PERIODIC REVIEW

Spokane River Upriver Dam and Donkey Island PCB Sediment Site

Facility Site ID: 65178472
Cleanup Site ID: 4213

Prepared by
Washington State Department of Ecology
Eastern Regional Office
Toxics Cleanup Program
Spokane, WA

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Table of Contents

1.0 INTRODUCTION

This document is a review by the Washington State Department of Ecology (Ecology) of post-cleanup site conditions and monitoring data at the Upriver Dam PCB (polychlorinated biphenyl) Sediment Site (Site) on the Spokane River (Figure 1). Cleanup at this Site was implemented under the Model Toxics Control Act (MTCA) regulations, Chapter 173-340 Washington Administrative Code (WAC). The purpose of this periodic review is to determine whether the cleanup remedy at the Site continues to be protective of human health and the environment.

Cleanup actions at this Site were conducted in accordance with the requirements of Consent Decree 03-2-00422-1 dated February 6, 2003 and entered into between Avista Development, Inc. (Avista), Kaiser Aluminum & Chemical Corporation (Kaiser), and Ecology. The remedy involved the containment of hazardous materials. Due to the design of the selected remedy to cap contaminated sediments in place, PCBs remain in sediments at concentrations exceeding the selected cleanup level for the Site.

WAC 173-340-420 (2) requires Ecology conduct a periodic review of a site every five years under the following conditions:

(a) Whenever Ecology conducts a cleanup action;
(b) Whenever Ecology approves a cleanup action under an order, agreed order or consent decree;
(c) Or, as resources permit, whenever Ecology issues a no further action opinion;
(d) And, one of the following conditions exists:
    1. Institutional controls or financial assurance are required as part of the cleanup.
    2. Where the cleanup level is based on a practical quantitation limit.
    3. Where, in Ecology's judgment, modifications to the default equations or assumptions using site-specific information would significantly increase the concentration of hazardous substances remaining at the site after cleanup, or the uncertainty in the ecological evaluation or the reliability of the cleanup action is such that additional review is necessary to assure long-term protection of human health and the environment.

When evaluating whether human health and the environment are being protected, the factors Ecology shall consider include [WAC 173-340-420(4)]:

- The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the site;
- New scientific information for individual hazardous substances of mixtures present at the site;
- New applicable state and federal laws for hazardous substances present at the site;
- Current and projected site use;
- Availability and practicability of higher preference technologies; and

- The availability of improved analytical techniques to evaluate compliance with cleanup levels.

Ecology shall publish a notice of all periodic reviews in the Site Register and provide an opportunity for public comment.

2.0 SUMMARY OF SITE CONDITIONS

2.1 Site History

The Spokane River (river) is a major river system that drains more than 4,900 square miles in Washington and Idaho. The river watershed includes areas in the northern Rocky Mountain and Columbia River ecoregions. The river begins as the Lake Coeur d'Alene outflow and flows through an urbanized and industrialized basin past the City of Spokane (Spokane) before eventually flowing into Lake Roosevelt, the dammed-up section of the Columbia River formed by Grand Coulee Dam. Mining operations, industries, and municipal wastewater treatment plants located within the watershed and upstream of the Site have discharged PCBs, heavy metals and wood waste into the river system. The river transported these contaminants and sediments contaminated with these materials downstream where they have settled in the depositional area just upstream of downtown Spokane which is created by Upriver Dam.

Upriver Dam (dam), first constructed in 1894, altered the natural flow of the river creating a low-energy impoundment area that serves as a depositional area for sediment traveling down the river. The river was originally a free-flowing system subject to seasonal variations in flow with high water/high flow events that periodically redistributed sediment deposits to more downstream locations. The dam has stabilized the system creating an impoundment area in which sediments, including contaminated sediments, have been deposited over time. Background investigations, discussed in Section 2.2, have characterized contaminated sediment deposits in the upper reaches of the river. The United States Environmental Protection Agency (USEPA) identified a 17-acre area upstream of the dam, containing sediment deposits with elevated levels of heavy metals (USEPA 2001). USEPA's Coeur d'Alene Basin Remedial Investigation/Feasibility Study focused on heavy metal contamination in the Basin without specifically addressing PCB-contaminated sediment deposits located upstream of the Spokane River Upriver Dam. Ecology, as the lead agency responsible for overseeing PCB cleanup on the river, initiated the characterization of sediment deposits containing PCBs in the impoundment area.

A partial failure of the dam occurred in May 1986. While water overtopped the spillway gates and caused considerable erosion of earthen-dam material downstream of the dam, there was no indication significant erosion occurred upstream of the spillway gates in the impoundment area. Radioisotope profiling of sediment cores from the PCB-contaminated deposits suggest that these sediments in the impoundment are stable and there is no indication of substantial widespread scouring and remobilization. While PCB-contaminated sediments at the Site targeted for cleanup have been generally stable, the deposits act as a source, or potential source, of dissolved PCBs to the overlying water column.

In 2001, the Spokane Regional Health District issued a PCB fish consumption advisory for areas along the Site. Analysis of tissues from rainbow trout, mountain whitefish, and large scale suckers living in the river revealed PCB levels were substantially above levels considered safe for human consumption. It was determined that eating any rainbow trout or mountain whitefish caught in the upper river between the dam and the Washington-Idaho state line was unsafe at that time. The Spokane Regional Health District determined meals of large scale suckers should be

limited to one meal per month and prepared in specific methods to limit consumption of tissue known to accumulate PCBs. The PCB advisory was updated in 2003 to include tissue analyses from Long Lake (Lake Spokane). The advisory has since been updated in 2009 with data collected in 2005. The current recommendation is fish caught from Upriver Dam to the Washington-Idaho state line are not to be consumed; fishing in this stretch of the river is catch and release only.

PCBs were produced between 1929 and 1977 in the United States. They were used in a wide variety of products, including capacitors, transformers, hydraulic fluids, plasticizers, adhesives, cutting oils, sealants, caulks and inks. PCBs are a family of chlorinated compounds that share the basic structure of two six-carbon benzene rings (biphenyl) linked by a single carbon-carbon bond and can have up to 10 chlorine atoms, one attached to each available carbon atom. There are 209 PCB compounds possible, depending on chlorine substitution patterns. For example, 3,3'-dichlorobiphenyl is a congener with two chlorines. PCB homologues are subcategories of PCB congeners having equal numbers of chlorine atoms.

Known PCB sources to the dam area of the river include:

- The Spokane Industrial Park, whose historic discharge was located at approximately River Mile (RM) 87 and which was formerly owned and operated by Pentzer Development Corporation, a corporation of which Avista is a successor;
- The Kaiser Trentwood Works located at approximately RM 86 and owned and operated by Kaiser;
- Liberty Lake Sewage Treatment Plant (RM 92); and
- The Inland Empire Paper Company paper plant at approximately RM 83.

Two distinct fine-grain sediment deposits, containing co-located PCBs, have been located within the Site in areas owned by the City of Spokane, the Washington Department of Natural Resources (DNR), and the Washington Department of Parks & Recreation. See Figure 2.

2.2 Site Physical Characteristics

2.2.1 Site Sediments

Sediment and sediment-bound contaminants within the river are transported downstream and deposited in impoundments along its length, including the dam impoundment area. The sediment sources to the upper river include remobilized channel bed material, bank erosion, and tributary inputs. Although Lake Coeur d'Alene provides a low-energy environment where much of the sediment derived from upstream watershed and former mining sources is deposited, some silts and clay remain suspended through the lake and enter the river. Fine-grain suspended sediments travel downstream, binding with contaminants, including PCBs originating from both point and non-point sources, and settle in downstream depositional areas.

The upstream end of the dam impoundment, at approximately RM 85 near Plante's Ferry Park, is approximately 17 miles downstream of the Post Falls Dam at RM 101.7. Even under seasonal low flow conditions, stream velocity between Post Falls and Plante's Ferry Park is generally high enough that sands and finer-grained materials do not appreciably settle in this area beyond small,

localized deposits. However, below Plante's Ferry Park, within the dam impoundment, river velocity slows considerably, particularly during seasonal low flow conditions and within the relatively wide and deep reach of the river immediately upstream of the dam at RM 79.8. Settling of fine-grained sediments and organic matter occurs within such lower energy environments resulting in the accumulation of sediments and organic sediment-bound contaminants such as PCBs. Similarly, sediment deposits contaminated by mining-related metals from Idaho have been identified by the USEPA in the 170-acre dam impoundment.

2.2.2 Site Groundwater (Hydrogeology)

The Site is located within the Spokane Valley Rathdrum Prairie Aquifer, a major regional water supply source. The aquifer is unconfined and is composed of coarse-grained glacial outwash deposits. Typical deposits include sand, gravel, and boulders, with minor amounts of silt and clay. Regional groundwater flow is generally to the west, following the river basin.

Groundwater flow directions in the vicinity of the dam are influenced by water impounded behind the dam. The pool behind the dam has an approximate elevation of 1,910 feet mean sea level (MSL), while the river elevation below the dam is approximately 1,880 feet MSL. This results in localized surface water exfiltration from the reservoir to the aquifer. Regional groundwater flow patterns resume downstream from the dam, with groundwater flow generally following the river basin. The most complete data sets covering the spring runoff and fall low flow periods were used to develop the groundwater contours. Lower gradients and the regional westward flow with discharge to the river appear to be restored within approximately one-half to one mile west of the dam. The presence of visible seepage discharges on both sides of the river within one-half mile of the dam, particularly at locations immediately below the dam and powerhouse, provides additional evidence of localized return flows.

2.3 Remedial Investigation/Feasibility Study

The Remedial Investigation (RI) for the Site was conducted in two phases beginning in early 2003 and completing in fall 2004 (Anchor 2005). The RI objectives were to characterize potential PCB contamination in surface water, groundwater, and sediments found in and around the Site. The investigation consisted of bathymetric surveys, sediment classification, groundwater collection from wells located down gradient of the Site, surface water collection from grab samples and semi-permeable membrane devices (SPMDs), and sediment sample collection through surface grabs and cores. The following sections describe in further detail the RI activities and results.

2.3.1 Sediments

Sediment samples from potential depositional zones located between the dam (RM 80 and RM 81.5) and near an island locally known as "Donkey Island" (RM 83.25 to 83.75) were collected and analyzed to characterize the nature and extent of PCB sediment contamination at the Site. Potential depositional zones were identified based upon field inspections, the results of the bathymetric survey, bottom profiling, and structure profiling. Sediment samples from 22 locations were collected and analyzed for chemicals of potential concern (COPCs). In late May 2003, Bluewater Engineering performed a combined bathymetric and sediment texture profiling survey within target depositional areas of the Site.

The sediment classification survey identified four potentially fine-grained sediment deposits within the Site having a continuous dimension in any direction of 50 feet or greater, or a minimum surface area of 250 square feet. These four areas are located along inner bends of the river channel or in off-channel embayments (for example, near Donkey Island) where sediment deposition may be focused in such a fluvial system. Initial investigation of the four areas thought to potentially contain fine-grained sediments and associated PCBs enabled the exclusion of one of the areas based on bathymetric survey results and observation of photographic transects of the study areas.

The objective of the focused sediment sampling activities was to investigate other depositional areas immediately upstream of the dam apron to determine if surface sediments in such depositional areas contained hazardous PCB concentrations. Based on the bathymetric survey and video transect of the four suspect deposits, sediment samples from three areas were analyzed for PCBs. To characterize the extent of PCB contamination, sediment cores were used to profile the PCBs in the largest deposit (Figure 2).

Sediment samples from the three remaining areas suspected to contain PCB contaminants were collected in June and July 2003. Additional sampling efforts were conducted in July 2004 to further delineate the contaminated sediment deposits identified by earlier sampling events. Specifically, sediment samples were collected from the large deposit immediately upstream of the dam, the two backwater channels of Donkey Island, and a small deposit on the south side of the riverbed. Three deposits suspected of containing elevated PCBs were evaluated in the Remedial Investigation and Feasibility Study (RI/FS). Sampling efforts enabled Ecology to select the deposits with elevated PCB levels. Two of the three deposits sampled contained PCB concentrations exceeding Ecology's selected cleanup levels discussed in Section 2.4.

These two contaminated deposits are discussed below and depicted in Figure 2.

Deposit 1 – approximately 3.7 acres in deep water zones (20 to 25 feet below normal pool level) near the dam (approximately RM 80.1 to 80.6), containing dry-weight (dw) surface sediment PCB concentrations up to 1,430 µg/Kg. Sub-surface sediments within the deposit contain PCBs at concentrations reaching 20 mg/Kg. The contaminated sediments had accumulated in a channel depression formed by the river prior to dam construction. Preliminary ownership determinations at Deposit 1 indicate that portions of the deposit or land adjacent to the deposit along the bank are owned by the City of Spokane, while the principal underwater sediments of concern are believed to be located within the bed and banks of the river owned by the State of Washington, under the control of the DNR.

Deposit 2 – a smaller (0.2 acre) shallow water area on the north bank side channels near Donkey Island (RM 83.4), containing surface sediment PCB concentrations up to 330 µg/Kg. The upland area is owned by the Washington Department of Parks and Recreation. Some submerged portions, as bed and bank of the river, may be owned by the State of Washington, under the control of DNR. Donkey Island is valuable riparian habitat that provides shelter for juvenile salmonids. Donkey Island is a highly heterogeneous environment consisting of areas that are only seasonally inundated as well as channels that have standing water throughout the year.

The proximity of the two backwater channels to known spawning areas for trout and other species enhances the ecological importance of this area.

2.3.2 Surface Water

Water column PCB concentrations at the Site were characterized by direct collection of surface water samples, as well as SPMD deployments. SPMD technology is based on rate-controlled chemical partitioning from the water column to enclosed neutral lipid materials, and can be used to mathematically extrapolate modeled steady-state water concentrations of dissolved organic chemicals such as PCBs (Huckins et al. 1993 and 2002). The results of the direct sampling and SPMD estimates of seasonal surface-water PCB concentrations are summarized in Section 2.3.2.2.

2.3.2.1 Water Chemistry Results

Total PCB concentrations in surface water were measured at the Site in early September 2003 during low flow conditions of nearly 500 cubic feet per second (cfs), measured at the Spokane gauge. The RI used two methods to calculate PCB concentrations in the water column. Chemistry results were reported as USEPA-method blank-qualified and blank-corrected values. PCBs reached a maximum concentration of approximately 120 picograms per liter (pg/L) at Boulder Beach at RM 82. Based on USEPA-method blank-qualified results, surface water PCB concentrations measured at the Site were below the current surface water quality standard of 170 pg/L, WAC 173-201A. However, samples collected during September at Boulder Beach and at the Upriver Dam forebay (RM 79.8) exceeded USEPA's 2002 recommended water quality criterion for total PCBs of 64 pg/L, and the alternative blank-corrected method indicated that concentrations were greater than 170 pg/L. Under MTCA, the National Recommended Water Quality Criterion for PCBs of 64 pg/L must be considered since it is recognized as an applicable, relevant, and appropriate requirement (ARAR). A narrative discussion of the nature and extent of water column total PCB concentrations at the Site, which ranged from 14 to roughly 120 pg/L, is provided below.

In September 2003, the highest validated total PCB concentration (approximately 120 pg/L) was detected in the surface water sample collected from Boulder Beach (RM 82), located upstream of Deposit 1. The surface water sample collected further downstream in the dam forebay (RM 79.8) also contained a similar total PCB concentration (approximately 110 pg/L). Conversely, water samples collected at and above the upstream Site boundary at Plante's Ferry Park (RM 84.6) and Barker Road (RM 90.4), respectively, both contained lower total PCB concentrations (14 to 17 pg/L). Much of the apparent increase in total PCB concentrations between Plante's Ferry Park and Boulder Beach was attributable to PCB-11. Increases in bottom water concentrations of certain PCB homologue groups near the dam forebay were potentially attributable to sediment-associated releases from deposits near the dam (primarily between RM 80.1 and 80.6).

In December 2003, all validated PCB results were relatively low, compared with those during the September 2003 sampling. Total PCB concentrations in surface water samples collected during December ranged from 15 to 29 pg/L, based on USEPA-qualified results, with no noticeable trends in the data. Based on the available data, the apparent seasonal increase in total PCB concentrations observed during September 2003 is indicative of surface water releases of

predominantly PCB-11 to the river system between Plante's Ferry Park and Boulder Beach. This increase appears to be from treated wastewater discharged from the Inland Empire Paper outfall (Ecology 2002) located in this stretch of the river. The apparent increase in certain PCB homologue groups in deep water samples collected between Boulder Beach and the dam forebay may be the result of a PCB release from Deposit 1. Based on chemical analysis performed on the sediment in each deposit, PCBs from Deposit 2 may also have been contributing to the PCBs measured in the surface water at the Site.

2.3.2.2 Semi-permeable Membrane Device (SPMD) Results

SPMDs placed in the water column supported the interpretation that PCB-11 is entering the river upstream of the sediment deposits. The SPMD results from the devices placed one meter over the bottom sediment deposits demonstrated a shift in PCB congeners that was consistent with the congener profile seen in the sediment in Deposit 1. The SPMDs were deployed at three stations along the dam PCB site. Specifically, SPMDs were deployed at Plante's Ferry Park, Boulder Beach, and in the dam forebay during the summer low flow and fall precipitation sampling intervals.

A comparison of SPMD-based semi-quantitative dissolved PCB concentration estimates with corresponding total PCB concentrations from direct water sampling at the same stations and over the same timeframe supported the conclusion that total PCB concentrations in the river increased as the river flows through the Deposit 1 area under low flow conditions. The PCB increases were concluded to be attributable to a combination of locally treated wastewater releases of PCB-11 between Plante's Ferry Park and Boulder Beach and releases of dissolved PCBs from the sediment deposits behind the dam. The SPMD data further corroborate that, on a river reach scale, concentrations of both dissolved and total PCBs were below the 170 pg/L water quality standard but above the National Recommended Criterion of 64 pg/L under the seasonal low flow conditions sampled.

2.3.3 Groundwater

All results taken during the RI/FS indicated that PCBs in groundwater were significantly below the MTCA Method B groundwater cleanup level of 500,000 pg/L based on the state and federal drinking water maximum contaminant level (MCL), and below the Method B level for groundwater of 44,000 pg/L, which is required to meet the maximum one in a million lifetime cancer risk. Average and maximum results were 23 and 70 pg/L, respectively, in the May 2003 samples. In September 2003, average and maximum results were 63 and 116 pg/L, respectively. The associated blanks ranged from 10 to 226 pg/L.

Down-gradient groundwater total PCB concentrations measured during the focused RI/FS sampling were similar to area background surface water PCB concentrations measured upstream of fine-grained sediment deposits at Boulder Beach. Maximum groundwater PCB concentrations were also substantially (more than 4,000-fold) lower than drinking water-based groundwater cleanup levels. It was concluded the groundwater results are consistent with river surface water conditions.

2.4 Cleanup Levels and Points of Compliance

The methodology and decision criteria that were implemented for the selection of cleanup levels and points of compliance for the protection of surface water, groundwater, and sediments are described in detail in the Cleanup Action Plan (CAP). The following sections briefly summarize the cleanup levels and points of compliance for each media type found at the Site.

2.4.1 Sediment Cleanup Levels

The selected sediment cleanup level was 62 µg/Kg. This sediment cleanup level was based on the lowest Apparent Effects Threshold (AET) for use in freshwater sediments as recommended by Michelson (2003). The freshwater sediment criteria described by Michelson (2003) were proposed to Ecology for rule adoption; however, Ecology never formally adopted the criteria.

2.4.2 Surface Water Cleanup Levels

The surface water cleanup level selected was 64 pg/L. This value is recommended by USEPA (2002) as a part of their ambient water quality standards. This value may be used under MTCA as the Method B cleanup level (WAC 173-340-730[3][b][i][B]) as it is considered an ARAR.

2.4.3 Groundwater Cleanup Levels

The primary potential pathway of PCB-contaminated groundwater exposure to human receptors in the vicinity of the dam is through groundwater consumption. Groundwater beneath the river near the dam occurs in the Spokane Valley-Rathdrum Prairie "Sole Source" Aquifer that serves as the drinking water supply for at least 400,000 people in Spokane County. In the vicinity of the dam impoundment, surface water generally flows from the impoundment into the groundwater; however, a regional westward groundwater flow with discharge to the river appears to be restored within approximately one-half to one mile downstream from the dam. As discussed in Section 2.3.3, maximum PCB concentrations in groundwater in the dam area are well below the MTCA groundwater cleanup levels and are approximately three orders of magnitude below the current drinking water maximum contaminant levels, so the water supply is safe for human consumption.

2.4.4 Sediment Point of Compliance

At the time of the cleanup action, the Sediment Management Standards' (SMS) default point of compliance for sediment and surface water cleanup levels was the 0-to-10-cm depth interval below the mudline. Radioisotope-dating evaluations support that the biologically active zone in the contaminated sediments does not extend below the 10-cm interval, and in several cores is limited to the 0-to-4-cm interval. Use of a default 0-to-10-cm point of compliance in the sediment cleanup level provides an additional level of protectiveness to address potential future improved conditions at the Site.

2.4.5 Surface Water Point of Compliance

For surface water, the point of compliance is the point or points at which hazardous substances are released to surface waters of the state.

2.4.6 Groundwater Point of Compliance

For groundwater, the point of compliance is the point or points where the groundwater cleanup levels must be attained for a Site to be in compliance with the cleanup standards. The groundwater

standard point of compliance is established throughout the Site from the uppermost levels of the saturated zone extending vertically to the lowest depth that could potentially be affected by the Site.

2.5 Selected Remedial Action

Four remedial action alternatives were developed for the Site:

1. Monitored Natural Recovery
2. Enhanced Natural Recovery
3. Engineered Sediment Capping
4. Removal, Off-site Disposal, and Residuals Capping

A combination of alternatives 3 and 4 was selected. Alternative 3 was selected for Deposit 1, while Alternative 4 was selected for Deposit 2. Descriptions of the alternatives selected for each deposit are below.

2.5.1 Selected Cleanup Action for Deposit 1

Placement of a clean cap system to isolate the underlying PCB-contaminated sediments from the biologically active zone and water column and further stabilize the sediments from potential worst-case hydrodynamic forces (i.e., erosion protection) was selected as the cleanup action for Deposit 1 (a portion of the Site with sediment PCB concentrations exceeding 62 µg/Kg that is defined in Figure 2). An appropriately engineered isolation cap, with a safety factor of 4, was determined appropriate for the sediments in Deposit 1, due to the effectiveness of the proposed remedy to eliminate toxicity to sediment-dwelling species while limiting potential water quality impacts during remediation efforts.

Ecology's safety factor requires a minimum 4-inch containment layer be placed over sediment in the deposit that exceeds the sediment cleanup level. The location of Deposit 1 serves to protect a containment system from disturbance and prevent incidental human contact with contaminated sediments.

The cap consisted of the following sequential layers:

- A nominal 6-inch lower layer of granular bituminous coal not to be less than 4 inches at any location following placement.
- An intermediate nominal 6-inch layer of sand.
- A surface nominal 3-inch cover layer of gravel armor.

The coal layer was constructed in Deposit 1 using precision hydraulic placement of approximately 6 to 8 inches of coal, verified in the field with detailed construction monitoring observations (e.g., sediment profile imaging [SPI] on a nominal 50-foot grid pattern), to ensure that a minimum 4 inches of coal material is placed at all SPI stations. The coal layer was then overlain with a nominal 6 inches of sand and covered with 3 inches of gravel armor. After completion, the surface area of the constructed cap is approximately 3.5 acres.

Long-term monitoring and adaptive management of the cap surface will be required to verify its effectiveness and repair any cap damage or flaws as long as the PCB-contaminated sediments remain.

2.5.2 Selected Cleanup Action for Deposit 2

The selected cleanup action for Deposit 2, a 0.2-acre backwater channel area on Donkey Island containing approximately 300 cubic yards of sediment with PCB concentrations exceeding 62 µg/Kg, was Alternative 4. As applied to Deposit 2, Alternative 4 resulted in the following actions:

a) Excavating the top 2 feet of sediment, thereby removing roughly 95 percent of the PCB-contaminated sediment mass from this area. The total estimated volume of excavated sediment was 600 cubic yards.
b) Backfilling the area with approximately two feet of clean sand to maintain the original grade and cap any residual PCBs.
c) Transporting excavated material, including residual water, to a regional landfill facility for disposal.

In addition to removing the contaminated sediments, Ecology required restoring the area to its approximate pre-excavation condition to preserve the valuable shoreline and river riparian/backwater habitat surrounding Deposit 2.

2.6 Long-Term Compliance Monitoring and Maintenance

2.6.1 Compliance Monitoring

As part of the CAP, surface and subsurface sediment sampling of Deposit 1 were required to be performed two (2008) and four (2010) years post-remediation as described in the Operations, Monitoring, and Maintenance Plan (OMMP; Anchor 2008). Sampling locations were determined by bathymetric surveys conducted prior to each sampling event as described in the OMMP.

Surface sediment sampling focused on the collection of material from the 0-to-10-cm biologically active layer of the cap. A total of two surface samples were collected during each monitoring event. Subsurface sediment sampling consisted of three cores at predetermined locations and two additional locations at relatively low spots on the cap based on the pre-sampling event bathymetric surveys. The sediment cores were taken by diver-assisted piston coring with a penetration depth goal of 1 or more feet below the bottom of the cap.

Both the surface and subsurface sediment samples were analyzed for:

- Total organic carbon (TOC)
- Total solids, grain size (percent gravel, sand, silt, clay)
- PCB Aroclors 1016, 1221, 1232, 1242, 1254, 1260, 1262, 1268

At the end of two sampling events, the monitoring program was evaluated to determine whether remedial actions at Deposit 1 have provided sufficient protection to human health and the environment and to determine whether the monitoring strategy should be revised. An evaluation of sediment compliance monitoring data is available in Section 3.1.2.

2.6.2 Inspections and Maintenance

Requirements for post-remediation inspection and maintenance of the Site were also described in the OMMP. Bathymetric surveys were required during the sediment sampling events and were compared to the post-remediation bathymetric survey to evaluate cap thickness in case of erosion or settlement. Also during the sampling events, divers conducted visual inspections to evaluate cap erosion or settlement.

The most recent inspection was from October 2, 2011. The inspection determined the cap appeared to be generally intact with no observed erosion or other loss of cap material. The complete inspection report for 2008 and 2010 is available on Ecology's online Integrated Site Information System (ISIS) database at:
http://ecyapps4/isis/Documents/DocumentViewer.aspx?csid=4213

3.0 PERIODIC REVIEW

3.1 Effectiveness of completed cleanup actions

3.1.1 Site Visit

Based upon the Site visit conducted October 23, 2013, the Site remains owned by the State and is used for recreational purposes. A photo log is in Appendix C of this Periodic Review.

The impermeable Site surfaces at Deposit 1 continue to eliminate direct exposure pathways to contaminated sediments based upon the last monitoring event in 2011.

3.1.2 Sediment

Sediment sampling was conducted two and four year's post-remediation at the Site in 2008 and 2010, respectively. Two surface grab samples were collected from material on top of the cap and five subsurface sediment profile cores were collected from the cap extending into the material below the cap during each sampling event. In addition, a bathymetric survey of Deposit 1 was conducted prior to each sampling event to evaluate cap thickness and help select locations for the surface and subsurface sediment samples.

Results from the 2008 monitoring event showed new sand material had deposited on the southern end of the cap (area closest to the mid-channel) in depths of a foot or more (Anchor 2009). Flows earlier in the year during the spring runoff resulted in a peak flow of 40,600 cfs that corresponds to an equivalent of a 25-year flood event. These high flows likely attributed to the new material that was observed on the cap. Other portions of the cap were observed to be intact with no signs of erosion and only general settling occurring. PCBs were not detected in either of the sand isolation layer or the underlying coal layer (Table 1, Appendix A) from subsurface sediment samples that were taken during the 2008 monitoring event. Native sediments below the cap were found to have PCBs in four of the five subsurface samples with concentrations ranging from 22 to 1,100 µg/Kg. PCBs were also detected in one of the two surface grab samples (Station G1), but the concentrations (26 µg/Kg) were below the selected Cleanup Level of 62 µg/Kg as specified in the CAP. Station G1 was collected from an area that was observed to have additional material deposited on the cap as described previously. The detected PCBs in Station G1 are likely associated with upstream sources deposited during the spring flood event; there are no indications of cap failure.

Results from the 2010 monitoring event found a general settling in portions of the cap, while the sand material observed in the 2008 monitoring event was no longer present (Anchor 2011). Analysis of the layers of the individual cores showed no loss of cap material and that the loss in elevation of the surface of the cap compared to the as-built survey conducted in 2006 is the result of the underlying native sediments compacting from the weight of the cap. PCBs were not detected in the sand isolation layer (Table 2, Appendix A) from subsurface sediment samples taken during the 2008 monitoring event; however, PCBs were detected (20 µg/Kg) in the coal absorption layer at Station SC-3, indicating the upward movement and absorption of PCBs from the native sediments below the cap to the coal layer. The upward movement and eventual absorption of PCBs to the coal layer is an expected result and indicates the remedy is working as designed. Native sediments below the cap were found to have PCBs in all five of the subsurface

samples with concentrations ranging from 47 to 5,200 µg/Kg. PCBs were not detected in either of the surface grab stations.

3.1.3 Institutional Controls

To ensure the protective remedy put in place at Deposit 1 is protected from future development that may impact its long-term protectiveness, Ecology encourages Avista to enter into an easement or lease agreement with the landowner, DNR. In addition, the location of the cap should be kept in the DNR Geographical Information System (GIS) database used when shoreline developments occur.

3.2 New scientific information for individual hazardous substances at the Site

There is no new relevant scientific information for the contaminants related to the Site.

3.3 New applicable state and federal laws for hazardous substances present at the Site

Screening levels at the Site were based on the current standards at the time of the remedial action for the protection of human health and the environment. Since the remedial action occurred, the SMS (WAC 173-204) were updated in September 2013 with sediment quality values for the protection of benthic-dwelling invertebrates in freshwater systems. The recently updated freshwater SMS for PCBs are 110 and 2,500 µg/Kg for the Sediment Quality Standard (SQS) and Cleanup Screening Level (CSL), respectively. Both the SQS and CSL are higher than the cleanup level that was originally selected for the Site (62 µg/Kg) and the revised cleanup level (48 µg/Kg) identified in Section 3.7. In addition, the sediment point of compliance was updated to be at the location that is protective of both aquatic life and human health. To protect aquatic life, the point of compliance was established as being within the biologically active zone. The biologically active zone was found not to occur beyond the 10-cm depth and in most cases occurred much shallower. Therefore, these regulatory changes do not impact whether the remedy is protective of human health and the environment because the Cleanup Level chosen for this Site is more protective and the sediment point of compliance includes the biologically active zone at the Site.

3.4 Current and projected Site use

The Site is currently under DNR jurisdiction. Recreational activities, including boating, may occur near the Site; however, impact to Deposit 1 is expected to be negligible.

3.5 Availability and practicability of higher preference technologies

The remedy implemented included containment of hazardous substances, and it continues to be protective of human health and the environment. While higher preference cleanup technologies may be available, they are not practicable at this Site due to cost considerations (as outlined in the CAP) and potential for release of PCBs into the water column.

3.6 Availability of improved analytical techniques

The analytical methods used at the time of the remedial actions were capable of detection below cleanup levels for contaminants of concern at the Site. The presence of improved analytical techniques does not affect decisions or recommendations made for the Site.

3.7 Cleanup Level Evaluation

In addition to reviewing whether new applicable state and federal laws for hazardous substances apply to the Site, a review of the methodologies for developing the cleanup levels implemented as a part of the remedial action was also performed. During this review, it was identified that the selected 62 µg/Kg cleanup level for PCBs found in sediment at the Site is not the most stringent cleanup level protective of human health and the environment as is required by state law. A cleanup value of 48 µg/Kg total PCBs is identified as the most stringent value protective of human health and the environment. This value is based on the EqP model, using a site-specific organic carbon partitioning coefficient value (Koc) of 457,088 L/Kg to determine a PCB sediment value protective of the USEPA-recommended 64 pg/L surface water criterion. The CAP and future periodic reviews will continue to use the 62 µg/Kg cleanup level to be consistent with the Consent Decree signed between Ecology and Avista.

For this review, an evaluation was done to determine if the implemented remedial actions at Deposits 1 and 2 meet the concentration of 48 µg/Kg total PCBs. A review of the data generated from previous reports, including the RI/FS, was performed. During this review, it was found that samples taken outside the areas of remediation at both Deposit 1 and 2 had PCBs at levels below 48 µg/Kg total PCBs. In addition, surface grab samples were also taken directly following the excavation of contaminated sediments at Deposit 2 (Anchor 2007). All of the samples except one were found to be below 48µg/Kg total PCBs. The one sample found to be above the 48 µg/Kg total PCBs level contained PCBs at an 80 µg/Kg concentration. The presence of this sample was determined to be anomalous and of no significant threat to human health and the environment due to other samples collected nearby having low to non-detect PCB concentrations and clean fill was placed on top of the area to restore the channel bottom to pre-excavation elevation. Based on this evaluation, Ecology has determined the remedial action completed at both Deposits 1 and 2 meets the value of 48 µg/Kg total PCBs.

3.8 Conclusions

Upon completion of this Periodic Review, Ecology has made the following determinations:

- The cleanup remedy implemented at the Site is currently protective of human health and the environment.
- To ensure long-term protectiveness, monitoring of the effectiveness of the remedial action and the integrity of the cap should continue in the future at a rate of once every five years to coincide with the Periodic Review schedule. As a result of the last monitoring event occurring in 2010, the next monitoring event should take place by 2017.

3.9 Next Review

This review covers the five-year post-remediation period and the two initial monitoring events. The next review for the Site will be scheduled as soon as practicable after the next monitoring

event. In the event that additional cleanup actions or institutional controls are required, the next periodic review will be scheduled five years from the completion of those activities.

4.0 REFERENCES

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APPENDIX A: TABLES

Table 1: Year Two Sediment PCB Results (µg/Kg)

	SC-1			SC-2			SC-3			SC-4			SC-5			G-1	G-2
Layer Type	Sand	Coal	Native	Sand	Coal	Native	Sand	Coal	Native	Sand	Coal	Native	Sand	Coal	Native	Sand	Sand
Aroclor 1016	4.8 U	4.8 U	48 U	4.7 U	5.1 U	4.7 U	4.9 U	4.8 U	4.9 U	4.7 U	5.1 U	4.8 U	4.8 U	5 U	4.9 U	4.9 U	5 U
Aroclor 1221	4.8 U	4.8 U	48 U	4.7 U	5.1 U	4.7 U	4.9 U	4.8 U	4.9 U	4.7 U	5.1 U	4.8 U	4.8 U	5 U	4.9 U	4.9 U	5 U
Aroclor 1232	4.8 U	4.8 U	48 U	4.7 U	5.1 U	4.7 U	4.9 U	4.8 U	4.9 U	4.7 U	5.1 U	4.8 U	4.8 U	5 U	4.9 U	4.9 U	5 U
Aroclor 1242	4.8 U	4.8 U	48 U	4.7 UJ	5.1 U	**86**	4.9 UJ	4.8 U	4.9 U	4.7 UJ	5.1 U	4.8 U	4.8 UJ	5 U	4.9 U	4.9 U	5 U
Aroclor 1248	4.8 U	4.8 U	**1100**	4.7 UJ	5.1 U	4.7 U	4.9 UJ	4.8 U	4.9 U	4.7 UJ	5.1 U	**22**	4.8 UJ	5 U	**420**	**26**	5 U
Aroclor 1254	4.8 U	4.8 U	48 U	4.7 UJ	5.1 U	4.7 U	4.9 UJ	4.8 U	4.9 U	4.7 UJ	5.1 U	4.8 U	4.8 UJ	5 U	4.9 U	4.9 U	5 U
Aroclor 1260	4.8 U	4.8 U	48 U	4.7 UJ	5.1 U	**26**	4.9 UJ	4.8 U	4.9 U	4.7 UJ	5.1 U	4.8 U	4.8 UJ	5 U	4.9 U	4.9 U	5 U
Total PCBs	4.8 U	4.8 U	**1100**	4.7 U	5.1 U	**112**	4.9 U	4.8 U	4.9 U	4.7 U	5.1 U	**22**	4.8 U	5 U	**420**	**26**	5 U

Table 2: Year Four Sediment PCB Results (µg/Kg)

	SC-1			SC-2			SC-3			SC-4			SC-5			G-1	G-2
Layer Type	Sand	Coal	Native	Sand	Coal	Native	Sand	Coal	Native	Sand	Coal	Native	Sand	Coal	Native	Sand	Sand
Aroclor 1016	9.7 U	9.7 U	10 U	9.6 U	9.7 U	19 U	9.6 U	9.8 U	130 U	9.6 U	9.9 U	18 U	9.7 U	9.8 U	240 U	9.8 U	9.9 U
Aroclor 1221	9.7 U	9.7 U	10 U	9.6 U	9.7 U	19 U	9.6 U	9.8 U	130 U	9.6 U	9.9 U	18 U	9.7 U	9.8 U	240 U	9.8 U	9.9 U
Aroclor 1232	9.7 U	9.7 U	10 U	9.6 U	9.7 U	19 U	9.6 U	9.8 U	130 U	9.6 U	9.9 U	18 U	9.7 U	9.8 U	240 U	9.8 U	9.9 U
Aroclor 1242	9.7 U	9.7 U	10 U	9.6 U	9.7 U	19 U	9.6 U	9.8 U	130 U	9.6 U	9.9 U	18 U	9.7 U	9.8 U	240 U	9.8 U	9.9 U
Aroclor 1248	9.7 U	9.7 U	**47**	9.6 U	9.7 U	280 U	9.6 U	**20**	**5200**	9.6 U	9.9 U	**140**	9.7 U	9.8 U	**5000**	9.8 U	9.9 U
Aroclor 1254	9.7 U	9.7 U	10 U	9.6 U	9.7 U	**450**	9.6 U	9.8 U	1300 U	9.6 U	9.9 U	64 U	9.7 U	9.8 U	1800 U	9.8 U	9.9 U
Aroclor 1260	9.7 U	9.7 U	10 U	9.6 U	9.7 U	19 U	9.6 U	9.8 U	170 U	9.6 U	9.9 U	18 U	9.7 U	9.8 U	240 U	9.8 U	9.9 U
Aroclor 1262	9.7 U	9.7 U	10 U	9.6 U	9.7 U	19 U	9.6 U	9.8 U	130 U	9.6 U	9.9 U	18 U	9.7 U	9.8 U	240 U	9.8 U	9.9 U
Aroclor 1268	9.7 U	9.7 U	10 U	9.6 U	9.7 U	19 U	9.6 U	9.8 U	130 U	9.6 U	9.9 U	18 U	9.7 U	9.8 U	240 U	9.8 U	9.9 U
Total PCBs	9.7 U	9.7 U	**47**	9.6 U	9.7 U	**450**	9.6 U	**20**	**5200**	9.6 U	9.9 U	**140**	9.7 U	9.8 U	**5000**	9.8 U	9.9 U

APPENDIX B: FIGURES

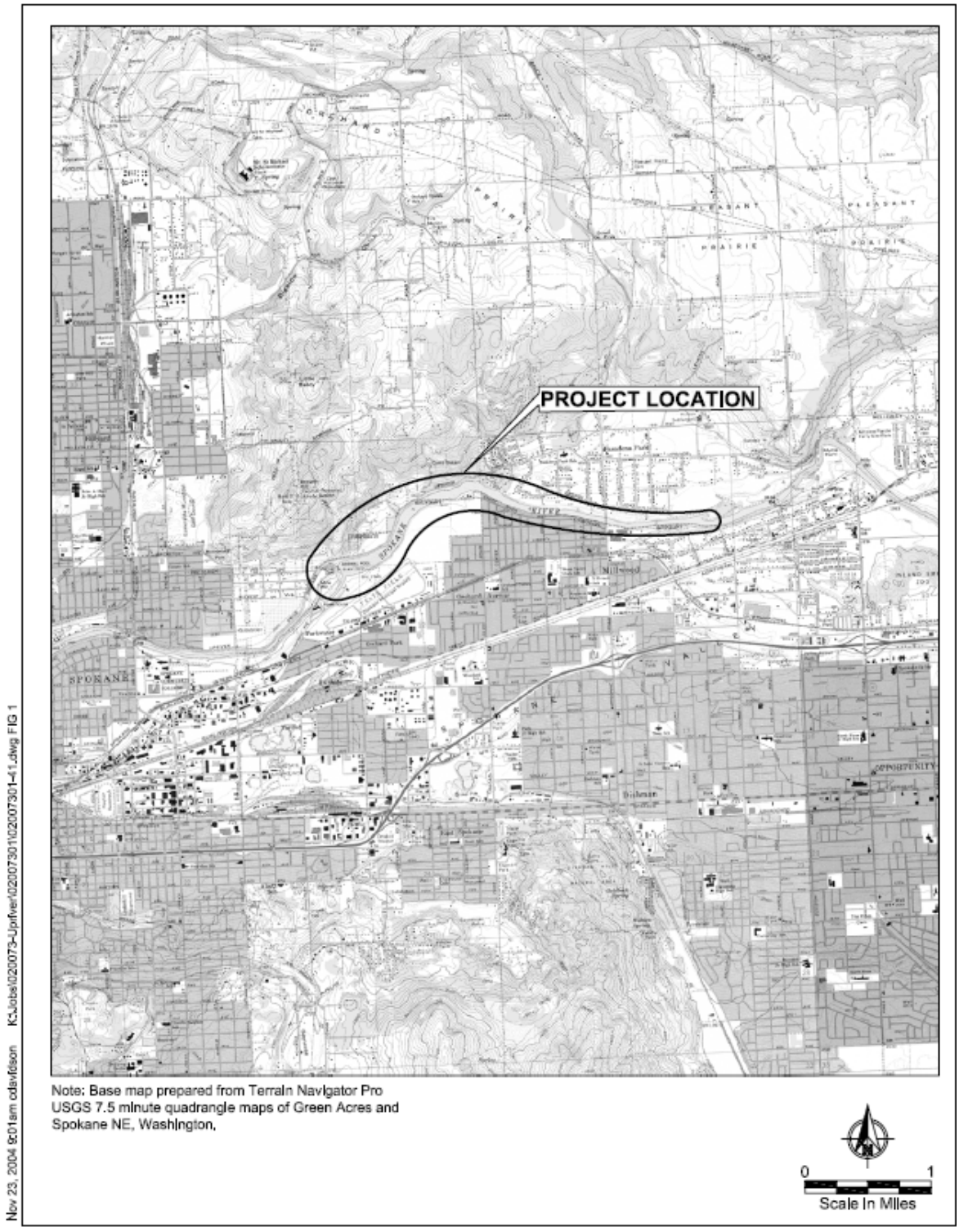

Figure 1. Site Vicinity. Courtesy of Anchor Environmental, L.L.C.

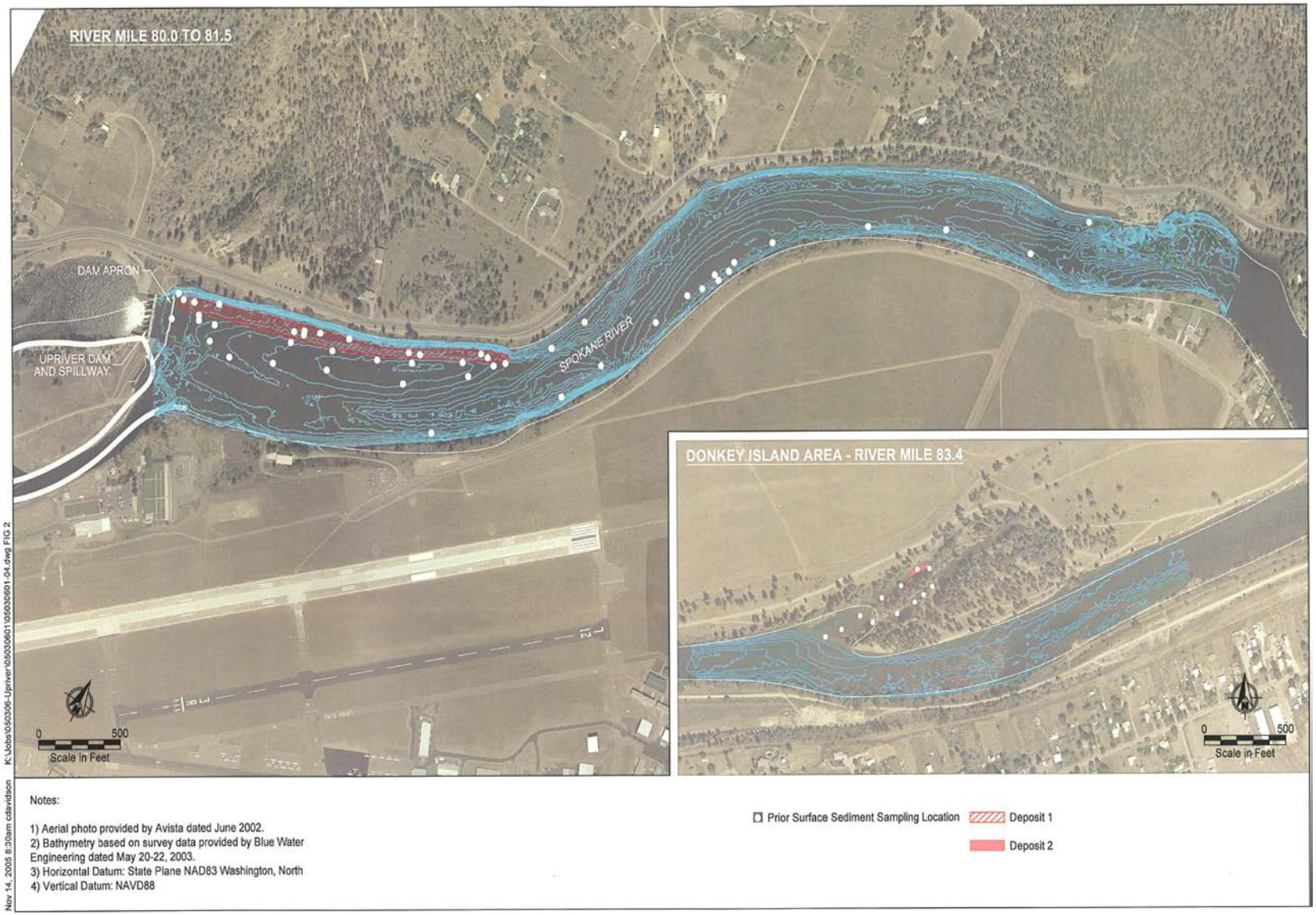

Figure 2. Overview of Site Deposits 1 and 2. Courtesy of Anchor Environmental, L.L.C.

APPENDIX C: PHOTO LOG

Photo 1: Location of Deposit 1 – from the north

Photo 2: Location of Deposit 1 – from the west

Photo 3: Deposit 2 - from the northeast

Photo 4: Deposit 2 – from the southwest