Newark Bay Study Area

Phase III Sediment Investigation

Quality Assurance Project Plan Amendment

Tierra Solutions, Inc.

East Brunswick, New Jersey

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Revision 2

Tables

Figures

Appendices

Acronyms and Abbreviations

AOC	Administrative Order on Consent
COPC	constituent of potential concern
CPG	Cooperating Parties Group
DEAR	Final Data Evaluation and Assessment Report
Deposition Report	Final Newark Bay Study Area Remedial Investigation Phase I and Phase II Sediment Deposition Report, Revision 1
DQO	Data Quality Objective
FS	Feasibility Study
LPRRP	Lower Passaic River Restoration Project
NBSA	Newark Bay Study Area
NOAA	National Oceanic and Atmospheric Administration
QAPP	Quality Assurance Project Plan
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-*p*-dioxin (dioxin)
PCDF	polychlorinated dibenzofuran (furan)
Phase II RIWP	Newark Bay Study Area Phase II Remedial Investigation Work Plan
Phase III QAPP Amendment	Newark Bay Study Area Phase III Sediment Investigation Quality Assurance Project Plan Amendment
Problem Formulation	Final Newark Bay Study Area Problem Formulation Baseline Human Health and Ecological Risk Assessment
RI	Remedial Investigation
SI	Sediment Investigation
SIM	selective ion monitoring
SOP	standard operating procedure
SOW	Statement of Work
SQT	sediment quality triad
SQT QAPP	Sediment Quality Triad and Porewater Sampling and Analysis Quality Assurance Project Plan
SVOC	semivolatile organic compound
TEPH	total extractable petroleum hydrocarbons
Tierra	Tierra Solutions, Inc.
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1. Introduction

This document is being submitted as an Amendment to the *Newark Bay Study Area Sediment Quality Triad and Porewater Sampling and Analysis Quality Assurance Project Plan* (SQT QAPP; Tierra 2015a). This document presents the Newark Bay Study Area Phase III Sediment Investigation Quality Assurance Project Plan Amendment (Phase III QAPP Amendment) for the proposed sampling of surface sediment (approximately 0 to 6 inches in depth) in the Newark Bay Study Area (NBSA). This Phase III QAPP Amendment has been developed to guide the third phase of sediment sampling for the NBSA, and has been prepared pursuant to Paragraph 39 of the Administrative Order on Consent (AOC) Index No. 02-2004-2010 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for Tierra Solutions, Inc. (Tierra), on behalf of Occidental Chemical Corporation (the successor to Diamond Shamrock Chemicals Company [formerly known as Diamond Alkali Company]). Tierra is undertaking a Remedial Investigation/ Feasibility Study (RI/FS) for the NBSA in accordance with the provisions of the AOC (U.S. Environmental Protection Agency [USEPA] 2004).

As described in the AOC, NBSA sediments are known to contain myriad chemicals, including (without limitation): polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), pesticides, and metals. Assessment of these constituents of potential concern (COPCs) is required by the AOC. To evaluate the COPCs, the AOC identifies three RI-related goals:

- *Nature and Extent of Sediment Contamination (RI Goal 1)*: Determine the horizontal and vertical distribution and concentrations of PCDDs, PCDFs, PCBs, PAHs, pesticides, and metals for the NBSA sediments (NBSA AOC Statement of Work [SOW], Section A.1).

- *Risk Assessment (RI Goal 2)*: Determine the primary human and ecological receptors (endpoints) of PCDD-, PCDF-, PCB-, PAH-, pesticide-, and metals-contaminated sediments in the NBSA (NBSA AOC SOW, Section A.2).

- *Source Identification (RI Goal 3)*: Determine the significant direct and indirect continuing sources of PCDDs, PCDFs, PCBs, PAHs, pesticides, and metals to the sediments in the NBSA (NBSA AOC SOW, Section A.3).

Due to the complexity of the NBSA, USEPA and Tierra agreed in 2005 that the RI would be implemented in multiple phases, as necessary. As such, sediment samples were collected in two phases during 2005 and 2007. Results from these Phase I and Phase II Sediment Investigations (SIs) are documented in the *Phase I and Phase II Field and Data Report* (Tierra 2008). Radiochemical data were evaluated with respect to the 1940 horizon and are presented in the *Final Newark Bay Study Area Remedial Investigation Phase I and Phase II Sediment Deposition Report, Revision 1* (Deposition Report; Tierra 2011). Analytical data evaluated with respect to characterization of nature and extent are presented in the *Final Phase I and Phase II Data Evaluation and Assessment Report, Revision 2* (DEAR; Tierra 2014a). The DEAR uses the Phase I and

Phase II data, in addition to sediment data from secondary sources (data collected for purposes other than the NBSA SI Program), to broadly characterize the distribution of contamination within the NBSA with respect to RI Goal 1.

On September 9, 2015, USEPA submitted a letter from Eugenia Naranjo of USEPA to Cliff Firstenberg of Tierra *Regarding Response to Tierra's Email Dated August 27, 2015, 2014 Oceanographic Data Collection – Administrative Order on Consent, for Remedial Investigation/Feasibility Study (RI/FS)* (USEPA 2015). This memorandum stated "after USEPA's review of Tierra's Data Gaps Report, and during discussions to finalize the DEAR, the USEPA evaluated the need for a Phase III sediment sampling program to fill contaminant nature and extent data gaps." The memorandum further describes a need to characterize subunits of Newark Bay at an appropriate scale for RI/FS decision-making because the existing data only allow for bay-wide decision making (USEPA 2015). As such, the following Data Quality Objectives (DQOs) were established to confirm that data collected during the Phase III sampling program were consistent with, and contributed to, meeting RI Goal 1 listed above, as well as to support RI/FS decision-making. The DQOs are as follows:

1. Determine the approximate boundaries of subunits within Newark Bay that contain statistically distinct concentrations of COPCs, especially dioxin.

2. Determine the means and variances of COPC concentrations within these subunits.

3. Determine how surface sediment COPC concentrations within these subunits vary with time.

Surface sediment samples will be collected as part of the Phase III sampling program to meet these DQOs in accordance with the following USEPA-approved documents:

- *Newark Bay Study Area Phase II Remedial Investigation Work Plan* (Phase II RIWP), Revision 2, Amendment 1, dated November 2007 (Tierra 2007)

- The SQT QAPP, Revision 2, dated August 2015 (Tierra 2015a)

The sampling will be performed in accordance with the Phase II RIWP and the SQT QAPP, except as noted in this Phase III QAPP Amendment. This Phase III QAPP Amendment provides the details of the Phase III surface sediment sampling (e.g., number of samples, sample locations, sampling method, etc.). Details related to porewater sampling, toxicity testing, bioaccumulation testing, and benthic invertebrate sample collection activities described in the SQT QAPP, including worksheets and appendices, that are not applicable to the Phase III sampling program will not be conducted.

2. Background Information

The NBSA is identified as Newark Bay and portions of the Hackensack River, Kill van Kull, and Arthur Kill. The NBSA is situated within one of the most urbanized and industrialized areas in the United States and is known to be contaminated with a number of chemicals, including, but not limited to, PCBs, PAHs, pesticides, herbicides, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCDDs/PCDFs, and metals (National Oceanic and Atmospheric Administration [NOAA] 1995; USEPA 1998).

The majority of the NBSA shoreline consists of commercial, developed, or abandoned properties. Information from the Reconnaissance Survey in September 2013 indicates that a majority of the shoreline (66%) consists of bulkhead and riprap (Tierra 2015b). Residential and recreational areas are located along the waterfront in many of these bulkhead and riprap areas, particularly along the eastern shoreline. Four new residential areas have been proposed for development (Tierra 2013). Figure 1 shows the locations of the proposed residential areas as well as the sediment samples that will be used for the human health risk assessment to characterize these areas.

Due to the size and complexity of the NBSA, USEPA and Tierra agreed in 2005 that the RI would be implemented in multiple phases. Collectively, the Phase I and Phase II investigations gathered information on NBSA sediment, as described in the Deposition Report (Tierra 2011) and DEAR (Tierra 2014a). The Phase III investigation (ongoing) is gathering information for risk assessment purposes and will also include additional sediment sampling to fill RI/FS data gaps. Activities conducted to date under Phase III of the RI have included documents related to the risk assessments (e.g., *Pathways Analysis Report* [USEPA 2006] and *Screening-Level Ecological Risk Assessment for Newark Bay Study Area* [USEPA 2008]) and data collection activities (i.e., SQT [including bioaccumulation and benthic invertebrate community sampling], porewater, crab, clam, fish tissue, and sediment collection). As part of the baseline risk assessment process, the *Final Newark Bay Study Area Problem Formulation Baseline Human Health and Ecological Risk Assessment* (Problem Formulation; Tierra 2013) was developed to document the goals and focus of the baseline risk assessments, and define the questions to be addressed during these evaluations. Consistent with the approved Problem Formulation, several planning documents have been developed for tissue and sediment sampling associated with the NBSA baseline human health and ecological risk assessments, including the *Technical Memorandum: Risk Assessment Field Sampling and Analysis Program – Newark Bay Study Area* (ARCADIS 2015), Reconnaissance Survey Report (Tierra 2015b), Crab and Clam Sampling and Analysis QAPP (Tierra 2014b), Fish Sampling and Analysis QAPP (Tierra 2014c), and SQT QAPP (Tierra 2015a). Additional history and background information on the NBSA can be found in the aforementioned documents.

3. Data Use

The data to be collected pursuant to this Phase III QAPP Amendment will be used to fill nature and extent data gaps and to characterize subunits of Newark Bay at an appropriate scale for RI/FS decision-making. Data collected from other sampling efforts in the NBSA will also be used (in conjunction with the data collected under this Phase III QAPP Amendment) to support the RI/FS. For example, sediment data collected in 2014 and 2015 as part of the sampling efforts described in the Crab and Clam Sampling and Analysis QAPP (Tierra 2014b) and SQT QAPP (Tierra 2015a) will also be used to evaluate COPCs in the NBSA.

The sample type that will be collected as part of this sampling event is sediment, which will be collected from locations throughout the NBSA. Surface sediment samples from approximately the top 6 inches (approximately 15 centimeters) will be collected for chemical analysis[1].

[1] See Section 5 for additional details regarding chemical analyses for sediment samples.

4. Sampling Program

This section of the Phase III QAPP Amendment presents the proposed sampling locations and sampling methodologies, a description of quality control samples to be collected during the program, and a discussion of the standard operating procedures (SOPs) to be followed during the execution of the field program. With the exception of SOP No. 10 – Sediment Sample Collection Using a Box Core, the SOPs were developed for use in the SQT QAPP (Tierra 2015a). These SOPs will be used for the Phase III program, and unless change or additional detail is required, everything remains unchanged from the SQT QAPP (Tierra 2015a). Worksheet #19-1 and SOP No. 6 – Sediment Sample Collection were modified via protocol modification forms during the SQT program; revised versions of these documents are included in Appendix A[2].

4.1 Sampling Locations

The number of sediment sampling locations proposed for the Phase III program was selected based on the size (areal extent) of each subunit targeted for sampling, as provided by USEPA (USEPA 2015), using a stratified, gridded sample design as described in detail in the *Technical Memorandum: Risk Assessment Field Sampling and Analysis Program – Newark Bay Study Area* (ARCADIS 2015). For purposes of the Phase III program, Newark Bay was divided into 6 subunits proposed by USEPA (USEPA 2015), as shown on Figure 2. Using SAS® 9.3, to assess the Phase I and Phase II surface sediment data and surface sediment data from secondary sources (data collected for purposes other than the NBSA SI Program), a sample size was calculated for each subunit as the minimum size necessary to estimate the mean concentration of 2,3,7,8-TCDD with less than 20% relative error at 95% confidence. Table 1 presents the minimum number of samples required per subunit to meet these statistical criteria.

Table 1
Required Number of Samples per Subunit

Subunit	Required Number of Samples
1	84
2	35
3	19
4	35
5	45
6	45
TOTAL	263

[2] For the Phase III sampling program, only the field and trip blanks listed on Worksheet #19-1 will be collected and submitted for analysis.

Using the number of samples required for each subunit shown in Table 1, a sampling grid was prepared and overlaid on each subunit. Each subunit grid consists of identically sized grid cells equaling the number of required samples for the given subunit. USEPA approved the size and layout of the individual grids via email on June 10, 2016 (USEPA 2016). A proposed Phase III sampling location was then placed in the center of each grid cell. For grid cells where a historical Phase I or Phase II sediment core fell within the grid cell, the proposed Phase III sampling location was adjusted to the historical core location rather than the center of the grid cell (USEPA 2016). For grid cells where a surface sediment sample was collected during the 2014 crab and clam or 2015 SQT sampling programs, a Phase III sample will not be collected (USEPA 2016). It is assumed these recent 2014 crab and clam sediment sampling locations and/or 2015 SQT sampling locations are representative of current surface sediment concentrations, therefore, a Phase III sediment sample is not needed. Based on these conditions, a total of 231 Phase III sediment sampling locations are proposed as shown in Table 2.

Table 2
Number of Proposed Phase III Sampling Locations

Subunit	Minimum Required Number of Samples	Number of Grid Cells Containing One or More Crab and Clam or SQT Sediment Samples	Total Number of Proposed Sampling Locations for Phase III	Total Number of Samples to be Analyzed During Phase III	Number of Phase I/II Locations to be Resampled
1	84	10	74	74	14
2	35	0	36	7*	NA
3	19	2	18	11**	5
4	35	4	31	31	6
5	45	13	32	32	6
6	45	5	40	40	6
TOTAL:	263	34	231	195***	37

Notes:
* 36 samples will be collected from Subunit 2; however, a subset of 31 of these samples will be condensed into 7 composite samples (representing only Subunit 2) for analysis.
** 10 samples will be collected from Port Newark Channel, Port Newark Pierhead Channel, and the dredged navigation channel areas in Subunit 3. These 10 samples and 5 of the 36 samples collected from Subunit 2 will be condensed into 3 composite samples for analysis. 6 samples will be condensed into 1 composite sample to represent Port Newark Channel, 3 samples from Subunit 3 will be combined with 4 samples from Subunit 2 to represent a portion of the main navigation channel, and 1 sample from Subunit 3 will be combined with 1 sample from Subunit 2 to represent the Port Newark Pierhead Channel. Another 8 grab samples from Subunit 3 will be analyzed as discrete samples.
*** Total Sample Counts: 231 is the total number of sediment samples to be collected; 195 is the total number of samples to be analyzed. 10 composite samples, representing 46 sampling locations, collected from the dredged navigation channel and port channels, will be analyzed.
NA = not applicable; all re-samples collected within the subunit will be included as composites.

Figure 2 shows the 231 proposed sampling locations. Figures 3 through 8 provide zoomed-in views of each subunit with location IDs assigned to each proposed sampling location. Table 3 provides a list of the sampling locations with additional location information.

4.2 Sampling Methodology

Sampling locations will be located in accordance with SOP No. 1 – Locating Sample Points Using Global Positioning System and SOP No. 2 – Positioning of the SQT QAPP (Tierra 2015a).

As required by USEPA, surface sediment samples will be collected using a coring method (USEPA 2016). Surficial sediment will be collected from each sampling location using a box core, followed by hand coring of the sediment within the box core using direct-push methods. The SOP for use of a box core is provided in Appendix B.

Prior to collecting cores from the box core, an initial single sediment grab sample will be collected from the center area of each box core for analysis of VOCs and total extractable petroleum hydrocarbons (TEPH)-purgeables, as described in Appendix B. This sample will not be composited or homogenized with the rest of the collected sediment.

One box core sample will be collected from each sampling location. From each box core, one 6-inch long, 5-inch diameter direct-push core will be collected to obtain sufficient sediment mass to perform all chemical analyses. Approximately 600 grams of sediment are required to perform all chemical analyses; each 5-inch diameter, 6-inch long core will yield approximately 760 grams of sediment assuming a minimum recovery of 75% (or 4.5 inches in length). Additional cores will be required at select locations for the collection of additional sediment mass required for USEPA split samples, field duplicate samples, and matrix spike/matrix spike duplicate sample analysis. The direct-push cores will be collected as described in Appendix B. The direct-push sediment cores collected from each sampling location will be homogenized until textural, color, and moisture homogeneity is achieved, as described in Appendix B. The homogenization container and tool will be decontaminated between sampling stations as described in SOP No. 3 – Decontamination of the SQT QAPP (Tierra 2015a). Once homogenized, the appropriate amount of sediment for each analysis will be placed in appropriately labeled sample containers as described in SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis of the SQT QAPP (Tierra 2015a). Samples for chemistry analysis will be stored on wet ice for shipment to the designated testing laboratories.

4.3 Navigation Channel Sampling Methodology

Sediment samples will be collected from the dredged navigation channels to characterize sediments that are accumulating preferentially in the channels. Per the USEPA, these data will be used to “assess exposure to biota during certain parts of their life cycle and to characterize recently deposited sediment in the NBSA” (USEPA 2016).

Sediment from the dredged navigation channels will be collected using a grab sampling device appropriate for the water depth and substrate type, as described in SOP No. 6 – Sediment Sample Collection of the SQT QAPP (Tierra 2015a) as modified, provided in Appendix A. One grab sample will be collected at each location. Each individual grab sample will be photo-documented and a description of the sediment will be recorded, as described in SOP No. 6 – Sediment Sample Collection.

For volatile analyses, the sample will be collected from the first location sampled for each composite. The volatile samples will be collected from the center area of the grab sampler for analysis of VOCs and TEPH-purgeables, as described in SOP No. 6 – Sediment Sample Collection of the SQT QAPP (Tierra 2015a) as modified, provided in Appendix A. This sample will not be composited or homogenized with the rest of the collected sediment. Bulk sediment samples will be collected from each location for the remaining sediment chemistry analyses.

Prior to sample preparation, the bulk sediment samples will be composited to create representative samples from the dredged navigation channel areas. Thirty-one individual samples from Subunit 2 will be combined to create seven composite samples for chemistry analysis, six individual samples from Subunit 3 will be combined to create one composite sample representing Port Newark Channel for chemistry analysis, two individual samples from the Port Newark Pierhead Channel in Subunits 2 and 3 will be combined to create one composite sample for chemistry analysis, and seven individual samples from the main navigation channel in Subunits 2 and 3 will be combined to create one composite sample for chemistry analysis. A summary of the individual sample locations that comprise each composite sample is provided in Table 4. Table 5 provides a summary of the number of composite samples to be collected by Subunit.

Table 5
Summary of Composite Samples by Subunit

Subunit	Number of Individual Samples Collected	Number of Composite Samples for Chemistry Analysis
2	31	7
3	6	1
2 & 3	9	2
Total	46	10

A description of the 10 composite samples to be collected is provided below.

- One composite sample from the Port Newark Channel (composite will be comprised of 6 individual grab samples from the closest adjacent sampling locations, as presented on Table 4)

- One composite sample from the Elizabeth Channel (composite will be comprised of 8 individual grab samples from the closest adjacent sampling locations, as presented on Table 4)

- One composite sample from the South Elizabeth Channel (composite will be comprised of 3 individual grab samples from the closest adjacent sampling locations, as presented on Table 4)

- One composite sample from the Port Newark Pierhead Channel (composite will be comprised of 2 individual grab samples evenly spaced across the pierhead, as presented on Table 4)

- Three composite samples from the main navigation channel between the Elizabeth Channel and Shooter's Island (composites will be comprised of individual grab samples from the closest adjacent sampling locations, as presented on Table 4)

- Three composite samples from the navigation channel between the Kill van Kull and the Arthur Kill (composites will be comprised of 4 or 5 individual grab samples from the closest adjacent sampling locations, as presented on Table 4)

The composite samples will be assigned a sample identification code as follows:

Characters 1 and 2:	Two characters to describe the water body where the sample was collected (i.e., for Phase III this will be NB for Newark Bay).
Characters 3 and 4:	Two digits to describe the phase during which the sample was collected. For example, the Phase III SI Program will be described as “03.”
Characters 5 through 7:	Three characters to describe the sample matrix. For example, this will be “SED” for sediment.
Characters 8 through 11:	Four characters to denote the type of analysis. For example, this will be “-CHM” for chemistry.
Characters 12 through 17:	Six characters to identify the composite number. For example, “COMP01” for composite sample number 1.

Example of Composite Sample Identification Code

The following is an example of a sediment composite sample identification number:

NB03SED-CHMCOMP01

Explanation:

Sample collected from Newark Bay, Phase III Program, sediment matrix, chemistry sample, composite number one.

A list of the individual sampling locations that make up each composite sample is provided in Table 4.

Bulk sediment samples from each individual sampling location making up each composite sample will be homogenized at the Sample Processing Area (i.e., Lister Avenue site) until textural, color, and moisture homogeneity is achieved as described in Appendix B. The homogenization container and tool will be

decontaminated between sampling stations as described in SOP No. 3 – Decontamination of the SQT QAPP (Tierra 2015a). Once homogenized, the appropriate amount of sediment for each analysis will be placed in sample containers as described in SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis of the SQT QAPP (Tierra 2015a). Samples for chemistry analysis will be stored on wet ice for shipment to the designated testing laboratories.

4.4 Quality Control Samples

Table 6 provides a list of sediment quality control samples to be collected during the Phase III program. This table replaces Worksheet #20-1 of the SQT QAPP (Tierra 2015a). Worksheet #28-1a of the SQT QAPP (Tierra 2015a) provides additional information regarding sediment quality control samples, and Worksheets #28-2a and 28-2b of the SQT QAPP (Tierra 2015a) provide additional information regarding blank quality control samples and sediment laboratory quality control samples, respectively.

4.5 Approved SOPs Incorporated in Amendment

Field documentation will be performed in accordance with SOP No. 8 – Documenting Field Activities of the SQT QAPP (Tierra 2015a), and data management will be performed in accordance with SOP No. 9 – Data Management of the SQT QAPP (Tierra 2015a). Management and disposal of investigation derived waste will be performed as described in SOP No. 4 – Management and Disposal of Residuals of the SQT QAPP (Tierra 2015a). Sample identification and labeling will be assigned as described in SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis of the SQT QAPP (Tierra 2015a) with the exception of the composite samples collected from the navigation channels. Sample identification and labeling of the composite samples is described in Section 4.3.

5. Chemical Analysis

The analyte list for sediment collected under this Phase III QAPP Amendment is based on available data collected under the following programs:

- Newark Bay SQT QAPP (Tierra 2015a)
- Newark Bay Crab and Clam QAPP (Tierra 2014b)
- Newark Bay Phase I and II Sediment Investigations (Tierra 2014a, 2011)
- Lower Passaic River Restoration Project (LPRRP) RI/FS Cooperating Parties Group (CPG) Fish and Decapod Crustacean Tissue Collection (Windward 2009a)
- LPRRP RI/FS CPG Surface Sediment and Benthic Invertebrate Sampling Program (Windward 2009b)

The chemical analyses planned for surface sediment samples collected in support of the Phase III program include chemical analyses performed under the CPG LPRRP, Phases I and II of the Newark Bay Sediment Investigations, the Crab and Clam QAPP, and the SQT QAPP. COPCs used for risk assessment purposes and which have low levels of detection and low concentrations based on the aforementioned programs have been eliminated from the list of analytes. Table 7 provides a comparison of the chemical groups proposed for sediment analysis in the NBSA under this Phase III QAPP Amendment and the analyses conducted under the CPG LPRRP, Phases I and II of the Newark Bay Sediment Investigations, the Crab and Clam QAPP, and the SQT QAPP. Target chemical groups and individual analytes for sediment analysis are provided in Worksheet #15-2 of the SQT QAPP (Tierra 2015a).

Table 7
Comparison of Chemical Groups for Sediment Analysis

Analyte Group	LPRRP	NBSA Phase I/II Sediment Investigation	Crab and Clam QAPP	SQT and Porewater QAPP	Proposed for NBSA Phase III Investigation
PCDDs/PCDFs	X	X	X	X	X
Congener PCBs	X	X	X	X	X
Aroclor PCBs	X	X	X	X	X
Metals	X	X	X	X	X
Mercury	X	X	X	X	X
Methylmercury	X		X	X	X
Hexavalent Chromium	X		X	X	

Analyte Group	LPRRP	NBSA Phase I/II Sediment Investigation	Crab and Clam QAPP	SQT and Porewater QAPP	Proposed for NBSA Phase III Investigation
SVOCs (including phthalates)	X	X	X	X	X
SVOC selective ion monitoring (SIM) (including alkylated)	X	X	X	X	X
VOCs	X	X	X	X	X
Percent Moisture	X	X	X	X	X
Pesticides	X	X	X	X	X
Herbicides	X	X	X	X	X
Butyltins	X	X	X	X	
Total Petroleum Hydrocarbons	X	X	X	X	X
Total Organic Carbon	X	X	X	X	X
pH	X		X	X	
Oxidation Reduction Potential			X	X	
Total Sulfide	X		X	X	
Total Phosphorus	X		X	X	
Total Kjeldahl Nitrogen	X		X	X	
AVS/SEM	X		X	X	
Ammonia	X		X	X	
Cyanide	X	X	X	X	X
Grain Size	X	X	X	X	X

Notes:
X = the analysis was conducted in previous sediment investigations or is planned as part of this Phase III QAPP Amendment

Chemical analyses will be conducted by contracted analytical laboratories in accordance with the Laboratory SOPs provided in the SQT QAPP (Tierra 2015a). Measurement performance criteria, by method, for blanks and sediment are provided in Worksheets #12-1 and 12-2 of the SQT QAPP (Tierra 2015a), and reference limits, by method, for blanks and sediment are provided in Worksheets #15-1 and 15-2 of the SQT QAPP (Tierra 2015a). Analytical SOP requirements for blanks and sediment samples are provided in Worksheet #19-1 (as modified, provided in Appendix A) and Worksheet #19-2 of the SQT QAPP (Tierra 2015a). Analytical methods and SOP references are provided in Worksheets #23-1 and 23-2 of the SQT QAPP (Tierra 2015a).

Data validation and verification activities will be completed in accordance with the Data Validation SOPs provided in the SQT QAPP (Tierra 2015a) and as described in SQT QAPP Worksheets #34, 35, 36, and 37.

6. References

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Tables

Table 3

Proposed Sediment Sampling Locations

Subunit	Location ID	Northing	Easting
1	179	665483	587411
1	180	664943	587857
1	181	664646	588427
1	182	664347	588992
1	183	664946	586443
1	184	665047	586861
1	185	664372	587559
1	186	664075	588130
1	187	663775	588777
1	188	663481	589266
1	189	664394	586122
1	190	664099	586691
1	191	663802	587262
1	192	663207	588403
1	193	662914	588972
1	194	663529	586394
1	195	663232	586965
1	196	662934	587535
1	197	662637	588106
1	198	662108	588724
1	199	663460	584948
1	200	663373	585713
1	201	662958	586097
1	202	662661	586667
1	203	662364	587238
1	204	662066	587808
1	205	661853	588266
1	206	662982	584659
1	207	662685	585229
1	208	662388	585800
1	209	662091	586370
1	210	661793	586941
1	211	661575	587420
1	212	662533	583573
1	213	662412	584361
1	214	662115	584932
1	215	661817	585502
1	216	661923	585956
1	217	661323	586652
1	218	661953	583522

Table 3
Proposed Sediment Sampling Locations

Subunit	Location ID	Northing	Easting
1	219	661842	584064
1	220	661544	584635
1	221	661310	585198
1	222	661834	582698
1	223	661568	583196
1	224	661305	583761
1	225	661165	584348
1	226	658938	587773
1	227	658116	589523
1	228	661528	581776
1	229	661149	582911
1	230	660021	584611
1	231	658850	586986
1	232	658503	587289
1	233	658322	588033
1	234	658025	588604
1	235	661111	581453
1	236	660021	583165
1	237	660004	583753
1	238	659536	584313
1	239	659238	584884
1	240	658941	585454
1	241	658635	586014
1	242	658527	586408
1	243	657759	587736
1	244	657496	588302
1	245	660932	580582
1	246	659881	581683
1	247	659431	583122
1	248	659060	584067
1	249	658777	584637
1	250	658468	585219
1	251	657837	586325
1	252	657644	586886
2	253	675605	586563
2	254	674784	587385
2	255	674467	588459
2	256	673407	591623
2	257	673354	589432
2	258	672679	590477

Table 3
Proposed Sediment Sampling Locations

Subunit	Location ID	Northing	Easting
2	259	671860	590994
2	260	671376	592550
2	261	671110	593714
2	262	670529	592304
2	263	669982	593238
2	264	668859	592733
2	265	667328	592082
2	266	666611	591709
2	267	665488	591197
2	268	666322	587163
2	269	665483	588525
2	270	665134	589477
2	271	664115	590607
2	272	663247	590161
2	273	661725	589312
2	274	661276	588352
2	275	660969	589159
2	276	660690	586417
2	277	660322	587567
2	278	659848	588685
2	279	659299	589762
2	280	658877	590919
2	281	660682	582577
2	282	660644	583663
2	283	660545	584830
2	284	660525	580907
2	285	659889	579770
2	286	659134	578493
2	287	658392	577043
2	288	657256	576565
3	289	686885	601907
3	290	685907	601142
3	291	684715	599413
3	292	684053	598799
3	293	682465	598017
3	294	679172	597355
3	295	678524	597028
3	296	679809	588283
3	297	679046	590013
3	298	678264	591603

Table 3

Proposed Sediment Sampling Locations

Subunit	Location ID	Northing	Easting
3	299	677794	592334
3	300	675699	595456
3	301	676281	593287
3	302	675380	594084
3	303	674935	595180
3	304	674968	592413
3	305	673866	594678
3	306	672570	594279
4	307	682915	600175
4	308	682671	600807
4	309	682655	599164
4	310	682343	599816
4	311	682012	600476
4	312	681670	601111
4	313	682032	598885
4	314	681683	599485
4	315	681352	600145
4	316	680690	601461
4	317	681181	599071
4	318	680693	599814
4	319	680362	600474
4	320	680031	601133
4	321	681069	597297
4	322	680373	598876
4	323	680033	599483
4	324	679702	600143
4	325	679398	600457
4	326	680615	597252
4	327	679672	599234
4	328	679043	599812
4	329	678773	600357
4	330	679505	596731
4	331	678383	599481
4	332	678121	600014
4	333	679048	596511
4	334	678369	596206
4	335	676963	595258
4	336	676435	595138
4	337	675773	594807
5	338	675048	593265

Table 3

Proposed Sediment Sampling Locations

Subunit	Location ID	Northing	Easting
5	339	674084	593746
5	340	673421	595505
5	341	673090	596269
5	342	672475	597376
5	343	672418	597849
5	344	673893	593022
5	345	673291	593542
5	346	672637	595222
5	347	672334	595974
5	348	672016	596773
5	349	672805	592457
5	350	672584	593401
5	351	671829	594925
5	352	671804	595488
5	353	671216	596456
5	354	671843	592966
5	355	671022	594622
5	356	670734	595338
5	357	669935	595021
5	358	669414	593994
5	359	669460	594432
5	360	668619	593657
5	361	668335	594385
5	362	667828	593318
5	363	667535	594068
5	364	667101	593681
5	365	666246	592642
5	366	665454	592315
5	367	663856	591679
5	368	663075	591330
5	369	659620	590903
6	370	686523	600760
6	371	686084	599913
6	372	685351	601345
6	373	685480	599545
6	374	684868	600815
6	375	684398	599931
6	376	684152	600492
6	377	683809	599535
6	378	683471	600093

Table 3

Proposed Sediment Sampling Locations

Subunit	Location ID	Northing	Easting
6	379	683266	599184
6	380	679805	598319
6	381	679142	598038
6	382	678815	598275
6	383	678450	597690
6	384	678210	598243
6	385	677800	598796
6	386	677830	597327
6	387	677547	597920
6	388	677224	598583
6	389	677198	599380
6	390	677176	596992
6	391	676883	597597
6	392	676560	598260
6	393	676232	598909
6	394	675907	599515
6	395	676516	596661
6	396	676373	597682
6	397	675897	597937
6	398	675574	598600
6	399	675857	596330
6	400	675557	596951
6	401	674910	598277
6	402	674625	598832
6	403	674870	596599
6	404	674570	597291
6	405	674247	597954
6	406	674525	595726
6	407	674230	596304
6	408	673907	596968
6	409	673584	597631

Notes:

1. Northing and easting coordinates are provided in the North American Datum of 1983.

Table 4
Summary of Navigation Channel Composite Samples

Geographic Area	Subunit	Location ID	Sample Name for Chemistry Analysis
Port Newark Channel	3	296	NB03SED-CHMCOMP01
		297	
		298	
		299	
		301	
		302	
Elizabeth Channel	2	253	NB03SED-CHMCOMP02
		254	
		255	
		257	
		258	
		259	
		260	
		262	
South Elizabeth Channel	2	268	NB03SED-CHMCOMP03
		269	
		270	
Main Channel #1 (Elizabeth Channel to Shooters Island)	2/3	261	NB03SED-CHMCOMP04
		263	
		264	
		265	
		303	
		305	
		306	
Main Channel #2 (Elizabeth Channel to Shooters Island)	2	266	NB03SED-CHMCOMP05
		267	
		271	
		272	
Main Channel #3 (Elizabeth Channel to Shooters Island)	2	273	NB03SED-CHMCOMP06
		274	
		275	
Main Channel #4 (Kill van Kull to Arthur Kill)	2	277	NB03SED-CHMCOMP07
		278	
		279	
		280	
Main Channel #5 (Kill van Kull to Arthur Kill)	2	281	NB03SED-CHMCOMP08
		282	
		283	
		276	
Main Channel #6 (Kill van Kull to Arthur Kill)	2	284	NB03SED-CHMCOMP09
		285	
		286	
		287	
		288	
Port Newark Pierhead Channel	2/3	256	NB03SED-CHMCOMP10
		304	

Table 6

Sediment Quality Control Sample Summary[a,b]

Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[c]	Number of Samples Collected	Number of Field Duplicate Pairs	Number of MS[d]	Number of MSD or Duplicate	Number of Trip Blanks[e]	Number of Field Blanks[f]	Total Number of Samples to Lab[g]
PCDDs/PCDFs	Low	L-1	195	10	10	10	NA	8	213
PCB Congeners	Low	L-2	195	10	10	10	NA	8	213
TAL Metals, Titanium	Low	L-3, L-29	195	10	10	10	NA	8	213
Mercury	Low	L-4	195	10	10	10	25	8	238
Methylmercury	Low	L-5	195	10	10	10	25	8	238
Chlorinated Herbicides	Low	L-7	195	10	10	10	NA	8	213
Semivolatile Organics	Low	L-8	195	10	10	10	NA	8	213
Semivolatile Organics SIM	Low	L-9	195	10	10	10	NA	8	213
Aroclor PCBs	Low	L-10	195	10	10	10	NA	8	213
Pesticides	Low	L-11	195	10	10	10	NA	8	213
Volatile Organics	Low	L-12	195	10	10	10	25	8	238
Cyanide	Low	L-13	195	10	10	10	NA	8	213
TOC	Low	L-15	195	10	10	10	NA	8	213
TEPH - purgeables	Low	L-33	195	10	10	10	NA	8	213
TEPH - extractables/alkanes	Low	L-16, L-31	195	10	10	10	NA	8	213
% Moisture	Low	L-20	195	10	NA	NA	NA	0	205
Grain Size	Low	L-27	195	10	NA	NA	NA	0	205

Notes:

[a]This table replaces Worksheet #20-1 of the Sediment Quality Triad and Porewater Sampling and Analysis QAPP (Tierra 2015a).

[b] Laboratory performance evaluation samples are part of the planned project quality control program. However, these samples are not listed here, as the quality control samples will be administered separately from sample collection control tasks. Ongoing PE samples will be submitted to the appropriate laboratory according to the following protocol. SDGs containing split samples (shared with USEPA) will have a PE sample submitted at a frequency of 1 for each SDG. USEPA will reserve the right to choose the split samples from the available samples collected. SDGs that do not contain USEPA split samples will have 1 PE sample submitted for laboratory analysis for every 40 field samples collected. Ongoing PE sample analyses are independent of the pre-program performance evaluation study.

[c] Referenced from the Analytical SOP References Table (Worksheet #23) of the SQT QAPP (Tierra 2015a).

Table 6

Sediment Quality Control Sample Summary[a,b]

[d] Assumes MS/MSD will be collected at a rate of one (MS) and one (MSD) per up to 20 samples or per SDG (whichever is more frequent) for all constituents, except cyanide, which will have one MS and laboratory duplicate per up to 20 samples collected or per SDG, whichever is more frequent. Grain size and % moisture will have laboratory duplicates (no MS/MSD).

[e] The number of trip blanks may vary depending upon the duration of sampling. One trip blank is required to be transported with each shipment of samples when volatile organic compounds, mercury, or methylmercury will be analyzed. This table assumes 25 shipments of samples.

[f] Assumes one field blank will be collected per week. The number of field blanks may vary depending upon the duration of sampling. This table assumes 6 weeks of sampling. Two pre-program field blanks will also be collected.

[g] This value excludes MS/MSD.

Acronyms and Abbreviations:

% = percent

MS = matrix spike

MSD = matrix spike duplicate

NA = not applicable

PCB = polychlorinated biphenyl

PCDDs/PCDFs = polychlorinated dibenzo-*p*- dioxins/polychlorinated dibenzofurans

PE = performance evaluation

QAPP = Quality Assurance Project Plan

SDG = sample delivery group

SIM = selective ion monitoring

SOP = Standard Operating Procedure

TAL = Target Analyte List

TEPH = total extractable petroleum hydrocarbons

TOC = total organic carbon

USEPA = U.S. Environmental Protection Agency

Figures

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
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LEGEND:

SEDIMENT SAMPLES TO CHARACTERIZE PROPOSED DEVELOPMENT AREAS IN THE HUMAN HEALTH RISK ASSESSMENT

- 2014 CRAB/CLAM SAMPLING PROGRAM
- 2015 SQT SAMPLING PROGRAM
- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION

AREAS SLATED FOR FUTURE DEVELOPMENT (INCLUDING RESIDENTIAL)

- BAYFRONT 1 REDEVELOPMENT PLAN AREA
- KAPKOWSKI ROAD REDEVELOPMENT AREA
- NORTH SHORE 2030
- WATERFRONT DEVELOPMENT DISTRICT
- PHASE I/PHASE II SI STUDY AREA BOUNDARY

PIERSONS CREEK
371
166
PORT NEWARK CHANNEL
ELIZABETH CHANNEL
NEWARK LIBERTY INTERNATIONAL AIRPORT
NEWARK BAY CDF (CELL 1S)
PERIPHERAL DITCH
SOUTH ELIZABETH CHANNEL
131B
155
131A
130
152
199
174
KILL VAN KULL
178
368
246
129
247
149
243
244
147
SHOOTERS ISLAND
PRALLS ISLAND

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. SHORELINE IS DIGITIZED FROM AERIAL PHOTO DATED JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).

0 3,000 6,000 Feet
GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION
QAPP AMENDMENT

PROPOSED DEVELOPMENT AREAS

REVISION 2, SEPTEMBER 2016

FIGURE
1

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
Z:\GISPROJECTS_ENV\Tierra\GIS\Task\NBSA\SedimentInvestigation\PhIII\QAPP_Amend\ProposedSedimentSamplingLocations_v2.mxd 9/19/2016 10:10:37 AM

LEGEND:

- 2005 NEWARK BAY PHASE I SEDIMENT INVESTIGATION
- 2007 NEWARK BAY PHASE II SEDIMENT INVESTIGATION
- 2014 CRAB/CLAM SAMPLING PROGRAM
- 2015 SQT SAMPLING PROGRAM

NEWARK BAY PHASE III SEDIMENT INVESTIGATION

- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION
- GRID POINT PREVIOUSLY SAMPLED (WILL NOT BE SAMPLED AS PART OF PHASE III)
- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION - COMPOSITE LOCATION
- NAVIGATION CHANNEL
- SHORELINE
- UNDERGROUND TRIBUTARY
- PHASE I/PHASE II SI STUDY AREA BOUNDARY

PROPOSED USEPA SUBUNIT

- 1
- 2
- 3
- 4
- 5
- 6

PIERSONS CREEK

PORT NEWARK CHANNEL

ELIZABETH CHANNEL

NEWARK LIBERTY INTERNATIONAL AIRPORT

NEWARK BAY CDF (CELL 1S)

PERIPHERAL DITCH

SOUTH ELIZABETH CHANNEL

KILL VAN KULL

SHOOTERS ISLAND

PRALLS ISLAND

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. SHORELINE IS DIGITIZED FROM AERIAL PHOTO DATED JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. THE AREA OF EACH GRID CELL WAS CALCULATED AS DESCRIBED IN USEPA'S GUIDANCE ON CHOOSING A SAMPLING DESIGN FOR ENVIRONMENTAL DATA COLLECTION (EPA/240/R-02/005) DATED DECEMBER 2002. SAMPLE POINTS ARE PLACED IN ALL GRID CELLS WITH AN AREA GREATER THAN 50% OF CALCULATED CELL SIZE.

0 3,000 6,000 Feet

GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION

QAPP AMENDMENT

PROPOSED SEDIMENT SAMPLING LOCATIONS

REVISION 2, SEPTEMBER 2016

FIGURE 2

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
Z:\GISPROJECTS_ENV\Tierra\GIS\Task\NBSA\SedimentInvestigation\PhIII\QAPP_Amend\ProposedSedSampLoc_Subunit1_v2.mxd 9/18/2016 7:08:46 PM

LEGEND:

- 2005 NEWARK BAY PHASE I SEDIMENT INVESTIGATION
- 2007 NEWARK BAY PHASE II SEDIMENT INVESTIGATION
- 2014 CRAB/CLAM SAMPLING PROGRAM
- 2015 SQT SAMPLING PROGRAM

NEWARK BAY PHASE III SEDIMENT INVESTIGATION

- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION
- GRID POINT PREVIOUSLY SAMPLED (WILL NOT BE SAMPLED AS PART OF PHASE III)
- NAVIGATION CHANNEL
- SHORELINE
- UNDERGROUND TRIBUTARY
- PHASE I/PHASE II SI STUDY AREA BOUNDARY

PROPOSED USEPA SUBUNIT

- 1
- 2
- 3
- 4
- 5
- 6

SOUTH ELIZABETH CHANNEL

SHOOTERS ISLAND

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. SHORELINE IS DIGITIZED FROM AERIAL PHOTO DATED JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. THE AREA OF EACH GRID CELL WAS CALCULATED AS DESCRIBED IN USEPA'S GUIDANCE ON CHOOSING A SAMPLING DESIGN FOR ENVIRONMENTAL DATA COLLECTION (EPA/240/R-02/005) DATED DECEMBER 2002. SAMPLE POINTS ARE PLACED IN ALL GRID CELLS WITH AN AREA GREATER THAN 50% OF CALCULATED CELL SIZE.

0 1,250 2,500 Feet

GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION

QAPP AMENDMENT

PROPOSED SEDIMENT SAMPLING LOCATIONS - SUBUNIT 1

REVISION 2, SEPTEMBER 2016

FIGURE 3

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
Z:\GISPROJECTS_ENV\Tierra\GIS\Task\NBSA\SedimentInvestigation\PhIII\QAPP_Amend\ProposedSedSampLoc_Subunit2_v2.mxd 9/18/2016 7:11:34 PM

LEGEND:

2005 NEWARK BAY PHASE I SEDIMENT INVESTIGATION

2007 NEWARK BAY PHASE II SEDIMENT INVESTIGATION

2014 CRAB/CLAM SAMPLING PROGRAM

2015 SQT SAMPLING PROGRAM

NEWARK BAY PHASE III SEDIMENT INVESTIGATION

PROPOSED PHASE III SEDIMENT SAMPLING LOCATION

GRID POINT PREVIOUSLY SAMPLED
(WILL NOT BE SAMPLED AS PART OF PHASE III)

PROPOSED PHASE III SEDIMENT SAMPLING LOCATION - COMPOSITE LOCATION

NAVIGATION CHANNEL

SHORELINE

UNDERGROUND TRIBUTARY

PHASE I/PHASE II SI STUDY AREA BOUNDARY

PROPOSED USEPA SUBUNIT

1

2

3

4

5

6

PORT NEWARK CHANNEL

ELIZABETH CHANNEL

NEWARK LIBERTY INTERNATIONAL AIRPORT

NEWARK BAY CDF (CELL 1S)

PERIPHERAL DITCH

SOUTH ELIZABETH CHANNEL

SHOOTERS ISLAND

253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
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0 2,000 4,000 Feet

GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION

QAPP AMENDMENT

PROPOSED SEDIMENT SAMPLING LOCATIONS - SUBUNIT 2

REVISION 2, SEPTEMBER 2016

FIGURE
4

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
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LEGEND:

- 2005 NEWARK BAY PHASE I SEDIMENT INVESTIGATION
- 2007 NEWARK BAY PHASE II SEDIMENT INVESTIGATION
- 2014 CRAB/CLAM SAMPLING PROGRAM
- 2015 SQT SAMPLING PROGRAM

NEWARK BAY PHASE III SEDIMENT INVESTIGATION

- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION
- GRID POINT PREVIOUSLY SAMPLED (WILL NOT BE SAMPLED AS PART OF PHASE III)
- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION - COMPOSITE LOCATION
- NAVIGATION CHANNEL
- SHORELINE
- UNDERGROUND TRIBUTARY
- PHASE I/PHASE II SI STUDY AREA BOUNDARY

PROPOSED USEPA SUBUNIT

- 1
- 2
- 3
- 4
- 5
- 6

289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306

PORT NEWARK CHANNEL

ELIZABETH CHANNEL

NEWARK BAY CDF (CELL 1S)

SOUTH ELIZABETH CHANNEL

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
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0 1,500 3,000 Feet

GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION

QAPP AMENDMENT

PROPOSED SEDIMENT SAMPLING LOCATIONS - SUBUNIT 3

REVISION 2, SEPTEMBER 2016

FIGURE 5

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
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LEGEND:

- 2005 NEWARK BAY PHASE I SEDIMENT INVESTIGATION
- 2007 NEWARK BAY PHASE II SEDIMENT INVESTIGATION
- 2014 CRAB/CLAM SAMPLING PROGRAM
- 2015 SQT SAMPLING PROGRAM

NEWARK BAY PHASE III SEDIMENT INVESTIGATION

- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION
- GRID POINT PREVIOUSLY SAMPLED (WILL NOT BE SAMPLED AS PART OF PHASE III)
- NAVIGATION CHANNEL
- SHORELINE
- UNDERGROUND TRIBUTARY
- PHASE I/PHASE II SI STUDY AREA BOUNDARY

PROPOSED USEPA SUBUNIT

- 1
- 2
- 3
- 4
- 5
- 6

307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. SHORELINE IS DIGITIZED FROM AERIAL PHOTO DATED JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. THE AREA OF EACH GRID CELL WAS CALCULATED AS DESCRIBED IN USEPA'S GUIDANCE ON CHOOSING A SAMPLING DESIGN FOR ENVIRONMENTAL DATA COLLECTION (EPA/240/R-02/005) DATED DECEMBER 2002. SAMPLE POINTS ARE PLACED IN ALL GRID CELLS WITH AN AREA GREATER THAN 50% OF CALCULATED CELL SIZE.

0 800 1,600 Feet
GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION
QAPP AMENDMENT

PROPOSED SEDIMENT SAMPLING LOCATIONS - SUBUNIT 4

REVISION 2, SEPTEMBER 2016

FIGURE 6

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
Z:\GISPROJECTS_ENV\Tierra\GIS\Task\NBSA\SedimentInvestigation\PhIII\QAPP_Amend\ProposedSedSampLoc_Subunit5_v2.mxd 9/18/2016 7:16:05 PM

LEGEND:

2005 NEWARK BAY PHASE I SEDIMENT INVESTIGATION

2007 NEWARK BAY PHASE II SEDIMENT INVESTIGATION

2014 CRAB/CLAM SAMPLING PROGRAM

2015 SQT SAMPLING PROGRAM

NEWARK BAY PHASE III SEDIMENT INVESTIGATION

PROPOSED PHASE III SEDIMENT SAMPLING LOCATION

GRID POINT PREVIOUSLY SAMPLED
(WILL NOT BE SAMPLED AS PART OF PHASE III)

NAVIGATION CHANNEL

SHORELINE

UNDERGROUND TRIBUTARY

PHASE I/PHASE II SI STUDY AREA BOUNDARY

PROPOSED USEPA SUBUNIT

1

2

3

4

5

6

NEWARK BAY CDF
(CELL 1S)

SOUTH ELIZABETH
CHANNEL

338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. SHORELINE IS DIGITIZED FROM AERIAL PHOTO DATED JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. THE AREA OF EACH GRID CELL WAS CALCULATED AS DESCRIBED IN USEPA'S GUIDANCE ON CHOOSING A SAMPLING DESIGN FOR ENVIRONMENTAL DATA COLLECTION (EPA/240/R-02/005) DATED DECEMBER 2002. SAMPLE POINTS ARE PLACED IN ALL GRID CELLS WITH AN AREA GREATER THAN 50% OF CALCULATED CELL SIZE.

0 1,250 2,500 Feet
GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION
QAPP AMENDMENT

PROPOSED SEDIMENT SAMPLING LOCATIONS - SUBUNIT 5

REVISION 2, SEPTEMBER 2016

FIGURE 7

City: SYR Div/Group: IM/DV Created By: ksinsabaugh Last Saved By: ksinsabaugh
Newark Bay (B0009989.0045.00006)
Z:\GISPROJECTS_ENV\Tierra\GIS\Task\NBSA\SedimentInvestigation\PhIII\QAPP_Amend\ProposedSedSampLoc_Subunit6_v2.mxd 9/18/2016 7:16:25 PM

LEGEND:

- 2005 NEWARK BAY PHASE I SEDIMENT INVESTIGATION
- 2007 NEWARK BAY PHASE II SEDIMENT INVESTIGATION
- 2014 CRAB/CLAM SAMPLING PROGRAM
- 2015 SQT SAMPLING PROGRAM

NEWARK BAY PHASE III SEDIMENT INVESTIGATION

- PROPOSED PHASE III SEDIMENT SAMPLING LOCATION
- GRID POINT PREVIOUSLY SAMPLED (WILL NOT BE SAMPLED AS PART OF PHASE III)
- NAVIGATION CHANNEL
- SHORELINE
- UNDERGROUND TRIBUTARY
- PHASE I/PHASE II SI STUDY AREA BOUNDARY

PROPOSED USEPA SUBUNIT

- 1
- 2
- 3
- 4
- 5
- 6

370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. SHORELINE IS DIGITIZED FROM AERIAL PHOTO DATED JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. THE AREA OF EACH GRID CELL WAS CALCULATED AS DESCRIBED IN USEPA'S GUIDANCE ON CHOOSING A SAMPLING DESIGN FOR ENVIRONMENTAL DATA COLLECTION (EPA/240/R-02/005) DATED DECEMBER 2002. SAMPLE POINTS ARE PLACED IN ALL GRID CELLS WITH AN AREA GREATER THAN 50% OF CALCULATED CELL SIZE.

0 1,000 2,000 Feet
GRAPHIC SCALE

NEWARK BAY STUDY AREA PHASE III
SEDIMENT INVESTIGATION
QAPP AMENDMENT

PROPOSED SEDIMENT SAMPLING LOCATIONS - SUBUNIT 6

REVISION 2, SEPTEMBER 2016

FIGURE 8

Appendix A

QAPP Worksheet #19-1 (UFP-QAPP Manual Section 3.1.2): Analytical SOP Requirements – Blanks

Matrix[a]	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[b]	Sample Volume (mL)[c]	Containers (number and type)[d]	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)[e,f]
Field/Rinse/Passive Sampler Blank	PCDDs/PCDFs	Low	L-1	1 L	1 L, G	4°C	30 days to extraction, 45 days until analysis
Field/Rinse/Passive Sampler Blank	PCB Congeners	Low	L-2	1 L	1 L, G	4°C	30 days to extraction, 40 days until analysis
Field/Rinse/Passive Sampler Blank	TAL Metals, Titanium	Low	L-3, L-29	250	250 mL, P	4°C, HNO_3 to pH <2	6 months
Field/Rinse/Passive Sampler/Trip Blank	Mercury[g]	Low	L-4	500	250 mL, fluoropolymer	4°C	48 hours to preservation, 28 days until analysis
Field/Rinse/Passive Sampler/Trip Blank	Methylmercury[g]	Low	L-5	250	250 mL, fluoropolymer no headspace	4°C	48 hours to preservation, 28 days until analysis
Field/Rinse Blank	Butyltins	Low	L-6	1 L	1 L, G	4ºC	7 days to extraction, 40 days until analysis
Field Blank	Chlorinated Herbicides	Low	L-7	1 L	1 L, G	4ºC	7 days to extraction, 40 days until analysis
Field/Rinse Blank	Semivolatile Organics	Low	L-8	250	250 mL, G	4ºC	7 days to extraction, 40 days until analysis
Field/Rinse/Passive Sampler Blank	Semivolatile Organics SIM	Low	L-9	250	1 L, G	4ºC	7 days to extraction, 40 days until analysis
Field/Rinse Blank	Aroclor PCBs	Low	L-10	1 L	1 L, G	4ºC	7 days to extraction, 40 days until analysis
Field/Rinse/Passive Sampler Blank	Pesticides	Low	L-11	1 L	1 L, G	4ºC	7 days to extraction, 40 days until analysis
Field/Trip Blank	Volatile Organics	Low	L-12	3-40	3x 40 mL vial, G no headspace	4°C, HCl to pH <2	14 days
Field Blank	Cyanide	Low	L-13	250	250 mL, P	4°C, NaOH to pH >12	14 days
Field Blank	TOC	Low	L-14	120	120 mL, G	4°C, H_2SO_4 to pH <2	14 days
Passive Sampler Blank	DOC	Low	L-44	80	120 mL, G	4°C	28 days
Field Blank	TEPH - purgeables	Low	L-33	120	3x 40 mL vial, G no headspace	4°C, HCl to pH <2	14 days
Field Blank	TEPH - extractables/alkanes	Low	L-16	1 L	1 L, G	4°C, HCl to pH <2	7 days to extraction, 40 days until analysis
Field Blank	Hexavalent Chromium	Low	L-17	70	250 mL, P	4°C	24 hours
Field Blank	Total Phosphorus	Low	L-23	500	500 mL, G	4°C, H_2SO_4 to pH <2	24 hours
Field Blank	Total Kjeldahl Nitrogen	Low	L-24	500			
Field/Passive Sampler Blank	Ammonia	Low	L-26	200	500 mL, P	4°C, H_2SO_4 to pH <2	28 days

See the last page of Worksheet #19-1 for a description of footnotes.

QAPP Worksheet #19-1 (UFP-QAPP Manual Section 3.1.2): Analytical SOP Requirements – Field/Rinse/Trip Blanks (continued)

Notes:

[a] Surface water samples are not planned for collection during this sampling program but this worksheet has been provided to describe field, rinse, passive sampler and trip blank sample collection requirements only. The passive sampler blank for organics will be an unused PE and/or POM sampler placed in DI water. The PE and/or POM sampler will be agitated in the DI water for the same amount of time as the PE and/or POM samplers are agitated in the sediment slurry. At the end of the testing period, the PE and/or POM strips will be shipped to the laboratories for chemical analysis. The passive sampler blank for inorganics will be an unused dialysis bag filled with DI water. The DI water will be allowed to sit in the dialysis bag for the same amount of time as the dialysis bags are exposed to the sediment and under the same light and temperature conditions. At the end of the testing period, the dialysis bags filled with DI water will be shipped to the laboratories for chemical analysis.

[b] Analytical methods are as specified in Worksheet #23-1.

[c] These are minimum sample volume requirements for a single sample analysis. Extra volume will be needed in order to fulfill quality control sample requirements, such as matrix spike/matrix spike duplicate and/or to provide contingency volume for analysis or breakage. For glass containers, if additional volume is available, a second container will be sent to provide additional volume.

[d] Samples for analyses having identical container and preservation requirements may be combined in the same container. Similarly, smaller- or larger-sized sample containers than those recommended here may be used as long as the quality, container material, and preservative specifications are met, and the containers or container used will hold sufficient mass/volume to meet the minimum requirements specified.

[e] Holding time is calculated from the date and time of sample collection, to the date and time of sample analysis (or extraction as noted).

[f] Maximum holding times listed are based upon those stipulated in corresponding data validation guidance located in Appendix E of this Sediment Quality Triad and Porewater Sampling and Analysis QAPP.

[g] Samples will be shipped at 4°C to the laboratory via overnight carrier on the same day they are collected. Preservation will occur at the laboratory within the specified holding time (immediately upon receipt) in order to minimize the sources of potential field contamination. Samples will be stored for a minimum of 48 hours at 4°C after preservation and prior to analysis to allow the acid to completely dissolve the metals adsorbed on the container walls.

°C = degrees Celsius
DOC = dissolved organic carbon
G = amber glass
H_2SO_4 = sulfuric acid
HCl = hydrochloric acid
HNO_3 = nitric acid
L = liter
mL = milliliters
NaOH = sodium hydroxide
P = plastic
PCB = polychlorinated biphenyl
PCDDs/PCDFs = polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans
SIM = selective ion monitoring
SOP = standard operating procedure
TAL = Target Analyte List
TEPH = total extractable petroleum hydrocarbons
TOC = total organic carbon

Standard Operating Procedure No. 6

Sediment Sample Collection

September 2016

Revision 2

1. Scope and Application

This standard operating procedure (SOP) describes the collection and field screening, logging, and subsequent sampling of sediment. This SOP is based on and is in general accordance with the methods used on the Lower Passaic River Restoration Project Cooperating Parties Group Quality Assurance Project Plan, Surface Sediment Chemical Analyses and Benthic Invertebrate Toxicity and Bioaccumulation Testing (Windward 2009). The general procedures to be utilized in obtaining sediment samples are outlined below. This SOP should be followed for any collecting, processing, logging, and sampling of sediment.

This SOP may change depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by Tierra Solutions Inc.'s (Tierra's) Facility Coordinator and the U.S. Environmental Protection Agency's Remedial Project Manager. The ultimate procedure employed will be documented in field notebook.

Other SOPs will be utilized with this procedure, including:

- SOP No. 1 – Locating Sample Points Using Global Positioning System
- SOP No. 2 – Positioning
- SOP No. 3 – Decontamination
- SOP No. 4 – Management and Disposal of Residuals
- SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 7 – Measuring Surface Water Quality
- SOP No. 8 – Documenting Field Activities.

In instances where this SOP will be utilized, a hard copy or electronic version will be available at the point of use.

2. Procedure

2.1. Equipment List

The following equipment will be needed during sediment sampling activities:

- personal protective equipment and other safety equipment, as required by the Health and Safety/Contingency Plan, Rev. 1 (HASCP; Tierra 2007)
- sampling vessel adequate for Newark Bay conditions
- marine VHF radio
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices)
- deployment equipment (e.g., winches, generator)
- grab sampler (e.g., Van Veen or equivalent)
- stainless steel bowl/buckets
- 10-20-gallon stainless steel bucket/tub
- stainless steel spoons/spatulas
- mechanical mixer (e.g., portable drill fitted with stainless steel paddle, portable stainless steel cement mixer)
- duct and packing tape
- 1-quart and 1-gallon freezer bags
- tape measure
- fathometer
- global positioning system (GPS)
- Standard No. 30 (600 micron) sieve/sieve bucket
- trowel
- forceps and magnifying glass
- garbage bags
- photoionization detector (PID)
- transport container with ice

- appropriate sample containers, preservative (70-90%)
- labels, and forms
- field notebook
- erasable whiteboard
- permanent waterproof marker or grease pencil
- digital camera.

2.2 Sediment Sampling

1. Don personal protective equipment, as required by the HASCP (Tierra 2007).

2. Navigate to the sampling location in accordance with SOP No 1. – Locating Sample Points Using a Global Positioning System and SOP No. 2 – Positioning.

3. Record water quality readings in accordance with SOP No. 7 – Measuring Surface Water Quality.

4. Collect sediment using grab sampler.

    a. Verify the sampler has been decontaminated in accordance SOP No. 3 – Decontamination.

    b. Secure the grab sampler to a cable of adequate length connected to a winch. In some cases, the grab sampler may be deployed and retrieved manually. Set the device to close upon contact with sediment surface.

    c. Slowly lower the grab sampler into its deployment orientation, just above the water surface. If manually deployed, lower the open sampler from the side of the boat making sure that the end of the rope is secured.

    d. Obtain water depth (to nearest 0.1 foot) from the fathometer and record on the Grab Sample Collection Form.

    e. Slowly lower the grab sampler into the water to the sediment surface using the water depth reading to anticipate when the bottom will be encountered. Allow the device to penetrate the sediment and close, capturing the grab sample.

    f. Record sample location with the GPS.

g. Record the proposed sample location in the field notebook. Location, date, time of collection, and description or surrounding area, as well as a photograph, will be recorded for each sample.

h. Slowly raise the grab sample to the deck of the sampling vessel.

i. Immediately open the sampler top panels. Assess and document the acceptability of the sample:

   i. jaws are completely closed

   ii. sampler achieved target penetration depth and did not over penetrate

   iii. sampler indicates no loss of surficial sediment from inside the sampler

   iv. grab sampler achieved acceptable percent recovery of 75 percent of the target sampling depth of 0-6 inches (4.5 inches). At least three attempts will be made at each location to obtain the target recovery.

      - If hard bottom or an unacceptable percent recovery is encountered at a sampling location, the field crew will probe the sediment bottom around the targeted location (no more than 500 feet from the target coordinates) to locate a more suitable sampling location.

      - If no suitable location can be located, regulatory agency will be contacted to suggest an alternate sampling location.

j. Open the dredge to allow the sediment to empty onto an aluminum foil pan or stainless steel bowl.

k. Immediately collect sediment for analysis of volatile compounds (e.g., volatile organic compounds and acid volatile sulfides/simultaneously extracted metals). Collect these samples prior to collecting the second grab.

l. Photo-document the sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, etc. Photos will include the sample identification, date, and time. The photo will also include a view of a ruler or tape measure for scale.

m. Describe sediment sample according to Unified Soil Classification System and document any other observations, such as, but not limited to, color, type of organic materials present, odor, sheen, and staining.

n. Multiple casts will be made adjacent to one another (consistent with SOP No. 2 – Positioning) and composited at each location until sufficient sample volume is obtained.

o. Set aside three individual replicate grabs in separate buckets/pans for benthic community processing.

p. Composite remaining sediment grabs for chemical, bioaccumulation, porewater, and toxicity processing into decontaminated 10-20-gallon stainless steel bucket.

5. Homogenize sediment samples for chemical, toxicity, bioaccumulation, and porewater analyses.

   a. Prior to homogenization, remove large unrepresentative materials (e.g., stones, shells, twigs).

   b. Mix sediment in 10-20 gallon decontaminated stainless steel bucket with decontaminated mechanical mixer until textural, color, and moisture homogeneity is achieved.

6. Photo-document the sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, etc. Photos will include the sample identification, date, and time. The photo will also include a view of a ruler or tape measure for scale.

7. Describe sediment sample according to Unified Soil Classification System and document any other observations, such as, but not limited to, color, type of organic materials present, odor[1], sheen, and staining.

8. Partition aliquots of homogenized sediment for chemical, toxicity, bioaccumulation, and porewater analyses into appropriate pre-cleaned sample bottles and buckets per SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis

   a. During distribution, periodically mix sediment using a stainless steel spoon or spatula to minimize stratification effects due to differential settling,

9. Sediment samples for benthic community samples will be sieved to isolate the benthic organisms.

[1] Sediment should not be smelled intentionally, due to health and safety concerns. However, if an odor is noted during processing activities, it should be recorded.

a. Empty contents of one replicate into a standard sieve (No. 30) and examine and characterize the substrate composition.

b. After completing the characterization, sieve sediments using bay water over side of boat to isolate material and benthic organisms larger than the sieve size.

c. Hand transfer the sieve contents to a sample jar and preserve in the field using 70-90% isopropyl alcohol.

10. Samples will be packaged and shipped in accordance with the shipping SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

3. Waste Management

Investigative-derived waste generated during the sediment sampling activities and disposable equipment will be transported for off-site disposal in accordance with SOP No. 4 – Management and Disposal of Residuals.

4. Quality Assurance

Field documentation, data reporting requirements, sampling handling, custody requirements, packing, handling, and shipping requirements, including laboratory custody procedures, analytical methods, quality control requirements, and laboratory specific quality assurance/quality control requirements are stated in the Sediment Quality Triad and Porewater Sampling and Analysis Quality Assurance Project Plan (SQT QAPP).

5. Documentation

Documentation of sample handling activities will be conducted in accordance with SOP No. 8 – Documenting Field Activities. Upon collection of sediment samples, the sediment sample should be logged in the field notebook.

Digital photographs of typical sediment types observed at the site and any unusual features should be obtained whenever possible. All photographs should include a ruler or common object for scale. Photo location, depth, and orientation must be recorded in the daily log or field notebook, and a label showing this information in the photo is useful.

6. References

Tierra. 2007. Newark Bay Study Area Remedial Investigation Work Plan [Rev. 1]. Volume 2 Health and Safety/Contingency Plan. September.

Windward. 2009. Lower Passaic River Restoration Project. Quality Assurance Project Plan. Surface Sediment Chemical Analyses and Benthic Invertebrate Toxicity and Bioaccumulation Testing. Final. October 8.

SURFACE SEDIMENT COLLECTION FORM

Project Name: _____ **Project no.:** _____

Date: _____ **Weather:** _____

Sampling Method: _____ **Crew:** _____

GRAB DATA	**Location ID:**			**Vessel Position Number:**	
Latitude/Northing (Y):				**Longitude/Easting (X):**	
Grab Sample Number	**Grab Sample Time**	**Bottom depth**	**Penetration Depth (cm)**	**Acceptable grab (Y/N)**	**Comments:**
SAMPLE DATA	**Sample ID:**				

Analyses needed before homogenization (circle): VOC TEPH-Purgeables Other:

Sediment type	**Sediment color**	**Sediment odor**		**Comments:** (i.e. redox potential discontinuity, organic matter, wood debris, shell fragments, sheen, fauna, field duplicate, etc.)
cobble	brown surface	none	H_2S	
gravel	drab olive	slight	petroleum	
sand (F M C)	brown	moderate	other:	
silt	gray	strong		
clay	black			

Relinquished By _____ Company _____ Date _____ Time _____

Accepted By _____ Company _____ Date _____ Time _____

Appendix B

Standard Operating Procedure No. 10

Sediment Sample Collection Using a Box Core

September 2016

Revision 2

1. Scope and Application

This standard operating procedure (SOP) describes the collection, logging, and sampling of sediment using a box core. This SOP may change depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by Tierra Solutions Inc.'s (Tierra's) Facility Coordinator and the U.S. Environmental Protection Agency's Remedial Project Manager. The ultimate procedure employed will be documented in a field notebook.

Other SOPs will be utilized with this procedure, including:

- SOP No. 1 – Locating Sample Points Using Global Positioning System
- SOP No. 2 – Positioning
- SOP No. 3 – Decontamination
- SOP No. 4 – Management and Disposal of Residuals
- SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 8 – Documenting Field Activities.

In instances where this SOP will be utilized, a hard copy or electronic version will be available at the point of use.

2. Procedure

2.1. Equipment List

The following equipment will be needed during sediment sampling activities:

- personal protective equipment and other safety equipment, as required by the Health and Safety/Contingency Plan, Rev. 1 (HASCP; Tierra 2007)
- sampling vessel adequate for Newark Bay conditions
- marine VHF radio
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices)

- deployment equipment (e.g., winch, generator)
- box core with weights
- stainless steel spoons/spatulas
- decontaminated Lexan coring tube with end caps
- plastic bin
- aluminum foil
- trash bags
- duct tape
- tape measure
- fathometer
- global positioning system (GPS)
- transport container with ice
- sample containers as designated in associated SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- labels and forms
- field notebook
- erasable whiteboard
- permanent waterproof marker or grease pencil
- digital camera
- Daily Activity Log, Box Core Collection Form, and Sample Processing Form
- Paper towels
- Siphon tubing, peristaltic pump, and/or turkey baster

2.2 Sediment Sampling

1. Complete Daily Activity Log (1 per day).

2. Don personal protective equipment, as required by the HASCP (Tierra 2007).

3. Navigate to the sampling location in accordance with SOP No 1. – Locating Sample Points Using a Global Positioning System and SOP No. 2 – Positioning.

4. Collect sediment using box core.

    a. Obtain water depth (to nearest 0.1 foot) from the fathometer and record on the Box Core Collection Form.

    b. Secure the box core to a cable of adequate length connected to a winch. Set the device to close upon contact with sediment surface.

    c. Slowly lower the box core into the water to the sediment surface using the water depth reading to anticipate when the bottom will be encountered. Allow the device to penetrate the sediment and close, capturing the sediment sample.

    d. Record final sample location using the GPS.

    e. Record the sample location and associated details in the field notebook. Location, date, time of collection, and description of surrounding area will be recorded for each sample.

    f. Slowly raise the box core to the deck of the sampling vessel.

    g. Following retrieval of the box core onto the sampling vessel, open the sampler top panels. Assess and document the acceptability of the sample:

        i. Jaws are completely closed.

        ii. Sampler achieved target penetration depth (6 inches) and did not over penetrate (i.e., overlying water is present, the sediment surface is not touching the top of the sampler, and sediment is not present on the top of the sampler).

        iii. Contents of sampler indicate no loss of surficial sediment from inside the sampler (e.g., no signs of washout).

        iv. Acceptable box core recovery is 75 percent of the target sampling depth of 0-6 inches (4.5 inches). At least three attempts will be made at each location to obtain the target recovery.

5. Remove the standing surface water by siphoning with tubing primed with site water or with a peristaltic pump or with a turkey baster. Take extra precaution to not disturb the sediment-water interface as surface water is removed.

6. Immediately collect sediment from the center of the box core for analysis of volatile compounds (e.g., volatile organic compounds, TEPH-purgeables, and acid volatile sulfides/simultaneously extracted metals [AVS/SEM]). Collect these samples prior to collecting the direct-push cores.

7. Collect 6-inch direct-push core manually by inserting individual Lexan core tubes into the sediment in the box core.

    a. Gently place Lexan core tube vertically on top of the sediment.

    b. Slowly push the coring tube, with straight, vertical entry, into the sediment until the targeted core depth is reached (or refusal).

    c. Measure and record the penetration depth on the Box Core Collection Form.

    d. Seal the top of the core tube by placing a core cap on the top to establish hydrostatic pressure within the barrel.

    e. Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

    f. Immediately after the bottom of the coring tube breaks the sediment surface, place a cap over the bottom to prevent the loss of material from the core tube.

    g. If the top cap does not provide sufficient pressure to retain the sediment in the core tube:

        i. Place a plastic bin under the box core.

        ii. Lower the box core so it is close to the bottom of the plastic bin.

        iii. Tip the box core 90 degrees to a horizontal position and lay it inside the plastic bin.

        iv. Open the jaws of the box core.

        v. Clear the sediment away from the bottom of the core with a stainless steel spoon until the bottom of the core is exposed.

        vi. Push the core through the sediment from the top to expose enough of the core liner to place the cap on the bottom of the core liner.

vii. Pull the capped core out of the box core.

h. Clean the core tube and plastic bin (if used) on the vessel by hosing it down with Newark Bay water. Dispose of used aluminum foil in trash bags for disposal in accordance with SOP No. 4 – Management and Disposal of Residuals.

i. Dry the outside of the core tube with paper towels. Secure the bottom and top caps with duct tape, and draw an arrow toward the top cap. Label "top" to indicate the top of the core. Label the core with the location ID, core number, date, and time, and record this information on the Box Core Collection Form.

j. Measure the recovered length of the sediment in the core tube (to the nearest 0.1 foot to the extent possible) and record it on the Box Core Collection Form. The distance between the top of the sediment in the coring tube and the bottom of the coring tube corresponds to the recovered length. The recovered core length may be less than the depth that the core was pushed, as a result of compaction. If this is the case, recovered core lengths less than the depth pushed will be acceptable. The recovered core length may also be less than the depth that the core was pushed because of a poor seal on the bottom core cap, resulting in sediment falling out of the core tube. If the field staff observe this situation, recovered core lengths less than the depth pushed will not be acceptable. In this instance, the location will be re-sampled.

k. Store the core vertically in a cooler while on the vessel until it can be transported to the Sample Processing Area.

l. Repeat steps a through j until a sufficient number of cores have been collected to meet analytical mass requirements as defined in Section 4.2 of the Phase III QAPP.

m. Multiple casts may be made adjacent to one another (consistent with SOP No. 2 – Positioning) until sufficient sample mass is obtained.

8. Transport cores from the sampling vessel to the Sample Processing Area and store in a dark, chilled location (cooler(s) or walk-in refrigerator).

9. Once in the Sample Processing Area, homogenize sediment samples from cores for chemical analyses.

a. Retrieve all cores for a given sampling location from the onsite cooler.

b. Photograph each core tube. Photos will include the location ID, core number, date, and time. The photo will also include a view of a ruler or tape measure for scale.

c. Empty contents of cores for a given location into a stainless steel mixing container.

d. Describe sediment sample according to Unified Soil Classification System and document any other observations, such as, but not limited to, color, type of organic materials present, odor[1], sheen, and staining.

e. Photograph the pre-homogenized sediment. Photos will include the sample identification, date, and time. The photo will also include a view of a ruler or tape measure for scale.

f. Remove large unrepresentative materials (e.g., stones, shells, twigs).

g. Mix sediment in decontaminated stainless steel container with decontaminated mixing tool until textural, color, and moisture homogeneity is achieved.

h. Photograph the post-homogenized sediment. Photos will include the sample identification, date, and time. The photo will also include a view of a ruler or tape measure for scale.

10. Partition aliquots of homogenized sediment for chemical analyses into appropriate pre-cleaned sample bottles per SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

    a. During distribution, periodically mix sediment using a stainless steel spoon or spatula to minimize stratification effects due to differential settling.

11. Samples will be packaged and shipped in accordance with the shipping SOP No. 5 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

3. Waste Management

Investigative-derived waste (IDW) sediment generated during sediment collection and processing activities and disposable equipment will be containerized and transported for off-site disposal in accordance with SOP No. 4 – Management and Disposal of Residuals.

[1] Sediment should not be smelled intentionally, due to health and safety concerns. However, if an odor is noted during processing activities, it should be recorded.

4. Quality Assurance

Field documentation, data reporting requirements, sample handling, custody requirements, packing, handling, and shipping requirements, including laboratory custody procedures, analytical methods, quality control requirements, and laboratory-specific quality assurance/quality control requirements are stated in the Sediment Quality Triad and Porewater Sampling and Analysis Quality Assurance Project Plan (SQT QAPP).

5. Documentation

Documentation of sample handling activities will be performed in accordance with SOP No. 8 – Documenting Field Activities of the SQT QAPP (Tierra 2015). Upon collection of sediment samples, the sediment sample should be logged in the field notebook.

Digital photographs of typical sediment types observed at the site and any unusual features should be obtained whenever possible. If needed, all photographs should include a ruler or common object for scale. Photo location, depth, and orientation must be recorded in the daily log or field notebook, and a label showing this information in the photo is useful.

6. References

Tierra. 2007. Newark Bay Study Area Remedial Investigation Work Plan [Rev. 1]. Volume 2 Health and Safety/Contingency Plan. September.

Tierra. 2015. Newark Bay Study Area Sediment Quality Triad and Porewater Sampling and Analysis Quality Assurance Project Plan, Revision 2. Tierra Solutions, Inc. East Brunswick, New Jersey. August.

DAILY ACTIVITY LOG
(Sheet 1 of 2)

I.	Date: _____			
II.	Vessel Name: _____			
III.	Personnel (Name/Affiliation/Role): _____ _____ _____ _____			
IV.	Equipment on Board:			
		Name/Type	Model No.	Serial No.
	Sampling Device:			
	DGPS:			
	Fathometer:			
	Other:			
	Other:			
V.	Weather Forecast Checked?: Yes No Describe Weather:			
VI.	Time of High Tide? Time of Low Tide?			

DAILY ACTIVITY LOG
(Sheet 2 of 2)

VII.	Date:
VIII.	Health and Safety Briefing Topic:
IX.	Notification:

Agency	Contact	Time (24-hour)

X.	Time of Departure from Marina: (24-hour)
XI.	Time of Return to Marina: (24-hour)
XII.	Name of Person Responsible for Log:

BOX CORE COLLECTION FORM

Project Name:_____ Project no.: _____

Date: _____ Weather: _____

Sampling Method: _____ Crew: _____

BOX CORE DATA	**Location ID:**				
Latitude/Northing (Y):				**Longitude/Easting (X):**	
Box Core Attempt Number	**Box Core Collection Time**	**Water Depth (ft)**	**Box Core Penetration Depth (inches)**	**Acceptable Box Core? (Yes/No)**	**Comments**

Core Number	**Box Core Attempt Number (see above)**	**Core Collection Time**	**Core Penetration Depth (inches)**	**Core Recovery Length (inches)**	**Apparent Gaps**

SAMPLE DATA	**Sample ID:**		
Analyses needed before homogenization (circle): VOC TEPH-Purgeables Other:			
Sediment Type cobble gravel sand (F M C) silt clay	**Sediment Color** brown surface drab olive brown gray black	**Sediment Odor** (i.e., none, H_2S, petroleum, etc.)	**Comments** (i.e. redox potential discontinuity, organic matter, wood debris, shell fragments, sheen, fauna, field duplicate, etc.)

Relinquished By_____ Company _____Date_____Time_____

Accepted By_____ Company _____Date_____Time_____

Surface Sediment Sample Processing Form

Date: _____ Time Cores Removed from Cooler: _____

Location ID: _____

Number of Cores to Homogenize: _____

Core Photographs:

Core Number	Photograph Number	Date Photographed	Time Photographed

Pre-Mixing Description of Sediment: _____

_____

_____

Photograph (pre-mixing):

Number: _____ Date: _____ Time: _____

Mixer:

Mixer Used? Y / N Time on: _____ Time off: _____

Homogeneity Achieved? Y / N

Post-Mixing Description of Sediment: _____

_____

Photograph (post- mixing):

Number: _____ Date: _____ Time: _____

Notes (i.e., PE samples, EPA split samples, field duplicate, MS/MSD, etc.): _____

_____

_____

_____

_____

_____

Person Responsible for Completing Form: _____