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SUBJECT: DRAFT FINAL HUMAN HEALTH RISK ASSESSMENT REPORT FORMER BENICIA ARSENAL

PCA: 14740 Site: 201114-47

DOCUMENT REVIEWED: Draft Final Human Health Risk Assessment (HHRA) Report Former Benicia Arsenal, Benicia, California. Prepared by US Army Corps of Engineers (USACE), Sacramento, California on August 2008. Envirostor request received by HERD August 24, 2009.

BACKGROUND: The Benicia Arsenal is a formerly used defense site (FUDS), located on 2,728 acres in Benicia, California. It functioned as an arsenal from 1849 to 1964. According to records of primary DoD land uses, the Former Benicia Arsenal (Arsenal) served the United States Army as a principal depot for ordnance and ordnance stores, as well as, the issuance, manufacture and testing of small arms. The location of activities in the Work Plan, the Industrial Area (Area I) served as the main industrial and manufacturing area throughout the 115-year history of the facility and was the center of activity at the former Arsenal. The Army operated industrial and manufacturing shops, maintenance facilities, cleaning and painting shops, a blacksmith shop, a welding shop, numerous vehicle and artillery repair shops, and a small arms shop, and fuel and waste storage areas at the former Arsenal. The industrial area also housed the former Arsenal's administrative offices, most of the permanent housing facilities, photographic laboratories, a firehouse, and a hospital. Fuel storage and dispensing facilities, a locomotive house, boiler houses, storehouse, and warehouse facilities, open storage facilities, fillsites, and quarries were also located within the area. After closure of the Arsenal, tenants and landowners used some buildings for a variety of manufacturing, maintenance, and repair activities.

On February 27, 2004, HERD provided our comments to an Expanded Site Inspection (SI) Draft Field Site Investigation Plan (FSIP) for the Arsenal. On June 22, 2005, HERD participated in a Restoration Advisory Board (RAB) meeting. On July 15, 2005, HERD reviewed a Draft Expanded Site Inspection (ESI) Report for Environmental Investigation at the Arsenal. On August 3, 2005 HERD prepared comments for the Draft Risk Assumptions Document. Finally, on September 2, 2009 HERD prepared comments for the Draft Final Soil Removal Action Work Plan.

SCOPE OF REVIEW: HERD has reviewed the Draft Final Human Health Risk Assessment Former Benicia Arsenal with respect to human health risk assessment.

GENERAL COMMENTS

1. Risk-Based Screening Levels.

    A. The Army's current approach of evaluating chemicals of potential concern (COPCs) is by comparing them against USEPA's residential Preliminary Remediation Goals (PRGs) or the USEPA's Soil Screening Levels (SSLs). HERD recommends the use of the USEPA's Cal-Modified 2009 Regional Screening Levels (RSLs) in place of the PRGs/SSLs. DTSC guidance documents, Human Health Risk Assessments Notes 3 and 4, have recently been published to assist with this methodology.
    http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-3.pdf
    http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA_Note4-6_24_09.pdf

2. Screening-Out Chemicals of Concern.

In general, HERD does not allow chemicals to be screened of a risk assessment and all detected compounds should be included. Chemicals can not be dropped out of a risk assessment solely based on presence below screening levels. The development of modern computerized spreadsheets facilitates carrying a larger number of chemicals through a risk assessment. Exceptions can be made for laboratory chemical artifacts as described in USEPA's Risk Assessment Guidance for Superfund Part A (RAGS) (http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf) and certain essential nutrients (sodium, potassium, calcium and magnesium only). Additionally, in some instances chemicals present at very low concentrations and detection frequency may be dropped after consultation with the HERD toxicologist. Factors needing to be weighed in dropping chemicals include the historical use of the chemical onsite, the frequency of detection, detection limits, chemical toxicity, and concentration detected, potential for bioaccumulation, spatial distribution, and essential nutrient status. HERD encourages that a list of chemicals be provided that are proposed

to be excluded from the detailed risk assessment. DTSC and toxicologists for the responsible party can then review this list prior to revising the risk assessment report.

As noted above, HERD does not agree with the screening out of chemicals based on comparison to screening criteria. Further, while historically, inorganic chemicals eliminated as COPCs were not carried forward into the quantitative risk assessment, more recent USEPA (2002) guidance recommends the presentation of total risk estimates (COPCs plus inorganic chemicals present at concentrations consistent with background) for comparison to the incremental risk estimates. HERD recommends that the document present both total and incremental risk estimates.

3. Evaluation of Lead.

   A. HERD recommends the Army evaluate potential impacts of lead detections using the DTSC Leadspread Preliminary Remediation Goal (PRG)-99 for residential scenarios, which corresponds to the 99th percentile, and the EPA Region 9 PRG for industrial scenarios. HERD determined the PRG-99 assuming exposures to children and is based on a threshold blood lead concentration of 10 micrograms of lead per deciliter of blood (µg/dl), which is in accordance with the Centers for Disease Control (CDC).

   B. The PRG-99 is 146 mg/kg for the non-pica child; this is the residential standard. For the industrial scenario the EPA Region 9 PRG is 800 mg/kg for industrial workers. With regard to lead in groundwater, if lead is a chemical of potential concern (COPC) (i.e. the filtered concentration exceeds the background threshold value (BTV)) and is present in unfiltered samples at concentrations exceeding 15 ug/L (the default in Leadspread), Leadspread should be used to evaluate residential child receptors because the 2004 Cal-modified PRG would not be protective of exposures from the groundwater pathway. This is significant in that the exposure point concentration (EPC) at Benicia Arsenal in soil is 798 mg/kg and the maximum detected concentration (MDC) is 1500 mg/kg. In groundwater the EPC and MDC for lead is 300 µg/L. Therefore, HERD recommends the use of Leadspread in the evaluation of residential child receptors.

   C. As noted previously, the MDC of lead in soil (1500 mg/kg) exceeds the industrial EPA Region 9 PRG of 800 mg/kg. In addition, the EPC and MDC for lead in groundwater (300 µg/L) exceed the California Department of Public Health (DPH) Maximum Contaminant Level (MCL) of 15 µg/L. HERD requests that the Army include a description of lead accompanied

with its detected concentrations across all media in the Toxicity Assessment of the HHRA. This should include a description of Leadspread results for the child receptor as well as comparisons of detected lead concentrations to the industrial 2004 Cal-modified PRG for soil and the MCL for detected lead in groundwater.

D. With regard to lead, the Office of Environmental Health Hazard Assessment (OEHHA) has developed a new toxicity evaluation. Subsequently, they have released a proposal for revised lead California Human Health Screening Levels (CHHSLs) substantially lower than the current PRGs discussed above. OEHHA has replaced the 10 µg/dL threshold blood concentration with a source-specific "benchmark change" of 1 µg/dL. Therefore, OEHHA is proposing new residential and commercial/industrial CHHSLs consistent with the newly established benchmark. The proposed new residential and commercial/industrial screening numbers and the accompanying documentation will be posted for public comment until June 30, 2009. We anticipate that the revised CHHSL will be finalized in the coming months. OEHHA's revised CHHSL may replace the PRGs in the future evaluation of risk from lead exposures.

4. Vapor Intrusion.

A. HERD does not concur with the statement that "*Worker exposures to workplace air are subjects of Occupational Safety Health Administration (OSHA) regulations*" on the basis that "*USEPA does not have current guidance on calculating risks and hazards posed by indoor air for industrial receptors.*" DTSC has published "Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air" (DTSC 2005) in order to evaluate risk via the vapor intrusion pathway for industrial land use.
http://www.dtsc.ca.gov/AssessingRisk/upload/HERD_POL_Eval_Subsurface_Vapor_Intrusion_interim_final.pdf

B. Characterization of contamination should be conducted in the lateral and vertical directions through subsurface sampling. For the vapor intrusion pathway, exposure to subsurface contamination is best characterized through the collection of soil gas samples. When there is known or potential groundwater contamination, water samples should also be collected to evaluate the aquifer's ability to degas Volatile Organic Chemicals (VOCs), which potentially may cause a vapor intrusion risk.

C. Soil gas is the preferred contaminant data to use for calculating the risk from the vapor intrusion pathway. It may be necessary to collect soil gas samples at two distinct time intervals to compensate for the effects of weather events, such as recent rainfall or barometric fluctuations. The minimum amount of soil gas sampling needed in the vertical direction to evaluate vapor intrusion is the collection of soil gas samples at 5 and 15 to 20 feet below surface grade. Soil gas samples should not be collected at depths shallower than 5 feet in order to minimize barometric pumping effects. For areas that overlie contaminated groundwater, an effort should be made to collect soil gas samples from immediately above the capillary fringe zone and half-way to the surface. For areas where the depth to groundwater is less than five feet, an attempt should be made to collect soil gas samples from beneath building foundations or similar settings, such as roads, parking lots, garage floors, and other areas that are covered with pavement, concrete, or a similar material, as a mechanism to evaluate the potential for vapor intrusion.

D. For chemicals known to exist in the subsurface, whether determined through direct measurement or historical records review, the chemicals should be evaluated for vapor intrusion even if the concentrations in soil gas concentrations are non-detectable.

E. When buildings exist over or near contaminated groundwater, vapor intrusion should be evaluated for this contaminant source. The risk associated with degassing of VOCs from the aquifer should be quantified in two steps. First, soil gas data should be collected over the areas of the contaminated groundwater, and the risk associated with the contaminated soil gas should be quantified. Second, groundwater data should be collected, and the risk associated with the contaminated groundwater should be quantified. Quantification of both risks is a way of evaluating which contamination source provides the greatest health threat.

5. Conceptual Site Model.

A. HERD recommends including a revised CSM to reveal all the potential exposure pathways (including soil depth) for each human receptor listed in Table 1.

Table 1. Recommended Potential Human Receptors, Exposure Pathways, and Environmental Medium of Concern for the Benicia Arsenal HHRA.

Potential Human Receptor	Complete Exposure Pathway	Environmental Medium of Concern
Current Residents	**Soil:** incidential ingestion inhalation of soil particulates in ambient air inhalation volatiles in indoor air (vapor intrusion) -direct dermal contact **Groundwater:** consumption of drinking water -inhalation of volatiles during domestic uses of groundwater -dermal contact during bathing	surface soil subsurface soil groundwater soil gas
Current Non-Intrusive Workers (Industrial)	**Soil:** incidential ingestion inhalation of soil particulates in ambient air inhalation volatiles in indoor air (vapor intrusion) -direct dermal contact **Groundwater:** consumption of drinking water	surface soil groundwater soil gas
Current Intrusive Worker (Construction)	**Soil:** incidential ingestion inhalation of soil particulates in ambient air -direct dermal contact **Groundwater:** consumption of drinking water direct dermal contact	surface soil subsurface soil groundwater
Future Residents	same as Current Residents	surface soil subsurface soil groundwater soil gas
Future Industrial Workers	same as Current Industrial	surface soil subsurface soil groundwater soil gas
Future Intrusive Worker (Construction)	same as Current Intrusive Worker	surface soil subsurface soil groundwater

B. The document describes soil depth as either surface (0 – 0.5 feet below ground surface) or as mixed interval (0 – 10 feet below ground surface). This is incorrect in that a mixed interval soil sample (0 – 10 ft) does not adequately delineate chemicals vertically in soil. It would be more appropriate to assess subsurface soil at various depths such as 1.5 ft, 4.5 ft, 7.5 ft, and 10 ft below ground surface. If groundwater is shallow, a subsurface soil sample should be collected as deep as possible prior to encountering groundwater. In this case, HERD recommends the collection of a groundwater grab sample to facilitate the characterization of the sample area.

6. Potential Human Receptors.

The conceptual site model (CSM) identifies the following for evaluation in the HHRA: future residents, current non-intrusive workers, future intrusive workers, and current indoor workers.

A. HERD does not concur with the HHRA evaluating solely the receptors listed above at the Arsenal. HERD's policy requires the inclusion of both current and future potential human receptors in risk assessment (DTSC, 1994a). The CSM should be updated to include current residents, current intrusive, and future non-intrusive workers. It should be noted that HERD is aware that the Army applied residential PRGs to estimate the maximum exposure and associated risk at the site. This approach should expedite the addition of the current residential receptor to the CSM.

B. The "Current Indoor Worker" category is superfluous. Based on the results in Table 20, HERD observes no significant differences in risk between the "Current Indoor Worker" and the "Current Non-Intrusive Worker". These two categories should be merged to the "Current Non-Intrusive Worker" category on the basis that perceived exposure pathways and parameters are identical for these receptors.

7. Exposure Assumptions.

A. Table 9 lists a summary of exposure assumptions used in the HHRA. HERD agrees with the values selected with two exceptions. Cal-modified exposure assumptions have been formulated to account for regional differences in calculating risk. For Skin Surface Area Exposed, HERD recommends a value of 5700 cm^2/day compared to 3,300 cm^2/day. For

Soil – to – Skin Adherence Factor, HERD recommends a value of 0.2 mg/cm^2 compared to 0.3 mg/cm^2. An explanation for the use of these values in conducting risk assessments is available in DTSC's Human Health Risk Assessment Note 1. http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA_Note1.pdf

B. The document states that absorption fraction (ABS) values for dermal uptake have been empirically derived from a number of sources. HERD recommends the use of ABS values presented in Appendix A of DTSC's HHRA Note 1 (See link above) in the evaluation of dermal uptake. In addition, the inclusion of a list or table presenting the ABSs utilized would be beneficial.

8. Detection Limits.

HERD requests the Army provide the limits of detection for chemical analytes in a Table for analysis, and ensure those limits are less than residential goals.

9. Dermal Evaluation.

In the derivation of a dermal Reference Dose (RfD), the oral RfD was multiplied by a gastrointestinal absorption factor. Similarly, a dermal Cancer Slope Factor (CSF) was derived by dividing the oral CSF by the gastrointestinal absorption factor. HERD recommends the use of the oral RfD/CSF in place of a calculated dermal RfD/CSF. It is HERD's experience that employing the latter method in risk assessment calculations results in an overestimation of risk via the dermal exposure pathway.

10. Carcinogens.

A number of carcinogenic chemicals are incorrectly evaluated as noncarcinogens in the risk assessment: hexachlorobutadiene, chloroform, ethylbenzene, benzo(g,h,i)perylene, and naphthalene. These chemicals require re-evaluation with respect to carcinogenicity. For benzo(g,h,i)perylene, HERD recommends the use of benzo(a)pyrene as a surrogate for use in risk calculations.

11. Site Background.

The document should include a section describing the investigated site background, historical operations, current operations, physical terrain, hydrogeology, current and future intended land use, and any additional information that may be relevant to conducting a thorough and comprehensive risk assessment.

12. Data and Sampling Locations.

HERD requests that the Army include all the sampling locations for the data presented in Tables 1, 2, and 3. In addition, the inclusion of detailed maps clearly marked for all sampling locations would greatly facilitate the risk assessment process and would ensure that the site can be fully evaluated with respect to characterization.

SPECIFIC COMMENTS

1. The correct units for soil-to-skin adherence factor should be mg/cm^2.

2. The Army provides a list of sources used in the selection of CSFs in evaluating carcinogenic risks associated with exposure to COPCs. OEHHA should be added to this list of sources, second only to the Integrated Risk Information System (IRIS) online database.

3. The hazard index (HI) for exposure to surface soil for current installation workers is listed in the text as 0.5. The carcinogenic risk is described as $2E^{-05}$. Table 17 lists the HI as 0.35, and the carcinogenic risk as $1.5E^{-05}$. HERD assumes these values are rounded, but other inconsistencies create uncertainty. The HI for a future intrusive worker is listed as 0.7 in the text, but Table 18 lists it as 0.6. The most inconsistent values lie in the dermal exposure to site groundwater. The HI in the text is $4E^{-12}$ and the cancer risk estimate is $6E^{-17}$. Table 19 describes the HI as $1.84E^{-11}$ and the cancer risk estimate as $9.7E^{-17}$. Please ensure that values in the text are consistent with values in the Tables.

4. In Section 6.2, the text reads, "the possibility that the shallow aquifer underlying the site would be used for drinking water is extremely low since." This sentence is incomplete and requires further explanation. In addition, groundwater will be evaluated as a drinking source in the risk assessment in the absence of a written statement from the Regional Quality Water Control Board (RQWCB).

5. It is unclear to HERD whether groundwater sample data is presented as filtered or unfiltered. HERD requests that unfiltered groundwater data be used in the risk assessment.

6. Table 3 is missing a footer explaining the California Industrial CHHSL reference.

7. HERD recommends the use of the Residential CHHSL when evaluating soil gas screening in addition to the Industrial CHHSL. http://www.calepa.ca.gov/brownfields/documents/2005/CHHSLsGuide.pdf

8. A page listing all of the acronyms and abbreviations used in the document should be included at the beginning of the report.

CONCLUSIONS

HERD has reviewed and commented on the Draft Final Human Health Risk Assessment as it pertains to human health risk assessment. HERD recommends that a significant number of changes be incorporated into the Draft Final HHRA. The document should plan to include any data, sampling locations, a site background, a lead evaluation, figures describing exposure pathways and receptors, and/or any information pertaining to a thorough assessment of risk. The correct methods of evaluating risk should be performed to DTSC/HERD guidelines. This includes the use of RSLs, proper exposure assumptions, the correct classification of chemicals as carcinogens, and preferred sampling terminology (soil depth). Also, vapor intrusion is a viable exposure pathway for both industrial and residential receptors. Proper soil gas sampling should be conducted, Volatile Organic Chemicals (VOCs) have been detected in the soil/groundwater, which further increases the likelihood of potential risk via this exposure pathway. All future changes to the document should be clearly identified.

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