EXECUTIVE SUMMARY

REASONS FOR THE DEVELOPMENT OF THIS SUPPLEMENTAL FEASIBILITY STUDY

Operable Unit 2 (OU-2) of the Harbor at Hastings Site (Site) is a contaminated sediment site, approximately 31 acres of size, located in the lower Hudson River, next to a former copper wire and cable plant in Hastings-On-Hudson, New York. Polychlorinated biphenyls (PCBs) and copper are the primary contaminants of concern.

The New York State Department of Environmental Conservation (NYSDEC) issued a proposed remedial action plan (PRAP) in 2003 that recommended the removal of all contaminated sediments above certain Preliminary Remediation Goals ("PRGs") within approximately 100 feet (ft) of the shoreline

After reviewing public comments on the proposed remedy, the Department agreed that additional data and investigation was needed before proceeding with remedy selection. Accordingly, Atlantic Richfield Company, working with the Department, engaged in extensive additional field work in the Hudson River to collect data to:

- Determine the extent of fill material and debris in the near shore portion of the river, and evaluate its impact on dredging remedies;
- Delineate the extent of PCB contamination in the Old Marina, on the north side of the plant site, and evaluate appropriate remedies for that area;
- Determine the level of copper and other metals observed on site that are in a bioavailable and potentially harmful form, and evaluate remedies for those metals;
- Develop a three-dimensional model of contaminant distribution in sediment that incorporates new and existing data, to determine the volume of impacted sediment, its location and depth, and to show where most of the PCB and copper mass is located; and
- Evaluate how remedy options for the river (OU-2) may be coordinated with the selected remedy for the plant site (Operable Unit 1 [OU-1]), focusing on the area around the shoreline bulkhead, which divides the two operable units, and on surrounding geotechnical and river conditions (sediment shear strength, slope, water velocity and depth, and other factors).

AR gathered these data in 2004-2005, and submitted them to NYSDEC in a series of short reports. These new data, and the technical conclusions that result from them, form the basis for this Supplemental Feasibility Study.

SIGNIFICANT TECHNICAL FINDINGS

The additional data shows that four site conditions have a significant impact on the range of feasible remedy options. These are:

River Fill

Much of the contaminated sediment is found in a submerged berm of fill material, pilings, and debris that is 20 to 40 ft thick at the western shoreline. The fill is steeply sloped near shore, and then slopes more gradually down to the natural river bottom, which is over 40 ft deep. The plant site was built in the mid 1800's and early 1900's by placing fill material (silt, sand, gravel, rip-rap, ash, slag, glass, metal debris, wood, crushed stone, brick fragments, and other debris) into areas of the river that were up to 40 ft deep, and the submerged river berm along the shoreline is an integral part of the structure that holds the plant site in place. Remedy options that seek to remove all or most of the berm present extraordinary geotechnical challenges.

PCB Location/Mass

Most of the PCB mass (99 percent) is found along the northwest shoreline of the site. Moreover, most of that contamination is located within a few feet of the shoreline in the top 7 to 9 ft of sediment and fill material (approximately 60 percent to 75 percent of the PCB mass). However, PCB contamination does extend along the northwest shoreline to depths of nearly 40 ft below the mudline,[1] which is consistent with the depth of PCB contamination found in the northwest corner of the adjacent OU-1 plant site. Although all PCBs in the river were found in solid form, there are areas of PCBs still in non-aqueous phase liquid (NAPL) form on the plant site. The depth of PCBs in this area, and the presence of NAPL near the shoreline, present unusual challenges to the complete removal of PCBs from the OU-2 Northwest Corner area.

Only 1 percent of the PCB mass was found outside the OU-2 Northwest Corner Area, generally at low levels near the 1 part per million (ppm) preliminary remedial goal (PRG). Indeed, the area-weighted average level of PCBs outside the northwest shoreline area is below the 1 ppm PRG. To remove this material would require removal of large volumes of harmless material (including fill material) at great expense to reach the small mass of PCBs found there.

Metal Location/Mass

Most of the metal mass above proposed PRGs is concentrated in a small area near the plant shoreline, approximately 20,000 square feet in total size (0.5 acre), in the top 6 to 8 ft of sediment and fill material. The likely source of the concentrated metal contamination is shoreline outfall discharge points that released copper and related metals (lead, nickel, zinc) into the river when the wire and cable plant was in operation from 1919 to until the plant closed and the discharge terminated in the 1970's.

This localized area of elevated metal contamination should be distinguished from low levels of copper and other metals that were found throughout the Site, both on shore and in the river, in surface and in deeper fill material, at levels that exceed NYSDEC's stated background level for the Hudson River.

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1 The river bottom surface varies across the site. At the shoreline edge the river bottom surface is made of rocky fill material (the berm) with sediment in between. As one moves away from shore, a layer of river sediments collects on top of the berm, with the thickest sediment layer found near the toe of the berm. "Mudline" is used to refer to the river bottom surface throughout this area.

Recent USEPA studies and guidance (2005) found that bulk metal concentrations do not accurately predict whether contaminated sediment will be harmful to aquatic life. Instead, USEPA found there is a close relationship between the bioavailable fraction of metals and harm to aquatic life. The bioavailable fraction of metals can be measured in pore water and predicted based on the concentrations of organic carbon, acid volatile sulfide (AVS) and simultaneously extracted metals (SEM). Over the past two years, these data have been developed for the Hastings site.

At the Hastings site, the only metals detected in pore water samples were well below NYSDEC water quality standards, suggesting that metals are not bioavailable or harmful. In addition, the data demonstrate that natural sources of AVS/SEM and organic carbon found in the river sediments are binding the metals throughout most of the Site and preventing them from becoming bioavailable. As a result, the data support a conclusion that sediment copper concentrations below 982 ppm are not bioavailable and are not toxic to benthic organisms. The data also indicate that copper is an acceptable marker for site-related metals contamination. All remedy options in this Supplemental Feasibility Study address those areas where copper in sediment is in excess of 982 ppm.

Geotechnical Limits

The upland or "OU-1" remedy includes a 40+ foot tall bulkhead wall along the entire plant shoreline. This wall will anchor a containment system designed for PCBs present in the Northwest Corner of the upland site. It is also critical for the structural stability of the upland portion of the property. The bulkhead requires a submerged berm of fill material in the river to help stabilize and support it. While the berm size varies with the bulkhead design, a berm is therefore an essential component of every river remedy option. It is possible to incorporate capping and containment options into the shoreline berm required to support OU-1. This Supplemental Feasibility Study evaluates the factors needed to construct and maintain a cap/berm that will remain effective when exposed to floods, ice, and other potential damage.

REMEDY SELECTION

This Supplemental Feasibility Study divides the OU-2 Site into a number of smaller areas of concern. These smaller areas are: (a) the Northwest Corner Area; (b) the Southern Area, (c) the Boat Slips, (d) the Old Marina Area; and (e) the Offshore Area. Each of these units has unique characteristics -- different contaminant distributions, different geotechnical concerns, different remedial implementability risks -- that impact remedy consideration.

This Supplemental Feasibility Study developed a range of remedy options for each of the smaller areas of concern. In general, the remedy options included dredging to the maximum depth feasible, limited dredging with a cap for remaining materials, and monitoring in areas where other remedy options are not feasible.

Northwest Corner Area

Because most of the PCBs (99 percent) are concentrated in this 3-acre area, all remedy options include significant dredging to remove these materials from the river. Most of the PCBs

are close to shore (within 20 ft), and near the surface, making it possible to remove a large percentage with near shore dredging of the upper layer of sediments. All remedies would also include the installation of a temporary rigid containment barrier out beyond the shoreline to provide containment of PCBs that will be suspended in the water column during dredging

Twenty-two percent of the elevated copper on site is also found in the Northwest Corner Area, in the top 6 to 8 ft of sediment. Most of the copper in the Northwest Corner Area can be removed from the river in option NW-1, and all of it can be removed in options NW-2 through NW-4.

Remedy Alternative	Description	PCBs Removed	Estimated Cost (net present worth)
NW-1	Dredge to elev. -7 ft along the shore where PRGs are exceeded and cap remainder *(recommended alternative)*	61 percent	$23.0 Million
NW-2A	Dredge to elev. -9 ft along the shore where PRGs are exceeded and deeper away from shore, then cap remainder	75 percent	$52.3 Million
NW-2B	Dredge to elev. -14 ft along the shore where PRGs are exceeded and deeper away from shore, then cap remainder	82 percent	$59.9 Million
NW-3	Incorporate material near shore into OU-1 remedy, and dredge all material exceeding PRGs remaining in river	99 percent[2]	$57.1 Million
NW-4	After piercing the basal sand with the shore-line bulkhead, dredge to elev. -32 ft along the shore where PRGs are exceeded and deeper away from shore, then cap remainder	99 percent	$96.2 Million

While NW-4 shows that there is a way to remove almost all of the deeper PCBs at this site as well, deep dredging along the shoreline bulkhead would create a risk of shoreline collapse that could only be controlled by installing an even deeper bulkhead into the basal sand. This bulkhead would pierce the protective aquitard that has contained PCB contamination in place for over 50 years, and create a 800-foot long pathway along both sides of the steel sheeting along the Northwest Corner for high levels of PCBs to migrate from above the aquitard into the Hudson groundwater aquifer below, violating federal guidelines, federal and state water quality

[2] Under Alternative NW-3 some of the PCB contamination would be incorporated into OU-1, which would require removal of the upper layer of contaminated sediment, and containment of the remainder in an above-ground protective cap and containment system, rather than the submerged protective cap used in NW-1, 2 and 4.

standards, and sound engineering practices. Remedy options that violate such standards are usually rejected in the FS screening process, but this Supplemental Feasibility Study evaluates the option in order to explain the risks and the reasons why deep dredging option is not an appropriate remedy for this site.

This Supplemental Feasibility Study proposes Alternative NW-1 for this remedy. Alternative NW-1 is protective of human health and the environment. Alternative NW-1 is a significant dredging remedy that requires substantial construction activity to implement. It would result in the removal of approximately 5,900 cubic yards of contaminated sediments, and numerous pilings, obstructions, and debris. NW-1 would also remove approximately 61 percent of the PCBs and provide a robust armored protective cap over the PCBs left in place, thereby ensuring that living organisms will not come into contact with the PCBs and that they will not be released into the environment. Alternative NW-1 can be implemented safely within the geotechnical stability constraints resulting from the load placed on the bulkhead by the upland portion of the site. In addition, NW-1 does not present the unacceptable risk of contaminating the basal sand and its clean groundwater aquifer.

The Southern Area

Less than 1 percent of the PCB mass is found along the rest of the plant shoreline, in a 2.3-acre area called the Southern Area to distinguish it from the rest of the site. PCBs in this area are intermittent, close to the 1 ppm PRG, and mostly found in the upper layers of sediment and fill material, although areas that had deep open water at the time of the PCB release (the boat slips and channels leading into them) may have PCBs at greater depths.

The primary contaminant in this area is copper. Including an area adjacent to the Southern Area further from shore, approximately 78 percent of the copper mass exceeding the PRG proposed for copper is concentrated into three areas totaling approximately 20,000 square feet in area, in the upper 6 to 8 ft of sediment and fill material.

All of the proposed remedies seek to remove and/or contain copper in excess of the 982 ppm PRG proposed for copper. Doing so would also address other site-related metals.

Remedy Alternative	Description	Copper Removed Based on Proposed PRG	Estimated Cost (net present worth)
SA-1	Cap the entire area as needed to contain PCBs and copper within 60 to 80 ft of the remaining shore *(recommended alternative)*	0	$5.1 million
SA-2	Dredge up to the top 2 ft of sediment and fill material where PRGs are exceeded within a temporary silt curtain located 60 to 80 ft away from shore, then cap as needed	10 percent	$19.0 million

Remedy Alternative	Description	Copper Removed Based on Proposed PRG	Estimated Cost (net present worth)
SA-3A	Remove the top 4 ft of fill from OU-1 within 100 ft of the shoreline and replace with lightweight fill. Dredge in the river to elev. -9 ft along the shore where PRGs are exceeded and deeper up to 60 ft away from shore, then cap as needed	19 percent	$20.8 million
SA-3B	Same as S-3A, but dredge in the river to elev. -14 ft along the shore where PRGs are exceeded and deeper up to 60 to 80 ft away from shore, then cap as needed. [3]	19 percent	$21.3 million
SA-4	Install a deep bulkhead wall into basal sand aquifer, dredge to elev. -23 ft at the shore where PRGs are exceeded and deeper up to 60 ft from shore to reach deep PCBs, and then cap as needed.	29 percent (and less than 0.1 percent PCBs)	$34.9 million

This Supplemental Feasibility Study recommends Alternative SA-1 for the Southern Area. This alternative will successfully contain those areas of PCB and copper contamination found above PRGs in the southern area. During remedial design, selective dredging would be considered if needed to maintain water depth as a result of capping.

Boat Slips and Old Marina: A total of less than 1 percent of the PCB mass is found in the former boat slips at the plant site (1.4 acres), and in the former marina located on the north side of the plant site (2.2 acres). The contamination is diffuse and close to the 1 ppm PRG for PCBs in most areas, although higher levels of PCB are found where the North Boat Slip, Old Marina, and Northwest Corner shoreline all meet. There is no copper above the proposed 982 ppm PRG in these areas.

The choice of a remedy for the boat slips and marina depends partly on whether they will be used for navigation in the future. Since AR does not plan to use the boat slips for navigation, and its affiliate owns and controls the submerged lands below, capping is an appropriate remedy for the boat slips. This Supplemental Feasibility Study proposes to use a man-made cap for the North Boat Slip where there is some contamination at the surface and at depth, and a natural

[3] A variation on Alternative SA-3 would target capping in those areas offshore adjacent to the Southern Area that have elevated levels of metals that may be bioavailable. This would result in capping two areas approximately 10,000 square feet in area. This additional capping would contain 35 percent of the total site copper mass exceeding the proposed PRG. The estimated capital cost for this additional capping is $0.2 million.

sediment cap in the South Boat Slip, where the top 8 ft of material are clean, and the area is filling in with river sediment.

A man-made cap could also be used to cover low level PCB contamination in the marina; although it would limit future navigation opportunities in this area by limiting water depth. Further discussion with the marina owner is needed to ensure that the remedy is compatible with future marina use plans.

Remedy Alternative	Description	PCBs Removed	Estimated Cost (net present worth)
NSlip-1	Dredge up to the top 2 ft of sediment and fill material exceeding PRGs only if needed, then cap *(recommended option)*	Less than 0.1 percent	$4.8 million
NSlip-2	Dredge to elev. -9 ft along the shore and deeper away from shore where sediment exceeds PRGs, then cap as needed (same as NW-2A)	0.1 percent	$13.1 million
OM-1	Dredge up to the top 2 ft of sediment and fill material exceeding PRGs, only if needed, then cap *(recommended alternative)*	Less than 0.1 percent	$9.3 million
OM-2	Dredge to elev. -9 ft along the shore and deeper away from shore, then cap as needed (same as NW-2A)	0.2 percent	$16.3 million

Offshore Area

Approximately 0.2 percent of the PCB contamination is found farther away from the plant shoreline in a 22 acre area of the main river channel. Copper exceeding the proposed PRG is limited to one 10,000 square foot area and one much smaller area within 100 to 150 ft of the shoreline. Other sources up and down river appear to have caused or contributed to contamination in the main channel. A substantial fraction of the PCBs here do not match the type of PCBs used at the wire and cable plant.

The contamination is found at low levels close to the PRGs, and conditions in the main channel make it very difficult to remove. The water is over 40 ft deep and flows at a high velocity. Silt curtains are not effective here, and solid containment structures are not feasible. Under these conditions, it is not feasible to remove these low levels of contamination with dredging. This Supplemental Feasibility Study proposes monitoring of natural recovery (ongoing natural capping) as the appropriate remedy for this area.

Summary

This Supplemental Feasibility Study recommends a remedy that combines an ambitious dredging project in the Northwest Corner area with a containment remedy that would isolate the remaining PCBs under a cap and berm system, and cap metals in near shore areas where copper exceeds 982 ppm.

The proposed remedy is protective of human health and the environment. It would remove over 60 percent of the PCBs and isolate metals that have any potential to be bioavailable. It would provide long term isolation of any remaining contaminated sediments, thereby protecting aquatic life.

Moreover, the combination of dredging and capping is particularly appropriate because dredging alone is unlikely to achieve a PCB level of 1 ppm or less. Experience at other sites has demonstrated that the sloughing of sediments into dredged areas and settlement of sediment suspended during dredging generally results in residual sediment levels in excess of 1 ppm. Those problems would likely be exacerbated at the Hastings site where the presence of significant debris, pilings, and obstructions on unstable slopes makes dredging difficult.

The proposed remedy would also avoid potential safety issues raised by the OU-1 geotechnical constraints and would allow for coordination of the OU-2 and OU-1 remedy. Other remedial alternatives present a greater risk of bulkhead instability and would likely result in significant delays in the implementation of the upland OU-1 remedy.

Finally, and importantly, the proposed remedy would not risk contamination of the basal sand aquifer. It thus meets an important consideration of doing no additional environmental harm and, unlike other remedies, meets New York state standards, criteria, and guidelines.

The net present worth of the proposed remedy is estimated to be $44 million, including capital costs and long term monitoring and maintenance. Cap maintenance would be incorporated into the bulkhead and containment system maintenance plan required as part of the remedy for OU-1.