# ATTACHMENT I

October 17, 2014

**Attachment I**

**GE-Housatonic River Site**
**Rest of River**
**Capping Principles Overview**

## Introduction

This documents sets forth principles and expectations with respect to the Engineered Cap Performance Standards and cap design objectives, methodology, and additional considerations, including cap thickness targets for the GE Housatonic Rest of River project. Specifically:

- EPA will ensure that the Engineered Cap Performance Standards are flexible enough to allow for construction of caps that are protective, permanent, and implementable and designed to minimize cap thickness to achieve these objectives.
    - It is recognized that cap thickness affects the dredge/excavation depth required and that there is commensurate value in minimizing the total cap thickness while ensuring that the cap will, over the long-term, physically isolate residual PCBs from human and environmental receptors and protect against future downstream transport.
    - Cap thickness can be minimized to the extent that one layer of material can satisfy more than one functional requirement such as mixing, chemical isolation, erosion protection, or habitat functions, as well as through other means.
- GE will have multiple opportunities in the process to ensure an effective cap design consistent with the Engineered Cap Performance Standards and based on the cap design principles set forth herein, and EPA will work cooperatively with GE during remedial design on cap design issues.
    - This document presents conceptual cap thickness targets for each reach of the Rest of River as further discussed below. Those thickness targets will be confirmed and other details of the specific engineered cap design parameters and requirements will be determined during the design process for the Rest of River remedy. Furthermore, through an Adaptive Management framework, GE can continue to optimize its cap design and construction methods as the project moves downriver.

## Design Objectives

- In-situ engineered caps for the project are intended to physically isolate contaminated sediments from potential ecological and human receptors, and minimize the transport of PCBs from the sediment beneath the caps to the bioavailable surface layer and the water column, consistent with the principles presented in EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (USEPA 2005) and *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998).

- The Engineered Cap Performance Standards specify a mixing and chemical isolation layer(s) and an erosion protection and habitat layer(s). For the chemical isolation component, they also specify the inclusion of a sorptive amendment such as total organic carbon (TOC) or activated carbon (AC), where necessary, to further attenuate the flux of PCBs. The Engineered Cap Performance Standards also contemplate the use of a filter layer between the chemical isolation layer material and erosion protection layer material where necessary. The objectives for these various cap layers are as follows:

  - Mixing and chemical isolation layer objectives:

    - The purpose of the mixing and chemical isolation layer(s) is to minimize the transport of PCBs up through the cap and into surface water and surficial sediment.
    - The mixing layer should be thick enough to prevent contamination of the chemical isolation layer material due to mixing with underlying contaminated sediments during cap placement, taking into account geotechnical considerations, placement techniques, and other factors as appropriate.
    - The design approach could include combining the mixing and chemical isolation layers (i.e., use of a single layer to serve both functions).
    - GE has utilized a model to make preliminary determinations of the isolation layer details in general accordance with EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA 2005) and *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998). As appropriate, GE will conduct additional modeling, using further site-specific data collected during the design process, to confirm these preliminary determinations.
    - Modeling has considered, and will continue to consider, the processes of advection, diffusion, sorption, bioturbation, and exchange with the surface water, and sediment deposition, consistent with current state-of-the practice for cap design.
    - Modeling has been, and will continue to be, parameterized based on site-specific data.
    - Modeling has been, and will continue to be, used to determine the thickness and composition (i.e., the amount of AC, TOC, or equivalent sorptive amendment) of the chemical isolation layer sufficient to minimize PCB concentrations at the cap surface (as defined by maintaining levels below a threshold value of 0.2 mg/kg for a minimum time period of 200 years).

  - Erosion protection layer objectives:

    - The engineered caps will include an erosion protection layer as necessary to minimize the potential for erosion and subsequent exposure of the underlying chemical isolation layer caused by currents and other erosional forces in the River.
    - The design flow event for the erosion protection layer is a flow event up to and including the 100-year return interval event.

- GE has utilized modeling and design calculations to make a preliminary determination of the erosion protection layer details in general accordance with EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA 2005) and *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998).
- The stable particle sizes necessary to resist the erosive forces in the different reaches of the River have been, and will continue to be, computed consistent with the above-referenced guidance documents or other pertinent EPA or U.S. Army Corps of Engineers (USACE) guidance.
- As appropriate, additional site-specific data and modeling will be used to determine the design velocities and associated bed shear stresses associated with various flow events.
- In addition, other potential erosional forces, including, but not limited to, bioturbation, wind-generated waves, debris, motor boat wakes, and ice impacts, will be considered. Some or all of these forces may have a negligible effect in some areas subject to capping.

- Geotechnical filter layer objectives:
  - The use of a geotechnical filter layer between the chemical isolation layer material and erosion protection layer material will be evaluated and may be necessary for those areas requiring cobble-sized material for erosion protection.
  - If needed, the geotechnical filter layer could be addressed through the placement of a geotextile layer consistent with the Engineered Cap Performance Standards specified above and pertinent EPA or USACE guidance.

- Other design objectives:
  - The design will evaluate the geotechnical stability of the caps (i.e., bearing capacity and slope stability).
  - The design will evaluate the need for a separate bioturbation layer. The erosion protection layer, where needed, could also perform the function of the bioturbation layer.
  - The design will incorporate habitat considerations. As appropriate, the design may include incorporation of the habitat layer into the erosion protection layer.
  - The design will consider the need for overplacement allowances for each layer as well as the associated specifications for sediment removal design, where applicable.
  - The caps cannot adversely affect flood storage capacity as per applicable state criteria.

**Additional Design Considerations**

The final in-situ engineered sediment cap designs for the Rest of River will be developed by GE for review and approval by EPA in accordance with the Engineered Cap Performance Standards and the above principles as well as the relevant provisions of the Consent Decree. Engineered

caps will be subject to inspection, monitoring and maintenance to ensure long term protectiveness of the remedy and to ensure they continue to meet Engineered Cap Performance Standards and function as designed.

This document specifies below conceptual thickness targets to meet the Engineered Cap Performance Standards as determined by the design considerations, objectives, and principles outlined in this document. During design, the composition and thickness of the capping materials will be optimized to promote reliability and effectiveness of the cap and to meet the Engineered Cap Performance Standards while minimizing cap thickness. The engineered cap thickness targets described below will be confirmed, based upon information developed during remedial design together with existing information, to meet the Engineered Cap Performance Standards as determined by the design principles and objectives outlined in this document.

The target cap thicknesses and layers are as follows:

- In Reach 5A:
  - Approximately 4.1 river miles (34 acres) of 1-foot-thick caps consisting of a 0.5-foot layer of fine gravel overlying a 0.5-foot sand layer amended with AC/TOC or equivalent as needed;
  - Approximately 0.6 river miles (5 acres) of 1-foot-thick caps consisting of a 0.5-foot coarse gravel layer overlying a 0.5-foot sand layer amended with AC/TOC or equivalent as needed; and
  - Approximately 0.4 river miles (3 acres) of 14-inch-thick caps consisting of 8 inches of cobble overlying a geotextile layer, which in turn overlies a 0.5-foot sand layer amended with TOC or equivalent as needed.
- In Reach 5B:
  - Backfill of excavation areas with material that is similar to existing sediment.
- In Reach 5C:
  - Approximately 2.6 river miles (37 acres) of 1-foot-thick caps consisting of a 0.5-foot fine gravel layer overlying a 0.5-foot sand layer amended with AC/TOC or equivalent as needed; and
  - Approximately 0.4 river miles (21 acres) of 6-inch-thick caps consisting of sand with a gradation designed to be stable and amended with AC/TOC or equivalent as needed.
- In Woods Pond, Rising Pond, and backwaters:
  - A cap of 6 inches thick, consisting of sand with a gradation designed to be stable and amended with AC/TOC or equivalent as needed; and
  - In the limited portions of backwaters areas, Woods Pond, and Rising Pond identified as having elevated velocities, caps similar to one of those in Reach 5A or Reach 5C, depending on local conditions.