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EMAIL AND THE VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY COMMENTS ON THE DRAFT SITE 4 PRE-FEASIBILITY STUDY TECHNICAL MEMORANDUM FISC WILLIAMSBURG VA
06/29/2015
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Subject: CAX: Site 4 Pre-FS Tech Memo - DEQ Comments
Attachments: Draft CAX Site 4 Pre-FS TM(DEQ).docx; Draft CAX Site 4 Pre-FS TM(DEQ).pdf

Follow Up Flag: Follow up
Flag Status: Completed

Thank you for giving the DEQ the opportunity to comment on the March 24, 2015 Pre-FS Tech Memo for the Site 4 at CAX.

The Tech Memo was received by the DEQ on March 31, 2015.

The DEQ's comments are attached (track changes via Word).

Please let me know if you have any questions.

Thanks,
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Site 4 Pre-Feasibility Study Technical Memorandum, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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DATE: October 19, 2015

Introduction

This Pre-Feasibility Study Technical Memorandum (Pre-FS TM) summarizes the site history and conceptual site model (CSM), provides the results of updated human health and ecological risk assessments, defines the soil polycyclic aromatic hydrocarbon (PAH) hotspot area, and presents the rationale for the site media to be evaluated in the FS for Site 4, located at Naval Weapons Station Yorktown Cheatham Annex (CAX). This Pre-FS TM is being developed to detail the steps ~~which~~ that need to be completed to move from the Remedial Investigation (RI) to FS stage within the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

The Site 4 Pre-FS TM was prepared for the United States Navy, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62470-11-D-8012, Contract Task Order (CTO) WE63, for submittal to the CAX Tier I Partnering Team, which consists of representatives from NAVFAC Mid-Atlantic, the United States Environmental Protection Agency (USEPA) Region III, and the Virginia Department of Environmental Quality (VDEQ).

Conceptual Site Model

CAX encompasses 2,300 acres east of Williamsburg, between Interstate 64 and the York River on the York-James Peninsula (**Figure 1**). CAX is located on the site of the DuPont Company's former Penniman Shell Loading Plant, and is currently used to supply Atlantic Fleet ships and provide recreational opportunities to military and civilian personnel. The former Penniman facility was used as a powder and shell loading plant during World War I and was closed in 1918.

Site 4, the Outdated Medical Supply Disposal Area, is composed of two burial investigation areas (Burial Investigation Areas 1 and 2), approximately 4 acres in size and located west of D Street, between Cheatham Annex Depot (CAD) buildings 11 and 12 (**Figure 2**). The history of Burial Investigation Area 1 (formerly identified as Area of Concern [AOC] 3 and later incorporated into Site 4) is unknown. It was originally identified as a surface debris pile of metal banding, a few empty drums, and charred wood with approximate dimensions of 20 feet by 20 feet by 10 feet high; the surface debris pile is located in the southwest corner of Burial Investigation Area 1 and adjacent to Upstream Pond (**Figure 2**). However, test pits excavated as part of the Site 4 and AOC 3 Site Inspection (SI) revealed buried debris in this area as well (CH2M HILL, 2011). Burial Investigation Area 2 (formerly known as Site 4 before Site 4 was expanded to include AOC 3) includes out-of-date medical supplies (including intravenous[IV] injection sets with syringes wrapped in aluminum foil or plastic, empty IV bottles, numerous sharps [both] metal and plastic]), and 1- inch metal banding.

Site 4 is heavily vegetated with shrubs and trees. In general, the topography of Site 4 slopes to the northeast towards D Street (**Figure 2**); however, locally the topography slopes towards Upstream Pond. Surface water flows from the areas surrounding CAD 11 and 12 and nearby drainage channels into Upstream Pond. The surface water

in Upstream Pond flows through a culvert under D Street and into Youth Pond. Surface water in Youth Pond then discharges through a culvert into the York River.

In general, soil at Burial Investigation Area 1 is predominately yellowish-brown sandy clay and clay underlain by greenish-grey silty sand. Soil at Burial Investigation Area 2 is predominately brown and gray silty sand. The shallow aquifer underlying Site 4 is the Yorktown-Eastover Aquifer, and during RI field activities, groundwater was encountered between approximately 5.38 and 8.80 feet below ground surface (ft bgs). Groundwater elevations are not expected to be impacted by the tide cycles and groundwater flows generally northeast towards the York River. Based on a calculated average hydraulic conductivity of 2.27 ft/day within the Yorktown-Eastover aquifer, an estimated effective porosity of 0.3, and an average horizontal hydraulic gradient of 0.005 ft/ft, the average lateral groundwater velocity towards the York River is estimated to be 0.038 ft/day.

While Site 4 is located within the restricted CAD area, access is not restricted to authorized CAX visitors (e.g., civilian employees and military personnel) since the gate along D Street near CAD Building 11 is no longer locked on a regular basis. Future land use at Site 4 is not expected to change and will likely continue as a wooded area in the foreseeable future. The CSM for Site 4 is depicted on **Figure 3**.

Previous Investigations

Previous investigations and remedial actions that helped characterize potential contamination at Site 4 are the 1998 Debris Removal (Baker, 2001), the 1999 Field Investigation (FI) (Baker, 2001), the 2001 Test Trench Excavation (Baker, 2002), the Screening-level Ecological Risk Assessment (SERA) (Baker, 2005), the 2009 Sites 4, 9, and AOC 3 Site Investigation (SI) (CH2M HILL, 2011), and the 2012 Site 4 RI (CH2M HILL, 2014). With the exception of a summary of the 2012 RI, detailed below, brief descriptions of the previous investigations are summarized in **Table 1**.

2012 Remedial Investigation

An RI was completed for Site 4 and consisted of buried debris delineation through test pitting, surface and subsurface soil sampling, surface sediment sampling, biota tissue sampling, monitoring well installation, groundwater monitoring and sampling, groundwater hydraulic conductivity “slug” testing, and reference pond surface and subsurface sediment sampling, surface water sampling, and biota tissue sampling. The investigation activities were completed to characterize the nature and extent of buried debris; potential contamination in soil, groundwater, and surface sediment; and to assess the potential risks posed by exposure to contamination by human and ecological receptors via a human health risk assessment (HHRA) and ecological risk assessment (ERA).

The Site 4 RI Report (CH2M HILL, 2014) concluded the following:

- Surface and buried debris within the two burial investigation areas represent the only identified source of CERCLA-regulated contamination at Site 4.
- There is significant potential for contaminants found in soil and sediment within drainages and surface water and sediment in both Upstream and Youth Ponds to have originated from non-CERCLA-regulated sources rather than from sources specific to Site 4.
- Semi-volatile organic compounds (SVOCs), PAHs, polychlorinated biphenyls (PCBs), and metals were detected in soil at concentrations exceeding screening criteria. The highest concentrations of PAHs were found outside of the burial investigation areas, at locations where no historic disposal or operational activities were known to or likely took place that would have resulted in a CERCLA-regulated release, and where the evidence suggests that non-CERCLA-regulated impacts from stormwater runoff in contact with asphalt and other PAH-containing impervious surfaces likely occurred. Since PCBs were only detected within the drainage channels, the evidence suggests that the PCBs may have been transported to and deposited within site drainage channel floodplain areas via stormwater runoff from an unknown source or sources in the upstream developed and industrialized areas to the west and southwest.
- Volatile organic compounds (VOCs), SVOCs, PAHs, metals, and one pesticide (dieldrin) were detected in groundwater at concentrations exceeding screening criteria. The pesticide detection appears to be an isolated occurrence due to the absence of dieldrin in the upgradient and downgradient groundwater samples, only

one detection of dieldrin in surface soil, the absence of dieldrin in subsurface soil, and the absence of dieldrin in the Upstream Pond surface water and sediment adjacent to the sample location; therefore, it is likely attributable to normal pesticide use at Department of Defense (DoD) facilities to control pests and weeds and not from pesticide disposal activities.

- The SVOCs and metals detected in surface water within the Site 4 drainage channels and Upstream Pond had concentrations exceeding screening criteria. However, stormwater in contact with PAH-containing impervious surfaces such as asphalt roads, asphalt parking lots, and building rooftops over a developed and industrialized upstream area of substantial acreage discharges to the Site 4 drainage channels and Upstream Pond; therefore, the SVOC concentrations may be the result of impacts from either Site 4 debris, stormwater bringing contaminants from non-CERCLA-regulated sources from upstream paved areas, or a combination of both.
- The SVOCs (primarily PAHs), pesticides, PCBs, and metals detected in sediment samples collected within the drainage channels southwest of Upstream Pond, within Upstream Pond sediment, and within Youth Pond sediment had concentrations exceeding screening criteria. The detected SVOC concentrations in the drainage channel sediment samples could be attributable to non-CERCLA-regulated contaminant sources unrelated to Site 4, to an unknown upstream CERCLA release unrelated to Site 4, or to impacts from buried debris within the Site 4 boundary. There is a strong possibility that the elevated PCB concentrations in Upstream Pond sediment are the result of non-site-related contaminants transported in stormwater from an unknown source or sources in the developed and industrialized areas to the west and south. The detected pesticide concentrations are likely attributable to normal pesticide use at DoD facilities to control pests and weeds rather than pesticide disposal activities.
- In the York River drainage channel, a number of SVOCs were detected at concentrations exceeding screening criteria. Of the SVOCs detected, approximately half were also detected in Youth Pond sediment samples, suggesting that the detected concentrations may be at least partially attributable to offsite contamination transported by the York River.
- There were PCBs and metals detected in Site 4, Upstream Pond, and Youth Pond animal tissue samples.
- The HHRA conducted as part of the Site 4 and Youth Pond RI report identified potential unacceptable risks associated with exposure to soil for exposure groupings that included surface soil within the fenced portion (or within the restricted portion of the CAD area) of Site 4 and combined surface and subsurface soil across the entire site [including areas within the fenced (restricted) portion and outside the fenced portion of the site]. These unacceptable hazards and risks were primarily associated with surface soil within the fenced portion of the site (sample CAA03-SS06-1109) and three samples outside the fenced area, but within the debris area (samples CAS004-4HA06-00-1199, CAS004-4-HA05-01-1199, and CAS004-4HA05-00-1199) (**Figure 4**). Potential unacceptable risks were also identified for exposure to Site 4 groundwater.
- The ERA identified potential unacceptable risks associated with exposure to surface and shallow subsurface soil at Site 4 and sediment within Upstream Pond.

Based on these conclusions and comments from the USEPA on the draft RI Report, the final RI Report recommended an FS be completed to develop and evaluate remedial alternatives to address the following:

- Buried debris at Site 4
- Groundwater at Site 4
- PCBs in Upstream Pond sediment
- PAHs in the drainage channel directing surface run off from the roof of CAD Building 12 and the adjacent paved areas to Site 4

Commented [WS1]: The DEQ concurs with the EPA's recommendations to address these items in the FS.

Human Health Risk Assessment

The HHRA conducted as part of the Site 4 and Youth Pond RI report (CH2M HILL, 2014) identified potential unacceptable non-carcinogenic hazards and carcinogenic risks associated with exposure to soil for exposure groupings that included surface soil within the fenced (restricted) portion of Site 4 and combined surface and subsurface soil across the entire site (including areas within the fenced portion and outside the fenced portion of

the site [including the debris areas]). These unacceptable hazards and risks were primarily associated with surface soil within the fenced portion of the site (sample CAA03-SS06-1109) and three samples outside the fenced area, including the disposal areas, but within the debris area (samples CAS004-4HA06-00-1199, CAS004-4-HA05-01-1199, and CAS004-4HA05-00-1199) (**Figure 4**). Therefore, to evaluate if there would be any potential unacceptable hazards or risks associated with future unrestricted use of the area outside the fenced portion of the site only, which includes the debris areas, additional risk calculations were performed for soil.The additional risk calculations were performed for two separate data groupings: all soil (surface and subsurface combined, within and outside of the debris areas) outside the fenced portion of the site (**Attachment 1**) and soil (surface and subsurface) outside the fenced portion of the site that is not within debris areas, since the debris areas will be evaluated for remedial options as part of the FS (**Attachment 2**). The only receptors evaluated in these additional risk calculations were future residents, the most conservative receptors (i.e., would have the highest risks) for evaluating unrestricted future use of the site.

The risk calculations were performed using the same methodology used for the HHRA included in the RI (CH2M HILL, 2014). Additionally, all screening levels to identify the contaminants of potential concern (COPCs), and all toxicity values and exposure factors used to calculate the non-carcinogenic hazards and carcinogenic risks in the RI HHRA, were used in this assessment. The Risk Assessment Guidance for Superfund (RAGS) Part D standard tables (USEPA, 2001) are included as **Attachment 1** and **Attachment 2** and include the Table 2s for identification of COPCs, the Table 3s identifying the exposure point concentrations, the Table 4s that include the exposure factors (the same as those used in the HHRA in the RI), the Table 5s and 6s that identify the toxicity factors (the same as those used in the HHRA in the RI), the Table 7s presenting the risk calculations, and the Table 9s summarizing the risk calculation results. Additionally, the ProUCL output is included in **Attachment 1** and **Attachment 2** for the estimation of the exposure point concentrations for the COPCs.

The COPCs identified for all soil outside the fenced portion of the site and included in the quantification of risk for this soil (**Attachment 1**) are:

- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Bis(2-Ethylhexyl)phthalate
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene
- Aldrin
- Arolcor-1242
- Aroclor-1260
- Aluminum
- Arsenic
- Hexavalent Chromium
- Cobalt
- Iron
- Manganese
- Thallium
- Vanadium

The COPCs identified for soil outside the fenced portion of the site, but not within debris areas, and included in the quantification of risk for this soil (**Attachment 2**) are:

- Benz(a)anthracene
- Benzo(a)pyrene

- Benzo(b)fluoranthene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene
- Aluminum
- Arsenic
- Hexavalent Chromium
- Cobalt
- Iron
- Thallium
- Vanadium

The results of the additional risk estimates are summarized below by area and receptor. The risk calculations for all soil outside the fenced area are presented in Tables 7.1.RME through 7.3.RME in **Attachment 1**, and summarized in Tables 9.1.RME through 9.3.RME in **Attachment 1**. The risk calculations for soil outside the fenced area not within the debris area are presented in Tables 7.1.RME through 7.3.RME in **Attachment 2**, and summarized in Tables 9.1.RME through 9.3.RME in **Attachment 2**. The constituents of concern (COCs) are identified below for each receptor. The COCs are those COPCs that contribute a~~n~~ hazard index (HI) greater than 0.1 to a cumulative target organ HI that exceeds 1 (USEPA's target HI), or a carcinogenic risk greater than 1×10^{-6} to a cumulative carcinogenic risk that exceeds 1×10^{-4} (upper end of USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$).

All soil outside fenced area

The risk assessment assumed that a future resident could be exposed to combined surface and subsurface soil outside the fenced area through ingestion and dermal contact. Although the soil was not specifically evaluated for emissions from soil to air and inhalation of air as part of the updated risk calculations, this pathway contributed an insignificant hazard and risk to the total hazard and risk associated with all soil (inside and outside the fenced area) in the RI and the concentrations in the soil outside the ~~fence~~fenced area are much lower than the concentrations included in the RI HHRA. Non-carcinogenic hazards were calculated for adult and child residents and carcinogenic risks were calculated for a lifetime child/adult resident following USEPA guidance.

Adult Resident

- Total RME HI=0.5 for exposure to soil outside the fenced area are less than the target HI of 1.

Child Resident

- Total RME HI=5 for exposure to soil outside the fenced area exceeds the target HI of 1.
  - COC is arsenic

Lifetime Child/Adult Resident

- Total cancer risk = $3x10^{-4}$, exceeds USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.
  - COCs are arsenic, carcinogenic PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, Dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, and bis[2-ethylhexyl]phthalate), PCBs (Aroclor-1242 and Aroclor-1260), and hexavalent chromium

Soil outside fenced area outside debris

The risk assessment assumed that a future resident could be exposed to combined surface and subsurface soil outside the fenced area that is not within debris areas through ingestion and dermal contact. Although the soil was not specifically evaluated for emissions from soil to air and inhalation of air as part of the updated risk calculations, this pathway contributed an insignificant hazard and risk to the total hazard and risk associated with all soil (inside and outside the fenced area) in the RI and the concentrations in the soil outside the ~~fence~~fenced area are much lower than the concentrations included in the RI HHRA. Non-carcinogenic hazards were calculated

for adult and child residents and carcinogenic risks were calculated for a lifetime child/adult resident following USEPA guidance.

Adult Resident

- Total RME HI=0.2 for exposure to soil outside the fenced area, but not within the debris areas, are less than the target HI of 1.

Child Resident

- Total RME HI=2 for exposure to soil outside the fenced area, but not within the debris areas, exceeds the target HI of 1; however, no target organ HIs exceed an HI of 1, therefore, there are no unacceptable non-carcinogenic hazards and no COCs.

Lifetime Child/Adult Resident

- Total cancer risk = $7x10^{-5}$, within USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Ecological Risk Assessment

In order to better support the FS evaluation of remedial alternatives, ecological risks were recalculated for terrestrial habitats using different spatial groupings of the soil data than were used in the RI. All soil samples located in the wooded habitats outside of the CAD building fence were divided into two groups, those within the debris areas and those outside of the debris areas (**Attachment 3 Table E-1**). Because the debris areas will be slated for remediation, this ERA focused on the areas outside of the debris areas to determine if ecological risks in those areas were acceptable or if they also needed to be considered for remediation. For comparison, the risks for the areas within the debris are also provided. The same methodology and parameter values used in the RI ERA were also used for this assessment.

Comparison with Ecological Screening Values

The maximum, arithmetic mean, and 95% upper confidence limit (UCL) of the arithmetic mean soil concentrations were compared with ecological screening values (ESVs). Chemicals were excluded from further consideration in the SERA if the hazard quotient (HQ) based on the maximum concentration was less than 1. Chemicals were generally excluded from further consideration in the Baseline ERA (BERA) if the HQ based on the 95% UCL was less than 1 and/or if the maximum detected concentration was less than the background upper tolerance limit (UTL).

Surface Soil

Maximum surface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-2**. **Attachment 3 Table E-3** identifies the exceedances of ESVs and background UTLs for each surface soil sample. Five metals (aluminum, iron, mercury, selenium, and zinc) and two pesticides (endrin and endrin aldehyde) equaled or exceeded ESVs based on maximum detected concentrations (**Attachment 3 Tables E-2 and E-3**). The ESVs for aluminum and iron were based on soil pH; soil pH data are reported in **Attachment 3 Table E-3**. The VOCs 2-Butanone and acetone were detected in at least one surface soil sample, but ESVs were not available. These nine chemicals were identified as Step 2 COPCs. One metal (thallium), one pesticide (endrin ketone), and seven SVOCs were not detected, but maximum detection limits equaled or exceeded ESVs. These nine chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL surface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-2**. Only endrin had an HQ that equaled or exceeded 1, based on detected 95% UCL concentrations, and also equaled or exceeded background UTLs (where available). Aluminum equaled or exceeded both the ESV and background UTL in 3 of 11 samples from this area, and the mean pH was slightly lower than the acceptable range. Thus, aluminum and endrin were identified as COPCs for further risk evaluation.

The VOC 2-Butanone was detected, but a soil ESV was not available. The maximum detected 2-Butanone concentration (24.0 micrograms per kilogram [µg/kg]) was less than soil ESVs for other, similar VOCs, which

ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, this chemical was not identified as a COPC for further risk evaluation. Acetone was also detected, but a soil ESV was not available. Acetone was detected at a maximum concentration (640 µg/kg) that exceeded soil ESVs for some other, similar VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, acetone was identified as a COPC for further risk evaluation.

Atrazine and 4-nitrophenol were not detected, but mean detection limits equaled or exceeded ESVs. These two SVOCs were not identified as COPCs for further risk evaluation, but are discussed in the uncertainty section.

For comparison, the screening of surface soil samples located within the debris areas is contained in **Attachment 3 Tables E-4** and **E-5**.

Shallow Subsurface Soil

Maximum shallow subsurface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-6**. **Attachment 3 Table E-7** identifies the exceedances of ESVs and background UTLs for each shallow subsurface soil sample. Three metals (aluminum, hexavalent chromium [but not total chromium], and iron) and one pesticide (endrin) equaled or exceeded ESVs based on maximum detected concentrations (**Attachment 3 Tables E-6 and E-7**). The ESVs for aluminum and iron were based on soil pH; soil pH data are reported in **Attachment 3 Table E-7**. Acetone was detected in at least one shallow subsurface soil sample, but an ESV was not available. These five chemicals were identified as Step 2 COPCs. Two pesticides (endrin aldehyde and endrin ketone) and six SVOCs were not detected, but maximum detection limits equaled or exceeded ESVs. These eight chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL shallow subsurface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-6**. Only endrin and hexavalent chromium had HQs that equaled or exceeded 1, based on detected 95% UCL concentrations, and also equaled or exceeded background UTLs (where available). Aluminum equaled or exceeded both the ESV and background UTL in 6 of 9 samples from this area, and the mean pH was slightly lower than the acceptable range. Thus, aluminum, hexavalent chromium, and endrin were identified as COPCs for further risk evaluation.

Acetone was detected, but a soil ESV was not available. The maximum acetone concentration (120 µg/kg) was less than soil ESVs for other, similar VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, acetone was not identified as a COPC for further risk evaluation.

Atrazine and 4-nitrophenol were not detected, but mean detection limits equaled or exceeded ESVs. These two SVOCs were not identified as COPCs for further risk evaluation, but are discussed in the uncertainty section.

For comparison, the screening of shallow subsurface soil samples located within the debris areas is contained in **Attachment 3 Tables E-8 and E-9**.

Terrestrial Food Web Exposures

In terrestrial habitats, Step 2 food web COPCs were selected by first comparing maximum surface soil concentrations with the lower of the available bird and mammal Ecological Site Screening Levels (Eco-SSLs) for analytes on the list of bioaccumulative chemicals. Chemicals that equaled or exceeded the Eco-SSLs based on the maximum surface soil concentration were retained for site-specific food web modeling. Those that did not were not evaluated further for terrestrial food web exposures. Chemicals that were on the bioaccumulative chemicals list and did not have Eco-SSLs were automatically included in site-specific food web modeling. The final Step 2 food web COPCs were selected based on a comparison of maximum exposure doses from site-specific food web modeling with the no observed adverse effect level (NOAEL)-based ingestion toxicity reference value (TRV). Those chemicals with an exposure dose equaling or exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. For Step 7, ingestion-based (food web) COPCs were based on a comparison of mean and 95% UCL exposure doses with ingestion TRVs based on the NOAEL, maximum acceptable toxicant concentration (MATC), and lowest observed adverse effect level (LOAEL). An exceedance of the 95% UCL-based MATC was generally considered an unacceptable risk at Step 7, although chemicals that exceeded the MATC, but not the LOAEL, were discussed for possible risk management considerations.

Attachment 3 Table E-10 shows the results of the initial screening against bird and mammal Eco-SSLs for samples outside of the debris areas. Five metals (cadmium, chromium, copper, lead, and zinc) and high molecular weight (HMW) PAHs equaled or exceeded one or both of the Eco-SSLs based on the maximum detected surface soil concentration and were retained for site-specific food web modeling.

The HQs based on maximum exposure doses for each upper trophic level terrestrial receptor are listed in **Attachment 3 Table E-11**. Based on a comparison to NOAELs, three metals (cadmium, chromium, and mercury) had HQs equaling or exceeding 1 for one or more receptors. Ingestion TRVs were not available for any receptor for 1,2,4,5-tetrachlorobenzene, 4-bromophenyl-phenylether, and 4-chlorophenyl-phenylether, none of which were detected in surface soil samples.

The HQs based on 95% UCL and mean exposure doses for each upper trophic level terrestrial receptor are listed in **Attachment 3 Tables E-12 and E-13**, respectively. Based on a comparison to NOAELs, no chemical had an HQ that equaled or exceeded 1 for any receptor. No chemicals were identified as COPCs for further risk evaluation and risks are acceptable for this exposure pathway.

For comparison, the food web modeling using samples located within the debris areas is contained in **Attachment 3 Tables E-14 through E-17**.

Risk Evaluation

In surface soil outside of the debris areas, aluminum, endrin, and acetone were identified as COPCs for further risk evaluation (**Attachment 3 Table E-2**), and aluminum, endrin, and hexavalent chromium were identified as COPCs for further risk evaluation in shallow subsurface soil (**Attachment 3 Table E-6**). Aluminum was identified as a COPC in surface soil due largely to the low measured soil pH in the two samples east of Upstream Pond (aluminum was the only COPC identified in this subarea in the RI ERA). The ratios to the background UTL for these two samples were 1.28 and 1.60, so they were not highly elevated relative to background. Thus, potential ecological risks related to aluminum are not expected to be ecologically significant. In shallow subsurface soil, aluminum exceeded both the ESV and background UTL in six samples, and the maximum ratio to the background UTL for these samples (2.45) was higher than in surface soil (1.60). However, there was no discernible pattern to these shallow subsurface exceedances and the range of concentrations for the six samples was fairly uniform (21,000 to 32,000 milligrams per kilogram [mg/kg]), suggesting that they are not site-related and may reflect background conditions.

Endrin exceeded ESVs in three surface soil samples and one shallow subsurface soil sample from the area outside of the debris. The surface soil concentration in two of the samples that exceeded the ESV (3.90 and 3.50 µg/kg) were comparable to the maximum observed concentration (3.50 µg/kg) in surface soil samples collected as part of the background study. The third surface soil exceedance (55.0 µg/kg), and the only shallow subsurface soil exceedance (8.60 µg/kg), occurred at the same sample location [CAA03-SS/SB-09 (**Figure 4**)]. Although the soil concentrations for endrin at this location were well above those observed in background samples, there were no other pesticide ESV exceedances at this location and only one other exceedance of both ESVs and background UTLs (aluminum in the subsurface sample). Thus, this sample location does not appear to be very impacted by potential site activities.

Acetone was identified as a COPC for further risk evaluation in surface soil outside of the debris areas and did not have an available soil ESV or background UTL. Acetone was detected at a maximum concentration (640 µg/kg) that exceeded some soil ESVs for other VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Only 2 of 7 surface soil samples had concentrations that exceeded 173 µg/kg, the lowest ESV for other VOCs. However, the USEPA Region 5 soil ESV for acetone (based on back-calculated food web models) is 2,500 µg/kg, which is greater than the maximum detected concentration in surface soil. Thus, acetone was not identified as a contaminant of concern (COC) in surface soil outside of the debris areas.

Hexavalent chromium exceeded its ESV in the only shallow subsurface soil sample it was analyzed in outside of the debris areas at an HQ of 1.08, but the ESV and background UTL for total chromium were not exceeded in this same sample. Thus, hexavalent chromium was not identified as a COC in surface soil outside of the debris areas.

Uncertainties

The uncertainties related to the BERA were discussed in detail as part of the RI ERA and also generally apply to this assessment except for the reporting limits. Reporting limits for some undetected analytes exceeded applicable ESVs in some media. **Attachment 3 Table E-18** summarizes these chemicals, by medium, and reports both the ratio of the minimum and maximum reporting limits to the ESV as well as the ratio of the mean value (calculated using one-half of the reporting limit for each sample) to the ESV. Because these chemicals were not detected, they are not known to be present on the site, but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the ESVs. The magnitude of the ratios can be used to qualitatively evaluate the magnitude of the associated uncertainty (that is, higher ratios are indicative of a greater likelihood that chemicals are present at concentrations that exceed the ESV relative to lower ratios). In surface soil, two undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 1.5 for only one of the two. In shallow subsurface soil, two undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 1.5 for only one of the two.

In summary, there were no chemicals with very high mean ratios, suggesting that the associated uncertainties are relatively low. Because standard analytical methods were used and the sample reporting limits were not elevated relative to the method reporting limits for the vast majority of samples and analytes, these uncertainties are considered acceptable and are unlikely to impact the conclusions of this ERA.

Recommendations

Site 4 Soil Risk Summary

Human Health Risks

Although unacceptable non-carcinogenic hazards and carcinogenic risks were identified for the soil outside the fenced area of Site 4, these risks are associated with the debris areas only, as demonstrated by no unacceptable non-carcinogenic hazards or carcinogenic risks associated with the soil outside the fenced area that does not include the debris areas. Therefore, no additional investigation or evaluation of soil outside the fenced area is necessary, with the exception of the debris area soil that will be evaluated in the FS.

Ecological Risks

The vast majority of the potential ecological risks in terrestrial habitats outside of the CAD area fence are associated with the debris areas. Potential risks in areas outside of the debris were low and considered to be generally acceptable. Therefore, no additional investigation or evaluation of soil outside the fenced area is necessary, with the exception of the debris area soil that will be evaluated in the FS.

Non-CERCLA-Regulated Sources

While a portion of the volume of stormwater runoff discharging to Upstream Pond, and ultimately Youth Pond, is potentially impacted by Site 4, as discussed in the RI Report (CH2M HILL, 2014), a considerable portion of the volume of stormwater runoff draining to these ponds may be impacted by non-CERCLA-regulated contaminant sources unrelated to Site 4. For example, the PAHs found in Site 4 samples are ubiquitous in urban environments from sources that include atmospheric emissions from industrial facilities such as power plants, automobile exhaust, tire particles, and asphalt. Stormwater draining from a considerable portion of the developed and industrialized areas north, west, and south of Upstream and Youth Ponds has been in contact with asphalt-paved parking lots and roads, as well as building rooftops, all of which are known to typically contain these PAHs. A large component of the stormwater flow that ultimately reaches Youth Pond does not flow through Upstream Pond and is not impacted by Site 4.

In addition, widespread detections of pesticides are likely the result of normal pesticide use at DoD facilities to control pests and weeds. The sample with the highest concentrations of pesticides was located in the immediate vicinity of CAD Building 12, approximately 100 feet upgradient of Burial Investigation Area 1. Pesticides were not known to be disposed at Site 4. The distribution and generally low detected concentrations of pesticides in soil are

likely attributable to normal pesticide use at DoD facilities to control pests and weeds, and not from pesticide disposal activities.

Consequently, there is significant potential for contaminants found in soil and sediment within drainages and surface water and sediment in both Upstream and Youth Ponds to have originated from non-CERCLA-regulated sources rather than from sources specific to Site 4. Therefore, with the exception of the voluntary PAH hotspot removal discussed below, it is recommended no action be taken to address PAHs and pesticides in any site media at Site 4, Upstream Pond, or Youth Pond.

Metals in Upstream Pond Sediment

While there are several possibly site-related metals posing potentially unacceptable ecological risk in sediment within Upstream Pond, given its small size and relative isolation, Upstream Pond contains a fairly abundant and diverse aquatic community. The results of the sediment toxicity testing in the BERA did not indicate any consistent impacts from COCs to organism survival, growth, or reproduction at any of the Upstream Pond locations. There also do not appear to be any widespread impacts from COCs to the benthic invertebrate community in Upstream Pond, based on the semi-quantitative biological survey that was conducted as part of the BERA. Any intrusive remedial actions to address the potential ecological risk would have detrimental physical effects on the habitats and biota that are currently present. These impacts would likely persist for a considerable period of time if natural processes are relied upon for recolonization, since there are no natural sources of colonizing organisms, other than Youth Pond. Further, since urban runoff from the stormwater system is also a possible source for the COCs, there would also be the potential for recontamination following any intrusive remedial action in the pond itself. For these reasons, it is recommended that these COCs in this medium not be carried forward to the FS.

Site 4 Groundwater

A UFP-SAP is currently being prepared for additional investigation of Site 4 groundwater. Therefore, groundwater will not be addressed in the FS unless the results of the forthcoming groundwater investigation indicate that inclusion of Site 4 groundwater in the FS is warranted.

PCBs in Site 4 Soil, Upstream Pond Sediment, and Upstream and Youth Ponds Fish Tissue

The detected PCBs were only found in soil in the immediate vicinity of Drainage Channel #1, near the confluence of Drainage Channels #1 and #2, upgradient of Upstream Pond. The confluence of the two drainage channels is a floodplain area that, while typically dry, is likely to be under water during heavy rain events and a deposition area for sediment transported by stormwater. Since PCBs were only detected within the drainage channels, the evidence suggests that the PCBs may have been transported to and deposited within site drainage channel floodplain areas via stormwater runoff from an unknown source or sources within the upstream developed and industrialized areas to the west and southwest.

Two PCBs were detected in sediment samples collected within Upstream Pond sediment at concentrations exceeding screening criteria during the RI (CH2M HILL, 2014). The highest PCB concentrations were found near where the site drainage channels direct stormwater into Upstream Pond, northeast of the surface debris pile within Burial Investigation Area 1, and in the northeastern corner of Upstream Pond. Since the PCBs detected in Upstream Pond sediment were only otherwise detected in drainage channels upstream of Site 4, there is a strong possibility that the elevated PCB concentrations in Upstream Pond sediment are the result of non-site-related contaminants transported in stormwater from the developed and industrialized areas to the west and south (such as stormwater discharged via Outfalls #35 and #2).

There were PCBs detected in both Upstream and Youth Ponds fish tissue samples. However, the Navy currently has fishing restrictions in place for Youth Pond and will voluntarily keep the fishing restrictions in place to protect against human exposure to PCBs in fish tissue.

As a result of evidence suggesting PCB contamination at Site 4, Upstream Pond, and in fish tissue is the result of non-site-related contaminants, it is recommended to address the PCBs under a separate to-be-determined (TBD)

site and voluntarily keep the Youth Pond fishing restrictions in place until the PCB contamination can be addressed, and any permanent LUCs, if warranted, are recommended under remedial activities associated with the TBD site.

Commented [WS2]: The DEQ concurs with the Navy's recommendation to address the PCBs under a separate TBD site and keep the fishing restrictions in place.

PAH Soil Hotspot

The highest concentrations of PAHs exceeding their respective screening criteria (PAH concentrations one to two orders of magnitude higher than in all other samples) were found in a surface soil sample (CAA03-SS06) collected approximately 100 feet upgradient and entirely outside of Burial Investigation Area 1, in a grassy area immediately adjacent to the south side of CAD Building 12 (**Figure 4**). The soil sample at this location was collected from a shallow drainage swale that directly receives stormwater runoff from the adjacent road and parking areas, as well as stormwater drainage from the CAD Building 12 rooftop via a downspout directly discharging to this swale, which indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts. Nevertheless, the Navy recommends that a voluntary PAH hotspot removal be completed around surface soil sample location CAA03-SS06 (collected from 0 to 6 inches bgs). The extent of the proposed removal area is approximately 80 square feet (ft^2) (assuming a 5-foot radius around the sample location) to a depth of 2 feet, for a total volume of 6 cubic yards (yd^3). The removal area is based on the nearest surface soil sample (CAA03-SS08) being within 20 feet of CAA03-SS06 and having PAH concentrations two to four orders of magnitude lower than CAA03-SS06 and based on the co-located subsurface soil sample, CAA03-SB06, collected from 6 to 24 inches bgs and having PAH concentrations one to two orders of magnitude lower than CAA03-SS06. Since the evidence indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts, it is recommended no post-excavation confirmation sampling be completed in association with this voluntary hotspot removal action.

Commented [WS3]: The DEQ concurs with the Navy's recommendation to complete a voluntary PAH hotspot removal around the referenced surface soil location.

Proposed Actions

Based on the conclusions and recommendations presented in the RI Report, as well as the recommendations presented in this pre-FS TM, an FS should be completed to develop and evaluate remedial alternatives to address the following medium and COCs:

- Soil and Buried debris at Site 4 (COCs are arsenic [human health and ecological], hexavalent chromium [human health], mercury [ecological], and zinc [ecological])
- Voluntary removal of the PAH hotspot around surface soil sample CAA03-SS06, near CAD Building 12

Commented [WS4]: The DEQ concurs with this recommendation for soil and buried debris although we recommend reiterating inclusion of groundwater will not be addressed unless results from the forthcoming groundwater investigation warrant inclusion.

References

Baker Environmental, Inc. (Baker). 2001. *Site Inspection Report, Site 4 and AOC 1, Naval Weapons Station Yorktown, Yorktown Virginia, Cheatham Annex Site*. May.

Baker. 2002. *Trenching Letter Report Site 1, Site 4, and AOC 2, Naval Weapons Station Yorktown Cheatham Annex Site, Williamsburg, Virginia.* June.

Baker. 2005. *Screening Level Ecological Risk Assessment Report for Sites 4 and 9. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia.* June.

CH2M HILL, Inc. (CH2M HILL). 2011. *Final Site Inspection Report, Site 4, Site 9, and Area of Concern 3. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. December.

CH2M HILL. 2014. *Final Site 4 and Youth Pond Remedial Investigation Report. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. November.

USEPA. 2001. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment) Final. *Publication 9285.7-47.* Office Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December.

Table

Figures

Attachment 1
Human Health Risk Assessment Tables – All Soil Outside Fenced Area

Attachment 2
Human Health Risk Assessment Tables – Soil Outside Fenced Area and Debris

Attachment 3
Ecological Risk Assessment Tables

Response to Comments

Regulatory Acceptance

site and voluntarily keep the Youth Pond fishing restrictions in place until the PCB contamination can be addressed, and any permanent LUCs, if warranted, are recommended under remedial activities associated with the TBD site.

PAH Soil Hotspot

The highest concentrations of PAHs exceeding their respective screening criteria (PAH concentrations one to two orders of magnitude higher than in all other samples) were found in a surface soil sample (CAA03-SS06) collected approximately 100 feet upgradient and entirely outside of Burial Investigation Area 1, in a grassy area immediately adjacent to the south side of CAD Building 12 (**Figure 4**). The soil sample at this location was collected from a shallow drainage swale that directly receives stormwater runoff from the adjacent road and parking areas, as well as stormwater drainage from the CAD Building 12 rooftop via a downspout directly discharging to this swale, which indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts. Nevertheless, the Navy recommends that a voluntary PAH hotspot removal be completed around surface soil sample location CAA03-SS06 (collected from 0 to 6 inches bgs). The extent of the proposed removal area is approximately 80 square feet (ft^2) (assuming a 5-foot radius around the sample location) to a depth of 2 feet, for a total volume of 6 cubic yards (yd^3). The removal area is based on the nearest surface soil sample (CAA03-SS08) being within 20 feet of CAA03-SS06 and having PAH concentrations two to four orders of magnitude lower than CAA03-SS06 and based on the co-located subsurface soil sample, CAA03-SB06, collected from 6 to 24 inches bgs and having PAH concentrations one to two orders of magnitude lower than CAA03-SS06. Since the evidence indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts, it is recommended no post-excavation confirmation sampling be completed in association with this voluntary hotspot removal action.

Proposed Actions

Based on the conclusions and recommendations presented in the RI Report, as well as the recommendations presented in this pre-FS TM, an FS should be completed to develop and evaluate remedial alternatives to address the following medium and COCs:

- Soil and Buried debris at Site 4 (COCs are arsenic [human health and ecological], hexavalent chromium [human health], mercury [ecological], and zinc [ecological])
- Voluntary removal of the PAH hotspot around surface soil sample CAA03-SS06, near CAD Building 12

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Not included on Table 1

TABLE 1

Summary of Previous Investigations

Site 4 Pre-Feasibility Study Technical Memorandum

WPNSTA Yorktown Cheatham Annex

Williamsburg, Virginia

Investigations/Action	Year	Investigation/Action Activities
Debris Removal (Baker, 2001a)	1998	During a site visit on May 4, 1998, with VDEQ officials, packages of unused needles wrapped in aluminum foil were found at the northeastern end of the site in a small drainage ditch near Upstream Pond. Later in May 1998, approximately 200 pounds of surface debris and 13 pounds of sharps (metal and plastic) were removed from the site. Surface debris removed included IV injection sets, many contained in aluminum or plastic bags, and small quantities (15 containers) of injectable drugs. The injectable drug containers contained either residue or small volumes (a few milliliters of liquid) and had either no labels or labels that were not legible. Additional surface debris, including metal banding, railroad ties, metal, corroded 55-gallon empty drums, and beverage containers, was observed at the site, but not removed.
Field Investigation (Baker, 2001a)	1999	Consisted of collecting soil samples from Site 4 and sediment samples from Upstream Pond. These samples were analyzed for Target Compound List (TCL) organic compounds (volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], pesticides, and PCBs), Target Analyte List (TAL) metals, cyanide, and explosives constituents. The results indicated that there was a potential for risk to human health due to the polycyclic aromatic hydrocarbons (PAHs) detected throughout the site.
Test Trench Excavation (Baker, 2002)	2001	14 test trenches (4-TT01 through 4-TT14) and six test holes (4TH01 through 4TH06) were excavated and examined to characterize and delineate the extent and types of buried waste within Burial Investigation Area 1. Based on the results of this investigation, the southern, eastern, and the southwestern subsurface debris boundaries were delineated. Buried material was observed to be thickest in the eastern portion of the site, where waste was encountered up to 5 feet below ground surface (bgs). The volume of buried material and overburden soil cover material was then estimated at 2,100 yd3. Surface debris, consisting of railroad ties, metal, and various trash items, was also encountered along the northern and western edges of this disposal area.
Screening-level Ecological Risk Assessment (Baker, 2005a)	2005	Completed for soil, sediment, and surface water to determine if potential risk to ecological receptors warranted either additional investigation beyond the conservative screening steps of the Ecological Risk Assessment (ERA) process or the removal of the site from further ecological consideration. In addition, the SERA was completed to identify any data gaps or areas of uncertainty that would require the collection of additional data to support ERA evaluations beyond the screening level. Results of the SERA indicated that there are multiple constituents of potential concern (COPCs) in soil, sediment, and surface water, including VOCs, SVOCs, pesticides, PCBs, and metals. Since multiple COPCs and complete exposure pathways were identified, the SERA recommended proceeding with Step 3A of the ERA process; however, additional data would need to be collected.
Site Inspection (CH2M HILL, 2011a)	2009	Conisted of test pitting, surface and subsurface soil sampling, installation of temporary groundwater wells, groundwater well development and sampling, abandonment of temporary groundwater wells, surface water sampling, and sediment (surface and subsurface) sampling. Results from the SI indicated that the extent of buried debris in Burial Investigation Area 2 had been delineated, but additional test pitting would be required to delineate the extent of buried debris in Burial Investigation Area 1. In addition, sampling results indicated potential risks to human health and ecological receptors, and an RI was recommended to further characterize the extent of contamination and to quantify the risks to human health and ecological receptors.

Consisted