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U S NAVY RESPONSE TO THE U S EPA REGION III COMMENTS ON THE DRAFT REMEDIAL INVESTIGATION REPORT FOR AREA OF CONCERN 6 (AOC 6) TNT SUBAREAS FISC WILLIAMSBURG VA

05/04/2015

CH2M HILL

Response to Comments
Draft Remedial Investigation (RI) Report for AOC 6 TNT Subareas

Naval Weapons Station Yorktown Cheatham Annex
Williamsburg, VA
May 4, 2015

The comments below were received via an email dated February 9, 2015 from Gerald Hoover, U.S. Environmental Protection Agency (EPA), Region III. The Navy's response follows each comment.

Original EPA HYDRO COMMENT (provided 2/9/15)

The concentrations of arsenic and iron in the up-gradient monitoring wells MW-06 and MW-02 are not a sufficient line of evidence to demonstrate that the arsenic and iron concentrations in groundwater at the site are attributable to background conditions. The Navy should explain in more detail, and should provide additional data, that can clearly demonstrate that the concentrations of arsenic and iron in groundwater are indeed attributable to naturally occurring background conditions.

Navy Response (provided via email 3/6/15): Regarding the upgradient site background monitoring wells, MW01 and MW06 (not MW02 as indicated by the comment), when the CAX AOC 6 TNT Subareas RI UFP-SAP was prepared, the Yorktown-Eastover Aquifer was assumed to be the surficial aquifer underlying these subareas, based on the limited data available from the temporary groundwater sampling wells previously advanced at these subareas. However, soil boring data collected during the RI led to the identification of the Columbia aquifer as the underlying surficial aquifer. The Columbia aquifer is thin, discontinuous and present only in isolated areas underlying the Yorktown and CAX facilities. Where present, it ranges in thickness from 5 to 20 feet, and groundwater within this aquifer is locally influenced by nearby surface water bodies (*Final Background Study Report, Naval Weapons Station Yorktown, Yorktown, Virginia and Cheatham Annex, Williamsburg, Virginia;* CH2M HILL, 2011). Because the Columbia aquifer underlying the facilities is limited and discontinuous, and there are few CERCLA sites with the potential to have impacted the aquifer, the background groundwater investigation conducted in 2009 focused on the Cornwallis Cave and Yorktown-Eastover aquifers, and basewide background levels were not established for the Columbia aquifer. As stated in Section 5.1 of the *Final Background Study Work Plan, Naval Weapons Station Yorktown, Yorktown, Virginia and Cheatham Annex, Williamsburg, Virginia* (CH2M HILL, 2009), "background/upgradient groundwater quality for CERCLA sites overlying the Columbia aquifer will be evaluated on a site-specific basis." Since there are no available basewide background analytical data for the Columbia aquifer, it is logical and appropriate to turn to site-specific monitoring wells that are screened in the same aquifer as known groundwater impacts, clearly upgradient of onsite sources and impacted areas, and not downgradient of any other impacted sites as a reasonable means to evaluate localized groundwater background conditions. Monitoring wells MW-01 and MW-06 are located upgradient of where historic site activities occurred at the AOC 6 TNT subareas, and the concentrations of arsenic and iron in these wells are, therefore, representative of groundwater background conditions.

Regarding the groundwater arsenic and iron results for the AOC 6 TNT subareas, the concentrations in question are as follows:

Well	Total			Dissolved		
	Arsenic (µg/L)	Iron (µg/L)	Manganese (µg/L)	Arsenic (µg/L)	Iron (µg/L)	Manganese (µg/L)
MW01	6.3	16,000	710	6	16,000	700
MW02	21	36,000 J	220	20	37,000 J	200
MW03	33	32,000	210	25	29,000	170
MW04	16	19,000	400	17	19,000	410
MW05	26	24,000	360	22	23,000	280
MW06	33	30,000	340	32	30,000	330

J = Analyte present, value may or may not be accurate or precise

[1]Although manganese is not referenced in the EPA comment, it is included in the table above because of the Virginia Coastal Plain discussion that follows.

Overall, naturally-occurring arsenic, iron and manganese concentrations within the coastal plain of southeast Virginia are typically *highly variable* and *elevated* due to the soil composition, as shown in the table that follows:

Max Background Values (Dissolved Fraction) for SE VA Navy Bases

Constituent	Southside				Peninsula		
	Little Creek[1] (µg/L)	St. Juliens Creek Annex[2] (µg/L)	Oceana[3] (µg/L)	Norfolk Naval Shipyard[4] (µg/L)	Camp Peary[5] (µg/L)	WPNSTA Yorktown and CAX[6] (µg/L)	
						Cornwallis Cave Aquifer	Yorktown-Eastover Aquifer
Arsenic	69.4	15.4	12.4	11.9	N/A	2.5	6.2
Iron	29,800	94,000	6,590	14,000	20.6	1,510 K	1,670 K
Manganese	1,510	11,800	251	308	161	77.2	79.7

K – reported value may be biased high, actual value may be lower

[1] Baker Environmental and CH2M HILL, 2000. *Background Investigation for Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* December.

[2] CH2M HILL, 2004. *Background Investigation Report Addendum for Groundwater, St. Juliens Creek Annex, Chesapeake, Virginia.* August.

[3] CH2M HILL, 2004. *Technical Memorandum Background Investigation Results for Select Inorganics, NAS Oceana, Virginia Beach, Virginia.* July.

[4] CH2M HILL, 2002. *Background Investigation, Norfolk Naval Shipyard, Portsmouth, Virginia.* May.

[5] Baker Environmental, 2002. *March 2003 Background Groundwater Study, Armed Forces Experimental Training Activity Camp Peary, Williamsburg, Virginia.* October.

[6] CH2M HILL, 2011. *Final Background Study Report, Naval Weapons Station Yorktown, Yorktown, Virginia, and Cheatham Annex, Williamsburg, Virginia.* May. (Note: Since the Cornwallis Cave aquifer is predominantly present west of the Camp Peary Scarp, and the Yorktown-Eastover Aquifer is predominantly present east of the Campy Peary Scarp, the maximum background values for both of these aquifers are included in this table)

In addition,

- Arsenic is commonly adsorbed to, or co-precipitated with, iron and manganese oxides, adsorbed to clay mineral surfaces, and associated with sulfide minerals. Natural dissolving or desorbing of arsenic from these source materials releases arsenic to groundwater.
- Iron oxides can be variable within soil as a result of chemical weathering (the “rusting” appearance on rocks).
- The arsenic occurrences correlate with elevated concentrations of iron and manganese, a strong

indication that arsenic is naturally-occurring and not from a site release.

- Concentrations of naturally-occurring arsenic in groundwater vary regionally due to a combination of climate and geology (USGS, 2000)[1].
- The U.S. Geological Survey (USGS) has collected and analyzed arsenic in potable (drinkable) water from 18,850 wells in 595 counties across the United States during the past two decades, and naturally-occurring arsenic concentrations in the coastal plain of southeast Virginia are typically detected above the MCL (see attached figure).

Therefore, the Navy maintains that the evidence from site data does not point to the concentrations of arsenic and iron in the Columbia aquifer groundwater at AOC 6 being attributable to a site release. In contrast, the evidence is consistent with the highly typical finding at CAX and other bases within the coastal plain of Virginia that the concentrations are attributable to naturally-occurring background conditions. Recommended text revisions to make this point in the RI report more clear are:

1. Section 4, 3rd paragraph – new text (in red) was added (and Footnote 7 removed):

   The background screening values used to evaluate the soil and groundwater sampling data are the surface and subsurface soil background 95 percent upper tolerance limits (UTLs) (CH2M HILL, 2011) and groundwater concentrations from monitoring wells CAA06-MW01 and CAA06-MW06, respectively. Since CAX background concentrations for groundwater are not available for the Columbia aquifer, background/upgradient groundwater quality for CERCLA sites overlying the Columbia aquifer was evaluated on a site-specific basis in accordance with the Final Background Study Work Plan, Naval Weapons Station Yorktown, Yorktown, Virginia and Cheatham Annex, Williamsburg, Virginia (CH2M HILL, 2009). Monitoring wells CAA06-MW01 and CAA06-MW06 are located upgradient of where historic site activities occurred at the AOC 6 TNT subareas and are not downgradient of other CERCLA sites; therefore, the groundwater analytical data from these two monitoring wells are representative of groundwater background conditions.

2. Section 4.2.2, First bullet (added text in red):

   - Total and dissolved arsenic exceeded the MCL and adjusted Tapwater RSL in five groundwater samples; however, all of the concentrations in monitoring wells within the study area boundary were below those detected in reference monitoring well CAA06-MW06, which is upgradient of the AOC 6 TNT Subareas. The arsenic concentrations were also higher compared in monitoring well CAA06-MW03, which is also upgradient of the former TNT Graining House, Sump, and Catch Box Ruins, since Penniman Lake was found to be recharging the surficial aquifer during the RI. Arsenic concentrations in groundwater at the AOC 6 TNT Subareas appear to be representative of naturally occurring conditions, as arsenic concentrations are typically elevated in the shallow coastal plains of southeast Virginia due to the aquifer composition and geochemical conditions. Arsenic is commonly adsorbed to, or co-precipitated with, iron and manganese oxides, adsorbed to clay mineral surfaces, and associated with sulfide minerals. Natural dissolving or desorbing of arsenic from these source materials releases arsenic to groundwater. In addition, the U.S. Geological Survey (USGS) has collected and analyzed arsenic in potable (drinkable) water from 18,850 wells in 595 counties across the United States during the past two decades, and naturally-occurring arsenic concentrations in the coastal plain of southeast Virginia are typically detected above the MCL (USGS, 2000).

[1] United States Geological Survey (USGS). 2000. *Arsenic in Ground-water Resources of the United States*. http://pubs.usgs.gov/fs/2000/fs063-00/fs063-00.html#HDR1

3. Section 4.2.2, Fourth bullet (added text in red):

- Total iron and manganese concentrations exceeded their respective adjusted Tapwater RSLs in each of the six groundwater samples. The maximum concentrations of total and dissolved iron detected in sample CAA06-GW02-1013 exceeded the respective concentrations detected in groundwater from reference wells CAA06-MW01 and CAA06-MW06, but were not significantly higher than the concentrations in reference well CAA06-MW06 and upgradient monitoring well CAA06-MW03. The concentrations of iron in groundwater are likely attributable to naturally occurring background conditions. With respect to total and dissolved manganese in groundwater samples, detected concentrations did not exceed those detected in groundwater in reference well CAA06-MW01. Similar to iron, manganese concentrations in groundwater are also likely attributable to naturally occurring, background conditions.

  Iron and manganese concentrations are typically elevated in groundwater of the shallow coastal plain of southeast Virginia due to the aquifer composition and geochemical conditions. Iron oxides can be variable within soil as a result of chemical weathering. The ORP and DO values in listed in Table 2-3 suggest a more reducing environment at the AOC 6 subareas. Under these conditions, iron hydroxides and manganese oxides present in the soil matrix can reductively dissolve into soluble forms as evidenced by elevated iron and manganese concentrations within groundwater.

Follow-up EPA Comment (provided via email 3/24/15): We agree with Navy's response that, provided there are no base-wide background analytical data available for the Columbia aquifer, using site-specific monitoring wells is logical and appropriate. However, the Navy's assertion that MW6, which is approximately 25 feet from and more closely resembles the constituent concentrations in MW2, is representative of background is a not a reasonable assumption. It may be up-gradient of the site buildings, but MW6 lies so close to the ambiguous site boundary that it cannot be definitely identified as not impacted by site activities.

Navy Response: As shown on the attached groundwater contour figure (Figure 3-5 from the draft RI), monitoring wells MW01 and MW06 (and MW02) are located upgradient of where historic site activities occurred at the AOC 6 TNT subareas, and the concentrations of arsenic and iron in these wells are, therefore, representative of groundwater background conditions. The closeness of MW6 to the site boundary is not important. The establishment of a site boundary line on a map is a fairly arbitrary activity conducted before site-specific investigations take place to identify the actual nature and extent of contamination inside the site boundary. What is important is the upgradient versus downgradient position, as well as, the closeness of MW06 relative to the actual source areas that have been identified and delineated as part of the CSM of the site. The results show that the source areas at this site are the immediate vicinities of the TNT Catch Box Ruins and the former TNT Graining House Sump, where elevated concentrations of TNT and/or lead were found. MW06 is well upgradient of these delineated source areas, and is, therefore, appropriate as a site-specific background well.

Also, the similarity in concentrations between MW06 and MW02 is irrelevant. MW06 is clearly upgradient of the source areas within the site boundary for the site-related risk drivers (TNT and lead) identified during the RI and delineated in the updated CSM – the immediate vicinities of the TNT Catch Box Ruins and the former TNT Graining House Sump. MW02 is also upgradient of the source areas where the soil contaminant concentrations are driving risk and could also arguably be considered a site-specific background well. Therefore, the similarity in arsenic and iron concentrations between MW06 and MW02 is not remarkable. However, the Navy elected to be very conservative and not include MW02 as a background well in its evaluation since it is closer, though still clearly upgradient, of the delineated source areas.

As stated previously, arsenic and iron concentrations have been shown time and time again at CAX and other sites in the surficial aquifer of the Virginia Coastal Plain to be naturally elevated due to the mineral composition of the aquifer matrix and the geochemical conditions, and that natural background concentrations typically drive risk for human exposure to groundwater (i.e., remediation of higher-than-background concentrations of arsenic and iron down to background concentrations typically does not mitigate risk). There is no evidence in the CSM based on the nature of historical site activities to indicate that arsenic and/or iron would somehow logically be COCs at this site. The overwhelmingly simple explanation is that arsenic and iron concentrations are elevated as they typically are in the surficial aquifer at virtually all similar sites in the Coastal Plain of Virginia. Carrying these constituents forward to an FS would waste valuable resources formulating and evaluating remedial alternatives that are not warranted and stand little chance of being implemented.

In addition, the Columbia aquifer would not be a suitable potable water source.

Lastly, given the Columbia aquifer's sparse presence at CAX, there is no guarantee we would encounter it again if additional wells were installed to represent background further from the site boundary.

EPA Biological Technical Assistance Group Comments

1. *BTAG Comment #1: Table 2-2 Groundwater and Penniman Lake Surface Water Elevations: According to this table the groundwater elevations ranged from 4.39 to 6.35 feet above mean sea level (amsl) and the Penniman Lake surface water elevation was 8.06 amsl. This report does not indicate how deep Penniman Lake is, therefore, it seems reasonable that there is a direct connection between groundwater and the lake and the lake could be gaining or losing depending on conditions. The connection between groundwater and Penniman Lake should be clarified.*

   Navy Response: The RI report does not dispute that a hydraulic connection exists between the groundwater of the surficial aquifer (Columbia aquifer) at AOC 6 and the adjacent surface water of Penniman Lake. This is clearly the case. However, during the RI field investigations at the time when concurrent measurements of the elevations of groundwater and the surface of Penniman Lake were made, as reported in Table 2-2, the elevation of the surface of Penniman Lake significantly exceeded the elevations of the water table in the adjacent Columbia aquifer at AOC 6. Regardless of the depth of Penniman Lake, these data indicate that the hydraulic pressure gradient at that time was directed from Penniman Lake to the adjacent surficial aquifer, indicating that Penniman Lake was recharging the Columbia aquifer. Moreover, it is stated in several places in the RI report (see text in Sections 6.2, 7.2.2, and 7.3.1) that these hydraulic pressure gradient conditions may not always exist, such that groundwater flow in the Columbia aquifer may at times potentially discharge into Penniman Lake (e.g., during times of drought when the water level in Penniman Lake may be lower).

2. *BTAG Comment #2: Figure 2-1 AOC 6 TNT Subareas RI Sample Locations: This figure identifies a berm to the north of the TNT Graining House and Catch Box Ruins. The text should explain the purpose and origin of the berm and why no samples were collected from it. The original topography of the area appears to be about 16 feet and the current top of the berm is approximately 30 feet (Figure 3-1) [see also Appendix J Ecological Risk Assessment, Section J.2.1]. The berm appears to be approximately 60 feet by 100 feet.*

   Navy Response: The following footnote will be added in conjunction with the first reference to Figure 2-1:

   > The "berm boundary" on Figure 2-1 represents the remnants of an earthen berm that was installed during construction of the former PSLP and assumed to provide some protection should an explosion occur. Berms [or "bunkers" as they are referred to on historic drawings (Weston, 1999)]

were constructed of various configurations (either completely surrounding or horseshoe- or L-shaped) around several of the former PSLP buildings where an unexpected detonation of explosive materials could occur. The berm is located outside of the footprint of the TNT Subareas; therefore, no sampling of this area is necessary.

3. *BTAG Comment #3: Figure 2-1: Previous comments identified the need for additional samples (surface water, sediment, and porewater) in King Creek adjacent to this site (e.g., Section 3.5.4 of this document also supports this position) and in the drainage feature from the dam to the creek, including the creek.*

   Navy Response: Comment noted. As stated in the responses to the referenced previous comments, the collection of samples from King Creek will occur as part of the Penniman Lake investigation. The type, number, and parameter list for any additional samples from King Creek will be determined during a future scoping session for the Penniman Lake investigation.

4. *BTAG Comment #4: Figure 2-1: No samples were collected from the graining house or the sump. Even if these were constructed of concrete, the integrity of the floor may have been compromised and allowed contaminants to escape to an area that has not been sampled. These contaminant concentrations may still be in the migration pathway. An explanation should be provided on why samples were not collected from these areas.*

   Navy Response: On June 4, 2013, a conference call was held with the CAX Partnering Team and EPA technical support (attendees included Scott Park/Navy, Sue Haug/EPA, Peter Knight/EPA BTAG, John McCloskey/EPA BTAG, Wade Smith/VDEQ, Laura Lampshire/CH2M HILL, Marlene Ivester/CH2M HILL, Bill Kappleman/CH2M HILL, and Roni Warren/CH2M HILL). During this meeting, it was agreed that the sump would be field checked during the RI, and if residual material was observed, a 3-point composite sample of the sump material would be collected and analyzed. As documented in Section 2.1.4 of the Draft RI Report, the sump was inspected on September 19, 2013. Since only organic material and flakes of scraped concrete were recovered, and no residual material was present, there was no residual material to sample.

5. *BTAG Comment #5: Section 6.3 on page 6-2 states that since Penniman Lake has now received a site designation (AOC 9), any further evaluation of surface water and sediment offshore of the AOC 6 TNT Subareas has been deferred to the Penniman Lake Site Inspection (SI). This approach would be acceptable if sediment sampling as part of the Penniman Lake SI was sufficient to characterize the nature and extent of explosives at AOC 6. However, sediment sampling in Penniman Lake adjacent to AOC 6 is limited (only one sample) and additional sampling as part of the Penniman Lake SI is recommended. Any additional sampling needs to consider the fact that activity at AOC 6 predates construction of the dam which likely results in different migration pathways than those present today.*

   Navy Response: Comment noted. Additional surface water and sediment sampling has occurred as part of the Penniman Lake SI, and the analyses included explosives. The number and location of these samples were agreed to as part of the Penniman Lake SI (Step 2) SAP, and the results are currently being evaluated as part of the Penniman Lake SI.

   In addition, it should be noted that one surface water and two sediment samples were collected from Penniman Lake during the EPA-led SI of the former Penniman Shell Loading Plant (Weston, 1999) at the suspected point of discharge of runoff from the TNT catch basin. The analyses included explosives, and the report concluded there was no analytical data (explosive or otherwise) which indicated the TNT subarea was currently impacting Penniman Lake. The AOC 6 SI surface water and sediment samples (collected adjacent to the TNT subareas and including explosives analysis) likewise concluded no potential unacceptable ecological risks were identified with exposure to surface water or sediment (surface and subsurface) within this subarea (CH2M HILL, 2012).

6. *BTAG Comment #6: Page 6-4, Section 6.5.2 Aquatic Habitats: The potential for risk from contaminants to ecological receptors (e.g., groundwater to surface water) has existed at this site since World War I. This means the contaminants may have already reached Penniman Lake or King Creek and may be different than the contaminants found in the groundwater during this study. This supports the need to assess the historical groundwater contaminant migration pathway, potentially including the collection sediment samples for use in the ecological risk assessment.*

   Navy Response: The need to assess a possible (and hypothetical) historical groundwater contaminant migration pathway was not previously presented as a concern during any of the CAX AOC 6 TNT Subarea RI SAP scoping sessions. In addition, the CAX Tier 1 Partnering Team agreed Penniman Lake (and King Creek) surface water and sediment should be evaluated under one comprehensive study, not split into multiple investigations. Therefore, the AOC 6 TNT subarea RI ERA will not include sediment samples. As stated in the response to BTAG comment #5, additional surface water and sediment samples have been collected from Penniman Lake and are being evaluated under the Penniman Lake SI. As stated in the response to BTAG comment #3, the type, number, and parameter list for any additional samples from King Creek will be determined during a future scoping session for the Penniman Lake investigation.

BTAG Comments Related to Appendix J Ecological Risk Assessment:

7. *BTAG Comment #7: Page J-15, Section J.4.1 Medium-Specific ESVs: For both soil and surface water the text indicates that when more than one ESV (ecological screening value) was available, "…the lowest of these values was typically selected." Please identify which contaminants did not have the lowest ESV selected and state the reasons why this approach was used.*

   Navy Response: The lowest value was always selected. The word "typically" will be removed from the text for both of the instances referenced in the comment.

8. *BTAG Comment #8: Page J-19, Section J.5.3.2 Terrestrial Food Web Exposures: The text states "…although chemicals that exceeded the MATC, but not the LOAEL, were discussed for possible risk management considerations." The results of this discussion including the possible risk management consideration need to be included in this section.*

   Navy Response: Since this situation did not arise in this particular ERA, the cited text is not relevant to the AOC 6 TNT Subarea ERA and will be deleted.

9. *BTAG Comment #9: Page J-21, Section J.5.4 Aquatic Habitats: The use of mean site concentrations are not appropriate for determining risk to ecological receptors that are immobile or have a limited home range. Maximum concentrations must also be considered when assessing risk to lower trophic level receptors.*

   Navy Response: Maximum concentrations were used to select Step 2 COPCs consistent with EPA and Navy ERA guidance. For Step 3A, COPC selection for groundwater considered both background (upgradient well) concentrations and central tendency chemical concentrations (since the endpoints evaluated were based on communities/populations and not individual organisms), as well as the magnitude and frequency of ESV and background exceedances (which account for maximum concentrations).

10. *BTAG Comment #10: Page J-22, Section J.5.5.2 Aquatic Habitats: The text states "…groundwater is not a significant transport medium for site-related constituents to Penniman Lake or King Creek, and site-related constituents that might reach these water bodies via groundwater would not pose an unacceptable risk to aquatic biota." Knowing when the dam was installed would help support or refute*

the first portion of this quote. Because no sampling has occurred in King Creek and only one sediment sample is located in Penniman Lake adjacent to this site, support for this position is not sufficient.

Navy Response: Please see the response to BTAG Comments 5 and 6.

11. *BTAG Comment #11: Page J-25, Section J.6 Uncertainties: Assessing ecological risk to lower trophic level receptors needs to consider maximum, not just mean, concentrations. The Wildlife Factors Handbook does not evaluate lower trophic level ecological receptors that are immobile or have a limited home range nor does it "specify" the use of average media concentrations. Citing this document to support using mean versus maximum concentrations for lower trophic level receptors is not appropriate.*

    Navy Response: Maximum concentrations were used to select Step 2 COPCs consistent with EPA and Navy ERA guidance. For Step 3A, COPC selection considered background soil UTLs and central tendency chemical concentrations (since the endpoints evaluated for terrestrial lower trophic level receptor groups were based on communities or populations and not individual organisms), as well as the magnitude and frequency of ESV and UTL exceedances (which account for maximum concentrations).

    The referenced bullet in the uncertainty section has been modified to read as follows:

    - Mean Versus Maximum Media Concentrations – As is typical in an ERA, a finite number of samples of environmental media were used to develop the exposure estimates. The maximum concentration provides a conservative estimate of risk for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile upper trophic level species with relatively large home ranges are those based on central tendency estimates of chemical concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the *Wildlife Exposure Factors Handbook* (USEPA, 1993), which specify the calculation of an average daily dose. Given the mobility of the upper trophic level receptor species used in the ERA, the use of maximum chemical concentrations (rather than 95% UCL and mean concentrations) in the SERA (Step 2) to estimate the exposure via food webs is very conservative. This conservatism was reduced to more realistic levels in the values selected for use in the BERA (Step 3A) food web evaluation.

      In cases where adequate spatial sampling coverage exists, central tendency estimates of chemical concentrations in exposure media are also appropriate for evaluating potential risks to populations of lower trophic level receptors because the members of the population are expected to be found throughout a site (where suitable habitat is present), rather than concentrated in one particular area. While effects on individual organisms might be important for some receptors, such as rare and endangered species, population- and community-level effects are typically more relevant to ecosystems. The 95% UCL of the arithmetic mean was typically used quantitatively in the BERA portion of this ERA to represent the average exposure scenarios during COPC selection.

12. *BTAG Comment #12: Page J-26, Section J.7 Risk Summary and Conclusions: The text states "Based on the results of this evaluation, groundwater is not a significant transport medium for site-related constituents to Penniman Lake or King Creek, and site-related constituents that might reach these water bodies via groundwater would not pose an unacceptable risk to aquatic biota." Based on this report, groundwater may discharge to both of these surface water bodies. Depending on how long the dam has been operational compared with AOC 6 TNT being constructed, groundwater flow may have been different than today (e.g., more flow toward Penniman Lake [or the wetland that was present before the lake]). The text does indicate that groundwater tends to flow toward King Creek. This means that additional sediment samples may be warranted from King Creek adjacent to (in the groundwater discharge area), upstream, and downstream of this site. In addition, more sediment samples need to be collected in*

Penniman Lake near this site in the groundwater discharge area. These would be in addition to Penniman Lake sediment sample CAA06-SD01.

Navy Response: Please see the response to BTAG Comments 5 and 6.

EPA TOXICOLOGIST'S COMMENTS

Overall, the methodologies to complete the human health risk assessment appear appropriate; however, the following comments and recommendations must be considered as the draft RI is finalized.

Major Concerns:

1. *Agree with the recommendations on page 8-2 in Section 8.2, except for the recommendation #3. For groundwater, the comparison to background should include a more robust statistical analysis than comparing the range of two background wells (one of which is debatable, see comment under Section 4 below) to the range of constituent concentrations at monitoring wells. The iron and arsenic concentrations in the monitoring wells may be attributable to naturally occurring background levels; however, the current analysis does not definitively support this conclusion. Recommend including groundwater as needing further action unless background analysis is improved.*

   Navy Response: Refer to the response to the EPA Hydro comment above and the response below regarding MW06.

2. *Lead was not identified as a COPC in Section H.6.2. Risk Assessment Results. This determination is correct using the mean concentration in soil and subsurface soil and the exposure parameters described in the Table 4s; however, the highest concentration observed, 1,100 mg/kg, was from a subsurface soil sample from within the Catch Box Ruins and was identified as an outlier using ProUCL 5.0. The next highest concentration, 580 mg/kg, was from a surface soil sample also within the Catch Box Ruins. Section H.6.4 addresses the possibility of lead as a hot spot but fails to provide a strategy moving forward. Recommend calculating human health risk of exposure to lead in surface and subsurface soils using concentrations within Catch Box Ruins (using sample Stations CAA06-SO01 and SO26).*

   Navy Response: Agree. We will evaluate risks associated with exposure to lead in the Catch Box Ruins, using samples CAA06-SO01 and SO26. Risks associated with exposure to surface soil, and combined surface and subsurface soil from these samples, will be evaluated, based on the exposure scenarios presented in Appendix I Table 1 evaluated in the HHRA. The RI text (and Appendices H and I) will be updated as needed following this evaluation.

Nature and Extent of Contamination (Section 4)

- *Page 4-1, 3rd paragraph – disagree with selection of MW-6 as a source of background concentrations for groundwater. This well, while outside the arbitrary TNT Subareas Study boundary, is more similar and closer in location to MW-2 than MW-1 (the other background source well).*

  Navy Response: The attached figure (Figure 3-5 from the draft RI report) shows the potentiometric surface contour map for the surficial aquifer at the site. Based on the water level data collected during the RI, this map shows that both MW-1 and MW-6 are clearly not downgradient of any of the source areas at the site. MW-2 is arguably upgradient of the significant potential source areas at the site as well, but it is close enough to the edge of the berm boundary that we have conservatively

considered it potentially impacted. Even in a scenario in which Penniman Lake was not recharging the surficial aquifer (as it was at the time water-level measurements in Figure 3-5 were collected), groundwater flow would be expected to be directed to the northeast toward Penniman Lake, such that MW-1 and MW-6 would continue to be not downgradient of the potential source areas at the site.

Human Health Risk Assessment (Section 5)

- *Page 5-3 – the COCs identified appear appropriate*

  Navy Response: Comment noted.

- *Page 5-3, last paragraph – replace "were found to" with "may," such that the arsenic and iron concentrations in soil "may be" attributable to naturally occurring background conditions. For a more definitive conclusion, a statistical comparison of estimated background concentrations with observed site concentrations is needed.*

  Navy Response: The text will be revised as requested.

- *Page 5-3 – please add text discussing risks associated with exposures to chromium VI to Appendix H, Section H.8, HHRA Summary.*

  Navy Response: The text included in Section 5 concerning chromium VI will also be included in Appendix H, Section H.8.

- *Page 5-4, first paragraph – delete comparison of iron ingestion for on-site receptor to recommended daily allowance and conclusion that iron ingestion from on-site ground water would be below the recommended daily allowance (RDA). This statement ignores that the iron intake from the ground water is not the sole source of iron and would be combined with regular dietary intake. The combined dietary intake, from ground water and diet, may be greater than the RDA; unfortunately, the text does not provide a quantitative comparison of the RDA with a combined iron intake, diet and on-site ground water, for any of the receptors.*

  Navy Response: The text will be deleted as requested.

Chemical Fate and Transport (Section 7)

- *Page 7-5, top of page – The sentence that only 3 inorganic constituents were identified as COCs in surface soil is followed by a sentence that indicates that lead was one of the 3 inorganic COCs. Lead was also labeled as a COC on page 7-7, first bullet. However, lead is not included as a COC in Section 5 or identified as such in Appendix H. Please clarify that lead was a COC in the ecological RA. A table outlining the COCs in each assessment at the beginning of Section 7 would be helpful.*

  Navy Response: Table 7-1, which is referenced in the first paragraph of section 7, summarizes the COCs at the TNT subareas by media and risk (that is, human health or ecological). It identifies lead as an ecological COC and not a human health COC. No changes will be made to this table. However, the first two sentences on Page 7-5 will be revised to clarify that arsenic and hexavalent chromium have been identified as human health COCs only while lead has been identified as an ecological COC only.

- *Page 7-7, last bullet – Definitively attributing arsenic and iron concentrations in soil to naturally occurring background is not possible given the information available and lack of statistical analysis. Arsenic and iron may be attributed to background. Replace "are" with "may be."*

  Navy Response: Refer to the response to the Hydro comment above. A "statistical analysis" is not feasible since there is not an extensive background data set for the Columbia aquifer at CAX, since it has such a limited extent. The reasonableness of using site-specific background data for comparison and evaluation in these circumstances is appropriate, logical and called for in this situation in the Background Study Work Plan for Yorktown and CAX. The evidence shows that the COCs at this site are the detected explosives and lead. The weight of evidence does not suggest that constituents such as arsenic and iron that have been well documented to be naturally elevated in soil and surficial aquifer groundwater at virtually every site at CAX are attributable to site activities at the AOC 6 TNT Subareas.

Conclusions and Recommendations (Section 8)

- *Page 8-1, 1st paragraph – The comparison to background should include a more robust statistical analysis than comparing the range of two background wells (one of which is debatable) to the range of constituent concentrations at monitoring wells. The iron and arsenic concentrations in the monitoring wells may very well be attributable to naturally occurring background levels; however, the current analysis does not definitively support this conclusion. Recommend including groundwater as needing further action unless background analysis is improved.*

  Navy Response: Refer to the response to the previous comment.

- *Page 8-2, Section 8.2 – Recommendations*
  1. *FFS for TNT and lead in soil → Agree.*
     No further action for arsenic and chromium VI in soil → Agree.
     - *Provide reference to source of background analysis. A table may be beneficial comparing the 95% UTL for surface soil and for subsurface soil against the observed arsenic and chromium concentrations. This is the only place in document that this comparison is made and a transparent explanation is beneficial.*
  2. *No further action for 2-nitrotoluene in soil → Agree.*
  3. *No further action for arsenic and iron in groundwater → Disagree. Background comparison not sufficient to make this determination.*

  Navy Response (to #1): There is an explanation in Appendix H that discusses arsenic being within the range of background. This text will be brought up to Section 5.3 of the RI, as well. Also, the table in the lower left corner on Figure 8-1 shows the surface and subsurface soil background UTLs for arsenic, while the tables for the individual sample results provide the arsenic concentrations. It's all on the same figure to allow for an easy comparison. The background comparison is just related to arsenic, as there are no background soil UTLs for chromium VI. The following revisions (red text) will be made to make the main RI text more clear/transparent:

  Section 5.3 – added paragraph (to be inserted immediately before the "The concentration of hexavalent chromium . . ." paragraph):

  > A comparison of site concentrations to background concentrations was not used to select the COPCs. Therefore, it is possible that any of the metals identified as COPCs and COCs may be associated with background conditions. Arsenic was identified as a COC in surface and subsurface soil. Arsenic concentrations in surface and subsurface soil ranged from 1.1 mg/kg

to 20.9 mg/kg. More than half of these detections were below the 95 percent UTL from the CAX/Yorktown background values of 6.36 mg/kg and 5.54 mg/kg for surface and subsurface soil, respectively. Therefore, it is possible some of the risk associated with exposure to arsenic in soil is from background conditions.

Section 8.2 – revisions to Item #1, second paragraph:

No further action is recommended for arsenic and hexavalent chromium. The arsenic concentrations are within the range of the soil background 95% UTLs (CH2M HILL, 2011), as shown on **Figure 8-1**. Hexavalent chromium was not detected in surface soil, and in subsurface soil, the risk to a residential receptor would fall within the acceptable risk range for this constituent, as discussed in Section 5.3.

Navy Response (to #3): Please refer to the response to the "*Page 7-7, last bullet" comment*.

Laboratory Analytical Data (Appendix G)

- Table G-3 – Table heading incorrectly labels the data as Raw Surface Soil. The data in the table are for groundwater.

  Navy Response: The table header for raw groundwater analytical data in Appendix G will be revised to indicate groundwater data.

Draft Human Health Risk Assessment (Appendix H)

- *Page H-4, Section H.3.2 – Selection of COPCs – Disagree with utilization of MW-6 as source of background groundwater concentrations. In addition, the comparison to background should rely on a more robust statistically significant analysis than comparing maximum constituent levels.*

  Navy Response: Refer to previous comment responses above.

- *Page H-5, Section H.4.1 – Conceptual Site Model for Human Health – Recommend including brief explanation, such as that included in Section 5.2, as to why the inhalation route is not a complete exposure pathway prior to bulleted list of current receptors and complete exposure routes.*

  Navy Response: The following text from Section 5.2, which is also included in Section H.2, "Since historic site use is not associated with significant volatile organic compound (VOC) contamination, and volatile constituents were not found to be potential constituents of concern during previous investigations, VOCs were not included in groundwater analysis. Therefore, the groundwater to air pathway is not considered a complete exposure pathway" will be repeated in Section H.4.1.

- *Page H-12, Section H.6.2.3 – Current Child Recreational User (as well as other relevant areas of document) – Recommend removing phrase "conservatively used to evaluate recreational exposure to soil," as this statement fails to provide meaningful information to the bullets. More appropriate in uncertainty section or not included in document at all, due to inherent 'conservatism' in risk assessment.*

  Navy Response: The phrase "conservatively used to evaluate recreational exposure to soil" will be deleted, and instead the sentence will be changed to "IEUBK model (Tables 11.3a and 11.3b, Figure 11-1, Appendix I) demonstrated no adverse effects above acceptable levels associated with exposure to lead for a residential or recreational child".

- *Section H.7:*
  - *Page H-15, Section H.7.1, 4th paragraph – Delete: "Therefore, it is possible that some of the risk associated with exposure to arsenic in soil is from background conditions." This statement is misleading, as there were arsenic concentrations that exceeded the 95% UTL from the CAX/Yorktown background and contributed to the risk calculation.*

    Navy Response: Since background concentrations of arsenic in soil at this site, across CAX, and across the coastal plain of Virginia are well documented to frequently exceed risk-based screening criteria, there is nothing misleading about this statement, and the suggested deletion is not necessary.

  - *Page H-16, Section H.7.2, 1st paragraph – Recommend: "… generally conservative and reflect ~~worst-case,~~ or upper bound~~,~~ assumptions for the exposure." The exposure factors are upper bound assumptions and the 'worst-case' descriptor is undefined.*

    Navy Response: The text will be revised as requested.

  - *Page H-16, Section H.7.2, 3rd paragraph – Delete: "During many construction projects, clean fill material… after any construction activities." The information provided by these 3 sentences is conjecture and does not present substantive information critical to the risk assessment.*

    Navy Response: The sentence will be deleted as requested.

  - *Page H-16, Section H.6.3, 1st paragraph – Delete: "The noncarcinogenic toxicity factors are most likely an overestimate of actual toxicity." Conjecture.*

    Navy Response: The sentence will be deleted as requested.

  - *Page H-16, Section H.6.3, 2nd paragraph – Delete: "…however, most of the experimental studies indicate the existence of a threshold value." Incorrect. A threshold for carcinogenicity cannot be determined by a single experimental study, and the statement that 'most' experimental studies support a threshold is not supported.*

    Navy Response: The text will be deleted as requested.

  - *Page H-16, Section H.6.3, 2nd paragraph – Rewrite: "Uncertainty is also associated with the application of the ~~MMOA~~ADAFs for chromium due to its mutagenic MOA; this may overestimate or underestimate risks.*

    Navy Response: The text will be revised as requested.

  - *Page H-16 – H-17, Section H.6.3, 3rd paragraph – Delete. PPRTVs <u>are</u> supported by the Agency.*

    Navy Response: The text will be modified to indicate "provisional toxicity values (such as values from ATSDR, HEAST, California EPA, and New Jersey DEP)…" The text was not intended to indicate that the provisional values were from the PPRTV database.

- *Page H-16 – H-17, Section H.6.3, 4th paragraph – Delete. The 'true' cancer risk is unknown and cannot be predicted to be 'less' than the predicted value.*

  Navy Response: The last sentence in the paragraph will be deleted.

- *Page H-16 – H-17, Section H.6.3, 5th paragraph – Delete. The interspecies uncertainty is captured in the interspecies uncertainty factor in the development of the RfD/RfC and is addressed in the toxicity assessment.*

  Navy Response: The paragraph will be deleted as requested.

- *Section H.~~7~~8 – Human Health Risk Summary – The COCs identified appear appropriate.*

  Navy Response: Comment noted.

- *Section H.8 – Human Health Risk Summary – Delete text concluding that iron ingestion from on-site groundwater would be below the recommended daily allowance (RDA) (a reference for the RDA was not provided). This statement ignores that the iron intake from the groundwater is not the sole source of iron and would be combined with regular dietary intake. The combined dietary intake, from groundwater and diet, may be greater than the RDA; unfortunately, the text does not provide a comparison of the RDA with a combined iron intake, diet and on-site groundwater, for any of the receptors.*

  Navy Response: The text will be deleted as requested.

Draft Human Health Risk Assessment Tables (Appendix I)

- *Reference EPA, 2014 → EPA, 2014c throughout Table 4s.*

  Navy Response: On 3/6/15, clarification for this comment was requested, as it is unclear what is being asked/requested. Do the RAGS D tables and text references need to be the same? We only have one EPA 2014 in the Table 4s, but in the text we have more, and therefore, the document reference as EPA, 2014 on the Table 4s is reference as EPA, 2014c in the text.

- *Table 4.1.CTE (and elsewhere) – Recommend ingestion rate for child of 50 rather than convoluted time-weighted average for birth to <6 years.*

  Navy Response: Per our discussion with the EPA RPM on 2/19/15, no change will be made to the HHRA calculations in Table 4.1.CTE for the AOC 6 TNT Subareas RI; however, should this be a change made for future documents? If so, what is the basis (reference) for the ingestion rate for a child of 50 mg/day? The time-weighted average is what is/has been used previously, based on the same method EPA has used to develop the RME ingestion rate for the child in EPA's 2014 Human Health Evaluation Manual, Supplement Guidance: Update of Standard Default Exposure Factors. Please clarify.

- *Table 4.2.RME (and elsewhere) – construction worker – Please justify/clarify exposure duration of 1 year for construction worker ingestion of surface and subsurface soil. Support for this parameter was not found in the reference provided.*

  Navy Response: The duration of 1 year for the construction worker was from Attachment B of EPA, 1991 referenced on Table 4.2.RME. "For certain outdoor activities in the commercial/industrial

setting (e.g., construction or landscaping), a soil ingestion rate……Thus, exposure frequency would generally be less than one year…"

- *Table 4.2.RME – resident (child/adult) – The age-adjusted ingestion rate of soil is not generally used to calculate the lifetime cancer risk for a resident (child/adult). The cancer risk is calculated for the child and for the adult, individually, and the cancer risks are then summed. It is recommended that the parameters for the child/adult resident are removed.*

  Navy Response: The EPA RSL table uses age-adjusted ingestion rates. Is it only appropriate to use them when calculating RSLs but not when calculating site risks? Please provide the guidance indicating age-adjusted ingestion rates should not be used to calculate lifetime cancer risks. Additionally, this is the approach that has been used for calculating residential risks for all recent HHRAs. As per our discussion with the EPA RPM on 2/19/15, no change will be made to the HHRA calculations in Table 4.1.RME.

- *Table 4.2.RME – construction worker – the Exposure Factors Handbook recommends a soil to skin adherence factor of 0.3; compared to the 0.12 provided in the draft table. Please clarify or use 0.3 from EFH.*

  Navy Response: The SSAF factor for construction worker will be changed to 0.3.

- *Table 4.3.RME – adult base worker, tap water – ingestion rate of water – the footnote states that 1.25 is half the value from EPA, 1991, but the reference in the table is EPA, 2014. Please clarify or correct footnote.*

  Navy Response: The footnote will be clarified to indicate as recommended by EPA, 1991, one half the adult resident ingestion rate of water (from EPA, 2014) used for the industrial worker.

- *Table 4.3.CTE – adult base worker, tap water – ingestion rate of water – assumes half ingestion rate of adult resident from EF Handbook but the adult intake rate was updated to 2.5 from 2. Please clarify or use 1.25 L/day.*

  Navy Response: The adult resident RME ingestion rate of water is 2.5 L/day. However, as shown on Table 4.3.CTE, the adult resident CTE ingestion rate is 0.99 L/day. Therefore, no change will be made.

- *Table 5.1 – insert footnote describing process for selecting RfDs for 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene, which do not have RfDs, based on 2,4-dinitrotoluene.*

  Navy Response: A footnote will be added stating: "as included on the RSL table, the RfD for 2,-dinitrotoluene is used for 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene".

- *Table 6.1 – Change column heading 'EPA Carcinogen Group' to 'Carcinogenicity Classification' – not all the carcinogenicity classifications are based on EPA documents.*

  Navy Response: The heading will be changed from the standard RAGS Part D table heading as requested.

- *Table 6.1 – Is the source for the chromium VI carcinogenicity classification CalEPA? Could not locate NJDEP document on chromium VI.*

  Navy Response: The source of carcinogenicity classification is IRIS. This will be added to Table 6.

- *Table 7.6.CTE – The cancer risk for the ingestion route CTE in the future construction worker could not be verified. Agency calculated risks were:*

	calculated by Agency	draft HHRA
24dinitrotoluene	3.4E-08	3.7E-09
246trinitrotoluene	4.3E-06	4.70E-07
2nitrotoluene	5.8E-07	6.50E-08
arsenic	4.9E-07	5.40E-08
chromium	2.6E-08	2.90E-09

  Navy Response: As per our discussion with the EPA RPM on 2/19/15, Table 7.6.CTE was re-checked by the HH risk assessor and no errors were found with the calculations in the draft HHRA.

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Legend

- Staff Gauge
- Groundwater Sample Location
- Groundwater and Surface/Subsurface Soil Sample Location
- Topographic High Point (dashed where approximated)
- Surficial Aquifer Potentiometric Surface Contour (dashed where inferred)
- Approximate Direction of Groundwater Flow
- Approximate AOC 6 TNT Subareas Study Boundary
- Berm Boundary
- Former TNT Graining House Sump/Former Catch Boxes boundary

Notes:
4.96 = Groundwater Elevation amsl
8.06 = Surface water Elevation amsl

N
W E
S

0 50 100
Feet

Figure 3-5
Surficial Aquifer Potentiometric Surface Contours – August 22, 2014
AOC 6 TNT Subareas Remedial Investigation
Cheatham Annex
Williamsburg, Virginia

CH2MHILL