Lower Passaic River Restoration Project

Draft Sampling Plan for Summer/Fall 2004

June 15, 2004

Malcolm Pirnie, Inc.

Developed in association with

HydroQual Inc.
Battelle

Section 1
Introduction

1.1 Purpose

The purpose of this plan is to describe the 2004-2005 hydrodynamic sampling that will be conducted in the Lower Passaic River and provide guidance for the proposed field work through detailed descriptions of the sampling and data gathering methods. Initially, hydrodynamic sampling that focuses on the Harrison Reach was proposed by Rutgers University and the U.S. Geological Survey (USGS) to aid the N.J. Department of Transportation - Office of Maritime Research (NJDOT-OMR) in the implementation of a pilot dredge study planned by NJDOT-OMR for 2005. According to the Rutgers and USGS 2004 proposal, Characterizing the circulation and dispersive nature of the Passaic River and its dependence on river discharge and tidal range: elucidation of major processes that determine the impact of the proposed Passaic River dredging project, the purpose of NJDOT-OMR's investigation is to "characterize the aspects of the circulation and dispersive nature of the Passaic and describe how these processes change with tidal range and river discharge."

This same type of information is also needed by the Superfund project team, led by the U.S. Environmental Protection Agency (USEPA) Region 2, for the entire 17-mile tidal stretch of the Lower Passaic River. Therefore, two studies that complement each other, one through NJDOT-OMR and the other through the Superfund project team are proposed. This document discusses the data to be collected through both studies and provides details on the Superfund sampling.

1.2 Objective

One of the primary objectives for the Lower Passaic River Remedial Investigation and Feasibility Study (RI/FS) is to develop and apply a scientifically-based model that specifically incorporates hydrodynamic transport, sediment transport, contaminant fate and transport and bioaccumulation processes. This model will be used as a tool for understanding historical and current sources and sinks of organic and inorganic contaminants in the Passaic River and adjacent water bodies through mass balance analyses, as well as provide the basis for an engineering evaluation of potential remedial scenarios. To support this objective, it is necessary to monitor the river under both long-term and specific short-term (*e.g.*, during high-flow storm events) conditions to provide the data for model calibration and for comparison with the model predictions so that model performance can be made representative of the actual system conditions. This will allow the model to be used to simulate alternative scenarios within the system under both existing and hypothetical future conditions.

Large modeling projects require extensive parameter estimation as well as extension and extrapolation of the available data. The 2004 monitoring program is intended to collect key data required to support the modeling effort. While some of the data collected will provide information on the long-term time series of hydrodynamic and suspended sediment concentrations, other data, like those obtained from experimental and field efforts on sediments deposition and erosion characteristics, will be used primarily for calibration of sediment parameters. In general, the greater the number of monitored locations and the frequency of data collection, the more closely the model can be made to replicate actual measured conditions. In addition, a geotechnical coring program will be conducted to gather information on sediment stratigraphy in the Lower Passaic River to plan future High Resolution and Low Resolution Coring efforts.

To meet these objectives, the proposed hydrodynamic sampling program will:

- Objective 1 - Provide a baseline data set within the estuary for calibrating and assessing the skill of the hydrodynamic components of the proposed Lower Passaic River Model.
- Objective 2 - Determine sediment erosion and deposition to characterize model parameters.

- Objective 3 - Provide baseline data for characterizing the discharge and loads of suspended solids over the Dundee Dam, a boundary condition for the Lower Passaic River Model.
- Objective 4 - Provide current bathymetric survey data to further characterize sediment mobility, aid in future sediment sampling and risk assessment investigation and provide a dataset for comparison to previous surveys.
- Objective 5 - Determine the processes controlling the short-term fate and transport of particles[1] within the estuary, especially at the estuarine turbidity maximum (ETM).
- Objective 6 - Determine the variability in total suspended solids (TSS), particulate organic carbon (POC), and grain size, under varying tidal conditions, upstream river discharge, and stratification.
- Objective 7 – Determine the sediment stratigraphy by advancing sediment cores initially every ½-mile and visually classifying the retrieved sediment. Physical properties analyses of collected sediment samples may be included in this program following consultation with USACE and USEPA.

Formatted: Bullets and Numbering

1.3 Sampling Scope

1.3.1 NJDOT-OMR Dredge Pilot Hydrodynamic Study

The **NJDOT-OMR** Dredge Pilot Hydrodynamic Study proposed by Robert Chant, Rutgers University and Tim Wilson, USGS, which will mainly cover areas down-estuary of the Harrison Reach (approximately river mile (RM) 4.4), will meet their study objectives through the following work:

- Installation of long-term moorings in the Passaic River and shipboard surveys to characterize the salinity and sediment structure of the River over a range of river

[1] Several of the important contaminants of potential concern (COPCs) in the Lower Passaic River (*e.g.*, dioxin, polychlorinated biphenyls (PCBs), mercury) are associated with particles. Various processes affect the total suspended sediment (TSS) concentrations in estuaries in time scales that vary from seconds to years. These processes include, but are not limited to, turbulence, tidal circulation, wind waves, freshwater discharge, and climate.

flow conditions. The fixed stations are expected to remain in place for a year from approximately June 2004 through June 2005. The discrete sample monitoring is expected to occur from June 2004 through June 2005.

- Detailed tidal cycle surveys in the Harrison Reach to characterize the spatial structure of currents, total suspended sediment, stratification and bottom shear stress in the vicinity of the pilot dredging study
- A dye study to quantify the dispersive nature of material released into the water column in the Harrison Reach of the river.

1.3.2 Superfund Study

The Superfund monitoring program will cover all five reaches that encompass the 17-mile tidal portion of the Lower Passaic River and will not duplicate the sampling conducted for NJDOT-OMR. The Superfund team's surveys and discrete sampling are expected to occur from October through November 2004 and, to the extent possible, the NJDOT-OMR and Malcolm Pirnie sampling efforts will complement each other. The activities that will be implemented to achieve the Superfund program objectives are listed in Section 2 below.

Section 2
Detailed Sampling Tasks and Procedures

2.1 Sampling Activities

During the fall 2004 Superfund monitoring program, the following sampling activities will be conducted:

- Moored instrumentation will be installed at fixed stations within each reach of the river to monitor turbidity, temperature, velocity, depth, conductivity. This activity will be required for Objectives 1 and 6.
- Shipboard and cross-sectional surveys will be conducted to monitor turbidity, temperature, velocity, depth, and conductivity, as well as to collect water samples for TSS, VSS, POC, beryllium-7 (Be-7) and thorium-234 (Th-234) analyses at different river flows, precipitation events and tidal ranges. This activity will be required for Objectives 1, 5 and 6. Note that studies in estuarine systems (Ciffroy et al., 2003; Feng et al. 1999a, 1999b) have suggested that naturally-occurring radionuclides that associate strongly with particles (*e.g.* Be-7 and Th-234) are useful tracers of the processes affecting particle dynamics within estuaries. A description of the use of these naturally-occurring radionuclides as particle tracers can be found in Appendix A.
- A gauging station will be installed above the Dundee Dam to monitor river discharge and collect samples for water quality analyses including: TSS/volatile suspended solid (VSS), POC, grain size, Be-7 and Th-234. This activity will be required for Objectives 3 and 5.
- Surface sediment samples will be collected for Be-7 and Th-234 analyses. This activity will be required for Objective 5.
- Special sediment characterization studies will be performed to characterize resuspension and deposition. This activity will be required for Objective 2.
- A bathymetric survey will be conducted for the entire 17-mile stretch. This activity will be required for Objective 4.

- A geotechnical coring program will be conducted for the portions of the entire 17-mile stretch that can be navigated by a vibracoring vessel. This activity will be required for Objective 7.

Formatted: Bullets and Numbering

A detailed description of the field work and sampling activities are presented below. The Standard Operating Procedures (SOPs) that are applicable to the field work are provided in Appendix B. Note that the grain size analysis mentioned in this monitoring plan refers to a rapid particle classification as cohesive (less than 62.5 µm) and non-cohesive (greater than 62.5 µm) fractions. The number of samples and analyses for each activity described below are summarized in Table 1.

2.2 Surface Water Monitoring At Moored Stations

The continuous monitoring using moored instrumentation installed at fixed stations within each reach of the Lower Passaic River, which will result in fixed-point time series of a variety of model calibration and evaluation data, including current velocities and directions, salinity, temperature and suspended sediment concentrations will be required to meet parts of objectives 1 and 6 given in Section 1.2. The activities of **NJDOT-OMR** and the Superfund team needed to achieve to conduct surface water monitoring at moored stations are summarized below.

2.2.1 NJDOT-OMR Activities

Based on the Rutgers/USGS final proposal (2004), **NJDOT-OMR** will install an array of six moorings (Figure 1). Two of these moorings will be deployed in the Harrison reach, one located in the deep channel, and the second on the shoaling southern flank. Each of these two moorings will contain an Acoustic Doppler Current Profiler (ADCP), surface and bottom conductivity/temperature (CT) sensors, and a bottom optical backscatter sensor (OBS). The other four moorings will contain surface- and bottom-mounted CT sensors. In addition, the farthest upstream and downstream moorings will each contain OBS sensors and paroscientific pressure sensors that are accurate to a few millimeters. The pressure sensors will provide estimates of along-river pressure gradients that, together with time-series of velocity measurements from the central array, can be used to provide bulk estimates of bottom shear stress, which will be useful for modeling efforts. The ADCPs will obtain estimates of current velocity in 25 cm bins at a temporal resolution of 15-30 minutes. The ADCP also records the acoustic backscatter that can be calibrated against the measured suspended sediment from bottle samples to provide high-resolution estimates of total suspended sediment.

NJDOT-OMR proposes two mooring deployments. The first is expected to run from late summer to late fall to capture both circulation during the low flow summer conditions and the increased river discharge rates that occur in the fall. The second deployment will cover the late winter/early spring to catch the spring freshet. In conjunction with these moorings, NJDOT-OMR plans to collect a single vertical profile of suspended sediment, total dissolved salt, conductivity, and water density in the vicinity of each mooring - once when the moorings are deployed and again when retrieved. As per the request of the Superfund team, the NJDOT-OMR TSS samples will also be analyzed for VSS. Up to 10 samples will be collected at 1 meter intervals. The data provided by these samples will document the calibration of the instrumentation. The maximum total number of samples collected for the mooring work is estimated at 240.

2.2.2 Superfund Team Activities

The **NJDOT-OMR** mooring installations end in the Newark Reach. Since information on hydrodynamics and sediment transport in the entire 17-mile tidal system is needed, the Superfund team will install 3 moorings in the following up-estuary areas: 1) one station between the Dundee Dam and the Third River; 2) one station between the Third River and the Second River, and; 3) one station in the Kearny Reach (see Figure 1). The Superfund team also expects that a fourth monitoring station will be installed in Newark Bay by Tierra Solutions, Inc. (TSI). The Superfund mooring stations will contain: (i) a surface and a bottom OBS unit that monitors turbidity (ii) surface and bottom CT sensors, with the surface sensors approximately 1meter below water surface and the bottom sensors approximately1 meter above the sediment (Kearny Reach and Newark Bay stations only); and (iii) an ADCP that monitors the water column current profile for all stations. During the deployment and retrieval of these moorings, the Superfund team will collect a single vertical profile of 10 1-Liter bottle samples at approximately 1 meter intervals, in the vicinity of each mooring. The total expected number of samples is 60 and each will be analyzed for TSS, VSS, and conductivity.

SOPs for collecting water samples for TSS, VSS and conductivity are provided in Appendix B.

2.3 Discrete Surface Water Sampling During CTD Shipboard Surveys

Data will be collected during shipboard surveys to supplement the data obtained from the moorings, as well as to:

- Characterize the strength of the two-layer flow in the tidal Passaic River
- Delineate the location of the salt wedge and the stratification as a function of river flow
- Identify the physical and chemical processes affecting the short-term particle transport and deposition
- Provide data to test the skill of the planned hydrodynamic model simulation of the Lower Passaic River

The activities of NJDOT-OMR and the Superfund team during the CTD surveys are summarized below.

2.3.1 NJDOT-OMR Activities

From June 2004 through June 2005, NJDOT-OMR will run approximately 12 CTD surveys beginning in Newark Bay and ending either at the head of salt or as far as the river is navigable. NJDOT-OMR will attempt to procure a low-clearance vessel so that, combined with operating at low tide, navigation will be possible in the upper reaches of the Lower River where bridge clearance can be less than 8 feet. They will select dates that cover a range of river discharges with emphasis on high-discharge conditions. Salinity will be measured with an OS-200 CTD probe that obtains estimates of salinity, temperature and pressure at a rate of 6 Hz. CTD casts will be made at approximately 1-km intervals in the river. The CTD will be mated with an OBS to characterize the suspended sediment concentration. Within each CTD section, approximately 10 1-liter bottle samples will be collected to calibrate the OBS sensor. In addition, NJDOT-OMR will sample the river water to determine the suspended sediment and salinity distribution in detail. At approximately 1-km intervals, one vertical profile will be sampled at four depths to characterize the particulate and salt distribution across the river. Samples will be collected at 1 meter below the surface, 1 meter above the bottom, and at 2 locations through the mid-range depth. The mid-river vertical profile will be made in the vicinity of the CTD tow, allowing the data to be used for instrument calibration as well as river characterization. Samples will be measured for suspended sediment, total dissolved salts, and conductivity. The total number of sampling locations for this objective is 960. A subsection of these samples will also be measured for density in the USGS District Laboratory.

The Superfund team has requested that NJDOT-OMR collect water samples during the CTD surveys for POC and grain size analysis. It is assumed that POC samples will be collected during the first two CTD surveys (approximately 50 samples), while grain size will be collected under different discharge conditions during any two CTD surveys (approximately 40 samples). The POC and grain size samples will be analyzed by the Superfund team. The TSS samples collected by NJDOT-OMR will also be analyzed for VSS by the USEPA Edison Lab.

2.3.2 Superfund Team Activities

The Superfund team will be involved in three separate activities including: (i) extending the CTD surveys up-estuary of the NJDOT-OMR CTD survey, (ii) collecting suspended particulates samples for radionuclides analysis along the longitudinal axis of the estuary and, (iii) collecting suspended particulate samples for radionuclides analysis at the ETM.

It is assumed that that the NJDOT-OMR CTD survey will likely end at approximately River Mile (RM) 12 because of a low bridge in this vicinity. To provide complete characterization of the 17-mile Lower River, the Superfund team will complement the NJDOT-OMR CTD surveys by conducting approximately 10 CTD surveys and collecting vertical profiles of water samples at approximately 1-mile intervals starting at Ackerman Bridge (approximately RM 16) and ending at RM 12. The Superfund team will collect water samples at 1 meter below the surface and 1 meter above the bottom at four stations per cross-section for TSS/VSS and conductivity analyses (80 samples). Approximately 16 water samples will be collected for grain size analysis.

During three of the CTD surveys, the Superfund team will collect large suspended particle samples in the vicinity of each mooring for radionuclide (Be-7 and Th-234) analysis. The samples will be collected by filtering large-volume water samples (from 200 to 1500 L, depending on location) using protocols described in Feng *et al.* (1999a) and summarized in Appendix B. Samples will be collected at two depth intervals: surface (approximately 1 meter below surface) and near-bottom (approximately 1 meter above bottom) using a boat-powered pumping system. The pumped water will be filtered to obtain approximately 5 to 15 grams of suspended sediment for analysis. Since this process may require up to two hours, the Superfund team will also collect separate aliquots of 500-ml water samples at the beginning and at the end of pumping at each station for TSS and conductivity analysis. These 500-mL samples will provide information on the changes in the water column properties during the pumping process. The analysis of this data will be in accordance with Feng *at al.* (1999b). The total number of suspended particulate samples for radionuclide analyses is expected to be 48; 96 water samples will be collected for TSS and conductivity analyses.

In an effort to understand the dynamics and sources of particles to the ETM, the Superfund team will also set up a cross-section of three stations in the ETM and collect large-volume water samples for analysis of suspended particle radionuclides (Be-7 and Th-234). Sampling will be conducted over the course of several tidal cycles in the ETM, with the three stations being sampled on three successive days [make clear 1 station per day]. The suspended particles will be collected approximately 6 to 8 times per day, at two depth intervals: surface (approximately 1 meter below the surface) and near bottom (approximately 1 meter above the bottom). Protocols for collecting these samples are provided in Appendix B. The analysis of this data will be performed in accordance with Feng *et al.* (1999b). The maximum number of samples to be collected for radionuclide analysis is 48; 96 water samples will be collected for TSS and conductivity.

2.4 Discrete Surface Water Sampling During Cross-Section Ship-Track Surveys

Most of the activities above focus on sampling along the main channel, with little consideration to cross-sectional variability. Cross-sectional surveys and sampling are important as they provide information on cross-channel circulation, especially along river bends. They also provide water quality cross-sectional distribution data that will be useful in assessing the model's capability to simulate observed vertical and cross-channel shears in the flow. Assessment of the model's capability to adequately simulate vertical and cross-channel shears in flow is critical since vertical and horizontal shears drive dispersion in a tidal riverine system (Rutgers/USGS Proposal, 2004; Taylor, 1951; Wilson and Okubo, 1975; Smith, 1976; Fischer, 1978). Cross-sectional ship track survey activities by NJDOT-OMR and the Superfund team are outlined below.

2.4.1 NJDOT-OMR Activities

NJDOT-OMR proposes a total of four days of shipboard surveys to characterize the tidal currents. This field work will occur in the late summer/early fall of 2004, with two of the shipboard surveys conducted during neap tide conditions and two surveys conducted during spring tide conditions. NJDOT-OMR will complete the sections shown in Figure 2 approximately once every hour over an 8-12 hour period. By fitting tidal period harmonics to time series of currents observed at grids along this track NJDOT-OMR will generate a detailed model of tidal currents in this reach during neap tide and spring tide conditions. NJDOT-OMR anticipates spending approximately 3 minutes surveying each 100-meter section to generate currents with resolution of approximately 10 meters in the cross-stream direction and 25-cm in the vertical. This would provide a more spatially detailed view of the tidal and subtidal motion in the Harrison Reach than provided by the moorings. In conjunction with these cross-sectional tidal current surveys NJDOT-OMR proposes to also characterize the cross sectional distribution of suspended sediment and dissolved salt in this reach of the river. During the shipboard surveys, samples will be collected at each cross section in a grid of three verticals at three depths (1 meter below surface, one meter above bottom, and mid section, 9 samples total per cross section). These samples will be analyzed for suspended sediment, dissolved salt, and conductivity. Approximately 470 samples will be collected.

During one of the shipboard surveys, the Superfund team has requested that NJDOT-OMR collect water samples for grain size (18 samples) along one cross-section in the Point No Point Reach and one cross-section along the Harrison Reach. Because the NJDOT-OMR TSS analysis will be done by the EPA Edison Lab, the Superfund Team has also requested that the TSS samples be analyzed for VSS.

2.4.2 Superfund Team Activities

Due to the limited extent of the NJDOT-OMR cross-section survey, the Superfund team will expand the cross-section surveys to areas up-estuary of the Harrison Reach. On two days during neap tides and two days during spring tides the Superfund team will conduct ship board surveys starting from approximately RM 5 up to the Ackerman Bridge, monitoring currents using an ADCP and collecting water samples along river sections spaced approximately 1 mile apart (12 cross-sections). At each cross-section, the Superfund team will: (i) use an ADCP to generate currents with resolution of approximately 10 meters in the cross-stream direction and 25-cm in the vertical, and (ii) collect water on a grid of three verticals at two depths (1 meter below surface and 1 meter above bottom) for TSS/VSS, and conductivity analysis (264 samples).

During one of the shipboard surveys, the Superfund team will collect additional water samples for grain size analysis along one cross-section in the Newark Reach, one cross-section in the Kearny Reach and two cross-sections in the Upstream Reach. Each cross-section will consist of a grid of three verticals at two depths (1 meter below surface and 1 meter above bottom) for a total 24 samples.

2.5 Monitoring Gauge and Water Quality at Dundee Dam

It is important to accurately quantify the flux of contaminants over Dundee Dam because Dundee Dam is a boundary condition for the proposed Superfund hydrodynamic and sediment transport model for Passaic River. The Superfund team and the EPA will work with the USGS to set up a temporary gauging station just above the dam, to quantify the discharge over the dam. In addition, this station will be used to collect surface water samples, under varying flow conditions, for TSS, VSS, grain size and POC analyses. The details of this monitoring are yet to be finalized.

2.6 Surface Sediment Sampling

Collection of surficial sediment samples will be conducted by the Superfund Team only. To compare the radionuclide activities in the water column relative to that in surface sediments, surface sediments samples (0 to 0.5 cm) will be collected by the Superfund field team in the vicinity of the moorings where water samples are collected for the radionuclide analysis (approximately 9 samples), as well as along the cross section of the

ETM (approximately 3 samples). The SOP for collecting surface sediments is given in Appendix B. The sediments will be analyzed for Be-7 and Th-234 along with grain size.

2.7 Special Sediment Studies

To enhance the models ability to simulate sediment transport, the Superfund team will conduct special sediment studies in 2004. This work will be carried out by the Chesapeake Biogeochemical Associates (http://www.fastol.com/~cba/Home.htm), located in Sharptown, Maryland, in association with the Superfund team. The Chesapeake Biogeochemical Associates proposes to carry out a 3-day field sampling program in the Passaic River during the late summer and early fall of 2004, providing data to support of the Superfund's effort to characterize sediment and contaminant transport in the Passaic. During this 3-day field program, sediment cores will be collected at 3 sites in the Passaic River for characterization of recent sedimentation rates and patterns using lead-210 (Pb-210) techniques and for erosion rates using a Gust Microcosm erosion testing device. Water column suspended particle samples will also be collected at 3 sites for settling velocity analysis using a Modified Valeport Settling Tube (Owen-type bottom withdrawal settling tube). The sampling locations will be chosen in consultation with EPA/USACE and with scientists conducting the NJDOT-OMR monitoring program, but will most likely include locations in the Lower Passaic near Newark Bay, in the Harrison Reach, and in fresh waters upstream. Sediment samples will also be collected for erosion testing using the HydroQual, Inc. Particle Entrainment Simulator (PES), and a direct comparison between the PES and the microcosm results will be made. Additional sediment samples will be collected for later laboratory testing with the PES to determine changes (increases) in erosion resistance with time following sediment disturbance.

The Pb-210 profiles will be measured over 15 depths in the top 40-50 cm of sediment from box cores collected using a small, easily deployable plastic box corer, which works very well for collecting intact undisturbed sediments. Sub-cores of box cores selected for their preservation of the sediment-water interface will be run in duplicate in the Gust Microcosm to test for changes in sediment erodibility and erosion rate over the range of

0-0.4 Pa applied shear stress, levels characteristic of typical tidal cycles in the Passaic. The Superfund team will follow typical erosion testing protocol, increasing shear stress through approximately 8 levels, with each level of constant stress lasting approximately 20 minutes. The data will be analyzed using the method of Sanford and Maa (2001). Similar erosion testing protocols will be followed with the HydroQual PES during the field program. Laboratory work with the PES will involve production of a sediment-water slurry using Passaic River water and the field collected sediment samples, which will be allowed to consolidate for periods of 1, 4, and 7 days before erosion testing. Settling velocity testing will be carried out on suspended sediment samples collected using the Valeport settling tube, following protocols described in Sanford *et al.* (2001).

2.8 Bathymetric Survey of River Bottom

The Superfund Team will conduct a bathymetric survey of the entire 17-mile stretch of the study area. This data will provide addition information to the modelers on sediment stability, and can be compared to historical surveys done at this site. The bathymetric survey will be conducted using a survey vessel and an Innerspace 455, 200 KHz single-beam survey grade fathometer for this work. The bathymetry shall be referenced to NGVD 29. The survey will be conducted using 100-foot lanes and its accuracy will be greater than or equal to +/- 0.5 feet. Approximately eight vertical controls will be established over the length of the river to complete the survey.

There are 20 bridges that cross the Passaic over the 17 mile survey area. There will be GPS multi-path errors, possibly at every bridge. As much as 500-1000 feet of coverage could be lost on each side of these bridges. This will be corrected by the use of Total Station. Following the completion of the survey work, the data will be reviewed and a determination will be made about multi-path errors around each bridge. A secondary survey will then be conducted using a Total Station setup to recollect data in those areas.

The survey team will use a Trimble real time kinematic (RTK) GPS capable of repeatable centimeter accuracy for navigation control and positioning while conducting the survey.

Positioning data will be collected in NJ State Plan NAD 83 and sent to a computer running Coastal Oceanographics Hypack Max software for survey control, ship positioning, and data acquisition. Positioning data will be collected every second while conducting surveys. Survey lines will run perpendicular to the riverbank.

The Superfund team will coordinate this effort with a USACE bathymetric survey on the navigable portion of the river that is expected to occur in summer 2004.

2.9 Geotechnical Coring Program

Deleted: ¶

Formatted: Justified, Line spacing: 1.5 lines

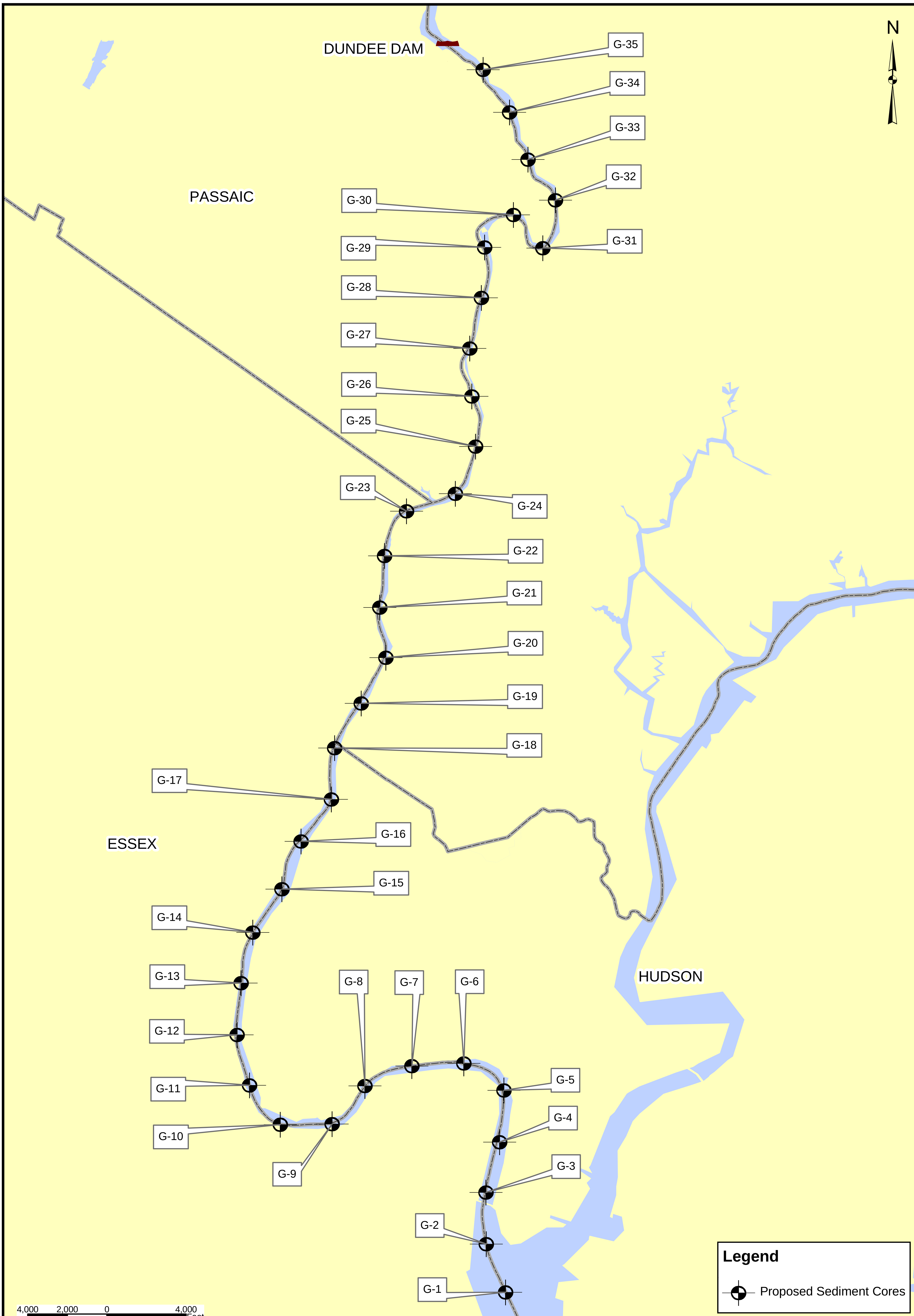
The Superfund team will conduct a geotechnical coring program over the portions of the entire 17-mile stretch that are navigable by a vibracoring vessel. Sediment cores will be collected initially every ½-mile from the mouth of the Lower Passaic River to the vicinity of the Dundee Dam, for a total of 35 cores. If available, geophysical data collected via WRDA efforts (side scan sonar and sub-bottom profiling) will be used to refine the selection of geotechnical coring locations by characterizing significant sediment types in the river. Input from historic data evaluation (e.g., historic geotechnical data and core descriptions) will also be considered for selection of geotechnical coring locations. Example coring locations are shown on Figure 2.

Sediment cores will be collected using vibracoring techniques and visually classified for stratigraphy and sediment type in accordance with the Unified Soil Classification System (USCS), according to the procedures in the SOP for geotechnical sampling provided in Appendix B. Positioning data will be collected at each coring location. A decision strategy for the geotechnical coring program that will allow field work to proceed in an adaptive, dynamic process is provided as Figure 3.

Based on review of USEPA comments on the Lower Passaic River Modeling Plan, physical properties analyses of collected sediment samples may be added to the geotechnical coring program, following consultation with USACE and USEPA.

Subject to Attorney Client, Work Product, Deliberative Process and/or Joint Prosecution Privileges; FOIA/OPRA Exempt

Source: S:\Projects\PASSAIC\MapDocuments\MXD\Proposed_Bore_Logs
2\18\05 2:48 PM



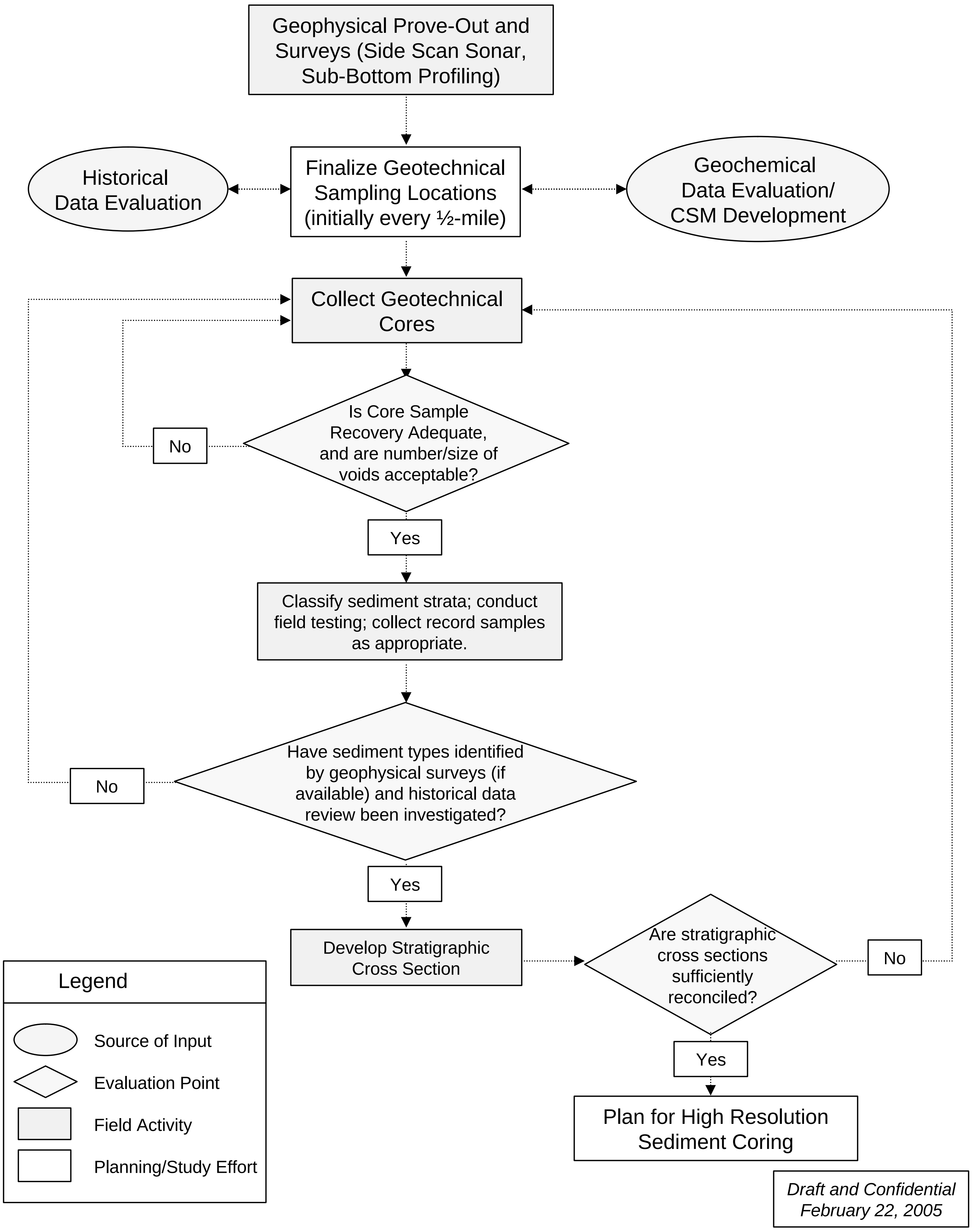
LOWER PASSAIC RIVER
NEW JERSEY

PROPOSED GEOTECHNICAL SEDIMENT CORES

FIGURE 2

FEBRUARY 2005

Figure 3: Design Strategy for Geotechnical Coring Efforts



Draft and Confidential
February 22, 2005

Table 1. Summary of Number of Samples and Analysis per Sampling Activity for Superfund Team and NJDOT-OMR Team

Activity	Superfund Team		NJDOT-OMR Team	
	Total # Samples	**Analysis (# Samples)**	**Total # Samples**	**Analysis (# Samples)**
Moorings	60	TSS,VSS, Conductivity (60 samples)	240	TSS,VSS[3], Conductivity, water density
CTD Surveys	396	TSS,VSS[2], Conductivity (272 samples)	1010	TSS,VSS[3], Conductivity (960 samples)
		Grain Size (16 samples)		[1]POC (50 samples)
		Be-7 & Th-243 (108 samples)		[1]Grain Size (40 samples)
Shipboard Surveys	288	TSS,VSS, conductivity (264 samples)	488	TSS,VSS[3], conductivity (470 samples)
		Grain Size (24 samples)		[1]Grain Size (18 samples)
Surface Sediment	12	Be-7 & Th-243, Grain size (12 samples)		
Geotechnical Program	35 cores	Visual classification via USCS (35 cores)[4]		

[1] Samples collected by NJDOT-OMR for Superfund Team
[2] VSS analysis performed on 80 of the 272 samples only
[3] VSS analysis of water samples will be done as per Superfund Team request.
[4]Physical properties analyses may be added based on consideration of USEPA comments on the Lower Passaic River Modeling Plan, in consultation with USACE and USEPA.

Formatted: Superscript

Formatted: Superscript

Deleted:

References:

Ciffroy, P., Reyss, J.L and Siclet, F. 2003, Determination of the residence time of suspended particles in the turbidity maximum of the Loire estuary by ^{7}Be analysis, Estuarine Coastal and Shelf Science. 57: 553-568

Feng, H., Cochran, J.K, and Hirschberg, J. 1999a. ^{234}Th and ^{7}Be as tracers for the transport and dynamics of suspended particles in a partially mixed estuary. Geochimica et Cosmochimica Acta. 63(17): 2487-2505.

Feng, H., Cochran, J.K, and Hirschberg, J. 1999b. ^{234}Th and ^{7}Be as tracers for the sources of particles to the turbidity maximum to the Hudson River estuary. Estuarine Coastal and Shelf Science. 49:629-645.

Fischer, H.B., 1973 Longitudinal dispersion and turbulent mixing in open-channel flow. Annu. Rev. Fluid Mech. 5:98-78.

Sanford, L.P., Suttles, S.E. and Halka, J.P., 2001. Reconsidering the physics of the Chesapeake Bay Estuarine Turbidity Maximum. Estuaries, 24(5): 655-669.

Sanford, L.P. and Maa, J.P.-Y., 2001. A unified erosion formulation for fine sediments. Marine Geology, 179(1-2): 9-23.

Smith, R., 1976, Longitudinal dispersion of a buoyant contaminant in a shallow channel. J. Fluid Mech 78 (Pt. 4) 677-688.

Taylor, G.I., 1954. The dispersion of matter in turbulent flow through a pipe. Proc. London Math. Soc. Ser A, 223:446-468.

Wilson, R.E., and A. Okubo, 1978. Longitudinal dispersion in a partially mixed estuary. J. Mar. Res. 36: 427-447.

APPENDIX A

Naturally-Occurring Radionuclides as Particle Tracers

Naturally-Occurring Radionuclides as Particle Tracers

One of the objectives of the Superfund monitoring program is the determination of the processes controlling the short-term particle dynamics within the estuary, especially in the region of the ETM. Studies done by Feng *et al*. (1999a, b) and Ciffroy *et al*. (2003) suggest that naturally occurring radionuclides can be used as tracers to understand the processes affecting particles dynamics in estuarine environments since the source terms and the rate of radioactive decay for these radionuclides are well known. Be-7 (half-life = 53 days) and Th-234 (half-life = 24 days), which have strong affinity for particle surfaces, were found useful in discerning short-term variations in the Hudson River Estuarine system. Th-234 is produced from Uranium-238 decay and a distribution coefficient (K_D) reported in the technical literature is summarized by Feng *et al*. (1999a) to be from 10^5 to 10^6. Th-234 production varies with salinity and Feng *et al*. (1999a) observed that if all other factors are equal, particles that scavenge Th-234 from higher salinity portion of the Hudson River estuary have higher excess Th-234 activities relative to those that are exposed to lower salinity water. Beryllium-7 (K_D approximately 10^5); however, is produced in the atmosphere by cosmic-ray spallation of nitrogen and oxygen, and atmospheric deposition is the main source to the estuary (Feng *et al*. 1999a). The different source functions of Th-234 and Be-7, along with their strong particle affinity and short half-lives, make them suitable for understanding the transport and fate of particles associated with contaminants in an estuarine system.

A distinctive feature of estuaries is the turbidity maximum zone, which is a region where the concentration of TSS may be a hundred times greater than concentrations both seaward and landward. There are several mechanisms responsible for the formation and maintenance of this region. Feng *et al*. (1999a, b) and Ciffroy *et al*. (2003) used natural radionuclides (Be-7 and Th-234) as tracers to understand the relative importance of local resuspension and lateral advection as sources to the ETM during the course of a tidal cycle, as well as the residence time of solids in the ETM (*e.g.*, Feng *et. al*., 1999a,b; Ciffroy *et. al*., 2003).

APPENDIX B

STANDARD OPERATING PROCEDURES

SOP List

SOP #1	Procedure for Surface Sediment Sampling
SOP #2	General Procedures for Shipboard Measurements
SOP #3	Station Information on Laptops
SOP #4	Procedure to Locate Sample Points Using a Global Positioning System (GPS)
SOP #5	Procedure for Sample Preservation
SOP #6	Procedure for Collecting Grab and Temporally Integrated Samples for Dissolved and Particulate Organic Carbon, Suspended Sediment and Grain Size, and Be and Th
SOP #7	Subcontractor Requirements for Bathymetric Surveys
SOP #8	Procedure to Document Field Activities
SOP #9	Procedure to Conduct Sample Management
SOP #10	Procedure for Geotechnical Coring and Sampling

Deleted: .

SOP #1: Procedure for Surface Sediment Sampling

I. Introduction

This SOP provides guidance on sediment sampling to be conducted at the Lower Passaic River Restoration Project Superfund Site.

II. Definitions

Sediment Samples. Environmental samples of potentially contaminated sediment, where sediment is defined as materials of geologic origin (*i.e.*, silts, sands, soils, and gravels) and/or organic matter deposited by water.

Grab Sample. A discrete sediment sample representative of a specific location at a given point in time.

Composite Sample. A nondiscrete sediment sample composed of more than one specific aliquot collected at various locations or at different points in time.

Transfer Device. Any instrument or vessel that contacts the sample during collection or transport (e.g., stainless steel trowel).

Eckman Dredge. A spring-activated clamshell-type scoop. The dredge is first lowered beneath the surface water in the open position and set upon the top layer of the sediment deposit. When the "messenger" weight is dropped down the guy line, the spring is tripped and closes the clamshell, collecting the sediment sample.

Ponar Dredge. A clamshell-type scoop activated by a counter-lever system. The shell is opened, latched in place, and slowly lowered to the bottom. When tension is released on the lowering cable, the latch releases and the lifting action of the cable on the lever system closes the clamshell, collecting the sediment sample.

Hand Corer. A thin-wall corer modified by the addition of a handle and a check valve on top. The corer is lowered beneath the surface water and driven through the sediment in a continuous motion. Once filled to capacity, the corer is twisted in the sediment prior to removal and retrieval of the collected sediment.

EnCore® Sampler. A dedicated, single use sampling device designed to collect a soil or sediment sample for volatile organic analysis without requiring use of methanol field preservation procedures in the field. A unique, reusable metal t-handle must be used with the En Core sampler to retrieve the sample.

III. Equipment

1. Eckman Dredge
2. Ponar Dredge
3. Hand Corer Sediment Sampler
4. 5-gram En Core® samplers
5. En Core® T-handle
6. Laptop computer
7. Digital camera
8. Global positioning system (GPS)
9. Stainless steel bowls
10. Stainless steel trowels, scoops, and spatulas
11. Disposable gloves
12. Plastic zip-loc bags
13. Plastic garbage bags
14. Measuring tapes
15. Polyethylene sheeting
16. Aluminum foil
17. 8-oz glass sample jars
18. Paper towels
19. Sample coolers
20. Ice

IV. Guidelines

Collection of sediment samples up-estuary and down-estuary of a hazardous waste site may be required to investigate potential sources of contaminant release to the surface water migration pathway and to biological receptors (*e.g.*, benthic organisms). Sediments are examined to measure whether contaminants are concentrating along stream bottoms, creating hot spots that may have high concentrations of dioxins/furans, heavy metals, pesticides/herbicides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) or low-solubility organic matter. Further, streams, lakes, and impoundments will likely demonstrate significant variations in sediment composition with respect to distance from inflows, discharges, or other disturbances. In addition, the presence of rocks, debris, and organic material may complicate sampling and require modification to sampling techniques. Prior to sample collection, the sediment sample location should be recorded in the field laptop. A Global Positioning System (GPS) should be used to locate the sampling location. Refer to SOP #4 for the GPS operating procedure.

Sediment samples near shore or above the water line are easily collected using a hand corer. If sediments are to be collected from deeper, larger streams or surface impoundments, clamshell scoops, such as the Eckman dredge or the Ponar dredge may be used to collect shallow sediment grab samples.

In general, the following considerations should be taken into account during sediment sampling activities:

- Down-estuary sediment samples should be collected before up-estuary samples.
- Care should be taken not to stand in the sediment deposits being sampled.
- The tidal cycle should be recorded whenever samples are collected.
- Sample collection should be in the following preferred order:
    1. In-situ surface water quality measurements (*e.g.*, temperature, dissolved oxygen (D.O.), pH, specific conductance)
    2. Volatile Organic Compounds (VOCs)
    3. Total Organic Carbon (TOC)
    4. Extractable Organic Compounds (SVOCs/Pesticides/PCBs)
    5. Dioxins/Furans
    6. Total Metals
    7. Cyanide
    8. Radionuclides
    9. Grain Size and other Physical Properties

SAMPLING PROTOCOL

1. Special Precautions for Sampling:

   The following general precautions should be taken when sampling:

   A. A clean pair of new, disposable gloves will be worn each time a different location is sampled. Gloves will be donned immediately prior to sampling.

   B. Sample containers for samples suspected of containing high concentrations of contaminants will be placed in separate plastic bags immediately after collection and decontamination of the outside of the container.

C. All used field equipment (trowel, bowls, *etc.*) to be decontaminated will be placed in plastic bags. All field waste (*e.g.*, personal protective equipment (PPE), plastic sheeting, towels) to be disposed of will be placed in another plastic bag.

D. If possible, one member of the field team will enter all field activity information into the field laptop computer, while the other member(s) collects all of the samples. All field activities will be documented as outlined in SOP #3.

E. Field personnel will use equipment constructed of approved sampling materials that are either single use or have been properly decontaminated. The decontamination procedures will be done in accordance with the Region II CERCLA Quality Assurance Manual.

F. Quality control/quality assurance (QA/QC) samples will be collected according to SOP #9.

G. The chain of custody procedures described in SOP #9 will be followed.

H. The sample management procedures described in SOP #9 will be followed.

2. Sample Collection:

The following procedures may be employed for the collection of sediment samples at the Lower Passaic River Restoration Project Superfund Site: (1) collection of sediment samples using an Eckman dredge, (2) collection of sediment samples using a Ponar dredge, and (3) collection of sediment samples using a hand corer.

General Sampling Procedures

1. Prior to sample collection, record the sediment sample location in the field laptop computer. Upload the surveyed map from the GIS/Database and mark the location on the map. Use a GPS to locate the sample. Refer to SOP #4 for the GPS operating procedure. Take a picture of the sample location.

2. Record the names of the field personnel present and the weather conditions in the field laptop computer.

3. Properly discard any samples not sent to a laboratory for analysis.

4. Record the following information in the field laptop computer:

- Sample identification number;
- Method of sample collection;
- Date and time of sample collection;

- Type of analyses;
- Whether this is a QC sample (*e.g.*, matrix spike, field duplicate, split sample) (if applicable); and
- Field rinsates associated with this sample (if applicable).

5. Decontaminate the exterior of all sample containers following collection (refer to Region II CERCLA Quality Assurance Manual). Place all chemical samples in zip-loc bags and place them on ice, or immediately submit the samples to the Sample Management Officer. Many non-chemical samples do not have to be cooled (*e.g.*, grain size)

<u>VOC Sample Collection Using the En Core® Sampler</u>

SEDIMENT SAMPLES FOR VOC ANALYSIS SHOULD NOT BE HOMOGENIZED. VOC SAMPLES ARE TO BE COLLECTED IMMEDIATELY FROM THE DREDGE OR CORER, PRIOR TO TRANSFER OF THE RETRIEVED SAMPLE INTO A DEDICATED STAINLESS STEEL TRAY OR BOWL.

1. Remove a 5-gram sampler and cap from package and position plunger rod so that the plunger can be moved freely from the top to the bottom of the coring/storage chamber. This is accomplished by pushing the plunger rod down until the small O-ring rests against the tabs. Note: The En Core® sampler is a single-use device.
2. Attach the T-handle to the sampler body by depressing the locking lever on the T-handle, placing the coring body (plunger end first) into the open end of the T-handle, aligning the slots on the coring body with the locking pins in the T-handle, and twisting the coring body clockwise to lock pins in slots. The plunger should be positioned so that the bottom of the plunger is flush with the bottom of the coring body/storage chamber.
3. Using the T-handle, push the En Core® sampler into the sediment in the sampling device until the coring body/storage chamber is completely full.
4. Verify that the coring/storage chamber is full by looking into the 5-gram viewing hole in the T-handle. The coring body/storage chamber is completely full if the small O-ring on the plunger rod is centered in the T-handle viewing hole.
5. Scrape a decontaminated spatula across the bottom of the coring body/storage chamber so the surface of the sediment in the sampler is flush with the opening of the coring body/storage chamber.
6. Quickly wipe the external surface of the coring body/storage chamber with a clean paper towel.

7. After ensuring that the sealing surfaces are clean, cap the coring body/storage chamber while it is still on the T-handle. This is done by gently sliding the cap onto the coring body/storage chamber with a twisting motion.
8. Remove the T-handle from the sampler and lock the plunger into position by rotating the plunger rod.
9. Fill out the sample label and attach to the cap of the En Core® sampler.
10. Place sampler back in its protective moisture-proof zip-lock bag.
11. Fill out sample information on bag and store bag on ice.
12. Repeat the above procedure using one more sampler. A total of three En Core® samplers will be collected per sample.

Homogenization Procedure for the Collection of Non-VOC Sediment Samples

1. Rocks, twigs, leaves and other debris should be removed if they are not considered part of the sample.
2. The sediment is then removed from the sampling device and placed in a stainless steel bowl.
3. Thoroughly mix the sample volume collected, using a dedicated or decontaminated stainless steel trowel or scoop. The sediment in the bowl should be scraped from the sides, corner and bottom, rolled to the middle of the bowl and thoroughly mixed.
4. Fill sample containers in the order specified on page 3 of this SOP.
5. Note that some non-chemical samples should not be homogenized. The field team will be informed by the field team lead when homogenization should not be performed.

Procedure for Sediment Sampling Using an Eckman Dredge.

1. Clean the stainless steel Eckman dredge according to the requirements for the analytical parameters to be measured. Refer to the Region II CERCLA Quality Assurance Manual for Decontamination.
2. Attach the necessary length of guy line to the dredge. Solid braided 5 mm (3/16 inch) nylon line is normally used for this purpose.
3. Slip the “messenger” weight onto the guy line and securely fasten the guy line to a stable immovable object.
4. Open the sampler jaws one at a time and attach the stainless steel clamshell leader to the trip head.

5. Lower the Eckman dredge to the top layer of the sediment deposit to be sampled.
6. Keeping the guy line slightly taut, drop the messenger down the guy line to release the trip head causing the clamshell jaws to spring shut.
7. Slowly raise the Eckman dredge clear of the surface.
8. Place the dredge in a stainless steel mixing bowl.
9. Open the top lids of the Eckman dredge.
10. Immediately collect the sediment VOC fraction directly from the center of the dredge using an EnCore® sampler as described on page 5 of this SOP.
11. Remove sediment sample from the center of the dredge to avoid potential cross-contamination of the sediments with the sides of the dredge and transfer the material to another stainless steel mixing bowl.
12. Repeat the sampling procedure above until sufficient sample quantity has been collected for the non-VOC fractions.
13. Homogenize the non-VOC fractions following the procedure on page 6 of this SOP.
14. Transfer the homogenized non-VOC fraction into the appropriate sample containers using the same stainless steel trowel or scoop used throughout this entire procedure.
15. Decontaminate the exterior of the sample container(s). Refer to the Region II CERLA Quality Assurance Manual for Decontamination.

Procedure for Sediment Sampling Using a Ponar Dredge

1. Clean the stainless steel Ponar dredge according to the requirements for the analytical parameters to be measured. Refer to the Region II CERLA Quality Assurance Manual for Decontamination.
2. Attach the necessary length of guy line to the dredge. Solid braided 5 mm (3/16 inch) nylon line is normally used for this purpose.
3. Measure and mark the distance to the top of the sediment deposit on the guy line.
4. Securely fasten the guy line to a stable immovable object.
5. Remove the safety locking pin.
6. Open the clamshell jaws until latched. From this point on, support the Ponar dredge by the guy line, or the sampler will be tripped, and the jaws will close.

CAUTION: Use extreme care in opening the Ponar dredge. Serious injury can result from getting a finger crushed in either the counter levels or the clamshell jaws.

7. Lower the Ponar dredge until contact with the sediment deposit is felt. Use the markings on the guy line to gauge the dredge's proximity to the upper surface of the sediment deposit.
8. Allow the guy line to slacken to close the jaws of the dredge.
9. Slowly raise the Ponar dredge clear of the surface.
10. Place the dredge in a stainless steel bowl and open the clamshell jaws.
11. Immediately collect the sediment VOC fraction directly from the dredge using an EnCore® sampler, as described on page 5 of this SOP.
12. Remove sediment sample from the center of the dredge to avoid potential cross-contamination of the sediments with the sides of the dredge and transfer the material to another stainless steel mixing bowl.
13. Repeat the sampling procedure above until sufficient sample quantity has been collected for the non-VOC fractions.
14. Homogenize the non-VOC fractions following the procedure on page 6 of this SOP.
15. Transfer the homogenized non-VOC fraction into the appropriate sample containers using the same stainless steel trowel or scoop used throughout this entire procedure.
16. Decontaminate the exterior of the sample container(s). Refer to the Region II CERLA Quality Assurance Manual for Decontamination.

<u>Procedure for Sediment Sampling Using a Hand Corer</u>.

1. Clean the Hand Corer according to the requirements for the analytical parameters to be measured. Refer to the Region II CERLA Quality Assurance Manual for Decontamination.
2. Force Corer into the sediment with a smooth motion.
3. Twist the Corer, then withdraw it in a single smooth motion.
4. Remove the nosepiece and immediately collect the sediment VOC fraction directly from the bottom of the hand corer using an EnCore® sampler, as described on page 5 of this SOP.
5. For other non-VOC analytical parameters, split the core into 0-6" and 6-12" sections and place the sections into separate stainless steel bowls.

6. Homogenize the non-VOC fractions following the procedure on page 6 of this SOP.
7. Transfer the homogenized non-VOC fraction into the appropriate sample containers using stainless steel trowel or scoops dedicated to each depth interval.
8. Decontaminate the exterior of the sample container. Refer to the Region II CERLA Quality Assurance Manual for Decontamination.

3. Sample Preservation

Sample preservation is typically intended to retard biological action, and hydrolysis, and to reduce sorption effects. Preservation methods for sediment samples are generally limited to no headspace in sample container (VOC samples only), refrigeration to 4 degrees C, and/or protection from light. Sample preservation procedures as outlined in SOP #5 will be followed.

V. References

ASTM D6418. Standard Practice for Using the Disposable En Core® Sampler for Sampling and Storing Soil for Volatile Organic Analysis. American Society for Testing and Materials, West Conshohocken, Pennsylvania. June 10, 1999.

USACE, 1994. Requirements for the Preparation of Sampling and Analysis Plans. Appendix C: Environmental Sampling Instructions, pp. C-43 to C-49. September 1994.

EPA, 1984 Characterization of Hazardous Waste Site – A Methods Manual, Volume 11, Available sampling methods, Second edition, Section 2.3.1, Method II-3: Collection of sludge or sediment samples with a scoop. pp. 2-9. Section 2.3.4, Method II-6: Sampling bottom sludges or sediments with a ponar grab. Section 2.3.2, Method 11-4: Sampling sludge or sediments with a gravity corer. pp 2-12 to 2-14, pp 2-15 to 2-17. Environmental Monitoring Systems Laboratory, Office of Research and Development. U.S. Environmental Protection Agency, Las Vegas, Nevada. EPA-600/4-84-076. December 1984.

EPA, 1987. A Compendium of Superfund Field Operations Methods. Section 10.2.6.3: Methods and Applications: Sediments and Sludges, pp. 10-40 to 10-43; p. 10-47. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement. U.S. Environmental Protection Agency, Washington, D.C. EPA/540/P-87/001. December 1987.

SOP #2: General Procedures for Shipboard Measurements
Adapted from Stevens Institute of Technology and Rutgers University Project Plan, Quality Assurance Plan, and Standard Operating Procedures For Study IE, New Jersey Toxics Reduction Workplan: (Newark Bay, Kill Van Kull and Arthur Kill) Version 1.1, 23 February 2001

Upon arrival at the measurement station, the vessel will be anchored and the vessel engines will be shut down. All instrumentation will be powered on and checked to insure proper operation. Using the on-board GPS system as well as landmarks (*e.g.* aids to navigation, proximity to shoreline), the vessel's position will be noted in the vessel log. The acoustic doppler current profiler (ADCP) will be attached to the floating platform, and the platform will be lowered from the side of the vessel and positioned outboard to the fullest extent. ADCP measurements will be recorded in transect mode in real-time via a laptop computer, allowing for constant checks on the data quality. The Conductivity, Temperature and Depth (CTD) logger and Optical Back Scatter (OBS) turbidity and suspended solids measurements will be performed by dropping the Applied Microsystems instrument overboard and lowering it to the bottom. There will be one person responsible for each of the two instruments mentioned here (ADCP and CTD/OBS) – a total of 2 individuals. These individuals will operate the instrument, store the instrument when not in use, maintain the instrument logbook, verify data quality, and store the data. The vessel captain will assist as needed, and will be responsible for assuring that the vessel remains anchored at the sampling location and that all mechanical and electrical systems are properly functioning during the sampling period. The captain is also responsible for ship safety, including the availability and use of life preservers/personal floatation devices and proper exposure protection by all members of the team.

The Applied Microsystems CTD/OBS will be programmed to sample continuously. CTD and OBS profiles will be obtained throughout the sampling period, at intervals of approximately 30 minutes.

The RD Instruments (RDI) ADCP will monitor the current profile on a continuous basis at the sampling location. The instrument will be programmed to measure the velocity profile using the maximum ping rate, and 50 cm vertical bins, with no averaging. The ambiguity velocity will be set at 300 cm/s; the temperature will be set to 10 degrees C, and the salinity will be set to 19 PSU.

TOPS-based water and suspended sediment samples and grab samples will be obtained over a period of approximately four hours, following the Standard Operating Procedures described in the summer 2004 Work Plan. The TOPS-based sampling will be performed by two individuals.

During instances when ship-board sampling is to be performed along transects between stations, the research vessel will be equipped only with an RDI ADCP and a Brancker CTD/OBS. The instruments will be programmed and the measurements will be obtained in the manner described above. In addition, ADCP measurements will be obtained while underway between measurement points. The location of the measurement points will be selected by the Field Team Leader, based on the distance between stations and the oceanographic and weather conditions at the time of the survey.

SOP #3 Station Information on Laptops
Adapted from Stevens Institute of Technology and Rutgers University Project Plan, Quality Assurance Plan, and Standard Operating Procedures For Study IE, New Jersey Toxics Reduction Workplan: (Newark Bay, Kill Van Kull and Arthur Kill) Version 1.1, 23 February 2001

A. 1.0 General

Each laptop will be used to record important observations for each event and store important information regarding the equipment and operations. These data are entered on the laptop for each station. Each field crew will carry personal field books to record notes and keep important phone numbers.

Inventory List

Year-Study-Event-Survey: ____

Date:________________ Operator:_______________________________________

SonTek ADP (3)
RDI ADCP (2)
LISST (6)
Brancker CTD (3)
D&A OBS (5)
Applied Microsystems CTD (2)
Aqua-Trak Tide Gauge (5)
Datalogger (5)
Instrument Manuals (7)
Laptop Computers (6)
Instrument Connection Cables and Dummy Plugs
Floppy and Zip Disks
Moorings (3)
Pens and Markers
Watch
Profiling Cage
Profile Line
ADCP Tow Body
Flashlight and batteries
Cell phone /charged battery

distilled water to rinse equipment
squirt bottles
paper towels
KimWipes

Pre-event mooring check-list

Year-Study-Event-Survey: ____

Station: __________________

Date:_____________ **Operator: _____________________________**

SonTek ADP
D&A OBS
Brancker CTD
Mooring
Laptop Computer
Floppy Disks
Zip Disks
GPS for Location
Water-proof pen
Sharpie
Tools – open end wrench, adjustable wrench, screw driver/nut driver
Cell phone with charged battery

OBS calibration supplies
Turbulence Tank
OBS
Laptop Computer
Seeding Solution

distilled water to rinse equipment
squirt bottles
paper towels
KimWipes

Copy of SOP's, instrument manuals
Field data sheets and forms
Emergency Procedure Document

PRE-EVENT SHIP-BOARD CHECK LIST

Year-Study-Event-Survey: ____________________________________

Station:________________

Date:_____________ **Operator: _________________________________**

RDI ADCP
Tow Body
Laptop Computer
Applied Microsystems CTD
D&A OBS
Instrument Manuals
Profiling Cage
Profiling Line
Floppy and Zip Disks
Pens and Markers
Watch
Flashlight and batteries
Cell phone /charged battery
Copy of SOP's, instrument manuals
Field data sheets and forms
Emergency Procedure Document
Life preservers and exposure suits
distilled water to rinse equipment
squirt bottles
KimWipes

Shipboard Hydrodynamic Measurements Form

Year-Study-Event-Survey: ___________________________

Station Name: ________________

Date/Time of Measurements: __________________________________

Time of HIGH/LOW Tide: ___________________________

(check/fill in all those that apply)

	RDI ADCP	CTD	SHIP-TRACK FILE
Towed Configuration			
Moored Configuration			
Vertical Profiling Configuration			
Bin Size			
Sampling Frequency			
Ensemble Interval			
Real-Time			
Autonomous			
Location of Pycnocline from surface			
Location of Turbidity Maximum			
Filename/location of data			
Tidal Stages Encountered			
Measurements over Fixed Mooring?			
Operator			

Comments:
____
____
____
____
____
____

Post-Event Shipboard Check List

Year-Study-Event-Survey:________________________________

Station: _________________ Date : ____________

<u>ADCP</u> **Operator: _____________________________**

Did the instrument turn on?
Are the data recorded on the shipboard laptop computer?
Is the file named properly?
Has the file been saved to a Zip Disk?
Did the entire data set record properly?
Approximate number of hours of data recorded: __________

<u>CTD</u> **Operator: _____________________________**

Did the instrument turn on?
Are the data recorded on the shipboard laptop computer?
Is the file named properly?
Has the file been saved to a Zip Disk?
Did the entire data set record properly?
Approximate number of hours of data recorded: __________

Notes regarding station and equipment conditions: ____

FORM 7. Equipment Instruction Books

Son-Tek ADP
RDI ADCP
Brancker CTD
Applied Microsystems CTD
D&A OBS

SOP #4 Procedure to Locate Sample Points Using a Global Positioning System (GPS)

I. Purpose

The purpose of this procedure is to provide reference information for the documentation of sample locations using a GPS at the Lower Passaic River Restoration Project Superfund Site.

Definitions

GPS - The GPS is a satellite-based positioning system, operated and controlled by the U.S. Department of Defense. The GPS includes 24 satellites, and can be used by anyone who has a GPS receiver. The GPS receiver is used for position determination, navigation, and survey tasks on land, sea, and in the air. The method of utilizing GPS varies with each application and the type of GPS equipment used. Operating methods range from low precision, code phase systems to highly accurate, carrier phase systems that facilitate on-the-fly measurements, also known as real-time kinematic surveying (RTK). Generally, the RTK system includes a GPS antenna, a GPS receiver, a radio modem and radio antenna, and a data collector for both the Roving Unit and the Base Station. Only the RTK system will be used to make measurements at the Lower Passaic River Restoration Project Superfund Site.

III. Equipment and Materials

1. Trimble 4800 Rover with related cables, power supply, and bipod/pole assembly (Rover Unit).

2. Trimble 4700 GPS base station with related cables, power supply and tripod stand (Base Station).

3. Trimble TSC1 data collector (Survey Controller).

4. Pacific Crest radio with antennas, related cables, power supply and tripod stand (Radio Station).

5. Map(s) with locations of known benchmark(s) in New Jersey State Plane Coordinate System.

6. Field Laptop.

IV. General Guidelines and Requirements

1. Prior to planning any survey activities with the GPS, verify in the field that benchmarks exist and are located in secure areas.

2. Prior to beginning any survey activities, verify all power sources have been properly charged.

3. Prior to the setup of the Base and Radio Stations, verify that all planned survey activities with the Rover Unit will occur within the operable range of the Base and Radio Stations and perform a check for adequate satellite coverage.

4. Prior to setup of the Base and Radio Stations, verify that all necessary access to the base station property has been granted.

5. When using the GPS, <u>at least</u> one person on the field team <u>must</u> be familiar with its operation and <u>must</u> have used the GPS on a prior occasion.

V. <u>Procedure</u>

1. Create a Job in the Survey Controller (hand-held unit) according to the following steps:

    A. Click the Files icon.
    B. Choose Job Management in the Files menu.
    C. Select the NEW F1 softkey.
    D. Type a suitable name.
    E. Press ENTER to accept the name.
    F. Press ENTER again to create the job.
    G. The Select Coordinate System menu appears. Use this menu to select the Job Parameters from the library - select from an existing Published Plane in the available database (e.g., 1983 NJ State Plane Coordinate System).
    H. Press ENTER to select this option.
    I. Confirm that the job has been saved, by selecting Files/Current to verify job setup status.

2. Check the Units and Survey Styles options in the Configuration menu (on hand-held unit). Check for the following parameters for the survey:

Angles:	**DDD.MMSS**
Lat/Long:	DDD.MMSS
Coordinate view:	Grid
Coordinate order:	North-East-Elev
Distance:	US survey feet
Height:	US survey feet

If the required Units and Survey Styles options are not the same as listed above, use the Toggle menu to correct them.

A. Choose the relevant units of measure (for example, U.S. Feet) to be used in the calculation of distance, height, or area from Configuration/Job/Units settings.

B. Select Grid type for distance display and calculation techniques for use by the Survey Controller from the Configuration/Job/Cogo settings.

C. Select the appropriate time-out, time stamp, correct local time, and local date displays from the Configuration/Controller/Time/Date settings.

D. Enable low voltage charging for the Survey Controller from the Configuration/Controller/Hardware settings.

3. Select the Configuration/Survey Styles/Trimble RTK setting option (on the hand-held unit) to view and work with all of the configuration options to be considered to use the Trimble RTK survey technique.

Rover options:

A. Select the Correction record type. Choose the CMR-plus option.

B. Set the Elevation mask to eliminate satellite(s) signals that are too low on the horizon for the GPS antenna (typically set at 13 degrees).

C. Set the correct Antenna/Type to obtain correct measurement options for the GPS antenna to the ground position.

D. Once all of the options in the real-time Survey menu are entered, select OK F1. The settings will remain for those options and will be applied for every real-time survey started using this Survey Style.

4. Setup Base and Radio Stations. Ensure that the Base Station-GPS Receiver is level and set up directly over an existing benchmark with known coordinates. The Radio Station should be located a minimum of 20 feet from the Base Station.

To start a base station receiver:

A. Connect the appropriate cables to the Base and Radio Stations.

B. Power on the Radio Station and set the frequency to that of the Base Station and Rover Unit.

C. Power on the base receiver and allow the GPS antenna to view satellites for at least 2 minutes.

D. On the Survey Controller, select the Survey icon.

E. Select the Survey Style: Trimble RTK.

F. From the Survey menu that appears, select the Start base receiver option. If acceptable, a prompt will appear to enter Base Station details.

G. Key in a point name (e.g., BASE1), press the ENTER key. A message should appear on the screen: point not in database. The HERE softkey now appears.

H. There are two ways to fill in the base coordinate information: 1) Key in the point name and 2) pressing the HERE softkey to allow the receiver to select the position. Since the Base Station should be setup over a benchmark with known coordinates, key in the Key in the point name and the benchmark coordinates (i.e., Northing, Easting, and Elevation).

I. Press ENTER if the displayed WGS-84 coordinates are correct for the base coordinates. If not, reenter the coordinates.

J. Enter a Feature Code to describe the point with a symbol or line work description that can be used in data display (i.e., BASE1).

K. Key in the correct Antenna height, in feet. This is measured from the ground position to the ground plane of the antenna.

L. Press the ENTER key to accept all the parameters and start the Base Station transmission via the Radio Station.

M. A message will appear “Base started” to indicate successful Base Station start-up. Upon successful start-up of the Base Station, check (observe the data light on the radio) that the Base Station radio transmitter is sending information.

6. Once the Base Station is started, the Rover Unit can be started. To start the Rover Unit:

   A. Disconnect Survey Controller from Base Station and connect it to the Rover Unit.

   B. Select the Survey icon.

   C. Select the Trimble RTK Survey Style.

   D. From the Survey menu, select Start Survey.

7. Initialization - Initializing the Survey must be done before measuring points. This is to confirm that the Base Station, Radio Station and the Rover Unit are working properly (i.e., set into NJ State Plane Coordinate System). The Rover Unit must be moved to a second benchmark for the verification of initialization.

   A. Select Initialization from the Survey menu.

   B. A screen appears displaying the receiver's current status: 1) If it reads Float, the unit is not yet initialized or 2) If it reads Fixed, initialization is already complete (skip to Step 7J).

   C. If the unit is not yet initialized Select the INIT F1 softkey.

   D. Choose the Known point method.

   E. Enter the Point name of the known point that is occupied.

   F. Enter the correct Antenna height. Confirm that the antenna is level and plumb over the known point.

   G. Select OK to allow the initialization to be computed.

   H. Wait for the known point initialization process.

   I. View the displayed results: 1) If initialization succeeds: select OK and continue to measure points with fixed initialization, or 2) If the initialization fails: analyze the results, check the antenna's position, and repeat from Step 7A.

J. When the initialization is successful, Esc back to the Survey menu. Go to the Position setting and verify the Rover Unit is situated over the second benchmark. Record this information in the field laptop.

8. Measuring Points

A. Select Measure points from the Survey menu.

B. Select Topographic point.

C. Move the equipment to the required position.

D. Check that the Point name is correct.

E. Select the Type of position (typically Topo point). These are the same types as configured in the Survey Style.

F. Enter the correct Antenna height.

G. Level the GPS antenna.

H. Select the MEASURE softkey (F1 or ENTER). Hold the range pole steady.

I. Select Store or ENTER to save the position.

J. Move the Rover Unit to the next position and repeat Steps 8A through 8I.

9. Ending a Survey

A. Use the Esc key to get the Survey menu.

B. Choose End Survey.

C. If other function windows are open, a prompt will appear to close them before ending the survey. Search for open windows by pressing the Next key. Close the windows one by one, Esc, until the option to turn off the Rover Unit appears. Retry End Survey.

D. A message will appear asking whether to turn off the Rover Unit. Do so, unless another survey job needs to be completed.

E. Press the key for 1 second to turn off the Survey Controller.

10. Uploading of Survey Data

A. At the completion of the survey, return to the location of a desktop or laptop computer that has the Trimble Survey Office computer program.

B. Connect the Survey Controller to the serial port on the computer using the serial port cable.

C. Start Trimble Survey Office and create a program file with the exact name of the survey job to be uploaded from the Survey Controller.

D. Power up the Survey Controller and activate the Upload setting.

E. Follow the prompts shown on the Trimble Survey Office program.

F. After uploading, power down the Survey Controller and disconnect the serial port cable.

G. Use the Trimble Survey Office program to convert the input file from the Survey Controller into a Microsoft Excel output file.

VI. Quality Control

The GPS has quality control features that are built into the system. The system will not allow measurements to be taken if there are not enough satellites available to provide accurate readings, if the satellite geometry is not conducive to the survey, if any radio signals are lost, and for other reasons. The system maintains quality control records during a survey that contain information about the quality of the GPS position, including the number of available satellites, satellite geometry, and horizontal and vertical precision levels. These records can be accessed at any time during or after a survey in order to assure that the necessary quality standards are being achieved.

VII. References

Surveying and Mapping Product Training, Real-time Surveying. Trimble Navigation Ltd., 1998.

Survey Controller Reference Manual, TSC1, Trimble Navigation Ltd., December 1997.

4400 Reference Manual, Trimble Navigation Ltd., May 1996.

SOP #5 Procedure for Sample Preservation

I. Introduction

This SOP provides guidance on sample preservation procedures to be employed at the Lower Passaic River Restoration Project Superfund Site.

II. Health and Safety

During sample preservation, limited quantities of strong acids and bases will be handled. Therefore, the following safety precautions will be followed:

- All proper personal protective equipment (PPE) will be worn. This includes safety gloves (nitrile) and safety glasses.
- Care will be taken not to splash or spill the substances.
- The acids and bases will not be stored in close proximity to each other.

III. Guidelines

The following procedures have been developed for preserving aqueous samples for VSS, TSS, POC and radiological parameters and sediment samples for radiological parameters.

Preservation

Add the required preservative to each sample using a pipette. Care should be taken not to touch the pipette against the sides of the bottles or the sample. Cap the bottle and gently turn it upside down. Check the pH of the sample bottle by pouring an aliquot of the sample over the pH paper. Do not dip the pH paper directly into the sample.

Cyanide Preservation

Add several milliliters of 10 molar (M) NaOH to each sample using a pipette. Care should be taken not to touch the pipette against the sides of the bottles or the sample. Cap the bottle and gently turn it upside down. Check the pH of the sample bottle by pouring an aliquot of the sample over the paper. Do not dip the pH paper directly into the sample. The pH of the sample should be > 12. If not, continuing adding NaOH following the steps detailed above until the proper pH is achieved.

General

All samples (soil and aqueous) sent for chemical (TAL/TCL) analysis should be kept at 4 to 6°C with ice.

Measurements	Minimum Volume Required	Containers[1]	Preservatives	Holding Time[2]
Aqueous				
TAL Metals (excl. Mercury)	1 L	P	HNO_3 to pH<2 Cool, 4°C	6 Months
Mercury	NA – put in TAL bottle	P	HNO_3 to pH<2 Cool, 4°C	28 Days
Cyanide	1 L	P	NaOH to pH>12 Cool, 4°C	14 Days
TCL Volatiles	80 mL	G w/septum	HCl to pH<2 Cool, 4°C	14 Days
TCL Semi-Volatiles	160 oz.	G	Cool, 4°C	7 Days to Extraction
Pesticides/PCBs				40 Days to Analysis
Radionuclide	5 to 9 L	P or G	HNO_3 to pH<2	6 Months
TSS	1 L	P	Cool, 4°C	7 Days
VSS	1 L	P	Cool, 4°C	7 Days
POC	200 mL	G	Cool, 4°C	Filter as soon as possible
Sediment				
TAL Metals (excl. Mercury)	8 oz.	G	Cool, 4°C	6 months
Mercury	NA – put in TAL bottle	G	Cool, 4°C	28 Days
Cyanide	NA – put in TAL bottle	G	Cool, 4°C	14 Days
TCL Volatiles	2 - Encore®	NA	Cool, 4°C	14 Days[3]
TCL Semi-Volatiles	8 oz.	G	Cool, 4°C	7 Days to Extraction
Pesticides/PCBs				40 Days to Analysis
Radionuclide	8 oz.	G	None	6 Months

[1] P = Plastic; G = Glass
[2] Holding time is from the date of sample collection
[3] The holding time is dependent upon the laboratory immediately preserving the sample

SOP #6 Procedures for collecting grab and temporally integrated samples for Dissolved and Particulate Organic Carbon, Suspended Sediment and Grain Size, and Be and Th Adapted from the New Jersey U.S. Geological Survey Project Plan, Quality Assurance Project Plan, and Standard Operating Procedures for New Jersey Toxic Reduction Workplan for the NY-NJ Harbor Head-of-Tide Sampling Study I-C Version 4: 05/18/2004 and ^{234}Th and ^{7}Be as tracers for the transport and dynamics of suspended particles in a partially mixed estuary by Huan Feng, J. Kirk Cochran, and David J. Hirschberg Marine Sciences Research Center, State University of New York, Stony Brook, NY 11794, USA

Introduction

Suspended particle samples will be collected for Be and Th analysis using a ship-powered pumping system to filter a large volume of water through two consecutive 0.5-mm polyethylene filter cartridges. This process is expected to require a 4-hour sampling duration. During the suspended particle sampling, grab samples will be collected for DOC, POC, suspended solids and grain size analysis.

DOC / POC Samples

1. Sampling

During each sampling event for suspended particles, discrete grab samples will be collected for measurement of dissolved (DOC), particulate (POC) organic carbon, and suspended sediment (SS) concentrations. This SOP describes the procedures and equipment used for collecting and processing these samples.

Grab samples for DOC/POC will be collected in 1L plastic sampling bottles equipped with Teflon lined lids. At hourly intervals during the 4-hour sampling period, and whenever a polyethylene cartridge filter is replaced, the field personnel will fill:

(1) one 1L plastic bottle at the intake line
(2) one 1L plastic bottle at the waste line
(3) one 1L plastic bottle at the post Flat-Filter line and
(4) one 1L plastic bottle at the post XAD-2 line.

2. Filtration.

The plastic 1 Liter sampling bottles for the POC/DOC will be transported to the laboratory and stored in a refrigerator at 4 ^{0}C. Each sample will be filtered using 25 mm diameter glass fiber filters. 125 mL of the filtrate to be analyzed for DOC will be collected in a 125 mL baked glass amber bottle. The recovered filters to be analyzed for POC will be shipped on ice to the lab for analysis. The 125mL of the filtrate will also be analyzed at the laboratory.

Filtration Equipment

Teflon pressure filter – Savillex model DOC25 – 25mm diameter filter holder, or 25mm glass vacuum filtration assembly
25-mm diameter glass microfiber filter – Whatman 25 mm diameter Whatman #1825-025 (VWR # 28497-925) or equivalent
Stainless steel 142mm diameter pressure filter and reservoir
142 mm diameter glass microfiber filters Whatman #1825-142 (VWR # 28497-907)

Laboratory grade compressed nitrogen, with tank regulator and copper tubing transfer line
Stainless-steel forceps
Small plastic petri dishes with covers– 150-mm diameter x 25-mm deep, pre-sterilized, equivalent to Falcon 1013.
Glass Graduated cylinder
Squirt bottle with organic free water
Squirt bottle with clean methanol
Labeling tape-white
Clear masking tape
Electrical tape
1.0 mL vials of 4.5 N (1:7) sulfuric acid (H_2SO_4) [Eagle-Picher Part #05285 UN 1830]
Permanent fine-point marking pen
Vinyl laboratory gloves
Whirl-Packs and Ziploc bags
Aluminum foil
Neon-colored label dots for sample identification

Filtration Process

Filtering is to be done within two weeks of collection of the POC and DOC samples, following the USGS-NJ NAQWA procedures outlined in NWQL Technical Memorandum 2000.04.

Use vinyl gloves for all procedures and handling of all equipment and samples. Pre-wash filter holders and tools with phosphate-free detergent; rinse with organic-free de-ionized water. Keep filter holders and tools covered in aluminum foil.

Place a 25 mm diameter glass fiber filter on the filter holder assembly and connect to the reservoir following the manufacturer's instructions. Pre-rinse the filter with 5-10 mL of de-ionized water. Shake the sample bottle vigorously to re-suspend sediment. If necessary, BEFORE SHAKING, remove 5-10 mL of sample to allow for small headspace in bottle. Rinse graduated cylinder with a small portion of sample, discard, then pour 125 mL of sample into graduated cylinder. Transfer this to the filter assembly, rinse graduated cylinder with 5-10 mL of de-ionized water, and transfer to the filter assembly. Place the filter assembly cap on, connect to the nitrogen tank, and apply no more than 10 psi of pressure. Collect filtrate in a pre-baked 125 mL amber glass bottle with a Teflon lined cap. Acidify sample with a 1.0 mL vial of 4.5 N (1:7) sulfuric acid (H_2SO_4). Cap and seal lid with electrical tape. NOTE: If Ag filters are used, DOC samples should NOT be acidified and Lab Code changes to 113.

Once the sample is completely filtered, release the pressure, open the filter assembly cap, rinse the sides of the reservoir with a sufficient volume of de-ionized water, and close the filter assembly and filter, discarding the filtrate. Using stainless steel forceps, remove the filter from the filter assembly; fold in half, place in foil and fold foil into a packet. Repeat this procedure two more times so as to obtain three 25 mm GF/F filters for POC analysis. Place all three filters in one foil packet and place the foil packet into two Whirl-Paks. Label the inner Whirl Pak with a piece of white tape containing the following information:

River name/station number
Date of collection
Time of Collection
Volume filtered

Place the filters in the nested Whirl-Paks into a Ziploc bag for shipping.

Label all filtered, acidified DOC water samples as follows:

River name/station number
Date of collection
Time of Collection

Use white labeling tape and a sharpie for the label and put clear packing tape over the white label to ensure it will stay on. Tape the lid of the amber bottle securely with electrical tape.

Keep all bottles and filters in the refrigerator until they are shipped/analyzed. Rinse filter assembly with phosphate-free detergent and de-ionized water between samples.

The 125mL of the filtrate will also be analyzed for DOC at the laboratory.

TSS and Grain Size Samples

1. Sampling

Grab samples for TSS and Grain Size will be collected in 1L plastic sampling bottles equipped with Teflon-lined lids at the beginning of the suspended particle sampling. In addition, at hourly intervals during the 4-hour sampling period, and whenever a cartridge filter is replaced, the field personnel will fill:

1) one 1L plastic bottle at the intake line
2) one 2L plastic bottle at the waste line
3) one 4L plastic bottle at the post Flat-Filter line and
4) one 4L plastic bottle at the post XAD-2 line.

Be and Th Samples

1. Sampling

Suspended particle samples will be collected by using a ship powered pumping system to filter a large volume of water (200–1500 L) through two consecutive 0.5-mm polyethylene cartridges (Microwynd DPPPZ1 0.5 micron nominal, Process Equipment & Supply Co., Union City, NJ) that filter particles from solution. At each sampling station, water will be filtered from a depth near the surface (0.5 m below surface) and near the bottom (1 m above the bottom). Water volumes filtered will be sufficient to obtain 5 to 15 g of suspended sediment for analysis. Pumping times will be typically 2 h to obtain sufficient samples for analysis. Efforts will be made to sample on the ebb tide, although this may not always be possible.

SOP #7 Subcontractor Requirement for Bathymetric Surveys

I. Guidelines

Bathymetric soundings will be collected by a subcontractor at approximately 2-foot intervals along sounding lines, with a line spacing of 25 feet. The bathymetric survey area consists of the entire 17-mile stretch of the Passaic River. Survey lines will be pre-plotted prior to commencement of the survey. Sufficient shore-based markers, surveyed into the New Jersey State Plane Coordinate System, will be established prior to commencement of the survey to be used for the shore-based positioning instrumentation.

Bathymetry measurements will be limited to high water periods (anticipated to be approximately four hours bracketing the predicted time of high tide) so that measurements can be taken over the more shallow areas of the river, as well as the deeper sections. The fathometer will be calibrated at the beginning of each day, and at least once every two hours during measurements, according to the procedure applicable to the instrument. The tide level will be recorded during the time period the measurements are made, as discussed on page 2 of this SOP.

Each survey line recording shall be labeled with the survey line number, direction of travel, date, time, and the name of the fathometer operator. A record of the survey line completed and calibrations shall be made in the field logbook.

Upon completion of field activities, the profiles will be adjusted using tidal data so that all data are reported relative to Mean Low Water (MLW) Datum.

SURVEY PROTOCOL

1. Special Precautions for Conducting Surveys:

   The following general precautions should be taken when conducting surveys:

   A. If applicable, prior to entering a piece of property, confirm that access to the property was granted.

2. Survey Procedures:

General procedures and specifications are provided below for conducting bathymetric surveys at the Lower Passaic River Restoration Project Superfund Site.

General Survey Procedures and Specifications

1. The survey vessel will have the capability of supporting and operation of positioning and sampling equipment.

2. Vessel Positioning – Horizontal control for the vessel and equipment will be maintained with an RTK DGPS, which can record position data in the following horizontal coordinate systems: 1983 North American Datum (NAD83) and New Jersey State Plane NAD 83. The DGPS consists of a dual frequency receiver GPS receiver with the base station instrument set over the vertical control point (*i.e.*, USGS benchmark) and the second instrument antennae on top of the fathometer to eliminate potential horizontal positioning offset errors. The typical specifications for a GPS system that provides acceptable horizontal and vertical control are given in the following table:

PARAMETER	ACCEPTABLE CRITERIA	UNIT OF MEASURE	VALIDATION FREQUENCY	CORRECTIVE ACTION
Source Level	+/- 2.5%	Decibel	Beginning and end of each survey line	Re-survey if out of compliance
Amplifier Gain	+/- 1.0%	Decibel	Same as above	Same as above
Receiver Gain	+/- 2.5%	Decibel	Same as above	Same as above
Receiver Signal/Noise	> 5	Ratio	Continuous	Re-survey if not immediately corrected
Navigation (Horizontal)	+/- 1.75	Feet	Continuous	Re-survey if not immediately corrected
Navigation (Vertical)	+/- 0.5	Feet	Continuous	Re-survey if not immediately corrected

3. The bathymetric survey will be conducted concurrently with the horizontal and vertical measurements to assist in the development of a topographic map of the bottom of the Passaic River. The water depth will be measured by a 200 kHz Survey Depth Sounder that uses single-beam survey technology, or equivalent. The sounder will be checked through calibration at the beginning and end of each day to compensate for variations in speed of sound in water and transducer mounting depth. The typical specifications for a depth sounding system that provides such accuracy is given in the above table. Relevant observations and changes in operational procedures will be noted in the field log.

4. The horizontal, vertical, and water depth data will be transferred to a computer during the survey activities and analyzed using the computer program Hypack Max, or equivalent. The computer program displays a geo-referenced base map and updates the drawing in real-time showing survey lines, vessel horizontal and

vertical positioning, and water depth. The program will also be used to develop the complete topography of the pilot study area.

5. Field activities will be documented onto the laptop computer by one member of the field personnel team. The following items will be recorded:

- Date and time of profile collection;
- Time of high tide;
- Weather conditions;
- Calibrations performed;
- Survey line number;
- Location along Passaic River (*e.g.* river miles, GPS, distance to river banks);
- Profiling method (*i.e.*, name and serial number of fathometer);
- Unusual conditions;
- Brief description of the area around the survey line location and the weather conditions at the time of profiling;
- Log with description of transect end point;
- Personnel present.

6. Survey and sounding equipment which has been immersed in the river will be decontaminated as described in Region II CERCLA Quality Assurance Manual for decontamination.

II. References

TAMS, 2004. Draft Project Plans for Geophysical Surveys and Sediment Coring. Appendix B: Aqua Survey, Inc., Field Sampling Plan. January 2004.

TSI, Inc., 1995. Passaic River Study Area: RI/FS Work Plans. Volume 3 of 5 – Field Sampling Plan; Appendix A – Standard Operating Procedures; SOP No. 3 – Bathymetric Surveying. January 1995.

SOP #8 Procedure to Document Field Activities

I. Introduction

The purpose of this guide is to provide reference information regarding the documentation of field activities conducted at the Lower Passaic River Restoration Project Superfund Site.

II. Definitions

Field Data – Any and all information collected during activities at the site.

Electronic Field Data Form – A standardized electronic data form used for the collection of information and/or technical data during field activities.

III. Guidelines

The documentation of field activities at uncontrolled hazardous waste sites is governed by a variety of legal guidelines that must be understood prior to the commencement of field activities. It is imperative that the personnel who will be conducting the field activities understand how the overall constitutional, statutory, and evidentiary legal requirements apply to the site inspection documentation and to the rights of potentially responsible parties.

The description of and observations made during field activities often provide the basis for technical site evaluations and other related written reports. All electronic records and notes generated in the field will be considered controlled evidentiary documents and may be subject to scrutiny in litigation. Consequently, it is essential that the Field Team Leader pay attention to detail and document to the greatest extent practicable every aspect of the inspection.

Personnel designated as responsible for the documentation of field activities must be aware that all electronic notes taken may provide the basis for the preparation of responses to legal interrogatories.

Field documentation must provide sufficient information and data to enable the reconstruction of field activities. A laptop computer using standardized electronic data forms will provide the basic means for documenting field activities.

Control and maintenance of laptops used in documentation of field activities is the responsibility of the Field Team Leader.

If the person responsible for documenting site inspection activities is someone other than the Field Team Leader, the transfer of responsibility must be documented.

Documentation of Field Activities

Electronic field entries must provide an unbiased, concise, and detailed description of all field activities.

Step-by-step instructions and procedures for documenting field activities are provided below. They are organized as follows:

1. The first set of instructions and procedures provide general guidance relating to the format and technique in which electronic field entries are to be made. It is important that field activities are documented in the most organized, chronological manner possible.

2. The second set of instructions and procedures provide guidance on the type of information to be recorded when field activities are electronically documented. In general, the following information must be recorded:

    - The identities and affiliation of the personnel conducting field activities.

    - A description of the type of field work being conducted (*e.g.*, surface water sampling, groundwater sampling, sediment core collection, etc.) and the equipment used.

    - The date and time the field activities were conducted, with specific temporal information for each task (*e.g.*, record the time activities commenced at each individual location, or when different types of activities commenced at the same location), if applicable.

    - The site where the field activities were conducted, and also any individual location within that site where work was performed (*e.g.*, specific sampling sites or gauging locations).

    - The general methodology used to conduct the activities.

Instruction and procedures relating to the format and technique in which electronic field entries are to be made follow:

1. Each day field activities are conducted the date, time, site name, location, names of Malcolm Pirnie personnel and their responsibilities, names of non-Malcolm Pirnie personnel, and observed weather conditions must be entered into the field laptop. Any deviations from the work plan that occur while field activities are being conducted must also be documented.

2. All photos taken must be associated with field entries and all photo locations must be referenced on a site map (for outdoor work) or site sketch (for indoor work). Information in the photo log must include the date, time, photographer, and a description.

3. All entries must be made in language that is objective, factual, and free of personal feelings or other terminology that might prove inappropriate.

4. All entries must be accompanied by the appropriate 24-hour clock time (such as 1530 instead of 3:30). A time and status entry is recommended every 30 minutes or less.

5. If the individual designated for field documentation tasks transfers those tasks to another team member, he or she must clearly document this transfer of responsibility.

6. At the end of each workday, all field data files will be uploaded to a database and a CD, or a disk back-up of the files will be created. Additionally, all electronic field data forms will be printed out at the end of each workday. The person(s) who made the entries must sign and date each page that is printed out.

Instructions and procedures providing guidance on the type of information related to field activities that must be recorded are provided below.

<u>General Site Information</u>

General site characteristics must be recorded. Information may include:

1. Type of access to the facility (locked gates, etc.).

2. The physical characteristics of the site and adjacent areas, such as topography, demography, distance to population centers (including residential, commercial, and industrial areas), wells, and prime agricultural land.

3. Any observations of unexpected conditions on the site (e.g., observation of drums that had not been previously recorded).

4. All information obtained from interviews with personnel granting access or responsible party personnel (if applicable), or other interested party contacts on site.

5. The names of any community contacts present on the site.

Sample Activities

A chronological record of each sampling activity must be kept. During sampling, the following information will be entered into the laptop:

1. Explanation for sampling at a specific location.

2. The field equipment used and purpose of use (i.e., screening), calibration methods used, field results, and quality control (QC) information.

3. The specific sampling location.

4. The sample matrix (*e.g.,* sediment, water, or air).

5. A sample description (e.g., color, texture, odor, sediment type, etc.) and any other important distinguishing features.

6. The sample identification number, volume, sampling interval, sampling method, and whether or not this is a quality control sample (e.g., duplicate). Any sample manipulations, for example compositing or preservation techniques, will also be recorded.

7. The date and time of sample and data collection and any factors that may affect their quality.

As part of chain-of-custody procedures, recorded on-site sampling information must include the sample number, date, time, sampling personnel, sample type, designation of sample as a grab or composite, and any preservative used. Sample locations should be referenced by sample number on the site sketch or map. The offer and/or act of providing sample splits to a third party (e.g., the responsible party or the responsible party representative; state, county, or municipal, environmental and/or health agency, etc.) must be documented.

Sample Dispatch Information

When sampling activities are complete, the various documents associated with sampling such as the chain-of-custody, traffic reports, Federal Express receipts, etc., must be stapled to the electronic forms printed out at the end of each workday.

Calculations and Measurements

Information for in-situ measurements must include a sample ID number, the date, the time, and personnel taking the measurements. If in-field calculations are necessary, they must be checked and signed by a second team member.

IV. References

U.S. EPA-Characterization of Hazardous Waste Sites - A Methods Manual, Volume I - Site Investigations, April 1985:

USACE Requirements for the Preparation of Sampling and Analysis Plans, September 1, 1994.

SOP #9 Procedure to Conduct Sample Management

I. Introduction

The purpose of this guideline is to provide reference information regarding the sample management procedures to be employed at the Lower Passaic River Restoration Project Superfund Site.

II. Definitions

Target Compound List (TCL) – A list of chemical substances consisting of 141 organic compounds. The list is broken into three subdivisions: volatiles, semi-volatiles, and pesticide/PCBs.

Target Analyte List (TAL) – A list of chemical substances consisting of 23 inorganic contaminants and cyanide.

Rinsate Blanks – Rinsate blanks are used to check sampling equipment for contamination. Rinsates are collected for each type of sampling equipment used on site. Demonstrated analyte-free water is poured over the equipment, collected into bottles, and analyzed for the analytes of concern.

Environmental Duplicate – These are two separate samples collected at the same sampling point. Environmental duplicates are primarily used to determine field sampling precision and are collected at a frequency of at least 5 percent per matrix.

Matrix Spike/Matrix Spike Duplicates (MS/MSD) – The process by which a known quantity of the analyte (or analytes) of interest is added to environmental samples prior to analysis. An aliquot of the sample is split into two sub-samples, spiked with the analyte of interest and analyzed. The analysis is used to evaluate the matrix effect of the sample upon the analytical methodology, and as an indicator of a laboratory's analytical bias and precision.

III. Guidelines

The purpose of a sample management program is to ensure that all of the samples collected during a hazardous waste site investigation are accounted for when the project is completed. The sample management officer is also responsible for assuring that the proper quality assurance/quality control (QA/QC) samples are collected. These goals can be achieved by adhering to the following procedures:

SAMPLE MANAGEMENT

1) Prepare the Sample Bottles

A) All sample bottles must be cleaned and prepared in accordance with OSWER Directive #9240.05A, December 1992, "Specifications and Guidance for obtaining Contaminant Free Sample Containers."

- Only certified clean sample bottles obtained from an approved supplier will be used. Copies of these certifications will be kept in the site file for future reference.

B) Sample bottles will be prepared prior to the sampling event whenever possible, as preparation of the bottles beforehand helps eliminate error. A sample label containing the following information will be affixed to each sample bottle:

1. Project name and/or number
2. Field ID or sample station number
3. Designation of sample as grab or composite
4. Sample matrix
5. Sample preservation notes
6. Analytical parameters

Clear, acetate tape will be applied over all labeling to maintain label integrity during decontamination procedures.

2) Sample Documentation, Packaging, and Shipping Procedures

One of the field personnel will be designated as the sample management officer. The sample management officer will bear the ultimate responsibility for the documentation, packaging, and shipping of the samples. These procedures are outlined below:

A) Documentation/Chain of Custody

Field Laptop

For documentation purposes, the sample management officer will enter the following sample management information into the field laptop:

- Sample date and time of collection
- Associated QC samples
- Any special designation (i.e., split, duplicate, MS/MSD, and rinsate samples)
- Analyses required
- Any problems (e.g., insufficient sample volume)

Chain of Custody

The sample management officer will also fill out the chain-of-custody (COC) form. The COC form serves as an official communication to the laboratory detailing the particular analyses required for each sample. For routine analytical services (RAS) samples, the EPA COC form will be utilized. For non-RAS samples either a Contract Laboratory Program (CLP) COC or a lab specific COC will be used. The lab specific COC must be equivalent to the EPA COC.

At the time of sampling, a chain of custody form will be filled out for each sample or group of samples. The sampler (under the sample management officer's direction) or sample management officer will complete a COC record to accompany each shipment from the field to the laboratory. The COC form will accompany the samples from the time of sampling through all transfers of custody. It will be kept on file at the laboratory where samples are analyzed and archived. The form will be filled out in triplicate; one copy will be retained by the Field Team Leader and two will be sent to the laboratory. A separate COC record will be filled out for split samples.

Errors will be crossed through with a single line, initialed, and dated. All entries will be legible. The following information will be recorded on the COC:

1. Project name and/or project number
2. Signature of sampler(s)
3. Sampling station number
4. Date and time of collection
5. Grab or composite sample designation
6. Sample matrix
7. Sampling location description
8. Field identification number
9. Analyses required
10. Preservation technique
11. Signatures and dates for transfers of custody
12. Air express/shipper's bill of lading identification numbers
13. Tracking (Laboratory Information Management System (LIMS)) number; this is only required for split samples

After all shipping and documentation is completed, the documentation will be maintained as follows:

Laboratory

- 1 original copy of all the chain-of-custody forms

Project File

- 2 original copies of all the chain-of-custody forms (one original will be sent back by the laboratory after sample analysis is complete)
- All original airbill receipts
- All bottle lot certifications

B) Packaging and Shipping Samples

1. Make sure the caps on the sample bottles are tightly sealed. Wipe down the outside of all of the sample bottles.

2. Preserve the samples according to the SOP#5 for Sample Preservation.

3. Apply one custody seal around the circumference of the bottle or over the cap and onto the sides of the bottle. The custody seal will be applied to the sample bottles in such a manner as to reveal if the bottle was opened during transit.

   Note: Septum vials should not be covered over the top.

4. Place each bottle in its own ziplock bag. Note: the two aqueous 40-ml VOA vials may be placed in one bag. Eliminate extra air space from the bag before resealing. The EnCore® device comes in its own ziplock bag, and this ziplock bag will be used.

5. Prepare the shipping container (i.e., cooler) so that no leakage can occur during shipping. All valves on the cooler will be securely sealed with duct tape, both inside and outside the cooler, and the cooler will be lined with either plastic or a large garbage bag. Only coolers that conform to the general design requirements in 49 CFR § 173.410 will be used for shipment.

6. Pack the coolers.

7. Surround the samples being shipped for chemical analysis (e.g., TAL/TCL) with bags of ice. The ice will not be kept in its original bag, but will be repacked into ziplock bags. Place a temperature blank (40-ml vial filled with DI water) into the cooler. Use enough ice to ensure that the proper temperature (4-6^{o}C) is achieved and maintained during transport. Note that not all samples (e.g. physical parameters) need to be cooled.

8. Place packing material over and around the sample bottles. Sufficient packing material will be used so the bottles will not move or break during transport.

9. After the cooler has been packed for shipment, the plastic or garbage bag will be closed and securely taped.

10. The COC form will be placed in a ziplock bag and taped to the inside of one of the coolers. Prior to shipment, the "relinquished by" and "received by" sections of the chain of custody form will be filled in. Generally, the shipper will not sign the chain of custody form. Therefore, the carrier's name is filled in by the sample management officer.

11. Close the cooler and seal with strapping tape.

12. Apply signed and dated custody seals to the cooler. Place two custody seals diagonally across from each other where the cooler lid meets the cooler. The custody seal will be applied in such a manner as to reveal if the cooler was opened during transit.

13. An address label will be placed on the outside of each cooler. The label will be covered with clear tape.

14. If more than one cooler is being sent to one destination, each cooler will be appropriately labeled as 1 of X, 2 of X, etc.

15. The Airbill will be attached to one of the coolers.

16. The laboratory will be notified of the shipment before 10 a.m. on the day after shipping.

QA/QC SAMPLES

The sample management officer is responsible for ensuring that the appropriate types and numbers of QA/QC samples are collected. These samples include rinsate blanks, trip blanks, temperature blanks, duplicates, splits, and MS/MSD samples.

Rinsate Blanks

Rinsate blanks are collected for each type of equipment used each day a when a decontamination event is carried out, with a maximum of one rinsate blank per equipment type per day. Composite rinsates will be collected from all equipment associated with a particular matrix (e.g., composite the rinsate from stainless steel scoops, bowls or trays, and scoopulas) for analysis of semi-volatile organics, pesticides, PCBs, inorganics, and radionuclides. Rinsate blank collection must be conducted sequentially on all sampling equipment. However, a separate rinsate blank for volatile organics analysis will be collected for each type of equipment associated to a particular sample matrix. Rinsate blanks are collected by pouring demonstrated analyte-free water over clean equipment and collecting the water into the proper sample bottles. Rinsate blanks are noted as such on the COC.

Environmental Duplicates

Duplicate samples are collected at a minimum frequency of 1 duplicate per 20 samples for each matrix (*e.g.*, soil or water), and are analyzed for all analytical parameters of interest. For soil samples, the volatile organic fraction is collected as a co-located grab sample while the non-volatile fraction is homogenized. The laboratory is not informed about which samples are duplicate samples (a fictitious sample identification is used for the duplicate and the association between the fictitious sample name and the corresponding environmental sample is noted in the field notes).

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The designation of a sample for MS/MSD analysis for organics and inorganics is required for 1 in 20 environmental samples per analytical parameter for each matrix sampled. No extra sample volume is usually required for the soil samples. MS/MSD samples are noted as such on the COC.

Split Samples

Split samples are collected at a minimum frequency of 1 duplicate for every 20 samples for each matrix sampled (*e.g.*, soil or water), and are analyzed for each analytical parameter. For sediment samples, the volatile organic fraction is collected as a co-located grab sample while the non-volatile fraction is homogenized. The split samples, along with associated trip blanks and temperature blanks, are sent to the government QA laboratory for analysis.

IV. References

U.S. Environmental Protection Agency. Region 2, Environmental Services Division, Monitoring Management Branch, CERCLA Quality Assurance Manual, October 1989, Revision 1.

Sampler's Guide to the Contract Laboratory Program (CLP), U.S. EPA, EPA-540/R-96/032.

Code of Federal Regulations, Title 49, Transportation Revised, October 1, 1986.

USEPA CLP SOW for Organic Analysis Multi-Media, Multi-Concentration, Doc. No. OLM04.2, 1999.

USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration, Doc. No. ILM04.0, 1996.

USACE Requirements for the Preparation of Sampling and Analysis Plans, September 1, 1994.

SOP #10: Procedure for Geotechnical Coring and Sampling

I. Introduction

This procedure describes the equipment and methods to be used to collect geotechnical sediment cores at the Lower Passaic River Superfund Site. This procedure specifically addresses collection of sediment cores using vibracoring techniques.

II. Definitions

ASTM: American Society for Testing and Materials.

PID: Photo ionization detector

RTK GPS: Real-Time Kinematic Global Positioning System

III. Equipment and Supplies

The following equipment will be needed to collect sediment cores:

- **Sampling Boat** capable of deploying vibracoring apparatus and with sufficient room for all vibracoring operations (i.e., core tube and equipment storage, lay down area, working space, and drummed disposal storage). Sampling boat must also be properly sized and equipped to operate in the typical water depths and conditions anticipated at the project site.
- **Calibrated Steel Rod** to investigate the sediment type and probe the depth of unconsolidated sediments at a sampling location and to determine the length of tubing to use.
- **Vibracorer** and ancillary equipment required for use.
- **Lexan Tubing** of appropriate diameter (approximately 2-inch O.D.) and wall thickness for use with the vibracoring apparatus.
- **Ponar Dredge** to use at locations where core samples cannot be collected (e.g., due to shallow sediment depth or other coring difficulties).
- **Personnel protective equipment (PPE)** - including hard hat, steel-toe boots, safety glasses, ear plugs, personal flotation devices, and disposable gloves.
- Measuring tapes, scales, field books, pens, pencils, and permanent markers, digital camera, field application equipment, and RTK GPS equipment.
- Power tools for cutting open collected core tubes including router or circular saw and pre-assembled wooden jig to guide the cutting tools.

Guidelines

The sampling procedures must be performed, observed, and adjusted as necessary to minimize sample disturbance, loss of soil structure, and the production of wash material and fallen cuttings.

The sediment samples will be visually classified by a field geotechnical engineer to identify and record subsurface strata, soil structure, and material characteristics. The visual engineering soil descriptions will be performed in accordance with Unified Soil Classification System (USCS) outlined in ASTM D 2487-98 and ASTM D 2488-93. The descriptions contain the following items:

- Color;
- Apparent density (e.g., very loose to very dense for sandy soils) or consistency (e.g., very soft to hard for plastic soils), moisture content (e.g., dry, moist, or wet);
- USCS description followed by the two letter USCS group symbol;
- Vane shear; and
- Any other soil structure observations (e.g., layered, varved, lenses, etc.).

Typical descriptions for a sandy and clayey soil are shown below:

Example #1 - Sandy soil description (less than 50% fines)
Brown, dense, moist, silty SAND with gravel (SM), some varved layers.

Example #2 - Clayey soil description (more than 50% fines)
Grey, soft, wet, sandy lean CLAY with gravel (CL), homogenous.

It should be noted that indications of soil structure (i.e., layering, orientation of soil grains, and other depositional features) are as important as, and can be even more important than, the material descriptions (i.e., grain size distribution, plasticity, consistency or density, among others). Even so-called disturbed sampling methods such as vibracoring generally retain a significant degree of soil structure for all but the most friable of soil types.

Soil types (i.e., engineering soil descriptions) can change over short distances, even within the length of a single sample. Collecting two or more specimens in close proximity could be necessary to accurately log soil strata and strata changes within some spoon samples.

IV. Geotechnical Boring Collection Procedure

Special Precautions for Sampling

The following general precautions should be taken when sampling:

1. A clean pair of new, disposable gloves will be worn each time a different location is sampled. Gloves should be put on immediately prior to sampling.

2. All used field equipment (e.g., trowel, bowls, etc.) to be decontaminated will be placed in plastic bags. All field waste (i.e., PPE, plastic sheeting, towels, etc.) to be disposed of will be placed in a separate plastic bag. All equipment will be properly decontaminated before using it on subsequent borings.

Utility Clearance and Decontamination

The applicable organization (U.S. Coast Guard) will be contacted for utility clearance prior to any core collection activities.

All non-dedicated equipment will be decontaminated following the completion of drilling and sampling activities at each boring location.

Procedure for Advancing Geotechnical Borings

1. All data from sediment core collection will be recorded in the laptop-based field application. Prior to the start of collection activities each day, the field application will automatically download the daily weather and tidal conditions from the NOAA website. A laptop computer loaded with the field application will be present on the sampling vessel or drilling barge, and upon completion of sampling at one location, all data from the core collection will be entered into the field application. The field application will prompt the user for the required information Blank field log sheets that can be used to record information manually also will be provided in case difficulties with data entry into field application on the boat are encountered. Manually recorded data will be transcribed into the field application at the end of each day.

2. Using the on-board GPS system, maneuver the sampling vessel to within 5 ft of the preprogrammed target coordinates for each sample location. Secure the vessel in place using spuds and/or anchors. Record in the field application the actual location from which the core was collected and the target location.

   If the water is too shallow for the sampling vessel to navigate (i.e., less than approximately 2 feet deep), the location will be temporarily abandoned, and the field sampling coordinator will be notified.

3. Use a calibrated steel rod to probe the sediment surface 3 to 5 ft away from the target location to determine the sediment thickness and type.

   - If the estimated sediment thickness at the probing area is greater than 6 inches, record probing information in the field application and attempt to collect a core using the vibracorer.

- If the estimated sediment thickness at the probing area is less than 6 inches, additional probing of the sediment surface will be conducted within 3 ft of the target location for deeper sediments. If thicker sediments are found, relocate the boat to the new coordinates and attempt to collect a core. If sediment depth appears to be systematically less than 6 inches, make one attempt at collection with the vibracorer. If 80% recovery is not achieved after one attempt, collect a sample with a ponar dredge.

4. Once the targeted area is deemed suitable for core collection, attach a clean, decontaminated core catcher (if they are used) to a clean core tube according to manufacturer's instructions. Mount a clean core barrel (if used) and the core tube/core catcher unit onto the vibracore device, using extension tubes as necessary.

5. Lower the coring apparatus with the core tube attached vertically through the water column tube end first, until the river bottom is reached. The vibracore apparatus should be activated as soon as the core tube reaches the sediment-water interface (i.e., based on the depth recorded from probing and/or encountering a resistance to descent of the apparatus) to immediately liquefy the sediments along the tube walls, reduce penetration resistance, and maximize sediment sample recovery.

6. Vibrate the core into the sediment to refusal. Measure and record the depth of core tube penetration into the sediments in the field database.

7. Pull the apparatus upward out of the river bottom and raise it to the surface, while maintaining the core in a vertical position.

   - Rinse off the outside of the core tube or core barrel with river water as the sample breaks the surface of the water

8. If core barrels and core catchers are not used during sampling, place a cap over the bottom of the tube before it breaks the surface of the water to prevent the loss of material from the tube. Secure the cap in place with duct tape when brought on board the vessel.

   - If a core barrel is used during sampling, attach a safety hook or other device to the bottom of the core tube and release the core tube from the vibracore unit. Slide the tube out of the barrel, keeping it as upright as possible. Place a cap over the bottom of the core tube/nose cone unit, securing it with duct tape. Rinse the outside of the core tube with river water if necessary.

9. Measure the recovered length of the sediment core and record it in the field application.
   - Insert a decontaminated stainless steel ruler with a "foot" into the top of the core tube and slowly lower it until the foot comes to rest on the surface of the sediment. It may be necessary to cut off excess tubing to make the

measurement. The distance between the top of the sediment in the core tube and the bottom of the coring tube corresponds to the estimated length of the recovered core. Mark the recovery on the outside of the core tube.

    - If using a core catcher, make a note of the height of the bottom of the core catcher inside the cap, as the bottom of the cap will not correspond to the bottom of the tube.

10. Compare the length of the recovered core with the core penetration depth.

11. If the recovered length of the sediment core is more than 80% of the penetration depth, keep the core.

12. If an insufficient amount of material is recovered, put the core tube aside and make additional attempts to collect a core that satisfies recovery goals (see below). If a compliant core is obtained, discard the non-compliant core into a re-sealable 5-gallon pail and store for subsequent investigation-derived waste (IDW) disposal.

    - An additional attempt will be made at a minimum distance of 1ft from previously attempted locations.

    - A maximum of three attempts to collect a core will be made for a given location ID. The “best” core—that with a recovery closest to the minimum acceptance criteria, should be retained.

        - For example, if the first attempt to collect a core yields a sample with a recovery of 65%, and the second attempt yields a sample with a recovery of 70%, the second sample should be kept and the first discarded.

    - Rinse the core tube with river water between consecutive attempts if the same core tube is used. If a core barrel is used, rinse it with river water between consecutive attempts,

    - If all three attempts to collect a core are unsuccessful based on recovery alone (i.e., less than 80% recovery), retain the final core for analysis and put flag in the field application that indicates that the targeted recovery was not achieved.

    - If an acceptable core cannot be collected within 3 feet of the node location, collect a grab sample using a Ponar dredge and note conditions preventing core collection in the field database.

13. After a successful core recovery enter prompted information into the field application:

    - Date

- Time of recovery
- Actual coordinates of the sample location
- Water depth (ft)
- Core tube material e.g., Lexan®)
- Core penetration depth (in)
- Observations, including probing results

14. Place a second cap on the top of the core tube and secure in place with duct tape.

15. Draw an arrow on the core tube with permanent marker to indicate the top of the core, and label the core tube with the station ID, date, and collection time using permanent marker.

16. Store the core vertically until classification is conducted by a field geotechnical engineer. To access the sediment for classification and collection of record samples, lay the core tube on a work surface or vessel deck horizontally and cut the tube open longitudinally with a router or circular saw, using a pre-built wooden jig to control the cutting tool. All collected sediments not jarred as record samples will be retained and drummed for disposal.

17. At locations where core samples cannot be collected, grab samples will be collected using a Ponar dredge. Lowering the Ponar dredge until it comes in contact with the sediment and the release mechanism trips, giving the lead line a tug to ensure that the device has closed. Retrieve the Ponar dredge and empty the contents into a new aluminum pan, draining out any excess water. Seal container with lid and duct tape and label with station ID, date, and collection time using permanent marker.

18. Decontaminate the Ponar dredge according to the following decontamination procedure:

    - Wash with laboratory grade detergent
    - Rinse with distilled water
    - Rinse with distilled water and air dry

Contain rinsate for disposal at the field processing laboratory or other mobilization site.

V. References

ASTM. D 2487. Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System). American Society for Testing and Materials, West Conshohocken, Pennsylvania. 1998.

ASTM D 2488. Standard Practice for Description and Identification of Soils, Visual-Manual Procedure. American Society for Testing and Materials, West Conshohocken, Pennsylvania. 2000.