Site Name: Zidell Waterfront Property
Location: Portland, Oregon
Type of Site: Former ship dismantling and barge construction
Contaminants of Concern: PCBs, metals, PAHs
Remedy: Cap over riverbank and sediment bed
Current Site Status: Post-construction monitoring and inspection

Case Study Objectives: Chemical isolation layer design, placement, and performance monitoring

Site Description: The Zidell site is a 30-acre parcel located along one-half mile of the Willamette River in Portland, Oregon, upstream of the Portland Harbor Superfund Site. Historical industrial activities include almost 100 years of ship building, ship dismantling, and barge building.

The primary risk management actions described in the ROD for the site include bank stabilization, capping, focused dredging, institutional controls, and natural recovery. To address varying water depth and bank slope conditions, several strategies were used in the design to stabilize the bank and to cap PCBs, metals, tributyltin, and other contaminants found in sediment. The clean up successfully addressed 32 acres of upland and 14 acres of submerged land.

Remedy Design: The final sediment cap was divided into three design reaches along the river to address variability in site conditions, topography, currents, and adjacent river uses. Individual detections of total PCB Aroclors ranged up to 7,200 parts per billion (ppb), with the highest concentrations near to shore. The selected cap footprint was predicted to achieve a reduction in the SWAC of total PCB Aroclors (the primary risk driver) within the sediment management area (including the capped area and adjacent sediments) of more than 90%, from 220 ppb to approximately 20 ppb. The remedial goal was to restore sediment within the sediment management area to ambient conditions, with a PCB SWAC between 10 and 20 ppb.

Cap design modeling was used to demonstrate long-term cap performance for a 2-foot-thick sand CIL (not augmented) and armoring layers. Sand was to be supplied from clean downstream navigation channel mine sites, permitted by the USACE, for which extensive characterization data was available to define model inputs. Maximum concentrations were evaluated in the cap model. Model sensitivity was evaluated for a range of model input parameters, CIL thickness, and contaminant concentrations. The cap model was developed to demonstrate compliance at the top of the sand layer and below the rock armor layer. Due to the armor layer thickness of more than 2 feet, bioturbation effects in the sand layer were not considered. The final model predicted that the surface of the CIL would reach a steady-state value (>1,000 years) that was less than the sediment cleanup levels that were established in the ROD. The final grading design for the sediment cap specified a minimum of 2 feet, though many areas were significantly thicker in order to address slope stability.

Within the barge slipway, a thin layer design was developed that relied on Reactive Core Mat® (RCM) by CETCO, which contained GAC and apatite. The thin layer design was required to fit within the 16-inch thickness of the barge launching rails and not interfere with operations. The design in the operational area called for a single layer of RCM containing GAC and apatite, with rock armoring. The cap model predicted satisfactory chemical isolation for more than 250 years.

Remedy Design and Construction: Hotspots of contamination were removed from the riverbank at the start of construction. Sediment remediation was sequenced to minimize opportunities for recontamination as a result of work in adjacent areas. Dredging was conducted in upstream areas first, while downstream dock pile removal was carried out. Following the dredging of the barge slipway, RCM was rolled out and secured over the ramp area and down to the river bottom by divers. The RCM was then covered by rock armor.

The contractor successfully demonstrated compliance with specification requirements limiting sand placement to a 1-foot lift as spread by a traditional clamshell dredge bucket onto a barge deck. The contractor-spread sand was slowly spread at the water surface allowing the particles to separate and filter through the water column to minimize settling velocity at the river bottom. Lift thickness was assessed by diver-retrieved sediment cores, which showed a very consistent lift application thickness of 11 to 13 inches. All sediment cores were sampled as part of the quality assurance program to demonstrate that the sediment cap had not been contaminated during installation.

After the first lift of sand cap had been placed, the contractor was allowed to place successively thicker lifts to achieve the design fill thicknesses ranging between 2 and 18 feet. The thicker fills were installed to increase the overall bank stability and limit the potential of a riverbank failure that could recontaminate the river bottom.

Post-Remedy Monitoring: The post-remedy performance program that is required by the ROD includes visual and chemical assessment on a periodic basis. An Operation Monitoring and Maintenance Plan also identifies actions required in the event that damage occurs to the cap as a result of natural forces (flood or earthquake) or impacts from ship traffic.

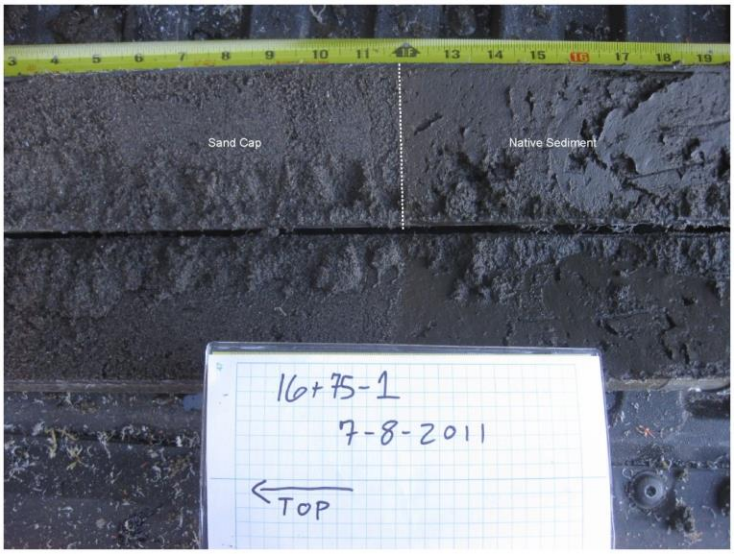
Annual engineering inspections evaluate the physical condition of all visible elements of the riverbank and sediment cap, with particular attention given to identifying any signs of erosion or differential settlement. Bathymetric survey of the sediment cap is conducted on five-year intervals and compared to the post-construction baseline survey. Three-dimensional surface analysis is performed to identify areas of significant change for further consideration. Chemical monitoring of the sediment within the sediment management area is performed on five-year intervals to demonstrate natural recovery. Sediment sampling is performed as a single decision unit using an incremental sampling methodology and assessed against the original sitewide SWAC calculations performed during remedy design.

RAOs/Project Objectives Achievement: Construction of the riverbank and sediment cap was completed in 2011. After 11 years of post-construction monitoring, the remedy is successful. The visual inspection routine has identified areas where vegetation on the riverbank cap was unable to withstand shoreline erosion, requiring supplemental placement of rock armor. The bathymetric monitoring program has demonstrated that the cap physically remains in place without significant settlement. The chemical monitoring events (conducted at years 1, 5, and 10) has consistently demonstrated that sediment concentrations within the sediment management area were decreased to levels that are consistent with ambient (10 to 20 ppb) and have become progressively lower.

References: Oregon Department of Environmental Quality, Zidell Waterfront Property Information Page, https://www.deq.state.or.us/Webdocs/Forms/Output/FPController.ashx?SourceIdType=11&SourceId=689

Figures/Photos (used with permission):

Chemical isolation layer sand placed in 1-foot lifts using traditional clamshell bucket.



QA diver core of sand lift placement verifying 12-inch thickness.