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U S EPA REVISIONS TO DRAFT FINAL SITE INVESTIGATION REPORT SITES 4 AND 9
AREA OF CONCERN 3 (AOC3) WITH TRANSMITTAL NWS YORKTOWN CHEATHAM
ANNEX WILLIAMSBURG VA
11/30/2011
U S EPA REGION III

Sawyer, Stephanie/VBO

From: Burchette.John@epamail.epa.gov
Sent: Wednesday, November 30, 2011 3:04 PM
To: krista.parra@navy.mil; Sawyer, Stephanie/VBO; Ivester, Marlene/VBO; Wade.Smith@deq.virginia.gov
Subject: Fw: CAX Sites 4, 9, and AOC 3 SI Report Revisions; Sent 10/20/11
Attachments: Revised Draft Final CAX Sites 4 9 AOC 3 SI Report_10_20_11-pk.docx

Guys,

The revised language that was included in the red-lined strikeout is acceptable (thanks for making the changes). Peter did submit a few additional in text concerns. If we can just make the corrections/clarifications we should be able to finalize this ASAP. Please contact me with any questions or concerns

John Burchette(3HIS11)
Remedial Project Manager
NPL/BRAC/Federal Facilities Branch
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029
Phone: 215.814.3378
Fax: 215.814.5518
Burchette.john@epa.gov

screening benchmark. Constituents contributing to the cumulative cancer risk were identified as COPCs, and included: arsenic and chromium.

In Step 3, based on the use of the 95 percent UCL for the EPC, a cumulative cancer risk of 3×10^{-4} was calculated; this value is greater than the 5×10^{-5} risk-ratio screening benchmark. Constituents contributing to the cumulative cancer risk were identified as COPCs, and included: arsenic and chromium. Chromium was the only COPC to contribute an individual cancer risk above 5×10^{-5} .

Exposure to subsurface sediment at Site 4 may result in unacceptable human health risks associated with arsenic and chromium, based on potential human exposure. The potential unacceptable carcinogenic risk is primarily associated with chromium, the only COPC to contribute to a risk above the screening benchmark level. However, in performing the risk assessment, it was assumed that all of the chromium detected in the subsurface sediment is in the hexavalent form, which is very unlikely. Chromium is generally found in natural sediment in the trivalent form, unless activities at the site have resulted in the release or formation of hexavalent chromium. Therefore, trivalent chromium is the form of chromium expected to be present at the site. Chromium was identified as a COPC in subsurface sediment when screened against the respective RSLs for hexavalent chromium. However, the maximum detected concentration for chromium in subsurface sediment was less than the RSL for trivalent chromium. Therefore, it is likely there would be no unacceptable carcinogenic risk associated with exposure to the subsurface sediment in the drainage ditches at Site 4.

Ecological Risk Evaluation

The ecological risk screening was performed to determine the potential for ecological risks associated with direct exposure to site media at Site 4 (surface and subsurface soils, surface water, and surface and subsurface sediment). The results of the ecological risk screening (**Appendix B**) provide a preliminary indication of potential risks from exposure to COPCs identified for the site, and are used to help determine whether the site requires further evaluation or the risks are acceptable. **Table B-4** lists the samples used in this evaluation and the spatial groupings.

Surface Soil

Eight inorganics (aluminum, copper, iron, lead, manganese, mercury, selenium, and zinc) and six pesticides (4,4'-DDT, aldrin, endrin, endrin aldehyde, endrin ketone, and gamma-chlordane) exceeded screening values based upon maximum detected concentrations (**Tables B-5** and **B-6**). All of these chemicals, except manganese, also exceeded background UTLs, where available. Acetone and carbazole lacked both screening values and background UTLs. Therefore, aluminum, copper, iron, lead, mercury, selenium, zinc, 4,4'-DDT, aldrin, endrin, endrin aldehyde, endrin ketone, gamma-chlordane, acetone, and carbazole were identified as initial COPCs.

The initial COPCs were then evaluated using more realistic assumptions to select refined COPCs, as follows:

- Acetone, which did not have a screening value, was detected at a maximum concentration (120 µg/kg) that was less than soil screening values for other, similar VOCs (**Table B-1**). Thus, this chemical was not identified as a refined COPC.

- Carbazole was detected in five surface soil samples at a maximum concentration of 250 µg/kg (0.25 mg/kg). While there is little information regarding the potential toxicity to soil invertebrates and/or terrestrial plants following direct exposure to this chemical, available data suggest that the maximum observed concentrations of this chemical are too low to elicit adverse effects. In studies with oligochaete worms exposed to carbazole-spiked soils, the resulting Lethal Concentration to 50 percent of the population (LC₅₀) and Effect Concentration to 50 percent of the population (EC₅₀) values were greater than 2,100 and 52 mg/kg, respectively (Sverdrup et al., 2002). In a similar study exposing collembolans (or springtails) to spiked soils, the LC₅₀ and EC₅₀ values were 2,500 and 35 mg/kg, respectively, for carbazole (Sverdrup et al., 2001). Applying an uncertainty factor of 5 to the lower of the two EC₅₀ values (to approximate a chronic NOEC) yields an effects concentration of 7.00 mg/kg. The maximum concentration of carbazole (0.25 mg/kg) is multiple orders of magnitude below these this effects concentrations. Therefore, carbazole was not identified as a refined COPC.
- The mean hazard quotients (HQs) for copper, iron, lead, selenium, zinc, 4,4'-DDT, and gamma-chlordane were less than one. Thus, these chemicals were not identified as refined COPCs.
- The mean HQ exceeded one for aldrin (1.17), endrin (2.67), endrin aldehyde (4.85), endrin ketone (5.51), and mercury (2.25). These five chemicals were identified as refined COPCs.
- Aluminum exceeded its pH-based soil screening value in eight of 10 samples and the mean pH at the site was also less than the pH-based screening value. Aluminum also exceeded background in two of 10 samples. Therefore, aluminum was identified as a refined COPC.

Comment [d1]: Justification for this uncertainty factor needs to be provided so the reader can decide if it is appropriate, or not.

Subsurface Soil

Five metals (aluminum, iron, mercury, selenium, and zinc), four pesticides (4,4'-DDT, aldrin, endosulfan II, and endrin ketone), bis(2-ethylhexyl)phthalate, and di-n-butylphthalate exceeded screening values based upon maximum detected concentrations (Tables B-7 and B-8). All of these chemicals, except iron, also exceeded background UTLs, where available. Screening values and background UTLs were not available for acetone and 2-butanone. Therefore, aluminum, mercury, selenium, zinc, 4,4'-DDT, aldrin, endosulfan II, endrin ketone, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, acetone, and 2-butanone were identified as initial COPCs.

The initial COPCs were then evaluated using more realistic assumptions to select refined COPCs, as follows:

- Acetone and 2-butanone, which did not have screening values, were detected at maximum concentrations (120 and 8.00 µg/kg, respectively) that were less than soil screening values for other, similar VOCs (Table B-1). Therefore, these chemicals were not identified as refined COPCs.
- The mean HQs for selenium, zinc, 4,4'-DDT, endosulfan II, bis(2-ethylhexyl)phthalate, and di-n-butylphthalate were less than one. Therefore, these chemicals were not identified as refined COPCs.

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sediment, and two SVOCs (benzo(a)anthracene and dibenz(a,h)anthracene), six pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan I, and endrin aldehyde), two PCBs (Aroclor-1254 and Aroclor-1260), and seven inorganics (aluminum, arsenic, barium, cadmium, chromium, iron and vanadium) exceeded one or more screening criterion in subsurface sediment.

Sediment (surface and subsurface) and surface water samples were collected from Upstream Pond during the Site 4 2009 SI field activities; however, these analytical results were used to evaluate the pond as a whole and are discussed in **Section 5**.

Step 2b—Conduct a Semiquantitative Risk Evaluation Using More Realistic Assumptions Human Health Risk Evaluation

Exposure to surface and subsurface soil at Site 4 may result in unacceptable human health risks associated with PAHs, pesticides/PCBs, and metals, based on potential human exposure. Exposure to groundwater at Site 4 may result in unacceptable human health risks associated with PCE and arsenic, based on potential human exposure. Exposure to indoor air at Site 4 may result in unacceptable human health risks associated with PCE. However, PCE is not likely site-related since the only detection was upgradient of the site. Arsenic in groundwater is likely related to the natural conditions of the aquifer and not likely to be site-related.

Exposure to surface water in the drainage ditches at Site 4 may result in unacceptable human health risks associated with arsenic and iron, based on potential human exposure. Exposure to surface sediment in the drainage ditches at Site 4 may result in unacceptable human health risks associated with benzo(a)pyrene, arsenic, and chromium and exposure to subsurface sediment in the drainage ditches at Site 4 may result in unacceptable human health risks associated with arsenic and chromium.

Ecological Risk Evaluation

Potential unacceptable ecological risks were identified with exposure to surface soil attributable to aldrin, endrin, endrin aldehyde, endrin ketone, aluminum and mercury. Potential unacceptable ecological risks were identified with exposure to subsurface soil attributable to aldrin, endrin ketone, aluminum, and mercury. In the Site 4 drainage ditches, there are no potential unacceptable ecological risks were identified with exposure to surface and subsurface sediment; however, there are potential unacceptable ecological risks identified with exposure to pyrene and iron in surface water.

Step 3—Is Further Investigation or Action Required?

Results from test pitting activities indicate that buried debris exists at Site 4 and the vertical and horizontal extent of the debris has been sufficiently characterized during test pitting activities. However, additional site characterization for environmental media (soil, groundwater, surface water, and sediment) will be needed.

An RI is recommended to characterize the nature and extent of contamination within soil, groundwater, surface water and sediment and to quantify the risk associated with all media. Information regarding the number of samples, sampling locations, sampling analytes, and how the sample data will be used in the RI will be agreed to by the CAX Partnering Team and submitted in an RI UFP-SAP, to be submitted under separate cover. The FS component would evaluate remedial alternatives to mitigate potential risks to human health and

ecological receptors in direct contact with debris and from potential contamination. Table 3-7 summarizes the results of the decision analysis for Site 4.

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human nutrient, and although the concentrations indicate a potential unacceptable hazard, it is likely that exposure to iron at the concentrations present on site would not result in any adverse health effects. Therefore, it is likely there would be no unacceptable carcinogenic risk or noncarcinogenic hazard associated with exposure to the subsurface sediment in the drainage ditches at Site 9.

Ecological Risk Evaluation

The ecological risk screening was performed to determine the potential for ecological risks associated with direct exposure to site media at Site 9 surface and subsurface soils. Separate screenings were conducted for the site and the adjacent drainage ditch. The results of the ecological risk screening (**Appendix B**) provide a preliminary indication of potential risks from exposure to COPCs identified for the site, and are used to help determine whether the site requires further evaluation or if the risks are acceptable. **Table B-4** lists the samples used in this evaluation and the spatial groupings.

Surface Soil (Site)

Four metals (copper, iron, manganese, and nickel) and three pesticides (dieldrin, endosulfan II, and endosulfan sulfate) exceeded screening values based upon maximum detected concentrations (**Tables B-34** and **B-35**). All of these constituents, except iron and manganese, also exceeded background UTLs, where available. Acetone and carbazole lacked both screening values and background UTLs. Therefore, copper, nickel, dieldrin, endosulfan II, endosulfan sulfate, acetone, and carbazole were identified as initial COPCs.

The initial COPCs were then evaluated using more-realistic assumptions to select refined COPCs, as follows:

- Acetone, which did not have a screening value, was detected at a maximum concentration (140 µg/kg) that was less than soil screening values for other, similar VOCs (**Table B-1**). Therefore, this chemical was not identified as a refined COPC.
- Carbazole was detected in one surface soil sample at a maximum concentration of 2.70 µg/kg (0.0027 mg/kg). While there is little information regarding the potential toxicity to soil invertebrates and/or terrestrial plants following direct exposure to this chemical, available data suggest that the maximum observed concentrations of this chemical are too low to elicit adverse effects. In studies with oligochaete worms exposed to carbazole-spiked soils, the resulting LC₅₀ and EC₅₀ values were greater than 2,100 and 52 mg/kg, respectively (Sverdrup et al., 2002). In a similar study exposing collembolans (or springtails) to spiked soils, the LC₅₀ and EC₅₀ values were 2,500 and 35 mg/kg, respectively, for carbazole (Sverdrup et al., 2001). Applying an uncertainty factor of 5 to the lower of the two EC₅₀ values (to approximate a chronic NOEC) yields an effects concentration of 7.00 mg/kg. The maximum concentration of carbazole (0.0027 mg/kg) is below this effects concentration. The maximum concentration of carbazole is well below these effect concentrations. Therefore, carbazole was not identified as a refined COPC.
- The mean HQs for nickel, dieldrin, and endosulfan II were less than one. Therefore, these chemicals were not identified as refined COPCs.

Comment [d2]: See previous comment about this issue.

- The mean HQ exceeded one for copper (1.74) and endosulfan sulfate (1.48). These two chemicals were identified as refined COPCs.

Subsurface Soil (Site)

One metal (copper) and one pesticide (endosulfan sulfate) exceeded screening values based upon maximum detected concentrations (Tables B-36 and B-37). These chemicals also exceeded background UTLs, where available. A screening value and background UTL were not available for acetone. Therefore, copper, endosulfan sulfate, and acetone were identified as initial COPCs.

The initial COPCs were then evaluated using more-realistic assumptions to select refined COPCs, as follows:

- Acetone, which did not have a screening value, was detected at a maximum concentration (93.0 µg/kg) that was less than soil screening values for other, similar VOCs (Table B-1). Therefore, this chemical was not identified as a refined COPC.
- The mean HQs for copper and endosulfan sulfate were less than one. Therefore, these two chemicals were not identified as refined COPCs.

No refined COPCs were identified for this medium and risks from this exposure pathway are considered acceptable.

Surface Sediment (Drainage Ditches)

Two metals (mercury and selenium), six pesticides (4,4'-DDT, dieldrin, endosulfan II, endosulfan sulfate, endrin ketone, and gamma-chlordane), and Aroclor-1260 exceeded screening values based upon maximum detected concentrations (Tables B-38 and B-39). All of these chemicals also exceeded background UTLs, where available. Carbazole lacked both screening values and background UTLs. Therefore, mercury, selenium, 4,4'-DDT, dieldrin, endosulfan II, endosulfan sulfate, endrin ketone, gamma-chlordane, Aroclor-1260, and carbazole were identified as initial COPCs.

The initial COPCs were then evaluated using more-realistic assumptions to select refined COPCs, as follows:

- Carbazole was detected in one surface soil sample at a maximum concentration of 52.0 µg/kg (0.052 mg/kg). While there is little information regarding the potential toxicity to soil invertebrates and/or terrestrial plants following direct exposure to this chemical, available data suggest that the maximum observed concentrations of this chemical are too low to elicit adverse effects. In studies with oligochaete worms exposed to carbazole-spiked soils, the resulting LC₅₀ and EC₅₀ values were greater than 2,100 and 52 mg/kg, respectively (Sverdrup et al., 2002). In a similar study exposing collembolans (or springtails) to spiked soils, the LC₅₀ and EC₅₀ values were 2,500 and 35 mg/kg, respectively, for carbazole (Sverdrup et al., 2001). Applying an uncertainty factor of 5 to the lower of the two EC₅₀ values (to approximate a chronic NOEC) yields an effects concentration of 7.00 mg/kg. The maximum concentration of carbazole (0.052 mg/kg) is below this effects concentration. The maximum concentration of carbazole is well below these effect concentrations. Therefore, carbazole was not identified as a refined COPC.

Comment [d3]: See previous comment about this issue.

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Ecological Risk Evaluation

Potential unacceptable ecological risks were identified with exposure to surface soil attributable to endosulfan sulfate and copper. No potential unacceptable ecological risks were identified with exposure to subsurface soil. In the Site 9 drainage ditches, potential unacceptable ecological risks were identified with exposure to surface sediment attributable to 4,4'-DDT, Aroclor-1260, dieldrin, endosulfan II, endosulfan sulfate, endrin ketone, gamma-chloradane, mercury and selenium. Potential unacceptable ecological risks were identified with exposure to subsurface sediment attributable to endosulfan II and endosulfan sulfate.

Step 3—Is further Investigation or Action Required?

Due to the small size of the site and extent of contamination, an expanded SI and interim removal action is recommended to further characterize and mitigate COPC_{copper} in surface soil and PAHs, Aroclor-1260, and arsenic, chromium, mercury, and selenium in sediment. Confirmation sampling would be conducted following the removal action. Information regarding the number of samples, sampling locations, sampling analytes, and how the sample data will be used in the expanded SI will be agreed to by the CAX Partnering Team and submitted in an expanded SI UFP-SAP, to be submitted under separate cover.

The initial COPCs were then evaluated using more-realistic assumptions to select refined COPCs, as follows:

- Acetone and 2-butanone, which did not have screening values, were detected at maximum concentrations (640 and 24.0 µg/kg, respectively) that were less than soil screening values for other, similar VOCs (Table B-1). Therefore, these two chemicals were not identified as refined COPCs.
- Benzaldehyde, which also did not have a screening value, was detected at a maximum concentration (200 µg/kg) that was less than soil screening values for other, similar SVOCs (Table B-1). Therefore, this chemical was not identified as a refined COPC.
- Carbazole and dibenzofuran were detected in 10 and one (of 11) surface soil samples, respectively, at maximum concentrations of 120,000 and 19,000 µg/kg (120 and 19.0 mg/kg), respectively. While there is little information regarding the potential toxicity to soil invertebrates and/or terrestrial plants following direct exposure to these two chemicals, available data suggest that the maximum observed concentration of dibenzofuran, but not carbazole, are too low to elicit adverse effects. In studies with oligochaete worms exposed to carbazole-spiked soils, the resulting LC₅₀ (survival) and EC₅₀ (reproduction) values were greater than 2,100 and 52 mg/kg, respectively (Sverdrup et al., 2002). Comparable values for dibenzofuran were 400 and 130 mg/kg, respectively. In a similar study exposing collembolans (or springtails) to spiked soils, the LC₅₀ and EC₅₀ values were 2,500 and 35 mg/kg, respectively, for carbazole and 50 and 23 mg/kg, respectively, for dibenzofuran (Sverdrup et al., 2001). Applying an uncertainty factor of 5 to the lower of the two EC₅₀ values (to approximate a chronic NOEC) yields an effects concentration of 7.00 mg/kg for carbazole and 4.60 mg/kg for dibenzofuran. Maximum surface soil concentrations for both carbazole and dibenzofuran were above these effects concentrations. Therefore, carbazole and dibenzofuran were identified as refined COPCs. Maximum surface soil concentrations for dibenzofuran were below these effect concentrations; however, maximum surface soil concentrations for carbazole were not. Therefore, carbazole was identified as a refined COPC.
- The mean HQs for aluminum, copper, iron, lead, mercury, nickel, selenium, thallium, zinc, endosulfan sulfate, and 3- and 4-methylphenol were less than one. Therefore, these 11 chemicals were not identified as refined COPCs.
- The mean HQ exceeded one for dieldrin (5.78), endosulfan I (31.8), endrin (11.2), endrin aldehyde (2.97), lindane (10.3), LMW PAHs (4.09), and HMW PAHs (7.25). These seven chemicals (plus the individual PAH compounds that comprise the LMW and HMW PAH groups) were identified as refined COPCs.

Comment [d4]: See previous comment on this issue.

Subsurface Soil

Four metals (aluminum, iron, manganese, and zinc) and three pesticides (endosulfan sulfate, endrin, and gamma-chlordane) exceeded screening values based upon maximum detected concentrations (Tables B-29 and B-30). All of these chemicals, except iron, also exceeded background UTLs, where available. Acetone, carbazole, and dibenzofuran lacked both screening values and background UTLs. Therefore, aluminum, manganese, zinc,

endosulfan sulfate, endrin, gamma-chlordane, acetone, carbazole, and dibenzofuran were identified as initial COPCs.

The initial COPCs were then evaluated using more-realistic assumptions to select refined COPCs, as follows:

- Acetone, which did not have a screening value, was detected at a maximum concentration (240 µg/kg) that was less than soil screening values for other, similar VOCs (Table B-1). Therefore, this chemical was not identified as a refined COPC.
- Carbazole and dibenzofuran were detected in five and two (of 11) subsurface soil samples, respectively, at maximum concentrations of 650 and 350 µg/kg (0.650 and 0.350 mg/kg), respectively. While there is little information regarding the potential toxicity to soil invertebrates and/or terrestrial plants following direct exposure to these two chemicals, available data suggest that the maximum observed concentrations of these two chemicals are too low to elicit adverse effects. In studies with oligochaete worms exposed to carbazole-spiked soils, the resulting LC₅₀ (survival) and EC₅₀ (reproduction) values were greater than 2,100 and 52 mg/kg, respectively (Sverdrup et al., 2002). Comparable values for dibenzofuran were 400 and 130 mg/kg, respectively. In a similar study exposing collembolans (or springtails) to spiked soils, the LC₅₀ and EC₅₀ values were 2,500 and 35 mg/kg, respectively, for carbazole and 50 and 23 mg/kg, respectively, for dibenzofuran (Sverdrup et al., 2001). Applying an uncertainty factor of 5 to the lower of the two EC₅₀ values (to approximate a chronic NOEC) yields an effects concentration of 7.00 mg/kg for carbazole and 4.60 mg/kg for dibenzofuran. Maximum surface soil concentrations for carbazole and dibenzofuran were well below these effects concentrations. Therefore, these two chemicals were not identified as refined COPCs.
- The mean HQs for aluminum, manganese, zinc, endosulfan sulfate, and gamma-chlordane were less than one. Therefore, these chemicals were not identified as refined COPCs.
- The mean HQ exceeded one for endrin (6.15). This chemical was identified as a refined COPC.

Comment [d5]: See previous comment on this issue.

Terrestrial Food Web

HQs based upon maximum exposure doses for each upper trophic level terrestrial receptor are listed in Table B-31 (calculations are included in Appendix B). Based upon a comparison to NOAELs, arsenic, cadmium, chromium, lead, mercury, selenium, silver, zinc, Aroclor-1260, dieldrin, endosulfan I, endrin, and 11 PAHs had HQs exceeding one for one or more receptors. Therefore, these 23 chemicals were identified as initial COPCs.

The initial COPCs were then evaluated using more-realistic assumptions to select refined COPCs, as follows:

- HQs based upon 95 percent UCL exposure doses for each upper trophic level terrestrial receptor are listed in Table B-32 (calculations are included in Appendix B). Based upon a comparison to NOAELs, dieldrin, chrysene, and pyrene had HQs exceeding one for at least one receptor. There were no exceedances based upon the LOAEL but one exceedance (for dieldrin) based upon the MATC.

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fluorene, indeno(1,2,3-cd)pyrene, naphthalene, PAH (HMW), PAH (LMW), phenanthrene, and pyrene), 10 pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, delta-BHC, dieldrin, endosulfan I, endosulfan sulfate, endrin, endrin aldehyde, and gamma-BHC [Lindane]), 1 PCB (Aroclor-1260), and 12 total inorganics (aluminum, arsenic, chromium, copper, iron, lead, mercury, nickel, selenium, silver, thallium, and zinc) exceeded one or more screening criteria in surface soil. Four VOCs (benzene, chloroform, ethylbenzene, and methylene chloride), 11 SVOCs (2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, dibenzofuran, hexachlorobenzene, indeno(1,2,3-cd)pyrene, and naphthalene), 9 pesticides (4,4'-DDD, 4,4'-DDE, aldrin, delta-BHC, dieldrin, endosulfan sulfate, endrin, gamma-BHC (Lindane), and gamma-Chlordane), and 10 total inorganics (aluminum, antimony, arsenic, chromium, cobalt, manganese, selenium, silver, vanadium, and zinc) exceeded one or more screening criteria in subsurface soil samples.

In groundwater, four VOCs (1,4-dichlorobenzene, benzene, ethylbenzene, and total xylenes), 9 SVOCs (2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, dibenzofuran, indeno(1,2,3-cd)pyrene, and naphthalene), one pesticide (dieldrin), seven total inorganics (aluminum, arsenic, chromium, iron, manganese, mercury, and vanadium) and four dissolved inorganics (arsenic, cobalt, iron, and manganese) exceeded at least one screening criterion.

In surface water, two SVOCs (benzo(a)pyrene and pyrene), seven total inorganics (aluminum, arsenic, barium, cadmium, copper, iron, and manganese), and one dissolved inorganic (barium) exceeded at least one screening criterion.

One VOC (carbon disulfide), 18 SVOCs (acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, PAH (HMW), PAH (LMW), PAH (total), phenanthrene, and pyrene), 12 pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-Chlordane, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, gamma-chlordane, and heptachlor epoxide), two PCBs (Aroclor-1254 and Aroclor-1260), and 11 inorganics (arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc) exceeded screening criteria in surface sediment. Eleven SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene), 11 pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-Chlordane, dieldrin, endosulfan I, endosulfan II, endrin, endrin aldehyde, gamma-Chlordane, and heptachlor epoxide), two PCBs (Aroclor-1254 and Aroclor-1260), and 12 inorganics (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, nickel, silver, vanadium, and zinc) exceeded screening criteria in subsurface sediment.

Step 2b—Conduct a Semi-quantitative Risk Evaluation Using More-Realistic Assumptions

Human Health Risk Evaluation

Exposure to surface soil at AOC 3 may result in unacceptable human health risks associated with PAHs, dieldrin, gamma-BHC, arsenic, and chromium, based on potential human exposure. Exposure to subsurface soil at AOC 3 may result in unacceptable human health

risks primarily associated with PAHs, arsenic, and chromium, based on potential human exposure.

Exposure to groundwater at AOC 3 may result in unacceptable human health risks associated with VOCs, PAHs, and metals based on potential human exposure. Exposure to indoor air at AOC 3 may result in unacceptable human health risks associated with benzene, ethylbenzene, and naphthalene, based on potential human exposure.

Exposure to surface water in Upstream Pond adjacent to Site 4 and AOC 3 may result in unacceptable human health risks associated with benzo(a)pyrene and arsenic, based on potential human exposure. The potential unacceptable carcinogenic risk is primarily associated with arsenic; arsenic was only detected in one of the eight surface water samples. Benzo(a)pyrene alone does not pose a potential unacceptable risk above the acceptable level of 5×10^{-5} .

Exposure to surface sediment in Upstream Pond adjacent to Site 4 and AOC 3 may result in unacceptable human health risks associated with PAHs, pesticides/PCBs, and metals, based on potential human exposure. Exposure to subsurface sediment in Upstream Pond adjacent to Site 4 and AOC 3 may result in unacceptable human health risks associated with benzo(a)pyrene, Aroclor-1254, dieldrin, arsenic, and chromium, based on potential human exposure.

Ecological Risk Evaluation

At AOC 3, potential unacceptable ecological risks were identified with exposure to surface soil attributable to 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzofuran, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, PAH (HMW), PAH (LMW), phenanthrene, pyrene, dieldrin, endosulfan I, endrin, endrin aldehyde, and gamma-BHC (lindane). Potential unacceptable ecological risks were identified with exposure to subsurface soil attributable to endrin.

In Upstream Pond, potential unacceptable ecological risks were identified with exposure to surface water attributable to benzo(a)pyrene, chrysene, and pyrene. Potential unacceptable ecological risks were identified with exposure to surface sediment attributable to 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, PAH (HMW), PAH (LMW), PAH (total), phenanthrene, pyrene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aroclor-1254, dieldrin, endosulfan I, endosulfan II, endrin, endrin aldehyde, heptachlor epoxide, methoxychlor, arsenic, barium, cadmium, copper, lead, silver, and zinc. Potential unacceptable risks were identified with exposure to subsurface sediment attributable to 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aroclor-1254, dieldrin, endosulfan I, endosulfan II, endrin, endrin aldehyde, endrin ketone, heptachlor epoxide, methoxychlor, barium, cadmium, and lead.

Step 3—Is further Investigation or Action Required?

Results from test pitting activities indicate that buried debris exists at AOC 3; however, since the depth of buried debris was greater than the maximum excavation depth of the

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equipment used during test pitting (8 feet) or buried debris was encountered below the water table in several test pits, the vertical and horizontal extent of the debris was not characterized during test pitting activities. Additional delineation for site environmental media (soil, groundwater, surface water, and sediment) will also be needed.

An RI is recommended to delineate the vertical and horizontal extent of buried debris near Upstream Pond and to characterize the nature and extent of contamination within soil, groundwater, surface water and sediment and to quantify the risk associated with all media. Information regarding the number of samples, sampling locations, sampling analytes, and how the sample data will be used in the RI will be agreed to by the CAX Partnering Team and submitted in an RI UFP-SAP, to be submitted under separate cover. The FS component would evaluate remedial alternatives to mitigate potential risk to human health and ecological receptors associated with debris and from media contamination. Table 5-7 summarizes the results of the decision analysis for AOC 3.