Exhibit A

FINAL
CLEANUP ACTION PLAN AND SCHEDULE

ALCOA INC

5701 NW Lower River Road
Vancouver Washington

December 2008

Table of Contents

Tables

Figures

1 INTRODUCTION

This Cleanup Action Plan (CAP) presents the selected cleanup action for the remediation of four areas of concern (AOCs) at the Alcoa Inc. (Alcoa)/Evergreen Aluminum LLC (Evergreen) Site (Site) in Vancouver, Washington. This CAP was developed by the Department of Ecology (Ecology) from information presented in the *Remedial Investigation/Feasibility Study for the Alcoa/Evergreen Vancouver Site* (RI/FS; Anchor 2008) and the *Final Focused Remedial Investigation and Feasibility Study for the Former Columbia Marine Lines Site* (SLR 2008) and prepared in accordance with the requirements of the Model Toxics Control Cleanup Act (MTCA; Ecology 2007a), Chapter 70.105D Revised Code of Washington (RCW), administered by Ecology under the MTCA Cleanup Regulation, Chapter 173-340 Washington Administrative Code (WAC).

A CAP is one of a series of documents used by Ecology in the cleanup process conducted under MTCA. This CAP will be made available to the public for review and comment. At the end of the public comment period, Ecology will closely consider concerns expressed regarding the planned remedial actions for the Site and issue a summary and response to any comments received. After consideration of public comments, this CAP will be implemented pursuant to a consent decree with Alcoa entered in Clark County Superior Court (with the Consent Decree).

The cleanup action alternatives chosen for the Site are protective of human health and the environment. Selected cleanup actions chosen for the Site include solutions that consider treatment technologies and source removal to the maximum extent practicable. Detailed descriptions of Ecology's selected cleanup actions are provided in Section 7. Forthcoming engineering designs and planning documents associated with the selected alternatives will provide for future monitoring of the Site in order to ensure the long-term effectiveness of all remedial actions in accordance with WACs 173-340-400 and 173-340-410.

1.1 Purpose and Scope

The primary state law that governs the cleanup of contaminated sites is MTCA. MTCA regulations define the process for the investigation and cleanup of contaminated sites. When contaminated sediments are involved, the cleanup standards and other procedures are also regulated by the Sediment Management Standards (SMS), Chapter 173-204 WAC. MTCA regulations specify criteria for the evaluation and conduct of a cleanup action, as well as soil and groundwater standards. SMS regulations dictate the standards for sediment cleanup. Under both, the cleanup must protect human health and the environment, meet state environmental standards and regulations in other laws that apply, and provide for monitoring to confirm compliance with Site cleanup standards. Specifically, Ecology has determined that Chapter 173-303 WAC (Dangerous Waste Regulations), Chapter 173-350 WAC (Solid Waste Handling Standards), RCW 90.48 (Water Pollution Control), and RCW 43.21C (State

Environmental Policy) are applicable at this Site. Additionally, Chapter 173-160 WAC (Minimum Standards for Construction and Maintenance of Wells) is a relevant and appropriate regulation if new wells are required on Site.

The CAP outlines the steps and procedures for conducting an environmental cleanup of the AOCs at the Site consistent with MTCA and SMS requirements, with the exception of the East Landfill AOC. A separate CAP will be issued to address trichloroethylene (TCE)-bearing groundwater within the vicinity of the East Landfill. Consistent with the requirements of WAC 173-340-380, this document provides the following information:

- A description of the Site (Section 2)
- The nature and extent of Site contamination (Section 3)
- The cleanup standards for Site contaminants (Section 4)
- A summary of the evaluated cleanup action alternatives (Sections 5 and 6)
- A general description of Ecology's selected cleanup action (Section 7)
- A schedule for implementation of the cleanup action (Section 8)

Pursuant to WAC 173-340-710(9)(e), Alcoa has the continuing obligation to determine whether permits, approvals, or other substantive requirements are required to implement the remedy. In the event that Ecology or Alcoa becomes aware of additional permits, approvals, or substantive requirements that apply to the remedial action, it shall promptly notify the other party of this knowledge. Ecology shall make the final determination on the application of any additional substantive requirements at the Site.

1.2 Applicability

The cleanup standards and actions presented in this document have been developed through the remediation process conducted with Ecology oversight. The cleanup levels and actions are site-specific and should not be considered as setting precedent for other similar sites. Potentially Liable Persons (PLPs) cleaning up sites independently, without Ecology oversight, may not cite numerical values of cleanup levels specified in this document as justification for cleanup levels in other unrelated sites. PLPs that are cleaning up other sites under Ecology oversight must base cleanup levels and cleanup standards on site-specific regulatory considerations and not on numerical values contained in this CAP.

1.3 Declaration

In accordance with WAC 173-340-360(2)(a), the selected cleanup actions meet the threshold requirements; are protective of human health and the environment; comply with applicable state and federal laws; and provide for compliance monitoring. Furthermore, the selected remedies are consistent with the preference of the State of Washington as stated in RCW 70.105D.030(1)(b) for permanent cleanup solutions.

1.4 Administrative Record

The documents used to make the decisions discussed in this CAP are part of the administrative record for the Site. The entire administrative record for the Site is available for public review by appointment at Ecology's Industrial Section in Lacey, Washington. To review or obtain copies of the above documents, contact Mr. Paul Skyllingstad, Ecology's Site Manager at (360) 407-6949.

2 SITE BACKGROUND

This section describes background information relevant to the cleanup of the Site. Information presented in this section includes a discussion of historical, current, and future site use.

2.1 Site Description

The Site is located on NW Lower River Road on the northern shore of the Columbia River at River Mile 103.3 in Clark County. It is approximately 3 miles northwest of downtown Vancouver, Washington and approximately 3 miles due west of Interstate 5. The facility covers approximately 208 acres (of which Alcoa currently owns 97 acres and Evergreen owns 111 acres). It is bound on the north by NW Lower River Road, on the east by property owned by the Port of Vancouver, on the south by the Columbia River, and on the west by multiple industrial property owners. The current land uses in the general vicinity of the Site are mixed use industrial and agricultural. The Site and surrounding area are shown in Figure 1.

The Site layout and current property boundaries are shown in Figure 2. The Site boundary includes the Evergreen and Alcoa properties, as well as property currently owned by Clark County and Clark Public Utility District (PUD). The latter two properties were previously owned and remediated by Alcoa under Ecology Agreed Order DE 97 TCI032.

2.2 Site History

The Site was developed in the late 1930s, with the completion of Alcoa's aluminum smelter in 1940. The aluminum smelting operations at the Site began in 1940. During World War II, Alcoa filled the eastern end of the smelter site with dredge sands from the Columbia River. From 1940 to 1970, Alcoa added a number of fabrication operations to the facility. By 1970, the facility contained an aluminum smelter and a series of fabrication plants to form the aluminum metal into finished goods such as wire, rod, and extruded channel. Alcoa operated the entire facility for approximately 45 years, until 1986.

Thereafter, Alcoa began remediating and selling individual land parcels and operations associated with the Site. In 1987, ACPC, Inc. purchased the cable mill operations and leased the associated land from Alcoa. In 1987, Alcoa sold the aluminum smelter to Vanalco, Inc.; however, Alcoa retained the title to the extrusion section of the property known as the Vancouver Extrusion Company (Vanexco) and the cable mill operation, subject to the ACPC lease. Vanexco was operated by Alcoa until 1991 when it was closed. Additionally, in 1991, Alcoa sold a tract of land lying west of the aluminum smelter to Russell Towboat and Moorage Company; this tract of land is not part of the Site. In 1994, a parcel of property known as the North Parcel was sold to the Clark County PUD for construction of a cogeneration plant. A cleanup was conducted in an area known as the Northeast Parcel and the property was sold to Clark County as a jail site in 1997. Vanalco owned and operated the aluminum smelter from 1987 until late 2000 when it ceased all manufacturing operations and entered bankruptcy. Glencore Washington LLC (now known as Evergreen) purchased the smelter assets from the bankruptcy estate in 2002. No manufacturing operations have taken place at the Site since December 2000.

Columbia Marine Lines (succeeded by Crowley Marine Services, Inc.) leased property and operated a marine repair facility on the Alcoa property west of the aluminum smelter (the Crowley Parcel) from approximately 1963 until 1984. Today, Evergreen owns the former aluminum smelter site and the stormwater lagoons, and owns the small sanitary sewer plant in common with Alcoa. Alcoa retains ownership of the remainder of the Site, including the river dock and loading area, the land east of the smelter (including the East Landfill, the former North and North 2 Landfill areas, and the South Bank Area), and the property to the west of the smelter (the Crowley Parcel).

2.3 Historical Site Use

The aluminum smelter, which included potlines, an aluminum casting facility, greenmill, carbon bakes, dock and raw materials handling system, laboratory, and miscellaneous support facilities, operated with only intermittent interruptions, from 1940 through 2000. The smelting operations required an extensive dry materials handling system for raw materials. Alumina ore was received by rail or ocean-going vessel. Other raw materials, including petroleum coke, coal tar pitch, anthracite coal, cryolite (sodium aluminum fluoride), and aluminum fluoride, were received by rail and truck.

The alumina was reduced to molten aluminum in the potlines. This reduction process involved the use of a carbon cathode and anode; both were manufactured on Site. Aluminum salts and electrolytes containing fluoride were introduced into the reduction process to increase the solubility of alumina. The molten aluminum was transferred to the casting facility where it was cast into a variety of products, including sow, billet, and sheet ingot. Many of these products required the aluminum to be alloyed with different metals, including copper, manganese, and magnesium.

Electricity is considered one of an aluminum smelter's raw materials. Bonneville Power Administration (BPA) owns a parcel of property on the northeastern side of the Site. BPA supplied power to transformer banks at the aluminum smelter, located on the north side of the aluminum smelter potrooms. The transformer banks contained large transformers and capacitors. These units fed electricity into rectifiers housed in adjacent buildings, and then on to the potlines. Prior to 1987, the original mercury-arc rectifiers used to provide power to the potlines were replaced with solid state rectifiers.

The aluminum smelter manufactured carbon anodes and cathodes, for the smelting operations at the Site. The carbon storage building housed the petroleum coke and coal tar pitch inventory. The greenmill mixed and heated the coke and pitch to form a paste, which was then pressed into the shape of an anode. The anodes were lowered into in-ground ring furnaces to bake and cure. The cathodes manufactured at the Site used either anthracite coal and pitch to form a paste, which was rammed into place to form the cathodic lining of the pot shell, or purchased cathode blocks and ram paste, which was used to form the potshell cathode lining. The pot shell is where the reduction of alumina to aluminum occurs.

The aluminum smelter had a complete maintenance department to support the operations. The maintenance department utilized land to the southeast of the carbon storage building as a scrap yard. Various materials were placed in this area prior to reuse or off-site recycling.

Several on-site landfills and material storage locations were operated on the eastern portion of the Site prior to the mid-1980s. Materials relating to Site operations, including alumina, bath, cryolite, aluminum fluoride, carbon, anodes, brick, concrete, plastic, wire, paper, drums, aluminum metal, pallets, conveyor belts, cable, metal piping, gravel, asphalt chunks; contaminated waste including miscellaneous small volumes containing trichloroethylene-bearing solvents, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons; and miscellaneous maintenance activity debris, were deposited in the landfills. Spent potlining (SPL; cathodes) were stored in a separate location that was remediated under Consent Decree 92-2-00783-9 between Alcoa and Ecology. Waste materials were transported off site following the closure of the landfills in the 1980s.

During the 1950s, Alcoa added fabrication facilities, including the extrusion plant, rod mill, and cable plant, at the Site. These fabrication facilities used large quantities of hydraulic oils in numerous pieces of equipment used in the manufacturing processes. Both water-soluble and petroleum-based hydraulic oils were used. Several additional expansions of the facilities took place during the 1950s and 1960s.

From approximately 1963 to approximately 1985, Alcoa leased property to Columbia Marine Lines, which was succeeded by Crowley Marine Services, Inc. (Crowley). During this time, Crowley operated a marine repair facility on the Site in an area adjacent to the stormwater ponds. Crowley deposited wastewater, including barge slops, wash water from barge gas freeing operations, and tug bilge slops, were deposited into a series of three dewatering ponds on the property.

2.4 Future Site Use and Development

Alcoa and Evergreen intend to sell their properties to a buyer which will use the property in an industrial capacity. Current plans for the Site include the development of rail lines across the properties and development of a car unloading and storage facility. In the future, a wide variety of industrial use activities may occur on the property.

To support the development, the former manufacturing, storage, and fabrication facilities were scheduled for demolition and final remedial actions have commenced as required by Ecology through Enforcement Order 4931 (Ecology 2007b). To date, Evergreen has completed demolition of the facilities on its property with the exception of the stormwater system. Evergreen has also excavated and disposed of over 51,000 tons of contaminated soil and waste at an off-site RCRA Subtitle D facility, and 7,200 tons of contaminated soil and waste at an off-site RCRA Subtitle C facility. Soils located on Evergreen property are now in compliance with the cleanup levels presented in Section 4.1.5. Alcoa is in the process of demolishing its remaining fabrication and storage facilities. Through a variety of consent decrees and orders, Alcoa has completed the remediation of several portions of the Site. Crowley has previously undertaken remedial actions pursuant to Order No. DE 85-591. This document provides the framework for the final remediation of the entire Site. The RI/FS documents provide a comprehensive discussion of the cleanup actions completed to date.

3 SITE CONDITIONS

The current site conditions and conceptual site model are based on a detailed review of the nature and extent of contamination on Site, the exposure pathways and receptors, and fate and transport processes of various Site contaminants in the environment. A comprehensive discussion of these key elements was presented in the RI/FS and is summarized in the remainder of this section.

3.1 Site Hydrogeology

Published reports were used to determine the regional geology, including U.S. Geological Survey reports and historical site investigation reports. The Site is located in the Portland Basin within the Columbia River floodplain. The Sandy River Mudstone and the Troutdale Formation are the oldest sediments in the Portland Basin. The Troutdale Formation overlies the Sandy River Mudstone.

The Troutdale Formation is overlain by sediments deposited during Pleistocene catastrophic flooding of the Columbia River (Trimble 1963). These flood deposits have been termed the Unconsolidated Sedimentary Aquifer (USA) (Swanson 1993). The USA is overlain by Quaternary Alluvium deposits consisting of very poorly consolidated silt and sand on the floodplains of the modern Columbia River (Madin 1990). In developed areas along the river shoreline, the Quaternary Alluvium is overlain by artificial fill consisting primarily of dredged river sand.

The Site geology has been determined by evaluating the findings of the investigations completed on Site and the findings from investigations completed on nearby properties. Early Site investigations by Robinson Noble and Hart Crowser (Robinson, Noble, & Carr 1982; Hart Crowser 1987a and 1987b) identified the presence of the following geologic units, from shallow to deep:

- Dredge Fill
- Quaternary Alluvium
- Troutdale Formation

Subsequent to Hart Crowser's work at the Site, regional investigations by the U.S. Geological Survey and recent investigations on nearby properties have determined that the unit previously identified as the Troutdale Formation is actually the USA. The four hydrogeologic units identified by Hart Crowser continue to be used in current Site investigations and are defined below.

- **Shallow Zone**: Dredge fill sand thickness ranges from about 7 to 25 feet depending upon the location. The Shallow Zone tends to be deeper (more than 20 feet) on the east side of the Site because of extensive filling activities that took place historically in that area. Groundwater is present in this zone seasonally. Groundwater in this zone may be locally perched on the finer grained materials in the underlying Intermediate Zone. Many monitoring wells screened in this zone are dry in late summer and fall.

- **Intermediate Zone**: This unit extends from an average of about 15 to 35 feet below ground surface (bgs). The top of this zone is the original ground surface present before dredge fill was placed in the 1940s. In certain locations, such as the East Landfill, this unit extends downward to as deep as 60 feet bgs. The Intermediate Zone is Quaternary Alluvium comprised of silt, fine sand, and clay, with lower hydraulic conductivity than the overlying Shallow Zone.
- **Deep Zone:** This unit extends from an average of about 35 to 95 feet bgs. However, in the southern part of the site, the Deep Zone extends as deep as 125 feet bgs. The Deep Zone is comprised of Quaternary Alluvium fine to medium sand.
- **Aquifer Zone:** The top of the Aquifer Zone is about 95 feet bgs in the northern portion of the site down to about 125 feet bgs in the southern site area near the river shoreline. The base of the Aquifer Zone has not been reached by Site borings. This unit was previously identified as the Troutdale Formation, but has subsequently been redefined by the U.S. Geological Survey as the USA. The Troutdale Formation lies below the USA. The identification of the Aquifer Zone as the USA is based primarily on the extremely high hydraulic conductivity of regional wells screened in this unit and the composition of the gravel. The coarse-grained flood deposits of the USA are the most permeable aquifer in the Portland Basin (Swanson 1993). Due to the high hydraulic conductivity of the USA, no regional supply wells extend down into the underlying Troutdale Formation. For consistency with previous nomenclature of historical Alcoa reports, the USA will continue to be referred to as the Aquifer Zone in Site documentation.

3.2 Previous Areas of Potential Concern

The RI identified ten source areas at the Site for potential remedial action to ensure protection of human health and the environment. For seven of these areas, Ecology determined that source removal was appropriate and the maximum practicable remedial action to address waste materials and impacted soil in accordance with WAC 173-340-360(3)(d). Two other areas not included on the list, the Vanexco/Rod Mill Building (Rod Mill) and concrete and the SPL Storage Area, were remediated under previous Consent Decrees between Alcoa and Ecology (95-2-03268-4 and 92-2-00783-9, respectively). The Vanexco/Rod Mill Building was a PCB soil and concrete cleanup and the SPL Storage Area was cyanide and fluoride source removal and soil cleanup.

The Rod Mill Consent Decree required the long-term maintenance of a cap initially designated as the building floor (constructed of asphalt and/or concrete) and the roof was to be maintained to prevent ponding of precipitation. To facilitate the current sale of the property, the Rod Mill building will be demolished. The new surface (either sand or asphalt) above the asphalt/concrete floor will be regraded to promote positive drainage away from the cap (i.e., the floor) in accordance with the Rod Mill Consent Decree. Ecology determined that this action is consistent with the Consent Decree. Groundwater monitoring down-gradient of the Rod Mill was performed for 5 years and was completed in 2001. During this period PCBs were not detected in any of the samples. Ecology approved termination of the monitoring program in 2003. Groundwater monitoring continues at the SPL Storage Area and meets the requirements of that Consent Decree. No further action is required for these two former source areas.

From 2007 through 2008, Evergreen remediated five of the initial Site AOCs through source removal activities under Ecology Enforcement Order 4931(Ecology 2007b). These AOCs include the Transformer/Rectifier Yards, Carbon Plant and Storage Buildings, Plant Emission Control Systems, Fluoride-Bearing Raw Material Handling Facilities, and the Scrap Metal Recycling Area. The cleanup actions in these areas included the removal of contaminants of concern (COC) impacted soil, waste, and raw materials. No additional remedial actions are required in these areas as the sources have been removed from the Site to the maximum extent practicable and the actions are protective of groundwater. However, final compliance reporting is still pending. Industrial cleanup levels were used in the removals. The following bullets summarize the work completed to date.

- Approximately 10,100 tons of PCB-impacted soil and foundation material were removed from the Transformer/Rectifier Yards and disposed of at an appropriate off-site landfill. During the course of the remedial activities, soil impacted by mineral oil was also identified. Materials above the Site cleanup level of 4,000 mg/kg TPH were excavated and disposed at an appropriate off-site facility. Post excavation surface sampling was conducted to verify that the required cleanup levels were achieved. No further action is required to remove PCB-impacted soils in this area as all material with concentrations greater than MTCA Method A Unrestricted Use cleanup levels were removed.
- The Carbon Plant and Storage Buildings, including foundations to 3 feet bgs, were demolished and approximately 17,350 tons of PAH, fluoride, and lead impacted soil and waste were excavated and disposed of appropriately at an off-site landfill. Composite samples were collected to verify that the post excavation surface met the required cleanup levels on a point-by-point basis. No further action is required to remove PAH-impacted soils in this area.
- The Plant Emission Control System area housed a historical emission control system and settling ponds. Approximately 2,860 tons of waste and soil impacted with fluoride, PAHs, PCBs, and TPH were excavated in this area. Excavated materials were disposed of at an appropriate off-site landfill and soil samples from the excavation were collected and analyzed for fluoride, PCBs, TPH, and PAHs. PAHs were detected above the Site cleanup level from two samples collected at 12 and 14

feet bgs. These PAHs were considered to be of low risk given the depth at which they were detected and the overall mass removal. Groundwater wells down-gradient of the Plant Emission Control System do not show contamination. On January 31, 2008, Evergreen received approval from Ecology to backfill the excavations. No further action is required to remove PAH-impacted soils in this area. Cleanup levels for all other COCs were met.

- The Fluoride-Bearing Raw Material Handling Facilities consists of raw material unloading facilities, storage facilities, and conveying equipment areas. An approximate 1.8-acre-area in this area was excavated and 9,100 tons of fluoride-impacted soil was transported to an appropriate off-site landfill for disposal. All verification soil samples collected and analyzed for fluoride met the Site-specific cleanup and remediation levels. Groundwater monitoring data collected prior to the source removal activities demonstrated that the source was localized, not mobile, and no impacts to groundwater occurred. No further action is required in this area.
- Approximately 1,400 tons of material containing cyanide, fluoride, TPH, PCBs, and metals over a 0.16-acre-area from the Scrap Metal Recycling Area were excavated and disposed of at an appropriate off-site landfill. Verification soil samples were collected and confirmed compliance with Site-specific remediation and cleanup levels. Additionally, down-gradient monitoring wells indicate that the groundwater is not impacted by this source area at the perimeter of the Site. No further action is required within this area.

3.3 Supplemental Remedial Actions

During the course of the demolition of the smelter facilities, three additional areas containing soil and waste above Site cleanup levels were identified. The following bullets summarize the remedial work completed to date.

- The Ingot Plant was located at the southwest corner of the potlines. During the demolition of the building that housed the former casthouse hydraulic systems in the Ingot Plant, elevated PCBs in floor brick, soil, and concrete rubble were identified. As part of the Ingot Plant remediation, 3,951 tons of brick, concrete, and soil containing total PCBs concentrations greater than 50 mg/kg were shipped offsite for disposal at an off-site RCRA Subtitle C facility, and 10,507 tons of PCB-impacted brick, concrete, and soil were shipped to an off-site RCRA Subtitle D facility. Remaining low-level soil contamination containing less than 10 mg/kg total PCBs in the westernmost portion of the former Ingot Plant footprint will be capped in-place with a 12-inch, soil barrier.
- In 1996, Vanalco filled a low-lying area of the perimeter dike in the SW corner of the facility with bake oven brick and other debris. During facility demolition activities, this area was sampled and confirmed to contain PAHs (TEF adjusted) above the site cleanup level of 18 mg/kg. Approximately 1,476 tons of brick, debris, and sand were

removed and residual soils were confirmed to contain less than 18 mg/kg residual PAHs (TEF adjusted). No further action is required in this area.

- The West Loading Dock of the potlines was historically used as a laydown and storage yard for equipment and materials to support ongoing potroom and Ingot Plant operations. During facility demolition activities, the West Dock was used as the primary staging and load-out area for salvageable materials such as steel and aluminum, as well as, a staging area for temporary storage of contaminated soil, brick, and concrete from ongoing remediation efforts. During the final stages of facility decommissioning, the asphalt surfaces where contaminated materials had been staged was removed. Following asphalt removal, visual inspection of the area indicated that portions of the West Loading Dock area had been used for the placement of some Ingot Plant-related debris, brick, and fluoride-bearing materials (reacted ore) prior to the placement of the asphalt surfacing. Approximately 1.3 acres of soil to a depth of 6 to 12 inches was excavated to remove visible evidence of residual materials. Upon removal, final verification samples were collected to confirm that Site soil cleanup levels had been achieved. A total of 325 tons of debris and soil containing PCBs greater than 50 mg/kg was shipped to an off-site RCRA Subtitle C facility, and 5,400 tons of PCB- and fluoride-impacted soil was shipped to an off-site RCRA Subtitle D facility. No further action is required in this area.

3.4 Site Areas of Concern

Based upon the above discussions, there are five remaining AOCs at the Site. As previously stated, one of these AOCs (TCE-bearing groundwater at the East Landfill) will be addressed in a separate CAP. The remaining areas require remedial action for the protection of human health and the environment at the Site. These AOCs include:

- PCB-Impacted Sediment. The PCB-Impacted Sediment AOC is located near the shore on the eastern side of the facility. It extends from the East Landfill to west of the dock. This AOC also addresses industrial waste located along the riverbank as described below.
- Crowley Parcel. The Crowley Parcel AOC covers several acres of land located on the western side of the property near the stormwater retention ponds.
- Dike Underground Storage Tanks (UST). The Dike USTs AOC is located in the north side of the dike directly south of the former potline building.
- Soluble Oil Area. This AOC is located east of the ACPC facility.

3.4.1 PCB-Impacted Sediments

The nature and extent of PCB-impacted sediment was characterized in a two-phase field program. Phase 1 sediment sampling was conducted in November and December 1999 by Windward Environmental (Windward 2000) to characterize the nature and extent of PCBs in sediments upstream, downstream, and in the immediate vicinity of the Clark County Public

Utility (CPU) outfall. A total of 34 stations were sampled and analyzed for total PCBs, total organic carbon, percent solids, and apparent grain size. Samples were collected from a series of transects. Two transects were positioned upstream of the CPU outfall to assess baseline sediment concentrations, two transects were positioned immediately upstream of the CPU outfall, and three transects were positioned downstream of the CPU outfall. PCB concentrations upstream of the CPU outfall were at or near the detection limit, whereas PCB concentrations immediately downstream of the CPU outfall were greater than 0.35 mg/kg. The highest concentrations of PCBs were located closest to the CPU outfall pipeline between the shoreline and the river shipping channel. Total PCB concentrations up to 28 mg/kg were detected immediately adjacent to the CPU outfall.

Phase 2 of the sediment sampling program was implemented to further refine the nature and extent of PCBs in surface and subsurface sediments adjacent to the CPU outfall. Phase 2 sediment sampling was conducted during two separate events. During the first event on August 15, 2000, 30 surface sediment samples were collected from 12 transect lines extending from the shoreline toward the Columbia River shipping channel. The transects were located on either side of the CPU outfall, beginning 700 feet upstream and continuing approximately 800 feet downstream of the outfall. A second sampling event was conducted from November 12 to 18, 2000, to collect additional surface sediment samples and subsurface samples. Surface sediment samples were collected from 26 additional stations downstream of the stations sampled during the first event and along transects located 900 to 2,500 feet downstream of the CPU outfall. Subsurface sediment samples were collected from 24 subtidal and three intertidal stations. One to two cores were collected from each of the 14 transects located 200 to 700 feet downstream of the CPU outfall.

The Phase 1 and 2 sampling data revealed that the highest PCBs concentrations in surface sediments at the Site, up to 25 mg/kg, were located immediately adjacent to the CPU outfall. Elevated surface sediment PCB concentrations (to 9.2 mg/kg) were detected near the shoreline at transects up to 1,200 feet downstream of the CPU outfall. Sediment samples collected from transects further downstream had much lower PCB concentrations that were similar to PCB concentrations 300 to 700 feet upstream of the CPU outfall. In areas removed from the CPU outfall, PCB concentrations in subsurface sediments were generally much lower than the corresponding concentrations in surface sediments. However, subsurface PCB concentrations in a sediment core collected immediately adjacent to the CPU outfall were as high as 300 mg/kg. PCB concentrations in subsurface sediments from areas outside the immediate vicinity of the CPU outfall were less than 0.50 mg/kg; most were less than 0.10 mg/kg. These results are consistent with the conceptual site model of PCB releases associated with the 1997 CPU outfall construction, and specifically from the mixing of impacted riverbank soils with nearshore sediment during this construction event.

The conceptual site model of PCB releases to sediments adjacent to and downstream of the CPU outfall predicts that localized migration of the PCBs occurred in the vicinity of the CPU outfall beginning with the construction event due to nearshore hydrodynamic processes in the Columbia River. The sediment RI data also reveal that the only source of contaminant releases to sediments at the Site is related to the 1997 excavation around the CPU outfall pipe. This source is now controlled.

As part of a river-wide characterization effort, the U.S. Army Corps of Engineers conducted sampling in June 2001 of the Federal channel and adjacent bed of the Columbia River. This study further confirmed the limits of PCB-impacted sediment defined by the 1999 and 2000 investigations. A total of 25 samples (24 surface grab samples and one core) were collected from the north side of the federal navigation channel and the adjacent nearshore area at Columbia River RM 103. In the six grab samples collected nearest to shore, PCB Aroclor 1248 was detected at concentrations above the Site-specific cleanup level for total PCBs. The results of the USACE study were consistent with previous characterization work performed by Windward.

The riverbank adjacent to the PCB-impacted sediments is comprised of brick, concrete, and some industrial fill. The industrial fill includes furnace slag and tar-like material from the anode production process. Waste profiling on the slag demonstrates that the material is non-hazardous, solid waste. The tar-like material contains PAHs in excess of 1 percent and therefore, classifies as a persistent, Washington state dangerous waste. In addition, SPL was located in an isolated area of the upper riverbank. These materials were placed during historical plant operations and have remained stable on the bank for several decades.

3.4.2 Crowley Parcel

The Crowley Parcel is located approximately 200 feet inland from the northern bank of the Columbia River to the west of the former Alcoa smelter facility shown on Figure 3. Prior to 1976, Pacific Inland Navigation operated the area as a barge maintenance and cleaning facility. In 1976, Crowley Marine Lines (a predecessor in business to Crowley Marine Services, Inc.) acquired the operations. From 1964 to 1983, water and waste materials from the barge maintenance and cleaning operation were deposited by Crowley into a series of three excavated pits (Ecology 1985). These excavation pits, termed the barge waste disposal area, were approximately 300 to 400 feet north of the Columbia River (GeoEngineers 1983). Historical aerial photographs indicate that the southern pit operated from 1964 to approximately 1966-1968, the western pit operated from 1966-1668 to 1969-1971, and the eastern pit operated from 1969-1971 to 1983 (SLR 2007; GeoEngineers 1985; GeoEngineers 1983). Each pit was backfilled soon after closure. Prior to backfilling the eastern pit, in January 1984, all liquids were removed (GeoEngineers 1985).

Over the course of operations, over 2 million gallons of waste materials were deposited in the barge waste disposal area (Crowley Marine Lines 1984). These waste materials consisted of barge slops, bilge slops, and water from gas freeing operations. Because the waste materials contained dilute petroleum hydrocarbon fuel products, the constituents of potential concern

(COPCs) for the Crowley Parcel included polycyclic aromatic hydrocarbons, total petroleum hydrocarbons gasoline fraction (TPH-G), total petroleum hydrocarbons (TPH-oil), total petroleum hydrocarbons diesel fraction (TPH-D), and BTEX (benzene, toluene, ethylbenzene, and xylene) (SECOR 1996). Contamination from the barge waste disposal area impacted the soil and groundwater in the vicinity of the former pits.

In 1983, the first of three hydrogeologic studies was conducted to obtain an evaluation of subsurface soil and groundwater conditions. In August 1984, Columbia Marine Lines informed Ecology of the closure and past uses of the former barge waste disposal area. Monitoring wells MW-1 through MW-21 were installed in the vicinity of the former barge waste disposal area in 1985 by Crowley Environmental Services Corp (GeoEngineers 1986).

Subsequently, in 1985, the second hydrogeologic investigation was conducted to further define the extent and characteristics of the contamination in the vicinity of the former barge waste disposal area. Free hydrocarbons or light non-aqueous phase liquid (LNAPL) petroleum hydrocarbons were observed on the water surface of the wells near the disposal site.

In April 1985, as part of the second hydrogeologic investigation, GeoEngineers recommended installation of a floating hydrocarbon recovery system. This system was installed in July 1985 and consisted of a hydrocarbon recovery well, trench, submersible pump, and wick-type hydrocarbon recovery unit. As needed, free hydrocarbons were also collected from the water surfaces of the monitoring wells using a vacuum truck.

In response to the notification of the past practices at the barge waste disposal area, Ecology issued an Agreed Order (No. DE 85-591) in August 1985. The Agreed Order stipulated that an effective hydrocarbon recovery system be installed and the horizontal and vertical extent of the contamination be determined. Additionally, under the Agreed Order, an oil-water separator was installed in the hydrocarbon recovery system and a third phase of the hydrogeologic study was completed.

With the addition of the hydrocarbon recovery system, the amount of LNAPL in each of the monitoring wells decreased over time. The hydrocarbon recovery system was operated until 1995 when observations indicated that it could not recover additional free hydrocarbons.

Beginning in 1996, on behalf of Crowley Marine Services Inc. (Crowley), SECOR International Incorporated (SECOR) conducted site investigations to support development of a cleanup action plan. This work included aquifer testing and groundwater quality testing to evaluate potential groundwater cleanup alternatives. SECOR recommended in situ cleanup using enhanced natural bioremediation (SECOR 1996).

SECOR subsequently conducted additional subsurface investigation at the site in 1999. The work scope included GeoProbe™ soil borings to collect soil samples, installation of temporary well points for groundwater and hydrologic monitoring, and laboratory testing. The work provided additional definition of the nature and extent of diesel in soil and groundwater (SECOR 1999).

In February 2000, SECOR conducted pilot tests of a dual phase vacuum extraction and bioventing system, an in situ bioremediation technique. Testing indicated that this method increased oxygen in the soil and expedited the in-situ biodegradation of petroleum hydrocarbons by indigenous microorganisms. Additionally, the pilot test provided important parameters for designing a full scale system.

During the summer of 2000, SECOR evaluated in situ bioventing and the excavation and treatment of impacted soils as remedial actions for the site. Based on encouraging pilot test results, the dual phase extraction process was chosen to be implemented. The dual phase extraction system was operated from November 2000 through February 2003 and from December 2004 through December 2005. Approximately 80 pounds of liquid phase hydrocarbons and 4,000 pounds of vapor phase hydrocarbons were extracted by this system. Based on measured biorespiration rates, the estimated mass of hydrocarbons removed by in-situ biodegradation was approximately 11,000 pounds (1,400 gallons) (SLR 2008).

Subsequently, focused groundwater and soil sampling were conducted until 2007. The most recent round of sampling was conducted in August 2007 by SLR International Corporation. Groundwater samples were collected from monitoring and extraction wells and sampled for TPH, BTEX, semi-volatile organic compounds (SVOCs), PAHs, and volatile organic compounds (VOCs). Soil samples were collected from a series of Geoprobe borings and also sampled for TPH, BTEX, PAHs, VOCs, and SVOCs.

With the exception of 1-methylnaphthalene, SVOCs and non-petroleum VOCs did not exceed screening levels (MTCA Method A or Method B cleanup levels) in soil or groundwater samples, which indicates that they contribute a small percentage of the overall threat to human health and the environment (WAC 173-340-703). Based on the investigation results, TPH (combined TPH-G, TPH-D, and TPH-O concentrations) was selected as an indicator hazardous substance for soil and for groundwater (SLR 2008).

3.4.3 Dike Underground Storage Tanks

In 1987, the four underground storage tanks (UST) on the dike, 1-34C, 2-34C, 3-34C, and 4-34C, were emptied, decontaminated, and abandoned in place. As part of the process to abandon a UST in place, Ecology recommends filling the UST with a solid inert material such as gravel, sand slurry, weak cement slurry, or foam. Each of the Dike USTs were filled with gravel upon closure. On behalf of Alcoa, Sweet-Edwards/EMCON, Inc (SE/E) performed investigation and pilot testing services of the four diesel USTs located near the river dike. SE/E installed five monitoring wells, detected diesel light non-aqueous phase liquid (LNAPL) in the wells, and conducted pilot testing of free product recovery in the wells (Sweet-Edwards/EMCON 1989a).

Three wells at the dike USTs were sampled in May 2007. One of the wells, T3-3, was also sampled in September 2007. The concentration of TPH-Dx observed in September was reduced from the May sampling event from 9,900 μg/L to 2,600 μg/L; however, both values exceed the 500 μg/L MTCA cleanup level for TPH-Dx in groundwater. The TPH-Dx that was quantified during the May sampling event displayed matrix interferences that may have elevated the measured TPH concentrations. These interferences were not in the groundwater samples in September, likely explaining the reduced concentration in TPH-Dx from May to September. The May sampling event showed that BTEX was not present in any of the wells near the dike USTs.

3.4.4 Soluble Oil Area

PCB-impacted water soluble oil was deposited in an equalization pond bordered on the north and south adjacent to spurs of the Burlington Northern Santa Fe (BNSF) railways, on the east by a berm, and on the west by a fence. During the 1988 SE/E investigation, samples of soil, groundwater, and sludge material (found on the surface and at depth in the soil) were collected. Composite soil samples indicated PCB concentrations ranged from 1.9 ppm to 107 ppm whereas the sludge material contained PCB concentrations up to 1,600 mg/kg (Sweet-Edwards/EMCON 1988). This investigation also determined that PCB concentrations in the native soils, located at approximately 8.5 feet bgs, were negligible (Sweet-Edwards/EMCON 1988).

In 1989, a supplemental soil and groundwater investigation was conducted in order to further define the horizontal and vertical extent of the PCB-impacted soil and provide background data for developing remedial alternatives (Sweet Edwards/EMCON 1989b). In general, in all media, PCB concentrations were found to diminish with depth and distance from the source.

In July 1989, Alcoa initially proposed to excavate all material with PCB concentrations greater than 25 ppm in accordance with 40 CFR 761.61(a)4(B) for low occupancy areas. This level was proposed by Alcoa because cleanup levels were not promulgated under MTCA at the time. After further discussions with Ecology and EPA, Alcoa chose to reduce the cleanup level to 15 ppm and remediate the area as a voluntary cleanup. By removing materials with PCB concentrations greater than 15 ppm, recognizing that residual PCB materials lacked mobility, and placing a clean cover over the excavated area, Alcoa constructed a remedy in compliance with Federal requirements for PCB cleanups. Ecology did not agree with the 15 mg/kg cleanup level.

On June 1, 1990, pre-excavation sampling was conducted to characterize the materials for disposal (Chemical Processors 1990a). Under direct supervision from Alcoa, Chemical

Processors began remediating the area by excavating sludge material and incrementally excavating impacted soil from 0 to 4 feet bgs, 4 to 8 feet bgs, and 8 to 10 feet bgs.

By October 19, 1990, all material with PCB concentrations greater than 15 mg/kg had been excavated. The excavation depth varied by location from 4 feet to at least 10 feet. A total of approximately 4,750 cubic cards of impacted soil had been excavated and was transported to an appropriate offsite landfill for disposal (Chemical Processors 1990b). Confirmation samples were collected and indicated that the in situ soils were less than 15 mg/kg PCB and the excavation was backfilled with on-site borrow material. According to the remediation plan, the excavations were backfilled with soil with PCB concentrations less than 15 mg/kg and the entire area was capped with a minimum 2-foot clean soil cap. Down-gradient groundwater monitoring data confirm that no impacts to groundwater occurred. Alcoa will remove PCB impacted soils greater than the site Industrial cleanup level.

4 CLEANUP REQUIREMENTS

This section describes the cleanup requirements that must be met by the remediation of the Site. Consistent with MTCA and SMS requirements, this section addresses four types of requirements: Cleanup Levels, Points of Compliance, Remediation Levels, and Applicable Local, State, and Federal Laws.

4.1 Cleanup and Remediation Levels

MTCA regulations provide three methods for determining cleanup standards for a contaminated Site. The standards provide a uniform, state-wide approach to cleanup that can be applied on a site-by-site basis. The two primary components of the standards, cleanup levels and points of compliance (POC), must be established for each site. Cleanup levels are established at the level where a particular hazardous substance does not threaten human health or the environment. POCs designate the location on the site where the cleanup levels must be met.

Cleanup levels for all Site media were developed following procedures described in the MTCA regulations. The development of sediment cleanup levels under MTCA is established in Chapter 173-340-760 WAC through reference to the SMS (Chapter 173-204 WAC). The sections below describe the methodology used to develop cleanup levels based on SMS, MTCA Method A and Method C procedures, applicable or relevant and appropriate requirements (ARARs), and risk-based calculations.

4.1.1 SMS Freshwater Procedures

Section V of the SMS provides guidance for the development of sediment cleanup standards. Although numerical values are provided for cleanups located within the marine waters of Puget Sound, Section 173-204-520(d) WAC states that criteria, methods, and procedures necessary in the development of freshwater sediment cleanup screening levels and minimum cleanup level criteria shall be determined on a case-by-case basis. The final cleanup level for the Site will be based on protection of human health, benthic aquatic organisms, and wildlife.

4.1.2 MTCA Procedures

The MTCA Cleanup Regulations (Sections 173-340-720, -730, and -740 WAC) establish procedures to develop cleanup levels for groundwater, surface water, and soil. MTCA Method A procedure is applicable to sites with relatively few hazardous substances. Cleanup levels based on this method for soil and groundwater are derived through selection of the most stringent concentration presented in the following sources:

- Concentrations listed in WAC Tables 173-720-1, -740-1, and -745-1.
- Concentrations established under ARARs
- Concentrations protective of the environment and surface water beneficial uses.

If these sources do not provide an appropriate value, then the cleanup level is based on the natural background concentration or the practical quantitation limit, whichever is higher. For qualifying sites, Method C procedures can be used to develop cleanup levels for specific media and COCs.

MTCA Method C procedures employ a risk-based evaluation of potential human health and environmental exposures to Site COCs. As defined in the MTCA regulation, for a given chemical detected in soil, groundwater, and/or surface water media, Method C cleanup levels must be at least as stringent as established state or federal standards or other laws (i.e., ARARs identified in Section 4.3) developed for human health and environmental protection. Not all chemicals have state or federal standards. If a state or federal standard was available, that ARAR was evaluated to ensure that it was protective under MTCA. If the ARAR was not protective, the cleanup level was adjusted to a lower value to ensure its protectiveness. MTCA Method C risk-based calculations and any deviations from ARAR values are discussed below.

The Method C procedure also requires that a cleanup level for one media must also be protective of the beneficial uses of other affected media. For example, since Site groundwater eventually discharges into the Columbia River, Site-specific groundwater cleanup levels also considered surface water protection requirements. The procedures for developing cleanup levels for groundwater, surface water, and soil are outlined in the MTCA Cleanup Regulations, Sections 173-340-720, -730, and -740 WAC, respectively. Included in these sections are the specific rules for evaluating cross-media protectiveness. Where relevant to the Site, cross-media protectiveness of cleanup levels is discussed below and incorporates the results of the fate and transport studies presented in previous sections of this report.

4.1.3 Sediment Cleanup and Remedial Action Levels

The SMS, Chapter 173-204 WAC, govern the identification and cleanup of contaminated sediment sites. Under the SMS, the primary endpoint for sediment quality evaluations is protection of human health and the environment, specifically the benthic community and wildlife, from adverse effects associated with COCs. While SMS cleanup levels have been promulgated for sediments in the marine environment, freshwater sediment quality criteria are currently determined on a case-by-case basis (Chapter 173-204-340 WAC). Numeric freshwater sediment quality values (SQVs) for a range of chemicals are still under development by Ecology, though interim guidelines have been released based on probable or apparent effects thresholds (AETs) calculated using the available regional database of synoptic chemistry and toxicity test information. Cleanup standards derived for the Site must consider protection of benthic organisms, as well as the protection of human health and ecological receptors.

Sediment cleanup levels for the Site with respect to benthic organisms were developed using information from several sources, including site-specific studies and other information available from Ecology and EPA. The current interim Ecology (2003) freshwater SQVs for PCBs consider the potential for localized toxicity to benthic invertebrate organisms and include updates of existing freshwater AETs and evaluations of other SQV measures that may provide improved reliability. Ecology is currently considering potential freshwater toxicity-based SQVs ranging from 62 µg/kg dry weight (lowest AET) to 354 µg/kg dry weight (second lowest AET) as identified in Table 4-1.

Table 4-1
Relevant Site-Specific Cleanup Levels

Parameter	Sediment PCB Concentration (µg/kg)	Basis
Natural Background Level	< 5	Lake Chelan TMDL and other regional studies
Human Health Protection (Target HCR = 10^{-6})	5	18 gms/day shellfish consumption; 50% diet fraction
Practical Quantitation Level	10 to 20	Ecology's Manchester Lab and other lab PQLs
Area Background Level	33	MTCAStat Upper 90 percentile: 10 upstream samples (Section 2.4)
Human Health Protection (Target HCR = 10^{-5})	49	18 gms/day shellfish consumption; 50% diet fraction
Lowest Technically Achievable Concentration	90	BPJ; Dredge & backfill; 8% generated residuals; complete mixing [(a)]
BPJ Site-Specific Human Health Protection (Target HCR = 10^{-5})	97	18 gms/day shellfish consumption; 25% diet fraction [(b)]
Benthos and Fish Risk Threshold	62 to 354	AETs; Michelsen (2003)
Proposed Remedial Action Level	320	Targets ~98% of existing mass for removal[(c)]
Wildlife Risk Threshold	320	Site-specific Gobas model
Other Implemented Freshwater Cleanup Levels	500 to 5,000	Average range from similar sites nation-wide
ARARs	Site Specific	SMS (Chapter 173-204-340 WAC)

Notes:

(a) This 'lowest technically achievable concentration' is based on the anticipated post-dredging residuals concentrations after a sand backfill is placed to restore pre-construction grades.

(b) Consistent with WAC 173-340-708(10)(b), modification of the default diet fraction is justified based on the limited availability of potentially harvestable shellfish at the Site given local sediment habitat and hydrologic conditions. Engineering or institutional controls are not required to control exposure.

(c) The actual dredge plan, which includes additional overdredge allowances, will target 99% of the existing mass.

HCR = Human Cancer Risk
BPJ = Best Professional Judgment
AET = Apparent Effects Threshold
TMDL = total maximum daily load
PQL = practical quantitation limit
ARAR = applicable or relevant and appropriate requirement

In addition to the evaluation of benthic effects, cleanup levels at the Site must protect against other adverse effects to human health and the environment, including food chain effects, associated with the potential bioaccumulation of PCBs. With respect to wildlife and human health, potential risks due to PCB uptake and bioaccumulation were considered during the development of the Site specific sediment cleanup levels. The Gobas and Zhang 1994 food web model was used to establish wildlife risk thresholds and estimation of the existing baseline human health risks associated with upper-bound consumption of Asian clams and other organisms from the Site area was determined.

The anticipated sediment remedial action at the Site involves mass removal to the maximum extent with modern, conventional dredging equipment capable of operating safely and effectively under the potentially difficult conditions at the Site (i.e., relatively steep riverbed slopes, dense sediments, and potentially adverse weather conditions). A mechanical dredge with a closed-bucket will be used to the extent practicable to remove the sediment. This method will reduce the volume of water which potentially could require treatment by removing the sediment close to its in situ water content. This design is permanent to the fullest extent. Although this method may also minimize the potential for resuspension, even with careful control of operations, dredging residuals will persist from sources including sloughing.

Estimates for dredging residuals were based on Patmont and Palermo 2007, which combined environmental dredging case study information with site-specific sampling data to obtain bounding-level predictions of generated residual concentrations and thicknesses for environmental dredging projects. In particular, the process by which dredging residuals were estimated for this project was performed step-wise to represent two scenarios: 1) dredging without subsequent residuals management; and 2) dredging with the subsequent placement of a residual sand layer within the dredge footprint. Site-wide average of generated residuals is expected to be less than 1.5 inches.

The results of the residuals analysis provide an evaluation of the lowest technically achievable cleanup levels for a dredging remedy with and without residuals management. Based on a best professional judgment (BPJ) assessment of the anticipated post-dredge Site conditions, it is recommended that a residuals management backfill layer be implemented as a necessary component to the remedial action. Furthermore, based on the analysis of predicted post-dredge, surface-weighted average concentrations (SWAC) ranges, a technically feasible, Site-specific cleanup level of 97 µg/kg will be adopted for the project. A 97-µg/kg cleanup level is protective of benthic organisms and wildlife (i.e., it is lower than cleanup levels adopted at other sites with similar conditions and receptors) and satisfies the Site-specific risk reduction goal for protection of human health.

As noted in Table 4-1, cleanup levels protective of benthic organisms and wildlife range from 62 µg/kg to 354 µg/kg; generally above the 97 µg/kg cleanup level. Although selection of a Remedial Action Level (RAL) up to 354 µg/kg would provide an action level for which a dredging remedy is both technically achievable and protective, targeting lower dredging RALs, such as 97 µg/kg, would significantly increase the volume of sediment to be removed and thus extending the duration of the project beyond the allotted environmental window and increasing the potential for down-stream migration of suspended material. Thus, targeting a lower RAL (and a larger associated dredge volume) would result in low incremental environmental benefit relative to overall risk reduction. A Site-specific RAL set at 320 µg/kg dry weight would target approximately 99 percent of the PCB mass (i.e., upon completion of a dredge plan design that includes overdredge allowances) and would immediately reduce risks to human health and the environment. For areas with concentrations below the RAL and above the cleanup level, enhanced natural recovery (i.e., placement of a minimum 6-inch sand layer) will be used. Table 4-2 summarizes the sediment PCB cleanup level and RAL specific to this Site.

Table 4-2
Site-Specific Sediment Cleanup Level and RAL

Parameter	Sediment PCB Concentration (µg/kg)	Protection Basis/Remedial Action
Site-specific Cleanup Level	97	Human health and wildlife
Remedial Action Level	320	Dredge Sediment above RAL

4.1.4 Groundwater Cleanup Levels

Future Site uses will continue to be industrial and there are no plans to extract water from the shallow water-bearing layers, and existing water supply regulations effectively preclude this potential Site exposure pathway within portions of the Site. However, consistent with MTCA procedures for determining potable water sources, potential drinking water uses were considered in the initial development of groundwater cleanup levels. Because the Site has few groundwater contaminants, Method A was used to develop cleanup levels for the Site COCs.

Final cleanup levels were selected as the most stringent of the Method A WAC 173-720-1 Table values and ARARs. The primary ARARs for groundwater in this case include the federal Drinking Water Standards and Health Advisories (EPA 2002) and the State Primary Drinking Water Regulations (Chapter 246-290 WAC). Because of the proximity to the Columbia River, the National Recommended Water Quality Criteria (EPA 2006), which establishes criteria for protection of surface water resources is also an ARAR.

The groundwater cleanup levels for each COC and the basis for selection are listed in Table 4-3.

Table 4-3
Groundwater Cleanup Levels

Chemical of Potential Concern	Groundwater Cleanup Level	Protection Basis
Fluoride (dissolved)	4 mg/L	State Drinking Water MCL
TPH Diesel Range	500 µg/L	MTCA Method A Standard Value
TPH Mineral Oil	500 µg/L	MTCA Method A Standard Value

While most of the fluoride-bearing groundwater at the Site is covered by the 1992 Consent Decree for the SPL Storage Area, a few minor exceedances (less than two times the cleanup level) were observed in Shallow Zone wells SP-4-S and T3-3. These two wells are located where cleanup activities have been completed and the sources have been removed to the maximum extent practicable. In the alternatives evaluation of the 1992 CAP for the SPL Storage Area, Ecology determined that treatment of low level fluoride-bearing groundwater was impracticable, particularly when present in the seasonal Shallow Zone. Therefore, it is appropriate to establish a fluoride groundwater remediation level (REL) that is protective of surface water resources and above which, remedial action addressing fluoride-bearing groundwater is needed.

Concentrations of fluoride in surface water up-gradient of the Site were monitored between 1992 and 2002 and ranged from 0.08 mg/L to 0.48 mg/L, averaging 0.24 mg/L. This data was collected as part of the requirements of the 1992 Consent Decree. As part of this investigation, a surface water sample was collected and a fluoride concentration of 0.127 mg/L was reported. The fate of fluoride along the pathway in which groundwater interacts with surface water is controlled by the presence of other ions (such as calcium) for fluoride to react with and form (precipitate) the mineral fluorapatite. The rate at which Site groundwater flows from the Intermediate Zone to the Columbia River is approximately 10 to 30 feet/year and is even less for the Shallow Zone. Based on this data, a mathematical simulation of the chemical reaction that occurs as fluorapatites precipitate can be performed to calculate a surface water concentration for a range of fluoride concentrations. Using a theoretical, upperbound groundwater concentration of 2,500 mg/L (fluoride), the calculated fluoride concentration in surface water is 0.25 mg/L, which is within the range of concentration observed up-gradient from the Site. Therefore, a fluoride groundwater REL of 2,500 mg/L will be established.

Table 4-4
Groundwater Remediation Levels

Chemical of Potential Concern	Groundwater Remediation Level	Protection Basis/Remedial Action
Fluoride	2,500 mg/L	Surface Water – Evaluate need for treatment or alternate remedial action

4.1.5 Soil Cleanup and Remediation Levels

The current and future Site use plans include industrial storage and light, medium, and heavy industrial operations, and meet the requirement of a "traditional industrial use" under the MTCA regulations (Section 173-340-745 WAC). Thus, industrial use is the appropriate basis for development of Site-specific soil cleanup levels under MTCA Method C. Soil cleanup levels for the Alcoa/Evergreen Site were developed for fluoride, PAHs, TPH, and PCBs by considering the following potential exposure/risk pathways:

- Human health protection from direct soil contact pathway exposure
- Human health protection from soil-to-groundwater pathway exposure
- Human health protection from soil-to-air pathway exposure
- Terrestrial ecological protection

4.1.5.1 Direct Soil Contact Pathway Exposure

Future development plans at the Site include grading of the existing Site with a minimum of 12 inches of clean fill and asphalt pavement; therefore, direct contact exposures to soil will be minimized. The primary potential pathway for direct contact would occur during earthwork operations and other activities required for Site development. Accordingly, cleanup levels were initially derived using WAC Equations 173-340-745-1, -745-2, and -745-3 for non-carcinogenic, carcinogenic, and petroleum COCs, respectively. On a Site-wide basis, no modifications were made to the standard parameters for these equations.

However, because the Toxic Substances Control Act (TSCA) regulation for PCBs lists more restrictive cleanup levels than those derived under Method C, the initial PCB cleanup level was adjusted downward from 66 mg/kg to 10 mg/kg. This value is also consistent with the Method A concentration for Industrial Use scenarios. Specific to the Crowley Parcel AOC, the MTCATPH11 spreadsheet was used to calculate a direct contact cleanup level for TPH. Petroleum fractionation data from eight samples was used to develop a range of potential TPH cleanup levels under a Method C industrial site use scenario. The median of the eight cleanup level values was computed as 30,949 mg/kg.

4.1.5.2 Soil-to-Groundwater Pathway Exposure

Cleanup levels based on Method C direct contact must also be adjusted as necessary to ensure groundwater resources are protected. However, when empirical data exists that indicates that current groundwater impacts are not occurring and sufficient time has elapsed for migration from source areas to the point of measurement to reinforce that demonstration, then cleanup levels derived for direct contact do not require adjustment. Furthermore, current Site conditions must be representative of future development scenarios, as is the case at this Site (i.e., impervious areas will be maintained and potentially expanded) and Site will be restricted to industrial use.

For PAHs, source control work is planned to remove the remaining on-Site material that is now subject to infiltration. The RI/FS discusses the groundwater collected during several years of monitoring, which demonstrates that Site groundwater is currently in compliance with Method A cleanup levels. Therefore, the PAH cleanup level was not adjusted downward for protection of groundwater resources.

For fluoride contaminated areas outside of the former SPL Storage Area, source removal of residual fluoride-bearing waste at the Site has been completed in accordance with Enforcement Order DE 4931 (between Ecology and Evergreen; Ecology 2007b). Upon removal of the residual waste and affected soil, it is expected that groundwater will attenuate to below the fluoride cleanup level. Data generated from Site-specific laboratory leaching tests and evaluated in the MTCA Equation 173-340-747-1 (below; the standard 3-phase partitioning model) indicate that a concentration of approximately 9,100 mg/kg fluoride in soil would be protective of groundwater resources (less than the standard cleanup value derived by Method C). Therefore, a soil REL of 9,000 mg/kg will be established and implemented during source control activities outside of the SPL area.

For PCBs, soil concentrations established under Method A are conservative and are protective of groundwater resources. Because the PCB cleanup level was adjusted downward for compliance with TSCA, it also meets the requirements of Method A. Therefore, no further adjustment of the PCB cleanup level is required.

At the Crowley Parcel AOC, the TPH cleanup level for leaching to groundwater was calculated by using Ecology's MTCATPH11 spreadsheet, assuming a potable groundwater receptor (i.e., 500 µg/L groundwater cleanup level). Each of the eight fractionated samples was evaluated separately after using the data adjustments discussed above for the direct contact evaluation. The leaching to groundwater evaluation was conducted for the unsaturated zone and the default soil parameter values were applied.

Soil cleanup levels were not calculated for the saturated zone because of difficulties demonstrating compliance with soil cleanup levels in the saturated zone. When evaluating results for soil samples in the saturated zone, it is difficult to know whether the concentrations observed reside in the water phase or on the soil phase. An empirical demonstration will be used to demonstrate that soil in the saturated zone is protective of groundwater [per WAC 173-340-747(9)]. After the groundwater concentrations decrease to below the groundwater cleanup level, the soil in the saturated zone must be protective of groundwater. Using this approach, the median TPH cleanup level for the eight fractionated samples is 5,070 mg/kg.

4.1.5.3 Soil-to-Air Pathway Exposure

For COCs that readily evaporate (such as diesel and solvents), the inhalation of vapors arising from impacted soil must be considered. Under Method C, the vapor pathway must be evaluated whenever a volatile substance is expected on Site. On this Site, diesel and residual range organics are present; however, the pathway is considered incomplete whenever the TPH concentration is less than 10,000 mg/kg for diesel range constituents. For residual range TPH, the pathway is considered incomplete when the existing concentrations are approximate to the cleanup level derived for protection of groundwater resources. TPH cleanup levels for this Site have been set under such conditions and are therefore protective of the soil-to-air pathway.

4.1.5.4 Terrestrial Ecological Protection

As previously stated, the Site will be redeveloped for industrial uses and impacted soil will be covered with a minimum of 12 inches of clean fill or other improvements such as buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed to the soil. Based on future Site conditions and using the exposure analysis procedure under WAC 173-340-7492 (2)(a)(ii), a simplified terrestrial ecological evaluation was not required. Regardless, a simplified terrestrial ecological evaluation was performed for the Site with respect to TPH. MTCA Table 749-2 states that a TPH cleanup level of 15,000 mg/kg that is protective of terrestrial ecological resources based on industrial/commercial site uses. Therefore, cleanup levels were not further adjusted for protection of terrestrial ecological resources, although all exposed areas (i.e., where institutional controls would not be placed or a remedial action conducted) meet the criteria in WAC Table 173-340-749-2.

Tables 4-5 and 4-6 summarize the soil cleanup and remediation levels specific to this Site.

Table 4-5
Soil Cleanup Levels

Chemical of Potential Concern	Soil Cleanup Level	Protection Basis
Fluoride	210,000 mg/kg	Direct Contact
PAHs[1]	18 mg/kg	Direct Contact
PCBs[2]	10 mg/kg	Direct Contact and Groundwater
TPH Diesel Range	2,000 mg/kg	Direct Contact and Groundwater
TPH Mineral Oil	4,000 mg/kg	Direct Contact and Groundwater
Crowley Parcel AOC TPH[3]	5,070 mg/kg	Groundwater

[1] Cleanup level developed for potentially carcinogenic PAHs based on the approved MTCA TEF procedure

[2] A cleanup level of 1 mg/kg will be adopted for areas designated for Unrestricted Use

[3] An independent TPH cleanup level was established for the Crowley Parcel AOC. TPH cleanup level is for combined TPH-G, TPH-D, and TPH-O concentrations.

Table 4-6
Soil Remediation Level

Chemical of Potential Concern	Soil Remediation Level	Protection Basis/Remedial Action
Fluoride	9,000 mg/kg	Groundwater – Excavate Soils above REL

4.2 Points of Compliance

This section establishes the point at which cleanup levels for various media must be met (i.e., the point of measurement).

4.2.1 Sediment Point of Compliance

Surface sediments within the biologically active surface water habitat zone are typically represented by samples collected across the top 10 cm (0 to 0.3 feet) below the mudline. A site-specific evaluation of the depth of the biologic zone has not been completed for this Site; however, based on observations during the remedial investigation it is likely that the zone is 10 cm or less. Therefore, use of a default 0 to 10 cm point of compliance for the sediment cleanup standard should provide an additional level of protectiveness at the Site.

4.2.2 Groundwater Point of Compliance

As defined in the MTCA regulations, the conservative default standard POC for groundwater extends from the uppermost level of the saturated zone to the lowest depth that could be potentially affected by Site releases. However, Site specific conditional points of compliance for groundwater cleanup levels may also be considered as it is anticipated that it is not practicable to meet the some or all groundwater cleanup levels throughout the Site within a reasonable timeframe.

For fluoride, it is appropriate to demonstrate compliance with groundwater cleanup levels at Conditional POC wells located along the shoreline, down-gradient from the respective source areas in accordance with WAC 173-340-720(8)(c). For TPH, the standard POC will be used to demonstrate compliance for those portions of the Site.

4.2.3 Soil Point of Compliance

For protection of groundwater, the POC is throughout the Site. The POC for direct contact with soils extends from the ground surface to the reasonable estimated depth of potential future soil excavations (e.g., to accommodate deep foundations or similar facilities), which can extend to 15 feet bgs or deeper [see WAC 173-340-740(6)(d)]. The POC for soil at the Site extends throughout the soil column from the ground surface to 15 feet bgs, except where deeper excavations are impracticable due to the presence of groundwater.

4.3 Applicable Local, State, and Federal Laws (ARARs)

Many environmental laws may apply to a cleanup action. In addition to meeting MTCA cleanup standard requirements as described above, a cleanup action must meet cleanup standard requirements and environmental standards set in applicable laws. The cleanup action must also comply with elements of other applicable environmental reviews and permitting requirements. Though a cleanup action performed under formal MTCA authorities (e.g., a Consent Decree) would be exempt from the procedural requirements of certain state and local environmental laws, the action must nevertheless comply with the substantive requirements of such laws (RCW70.105D.090; WAC173-340-710). Potentially applicable federal, state, and local laws that may impact the implementation of remedial actions at the Alcoa Vancouver Site are listed below.

4.3.1 Federal Requirements

- Clean Water Act (33 USC Section 1251 et seq.)
  - Discharges of Pollutants into Navigable Waters
  - National Pollutant Discharge Elimination System
- Toxic Substances Control Act (TSCA) [15 USC s/s 2601 et seq. (1976)]
- Memorandum of Agreement between EPA and Corps [Mitigation under Clean Water Act Section 404(b)(1)]
- Resource Conservation and Recovery Act
- Federal Clean Air Act (42 USC 7401 et seq.)
- Endangered Species Act [16 USC 1536 (a) – (d); 50 CFR Part 402]
- U.S. Fish and Wildlife Mitigation Policy (46 FR 7644)
- Fish and Wildlife Coordination Act (16 USC 661 et seq.)
- Protection of Wetlands, Executive Order 11990 (40 CFR Part 6, Appendix A)
- National Historic Preservation Act (36 CFR 800)
- National Environmental Policy Act Review

4.3.2 Washington State and Local Requirements

- Washington MTCA (Chapter 70.105D RCW)
- Washington SMS (Chapter 173-204 WAC)
- State Environmental Policy Act (SEPA) (RCW 43.21C; WAC 197-11)
- Washington Water Pollution Control Act (Chapter 90.48 RCW; Chapter 173-201A WAC)
- Washington Shoreline Management Act (Chapter 90.58 RCW; Chapter 173-14 WAC)
- Washington State Clean Air Act (RCW 70.94; WAC 173-400, 403)
- Washington Hydraulics Code (Chapter 75.20 RCW; Chapter 220-110 WAC)
- Washington Solid Waste Management — Reduction and Recycling Act (Chapter 70.95 RCW; Chapter 173-350 WAC)
- Washington Hazardous Waste Management Act (Chapter 70.105 RCW; Chapter 173-303 WAC)
- Washington Department of Fisheries Habitat Management Policy (POL 410)

- Compensatory Mitigation Policy for Aquatic Resources (Chapters 75.20 and 90.48 RCW)
- Water Resources Act (Chapter 90.54 RCW)
- State Aquatic Lands Management Laws Washington State Constitution Articles XV, XVII, XXVII (RCW 79.90 through 79.96; WAC 332-30)
- Growth Management Act (Chapters 36.70A; 36.70.A.150; and 36.70.A.200 RCW)
- State Historic Preservation Act (Chapter 27, 34, 44, and 53 RCW)
- Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC)

5 DESCRIPTION OF FEASIBILITY STUDY ALTERNATIVES

This section includes a summary of the remedial alternatives that were considered in the Alcoa and Crowley RI/FS documents. The section is introduced with a discussion of the remedial action objectives that pertain to the Site.

5.1 Remedial Action Objectives

This section defines the remedial action objectives (RAO) for each of the Site AOCs identified in Section 3.4. The general RAOs for the Site as they pertain to the various COCs include:

1. Protection of human health and the environment from direct contact with COC-impacted media (i.e., soil, waste, raw materials, sediment, and groundwater)
2. Protection of groundwater resources from direct contact with COC-impacted media (i.e., soil, waste, and raw materials)
3. Protection of human health and the environment from potential exposure due to ingestion of surface water affected by COC-bearing groundwater discharging from the Site into the Columbia River
4. Protection of human health and the environment from potential exposure due to ingestion of Site groundwater
5. Reduction of on-site volume or mass of impacted media containing Site COCs

The remainder of this section describes the RAOs applicable to the Site AOCs and summarizes the activities required to demonstrate achievement of the objectives. The presumptive remedies for the Dike USTs and Soluble Oil Area AOCs were developed in accordance with MTCA 173-340-360(3)(d) to achieve the applicable RAOs and were designed to remove source materials to the maximum extent practicable. Selection for these remedies is based on the expectation that soil cleanup levels defined in Section 4.1.5 would be achieved at a standard POC thus warranting no further action in accordance with WAC 173-340-350(8)(a). Upon completion of source removal within these AOCs, it is anticipated that subsequent groundwater monitoring would indicate compliance with cleanup levels defined in Section 4.1.4.

5.1.1 PCB-Impacted Sediment

Sediments of the Columbia River adjacent to the Site are impacted with PCBs at levels that pose a potential threat to human health and the environment. The planned remedial action at the Site to address affected sediment includes a design that is permanent, provides mass removal to the maximum extent practicable, and addresses public concerns. To further evaluate the benefit of the removal alternative, an additional remedial alternative was developed that considers in situ containment of sediments above the RAL. The alternatives are compared and contrasted against the MTCA and SMS threshold criteria in Section 6.1. Both alternatives are designed to protect human health, benthic aquatic organisms, and wildlife. Specifically, the preferred remedy will achieve the Site-specific sediment cleanup level as measured on a surface weighted average concentration (SWAC)-basis upon implementation.

5.1.2 Crowley Parcel

The soil and groundwater at the Crowley Parcel have been impacted by PAHs, TPH-G, TPH-oil, TPH-D, and BTEX. Although historic remediation actions have occurred, residual contamination is present in both the soil and groundwater. The alternatives were developed to determine the most permanent solution for the AOC that provides a source control benefit to the maximum extent practicable. The four cleanup action alternatives involve reducing or removing the source of contamination. By removing the source of contamination, the impact on groundwater will be reduced. These alternatives are protective of human health and the environment and meet the Site RAOs.

5.1.3 Dike USTs

The Dike USTs were abandoned in place in 1987; however, residual product has been subsequently detected in extraction well T3-3, and soil sampling in the vicinity of the tanks has detected diesel. Sampling of UST well T3-3 also found TPH in excess of MTCA Method A cleanup levels for groundwater. The presumptive remedy for this AOC will include removing the tanks, free product (if encountered), and soils exceeding cleanup levels protective of groundwater. No further remedial action would be required to meet the general Site RAOs upon completion of the source removal activities.

5.1.4 Soluble Oil Area

Historical documents indicate that soil and sludge with PCB concentrations above 15 mg/kg were removed from the Soluble Oil Area in 1990; however, impacted soils above the Site cleanup levels may persist. Although the pathway to groundwater was demonstrated as incomplete based on monitoring data, impacted materials with PCB concentrations greater than 10 mg/kg will be removed from this area as a presumptive remedy to prevent direct contact with PCB-impacted material above Site cleanup levels. These actions are also protective of groundwater; therefore, no further remediation beyond source removal is required to meet the general Site RAOs.

5.2 Sediment Cleanup Alternatives

The sediment cleanup alternatives considered in the Alcoa/Evergreen RI/FS were active remedial measures. Specifically, two remedial alternatives were developed to address sediment contamination. These include:

- Alternative S-1: Sediment Removal with Enhanced Natural Recovery (ENR)
- Alternative S-2: In Situ Containment of Sediment with Enhanced Natural Recovery

The remainder of this section describes the two sediment remedial alternatives that were considered in the RI/FS. Table 5-1 provides a summary of the general response actions (GRA; e.g., removal, containment, treatment, etc.) used in each alternative.

Table 5-1
Summary of PCB-Impacted Sediment AOC Remedial Alternative Components

Remedial Alternative	Institutional Controls	MNR	ENR	Containment	Removal & Disposal	Treatment	Reuse & Recycling
S-1	No	No	Yes	No	Yes	No	Yes
S-2	Yes	No	Yes	Yes	No	No	No

Notes:
1. A typical 'No Action' alternative was not considered for this AOC as an active remedial measure was pre-selected.
MNR: Monitored Natural Recovery
ENR: Enhanced Natural Recovery

5.2.1 Alternative S-1: Sediment Removal with ENR

Alternative S-1 includes dredging, dewatering, and disposing of PCB-impacted sediments; placing clean sand to manage residuals, restore natural grades, and enhance natural recovery; excavating industrial wastes located on the riverbank; and, placing shoreline protection materials. Specifically, the alternative would remove approximately 56,000 cy of sediments above the 320 µg/kg RAL and the placement of approximately 60,000 cy of sand. It is anticipated that a portion of the work could be completed during seasonal low river stages from the shore. BMPs such as silt fencing and sand berms would be used as necessary to prevent erosion into the Columbia River and to keep work areas reasonably dry.

During the acceptable in-water, environmental work window (November 1 through February 28), dredging and backfill activities would commence. Turbidity monitoring would occur throughout construction and BMPs would be employed to prevent excessive sediment resuspension and other environmental impacts. Dredging of the sediment subject to TSCA disposal regulations (i.e., greater than 50 mg/kg PCBs) would occur first followed by the remaining areas designated for off-site disposal. Material subject to TSCA disposal requirements would be transferred on site and dewatered prior to being loaded into lined trucks prior to shipment to a fully permitted, off-site disposal facility. The fluid from dewatering would either be treated on-site prior to discharge to the Columbia River, or it would be transported to an off-site regulated facility for disposal.

Dredge sediment designated for off-site disposal as solid waste may be handled in two ways. Sediment treated as solid waste may be transferred and dewatered on-site using the equipment used to process the TSCA material (after appropriate decontamination procedures are employed) prior to transfer by truck to an upland facility. Alternatively, the material may be transferred by barge, without prior dewatering other than the initial decanting of accumulated free water within the barge, directly to a transfer facility upstream of the Site on the Columbia River.

The next segments to be removed would target the sediment to be disposed of on site in the North and North 2 Landfills (i.e., sediment less than 10 mg/kg PCBs). This material would be transferred on site and placed within the North and North 2 Landfills footprint where it would be allowed to passively dewater prior to final compaction and covering with a 1-foot sand layer. Finally, sediment retained for beneficial use (i.e., sediment less than 1 mg/kg PCBs) would be dredged last, transferred on site, and stockpiled. The stockpile would be located away from the shoreline and covered to prevent transport of the material back to the affected area prior to final placement as on-site fill.

Upon completion of the dredging and sand placement work, confirmation sampling would be performed to ensure compliance with the 97 µg/kg PCB cleanup level. The results would then be evaluated on a SWAC basis. In the event compliance is not demonstrated, an additional layer (minimum 6 inches) of ENR material would be placed and samples re-collected. No additional dredging or sand placement would be performed.

5.2.2 Alternative S-2: In Situ Containment of Sediment with ENR

In this remedial alternative, an isolation cap composed of a sand layer beneath an armoring layer would be placed over the affected sediments that are above the RAL (320 µg/kg) at the Site. Capping forms a surface barrier to physically isolate the affected sediments from the aquatic environment. The cap would be designed to effectively contain and isolate the affected sediments from the overlying water column and benthic habitat and prevent contaminant migration through the cap into the surrounding water body. The armor layer would consist of sufficient thickness and grain size to resist long-term erosive forces from mechanical scour, wave action, or burrowing organisms. For sediments above the cleanup level, but below the RAL, an ENR layer consisting of a minimum 6 inches of sand would be placed.

Pending remedial design, the isolation cap would consist of two layers: approximately 1 foot of sand and 2 feet of quarry spall armoring. The 1-foot sand layer (comprised of minimum 6 inches with an allowable overplacement for construction of 6 inches) would be used for the chemical isolation layer to effectively isolate the underlying affected sediments. For this evaluation, it is assumed that imported sand would be required for the capping material. The 2-foot fine gravel/quarry spall armoring layer (comprised of minimum 12 inches of material with an allowable overplacement for construction of 12 inches), would be included at the top of the cap to prevent erosion from wind and vessel-generated wave action, as well as the potential for future propeller wash effects.

For the ENR layer, it is anticipated a total of 1 foot of material may be placed, as the ENR layer design would include a 6-inch overplacement allowance. In addition to local upland sources, ENR material could potentially be obtained from a clean sediment source, such as from regular maintenance dredging operations on the Columbia River, which occurs annually along various reaches of the river. Regardless of the selected sand source, regular QA/QC testing would be performed to ensure compliance with established cleanup levels.

All material placement would commence downslope where applicable. All cleanup areas of the Site would be monitored during construction to document compliance with turbidity standards and other permit requirements. Upon completion of the construction, bathymetric surveys would be performed to confirm that the minimum placement thicknesses are achieved and, if necessary, surveys would be verified via core collection. Long-term monitoring and maintenance of the cap would be performed. No dredging or PCB mass removal would occur under this alternative.

5.3 Crowley Parcel Cleanup Alternatives

Four remedial alternatives were developed for consideration at the Crowley Parcel AOC.

- Alternative CP-1: Excavation and Off-Site Disposal
- Alternative CP-2: Excavation and On-Site Treatment
- Alternative CP-3: Bioventing
- Alternative CP-4: In situ Chemical Oxidation

The remainder of this section discusses each of these alternatives and Table 5-2 provides a summary of the different components used in each alternative.

Table 5-2
Summary of Crowley Parcel AOC Remedial Alternative Components

Remedial Alternative	Institutional Controls	Natural Attenuation	Containment	Removal & Disposal	Treatment
CP-1	Yes	Yes	No	Yes	No
CP-2	Yes	Yes	No	Removal Only	Yes
CP-3	Yes	Yes	No	No	Yes
CP-4	Yes	Yes	No	No	Yes

Note: A typical 'No Action' alternative was not considered for this AOC as an active remedial measure was pre-selected.

5.3.1 Alternative CP-1: Excavation and Off-Site Disposal

Alternative CP-1 complies with MTCA standards through the removal of all materials with TPH concentrations above 5,070 mg/kg, the TPH soil cleanup level established for the Crowley Parcel (discussed in Section 4.1.5). Under this alternative, approximately 12,500 cubic yards of relatively clean soil ranging from the ground surface to 6 to 10 feet bgs would be removed. Then, approximately 4,200 cubic yards of impacted soil would be excavated. Samples collected from the excavation sidewalls would determine the lateral extent of the excavations and excavation will continue until sidewall samples are below the cleanup level. Vertically, the excavation would continue to the extent of contamination – which is anticipated be to approximately 1 foot below the low seasonal groundwater table (approximately 15 to 17 feet bgs) – as feasible depending on feasibility related to the ability to dewater the excavation and maintain safe excavation practices.

During excavation, groundwater would be pumped from the excavation pits and treated on-site via an existing oil/water separator, bag filters, and activated carbon. After treatment, groundwater would be stored in a temporary storage tank for laboratory testing of TPH concentrations. If the TPH levels are determined to be below the groundwater cleanup level, the water would be injected into the extraction/injection trench previously used for the bioventing system, which would be re-registered with Ecology as an injection point. Depending on the season, groundwater is encountered at the site at approximately 14 to 17 feet bgs and preliminary calculations indicate that up to 250,000 gallons of groundwater could be extracted and require treatment.

Stockpiled soil would be tested for TPH. Soil with TPH concentrations less than the established cleanup level would be used to backfill the excavation. Any material containing TPH concentrations above the established cleanup level would be transported off-site for disposal. Excavations would be capped by re-grading of the Site or another source of clean backfill.

Following excavation and source removal, the area would be remediated through monitored natural attenuation. New wells would be installed to replace those which were removed during the excavation activities. Groundwater monitoring would occur during the monitored natural attenuation period, which is anticipated to take approximately 6 years. Institutional controls would be placed on the property to restrict its future use to industrial purposes.

5.3.2 Alternative CP-2: Excavation and On-Site Treatment

Alternative CP-2 consists of excavation and on-site bioremediation of impacted soils. As described in Alternative CP-1, all materials with TPH concentrations above the TPH cleanup level for the Crowley Parcel would be excavated. The horizontal extent of the excavation would be determined from sidewall samples, whereas vertical excavation would continue to the extent of contamination – which is anticipated be to approximately 1 foot below the low seasonal groundwater table (approximately 15 to 17 feet bgs) – as feasible depending on feasibility related to the ability to dewater the excavation and maintain safe excavation practices. As previously mentioned, approximately 4,200 cubic yards of impacted materials will be excavated from 6 to 10 feet bgs. The clean soil above the impacted soil would be removed and stockpiled for placement into the excavations and use in constructing the bioremediation cell.

Groundwater would be pumped from the excavation pits and treated on-site via an existing oil/water separator, bag filters, and activated carbon. After treatment, groundwater will be stored in a temporary storage tank for laboratory testing of TPH concentrations. If the TPH level is determined to be below the groundwater cleanup level, the water would be injected into the extraction/injection trench previously used for the bioventing system which would be re-registered with Ecology as an injection point. Depending on the season, groundwater is located approximately 14 to 17 feet bgs, and preliminary calculations indicate that up to 250,000 gallons of groundwater could be extracted and require treatment..

Stockpiled "clean" soil will be tested for TPH. Soil with TPH concentrations less than the established cleanup level will be used to backfill the excavation. Any material containing TPH concentrations above the established cleanup level will be segregated for bioremediation. If necessary, excavations will be filled by re-grading of the Site or another source of clean backfill to construct the bioremediation cell.

Excavated soil would be separated and placed in 2 to 3 foot thick lifts in a 1 to 2 acre bioremediation treatment cell. The cell would be graded to slope towards the center of the cell, and silt fencing would be installed around the perimeter of each cell to minimize stormwater flow out of the cells. Nutrients and water would be added to the cell and mixed on a regular basis. Bioremediation progress would be monitored through the collection of quarterly samples.

Following excavation and bioremediation, the area would be remediated through monitored natural attenuation. Final cover will be established using one foot of clean soil. New wells would be installed to replace those which were removed during the excavation activities. Groundwater monitoring would occur during the monitored natural attenuation period, which is anticipated to take approximately 6 years. Institutional controls would be placed on the property to restrict its future use to industrial purposes.

5.3.3 Alternative CP-3: Bioventing

Alternative CP-3 is an in situ treatment method that consists of treating the soil impacted with TPH concentrations above 5,070 mg/kg through bioventing and treating groundwater in the impacted areas using dual phase extraction methods. Bioventing stimulates biodegradation through oxygenation of the subsurface and soil vapor extraction is used to remove volatile organic compounds. Groundwater extracted would be treated with bag filters and liquid-phase carbon units prior to reinjection into the extraction trench at the Site.

A hollow stem auger drill rig would install approximately 40 2-inch wells for the bioventing system. Each of the wells would be connected to a vacuum blower system. When soil vapors are extracted they would be treated by vapor-phase carbon units, prior to discharge to the atmosphere. On a monthly basis liquid and vapor effluents would be sampled, spent carbon would be replaced, flow rates would be monitored and equipment would be maintained, repaired, and replaced, as necessary.

Quarterly or semi-annually, soil samples would be collected in the area treated by the bioventing system using a Geoprobe. If the TPH concentrations in the soil samples were below the established cleanup levels, the system would be shut down. Approximately 30 months of operation would be anticipated for the bioventing process.

Following the bioventing process, the area would be remediated through monitored natural attenuation. New wells would be installed to replace those which were removed during the excavation activities. Groundwater monitoring would occur during the monitored natural attenuation period, which is anticipated to take approximately 12 years. Institutional controls would be placed on the property to restrict its future use to industrial purposes.

5.3.4 Alternative CP-4: In Situ Chemical Oxidation

Alternative CP-4 is an in situ soil and groundwater treatment method which consists of injection of oxidizing chemicals into the subsurface of the impacted area using an adapted Geoprobe rig. The oxidizing chemicals would break down organic materials into carbon dioxide and water through chemical reactions. An initial injection of Fenton's Reagent, a strong oxidizing chemical, would be conducted at approximately 80 injection points. The number and spatial distribution of the injection points would be developed by approximating the radius of influence of each injection and assuming a 10% overlap for injection points.

After approximately 3 months, Geoprobe borings would be drilled and conformational soil samples would be collected. Additional injection and sampling events would be conducted until TPH soil cleanup levels are met. For cost purposes, it is assumed that a total of three injection and sampling events would be conducted to meet TPH soil cleanup levels.

Following chemical oxidation treatment, the area would be remediated through monitored natural attenuation. New wells would be installed to replace those which were removed during the excavation activities. Groundwater monitoring would occur during the monitored natural attenuation period, which is anticipated to take approximately 12 years after the in situ treatment event. Institutional controls would be placed on the property to restrict its future use to industrial purposes.

6 EVALUATION OF REMEDIAL ALTERNATIVES

The FS documents evaluated a range of remedial alternatives and provided a comparative evaluation of those alternatives against MTCA remedy selection criteria. As part of its cleanup decision for the Site, Ecology reserves the right to consider other information, including issues raised during public comment, and/or to conduct its own evaluation of alternatives to assist in making its cleanup decision.

6.1 Minimum Requirements for Cleanup Actions

WAC 173-340-360(2) defines the minimum requirements that all remedial alternatives must achieve in order to be considered as a potential final cleanup action at a site. In this WAC section, MTCA identifies specific criteria against which alternatives are to be evaluated, and categorizes them as either "threshold" or "other" criteria. All cleanup actions must meet the requirements of the threshold criteria. The other MTCA criteria are considered when selecting from among the alternatives that fulfill the threshold requirements. This section provides an overview of these regulatory criteria. The consistency of each alternative with these criteria is then discussed in the subsequent sections.

6.1.1 Threshold Requirements

The threshold MTCA requirements for a selected cleanup action are as follows:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal laws
- Provide for compliance monitoring

Together, the site-specific cleanup levels and POCs are referred to as cleanup standards. The overall protectiveness that a cleanup alternative provides depends on its ability to meet cleanup standards for Site COCs. All alternatives are expected to ultimately achieve compliance with cleanup standards and ARARs, although the estimated time required to accomplish such compliance may vary among the alternatives.

Of the proposed alternatives (for each AOC), No Action alternatives generally do not meet threshold requirements because they do not include monitoring to verify compliance with cleanup levels. The remaining alternatives all achieve the threshold requirements, as these alternatives protect human health and the environment, would result in compliance with cleanup levels, and provide for appropriate protection and compliance monitoring. More detailed assessments of restoration timeframes and other relevant MTCA considerations are provided below.

6.1.2 Other MTCA/SMS Requirements

Other requirements for evaluating remedial alternatives for the selection of a cleanup action include:

- Use of permanent solutions to the maximum extent practicable [Procedure in WAC 173-340-360(3)]. MTCA specifies that when selecting a cleanup action, preference shall be given to actions that are "permanent solutions to the maximum extent practicable." The regulations specify the manner in which this analysis of permanence is to be conducted. Specifically, the regulations require that the costs and benefits of each of the project alternatives be balanced using a "disproportionate cost analysis." The criteria for conducting this analysis are described in Section 6.1.2.1 below.
- Provide for a reasonable restoration timeframe [Procedure in WAC 173-340-360(4)]. MTCA places a preference on those alternatives that, while equivalent in other respects, can be implemented in a shorter period of time. MTCA includes a summary of factors that can be considered in evaluating whether a cleanup action provides for a reasonable restoration timeframe. SMS regulations place a specific preference on remedies that can be completed and meet standards within a 10- year restoration time-frame for in-water work. The criteria for conducting this analysis are described in Section 6.1.2.2 below.
- Consider public concerns. Ecology has considered public comments submitted during the recent Agreed Order and Enforcement Order processes in making its preliminary selection of a cleanup alternative for the Site and Ecology will consider comment on this document before finalizing the remedy.
- The degree to which recycling, reuse, and waste minimization are employed. This is a requirement specific to SMS that is not included explicitly in MTCA.
- Environmental impact. SMS requires that sufficient information shall be provided to fulfill the requirements of chapter 43.21CRCW, the State Environmental Policy Act.

6.1.2.1 Disproportionate Cost Analysis

The primary test to determine if a remedial alternative uses permanent solution to the maximum extent practicable is the disproportionate cost analysis (DCA). Essentially this analysis ranks the costs and environmental benefits of each of the remedial alternatives against seven criteria to determine the most practicable 'permanent' alternative against which to evaluate and compare the other alternatives. The analysis compares the relative benefits of each alternative against those provided by the most permanent alternative using the seven criteria. The majority of these benefits are environmentally based while others are related but non-environmental, such as "implementability." The comparison of costs and benefits may be quantitative, but is more often qualitative, or subjective. Costs are disproportionate to benefits if the incremental costs of the more permanent alternative exceed the incremental degree of benefits achieved by the other lower-cost alternative [WAC 173-340-360(e)(i)].

Where two or more alternatives are equal in benefits, Ecology shall select the less costly alternative [WAC 173-340-360(e)(ii)(c))]. The DCA criteria include:

- Protectiveness
- Permanence
- Effectiveness over the long term
- Management of short-term risks
- Technical and administrative implementability
- Consideration of public concerns
- Cost

General descriptions of each of the seven MTCA criteria used in the DCA are described below consistent with WAC 173-340-360(f).

Protectiveness

Overall protectiveness is a parameter that considers many factors. First, it considers the extent to which human health and the environment are protected and the degree to which overall risks at a site are reduced. It also considers the time required to reduce risk at the facility and attain cleanup standards. Both on-site and off-site risks resulting from implementing the alternative are considered. Finally, it measures the improvement of the overall environmental quality at the site

Permanence

The permanence of remedies under MTCA is measured by the relative reduction in toxicity, mobility or volume of hazardous substances, including both the original contaminated media, and to a lesser degree the residuals generated by the cleanup action as this is included in short term risk management. Under MTCA regulations treatment actions that destroy contaminants (thereby reducing toxicity, mobility, and volume) are considered more permanent than containment actions (which only reduce the mobility).

Long-Term Effectiveness

Long-term effectiveness is a parameter that expresses the degree of certainty that the alternative will be successful in maintaining compliance with cleanup standards over the long-term performance of the remedy. The MTCA regulations contain a specific preference ranking for different types of technologies that is considered as part of the comparative analysis. MTCA ranks the following types of cleanup action components in descending order of relative long-term effectiveness:

- Reuse and recycling (and waste minimization under SMS)
- Destruction or detoxification
- Immobilization or solidification
- On-site or off-site disposal in an engineered, lined and monitored facility

- On-site isolation or containment with attendant engineering controls
- Institutional controls and monitoring

The regulations recognize that in most cases the cleanup alternatives will combine multiple technologies to accomplish remedial objectives. The preference ranking must be considered along with other site-specific factors in the ranking of long-term effectiveness.

Short-Term Risk Management

Short-term risk management is a parameter that measures the relative magnitude and complexity of actions required to maintain protection of human health and the environment during implementation of the cleanup action. Cleanup actions carry short-term risks such as potential mobilization of contaminants during construction, or safety risks typical to large construction projects. Generally, the majority of short-term risks can be managed through the use of best practices during project design and construction, and other risks are inherent to project alternatives. As stated above, because the risk is short-lived its overall environmental risk to human health and the environment is limited.

Implementability

Implementability is an overall measurement expressing the relative difficulty and uncertainty of implementing the project. It includes technical factors such as the availability of mature technologies and experienced contractors to accomplish the cleanup work. It also includes administrative factors associated with permitting and completing the cleanup. Evaluating an alternative's technical and administrative implementability includes consideration of the following:

- Potential for landowner cooperation
- Whether the alternative is technically possible
- Availability of necessary facilities, services, and materials
- Administrative and regulatory requirements
- Scheduling
- Size and complexity of the alternative
- Monitoring requirements
- Access for construction and monitoring
- Integration of existing operations with the remedial action

Consideration of Public Concerns

The public involvement process under MTCA is used to identify public concerns regarding alternatives. The extent to which an alternative addresses those concerns is considered as part of the remedy selection process. This includes concerns raised by individuals, community groups, local governments, tribes, federal and state agencies, and other organizations that may have an interest in or knowledge of the site.

Remedy Costs

The analysis of costs under MTCA includes all costs associated with implementing the alternative, including design, construction, long-term monitoring and institutional controls (WAC 173-340-360(3)(f)(iii)). Costs are intended to be comparable among different project alternatives to assist in the overall analysis of relative costs and benefits of different alternatives. Costs are evaluated against remedy benefits in order to assess cost-effectiveness and remedy practicability.

6.1.2.2 Restoration Timeframe

MTCA also provides specific guidelines for determining a reasonable restoration timeframe. The following factors are to be considered:

- Potential risks posed by the site to human health and the environment
- Practicability of achieving a shorter restoration timeframe
- Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site
- Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site
- Availability of alternative water supplies
- Likely effectiveness and reliability of institutional controls
- Ability to control and monitor migration of hazardous substances from the site
- Toxicity of the hazardous substances at the site
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions

6.2 Evaluation of Sediment Cleanup Alternatives

As previously discussed, two alternatives were developed for the remediation of the Sediment AOC, including sediment removal with ENR and in situ containment with ENR. In the remainder of this section each of these alternatives is evaluated in terms of the MTCA criteria described in Section 6.1.

6.2.1 Protectiveness

For this Site, both sediment alternatives are expected to provide similar restoration timeframes on a Site-wide basis, as the dredging and backfill alternative is expected to meet the cleanup standard immediately upon construction of the remedy. Typically, dredging alternatives experience a slight lag in cleanup level compliance in comparison to isolation cap remedies as dredging residuals often persist for a short time after the initial remedial action. However, because this project incorporates a sand backfill component to restore pre-construction habitat grades, it is expected that dredging residuals would be managed through attenuation. Both alternatives also include ENR components within identical footprints;

therefore, the restoration timeframe would be consistent within those areas. Both alternatives equally satisfy the criteria for a reasonable restoration timeframe and are expected to achieve cleanup levels within months of the start of the remedial action.

6.2.2 Permanence

As discussed in Section 6.1.2.1, the permanence of a cleanup action is measured by the degree to which it permanently reduces the toxicity, mobility, or volume of hazardous substances. Upon dredging, the sediment would be removed from the affected area and contained upland through a combination of disposal process options. Although, the capping alternative does not reduce the mass of materials within the deposit, it does reduce the toxicity and reasonably prevent mobility. The toxicity and volume of PCBs addressed by the capping alternative would be reduced over the long term by natural attenuation, although the degradation rate would likely be reduced under anaerobic conditions. Therefore, the dredging alternative provides a higher degree of permanence in comparison to the capping alternative.

6.2.3 Effectiveness over the Long Term

Both alternatives are effective in managing long-term risk. However, the dredging alternative relies upon higher ranking, preferred MTCA cleanup action measures, as discussed in Section 6.1.2.1, such as beneficial use and off-site disposal, in comparison to the capping alternative, which is composed of in situ isolation and long-term monitoring. In addition, the capping alternative is subject to unknown future conditions such as changes in hydraulic conditions (i.e., dam flow) and Site uses (e.g., potential shoreline development to provide deep water berths). Therefore, the dredging alternative provides a preferred longer-term benefit.

6.2.4 Management of Short-Term Risks

Management of short-term risks (a.k.a. short-term effectiveness) is the degree to which human health and the environment are affected in the short-term. The dredging alternative is likely to have greater short-term risk associated with water quality impacts; however, due to the coarse nature of the target sediment, increased turbidity is expected to be minimal. The upland transfer of sediment for final disposal may also have a potential short-term impact through the potential for spills. BMPs, such as control of dredging rate and spill guards for conveyor systems, are typically employed to address and minimize short-term impact concerns associated with dredging. Therefore, capping alternative provides a slightly greater short-term risk management as the affected sediment is minimally disturbed.

6.2.5 Technical and Administrative Implementability

Both alternatives are technically feasible and satisfy the implementability criteria to a high degree; however placement of cap materials in deep water presents a slightly greater challenge to the contractor.

6.2.6 Consideration of Public Concerns

Public concerns will be addressed during the forthcoming public notice period.

6.2.7 Cost

In general, the capping alternative is a lower cost solution to achieve the goals of the remedial action. However, the dredging costs are not substantially greater when future Site development is considered. That is, the dredging alternative would not restrict potential long-term development options such as berth construction. Under the capping scenario, future redevelopment may require cap removal or placement of additional armoring to ensure stability, thus incurring future capital costs. Therefore, selection of the capping alternative would likely only provide a short-term cost benefit. Ultimately, costs are a minor consideration because the decision has been made to remove the PCB-impacted sediment to the maximum extent practicable.

6.2.8 Provision for a Reasonable Restoration Timeframe

Both alternatives equally satisfy the SMS criteria for a reasonable restoration timeframe and are expected to achieve cleanup levels within months of the start of the remedial action.

6.2.9 Evaluation Summary

Both sediment alternatives provide relatively equal environmental benefits. Typically, Ecology would select the lower cost alternative in cases where the DCA determines equal benefits. However, Alternative S-1 (Sediment Removal with ENR) was selected as the preferred remedy to address the PCB-impacted sediment because it provides the greatest overall environmental benefit in terms of permanence, long-term risk reduction to human health and ecological receptors, maximum mass removal, reasonable restoration timeframe, and appropriate management of short-term impacts. The remedy also meets the intent of other MTCA goals in taking advantage of beneficial use opportunities.

6.3 Evaluation of Crowley Parcel Cleanup Alternatives

As previously described, four cleanup alternatives were developed for consideration for the remediation of the Crowley Parcel AOC. These alternatives include excavation and off-site disposal of impacted soil, excavation and on-site treatment of impacted soil, bioventing, and in situ chemical oxidation. The remainder of this section evaluates each of these alternatives in terms of the MTCA criteria described in Section 6.1.

6.3.1 Protectiveness

All alternatives are anticipated to provide a reasonable restoration timeframe. After each of the primary remedial actions (i.e., excavation, on-site treatment, bioventing, or in situ treatment) is conducted, monitored natural attenuation is expected to occur. The monitored natural attenuation time frame for Alternative CP-1 and Alternative CP-2 is expected to be approximately half of that required for Alternative CP-3 and Alternative CP-4. Of the alternatives, Alternative CP-1 is anticipated to provide the shortest restoration time frame because materials could be excavated within several months whereas on-site treatment could last up to 2 years, bioventing is estimated to require approximately 30 months of operation, and in situ treatment could require up to approximately a year of active remediation activities. Overall, Alternative CP-1 and Alternative CP-2 are anticipated to provide the shortest timeframes.

6.3.2 Permanence

All alternatives are considered permanent under MTCA regulations because there is a reduction in the toxicity, mobility, or volume of the contaminants. In the cases of Alternatives CP-1 and CP-2, the impacted soils are physically removed and any groundwater that is encountered is treated prior to reinjection. For Alternative CP-3, volatile organic compounds are removed from the impacted soil via vapor extraction and impacted groundwater is extracted through the dual phase extraction methods. In this case, the groundwater is treated prior to reinjection. Alternative CP-4 also removes the contaminants through chemical reactions which breakdown the contaminants into less hazardous by-products.

6.3.3 Effectiveness over the Long Term

Alternative CP-1 and Alternative CP-2 are considered to be the most effective over the long term because of the physical removal of the contaminants and impacted soil. The effectiveness of Alternative CP-3 and Alternative CP-4 is potentially limited by subsurface heterogeneities.

6.3.4 Management of Short-Term Risks

For Alternative CP-1, short term risks are associated with the transfer of the impacted materials for final disposal. For Alternative CP-2, there may be short term risks associated with the transfer of impacted materials from the excavation to the bioremediation cell and with containing the impacted material within the treatment cells. Short term risks are also associated with the handling of strong oxidizing agents as required for Alternative 4.

6.3.5 Technical and Administrative Implementability

All of the alternatives proposed for the Crowley Parcel are considered technically feasible and implementable. According to the Crowley RI/FS, the alternatives are ranked in the following order, from easiest to most difficult to implement: Alternative CP-4 (In situ Chemical Oxidation), Alternative CP-3 (Bioventing), Alternative CP-1 (Excavation and Off-site Disposal), and Alternative CP-2 (Excavation and On-site Treatment).

Alternative CP-1 and Alternative CP-2 are ranked as the most difficult to implement due to the excavation of impacted soil. Of these two alternatives, Alternative CP-2 is ranked as more difficult to implement because of the on-site treatment actions. Although Alternative CP-4 is considered the easiest to implement because materials (soil or groundwater) are not removed from the subsurface, special considerations would be required for handling the strong oxidizing agents.

6.3.6 Consideration of Public Concerns

Public concerns will be addressed during the forthcoming public notice period.

6.3.7 Cost

The approximate cost for each of the remedial alternatives is shown in the Table 6-1.

Table 6-1
Approximate Costs for Crowley Parcel Remedial Alternatives

Remedial Alternative	Approximate Cost	Monitoring Included in Costs
Alternative CP-1: Excavation and Off-site Disposal	$970,000	1 year of quarterly monitoring 1 year of semi-annual monitoring 3 years of annual monitoring 1 final year of quarterly monitoring
Alternative CP-2: Excavation and On-site Treatment	$740,000	1 year of quarterly monitoring 1 year of semi-annual monitoring 3 years of annual monitoring 1 final year of quarterly monitoring
Alternative CP-3: Bioventing	$1,200,000	1 year of quarterly monitoring 1 year of semi-annual monitoring 9 years of annual monitoring 1 final year of quarterly monitoring
Alternative CP-4: In situ Chemical Oxidation	$2,000,000	1 year of quarterly monitoring 1 year of semi-annual monitoring 9 years of annual monitoring 1 final year of quarterly monitoring

Alternative CP-2 is considerably less expensive than Alternative CP-3 or Alternative CP-4, yet it is more effective. Similarly, Alternative CP-2 offers the same effectiveness as Alternative 1 yet is less expensive. Therefore, Alternative CP-2, Excavation and On-Site Treatment, is among the most effective remedial alternatives and the least expensive.

7 SELECTED CLEANUP ACTIONS

7.1 PCB-Impacted Sediment

Alternative S-1 – Sediment Removal with ENR was selected as the preferred remedy to address the PCB-impacted sediment because it provides the greatest overall environmental benefit in terms of permanence, long-term risk reduction to human health and ecological receptors, maximum mass removal, reasonable restoration timeframe, and appropriate management of short-term impacts. The remedy also meets the intent of other MTCA goals in taking advantage of beneficial use opportunities.

The alternative includes a combination of dredging to the maximum extent practicable using the 320 μg/kg RAL established in Section 4.1, the placement of clean sand to manage dredge residuals, and the placement of an ENR sand layer over the areas that exceed the 97 μg/kg cleanup level but are below the RAL. Construction of the in-water work will undermine the adjacent bank. Prior to dredging, industrial waste (i.e., slag, tar-like material, and SPL identified in Section 3.4.1) will be removed from the surface of the riverbank and disposed of at an appropriate off-site facility. As necessary, other deleterious materials, such as debris, brick, and concrete will be removed and either disposed of off site at a construction debris landfill or, as appropriate, stockpiled on site for crushing and beneficial use. The stability of the remaining bank will be evaluated and oversteepened areas regraded and erosion protection placed. Existing vegetation will be preserved to the greatest extent possible; however, armoring to protect against wave action is required and will be installed to protect exposed areas.

During the acceptable environmental work window (November 1 through February 28), dredging and sand placement activities would commence. Dredging of the sediment subject to TSCA Subtitle C disposal regulations (i.e., greater than 50 mg/kg PCBs) would occur first followed by the remaining areas designated for off-site disposal. Material subject to TSCA Subtitle C disposal requirements would be transferred on site and dewatered prior to being loaded into lined trucks prior to shipment an approved off-site disposal facility. The effluent from dewatering TSCA Subtitle C sediment would either be treated on site and discharged back into the Columbia River or it would be transported to an off-site, regulated facility for disposal. Dredge sediment designated for off-site disposal as TSCA Subtitle D would be transferred by barge, without prior dewatering other than the initial decanting of accumulated free water within the barge, directly to a transfer facility upstream of the Site on the Columbia River. Any decanted water from Subtitle D sediments would be collected and treated prior to discharge into the Columbia River.

The next segments to be removed would target the sediment to be disposed of on Site in the North and North 2 Landfills (i.e., sediment less than 10 mg/kg PCBs). This material would be transferred on site and placed within the North and North 2 Landfills footprint where it would be allowed to passively dewater prior to final compaction and covering. Finally, sediment retained for beneficial use (i.e., sediment less than 1 mg/kg PCBs) would be dredged last, transferred on Site, and stockpiled. The stockpile would be located away from the shoreline to prevent transport of the material back to the affected area prior to final placement as on-site fill. All free barge water generated during the dredging of sediments less than 10 mg/kg PCBs would be collected and pumped directly upland for infiltration to groundwater or disposal at the local sanitary sewer. After all sediment to be disposed of in the North and North 2 Landfills is placed, the area would be covered with a one-foot lift of clean sand.

Upon confirmation that the minimum required dredge elevations are achieved, clean sand would be placed to restore all dredged areas to natural grades. Placement of the 6-inch minimum ENR layer would be sequenced with this work. Confirmation samples would be taken after placement of the clean sand to evaluate compliance with the cleanup level on a SWAC basis. During the confirmation sampling event, additional samples would be collected from the upstream reach of the Columbia River to characterize material that may potentially migrate to the Site in subsequent years. In the event the SWAC exceeds the cleanup level, an additional ENR material layer (minimum 6 inches) would be placed and the area resampled. As discussed in Section 4.1.3, initiation of supplemental dredging would not effectively reduce residual contamination; therefore, additional dredging is not practicable and would not be required. In addition, the selected remedial alternative technology targets the removal of affected sediment to the greatest extent practicable and the technology is ineffective at further reducing the remaining mass. No additional long-term monitoring would be required as Site sediment would no longer pose a risk to human health or the environment. In the unlikely event the cleanup level is not met on a SWAC basis after the additional ENR material is placed, no further dredging, backfill, or monitoring will be required.

Plans describing the cleanup action including an engineering design report, construction specifications and drawings, and a Project Control Plan (PCP) will be developed. These documents will present the engineering criteria, assumptions, and calculations used to design the remedial action, the general means and methods the remedial contractor will use to implement the action, and a schedule for completing the project. The PCP will establish quality control and performance/compliance metrics in accordance with WAC 173-340-410 and will include:

- A HASP pursuant to WAC 173-340-810(2) addressing all applicable federal or state worker safety requirements.
- A Sampling and Analysis Plan (SAP) that specifies procedures to ensure that sample collection, handling, and analysis will result in data of sufficient quality to evaluate the effectiveness of remedial actions at the Site. The SAP will be prepared by the implementers of the remedial action and will include the elements defined in WAC 173-340-820. The SAP will define the locations of confirmation sampling points

used to confirm that the cleanup action has attained cleanup standards and other performance standards.

- A Water Quality Monitoring Plan (WQMP) will be prepared to define the monitoring to confirm that human health and the environment are adequately protected during the construction period of the cleanup action as defined by the permit conditions.
- Data analysis and evaluation procedures used to demonstrate and confirm compliance with, and justification for these procedures.
- A Construction Quality Assurance Plan (CQAP), which will specify procedures for ensuring quality control during construction.
- Other information as required by Ecology.

7.2 Crowley Parcel

Alternative CP-2 - Excavation and On-Site Treatment is the proposed cleanup action. This alternative is consistent with MTCA requirements for the development of cleanup alternatives and was chosen as the preferred remedial action because of its permanence and long term effectiveness. Additionally, Alternative CP-2 meets the intent of other MTCA goals for reasonable restoration timeframe, management of short-term risks, and implementability. A work plan for the cleanup of the Crowley Parcel via excavation and on-site treatment will be developed and submitted to Ecology for approval before initiation of the proposed cleanup actions. The activities to be described in the work plan are discussed below.

Four areas of the Crowley Parcel contain soil with TPH concentrations greater than the Crowley Parcel soil cleanup level of 5,070 mg/kg. Each of these areas would be excavated to remove the TPH impacted soil. Excavation activities are expected to occur in October 2008 when the groundwater table is seasonably low. Applicable City of Vancouver permits will be obtained prior to conducting the work. Prior to excavation, monitoring wells in the vicinity of the excavations would be protected, the area would be chipped and grubbed, and silt fencing and other erosion control BMPs would be implemented. Any monitoring wells contained within the limits of the excavation would be decommissioned and removed. Additionally, the Crowley Parcel would be regraded to maximize the area of land with an elevation of approximately 31 feet using the NGVD 1929, which is above the 30 feet NGVD 1929 flood level established by the City of Vancouver.

The TPH contaminated soil in each of the excavation areas is covered by clean overburden soil. It is estimated that approximately 12,500 cubic yards of clean overburden material would be removed and stockpiled on-site. The clean material would be sampled and analyzed for TPH-G, TPH-D, and TPH-O. The number of samples collected would depend on the volume of stockpiled soil. The TPH impacted soil would also be removed from each of the excavations and stockpiled on polyethylene liner at a location distinct from the clean overburden storage area. It is anticipated that approximately 4,200 cubic yards of impacted soil would be excavated. The side slopes of each of the excavations would vary from 1:1 to 1:3 and the excavations are expected to extend vertically to approximately 1 foot below the low seasonal groundwater table at approximately 14 to 17 feet bgs, depending on season and surface topography. On the horizontal scale, excavation would continue until conformational soil samples indicated the soil was below the soil TPH cleanup levels.

At each of the excavations, if groundwater is not present, the clean overburden would be backfilled into the excavation area. During the excavation activities, the depth of groundwater on-site is anticipated to be approximately 13 to 14 bgs. Any groundwater encountered in the excavations would be removed; treated on-site with an oil-water separator, bag filters, and activated carbon; and pumped into a temporary storage tank. Samples would be collected and analyzed for TPH-G, TPH-D, and TPH-O. If the TPH concentrations are below the groundwater cleanup level, the water would be re-injected into the subsurface under Ecology-approved injection well permit #12092 or at another approved injection point. It is anticipated that approximately 250,000 gallons of extracted groundwater would require treatment. If free product is encountered, additional measures would be taken to properly dispose of the free product.

Impacted soil would be treated in an approximately 1-acre bioremediation treatment cell. The cell would be constructed to have a sloped base with a 6-mil polyethylene liner covered by a minimum of 6 inches of clean overburden soil. Berms of at least 32 feet NGVD 1929 would surround the cell and a drainage sump would be located in the center. TPH-impacted soil would be placed in the cell with a thickness of 2 to 3 feet and graded with an inward slope. Water collected in the sump would be treated by the groundwater treatment system and re-injected. Soil in the treatment cell would be turned and mixed monthly and nutrients and water may be added to enhance the bioremediation process. On a quarterly basis, soil samples would be collected from the treatment cell and analyzed for TPH concentrations. As portions of the treatment cell are bioremediated, confirmation samples will be collected. Cell divisions will be designated as complete as confirmation samples demonstrate that TPH concentrations are below the soil cleanup levels. Following remediation of all impacted soil, the bioremediation cell would be decommissioned and the land would be regraded. At least one foot of clean soil would be backfilled on top of the bioremediated soil.

A Remedial Action Work Plan describing the engineering criteria, assumptions, and calculations used to design the remedial action, the general means and methods the remedial contractor will use to implement the action, and a proposed schedule for completing the project is required prior to the start of the remediation. A sampling and analysis plan (SAP) will also be prepared to establish quality control and performance/compliance metrics in accordance with WAC 173-340-410 and will include:

- An AOC-specific HASP pursuant to WAC 173-340-810(2). The plan will address all applicable federal or state worker safety requirements.

- A SAP that specifies procedures to ensure that sample collection, handling, and analysis will result in data of sufficient quality to evaluate the effectiveness of remedial actions at the Site. The SAP will be prepared by the implementers of the remedial action and will include the elements defined in WAC 173-340-820.
- Data analysis and evaluation procedures used to demonstrate and confirm compliance with, and justification for these procedures.
- Procedures for ensuring quality control during construction.
- Other information as required by Ecology.

The sampling and analysis plan (SAP) will address the types of compliance monitoring, as appropriate, to be conducted including:

- Protection Monitoring: This type of monitoring is used to confirm that human health and the environment are adequately protected during the construction period of the cleanup action as defined by the site-specific HASP and permit conditions.
- Performance Monitoring: Performance monitoring is used to confirm that the cleanup action has attained cleanup standards and other performance standards.
- Confirmation Monitoring: Used to confirm the long-term effectiveness of the cleanup action once performance standards have been attained.

7.3 Dike USTs and Soluble Oil Area

The presumptive remedy for the Dike USTs and Soluble Oil Area consists of removal and off-site disposal of the COC-impacted soil, waste, and raw materials. The contaminated material will be removed until the remaining soil meets the Site soil cleanup levels.

The presumptive remedy for the Dike USTs will include removal of the tanks, free product, and impacted soils exceeding the Site cleanup levels. Materials removed from the Site will be disposed of at an appropriate off-site landfill. Removal of the source materials is protective of groundwater and meets the general Site RAOs.

Impacted materials with PCB concentrations greater than 10 mg/kg will be removed from the Soluble Oil Area and disposed of at an off-site location. This presumptive remedy will prevent direct contact with PCB-impacted material above Site cleanup levels. After removal, an appropriate cap will be placed over the area in accordance with MTCA regulations. These actions are protective of groundwater; therefore, no further remediation beyond source removal is required for this area to meet the general Site RAOs.

Selection of these remedies is based on the expectation that soil cleanup levels defined in Section 4.1.5 will be achieved at a standard point of compliance, thus warranting no further action in accordance with WAC 173-340-350(8)(a). Upon completion of source removal activities within these AOCs, it is anticipated that subsequent groundwater samples collected from excavations would indicate compliance with cleanup levels defined in Section 4.1.4 and no further action would be required.

A Remedial Action Work Plan describing the engineering criteria and assumptions used to design the remedial action, the means and methods the remedial contractor will use to implement the action, and a schedule for completing the project shall be submitted prior to the start of construction. A Project Control Plan (PCP) will also be prepared to establish quality control and performance/compliance metrics in accordance with WAC 173-340-410 and will include:

- A HASP pursuant to WAC 173-340-810(2) addressing all applicable federal or state worker safety requirements.
- A SAP that specifies procedures to ensure that sample collection, handling, and analysis will result in data of sufficient quality to evaluate the effectiveness of remedial actions at the Site. The SAP will be prepared by the implementers of the remedial action and will include the elements defined in WAC 173-340-820. The SAP will define the locations of confirmation sampling points used to confirm that the cleanup action has attained cleanup standards and other performance standards.
- Data analysis and evaluation procedures used to demonstrate and confirm compliance with, and justification for these procedures.
- Other information as required by Ecology.

7.4 Institutional Controls

In conjunction with compliance monitoring, institutional controls will be applied to limit or prohibit activities that could interfere with the integrity of the cleanup action or result in exposure to hazardous substances. The institutional controls to be applied at the Site include the filing of a restrictive covenant (WAC 173-340-440) that describes the condition of the property, declares that a cleanup was completed at the Site, restricts the disturbance of upland caps, prohibits the modification of the caps without the prior written approval of Ecology, and limits the Site to industrial uses. The restrictive covenant will also control and limit extraction of groundwater from the Site within the Crowley Parcel AOC and the fluoride-bearing groundwater surrounding the SPL Storage Area not covered by previously recorded restrictive covenants. The restrictive covenant will be subject to Ecology's approval before being recorded. Alcoa shall record the restrictive covenant for its property in accordance with the Consent Decree. In addition, the restrictive covenant will require owners of the property to notify all lessees or property purchasers of the restrictions on the use of the properties. Finally, the restrictive covenant will require the owners of the property to make provisions for continued monitoring and operation and maintenance of the remedial action prior to conveying title, easement, lease, or other interest in the Site.

7.5 Groundwater Monitoring and Cap Maintenance

Alcoa shall conduct groundwater monitoring at the Site. This monitoring shall incorporate the groundwater monitoring requirements from Alcoa's July 2001 Groundwater Monitoring Plan for the Former Vancouver Operations and Alcoa's June 2006 Groundwater Monitoring and East Landfill Cap Maintenance Plan. In addition to those monitoring requirements, Alcoa shall monitor one additional well cluster, EVGR-02.

Alcoa's July 2001 Groundwater Monitoring Plan, which Ecology approved in 2001, was designed to consolidate the existing system and decommission 75 wells previously required by Consent Decree 92-2-00783-9 between Alcoa and Ecology. Twenty-one new wells were added to the existing network reducing the groundwater monitoring network to 41 wells. In August of 2003, Alcoa submitted a monitoring well decommissioning and installation work plan to complete the installation and decommissioning work. Ecology approved the decommissioning and installation plan and a new monitoring network was established for the Site in 2003.

In June 2006, Alcoa submitted a Groundwater Monitoring and East Landfill Cap Maintenance Plan to fulfill the requirements of Agreed Order No. DE 03 TCPIS-5737. The 2006 monitoring plan was consistent with the July 2001 plan and incorporated and fulfilled the monitoring requirements of Consent Decree 92-2-00783-9. In 2007, Evergreen Aluminum installed two groundwater monitoring well clusters (EVGR-01, EVGR-02). One monitoring well cluster, EVGR-02, was added to the site-wide groundwater monitoring plan in 2008.

Alcoa shall perform cap maintenance activities at the former SPL Storage Area (NPL Site), as required by Consent Decree 92-2-00783-9. The SPL Storage Area cap maintenance activities will continue until groundwater cleanup levels are met at this area of the Site. The SPL Storage Area cap maintenance activities and schedule will follow the schedule and maintenance plan found in Section 3 and Table 3-1 of the 2006 Groundwater Monitoring and East Landfill Cap Maintenance Plan for the East Landfill. The 2006 maintenance plan elements are consistent with Consent Decree 92-2-00783-9 and fulfill the requirements of that Decree.

The 2006 site-wide Groundwater Monitoring and East Landfill Maintenance Plan, with the addition of the Evergreen monitoring well cluster (EVGR-02) and SPL Storage Area cap maintenance activities, are the site-wide groundwater compliance monitoring and landfill maintenance plans for the Site. Table 7-1 is the groundwater monitoring well list and monitoring schedule for the entire Site.

Table 7-1
Groundwater Monitoring Well List and Monitoring Schedule

Well Identification	Zone	Analytical Frequency			
		CN/FL	TOX/TOC	PAHs/PCBs	VOCs
SPL Storage Area					
EVGR-02	S	Annual	-	-	-
EVGR-02	I	Annual	-	-	-
EVGR-02	D	Annual	-	-	-
EVGR-02	A	Annual	-	-	-
MW-52	S	Annual	-	-	-
MW-8	I	Annual	-	-	-
MW-8	D	Annual	-	-	-
MW-8	A	Annual	-	-	-
MW-30	S	Annual	-	-	-
MW-30	I	Annual	-	-	-
MW-30	D	Annual	-	-	-
MW-49	S	Annual	Quarterly	-	-
MW-18	I	Annual	Quarterly	-	-
MW-49	D	Annual	Quarterly	-	-
MW-18	A	Annual	Quarterly	-	-
MW-50	S	Annual	Quarterly	-	-
MW-19	I	Annual	Quarterly	-	-
MW-50	D	Annual	Quarterly	-	-
MW-50	A	Annual	Quarterly	-	-
MW-51	S	Annual	Quarterly	-	-
MW-51	I	Annual	Quarterly	-	-
MW-51	D	Annual	Quarterly	-	-
MW-51	A	Annual	Quarterly	-	-
North and North 2 Landfill Area					
MW-47	I	-	-	Annual	Quarterly
MW-47	D	-	-	Annual	Quarterly
MW-47	A	-	-	Annual	Quarterly
MW-48	I	-	-	Annual	Quarterly
MW-48	D	-	-	Annual	Quarterly
MW-48	A	-	-	Annual	Quarterly
East Landfill Area					
MW-35	S	-	-	Annual	Quarterly
MW-35	I	-	-	Annual	Quarterly
MW-35	D	-	-	Annual	Quarterly
MW-35	A	-	-	Annual	Quarterly
MW-41	S	-	-	Annual	Quarterly
MW-41	I	-	-	Annual	Quarterly
MW-41	D	-	-	Annual	Quarterly
MW-46	I	-	-	Annual	Quarterly
MW-46	D	-	-	Annual	Quarterly
MW-46	A	-	-	Annual	Quarterly
MW-94-1	I	-	-	Annual	Quarterly
MW-94-1	D	-	-	Annual	Quarterly

Well Identification	Zone	Analytical Frequency			
		CN/FL	TOX/TOC	PAHs/PCBs	VOCs
MW-94-1	A	-	-	Annual	Quarterly
MW-94-2	I	-	-	Annual	Quarterly
MW-94-2	D	-	-	Annual	Quarterly
MW-94-2	A	-	-	Annual	Quarterly
TOTALS	**45**	**23**	**12**	**22**	**22**

Footnotes:
"Annual" event scheduled for second month of fourth quarter each year
"Quarterly" event scheduled for second month of each quarter each year
CN/FL = cyanide and fluoride
TOX/TOC = total organic halides/total organic carbon
PAHs/PCBs = polycyclic aromatic hydrocarbons/polychlorinated biphenyls
VOCs = volatile organic compounds
S = Shallow; D = Deep; I = Intermediate; A = Aquifer

8 IMPLEMENTATION OF CLEANUP ACTION

This chapter describes the manner in which the cleanup actions will be implemented. It provides a description of how work will be coordinated between the different AOCs and a schedule for the implementation of cleanup actions.

8.1 Coordination with Other Work

Coordination will be necessary to execute the various cleanup actions on the Site in an efficient manner. Source removal activities at the Dike USTs and Soluble Oil AOCs are anticipated to begin in September 2008 per the requirements of Enforcement Order 5660 (Ecology 2008). In-water cleanup actions will be conducted during the acceptable environmental work window from November 1, 2008 through February 28, 2009. Prior to in-water cleanup actions being conducted, upland preparations along the riverbank will be conducted per Enforcement Order 5660 (Ecology 2008). The Crowley Parcel is located on the western portion of the Site away from all other AOCs and is expected to occur between October 2008 and December 2010.

8.2 Permits

Chapter 70.105D RCW exempts remedial actions conducted under a consent decree, order, or agreed order from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals. However, Ecology must determine compliance with the substantive provisions of such permits or approvals. In addition, any permits required under federal law to perform the cleanup must be obtained.

8.3 Schedule

An outline of the tentative schedule for implementation of the remedial action activities is given below in Table 8-1.

Table 8-1
Tentative Schedule for Implementation of Cleanup Actions

Action	Timeframe
Crowley Parcel Work Plan Submitted	August 2008
RI/FS, CAP, CD, & SEPA Public Comment	September/October 2008
In-Water WQMP Submitted	September 2008
In-Water Plans and Specs Submitted	September 2008
Mobilization for In-Water Work	Late September 2008
Dike USTs Remediation Begins	Fall 2008
Soluble Oil Area Remediation Begins	Fall 2008

Action	Timeframe
Response to Public Comments Issued	Late October 2008
Riverbank Preparation Commences	November 2008
In-Water Cleanup Actions Performed	December 1, 2008 - February 28, 2008
Final Consent Decree	January 2009
Crowley Parcel Work Commences	January/February 2009
In-water Completion Report Submitted	Summer 2009
Crowley Parcel Remediation Complete	December 2010
Crowley Parcel Completion Report Submitted	Spring 2011

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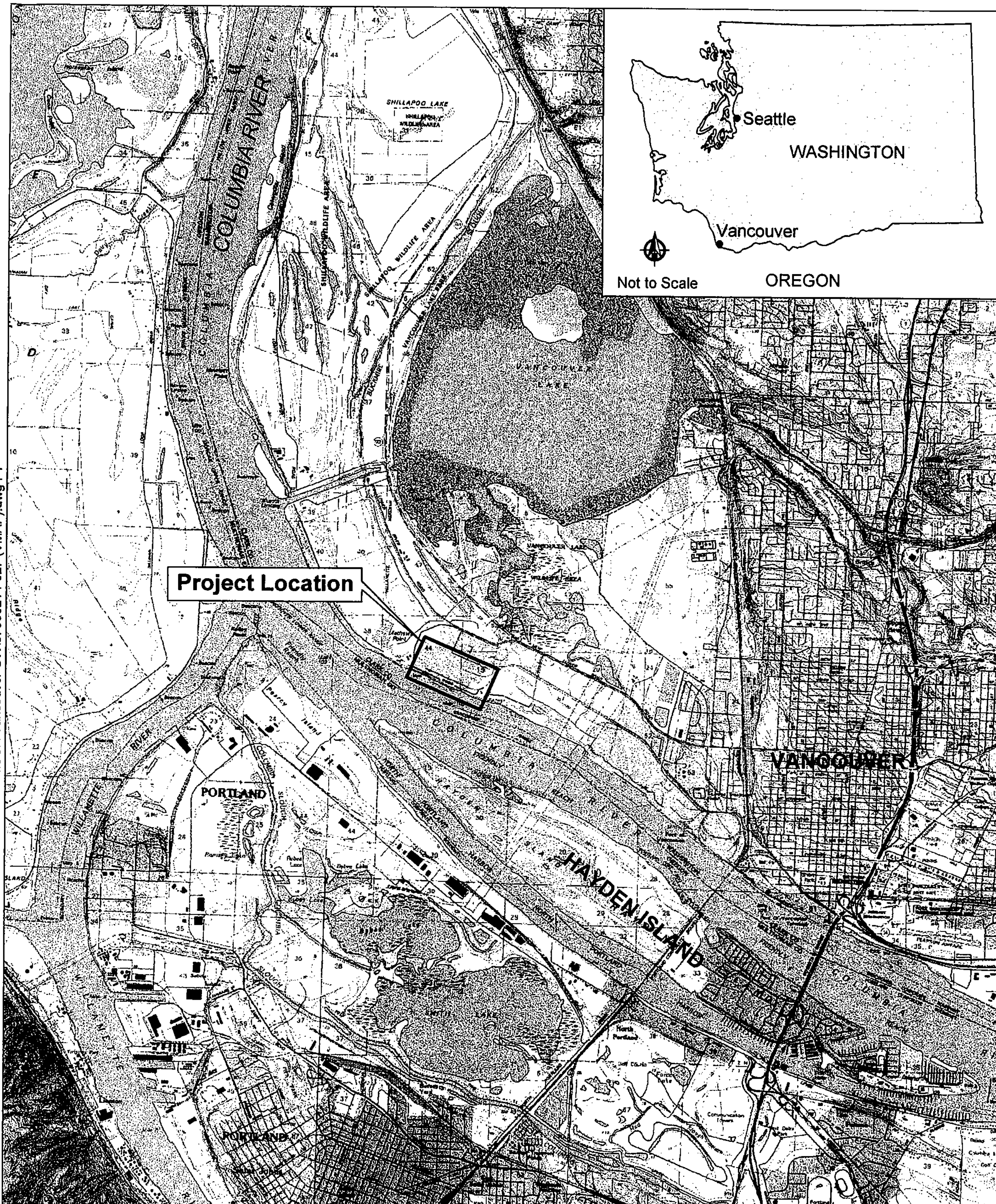

Note: Base map prepared from Terrain Navigator Pro USGS 7.5 minute quadrangle maps of Linnton, Sauvie Island, and Vancouver, Washington, and Portland, Oregon.

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Figure 1
Vicinity Map
ALCOA/Evergreen Site CAP
Vancouver, Washington

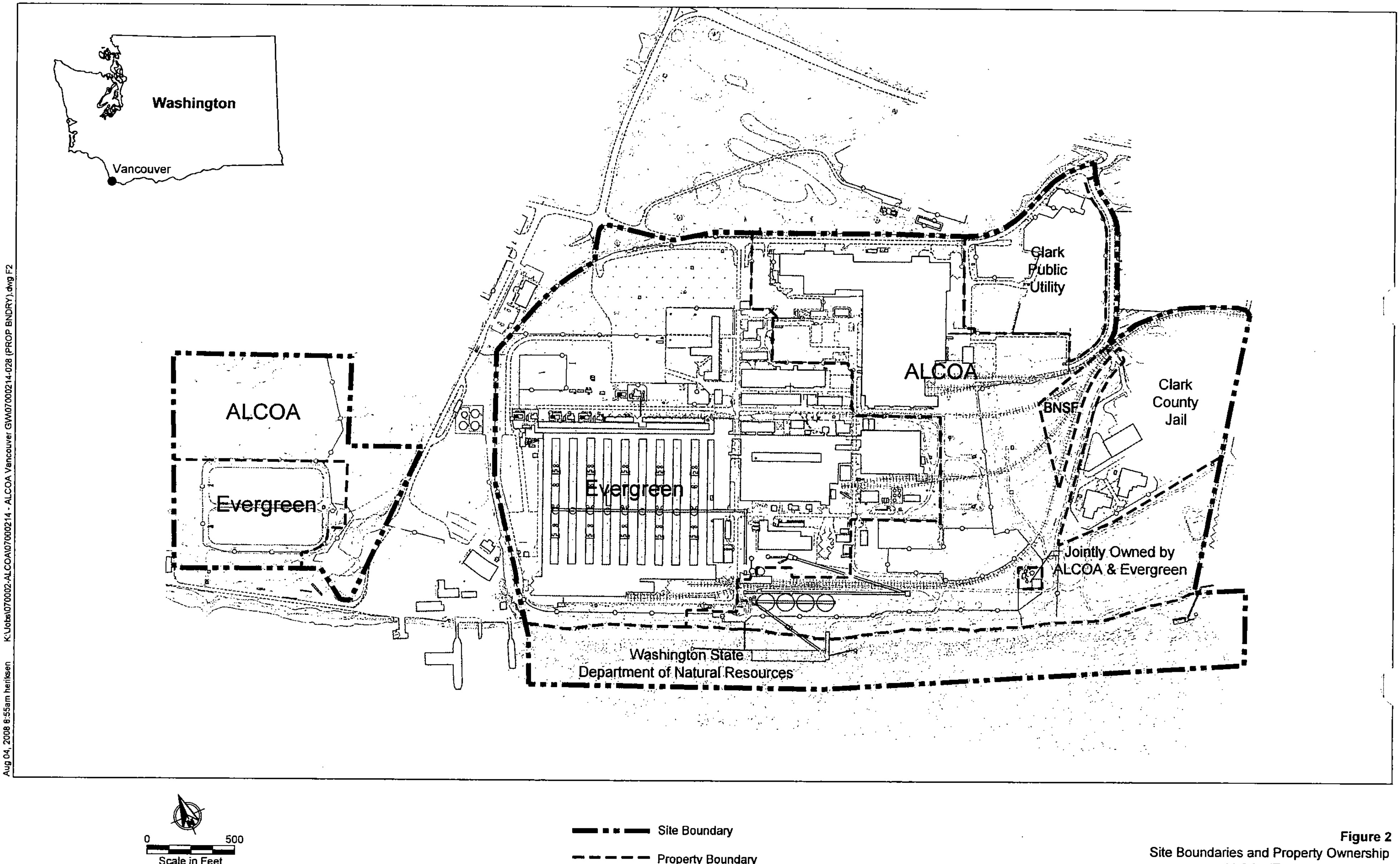

Figure 2
Site Boundaries and Property Ownership
ALCOA/Evergreen Site CAP
Vancouver, Washington

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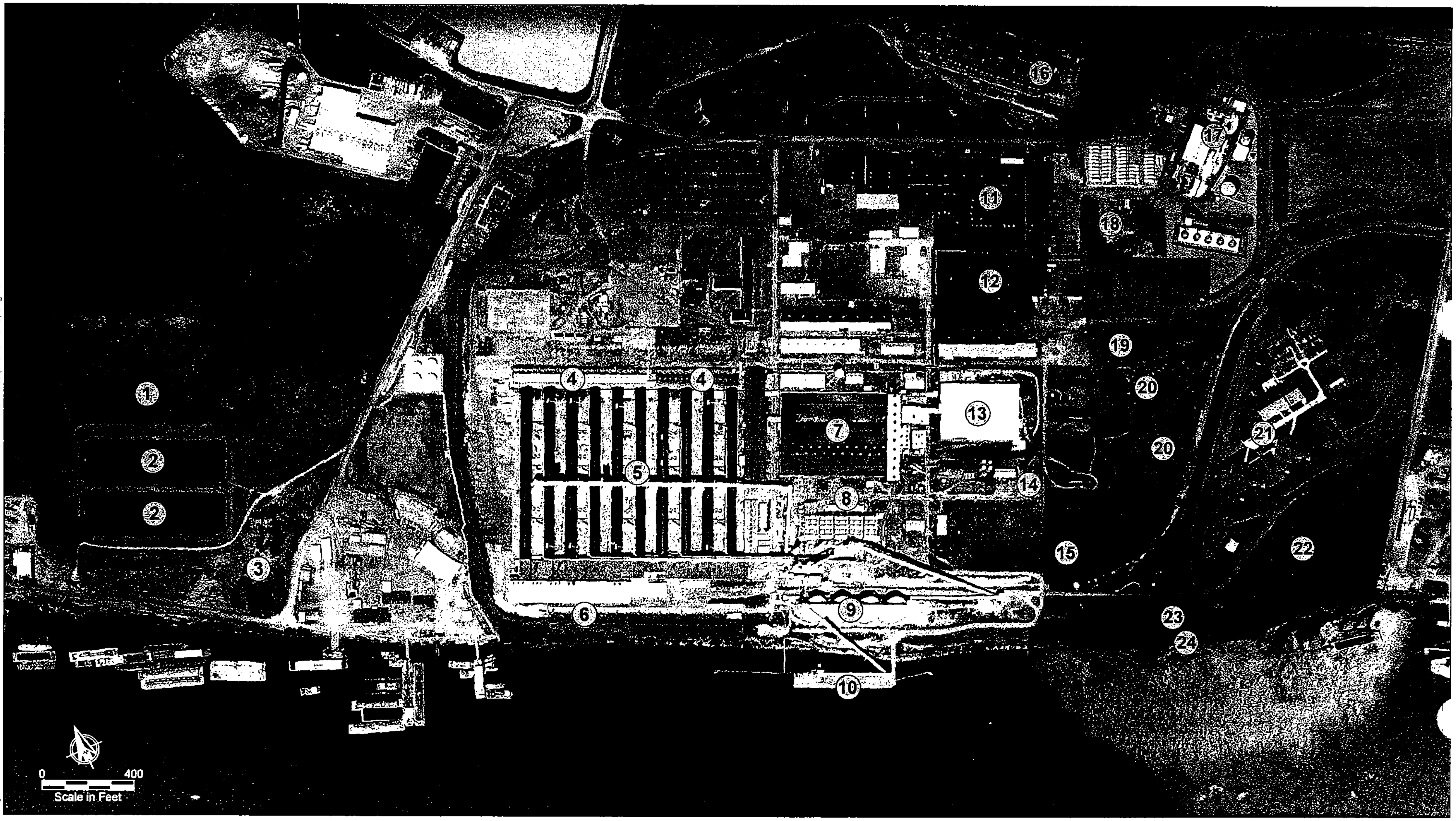

1 Sludge Pond
2 Stormwater Lagoons
3 Crowley Site
4 Transformer/Rectifier Yards
5 Potlines
6 Dike UST
7 Carbon Plant
8 Carbon Plant Emission Control System
9 Alumina and Raw Material Handling
10 Dock
11 Vanexco/Rod Mill Facilities
12 ACPC Facilities
13 Carbon Storage
14 Scrap Metal Recycling Area
15 SPL Storage Area
16 Bonneville Power Station
17 Clark County Public Utility
18 Hydraulic Oil Lagoons
19 Soluble Oil Area
20 North and North 2 Landfills
21 Northeast Parcel (Clark County Jail)
22 East Landfill
23 South Bank Area
24 CPU Outfall

Figure 3
Historical Site Layout
ALCOA/Evergreen Site CAP
Vancouver, Washington