+03	1.450e+04	2.820e+04
1.682e+01	3.449e-05	5.344e+01	2.654e+03	1.486e+04	2.883e+04
1.727e+01	3.714e-05	5.659e+01	2.750e+03	1.521e+04	2.945e+04
1.773e+01	3.998e-05	5.990e+01	2.848e+03	1.557e+04	3.007e+04
1.818e+01	4.304e-05	6.339e+01	2.948e+03	1.592e+04	3.068e+04
1.864e+01	4.632e-05	6.705e+01	3.050e+03	1.627e+04	3.129e+04
1.909e+01	4.985e-05	7.089e+01	3.155e+03	1.663e+04	3.189e+04
1.955e+01	5.365e-05	7.492e+01	3.262e+03	1.698e+04	3.249e+04
2.000e+01	5.773e-05	7.916e+01	3.372e+03	1.734e+04	3.308e+04
2.045e+01	6.211e-05	8.360e+01	3.484e+03	1.769e+04	3.367e+04
2.091e+01	6.682e-05	8.826e+01	3.598e+03	1.805e+04	3.426e+04
2.136e+01	7.187e-05	9.314e+01	3.716e+03	1.840e+04	3.484e+04
2.182e+01	7.731e-05	9.826e+01	3.836e+03	1.876e+04	3.542e+04
2.227e+01	8.314e-05	1.036e+02	3.958e+03	1.911e+04	3.600e+04
2.273e+01	8.941e-05	1.092e+02	4.084e+03	1.947e+04	3.657e+04
2.318e+01	9.614e-05	1.151e+02	4.212e+03	1.983e+04	3.714e+04
2.364e+01	1.034e-04	1.212e+02	4.343e+03	2.019e+04	3.771e+04
2.409e+01	1.111e-04	1.277e+02	4.477e+03	2.055e+04	3.827e+04
2.455e+01	1.194e-04	1.344e+02	4.614e+03	2.091e+04	3.884e+04
2.500e+01	1.284e-04	1.414e+02	4.754e+03	2.127e+04	3.940e+04
2.545e+01	1.379e-04	1.487e+02	4.898e+03	2.164e+04	3.995e+04
2.591e+01	1.482e-04	1.563e+02	5.044e+03	2.200e+04	4.051e+04
2.636e+01	1.592e-04	1.643e+02	5.193e+03	2.237e+04	4.106e+04
2.682e+01	1.710e-04	1.726e+02	5.346e+03	2.273e+04	4.161e+04
2.727e+01	1.837e-04	1.813e+02	5.502e+03	2.310e+04	4.216e+04
2.773e+01	1.973e-04	1.903e+02	5.661e+03	2.347e+04	4.271e+04
2.818e+01	2.118e-04	1.997e+02	5.823e+03	2.384e+04	4.325e+04
2.864e+01	2.274e-04	2.094e+02	5.989e+03	2.422e+04	4.380e+04
2.909e+01	2.441e-04	2.196e+02	6.159e+03	2.459e+04	4.434e+04
2.955e+01	2.620e-04	2.301e+02	6.331e+03	2.497e+04	4.488e+04
3.000e+01	nan nan	6.364e+06	1.039e+07	1.282e+07	
3.045e+01	2.823e+03	5.272e+05	6.557e+06	1.045e+07	1.286e+07
3.091e+01	2.136e+04	2.936e+06	7.034e+06	1.059e+07	1.294e+07
3.136e+01	1.277e+05	4.645e+06	7.665e+06	1.080e+07	1.305e+07
3.182e+01	7.020e+05	5.930e+06	8.350e+06	1.106e+07	1.319e+07
3.227e+01	3.360e+06	7.005e+06	9.038e+06	1.137e+07	1.337e+07
3.273e+01	5.053e+06	7.948e+06	9.706e+06	1.172e+07	1.356e+07
3.318e+01	6.366e+06	8.797e+06	1.035e+07	1.208e+07	1.378e+07
3.364e+01	7.475e+06	9.574e+06	1.096e+07	1.246e+07	1.401e+07
3.409e+01	8.450e+06	1.029e+07	1.154e+07	1.285e+07	1.426e+07
3.455e+01	9.329e+06	1.097e+07	1.209e+07	1.324e+07	1.452e+07
3.500e+01	1.013e+07	1.160e+07	1.261e+07	1.363e+07	1.479e+07
3.545e+01	1.088e+07	1.219e+07	1.312e+07	1.401e+07	1.506e+07
3.591e+01	1.157e+07	1.276e+07	1.360e+07	1.439e+07	1.534e+07

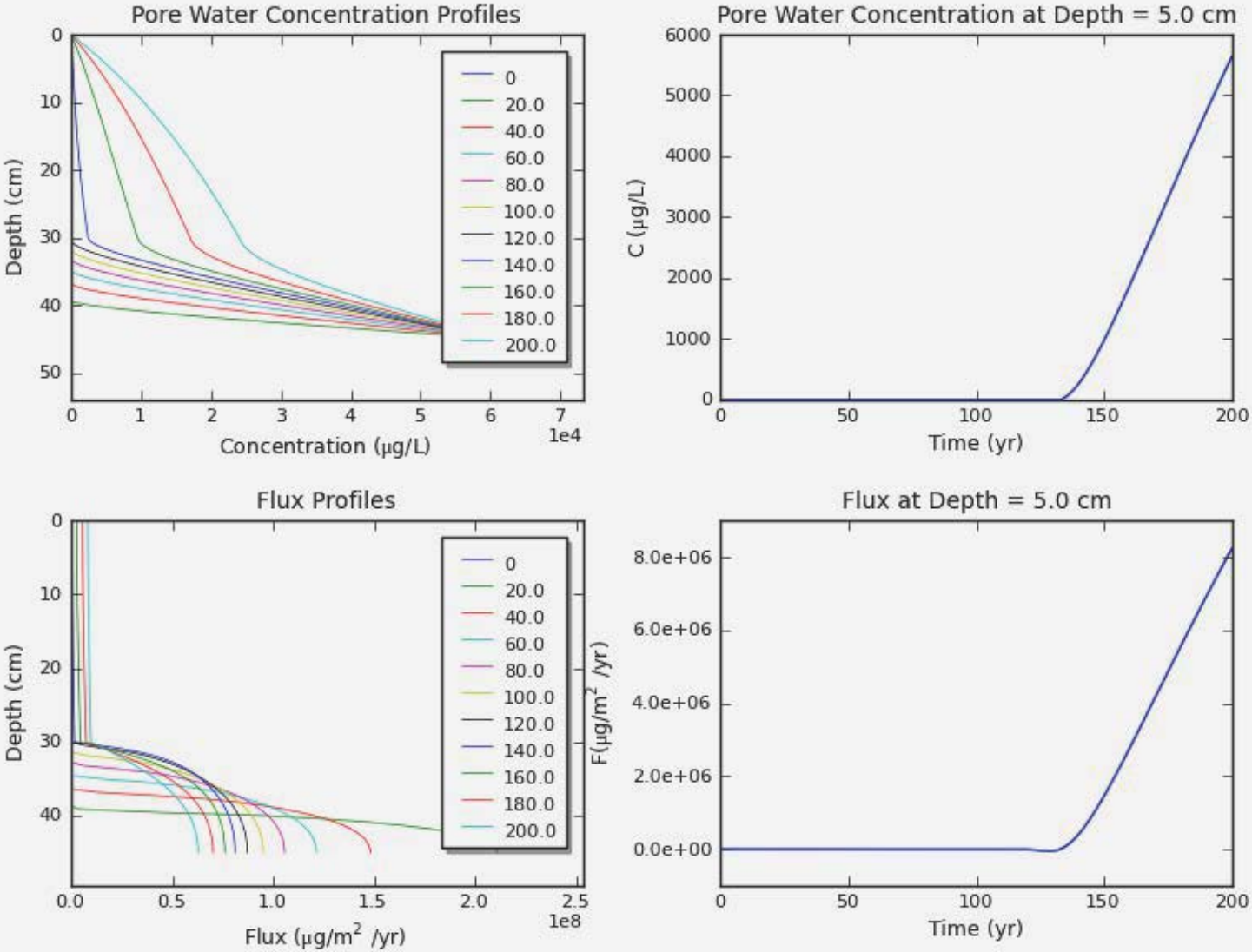
3.636e+01	1.223e+07	1.329e+07	1.406e+07	1.477e+07	1.562e+07
3.682e+01	1.284e+07	1.380e+07	1.450e+07	1.513e+07	1.590e+07
3.727e+01	1.342e+07	1.429e+07	1.493e+07	1.549e+07	1.618e+07
3.773e+01	1.398e+07	1.476e+07	1.533e+07	1.584e+07	1.645e+07
3.818e+01	1.451e+07	1.521e+07	1.573e+07	1.618e+07	1.673e+07
3.864e+01	1.501e+07	1.564e+07	1.611e+07	1.651e+07	1.700e+07
3.909e+01	1.549e+07	1.606e+07	1.648e+07	1.684e+07	1.727e+07
3.955e+01	1.595e+07	1.646e+07	1.683e+07	1.715e+07	1.753e+07
4.000e+01	1.640e+07	1.684e+07	1.717e+07	1.746e+07	1.779e+07
4.045e+01	1.682e+07	1.721e+07	1.751e+07	1.775e+07	1.805e+07
4.091e+01	1.723e+07	1.757e+07	1.783e+07	1.804e+07	1.830e+07
4.136e+01	1.763e+07	1.792e+07	1.814e+07	1.833e+07	1.854e+07
4.182e+01	1.801e+07	1.825e+07	1.844e+07	1.860e+07	1.878e+07
4.227e+01	1.837e+07	1.858e+07	1.873e+07	1.887e+07	1.902e+07
4.273e+01	1.872e+07	1.889e+07	1.902e+07	1.912e+07	1.925e+07
4.318e+01	1.907e+07	1.920e+07	1.929e+07	1.938e+07	1.947e+07
4.364e+01	1.940e+07	1.949e+07	1.956e+07	1.962e+07	1.969e+07
4.409e+01	1.971e+07	1.977e+07	1.982e+07	1.986e+07	1.991e+07
4.455e+01	2.002e+07	2.005e+07	2.007e+07	2.009e+07	2.012e+07
4.500e+01	2.032e+07	2.032e+07	2.032e+07	2.032e+07	2.032e+07

Time(yr) 2.000e+02

Depth (cm)	Total Concentrations (μg/L)
0.000e+00	2.493e+01
4.545e-01	1.512e+03
9.091e-01	2.973e+03
1.364e+00	4.409e+03
1.818e+00	5.821e+03
2.273e+00	7.210e+03
2.727e+00	8.575e+03
3.182e+00	9.918e+03
3.636e+00	1.124e+04
4.091e+00	1.254e+04
4.545e+00	1.382e+04
5.000e+00	1.508e+04
5.455e+00	1.631e+04
5.909e+00	1.753e+04
6.364e+00	1.873e+04
6.818e+00	1.992e+04
7.273e+00	2.108e+04
7.727e+00	2.223e+04
8.182e+00	2.336e+04
8.636e+00	2.447e+04
9.091e+00	2.557e+04
9.545e+00	2.665e+04
1.000e+01	2.771e+04
1.045e+01	2.876e+04
1.091e+01	2.980e+04
1.136e+01	3.082e+04
1.182e+01	3.183e+04
1.227e+01	3.283e+04
1.273e+01	3.381e+04
1.318e+01	3.478e+04
1.364e+01	3.574e+04
1.409e+01	3.668e+04

1.455e+01	3.761e+04
1.500e+01	3.854e+04
1.545e+01	3.945e+04
1.591e+01	4.035e+04
1.636e+01	4.123e+04
1.682e+01	4.211e+04
1.727e+01	4.298e+04
1.773e+01	4.384e+04
1.818e+01	4.469e+04
1.864e+01	4.553e+04
1.909e+01	4.636e+04
1.955e+01	4.719e+04
2.000e+01	4.800e+04
2.045e+01	4.881e+04
2.091e+01	4.960e+04
2.136e+01	5.040e+04
2.182e+01	5.118e+04
2.227e+01	5.195e+04
2.273e+01	5.272e+04
2.318e+01	5.348e+04
2.364e+01	5.424e+04
2.409e+01	5.498e+04
2.455e+01	5.573e+04
2.500e+01	5.646e+04
2.545e+01	5.719e+04
2.591e+01	5.791e+04
2.636e+01	5.863e+04
2.682e+01	5.934e+04
2.727e+01	6.005e+04
2.773e+01	6.075e+04
2.818e+01	6.145e+04
2.864e+01	6.214e+04
2.909e+01	6.283e+04
2.955e+01	6.351e+04
3.000e+01	1.452e+07
3.045e+01	1.455e+07
3.091e+01	1.461e+07
3.136e+01	1.469e+07
3.182e+01	1.478e+07
3.227e+01	1.490e+07
3.273e+01	1.503e+07
3.318e+01	1.517e+07
3.364e+01	1.533e+07
3.409e+01	1.550e+07
3.455e+01	1.568e+07
3.500e+01	1.587e+07
3.545e+01	1.606e+07
3.591e+01	1.627e+07
3.636e+01	1.647e+07
3.682e+01	1.668e+07
3.727e+01	1.690e+07
3.773e+01	1.711e+07
3.818e+01	1.733e+07
3.864e+01	1.754e+07
3.909e+01	1.775e+07
3.955e+01	1.797e+07

4.000e+01	1.818e+07
4.045e+01	1.839e+07
4.091e+01	1.860e+07
4.136e+01	1.880e+07
4.182e+01	1.900e+07
4.227e+01	1.920e+07
4.273e+01	1.940e+07
4.318e+01	1.959e+07
4.364e+01	1.978e+07
4.409e+01	1.996e+07
4.455e+01	2.014e+07
4.500e+01	2.032e+07


Pore Water Concentration Profiles
Depth (cm)
Concentration (μg/L)
1e4
0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
Pore Water Concentration at Depth = 5.0 cm
C (μg/L)
Time (yr)
Flux Profiles
Depth (cm)
Flux (μg/m² /yr)
1e8
Flux at Depth = 5.0 cm
F(μg/m² /yr)
Time (yr)

Model Run Report for "Aqugate_Soil_Barrier_Rev_2014-0724_12inchAGPAC.cpsm"

Version: CapSim 2.6

Date and Time: 2014-07-24 15:39:56

Model setup:

Model the underlying sediment using a constant concentration boundary condition
Ignore bioturbation at the top of the system
Ignore consolidation of the underlying sediment
Ignore deposition of fresh sediment on the cap
Model a 2 layer system

Layer Parameters:

Overlying water concentration:	0.000e+00 µg/L

Layer 1: Sediment

initial concentration:	0.000e+00 µg/L
depth:	30.0 cm
porosity:	0.55
bulk density:	1.20 g/cm³
sorption isotherm:	Linear--Kocfoc
organic carbon fraction	0.030
Kd	1.767e+00 L/kg
retardation factor:	5.503e-01
tortuosity correction:	Boudreau
hydrodynamic dispersivity:	1.00 cm
effection diffusion coefficient:	6.621e+01 cm²/yr
decay rate:	None

Layer 2: Activated Carbon

initial concentration:	0.000e+00 µg/L
depth:	30.0 cm
porosity:	0.66
bulk density:	0.13 g/cm³
sorption isotherm:	Freundlich
Freundlich Kf:	3.00e+06 µg/kg/(µg/L)^(1/n)
Freundlich 1/n:	0.36
retardation factor:	Variable but > 6.774e-01
tortuosity correction:	Millington & Quirk
hydrodynamic dispersivity:	1.00 cm
effection diffusion coefficient:	1.486e+02 cm²/yr
decay rate:	None

Underlying pore water concentration: 6.100e+04 μg/L

Flow and System Parameters:

Chemical name:	benzene-15C
Temperature:	15.0°C
Darcy velocity:	2.54 cm/yr
Molecular diffusivity:	8.06e-06 cm²/s
Organic carbon partition coefficient:	1.77 log(L/kg)
Dissolved organic carbon partition coefficient:	1.55 log(L/kg)
Dissolved organic matter concentration:	194.0 μg/L
Benthic boundary layer mass transfer coefficient:	1.0 cm/hr

Model output:

Depth of interest: 5.0 cm

Time (yrs)	C (μg/L)	F (μg/m²/yr)	q (μg/kg)	W(μg/L)
0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.119e-01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.024e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.536e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.048e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.560e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.072e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.583e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.095e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.607e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.119e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.631e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.143e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.655e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.167e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.679e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.191e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.703e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.215e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.726e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.024e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.075e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.126e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.177e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.229e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.280e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.331e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.382e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.433e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.485e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.536e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.587e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.638e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.689e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.741e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.792e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.843e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.894e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00

1.945e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.996e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.048e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.099e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.150e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.201e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.252e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.304e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.355e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.406e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.457e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.508e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.560e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.611e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.662e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.713e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.764e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.816e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.867e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.918e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
2.969e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.020e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.072e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.123e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.174e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.225e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.276e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.327e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.379e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.430e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.481e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.532e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.583e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.635e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.686e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.737e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.788e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.839e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.891e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.942e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
3.993e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.044e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.095e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.147e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.198e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.249e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.300e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.351e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.403e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.454e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.505e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.556e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.607e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.658e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.710e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.761e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00

4.812e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.863e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.914e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
4.966e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.017e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.068e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.119e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.170e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.222e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.273e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.324e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.375e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.426e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.478e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.529e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.580e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.631e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.682e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.733e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.785e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.836e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.887e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.938e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
5.989e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.041e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.092e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.143e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.194e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.245e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.297e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.348e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.399e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.450e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.501e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.553e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.604e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.655e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.706e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.757e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.809e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.860e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.911e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
6.962e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.013e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.064e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.116e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.167e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.218e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.269e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.320e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.372e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.423e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.474e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.525e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.576e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.628e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00

7.679e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.730e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.781e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.832e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.884e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.935e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
7.986e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.037e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.088e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.140e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.191e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.242e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.293e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.344e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.395e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.447e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.498e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.549e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.600e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.651e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.703e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.754e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.805e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.856e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.907e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
8.959e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.010e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.061e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.112e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.163e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.215e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.266e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.317e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.368e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.419e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.471e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.522e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.573e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.624e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.675e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.726e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.778e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.829e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.880e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.931e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
9.982e+01	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.003e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.008e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.014e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.019e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.024e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.029e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.034e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.039e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.044e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.049e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00

1.055e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.060e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.065e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.070e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.075e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.080e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.085e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.090e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.096e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.101e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.106e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.111e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.116e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.121e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.126e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.131e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.136e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.142e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.147e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.152e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.157e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.162e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.167e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.172e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.177e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.183e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.188e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.193e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.198e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.203e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.208e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.213e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.218e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.223e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.229e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.234e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.239e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.244e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.249e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.254e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.259e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.264e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.270e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.275e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.280e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.285e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.290e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.295e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.300e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.305e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.311e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.316e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.321e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.326e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.331e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.336e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00

1.341e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.346e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.351e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.357e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.362e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.367e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.372e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.377e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.382e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.387e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.392e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.398e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.403e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.408e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.413e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.418e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.423e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.428e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.433e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.438e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.444e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.449e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.454e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.459e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.464e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.469e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.474e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.479e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.485e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.490e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.495e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.500e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.505e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.510e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.515e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.520e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.526e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.531e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.536e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.541e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.546e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.551e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.556e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.561e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.566e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.572e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.577e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.582e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.587e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.592e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.597e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.602e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.607e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.613e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.618e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.623e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00

1.628e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.633e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.638e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.643e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.648e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.653e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.659e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.664e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.669e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.674e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.679e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.684e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.689e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.694e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.700e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.705e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.710e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.715e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.720e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.725e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.730e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.735e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.741e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.746e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.751e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.756e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.761e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.766e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.771e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.776e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.781e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.787e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.792e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.797e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.802e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.807e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.812e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.817e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.822e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.828e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.833e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.838e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.843e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.848e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.853e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.858e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.863e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.869e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.874e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.879e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.884e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.889e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.894e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.899e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.904e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.909e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00

1.915e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.920e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.925e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.930e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.935e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.940e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.945e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.950e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.956e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.961e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.966e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.971e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.976e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.981e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.986e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.991e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
1.996e+02	0.000e+00	0.000e+00	0.000e+00	0.000e+00

Pore Water Concentration Profiles at Various Times

Time (yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)		Pore Water Concentrations (μg/L)			
0.000e+00	0.000e+00	4.821e-111	8.364e-96	2.521e-85	9.461e-77
6.000e-01	0.000e+00	3.881e-109	6.706e-94	2.014e-83	7.572e-75
1.200e+00	0.000e+00	7.726e-109	1.330e-93	3.979e-83	1.498e-74
1.800e+00	0.000e+00	1.168e-108	1.997e-93	5.941e-83	2.243e-74
2.400e+00	0.000e+00	1.584e-108	2.683e-93	7.920e-83	3.002e-74
3.000e+00	0.000e+00	2.030e-108	3.401e-93	9.936e-83	3.784e-74
3.600e+00	0.000e+00	2.518e-108	4.161e-93	1.201e-82	4.601e-74
4.200e+00	0.000e+00	3.058e-108	4.975e-93	1.416e-82	5.462e-74
4.800e+00	0.000e+00	3.661e-108	5.856e-93	1.640e-82	6.377e-74
5.400e+00	0.000e+00	4.342e-108	6.817e-93	1.875e-82	7.359e-74
6.000e+00	0.000e+00	5.115e-108	7.871e-93	2.124e-82	8.418e-74
6.600e+00	0.000e+00	5.996e-108	9.035e-93	2.388e-82	9.567e-74
7.200e+00	0.000e+00	7.004e-108	1.032e-92	2.669e-82	1.082e-73
7.800e+00	0.000e+00	8.158e-108	1.176e-92	2.969e-82	1.219e-73
8.400e+00	0.000e+00	9.482e-108	1.335e-92	3.290e-82	1.369e-73
9.000e+00	0.000e+00	1.100e-107	1.513e-92	3.633e-82	1.534e-73
9.600e+00	0.000e+00	1.275e-107	1.711e-92	4.002e-82	1.716e-73
1.020e+01	0.000e+00	1.476e-107	1.932e-92	4.397e-82	1.916e-73
1.080e+01	0.000e+00	1.706e-107	2.180e-92	4.822e-82	2.138e-73
1.140e+01	0.000e+00	1.971e-107	2.456e-92	5.277e-82	2.382e-73
1.200e+01	0.000e+00	2.275e-107	2.765e-92	5.764e-82	2.652e-73
1.260e+01	0.000e+00	2.623e-107	3.110e-92	6.286e-82	2.951e-73
1.320e+01	0.000e+00	3.022e-107	3.496e-92	6.845e-82	3.281e-73
1.380e+01	0.000e+00	3.479e-107	3.926e-92	7.440e-82	3.646e-73
1.440e+01	0.000e+00	4.001e-107	4.406e-92	8.075e-82	4.051e-73
1.500e+01	0.000e+00	4.598e-107	4.940e-92	8.750e-82	4.497e-73
1.560e+01	0.000e+00	5.280e-107	5.536e-92	9.465e-82	4.992e-73
1.620e+01	0.000e+00	6.057e-107	6.200e-92	1.022e-81	5.538e-73
1.680e+01	0.000e+00	6.942e-107	6.937e-92	1.102e-81	6.142e-73
1.740e+01	0.000e+00	7.948e-107	7.757e-92	1.185e-81	6.809e-73
1.800e+01	0.000e+00	9.091e-107	8.668e-92	1.273e-81	7.547e-73
1.860e+01	0.000e+00	1.039e-106	9.677e-92	1.364e-81	8.361e-73
1.920e+01	0.000e+00	1.186e-106	1.080e-91	1.458e-81	9.260e-73

1.980e+01	0.000e+00	1.352e-106	1.204e-91	1.554e-81	1.025e-72
2.040e+01	0.000e+00	1.539e-106	1.341e-91	1.652e-81	1.135e-72
2.100e+01	0.000e+00	1.750e-106	1.492e-91	1.751e-81	1.256e-72
2.160e+01	0.000e+00	1.987e-106	1.659e-91	1.850e-81	1.389e-72
2.220e+01	0.000e+00	2.252e-106	1.843e-91	1.947e-81	1.535e-72
2.280e+01	0.000e+00	2.550e-106	2.045e-91	2.040e-81	1.697e-72
2.340e+01	0.000e+00	2.881e-106	2.267e-91	2.127e-81	1.875e-72
2.400e+01	0.000e+00	3.250e-106	2.510e-91	2.206e-81	2.071e-72
2.460e+01	0.000e+00	3.659e-106	2.777e-91	2.273e-81	2.286e-72
2.520e+01	0.000e+00	4.110e-106	3.068e-91	2.324e-81	2.523e-72
2.580e+01	0.000e+00	4.606e-106	3.386e-91	2.355e-81	2.783e-72
2.640e+01	0.000e+00	5.149e-106	3.732e-91	2.360e-81	3.069e-72
2.700e+01	0.000e+00	5.740e-106	4.107e-91	2.332e-81	3.382e-72
2.760e+01	0.000e+00	6.379e-106	4.513e-91	2.265e-81	3.727e-72
2.820e+01	0.000e+00	7.064e-106	4.952e-91	2.149e-81	4.104e-72
2.880e+01	0.000e+00	7.794e-106	5.424e-91	1.973e-81	4.517e-72
2.940e+01	0.000e+00	8.562e-106	5.930e-91	1.726e-81	4.970e-72
3.000e+01	0.000e+00	9.360e-106	6.471e-91	1.394e-81	5.465e-72
3.060e+01	0.000e+00	1.916e-107	8.847e-93	1.994e-82	2.862e-74
3.120e+01	0.000e+00	2.957e-105	2.026e-90	4.644e-81	1.697e-71
3.180e+01	0.000e+00	5.385e-102	1.283e-87	3.083e-77	1.120e-69
3.240e+01	0.000e+00	3.323e-99	9.367e-85	1.421e-74	1.494e-66
3.300e+01	0.000e+00	1.234e-97	1.671e-82	1.902e-72	7.399e-64
3.360e+01	0.000e+00	1.050e-93	1.012e-79	1.178e-69	1.434e-61
3.420e+01	0.000e+00	4.382e-91	7.536e-77	7.930e-67	1.806e-59
3.480e+01	0.000e+00	1.122e-88	1.469e-74	1.844e-64	2.231e-56
3.540e+01	0.000e+00	1.796e-85	7.278e-72	2.971e-62	7.712e-54
3.600e+01	0.000e+00	4.876e-83	5.928e-69	3.831e-59	1.072e-51
3.660e+01	0.000e+00	2.993e-80	1.337e-66	1.261e-56	3.331e-49
3.720e+01	0.000e+00	2.769e-77	4.684e-64	4.132e-55	2.637e-46
3.780e+01	0.000e+00	4.048e-75	4.517e-61	1.445e-51	8.265e-44
3.840e+01	0.000e+00	6.035e-72	1.215e-58	6.859e-49	9.181e-42
3.900e+01	0.000e+00	3.908e-69	2.466e-56	1.245e-46	4.263e-39
3.960e+01	0.000e+00	9.388e-68	3.284e-53	2.979e-44	2.756e-36
4.020e+01	0.000e+00	1.050e-63	1.089e-50	2.997e-41	8.321e-34
4.080e+01	0.000e+00	5.097e-61	7.079e-49	1.038e-38	1.247e-31
4.140e+01	0.000e+00	5.519e-59	2.265e-45	9.616e-37	2.396e-29
4.200e+01	0.000e+00	1.657e-55	9.489e-43	9.377e-34	2.655e-26
4.260e+01	0.000e+00	6.170e-53	4.595e-41	5.677e-31	1.094e-23
4.320e+01	0.000e+00	1.648e-50	1.476e-37	1.418e-28	2.349e-21
4.380e+01	0.000e+00	2.436e-47	7.736e-35	5.380e-27	9.525e-20
4.440e+01	0.000e+00	6.877e-45	1.012e-32	1.962e-23	2.842e-16
4.500e+01	0.000e+00	3.315e-42	8.574e-30	8.744e-21	1.211e-13
4.560e+01	0.000e+00	3.358e-39	5.586e-27	1.943e-18	3.133e-11
4.620e+01	0.000e+00	6.827e-37	1.152e-24	1.415e-16	3.965e-09
4.680e+01	0.000e+00	5.567e-34	3.543e-22	3.491e-13	1.509e-06
4.740e+01	0.000e+00	4.310e-31	3.473e-19	1.627e-10	1.381e-03
4.800e+01	0.000e+00	5.754e-29	1.133e-16	3.307e-08	5.546e-01
4.860e+01	0.000e+00	8.074e-26	5.408e-16	5.473e-06	1.216e+02
4.920e+01	0.000e+00	5.139e-23	1.919e-11	6.528e-03	1.387e+03
4.980e+01	0.000e+00	4.369e-21	1.019e-08	2.371e+00	3.216e+03
5.040e+01	0.000e+00	1.030e-17	1.810e-06	4.428e+02	5.469e+03
5.100e+01	0.000e+00	5.990e-15	8.910e-04	2.259e+03	8.050e+03
5.160e+01	0.000e+00	4.178e-13	7.482e-01	4.708e+03	1.089e+04
5.220e+01	0.000e+00	1.283e-09	2.270e+02	7.619e+03	1.395e+04
5.280e+01	0.000e+00	7.505e-07	2.446e+03	1.089e+04	1.717e+04

5.340e+01	0.000e+00	3.970e-05	5.577e+03	1.445e+04	2.054e+04
5.400e+01	0.000e+00	1.808e-01	9.372e+03	1.823e+04	2.401e+04
5.460e+01	0.000e+00	1.012e+02	1.366e+04	2.219e+04	2.758e+04
5.520e+01	0.000e+00	3.260e+03	1.832e+04	2.630e+04	3.121e+04
5.580e+01	0.000e+00	8.314e+03	2.327e+04	3.051e+04	3.490e+04
5.640e+01	0.000e+00	1.454e+04	2.842e+04	3.480e+04	3.862e+04
5.700e+01	0.000e+00	2.153e+04	3.372e+04	3.915e+04	4.236e+04
5.760e+01	0.000e+00	2.903e+04	3.912e+04	4.352e+04	4.611e+04
5.820e+01	0.000e+00	3.685e+04	4.459e+04	4.791e+04	4.986e+04
5.880e+01	0.000e+00	4.485e+04	5.007e+04	5.230e+04	5.360e+04
5.940e+01	0.000e+00	5.293e+04	5.555e+04	5.666e+04	5.732e+04
6.000e+01	0.000e+00	6.100e+04	6.100e+04	6.100e+04	6.100e+04

Time (yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)		Pore Water Concentrations (μg/L)			
0.000e+00	1.492e-70	1.025e-63	4.229e-58	5.627e-54	8.265e-48
6.000e-01	1.185e-68	8.207e-62	3.386e-56	4.576e-52	6.589e-46
1.200e+00	2.326e-68	1.624e-61	6.702e-56	9.201e-52	1.299e-45
1.800e+00	3.436e-68	2.432e-61	1.004e-55	1.413e-51	1.932e-45
2.400e+00	4.513e-68	3.255e-61	1.345e-55	1.957e-51	2.562e-45
3.000e+00	5.555e-68	4.104e-61	1.697e-55	2.570e-51	3.193e-45
3.600e+00	6.559e-68	4.991e-61	2.066e-55	3.274e-51	3.829e-45
4.200e+00	7.522e-68	5.926e-61	2.455e-55	4.087e-51	4.474e-45
4.800e+00	8.440e-68	6.920e-61	2.871e-55	5.032e-51	5.130e-45
5.400e+00	9.308e-68	7.985e-61	3.317e-55	6.130e-51	5.801e-45
6.000e+00	1.012e-67	9.133e-61	3.800e-55	7.404e-51	6.492e-45
6.600e+00	1.087e-67	1.038e-60	4.324e-55	8.879e-51	7.204e-45
7.200e+00	1.155e-67	1.173e-60	4.896e-55	1.058e-50	7.943e-45
7.800e+00	1.216e-67	1.321e-60	5.522e-55	1.254e-50	8.710e-45
8.400e+00	1.267e-67	1.482e-60	6.209e-55	1.479e-50	9.511e-45
9.000e+00	1.308e-67	1.659e-60	6.963e-55	1.735e-50	1.035e-44
9.600e+00	1.337e-67	1.853e-60	7.792e-55	2.028e-50	1.122e-44
1.020e+01	1.354e-67	2.066e-60	8.705e-55	2.360e-50	1.214e-44
1.080e+01	1.355e-67	2.300e-60	9.711e-55	2.736e-50	1.311e-44
1.140e+01	1.340e-67	2.558e-60	1.082e-54	3.160e-50	1.413e-44
1.200e+01	1.305e-67	2.841e-60	1.204e-54	3.639e-50	1.520e-44
1.260e+01	1.248e-67	3.152e-60	1.339e-54	4.177e-50	1.633e-44
1.320e+01	1.166e-67	3.495e-60	1.488e-54	4.781e-50	1.752e-44
1.380e+01	1.056e-67	3.871e-60	1.651e-54	5.457e-50	1.878e-44
1.440e+01	9.138e-68	4.286e-60	1.832e-54	6.213e-50	2.011e-44
1.500e+01	7.360e-68	4.741e-60	2.031e-54	7.058e-50	2.151e-44
1.560e+01	5.178e-68	5.242e-60	2.250e-54	7.999e-50	2.300e-44
1.620e+01	2.542e-68	5.792e-60	2.491e-54	9.047e-50	2.456e-44
1.680e+01	6.041e-69	6.396e-60	2.756e-54	1.021e-49	2.622e-44
1.740e+01	4.322e-68	7.060e-60	3.049e-54	1.151e-49	2.797e-44
1.800e+01	8.680e-68	7.789e-60	3.370e-54	1.294e-49	2.981e-44
1.860e+01	1.375e-67	8.589e-60	3.724e-54	1.453e-49	3.176e-44
1.920e+01	1.962e-67	9.467e-60	4.113e-54	1.629e-49	3.381e-44
1.980e+01	2.639e-67	1.043e-59	4.540e-54	1.824e-49	3.597e-44
2.040e+01	3.414e-67	1.149e-59	5.010e-54	2.040e-49	3.825e-44
2.100e+01	4.299e-67	1.265e-59	5.526e-54	2.277e-49	4.065e-44
2.160e+01	5.307e-67	1.392e-59	6.093e-54	2.540e-49	4.317e-44
2.220e+01	6.451e-67	1.531e-59	6.716e-54	2.830e-49	4.583e-44
2.280e+01	7.746e-67	1.684e-59	7.399e-54	3.149e-49	4.862e-44
2.340e+01	9.208e-67	1.851e-59	8.149e-54	3.501e-49	5.154e-44

2.400e+01	1.086e-66	2.035e-59	8.972e-54	3.888e-49	5.461e-44
2.460e+01	1.271e-66	2.236e-59	9.874e-54	4.314e-49	5.783e-44
2.520e+01	1.479e-66	2.456e-59	1.086e-53	4.782e-49	6.119e-44
2.580e+01	1.712e-66	2.697e-59	1.195e-53	5.298e-49	6.471e-44
2.640e+01	1.973e-66	2.961e-59	1.314e-53	5.864e-49	6.838e-44
2.700e+01	2.265e-66	3.251e-59	1.444e-53	6.486e-49	7.221e-44
2.760e+01	2.591e-66	3.567e-59	1.587e-53	7.169e-49	7.620e-44
2.820e+01	2.954e-66	3.914e-59	1.743e-53	7.919e-49	8.035e-44
2.880e+01	3.359e-66	4.294e-59	1.915e-53	8.741e-49	8.466e-44
2.940e+01	3.811e-66	4.710e-59	2.102e-53	9.644e-49	8.912e-44
3.000e+01	4.313e-66	5.165e-59	2.308e-53	1.063e-48	9.374e-44
3.060e+01	1.569e-67	2.824e-62	1.453e-56	8.586e-51	1.778e-45
3.120e+01	1.278e-65	1.591e-58	7.108e-53	3.248e-48	2.925e-43
3.180e+01	2.287e-62	5.708e-56	2.421e-50	1.816e-45	2.858e-41
3.240e+01	1.107e-59	1.388e-53	5.369e-48	6.385e-43	2.695e-38
3.300e+01	3.127e-57	1.577e-51	6.050e-46	1.702e-40	9.560e-36
3.360e+01	2.267e-55	5.163e-49	1.106e-43	3.123e-38	2.557e-33
3.420e+01	2.610e-52	3.682e-46	8.406e-41	1.893e-36	5.527e-31
3.480e+01	1.434e-49	1.171e-43	2.705e-38	1.150e-33	9.115e-29
3.540e+01	3.535e-47	2.199e-41	6.216e-36	5.677e-31	8.822e-27
3.600e+01	1.237e-45	1.081e-39	1.130e-33	1.713e-28	6.971e-25
3.660e+01	2.597e-42	1.100e-36	1.254e-31	4.330e-26	6.605e-22
3.720e+01	1.174e-39	6.174e-34	2.880e-29	9.446e-24	2.541e-19
3.780e+01	2.885e-37	2.144e-31	2.622e-26	1.468e-21	8.297e-17
3.840e+01	3.157e-35	4.935e-29	1.020e-23	2.011e-20	2.373e-14
3.900e+01	1.066e-32	4.120e-27	2.635e-21	8.119e-17	5.806e-12
3.960e+01	8.132e-30	2.154e-24	4.829e-19	3.398e-14	1.254e-09
4.020e+01	2.857e-27	1.195e-21	5.713e-17	9.986e-12	2.608e-07
4.080e+01	5.618e-25	3.576e-19	3.010e-15	2.707e-09	5.497e-05
4.140e+01	4.724e-24	8.174e-17	6.183e-12	7.099e-07	1.093e-02
4.200e+01	4.184e-20	1.458e-14	3.147e-09	1.653e-04	1.779e+00
4.260e+01	1.908e-17	6.059e-13	1.081e-06	3.103e-02	1.950e+02
4.320e+01	5.962e-15	1.116e-09	2.711e-04	4.328e+00	9.868e+02
4.380e+01	1.403e-12	6.187e-07	5.091e-02	3.878e+02	2.068e+03
4.440e+01	1.322e-10	1.964e-04	7.461e+00	1.317e+03	3.371e+03
4.500e+01	8.341e-08	4.343e-02	5.438e+02	2.556e+03	4.854e+03
4.560e+01	5.418e-05	7.181e+00	1.605e+03	4.025e+03	6.489e+03
4.620e+01	1.759e-02	5.863e+02	2.999e+03	5.679e+03	8.252e+03
4.680e+01	3.650e+00	1.773e+03	4.642e+03	7.490e+03	1.013e+04
4.740e+01	4.513e+02	3.332e+03	6.484e+03	9.433e+03	1.210e+04
4.800e+01	1.739e+03	5.167e+03	8.492e+03	1.149e+04	1.415e+04
4.860e+01	3.462e+03	7.221e+03	1.064e+04	1.364e+04	1.627e+04
4.920e+01	5.505e+03	9.457e+03	1.291e+04	1.588e+04	1.845e+04
4.980e+01	7.802e+03	1.184e+04	1.527e+04	1.819e+04	2.068e+04
5.040e+01	1.031e+04	1.436e+04	1.773e+04	2.055e+04	2.296e+04
5.100e+01	1.299e+04	1.698e+04	2.025e+04	2.297e+04	2.527e+04
5.160e+01	1.581e+04	1.970e+04	2.284e+04	2.543e+04	2.762e+04
5.220e+01	1.875e+04	2.249e+04	2.547e+04	2.793e+04	2.999e+04
5.280e+01	2.179e+04	2.534e+04	2.815e+04	3.045e+04	3.237e+04
5.340e+01	2.492e+04	2.824e+04	3.086e+04	3.299e+04	3.478e+04
5.400e+01	2.810e+04	3.118e+04	3.359e+04	3.555e+04	3.719e+04
5.460e+01	3.134e+04	3.415e+04	3.634e+04	3.812e+04	3.960e+04
5.520e+01	3.461e+04	3.714e+04	3.911e+04	4.070e+04	4.202e+04
5.580e+01	3.791e+04	4.014e+04	4.187e+04	4.327e+04	4.443e+04
5.640e+01	4.123e+04	4.315e+04	4.464e+04	4.584e+04	4.684e+04
5.700e+01	4.455e+04	4.616e+04	4.740e+04	4.841e+04	4.924e+04

5.760e+01	4.787e+04	4.916e+04	5.016e+04	5.096e+04	5.162e+04
5.820e+01	5.118e+04	5.215e+04	5.290e+04	5.350e+04	5.400e+04
5.880e+01	5.448e+04	5.512e+04	5.562e+04	5.602e+04	5.635e+04
5.940e+01	5.775e+04	5.807e+04	5.832e+04	5.852e+04	5.869e+04
6.000e+01	6.100e+04	6.100e+04	6.100e+04	6.100e+04	6.100e+04

Time (yr) 2.000e+02

Depth (cm)	Pore Water Concentrations (μg/L)
0.000e+00	4.049e-43
6.000e-01	3.230e-41
1.200e+00	6.370e-41
1.800e+00	9.486e-41
2.400e+00	1.260e-40
3.000e+00	1.573e-40
3.600e+00	1.891e-40
4.200e+00	2.215e-40
4.800e+00	2.547e-40
5.400e+00	2.891e-40
6.000e+00	3.247e-40
6.600e+00	3.619e-40
7.200e+00	4.009e-40
7.800e+00	4.418e-40
8.400e+00	4.851e-40
9.000e+00	5.308e-40
9.600e+00	5.793e-40
1.020e+01	6.309e-40
1.080e+01	6.858e-40
1.140e+01	7.444e-40
1.200e+01	8.070e-40
1.260e+01	8.740e-40
1.320e+01	9.457e-40
1.380e+01	1.023e-39
1.440e+01	1.105e-39
1.500e+01	1.193e-39
1.560e+01	1.288e-39
1.620e+01	1.390e-39
1.680e+01	1.500e-39
1.740e+01	1.618e-39
1.800e+01	1.744e-39
1.860e+01	1.880e-39
1.920e+01	2.027e-39
1.980e+01	2.184e-39
2.040e+01	2.353e-39
2.100e+01	2.535e-39
2.160e+01	2.731e-39
2.220e+01	2.941e-39
2.280e+01	3.168e-39
2.340e+01	3.411e-39
2.400e+01	3.673e-39
2.460e+01	3.954e-39
2.520e+01	4.257e-39
2.580e+01	4.582e-39
2.640e+01	4.932e-39
2.700e+01	5.308e-39
2.760e+01	5.713e-39

2.820e+01	6.147e-39
2.880e+01	6.615e-39
2.940e+01	7.117e-39
3.000e+01	7.656e-39
3.060e+01	5.531e-41
3.120e+01	2.369e-38
3.180e+01	4.391e-36
3.240e+01	6.350e-34
3.300e+01	5.233e-32
3.360e+01	7.880e-30
3.420e+01	6.044e-27
3.480e+01	2.305e-24
3.540e+01	6.965e-22
3.600e+01	1.782e-19
3.660e+01	4.036e-17
3.720e+01	8.579e-15
3.780e+01	1.793e-12
3.840e+01	3.636e-10
3.900e+01	6.789e-08
3.960e+01	1.157e-05
4.020e+01	1.950e-03
4.080e+01	3.389e-01
4.140e+01	4.823e+01
4.200e+01	6.618e+02
4.260e+01	1.573e+03
4.320e+01	2.714e+03
4.380e+01	4.038e+03
4.440e+01	5.514e+03
4.500e+01	7.117e+03
4.560e+01	8.829e+03
4.620e+01	1.064e+04
4.680e+01	1.252e+04
4.740e+01	1.448e+04
4.800e+01	1.650e+04
4.860e+01	1.857e+04
4.920e+01	2.069e+04
4.980e+01	2.285e+04
5.040e+01	2.504e+04
5.100e+01	2.725e+04
5.160e+01	2.949e+04
5.220e+01	3.175e+04
5.280e+01	3.401e+04
5.340e+01	3.629e+04
5.400e+01	3.857e+04
5.460e+01	4.085e+04
5.520e+01	4.313e+04
5.580e+01	4.541e+04
5.640e+01	4.768e+04
5.700e+01	4.994e+04
5.760e+01	5.218e+04
5.820e+01	5.441e+04
5.880e+01	5.663e+04
5.940e+01	5.882e+04
6.000e+01	6.100e+04

Flux Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)			Flux (μg/m²/yr)		
0.000e+00	0.000e+00	-4.224e-105	7.329e-90	2.209e-79	8.290e-71
6.000e-01	0.000e+00	-4.335e-105	7.460e-90	2.233e-79	8.407e-71
1.200e+00	0.000e+00	-4.499e-105	7.654e-90	2.268e-79	8.580e-71
1.800e+00	0.000e+00	-4.773e-105	7.976e-90	2.325e-79	8.866e-71
2.400e+00	0.000e+00	-5.161e-105	8.428e-90	2.405e-79	9.266e-71
3.000e+00	0.000e+00	-5.669e-105	9.015e-90	2.508e-79	9.784e-71
3.600e+00	0.000e+00	-6.307e-105	9.742e-90	2.633e-79	1.042e-70
4.200e+00	0.000e+00	-7.085e-105	1.062e-89	2.781e-79	1.119e-70
4.800e+00	0.000e+00	-8.019e-105	1.165e-89	2.953e-79	1.209e-70
5.400e+00	0.000e+00	-9.125e-105	1.285e-89	3.148e-79	1.313e-70
6.000e+00	0.000e+00	-1.042e-104	1.424e-89	3.368e-79	1.432e-70
6.600e+00	0.000e+00	-1.194e-104	1.583e-89	3.613e-79	1.568e-70
7.200e+00	0.000e+00	-1.371e-104	1.763e-89	3.883e-79	1.721e-70
7.800e+00	0.000e+00	-1.575e-104	1.968e-89	4.179e-79	1.894e-70
8.400e+00	0.000e+00	-1.811e-104	2.199e-89	4.502e-79	2.087e-70
9.000e+00	0.000e+00	-2.083e-104	2.459e-89	4.853e-79	2.303e-70
9.600e+00	0.000e+00	-2.395e-104	2.751e-89	5.232e-79	2.545e-70
1.020e+01	0.000e+00	-2.754e-104	3.078e-89	5.640e-79	2.814e-70
1.080e+01	0.000e+00	-3.165e-104	3.445e-89	6.076e-79	3.112e-70
1.140e+01	0.000e+00	-3.636e-104	3.854e-89	6.542e-79	3.444e-70
1.200e+01	0.000e+00	-4.175e-104	4.311e-89	7.035e-79	3.812e-70
1.260e+01	0.000e+00	-4.789e-104	4.820e-89	7.557e-79	4.220e-70
1.320e+01	0.000e+00	-5.490e-104	5.387e-89	8.106e-79	4.672e-70
1.380e+01	0.000e+00	-6.287e-104	6.017e-89	8.680e-79	5.171e-70
1.440e+01	0.000e+00	-7.194e-104	6.717e-89	9.276e-79	5.724e-70
1.500e+01	0.000e+00	-8.223e-104	7.493e-89	9.893e-79	6.335e-70
1.560e+01	0.000e+00	-9.389e-104	8.353e-89	1.052e-78	7.009e-70
1.620e+01	0.000e+00	-1.071e-103	9.305e-89	1.117e-78	7.754e-70
1.680e+01	0.000e+00	-1.220e-103	1.036e-88	1.181e-78	8.575e-70
1.740e+01	0.000e+00	-1.388e-103	1.152e-88	1.245e-78	9.481e-70
1.800e+01	0.000e+00	-1.577e-103	1.280e-88	1.307e-78	1.048e-69
1.860e+01	0.000e+00	-1.789e-103	1.420e-88	1.366e-78	1.158e-69
1.920e+01	0.000e+00	-2.027e-103	1.575e-88	1.421e-78	1.279e-69
1.980e+01	0.000e+00	-2.292e-103	1.745e-88	1.469e-78	1.412e-69
2.040e+01	0.000e+00	-2.588e-103	1.931e-88	1.508e-78	1.559e-69
2.100e+01	0.000e+00	-2.916e-103	2.134e-88	1.536e-78	1.720e-69
2.160e+01	0.000e+00	-3.279e-103	2.356e-88	1.549e-78	1.897e-69
2.220e+01	0.000e+00	-3.678e-103	2.598e-88	1.543e-78	2.091e-69
2.280e+01	0.000e+00	-4.117e-103	2.860e-88	1.514e-78	2.304e-69
2.340e+01	0.000e+00	-4.595e-103	3.145e-88	1.456e-78	2.538e-69
2.400e+01	0.000e+00	-5.114e-103	3.452e-88	1.363e-78	2.794e-69
2.460e+01	0.000e+00	-5.673e-103	3.784e-88	1.228e-78	3.075e-69
2.520e+01	0.000e+00	-6.271e-103	4.139e-88	1.042e-78	3.383e-69
2.580e+01	0.000e+00	-6.903e-103	4.520e-88	7.953e-79	3.719e-69
2.640e+01	0.000e+00	-7.563e-103	4.925e-88	4.759e-79	4.087e-69
2.700e+01	0.000e+00	-8.243e-103	5.355e-88	7.027e-80	4.489e-69
2.760e+01	0.000e+00	-8.930e-103	5.808e-88	-4.371e-79	4.927e-69
2.820e+01	0.000e+00	-9.605e-103	6.283e-88	-1.064e-78	5.406e-69
2.880e+01	0.000e+00	-1.024e-102	6.777e-88	-1.832e-78	5.927e-69

2.940e+01	0.000e+00	-1.081e-102	7.284e-88	-2.760e-78	6.493e-69
3.000e+01	0.000e+00	-1.134e-102	7.800e-88	-3.782e-78	7.085e-69
3.060e+01	0.000e+00	4.821e-101	-3.311e-86	-7.482e-77	-2.778e-67
3.120e+01	0.000e+00	-6.668e-98	1.588e-83	3.817e-73	-1.387e-65
3.180e+01	0.000e+00	-4.115e-95	1.160e-80	1.760e-70	1.850e-62
3.240e+01	0.000e+00	1.527e-93	2.069e-78	2.356e-68	9.163e-60
3.300e+01	0.000e+00	1.301e-89	-1.253e-75	-1.458e-65	1.776e-57
3.360e+01	0.000e+00	5.427e-87	-9.333e-73	-9.820e-63	-2.236e-55
3.420e+01	0.000e+00	-1.389e-84	-1.820e-70	-2.284e-60	-2.763e-52
3.480e+01	0.000e+00	-2.224e-81	9.012e-68	3.679e-58	-9.551e-50
3.540e+01	0.000e+00	-6.038e-79	7.342e-65	4.744e-55	-1.328e-47
3.600e+01	0.000e+00	3.707e-76	1.656e-62	1.562e-52	4.124e-45
3.660e+01	0.000e+00	3.429e-73	-5.800e-60	5.120e-51	3.266e-42
3.720e+01	0.000e+00	5.013e-71	-5.593e-57	-1.790e-47	1.024e-39
3.780e+01	0.000e+00	-7.474e-68	-1.505e-54	-8.494e-45	1.137e-37
3.840e+01	0.000e+00	-4.840e-65	3.054e-52	-1.541e-42	-5.278e-35
3.900e+01	0.000e+00	-1.164e-63	4.067e-49	3.688e-40	-3.413e-32
3.960e+01	0.000e+00	1.300e-59	1.348e-46	3.711e-37	-1.030e-29
4.020e+01	0.000e+00	6.312e-57	-8.764e-45	1.285e-34	-1.545e-27
4.080e+01	0.000e+00	-6.833e-55	-2.805e-41	1.191e-32	2.967e-25
4.140e+01	0.000e+00	-2.052e-51	-1.175e-38	-1.161e-29	3.288e-22
4.200e+01	0.000e+00	-7.640e-49	-5.692e-37	-7.030e-27	1.355e-19
4.260e+01	0.000e+00	2.041e-46	1.828e-33	-1.756e-24	2.909e-17
4.320e+01	0.000e+00	3.016e-43	9.581e-31	6.659e-23	-1.179e-15
4.380e+01	0.000e+00	8.517e-41	1.254e-28	2.430e-19	-3.519e-12
4.440e+01	0.000e+00	-4.105e-38	-1.062e-25	1.083e-16	-1.500e-09
4.500e+01	0.000e+00	-4.159e-35	-6.917e-23	2.407e-14	-3.880e-07
4.560e+01	0.000e+00	-8.455e-33	-1.427e-20	-1.752e-12	-4.910e-05
4.620e+01	0.000e+00	6.893e-30	4.388e-18	-4.324e-09	1.869e-02
4.680e+01	0.000e+00	5.338e-27	4.301e-15	-2.015e-06	1.710e+01
4.740e+01	0.000e+00	7.126e-25	1.403e-12	-4.095e-04	6.869e+03
4.800e+01	0.000e+00	-9.998e-22	6.721e-12	6.776e-02	1.507e+06
4.860e+01	0.000e+00	-6.364e-19	-2.377e-07	8.084e+01	1.720e+07
4.920e+01	0.000e+00	-5.412e-17	-1.262e-04	2.936e+04	3.868e+07
4.980e+01	0.000e+00	1.275e-13	-2.241e-02	5.484e+06	5.137e+07
5.040e+01	0.000e+00	7.418e-11	1.103e+01	2.806e+07	6.125e+07
5.100e+01	0.000e+00	5.175e-09	9.266e+03	5.339e+07	6.922e+07
5.160e+01	0.000e+00	-1.589e-05	2.811e+06	6.757e+07	7.579e+07
5.220e+01	0.000e+00	-9.294e-03	3.034e+07	7.849e+07	8.130e+07
5.280e+01	0.000e+00	-4.918e-01	6.687e+07	8.732e+07	8.596e+07
5.340e+01	0.000e+00	2.239e+03	8.719e+07	9.457e+07	8.993e+07
5.400e+01	0.000e+00	1.253e+06	1.025e+08	1.006e+08	9.331e+07
5.460e+01	0.000e+00	4.039e+07	1.143e+08	1.055e+08	9.617e+07
5.520e+01	0.000e+00	1.025e+08	1.236e+08	1.097e+08	9.858e+07

5.580e+01	0.000e+00	1.418e+08	1.309e+08	1.130e+08	1.006e+08
5.640e+01	0.000e+00	1.674e+08	1.367e+08	1.158e+08	1.022e+08
5.700e+01	0.000e+00	1.849e+08	1.411e+08	1.179e+08	1.036e+08
5.760e+01	0.000e+00	1.970e+08	1.445e+08	1.196e+08	1.046e+08
5.820e+01	0.000e+00	2.053e+08	1.469e+08	1.208e+08	1.054e+08
5.880e+01	0.000e+00	2.105e+08	1.485e+08	1.217e+08	1.059e+08
5.940e+01	0.000e+00	2.134e+08	1.494e+08	1.222e+08	1.062e+08
6.000e+01	0.000e+00	2.152e+08	1.500e+08	1.225e+08	1.064e+08

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)			Flux (μg/m²/yr)		
0.000e+00	-1.307e-64	-8.984e-58	3.705e-52	-4.931e-48	-7.242e-42
6.000e-01	-1.305e-64	-9.113e-58	3.761e-52	-5.162e-48	-7.288e-42
1.200e+00	-1.301e-64	-9.302e-58	3.842e-52	-5.507e-48	-7.353e-42
1.800e+00	-1.294e-64	-9.616e-58	3.977e-52	-6.079e-48	-7.461e-42
2.400e+00	-1.284e-64	-1.005e-57	4.165e-52	-6.881e-48	-7.611e-42
3.000e+00	-1.270e-64	-1.062e-57	4.409e-52	-7.919e-48	-7.803e-42
3.600e+00	-1.252e-64	-1.132e-57	4.708e-52	-9.201e-48	-8.036e-42
4.200e+00	-1.229e-64	-1.215e-57	5.066e-52	-1.074e-47	-8.311e-42
4.800e+00	-1.200e-64	-1.312e-57	5.486e-52	-1.255e-47	-8.628e-42
5.400e+00	-1.164e-64	-1.424e-57	5.970e-52	-1.464e-47	-8.988e-42
6.000e+00	-1.120e-64	-1.552e-57	6.522e-52	-1.705e-47	-9.390e-42
6.600e+00	-1.066e-64	-1.696e-57	7.148e-52	-1.979e-47	-9.836e-42
7.200e+00	-1.002e-64	-1.859e-57	7.853e-52	-2.289e-47	-1.033e-41
7.800e+00	-9.239e-65	-2.040e-57	8.643e-52	-2.639e-47	-1.086e-41
8.400e+00	-8.315e-65	-2.243e-57	9.524e-52	-3.031e-47	-1.145e-41
9.000e+00	-7.220e-65	-2.468e-57	1.051e-51	-3.470e-47	-1.208e-41
9.600e+00	-5.930e-65	-2.717e-57	1.159e-51	-3.960e-47	-1.276e-41
1.020e+01	-4.419e-65	-2.993e-57	1.280e-51	-4.505e-47	-1.349e-41
1.080e+01	-2.655e-65	-3.297e-57	1.414e-51	-5.112e-47	-1.428e-41
1.140e+01	-6.073e-66	-3.633e-57	1.561e-51	-5.786e-47	-1.512e-41
1.200e+01	1.762e-65	-4.002e-57	1.724e-51	-6.534e-47	-1.601e-41
1.260e+01	4.492e-65	-4.409e-57	1.903e-51	-7.362e-47	-1.696e-41

1.320e+01	7.628e-65	-4.856e-57	2.101e-51	-8.278e-47	-1.798e-41
1.380e+01	1.122e-64	-5.347e-57	2.319e-51	-9.291e-47	-1.905e-41
1.440e+01	1.531e-64	-5.887e-57	2.558e-51	-1.041e-46	-2.019e-41
1.500e+01	1.998e-64	-6.479e-57	2.821e-51	-1.164e-46	-2.140e-41
1.560e+01	2.527e-64	-7.128e-57	3.111e-51	-1.301e-46	-2.267e-41
1.620e+01	3.126e-64	-7.841e-57	3.429e-51	-1.451e-46	-2.401e-41
1.680e+01	3.803e-64	-8.622e-57	3.778e-51	-1.616e-46	-2.543e-41
1.740e+01	4.566e-64	-9.477e-57	4.161e-51	-1.798e-46	-2.692e-41
1.800e+01	5.424e-64	-1.042e-56	4.582e-51	-1.998e-46	-2.848e-41
1.860e+01	6.388e-64	-1.144e-56	5.043e-51	-2.219e-46	-3.012e-41
1.920e+01	7.468e-64	-1.257e-56	5.550e-51	-2.461e-46	-3.184e-41
1.980e+01	8.678e-64	-1.380e-56	6.105e-51	-2.727e-46	-3.365e-41
2.040e+01	1.003e-63	-1.515e-56	6.713e-51	-3.019e-46	-3.553e-41
2.100e+01	1.154e-63	-1.662e-56	7.380e-51	-3.340e-46	-3.749e-41
2.160e+01	1.322e-63	-1.824e-56	8.110e-51	-3.692e-46	-3.954e-41
2.220e+01	1.510e-63	-2.001e-56	8.911e-51	-4.078e-46	-4.167e-41
2.280e+01	1.718e-63	-2.194e-56	9.787e-51	-4.501e-46	-4.388e-41
2.340e+01	1.950e-63	-2.406e-56	1.075e-50	-4.966e-46	-4.617e-41
2.400e+01	2.207e-63	-2.638e-56	1.180e-50	-5.475e-46	-4.855e-41
2.460e+01	2.493e-63	-2.892e-56	1.295e-50	-6.032e-46	-5.099e-41
2.520e+01	2.810e-63	-3.169e-56	1.421e-50	-6.643e-46	-5.352e-41
2.580e+01	3.161e-63	-3.473e-56	1.558e-50	-7.312e-46	-5.611e-41
2.640e+01	3.551e-63	-3.806e-56	1.709e-50	-8.045e-46	-5.877e-41
2.700e+01	3.983e-63	-4.169e-56	1.874e-50	-8.848e-46	-6.148e-41
2.760e+01	4.461e-63	-4.568e-56	2.054e-50	-9.726e-46	-6.425e-41
2.820e+01	4.992e-63	-5.003e-56	2.252e-50	-1.069e-45	-6.706e-41
2.880e+01	5.579e-63	-5.481e-56	2.467e-50	-1.174e-45	-6.990e-41
2.940e+01	6.227e-63	-6.000e-56	2.702e-50	-1.289e-45	-7.274e-41

3.000e+01	6.912e-63	-6.546e-56	2.948e-50	-1.409e-45	-7.561e-41
3.060e+01	-2.116e-61	2.609e-54	-1.166e-48	5.338e-44	4.784e-39
3.120e+01	-2.832e-58	7.069e-52	-2.998e-46	2.249e-41	-3.539e-37
3.180e+01	-1.371e-55	1.719e-49	-6.649e-44	7.907e-39	-3.337e-34
3.240e+01	-3.872e-53	1.953e-47	-7.493e-42	2.108e-36	-1.184e-31
3.300e+01	-2.808e-51	-6.393e-45	1.370e-39	3.868e-34	-3.167e-29
3.360e+01	3.232e-48	-4.560e-42	1.041e-36	2.345e-32	-6.845e-27
3.420e+01	1.776e-45	-1.451e-39	3.350e-34	-1.424e-29	-1.129e-24
3.480e+01	4.378e-43	-2.724e-37	7.698e-32	-7.030e-27	-1.093e-22
3.540e+01	1.533e-41	-1.339e-35	1.400e-29	-2.121e-24	8.631e-21
3.600e+01	-3.216e-38	1.362e-32	1.553e-27	-5.362e-22	8.179e-18
3.660e+01	-1.454e-35	7.646e-30	-3.566e-25	-1.170e-19	3.146e-15
3.720e+01	-3.573e-33	2.656e-27	-3.247e-22	-1.818e-17	1.028e-12
3.780e+01	-3.909e-31	6.112e-25	-1.263e-19	-2.493e-16	2.938e-10
3.840e+01	1.320e-28	5.103e-23	-3.263e-17	1.005e-12	7.191e-08
3.900e+01	1.007e-25	-2.667e-20	-5.981e-15	4.208e-10	1.553e-05
3.960e+01	3.538e-23	-1.480e-17	-7.076e-13	1.237e-07	3.229e-03
4.020e+01	6.957e-21	-4.429e-15	3.726e-11	3.353e-05	6.807e-01
4.080e+01	5.860e-20	-1.012e-12	7.656e-08	8.792e-03	1.353e+02
4.140e+01	-5.181e-16	-1.806e-10	3.898e-05	2.048e+00	2.203e+04
4.200e+01	-2.363e-13	-7.505e-09	1.338e-02	3.843e+02	2.416e+06
4.260e+01	-7.384e-11	1.382e-05	3.357e+00	5.361e+04	1.225e+07
4.320e+01	-1.738e-08	7.661e-03	6.304e+02	4.803e+06	2.345e+07
4.380e+01	-1.638e-06	2.433e+00	9.241e+04	1.635e+07	3.005e+07
4.440e+01	1.033e-03	5.379e+02	6.735e+06	2.718e+07	3.535e+07
4.500e+01	6.710e-01	8.894e+04	1.992e+07	3.418e+07	3.984e+07
4.560e+01	2.178e+02	7.261e+06	3.082e+07	3.970e+07	4.373e+07
4.620e+01	4.520e+04	2.202e+07	3.836e+07	4.436e+07	4.714e+07
4.680e+01	5.590e+06	3.446e+07	4.433e+07	4.839e+07	5.016e+07
4.740e+01	2.160e+07	4.287e+07	4.932e+07	5.192e+07	5.285e+07
4.800e+01	3.773e+07	4.947e+07	5.361e+07	5.504e+07	5.526e+07
4.860e+01	4.751e+07	5.496e+07	5.736e+07	5.782e+07	5.742e+07
4.920e+01	5.514e+07	5.965e+07	6.066e+07	6.030e+07	5.937e+07
4.980e+01	6.146e+07	6.373e+07	6.357e+07	6.251e+07	6.112e+07
5.040e+01	6.683e+07	6.728e+07	6.615e+07	6.448e+07	6.269e+07
5.100e+01	7.144e+07	7.040e+07	6.843e+07	6.625e+07	6.410e+07
5.160e+01	7.542e+07	7.314e+07	7.046e+07	6.783e+07	6.537e+07
5.220e+01	7.886e+07	7.554e+07	7.226e+07	6.923e+07	6.651e+07
5.280e+01	8.185e+07	7.765e+07	7.384e+07	7.048e+07	6.752e+07
5.340e+01	8.443e+07	7.949e+07	7.524e+07	7.158e+07	6.841e+07
5.400e+01	8.666e+07	8.109e+07	7.645e+07	7.254e+07	6.920e+07
5.460e+01	8.856e+07	8.247e+07	7.751e+07	7.338e+07	6.989e+07
5.520e+01	9.019e+07	8.366e+07	7.842e+07	7.411e+07	7.048e+07
5.580e+01	9.155e+07	8.466e+07	7.919e+07	7.472e+07	7.099e+07
5.640e+01	9.268e+07	8.549e+07	7.983e+07	7.524e+07	7.142e+07
5.700e+01	9.359e+07	8.616e+07	8.036e+07	7.566e+07	7.176e+07

5.760e+01	9.431e+07	8.669e+07	8.077e+07	7.600e+07	7.204e+07
5.820e+01	9.484e+07	8.709e+07	8.108e+07	7.625e+07	7.225e+07
5.880e+01	9.521e+07	8.737e+07	8.130e+07	7.642e+07	7.240e+07
5.940e+01	9.542e+07	8.753e+07	8.143e+07	7.653e+07	7.248e+07
6.000e+01	9.556e+07	8.763e+07	8.151e+07	7.659e+07	7.254e+07

Time(yr) 2.000e+02

Depth (cm)	Flux (μg/m²/yr)
0.000e+00	3.548e-37
6.000e-01	3.575e-37
1.200e+00	3.613e-37
1.800e+00	3.677e-37
2.400e+00	3.766e-37
3.000e+00	3.881e-37
3.600e+00	4.020e-37
4.200e+00	4.186e-37
4.800e+00	4.378e-37
5.400e+00	4.597e-37
6.000e+00	4.844e-37
6.600e+00	5.120e-37
7.200e+00	5.427e-37
7.800e+00	5.766e-37
8.400e+00	6.139e-37
9.000e+00	6.547e-37
9.600e+00	6.993e-37
1.020e+01	7.478e-37
1.080e+01	8.006e-37
1.140e+01	8.579e-37
1.200e+01	9.200e-37
1.260e+01	9.873e-37
1.320e+01	1.060e-36
1.380e+01	1.139e-36
1.440e+01	1.223e-36
1.500e+01	1.315e-36
1.560e+01	1.414e-36
1.620e+01	1.520e-36
1.680e+01	1.635e-36
1.740e+01	1.759e-36
1.800e+01	1.892e-36
1.860e+01	2.036e-36
1.920e+01	2.190e-36
1.980e+01	2.356e-36
2.040e+01	2.535e-36
2.100e+01	2.727e-36
2.160e+01	2.934e-36
2.220e+01	3.157e-36
2.280e+01	3.396e-36
2.340e+01	3.654e-36
2.400e+01	3.930e-36
2.460e+01	4.227e-36
2.520e+01	4.547e-36
2.580e+01	4.890e-36
2.640e+01	5.259e-36
2.700e+01	5.655e-36
2.760e+01	6.081e-36

2.820e+01	6.537e-36
2.880e+01	7.028e-36
2.940e+01	7.552e-36
3.000e+01	8.098e-36
3.060e+01	-3.881e-34
3.120e+01	-5.438e-32
3.180e+01	-7.865e-30
3.240e+01	-6.481e-28
3.300e+01	9.758e-26
3.360e+01	7.485e-23
3.420e+01	2.854e-20
3.480e+01	8.625e-18
3.540e+01	2.207e-15
3.600e+01	4.998e-13
3.660e+01	1.062e-10
3.720e+01	2.221e-08
3.780e+01	4.503e-06
3.840e+01	8.408e-04
3.900e+01	1.433e-01
3.960e+01	2.414e+01
4.020e+01	4.197e+03
4.080e+01	5.973e+05
4.140e+01	8.203e+06
4.200e+01	1.905e+07
4.260e+01	2.581e+07
4.320e+01	3.121e+07
4.380e+01	3.569e+07
4.440e+01	3.952e+07
4.500e+01	4.286e+07
4.560e+01	4.581e+07
4.620e+01	4.845e+07
4.680e+01	5.081e+07
4.740e+01	5.295e+07
4.800e+01	5.487e+07
4.860e+01	5.662e+07
4.920e+01	5.819e+07
4.980e+01	5.962e+07
5.040e+01	6.091e+07
5.100e+01	6.208e+07
5.160e+01	6.312e+07
5.220e+01	6.406e+07
5.280e+01	6.490e+07
5.340e+01	6.565e+07
5.400e+01	6.631e+07
5.460e+01	6.688e+07
5.520e+01	6.738e+07
5.580e+01	6.781e+07
5.640e+01	6.817e+07
5.700e+01	6.846e+07
5.760e+01	6.870e+07
5.820e+01	6.887e+07
5.880e+01	6.900e+07
5.940e+01	6.907e+07
6.000e+01	6.912e+07

Solid Concentration Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)	Solid Concentrations (μg/kg)				
0.000e+00	0.000e+00	8.516e-111	1.477e-95	4.453e-85	1.671e-76
6.000e-01	0.000e+00	6.856e-109	1.185e-93	3.559e-83	1.338e-74
1.200e+00	0.000e+00	1.365e-108	2.349e-93	7.030e-83	2.647e-74
1.800e+00	0.000e+00	2.063e-108	3.527e-93	1.050e-82	3.963e-74
2.400e+00	0.000e+00	2.798e-108	4.740e-93	1.399e-82	5.303e-74
3.000e+00	0.000e+00	3.587e-108	6.007e-93	1.755e-82	6.685e-74
3.600e+00	0.000e+00	4.448e-108	7.350e-93	2.121e-82	8.128e-74
4.200e+00	0.000e+00	5.401e-108	8.788e-93	2.501e-82	9.648e-74
4.800e+00	0.000e+00	6.468e-108	1.034e-92	2.897e-82	1.127e-73
5.400e+00	0.000e+00	7.671e-108	1.204e-92	3.313e-82	1.300e-73
6.000e+00	0.000e+00	9.036e-108	1.391e-92	3.752e-82	1.487e-73
6.600e+00	0.000e+00	1.059e-107	1.596e-92	4.218e-82	1.690e-73
7.200e+00	0.000e+00	1.237e-107	1.824e-92	4.715e-82	1.911e-73
7.800e+00	0.000e+00	1.441e-107	2.077e-92	5.244e-82	2.153e-73
8.400e+00	0.000e+00	1.675e-107	2.358e-92	5.811e-82	2.418e-73
9.000e+00	0.000e+00	1.944e-107	2.672e-92	6.418e-82	2.710e-73
9.600e+00	0.000e+00	2.252e-107	3.022e-92	7.070e-82	3.031e-73
1.020e+01	0.000e+00	2.607e-107	3.414e-92	7.768e-82	3.385e-73
1.080e+01	0.000e+00	3.014e-107	3.851e-92	8.518e-82	3.776e-73
1.140e+01	0.000e+00	3.482e-107	4.339e-92	9.322e-82	4.208e-73
1.200e+01	0.000e+00	4.018e-107	4.885e-92	1.018e-81	4.685e-73
1.260e+01	0.000e+00	4.633e-107	5.495e-92	1.111e-81	5.213e-73
1.320e+01	0.000e+00	5.338e-107	6.175e-92	1.209e-81	5.796e-73
1.380e+01	0.000e+00	6.145e-107	6.935e-92	1.314e-81	6.442e-73
1.440e+01	0.000e+00	7.068e-107	7.783e-92	1.427e-81	7.155e-73
1.500e+01	0.000e+00	8.123e-107	8.727e-92	1.546e-81	7.945e-73
1.560e+01	0.000e+00	9.327e-107	9.780e-92	1.672e-81	8.818e-73
1.620e+01	0.000e+00	1.070e-106	1.095e-91	1.806e-81	9.783e-73
1.680e+01	0.000e+00	1.226e-106	1.225e-91	1.946e-81	1.085e-72
1.740e+01	0.000e+00	1.404e-106	1.370e-91	2.094e-81	1.203e-72
1.800e+01	0.000e+00	1.606e-106	1.531e-91	2.249e-81	1.333e-72
1.860e+01	0.000e+00	1.835e-106	1.710e-91	2.409e-81	1.477e-72
1.920e+01	0.000e+00	2.094e-106	1.907e-91	2.575e-81	1.636e-72
1.980e+01	0.000e+00	2.388e-106	2.126e-91	2.745e-81	1.811e-72
2.040e+01	0.000e+00	2.718e-106	2.368e-91	2.919e-81	2.005e-72
2.100e+01	0.000e+00	3.091e-106	2.635e-91	3.094e-81	2.218e-72
2.160e+01	0.000e+00	3.510e-106	2.930e-91	3.268e-81	2.453e-72
2.220e+01	0.000e+00	3.979e-106	3.255e-91	3.439e-81	2.712e-72
2.280e+01	0.000e+00	4.504e-106	3.612e-91	3.604e-81	2.998e-72
2.340e+01	0.000e+00	5.090e-106	4.004e-91	3.758e-81	3.312e-72
2.400e+01	0.000e+00	5.741e-106	4.435e-91	3.897e-81	3.658e-72
2.460e+01	0.000e+00	6.463e-106	4.906e-91	4.015e-81	4.038e-72
2.520e+01	0.000e+00	7.260e-106	5.420e-91	4.105e-81	4.457e-72
2.580e+01	0.000e+00	8.136e-106	5.981e-91	4.160e-81	4.916e-72
2.640e+01	0.000e+00	9.095e-106	6.592e-91	4.168e-81	5.421e-72
2.700e+01	0.000e+00	1.014e-105	7.255e-91	4.120e-81	5.975e-72
2.760e+01	0.000e+00	1.127e-105	7.972e-91	4.001e-81	6.583e-72
2.820e+01	0.000e+00	1.248e-105	8.747e-91	3.796e-81	7.250e-72
2.880e+01	0.000e+00	1.377e-105	9.581e-91	3.486e-81	7.980e-72
2.940e+01	0.000e+00	1.513e-105	1.048e-90	3.049e-81	8.780e-72
3.000e+01	nan nan	1.021e-26	2.339e-23	6.648e-20	
3.060e+01	0.000e+00	1.145e-32	nan nan	nan	

3.120e+01	0.000e+00	7.025e-32	nan	nan	nan
3.180e+01	nan	nan	1.570e-25	8.573e-22	nan
3.240e+01	nan	nan	1.686e-24	7.799e-21	6.025e-18
3.300e+01	nan	nan	1.090e-23	4.546e-20	5.624e-17
3.360e+01	0.000e+00	1.011e-27	nan	nan	3.745e-16
3.420e+01	0.000e+00	8.874e-27	nan	nan	nan
3.480e+01	0.000e+00	nan	nan	nan	nan
3.540e+01	nan	nan	7.370e-20	2.125e-16	nan
3.600e+01	nan	nan	8.230e-19	2.800e-15	nan
3.660e+01	0.000e+00	7.056e-23	5.788e-18	2.256e-14	1.060e-11
3.720e+01	0.000e+00	8.248e-22	nan	7.924e-14	1.172e-10
3.780e+01	0.000e+00	4.963e-21	nan	nan	9.276e-10
3.840e+01	nan	nan	nan	nan	5.055e-09
3.900e+01	nan	nan	2.872e-14	nan	nan
3.960e+01	0.000e+00	nan	3.828e-13	6.423e-10	nan
4.020e+01	0.000e+00	6.379e-17	3.093e-12	7.739e-09	nan
4.080e+01	0.000e+00	5.912e-16	nan	6.352e-08	nan
4.140e+01	nan	nan	nan	3.243e-07	1.492e-04
4.200e+01	nan	nan	nan	nan	1.861e-03
4.260e+01	nan	nan	nan	nan	1.626e-02
4.320e+01	0.000e+00	3.591e-12	1.652e-07	nan	1.124e-01
4.380e+01	0.000e+00	4.969e-11	1.574e-06	nan	nan
4.440e+01	nan	3.790e-10	9.100e-06	2.007e-02	nan
4.500e+01	nan	nan	nan	1.804e-01	nan
4.560e+01	nan	nan	nan	1.262e+00	nan
4.620e+01	0.000e+00	nan	nan	nan	nan
4.680e+01	0.000e+00	3.203e-06	5.687e-02	nan	2.407e+04
4.740e+01	nan	3.512e-05	6.789e-01	nan	2.803e+05
4.800e+01	nan	2.045e-04	5.453e+00	nan	2.426e+06
4.860e+01	nan	nan	9.572e+00	3.827e+04	1.690e+07
4.920e+01	0.000e+00	nan	nan	4.903e+05	4.058e+07
4.980e+01	0.000e+00	nan	nan	4.093e+06	5.493e+07
5.040e+01	0.000e+00	2.300e+00	nan	2.690e+07	6.649e+07
5.100e+01	nan	2.275e+01	2.394e+05	4.837e+07	7.642e+07
5.160e+01	nan	1.049e+02	2.703e+06	6.300e+07	8.521e+07
5.220e+01	0.000e+00	nan	2.115e+07	7.492e+07	9.314e+07
5.280e+01	0.000e+00	nan	4.977e+07	8.520e+07	1.004e+08
5.340e+01	0.000e+00	nan	6.696e+07	9.433e+07	1.071e+08
5.400e+01	nan	1.621e+06	8.072e+07	1.026e+08	1.133e+08
5.460e+01	nan	1.581e+07	9.245e+07	1.101e+08	1.191e+08
5.520e+01	nan	5.519e+07	1.028e+08	1.170e+08	1.245e+08
5.580e+01	0.000e+00	7.731e+07	1.120e+08	1.235e+08	1.296e+08
5.640e+01	0.000e+00	9.455e+07	1.203e+08	1.294e+08	1.344e+08
5.700e+01	nan	1.089e+08	1.280e+08	1.350e+08	1.389e+08
5.760e+01	nan	1.213e+08	1.350e+08	1.403e+08	1.433e+08
5.820e+01	nan	1.321e+08	1.415e+08	1.452e+08	1.473e+08
5.880e+01	0.000e+00	1.418e+08	1.476e+08	1.499e+08	1.512e+08
5.940e+01	0.000e+00	1.505e+08	1.532e+08	1.543e+08	1.549e+08
6.000e+01	0.000e+00	1.584e+08	1.584e+08	1.584e+08	1.584e+08

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02

Depth (cm)	Solid Concentrations (μg/kg)				
0.000e+00	2.636e-70	1.811e-63	7.470e-58	9.940e-54	1.460e-47
6.000e-01	2.093e-68	1.450e-61	5.981e-56	8.083e-52	1.164e-45
1.200e+00	4.108e-68	2.869e-61	1.184e-55	1.625e-51	2.294e-45

1.800e+00	6.069e-68	4.296e-61	1.774e-55	2.497e-51	3.413e-45
2.400e+00	7.972e-68	5.750e-61	2.375e-55	3.457e-51	4.526e-45
3.000e+00	9.813e-68	7.250e-61	2.998e-55	4.540e-51	5.641e-45
3.600e+00	1.159e-67	8.816e-61	3.649e-55	5.783e-51	6.765e-45
4.200e+00	1.329e-67	1.047e-60	4.337e-55	7.220e-51	7.903e-45
4.800e+00	1.491e-67	1.222e-60	5.071e-55	8.889e-51	9.062e-45
5.400e+00	1.644e-67	1.411e-60	5.860e-55	1.083e-50	1.025e-44
6.000e+00	1.788e-67	1.613e-60	6.713e-55	1.308e-50	1.147e-44
6.600e+00	1.921e-67	1.833e-60	7.639e-55	1.569e-50	1.273e-44
7.200e+00	2.041e-67	2.072e-60	8.650e-55	1.869e-50	1.403e-44
7.800e+00	2.147e-67	2.333e-60	9.755e-55	2.215e-50	1.539e-44
8.400e+00	2.238e-67	2.618e-60	1.097e-54	2.612e-50	1.680e-44
9.000e+00	2.310e-67	2.930e-60	1.230e-54	3.066e-50	1.828e-44
9.600e+00	2.363e-67	3.273e-60	1.376e-54	3.582e-50	1.983e-44
1.020e+01	2.392e-67	3.650e-60	1.538e-54	4.168e-50	2.145e-44
1.080e+01	2.394e-67	4.063e-60	1.716e-54	4.833e-50	2.316e-44
1.140e+01	2.366e-67	4.518e-60	1.911e-54	5.583e-50	2.496e-44
1.200e+01	2.304e-67	5.018e-60	2.127e-54	6.428e-50	2.685e-44
1.260e+01	2.204e-67	5.569e-60	2.365e-54	7.379e-50	2.885e-44
1.320e+01	2.059e-67	6.174e-60	2.628e-54	8.445e-50	3.095e-44
1.380e+01	1.865e-67	6.839e-60	2.917e-54	9.640e-50	3.318e-44
1.440e+01	1.614e-67	7.571e-60	3.236e-54	1.098e-49	3.553e-44
1.500e+01	1.300e-67	8.375e-60	3.587e-54	1.247e-49	3.801e-44
1.560e+01	9.148e-68	9.260e-60	3.974e-54	1.413e-49	4.063e-44
1.620e+01	4.491e-68	1.023e-59	4.400e-54	1.598e-49	4.339e-44
1.680e+01	1.067e-68	1.130e-59	4.869e-54	1.804e-49	4.632e-44
1.740e+01	7.635e-68	1.247e-59	5.386e-54	2.032e-49	4.940e-44
1.800e+01	1.533e-67	1.376e-59	5.954e-54	2.286e-49	5.266e-44
1.860e+01	2.429e-67	1.517e-59	6.579e-54	2.567e-49	5.610e-44
1.920e+01	3.467e-67	1.672e-59	7.266e-54	2.878e-49	5.972e-44
1.980e+01	4.661e-67	1.843e-59	8.021e-54	3.222e-49	6.354e-44
2.040e+01	6.031e-67	2.029e-59	8.851e-54	3.603e-49	6.757e-44
2.100e+01	7.595e-67	2.234e-59	9.763e-54	4.023e-49	7.181e-44
2.160e+01	9.375e-67	2.459e-59	1.076e-53	4.487e-49	7.627e-44
2.220e+01	1.140e-66	2.705e-59	1.186e-53	4.999e-49	8.096e-44
2.280e+01	1.368e-66	2.975e-59	1.307e-53	5.563e-49	8.588e-44
2.340e+01	1.627e-66	3.271e-59	1.440e-53	6.184e-49	9.105e-44
2.400e+01	1.918e-66	3.595e-59	1.585e-53	6.868e-49	9.647e-44
2.460e+01	2.245e-66	3.950e-59	1.744e-53	7.620e-49	1.022e-43
2.520e+01	2.613e-66	4.339e-59	1.919e-53	8.448e-49	1.081e-43
2.580e+01	3.024e-66	4.765e-59	2.111e-53	9.358e-49	1.143e-43
2.640e+01	3.486e-66	5.231e-59	2.321e-53	1.036e-48	1.208e-43
2.700e+01	4.001e-66	5.742e-59	2.551e-53	1.146e-48	1.276e-43
2.760e+01	4.577e-66	6.302e-59	2.804e-53	1.266e-48	1.346e-43
2.820e+01	5.219e-66	6.915e-59	3.080e-53	1.399e-48	1.419e-43
2.880e+01	5.934e-66	7.586e-59	3.383e-53	1.544e-48	1.495e-43
2.940e+01	6.732e-66	8.320e-59	3.714e-53	1.704e-48	1.574e-43
3.000e+01	8.823e-18	nan	3.372e-13	nan	nan
3.060e+01	2.676e-18	nan	2.375e-14	nan	2.329e-10
3.120e+01	nan	4.674e-15	nan	2.406e-11	1.462e-09
3.180e+01	nan	3.886e-14	nan	2.346e-10	nan
3.240e+01	nan	2.808e-13	nan	1.936e-09	nan
3.300e+01	nan	1.543e-12	nan	1.446e-08	nan
3.360e+01	nan	nan	1.030e-09	9.444e-08	nan
3.420e+01	8.074e-13	nan	1.122e-08	4.139e-07	nan
3.480e+01	7.825e-12	nan	8.968e-08	nan	nan

3.540e+01	5.683e-11	nan	6.350e-07	nan	nan	
3.600e+01	2.044e-10	nan	4.133e-06	nan	6.035e-03	
3.660e+01	nan	3.404e-07	2.252e-05	nan	7.117e-02	
3.720e+01	nan	3.325e-06	nan	nan	6.066e-01	
3.780e+01	nan	2.731e-05	nan	nan	4.875e+00	
3.840e+01	nan	1.935e-04	nan	nan	3.734e+01	
3.900e+01	9.270e-06	9.517e-04	nan	4.837e+00	2.705e+02	
3.960e+01	1.011e-04	nan	nan	4.250e+01	1.873e+03	
4.020e+01	8.341e-04	nan	nan	3.288e+02	1.279e+04	
4.080e+01	5.584e-03	nan	1.776e+01	2.471e+03	8.781e+04	
4.140e+01	1.202e-02	nan	2.767e+02	1.835e+04	5.902e+05	
4.200e+01	nan	nan	2.608e+03	1.305e+05	3.691e+06	
4.260e+01	nan	nan	2.134e+04	8.593e+05	2.002e+07	
4.320e+01	nan	1.796e+03	1.560e+05	5.084e+06	3.590e+07	
4.380e+01	nan	1.746e+04	1.027e+06	2.565e+07	4.685e+07	
4.440e+01	nan	1.389e+05	6.185e+06	3.983e+07	5.586e+07	
4.500e+01	8.487e+03	9.699e+05	2.897e+07	5.056e+07	6.370e+07	
4.560e+01	8.736e+04	6.100e+06	4.277e+07	5.954e+07	7.071e+07	
4.620e+01	7.005e+05	2.976e+07	5.356e+07	6.740e+07	7.711e+07	
4.680e+01	4.781e+06	4.433e+07	6.268e+07	7.446e+07	8.300e+07	
4.740e+01	2.709e+07	5.563e+07	7.069e+07	8.091e+07	8.848e+07	
4.800e+01	4.402e+07	6.514e+07	7.790e+07	8.686e+07	9.362e+07	
4.860e+01	5.640e+07	7.349e+07	8.449e+07	9.240e+07	9.845e+07	
4.920e+01	6.665e+07	8.098e+07	9.057e+07	9.759e+07	1.030e+08	
4.980e+01	7.556e+07	8.782e+07	9.623e+07	1.025e+08	1.073e+08	
5.040e+01	8.353e+07	9.412e+07	1.015e+08	1.071e+08	1.114e+08	
5.100e+01	9.078e+07	9.998e+07	1.065e+08	1.115e+08	1.154e+08	
5.160e+01	9.744e+07	1.055e+08	1.112e+08	1.156e+08	1.191e+08	
5.220e+01	1.036e+08	1.106e+08	1.157e+08	1.196e+08	1.227e+08	
5.280e+01	1.094e+08	1.155e+08	1.199e+08	1.234e+08	1.261e+08	
5.340e+01	1.148e+08	1.201e+08	1.240e+08	1.270e+08	1.294e+08	
5.400e+01	1.199e+08	1.244e+08	1.278e+08	1.304e+08	1.326e+08	
5.460e+01	1.247e+08	1.286e+08	1.315e+08	1.338e+08	1.356e+08	
5.520e+01	1.292e+08	1.325e+08	1.350e+08	1.370e+08	1.385e+08	
5.580e+01	1.335e+08	1.363e+08	1.384e+08	1.400e+08	1.413e+08	
5.640e+01	1.376e+08	1.399e+08	1.416e+08	1.429e+08	1.441e+08	
5.700e+01	1.415e+08	1.433e+08	1.447e+08	1.458e+08	1.467e+08	
5.760e+01	1.452e+08	1.466e+08	1.477e+08	1.485e+08	1.492e+08	
5.820e+01	1.487e+08	1.497e+08	1.505e+08	1.511e+08	1.516e+08	
5.880e+01	1.521e+08	1.528e+08	1.533e+08	1.536e+08	1.540e+08	
5.940e+01	1.553e+08	1.557e+08	1.559e+08	1.561e+08	1.562e+08	
6.000e+01	1.584e+08	1.584e+08	1.584e+08	1.584e+08	1.584e+08	

Time(yr) 2.000e+02

Depth (cm)	Solid Concentrations (μg/kg)
0.000e+00	7.152e-43
6.000e-01	5.706e-41
1.200e+00	1.125e-40
1.800e+00	1.676e-40
2.400e+00	2.226e-40
3.000e+00	2.779e-40
3.600e+00	3.340e-40
4.200e+00	3.912e-40
4.800e+00	4.500e-40
5.400e+00	5.107e-40

6.000e+00	5.737e-40
6.600e+00	6.394e-40
7.200e+00	7.082e-40
7.800e+00	7.805e-40
8.400e+00	8.569e-40
9.000e+00	9.376e-40
9.600e+00	1.023e-39
1.020e+01	1.114e-39
1.080e+01	1.211e-39
1.140e+01	1.315e-39
1.200e+01	1.426e-39
1.260e+01	1.544e-39
1.320e+01	1.671e-39
1.380e+01	1.806e-39
1.440e+01	1.952e-39
1.500e+01	2.108e-39
1.560e+01	2.276e-39
1.620e+01	2.456e-39
1.680e+01	2.650e-39
1.740e+01	2.858e-39
1.800e+01	3.081e-39
1.860e+01	3.322e-39
1.920e+01	3.580e-39
1.980e+01	3.858e-39
2.040e+01	4.157e-39
2.100e+01	4.478e-39
2.160e+01	4.824e-39
2.220e+01	5.196e-39
2.280e+01	5.596e-39
2.340e+01	6.025e-39
2.400e+01	6.488e-39
2.460e+01	6.985e-39
2.520e+01	7.520e-39
2.580e+01	8.095e-39
2.640e+01	8.713e-39
2.700e+01	9.377e-39
2.760e+01	1.009e-38
2.820e+01	1.086e-38
2.880e+01	1.168e-38
2.940e+01	1.257e-38
3.000e+01	5.693e-08
3.060e+01	nan
3.120e+01	nan
3.180e+01	nan
3.240e+01	nan
3.300e+01	nan
3.360e+01	9.997e-05
3.420e+01	1.092e-03
3.480e+01	9.283e-03
3.540e+01	7.254e-02
3.600e+01	5.339e-01
3.660e+01	3.761e+00
3.720e+01	2.589e+01
3.780e+01	1.772e+02
3.840e+01	1.199e+03
3.900e+01	7.881e+03

3.960e+01	5.011e+04
4.020e+01	3.173e+05
4.080e+01	2.032e+06
4.140e+01	1.211e+07
4.200e+01	3.109e+07
4.260e+01	4.246e+07
4.320e+01	5.167e+07
4.380e+01	5.961e+07
4.440e+01	6.669e+07
4.500e+01	7.310e+07
4.560e+01	7.900e+07
4.620e+01	8.448e+07
4.680e+01	8.960e+07
4.740e+01	9.441e+07
4.800e+01	9.895e+07
4.860e+01	1.033e+08
4.920e+01	1.074e+08
4.980e+01	1.113e+08
5.040e+01	1.150e+08
5.100e+01	1.185e+08
5.160e+01	1.220e+08
5.220e+01	1.252e+08
5.280e+01	1.284e+08
5.340e+01	1.314e+08
5.400e+01	1.343e+08
5.460e+01	1.371e+08
5.520e+01	1.398e+08
5.580e+01	1.425e+08
5.640e+01	1.450e+08
5.700e+01	1.474e+08
5.760e+01	1.498e+08
5.820e+01	1.520e+08
5.880e+01	1.542e+08
5.940e+01	1.564e+08
6.000e+01	1.584e+08

Total Concentration Profiles at Various Times

Time(yr)	0.000e+00	2.000e+01	4.000e+01	6.000e+01	8.000e+01
Depth (cm)	Total Concentrations (μg/L)				
0.000e+00	0.000e+00	1.287e-110	2.233e-95	6.731e-85	2.526e-76
6.000e-01	0.000e+00	1.036e-108	1.790e-93	5.378e-83	2.022e-74
1.200e+00	0.000e+00	2.063e-108	3.550e-93	1.062e-82	4.000e-74
1.800e+00	0.000e+00	3.118e-108	5.331e-93	1.586e-82	5.989e-74
2.400e+00	0.000e+00	4.229e-108	7.164e-93	2.115e-82	8.015e-74
3.000e+00	0.000e+00	5.421e-108	9.079e-93	2.653e-82	1.010e-73
3.600e+00	0.000e+00	6.722e-108	1.111e-92	3.206e-82	1.228e-73
4.200e+00	0.000e+00	8.163e-108	1.328e-92	3.779e-82	1.458e-73
4.800e+00	0.000e+00	9.775e-108	1.563e-92	4.378e-82	1.703e-73
5.400e+00	0.000e+00	1.159e-107	1.820e-92	5.007e-82	1.965e-73
6.000e+00	0.000e+00	1.366e-107	2.102e-92	5.671e-82	2.247e-73
6.600e+00	0.000e+00	1.601e-107	2.412e-92	6.375e-82	2.554e-73
7.200e+00	0.000e+00	1.870e-107	2.756e-92	7.125e-82	2.888e-73
7.800e+00	0.000e+00	2.178e-107	3.139e-92	7.926e-82	3.254e-73
8.400e+00	0.000e+00	2.532e-107	3.564e-92	8.783e-82	3.655e-73

9.000e+00	0.000e+00	2.938e-107	4.038e-92	9.700e-82	4.096e-73
9.600e+00	0.000e+00	3.404e-107	4.568e-92	1.068e-81	4.581e-73
1.020e+01	0.000e+00	3.940e-107	5.159e-92	1.174e-81	5.116e-73
1.080e+01	0.000e+00	4.555e-107	5.820e-92	1.287e-81	5.707e-73
1.140e+01	0.000e+00	5.262e-107	6.558e-92	1.409e-81	6.359e-73
1.200e+01	0.000e+00	6.073e-107	7.383e-92	1.539e-81	7.081e-73
1.260e+01	0.000e+00	7.002e-107	8.304e-92	1.678e-81	7.878e-73
1.320e+01	0.000e+00	8.068e-107	9.333e-92	1.827e-81	8.760e-73
1.380e+01	0.000e+00	9.287e-107	1.048e-91	1.986e-81	9.735e-73
1.440e+01	0.000e+00	1.068e-106	1.176e-91	2.156e-81	1.081e-72
1.500e+01	0.000e+00	1.228e-106	1.319e-91	2.336e-81	1.201e-72
1.560e+01	0.000e+00	1.410e-106	1.478e-91	2.527e-81	1.333e-72
1.620e+01	0.000e+00	1.617e-106	1.655e-91	2.729e-81	1.479e-72
1.680e+01	0.000e+00	1.853e-106	1.852e-91	2.942e-81	1.640e-72
1.740e+01	0.000e+00	2.122e-106	2.071e-91	3.165e-81	1.818e-72
1.800e+01	0.000e+00	2.427e-106	2.314e-91	3.398e-81	2.015e-72
1.860e+01	0.000e+00	2.773e-106	2.584e-91	3.641e-81	2.232e-72
1.920e+01	0.000e+00	3.165e-106	2.882e-91	3.892e-81	2.472e-72
1.980e+01	0.000e+00	3.608e-106	3.213e-91	4.149e-81	2.737e-72
2.040e+01	0.000e+00	4.108e-106	3.579e-91	4.411e-81	3.030e-72
2.100e+01	0.000e+00	4.671e-106	3.983e-91	4.676e-81	3.352e-72
2.160e+01	0.000e+00	5.304e-106	4.428e-91	4.939e-81	3.707e-72
2.220e+01	0.000e+00	6.014e-106	4.919e-91	5.198e-81	4.099e-72
2.280e+01	0.000e+00	6.807e-106	5.459e-91	5.446e-81	4.531e-72
2.340e+01	0.000e+00	7.692e-106	6.052e-91	5.679e-81	5.006e-72
2.400e+01	0.000e+00	8.677e-106	6.702e-91	5.889e-81	5.528e-72
2.460e+01	0.000e+00	9.768e-106	7.414e-91	6.068e-81	6.103e-72
2.520e+01	0.000e+00	1.097e-105	8.192e-91	6.204e-81	6.735e-72
2.580e+01	0.000e+00	1.230e-105	9.040e-91	6.287e-81	7.430e-72
2.640e+01	0.000e+00	1.375e-105	9.963e-91	6.300e-81	8.193e-72
2.700e+01	0.000e+00	1.532e-105	1.096e-90	6.227e-81	9.030e-72
2.760e+01	0.000e+00	1.703e-105	1.205e-90	6.047e-81	9.949e-72
2.820e+01	0.000e+00	1.886e-105	1.322e-90	5.737e-81	1.096e-71
2.880e+01	0.000e+00	2.081e-105	1.448e-90	5.268e-81	1.206e-71
2.940e+01	0.000e+00	2.286e-105	1.583e-90	4.608e-81	1.327e-71
3.000e+01	nan nan	1.307e-27	2.994e-24	8.509e-21	
3.060e+01	0.000e+00	1.465e-33	nan nan	nan	
3.120e+01	0.000e+00	8.992e-33	nan nan	nan	
3.180e+01	nan nan	2.010e-26	1.097e-22	nan	
3.240e+01	nan nan	2.158e-25	9.983e-22	7.711e-19	
3.300e+01	nan nan	1.395e-24	5.819e-21	7.198e-18	
3.360e+01	0.000e+00	1.294e-28	nan nan	4.794e-17	
3.420e+01	0.000e+00	1.136e-27	nan nan	nan	
3.480e+01	0.000e+00	nan nan	nan nan		
3.540e+01	nan nan	9.433e-21	2.720e-17	nan	
3.600e+01	nan nan	1.053e-19	3.584e-16	nan	
3.660e+01	0.000e+00	9.031e-24	7.409e-19	2.888e-15	1.357e-12
3.720e+01	0.000e+00	1.056e-22	nan	1.014e-14	1.500e-11
3.780e+01	0.000e+00	6.352e-22	nan nan	1.187e-10	
3.840e+01	nan nan	nan nan	6.471e-10		
3.900e+01	nan nan	3.677e-15	nan nan		
3.960e+01	0.000e+00	nan	4.900e-14	8.222e-11	nan
4.020e+01	0.000e+00	8.165e-18	3.959e-13	9.907e-10	nan
4.080e+01	0.000e+00	7.568e-17	nan	8.130e-09	nan
4.140e+01	nan nan	nan	4.151e-08	1.910e-05	
4.200e+01	nan nan	nan nan	2.382e-04		

4.260e+01	nan	nan	nan	nan	2.082e-03	
4.320e+01	0.000e+00	4.597e-13	2.114e-08	nan	1.438e-02	
4.380e+01	0.000e+00	6.361e-12	2.015e-07	nan	nan	
4.440e+01	nan	4.851e-11	1.165e-06	2.569e-03	nan	
4.500e+01	nan	nan	nan	2.309e-02	nan	
4.560e+01	nan	nan	nan	1.615e-01	nan	
4.620e+01	0.000e+00	nan	nan	nan	nan	
4.680e+01	0.000e+00	4.100e-07	7.280e-03	nan	3.081e+03	
4.740e+01	nan	4.495e-06	8.690e-02	nan	3.588e+04	
4.800e+01	nan	2.618e-05	6.980e-01	nan	3.106e+05	
4.860e+01	nan	nan	1.225e+00	4.899e+03	2.163e+06	
4.920e+01	0.000e+00	nan	nan	6.275e+04	5.195e+06	
4.980e+01	0.000e+00	nan	nan	5.240e+05	7.033e+06	
5.040e+01	0.000e+00	2.944e-01	nan	3.444e+06	8.515e+06	
5.100e+01	nan	2.912e+00	3.064e+04	6.192e+06	9.787e+06	
5.160e+01	nan	1.342e+01	3.459e+05	8.067e+06	1.091e+07	
5.220e+01	0.000e+00	nan	2.707e+06	9.595e+06	1.193e+07	
5.280e+01	0.000e+00	nan	6.372e+06	1.091e+07	1.286e+07	
5.340e+01	0.000e+00	nan	8.575e+06	1.208e+07	1.372e+07	
5.400e+01	nan	2.075e+05	1.034e+07	1.314e+07	1.451e+07	
5.460e+01	nan	2.024e+06	1.184e+07	1.411e+07	1.526e+07	
5.520e+01	nan	7.066e+06	1.317e+07	1.500e+07	1.595e+07	
5.580e+01	0.000e+00	9.901e+06	1.435e+07	1.582e+07	1.661e+07	
5.640e+01	0.000e+00	1.211e+07	1.542e+07	1.659e+07	1.723e+07	
5.700e+01	nan	1.395e+07	1.640e+07	1.731e+07	1.781e+07	
5.760e+01	nan	1.554e+07	1.731e+07	1.799e+07	1.837e+07	
5.820e+01	nan	1.694e+07	1.814e+07	1.862e+07	1.889e+07	
5.880e+01	0.000e+00	1.818e+07	1.892e+07	1.922e+07	1.939e+07	
5.940e+01	0.000e+00	1.930e+07	1.964e+07	1.979e+07	1.987e+07	
6.000e+01	0.000e+00	2.032e+07	2.032e+07	2.032e+07	2.032e+07	

Time(yr)	1.000e+02	1.200e+02	1.400e+02	1.600e+02	1.800e+02
Depth (cm)	Total Concentrations (μg/L)				
0.000e+00	3.984e-70	2.737e-63	1.129e-57	1.502e-53	2.207e-47
6.000e-01	3.163e-68	2.191e-61	9.039e-56	1.222e-51	1.759e-45
1.200e+00	6.209e-68	4.336e-61	1.789e-55	2.457e-51	3.468e-45
1.800e+00	9.173e-68	6.493e-61	2.681e-55	3.773e-51	5.158e-45
2.400e+00	1.205e-67	8.690e-61	3.590e-55	5.224e-51	6.840e-45
3.000e+00	1.483e-67	1.096e-60	4.531e-55	6.862e-51	8.526e-45
3.600e+00	1.751e-67	1.332e-60	5.515e-55	8.740e-51	1.022e-44
4.200e+00	2.008e-67	1.582e-60	6.555e-55	1.091e-50	1.194e-44
4.800e+00	2.253e-67	1.847e-60	7.665e-55	1.343e-50	1.370e-44
5.400e+00	2.485e-67	2.132e-60	8.857e-55	1.636e-50	1.549e-44
6.000e+00	2.702e-67	2.438e-60	1.015e-54	1.977e-50	1.733e-44
6.600e+00	2.903e-67	2.770e-60	1.155e-54	2.371e-50	1.923e-44
7.200e+00	3.084e-67	3.132e-60	1.307e-54	2.825e-50	2.121e-44
7.800e+00	3.245e-67	3.526e-60	1.474e-54	3.348e-50	2.326e-44
8.400e+00	3.382e-67	3.957e-60	1.658e-54	3.948e-50	2.539e-44
9.000e+00	3.492e-67	4.429e-60	1.859e-54	4.633e-50	2.763e-44
9.600e+00	3.571e-67	4.947e-60	2.080e-54	5.414e-50	2.997e-44
1.020e+01	3.614e-67	5.516e-60	2.324e-54	6.300e-50	3.242e-44
1.080e+01	3.618e-67	6.141e-60	2.593e-54	7.304e-50	3.500e-44
1.140e+01	3.576e-67	6.829e-60	2.889e-54	8.437e-50	3.772e-44
1.200e+01	3.483e-67	7.585e-60	3.215e-54	9.715e-50	4.058e-44
1.260e+01	3.331e-67	8.416e-60	3.575e-54	1.115e-49	4.360e-44

1.320e+01	3.112e-67	9.330e-60	3.972e-54	1.276e-49	4.678e-44
1.380e+01	2.818e-67	1.034e-59	4.409e-54	1.457e-49	5.014e-44
1.440e+01	2.440e-67	1.144e-59	4.891e-54	1.659e-49	5.369e-44
1.500e+01	1.965e-67	1.266e-59	5.421e-54	1.884e-49	5.744e-44
1.560e+01	1.383e-67	1.399e-59	6.006e-54	2.136e-49	6.140e-44
1.620e+01	6.787e-68	1.546e-59	6.650e-54	2.415e-49	6.558e-44
1.680e+01	1.613e-68	1.708e-59	7.359e-54	2.726e-49	7.000e-44
1.740e+01	1.154e-67	1.885e-59	8.140e-54	3.072e-49	7.466e-44
1.800e+01	2.317e-67	2.079e-59	8.998e-54	3.455e-49	7.959e-44
1.860e+01	3.672e-67	2.293e-59	9.942e-54	3.880e-49	8.478e-44
1.920e+01	5.239e-67	2.528e-59	1.098e-53	4.350e-49	9.026e-44
1.980e+01	7.044e-67	2.785e-59	1.212e-53	4.870e-49	9.604e-44
2.040e+01	9.114e-67	3.067e-59	1.338e-53	5.445e-49	1.021e-43
2.100e+01	1.148e-66	3.377e-59	1.475e-53	6.080e-49	1.085e-43
2.160e+01	1.417e-66	3.716e-59	1.627e-53	6.781e-49	1.153e-43
2.220e+01	1.722e-66	4.088e-59	1.793e-53	7.555e-49	1.224e-43
2.280e+01	2.068e-66	4.496e-59	1.975e-53	8.407e-49	1.298e-43
2.340e+01	2.459e-66	4.943e-59	2.176e-53	9.346e-49	1.376e-43
2.400e+01	2.898e-66	5.433e-59	2.395e-53	1.038e-48	1.458e-43
2.460e+01	3.393e-66	5.970e-59	2.636e-53	1.152e-48	1.544e-43
2.520e+01	3.948e-66	6.557e-59	2.900e-53	1.277e-48	1.634e-43
2.580e+01	4.571e-66	7.201e-59	3.190e-53	1.414e-48	1.728e-43
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2.700e+01	6.047e-66	8.679e-59	3.856e-53	1.732e-48	1.928e-43
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3.000e+01	1.129e-18	nan	4.316e-14	nan	nan
3.060e+01	3.426e-19	nan	3.039e-15	nan	2.981e-11
3.120e+01	nan	5.983e-16	nan	3.080e-12	1.871e-10
3.180e+01	nan	4.973e-15	nan	3.003e-11	nan
3.240e+01	nan	3.594e-14	nan	2.478e-10	nan
3.300e+01	nan	1.975e-13	nan	1.851e-09	nan
3.360e+01	nan	nan	1.319e-10	1.209e-08	nan
3.420e+01	1.034e-13	nan	1.436e-09	5.298e-08	nan
3.480e+01	1.002e-12	nan	1.148e-08	nan	nan
3.540e+01	7.274e-12	nan	8.128e-08	nan	nan
3.600e+01	2.616e-11	nan	5.290e-07	nan	7.725e-04
3.660e+01	nan	4.357e-08	2.882e-06	nan	9.109e-03
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3.780e+01	nan	3.496e-06	nan	nan	6.239e-01
3.840e+01	nan	2.477e-05	nan	nan	4.780e+00
3.900e+01	1.187e-06	1.218e-04	nan	6.191e-01	3.462e+01
3.960e+01	1.294e-05	nan	nan	5.440e+00	2.398e+02
4.020e+01	1.068e-04	nan	nan	4.208e+01	1.637e+03
4.080e+01	7.148e-04	nan	2.273e+00	3.163e+02	1.124e+04
4.140e+01	1.538e-03	nan	3.541e+01	2.348e+03	7.555e+04
4.200e+01	nan	nan	3.339e+02	1.671e+04	4.725e+05
4.260e+01	nan	nan	2.732e+03	1.100e+05	2.563e+06
4.320e+01	nan	2.299e+02	1.996e+04	6.507e+05	4.595e+06
4.380e+01	nan	2.235e+03	1.315e+05	3.283e+06	5.999e+06
4.440e+01	nan	1.778e+04	7.917e+05	5.099e+06	7.152e+06
4.500e+01	1.086e+03	1.241e+05	3.708e+06	6.474e+06	8.156e+06
4.560e+01	1.118e+04	7.809e+05	5.475e+06	7.624e+06	9.055e+06
4.620e+01	8.967e+04	3.810e+06	6.858e+06	8.631e+06	9.875e+06

4.680e+01	6.120e+05	5.675e+06	8.026e+06	9.536e+06	1.063e+07
4.740e+01	3.467e+06	7.123e+06	9.053e+06	1.036e+07	1.133e+07
4.800e+01	5.635e+06	8.342e+06	9.977e+06	1.113e+07	1.199e+07
4.860e+01	7.222e+06	9.411e+06	1.082e+07	1.184e+07	1.261e+07
4.920e+01	8.535e+06	1.037e+07	1.160e+07	1.250e+07	1.320e+07
4.980e+01	9.677e+06	1.125e+07	1.233e+07	1.313e+07	1.375e+07
5.040e+01	1.070e+07	1.206e+07	1.301e+07	1.372e+07	1.428e+07
5.100e+01	1.163e+07	1.281e+07	1.365e+07	1.428e+07	1.478e+07
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5.400e+01	1.536e+07	1.595e+07	1.638e+07	1.672e+07	1.699e+07
5.460e+01	1.598e+07	1.648e+07	1.685e+07	1.715e+07	1.738e+07
5.520e+01	1.656e+07	1.699e+07	1.731e+07	1.756e+07	1.776e+07
5.580e+01	1.711e+07	1.747e+07	1.774e+07	1.795e+07	1.812e+07
5.640e+01	1.764e+07	1.793e+07	1.815e+07	1.833e+07	1.847e+07
5.700e+01	1.814e+07	1.837e+07	1.855e+07	1.869e+07	1.881e+07
5.760e+01	1.862e+07	1.880e+07	1.893e+07	1.904e+07	1.913e+07
5.820e+01	1.907e+07	1.920e+07	1.930e+07	1.938e+07	1.944e+07
5.880e+01	1.951e+07	1.959e+07	1.965e+07	1.970e+07	1.975e+07
5.940e+01	1.992e+07	1.996e+07	1.999e+07	2.002e+07	2.004e+07
6.000e+01	2.032e+07	2.032e+07	2.032e+07	2.032e+07	2.032e+07

Time(yr) 2.000e+02

Depth (cm)	Total Concentrations (μg/L)
0.000e+00	1.081e-42
6.000e-01	8.624e-41
1.200e+00	1.701e-40
1.800e+00	2.532e-40
2.400e+00	3.364e-40
3.000e+00	4.200e-40
3.600e+00	5.048e-40
4.200e+00	5.913e-40
4.800e+00	6.801e-40
5.400e+00	7.718e-40
6.000e+00	8.670e-40
6.600e+00	9.663e-40
7.200e+00	1.070e-39
7.800e+00	1.180e-39
8.400e+00	1.295e-39
9.000e+00	1.417e-39
9.600e+00	1.547e-39
1.020e+01	1.684e-39
1.080e+01	1.831e-39
1.140e+01	1.987e-39
1.200e+01	2.155e-39
1.260e+01	2.333e-39
1.320e+01	2.525e-39
1.380e+01	2.730e-39
1.440e+01	2.950e-39
1.500e+01	3.186e-39
1.560e+01	3.440e-39
1.620e+01	3.712e-39
1.680e+01	4.005e-39

1.740e+01	4.319e-39
1.800e+01	4.657e-39
1.860e+01	5.020e-39
1.920e+01	5.411e-39
1.980e+01	5.831e-39
2.040e+01	6.282e-39
2.100e+01	6.768e-39
2.160e+01	7.291e-39
2.220e+01	7.852e-39
2.280e+01	8.457e-39
2.340e+01	9.107e-39
2.400e+01	9.805e-39
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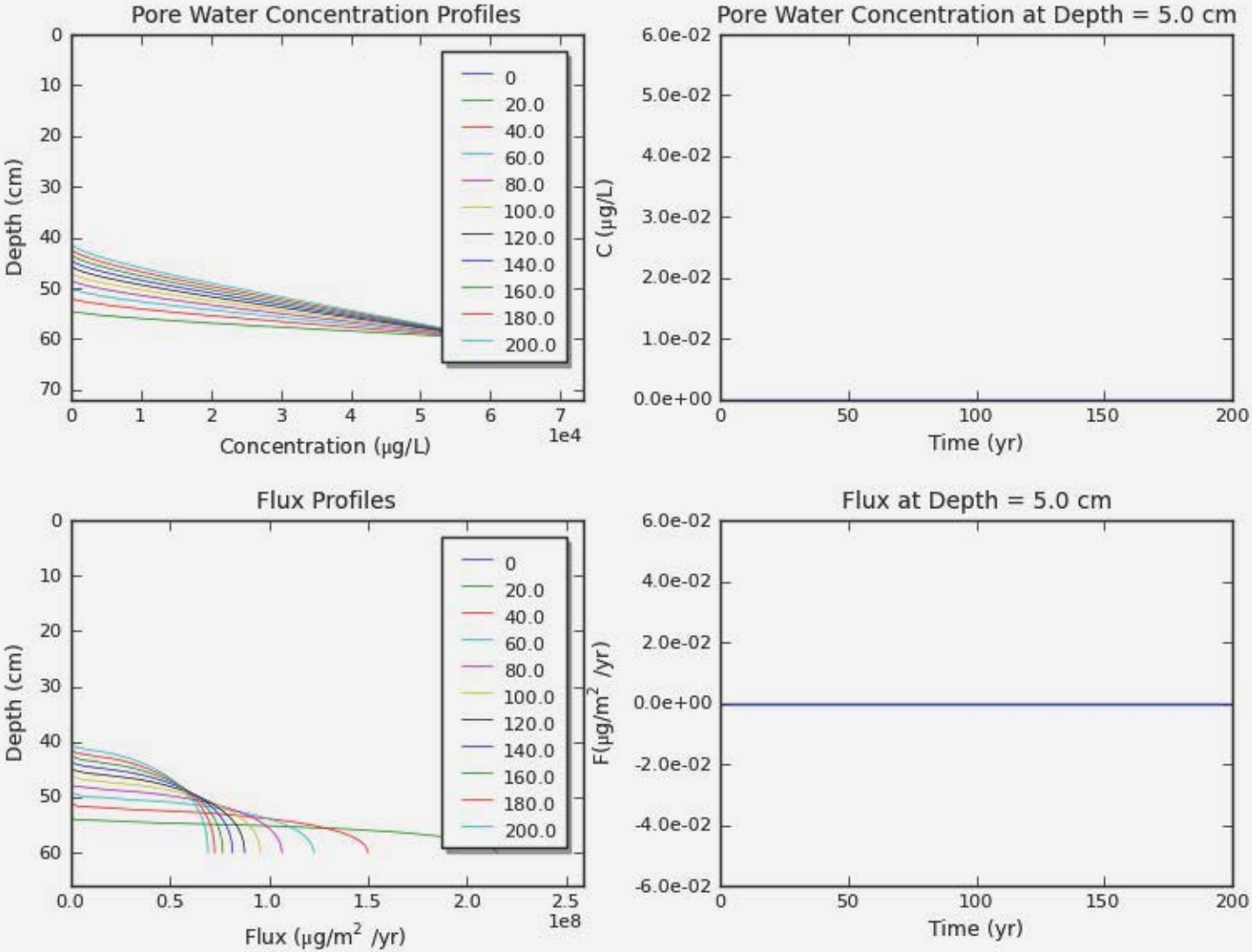
2.520e+01	1.137e-38
2.580e+01	1.223e-38
2.640e+01	1.317e-38
2.700e+01	1.417e-38
2.760e+01	1.525e-38
2.820e+01	1.641e-38
2.880e+01	1.766e-38
2.940e+01	1.900e-38
3.000e+01	7.287e-09
3.060e+01	nan
3.120e+01	nan
3.180e+01	nan
3.240e+01	nan
3.300e+01	nan
3.360e+01	1.280e-05
3.420e+01	1.398e-04
3.480e+01	1.188e-03
3.540e+01	9.285e-03
3.600e+01	6.834e-02
3.660e+01	4.813e-01
3.720e+01	3.314e+00
3.780e+01	2.268e+01
3.840e+01	1.535e+02
3.900e+01	1.009e+03
3.960e+01	6.414e+03
4.020e+01	4.062e+04
4.080e+01	2.601e+05
4.140e+01	1.550e+06
4.200e+01	3.980e+06
4.260e+01	5.436e+06
4.320e+01	6.615e+06
4.380e+01	7.633e+06
4.440e+01	8.540e+06
4.500e+01	9.362e+06
4.560e+01	1.012e+07
4.620e+01	1.082e+07
4.680e+01	1.148e+07
4.740e+01	1.209e+07
4.800e+01	1.268e+07
4.860e+01	1.323e+07
4.920e+01	1.375e+07
4.980e+01	1.426e+07
5.040e+01	1.473e+07

5.100e+01	1.519e+07
5.160e+01	1.563e+07
5.220e+01	1.605e+07
5.280e+01	1.646e+07
5.340e+01	1.685e+07
5.400e+01	1.722e+07
5.460e+01	1.758e+07
5.520e+01	1.793e+07
5.580e+01	1.827e+07
5.640e+01	1.859e+07
5.700e+01	1.890e+07
5.760e+01	1.921e+07
5.820e+01	1.950e+07
5.880e+01	1.978e+07
5.940e+01	2.005e+07
6.000e+01	2.032e+07


Pore Water Concentration Profiles
Depth (cm)
Concentration (μg/L)
1e4
0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
Pore Water Concentration at Depth = 5.0 cm
C (μg/L)
Time (yr)
Flux Profiles
Depth (cm)
Flux (μg/m^2 /yr)
1e8
Flux at Depth = 5.0 cm
F(μg/m^2 /yr)
Time (yr)

APPENDIX E

Remedial Action Work Plan

REMEDIAL ACTION WORK PLAN

LOWER SOUTH POND SEDIMENTS ADJACENT TO WEST HIDE PILE

Industri-plex Operable Unit 2
(including Wells G&H Operable Unit 3) Superfund Site
Woburn, Massachusetts

Prepared by:

de maximis, inc.

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July 31, 2014

Disclaimer: This document is a DRAFT document prepared by the Settling Defendants under a government Consent Decree. This document has not undergone formal review by the U.S. Environmental Protection Agency (EPA) or the Massachusetts Department of Environmental Protection (MassDEP). The opinions, findings, and conclusions, expressed are those of the author and not those of the EPA or the MassDEP.

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LIST OF ACRONYMS

Acronym	Agency/Organization/Definition
AAD	Atlantic Avenue Drainway
ARAR	Applicable or Relevant and Appropriate Requirement
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Contaminant of Concern
CPM	Critical Path Method
CQA	Construction Quality Assurance
CRSP	Community Relations Support Plan
CSM	Conceptual Site Model
DO	Dissolved Oxygen
EHP	East Hide Pile
EMP	Environmental Monitoring Plan
EPA	United States Environmental Protection Agency
FML	Flexible Membrane Liner (Geomembrane)
FSP	Field Sampling Plan
GSIP	Groundwater/Surface Water Investigation Plan
HASP	Site-specific Health & Safety Plan
HBHA	Halls Brook Holding Area
IC	Institutional Control
MassDEP	Massachusetts Department of Environmental Protection
MBTA	Massachusetts Bay Transportation Authority
NBSD	New Boston Street Drainway
NRWQC-CCC	National Recommended Water Quality Criterion
O&M	Operations and Maintenance
OU1	Operable Unit 1 (Industri-plex Site)
OU2	Operable Unit 2 (Industri-plex Site)

LIST OF ACRONYMS
(continued)

Acronym	Agency/Organization/Definition
PDI	Pre-Design Investigation
POP	Project Operations Plan
QAPP	Quality Assurance Project Plan
RAO	Response Action Objective
RD/RA	Remedial Design/Remedial Action
RDC	Remedial Design Contractor
RDWP	Remedial Design Work Plan
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
ROW	Right of Way
S.U.	Standard pH Units
SAP	Sampling and Analysis Plan
SC	Supervising Contractor
SMP	Site Management Plan
SOW	Statement of Work
SWMP	Surface Water Monitoring Plan
VOC	Volatile Organic Compound
WHP	West Hide Pile

1.0 INTRODUCTION

1.1 Scope and Objective

This document serves as the Remedial Action Work Plan (RAWP) for the Lower South Pond (LSP) Sediments Adjacent to West Hide Pile (WHP) for the Industri-plex Superfund Site Operable Unit 2 (OU2) in Woburn, Massachusetts (the Site, see Figure 1). The RAWP has been prepared to implement one component of the remedy required pursuant to the terms of the Consent Decree (CD) entered in Civil Action No. 1:08-cv-10325 and the Statement of Work (SOW) appended to the CD. This RAWP is a required components of the 100% Remedial Design (100% RD) per section V(B)(4)(g and h) of the SOW. The work described herein is being undertaken by Pharmacia LLC by its Attorney-in-Fact Monsanto Company and Stauffer Management Company LLC, as litigation agent for Bayer CropScience Inc. (collectively, the Settling Defendants or SDs).

1.2 Overview of the Remedial Construction Elements Required to Implement the Remedy

A series of Remedial Action (RA) implementation activities and post-construction compliance monitoring activities will be conducted to remediate and monitor the Site. This section presents a brief description of the remedial construction elements to be completed at LSP portion of the Site. Detailed descriptions of the field tasks required to complete each of the LSP remedial construction elements are described in the 100% RD document (including drawings, plans, and specifications), as well as the 95% RD Field Sampling Plan (FSP) and Construction Quality Assurance Plan (CQAP) provided in Attachment E3 of the March 15, 2014 submission. Long-term monitoring for the Site is provided in the draft Environmental Monitoring Plan (EMP), which is included as Appendix H of the 95% RD. Components of this RAWP, such as the FSP and Quality Assurance Project Plan (QAPP), are referenced in the EMP.

This RAWP is being submitted following EPA's conditional approval of the 100% RD related to the LSP sediments adjacent to WHP (abbreviated LSP-WHP below) via EPA's letter dated June 30, 2014. The LSP-WHP work is being expedited relative to other portions of the Site.

The approximate area of WHP-LSP excavation shown on Drawing G-404 (see Appendix A of the 100% RD) includes both sediment currently under water and an area of soil immediately to the west of the sediment area to provide an added buffer. The sediments above the Preliminary Remediation Goal (PRG) in the LSP will be dredged, disposed off-site and restored. Some of the soils adjacent to these sediments and under the eastern portion of WHP's existing OU1 protective cover will be removed, disposed off-site, and restored so that these soils do not impact the restored sediments and as part of the construction means and methods to facilitate sediment removal.

1.3 Related Project Documents

The following documents have been developed for this RA and are summarized below.

1.3.1 Construction Drawings

Construction Drawings have been developed to document and detail the existing conditions, as well as the proposed construction activities. The Construction Drawings incorporate and are based on the LSP-WHP 100% RD. Construction Drawings are located in Appendix A of the 100% RD.

1.3.2 Construction Specifications

LSP-WHP Construction Specifications are located in Appendix A of the 100% RD. The specifications detail the construction activities and outline the technical aspects applicable to the work and are based on the 100% RD.

1.3.3 Health and Safety Plan

A site-specific HASP will be prepared in accordance with the requirements of Title 29, Code of Federal Regulations (CFR) Part 1910.120 to protect onsite personnel, visitors, and the public from physical harm and exposure to hazardous materials during the RA activities and will be submitted as part of the specification submittal process.

The objective of the HASP is to verify that onsite workers, support area personnel, and nearby pedestrians are not being exposed to hazardous substances at concentrations greater than applicable standards. The HASP outlines the instrumentation and procedures for monitoring and recording the concentrations of airborne dust during the excavation activities. Data collected will form the basis for any modifications of work practices and/or engineering controls to reduce emissions.

1.4 Roles and Responsibilities

The personnel involved in the LSP-WHP RA activities include the following: EPA, Settling Defendant (SD's), SD's Project Coordinator and Construction Manager, Remedial Design Engineer, RA Contractor and Roux Associates. The roles and responsibilities of all teams are described below.

1.4.1 EPA Project Personnel

The EPA is the lead agency responsible for managing the removal and cleanup activities at Site. Mr. Joseph LeMay, P.E. will serve as the EPA Region I Remedial Project Manager (RPM).

The EPA Region I RPM is primarily responsible for the following items related to Site:

- Conducting/coordinating EPA's review and approval of RAWP and associated submittals
- Coordinating, directing, and reviewing the work the SD's and their Contractors to assure compliance with the National Contingency Plan (NCP), ROD, and RD/RA CD and SOW

1.4.2 EPA Oversight Contractor

AECOM is the EPA oversight contractor for the RA and will, at EPA's direction, review SD submittals, monitor work, and act as a representative of the EPA. Mr. Paul Dombrowski and Mr. Gordon Bullard will serve as the AECOM Project Managers.

1.4.3 MassDEP Involvement

MassDEP will provide review and comment regarding the state regulatory aspects of this project. Their review process for RA documents will occur concurrently with that of the EPA as described in the SOW.

1.4.4 Settling Defendants

The SDs responsible to implement the LSP-WHP RA includes:

- Pharmacia Corporation LLC by its Attorney-in-Fact Monsanto Company
- Stauffer Management Company LLC, as Litigation Agent for Bayer CropScience

Roles and responsibilities of the SD include procuring the construction and operation and maintenance of the remedy.

1.4.5 Project Coordinator, Project Manager & Construction Manager

The SDs have designated Bruce Thompson of ***de maximis, inc.*** (de maximis) as the Project Coordinator and Todd Majer (de maximis) as their Project Manager with responsibility for directing and supervising all actions called for in the RD/RA CD and SOW. Mr. Stan Baker or Mr. Leon Christian (de maximis) will be the Construction Manager.

The Construction Manager is responsible for proper implementation of the construction activities. The Project Coordinator's primary function is to ensure that all construction objectives are achieved successfully and in accordance with the project requirements. The Project Coordinator will function as the primary point of contact and control matters concerning the project.

1.4.6 Remedial Design Engineer

The Remedial Design Engineer (RDE) is responsible for working with the Construction Manager to understand day-to-day management of field activities and data collection. The RDE will be Mark Kelley, P.E., of Haley & Aldrich, Inc. The RDE responsibilities also include reviewing Contractor submittals, assisting in monitoring the progress and quality of investigative data collection, preparing and reviewing interim monitoring reports, updating plan and specification changes during construction, and providing technical support of project activities. In addition, the RDE will participate in the pre-final and final inspection of completed work, and prepare a project Remedial Completion Report. The RDE may provide one or more Construction Monitoring staff to act as the RDE agent on-site during the construction process or rely on the Construction Manager for this duty. If used, the Construction Monitoring staff will serve as a liaison to the Construction Manager and RA Constructor, maintaining job records, reviewing submittals, reviewing work performed, preparing progress reports, disapproving defective work, making recommendations concerning inspections and tests, and drafting change orders.

1.4.7 Construction Contractor

The Industri-plex OU2 Environmental Remedial Trust has contracted with Cornerstone Construction Services to perform the LSP-WHP RA activities. Mr. Kenneth Lafferty of Cornerstone will serve as the Project Manager for implementation of the work.

2.0 PRE-CONSTRUCTION PREPARATION ACTIVITIES

Prior to the start of any construction activities, the following pre-construction preparation activities will be implemented:

1. Documentation of existing conditions in the area, consisting of the following:
    a. Collection of groundwater elevations to evaluate the existing hydraulic gradients during dewatering of the excavation.
    b. Existing physical conditions and existing landscape and other site features will be inspected and documented.
2. Coordination with local utility companies, including DIGSAFE notification will be conducted before beginning excavation activities.

In addition, time critical materials and equipment will be procured in advance of the anticipated start date of the project. Project data or shop drawing(s) will be reviewed by the RDE and Construction Contractor. All subcontracts and purchase orders will be issued and the critical subcontractors will be scheduled in advance.

3.0 CONSTRUCTION ACTIVITIES

General Basis of Work

Due to the surrounding geography, limited access, anticipated groundwater and surface water concerns, it is anticipated that the work area will be setup for an immediate excavation in the dry or damp. A sediment stockpile management staging area will be constructed on the upper reaches of the WHP. The sediment dewatering and water treatment systems will be staged as close to the excavation area as possible. Upon dewatering of the surface water (by use of surface water dams and pumps), the targeted sediment will be excavated to the required depth, preliminarily stabilized only for onsite transport to the staging area by off-road articulating dump trucks. This will allow for expedited removal, timely collection of confirmatory sediment samples, and restoration of the area and termination of the water handling and treatment operation as quickly as possible.

The WHP work will be completed in phases and is scheduled to take approximately six to eight weeks to complete. Actual phasing limits and timing will be adjusted based on the production and availability of resources. Mobilization and construction activities for the project are scheduled to commence on or before September 2, 2014. The following phases of work are anticipated to be performed:

Phase I – Mobilization and Site Setup
Phase II – Preparation for Excavation
Phase III – Water Treatment
Phase IV – Excavation
Phase V – Waste Stabilization
Phase VI – Site Restoration

Mobilization and Site Setup

All necessary equipment and personnel will be mobilized to the site. The support area will be setup with a crew trailer, a portable restroom and hand wash station. A tool storage container will be placed in the staging area for ease of access. Erosion and sedimentation controls will be installed as outlined in the Construction Drawings. Access to the WHP work area will be through the Anderson Regional Transportation Center (RTC) parking lot off of the RTC access road. To support over the road truck traffic, the chain link fence and gate will be modified to handle all construction vehicles. A temporary staging area for sediment and waste will be constructed using haybales, and it will be lined with geotextile and a HDPE liner. A ramp will be constructed to allow the off-road trucks to dump securely and safety into the staging area. The staging area will be constructed in a secure manner to avoid rain run-off entering the area while the material is processed and loaded out for offsite disposal. The sediment stockpiles being managed within the footprint of the sediment management area will be covered daily to minimize rain water contribution into the sediment.

A temporary access road from the staging area to the LSP will be installed in select areas per the Construction Drawings to protect the engineered OU1 cover along with erosion controls. An existing swale will be culvertized and a truck crossing will be installed. The laydown area for clean construction materials will be prepared on the existing gravel areas to reduce restoration efforts. Signage will be installed and the area will be secured using the existing fence system. Work zones will be delineated using cones or other means (i.e., caution tape) necessary to separate the different construction areas.

Preparation for Excavation

The area of the removal will be prepared for excavation in the damp. A silt curtain will be installed to the east of the excavation area as detailed on the Construction Drawings. Upon installation of the silt curtain, the Portadam® barrier will be installed to create a surface water barrier. The Portadam will be required to be keyed into the slope of the existing riprap and soil cover to the extent required to prevent short circuiting of the hydraulic barrier. The area will initially be dewatered by use surface water pump(s), direct discharge to the LSP. In the event the water becomes turbid, or the water level is within 24 inches of the LSP bottom, the surface water will be conveyed to the water treatment system. After surface dewatering, a well point system will be installed to control water in the excavation area.

Water Treatment

The water treatment system will be setup on a constructed pad within the work area. The system will be comprised of a primary fractionation or flow equalization tank, a multimedia filter vessel with sand/clay filter media, two in series double 10 micron bag filter units, two in series double 2,000 pound granulated activated carbon vessels and two high volume water pumps to treat and transport water from a well point system. The discharge point for the system will be on the outer limits of the silt curtain. Discharge will be through an energy diffuser to eliminate any scouring or erosion from the system flow. Sampling ports will be accessible to collect confirmatory samples on a 24-hour turn-around-time per the specifications. Due to the anticipated infiltration rates, the dewatering system will be required to operate continuously upon the commencement of excavation activities. The volume of dewatering is anticipated to exceed the ability to provide onsite storage of water; therefore a continuous system will be required with no batch treatment.

Excavation

Upon setup of the staging areas, preparation for the excavation and the water treatment system, the removal of the targeted sediment will commence. The removal will progress from the eastern most edge towards the western most edge. Based on the Construction Drawings, the excavation area is estimated to be approximately 900 cubic yards, sloping evenly from 6 feet deep to 2 feet deep. Immediately upon removal of sufficient depth and extent in each segment, confirmatory samples will be collected for rush analysis per the specifications. As sediment is excavated, it will be gathered into piles within the work area, stabilized to a sufficient level that will allow for onsite transport to the staging area located atop the WHP. The excavator will load the material into off road articulating trucks in a manner that will prevent spillage. The excavator operator will partially fill each bucket and shake off any excess. The excavator swing path will be prepared to protect the ground surface that is not within the excavating area. Where required, the excavator will utilize mud mats to access the further extents of the area. Upon receiving confirmatory analysis indicating the results are below the PRG the area will immediately be prepared for restoration activities. During this phase of the work, multiple shifts or extended shifts will be utilized to minimize the duration of dewatering and treatment.

Stabilize Waste and Loadout

The sediment staging area will be secure and, depending upon the characteristics of the sediment; additional stabilization will be performed to allow for transportation and disposal. Upon completion of a waste profile and acceptance at a proper facility, trucks will be loaded for the transportation of the waste. Upon completion of the loadout, the staging area will be cleaned, dismantled and restored to pre-construction condition.

Decontaminate, Restoration and Demobilization

Upon completion of the excavation activities, all equipment and tools will be properly decontaminated and work areas will be restored to pre-construction conditions.

3.1 Contingency Measures

In general, the installed silt curtain will be the primary safeguard for mobilized sediments in the event of the PortaDam failure. The secondary outlets (i.e., easterly towards the Aberjona River) to the LSP will be blocked prior to the project commencement in a manner that will allow for timely removal as needed in the event of elevated water levels from storm events. The primary outlet (i.e., discharging into the Created Wetland) will be left unobstructed to allow for pond drainage with location materials (i.e. sandbags) at the ready. In the event of a catastrophic failure where water needs to be held, the sandbag dams will be installed. Sand bags will be staged and stockpiled as shown on the Construction Drawings.

3.2 Spill Prevention Control and Countermeasure

An important aspect of an effective response procedure during an oil or substance release incident is to keep the material separated from water to minimize potential migration and the resulting potential increase in human and environmental exposure. Every effort will be made to prevent spills and emphasize substance containment at the source rather than resort to separation of the material from expanded portions of the environment or downstream waters.

3.2.1 Supplies

The following supplies will be readily available at the site:

- Drip bucket/pan to catch and contain small drips or leaks;
- Spill kit that includes oil absorbent material (e.g., Speedi-Dri™ and oleophilic pads), salvage drum, plastic sheeting, and spill containment socks;
- Shovel and yard brush to facilitate construction of temporary berms and cleanup of releases;
- Fire extinguisher; and,
- Plug and patch kit to temporarily seal punctures in tanks and hoses.

3.2.2 Discovery of a Release

Personnel discovering a release of material from a container, tank, or operating equipment will initiate the following activities immediately.

- **Extinguish any sources of ignition.** Until the material is identified to be nonflammable and noncombustible, all potential sources of ignition in the area will be removed. Vehicles will be turned off. If the ignition source is stationary, attempt to move spilled material away from the ignition source. Avoid sparks and movement that might create static electricity.
- **Attempt to stop the release at its source.** Precautions to minimize potential danger to human health from the release will be implemented. Simple procedures (e.g., turning valves, plugging leaks, etc.) may be attempted if there is no significant health or safety hazard and there is a reasonable certainty of the origin of the leak.
- **Initiate spill notification and reporting procedures.** Report the incident immediately to the Site Supervisor. If there is an immediate threat to human life (e.g., a fire in progress or fumes overcoming workers), an immediate alarm will be sounded to evacuate the building and the Fire Department called. The assistance of the Fire Department's hazardous materials response team and/or an

environmental remediation contractor will be requested if an uncontrollable spill has occurred and/or if the spill has migrated.

3.2.3 Containment of a Release

To contain a release, the following general procedure will be followed.

- **Attempt to stop the release at the source.** If the source of the release has not been found, and special protective equipment is necessary to approach the release area, or if assistance is required to stop the release, the Fire Department and/or remedial contractor will be called to halt the discharge at its source.
- **Contain the material released into the environment.** Following proper safety procedures, the spill will be contained by absorbent materials and temporary dikes using shovels and brooms. Spill kits that include absorbent materials, containment socks, rags, and salvage drums located at the Site.

3.2.4 Spill Cleanup

- **Recover or cleanup the material spilled.** As much material as possible will be recovered and reused where appropriate. Areas affected by a release will be frequently monitored immediately following a release to identify the potential presence of additional accumulated product. Equipment onsite will be made available to respond to a release and be dedicated for this purpose. Product that is pooled within containment structures (concrete or temporary), puddled in low-lying areas, or held within pipes or culverts should be immediately removed. Pumping or other means of product removal will begin as soon as practicable after a release to recover as much free product as practicable. The intent of this approach is to increase the efficiency of the recovery and serve to minimize potential transport of emulsified or dissolved phase material to uncontrolled areas. It may be necessary to provide a temporary storage tank(s) to accommodate recovered product depending upon the size of the release. Material that cannot be reused will be declared waste. Spilled liquids absorbed by solid materials shall be shoveled into open top, 55-gallon drums, or if the size of the spill warrants, into a lined roll-off container(s). When drums are filled after a cleanup, the drum lids shall be secured and the drums shall be appropriately labeled (or relabeled) identifying the substance(s), the date of the spill/cleanup, and the facility name and location. Combining non-compatible materials can cause potentially dangerous chemical and/or physical reactions or may severely limit disposal options.
- **Cleanup of the spill area.** Surfaces that are impacted by the release will be cleaned by the use of an appropriate substance or water. Cleanup water must be minimized, contained, and properly disposed. Excavated materials will be temporarily stockpiled and segregated, if possible, according to the degree of impact and placed on polyethylene at a location well away from areas that may need further investigation or excavation. The stockpile(s) will be covered with polyethylene, secured, and arrangements made for proper disposal of impacted materials.
- **Decontaminate tools and equipment used in cleanup**. Tools and equipment that have been used will be decontaminated before replacing them in the spill control kit.

3.3 Well Abandonment/Decommissioning

Monitoring wells MW-105S, MW-105D, MW-107S and MW-107D will be decommissioned during LSP-WHP remedial activities. Well abandonment/decommissioning will be completed in compliance with the requirements of the MassDEP Standard References for Monitoring Wells, Section 4.6, Decommissioning of Monitoring Wells. A Decommissioned Well Report will be completed for each well abandoned/decommissioned.

3.4 Weekly Reporting

The Project Manager will provide EPA with a weekly progress report during remedial activities.

The Contractor will provide weekly reports to the Construction Manager during remedial construction. Contractor reports will detail work progress, schedule status, and plans for the following week. Additional details regarding the Contractor reports are listed in the Administrative Requirements Specification (Section 013000).

3.5 Construction Contractor Submittal/Approval Process

All submittals (including shop drawings, product data, initial selection samples, verification samples, calculations, coordination drawings, schedules, etc.) must be submitted as required by the Construction Specifications. In general, all Contractor submittals must be submitted in writing and in conformance with the Construction Specifications. Additional details and rules regarding the submittal process are included in the Submittal Specification, Section 013300.

Required submittals from the Contractor are subject to review and approval by EPA. EPA review and approval must occur in a timely manner that will not impact the sequence and schedule of construction. SDs will attempt to provide EPA as much review time as possible. If EPA response or approval to a Contractor submittal is not received within three working days after providing the submittal to EPA, then EPA approval will be assumed.

3.6 Change Order and Design Modification Procedures

Clarification and modification requests will be submitted in accordance with the Contract Documents (e.g., Section 013300). Such requests may be submitted to the SDs Representative or Construction Manager depending on the modification or change requested. The content of all Change Order and Design Modifications must comply with associated specifications.

Design Modifications will be evaluated by the Construction Manager and the RDE. As outlined in Specification Section 013300, the RDE shall review and return submittals to the Contractor within 5 days of the stamped received date. If the design modification is generally approved by the RDE, the modification will be provided to EPA for review (within 3 days of receipt) before a final response is provided to the Contractor. As with other Construction Contractor Submittals, EPA and MassDEP will have three working days to comment on or approve a submittal; otherwise their approval will be presumed.

4.0 CONSTRUCTION SCHEDULE

4.1 Project Construction and Delivery Strategy

It is anticipated that the LSP-WHP RA will be constructed under one contract. Construction will begin in the most eastern portion of the impacted area and proceed to the most western side of the impacted sediment.

4.2 Schedule of Work

A preliminary schedule identifying target Contractor mobilization dates and estimated construction duration is included as Figure 3.

Specification Section 013000 requires a Construction Sequencing Plan and Progress Schedule be submitted by the Contractor for review within one week following receipt of the Notice of Award.

5.0 DRAFT PROJECT OPERATIONS PLAN

The draft 95% RD Project Operations Plan (POP) and associated attachments will guide the construction of the remedy as well as sampling and monitoring of the selected remedy. The draft 95% RD POP documents also provide details to guide the long-term environmental monitoring activities of the EMP.

Specific plans that make up the POP documents are as follows:

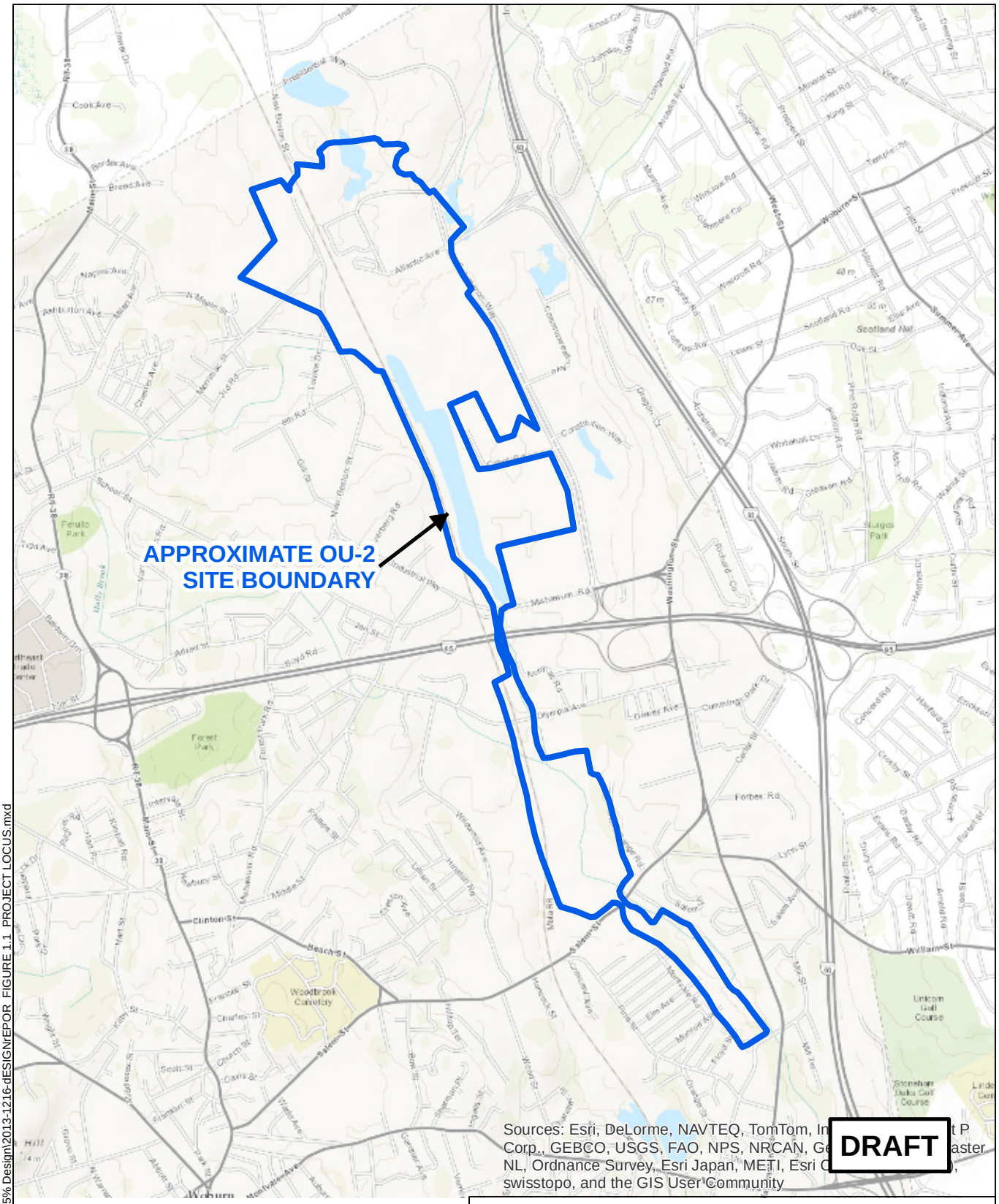
- **Attachment E2: Site Management Plan (SMP)**
  The SMP provides a written understanding and commitment of how various property aspects will be managed, such as access, security, contingency procedures, management responsibilities, field activity schedule, air monitoring, waste disposal, and data handling.

- **Attachment E3: Sampling and Analysis Plan (SAP)**
  The SAP ensures that sampling and data collection activities will be implemented following specific data-gathering methods, and enable the project to achieve the data quality objectives dictated by the intended use of the data. The SAP is comprised of two documents, a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP).
  - **Quality Assurance Project Plan (QAPP)**
    The QAPP documents the site-specific objectives, policies, organizations, functional activities, sampling and analysis activities, and specific quality assurance/quality control activities designed to achieve the data quality objectives of the RA, including verification and compliance monitoring and the EMP. The QAPP provides the sampling, analytical, and data validation procedures, as well as quality assurance and quality control requirements in accordance with EPA requirements and guidance.
  - **Field Sampling Plan (FSP) and Construction Quality Assurance Plan (CQAP)**
    The FSP portion of the document describes the sampling and analysis activities required to support each RA and the associated long-term monitoring under the EMP. In addition, the document will include construction quality assurance (CQA) details such as inspection and sampling activities that will be required to monitor the construction and/or installation of the components of the RAs, and verify compliance with health and safety procedures and environmental requirements. The CQA details will also present the criteria and associated quality control procedures for acceptance and rejection, checklists and associated documentation for CQA activities, and a process for responding to significant weather events during construction of each RA.

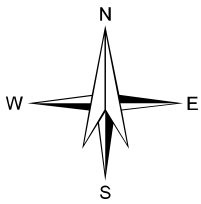
- **Attachment E4: Site-Specific Health and Safety Plan (HASP)**
  The HASP presents the health and safety measures to be implemented during the Site work, including hazard assessments of project tasks, protective measures to be taken, and contingency planning. The Construction Contractor will also submit a HASP as part of the submittal process.

- **Attachment E5: Community Relations Support Plan (CRSP**)
  The CRSP provides a written understanding and commitment of how the SDs will support the EPA's Community Involvement Program at the Site.

FIGURES



SITE COORDINATES: 42°30'21"N 71°8'12"W



U.S.G.S. QUADRANGLE: WILMINGTON, MA

HALEY & ALDRICH

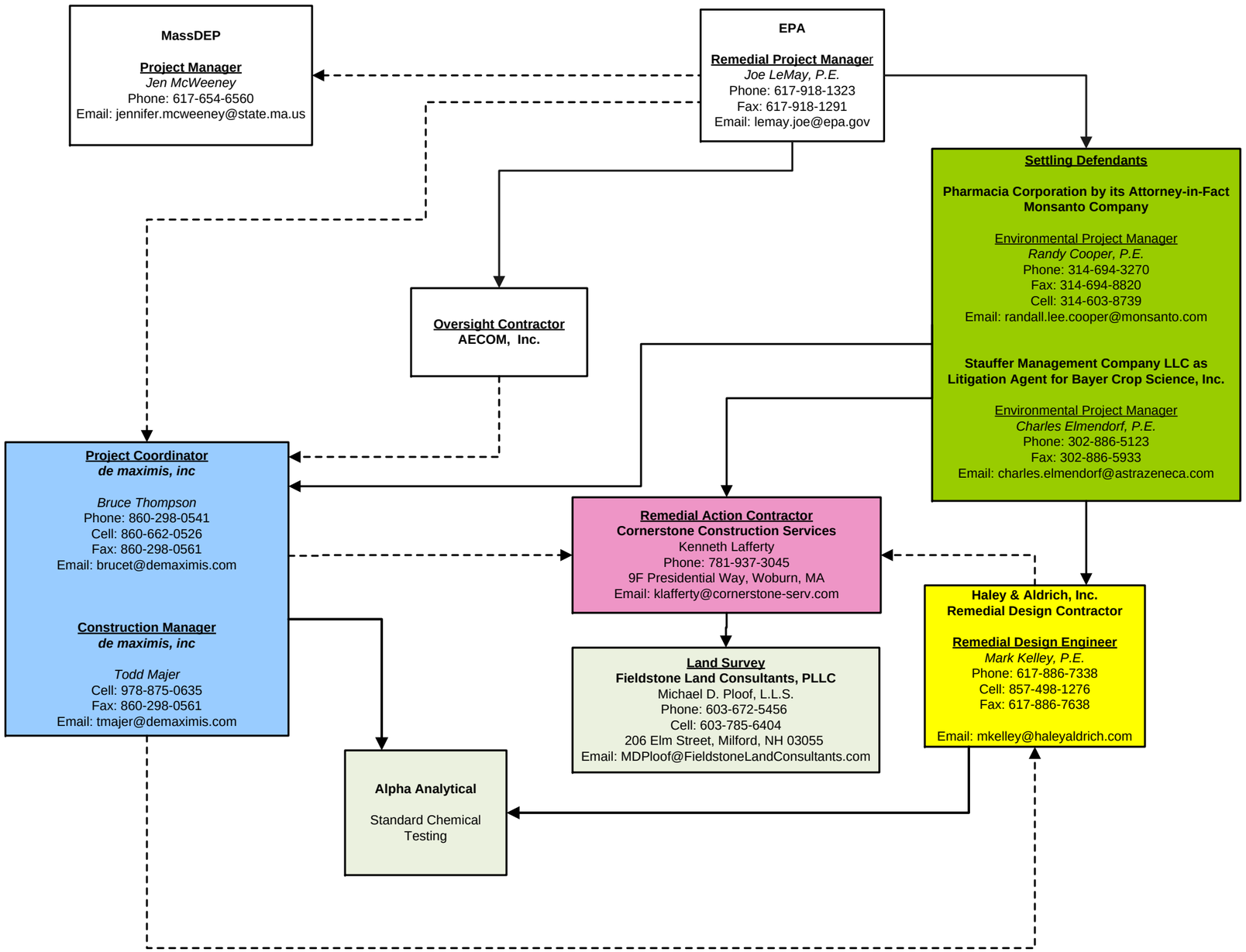
100% REMEDIAL DESIGN- LOWER SOUTH POND
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PROJECT LOCUS

SCALE: 1:24,000
JULY 2014

FIGURE 1

G:\33020\GLOBAL\GIS\MapProjects\95% Design\2013-1216-dESIGNREPOR FIGURE 1.1 PROJECT LOCUS.mxd



LEGEND

Reporting Relationship

Lines of Communication

DRAFT

HALEY & ALDRICH

REMEDIAL ACTION WORK PLAN
LOWER SOUTH POND SEDIMENTS ADJACENT TO WEST HIDE PILE
INDUSTRI-PLEX SITE OPERABLE UNIT 2
WOBURN, MASSACHUSETTS

PROJECT ORGANIZATION CHART

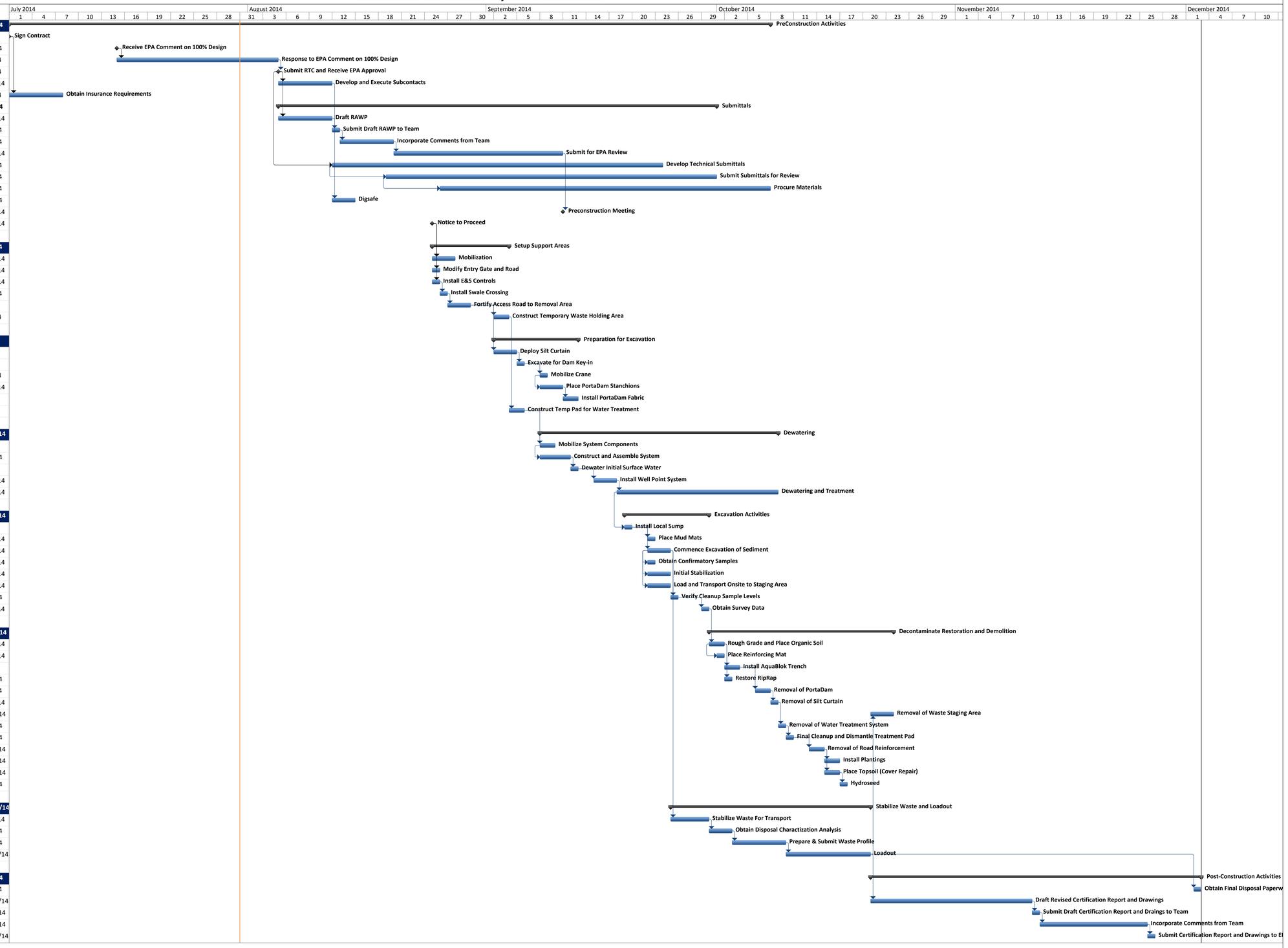
SCALE: NONE
PRINT DATE: 7/30/2014

FIGURE 2

G:\33020\240\Standalone_WHP_LSP\Figs\RAWP\2014-0729-ProjectOrganizationChart.vsd

FIGURE 3
IndustriPlex Superfund Site
Operable Unit 2
Lower South Pond Sediments Adjacent to West Hide Pile

ID	Task Mode	Task Name	Duration	Start	Finish
1		**PreConstruction Activities**	**70 days**	**Tue 7/1/14**	**Tue 10/7/14**
2		Sign Contract	0 days	Tue 7/1/14	Tue 7/1/14
3		Receive EPA Comment on 100% Design	0 days	Tue 7/15/14	Tue 7/15/14
4		Response to EPA Comment on 100% Design	15 days	Tue 7/15/14	Mon 8/4/14
5		Submit RTC and Receive EPA Approval	0 days	Mon 8/4/14	Mon 8/4/14
6		Develop and Execute Subcontacts	5 days	Tue 8/5/14	Mon 8/11/14
7		Obtain Insurance Requirements	5 days	Tue 7/1/14	Mon 7/7/14
8		**Submittals**	**40 days**	**Tue 8/5/14**	**Tue 9/30/14**
9		Draft RAWP	5 days	Tue 8/5/14	Mon 8/11/14
10		Submit Draft RAWP to Team	1 day	Tue 8/12/14	Tue 8/12/14
11		Incorporate Comments from Team	5 days	Wed 8/13/14	Tue 8/19/14
12		Submit for EPA Review	15 days	Wed 8/20/14	Wed 9/10/14
13		Develop Technical Submittals	30 days	Tue 8/12/14	Tue 9/23/14
14		Submit Submittals for Review	30 days	Tue 8/19/14	Tue 9/30/14
15		Procure Materials	30 days	Tue 8/26/14	Tue 10/7/14
16		Digsafe	3 days	Tue 8/12/14	Thu 8/14/14
17		Preconstruction Meeting	0 days	Wed 9/10/14	Wed 9/10/14
18		Notice to Proceed	0 days	Mon 8/25/14	Mon 8/25/14
19					
20		**Setup Support Areas**	**7 days**	**Mon 8/25/14**	**Wed 9/3/14**
21		Mobilization	3 days	Mon 8/25/14	Wed 8/27/14
22		Modify Entry Gate and Road	1 day	Mon 8/25/14	Mon 8/25/14
23		Install E&S Controls	1 day	Mon 8/25/14	Mon 8/25/14
24		Install Swale Crossing	1 day	Tue 8/26/14	Tue 8/26/14
25		Fortify Access Road to Removal Area	3 days	Wed 8/27/14	Fri 8/29/14
26		Construct Temporary Waste Holding Area	2 days	Tue 9/2/14	Wed 9/3/14
27					
28		**Preparation for Excavation**	**9 days**	**Tue 9/2/14**	**Fri 9/12/14**
29		Deploy Silt Curtain	3 days	Tue 9/2/14	Thu 9/4/14
30		Excavate for Dam Key-in	1 day	Fri 9/5/14	Fri 9/5/14
31		Mobilize Crane	1 day	Mon 9/8/14	Mon 9/8/14
32		Place PortaDam Stanchions	3 days	Mon 9/8/14	Wed 9/10/14
33		Install PortaDam Fabric	2 days	Thu 9/11/14	Fri 9/12/14
34		Construct Temp Pad for Water Treatment	2 days	Thu 9/4/14	Fri 9/5/14
35					
36		**Dewatering**	**23 days**	**Mon 9/8/14**	**Wed 10/8/14**
37		Mobilize System Components	2 days	Mon 9/8/14	Tue 9/9/14
38		Construct and Assemble System	4 days	Mon 9/8/14	Thu 9/11/14
39		Dewater Initial Surface Water	1 day	Fri 9/12/14	Fri 9/12/14
40		Install Well Point System	3 days	Mon 9/15/14	Wed 9/17/14
41		Dewatering and Treatment	15 days	Thu 9/18/14	Wed 10/8/14
42					
43		**Excavation Activities**	**7 days**	**Fri 9/19/14**	**Mon 9/29/14**
44		Install Local Sump	1 day	Fri 9/19/14	Fri 9/19/14
45		Place Mud Mats	1 day	Mon 9/22/14	Mon 9/22/14
46		Commence Excavation of Sediment	3 days	Mon 9/22/14	Wed 9/24/14
47		Obtain Confirmatory Samples	1 day	Mon 9/22/14	Mon 9/22/14
48		Initial Stabilization	3 days	Mon 9/22/14	Wed 9/24/14
49		Load and Transport Onsite to Staging Area	3 days	Mon 9/22/14	Wed 9/24/14
50		Verify Cleanup Sample Levels	1 day	Thu 9/25/14	Thu 9/25/14
51		Obtain Survey Data	1 day	Mon 9/29/14	Mon 9/29/14
52					
53		**Decontaminate Restoration and Demolition**	**18 days**	**Tue 9/30/14**	**Thu 10/23/14**
54		Rough Grade and Place Organic Soil	2 days	Tue 9/30/14	Wed 10/1/14
55		Place Reinforcing Mat	1 day	Wed 10/1/14	Wed 10/1/14
56		Install AquaBlok Trench	2 days	Thu 10/2/14	Fri 10/3/14
57		Restore RipRap	1 day	Thu 10/2/14	Thu 10/2/14
58		Removal of PortaDam	2 days	Mon 10/6/14	Tue 10/7/14
59		Removal of Silt Curtain	1 day	Wed 10/8/14	Wed 10/8/14
60		Removal of Waste Staging Area	3 days	Tue 10/21/14	Thu 10/23/14
61		Removal of Water Treatment System	1 day	Thu 10/9/14	Thu 10/9/14
62		Final Cleanup and Dismantle Treatment Pad	1 day	Fri 10/10/14	Fri 10/10/14
63		Removal of Road Reinforcement	2 days	Mon 10/13/14	Tue 10/14/14
64		Install Plantings	2 days	Wed 10/15/14	Thu 10/16/14
65		Place Topsoil (Cover Repair)	2 days	Wed 10/15/14	Thu 10/16/14
66		Hydroseed	1 day	Fri 10/17/14	Fri 10/17/14
67					
68		**Stabilize Waste and Loadout**	**18 days**	**Thu 9/25/14**	**Mon 10/20/14**
69		Stabilize Waste For Transport	3 days	Thu 9/25/14	Mon 9/29/14
70		Obtain Disposal Charactization Analysis	3 days	Tue 9/30/14	Thu 10/2/14
71		Prepare & Submit Waste Profile	5 days	Fri 10/3/14	Thu 10/9/14
72		Loadout	7 days	Fri 10/10/14	Mon 10/20/14
73					
74		**Post-Construction Activities**	**31 days**	**Tue 10/21/14**	**Tue 12/2/14**
75		Obtain Final Disposal Paperwork	1 day	Tue 12/2/14	Tue 12/2/14
76		Draft Revised Certification Report and Drawings	15 days	Tue 10/21/14	Mon 11/10/14
77		Submit Draft Certification Report and Drainge to Team	1 day	Tue 11/11/14	Tue 11/11/14
78		Incorporate Comments from Team	10 days	Wed 11/12/14	Tue 11/25/14
79		Submit Certification Report and Drawings to EPA	1 day	Wed 11/26/14	Wed 11/26/14



Project: 09010 Construction Sche
Date: Thu 7/31/14
Prepared For: de maximis, inc.
Prepared By:Cornerstone Constru

Task | Milestone | Project Summary | External Milestone | Inactive Milestone | Manual Task | Manual Summary Rollup | Start-only | Deadline
Split | Summary | External Tasks | Inactive Task | Inactive Summary | Duration-only | Manual Summary | Finish-only | Progress

APPENDIX I

Response to Comments on 95% Remedial Design (RD)

Response to Comments
on 95% Remedial Design (RD)
West Hide Pile Industri-Plex Superfund Site Operable Unit 2
Woburn, Massachusetts
July 31, 2014

1. *General Comment. The title of this additional action should be changed to "Lower South Pond (LSP) Sediments Adjacent to West Hide Pile (WHP)." This action is intended to address the sediments impacted with benzene discovered in the LSP during predesign investigations.*

Response: Title of the Remedial Action was changed to Lower South Pond (LSP) Sediments Adjacent to West Hide Pile (WHP).

2. *General Comment. The 100% Remedial Design (RD) for the West Hide Pile Remedy was included within the 95% Design for the overall OU-2 remedy, but not as a stand-alone document as requested in the EPA letter dated January 15, 2014. Please prepare a stand-alone 100% RD for the West Hide Pile.*

Response: Comment noted. A stand-alone100% RD for the LSP Sediments Adjacent to WHP will be submitted.

3. *General Comment. EPA established a sediment ecological Preliminary Remediation Goal (PRG) of 1.472 mg/kg for benzene impacted sediment in the LSP adjacent to the WHP. These benzene impacted sediments above a concentration of 1.472 mg/kg shall be dredged, disposed off-site, and restored (all disturbed areas). This remedial approach is consistent with the sediment dredging, off-site disposal, and restoration approach outlined in the ROD and SOW for the Southern Portion of the HBHA Pond, Wells G&H Wetland and Cranberry Bog Conservation Area. The Environmental Monitoring Plan (EMP) for this portion of the RD (i.e. LSP sediments) will be finalized within the overall final RD. The EMP for this area shall be prepared consistent with the intent of the ROD and SOW and include long term groundwater, surface water and sediment monitoring to ensure:*

- The current understanding of benzene fate and transport remains accurate and unchanged; and,
- Sediment in the LSP do not become contaminated with benzene above the established PRG in the future.

Response: The Final 100% RD EMP will include long-term sampling for the LSP sediments adjacent to the WHP.

***4**. General Comment. Much of the means and methods for construction and construction sequencing will be provided by the Contractor in the required contract submittals (for example the Excavated Soil and Materials Management Plan). In addition, critical design considerations for dewatering pumping rates and treatment system flow rates are to be determined by the Contractor based on limited data provided in the RD document. It is recommended that the design provide as much of these details as possible. These contract submittals will require further review by EPA.*

Response: Comment noted. The Remedial Action Work Plan (RAWP) and contract submittals will provide the necessary means and methods of construction and construction sequencing.

***5**. General Comment on Contingency Measures. The RD and/or Remedial Action Work Plan need to include contingency procedures in the event of a catastrophic failure of the PortaDam during removal of the sediment.*

Response: A detailed descriptions of the contingency measures will be included in RAWP. In general, the installed silt curtain will be the primary safeguard for mobilized sediments in the event of the PortaDam failure. The secondary outlets (i.e., easterly towards the Aberjona River) to the LSP will be blocked prior to the project commencement in a manner that will allow for timely removal as needed in the event of elevated water levels from storm events. The primary outlet (i.e., discharging into the Created Wetland) will be left unobstructed to allow for pond drainage with location materials (i.e. sandbags) at the ready. In the event of a catastrophic failure where water is to be held, a sandbag dam will be installed.

***6.** General Comment on Specifications. Only four specification sections are referenced under the West Hide Pile (WHP) work within the narrative section, yet many other specification sections are relevant. Please assemble a list of all specifications that are relevant to the WHP work.*

Response: Relevant WHP specifications are listed below:

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS (attached by reference)
001000 INSTRUCTIONS TO BIDDERS
002000 BID FORM
003000 MEASUREMENT AND PAYMENT

DIVISION 01 – GENERAL REQUIREMENTS
011100 SUMMARY OF WORK

013000 ADMINISTRATIVE REQUIREMENTS
013300 SUBMITTAL PROCEDURES
013529 HEALTH AND SAFETY
014000 QUALITY REQUIREMENTS
014200 REFERENCES
015000 TEMPORARY FACILITIES AND CONTROLS
016000 PRODUCT REQUIREMENTS
017000 PREPARATION AND CLOSEOUT REQUIREMENTS

DIVISION 02 – EXISTING CONDITIONS
020000 EXISTING CONDITIONS
023200 SAMPLING, TESTING, AND DATA EVALUATION
026113 EXCAVATED SOIL AND MATERIALS MANAGEMENT PLAN

DIVISION 31 – EARTHWORK
310000 EARTHWORK
310519.13 NON-WOVEN GEOTEXTILE
310519.16 GEOMEMBRANE
311100 SITE CLEARING
312319 CONSTRUCTION DEWATERING AND WATER TREATMENT
312500 EROSION AND SEDIMENTATION CONTROLS
313619 ARMOR MATTRESS

DIVISION 32 – EXTERIOR IMPROVEMENTS
327100 WETLAND AND UPLAND RESTORATION
323100 FENCES AND GATES

DIVISION 33 – UTILITIES
332900 WELL ABANDONMENT

DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION
350140 TEMPORARY WATER DIVERSIONS

DIVISION 44 – REMEDIAL PROCESS EQUIPMENT
441123 CONSTRUCTION DUST AND ODOR CONTROL
444000 WATER TREATMENT EQUIPMENT

7. *General Comment on Appendix Materials. Appendix A of the 30% RD included some data and studies from the Pre-Design Investigations; however, additional data was collected after the 30% RD during 2012– 2013. All of this data must be included within the 100% RD and be referenced to further support the 100% RD fate and transport discussions regarding the benzene impacted sediment area in the LSP by the WHP. This PDI data is central to the*

basis of this design. For completeness, the groundwater, surface water, sediment PDI information needs to be included with the 100% RD so this can be a standalone document.
Response: All data will be included in the stand-alone 100% RD for the LSP Sediments Adjacent to WHP.

8. *Section 2.2. For the RD text to be consistent with the SOW and approved RDWP, proposed edits are included for Sections 2.2, 2.2.1, and 2.2.2.1. Please incorporate the revised text into the 100% RD.*

Response: The 100% RD text will be revised accordingly.

9. *Section 2.2. The approximate area of excavation shown on Drawing G-404 includes both sediment currently under water and an area of soil immediately to the west of the sediment area. The text as written does not mention the abovementioned soil or is not differentiated from the sediment below water. Please revise the 100% RD text to provide additional details on handling of the sediment and soil separately, as necessary. EPA currently understands that existing organic silt layer containing benzene concentrations includes both sediments and soils. The sediments above the PRG in the LSP will be dredged, disposed off-site and restored. Some of the soils adjacent to these sediments and under the eastern portion of WHP existing OU1 protective cover will be removed, disposed off-site, and restored so that these soils do not impact the restored sediments (benzene desorption, etc.) and as part of the construction means and methods.*

Response: The 100% RD text will be revised accordingly.

10. *Section 2.2.1, Page 12: References are made to the groundwater transport rate being less than one inch per year and that groundwater flow is to the south. This is a critical site-specific parameter in support of the statement that benzene transport in groundwater to the pond is limited. Please provide all site-specific data and calculations in the RD to support this transport rate and include along with all other data in an Appendix in the 100% RD for the WHP.*

Response: Supporting site-specific data and calculations with be included in the stand-alone 100% RD.

11. *Section 2.2.1 Page 11-12. The investigations performed by the SDs support the rationale for the proposed Remedial Action but did not comprehensively identify all sources and transport pathways possible beneath and adjacent to the WHP. To simplify, please incorporate the revised text into*

the 100% RD referenced in Comment 7 above.

Response: Revised text will be incorporated into the 100% RD.

12. *Section 2.2.2.1, 2nd bullet, Page 12. The text notes that the organic silt/fill exhibits lower hydraulic conductivity than the underlying sand. To support this statement in the RD, please provide a summary of the site hydraulic conductivity values in a table or appendix.*

Response: Site hydraulic conductivity values will be included as a table in the 100% RD.

13. *Section 2.2.2.1 Page 12. The text states that the PDI-9 investigation results were provided in the 30% Design. The 100% RD will need to be a stand-alone document. Consistent with General Comment 2 and 7 above, all the sample results and PDI data collected should be included with the 100% RD.*

Response: Sample results and PDI-9 data will be included in the 100% RD.

14. *Section 2.2.3, Page 13-15. The design calculations (Appendix A, Attachment A3) include the catalog cut sheet for the geotextile, the model run and calculations for the Aquagate, and the percent solids data for the sediments. As noted above, the section should also include all other PDI data used to inform the design. In addition, all data should be included in an Appendix.*

Response: Comment noted. All data will be included in the 100% RD.

15. *Section 2.2.3. This section does not include surface water monitoring while sediment removal and excavation are being conducted. Surface water monitoring should be performed daily consistent with Figure 2.1-2 at the outlet by the Enhanced Wetland and the Atlantic Avenue Drainway monitoring station. As work proceeds and conditions become more predictable monitoring frequency can be reduced with EPA approval.*

Response: The 100% RD text will be revised accordingly.

16. *Section 2.2.3.1, subsection A, Page 13-14. The text states that prior to the start of construction additional sediment delineation cores will be collected to confirm the extent of removal. Please revise the text and figures based these cores which were collected in April 2014. Please also provide all data from these additional cores within an appendix of the 100% RD.*

Response: Text and figures will be revised accordingly and data included within the 100% RD.

17. *Section 2.2.3.1, subsection A, Page 13. Section 2.2.3.1.A. It is recommended that pre-remediation samples also be collected from the entire sediment layer and evaluated with the planned dewatering method (i.e. gravity) to assess the time required to dewater and the extent of dewatering achievable by gravity alone. This information may be helpful in determining the appropriate construction sequencing, the ability to dewater the sediments within the excavation, and the volume of solidification/stabilizing materials needed.*

Response: Dewatering tests **were** performed on the sediments and the results will be provided in the stand-alone 100% RD.

18. *Section 2.2.3.1, subsections B, C, D, Page 14. For completeness, please provide additional detail in the text, specifically related to the extent of removal, including but not limited to.*

- Definition of how the bottom of the excavation is defined (i.e., observed sand below sediment, depth of removal);
- Approximate area and sediment thickness for removal;
- Clarification if the 600 CY is sediment under water or all removed volume of sediment and soil; and,
- Clarification of the confirmatory samples to be collected by the Contractor, including frequency, field analyses, laboratory analyses, and turn-around time. These details or preliminary concept are not provided in the field sampling plan either.

Response: The 100% RD text will be revised accordingly.

19. *Section 2.2.3.1, subsection C, Page 14. The text states that the excavation will be performed from the western shore of the WHP. Based on the drawings the eastern limits of excavation could extend over 45 feet from the shore. For clarity, please update the text regarding methods for accessing the areas furthest from the shore, such as a long-reach type excavator or conventional excavation equipment used in conjunction with mud mats or other temporary platforms.*

Response: Specific means and methods will be documented in the RAWP. In general, mud mats and a medium sized excavator (i.e. a CAT 320's reach is approximately 30 ft) will be used to access the eastern limits of excavation.

20. *Section 2.2.3.1, subsection C, Page 14. Please provide additional details on how the excavated sediment will be conveyed from the excavation to the roll-offs located over 100 feet from the excavation. If not being directly loaded into the roll-off containers, please explain how the ground surface will be protected from spills occurring during transfer from the excavator to a transport vehicle, to the roll-off. If a transport vehicle will be used to shuttle the excavated sediment from the excavation to the roll-off, please provide a description of any improvements to be made, such as a temporary roadway, to protect the existing cap from vehicle damage.*

Response: Specific means and methods will be documented in the RAWP. Based on the limited volume of material to be removed, and further consideration of the cycle time for dewatering two rolloff containers at a time, it is anticipated that the material will be excavated and stockpiled within the excavation area. Limited stabilization of the material will be performed in the excavation area, and the material will be loaded into off-road, low ground pressure articulating truck(s) and transported to a sediment holding cell on the top of the WHP. Loading of the material into trucks will be performed with the truck on clean base. The swing area outside of the excavation limits will be protected with poly sheeting. Excavator operators will load with less than heaping bucket loads and will shake excess prior to cycling.

21. *Section 2.2.3.1, subsection D. For clarity, please provide additional details on the strategy or pattern for collecting confirmatory samples, for example, a 10-foot grid. See also comment on Drawing C-403.*

Response: The 100% RD text will be revised accordingly.

22. *Section 2.2.3.2.E Page 16. This section briefly discusses well abandonment. Piezometers, including PZ-101, within the removal area should be accounted for with this section. Please update the quantities of wells for abandonment as well as provide details, particularly if the abandonment method will be different for the piezometers than the monitoring wells. In addition, monitoring wells MW-104D and MW-106D should not be removed as the abandonment process could compromise the integrity of the monitoring wells to remain in place (i.e., MW-104S and MW-106S).*

Response: The 100% RD text will be revised accordingly.

23*. Section 2.2.3.3.B, Page 17. Please provide the estimated pumping rate to achieve and maintain "dry conditions" in the excavation should be presented. This is a critical design element for the Dewatering Effluent Treatment System*

(DETS). The proposed discharge of the DETS is within the zone between the Port-a-Dam and the outlying silt curtain. Please describe how the discharge end of the hose will be positioned and supported so as to diffuse the discharge velocity of the treated water and not stir up sediments within the silt curtain area.

Response: Discharge of all treated water will occur outside the silt curtain on an energy diffuser located at the shoreline. This discharge will be monitored to ensure no erosion occurs. The energy diffusers products will include a combination of some or all of the following: rock base, discharge baskets and fabrics. These details, along with estimated pumping rates, will be included in the RAWP.

24. *Attachment A3 (AquaBlok Calculations). Aquagate + PAC™ (10% PAC formulation) is proposed as an additional protective measure against potential benzene migration in groundwater into the remediated area. A technical memorandum in Attachment A3 includes information related to the inputs, assumptions, and output used to determine the quantity of Aquagate to be used. As presented the memorandum is unclear on why specific input values were selected as well as how the model output was used to determine the design quantities. To further support the design and ensure protectiveness of the Aquagate, it is recommended that the technical memorandum be revised with the following:*

- A table of all input parameters with a range of site-specific observed values and rationale on the chosen values, including but not limited to porosity, fraction, total organic carbon, groundwater velocity, and temperature. Further, the memorandum assumed a temperature of 20 Celsius, which is warm for average groundwater in Massachusetts;
- A sensitivity analysis of Aquagate thickness. The memorandum only included a thickness of 6 inches; and,
- Provide a description/narrative of each of the four model output plots and how each supports the design quantities. For example, why are thicknesses of 40 and 50 cm presented based on the assumed sediment and Aquagate thicknesses. The top right plot has an empty plot space, and it should be defined if 5 cm is the distance into sediment or within the Aquagate.

Response: The memorandum will be revised to address the above recommendations.

25. *Specifications General. In Specification 310000 (Earthwork) in subsection 1.09.D product information for AquaGate+PAC is listed as Group 3, to be submitted 3 weeks prior to use; however, the product and quantity is specified*

in the 95% RD. For facilitating the future review process of contractor documents, it is recommended to provide as much information as possible with the 100% RD for the WHP to reduce contractor required submittals and reducing review time upon submittal.

Response: Comment noted.

26. *Specification 011100 Summary of Work*

- *Section 1.02.D.1.b. The text implies that permits may be necessary. The SD are required to comply with all substantive requirements of a permit, but obtaining a permit is exempt under CERCLA. Please clarify any substantive permit requirements that may be applicable to this project. If none, then this text language should be amended or deleted.*

Response: The permit language will be deleted.

- *Section 1.02.D.1.g-i. Numerous locations are listed in this Section are not shown on the drawings, specifically, the office trailer, other temporary facilities, temporary fencing, and material storage and laydown areas. Please update the drawings to show locations of these features.*

Response: Drawings will be updated to include locations of temporary facilities, temporary fencing, material storage and laydown areas.

27. Specification 015000 – Temporary Facilities and Controls

- *Section 1.07.A.1. The location of the field offices are not shown on the drawings. Please update the drawings.*

Response: Drawings will be updated to include locations of the temporary field office.

- *Section 2.02.A. The requirement to provide plastic barrier fence at the limits of work presents a potential to damage the underlying OU-1 permeable cap from driving the fencing support posts. Please provide rationale for this fence requirement or remove.*

Response: Drawings will be updated to delineate the limits of work using other means such as cones and/or caution tape.

28. *Specification 20000 – Existing Conditions.*

- *Section 1.02. The list of documents that the Contractor is to "review and understand" is very long, and it may be difficult to expect that a Contractor review and understand this information within the bid preparation period. If the Contractor is unfamiliar with the existing conditions, then Contractor review and understanding of the long list of documents may lead to delays.*

Response: The Settling Defendants have selected Cornerstone Construction Services (Cornerstone) Woburn, MA to perform the WHP remedial activities. Cornerstone was selected based on their site experience, site knowledge and understanding of existing site conditions.

29. *Specification 026113 – Excavated Soil and Materials Management Plan*

- *Section 1.02.D. The specification states that all excavated materials will be stockpiled and covered in designated stockpile areas. However, the drawings depict that all excavated materials will be stored in roll-offs. Please clarify.*

Response: A HDPE lined stockpile area will be constructed at the top of the WHP for the storage and stabilization of the material. Upon stabilization of the sediment, off-road trucks will be able to access the storage area on clean base for the load out of material.

- *Section 3.09.B. As the potential for a release of oil is presented, the Contractor should maintain a reasonable quantity of oil absorbent materials as part of its contingency plan. Having these materials onsite is also prudent given that hydraulic equipment will be working within the limits of the pond. Please update accordingly.*

Response: Comment noted. The RAWP will detail Spill Prevention, Control and Countermeasures (SPCC).

30. *Specification 310000 – Earthwork*

- *Section 1.06.A.1. For Topsoil, a soil fertility test should also be performed to ensure vegetation will grow. Please revise.*

Response: A soil fertility test will be added to the specifications (i.e., UMASS Agriculture Fertility Test).

- *Section 2.02.D. The geotextiles specified for the wetland marker layer (Mirafi 140N) does not meet the requirements specified in the OU-1 remedy for the wetland sediment remedy. Under OU-1, the 16-ounce geotextile was used. The table below presents a comparison of specifications for the*

various products proposed for the WHP OU-2 remedy (right three columns with blue headings) versus the OU-1 specifications (left three columns with green headings). The

appropriate Mirafi product that meets the OU-1 16-ounce specification is the Mirafi 1160N product. Please provide the design analysis for substituting a lesser material.

Property	100% Design OU-1 6oz	100% Design OU-1 10oz	100% Design OU-1 16oz	Mirafi 140N 4-oz	Mirafi 180N 8 oz	Mirafi 1160N 16 oz
Grab Strength	150 lbs	225 lbs	350 lbs	120 lbs	205 lbs	380 lbs
Trapezoidal Tear Strength	65 lbs	90 lbs	110 lbs	50 lbs	80 lbs	140 lbs
Burst Strength	325 psi	500 psi	700 psi	NA	NA	NA
Puncture Strength	85 lbs	140 lbs	200 lbs	310 lbs	500 lbs	1025 lbs
AOS	US Sieve 100	US Sieve 100	US Sieve 100	US Sieve 70	US Sieve 80	US Sieve 100

Response: Product material Mirafi 1160N (i.e., 16-ounce geotextile) will be used. Text and Drawings will be revised accordingly.

***31**. Specification 310519 – Non-Woven Geotextile*

- *Section 3.02.B.1. If overlapping is allowed, the overlap must extend a minimum of 3-feet in all directions from the tear, edge, hole, or opening being covered to maintain the continuity of the cover based on the OU1 design specifications.*

Response: Comment noted.

32. Specification 312319 – Construction Dewatering and Water Treatment

- *General. Unless the estimated pumping rate is provided in the design, the specification should include all relevant soil and groundwater data for the Contractor to reasonably estimate the expected pumping rates to achieve and maintain the desired drawdown levels. This information is also necessary to properly size the treatment equipment.*

Response: The Site Contractor has been provided all relevant soil and groundwater data to adequately estimate pumping rates.

- *Section 1.06.B.3. For clarity, please state in the text that the upstream (i.e. background) sample locations are shown on the construction drawings.*

Response: The 100% RD text will be revised accordingly.

- *Section 1.06.B.4. Performance/break-through monitoring should include sampling between the carbon vessels (midfluent) in the event higher benzene concentrations than expected are pumped to the DETS. See next comment below.*

Response: Shop drawing of the treatment system will be prepared as part of the submittal review process. A Intermediary mid-point sampling port will be included between the granular activated carbon (GAC) vessels.

- *Section 1.06.B.5. Dewatering in the excavation to the depths indicated could result in a radius of influence that extends well beyond the shore of the WHP. Contaminants in groundwater below the WHP exceeding the concentrations currently observed in pore water and groundwater below the proposed sediment excavation area could be drawn to the excavation area by the dewatering pumping. The proposed sample frequency of the first and third day and weekly thereafter may be insufficient to monitor abrupt changes in contaminant concentrations in the DTES influent. It is recommended that sampling be performed daily during the first week of operation once the desired dewatering depth is achieved at the influent, midfluent, and effluent. If influent concentrations remain constant, then consideration could be given to sampling less frequently (i.e., weekly). Please update.*

Response: The 100% RD text will be revised to include daily sampling during the first 7-days of dewatering and every third day thereafter.

- *Section 1.06.B.5. Please specify the laboratory turn-around time required for all samples collected as part of the WHP dewatering work. Given the nature of possible fluctuations in contaminant concentrations and the current uncertainty of pumping rates, it is recommended that TAT be minimized to "Rush"/24-hour.*

Response: The 100% RD text will be revised accordingly.

- *Section 3.01. It is recommended to revise the specifications for the contractor to monitor groundwater levels in WHP monitoring wells remaining (i.e. MW-101, MW-104S, MW-10, and MW-106S) to evaluate the area of influence caused by the dewatering activities.*

Response: The groundwater levels in the area of the WHP remedial activities will be monitored. The 100% RD text will be revised accordingly.

- *Table 312319-1. The table appears to represent anticipated contamination*

levels in groundwater at the HBHA Pond location, as several of the contaminants listed have not been detected in the groundwater at the WHP. Please provide a table of contaminants and respective treatment concentrations that are representative of the maximum historically detected concentrations of COCs in groundwater at the WHP.

Response: The table will be revised accordingly.

33. *Specification 312500- Erosion and Sedimentation Controls.*

- *Section 1.02.B.1. To prevent damage, rough grading of the OU-1 cap should not be allowed. Please revise.*

Response: The 100% RD text will be revised to eliminate rough grading of the existing OU-1 cap.

- *Section 3.02.B. To prevent damage to the underlying OU-1 cap geosynthetic materials, in Class C and Class D land stakes should not be driven to a depth of greater than 12 inches. Please revise.*

Response: The 100% RD text will be revised accordingly.

- *Section 3.02.G. To prevent damage to the underlying cap, a maximum depth of the silt fence trench should be specified to not exceed 12 inches. Please revise.*

Response: The 100% RD text will be revised accordingly.

- *Section 3.02.H. To prevent damage to the underlying cap, silt fence posts should not be driven to a depth exceeding 12 inches below grade. Please revise.*

Response: The 100% RD text will be revised accordingly.

34. *Specification 332900, Well Abandonment.*

- *Section 1.07.C. This section references submitting a well abandonment/ decommissioning form using the template form provided in the FSP. The well abandonment form was not located in the Field Sampling Plan. Please provide the well abandonment form that is consistent with the requirements of the requirements provided in the Commonwealth of Massachusetts, Department of Environmental Protection (MassDEP), Standard References for Monitoring Wells (January 1991).*
- *Section 3.03. According to the specification, an attempt will be made to pull*

out the well screens and risers. If this attempt fails, the proposed plan is to grout the well in-place. In accordance with the MassDEP Standard References for Monitoring Wells (January 1991), if the well is to be grouted in place the well screen must be adequately perforated to allow the grout to penetrate the filter pack. In addition, the MassDEP recommends that the well casing be terminated 3-4 feet below grade. However, to avoid disturbances to the existing OU-1 cap system, the well casing should not be terminated further than the depth of the underlying geosynthetics used for the existing cap.

- *Section 3.03.F. This section directs the Contractor to apply grout to the surface. It is recommended to apply grout to a depth of six inches below grade and fill with clean fill or sand above and properly compacted to minimize subsidence in accordance with the MassDEP standard reference.*

Response: Well abandonment will be performed in accordance the MassDEP Standard References for Monitoring Wells (January 1991). A Well Abandonment form will be provided in the RAWP.

35. *Drawings, General Comment. The survey control network for the site should be presented on the drawings in order for the contractor to layout the work, protect the existing OU-1 remedy, and be able to accurately prepare as-built drawings. Please update.*

Response: Survey control will be added to Drawing G-404.

36. *Drawing G-403. The Class C/Class A boundary line should be presented. Please include.*

Response: The Class C/Class A boundary will be added to the Drawings.

37. Drawing C-400.

- *A note states that prior to installing the temporary road, that existing topsoil and grasses will be stripped prior to filling and that the existing permeable cap system should not be disturbed. Note that the topsoil and grasses are an integral part of the permeable cap system, and the geotextile fabric is immediately below the topsoil approximately 16" below the ground surface. It is recommended that the temporary road be constructed on top of the existing topsoil and grasses. Please clarify.*

Response: The reference note will be removed.

- ***As depicted, the PortaDam frame and base are level with the top of***

the organic soils, which leaves approximately two feet of freeboard at the top. What is the minimum freeboard that must be maintained? If the organic soils compress and the PortaDam settles lower in the mud than shown, what additional measures will be taken to ensure that sufficient freeboard exists to compensate for an unexpected rise in water level?

Response: On May 30 representatives from the Contractor (Cornerstone) and portable water barrier system (PortaDam) conducted a site visit to collect information to verify the effectiveness of the portable water barrier system. A survey of the water depths and sediment depth and sediment softness was performed along the anticipated footprint of the PortaDam. The depths were recorded approximately every 15 feet. Based on the sediment thickness and stability, it was determined that available freeboard (3-5 feet) would be available to allow for fluctuations in the water levels.

- *Note 7. The note proposes excavation and removal of the OU-1 cap topsoil and underlying soils. However, this significantly increases the possibility of damaging the cap, breaching the underlying geotextile fabric, and causing cross-contamination. EPA recommends that the temporary road be constructed on top of the existing OU-1 cap.*

Response: Note 7 will be revised accordingly.

- *On the drawing label for the silt curtain, the label states "…SEE NOTES REGARDING PLACEMENT OF PERMEABLE PANELS". The notes do not discuss the location of the permeable sections of the silt curtain. The construction detail provided on drawing C-406 states that 10% of the silt curtain length will be permeable section. Please identify where the permeable sections will be installed.*

Response: The Silt Curtain Detail will be revised to depict the locations of the permeable panels.

38. *Drawing C-401.*

- *In the event of a rain storm, the discharge to the Created Wetland may be insufficient to release stored water in the pond and could cause a rise in water level that could impact the PortaDam structure and the excavation. How will the PortaDam be protected during rain storm events? At a minimum, it is suggested that LSP stage be monitored during rain storm events and if necessary, the temporary aquadam be opened to assist with LSP discharge.*

Response: At a minimum, the silt curtain will provide protection to the PortaDam. The LSP stage will be monitored in the event a storm event is forecasted and the aquadams (i.e., sandbag dams) will be removed to assist the LSP discharge.

39. *Drawings C400 and C401.*

- *Both drawings show the discharge of the DETS to be in open water while Drawing C-403 shows the discharge to be on the riprap. Please confirm which drawing is accurate and correct accordingly.*

Response: Drawings will be revised to depict the DETS discharges to the existing riprap apron and on the downward side of the silt curtain.

40. *Drawing C-403.*

- *Several drawings show the PortaDam terminating at the riprap toe drain. The toe drain is constructed of large rock and extends to a depth below the proposed pond water level. If left unsealed, the toe drain will serve as a conduit for pond water to bypass the PortaDam structure and enter the excavation. Please explain how the riprap will be sealed.*

Response: Riprap will be removed and the Portadam structure, including a fifteen foot liner extending out from the Portadam structure, installed and sandbagged to obtain the proper seal.

- *For clarity, please show the staging area for all excavated materials that will be reused (e.g. riprap rock).*

Response: The drawing will be revised to depict the excavated material staging area.

- *The proposed locations of confirmatory samples need to be updated based on the revised sediment removal extents shown on design drawings dated June 27, 2014. The proposed locations for the confirmatory samples appear inadequate. At a minimum, samples should be collected on an approximate 20-foot grid. Please revise.*

Response: Proposed locations of confirmatory samples will be revised to a 20-foot grid.

41. *Aberjona Study Coalition. Please find attached the Aberjona Study*

Coalition comments. Please address these comments.EPA believes that many of the Aberjona Study Coalition comments can be addressed by providing all the groundwater, surface water, and sediment data collected by the LSP and WHP (see EPA Comment 7).

Response: Attachment No. 1 presents the response to comments obtained from the Aberjona Study Coalition.

Attachment 1

Response to Comments
on 95% Remedial Design (RD)
West Hide Pile Industri-Plex Superfund Site Operable Unit 2
Woburn, Massachusetts
Prepared by CDM Smith dated April 21, 2014
July 2014

1. *EPA general comment #10 on the 30% RD indicated that remedial design (RD) components for the West Hide Pile (WHP) (particularly for benzene) and East Hide Pile (EHP) (particularly for arsenic) needed to be included in the 95% RD submittal. Furthermore, the PDI-9 field investigation included the collection of additional groundwater, sediment, and surface water data in the LSP in the vicinity of both the WHP and EHP and these data were used by the Settling Defendants (SDs) for the WHP. However, the 100% design provided for the WHP within the 95% RD document does not include an evaluation of or RD for impacts associated with the EHP and does not appear to be proposed for inclusion in the submittal due in June 2014. This missing component should be included in the June 2014 submittal or in a separate submittal for review as it may lead to revision of the total area selected for excavation.*

Response: Additional PDI-9 data was submitted to EPA on July 11, 2014. EPA has conditionally approved the 100% RD for the Lower South Pond Sediments Adjacent the West Hide Pile. The East Hide Pile is being addressed under Operable Unit No. 1. As of July 15, 2014, all impacted sediment in the referenced EHP drainway have been removed.

2. *Groundwater data submitted to date do not support the conclusion that groundwater is not a source of benzene (or other contaminants such as ammonia or arsenic) to the Lower South Pond (LSP). In fact, EPA indicated that their review of the groundwater data concluded elevated groundwater concentrations of benzene at the WHP is the primary source of benzene contamination to LSP and consequently groundwater needed to be addressed as part of the selected remedy (Comment #36 on the 30% RD). Excavation of sediment in the LSP may reduce the immediate risks to ecological receptors currently exposed to benzene (and other contaminants) in LSP media. However, excavation alone does not preclude re-contamination of the LSP from ongoing or future groundwater discharge. The evaluation in the PDI-9 investigation does not allow for the definitive conclusion that groundwater is not discharging to the LSP, even at a slow rate, and does not support excavation alone as the selected remedy. Thus, the selected RD should be*

reconsidered to include groundwater controls or mitigation for future exposures, such as originally proposed in the Record of Decision (ROD).

Response: Comment noted.

***3**. Why were arsenic and ammonia (or other contaminants) not considered when developing the overall cleanup strategy (and post-excavation confirmatory sample analysis following excavation) for the LSP since they are associated with sources related to the WHP (and EHP)? Both of these chemicals are associated with historical sources and can impact human and ecological receptors at the LSP and further downstream. EPA developed a PRG for benzene in sediment; however, other contaminants may impact ecological receptors and lack of sampling for them or including cleanup standards for them does not preclude their effects.*

Response: Refer to response to Comment 1.

***4.** Since the PDI-9 field investigation was used to inform and develop the 95% RD for the WHP, why were only two piezometer locations determined to be indicative of the area of influence of the WHP (PZ-116 and PZ-117), which were associated with deeper groundwater. There is no evidence that shallower groundwater does not influence concentrations in media of the LSP. Historical data indicate that the highest concentrations of benzene were observed in groundwater along the eastern edge of the WHP and that benzene was associated with both shallow and deep groundwater. Thus, why were locations PZ-103, PZ-104, PZ-106, PZ-109 and PZ-111 or the piezometer locations northeast of the WHP from the PDI-9 investigation not included in the evaluation of influences from the WHP? For example, benzene was observed in groundwater from location PZ-103 at a concentration above the cleanup level in July 2011 and in sediment samples from locations PZ-101N, PZ-101E and PZ-101S. These sample locations are in the same general area. How could groundwater historically influence the WHP but not currently do so?*

Response: Comment noted.

***5.** Assuming that reducing conditions will remain at the WHP, how will the selected remedy prevent migration of contaminants (particularly ammonia) to the LSP or to sensitive areas further downstream? How will sources be controlled or monitored?*

Response: Monitoring details will be provided in the 100% Environmental Monitoring Plan.

6. *Are sources of contaminants from overland flow or leaching controlled so that the LSP adjacent to the WHP (and EHP) cannot contribute to future sediment and surface water contamination?*

Response: Long-term monitoring of this area will be completed in accordance with the 100% Environmental Monitoring Plan.

7. *The RD for the WHP is provided in Section 2.2.1 with the basis for the selection provided in Section 2.2.1. Several results and conclusions from the PDI-9 investigation are provided in a series of bullets as rationale for selection of excavation alone as opposed to a design that includes a groundwater component. However, an evaluation of the data is not provided to support these conclusions either in the PDI-9 investigation results or in the 100% RD for this portion of the site. Were these data and evaluations conducted on behalf of the SDs provided under separate cover or are they lacking?*

Response: Refer to response to Comment 1.

8. *One of the points provided as rationale for selection of the design in Section 2.2.2.1 states that upland soils contaminated with benzene are likely from historical fill soils. The ROD states, "Although these soils are capped and no longer a threat from erosion, these contaminants remain on-site and represent the most significant source of contamination at Industri-plex OU-2. Some of these chemicals have remained adsorbed to soils while others have been mobilized into deeper soils, into groundwater, and into the adjacent wetlands, HBHA and Aberjona River." How are these soils, soils along the slopes of the WHP, not expected to potentially become a future source of impacts to the LSP?*

Response: Long-term monitoring of the groundwater and sediment will be completed in accordance with the 100% Environmental Monitoring Plan.

9. *One of the points provided as rationale for selection of the design in Section 2.2.2.1 is a series of historical aerial photographs. Where are these presented so that the conclusions can be corroborated?*

Response: Historical aerial photographs were presented to EPA during a meeting on July 16, 2013. Presentation included in Attachment 2.

10. *Section 2.2.3.1 indicates that the PDI-9 investigation results will be used to estimate the lateral and vertical extent of contaminated sediment. Sediment sample collection appears to be limited to the top six inches, which would be consistent with the current biologically active zone in the LSP. However, if*

excavation is approved as the remedy or a portion of the remedy for the WHP, there is currently no understanding of the sediment quality currently deeper than six inches. Thus, the sediment that will become surface sediment (currently 6-12 inches) should be sampled so that the entire strata associated with future exposure will be characterized, not just as post-excavation samples confirming that the bottom of the excavation (the future top inch) meets the PRG for benzene. Currently, such a sampling strategy is not specified in the 100% RD for the WHP in terms of vertical characterization (Sections 2.2.3.1 A or D).

Response: Refer to response to Comment #1.

Attachment 2

HISTORICAL AERIAL PHOTOGRAPH PRESENTATION

Industri-plex OU2 Superfund Site

Remedial Design Update

July 16, 2013

de maximis, inc.

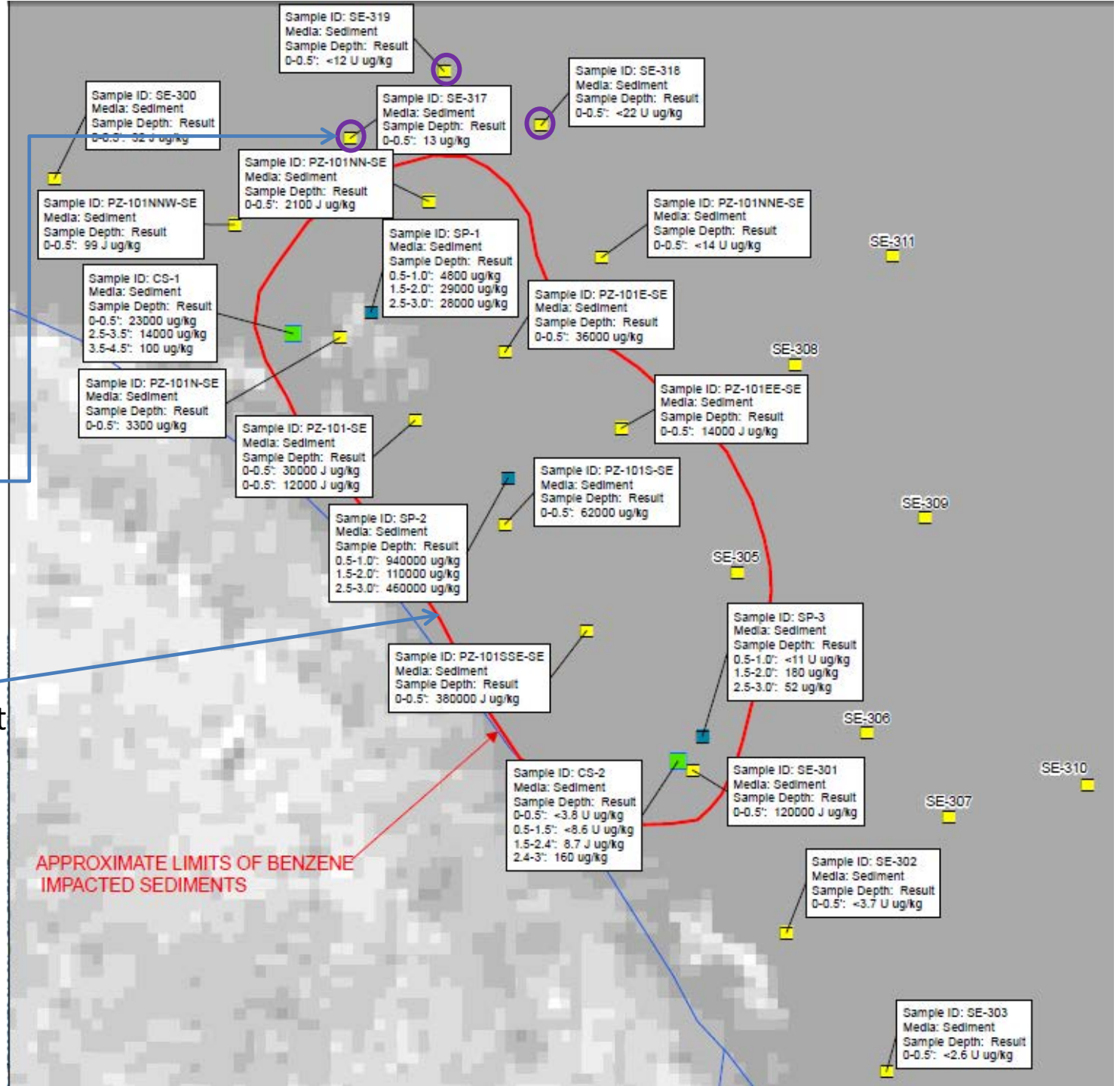
WHP Investigation

Overview of Investigation Results

- Extent of Benzene impacted sediments determined
- Benzene exists in a low-permeability, highly organic lens that underlies both the LSP and the WHP landfill
- Limited groundwater migration into or out of impacted lens
- Limited benzene migration into or out of impacted lens
- Limited treatment options for benzene impacted lens

Determined Limits of Benzene Impacted Sediments

- Benzene below 1 mg/kg @ SE-317-319
- Impacted Area is ~1,615 square feet



Current Conditions (2008 Aerial Photo)

de maximis, inc.

Aerial Photo Comparisons

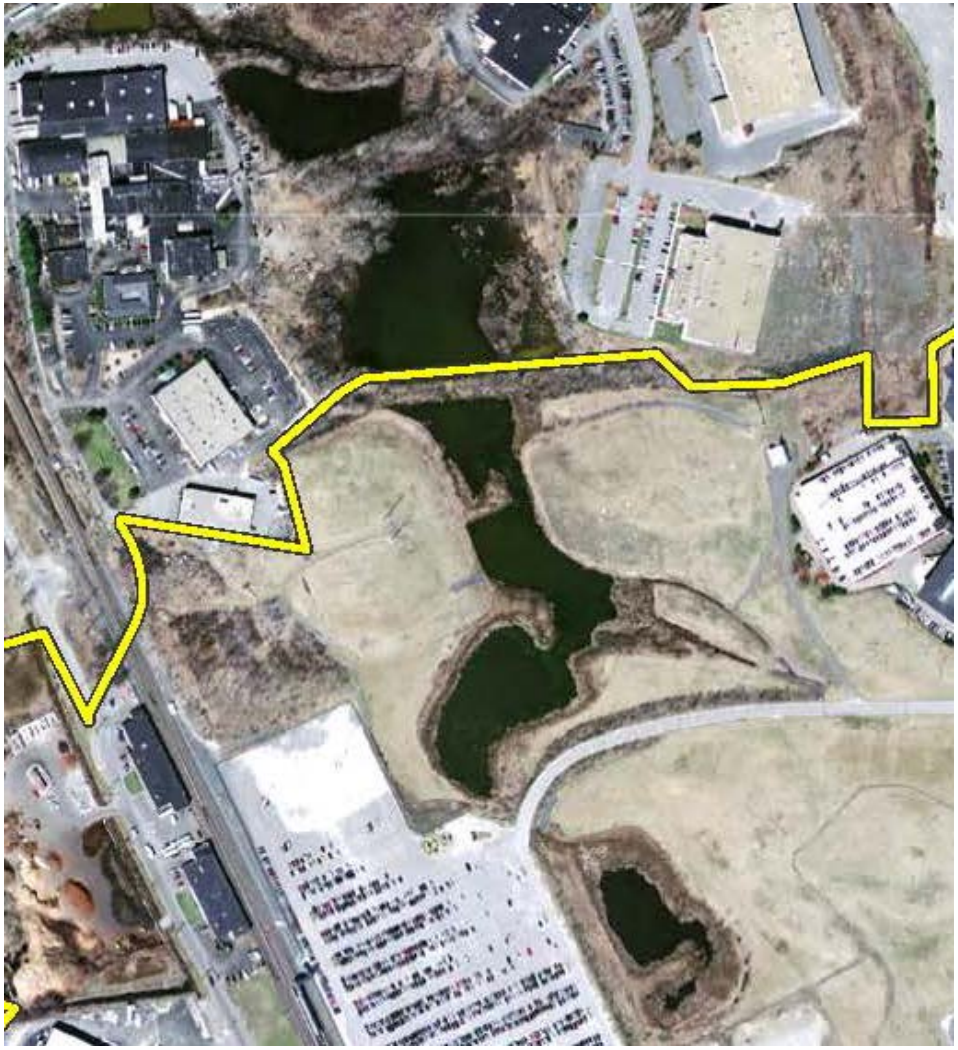
2008

1995

de maximis, inc.

Aerial Photo Comparisons

2008



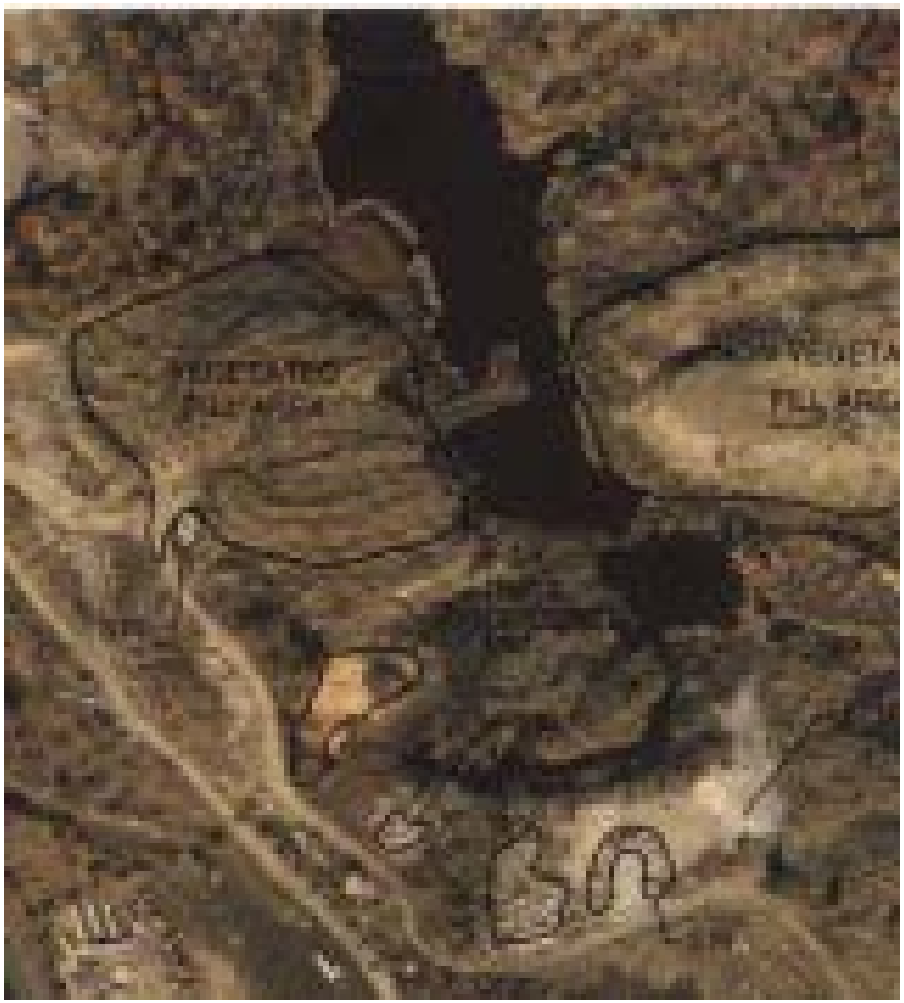
1985

de maximis, inc.

Aerial Photo Comparisons

2008

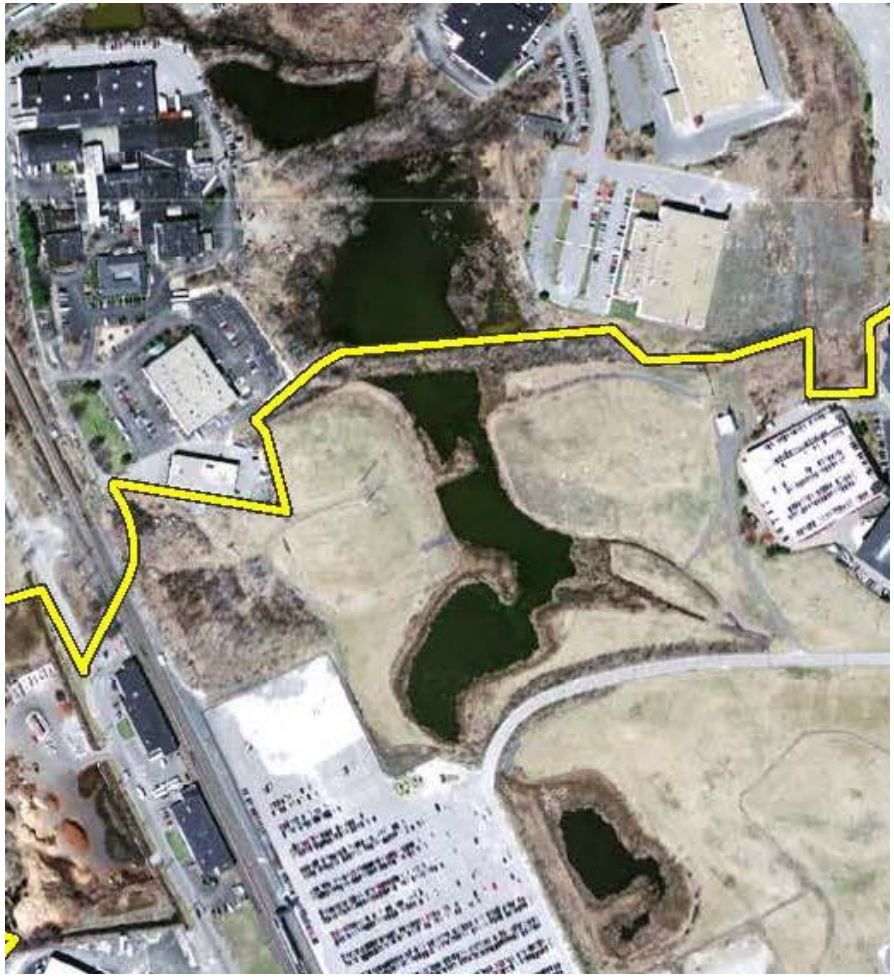
1980



de maximis, inc.

Aerial Photo Comparisons

2008



1975

de maximis, inc.

Aerial Photo Comparisons

2008

1971

de maximis, inc.

Aerial Photo Comparisons

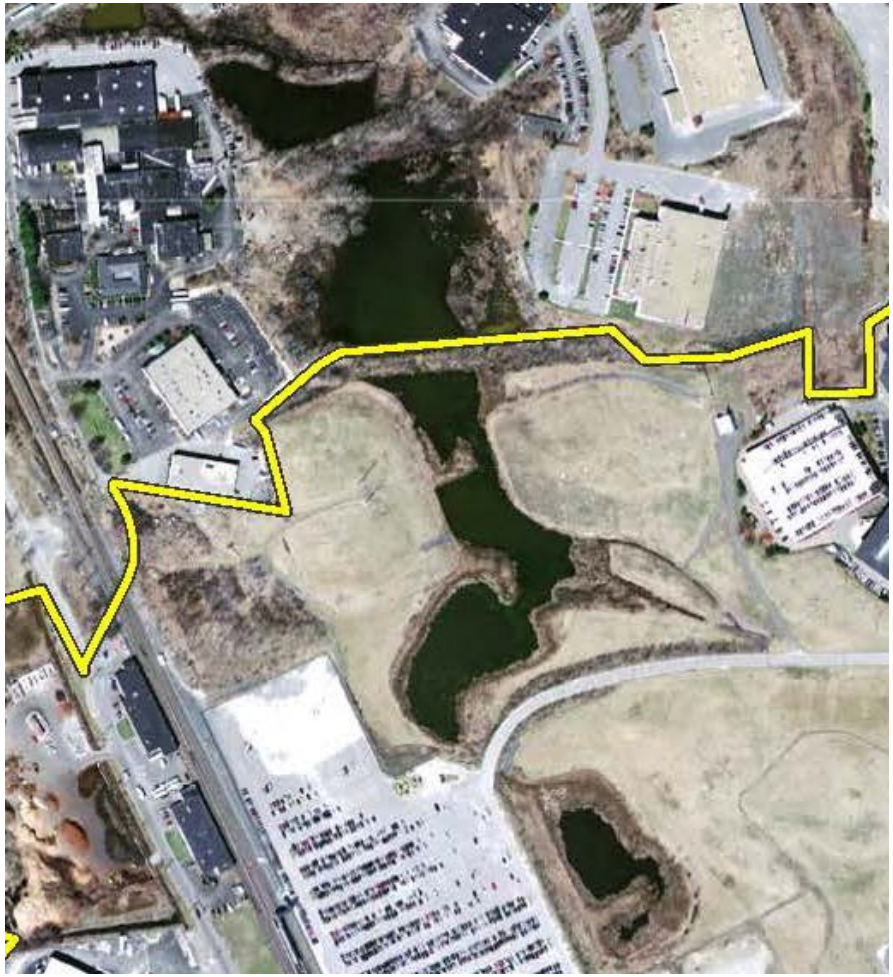
2008

1952

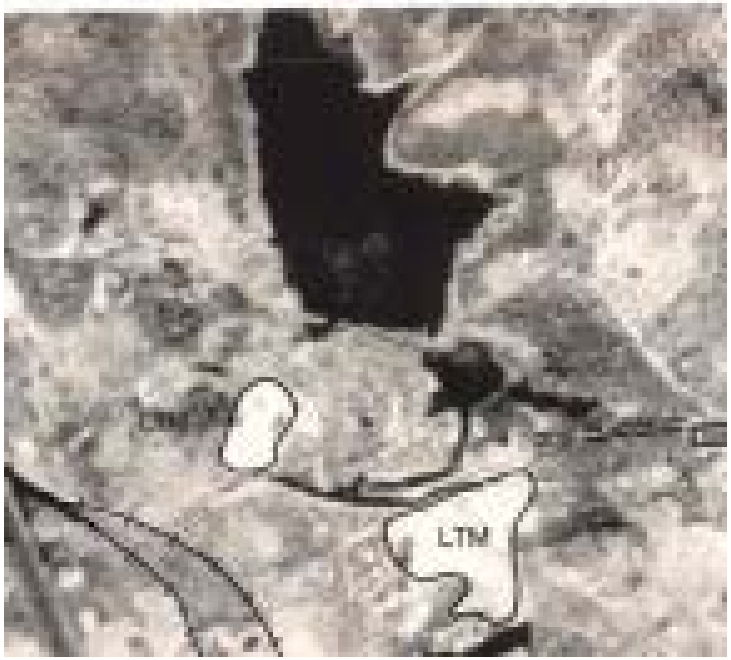
de maximis, inc.

Aerial Photo Comparisons

2008



1938



de maximis, inc.