Long-Term Cap Monitoring and Maintenance Plan—Revision 0

River Mile 10.9 Removal Action, Lower Passaic River Study Area

Prepared for

Cooperating Parties Group, Newark, New Jersey

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CH2MHILL®

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Contents

Acronyms and Abbreviations

AOC	Administrative Settlement Agreement and Order on Consent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
COPC	chemical of potential concern
CPG	Cooperating Parties Group
ft	foot, feet
in.	inch, inches
LPR	Lower Passaic River
LPRSA	Lower Passaic River Study Area
NCP	National Contingency Plan
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QAPP	Quality Assurance Project Plan
RM	river mile
SAP	sampling and analysis plan
SOP	standard operating procedure
SPME	Solid-phase microextraction
SVOC	semivolatile organic compounds
TCRA	Time-Critical Removal Action
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
yd^3	cubic yard

SECTION 1

Introduction

This Long-Term Cap Monitoring and Maintenance Plan (LTM Plan) for River Mile (RM) 10.9 of the Lower Passaic River (LPR) has been prepared pursuant to the Administrative Settlement Agreement and Order on Consent (AOC) for Removal Action, Docket No. 02-2012-2015 (USEPA, 2012a), by the Cooperating Parties Group (CPG). The AOC became effective on June 18, 2012.

Sediment removal from RM 10.9 and subsequent capping will be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as a Time-Critical Removal Action (TCRA). The removal action selected by the USEPA is presented in the Action Memorandum/Enforcement dated May 21, 2012 (USEPA, 2012b).

The long-term monitoring program will be implemented to ensure that the protectiveness and integrity of the engineered cap is maintained over its lifetime. The activities to be conducted include both physical and chemical performance monitoring as discussed herein.

1.1 Project Description

Because of elevated concentrations of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), mercury, and other chemicals of potential concern (COPCs) and the potential for receptors from the neighboring park to be exposed to them, the CPG is required under the TCRA to perform all actions necessary to remove, treat, and/or properly dispose of approximately 18,000 cubic yards (yd^3) of sediment from a designated portion of RM 10.9.

The TCRA specifies removing a predetermined depth of sediment (uppermost 2 ft) and capping in-place the remaining sediment. The remedial action objectives are to mitigate potential threats to public health, welfare, and the environment posed by the presence of chemicals in the RM 10.9 Removal Area surface sediments and to minimize the bioavailability of these chemicals. To achieve these objectives, following completion of the sediment removal, an appropriately protective cap will be designed, constructed, monitored, and maintained. Most of the removal area will be capped; however, a small portion along the shore at the removal area's easternmost end cannot be capped due to slope instability.

1.2 Site Background

The RM 10.9 Study Area extends, bank to bank, from RM 10 to RM 12 of the Lower Passaic River Study Area (LPRSA) (**Figure 1-1**). The RM 10.9 Sediment Deposit Area, an area within the RM 10.9 Study Area, extends approximately 2,380 ft, from RM 10.65 to RM 11.1. The RM 10.9 Removal Area (**Figure 1-2**) is an approximately 5.6-acre area located on the eastern side of the LPRSA within the RM 10.9 Sediment Deposit Area. It is situated along an inside bend of the LPR, upstream of the DeJessa Park Avenue Bridge, and includes the mudflat and point bar in the eastern half of the river channel. The removal area is bounded to the west by the navigation channel of the Passaic River and to the east by the Riverside Park complex. Sediments will be dredged, and a cap subsequently placed, within a designated area of the RM 10.9 Removal Area.

SECTION 2

Cap Design Summary

A cap will be placed on the post-dredge sediment to physically and chemically isolate the remaining sediment COPCs from the environment by means of chemical containment and erosion protection. The key components of the cap, presented in **Figure 2-1,** include a 6 in. sand layer, which will be placed directly above the post-dredge sediments and covered by an active cap layer, which will be overlain by a geotextile; a top armor layer will be the topmost component. A summary of the cap design elements are presented below and discussed in more detail in the RM 10.9 Pre-Final Design (CH2M HILL, 2012).

2.1 Armor Layer

The top armor layer is designed to prevent erosion of the cap material during high river flows or other environmental forces. The preliminary armor layer design is based on a flow of 32,000 cubic feet per second (cfs) which is more than a 100-year return period flood flow. Use of the 100-year return period flood for the design is consistent with recommendations in USEPA (2005) guidance; however, the cap is expected to remain generally intact even if the 100-year return period flow is exceeded. The armor layer will be revised once a 100-year return flow (22,000 cfs) is simulated with the RM 10.9 hydrodynamic model. The river's velocities and associated erosive forces are not uniform, and the highest velocities used for design impact only small portions of the cap on its western edge. Thus, the vast majority of the cap will withstand flows that are higher than the 100-year return period flood.

The armor layer will consist of stones of Type A and Type B size gradations. The Type A armor layer will consist of a D_{50} of 7 in. in areas below (deeper than) the -3.0 ft contour, and Type B armor layer will consist of a D_{50} of 4 in. in areas above (shallower than) the -3.0 ft contour. Contour elevations refer to elevations before dredging bathymetry. The Type A armor layer will be 18 in. thick, and the Type B armor layer will be 12 in. thick.

2.2 Physical Separation and Stabilization Layers

A sand layer 6 in. thick will physically separate the sediment and the active layer, which will reduce the physical fouling of the active layer by the sediments. A geotextile will be placed between the active layer and the armor layer. The function of the geotextile is to protect the chemical isolation layer during placement of the armor layer and to prevent the active material from being eroded through the stone layer. The geotextile also acts as a bioturbation barrier in addition to the armor stone layer, thereby preventing burrowing benthic organisms from passing into the active layer and the contaminated sediment.

2.3 Active Cap Layer

The active cap layer will consist of either activated carbon or organoclay, or a mixture of both materials. The active layer will be either a Reactive Core Mat(s) as manufactured by CETCO or AquaGate composite particles manufactured by AquaBlok. A treatability study will be performed using site sediments to determine which materials (i.e., activated carbon and/or organoclay) best meet the cap performance criteria.

SECTION 3

Cap Monitoring

Long-term monitoring of the cap will be performed to evaluate the continuing integrity and environmental protectiveness of the cap and to access the need for maintenance. This section presents the monitoring objectives and approach.

3.1 Monitoring Objective

The main objective of long-term monitoring is to ensure that the cap is performing the basic functions, such as physical and chemical isolation, required to meet the remedial objectives. The monitoring activities will focus specifically on cap integrity, thickness, consolidation, and the potential breakthrough of COPCs via chemical migration through the cap.

3.1.1 Physical Performance Monitoring

The physical performance monitoring of the cap will be performed to monitor the cap integrity and thickness in response to physical processes such as erosion due to high flows, ice scour, flooding, and anthropogenic activities.

3.1.2 Chemical Performance Monitoring

The main objective of the chemical performance monitoring is to ensure chemical containment. The chemical performance of the cap will be monitored over time based upon pore water concentrations in the armor layer.

3.2 Monitoring Approach

The long-term monitoring will involve routine periodic monitoring of the physical integrity of the cap as well as event-based monitoring triggered by high flow events or in-river construction activities that could affect the integrity of cap:

- Routine physical monitoring—1 year after construction and every 5 years thereafter for 30 years
- Routine chemical monitoring— 5, 30, and 100 years after construction and every 100 years thereafter Event-based monitoring—after specified high-flow events and in-river construction activities

3.2.1 Routine Monitoring

Routine monitoring will be performed using non-destructive means (i.e., bathymetric surveys, poling and probing, and pore water sampling) to evaluate cap integrity and ensure chemical containment. The routine physical monitoring will be performed 1 year after cap construction and every 5 years thereafter or until otherwise determined as a part of the 5-year review process. The physical monitoring will be accompanied by chemical monitoring at years 5 and 30. Termination of routine physical cap monitoring may be appropriate prior to completion of the full 30-year monitoring period if cap performance is found to be consistently within acceptable criteria. During each 5-year review, the physical and chemical data collected to date will be considered to determine whether it is appropriate to decrease the cap monitoring period.

3.2.2 Event-Based Monitoring

Event-based monitoring will be performed in addition to the routine monitoring following river flow events or construction activities that could affect the integrity of the cap. The flows for RM 10.9 are approximated using measurements from LPR gauging station Little Falls. Flow rates corresponding to recurrence intervals ranging from 5 years to 100 years are presented in **Table 3-1**.

Event-based monitoring will be performed within 6 months following a designated river flow event. Daily average flow exceeding the flow events listed in **Table 3-1** will be used to trigger the event-based bathymetric surveys. Additional event-based cap monitoring will occur each time the 100-year flow event is exceeded.

In addition to flow events and in-river construction activities, significant cap erosion can trigger monitoring. Erosion that results in a significant cap elevation differential (i.e., detectable within the sensitivity of the bathymetric survey) between the previous bathymetric surveys and the most recent bathymetric survey will require additional monitoring. However, since consolidation beneath the cap can also cause a differential in bathymetric surveys, the underlying source of the elevation change (i.e., distinction between cap erosion and cap consolidation) must be determined prior to initiating additional monitoring.

TABLE 3-1
Summary of Designated Lower Passaic River Flow Events
RM 10.9 Long-Term Monitoring Plan, Lower Passaic River Study Area, New Jersey

Recurrence Interval (Years)	Flow Rate (cfs)
5	10,485
10	12,906
25	16,237
50	18,920
100	21,777

3.3 Data Quality Objectives

The data quality objectives define the quality of data required to meet the project objectives. The physical and chemical performance monitoring activities will be conducted using standard operating procedures (SOPs) and acceptable levels of precision, accuracy and representativeness. The performance monitoring methods and procedures are defined in the SOPs (Appendix A), the Sampling and Analysis Plan (SAP) (Appendix B), and the Quality Assurance Project Plan (QAPP) (Appendix C).

SECTION 4

Physical Performance Monitoring

The cap is designed to effectively resist physical processes that can affect the cap integrity and thickness. Physical performance monitoring will be performed to assure the physical structure of the cap remains intact and the overall cap continues to perform its function to physically and chemically isolate the underlying contaminated sediment. Bathymetric surveys and other techniques such as poling and probing will be used to monitor the physical integrity of the cap.

4.1 Bathymetry Survey

The long-term monitoring bathymetric surveys will be performed using either single beam or multibeam acoustical systems that conform to U.S. Army Corps of Engineers (USACE) guidelines (USACE, 2004). Bathymetry survey and equipment requirements are detailed in Appendix D. Additional procedural requirements are included in the SOPs (Appendix A).

The survey data will be collected along the same transects for each survey to the extent possible to aid in data comparisons. Bathymetric changes over time will be used to identify potential changes in the physical integrity of the armor layer or the overall cap. During interpretation of the bathymetric survey data, consolidation of soft sediments beneath the engineered cap will also be considered. The extent of consolidation depends on the thickness of cap, the elapsed time after cap placement, the thickness of soft sediments beneath the cap, and initial condition and consolidation properties of the sediment.

For the RM 10.9 Removal Area, consolidation is expected to be in the range of 9 in. or greater. The consolidation of soft sediments is a long-term process, although most of the consolidation is expected to occur within the first year after cap placement. However, long-term physical monitoring of the RM 10.9 Removal Area will determine the consolidation time after cap placement. The physical cap monitoring will also detect if uneven consolidation beneath the cap is sufficient to affect cap integrity.

4.2 Armor Layer Assessment

The changes in bathymetry surveys over time will be compared to evaluate changes in the armor layer that could affect the integrity and thickness of the cap. If bathymetry survey data indicate erosion at least 50 percent of the way through the armor layer over an area covering greater than 5 percent of the total cap area, the affected cap area will be assessed by poling and/ or diver inspection. If the poling and/or diver inspection confirms the integrity of armor layer, then settlement of sediment substrate will be determined. Poling will be completed with a standard poling rod (e.g., ¾ in. diameter) with gradations of 0.1 ft to estimate sediment thickness. The poling inspections will performed to determine the presence of gravel/stone based upon pole refusal and measurements to the top of armor layer.

SECTION 5

Chemical Performance Monitoring

Chemical performance monitoring will be conducted to assure that the cap continues to chemically isolate the environment from COPCs remaining in the postdredge sediments. The chemical performance data will determine whether the cap is performing as designed and will also identify the need for cap maintenance.

Solid-phase microextraction (SPME) and pore water diffusion equilibrium (peeper) methods will be used during the routine chemical monitoring activities to detect and quantify chemical transport through the cap. These methods greatly reduce the need for large volumes of sediment pore water, which is inherently more difficult to collect, ship, and prepare for analysis. A description of the SPME samplers and peepers are provided in the SOPs (Appendix A). A detailed sampling plan and data quality objectives are provided in the SAP (Appendix B) and QAPP (Appendix C).

5.1 Chemical Migration Evaluation

Chemical migration through the sediment cap can result from the advection of pore water due to changes in effective stress, waves, groundwater flux, or consolidation. To monitor for and detect breakthrough of COPCs originating from the underlying postdredge sediments, pore water within the armor layer of the cap will be characterized. These results will represent constituents in pore water that vertically migrated up through the chemical isolation (active) layer of the cap.

Since each chemical interacts with pore water and cap materials differently, sampling that focuses on the more mobile and water soluble constituents provides an efficient and effective way to monitor the system as a whole. For example, phenanthrene has a lower molecular weight and higher water solubility than many of the COPCs present at the site. It also has a lower sorption capacity in sediments than do dioxin/furan and PCB congeners. These properties make phenanthrene more mobile than the heavier and stronger sorbing hydrophobic organic COPCs and an ideal candidate for monitoring potential breakthrough of organic COPCs through the cap. For this reason, phenanthrene concentrations in pore water will be monitored and serve as a surrogate for organic COPC transport through the cap. In addition to phenanthrene, total mercury will be directly measured to monitor the potential breakthrough of this COPC. Mercury is being considered separately because the reactive transport of the various mercury species does not follow the same mechanisms as the organic COPCs.

5.2 Monitoring Approach

SPME methods will be used to monitor phenanthrene migration through the cap. The SPME sampling devices will consist of fused silica fibers coated with a polymeric stationary phase such as polydimethylsiloxane. When these fibers are exposed to the media (e.g., pore water) analytes present in the media partition onto the coating until it reaches equilibrium. After the SPMEs reach equilibrium, the fibers will be retrieved and transported to the laboratory for analysis.

Mercury migration will be monitored using peepers. These devices contain small chambers with membranes that are filled with distilled water. The membranes allow dissolved constituents from the surrounding pore water to diffuse into the devise. Similar to the SPMEs, once equilibrium is reached the devices are retrieved and transported to the laboratory for analysis.

The monitoring devices will be deployed at the bottom of the armor layer, just above the geotextile. For this deployment, each device will be encased in a protective casing; however, the armor layer will still need to be temporarily removed in the vicinity of each sampler to reach the desired depth. The devices will be deployed at five equally-spaced locations along the cap, as indicated on Figure 5-1. In addition, two devices will be deployed, co-located with two of the armor layer sampling locations, to measure surface concentrations in the water column. To characterize background concentrations, surface water devices will be suspended above the cap surface in the water column.

Chemical concentration trends will be evaluated at each location to identify potential vertical migration up through the cap. If a statistically significant trend is identified at a give location, the appropriate steps will be taken to determine if this increase in concentration represents chemical breakthrough and whether a cap maintenance response action is warranted.

SECTION 6

Cap Maintenance

The maintenance of the cap includes repair or enhancement or other contingency actions as appropriate depending upon monitoring data or other information that indicate a pattern of cap degradation.

6.1 Cap Maintenance Trigger

A cap maintenance response action will be triggered if the monitoring data indicate that an area greater than 5 percent of the total cap area has eroded at least 50 percent through the armor layer or if chemical breakthrough is observed above risk-based levels.

6.2 Potential Response Actions

If a cap maintenance response action is triggered, the possible response actions will include:

- Repairing identified area
- Enhancing the armor layer in required area
- Enacting institutional or other controls to help minimize further cap erosion
- Removing the affected portion of the cap and the underlying contaminated sediment if an engineering evaluation determines that cap repair and/or other controls are unlikely to be effective in preventing recurrent future erosion
- Increasing the frequency of cap monitoring in the eroded area

Additional supplemental evaluations may be performed to identify which additional response activities may be appropriate for consideration. If monitoring or other information shows a pattern of cap degradation in multiple areas, then additional response activities may be considered, including cap enhancement (e.g., application of a thicker armor stone layer or use of larger armor stone) or cap and underlying contaminated sediment removal.

SECTION 7
References

CH2M HILL. 2012. River Mile 10.9 Prefinal Design Report, Lower Passaic River Study Area, October.

USACE (U.S. Army Corps of Engineers). 2004. Engineering and Design – Bathymetric Surveying Manual, Number EM 1110-2-1003. Revised April 2004.

USEPA (U.S. Environmental Protection Agency). 2012a. Diamond Alkali, Lower Passaic River Study Area—River Mile 10.9 Administrative Settlement Agreement and Order on Consent for Removal Action. May 21 (effective June 15).

USEPA (U.S. Environmental Protection Agency). 2012b. Action Memorandum/Enforcement: Determination of Need to Conduct a CERCLA Time Critical Removal Action at the Diamond Alkali Superfund Site, Lower Passaic River Study Area, River Mile 10.9 Removal Area.

Appendix A
Standard Operating Procedures

Appendix B
Sampling and Analysis Plan

Appendix C
Quality Assurance Project Plan

Appendix D
Bathymetry Survey and Equipment Details