

# Revision Summary for the Site 10 Human Health Risk Assessment, Norfolk Naval Shipyard, Portsmouth, Virginia

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DATE: April 5, 2006

## 1.1 Introduction

This memorandum presents the changes made to the Draft Human Health Risk Assessment (HHRA) for Site 10 at the Norfolk Naval Shipyard (NNSY) in Portsmouth Virginia. The HHRA for Site 10 is documented in the Remedial Investigation/Human Health Risk Assessment/Focused Feasibility Study (RI/HHRA/FFS) Report which was distributed as a draft document for the Project Management Team (PMT) review in December 2005. Navy, US Environmental Protection Agency (EPA) and the Virginia Department of Environmental Quality (VDEQ) submitted comments on the Draft Report in March 2006. The responses to comments to EPA were distributed to the NNSY PMT on March 20, 2006. The significant changes to the HHRA based on the comments from the Navy, EPA and the VDEQ are summarized herein. Attachments to this tech memo include the Response to EPA comments, revised Section 7 Text, Section 7 Tables, and Appendix D-1 and D-2 HHRA Tables.

## 1.2 Summary of Document Revisions

### 1.2.1 Revisions Based Upon USEPA Comments

USEPA provided Human Health comments on the Draft Remedial Investigation, Human Health Risk Assessment, and Focused Feasibility Study Report for NNSY Site 10 on February 8, 2006. Changes to the document based on comments received by the USEPA are:

- 1) The site wide screening for fugitive and volatile emissions (which includes Dry Dock 8 was added to Appendix D-1 Table 2s.
- 2) Table 7-10 has been added to the HHRA to assess the draft 2001 TCE toxicity values.
- 3) "Calculations of Preliminary Remediation Goals (PRGs)" within the subtitle of Table 7-7 has been removed.
- 4) The final IEUBK model histogram presenting the percentage of populations with blood levels above 5% is included as Table 7-9/Appendix D-1.

- 5) The adult resident has been added as a potential receptor in Table 1.0 of Appendix D-1, but the exposure scenario was not evaluated since the child resident was considered representative of a resident and more conservative than an adult.
- 6) The inhalation cancer slope factor for bis(2-ethylhexyl)phthalate was revised to 1.4E-02 in Table 6.2 of Appendix D.

### **1.2.2 Revisions Based Upon VDEQ Comments**

The VDEQ deferred the technical review by a toxicologist to the EPA. However general comments were provided by the State regulatory project manager. Based on a comment from the VDEQ a discussion was added to the *Uncertainties Section of the HHRA* (Section 7.7) regarding iron and manganese as essential nutrients in groundwater.

### **1.2.3 Revisions Based Upon Navy Comments**

- 1.2.4 It was noted in the Navy's review of the Draft RI/HHRA/FFS, that the calculations of the cancer risks and non cancer hazards in text tables 7-3 and 7-4 were not consistent with Appendix D -1 due to a linking error in the excel spreadsheet. The revised section 7 text tables are attached. Additionally, the Navy commented on a production error which listed Appendix D throughout the Draft report which did not match the tables. The Final will have an Appendix D with two subsections. Subsection D-1 will contain all of the Site 10 risk assessment tables and subsection D-2 will contain the Dry Dock 8 risk assessment tables.

## **1.3 Conclusion**

Revisions were made to the Executive Summary and RI/HHRA Conclusions (Section 8) of the document to reflect the revisions in the HHRA. Additionally, comments on other sections of the document were received from members of the PMT. Therefore a Draft Final RI/HHRA/FFS Report for NNSY Site 10 will be submitted for regulatory review and finalized when the PMT reaches agreement regarding the report revisions.

**Attachment A**

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**NAVY RESPONSE TO COMMENTS**  
**EPA HUMAN HEALTH COMMENTS DATED FEBRUARY 8, 2006 ON DRAFT**  
**RI/HHRA/FFS**  
**NNSY SITE 10**

1. The report should include the raw analytical background data to confirm the results of the statistical UTL testing. In addition, EPA recommends additional background statistical tests since UTL testing can be problematic when data are not normally or lognormally distributed.

Response to Comment No. 1

In preparation of the RTCs, the Navy requested further clarification of this comment. EPA restated the comment in an email dated March 7, 2006.

"The report should provide the document reference necessary to confirm the background UTL statistical test. In other words, the report should provide the reference where the background UTL values were derived and where the raw analytical background data can be located (NNSY Background Report, 2003)."

Following receipt of this comment, the Navy submitted background data tables to EPA at their request. Additionally, the background report for NNSY is referenced in the RI/HHRA/FFS. The comment has been resolved and there will be no revisions to the Human Health Risk Assessment.

2. Section 7.1 and Table 1.0. Please explain why fugitive and volatile emissions from soils are being quantitatively evaluated for the Dry Dock Expansion Area but only qualitatively evaluated for soils\* (surface and subsurface soil combined). In addition, Section 7.2 should include the potential for the construction workers to be exposed to fugitive and volatile emissions from soils\*.

Response to Comment No. 2

The dry dock was evaluated separately to assess construction worker exposure and included all exposure pathways. For consistency, exposure to fugitive and volatile emissions from soil has been evaluated site-wide. As was done for the dry dock area, the air concentrations were modeled using the soil data, and then screened by comparing them to the ambient air RBCs. This screening was added to Appendix D-1 Table 2s. There were no COPCs retained for this pathway. There were no COPCs retained for the fugitive and volatile emissions from soil pathway for the construction worker (or any receptor), as shown in Section 7.1, therefore, this pathway was not added to Section 7.2.

3. Section 7.7. The last paragraph discusses the uncertainty in the analysis of the trichloroethene (TCE) as a result of differing toxicity values. EPA recommends including the final risk results for TCE in a separate table using the draft 2001 TCE toxicity values.

Response to Comment No. 3

The draft 2001 toxicity value for TCE has been used to calculate risk results for informational purposes. The results are discussed in Section 7.7 and included in Table 7-10.

4. Table 7-7 and 7-8. The subtitle to this page is identified as "Calculations of Preliminary Remediation Goals (PRGs)." Since the table does not provide remediation goals, this title appears to be mislabeled? In addition, the report should also include the IEUBK model histogram which provides the final IEUBK results (e.g., percentage of populations with blood levels above 5%).

Response to Comment No. 4

"Calculations of Preliminary Remediation Goals (PRGs)" within the subtitle of Table 7-7 is a typographical error. This text has been removed from the table. The final IEUBK model histogram presenting the percentage of populations with blood levels above 5% is included as Table 7-9/Appendix D-1.

5. Table 1.0. The adult resident must also be included as a potential receptor because the non-carcinogenic risk for adults must also be presented in the report. The current report only provides the non-carcinogenic risk results for the child resident.

Response to Comment No. 5

The adult resident has been added as a potential receptor in Table 1.0 of Appendix D, although the exposure scenario was not evaluated. The HI for a child would be greater than an adult. Since the HI for a child was unacceptable, the HI for any resident is unacceptable. The child resident was considered representative of a resident and more conservative than an adult.

6. Table 6.2. The inhalation cancer slope factor for bis(2-ethylhexyl)phthalate is 1.4E-02.

Response to Comment No. 6

The inhalation cancer slope factor for bis(2-ethylhexyl)phthalate should be 1.4E-02 in lieu of the "N/A" provided in Table 6.2 of Appendix D. Inhalation of this compound from groundwater was not evaluated since it is not a VOC.

7. Table 7.2RME. The soils\* lifetime (cancer) dermal risk results can not be duplicated. Please recheck the algorithm used to produce these results.

Response to Comment No. 7

The results for soils\* lifetime (cancer) dermal risk in Table 7.2 RME were re-checked. The total dermal risk for this exposure route is 2.6E-05 as listed in the table.

**Attachment B**

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## SECTION 7

# Human Health Risk Assessment

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The objectives of this investigation are to assess potential human health risks to construction workers, industrial workers, and hypothetical future residents from exposure to groundwater and soil at Site 10, and to identify any localized areas where action could be taken to either achieve *unrestricted use of Site 10*, or allow for an industrial use restriction of the site. The HHRA incorporates the general risk assessment methodology described by EPA guidance documents (December 1989, December 2001, July 2004) and EPA Region III guidelines and procedures (January 1993, June 2003) for performing human health risk assessments under CERCLA.

Analytical data collected during two site investigations (one in September 2001, the other in April 2004) were evaluated in the human health risk assessment. Data collected from the area where dry dock 8 will potentially be expanded were also evaluated separately to determine if there are any potential risks to the construction worker who will be doing the expansion work. Figure 4-1 shows the locations of these samples as well as the approximate boundary of Site 10. Table 7-1 lists the samples collected during both events and evaluated in this risk assessment.

A complete summary of the analytical results evaluated in this HHRA are presented in Appendix C. Detected constituents are identified in Tables 5-3, 5-4, 5-5, and 5-6 in Section 5.

## Constituents of Potential Concern

The maximum detected concentration of each constituent was compared to the risk-based screening criteria discussed below to select the constituents of potential concern (COPCs). If the maximum detected concentration exceeded the screening criterion, the constituent was selected as a COPC. Constituents that were not detected in any of the samples at concentrations exceeding the criteria were not retained as COPCs, and therefore were not evaluated beyond this step in the risk assessment.

Soil data were compared to the EPA Region III RBCs for residential contact with soil (EPA, October 2005). Additionally, air concentrations associated with fugitive and volatile emissions from soil were modeled based on the soil data, following EPA's Soil Screening Guidance Document (EPA, April 1996). The calculated air concentrations were compared to EPA Region III ambient air RBCs (EPA, October 2005). There were no COPCs retained for the soil-to-air pathway based on this screening. Groundwater data were compared to the EPA Region III RBCs for tap water. The RBCs that are based on noncarcinogenic effects were divided by 10 to account for exposure to multiple constituents. The RBCs that are based on carcinogenic endpoints were used as presented in the RBC table. Lead concentrations in soil were compared to the EPA residential child soil screening value of 400 mg/kg, as determined by the Integrated Exposure Uptake Biokinetic (IEUBK) Model (EPA, August 1994). Lead concentrations in groundwater were compared to the EPA Safe

Drinking Water Act action level of 15 µg/L. Appendix D-1, Tables 2.1 through 2.5 show the results of the COPC selection for constituents detected in soil and groundwater.

For the dry dock 8 expansion area, soil data were compared to the EPA Region III RBCs for residential contact with soil (EPA, October 2005). Air concentrations associated with fugitive and volatile emissions from soil were modeled based on the soil data, following EPA's Soil Screening Guidance Document (EPA, April 1996), and compared to EPA Region III ambient air RBCs (EPA, April 2005). There were no COPCs retained for the soil-to-air pathway based on this screening. Appendix D-2, Tables 2.1 and 2.2 show the results of the COPC selection for soil for the dry dock 8 expansion area.

Comment [CH1]: EPA RTC

Table 7-2 identifies the COPCs selected for soil and groundwater. For surface soil, five PAHs, one pesticide, and fourteen inorganics were selected as COPCs based on screening the maximum detected concentrations against the residential soil RBCs. In combined surface and subsurface soil, six PAHs, one pesticide, and fourteen inorganics were selected as COPCs. Five VOCs, three SVOCs, four pesticides, and eight inorganics were selected as COPCs for groundwater based on screening the maximum detected concentration against the tap water RBCs.

For the dry dock 8 expansion area, one PAH and six metals were selected as COPCs.

## Potential Receptors

There is no current exposure to media at Site 10. The majority of the site is covered by buildings, pavement, or gravel, eliminating exposure to soil. Groundwater at Site 10, or anywhere on the Base, is not currently used as a potable water supply. A construction worker, industrial worker, and lifetime resident were identified as potential future receptors at Site 10. The construction worker could be exposed to soil (combined surface and subsurface) via incidental ingestion and dermal contact, and groundwater via dermal contact and inhalation of groundwater vapors from an open excavation. The future industrial worker could be exposed to surface soil (if pavement is removed, but no other significant re-working or re-grading of the site and site soil is performed) or combined surface and subsurface soil via incidental ingestion and dermal contact, and groundwater via ingestion. Future residents could be exposed to soil (combined surface and subsurface) via incidental ingestion and dermal contact, and groundwater used as a potable water supply via ingestion, dermal contact, and inhalation of vapors. The future resident risk evaluation included evaluation of a child resident for noncarcinogenic hazards and a lifetime resident for carcinogenic risks. It was assumed, that since the child resident scenario is more conservative than an adult resident scenario, if this scenario showed no risk, it could be assumed the adult resident would also not have risk. Exposure to volatile and fugitive dust emissions from soil is not a complete pathways for any of the receptors, as no COPCs were retained for this pathway (Appendix D-1, Tables 2.2 and 2.4, and Appendix D-2, Table 2-2).

Comment [CH2]: RTC for comment # 5

## Exposure Parameters

Reasonable maximum exposure (RME) and central tendency exposure (CTE) parameters were compiled. The exposure parameters used to estimate the risks to each of the potential

receptors are included in Appendix D-1, Tables 4.1.RME through 4.4.RME and 4.1.CTE through 4.3.CTE. The RME parameters are discussed below. The CTE parameters were only used to estimate CTE risks and hazards when RME risks exceeded EPA target risk levels (as discussed in Section 7.6)

Construction workers were assumed to be exposed to site soils and groundwater 250 days per year, 8 hours per day, for 1 year. It was assumed that the construction workers would incidentally ingest 480 mg of soil per day from the site. This incidental soil ingestion rate is considered appropriate for "contact-intensive" activities, such as construction work (EPA, March 2001). Dermal exposure to constituents in soil and groundwater was estimated using recommendations in RAGS E (EPA, July 2004), as appropriate. It was assumed that construction workers wear a short-sleeved shirt, long pants, and shoes; therefore, the exposed skin surface area (3,300 cm<sup>2</sup>) accounts for head, hands, and forearms. The soil-to-skin adherence factor (0.3 mg/cm<sup>2</sup>) is the 95<sup>th</sup> percentile for utility workers (EPA, September 2001). It was assumed that the inhalation rate for the construction worker is 2.5 m<sup>3</sup>/hour, which is the recommended inhalation rate for adults working outdoors performing heavy activities, based on short-term exposure (EPA, August 1997)

Industrial workers were assumed to be exposed to site soils and groundwater for 250 days per year, 8 hours per day, for 25 years. It was assumed that the industrial workers would incidentally ingest 100 mg of soil per day from the site. Dermal exposure to constituents in soil was estimated using recommendations in RAGS E (EPA, July 2004), as appropriate. It was assumed that industrial workers wear a short-sleeved shirt, long pants, and shoes; therefore, the exposed skin surface area (3,300 cm<sup>2</sup>) accounts for head, hands, and forearms. The soil-to-skin adherence factor (0.2 mg/cm<sup>2</sup>) is the EPA recommended value for commercial/industrial workers (EPA, July 2004). It was conservatively assumed that site groundwater would be used as a potable water supply for the industrial worker, and the workers would ingest 1 liter of water per day while at work.

A child resident was evaluated for noncarcinogenic hazards, and a lifetime resident was evaluated for carcinogenic risks associated with hypothetical future residential use of Site 10. Future lifetime residents were assumed to be exposed to site soils and groundwater for 350 days per year for 30 years, and future child residents were assumed to be exposed for 6 years. It was assumed that each day a child resident would incidentally ingest 200 mg of soil per day, and the lifetime resident would incidentally ingest 114 mg soil-year/kg body weight-day of soil (see Attachment B, Table 4.2.RME for calculation of this lifetime residential ingestion factor) from the site. Dermal exposure to constituents in soil and groundwater was estimated using recommendations in RAGS E (EPA, July 2004), as appropriate. Inhalation of volatiles while showering was calculated for the lifetime resident. The inhalation rate used for the lifetime resident while showering was 0.83 m<sup>3</sup> per day. The other parameters associated with the shower model are shown in Appendix D-1, Table 7.2.RME Supplement C.

The following constituent-specific dermal absorption fraction values were used to estimate dermal exposure to both surface and subsurface soil constituents:

- 0.13 for PAHs
- 0.10 for all other SVOCs and pesticides
- 0.03 arsenic

- 0.001 for cadmium
- 0.01 for all other inorganics

## Exposure Point Concentrations

Exposure point concentrations (EPCs) are estimated medium- and chemical-specific concentrations that a receptor may contact. EPCs may be directly monitored or estimated using environmental models. For this assessment volatile emissions from groundwater while showering were estimated for the resident using the Foster and Chrostowski shower model (Appendix D-1, Table 7.2.RME Supplement C) and for the construction worker using a two-film volatilization model (Appendix D-1, Table 7.1.RME Supplement B). Filtered groundwater data was used in this assessment to calculate the EPCs for the inorganic COPCs.

Both RME and CTE EPCs were calculated for the COPCs. The RME EPCs were calculated in accordance with EPA guidance (EPA, December 2002). The RME EPCs were calculated as the 95 percent upper confidence limit (95 percent UCL) of the arithmetic mean concentration. ProUCL, Version 3.0 (EPA, April 2004), was used to calculate the UCLs and determine the distribution data fit. ProUCL 3.0 includes three possible data distribution tests: normal distribution, lognormal distribution, and gamma or approximate gamma distribution. The UCL is then calculated based on the data distribution. If the dataset does not fit any of these distributions, then ProUCL includes nonparametric methods to calculate the UCL.

The distribution that the data fit, as determined by ProUCL, was used to select the appropriate UCL calculation method. The recommendations outlined in the ProUCL model documentation were used to select the appropriate UCL (EPA, April 2004).

The average concentration was used as the EPC for CTE scenarios. For data that fit a lognormal distribution (based on the Shapiro-Wilk W-test), the minimum variance unbiased estimate of the mean (MVUE) was used as the EPC (Gilbert, 1987). For data that fit a normal or gamma distribution, the average of the data was used as the CTE EPC. For data sets that did not fit normal, lognormal, or gamma distributions, the average concentration of the data was used as the EPC.

The RME and CTE EPCs are included in Appendix D-1, Tables 3.1.RME through 3.3.RME and 3.1.CTE through 3.3.CTE, and for the dry dock 8 area, Appendix D-2, Table 3.1.

## Toxicity Assessment

Toxicity assessment defines the relationship between the magnitude of exposure and possible severity of adverse effects, and weighs the quality of available toxicological evidence. Health effects are divided into two broad groups: noncarcinogenic and carcinogenic effects. This division is based on the different mechanisms of action currently associated with each category, and therefore these differences affect how dose-response is estimated. Constituents that cause noncarcinogenic health effects are evaluated independently from those that cause carcinogenic effects. Some constituents may elicit both noncarcinogenic and carcinogenic effects, and are therefore evaluated in both groups.

The primary source of toxicity values is the EPA's Integrated Risk Information System (IRIS) database, which contains up-to-date toxicity and dose-response information for numerous chemicals. IRIS includes only noncarcinogenic reference doses (RfDs) and cancer slope factors (CSFs) that have been verified by EPA work groups. The IRIS database is the EPA's preferred source of toxicity information. In accordance with EPA guidance (EPA, December 2003), the second tier of toxicity factors is the Provisional Peer Reviewed Toxicity Value (PPRTV) database maintained by the EPA's National Center for Environmental Assessment (NCEA) and the Superfund Health Risk Technical Support Center (STSC). If toxicity data are not available from either of these sources, EPA will consider toxicity values obtained from other EPA and peer-reviewed non-EPA sources. The use of provisional toxicity values, such as those from the PPRTV database, in an HHRA increases the uncertainty of the quantitative risk estimate.

The toxicity values used in this HHRA are presented on Tables 5.1, 5.2, 6.1, and 6.2, in Appendix D-1.

When subchronic toxicity values for noncarcinogenic effects were available, they were used for the construction worker because of the short exposure duration (1 year). It should be noted that IRIS does not contain subchronic toxicity values; all subchronic toxicity information was obtained from either Tier II (PPRTV) or Tier III (HEAST) sources.

Lead does not have available published toxicity factors, and therefore is assessed differently than the other COPCs. Lead is regulated by EPA based on the concentration of lead in blood in children. The blood-lead concentration is estimated by using a physiologically based pharmacokinetic model, the IEUBK Model (EPA, May 2002). Risks associated with residential exposure to lead are evaluated using EPA's IEUBK Model. The principal assumption associated with the use of IEUBK is that a child from ages 0 to 7 years old is the receptor for potential exposure to lead in soil. The EPA has also developed a model that can be applied to industrial workers exposed to lead, which relates soil lead intake to blood lead concentrations of women of child-bearing age (EPA, December 1996). The methodology focuses on estimating fetal blood lead concentrations in women exposed to lead-contaminated soils. The average lead concentration is used as the exposure concentration in both models.

## **Risk Characterization**

The RME and CTE results of the HHRA evaluation for the whole site are summarized on Tables 7-3 and 7-4, Tables 9.1.RME through 9.4.RME, and 9.1.CTE through 9.3.CTE in Appendix D-1. The results of the HHRA for the dry dock 8 expansion area are summarized on Table 7-5 and Appendix D-2, Table 9.1. The risk calculations are presented in Appendix D-1, Tables 7.1.RME through 7.4.RME and 7.1.CTE through 7.3.CTE for the site, and Appendix D-2, Table 7.1.RME for the dry dock 8 expansion area.

The noncarcinogenic hazard quotient (HQ) is calculated by dividing the intake (calculated in Appendix D-1, Table 7s using the exposure parameters discussed in Section 7.4 and the exposure point concentrations discussed in Section 7.5) by the RfD (shown on Tables 5.1 and 5.2, Appendix D-1). All of the individual chemical HQs for each exposure scenario are summed to estimate the noncarcinogenic hazard index (HI) for that scenario. EPA's target noncarcinogenic HI is 1.0. An HI less than 1.0 indicates that there are no potential

noncarcinogenic risks. An HI above 1.0 indicates that there is some potential for adverse noncarcinogenic health effects associated with exposure by the receptor, possibly warranting remedial action. When the HI is greater than 1, the individual constituent HQs were summed by the resulting health effect or target organ. If the HIs summed by target organ are not greater than 1, it is assumed that there would be no adverse noncarcinogenic health effects.

The carcinogenic risk is calculated by multiplying the intake by the CSF (shown on Tables 6.1 and 6.2, Appendix D-1). EPA's target carcinogenic risk range is between  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ . Carcinogenic risks below or within this range are assumed to be acceptable.

CTE risks were calculated for receptors and media that had RME risks or hazards greater than EPA's target levels.

#### **Construction Worker, site-wide**

Construction worker exposure to soil could result in a carcinogenic risk of  $5.5 \times 10^{-6}$ , which is within EPA's target carcinogenic risk range. The noncarcinogenic HI of 2.0 associated with exposure to soil exceeds EPA's target HI; however, none of the individual target organs/effects have HIs greater than 1, and therefore the noncarcinogenic hazard is considered to be acceptable. Because the noncancer HI was greater than 1, a CTE evaluation for a construction worker in contact with soil was performed (Appendix D-1, Table 9.1.CTE). The CTE HI (0.83) is less than the EPA target level of 1.

Construction worker exposure to shallow groundwater could result in a carcinogenic risk of  $3.3 \times 10^{-7}$  and a noncarcinogenic HI of 0.38, both of which are less than EPA's target risk levels.

Lead was retained as a COPC for combined surface soil and subsurface soil. As discussed in Section 7.6, exposure to lead is evaluated for adult workers using the adult lead model (EPA, December 1996). This approach uses a methodology to relate soil lead intake to blood lead concentrations in women of child-bearing age. The methodology focuses on estimating fetal blood lead concentration in women exposed to lead contaminated soils. This guidance provides a set of default parameter values that can be used in cases where high quality data are not available to support site-specific estimates. The mean lead soil concentration was used in the model, along with the default values for all of the other parameters.

The results of the adult lead model for soil are summarized in Table 7-6. As shown in the table, the highest 95th percentile blood lead concentration among fetuses of adult workers is  $8.8 \mu\text{g}/\text{dL}$ . The probability that the fetal lead blood concentration would be greater than the target blood lead concentration of  $10 \mu\text{g}/\text{dL}$  is 3.6 percent and is below the goal of 5 percent. Therefore, exposure to lead in soil is not considered a health concern for the fetuses of workers.

#### **Industrial Worker**

As discussed in Section 7.3, the future industrial worker could be exposed to either surface soil (if pavement is removed, but no other significant re-working or re-grading of the site and site soil is performed) or combined surface and subsurface soil. Industrial worker exposure to surface soil could result in a carcinogenic risk of  $3.4 \times 10^{-5}$ , which is within EPA's target carcinogenic risk range. The noncarcinogenic HI of 0.64 associated with exposure to surface soil is less than EPA's target HI.

Industrial worker exposure to combined surface and subsurface soil could result in a carcinogenic risk of  $3.7 \times 10^{-5}$ , which is within EPA's target carcinogenic risk range. The noncarcinogenic HI of 0.53 associated with exposure to soil is less than EPA's target HI.

Industrial worker exposure to shallow groundwater could result in a carcinogenic risk of  $1.2 \times 10^{-4}$ , which is greater than EPA's target carcinogenic risk range. The risk is primarily driven by arsenic. Because the carcinogenic risk was greater than  $1 \times 10^{-4}$ , a CTE evaluation for an industrial worker in contact with shallow groundwater was performed (Appendix D-1, Table 9.3.CTE). The CTE carcinogenic risk ( $2.5 \times 10^{-5}$ ) is within the EPA's target carcinogenic risk range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ . The noncarcinogenic HI of 2.6 associated with exposure to shallow groundwater by industrial workers exceeds EPA's target HI. Because the noncancer HI was greater than 1, a CTE evaluation for an industrial worker in contact with shallow groundwater was performed (Appendix D-1, Table 9.3.CTE). The CTE HI of 1.3 associated with exposure to shallow groundwater exceeds EPA's target HI; however, none of the individual target organs/effects have HIs greater than 1, and therefore the noncarcinogenic hazard is considered to be acceptable.

Lead was retained as a COPC for both surface soil and combined surface and subsurface soil. Exposure to lead in combined surface and subsurface soil by adult workers is discussed in the previous section for the construction worker. The results of the adult lead model for surface soil are summarized in Table 7-7. As shown in the table, the highest 95th percentile blood lead concentration among fetuses of adult workers is  $10.2 \mu\text{g}/\text{dL}$ . The probability that the fetal lead blood concentration would be greater than the target blood lead concentration of  $10 \mu\text{g}/\text{dL}$  is 5.2 percent and is slightly above the goal of 5 percent. Therefore, exposure to lead in surface soil may pose a slight risk for the fetuses of workers.

#### **Resident**

Future lifetime resident exposure to soil could result in a carcinogenic risk of  $1.4 \times 10^{-4}$ , which is greater than EPA's target carcinogenic risk range. The risk is primarily driven by arsenic with a smaller contribution from PAHs. Because the carcinogenic risk was greater than  $1 \times 10^{-4}$ , a CTE evaluation for a lifetime resident in contact with soil was performed (Appendix D-1, Table 9.2.CTE). The CTE carcinogenic risk ( $1.5 \times 10^{-5}$ ) is within the EPA's target carcinogenic risk range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ . The noncarcinogenic HI of 5.6 associated with exposure to soil by child residents exceeds EPA's target HI. The hazard is primarily driven by arsenic (the only constituent with an individual HI above 1) with smaller contributions from copper, iron, and mercury. Because the noncancer HI was greater than 1, a CTE evaluation for a child resident in contact with soil was performed (Appendix D-1, Table 9.2.CTE). The CTE HI (0.91) is below the EPA target level of 1. Therefore, since there is a RME hazard above EPA's target HI to the child resident, and a RME carcinogenic risk to the residential child, it was assumed that for the residential scenario.

Future lifetime resident exposure to shallow groundwater could result in a carcinogenic risk of  $5.5 \times 10^{-4}$ , which is greater than EPA's target carcinogenic risk range. The risk is primarily driven by arsenic. Because the carcinogenic risk was greater than  $1 \times 10^{-4}$ , a CTE evaluation for a lifetime resident in contact with shallow groundwater was performed (Appendix D-1, Table 9.2.CTE). The CTE carcinogenic risk ( $1.2 \times 10^{-4}$ ) is greater than the EPA's target carcinogenic risk range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ . The noncarcinogenic HI of 39 associated with exposure to shallow groundwater by child residents exceeds EPA's target HI. Since the

noncarcinogenic HI exceeds EPA's target HI for the child residents it would also exceed for the adult residents. The hazard is primarily driven arsenic, iron, and manganese, all contributing individual HIs greater than 1.0. Because the noncancer HI was greater than 1, a CTE evaluation for a child resident in contact with shallow groundwater was performed (Appendix D-1, Table 9.2.CTE). The CTE HI (6.5) is greater than the EPA target level of 1.

Lead was retained as a COPC for combined surface and subsurface soil. As discussed in Section 7.6, exposure to lead is evaluated for child residents using the IEUBK model (EPA, May 2002). The results of the IEUBK model for surface soil are summarized in Table 7-8 and Table 7-9. The IEUBK evaluation resulted in a geometric mean blood concentration of 5.7 µg/dL (micrograms of lead per deciliter blood) for children 0 to 84 months old. Approximately 12 percent of this population had a blood lead level greater than EPA's recommended level of 10 µg/dL. EPA considers lead in soil not to be a health concern if less than 5 percent of the population has a blood-lead level greater than 10 µg/dL. Therefore, residential exposure to lead in surface soil may be a potential health concern for residential children.

Comment [CH3]: EPA RTC to comment #4.

### **Construction Worker, Dry Dock 8 Expansion**

Construction worker exposure to surface and subsurface soil could result in a carcinogenic risk of  $8.5 \times 10^{-7}$ , which is less than EPA's target carcinogenic risk range. The noncarcinogenic HI of 0.65 associated with exposure to surface soil is less than EPA's target HI of 1.

Therefore, construction worker exposure to surface soil and subsurface soil during the dry dock 8 expansion project will not result in any hazards or risks greater than EPA's target levels.

## **Uncertainty/Limitations**

The risk measures used in Superfund site risk assessments are not fully probabilistic estimates of risk but are conditional estimates given a set of assumptions about exposure and toxicity that are realized. Thus, it is important to specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective (EPA, 1989). The uncertainty related to all aspects of this HHRA have been addressed by using conservative assumptions, where applicable. This section summarizes some of the key assumptions/limitations inherent in the risk characterization calculations performed in this assessment.

The uncertainty in sampling and possibility of missing a contaminated location is expected to be minimal at this site because of the amount of sampling data available for the site. The quantitative uncertainty associated with the other factors is also minimal because the data were validated before use in the risk assessment. The general assumptions used in the COPC selection are conservative to ensure the estimation of highest possible risk.

Comparison of the site data to background data was not used as criteria in the selection of the COPCs. However, the maximum detected concentration of the primary risk driver for residential exposure to soil, arsenic, exceeds the 95 percent UTL for this constituent in background soil. Additionally, the maximum detected concentrations of the risk drivers for

residential and or industrial exposure to groundwater, arsenic, iron, and manganese, exceed the background 95 percent UTL.

The dermal exposure to soil pathway is a large source of uncertainty in the risk assessment. The percent of a constituent absorbed through the skin is likely to be affected by many parameters. Some of the parameters include soil loading, soil moisture content, organic content, pH, and presence of other constituents. The availability of a chemical depends on site-specific fate and transport properties of the chemical species available for eventual absorption of skin. Constituent concentrations, specific properties of the constituent, and soil release kinetics all impact the amount of a constituent that is absorbed. These factors contribute to the uncertainty associated with these estimates and make quantitation of the amount of certain constituents absorbed from soil difficult.

Use of provisional toxicity factors increases the degree of uncertainty associated with the risk assessment. Provisional chronic RfDs for aluminum, cobalt, copper, iron, vanadium, 1,1,2,2-tetrachloroethane, and trichloroethene were used in this assessment. Therefore, the quantitative estimates of risk for these constituents are associated with greater uncertainty. It should also be noted that although the RBCs for aluminum, cobalt, dibenzofuran, and cis-1,2-dichloroethene have been removed from the EPA Region III RBC because the provisional toxicity values used to calculate the RBCs have expired, the RBCs for these constituents from the April 2005 RBC table were used for the COPC screening. Because IRIS does not include subchronic toxicity values, the subchronic RfDs used in this assessment are also associated with greater uncertainty.

Iron is an essential human nutrient, which complicates the derivation of an RfD (USEPA, January 1999). The future child resident had an estimated HQ from ingestion of iron in groundwater of 8.5, which is greater than the USEPA target value of 1. The estimated RME intake of iron via ingestion of groundwater (2.6 mg/kg-day; Appendix D Table 7.2.RME) is only slightly above the recommended daily allowance (RDA) range for children ages 6 months to 10 years (0.36 – 1.11 mg/kg-day) (EPA, January 1999). Additionally the intake is below the maximum daily intake that is likely to pose no risk of adverse effects, or the UL. The iron UL for children is 2.7 mg/day (Institute of Medicine, 2005). Therefore, exposure to iron in groundwater may not be a health concern for the future resident.

Although the oral RfD for manganese is not provisional (that is, the RfD has been approved by an EPA workgroup), the derivation of toxicity factors for essential nutrients is complicated, and therefore, warrants further discussion. Manganese is an essential human nutrient responsible for activating several enzymes (EPA, 2006). Disease states have been documented in humans associated with both deficiencies and excess intakes of manganese (EPA, 2006). The IRIS profile for manganese states, "The reference dose is estimated to be an intake for the general population that is not associated with adverse health effects; this is not meant to imply that intakes above the reference dose are necessarily associated with toxicity. Some individuals may, in fact, consume a diet that contributes more than 10 mg Mn/day without any cause for concern," (EPA, 2006). Ingestion of manganese in groundwater may result in an HI of 1.7 to a future child resident, based on a daily intake rate of 0.034 mg/kg-day, which corresponds to an intake of 0.51 mg/day (Appendix D, Table 7.2.RME). Dermal contact with manganese in groundwater while bathing may result in an HI of 21, based on a daily intake rate of 0.017 mg/kg-day, corresponding to an intake of 0.26 mg/day (Appendix D, Table 7.2). The combined intake from ingestion and dermal

contact is much lower than the RDA for manganese for a child 1 to 3 years of age of 65 mg/day (Institute of Medicine, 2005). Therefore, exposure to manganese in the groundwater is not expected to be a health concern for the child resident.

**Comment [CH4]:** Response to DEQ

The draft 2001 trichloroethene toxicity values (EPA, August 2001) were not used in the risk assessment. Risks were calculated using the 1986 trichloroethene toxicity values that have been withdrawn from IRIS. When risks are calculated using the draft 2001 trichloroethene toxicity values, there are still no risks greater than EPA target levels associated with exposure to trichloroethene. The contribution from trichloroethene to the total risks and hazards are very small. The effects of the use of the Draft 2001 TCE toxicity versus the 1986 toxicity values are shown in Table 7-10.

**Comment [CH5]:** EPA RTC to comment #3



## **Attachment C**

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**Table 7-1**  
**Summary of Data Evaluated in Site 10 Human Health Risk Assessment**  
**NNSY Site 10**

Medium	Date of Sampling	Sample	Parameters	
<b>Soil</b>				
Surface Soil (0 to 6 inches)	Sep-01	LDLFL 1927-SS01-00	METAL, PEST/PCB, SVOA, VOA	
	Sep-01	LDLFL 1927-SS05-00	METAL, PEST/PCB, SVOA, VOA	
	Sep-01	LDLFL 1927-SS07-00	METAL, PEST/PCB, SVOA, VOA	
	Sep-01	LDLFL 1927-SS08-00	METAL, PEST/PCB, SVOA, VOA	
	Sep-01	LDLFL 1927-SS09-00	METAL, PEST/PCB, SVOA, VOA	
	Sep-01	LDLFL 1927-SS10-00	METAL, PEST/PCB, SVOA, VOA	
	Sep-01	LDLFL 1927-SS12-00	METAL, PEST/PCB, SVOA, VOA	
	Sep-01	LDLFL 1927-SS15-00	METAL, PEST/PCB, SVOA, VOA	
	Apr-04	10-SO01-00	METAL, SVOA	
	Apr-04	10-SO02-00	METAL, SVOA	
	Apr-04	10-SO03-00	METAL, SVOA	
	Apr-04	10-SO03-00-P	METAL, SVOA	
	Apr-04	10-SO04-00	METAL, SVOA	
	Apr-04	10-SO05-00	METAL, SVOA	
	Apr-04	10-SO06-00	METAL, SVOA	
	Apr-04	10-SO07-00	METAL, SVOA	
	Apr-04	10-SO07-00-P	METAL, SVOA	
	Apr-04	10-SO08-00	METAL, SVOA	
	Apr-04	10-SO09-00	METAL, SVOA	
	Apr-04	10-SO10-00	METAL, SVOA	
	Apr-04	10-SO11-00	METAL, PEST/PCB, SVOA, VOA	
	Apr-04	10-SO12-00	METAL, PEST/PCB, SVOA, VOA	
	Apr-04	10-SO13-00	METAL, PEST/PCB, SVOA, VOA	
	Apr-04	10-SO14-00	METAL, PEST/PCB, SVOA, VOA	
	Subsurface Soil (Below 2 feet)	Sep-01	SSP-LDFL 1927-SB01-01	METAL, PEST/PCB, SVOA, VOA
		Sep-01	SSP-LDFL 1927-SB02-01	METAL, PEST/PCB, SVOA, VOA
		Sep-01	SSP-LDFL 1927-SB03-01	METAL, PEST/PCB, SVOA, VOA
		Sep-01	SSP-LDFL 1927-SB04-02	METAL, PEST/PCB, SVOA, VOA
Sep-01		SSP-LDFL 1927-SB04-02-P	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB05-01	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB06-01	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB06-01-P	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB07-01	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB08-01	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB09-01	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB10-01	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB10-01-P	METAL, PEST/PCB, SVOA, VOA	
Sep-01		SSP-LDFL 1927-SB12-01	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO01-01	METAL, SVOA	
Apr-04		10-SO02-01	METAL, SVOA	
Apr-04		10-SO03-01	METAL, SVOA	
Apr-04		10-SO03-01-P	METAL, SVOA	
Apr-04		10-SO04-01	METAL, SVOA	
Apr-04		10-SO05-01	METAL, SVOA	
Apr-04		10-SO06-01	METAL, SVOA	
Apr-04		10-SO07-01	METAL, SVOA	
Apr-04		10-SO07-01-P	METAL, SVOA	
Apr-04		10-SO08-01	METAL, SVOA	
Apr-04		10-SO09-01	METAL, SVOA	
Apr-04		10-SO10-01	METAL, SVOA	
Apr-04		10-SO11-01	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO12-01	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO13-01	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO14-01	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO15-00	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO15-01	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO15-02	METAL, PEST/PCB, SVOA, VOA	
Apr-04		10-SO16-00	METAL, PEST/PCB, SVOA, VOA	
Apr-04	10-SO16-01	METAL, PEST/PCB, SVOA, VOA		
Apr-04	10-SO16-02	METAL, PEST/PCB, SVOA, VOA		

**Table 7-1  
Summary of Data Evaluated in Site 10 Human Health Risk Assessment  
NNSY Site 10**

Medium	Date of Sampling	Sample	Parameters
<b>Groundwater</b>			
	Oct-01	LDFL 1927-MW01-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW02-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW03-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW04-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW05-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW06-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW07-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW08-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW09-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW10-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW10-01D-P	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Oct-01	LDFL 1927-MW11-01D	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Apr-04	10-MW01-04B	METAL (filtered and total), VOA
	Apr-04	10-MW01P-04B	METAL (filtered and total), VOA
	Apr-04	10-MW02-04B	METAL (filtered and total), VOA
	Apr-04	10-MW03-04B	METAL (filtered and total), VOA
	Apr-04	10-MW04-04B	METAL (filtered and total), VOA
	Apr-04	10-MW05-04B	METAL (filtered and total), VOA
	Apr-04	10-MW06-04B	METAL (filtered and total), VOA
	Apr-04	10-MW07-04B	METAL (filtered and total), VOA
	Apr-04	10-MW08-04B	METAL (filtered and total), VOA
	Apr-04	10-MW09-04B	METAL (filtered and total), VOA
	Apr-04	10-MW10-04B	METAL (filtered and total), VOA
	Apr-04	10-MW11-04B	METAL (filtered and total), VOA
	Apr-04	10-MW-12-04B	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Apr-04	10-MW12P-04B	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Apr-04	10-MW13-04B	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Apr-04	10-MW14-04B	METAL (filtered and total), PEST/PCB, SVOA, VOA
	Apr-04	10-MW15-04B	METAL (filtered and total), PEST/PCB, SVOA, VOA
<b>Dry Dock 8</b>			
Soil	Sep-01	SSP-LDFL1927-SB09-01	METAL, PEST/PCB, SVOA, VOA
	Sep-01	SSP-LDFL1927-SS09-00	METAL, PEST/PCB, SVOA, VOA
	Apr-04	10-SO15-00	METAL, PEST/PCB, SVOA, VOA
	Apr-04	10-SO15-01	METAL, PEST/PCB, SVOA, VOA
	Apr-04	10-SO15-02	METAL, PEST/PCB, SVOA, VOA
	Apr-04	10-SO16-00	METAL, PEST/PCB, SVOA, VOA
	Apr-04	10-SO16-01	METAL, PEST/PCB, SVOA, VOA
	Apr-04	10-SO16-02	METAL, PEST/PCB, SVOA, VOA

**Table 7- 2**  
**Summary of Chemicals of Potential Concern**  
**NNSY Site 10**

Groundwater	Soil		Dry Dock 8 Soil
	Surface Soil	Surface and Subsurface Soil	Surface and Subsurface
1,1,2,2-Tetrachloroethane	Benzo(a)anthracene	Benzo(a)anthracene*	Benzo(a)pyrene
Benzene	Benzo(a)pyrene*	Benzo(a)pyrene*	Aluminum
Chloroform	Benzo(b)fluoranthene	Benzo(b)fluoranthene*	Arsenic
Trichloroethene	Dibenz(a,h)anthracene*	Benzo(k)fluoranthene	Chromium
Vinyl chloride	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene*	Iron
2-Methylnaphthalene	Heptachlor epoxide	Indeno(1,2,3-cd)pyrene	Manganese
Butylbenzylphthalate	Aluminum	Heptachlor Epoxide	Vanadium
bis(2-Ethylhexyl)phthalate	Antimony	Aluminum	
Aldrin	Arsenic*	Antimony	
Dieldrin	Cadmium	Arsenic*	
Heptachlor epoxide	Chromium	Cadmium	
beta-BHC	Copper*	Chromium	
Antimony	Iron*	Copper*	
Arsenic	Lead*	Iron*	
Cadmium	Manganese	Lead*	
Cobalt	Mercury*	Manganese	
Iron	Nickel	Mercury	
Manganese	Silver	Nickel	
Nickel	Vanadium	Silver	
Selenium	Zinc	Vanadium	
		Zinc	

\* In addition to exceeded USEPA Region III Residential Soil RBCs, these constituents exceed the Industrial Soil RBCs.

**Table 7-3**  
**Summary of RME Cancer Risks and Hazard Indices**  
**NNSY Site 10**

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-5</sup> and <10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-6</sup> and <10 <sup>-5</sup>	Hazard Index	Chemicals with HI>1
Construction Worker	Soil	Ingestion	4.8E-06			Arsenic	1.7	
		Dermal Contact	7.4E-07				0.29	
		Inhalation	NA				NA	
		Total	5.5E-06				2.0	
	Groundwater	Ingestion	NA				NA	
		Dermal Contact	3.3E-07				0.38	
		Inhalation	6.5E-09				0.00029	
		Total	3.3E-07				0.38	
	All Media	Total	5.9E-06				2.4	
	Industrial Worker	Surface Soil	Ingestion	2.5E-05		Arsenic	Benzo(a)pyrene, Dibenz(a,h)anthracene	0.43
Dermal Contact			9.6E-06			Arsenic, Benzo(a)pyrene, Dibenz(a,h)anthracene	0.21	
Inhalation			NA				NA	
Total			3.4E-05				0.64	
Groundwater		Ingestion	1.2E-04	Arsenic		Vinyl chloride, Aldrin, Dieldrin, Hetptachlor epoxide	2.6	Iron
		Dermal Contact	NA				NA	
		Inhalation	NA				NA	
		Total	1.2E-04				2.6	
All Media		Total	1.6E-04				3.3	
Industrial Worker		Soil	Ingestion	2.5E-05		Arsenic	Benzo(a)anthracene, Benzo(a)pyrene, Dibenz(a,h)anthracene	0.35
	Dermal Contact		1.2E-05			Arsenic, Benzo(a)pyrene, Dibenz(a,h)anthracene	0.18	
	Inhalation		NA				NA	
	Total		3.7E-05				0.53	
	Groundwater	Ingestion	1.2E-04	Arsenic		Vinyl chloride, Aldrin, Dieldrin, Hetptachlor epoxide	2.6	Iron
		Dermal Contact	NA				NA	
		Inhalation	NA				NA	
		Total	1.2E-04				2.6	
	All Media	Total	1.6E-04				3.1	

**Table 7-3  
Summary of RME Cancer Risks and Hazard Indices  
NNSY Site 10**

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-5</sup> and <10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-6</sup> and <10 <sup>-5</sup>	Hazard Index	Chemicals with HI>1
Resident	Soil	Ingestion	1.1E-04		Arsenic, Benzo(a)pyrene, Dibenz(a,h)anthracene	Benzo(a)pyrene, Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene	4.6	Arsenic
		Dermal Contact	2.6E-05			Arsenic, Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene	1.0	
		Inhalation	NA				NA	
		Total	1.4E-04				5.6	
	Groundwater	Ingestion	5.2E-04	Arsenic	Vinyl chloride	1,1,2,2-Tetrachloroethane, Bis(2-Ethylhexyl)phthalate, Aldrin, Dieldrin, Heptachlor epoxide	17	Arsenic, Iron, Manganese
		Dermal Contact	2.0E-05			Butylbenzylphthalate, Bis(2-Ethylhexyl)phthalate, Dieldrin, Heptachlor epoxide	22	Manganese
		Inhalation	1.3E-05			1,1,2,2-Tetrachloroethane	NA	
		Total	5.5E-04				39	
		All Media	Total	6.9E-04				44

NA - Not applicable, pathway incomplete.

**Table 7-4**  
**Summary of CTE Cancer Risks and Hazard Indices**  
**NNSY Site 10**

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-5</sup> and <10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-6</sup> and <10 <sup>-5</sup>	Hazard Index	Chemicals with HI>1
Construction Worker	Soil	Ingestion	NA				0.79	
		Dermal Contact	NA				0.046	
		Inhalation	NA				NA	
		Total	NA				0.83	
	All Media	Total	NA				0.83	
Industrial Worker	Groundwater	Ingestion	2.5E-05		Arsenic		1.3	
		Dermal Contact	NA				NA	
		Inhalation	NA				NA	
		Total	2.5E-05				1.3	
	All Media	Total	2.5E-05				1.3	

**Table 7-4  
Summary of CTE Cancer Risks and Hazard Indices  
NNSY Site 10**

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-5</sup> and <10 <sup>-4</sup>	Chemicals with Cancer Risks >10 <sup>-6</sup> and <10 <sup>-5</sup>	Hazard Index	Chemicals with HI>1
Resident	Soil	Ingestion	1.4E-05			Arsenic, Benzo(a)pyrene, Dibenz(a,h)anthracene	0.84	
		Dermal Contact	1.0E-06				0.08	
		Inhalation	NA				NA	
		Total	1.5E-05				0.91	
	Groundwater	Ingestion	1.2E-04	Arsenic		Vinyl Chloride, Aldrin, Dieldrin	6.3	Arsenic, Iron
		Dermal Contact	2.3E-06				0.12	
		Inhalation	3.0E-06				NA	
		Total	1.3E-04				6.5	
		All Media	Total	1.4E-04				7.5

NA - Not applicable, pathway incomplete.

**Table 7-5**  
**Summary of RME Cancer Risks and Hazard Indices**  
**Dry Dock 8 Expansion Area**  
**NNSY Site 10**

<b>Receptor</b>	<b>Media</b>	<b>Exposure Route</b>	<b>Cancer Risk</b>	<b>Chemicals with Cancer Risks &gt;10<sup>-4</sup></b>	<b>Chemicals with Cancer Risks &gt;10<sup>-5</sup> and &lt;10<sup>-4</sup></b>	<b>Chemicals with Cancer Risks &gt;10<sup>-6</sup> and &lt;10<sup>-5</sup></b>	<b>Hazard Index</b>	<b>Chemicals with HI&gt;1</b>
Construction Worker	Surface and Subsurface Soil	Ingestion	5.3E-07				0.35	
		Dermal Contact	5.4E-08				0.035	
		Inhalation	NA				NA	
		Total	5.9E-07				0.39	
	All Media	Total	5.9E-07				0.39	

NA - Not applicable, pathway incomplete.

**Table 7-6**  
**Soil (Combined Surface and Subsurface)**  
**Calculations of Blood Lead Concentrations (PbBs)**  
 U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 8/14/01

Exposure Variable	PbB Equation <sup>1</sup>		Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario			
	1*	2**			Using Equation 1		Using Equation 2	
					GSDi = 1.9	GSDi = 2.3	GSDi = 1.9	GSDi = 2.3
PbS	X	X	Soil lead concentration	ug/g or ppm	477	477	477	477
R <sub>fetal/maternal</sub>	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD <sub>i</sub>	X	X	Geometric standard deviation PbB	--	1.9	2.3	1.9	2.3
PbB <sub>0</sub>	X	X	Baseline PbB	ug/dL	1.4	1.8	1.4	1.8
IR <sub>S</sub>	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	--	--
IR <sub>S+D</sub>		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.050	0.050
W <sub>S</sub>		X	Weighting factor; fraction of IR <sub>S+D</sub> ingested as outdoor soil	--	--	--	1.0	1.0
K <sub>SD</sub>		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
AF <sub>S,D</sub>	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
EF <sub>S,D</sub>	X	X	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
AT <sub>S,D</sub>	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PbB <sub>adult</sub>			PbB of adult worker, geometric mean	ug/dL	2.1	2.5	2.1	2.5
PbB <sub>fetal,0.95</sub>			95th percentile PbB among fetuses of adult workers	ug/dL	5.4	8.8	5.4	8.8
PbB <sub>t</sub>			Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0	10.0	10.0	10.0
P(PbB <sub>fetal</sub> > PbB <sub>t</sub> )			Probability that fetal PbB > PbB <sub>t</sub> , assuming lognormal distribution	%	0.5%	3.6%	0.5%	3.6%

<sup>1</sup> Equation 1 does not apportion exposure between soil and dust ingestion (excludes W<sub>S</sub>, K<sub>SD</sub>).  
 When IR<sub>S</sub> = IR<sub>S+D</sub> and W<sub>S</sub> = 1.0, the equations yield the same PbB<sub>fetal,0.95</sub>.

\*Equation 1, based on Eq. 1, 2 in USEPA (1996).

$PbB_{adult} =$	$(PbS \cdot BKSF \cdot IR_{S+D} \cdot AF_{S,D} \cdot EF_{S,D} / AT_{S,D}) + PbB_0$
$PbB_{fetal,0.95} =$	$PbB_{adult} \cdot (GSD_i)^{1.645} \cdot R$

\*\*Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).

$PbB_{adult} =$	$PbS \cdot BKSF \cdot ((IR_{S+D} \cdot AF_{S,D} \cdot EF_{S,D} \cdot W_S] + [K_{SD} \cdot (IR_{S+D}) \cdot (1 - W_S) \cdot AF_D \cdot EF_D]) / 365 + PbB_0$
$PbB_{fetal,0.95} =$	$PbB_{adult} \cdot (GSD_i)^{1.645} \cdot R$

**Table 7-7**  
**Surface Soil**  
**Calculations of Blood Lead Concentrations (PbBs)**  
 U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 8/14/01

Exposure Variable	PbB Equation <sup>1</sup>		Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario			
	1*	2**			Using Equation 1		Using Equation 2	
					GSDi = 1.9	GSDi = 2.3	GSDi = 1.9	GSDi = 2.3
PbS	X	X	Soil lead concentration	ug/g or ppm	741	741	741	741
R <sub>fetal/maternal</sub>	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD <sub>i</sub>	X	X	Geometric standard deviation PbB	--	1.9	2.3	1.9	2.3
PbB <sub>0</sub>	X	X	Baseline PbB	ug/dL	1.4	1.8	1.4	1.8
IR <sub>S</sub>	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	--	--
IR <sub>S+D</sub>		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.050	0.050
W <sub>S</sub>		X	Weighting factor; fraction of IR <sub>S+D</sub> ingested as outdoor soil	--	--	--	1.0	1.0
K <sub>SD</sub>		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
AF <sub>S,D</sub>	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
EF <sub>S,D</sub>	X	X	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
AT <sub>S,D</sub>	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PbB <sub>adult</sub>			PbB of adult worker, geometric mean	ug/dL	2.5	2.9	2.5	2.9
PbB <sub>fetal,0.95</sub>			95th percentile PbB among fetuses of adult workers	ug/dL	6.4	10.2	6.4	10.2
PbB <sub>t</sub>			Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0	10.0	10.0	10.0
P(PbB <sub>fetal</sub> > PbB <sub>t</sub> )			Probability that fetal PbB > PbB <sub>t</sub> , assuming lognormal distribution	%	1.0%	5.2%	1.0%	5.2%

<sup>1</sup> Equation 1 does not apportion exposure between soil and dust ingestion (excludes W<sub>S</sub>, K<sub>SD</sub>).  
 When IR<sub>S</sub> = IR<sub>S+D</sub> and W<sub>S</sub> = 1.0, the equations yield the same PbB<sub>adult,0.95</sub>.

\*Equation 1, based on Eq. 1, 2 in USEPA (1996).

$PbB_{adult} =$	$(PbS \cdot BKSF \cdot IR_{S+D} \cdot AF_{S,D} \cdot EF_{S,D} / AT_{S,D}) + PbB_0$
$PbB_{fetal,0.95} =$	$PbB_{adult} \cdot (GSD_i^{1.645} \cdot R)$

\*\*Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).

$PbB_{adult} =$	$PbS \cdot BKSF \cdot ((IR_{S+D} \cdot AF_{S,D} \cdot EF_{S,D} \cdot W_S) + [K_{SD} \cdot (IR_{S+D}) \cdot (1 - W_S)] \cdot AF_D \cdot EF_D) / 365 + PbB_0$
$PbB_{fetal,0.95} =$	$PbB_{adult} \cdot (GSD_i^{1.645} \cdot R)$

Table 7-8  
 Combined Surface and Subsurface Soil  
 LEAD MODEL FOR WINDOWS Version 1.0 Build 252

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Model Version: 1.0 Build 252
User Name: R Warren
Date: 10/11/2004
Site Name: NNSY Site 10
Operable Unit: Combined Surface and Subsurface Soil
Run Mode: Site Risk Assessment
-----
  
```

# Soil/Dust Data  
 Arithmetic Average Concentration of Lead in Soil

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The time step used in this model run: 3 - Hourly (24 times a day).
  
```

\*\*\*\*\* Air \*\*\*\*\*

Indoor Air Pb Concentration: 30.000 percent of outdoor.  
 Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m <sup>3</sup> /day)	Lung Absorption (%)	Outdoor Air Pb Conc (ug Pb/m <sup>3</sup> )
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

\*\*\*\*\* Diet \*\*\*\*\*

Age	Diet Intake(ug/day)
.5-1	5.530
1-2	5.780
2-3	6.490
3-4	6.240
4-5	6.010
5-6	6.340
6-7	7.000

\*\*\*\*\* Drinking Water \*\*\*\*\*

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 ug Pb/L

\*\*\*\*\* Soil & Dust \*\*\*\*\*

Multiple Source Analysis Used

Average multiple source concentration: 343.900 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700

Outdoor airborne lead to indoor household dust lead concentration: 100.000

Use alternate indoor dust Pb sources? No

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
.5-1	477.000	343.900
1-2	477.000	343.900
2-3	477.000	343.900
3-4	477.000	343.900
4-5	477.000	343.900
5-6	477.000	343.900
6-7	477.000	343.900

\*\*\*\*\* Alternate Intake \*\*\*\*\*

Age	Alternate (ug Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

\*\*\*\*\* Maternal Contribution: Infant Model \*\*\*\*\*

Maternal Blood Concentration: 2.500 ug Pb/dL

\*\*\*\*\* CALCULATED BLOOD LEAD AND LEAD UPTAKES: \*\*\*\*\*

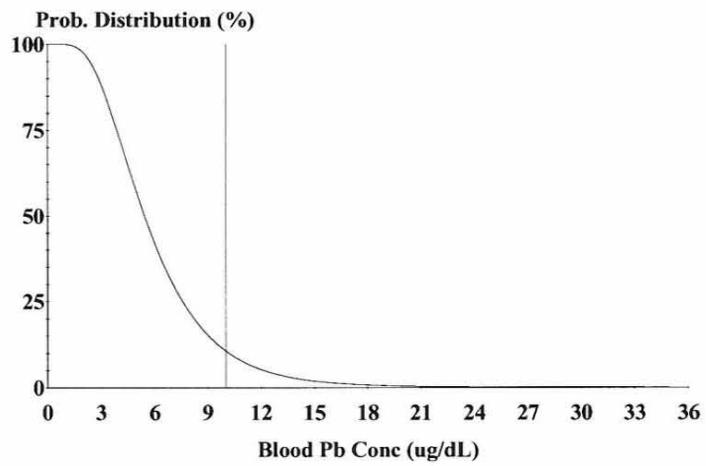
Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.414	0.000	0.349
1-2	0.034	2.476	0.000	0.857
2-3	0.062	2.832	0.000	0.908
3-4	0.067	2.774	0.000	0.942
4-5	0.067	2.767	0.000	1.013
5-6	0.093	2.957	0.000	1.082
6-7	0.093	3.286	0.000	1.108

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	8.989	11.773	6.3
1-2	14.008	17.375	7.1
2-3	14.271	18.072	6.7
3-4	14.539	18.322	6.4
4-5	11.155	15.002	5.3

5-6	10.171	14.304	4.5
6-7	9.668	14.156	4.1

Table 7-9  
IEUBK Model Results - Residential Child  
Combined Surface and Subsurface Soil  
NNSY Site 10



Cutoff = 10.000 ug/dl  
Geo Mean = 5.709  
GSD = 1.600  
% Above = 11.650

Age Range = 0 to 84 months  
Time Step = Hourly  
Run Mode = Site Risk Assessment

**Table 7-10**  
**Effect of Use of Draft 2001 TCE Toxicity Values on Human Health Risk Assessment Results**  
**NNSY Site 10**

Receptor	Media	Pre-2001 TCE Toxicity Values		Draft-2001 TCE Toxicity Values	
		Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Future Construction Worker	Groundwater - Water at NNSY	3.3E-07	0.38	3.3E-07	0.38
	<b>TOTAL</b>	3.3E-07	0.4	3.3E-07	0.4
Future Resident - Lifetime (cancer) Child (non cancer)	Groundwater - Water at NNSY	5.5E-04	38.8	5.53E-04	38.9
	<b>TOTAL</b>	5.5E-04	38.8	5.5E-04	38.9
Future Industrial Worker	Groundwater - Water at NNSY	1.2E-04	2.6	1.2E-04	2.6
	<b>TOTAL</b>	1.2E-04	2.6	1.2E-04	2.6

## **Attachment D**

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## **Attachment D1**

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TABLE 1  
SELECTION OF EXPOSURE PATHWAYS  
NNSY SITE 10

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway				
Future	Surface Soil	Surface Soil	Exposed Surface Soil at NNSY	Industrial Worker	Adult	Dermal Absorption	On-Site	Quant	Industrial workers may contact surface soil while on site.				
						Ingestion	On-Site	Quant	Industrial workers may contact surface soil while on site.				
		Air	Emissions from Exposed Surface Soil at NNSY	Industrial Worker	Adult	Inhalation	On-Site	Quant	Industrial workers may inhale vapors and dust while on site.				
	Soil*	Soil*	Exposed Surface Soil at NNSY	Resident	Adult	Dermal Absorption	On-Site	Qual	The Resident Adult scenario was not evaluated. Evaluation of the child resident is more conservative.				
						Ingestion	On-Site	Qual	The Resident Adult scenario was not evaluated. Evaluation of the child resident is more conservative.				
						Child	Dermal Absorption	On-Site	Quant	Future residential use may result in residents contacting subsurface soil.			
							Ingestion	On-Site	Quant	Future residential use may result in residents contacting subsurface soil.			
						Child/Adult	Dermal Absorption	On-Site	Quant	Future residential use may result in residents contacting subsurface soil.			
							Ingestion	On-Site	Quant	Future residential use may result in residents contacting subsurface soil.			
					Construction Worker	Dermal Absorption	On-Site	Quant	Construction workers may contact subsurface soil during construction activities.				
						Ingestion	On-Site	Quant	Construction workers may contact subsurface soil during construction activities.				
					Industrial Worker	Dermal Absorption	On-Site	Quant	Industrial workers may contact subsurface soil while on site.				
						Ingestion	On-Site	Quant	Industrial workers may contact subsurface soil while on site.				
					Air	Emissions from Soil* at NNSY	Resident	Adult	Inhalation	On-Site	Qual	The Resident Adult scenario was not evaluated. Evaluation of the child resident is more conservative.	
									Child	Inhalation	On-Site	Quant	If site used for future residential development, residents could inhale vapors and dust from soil.
										Child/Adult	Inhalation	On-Site	Quant
							Construction Worker	Adult	Inhalation	On-Site	Quant	Construction Workers may be exposed to emissions from soil during construction activities.	
							Industrial Worker	Adult	Inhalation	On-Site	Quant	Industrial workers may inhale vapors and dust while on site.	

TABLE 1  
SELECTION OF EXPOSURE PATHWAYS  
NNSY SITE 10

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Groundwater at NNSY	Resident	Adult	Dermal Absorption	On-Site	Qual	The Resident Adult scenario was not evaluated. Evaluation of the child resident is more conservative.
						Ingestion	On-Site	Qual	The Resident Adult scenario was not evaluated. Evaluation of the child resident is more conservative.
					Child	Dermal Absorption	On-Site	Quant	Although unlikely, groundwater was evaluated for future residential potable use.
						Ingestion	On-Site	Quant	Although unlikely, groundwater was evaluated for future residential potable use.
					Child/Adult	Dermal Absorption	On-Site	Quant	Although unlikely, groundwater was evaluated for future residential potable use.
						Ingestion	On-Site	Quant	Although unlikely, groundwater was evaluated for future residential potable use.
				Construction Worker	Adult	Dermal Absorption	On-Site	Quant	Construction workers may contact groundwater during construction activities.
	Industrial Worker	Adult	Ingestion	On-Site	Quant	Although unlikely, groundwater was evaluated as a future potable water supply.			
	Groundwater	Air	Groundwater at NNSY	Resident	Adult	Inhalation	On-Site	Qual	The Resident Adult scenario was not evaluated. Evaluation of the child resident is more conservative.
					Child/Adult	Inhalation	On-Site	Quant	Although unlikely, groundwater was evaluated for future residential potable use.
				Construction Worker	Adult	Inhalation	On-Site	Quant	Construction workers may be exposed to volatile emissions from groundwater during construction activities.

Table 2.1  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residentail Screening

Scenario Timeframe: Future  
 Medium: Surface Soil  
 Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Exposed Surface Soil at NNSY	78-93-3	2-Butanone	0.002 J	0.006 J	MG/KG	10-SO12-00	6/12	0.01 - 0.012	0.006	NA	4,693 N	NA	NA	NO	BSL
	67-64-1	Acetone	0.004 J	0.03	MG/KG	10-SO12-00	4/12	0.01 - 0.012	0.03	NA	7,039 N	NA	NA	NO	BSL
	75-15-0	Carbon disulfide	0.002 J	0.002 J	MG/KG	SSP-LDFL1927-SS01-00, SSP-LDFL1927-SS15-00	2/12	0.01 - 0.012	0.002	NA	782 N	NA	NA	NO	BSL
	98-82-8	Cumene	0.002 J	0.002 J	MG/KG	SSP-LDFL1927-SS10-00	1/12	0.01 - 0.012	0.002	NA	782 N	NA	NA	NO	BSL
	108-87-2	Methylcyclohexane	0.004 J	0.004 J	MG/KG	SSP-LDFL1927-SS10-00	1/12	0.01 - 0.012	0.004	NA	N/A	NA	NA	NO	NTX
	79-01-6	Trichloroethene	0.003 J	0.003 J	MG/KG	SSP-LDFL1927-SS15-00	1/12	0.01 - 0.012	0.003	NA	1.60 C	NA	NA	NO	BSL
	91-57-6	2-Methylnaphthalene	0.037 J	1.1	MG/KG	SSP-LDFL1927-SS10-00	6/22	0.34 - 17	1.1	NA	31.3 N	NA	NA	NO	BSL
	83-32-9	Acenaphthene	0.063 J	2.8 J	MG/KG	10-SO10-00	5/22	0.34 - 17	2.8	NA	469 N	NA	NA	NO	BSL
	91-20-3	Acenaphthylene	0.037 J	0.26 J	MG/KG	SSP-LDFL1927-SS15-00	2/22	0.34 - 17	0.26	NA	156 N	NA	NA	NO	BSL
	98-86-2	Acetophenone	0.044 J	0.044 J	MG/KG	10-SO06-00	1/22	0.34 - 17	0.044	NA	782 N	NA	NA	NO	BSL
	120-12-7	Anthracene	0.041 J	0.4 J	MG/KG	SSP-LDFL1927-SS15-00	10/22	0.34 - 17	0.4	NA	2,346 N	NA	NA	NO	BSL
	100-52-7	Benzaldehyde	0.04 J	0.088 J	MG/KG	SSP-LDFL1927-SS15-00	3/22	0.34 - 17	0.088	NA	782 N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	0.039 J	1.8	MG/KG	10-SO08-00	13/22	0.34 - 17	1.8	NA	0.875 C	NA	NA	YES	ASL
	50-32-8	Benzo(a)pyrene	0.041 J	1.6	MG/KG	10-SO08-00	13/22	0.34 - 17	1.6	NA	0.0875 C	NA	NA	YES	ASL
	205-99-2	Benzo(b)fluoranthene	0.055 J	3.1	MG/KG	10-SO08-00	14/22	0.34 - 17	3.1	NA	0.875 C	NA	NA	YES	ASL
	191-24-2	Benzo(g,h,i)perylene	0.043 J	1.1 J	MG/KG	10-SO07-00-P	13/22	0.34 - 17	1.1	NA	235 N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	0.044 J	1.5	MG/KG	10-SO08-00	12/22	0.34 - 17	1.5	NA	8.75 C	NA	NA	NO	BSL
	86-74-8	Carbazole	0.04 J	0.13 J	MG/KG	10-SO07-00-P	4/22	0.34 - 17	0.13	NA	31.9 C	NA	NA	NO	BSL
	218-01-9	Chrysene	0.052 J	2	MG/KG	10-SO08-00	14/22	0.34 - 17	2	NA	87.5 C	NA	NA	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	0.039 J	0.54	MG/KG	10-SO07-00-P	7/22	0.34 - 17	0.54	NA	0.0875 C	NA	NA	YES	ASL
	132-64-9	Dibenzofuran	0.05 J	0.19 J	MG/KG	10-SO08-00	5/22	0.34 - 17	0.19	NA	15.6 N	NA	NA	NO	BSL
	206-44-0	Fluoranthene	0.039 J	6.3 J	MG/KG	10-SO10-00	15/22	0.34 - 17	6.3	NA	313 N	NA	NA	NO	BSL
	86-73-7	Fluorene	0.11 J	0.35 J	MG/KG	10-SO08-00	3/22	0.34 - 17	0.35	NA	313 N	NA	NA	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.04 J	1 J	MG/KG	10-SO07-00-P	13/22	0.34 - 17	1	NA	0.875 C	NA	NA	YES	ASL
	91-20-3	Naphthalene	0.061 J	0.26 J	MG/KG	10-SO08-00	4/22	0.34 - 17	0.26	NA	156 N	NA	NA	NO	BSL
	87-86-5	Pentachlorophenol	0.11 J	0.2 J	MG/KG	10-SO06-00	2/22	0.86 - 44	0.2	NA	5.32 C	NA	NA	NO	BSL
	85-01-8	Phenanthrene	0.052 J	7.5 J	MG/KG	10-SO10-00	14/22	0.34 - 17	7.5	NA	235 N	NA	NA	NO	BSL
	129-00-0	Pyrene	0.05 J	8.5 J	MG/KG	10-SO10-00	16/22	0.34 - 17	8.5	NA	235 N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	0.086 J	0.45	MG/KG	SSP-LDFL1927-SS05-00	8/22	0.34 - 17	0.45	NA	45.6 C	NA	NA	NO	BSL
	72-55-9	4,4'-DDE	0.0026 J	0.0026 J	MG/KG	SSP-LDFL1927-SS01-00	1/12	0.0036 - 0.004	0.0026	NA	1.88 C	NA	NA	NO	BSL
	53494-70-5	Endrin ketone	0.0046 J	0.0046 J	MG/KG	SSP-LDFL1927-SS15-00	1/12	0.0036 - 0.004	0.0046	NA	2.35 N	NA	NA	NO	BSL
	76-44-8	Heptachlor	0.0025 J	0.0025 J	MG/KG	SSP-LDFL1927-SS01-00	1/12	0.0018 - 0.0021	0.0025	NA	0.142 C	NA	NA	NO	BSL
	1024-57-3	Heptachlor epoxide	0.13 D	0.13 D	MG/KG	SSP-LDFL1927-SS01-00	1/12	0.0018 - 0.018	0.13	NA	0.0702 C	NA	NA	YES	ASL
	319-85-7	beta-BHC	0.0036	0.0055 J	MG/KG	SSP-LDFL1927-SS15-00	3/12	0.0018 - 0.0021	0.0055	NA	0.355 C	NA	NA	NO	BSL
	-	beta-Chlordane	0.0018 J	0.0018 J	MG/KG	SSP-LDFL1927-SS01-00	1/8	0.0018 - 0.0021	0.0018	NA	1.82 C	NA	NA	NO	BSL
	7429-90-5	Aluminum	2,960	9,130	MG/KG	10-SO14-00	22/22	6.1 - 48.53	9130	NA	7,821 N	NA	NA	YES	ASL

Table 2.1  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Future  
 Medium: Surface Soil  
 Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-36-0	Antimony	0.43 L	36.2	MG/KG	10-SO10-00	9/22	0.38 - 14.56	36.2	NA	3.13 N	NA	NA	YES	ASL
	7440-38-2	Arsenic	1.1 J	124 J	MG/KG	10-SO07-00	22/22	0.72 - 2.42	124	NA	0.426 C	NA	NA	YES	ASL
	7440-39-3	Barium	16.3 J	696	MG/KG	10-SO11-00	22/22	0.087 - 48.53	696	NA	1,600 N	NA	NA	NO	BSL
	7440-41-7	Beryllium	0.1 J	0.82	MG/KG	10-SO04-00	22/22	0.02 - 1.21	0.82	NA	15.6 N	NA	NA	NO	BSL
	7440-43-9	Cadmium	0.21 J	10	MG/KG	10-SO11-00	17/22	0.052 - 1.21	10	NA	7.82 N	NA	NA	YES	ASL
	7440-70-2	Calcium	709 J	75,200	MG/KG	10-SO06-00	22/22	10.6 - 1213.35	75200	NA	N/A	NA	NA	NO	NUT
	7440-47-3	Chromium	7.1	85.6	MG/KG	10-SO04-00	22/22	0.15 - 2.42	85.6	NA	23.5 N	NA	NA	YES	ASL
	7440-48-4	Cobalt	0.81 J	8.9 J	MG/KG	SSP-LDFL1927-SS01-00	22/22	0.18 - 12.13	8.9	NA	156 N	NA	NA	NO	BSL
	7440-50-8	Copper	4.1	14,000	MG/KG	10-SO06-00	22/22	0.69 - 6.06	14000	NA	313 N	NA	NA	YES	ASL
	57-12-5	Cyanide	0.11 J	0.2 J	MG/KG	SSP-LDFL1927-SS01-00	2/22	0.16 - 0.6	0.2	NA	156 N	NA	NA	NO	BSL
	7439-89-6	Iron	3,720	54,700	MG/KG	10-SO11-00	22/22	3.3 - 24.26	54700	NA	2,346 N	NA	NA	YES	ASL
	7439-92-1	Lead	6.1	3,260	MG/KG	10-SO11-00	22/22	0.54 - 0.72	3260	NA	400	NA	NA	YES	ASL
	7439-95-4	Magnesium	302 J	3,230	MG/KG	10-SO02-00	22/22	11.5 - 1213.35	3230	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	15.3	718	MG/KG	10-SO11-00	22/22	0.087 - 3.64	718	NA	156 N	NA	NA	YES	ASL
	7439-97-6	Mercury	0.05 J	40.5	MG/KG	SSP-LDFL1927-SS15-00	19/22	0.018 - 1.04	40.5	NA	2.3 N	NA	NA	YES	ASL
	7440-02-0	Nickel	3.2 J	184	MG/KG	10-SO11-00	21/22	0.27 - 9.7	184	NA	156 N	NA	NA	YES	ASL
	7440-09-7	Potassium	281 J	2,340	MG/KG	10-SO02-00	22/22	10.2 - 1213.35	2340	NA	N/A	NA	NA	NO	NUT
	7782-49-2	Selenium	0.71 J	1.7 J	MG/KG	10-SO06-00	3/22	0.52 - 1.21	1.7	NA	39.1 N	NA	NA	NO	BSL
	7440-22-4	Silver	0.4 J	116	MG/KG	10-SO09-00	3/22	0.17 - 2.42	116	NA	39.1 N	NA	NA	YES	ASL
	7440-23-5	Sodium	73.5 J	2,320	MG/KG	SSP-LDFL1927-SS15-00	21/22	12 - 1213.35	2320	NA	N/A	NA	NA	NO	NUT
	7440-62-2	Vanadium	10.2 J	45.4	MG/KG	10-SO11-00	22/22	0.2 - 12.13	45.4	NA	7.82 N	NA	NA	YES	ASL
	7440-66-6	Zinc	14.2	5,340	MG/KG	10-SO11-00	22/22	3.5 - 8	5340	NA	2,346 N	NA	NA	YES	ASL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 25, 2005, U.S. EPA Region III, Jennifer Hubbard.

RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.

RBC value for endrin used as surrogate for endrin aldehyde and endrin ketone.

RBC value for cadmium-food used as surrogate for cadmium.

RBC value for chlordane used as surrogate for beta-chlordane.

RBC value for chromium VI used for total chromium.

The soil value of 400 mg/kg is from Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.

RBC value for manganese-nonfood used as surrogate for manganese.

RBC value for mercuric chloride used as surrogate for mercury.

RBC for aluminum, cobalt, and dibenzofuran withdrawn from October 2005 RBC table due to expiration of NCEA provisional toxicity value. Value is from the April 2005 RBC Table.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/

To Be Considered

J = Estimated Value

K = Biased High

L = Biased Low

D = Diluted

C = Carcinogenic

N = Noncarcinogenic

Table 2.2  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Current  
 Medium: Surface Soil  
 Exposure Medium: Air  
 Exposure Point: Emissions from exposed Surface Soil at NNSY

CAS Number	Chemical	Minimum [1] Concentration	Minimum Qualifier	Maximum [1] Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
78-93-3	2-Butanone	7.9E-08	J	2.4E-07	J	MG/M <sup>3</sup>	10-SO12-00	6/12	(6)	2.4E-07		5.1E-01 N			NO	BSL
67-64-1	Acetone	2.5E-07	J	1.8E-06	J	MG/M <sup>3</sup>	10-SO12-00	4/12	(6)	1.8E-06		3.3E-01 N			NO	BSL
75-15-0	Carbon disulfide	1.3E-06	J	1.3E-06	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00, SSP-LDFL1927-SS15-00	2/12	(6)	1.3E-06		7.3E-02 N			NO	BSL
98-82-8	Cumene	4.3E-07	J	4.3E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS10-00	1/12	(6)	4.3E-07		4.0E-02 N			NO	BSL
108-87-2	Methylcyclohexane	1.8E-06	J	1.8E-06	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS10-00	1/12	(6)	1.8E-06		3.1E-01 N			NO	BSL
79-01-6	Trichloroethene	7.1E-07	J	7.1E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	1/12	(6)	7.1E-07		1.6E-05 C			NO	BSL
91-57-6	2-Methylnaphthalene	4.9E-07	J	1.5E-05	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS10-00	6/22	(6)	1.5E-05		1.5E-03 N			NO	BSL
83-32-9	Acenaphthene	2.2E-07	J	9.9E-06	J	MG/M <sup>3</sup>	10-SO10-00	5/22	(6)	9.9E-06		2.2E-02 N			NO	BSL
91-20-3	Acenaphthylene	1.3E-07	J	9.0E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	2/22	(6)	9.0E-07		3.3E-04 N			NO	BSL
98-86-2	Acetophenone	5.2E-07	J	5.2E-07	J	MG/M <sup>3</sup>	10-SO06-00	1/22	(6)	5.2E-07		3.7E-02 N			NO	BSL
120-12-7	Anthracene	4.1E-08	J	4.0E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	10/22	(6)	4.0E-07		1.1E-01 N			NO	BSL
100-52-7	Benzaldehyde	9.7E-06	J	2.1E-05	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	3/22	(6)	2.1E-05		3.7E-02 N			NO	BSL
56-55-3	Benzo(a)anthracene	3.2E-09	J	1.5E-07	J	MG/M <sup>3</sup>	10-SO08-00	13/22	(6)	1.5E-07		8.6E-06 C			NO	BSL
50-32-8	Benzo(a)pyrene	1.3E-09	J	5.2E-08	J	MG/M <sup>3</sup>	10-SO08-00	13/22	(6)	5.2E-08		2.0E-06 C			NO	BSL
205-99-2	Benzo(b)fluoranthene	9.2E-09	J	5.2E-07	J	MG/M <sup>3</sup>	10-SO08-00	14/22	(6)	5.2E-07		8.6E-06 C			NO	BSL
191-24-2	Benzo(g,h,i)perylene	8.8E-09	J	2.2E-07	J	MG/M <sup>3</sup>	10-SO07-00-P	13/22	(6)	2.2E-07		1.1E-02 N			NO	BSL
207-08-9	Benzo(k)fluoranthene	8.9E-10	J	3.0E-08	J	MG/M <sup>3</sup>	10-SO08-00	12/22	(6)	3.0E-08		8.6E-05 C			NO	BSL
86-74-8	Carbazole	1.2E-08	J	3.8E-08	J	MG/M <sup>3</sup>	10-SO07-00-P	4/22	(6)	3.8E-08		3.1E-04 C			NO	BSL
218-01-9	Chrysene	1.5E-08	J	5.7E-07	J	MG/M <sup>3</sup>	10-SO08-00	14/22	(6)	5.7E-07		8.6E-04 C			NO	BSL
53-70-3	Dibenz(a,h)anthracene	4.0E-10	J	5.5E-09	J	MG/M <sup>3</sup>	10-SO07-00-P	7/22	(6)	5.5E-09		8.6E-07 C			NO	BSL
132-64-9	Dibenzofuran	1.9E-07	J	7.3E-07	J	MG/M <sup>3</sup>	10-SO08-00	5/22	(6)	7.3E-07		7.3E-04 N			NO	BSL
206-44-0	Fluoranthene	9.9E-09	J	1.6E-06	J	MG/M <sup>3</sup>	10-SO10-00	15/22	(6)	1.6E-06		1.5E-02 N			NO	BSL
86-73-7	Fluorene	1.7E-07	J	5.3E-07	J	MG/M <sup>3</sup>	10-SO08-00	3/22	(6)	5.3E-07		1.5E-02 N			NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	5.7E-10	J	1.4E-08	J	MG/M <sup>3</sup>	10-SO07-00-P	13/22	(6)	1.4E-08		8.6E-06 C			NO	BSL
91-20-3	Naphthalene	1.1E-06	J	4.6E-06	J	MG/M <sup>3</sup>	10-SO08-00	4/22	(6)	4.6E-06		3.3E-04 N			NO	BSL
87-86-5	Pentachlorophenol	3.0E-08	J	5.5E-08	J	MG/M <sup>3</sup>	10-SO06-00	2/22	(6)	5.5E-08		5.2E-05 C			NO	BSL
85-01-8	Phenanthrene	1.1E-08	J	1.5E-06	J	MG/M <sup>3</sup>	10-SO10-00	14/22	(6)	1.5E-06		1.1E-02 N			NO	BSL
129-00-0	Pyrene	1.0E-08	J	1.7E-06	J	MG/M <sup>3</sup>	10-SO10-00	16/22	(6)	1.7E-06		1.1E-02 N			NO	BSL
117-81-7	bis(2-Ethylhexyl)phthalate	3.7E-10	J	1.9E-09	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS05-00	8/22	(6)	1.9E-09		4.5E-04 C			NO	BSL
72-55-9	4,4'-DDE	2.0E-12	J	2.0E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	1/12	(6)	2.0E-12		1.8E-05 C			NO	BSL
53494-70-5	Endrin ketone	3.5E-12	J	3.5E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	1/12	(6)	3.5E-12		1.1E-04 N			NO	BSL
76-44-8	Heptachlor	1.9E-12	J	1.9E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	1/12	(6)	1.9E-12		1.4E-06 C			NO	BSL
1024-57-3	Heptachlor epoxide	9.8E-11	D	9.8E-11	D	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	1/12	(6)	9.8E-11		1.4E-06 C			NO	BSL
319-85-7	beta-BHC	2.7E-12	J	4.2E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	3/12	(6)	4.2E-12		3.5E-06 C			NO	BSL
-	beta-Chlordane	1.4E-12	J	1.4E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	1/8	(6)	1.4E-12		1.8E-05 C			NO	BSL
7429-90-5	Aluminum	2.2E-06		6.9E-06		MG/M <sup>3</sup>	10-SO14-00	22/22	(6)	6.9E-06		3.7E-04 N			NO	BSL

Table 2.2  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Current  
 Medium: Surface Soil  
 Exposure Medium: Air  
 Exposure Point: Emissions from exposed Surface Soil at NNSY

CAS Number	Chemical	Minimum [1] Concentration	Minimum Qualifier	Maximum [1] Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
7440-36-0	Antimony	3.3E-10	L	2.7E-08		MG/M <sup>3</sup>	10-SO10-00	9/22	(6)	2.7E-08		1.5E-04 N			NO	BSL
7440-38-2	Arsenic	8.3E-10	J	9.4E-08	J	MG/M <sup>3</sup>	10-SO07-00	22/22	(6)	9.4E-08	10-SO07-00	4.1E-07 C			NO	BSL
7440-39-3	Barium	1.2E-08	J	5.3E-07		MG/M <sup>3</sup>	10-SO11-00	22/22	(6)	5.3E-07		5.1E-05 N			NO	BSL
7440-41-7	Beryllium	7.6E-11	J	6.2E-10		MG/M <sup>3</sup>	10-SO04-00	22/22	(6)	6.2E-10		7.5E-07 C			NO	BSL
7440-43-9	Cadmium	1.6E-10	J	7.6E-09		MG/M <sup>3</sup>	10-SO11-00	17/22	(6)	7.6E-09		9.9E-07 C			NO	BSL
7440-70-2	Calcium	5.4E-07	J	5.7E-05		MG/M <sup>3</sup>	10-SO06-00	22/22	(6)	5.7E-05		NA			NO	BSL
7440-47-3	Chromium	5.4E-09		6.5E-08		MG/M <sup>3</sup>	10-SO04-00	22/22	(6)	6.5E-08		1.5E-07 C			NO	BSL
7440-48-4	Cobalt	6.1E-10	J	6.7E-09	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	22/22	(6)	6.7E-09		6.4E-07 C			NO	BSL
7440-50-8	Copper	3.1E-09		1.1E-05		MG/M <sup>3</sup>	10-SO06-00	22/22	(6)	1.1E-05		1.5E-02 N			NO	BSL
57-12-5	Cyanide	8.3E-11	J	1.5E-10	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	2/22	(6)	1.5E-10		7.3E-03 N			NO	BSL
7439-89-6	Iron	2.8E-06		4.1E-05		MG/M <sup>3</sup>	10-SO11-00	22/22	(6)	4.1E-05		1.1E-01 N			NO	BSL
7439-92-1	Lead	4.6E-09		2.5E-06		MG/M <sup>3</sup>	10-SO11-00	22/22	(6)	2.5E-06		NA			NO	BSL
7439-95-4	Magnesium	2.3E-07	J	2.4E-06		MG/M <sup>3</sup>	10-SO02-00	22/22	(6)	2.4E-06		NA			NO	BSL
7439-96-5	Manganese	1.2E-08		5.4E-07		MG/M <sup>3</sup>	10-SO11-00	22/22	(6)	5.4E-07		5.2E-06 N			NO	BSL
7439-97-6	Mercury	3.8E-11	J	3.1E-08		MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	19/22	(6)	3.1E-08		1.1E-04 N			NO	BSL
7440-02-0	Nickel	2.4E-09	J	1.4E-07		MG/M <sup>3</sup>	10-SO11-00	21/22	(6)	1.4E-07		7.3E-03 N			NO	BSL
7440-09-7	Potassium	2.1E-07	J	1.8E-06		MG/M <sup>3</sup>	10-SO02-00	22/22	(6)	1.8E-06		NA			NO	BSL
7782-49-2	Selenium	5.4E-10	J	1.3E-09	J	MG/M <sup>3</sup>	10-SO06-00	3/22	(6)	1.3E-09		1.8E-03 N			NO	BSL
7440-22-4	Silver	3.0E-10	J	8.8E-08		MG/M <sup>3</sup>	10-SO09-00	3/22	(6)	8.8E-08		1.8E-03 N			NO	BSL
7440-23-5	Sodium	5.6E-08	J	1.8E-06		MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	21/22	(6)	1.8E-06		NA			NO	BSL
7440-62-2	Vanadium	7.7E-09	J	3.4E-08		MG/M <sup>3</sup>	10-SO11-00	22/22	(6)	3.4E-08		3.7E-04 N			NO	BSL
7440-66-6	Zinc	1.1E-08		4.0E-06		MG/M <sup>3</sup>	10-SO11-00	22/22	(6)	4.0E-06		1.1E-01 N			NO	BSL

[1] Minimum/maximum detected soil concentration multiplied by 1/PEF (1.32E+9 m<sup>3</sup>/kg) and 1/VF (chemical specific for VOCs only) to get air concentration. PEF and VF from EPA's Soil Screening Guidance. VFs calculated in Table 2.2A.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 25, 2005, U.S. EPA Region III, Jennifer Hubbard. Ambient Air.

RBC value for cadmium-food used as surrogate for cadmium.

RBC value for Chromium VI used for total chromium.

RBC value for chlordane used as surrogate for beta-chlordane.

RBC value for mercuric chloride used as surrogate for mercury.

RBC for aluminum, cobalt, and dibenzofuran withdrawn from October 2005 RBC table due to expiration of NCEA provisional toxicity value. Value is from the April 2005 RBC Table.

RBC value for manganese-nonfood used as surrogate for manganese.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

(6) See Table 2.1 for surface soil data detection limits, concentrations converted from surface soil data to air concentrations.

SQL = Sample Quantification Limit

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/  
 To Be Considered

J = Estimated Value

K = Biased High

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

SSL = Region III Soil Screening Level, Soil to Groundwater Migration, DAF 20

Table 2.2A  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 Calculation of Generic Chemical Specific VF Factors

NNSY Site 10 Residential Screening

Chemical	Diffusivity in Air (D <sub>a</sub> ) (cm <sup>2</sup> /s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D <sub>w</sub> ) (cm <sup>2</sup> /s)	Soil Organic Carbon Partition Coeff. (K <sub>oc</sub> ) (cm <sup>2</sup> /g)	Soil Water Partition Coeff. (K <sub>d</sub> = K <sub>oc</sub> × F <sub>oc</sub> ) (g/cm <sup>3</sup> )	Solubility in Water (S) (mg/L)	Apparent Diffusivity (D <sub>a</sub> ) (cm <sup>2</sup> /s)	Volatilization Factor (VF) (m <sup>3</sup> /kg)
2-Butanone	8.95E-02	1.12E-03	9.80E-06	4.50E+00	2.70E-02	2.68E+05	4.26E-05	2.52E+04
Acetone	1.24E-01	1.59E-03	1.14E-05	5.75E-01	3.45E-03	1.00E+06	1.02E-04	1.63E+04
Carbon disulfide	1.04E-01	1.24E+00	1.00E-05	4.57E+01	2.74E-01	1.19E+03	1.13E-02	1.55E+03
Cumene	7.50E-02	4.70E-01	7.10E-06	2.20E+02	1.32E+00	6.10E+01	1.24E-03	4.66E+03
Methylcyclohexane	9.86E-02	1.76E+01	8.52E-06	2.19E+03	1.31E+01	1.40E+01	5.59E-03	2.20E+03
Trichloroethene	7.90E-02	4.22E-01	9.10E-06	1.66E+02	9.96E-01	1.10E+03	1.51E-03	4.23E+03
2-Methylnaphthalene	5.60E-02	2.07E-02	7.84E-06	2.13E+03	1.28E+01	2.54E+01	4.80E-06	7.50E+04
Acenaphthene	4.21E-02	6.36E-03	7.69E-06	7.08E+03	4.25E+01	4.24E+00	3.36E-07	2.83E+05
Acenaphthylene	4.39E-02	5.11E-03	7.53E-06	6.12E+03	3.67E+01	1.61E+01	3.25E-07	2.88E+05
Acetophenone	6.00E-02	4.25E-04	8.73E-06	4.62E+01	2.77E-01	6.13E+03	3.75E-06	8.49E+04
Anthracene	3.24E-02	2.67E-03	7.74E-06	2.95E+04	1.77E+02	4.34E-02	2.63E-08	1.01E+06
Benzaldehyde	7.30E-02	1.09E-03	7.30E-02	3.27E+01	1.96E-01	6.57E+03	1.58E-03	4.13E+03
Benzo(a)anthracene	5.10E-02	1.37E-04	9.00E-06	3.98E+05	2.39E+03	9.00E-06	1.80E-10	1.23E+07
Benzo(a)pyrene	4.30E-02	4.63E-05	9.00E-06	1.02E+06	6.12E+03	1.62E-03	~ 2.67E-11	3.18E+07
Benzo(b)fluoranthene	2.26E-02	4.55E-03	5.56E-06	1.23E+06	7.38E+03	1.50E-03	7.47E-10	6.01E+06
Benzo(g,h,i)perylene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06
Benzo(k)fluoranthene	2.26E-02	3.40E-05	5.56E-06	1.23E+06	7.38E+03	8.00E-04	1.03E-11	5.11E+07
Carbazole	3.90E-02	6.26E-07	7.03E-06	3.39E+03	2.03E+01	7.48E+00	2.25E-09	3.47E+06
Chrysene	2.48E-02	3.88E-03	6.21E-06	3.98E+05	2.39E+03	1.60E-03	2.16E-09	3.53E+06
Dibenz(a,h)anthracene	2.02E-02	5.03E-06	5.18E-06	2.62E+06	1.57E+04	1.03E-03	2.44E-12	1.05E+08
Dibenzofuran	6.19E-02	3.98E-03	1.00E-05	5.48E+03	3.29E+01	5.65E+00	4.00E-07	2.60E+05
Fluoranthene	3.02E-02	6.60E-04	6.35E-06	1.07E+05	6.42E+02	2.06E-01	1.72E-09	3.97E+06
Fluorene	3.63E-02	2.61E-03	7.88E-06	1.38E+04	8.28E+01	1.98E+00	6.15E-08	6.63E+05
Indeno(1,2,3-cd)pyrene	1.90E-02	6.56E-05	5.66E-06	3.47E+06	2.08E+04	2.20E-05	4.92E-12	7.41E+07
Naphthalene	5.90E-02	1.98E-02	7.50E-06	1.19E+03	7.15E+00	3.10E+01	8.59E-06	5.60E+04
Pentachlorophenol	5.60E-02	1.00E-06	6.10E-06	3.38E+03	2.03E+01	1.40E+01	2.05E-09	3.63E+06
Phenanthrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06
Pyrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06
bis(2-Ethylhexyl)phthalate	3.51E-02	4.18E-06	3.66E-06	1.51E+07	9.06E+04	3.40E-01	3.43E-13	2.81E+08
4,4'-DDE	NV	NV	NV	NV	NV	NV	NV	NV
Endrin ketone	NV	NV	NV	NV	NV	NV	NV	NV
Heptachlor	NV	NV	NV	NV	NV	NV	NV	NV
Heptachlor epoxide	NV	NV	NV	NV	NV	NV	NV	NV
beta-BHC	NV	NV	NV	NV	NV	NV	NV	NV
beta-Chlordane	NV	NV	NV	NV	NV	NV	NV	NV

$$\text{Volatilization factor (VF)} = \frac{Q/C \cdot (3.14 \cdot D_a \cdot T)^{1/2} \cdot 10^{-4} \cdot m^2/cm^2}{2 \cdot r_b \cdot D_a} \quad (m^3/kg)$$

$$\text{Apparent Diffusivity (D}_a\text{)} = \frac{[(Q_a^{100} \cdot D_i \cdot H' + Q_w^{100} \cdot D_w)/n^2]}{(r_b \cdot K_d + Q_w + Q_a \cdot H')} \quad (cm^2/s)$$

Parameters	Values
Q/C - Inverse of the mean concentration at the center of a 0.5-acre-square source for Philadelphia (g/m <sup>2</sup> -s per kg/m <sup>3</sup> )	90.24
T - Exposure interval(s)	9.5E+08
r <sub>b</sub> - Soil bulk density (g/cm <sup>3</sup> )	1.5
Q <sub>a</sub> - Air-filled soil porosity (L <sub>air</sub> /L <sub>void</sub> ) = n - Q <sub>w</sub>	0.26
n - Total soil porosity (L <sub>pore</sub> /L <sub>soil</sub> ) = 1 - (r <sub>s</sub> /r <sub>s</sub> )	0.43
Q <sub>w</sub> - Water-filled soil porosity (L <sub>water</sub> /L <sub>soil</sub> )	0.15
r <sub>s</sub> - Soil particle density (g/cm <sup>3</sup> )	2.65
f <sub>oc</sub> - fraction organic carbon in soil (g/g)	0.006

Chemical and physical properties from USEPA, 1996, *Soil Screening Guidance: User's Guide*, EPA/540/R-96/018.

Table 2.3  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Future  
 Medium: Soil\*  
 Exposure Medium: Soil\*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Soil*	79-00-5	1,1,2-Trichloroethane	4.00E-03 J	4.00E-03 J	mg/kg	10-SO12-01	1/33	0.01 - 0.02	4.00E-03		1.12E+01 C			NO	BSL
	78-93-3	2-Butanone	2.00E-03 J	1.20E-02 J	mg/kg	SSP-LDFL1927-SB12-01	14/33	0.01 - 0.02	1.20E-02		4.69E+03 N			NO	BSL
	67-64-1	Acetone	4.00E-03 J	3.00E-02	mg/kg	10-SO12-00	13/33	0.01 - 0.02	3.00E-02		7.04E+03 N			NO	BSL
	75-15-0	Carbon disulfide	2.00E-03 J	5.00E-03 J	mg/kg	10-SO16-02	4/33	0.01 - 0.02	5.00E-03		7.82E+02 N			NO	BSL
	98-82-8	Cumene	2.00E-03 J	4.00E-03 J	mg/kg	SSP-LDFL1927-SB04-02-P	2/33	0.01 - 0.02	4.00E-03		7.82E+02 N			NO	BSL
	110-82-7	Cyclohexane	6.00E-03 J	6.00E-03 J	mg/kg	SSP-LDFL1927-SB10-01	1/33	0.01 - 0.02	6.00E-03		3.90E+04 N			NO	BSL
	108-87-2	Methylcyclohexane	3.00E-03 J	1.70E-02	mg/kg	SSP-LDFL1927-SB10-01	4/33	0.01 - 0.02	1.70E-02		N/A			NO	NTX
	75-09-2	Methylene chloride	3.80E-02	5.40E-02	mg/kg	10-SO16-02	2/33	0.01 - 0.02	5.40E-02		8.52E+01 C			NO	BSL
	79-01-6	Trichloroethene	3.00E-03 J	3.00E-03 J	mg/kg	SSP-LDFL1927-SS15-00	1/33	0.01 - 0.02	3.00E-03		1.60E+00 C			NO	BSL
	92-52-4	1,1-Biphenyl	8.40E-02 J	1.30E-01 J	mg/kg	SSP-LDFL1927-SB12-01	2/53	0.34 - 17	1.30E-01		3.91E+02 N			NO	BSL
	91-57-6	2-Methylnaphthalene	3.70E-02 J	1.50E+00	mg/kg	SSP-LDFL1927-SB10-01-P	13/53	0.34 - 17	1.50E+00		3.13E+01 N			NO	BSL
	101-55-3	4-Bromophenyl-phenylether	1.20E-01 J	1.20E-01 J	mg/kg	10-SO16-02	1/53	0.34 - 17	1.20E-01		3.91E+01 N			NO	BSL
	83-32-9	Acenaphthene	3.70E-02 J	8.10E+00 J	mg/kg	10-SO12-01	15/53	0.34 - 17	8.10E+00		4.69E+02 N			NO	BSL
	91-20-3	Acenaphthylene	3.70E-02 J	2.60E-01 J	mg/kg	SSP-LDFL1927-SS15-00	4/53	0.34 - 17	2.60E-01		1.56E+02 N			NO	BSL
	98-86-2	Acetophenone	4.40E-02 J	1.20E-01 J	mg/kg	10-SO05-01	3/53	0.34 - 17	1.20E-01		7.82E+02 N			NO	BSL
	120-12-7	Anthracene	4.00E-02 J	3.40E+01	mg/kg	10-SO12-01	23/53	0.34 - 17	3.40E+01		2.35E+03 N			NO	BSL
	100-52-7	Benzaldehyde	4.00E-02 J	2.40E-01 J	mg/kg	SSP-LDFL1927-SB12-01	6/53	0.34 - 17	2.40E-01		7.82E+02 N			NO	BSL
	56-55-3	Benzo(a)anthracene	3.90E-02 J	2.60E+01	mg/kg	10-SO12-01	28/53	0.34 - 17	2.60E+01		8.75E-01 C			YES	ASL
	50-32-8	Benzo(a)pyrene	4.10E-02 J	6.60E+00 J	mg/kg	10-SO12-01	28/53	0.34 - 17	6.60E+00		8.75E-02 C			YES	ASL
	205-99-2	Benzo(b)fluoranthene	4.10E-02 J	1.00E+01 J	mg/kg	10-SO12-01	31/53	0.34 - 17	1.00E+01		8.75E-01 C			YES	ASL
	191-24-2	Benzo(g,h,i)perylene	4.30E-02 J	2.00E+00	mg/kg	10-SO06-01	26/53	0.34 - 17	2.00E+00		2.35E+02 N			NO	BSL
	207-08-9	Benzo(k)fluoranthene	4.40E-02 J	9.50E+00 J	mg/kg	10-SO12-01	28/53	0.34 - 17	9.50E+00		8.75E+00 C			YES	ASL
	105-60-2	Caprolactam	2.80E-01 J	2.80E-01 J	mg/kg	10-SO16-00	1/53	0.34 - 17	2.80E-01		3.91E+03 N			NO	BSL
	86-74-8	Carbazole	4.00E-02 J	1.90E-01 J	mg/kg	SSP-LDFL1927-SB01-01	8/53	0.34 - 17	1.90E-01		3.19E+01 C			NO	BSL
	218-01-9	Chrysene	5.20E-02 J	2.90E+01	mg/kg	10-SO12-01	30/53	0.34 - 17	2.90E+01		8.75E+01 C			NO	BSL
	84-74-2	Di-n-butylphthalate	2.80E-01 J	2.80E-01 J	mg/kg	10-SO16-02	1/53	0.34 - 17	2.80E-01		7.82E+02 N			NO	BSL
	53-70-3	Dibenz(a,h)anthracene	3.90E-02 J	1.30E+00	mg/kg	10-SO06-01	16/53	0.34 - 17	1.30E+00		8.75E-02 C			YES	ASL
	132-64-9	Dibenzofuran	4.40E-02 J	4.80E+00 J	mg/kg	10-SO12-01	12/53	0.34 - 17	4.80E+00		1.56E+01 N			NO	BSL
	206-44-0	Fluoranthene	3.90E-02 J	1.30E+02	mg/kg	10-SO12-01	32/53	0.34 - 17	1.30E+02		3.13E+02 N			NO	BSL
	86-73-7	Fluorene	4.20E-02 J	1.40E+01 J	mg/kg	10-SO12-01	11/53	0.34 - 17	1.40E+01		3.13E+02 N			NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	4.00E-02 J	2.20E+00	mg/kg	10-SO06-01	26/53	0.34 - 17	2.20E+00		8.75E-01 C			YES	ASL
	91-20-3	Naphthalene	6.10E-02 J	3.80E-01 J	mg/kg	SSP-LDFL1927-SB12-01	9/53	0.34 - 17	3.80E-01		1.56E+02 N			NO	BSL
	87-86-5	Pentachlorophenol	1.10E-01 J	3.70E-01 J	mg/kg	SSP-LDFL1927-SB04-02	4/52	0.86 - 44	3.70E-01		5.32E+00 C			NO	BSL
	85-01-8	Phenanthrene	5.20E-02 J	8.30E+01	mg/kg	10-SO12-01	31/53	0.34 - 17	8.30E+01		2.35E+02 N			NO	BSL
	129-00-0	Pyrene	5.00E-02 J	1.10E+02	mg/kg	10-SO12-01	33/53	0.34 - 17	1.10E+02		2.35E+02 N			NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	7.90E-02 J	1.50E+00	mg/kg	SSP-LDFL1927-SB01-01	22/53	0.34 - 17	1.50E+00		4.56E+01 C			NO	BSL

Table 2.3  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Future  
 Medium: Soil\*  
 Exposure Medium: Soil\*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	72-54-8	4,4-DDD	3.20E-03 J	3.20E-03 J	mg/kg	SSP-LDFL1927-SB02-01	1/33	0.0035 - 0.0063	3.20E-03		2.66E+00 C			NO	BSL
	72-55-9	4,4-DDE	2.60E-03 J	4.80E-03 J	mg/kg	10-SO11-01	2/33	0.0035 - 0.0063	4.80E-03		1.88E+00 C			NO	BSL
	53494-70-5	Endrin ketone	3.20E-03 J	4.60E-03 J	mg/kg	SSP-LDFL1927-SS15-00	2/33	0.0035 - 0.0063	4.60E-03		2.35E+00 N			NO	BSL
	76-44-8	Heptachlor	2.20E-03 J	2.50E-03 J	mg/kg	SSP-LDFL1927-SS01-00	2/33	0.0018 - 0.0033	2.50E-03		1.42E-01 C			NO	BSL
	1024-57-3	Heptachlor epoxide	1.20E-03 J	1.30E-01 D	mg/kg	SSP-LDFL1927-SS01-00	3/33	0.0018 - 0.018	1.30E-01		7.02E-02 C			YES	ASL
	5103-71-9	alpha-Chlordane	3.60E-03 J	3.60E-03 J	mg/kg	10-SO11-01	1/33	0.0018 - 0.0033	3.60E-03		1.82E+00 C			NO	BSL
	319-85-7	beta-BHC	2.70E-03	5.50E-03 J	mg/kg	SSP-LDFL1927-SS15-00	5/33	0.0018 - 0.0033	5.50E-03		3.55E-01 C			NO	BSL
	-	beta-Chlordane	1.60E-03 J	2.10E-03 J	mg/kg	SSP-LDFL1927-SB01-01	3/19	0.0018 - 0.0026	2.10E-03		1.82E+00 C			NO	BSL
	7429-90-5	Aluminum	4.04E+02	2.27E+04	mg/kg	SSP-LDFL1927-SB06-01-P	53/53	5.7 - 60.09	2.27E+04		7.82E+03 N			YES	ASL
	7440-36-0	Antimony	4.30E-01 L	3.62E+01	mg/kg	10-SO10-00	14/53	0.36 - 18.02	3.62E+01		3.13E+00 N			YES	ASL
	7440-38-2	Arsenic	3.10E-01 J	1.24E+02 J	mg/kg	10-SO07-00	51/53	0.68 - 3	1.24E+02		4.26E-01 C			YES	ASL
	7440-39-3	Barium	2.80E+00 J	1.49E+03	mg/kg	10-SO01-01	52/53	0.082 - 60.09	1.49E+03		1.60E+03 N			NO	BSL
	7440-41-7	Beryllium	3.70E-02 J	1.40E+00	mg/kg	10-SO16-02	53/53	0.019 - 1.5	1.40E+00		1.56E+01 N			NO	BSL
	7440-43-9	Cadmium	8.50E-02 J	1.00E+01	mg/kg	10-SO11-00	38/53	0.049 - 1.5	1.00E+01		7.82E+00 N			YES	ASL
	7440-70-2	Calcium	2.12E+02 J	1.13E+05	mg/kg	10-SO05-01	52/53	9.9 - 1502.42	1.13E+05		N/A			NO	NUT
	7440-47-3	Chromium	1.40E+00	1.81E+02	mg/kg	10-SO04-01	53/53	0.14 - 3	1.81E+02		2.35E+01 N			YES	ASL
	7440-48-4	Cobalt	4.70E-01 J	1.97E+01	mg/kg	10-SO16-02	53/53	0.17 - 15.02	1.97E+01		1.56E+02 N			NO	BSL
	7440-50-8	Copper	1.60E+00 J	1.40E+04	mg/kg	10-SO06-00	52/53	0.65 - 7.51	1.40E+04		3.13E+02 N			YES	ASL
	57-12-5	Cyanide	5.00E-02 J	2.20E-01 J	mg/kg	SSP-LDFL1927-SB04-02	7/53	0.16 - 0.75	2.20E-01		1.56E+02 N			NO	BSL
	7439-89-6	Iron	7.17E+02	5.47E+04	mg/kg	10-SO11-00	53/53	3.1 - 30.04	5.47E+04		2.35E+03 N			YES	ASL
	7439-92-1	Lead	1.70E+00	3.26E+03	mg/kg	10-SO11-00	53/53	0.51 - 0.94	3.26E+03		4.00E+02			YES	ASL
	7439-95-4	Magnesium	7.12E+01 J	1.15E+04 J	mg/kg	10-SO03-01	53/53	10.8 - 1502.42	1.15E+04		N/A			NO	NUT
	7439-96-5	Manganese	6.00E+00	7.18E+02	mg/kg	10-SO11-00	53/53	0.082 - 4.5	7.18E+02		1.56E+02 N			YES	ASL
	7439-97-6	Mercury	2.80E-02 J	4.05E+01	mg/kg	SSP-LDFL1927-SS15-00	43/53	0.018 - 1.18	4.05E+01		2.35E+00 N			YES	ASL
	7440-02-0	Nickel	6.90E-01 J	3.35E+02	mg/kg	10-SO04-01	50/53	0.25 - 12.01	3.35E+02		1.56E+02 N			YES	ASL
	7440-09-7	Potassium	1.83E+02 J	2.37E+03 J	mg/kg	10-SO03-01	52/53	9.6 - 1502.42	2.37E+03		N/A			NO	NUT
	7782-49-2	Selenium	5.50E-01 J	6.30E+00	mg/kg	10-SO05-01	10/53	0.49 - 1.5	6.30E+00		3.91E+01 N			NO	BSL
	7440-22-4	Silver	2.30E-01 J	1.16E+02	mg/kg	10-SO09-00	8/53	0.16 - 3	1.16E+02		3.91E+01 N			YES	ASL
	7440-23-5	Sodium	5.00E+01 J	2.32E+03	mg/kg	SSP-LDFL1927-SS15-00	48/53	11.3 - 1502.42	2.32E+03		N/A			NO	NUT
	7440-62-2	Vanadium	1.80E+00 J	4.55E+01	mg/kg	SSP-LDFL1927-SB06-01-P	53/53	0.18 - 15.02	4.55E+01		7.82E+00 N			YES	ASL
	7440-66-6	Zinc	4.80E+00 J	5.34E+03	mg/kg	10-SO11-00	52/53	3.3 - 8	5.34E+03		2.35E+03 N			YES	ASL

\* Surface soil & subsurface soil combined

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 25, 2005, U.S. EPA Region III, Jennifer Hubbard.

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/

To Be Considered

J = Estimated Value

Table 2.3  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Future Medium: Soil* Exposure Medium: Soil*
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Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
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RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.  
 RBC value for 4-Methylphenol used as surrogate for 4-Bromophenyl-phenylether  
 RBC value for chlordane used as surrogate for beta-chlordane  
 RBC value for endrin used as surrogate for endrin aldehyde and endrin ketone.  
 RBC value for cadmium-food used as surrogate for cadmium.  
 RBC value for chromium VI used for total chromium.  
 The soil value of 400 mg/kg is from Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.  
 RBC value for manganese-nonfood used as surrogate for manganese.  
 RBC value for mercuric chloride used as surrogate for mercury.  
 RBC for aluminum, cobalt, and dibenzofuran withdrawn from October 2005 RBC table due to expiration of NCEA provisional toxicity value. Value is from the April 2005 RBC Table.

K = Biased High  
 L = Biased Low  
 D = Diluted  
 C = Carcinogenic  
 N = Noncarcinogenic

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)  
 Deletion Reason: No Toxicity Information (NTX)  
 Essential Nutrient (NUT)  
 Below Screening Level (BSL)

Table 2.4  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Current  
 Medium: Soil\*  
 Exposure Medium: Air  
 Exposure Point: Emissions from exposed Surface Soil at NNSY

CAS Number	Chemical	Minimum [1] Concentration	Minimum Qualifier	Maximum [1] Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
79-00-5	1,1,2-Trichloroethane	4.8E-07	J	4.8E-07	J	MG/M <sup>3</sup>	10-SO12-01	1/33	(6)	4.8E-07		1.10E-04 C			NO	BSL
78-93-3	2-Butanone	7.9E-08	J	4.8E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB12-01	14/33	(6)	4.8E-07		5.1E-01 N			NO	BSL
67-64-1	Acetone	2.5E-07	J	1.8E-06	J	MG/M <sup>3</sup>	10-SO12-00	13/33	(6)	1.8E-06		3.3E-01 N			NO	BSL
75-15-0	Carbon disulfide	1.3E-06	J	3.2E-06	J	MG/M <sup>3</sup>	10-SO16-02	4/33	(6)	3.2E-06		7.3E-02 N			NO	BSL
98-82-8	Cumene	4.3E-07	J	8.6E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB04-02-P	2/33	(6)	8.6E-07		4.0E-02 N			NO	BSL
110-82-7	Cyclohexane	4.2E-06	J	4.2E-06	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB10-01	1/33	(6)	4.2E-06		6.2E-01 N			NO	BSL
108-87-2	Methylcyclohexane	1.4E-06	J	7.7E-06	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB10-01	4/33	(6)	7.7E-06		3.1E-01 N			NO	BSL
75-09-2	Methylene chloride	1.2E-05	J	1.7E-05	J	MG/M <sup>3</sup>	10-SO16-02	2/33	(6)	1.7E-05		3.8E-03 C			NO	BSL
79-01-6	Trichloroethene	7.1E-07	J	7.1E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	1/33	(6)	7.1E-07		1.6E-05 C			NO	BSL
92-52-4	1,1-Biphenyl	3.9E-07	J	6.0E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB12-01	2/53	(6)	6.0E-07		1.8E-02 N			NO	BSL
91-57-6	2-Methylnaphthalene	4.9E-07	J	2.0E-05	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB10-01-P	13/53	(6)	2.0E-05		1.5E-03 N			NO	BSL
101-55-3	4-Bromophenyl-phenylether	9.1E-11	J	9.1E-11	J	MG/M <sup>3</sup>	10-SO16-02	1/53	(6)	9.1E-11		1.8E-03 N			NO	BSL
83-32-9	Acenaphthene	1.3E-07	J	2.9E-05	J	MG/M <sup>3</sup>	10-SO12-01	15/53	(6)	2.9E-05		2.2E-02 N			NO	BSL
91-20-3	Acenaphthylene	1.3E-07	J	9.0E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	4/53	(6)	9.0E-07		3.3E-04 N			NO	BSL
98-86-2	Acetophenone	5.2E-07	J	1.4E-06	J	MG/M <sup>3</sup>	10-SO05-01	3/53	(6)	1.4E-06		3.7E-02 N			NO	BSL
120-12-7	Anthracene	4.0E-08	J	3.4E-05	J	MG/M <sup>3</sup>	10-SO12-01	23/53	(6)	3.4E-05		1.1E-01 N			NO	BSL
100-52-7	Benzaldehyde	9.7E-06	J	5.8E-05	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB12-01	6/53	(6)	5.8E-05		3.7E-02 N			NO	BSL
56-55-3	Benzo(a)anthracene	3.2E-09	J	2.1E-06	J	MG/M <sup>3</sup>	10-SO12-01	28/53	(6)	2.1E-06		8.6E-06 C			NO	BSL
50-32-8	Benzo(a)pyrene	1.3E-09	J	2.1E-07	J	MG/M <sup>3</sup>	10-SO12-01	28/53	(6)	2.1E-07		2.0E-06 C			NO	BSL
205-99-2	Benzo(b)fluoranthene	6.9E-09	J	1.7E-06	J	MG/M <sup>3</sup>	10-SO12-01	31/53	(6)	1.7E-06		8.6E-06 C			NO	BSL
191-24-2	Benzo(g,h,i)perylene	8.8E-09	J	4.1E-07	J	MG/M <sup>3</sup>	10-SO06-01	26/53	(6)	4.1E-07		1.1E-02 N			NO	BSL
207-08-9	Benzo(k)fluoranthene	8.9E-10	J	1.9E-07	J	MG/M <sup>3</sup>	10-SO12-01	28/53	(6)	1.9E-07		8.6E-05 C			NO	BSL
105-60-2	Caprolactam	6.3E-07	J	6.3E-07	J	MG/M <sup>3</sup>	10-SO16-00	1/53	(6)	6.3E-07		1.8E-01 N			NO	BSL
86-74-8	Carbazole	1.2E-08	J	5.5E-08	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB01-01	8/53	(6)	5.5E-08		3.1E-04 C			NO	BSL
218-01-9	Chrysene	1.5E-08	J	8.2E-06	J	MG/M <sup>3</sup>	10-SO12-01	30/53	(6)	8.2E-06		8.6E-04 C			NO	BSL
84-74-2	Di-n-butylphthalate	2.7E-08	J	2.7E-08	J	MG/M <sup>3</sup>	10-SO16-02	1/53	(6)	2.7E-08		3.7E-02 N			NO	BSL
53-70-3	Dibenz(a,h)anthracene	4.0E-10	J	1.3E-08	J	MG/M <sup>3</sup>	10-SO06-01	16/53	(6)	1.3E-08		8.6E-07 C			NO	BSL
132-64-9	Dibenzofuran	1.7E-07	J	1.8E-05	J	MG/M <sup>3</sup>	10-SO12-01	12/53	(6)	1.8E-05		7.3E-04 N			NO	BSL
206-44-0	Fluoranthene	9.9E-09	J	3.3E-05	J	MG/M <sup>3</sup>	10-SO12-01	32/53	(6)	3.3E-05		1.5E-02 N			NO	BSL
86-73-7	Fluorene	6.3E-08	J	2.1E-05	J	MG/M <sup>3</sup>	10-SO12-01	11/53	(6)	2.1E-05		1.5E-02 N			NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	5.7E-10	J	3.1E-08	J	MG/M <sup>3</sup>	10-SO06-01	26/53	(6)	3.1E-08		8.6E-06 C			NO	BSL
91-20-3	Naphthalene	1.1E-06	J	6.8E-06	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB12-01	9/53	(6)	6.8E-06		3.3E-04 N			NO	BSL
87-86-5	Pentachlorophenol	3.0E-08	J	1.0E-07	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB04-02	4/52	(6)	1.0E-07		5.2E-05 C			NO	BSL
85-01-8	Phenanthrene	1.1E-08	J	1.7E-05	J	MG/M <sup>3</sup>	10-SO12-01	31/53	(6)	1.7E-05		1.1E-02 N			NO	BSL
129-00-0	Pyrene	1.0E-08	J	2.2E-05	J	MG/M <sup>3</sup>	10-SO12-01	33/53	(6)	2.2E-05		1.1E-02 N			NO	BSL
117-81-7	bis(2-Ethylhexyl)phthalate	3.4E-10	J	6.5E-09	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB01-01	22/53	(6)	6.5E-09		4.5E-04 C			NO	BSL
72-54-8	4,4'-DDD	2.4E-12	J	2.4E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB02-01	1/33	(6)	2.4E-12		2.6E-05 C			NO	BSL
72-55-9	4,4'-DDE	2.0E-12	J	3.6E-12	J	MG/M <sup>3</sup>	10-SO11-01	2/33	(6)	3.6E-12		1.8E-05 C			NO	BSL
53494-70-5	Endrin ketone	2.4E-12	J	3.5E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	2/33	(6)	3.5E-12		1.1E-04 N			NO	BSL
76-44-8	Heptachlor	1.7E-12	J	1.9E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	2/33	(6)	1.9E-12		1.4E-06 C			NO	BSL
1024-57-3	Heptachlor epoxide	9.1E-13	J	9.8E-11	D	MG/M <sup>3</sup>	SSP-LDFL1927-SS01-00	3/33	(6)	9.8E-11		1.4E-06 C			NO	BSL
5103-71-9	alpha-Chlordane	2.7E-12	J	2.7E-12	J	MG/M <sup>3</sup>	10-SO11-01	1/33	(6)	2.7E-12		1.8E-05 C			NO	BSL
319-85-7	beta-BHC	2.0E-12	J	4.2E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	5/33	(6)	4.2E-12		3.5E-06 C			NO	BSL
-	beta-Chlordane	1.2E-12	J	1.6E-12	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB01-01	3/19	(6)	1.6E-12		1.8E-05 C			NO	BSL

Table 2.4  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Residential Screening

Scenario Timeframe: Current  
 Medium: Soil\*  
 Exposure Medium: Air  
 Exposure Point: Emissions from exposed Surface Soil at NNSY

CAS Number	Chemical	Minimum [1] Concentration	Minimum Qualifier	Maximum [1] Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
7429-90-5	Aluminum	3.1E-07		1.7E-05		MG/M <sup>3</sup>	SSP-LDFL1927-SB06-01-P	53/53	(6)	1.7E-05		3.7E-04 N			NO	BSL
7440-36-0	Antimony	3.3E-10	L	2.7E-08		MG/M <sup>3</sup>	10-SO10-00	14/53	(6)	2.7E-08		1.5E-04 N			NO	BSL
7440-38-2	Arsenic	2.3E-10	J	9.4E-08	J	MG/M <sup>3</sup>	10-SO07-00	51/53	(6)	9.4E-08		4.1E-07 C			NO	BSL
7440-39-3	Barium	2.1E-09	J	1.1E-06		MG/M <sup>3</sup>	10-SO01-01	52/53	(6)	1.1E-06		5.1E-05 N			NO	BSL
7440-41-7	Beryllium	2.8E-11	J	1.1E-09		MG/M <sup>3</sup>	10-SO16-02	53/53	(6)	1.1E-09		7.5E-07 C			NO	BSL
7440-43-9	Cadmium	6.4E-11	J	7.6E-09		MG/M <sup>3</sup>	10-SO11-00	38/53	(6)	7.6E-09		9.9E-07 C			NO	BSL
7440-70-2	Calcium	1.6E-07	J	8.6E-05		MG/M <sup>3</sup>	10-SO05-01	52/53	(6)	8.6E-05		NA			NO	BSL
7440-47-3	Chromium	1.1E-09		1.4E-07		MG/M <sup>3</sup>	10-SO04-01	53/53	(6)	1.4E-07		1.5E-07 C			NO	BSL
7440-48-4	Cobalt	3.6E-10	J	1.5E-08		MG/M <sup>3</sup>	10-SO16-02	53/53	(6)	1.5E-08		6.4E-07 C			NO	BSL
7440-50-8	Copper	1.2E-09	J	1.1E-05		MG/M <sup>3</sup>	10-SO06-00	52/53	(6)	1.1E-05		1.5E-02 N			NO	BSL
57-12-5	Cyanide	3.8E-11	J	1.7E-10	J	MG/M <sup>3</sup>	SSP-LDFL1927-SB04-02	7/53	(6)	1.7E-10		7.3E-03 N			NO	BSL
7439-89-6	Iron	5.4E-07		4.1E-05		MG/M <sup>3</sup>	10-SO11-00	53/53	(6)	4.1E-05		1.1E-01 N			NO	BSL
7439-92-1	Lead	1.3E-09		2.5E-06		MG/M <sup>3</sup>	10-SO11-00	53/53	(6)	2.5E-06		NA			NO	BSL
7439-95-4	Magnesium	5.4E-08	J	8.7E-06	J	MG/M <sup>3</sup>	10-SO03-01	53/53	(6)	8.7E-06		NA			NO	BSL
7439-96-5	Manganese	4.5E-09		5.4E-07		MG/M <sup>3</sup>	10-SO11-00	53/53	(6)	5.4E-07		5.2E-06 N			NO	BSL
7439-97-6	Mercury	2.1E-11	J	3.1E-08		MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	43/53	(6)	3.1E-08		1.1E-04 N			NO	BSL
7440-02-0	Nickel	5.2E-10	J	2.5E-07		MG/M <sup>3</sup>	10-SO04-01	50/53	(6)	2.5E-07		7.3E-03 N			NO	BSL
7440-09-7	Potassium	1.4E-07	J	1.8E-06	J	MG/M <sup>3</sup>	10-SO03-01	52/53	(6)	1.8E-06		NA			NO	BSL
7782-49-2	Selenium	4.2E-10	J	4.8E-09		MG/M <sup>3</sup>	10-SO05-01	10/53	(6)	4.8E-09		1.8E-03 N			NO	BSL
7440-22-4	Silver	1.7E-10	J	8.8E-08		MG/M <sup>3</sup>	10-SO09-00	8/53	(6)	8.8E-08		1.8E-03 N			NO	BSL
7440-23-5	Sodium	3.8E-08	J	1.8E-06		MG/M <sup>3</sup>	SSP-LDFL1927-SS15-00	48/53	(6)	1.8E-06		NA			NO	BSL
7440-62-2	Vanadium	1.4E-09	J	3.4E-08		MG/M <sup>3</sup>	SSP-LDFL1927-SB06-01-P	53/53	(6)	3.4E-08		3.7E-04 N			NO	BSL
7440-66-6	Zinc	3.6E-09	J	4.0E-06		MG/M <sup>3</sup>	10-SO11-00	52/53	(6)	4.0E-06		1.1E-01 N			NO	BSL

[1] Minimum/maximum detected soil concentration multiplied by 1/PEF (1.32E+9 m3/kg) and 1/VF (chemical specific for VOCs only) to get air concentration. PEF and VF from EPA's Soil Screening Guidance. VFs calculated in Table 2.2A.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 25, 2005, U.S. EPA Region III, Jennifer Hubbard. Ambient Air.

RBC value for cadmium-food used as surrogate for cadmium.

RBC value for Chromium VI used for total chromium.

RBC value for chlordane used as surrogate for beta-chlordane.

RBC value for mercuric chloride used as surrogate for mercury.

RBC for aluminum, cobalt, and dibenzofuran withdrawn from October 2005 RBC table due to expiration of NCEA provisional toxicity value. Value is from the April 2005 RBC Table.

RBC value for manganese-nonfood used as surrogate for manganese.

RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.

RBC value for 4-Methylphenol used as surrogate for 4-Bromophenyl-phenylether

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

(6) See Table 2.1 for surface soil data detection limits, concentrations converted from surface soil data to air concentrations.

SQL = Sample Quantification Limit

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/

To Be Considered

J = Estimated Value

K = Biased High

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

SSL = Region III Soil Screening Level, Soil to Groundwater Migration, DAF 20

Table 2.4A  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 Calculation of Generic Chemical Specific VF Factors  
 NNSY Site 10 Residential Screening

Chemical	Diffusivity in Air (D <sub>a</sub> ) (cm <sup>2</sup> /s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D <sub>w</sub> ) (cm <sup>2</sup> /s)	Soil Organic Carbon Partition Coeff. (K <sub>oc</sub> ) (cm <sup>2</sup> /g)	Soil Water Partition Coeff. (K <sub>oc</sub> × F <sub>oc</sub> ) (g/cm <sup>3</sup> )	Solubility in Water (S) (mg/L)	Apparent Diffusivity (D <sub>a</sub> ) (cm <sup>2</sup> /s)	Volatilization Factor (VF) (m <sup>2</sup> /kg)
1,1,2-Trichloroethane	7.80E-02	3.74E-02	8.80E-06	5.01E+01	3.01E-01	4.42E+03	3.82E-04	8.41E+03
2-Butanone	8.95E-02	1.12E-03	9.80E-06	4.50E+00	2.70E-02	2.68E+05	4.26E-05	2.52E+04
Acetone	1.24E-01	1.59E-03	1.14E-05	5.75E-01	3.45E-03	1.00E+06	1.02E-04	1.63E+04
Carbon disulfide	1.04E-01	1.24E+00	1.00E-05	4.57E+01	2.74E-01	1.19E+03	1.13E-02	1.55E+03
Cumene	7.50E-02	4.70E-01	7.10E-06	2.20E+02	1.32E+00	6.10E+01	1.24E-03	4.66E+03
Cyclohexane	8.00E-02	8.20E+00	9.00E-06	1.60E+02	9.60E-01	5.50E+01	1.34E-02	1.42E+03
Methylcyclohexane	9.86E-02	1.78E+01	8.52E-06	2.19E+03	1.31E+01	1.40E+01	5.59E-03	2.20E+03
Methylene chloride	1.01E-01	8.98E-02	1.17E-05	1.17E+01	7.02E-02	1.30E+04	2.58E-03	3.23E+03
Trichloroethene	7.90E-02	4.22E-01	9.10E-06	1.60E+02	9.98E-01	1.10E+03	1.51E-03	4.23E+03
1,1-Biphenyl	4.04E-02	1.23E-02	8.15E-06	7.76E+03	4.66E+01	7.50E+00	5.68E-07	2.18E+05
2-Methylnaphthalene	5.60E-02	2.07E-02	7.84E-06	2.13E+03	1.28E+01	2.54E+01	4.80E-06	7.50E+04
4-Bromophenyl-phenylether		4.87E-03		4.16E+03	2.50E+01	1.45E+00		
Acenaphthene	4.21E-02	6.36E-03	7.69E-06	7.08E+03	4.25E+01	4.24E+00	3.36E-07	2.83E+05
Acenaphthylene	4.39E-02	5.11E-03	7.53E-06	6.12E+03	3.67E+01	1.61E+01	3.25E-07	2.88E+05
Acetophenone	6.00E-02	4.25E-04	8.73E-06	4.62E+01	2.77E-01	6.13E+03	3.75E-06	8.49E+04
Anthracene	3.24E-02	2.67E-03	7.74E-06	2.95E+04	1.77E+02	4.34E-02	2.63E-06	1.01E+06
Benzo(a)anthracene	7.30E-02	1.09E-03	7.30E-02	3.27E+01	1.96E-01	6.57E+03	1.58E-03	4.13E+03
Benzo(a)anthracene	5.10E-02	1.37E-04	9.00E-06	3.98E+05	2.39E+03	9.00E-06	1.80E-10	1.23E+07
Benzo(a)pyrene	4.30E-02	4.63E-05	9.00E-06	1.02E+06	6.12E+03	1.62E-03	2.67E-11	3.18E+07
Benzo(b)fluoranthene	2.26E-02	4.65E-03	5.56E-06	1.23E+06	7.38E+03	1.50E-03	7.47E-10	6.01E+06
Benzo(g,h,i)perylene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06
Benzo(k)fluoranthene	2.26E-02	3.40E-05	5.56E-06	1.23E+06	7.38E+03	8.00E-04	1.03E-11	5.11E+07
Caprolactam	6.54E-02	1.03E-06	8.99E-06	5.74E+01	3.44E-01	7.72E+05	1.37E-07	4.45E+05
Carbazole	3.90E-02	6.26E-07	7.03E-06	3.39E+03	2.03E+01	7.48E+00	2.25E-09	3.47E+06
Chrysene	2.48E-02	3.88E-03	6.21E-06	3.98E+05	2.39E+03	1.60E-03	2.16E-09	3.53E+06
Di-n-butylphthalate	4.38E-02	3.85E-08	7.86E-06	3.39E+04	2.03E+02	1.12E+01	2.46E-10	1.05E+07
Dibenz(a,h)anthracene	2.02E-02	5.03E-06	5.18E-06	2.62E+06	1.57E+04	1.03E-03	2.44E-12	1.05E+08
Dibenzofuran	6.19E-02	3.98E-03	1.00E-05	5.48E+03	3.29E+01	5.65E+00	4.00E-07	2.60E+05
Fluoranthene	3.02E-02	6.60E-04	6.35E-06	1.07E+05	6.42E+02	2.06E-01	1.72E-09	3.97E+06
Fluorene	3.63E-02	2.61E-03	7.86E-06	1.38E+04	8.28E+01	1.98E+00	6.15E-08	6.63E+05
Indeno(1,2,3-cd)pyrene	1.90E-02	6.56E-05	5.66E-06	3.47E+06	2.08E+04	2.20E-05	4.92E-12	7.41E+07
Naphthalene	5.90E-02	1.98E-02	7.50E-06	1.19E+03	7.15E+00	3.10E+01	8.59E-06	5.60E+04
Pentachlorophenol	5.60E-02	1.00E-06	6.10E-06	3.38E+03	2.03E+01	1.40E+01	2.05E-09	3.63E+06
Phenanthrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06
Pyrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06
bis(2-Ethylhexyl)phthalate	3.51E-02	4.18E-06	3.66E-06	1.51E+07	9.06E+04	3.40E-01	3.43E-13	2.81E+08
4,4'-DDD	NV	NV	NV	NV	NV	NV	NV	NV
4,4'-DDE	NV	NV	NV	NV	NV	NV	NV	NV
Endrin ketone	NV	NV	NV	NV	NV	NV	NV	NV
Heptachlor	NV	NV	NV	NV	NV	NV	NV	NV
Heptachlor epoxide	NV	NV	NV	NV	NV	NV	NV	NV
alpha-Chlordane	NV	NV	NV	NV	NV	NV	NV	NV
beta-BHC	NV	NV	NV	NV	NV	NV	NV	NV
beta-Chlordane	NV	NV	NV	NV	NV	NV	NV	NV

$$\text{Volatilization factor (VF)} = \frac{Q/C \cdot (3.14 \cdot D_a \cdot T)^{1/2} \cdot 10^{-4} \text{ m}^2/\text{cm}^2}{2 \cdot r_b \cdot D_a} \text{ (m}^2/\text{kg)}$$

$$\text{Apparent Diffusivity (D}_a\text{)} = \frac{[(Q_a^{10/3} \cdot D_i \cdot H' + Q_w^{10/3} \cdot D_w)/n^2]}{(r_b \cdot K_{oc} + Q_w + Q_a \cdot H')} \text{ (cm}^2/\text{s)}$$

Parameters	Values
Q/C - Inverse of the mean concentration at the center of a 0.5-acre-square source for Philadelphia (g/m <sup>2</sup> -s per kg/m <sup>3</sup> )	90.24
T - Exposure interval(s)	9.5E+08
r <sub>b</sub> - Soil bulk density (g/cm <sup>3</sup> )	1.5
Q <sub>a</sub> - Air-filled soil porosity (L <sub>air</sub> /L <sub>soil</sub> ) = n - Q <sub>w</sub>	0.28
n - Total soil porosity (L <sub>pore</sub> /L <sub>soil</sub> ) = 1 - (ρ/ρ <sub>s</sub> )	0.43
Q <sub>w</sub> - Water-filled soil porosity (L <sub>water</sub> /L <sub>soil</sub> )	0.15
ρ <sub>s</sub> - Soil particle density (g/cm <sup>3</sup> )	2.65
f <sub>oc</sub> - fraction organic carbon in soil (g/g)	0.006

Chemical and physical properties from USEPA, 1996, Soil Screening Guidance: User's Guide, EPA/540/R-96/018.

Table 2.5  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10

Scenario Timeframe: Future  
 Medium: Groundwater  
 Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Groundwater at NNSY	79-34-5	1,1,2,2-Tetrachloroethane	0.57	0.57	UG/L	10-MW10-04B	1/26	0.5 - 5	0.57	NA	0.0527 C	NA	NA	YES	ASL
	75-34-3	1,1-Dichloroethane	0.24 J	1.4	UG/L	10-MW14-04B	3/26	0.5 - 5	1.4	NA	90.0 N	NA	NA	NO	BSL
	87-61-6	1,2,3-Trichlorobenzene	0.14 J	0.14 J	UG/L	10-MW10-04B	1/15	0.5 - 0.5	0.14	NA	0.716 N	NA	NA	NO	BSL
	67-64-1	Acetone	3 J	6 J	UG/L	SSP-LDFL1927-MW10-01D-P	4/26	5 - 25	6	NA	548 N	NA	NA	NO	BSL
	71-43-2	Benzene	0.4 J	0.49 J	UG/L	10-MW13-04B	2/26	0.5 - 5	0.49	NA	0.336 C	NA	NA	YES	ASL
	75-15-0	Carbon disulfide	0.29 J	0.38 J	UG/L	10-MW11-04B	2/26	0.5 - 5	0.38	NA	104 N	NA	NA	NO	BSL
	108-90-7	Chlorobenzene	0.13 J	0.37 J	UG/L	10-MW14-04B	2/26	0.5 - 5	0.37	NA	10.6 N	NA	NA	NO	BSL
	67-66-3	Chloroform	0.3 J	0.6 J	UG/L	SSP-LDFL1927-MW05-01D	2/26	0.5 - 5	0.6	NA	0.155 C	NA	NA	YES	ASL
	74-87-3	Chloromethane	0.1 J	0.99	UG/L	10-MW04-04B	3/26	0.5 - 5	0.99	NA	19.0 N	NA	NA	NO	BSL
	98-82-8	Cumene	0.14 J	3	UG/L	10-MW10-04B	2/15	0.5 - 0.5	3	NA	65.8 N	NA	NA	NO	BSL
	100-41-4	Ethylbenzene	0.11 J	0.11 J	UG/L	10-MW01P-04B	1/26	0.5 - 5	0.11	NA	134 N	NA	NA	NO	BSL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	1.1	1.1	UG/L	10-MW06-04B	1/15	0.5 - 0.5	1.1	NA	2.64 C	NA	NA	NO	BSL
	108-87-2	Methylcyclohexane	0.24 J	1.1	UG/L	10-MW10-04B	10/15	0.5 - 0.5	1.1	NA	628 N	NA	NA	NO	BSL
	108-88-3	Toluene	0.12 J	0.45 J	UG/L	10-MW13-04B	2/26	0.5 - 5	0.45	NA	230.0 N	NA	NA	NO	BSL
	79-01-6	Trichloroethane	0.2 J	0.2 J	UG/L	SSP-LDFL1927-MW02-01D	1/26	0.5 - 5	0.2	NA	0.0264 C	NA	NA	YES	ASL
	75-01-4	Vinyl chloride	0.21 J	0.9 J	UG/L	SSP-LDFL1927-MW02-01D	5/26	0.5 - 5	0.9	NA	0.015 C	NA	NA	YES	ASL
	1330-20-7	Xylene, total	0.27 J	1.5	UG/L	10-MW10-04B	4/26	0.5 - 5	1.5	NA	21.3 N	NA	NA	NO	BSL
	156-59-2	cis-1,2-Dichloroethene	0.09 J	0.8 J	UG/L	SSP-LDFL1927-MW02-01D	5/26	0.5 - 5	0.8	NA	6.08 N	NA	NA	NO	BSL
	156-60-5	trans-1,2-Dichloroethene	0.2 J	0.2 J	UG/L	SSP-LDFL1927-MW02-01D	1/26	0.5 - 5	0.2	NA	11.0 N	NA	NA	NO	BSL
	105-67-9	2,4-Dimethylphenol	10 J	10 J	UG/L	10-MW13-04B	1/15	5 - 5	10	NA	73 N	NA	NA	NO	BSL
	91-57-6	2-Methylnaphthalene	8	8	UG/L	SSP-LDFL1927-MW10-01D-P	1/15	5 - 5	8	NA	2.43 N	NA	NA	YES	ASL
	83-32-9	Acenaphthene	0.5 J	1 J	UG/L	SSP-LDFL1927-MW06-01D	3/15	5 - 5	1	NA	36.5 N	NA	NA	NO	BSL
	85-68-7	Butylbenzylphthalate	64	64	UG/L	10-MW13-04B	1/15	5 - 5	64	NA	35 C	NA	NA	YES	ASL
	105-60-2	Caprolactam	2 J	2 J	UG/L	10-MW15-04B	1/4	5 - 5	2	NA	1,825 N	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	82	82	UG/L	10-MW13-04B	1/15	5 - 10	82	NA	365 N	NA	NA	NO	BSL
	132-64-9	Dibenzofuran	0.4 J	0.5 J	UG/L	SSP-LDFL1927-MW10-01D-P	2/15	5 - 5	0.5	NA	1.22 N	NA	NA	NO	BSL
	206-44-0	Fluoranthene	0.5 J	0.5 J	UG/L	SSP-LDFL1927-MW01-01D	1/15	5 - 5	0.5	NA	146 N	NA	NA	NO	BSL
	86-73-7	Fluorene	0.4 J	1 J	UG/L	SSP-LDFL1927-MW10-01D-P	2/15	5 - 5	1	NA	24.3 N	NA	NA	NO	BSL
	85-01-8	Phenanthrene	0.7 J	1 J	UG/L	SSP-LDFL1927-MW07-01D	4/15	5 - 5	1	NA	18.3 N	NA	NA	NO	BSL
	108-95-2	Phenol	1 J	1 J	UG/L	SSP-LDFL1927-MW06-01D	1/15	5 - 5	1	NA	1,095 N	NA	NA	NO	BSL
	129-00-0	Pyrene	3 J	3 J	UG/L	10-MW13-04B	1/15	5 - 5	3	NA	18.3 N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	4 J	34	UG/L	10-MW13-04B	2/15	5 - 5	34	NA	4.78 C	NA	NA	YES	ASL
	72-54-8	4,4'-DDD	0.022 J	0.11 J	UG/L	SSP-LDFL1927-MW10-01D-P	9/15	0.018 - 0.19	0.11	NA	0.279 C	NA	NA	NO	BSL
	72-55-9	4,4'-DDE	0.02 J	0.021 J	UG/L	SSP-LDFL1927-MW11-01D	2/15	0.018 - 0.19	0.021	NA	0.197 C	NA	NA	NO	BSL
	50-29-3	4,4'-DDT	0.022 J	0.046 J	UG/L	SSP-LDFL1927-MW06-01D	4/15	0.018 - 0.19	0.046	NA	0.197 C	NA	NA	NO	BSL
	309-00-2	Aldrin	0.016 J	0.044 J	UG/L	SSP-LDFL1927-MW03-01D	6/15	0.0091 - 0.01	0.044	NA	0.00394 C	NA	NA	YES	ASL
	60-57-1	Dieldrin	0.022 J	0.043 J	UG/L	SSP-LDFL1927-MW02-01D	6/15	0.018 - 0.19	0.043	NA	0.00419 C	NA	NA	YES	ASL
	959-98-8	Endosulfan I	0.0075 J	0.042	UG/L	SSP-LDFL1927-MW06-01D	4/15	0.0091 - 0.01	0.042	NA	21.9 N	NA	NA	NO	BSL
	1031-07-8	Endosulfan sulfate	0.0043 J	0.028 J	UG/L	SSP-LDFL1927-MW03-01D	3/15	0.018 - 0.19	0.028	NA	21.9 N	NA	NA	NO	BSL
	72-20-8	Endrin	0.028 J	0.12	UG/L	SSP-LDFL1927-MW10-01D-P	8/15	0.018 - 0.19	0.12	NA	1.10 N	NA	NA	NO	BSL
	7421-93-4	Endrin aldehyde	0.022 J	0.079 J	UG/L	SSP-LDFL1927-MW10-01D-P	8/15	0.018 - 0.19	0.079	NA	1.10 N	NA	NA	NO	BSL
	1024-57-3	Heptachlor epoxide	0.0098 J	0.07 J	UG/L	SSP-LDFL1927-MW11-01D	4/15	0.0091 - 0.01	0.07	NA	0.00736 C	NA	NA	YES	ASL

Table 2.5  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10

Scenario Timeframe: Future  
 Medium: Groundwater  
 Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	72-43-5	Methoxychlor	0.094 J	0.094 J	UG/L	SSP-LDFL1927-MW10-01D, SSP-LDFL1927-MW10-01D-P	1/15	0.09 - 0.11	0.094	NA	18.3 N	NA	NA	NO	BSL
	319-84-6	alpha-BHC	0.0069 J	0.0069 J	UG/L	SSP-LDFL1927-MW11-01D	1/15	0.0091 - 0.011	0.0069	NA	0.0106 C	NA	NA	NO	BSL
	5103-71-9	alpha-Chlordane	0.0072 J	0.032 J	UG/L	SSP-LDFL1927-MW10-01D-P	9/15	0.0091 - 0.011	0.032	NA	0.191 C	NA	NA	NO	BSL
	319-85-7	beta-BHC	0.02 J	0.056 J	UG/L	SSP-LDFL1927-MW03-01D	4/15	0.0091 - 0.011	0.056	NA	0.0372 C	NA	NA	YES	ASL
	-	beta-Chlordane	0.013 J	0.057 J	UG/L	SSP-LDFL1927-MW11-01D	8/11	0.0091 - 0.011	0.057	NA	0.191 C	NA	NA	NO	BSL
	319-86-8	delta-BHC	0.0076 J	0.034 J	UG/L	SSP-LDFL1927-MW10-01D	4/15	0.0091 - 0.011	0.034	NA	0.0372 C	NA	NA	NO	BSL
	58-89-9	gamma-BHC (Lindane)	0.0044 J	0.022 J	UG/L	SSP-LDFL1927-MW04-01D, SSP-LDFL1927-MW07-01D	7/15	0.0091 - 0.011	0.022	NA	0.0515 C	NA	NA	NO	BSL
	7440-36-0	Antimony	11.5 J	12.2 J	UG/L	10-MW14-04B	2/26	10 - 60	12.2	NA	1.46 N	NA	NA	YES	ASL
	7440-38-2	Arsenic	3 J	52.9 J	UG/L	10-MW07-04B	19/26	2.6 - 10	52.9	NA	0.0446 C	NA	NA	YES	ASL
	7440-39-3	Barium	14.2 J	513 J	UG/L	10-MW14-04B	25/26	0.78 - 200	513	NA	730 N	NA	NA	NO	BSL
	7440-43-9	Cadmium	1.3 J	5.8 J	UG/L	10-MW09-04B	3/26	0.48 - 5	5.8	NA	1.83 N	NA	NA	YES	ASL
	7440-70-2	Calcium	12,400 J	272,000 J	UG/L	SSP-LDFL1927-MW07-01D	26/26	77.4 - 5000	272000	NA	N/A	NA	NA	NO	NUT
	7440-47-3	Chromium	1 J	1.3 J	UG/L	SSP-LDFL1927-MW06-01D	4/26	0.87 - 10	1.3	NA	11.0 N	NA	NA	NO	BSL
	7440-48-4	Cobalt	1.3 J	218 J	UG/L	10-MW14-04B	3/26	1.9 - 50	218	NA	73 N	NA	NA	YES	ASL
	7440-50-8	Copper	2.2 J	6.1 J	UG/L	10-MW06-04B	12/26	1.1 - 25	6.1	NA	146 N	NA	NA	NO	BSL
	7439-89-6	Iron	420 J	249,000 J	UG/L	10-MW14-04B	22/26	32.2 - 100	249000	NA	1,095 N	NA	NA	YES	ASL
	7439-95-4	Magnesium	4,310 J	557,000 J	UG/L	SSP-LDFL1927-MW01-01D	26/26	28.2 - 5000	557000	NA	N/A	NA	NA	NO	NUT
	7439-96-5	Manganese	45.6 J	2,220 J	UG/L	10-MW14-04B	26/26	2 - 15	2220	NA	73 N	NA	NA	YES	ASL
	7440-02-0	Nickel	1.6 J	135 J	UG/L	10-MW14-04B	9/26	1.8 - 40	135	NA	73 N	NA	NA	YES	ASL
	7440-09-7	Potassium	1,660 J	283,000 J	UG/L	SSP-LDFL1927-MW01-01D	26/26	54.8 - 5000	283000	NA	N/A	NA	NA	NO	NUT
	7782-49-2	Selenium	6.8 J	31.4 J	UG/L	10-MW01-04B	4/26	5 - 5.3	31.4	NA	18.3 N	NA	NA	YES	ASL
	7440-23-5	Sodium	9,800 J	4,110,000 J	UG/L	SSP-LDFL1927-MW01-01D	26/26	60.9 - 100000	4110000	NA	N/A	NA	NA	NO	NUT
	7440-62-2	Vanadium	0.97 J	2.6 J	UG/L	SSP-LDFL1927-MW06-01D	4/26	1.5 - 50	2.6	NA	3.65 N	NA	NA	NO	BSL
	7440-66-6	Zinc	28 J	655 J	UG/L	10-MW15-04B	3/26	15.6 - 20	655	NA	1,095 N	NA	NA	NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 25, 2005, U.S. EPA Region III, Jennifer Hubbard.

RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.

RBC value for chlordane used as surrogate for beta-chlordane

RBC value for endosulfan used as surrogate for endosulfan I, endosulfan II, and endosulfan sulfate.

RBC value for endrin used as surrogate for endrin aldehyde and endrin ketone.

RBC value for technical-HCH used as surrogate for delta-BHC.

RBC value for cadmium-water used as surrogate for cadmium.

RBC value for chromium VI used for total chromium.

RBC value for manganese-nonfood used as surrogate for manganese.

RBC value for 1,2,4-trichlorobenzene used as surrogate for 1,2,3-trichlorobenzene.

RBC for cobalt, dibenzofuran, and cis-1,2-dichloroethene withdrawn from October 2005 RBC table due to expiration of NCEA provisional toxicity value. Value is from the April 2005 RBC Table.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)

Essential Nutrient (NUT)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/

To Be Considered

J = Estimated Value

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

Table 2.5  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
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Below Screening Level (BSL)

Table 3.1  
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY  
NNSY Site 10

Scenario Timeframe: Future  
Medium: Surface Soil  
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T/G/NP)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Exposed Surface Soil at NNSY	Benzo(a)anthracene	MG/KG	0.803	1.46 (T)	1.80	1.46	MG/KG	95% Cheb	(1)
	Benzo(a)pyrene	MG/KG	0.806	4.59 (NP)	1.60	1.60	MG/KG	Max	(2, 6)
	Benzo(b)fluoranthene	MG/KG	0.904	4.82 (NP)	3.10	3.10	MG/KG	Max	(2, 6)
	Dibenz(a,h)anthracene	MG/KG	0.612	4.37 (NP)	0.54	0.54	MG/KG	Max	(2, 6)
	Indeno(1,2,3-cd)pyrene	MG/KG	0.677	4.43 (NP)	1.00	1.00	MG/KG	Max	(2, 6)
	Heptachlor epoxide	MG/KG	0.0117	0.12 (NP)	0.13	0.12	MG/KG	99% Cheb-m	(6)
	Aluminum	MG/KG	5,633	6,324 (N)	9,130	6,324	MG/KG	95% UCL-N	(3)
	Antimony	MG/KG	2.34	18.5 (NP)	36.2	18.5	MG/KG	99% Cheb-m	(6)
	Arsenic	MG/KG	20.7	33.6 (G)	124	33.6	MG/KG	95% Gamma	(1,4,5)
	Cadmium	MG/KG	1.89	3.27 (G)	10.00	3.3	MG/KG	95% Gamma	(4,5)
	Chromium	MG/KG	27.2	36.8 (G)	85.6	36.8	MG/KG	95% Gamma	(1,4,5)
	Copper	MG/KG	925	2,776 (T)	14,000	2,776	MG/KG	95% Cheb	(1)
	Iron	MG/KG	19,501	25,746 (G)	54,700	25,746	MG/KG	95% Gamma	(1,4,5)
	Lead	MG/KG	741	1,445 (G)	3,260	741	MG/KG	Mean	(7)
	Manganese	MG/KG	195	276 (G)	718	276	MG/KG	95% Gamma	(1,4,5)
	Mercury	MG/KG	4.72	10.8 (G)	40.5	10.8	MG/KG	95% Adj Gamma	(1,4,5)
	Nickel	MG/KG	41.0	66.9 (G)	184	66.9	MG/KG	95% Gamma	(1,4,5)
	Silver	MG/KG	5.40	57.8 (NP)	116	57.8	MG/KG	99% Cheb-m	(6)
	Vanadium	MG/KG	21.8	26.5 (G)	45.4	26.5	MG/KG	95% Gamma	(1,5)
	Zinc	MG/KG	959	1,694 (G)	5,340	1,694	MG/KG	95% Gamma	(1,4,5)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data using H-Statistic (95% UCL-T); 95% UCL Chebyshev MVUE (95% Cheb); 99% UCL Chebyshev (mean, sd) (99% Cheb-m); 95% UCL based on Approximate Gamma Distribution (95% Gamma); 95% UCL based on Adjusted Gamma Distribution (95% Adj Gamma)

- (1) Shapiro-Wilk W Test indicates data are log-normally distributed.
- (2) 95% UCL (or mean) exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
- (3) Shapiro-Wilks W Test indicates data are normally distributed.
- (4) Anderson-Darling test indicates data are gamma distributed.
- (5) K-Smirnov test indicates data are gamma distributed.
- (6) Data do not fit normal, lognormal, or gamma distribution.
- (7) For lead, arithmetic mean concentration used as exposure point concentration.

N - Normal  
T - Log-Normal  
G - Gamma  
NP - Non-Parametric

Table 3.2  
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY  
NNSY Site 10

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Exposed Soil at NNSY	Benzo(a)anthracene	mg/kg	1.12E+00	4.30E+00 (NP)	2.60E+01	4.30E+00	mg/kg	97.5% Cheb-m	(6)
	Benzo(a)pyrene	mg/kg	7.29E-01	2.00E+00 (NP)	6.60E+00 J	2.00E+00	mg/kg	97.5% Cheb-m	(6)
	Benzo(b)fluoranthene	mg/kg	8.38E-01	2.39E+00 (NP)	1.00E+01 J	2.39E+00	mg/kg	97.5% Cheb-m	(6)
	Benzo(k)fluoranthene	mg/kg	7.32E-01	2.20E+00 (NP)	9.50E+00 J	2.21E+00	mg/kg	97.5% Cheb-m	(6)
	Dibenz(a,h)anthracene	mg/kg	5.42E-01	1.47E+00 (NP)	1.30E+00	1.47E+00	mg/kg	95% Cheb-m	(6)
	Indeno(1,2,3-cd)pyrene	mg/kg	6.35E-01	1.57E+00 (NP)	2.20E+00	1.57E+00	mg/kg	95% Cheb-m	(6)
	Heptachlor epoxide	mg/kg	4.99E-03	2.20E-02 (NP)	1.30E-01 D	2.20E-02	mg/kg	95% Cheb-m	(6)
	Aluminum	mg/kg	6.47E+03	7.61E+03 (G)	2.27E+04	7.61E+03	mg/kg	95% Gamma	(1, 4, 5)
	Antimony	mg/kg	1.22E+00	5.46E+00 (NP)	3.62E+01	5.46E+00	mg/kg	97.5% Cheb-m	(6)
	Arsenic	mg/kg	1.49E+01	2.66E+01 (T)	1.24E+02 J	2.66E+01	mg/kg	95% UCL-T	(1)
	Cadmium	mg/kg	1.29E+00	2.81E+00 (NP)	1.00E+01	2.81E+00	mg/kg	97.5% Cheb-m	(6)
	Chromium	mg/kg	2.57E+01	3.44E+01 (T)	1.81E+02	3.44E+01	mg/kg	95% UCL-T	(1)
	Copper	mg/kg	7.29E+02	2.51E+03 (T)	1.40E+04	2.51E+03	mg/kg	95% Cheb	(1)
	Iron	mg/kg	1.57E+04	1.84E+04 (N)	5.47E+04	1.84E+04	mg/kg	95% UCL-N	(3)
	Lead	mg/kg	4.77E+02	2.11E+03 (T)	3.26E+03	4.77E+02	mg/kg	Mean	(7)
	Manganese	mg/kg	1.48E+02	2.6E+02 (NP)	7.18E+02	2.64E+02	mg/kg	97.5% Cheb-m	(6)
	Mercury	mg/kg	3.47E+00	1.75E+01 (T)	4.05E+01	1.75E+01	mg/kg	95% Cheb	(1)
	Nickel	mg/kg	3.39E+01	6.18E+01 (T)	3.35E+02	6.18E+01	mg/kg	95% UCL-T	(1)
	Silver	mg/kg	2.38E+00	1.60E+01 (NP)	1.16E+02	1.60E+01	mg/kg	97.5% Cheb-m	(6)
	Vanadium	mg/kg	1.92E+01	2.21E+01 (G)	4.55E+01	2.21E+01	mg/kg	95% Gamma	(1, 4, 5)
Zinc	mg/kg	6.56E+02	2.94E+03 (T)	5.34E+03	2.94E+03	mg/kg	95% UCL-T	(1)	

\* Surface soil & subsurface soil combined.

Full statistics for data included in Appendix.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data using H-Statistic (95% UCL-T);

95% UCL Chebyshev MVUE (95% Cheb); 97.5% UCL Chebyshev (mean, sd) (97.5% Cheb-m); 99% UCL Chebyshev (mean, sd) (99% Cheb-m);

95% UCL based on Approximate Gamma Distribution (95% Gamma); 95% UCL based on Adjusted Gamma Distribution (95% Adj Gamma)

- (1) Lillifores Test indicates data are log-normally distributed.
- (2) 95% UCL (or mean) exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
- (3) Lillifores Test indicates data are normally distributed.
- (4) Anderson-Darling test indicates data are gamma distributed.
- (5) K-Smirnov test indicates data are gamma distributed.
- (6) Data do not fit normal, lognormal, or gamma distribution.
- (7) For lead, arithmetic mean concentration used as exposure point concentration.

N - Normal  
T - Log-Normal  
G - Gamma  
NP - Non-Parametric

Table 3.3  
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY  
NNSY Site 10

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T/G/NP)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Groundwater at NNSY	1,1,2,2-Tetrachloroethane	UG/L	0.52	1.03 (NP)	0.57	0.57	UG/L	Max	(2,6)
	Benzene	UG/L	0.52	1.03 (NP)	0.49 J	0.49	UG/L	Max	(2,6)
	Chloroform	UG/L	0.51	1.02 (NP)	0.60 J	0.60	UG/L	Max	(2,6)
	Trichloroethene	UG/L	0.50	1.01 (NP)	0.20 J	0.20	UG/L	Max	(2,6)
	Vinyl chloride	UG/L	0.55	1.06 (NP)	0.90 J	0.90	UG/L	Max	(2,6)
	2-Methylnaphthalene	UG/L	2.87	3.51 (NP)	8.0	3.51	UG/L	95% UCL-N	(6)
	Butylbenzylphthalate	UG/L	6.60	24.47 (NP)	64.0	24.5	UG/L	95% Cheb-m	(6)
	bis(2-Ethylhexyl)phthalate	UG/L	4.7	13.8 (NP)	34	13.8	UG/L	95% Cheb-m	(6)
	Aldrin	UG/L	0.015	0.030 (NP)	0.044 J	0.030	UG/L	95% Cheb-m	(6)
	Dieldrin	UG/L	0.019	0.032 (NP)	0.043 J	0.032	UG/L	95% Cheb-m	(6)
	Heptachlor epoxide	UG/L	0.015	0.040 (NP)	0.070 J	0.040	UG/L	95% Cheb-m	(6)
	beta-BHC	UG/L	0.013	0.029 (NP)	0.056	0.029	UG/L	95% Cheb-m	(6)
	Antimony	UG/L	4.19	6.53 (NP)	12.2 J	6.53	UG/L	95% Cheb-m	(6)
	Arsenic	UG/L	14.1	21.1 (G)	52.9	21.1	UG/L	95% Gamma	(4,5)
	Cadmium	UG/L	0.63	1.76 (NP)	5.8	1.76	UG/L	95% Cheb-m	(6)
	Cobalt	UG/L	9.21	92.3 (NP)	218	92.3	UG/L	99% Cheb-m	(6)
	Iron	UG/L	20,301	39,922 (G)	249,000	39,922	UG/L	95% Adj Gamma	(4,5)
	Manganese	UG/L	362	536 (T)	2,220	536	UG/L	95% UCL-T	(1)
	Nickel	UG/L	6.51	57.7 (NP)	135	57.7	UG/L	99% Cheb-m	(6)
Selenium	UG/L	5.02	10.8 (NP)	31.4 J	10.8	UG/L	95% Cheb-m	(6)	

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data using H-Statistic (95% UCL-T); 95% UCL Chebyshev MVUE (95% Cheb); 97.5% UCL Chebyshev MVUE (97.5% Cheb); 95% UCL Chebyshev (mean, sd) (95% Cheb-m); 99% UCL Chebyshev (mean, sd) (99% Cheb-m); 95% UCL based on Approximate Gamma Distribution (95% Gamma); 95% UCL based on Adjusted Gamma Distribution (95% Adj Gamma)

- (1) Shapiro-Wilk W Test indicates data are log-normally distributed.
- (2) 95% UCL (or mean) exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
- (3) Shapiro-Wilks W Test indicates data are normally distributed.
- (4) Anderson-Darling test indicates data are gamma distributed.
- (5) K-Smirnov test indicates data are gamma distributed.
- (6) Data do not fit normal, lognormal, or gamma distribution.

N - Normal  
T - Log-Normal  
G - Gamma  
NP - Non-Parametric

Table 3.1 CTE  
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY  
NNSY Site 10

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T/G/NP)	Maximum Concentration (Qualifier)	Exposure Point Concentration				
						Value	Units	Statistic	Rationale	
Exposed Surface Soil at NNSY	Benzo(a)anthracene	MG/KG	0.803	1.46 (T)	1.80	0.62	MG/KG	Mean-T	(1)	
	Benzo(a)pyrene	MG/KG	0.806	4.59 (NP)	1.60	0.81	MG/KG	Mean-N	(4)	
	Benzo(b)fluoranthene	MG/KG	0.904	4.82 (NP)	3.10	0.90	MG/KG	Mean-N	(4)	
	Dibenz(a,h)anthracene	MG/KG	0.612	4.37 (NP)	0.54	0.54	MG/KG	Max	(4)	
	Indeno(1,2,3-cd)pyrene	MG/KG	0.677	4.43 (NP)	1.00	J	0.68	MG/KG	Mean-N	(4)
	Heptachlor epoxide	MG/KG	0.0117	0.12 (NP)	0.13	D	0.01	MG/KG	Mean-N	(4)
	Aluminum	MG/KG	5,633	6,324 (N)	9,130		5632.73	MG/KG	Mean-N	(2)
	Antimony	MG/KG	2.34	18.5 (NP)	36.2		2.34	MG/KG	Mean-N	(4)
	Arsenic	MG/KG	20.7	33.6 (G)	124	J	20.74	MG/KG	Mean-N	(3)
	Cadmium	MG/KG	1.89	3.27 (G)	10.00		1.89	MG/KG	Mean-N	(3)
	Chromium	MG/KG	27.2	36.8 (G)	85.6		27.20	MG/KG	Mean-N	(3)
	Copper	MG/KG	925	2,776 (T)	14,000		0.84	MG/KG	Mean-T	(1)
	Iron	MG/KG	19,501	25,746 (G)	54,700		19,501	MG/KG	Mean-N	(3)
	Lead	MG/KG	741	1,445 (G)	3,260		741	MG/KG	Mean-N	(3)
	Manganese	MG/KG	195	276 (G)	718		195	MG/KG	Mean-N	(3)
	Mercury	MG/KG	4.72	10.8 (G)	40.5		5	MG/KG	Mean-N	(3)
	Nickel	MG/KG	41.0	66.9 (G)	184		41	MG/KG	Mean-N	(3)
	Silver	MG/KG	5.40	57.8 (NP)	116		5	MG/KG	Mean-N	(4)
	Vanadium	MG/KG	21.8	26.5 (G)	45.4		22	MG/KG	Mean-N	(3)
	Zinc	MG/KG	959	1,694 (G)	5,340		959	MG/KG	Mean-N	(3)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data using H-Statistic (95% UCL-T); 95% UCL Chebyshev MVUE (95% Cheb); 99% UCL Chebyshev (mean, sd) (99% Cheb-m); 95% UCL based on Approximate Gamma Distribution (95% Gamma); 95% UCL based on Adjusted Gamma Distribution (95% Adj Gamma);  
Statistics: Maximum Detected Value (Max); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T); Mean value of Normally-distributed data (Mean-N).

- (1) Data are determined to lognormally distributed; use MVUE mean.
- (2) Data are normally distributed; use normal mean.
- (3) Data are determined to best fit a gamma distribution; use normal mean.
- (4) Data distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed); use normal mean.

N - Normal  
T- Log-Normal  
G - Gamma  
NP - Non-Parametric

Table 3.2 CTE  
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY  
NNSY Site 10

Scenario Timeframe: Future Medium: Soil* Exposure Medium: Soil*
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Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Exposed Soil at NNSY	Benzo(a)anthracene	mg/kg	1.12E+00	4.30E+00 (NP)	2.60E+01	1.12E+00	mg/kg	Mean-N	(4)
	Benzo(a)pyrene	mg/kg	7.29E-01	2.00E+00 (NP)	6.60E+00 J	7.29E-01	mg/kg	Mean-N	(4)
	Benzo(b)fluoranthene	mg/kg	8.38E-01	2.39E+00 (NP)	1.00E+01 J	8.38E-01	mg/kg	Mean-N	(4)
	Benzo(k)fluoranthene	mg/kg	7.32E-01	2.20E+00 (NP)	9.50E+00 J	7.32E-01	mg/kg	Mean-N	(4)
	Dibenz(a,h)anthracene	mg/kg	5.42E-01	1.47E+00 (NP)	1.30E+00	5.42E-01	mg/kg	Mean-N	(4)
	Indeno(1,2,3-cd)pyrene	mg/kg	6.35E-01	1.57E+00 (NP)	2.20E+00	6.35E-01	mg/kg	Mean-N	(4)
	Heptachlor epoxide	mg/kg	4.99E-03	2.20E-02 (NP)	1.30E-01 D	4.99E-03	mg/kg	Mean-N	(4)
	Aluminum	mg/kg	6.47E+03	7.61E+03 (G)	2.27E+04	6.47E+03	mg/kg	Mean-N	(3)
	Antimony	mg/kg	1.22E+00	5.46E+00 (NP)	3.62E+01	1.22E+00	mg/kg	Mean-N	(4)
	Arsenic	mg/kg	1.49E+01	2.66E+01 (T)	1.24E+02 J	1.53E+01	mg/kg	Mean-T	(1)
	Cadmium	mg/kg	1.29E+00	2.81E+00 (NP)	1.00E+01	1.29E+00	mg/kg	Mean-N	(4)
	Chromium	mg/kg	2.57E+01	3.44E+01 (T)	1.81E+02	2.55E+01	mg/kg	Mean-T	(1)
	Copper	mg/kg	7.29E+02	2.51E+03 (T)	1.40E+04	7.29E+02	mg/kg	Mean-N	(1)
	Iron	mg/kg	1.57E+04	1.84E+04 (N)	5.47E+04	1.69E+04	mg/kg	Mean-T	(3)
	Lead	mg/kg	4.77E+02	2.11E+03 (T)	3.26E+03	4.77E+02	mg/kg	Mean-N	(1)
	Manganese	mg/kg	1.48E+02	2.6E+02 (NP)	7.18E+02	1.48E+02	mg/kg	Mean-N	(4)
	Mercury	mg/kg	3.47E+00	1.75E+01 (T)	4.05E+01	5.46E+00	mg/kg	Mean-T	(1)
	Nickel	mg/kg	3.39E+01	6.18E+01 (T)	3.35E+02	3.41E+01	mg/kg	Mean-T	(1)
	Silver	mg/kg	2.38E+00	1.60E+01 (NP)	1.16E+02	2.38E+00	mg/kg	Mean-N	(4)
	Vanadium	mg/kg	1.92E+01	2.21E+01 (G)	4.55E+01	1.92E+01	mg/kg	Mean-N	(3)
Zinc	mg/kg	6.56E+02	2.94E+03 (T)	5.34E+03	1.04E+03	mg/kg	Mean-T	(1)	

\* Surface soil & subsurface soil combined.

Full statistics for data included in Appendix.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data using H-Statistic (95% UCL-T);

95% UCL Chebyshev MVUE (95% Cheb); 97.5% UCL Chebyshev (mean, sd) (97.5% Cheb-m); 99% UCL Chebyshev (mean, sd) (99% Cheb-m);

95% UCL based on Approximate Gamma Distribution (95% Gamma); 95% UCL based on Adjusted Gamma Distribution (95% Adj Gamma)

Statistics: Maximum Detected Value (Max); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T);

Mean value of Normally-distributed data (Mean-N).

(1) Data are determined to lognormally distributed; use MVUE mean.

(2) Data are normally distributed; use normal mean.

(3) Data are determined to best fit a gamma distribution; use normal mean.

(4) Data distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed); use normal mean.

N - Normal

T- Log-Normal

G - Gamma

NP - Non-Parametric

Table 3.3 CTE  
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY  
NNSY Site 10

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T/G/NP)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Groundwater at NNSY	1,1,2,2-Tetrachloroethane	UG/L	0.52	1.03 (NP)	0.57	0.52	UG/L	Mean-N	(4)
	Benzene	UG/L	0.52	1.03 (NP)	0.49 J	0.52	UG/L	Mean-N	(4)
	Chloroform	UG/L	0.51	1.02 (NP)	0.60 J	0.51	UG/L	Mean-N	(4)
	Trichloroethene	UG/L	0.50	1.01 (NP)	0.20 J	0.50	UG/L	Mean-N	(4)
	Vinyl chloride	UG/L	0.55	1.06 (NP)	0.90 J	0.55	UG/L	Mean-N	(4)
	2-Methylnaphthalene	UG/L	2.87	3.51 (NP)	8.0	2.87	UG/L	Mean-N	(4)
	Butylbenzylphthalate	UG/L	6.60	24.47 (NP)	64.0	6.60	UG/L	Mean-N	(4)
	bis(2-Ethylhexyl)phthalate	UG/L	4.7	13.8 (NP)	34	4.70	UG/L	Mean-N	(4)
	Aldrin	UG/L	0.015	0.030 (NP)	0.044 J	0.01	UG/L	Mean-N	(4)
	Dieldrin	UG/L	0.019	0.032 (NP)	0.043 J	0.02	UG/L	Mean-N	(4)
	Heptachlor epoxide	UG/L	0.015	0.040 (NP)	0.070 J	0.02	UG/L	Mean-N	(4)
	beta-BHC	UG/L	0.013	0.029 (NP)	0.056	0.01	UG/L	Mean-N	(4)
	Antimony	UG/L	4.19	6.53 (NP)	12.2 J	4.19	UG/L	Mean-N	(4)
	Arsenic	UG/L	14.1	21.1 (G)	52.9	14.05	UG/L	Mean-N	(3)
	Cadmium	UG/L	0.63	1.76 (NP)	5.8	0.63	UG/L	Mean-N	(4)
	Cobalt	UG/L	9.21	92.3 (NP)	218	9.21	UG/L	Mean-N	(4)
	Iron	UG/L	20,301	39,922 (G)	249,000	20301.40	UG/L	Mean-N	(3)
	Manganese	UG/L	362	536 (T)	2,220	338.82	UG/L	Mean-T	(1)
Nickel	UG/L	6.51	57.7 (NP)	135	6.5	UG/L	Mean-N	(4)	
Selenium	UG/L	5.02	10.8 (NP)	31.4 J	5.0	UG/L	Mean-N	(4)	

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data using H-Statistic (95% UCL-T);  
95% UCL Chebyshev MVUE (95% Cheb); 97.5% UCL Chebyshev MVUE (97.5% Cheb); 95% UCL Chebyshev (mean, sd) (95% Cheb-m);  
99% UCL Chebyshev (mean, sd) (99% Cheb-m); 95% UCL based on Approximate Gamma Distribution (95% Gamma);  
95% UCL based on Adjusted Gamma Distribution (95% Adj Gamma)  
Statistics: Maximum Detected Value (Max); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T);  
Mean value of Normally-distributed data (Mean-N).

- (1) Data are determined to lognormally distributed; use MVUE mean.
- (2) Data are normally distributed; use normal mean.
- (3) Data are determined to best fit a gamma distribution; use normal mean.
- (4) Data distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed); use normal mean.

N - Normal  
T - Log-Normal  
G - Gamma  
NP - Non-Parametric

TABLE 4.1.RME  
VALUES USED FOR DAILY INTAKE CALCULATIONS  
REASONABLE MAXIMUM EXPOSURE  
NNSY Site 10

Scenario Timeframe: Future  
Medium: Surface Soil  
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Worker	Adult	Exposed Surface Soil at NNSY	CS	Chemical Concentration in Soil	Calculated	mg/kg	See Table 3.1 RME	Chronic Daily Intake (CDI) (mg/kg-day) = $CS \times IR-S \times EF \times ED \times CF1 \times 1/BW \times 1/AT$
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	EPA, 1989	
Dermal	Industrial Worker	Adult	Exposed Surface Soil at NNSY	CS	Chemical Concentration in Soil	Calculated	mg/kg	See Table 3.1 RME	CDI (mg/kg-day) = $CS \times SA \times SSAF \times DABS \times CF1 \times EF \times ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	3,300	cm <sup>2</sup>	EPA, 2004 (5)	
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm <sup>2</sup> -day	EPA, 2004 (6)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	--	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

Notes:

- (1) Professional Judgement assuming 1 year for duration of construction project.
- (2) USEPA recommended value for adult and child resident (USEPA, 2001).
- (3) USEPA recommended value for construction workers.
- (4) USEPA value for construction worker, 95th percentile (USEPA, 2001).
- (5) RME SA recommended by USEPA for commercial/industrial workers and includes head, hands, and forearm (USEPA 2001).
- (6) USEPA recommended value for commercial/industrial worker (USEPA, 2001).

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.  
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.  
EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 5.1  
NON-CANCER TOXICITY DATA -- ORAL/DERMAL  
NNSY Site 10

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Aldrin	Chronic	3.0E-05	mg/kg-day	N/A	3.0E-05	mg/kg-day	Liver	1000/1	IRIS	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aluminum	Chronic	1.0E+00	mg/kg-day	NA	1.0E+00	mg/kg-day	CNS	100	PPRTV	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Antimony	Chronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	Blood	1000/1	IRIS	08/09/04
	Subchronic	2.0E-04	mg/kg-day	15%	3.0E-05	mg/kg-day	Blood	300	PPRTV	08/09/04
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin/vascular	3/1	IRIS	08/09/04
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin/vascular	3	HEAST	07/01/97
Benzene	Chronic	4.0E-03	mg/kg-day	NA	4.0E-03	mg/kg-day	Blood	300/1	IRIS	08/09/04
	Subchronic	3.0E-03	mg/kg-day	NA	3.0E-03	mg/kg-day	Blood	3000	NCEA	07/08/98
Benzo(a)anthracene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
beta-BHC	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
bis(2-Ethylhexyl)phthalate)	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Liver	1000/1	IRIS	08/09/04
	Subchronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Reproductive	3000	NCEA	03/28/96
Butylbenzophthalate	Chronic	2.0E-01	mg/kg-day	N/A	2.0E-01	mg/kg-day	Liver	1000/1	IRIS	08/16/05
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cadmium (food) (for soil)	Chronic	1.0E-03	mg/kg-day	2.5%	2.5E-05	mg/kg-day	Kidney	10/1	IRIS	08/09/04
	Subchronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	N/A	N/A
Cadmium (water)	Chronic	5.0E-04	mg/kg-day	5.0%	2.5E-05	mg/kg-day	Kidney	10/1	IRIS	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 5.1  
NON-CANCER TOXICITY DATA -- ORAL/DERMAL  
NNSY Site 10

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Chloroform	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	1000/1	IRIS	08/09/04
	Subchronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	1000	HEAST	07/01/97
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	NOAEL	300/3	IRIS	08/09/04
	Subchronic	2.0E-02	mg/kg-day	2.5%	5.0E-04	mg/kg-day	NOAEL	100	HEAST	07/01/97
Cobalt	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Blood	10/1	PPRTV	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Copper	Chronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day	Gastrointestinal	N/A	HEAST	07/01/97
	Subchronic	4.0E-02	mg/kg-day	N/A	4.0E-02	mg/kg-day	Gastrointestinal	N/A	HEAST	07/01/97
Dibenzo(a,h)anthracene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dieldrin	Chronic	5.0E-05	mg/kg-day	N/A	5.0E-05	mg/kg-day	Liver	100/1	IRIS	08/09/04
	Subchronic	5.0E-05	mg/kg-day	N/A	5.0E-05	mg/kg-day	Liver	100	HEAST	07/01/97
Heptachlor epoxide	Chronic	1.3E-05	mg/kg-day	N/A	1.3E-05	mg/kg-day	Liver	1000/1	IRIS	08/09/04
	Subchronic	1.3E-05	mg/kg-day	N/A	1.3E-05	mg/kg-day	Liver	1000	HEAST	07/01/97
Indeno(1,2,3-cd)pyrene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iron	Chronic	3.0E-01	mg/kg-day	N/A	3.0E-01	mg/kg-day	Gastrointestinal, Blood, Liver	1	NCEA	01/05/99
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese (nonfood)	Chronic	2.0E-02	mg/kg-day	4%	8.0E-04	mg/kg-day	CNS	1/1	IRIS	08/09/04
	Subchronic	N/A	mg/kg-day	N/A	N/A	mg/kg-day	N/A	N/A	N/A	N/A
Manganese (food)	Chronic	1.4E-01	mg/kg-day	4%	5.6E-03	mg/kg-day	CNS	1/1	IRIS	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mercury (as Mercuric chloride)	Chronic	3.0E-04	mg/kg-day	7%	2.1E-05	mg/kg-day	Immune System	1000/1	IRIS	08/09/04
	Subchronic	3.0E-04	mg/kg-day	7%	2.1E-05	mg/kg-day	Kidney	1000	HEAST	07/01/97
2-Methylnaphthalene	Chronic	4.0E-03	mg/kg-day	N/A	4.0E-03	mg/kg-day	Lung	1000/1	IRIS	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel	Chronic	2.0E-02	mg/kg-day	4%	8.0E-04	mg/kg-day	Decreased Body Weight	300/1	IRIS	08/09/04
	Subchronic	2.0E-02	mg/kg-day	4%	8.0E-04	mg/kg-day	Whole body	300	HEAST	07/01/97

TABLE 5.1  
NON-CANCER TOXICITY DATA -- ORAL/DERMAL  
NNSY Site 10

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Selenium	Chronic	5.0E-03	mg/kg-day	30-80%	5.0E-03	mg/kg-day	Whole body	3/1	IRIS	08/09/04
	Subchronic	5.0E-03	mg/kg-day	30-80%	5.0E-03	mg/kg-day	Whole body	3	HEAST	07/01/97
Silver	Chronic	5.0E-03	mg/kg-day	4%	2.0E-04	mg/kg-day	Skin	3/1	IRIS	08/09/04
	Subchronic	5.0E-03	mg/kg-day	4%	2.0E-04	mg/kg-day	Skin	3	HEAST	07/01/97
1,1,2,2-Tetrachloroethane	Chronic	6.0E-02	mg/kg-day	N/A	6.0E-02	mg/kg-day	Liver	N/A	PPRTV	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trichloroethene	Chronic	6.0E-03	mg/kg-day	N/A	6.0E-03	mg/kg-day	Liver, Kidney, Fetus	3000		1986
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vanadium	Chronic	1.0E-03	mg/kg-day	2.6%	2.6E-05	mg/kg-day	Kidney	300	NCEA	05/01/00
	Subchronic	7.0E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	Lifetime	100	HEAST	07/01/97
Vinyl chloride	Chronic	3.0E-03	mg/kg-day	N/A	3.0E-03	mg/kg-day	Liver	30/1	IRIS	08/09/04
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Zinc	Chronic	3.0E-01	mg/kg-day	N/A	3.0E-01	mg/kg-day	Blood	3/1	IRIS	08/09/04
	Subchronic	3.0E-01	mg/kg-day	N/A	3.0E-01	mg/kg-day	Blood	3	HEAST	07/01/97

N/A = Not Applicable or Not Available.

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Interim)).

Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%.

Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

HEAST= Health Effects Assessment Summary Tables

RESP = Respiratory System

IRIS = Integrated Risk Information System

CNS = Central Nervous System

NCEA = National Center for Environmental Assessment

NOAEL = No adverse effect level

PPRTV = Provisional Peer Reviewed Toxicity Values

(2) Provide equation for derivation in text.

(3) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

TABLE 5.2  
NON-CANCER TOXICITY DATA -- INHALATION  
NNSY Site 10

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC/RfD: Target Organ (2)	Dates (3) (MM/DD/YY)
Aldrin	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aluminum	Chronic	5.00E-03	mg/m <sup>3</sup>	1.00E-03	mg/kg-day	CNS	300	PPRTV	8/9/2004
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Antimony	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	4.00E-04	N/A	1.14E-04	N/A	Lung	100	PPRTV	8/9/2004
Arsenic	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzene	Chronic	3.01E-02	mg/m3	8.6E-03	mg/kg-day	Blood	300/1	IRIS	8/9/2004
	Subchronic	6.0E-02	mg/m3	1.7E-02	mg/kg-day	Blood	100	NCEA	7/2/1996
Benzo(a)anthracene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
beta-BHC	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
bis(2-Ethylhexyl)phthalate	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Butylbenzophthalate	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cadmium (food and water)	Chronic	2.00E-04	mg/m3	5.7E-05	mg/kg-day	Kidney	N/A	NCEA	12/29/2003
	Subchronic	9.00E-04	mg/m3	2.6E-04	mg/kg-day	Kidney	N/A	NCEA	12/29/2003
Chloroform	Chronic	4.90E-02	mg/m <sup>3</sup>	1.40E-02	mg/kg-day	Liver, Kidney	10	NCEA	12/1/1997
	Subchronic	3.00E-03	mg/m <sup>3</sup>	8.60E-04	mg/kg-day	Liver, Kidney	100	NCEA	12/1/1997
Chromium (hexavalent)	Chronic	1.05E-04	mg/m <sup>3</sup>	3.00E-05	mg/kg-day	Respiratory System	300/1	IRIS	8/9/2004
	Subchronic	4.00E-06	mg/m <sup>3</sup>	1.14E-06	mg/kg-day	Respiratory System	100	NCEA	5/14/1993
Cobalt	Chronic	2.00E-05	mg/m <sup>3</sup>	5.70E-06	mg/kg-day	Respiratory System	100	PPRTV	8/9/2004
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 5.2  
NON-CANCER TOXICITY DATA -- INHALATION  
NNSY Site 10

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RFC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RFC:RfD: Target Organ (2)	Dates (3) (MM/DD/YY)
Copper	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Dibenzo(a,h)anthracene	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dieldrin	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Heptachlor epoxide	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Iron	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Lead	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Manganese	Chronic Subchronic	5.01E-05 N/A	mg/m <sup>3</sup> N/A	1.43E-05 N/A	mg/kg-day N/A	CNS N/A	1000/1 N/A	IRIS N/A	8/9/2004 N/A
Mercury (inorganic)	Chronic Subchronic	3.01E-04 3.0E-04	mg/m <sup>3</sup> mg/m3	8.6E-05 8.6E-05	mg/kg-day mg/kg-day	CNS CNS	30/1 30	IRIS HEAST	8/9/2004 07/1998
2-Methylnaphthalene	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Nickel	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Selenium	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Silver	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	IRIS N/A	8/9/2004 N/A
1,1,1,2,2-Tetrachloroethane	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Trichloroethene	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	1000 N/A	N/A N/A	N/A N/A
Vanadium	Chronic Subchronic	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Vinyl chloride	Chronic Subchronic	9.80E-02 N/A	mg/m3	2.8E-02 N/A	mg/kg-day N/A	Liver N/A	30/1 N/A	IRIS N/A	8/9/2004 N/A
Zinc	Chronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 5.2  
 NON-CANCER TOXICITY DATA -- INHALATION  
 NNSY Site 10

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC/RfD: Target Organ (2)	Dates (3) (MM/DD/YY)
	Subchronic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

(1) Provide equation used for derivation in text.

(2) HEAST, Alternative Methods used as source of barium values.

Chromium and cadmium values were withdrawn from HEAST, but available in Region III RBC Table.

(3) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

NCEA = National Center for Environmental Assessment

PPRTV = Provisional Peer Reviewed Toxicity Values

TABLE 6.1  
 CANCER TOXICITY DATA -- ORAL/DERMAL  
 NNSY Site 10

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (MM/DD/YY)
Aldrin	1.7E+01	N/A	1.7E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Aluminum	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	N/A	NCEA	8/13/1999
Antimony	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Arsenic	1.5E+00	95%	1.5E+00	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Benzene	5.5E-02	N/A	5.5E-02	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Benzo(a)anthracene	7.3E-01	58% - 89%	7.3E-01	(mg/kg-day) <sup>-1</sup>	B2	RBC - NCEA	10/15/2003
Benzo(a)pyrene	7.3E+00	58% - 89%	7.3E+00	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Benzo(b)fluoranthene	7.3E-01	58% - 89%	7.3E-01	(mg/kg-day) <sup>-1</sup>	B2	RBC - NCEA	10/15/2003
Benzo(k)fluoranthene	7.3E-02	58% - 89%	7.3E-02	(mg/kg-day) <sup>-1</sup>	B2	NCEA	7/1/1993
beta-BHC	1.8E+00	N/A	1.8E+00	(mg/kg-day) <sup>-1</sup>	C	IRIS	8/5/2004
bis(2-Ethylhexyl)phthalate)	1.4E-02	N/A	1.4E-02	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Butylbenzylphthalate	1.9E-03	N/A	1.9E-03	(mg/kg-day) <sup>-1</sup>		P-RBC	4/7/2005
Cadmium-Soil	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	B1	IRIS	8/5/2004
Cadmium-Water	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	B1	IRIS	8/5/2004
Chloroform	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Chromium (VI)	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
Cobalt	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	NA	IRIS	8/5/2004
Copper	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
Dibenzo(a,h)anthracene	7.3E+00	58% - 89%	7.3E+00	(mg/kg-day) <sup>-1</sup>	B2	NCEA	7/1/1993
Dieldrin	1.6E+01	N/A	1.6E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Heptachlor Epoxide	9.1E+00	N/A	9.1E+00	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Indeno(1,2,3-cd)pyrene	7.3E-01	58% - 89%	7.3E-01	(mg/kg-day) <sup>-1</sup>	B2	RBC - NCEA	10/15/2003
Iron	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	NA	NCEA	1/5/1999
Lead	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	NA	IRIS	8/5/2004
Manganese (nonfood)	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
Manganese (food)	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
Mercury	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
2-Methylnaphthalene	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Nickel	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004

TABLE 6.1  
 CANCER TOXICITY DATA -- ORAL/DERMAL  
 NNSY Site 10

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (MM/DD/YY)
Selenium	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Silver	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
1,1,2, 2-Tetrachloroethane	2.0E-01	N/A	2.0E-01	(mg/kg-day) <sup>-1</sup>	C	IRIS	8/9/2004
Trichloroethene	1.1E-02	N/A	1.1E-02	(mg/kg-day) <sup>-1</sup>	B1		1986
Vanadium	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Vinyl chloride (lifetime from adult)	7.2E-01	N/A	7.2E-01	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Vinyl chloride (lifetime from birth)	1.4E+00	N/A	1.4E+00	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Zinc	N/A	N/A	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004

N/A-Not available

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

RBC = EPA Region III RBC Table, 4/7/2005

EPA Carcinogen Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

(1) Source: Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Interim).

Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

TABLE 6.2  
 CANCER TOXICITY DATA -- INHALATION  
 NNSY Site 10

Chemical of Potential Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date (MM/DD/YY)
Aldrin	4.9E-03	(ug/m3) <sup>-1</sup>	1.7E+01	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Aluminum	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Antimony	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Arsenic	4.0E-03	(ug/m3) <sup>-1</sup>	1.5E+01	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Benzene	7.7E-06	(ug/m3) <sup>-1</sup>	2.7E-02	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Benzo(a)anthracene	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	B2	RBC - NCEA	10/15/2003
Benzo(a)pyrene	8.9E-04	(ug/m3) <sup>-1</sup>	3.1E+00	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Benzo(b)fluoranthene	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	B2	RBC - NCEA	10/15/2003
Benzo(k)fluoranthene	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	B2	NCEA	7/1/1993
beta-BHC	5.3E-04	(ug/m3) <sup>-1</sup>	1.8E+00	(mg/kg-day) <sup>-1</sup>	C	IRIS	8/5/2004
bis(2-Ethylhexyl)phthalate)	4.0E-06	(ug/m3) <sup>-1</sup>	1.4E-02	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Butylbenzylphthalate	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/17/2005
Cadmium-Soil	1.8E-03	(ug/m3) <sup>-1</sup>	6.3E+00	(mg/kg-day) <sup>-1</sup>	B1	IRIS	8/5/2004
Cadmium-Water	1.8E-03	(ug/m3) <sup>-1</sup>	6.3E+00	(mg/kg-day) <sup>-1</sup>	B1	IRIS	8/5/2004
Chloroform	2.3E-05	(ug/m3) <sup>-1</sup>	8.1E-02	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Chromium (VI)	1.2E-02	(ug/m3) <sup>-1</sup>	4.1E+01	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Cobalt	2.8E-03	(ug/m3) <sup>-1</sup>	9.8E+00	(mg/kg-day) <sup>-1</sup>	B1	PPRTV	8/9/2004
Copper	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
Dibenzo(a,h)anthracene	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	B2	NCEA	7/1/1993
Dieldrin	4.6E-03	(ug/m3) <sup>-1</sup>	1.6E+01	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Indeno(1,2,3-cd)pyrene	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	B2	RBC - NCEA	10/15/2003
Heptachlor Epoxide	2.6E-03	(ug/m3) <sup>-1</sup>	9.1E+00	(mg/kg-day) <sup>-1</sup>	B2	IRIS	8/5/2004
Iron	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	NCEA	1/5/1999
Lead	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	NA	IRIS	8/5/2004
Manganese (nonfood)	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
Manganese (food)	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
Mercury	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004
2-Methylnaphthalene	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Nickel	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Selenium	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Silver	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
1,1,2,2-Tetrachloroethane	5.7E-05	(ug/m3) <sup>-1</sup>	2.0E-01	(mg/kg-day) <sup>-1</sup>	C	IRIS	8/5/2004
Trichloroethene	1.7E-06	(ug/m3) <sup>-1</sup>	6.0E-03	(mg/kg-day) <sup>-1</sup>	B1		1986
Vanadium	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	N/A	IRIS	8/5/2004
Vinyl chloride (lifetime from adult)	4.3E-06	(ug/m3) <sup>-1</sup>	1.5E-02	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Vinyl chloride (lifetime from birth)	8.6E-06	(ug/m3) <sup>-1</sup>	3.0E-02	(mg/kg-day) <sup>-1</sup>	A	IRIS	8/5/2004
Zinc	N/A	(ug/m3) <sup>-1</sup>	N/A	(mg/kg-day) <sup>-1</sup>	D	IRIS	8/5/2004

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

EPA Group:

A - Human carcinogen

TABLE 6.2  
 CANCER TOXICITY DATA -- INHALATION  
 NNSY Site 10

Chemical of Potential Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date (MM/DD/YY)
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NCEA = National Center for Environmental Assessment  
 PPRTV = Provisional Peer Reviewed Toxicity Values  
 N/A = Not Available

B1 - Probable human carcinogen - indicates that limited human data are available  
 B2 - Probable human carcinogen - indicates sufficient evidence in animals and  
 inadequate or no evidence in humans  
 C - Possible human carcinogen  
 D - Not classifiable as a human carcinogen  
 E - Evidence of noncarcinogenicity

(1) Adjustment Factor applied to Unit Risk to calculate Inhalation Slope Factor =  
 $70\text{kg} \times 1/20\text{m}^3/\text{day} \times 1000\text{ug}/\text{mg}$

(2) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

For RBC values, provide the date of last change in the Tables.

Notes for specific chemicals:

Trichloroethene slope factor is a range from 0.02 to 0.4 kg-d/mg. The median of 0.21 may be used for general populations, 0.4 for sensitive populations.

TABLE 7.1.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RFC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	NNSY	Ingestion	Benzo(a)anthracene	4.3E+00	mg/kg	2.9E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.1E-07	2.0E-05	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.0E+00	mg/kg	1.3E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	9.8E-07	9.4E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.4E+00	mg/kg	1.6E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.2E-07	1.1E-05	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	2.2E+00	mg/kg	1.5E-07	mg/kg/day	7.3E-02	1/(mg/kg-day)	1.1E-08	1.0E-05	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.5E+00	mg/kg	9.9E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	7.2E-07	6.9E-06	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	1.6E+00	mg/kg	1.1E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	7.7E-08	7.4E-06	mg/kg/day	NA	NA	NA
				Heptachlor Epoxide	2.2E-02	mg/kg	1.5E-09	mg/kg/day	9.1E+00	1/(mg/kg-day)	1.3E-08	1.0E-07	mg/kg/day	1.3E-05	mg/kg/day	8.0E-03
				Aluminum	7.6E+03	mg/kg	5.1E-04	mg/kg/day	NA	NA	NA	3.6E-02	mg/kg/day	1.0E+00	mg/kg/day	3.6E-02
				Antimony	5.5E+00	mg/kg	3.7E-07	mg/kg/day	NA	NA	NA	2.6E-05	mg/kg/day	2.0E-04	mg/kg/day	1.3E-01
				Arsenic	2.7E+01	mg/kg	1.8E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	2.7E-06	1.2E-04	mg/kg/day	3.0E-04	mg/kg/day	4.2E-01
				Cadmium	2.8E+00	mg/kg	1.9E-07	mg/kg/day	NA	NA	NA	1.3E-05	mg/kg/day	1.0E-03	mg/kg/day	1.3E-02
				Chromium	3.4E+01	mg/kg	2.3E-06	mg/kg/day	NA	NA	NA	1.6E-04	mg/kg/day	2.0E-02	mg/kg/day	8.1E-03
				Copper	2.5E+03	mg/kg	1.7E-04	mg/kg/day	NA	NA	NA	1.2E-02	mg/kg/day	4.0E-02	mg/kg/day	2.9E-01
				Iron	1.8E+04	mg/kg	1.2E-03	mg/kg/day	NA	NA	NA	8.7E-02	mg/kg/day	3.0E-01	mg/kg/day	2.9E-01
				Lead	4.8E+02	mg/kg	3.2E-05	mg/kg/day	NA	NA	NA	2.2E-03	mg/kg/day	NA	NA	NA
				Manganese	2.6E+02	mg/kg	1.8E-05	mg/kg/day	NA	NA	NA	1.2E-03	mg/kg/day	2.0E-02	mg/kg/day	6.2E-02
				Mercury	1.7E+01	mg/kg	1.2E-06	mg/kg/day	NA	NA	NA	8.2E-05	mg/kg/day	3.0E-04	mg/kg/day	2.7E-01
				Nickel	6.2E+01	mg/kg	4.1E-06	mg/kg/day	NA	NA	NA	2.9E-04	mg/kg/day	2.0E-02	mg/kg/day	1.5E-02
				Silver	1.6E+01	mg/kg	1.1E-06	mg/kg/day	NA	NA	NA	7.5E-05	mg/kg/day	5.0E-03	mg/kg/day	1.5E-02
				Vanadium	2.2E+01	mg/kg	1.5E-06	mg/kg/day	NA	NA	NA	1.0E-04	mg/kg/day	1.0E-03	mg/kg/day	1.0E-01
Zinc	2.9E+03	mg/kg	2.0E-04	mg/kg/day	NA	NA	NA	1.4E-02	mg/kg/day	3.0E-01	mg/kg/day	4.6E-02				
Exp. Route Total										4.8E-06				1.7E+00		

TABLE 7.1.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal Absorption	Benzo(a)anthracene	4.3E+00	mg/kg	7.7E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	5.6E-08	5.4E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.0E+00	mg/kg	3.6E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.6E-07	2.5E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.4E+00	mg/kg	4.3E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	3.1E-08	3.0E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	2.2E+00	mg/kg	4.0E-08	mg/kg/day	7.3E-02	1/(mg/kg-day)	2.9E-09	2.8E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.5E+00	mg/kg	2.6E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.9E-07	1.9E-06	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	1.6E+00	mg/kg	2.8E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.1E-08	2.0E-06	mg/kg/day	NA	NA	NA
				Heptachlor Epoxide	2.2E-02	mg/kg	4.0E-10	mg/kg/day	9.1E+00	1/(mg/kg-day)	3.6E-09	2.8E-08	mg/kg/day	1.3E-05	NA	2.1E-03
				Aluminum	7.6E+03	mg/kg	1.1E-05	mg/kg/day	NA	NA	NA	7.4E-04	mg/kg/day	1.0E+00	mg/kg/day	7.4E-04
				Antimony	5.5E+00	mg/kg	7.6E-09	mg/kg/day	NA	NA	NA	5.3E-07	mg/kg/day	3.0E-05	mg/kg/day	1.8E-02
				Arsenic	2.7E+01	mg/kg	1.1E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.7E-07	7.7E-06	mg/kg/day	3.0E-04	mg/kg/day	2.6E-02
				Cadmium	2.8E+00	mg/kg	3.9E-09	mg/kg/day	NA	NA	NA	2.7E-07	mg/kg/day	2.5E-05	mg/kg/day	1.1E-02
				Chromium	3.4E+01	mg/kg	4.8E-08	mg/kg/day	NA	NA	NA	3.3E-06	mg/kg/day	5.0E-04	mg/kg/day	6.7E-03
				Copper	2.5E+03	mg/kg	3.5E-06	mg/kg/day	NA	NA	NA	2.4E-04	mg/kg/day	4.0E-02	mg/kg/day	6.1E-03
				Iron	1.8E+04	mg/kg	2.6E-05	mg/kg/day	NA	NA	NA	1.8E-03	mg/kg/day	3.0E-01	mg/kg/day	6.0E-03
				Lead	4.8E+02	mg/kg	6.6E-07	mg/kg/day	NA	NA	NA	4.6E-05	mg/kg/day	NA	mg/kg/day	NA
				Manganese	2.6E+02	mg/kg	3.7E-07	mg/kg/day	NA	NA	NA	2.6E-05	mg/kg/day	8.0E-04	mg/kg/day	3.2E-02
				Mercury	1.7E+01	mg/kg	2.4E-08	mg/kg/day	NA	NA	NA	1.7E-06	mg/kg/day	2.1E-05	mg/kg/day	8.1E-02
				Nickel	6.2E+01	mg/kg	8.5E-08	mg/kg/day	NA	NA	NA	6.0E-06	mg/kg/day	8.0E-04	mg/kg/day	7.5E-03
				Silver	1.6E+01	mg/kg	2.2E-08	mg/kg/day	NA	NA	NA	1.6E-06	mg/kg/day	2.0E-04	mg/kg/day	7.8E-03
				Vanadium	2.2E+01	mg/kg	3.1E-08	mg/kg/day	NA	NA	NA	2.1E-06	mg/kg/day	2.6E-05	mg/kg/day	8.3E-02
				Zinc	2.9E+03	mg/kg	4.1E-06	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	3.0E-01	mg/kg/day	9.5E-04
			Exp. Route Total								7.4E-07					2.9E-01
		Exposure Point Total									5.5E-06					2.0E+00
	Exposure Medium Total										5.5E-06					2.0E+00
Soil* Total											5.5E-06					2.0E+00
Groundwater	Groundwater	Water at NNSY	Dermal Absorption	1,1,2,2-Tetrachloroethane	5.7E-01	ug/l	1.8E-08	ug/l	2.0E-01	mg/kg/day	3.5E-09	1.2E-06	mg/kg/day	6.0E-02	mg/kg/day	2.0E-05
				Benzene	4.9E-01	ug/l	2.8E-08	ug/l	5.5E-02	mg/kg/day	1.5E-09	2.0E-06	mg/kg/day	4.0E-03	mg/kg/day	4.9E-04
				Chloroform	6.0E-01	ug/l	1.7E-08	ug/l	NA	NA	NA	1.2E-06	mg/kg/day	1.0E-02	mg/kg/day	1.2E-04
				Trichloroethene	2.0E-01	ug/l	9.8E-09	ug/l	1.1E-02	mg/kg/day	1.1E-10	6.8E-07	mg/kg/day	6.0E-03	mg/kg/day	1.1E-04
				Vinyl chloride	9.0E-01	ug/l	1.9E-08	ug/l	7.2E-01	mg/kg/day	1.4E-08	1.4E-06	mg/kg/day	3.0E-03	mg/kg/day	4.5E-04
				2-Methylnaphthalene	3.5E+00	ug/l	1.6E-06	ug/l	NA	NA	NA	1.1E-04	mg/kg/day	4.0E-03	mg/kg/day	2.8E-02
				Butylbenzylphthalate	2.4E+01	ug/l	4.1E-06	ug/l	1.9E-03	mg/kg/day	7.7E-09	8.1E-04	mg/kg/day	2.0E-01	mg/kg/day	4.0E-03
				bis(2-Ethylhexyl)phthalate	1.4E+01	ug/l	4.1E-06	ug/l	1.4E-02	mg/kg/day	5.7E-08	2.8E-04	mg/kg/day	2.0E-02	mg/kg/day	1.4E-02
				Aldrin	3.0E-02	ug/l	5.3E-10	ug/l	1.7E+01	mg/kg/day	9.0E-09	3.7E-08	mg/kg/day	3.0E-05	mg/kg/day	1.2E-03

TABLE 7.1.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations								
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Groundwater	Air	Emmissions from Water at NNSY	Inhalation	Dieldrin	3.2E-02	ug/l	4.3E-09	ug/l	1.6E+01	mg/kg/day	6.9E-08	3.0E-07	mg/kg/day	5.0E-05	mg/kg/day	6.0E-03				
				Heptachlor epoxide	4.0E-02	ug/l	3.6E-09	ug/l	9.1E+00	mg/kg/day	3.3E-08	2.6E-07	mg/kg/day	1.3E-05	mg/kg/day	2.0E-02				
				beta-BHC	2.9E-02	ug/l	6.1E-09	ug/l	1.8E+00	mg/kg/day	1.1E-08	4.3E-07	mg/kg/day	NA	NA	NA				
				Antimony	6.5E+00	ug/l	2.4E-08	ug/l	NA	NA	NA	1.7E-06	mg/kg/day	3.0E-05	mg/kg/day	5.6E-02				
				Arsenic	2.1E+01	ug/l	7.8E-08	NA	1.5E+00	mg/kg/day	1.2E-07	5.4E-06	mg/kg/day	3.0E-04	mg/kg/day	1.8E-02				
				Cadmium	1.8E+00	ug/l	6.5E-09	NA	NA	NA	NA	4.5E-07	mg/kg/day	2.5E-05	mg/kg/day	1.8E-02				
				Cobalt	9.2E+01	ug/l	1.4E-07	NA	NA	NA	NA	9.5E-06	mg/kg/day	2.0E-02	mg/kg/day	4.8E-04				
				Iron	4.0E+04	ug/l	1.5E-04	NA	NA	NA	NA	1.0E-02	mg/kg/day	3.0E-01	mg/kg/day	3.4E-02				
				Manganese	5.4E+02	ug/l	2.0E-06	NA	NA	NA	NA	1.4E-04	mg/kg/day	8.0E-04	mg/kg/day	1.7E-01				
				Nickel	5.8E+01	ug/l	4.3E-08	NA	NA	NA	NA	3.0E-06	mg/kg/day	8.0E-04	mg/kg/day	3.7E-03				
				Selenium	1.1E+01	ug/l	4.0E-08	NA	NA	NA	NA	2.8E-06	mg/kg/day	5.0E-03	mg/kg/day	5.6E-04				
				Exp. Route Total										3.2E-07			3.8E-01			
				Exposure Medium Total										3.2E-07			3.8E-01			
				Groundwater	Air	Emmissions from Water at NNSY	Inhalation	1,1,2,2-Tetrachloroethane	4.3E-06	mg/m3	1.2E-08	mg/kg/day	2.0E-01	mg/kg/day	2.4E-09	8.5E-07	mg/kg/day	NA	mg/kg/day	NA
								Benzene	5.0E-06	mg/m3	1.4E-08	mg/kg/day	2.7E-02	mg/kg/day	3.8E-10	9.8E-07	mg/kg/day	8.6E-03	mg/kg/day	1.1E-04
								Chloroform	5.5E-06	mg/m3	1.5E-08	mg/kg/day	8.1E-02	mg/kg/day	1.2E-09	1.1E-06	mg/kg/day	1.4E-02	mg/kg/day	7.7E-05
								Trichloroethene	1.8E-06	mg/m3	5.0E-09	mg/kg/day	6.0E-03	mg/kg/day	3.0E-11	3.5E-07	mg/kg/day	NA	NA	NA
								Vinyl chloride	9.7E-06	mg/m3	2.7E-08	mg/kg/day	1.5E-02	mg/kg/day	4.1E-10	1.9E-06	mg/kg/day	2.8E-02	mg/kg/day	6.8E-05
								2-Methylnaphthalene	2.9E-05	mg/m3	8.1E-08	mg/kg/day	NA	NA	NA	5.6E-06	mg/kg/day	NA	NA	NA
Exposure Point Total										4.5E-09			2.6E-04							
Exposure Medium Total										4.5E-09			2.6E-04							
Groundwater Total										3.3E-07			3.8E-01							
Total of Receptor Risks Across All Media										5.9E-06	Total of Receptor Hazards Across All Media		2.4E+00							

\* Surface and subsurface soil combined.

Table 7.1.RME Supplement A  
 Calculation of DAevent  
 Construction Worker, Groundwater  
 NNSY Site 10

Chemical of Potential Concern	Groundwater Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ <sub>event</sub> ) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm <sup>2</sup> -event)	Eq
1,1,2,2-Tetrachloroethene	5.7E-01	6.9E-03	3.4E-02	9.3E-01	2.2E+00	1.0E+00	8	3.8E-08	3
Benzene	4.9E-01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	8	6.0E-08	3
Chloroform	6.0E-01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	8	3.6E-08	3
Trichloroethene	2.0E-01	1.2E-02	5.3E-02	5.8E-01	1.4E+00	1.0E+00	8	2.1E-08	3
Vinyl Chloride	9.0E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	8	4.2E-08	3
2-Methylnaphthalene	3.5E+00	1.4E-01	6.5E-01	6.6E-01	2.6E+00	1.0E+00	8	3.4E-06	3
Butylbenzylphthalate	2.4E+01	5.4E-02	3.7E-01	5.9E+00	1.4E+01	1.0E+00	8	2.5E-05	2
bis(2-Ethylhexyl)phthalate	1.4E+01	2.5E-02	1.9E-01	1.7E+01	4.0E+01	8.0E-01	8	8.8E-06	2
Aldrin	3.0E-02	1.4E-03	1.0E-02	1.2E+01	2.9E+01	1.0E+00	8	1.1E-09	2
Dieldrin	3.2E-02	1.2E-02	9.0E-02	1.5E+01	3.5E+01	8.0E-01	8	9.3E-09	2
Hept. Epox	4.0E-02	8.6E-03	6.5E-02	1.3E+01	3.2E+01	8.0E-01	8	7.9E-09	2
Beta BHC	2.9E-02	2.8E-02	1.8E-01	4.5E+00	1.1E+01	1.0E+00	8	1.3E-08	2
Antimony	6.5E+00	1.0E-03	NA	NA	NA	NA	8	5.2E-08	1
Arsenic	2.1E+01	1.0E-03	NA	NA	NA	NA	8	1.7E-07	1
Cadmium	1.8E+00	1.0E-03	NA	NA	NA	NA	8	1.4E-08	1
Cobalt	9.2E+01	4.0E-04	NA	NA	NA	NA	8	3.0E-07	1
Iron	4.0E+04	1.0E-03	NA	NA	NA	NA	8	3.2E-04	1
Manganese	5.4E+02	1.0E-03	NA	NA	NA	NA	8	4.3E-06	1
Nickel	5.8E+01	2.0E-04	NA	NA	NA	NA	8	9.2E-08	1
Selenium	1.1E+01	1.0E-03	NA	NA	NA	NA	8	8.6E-08	1

Inorganics: DAevent (mg/cm<sup>2</sup>-event) =  
 Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm<sup>3</sup> (eq 1)

Organics: DAevent (mg/cm<sup>2</sup>-event) =

$$\text{If } t_{\text{event}} \leq t^*, \text{ then } DA_{\text{event}} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{\text{event}} \times t_{\text{event}}}{\pi}} \quad (\text{eq 2})$$

$$\text{If } t_{\text{event}} \geq t^*, \text{ then } DA_{\text{event}} = FA \times K_p \times C_w \left[ \frac{t_{\text{event}}}{1+B} + 2 \times \tau_{\text{event}} \left( \frac{1+3B+3B^2}{(1+B)^2} \right) \right] \quad (\text{eq 3})$$

Notes:

Permeability constants (Kp), B, lag time, and t\* from EPA 2001, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Interim)*. EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below. Parameters B, tau, t\* were calculated for 2-methylnaphthalene, and beta-BHC.

NA - not applicable.

Heptachlor used as surrogate for Heptachlor Epoxide.

**Table 7.1.RME Supplement B**  
**Inhalation of Volatiles from Groundwater During Construction**  
**Inhalation Exposure Concentrations Calculated Using a Two-Film Volatilization Model**  
**Future Construction Worker Senario**  
**NNSY Site 10**

Chemical	Cw (µg/L)	MW (mol/gram)	K <sub>H</sub> (unitless)	k <sub>l</sub> (cm/hr)	k <sub>g</sub> (cm/hr)	K <sub>v</sub> (cm/hr)	ER (mg/hr)	ERa (g/sec-m <sup>2</sup> )	Ca (mg/m <sup>3</sup> )
1,1,2,2-Tetrachloroethane	5.70E-01	1.68E+02	1.41E-02	2.91E+00	1.76E+03	2.60E+00	1.48E+00	1.53E-10	4.33E-06
Benzene	4.90E-01	7.81E+01	2.28E-01	3.52E+00	2.13E+03	3.49E+00	1.71E+00	1.76E-10	5.00E-06
Chloroform	6.00E-01	1.19E+02	1.50E-01	3.17E+00	1.92E+03	3.13E+00	1.88E+00	1.93E-10	5.49E-06
Trichloroethene	2.00E-01	1.31E+02	4.22E-01	3.09E+00	1.88E+03	3.08E+00	6.16E-01	6.34E-11	1.80E-06
Vinyl Chloride	9.00E-01	6.30E+01	1.11E+00	3.71E+00	2.25E+03	3.71E+00	3.34E+00	3.43E-10	9.75E-06
2-Methylnaphthalene	3.51E+00	1.42E+02	2.12E-02	3.03E+00	1.84E+03	2.81E+00	9.88E+00	1.02E-09	2.88E-05

Equations	
Equation 1	$K_v = 1 / (1/k_l + 1/K_H * K_g)$
Equation 2	$k_g = 700(18/MW)^{1/4} V$
Equation 3	$k_l = (32/MW)^{1/4} K_a'$
Equation 4	$ER = K_v * C_w * L / 1000 \text{ cm}^3 * \text{mg} / 1000 \mu\text{g}$
Equation 5	$ERa = ER * \text{g} / 1000 \text{ mg} * \text{hr} / 60 \text{ min} * \text{min} / 60 \text{ sec} * 1/A$

Variables	Units	Exposure Assumptions
Cw = groundwater concentration	(µg/L)	chem-specific
MW = molecular weight	(mol/gram)	chem-specific
K <sub>H</sub> - Henry's Law Constant	(unitless)	chem-specific
K <sub>v</sub> = volatilization rate	(cm/hr)	Solved by Eq 1
k <sub>g</sub> = gas phase transfer coefficient	(cm/hr)	Solved by Eq 2
k <sub>l</sub> = liquid phase transfer coefficient	(cm/hr)	Solved by Eq 3
V = wind speed	(m/s)	4.4
K <sub>a</sub> ' = aeration rate	(cm/hr)	0.0633
ER = emission rate	(mg/hr)	Solved by Eq 4
A = area of excavation (utility ditch)	(m <sup>2</sup> )	2,700
ERa = area emission rate	(g/sec-m <sup>2</sup> )	Solved by Eq 5
Ca = air concentration	(mg/m <sup>3</sup> )	Solved using SCREEN3 model

Note: aeration rate based on aeration rate for small pond (0.1/day) multiplied by depth of water in excavation (1/2 ft)

TABLE 7.1.CTE  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 CENTRAL TENDANCY  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal Absorption	Benzo(a)anthracene	1.1E+00	mg/kg	NA	NA	NA	NA	NA	4.1E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	7.3E-01	mg/kg	NA	NA	NA	NA	NA	2.7E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	8.4E-01	mg/kg	NA	NA	NA	NA	NA	3.1E-07	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	7.3E-01	mg/kg	NA	NA	NA	NA	NA	2.7E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	5.4E-01	mg/kg	NA	NA	NA	NA	NA	2.0E-07	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	6.3E-01	mg/kg	NA	NA	NA	NA	NA	2.3E-07	mg/kg/day	NA	NA	NA
				Heptachlor Epoxide	5.0E-03	mg/kg	NA	NA	NA	NA	NA	1.8E-09	mg/kg/day	1.3E-05	NA	1.4E-04
				Aluminum	6.5E+03	mg/kg	NA	NA	NA	NA	NA	1.8E-04	mg/kg/day	1.0E+00	mg/kg/day	1.8E-04
				Antimony	1.2E+00	mg/kg	NA	NA	NA	NA	NA	3.5E-08	mg/kg/day	3.0E-05	mg/kg/day	1.2E-03
				Arsenic	1.5E+01	mg/kg	NA	NA	NA	NA	NA	1.3E-06	mg/kg/day	3.0E-04	mg/kg/day	4.3E-03
				Cadmium	1.3E+00	mg/kg	NA	NA	NA	NA	NA	3.6E-08	mg/kg/day	2.5E-05	mg/kg/day	1.5E-03
				Chromium	2.6E+01	mg/kg	NA	NA	NA	NA	NA	7.2E-07	mg/kg/day	5.0E-04	mg/kg/day	1.4E-03
				Copper	7.3E+02	mg/kg	NA	NA	NA	NA	NA	2.1E-05	mg/kg/day	4.0E-02	mg/kg/day	5.2E-04
				Iron	1.7E+04	mg/kg	NA	NA	NA	NA	NA	4.8E-04	mg/kg/day	3.0E-01	mg/kg/day	1.6E-03
				Lead	4.8E+02	mg/kg	NA	NA	NA	NA	NA	1.3E-05	mg/kg/day	NA	mg/kg/day	NA
				Manganese	1.5E+02	mg/kg	NA	NA	NA	NA	NA	4.2E-06	mg/kg/day	8.0E-04	mg/kg/day	5.2E-03
				Mercury	5.5E+00	mg/kg	NA	NA	NA	NA	NA	1.5E-07	mg/kg/day	2.1E-05	mg/kg/day	7.4E-03
				Nickel	3.4E+01	mg/kg	NA	NA	NA	NA	NA	9.7E-07	mg/kg/day	8.0E-04	mg/kg/day	1.2E-03
				Silver	2.4E+00	mg/kg	NA	NA	NA	NA	NA	6.7E-08	mg/kg/day	2.0E-04	mg/kg/day	3.4E-04
				Vanadium	1.9E+01	mg/kg	NA	NA	NA	NA	NA	5.4E-07	mg/kg/day	2.6E-05	mg/kg/day	2.1E-02
			Zinc	1.0E+03	mg/kg	NA	NA	NA	NA	NA	2.9E-05	mg/kg/day	3.0E-01	mg/kg/day	9.8E-05	
			Exp. Route Total								0.0E+00					4.6E-02
			Exposure Point Total								0.0E+00					8.3E-01
			Exposure Medium Total								0.0E+00					8.3E-01
			Soil* Total								0.0E+00					8.3E-01
							Total of Receptor Risks Across All Media				0.0E+00	Total of Receptor Hazards Across All Media				8.3E-01

\* Surface and subsurface soil combined.

TABLE 7.2.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Resident  
 Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations								
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Soil*	Soil*	NNSY	Ingestion	Benzo(a)anthracene	4.3E+00	mg/kg	6.7E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	4.9E-06	5.5E-05	mg/kg/day	NA	NA	NA				
				Benzo(a)pyrene	2.0E+00	mg/kg	3.1E-06	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.3E-05	2.6E-05	mg/kg/day	NA	NA	NA				
				Benzo(b)fluoranthene	2.4E+00	mg/kg	3.7E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.7E-06	3.1E-05	mg/kg/day	NA	NA	NA				
				Benzo(k)fluoranthene	2.2E+00	mg/kg	3.5E-06	mg/kg/day	7.3E-02	1/(mg/kg-day)	2.5E-07	2.8E-05	mg/kg/day	NA	NA	NA				
				Dibenz(a,h)anthracene	1.5E+00	mg/kg	2.3E-06	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.7E-05	1.9E-05	mg/kg/day	NA	NA	NA				
				Indeno(1,2,3-cd)pyrene	1.6E+00	mg/kg	2.5E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.8E-06	2.0E-05	mg/kg/day	NA	NA	NA				
				Heptachlor Epoxide	2.2E-02	mg/kg	3.4E-08	mg/kg/day	9.1E+00	1/(mg/kg-day)	3.1E-07	2.8E-07	mg/kg/day	1.3E-05	mg/kg/day	2.2E-02				
				Aluminum	7.6E+03	mg/kg	1.2E-02	mg/kg/day	NA	NA	NA	9.7E-02	mg/kg/day	1.0E+00	mg/kg/day	9.7E-02				
				Antimony	5.5E+00	mg/kg	8.5E-06	mg/kg/day	NA	NA	NA	7.0E-05	mg/kg/day	4.0E-04	mg/kg/day	1.7E-01				
				Arsenic	2.7E+01	mg/kg	4.1E-05	mg/kg/day	1.5E+00	1/(mg/kg-day)	6.2E-05	3.4E-04	mg/kg/day	3.0E-04	mg/kg/day	1.1E+00				
				Cadmium	2.8E+00	mg/kg	4.4E-06	mg/kg/day	NA	NA	NA	3.6E-05	mg/kg/day	1.0E-03	mg/kg/day	3.6E-02				
				Chromium	3.4E+01	mg/kg	5.4E-05	mg/kg/day	NA	NA	NA	4.4E-04	mg/kg/day	3.0E-03	mg/kg/day	1.5E-01				
				Copper	2.5E+03	mg/kg	3.9E-03	mg/kg/day	NA	NA	NA	3.2E-02	mg/kg/day	4.0E-02	mg/kg/day	8.0E-01				
				Iron	1.8E+04	mg/kg	2.9E-02	mg/kg/day	NA	NA	NA	2.4E-01	mg/kg/day	3.0E-01	mg/kg/day	7.9E-01				
				Lead	4.8E+02	mg/kg	7.4E-04	mg/kg/day	NA	NA	NA	6.1E-03	mg/kg/day	NA	mg/kg/day	NA				
				Manganese	2.6E+02	mg/kg	4.1E-04	mg/kg/day	NA	NA	NA	3.4E-03	mg/kg/day	2.0E-02	mg/kg/day	1.7E-01				
				Mercury	1.7E+01	mg/kg	2.7E-05	mg/kg/day	NA	NA	NA	2.2E-04	mg/kg/day	3.0E-04	mg/kg/day	7.4E-01				
				Nickel	6.2E+01	mg/kg	9.6E-05	mg/kg/day	NA	NA	NA	7.9E-04	mg/kg/day	2.0E-02	mg/kg/day	3.9E-02				
				Silver	1.6E+01	mg/kg	2.5E-05	mg/kg/day	NA	NA	NA	2.0E-04	mg/kg/day	5.0E-03	mg/kg/day	4.1E-02				
				Vanadium	2.2E+01	mg/kg	3.5E-05	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	1.0E-03	mg/kg/day	2.8E-01				
				Zinc	2.9E+03	mg/kg	4.6E-03	mg/kg/day	NA	NA	NA	3.8E-02	mg/kg/day	3.0E-01	mg/kg/day	1.3E-01				
				<b>Exp. Route Total</b>										<b>1.1E-04</b>				<b>4.6E+00</b>		
							Dermal Absorption	Benzo(a)anthracene	4.3E+00	mg/kg	2.8E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.0E-06	2.0E-05	mg/kg/day	NA	NA	NA
								Benzo(a)pyrene	2.0E+00	mg/kg	1.3E-06	mg/kg/day	7.3E+00	1/(mg/kg-day)	9.4E-06	9.3E-06	mg/kg/day	NA	NA	NA
								Benzo(b)fluoranthene	2.4E+00	mg/kg	1.5E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.1E-06	1.1E-05	mg/kg/day	NA	NA	NA
								Benzo(k)fluoranthene	2.2E+00	mg/kg	1.4E-06	mg/kg/day	7.3E-02	1/(mg/kg-day)	1.0E-07	1.0E-05	mg/kg/day	NA	NA	NA
								Dibenz(a,h)anthracene	1.5E+00	mg/kg	9.5E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	6.9E-06	6.9E-06	mg/kg/day	NA	NA	NA
								Indeno(1,2,3-cd)pyrene	1.6E+00	mg/kg	1.0E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	7.4E-07	7.3E-06	mg/kg/day	NA	NA	NA
Heptachlor Epoxide	2.2E-02	mg/kg	1.4E-08					mg/kg/day	9.1E+00	1/(mg/kg-day)	1.3E-07	1.0E-07	mg/kg/day	1.3E-05	mg/kg/day	7.9E-03				
Aluminum	7.6E+03	mg/kg	3.8E-04					mg/kg/day	NA	NA	NA	2.7E-03	mg/kg/day	1.0E+00	mg/kg/day	2.7E-03				
Antimony	5.5E+00	mg/kg	2.7E-07	mg/kg/day	NA	NA	NA	2.0E-06	mg/kg/day	6.0E-05	mg/kg/day	3.3E-02								

TABLE 7.2.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Resident  
 Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Arsenic	2.7E+01	mg/kg	3.9E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	5.9E-06	2.9E-05	mg/kg/day	3.0E-04	mg/kg/day	9.5E-02
				Cadmium	2.8E+00	mg/kg	1.4E-07	mg/kg/day	NA	NA	NA	1.0E-06	mg/kg/day	2.5E-05	mg/kg/day	4.0E-02
				Chromium	3.4E+01	mg/kg	1.7E-06	mg/kg/day	NA	NA	NA	1.2E-05	mg/kg/day	5.0E-04	mg/kg/day	2.5E-02
				Copper	2.5E+03	mg/kg	1.2E-04	mg/kg/day	NA	NA	NA	9.0E-04	mg/kg/day	4.0E-02	mg/kg/day	2.2E-02
				Iron	1.8E+04	mg/kg	9.1E-04	mg/kg/day	NA	NA	NA	6.6E-03	mg/kg/day	3.0E-01	mg/kg/day	2.2E-02
				Lead	4.8E+02	mg/kg	2.4E-05	mg/kg/day	NA	NA	NA	1.7E-04	mg/kg/day	NA	NA	NA
				Manganese	2.6E+02	mg/kg	1.3E-05	mg/kg/day	NA	NA	NA	9.4E-05	mg/kg/day	8.0E-04	mg/kg/day	1.2E-01
				Mercury	1.7E+01	mg/kg	8.6E-07	mg/kg/day	NA	NA	NA	6.2E-06	mg/kg/day	2.1E-05	mg/kg/day	3.0E-01
				Nickel	6.2E+01	mg/kg	3.1E-06	mg/kg/day	NA	NA	NA	2.2E-05	mg/kg/day	8.0E-04	mg/kg/day	2.8E-02
				Silver	1.6E+01	mg/kg	7.9E-07	mg/kg/day	NA	NA	NA	5.7E-06	mg/kg/day	2.0E-04	mg/kg/day	2.9E-02
				Vanadium	2.2E+01	mg/kg	1.1E-06	mg/kg/day	NA	NA	NA	7.9E-06	mg/kg/day	2.6E-05	mg/kg/day	3.0E-01
				Zinc	2.9E+03	mg/kg	1.5E-04	mg/kg/day	NA	NA	NA	1.1E-03	mg/kg/day	3.0E-01	mg/kg/day	3.5E-03
				Exp. Route Total							2.6E-05					1.0E+00
				Exposure Point Total							1.4E-04					5.6E+00
				Exposure Medium Total							1.4E-04					5.6E+00
				Sussurface Soil							1.4E-04					5.6E+00
Groundwater	Groundwater	NNSY	Ingestion	1,1,2,2-Tetrachloroethane	5.7E-01	ug/l	8.5E-06	ug/l	2.0E-01	1/(mg/kg-day)	1.7E-06	3.6E-05	mg/kg/day	6.0E-02	mg/kg/day	6.1E-04
				Benzene	4.9E-01	ug/l	7.3E-06	ug/l	5.5E-02	1/(mg/kg-day)	4.0E-07	3.1E-05	mg/kg/day	4.0E-03	mg/kg/day	7.8E-03
				Chloroform	6.0E-01	ug/l	9.0E-06	ug/l	NA	NA	NA	3.8E-05	mg/kg/day	1.0E-02	mg/kg/day	3.8E-03
				Trichloroethene	2.0E-01	ug/l	3.0E-06	ug/l	1.1E-02	1/(mg/kg-day)	3.3E-08	1.3E-05	mg/kg/day	6.0E-03	mg/kg/day	2.1E-03
				Vinyl chloride	9.0E-01	ug/l	1.3E-05	ug/l	1.4E+00	1/(mg/kg-day)	1.9E-05	5.8E-05	mg/kg/day	3.0E-03	mg/kg/day	1.9E-02
				2-Methylnaphthalene	3.5E+00	ug/l	5.2E-05	ug/l	NA	NA	NA	2.2E-04	mg/kg/day	4.0E-03	mg/kg/day	5.6E-02
				Butylbenzophthalate	2.4E+01	ug/l	3.7E-04	ug/l	1.9E-03	1/(mg/kg-day)	6.9E-07	1.6E-03	mg/kg/day	2.0E-01	mg/kg/day	7.8E-03
				bis(2-Ethylhexyl)phtthalate	1.4E+01	ug/l	2.1E-04	ug/l	1.4E-02	1/(mg/kg-day)	2.9E-06	8.8E-04	mg/kg/day	2.0E-02	mg/kg/day	4.4E-02
				Aldrin	3.0E-02	ug/l	4.5E-07	ug/l	1.7E+01	1/(mg/kg-day)	7.7E-06	1.9E-06	mg/kg/day	3.0E-05	mg/kg/day	6.5E-02
				Dieldrin	3.2E-02	ug/l	4.8E-07	ug/l	1.6E+01	1/(mg/kg-day)	7.7E-06	2.1E-06	mg/kg/day	5.0E-05	mg/kg/day	4.1E-02
				Heptachlor epoxide	4.0E-02	ug/l	6.0E-07	ug/l	9.1E+00	1/(mg/kg-day)	5.5E-06	2.6E-06	mg/kg/day	1.3E-05	mg/kg/day	2.0E-01
				beta-BHC	2.9E-02	ug/l	4.3E-07	ug/l	1.8E+00	1/(mg/kg-day)	7.7E-07	1.8E-06	mg/kg/day	NA	NA	NA
				Antimony	6.5E+00	ug/l	9.7E-05	ug/l	NA	NA	NA	4.2E-04	mg/kg/day	4.0E-04	mg/kg/day	1.0E+00
				Arsenic	2.1E+01	ug/l	3.1E-04	ug/l	1.5E+00	1/(mg/kg-day)	4.7E-04	1.3E-03	mg/kg/day	3.0E-04	mg/kg/day	4.5E+00
				Cadmium	1.8E+00	ug/l	2.6E-05	ug/l	NA	NA	NA	1.1E-04	mg/kg/day	5.0E-04	mg/kg/day	2.3E-01
				Cobalt	9.2E+01	ug/l	1.4E-03	ug/l	NA	NA	NA	5.9E-03	mg/kg/day	2.0E-02	mg/kg/day	3.0E-01
				Iron	4.0E+04	ug/l	6.0E-01	ug/l	NA	NA	NA	2.6E+00	mg/kg/day	3.0E-01	mg/kg/day	8.5E+00
				Manganese	5.4E+02	ug/l	8.0E-03	ug/l	NA	NA	NA	3.4E-02	mg/kg/day	2.0E-02	mg/kg/day	1.7E+00
				Nickel	5.8E+01	ug/l	8.6E-04	ug/l	NA	NA	NA	3.7E-03	mg/kg/day	2.0E-02	mg/kg/day	1.8E-01
				Selenium	1.1E+01	ug/l	1.6E-04	ug/l	NA	NA	NA	6.9E-04	mg/kg/day	5.0E-03	mg/kg/day	1.4E-01
				Exp. Route Total							5.2E-04					1.7E+01

TABLE 7.2.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Resident  
 Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	1,1,2,2-Tetrachloroethane	5.7E-01	ug/l	1.1E-06	ug/l	2.0E-01	1/(mg/kg-day)	2.1E-07	4.4E-06	mg/kg/day	6.0E-02	mg/kg/day	7.4E-05
				Benzene	4.9E-01	ug/l	1.1E-06	ug/l	5.5E-02	1/(mg/kg-day)	6.0E-08	4.6E-06	mg/kg/day	4.0E-03	mg/kg/day	1.2E-03
				Chloroform	6.0E-01	ug/l	8.0E-07	ug/l	NA	NA	NA	3.4E-06	mg/kg/day	1.0E-02	mg/kg/day	3.4E-04
				Trichloroethene	2.0E-01	ug/l	5.1E-07	ug/l	1.1E-02	1/(mg/kg-day)	5.6E-09	2.1E-06	mg/kg/day	6.0E-03	mg/kg/day	3.6E-04
				Vinyl chloride	9.0E-01	ug/l	6.9E-07	ug/l	1.4E+00	1/(mg/kg-day)	9.6E-07	2.9E-06	mg/kg/day	3.0E-03	mg/kg/day	9.6E-04
				2-Methylnaphthalene	3.5E+00	ug/l	1.1E-04	ug/l	NA	NA	NA	4.7E-04	mg/kg/day	4.0E-03	mg/kg/day	1.2E-01
				Butylbenzophthalate	2.4E+01	ug/l	8.9E-04	ug/l	1.9E-03	1/(mg/kg-day)	1.7E-06	3.7E-03	mg/kg/day	2.0E-01	mg/kg/day	1.9E-02
				bis(2-Ethylhexyl)phthalate	1.4E+01	ug/l	3.1E-04	ug/l	1.4E-02	1/(mg/kg-day)	4.4E-06	1.3E-03	mg/kg/day	2.0E-02	mg/kg/day	6.6E-02
				Aldrin	3.0E-02	ug/l	4.1E-08	ug/l	1.7E+01	1/(mg/kg-day)	6.9E-07	1.7E-07	mg/kg/day	3.0E-05	mg/kg/day	5.7E-03
				Dieldrin	3.2E-02	ug/l	3.3E-07	ug/l	1.6E+01	1/(mg/kg-day)	5.3E-06	1.4E-06	mg/kg/day	5.0E-05	mg/kg/day	2.8E-02
				Heptachlor epoxide	4.0E-02	ug/l	2.8E-07	ug/l	9.1E+00	1/(mg/kg-day)	2.6E-06	1.2E-06	mg/kg/day	1.3E-05	mg/kg/day	9.1E-02
				beta-BHC	2.9E-02	ug/l	4.7E-07	ug/l	1.8E+00	1/(mg/kg-day)	8.4E-07	2.0E-06	mg/kg/day	NA	NA	NA
				Antimony	6.5E+00	ug/l	5.6E-07	ug/l	NA	1/(mg/kg-day)	NA	2.8E-06	mg/kg/day	6.0E-05	mg/kg/day	4.6E-02
				Arsenic	2.1E+01	ug/l	1.8E-06	ug/l	1.5E+00	1/(mg/kg-day)	2.7E-06	8.9E-06	mg/kg/day	3.0E-04	mg/kg/day	3.0E-02
				Cadmium	1.8E+00	ug/l	1.5E-07	ug/l	NA	NA	NA	7.4E-07	mg/kg/day	2.5E-05	mg/kg/day	3.0E-02
				Cobalt	9.2E+01	ug/l	3.1E-06	ug/l	NA	NA	NA	7.4E-07	mg/kg/day	2.0E-02	mg/kg/day	3.7E-05
				Iron	4.0E+04	ug/l	3.4E-03	ug/l	NA	NA	NA	1.6E-05	mg/kg/day	3.0E-01	mg/kg/day	5.2E-05
				Manganese	5.4E+02	ug/l	4.6E-05	ug/l	NA	NA	NA	1.7E-02	mg/kg/day	8.0E-04	mg/kg/day	2.1E+01
				Nickel	5.8E+01	ug/l	9.8E-07	ug/l	NA	NA	NA	2.3E-04	mg/kg/day	8.0E-04	mg/kg/day	2.8E-01
				Selenium	1.1E+01	ug/l	9.2E-07	ug/l	NA	NA	NA	4.9E-06	mg/kg/day	5.0E-03	mg/kg/day	9.7E-04
			Exp. Route Total								1.9E-05					2.2E+01
			Exposure Medium Total								5.4E-04					3.9E+01
			Inhalation	1,1,2,2-Tetrachloroethane	5.7E-01	ug/l	1.8E-05	mg/kg/day	2.0E-01	1/(mg/kg-day)	3.7E-06	NA	NA	NA	NA	NA
				Benzene	4.9E-01	ug/l	3.1E-05	mg/kg/day	2.7E-02	1/(mg/kg-day)	8.4E-07	NA	NA	NA	NA	NA
				Chloroform	6.0E-01	ug/l	3.2E-05	mg/kg/day	8.1E-02	1/(mg/kg-day)	2.6E-06	NA	NA	NA	NA	NA
				Trichloroethene	2.0E-01	ug/l	1.1E-05	mg/kg/day	6.0E-03	1/(mg/kg-day)	6.4E-08	NA	NA	NA	NA	NA
				Vinyl chloride	9.0E-01	ug/l	6.3E-05	mg/kg/day	3.0E-02	1/(mg/kg-day)	1.9E-06	NA	NA	NA	NA	NA
				2-Methylnaphthalene	3.5E+00	ug/l	1.3E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exposure Point Total								9.1E-06					0.0E+00
			Exposure Medium Total								9.1E-06					0.0E+00
			Groundwater Total								5.5E-04					3.9E+01
			Total of Receptor Risks Across All Media								6.9E-04					4.4E+01

\* Surface and subsurface soil combined.

Table 7.2.RME Supplement A  
 Calculation of DAevent  
 Resident Adult, Groundwater  
 NNSY Site 10

Chemical of Potential Concern	Groundwater Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ <sub>event</sub> ) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm <sup>2</sup> -event)	Eq
1,1,2,2-Tetrachloroethane	5.70E-01	6.9E-03	3.4E-02	9.3E-01	2.2E+00	1.0E+00	0.58	8.0E-09	2
Benzene	4.90E-01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	0.58	8.3E-09	2
Chloroform	6.00E-01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.58	6.1E-09	2
Trichloroethene	2.00E-01	1.2E-02	5.3E-02	5.8E-01	1.4E+00	1.0E+00	0.58	3.8E-09	2
Vinyl chloride	9.00E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.58	5.2E-09	3
2-Methylnaphthalene	3.51E+00	1.4E-01	6.5E-01	6.6E-01	2.6E+00	1.0E+00	0.58	8.5E-07	2
Butylbenzylphthalate	2.45E+01	5.4E-02	3.7E-01	5.9E+00	1.4E+01	1.0E+00	0.58	6.8E-06	2
bis(2-Ethylhexyl)phthalate	1.38E+01	2.5E-02	1.9E-01	1.7E+01	4.0E+01	8.0E-01	0.58	2.4E-06	2
Aldrin	3.03E-02	1.4E-03	1.0E-02	1.2E+01	2.9E+01	1.0E+00	0.58	3.1E-10	2
Dieldrin	3.24E-02	1.2E-02	9.0E-02	1.5E+01	3.5E+01	8.0E-01	0.58	2.5E-09	2
Heptachlor epoxide	4.03E-02	8.6E-03	6.5E-02	1.3E+01	3.2E+01	8.0E-01	0.58	2.1E-09	2
beta-BHC	2.86E-02	2.8E-02	1.8E-01	4.5E+00	1.1E+01	1.0E+00	0.58	3.6E-09	2
Antimony	6.53E+00	1.0E-03	NA	NA	NA	NA	0.58	3.8E-09	1
Arsenic	2.11E+01	1.0E-03	NA	NA	NA	NA	0.58	1.2E-08	1
Cadmium	1.76E+00	1.0E-03	NA	NA	NA	NA	0.58	1.0E-09	1
Cobalt	9.23E+01	4.0E-04	NA	NA	NA	NA	0.58	2.1E-08	1
Iron	3.99E+04	1.0E-03	NA	NA	NA	NA	0.58	2.3E-05	1
Manganese	5.36E+02	1.0E-03	NA	NA	NA	NA	0.58	3.1E-07	1
Nickel	5.77E+01	2.0E-04	NA	NA	NA	NA	0.58	6.7E-09	1
Selenium	1.08E+01	1.0E-03	NA	NA	NA	NA	0.58	6.3E-09	1

Inorganics: DAevent (mg/cm<sup>2</sup>-event) =  
 Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm<sup>3</sup> (eq 1)

Organics: DAevent (mg/cm<sup>2</sup>-event) =

$$\text{If } t_{\text{event}} \leq t^*, \text{ then } DA_{\text{event}} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{\text{event}} \times t_{\text{event}}}{\pi}} \quad (\text{eq 2})$$

$$\text{If } t_{\text{event}} \geq t^*, \text{ then } DA_{\text{event}} = FA \times K_p \times C_w \left[ \frac{t_{\text{event}}}{1+B} + 2 \times \tau_{\text{event}} \left( \frac{1+3B+3B^2}{(1+B)^2} \right) \right] \quad (\text{eq 3})$$

Notes:

Permeability constants (Kp), B, lag time, and t\* from EPA 2001, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Interim)*. EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below. Parameters B, tau, t\* were calculated for 2-methylnaphthalene, and beta-BHC.

NA - not applicable.

Heptachlor used as surrogate for Heptachlor Epoxide.

Table 7.2.RME Supplement B  
 Calculation of DAevent  
 Resident Child, Groundwater  
 NNSY Site 10

Chemical of Potential Concern	Groundwater Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ <sub>event</sub> ) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm <sup>2</sup> -event)	Eq
1,1,2,2-Tetrachloroethane	5.70E-01	6.9E-03	3.4E-02	9.3E-01	2.2E+00	1.0E+00	1	1.0E-08	2
Benzene	4.90E-01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	1	1.1E-08	3
Chloroform	6.00E-01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	1	8.0E-09	2
Trichloroethene	2.00E-01	1.2E-02	5.3E-02	5.8E-01	1.4E+00	1.0E+00	1	5.1E-09	2
Vinyl chloride	9.00E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	1	6.8E-09	3
2-Methylnaphthalene	3.51E+00	1.4E-01	6.5E-01	6.6E-01	2.6E+00	1.0E+00	1	1.1E-06	2
Butylbenzylphthalate	2.45E+01	5.4E-02	3.7E-01	5.9E+00	1.4E+01	1.0E+00	1	8.9E-06	2
bis(2-Ethylhexyl)phthalate	1.38E+01	2.5E-02	1.9E-01	1.7E+01	4.0E+01	8.0E-01	1	3.1E-06	2
Aldrin	3.03E-02	1.4E-03	1.0E-02	1.2E+01	2.9E+01	1.0E+00	1	4.0E-10	2
Dieldrin	3.24E-02	1.2E-02	9.0E-02	1.5E+01	3.5E+01	8.0E-01	1	3.3E-09	2
Heptachlor epoxide	4.03E-02	8.6E-03	6.5E-02	1.3E+01	3.2E+01	8.0E-01	1	2.8E-09	2
beta-BHC	2.86E-02	2.8E-02	1.8E-01	4.5E+00	1.1E+01	1.0E+00	1	4.7E-09	2
Antimony	6.53E+00	1.0E-03	NA	NA	NA	NA	1	6.5E-09	1
Arsenic	2.11E+01	1.0E-03	NA	NA	NA	NA	1	2.1E-08	1
Cadmium	1.76E+00	1.0E-03	NA	NA	NA	NA	1	1.8E-09	1
Cobalt	9.23E+01	4.0E-04	NA	NA	NA	NA	1	3.7E-08	1
Iron	3.99E+04	1.0E-03	NA	NA	NA	NA	1	4.0E-05	1
Manganese	5.36E+02	1.0E-03	NA	NA	NA	NA	1	5.4E-07	1
Nickel	5.77E+01	2.0E-04	NA	NA	NA	NA	1	1.2E-08	1
Selenium	1.08E+01	1.0E-03	NA	NA	NA	NA	1	1.1E-08	1

Inorganics: DAevent (mg/cm<sup>2</sup>-event) =  
 Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm<sup>3</sup> (eq 1)

Organics: DAevent (mg/cm<sup>2</sup>-event) =

$$\text{If } t_{\text{event}} \leq t^*, \text{ then } DA_{\text{event}} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{\text{event}} \times t_{\text{event}}}{\pi}} \quad (\text{eq 2})$$

$$\text{If } t_{\text{event}} \geq t^*, \text{ then } DA_{\text{event}} = FA \times K_p \times C_w \left[ \frac{t_{\text{event}}}{1+B} + 2 \times \tau_{\text{event}} \left( \frac{1+3B+3B^2}{(1+B)^2} \right) \right] \quad (\text{eq 3})$$

Notes:

Permeability constants (Kp), B, lag time, and t\* from EPA 2001, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Interim)*. EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below. Parameters B, tau, t\* were calculated for 2-methylnaphthalene, and beta-BHC.

NA - not applicable.

Heptachlor used as surrogate for Heptachlor Epoxide.

**Table 7.2.RME Supplement C**  
**Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model**  
**NNSY Site 10**

Chemical	Exposure Point Concentration Cwo (ug/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m <sup>3</sup> /mole)	Kg (VOC) (cm/hr)	KI(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (ug/l)	S (ug/m <sup>3</sup> - min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
1,1,2,2-Tetrachloroethane	5.7E-01	1.7E+02	3.81E-04	9.8E+02	1.0E+01	6.2E+00	8.3E+00	1.4E-01	9.2E-01	5.6E-05
Benzene	4.9E-01	7.8E+01	5.43E-03	1.4E+03	1.5E+01	1.4E+01	1.9E+01	2.3E-01	1.6E+00	9.5E-05
Chloroform	6.0E-01	1.2E+02	2.87E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	2.4E-01	1.6E+00	9.6E-05
Trichloroethene	2.0E-01	1.3E+02	1.03E-02	1.1E+03	1.2E+01	1.1E+01	1.5E+01	8.0E-02	5.3E-01	3.2E-05
Vinyl Chloride	9.0E-01	6.3E+01	8.19E-02	1.6E+03	1.7E+01	1.7E+01	2.3E+01	4.7E-01	3.2E+00	1.9E-04
2-Methylnaphthalene	3.5E+00	1.4E+02	4.83E-04	1.1E+03	1.1E+01	7.3E+00	9.9E+00	9.9E-01	6.6E+00	4.0E-04

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
KI(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	ug/l	Solved by Eq 5
sdt = shower droplet drop time	sec	2
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	20
SV = shower room air volume	m <sup>3</sup>	3
S = indoor VOC generation rate	ug/m <sup>3</sup> -min	Solved by Eq 6
VR = ventilation rate	l/min	13.8

Variables	Units	Exposure Assumptions
BW = body weight	kg	70
Ds = duration of shower	min	12
Dt = total duration in shower room	min	35
R = air exchange rate	min <sup>-1</sup>	0.0083
Ca = indoor air concentration of VOCs	ug/m <sup>3</sup>	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	3000 * (18 / HH) <sup>0.5</sup>
Equation 2:	KI(VOC) =	20 * (44 / HH) <sup>0.5</sup>
Equation 3:	KL =	((1 / KI(VOC)) + (0.024 / (Kg (VOC) * H))) <sup>-1</sup>
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul)) <sup>-0.5</sup> ))
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))
Equation 6:	S =	(Cwd * FR / SV)
Equation 7:	see time series example on Table I-GW-5	
Equation 8:	<b>Einh =</b>	<b>If t&gt;Ds</b> (((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

Henry's Law Constant from USEPA's *Superfund Public Health Evaluation Manual*. USEPA/540/1-86/060, October 1986.  
Naphthalene used as surrogate for 2-Methylnaphthalene for Henry's Law Constant.

TABLE 7.3.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Industrial Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations								
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Surface Soil	Surface Soil	NNSY	Ingestion	Benzo(a)anthracene	1.5E+00	mg/kg	5.1E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	3.7E-07	1.4E-06	mg/kg/day	NA	NA	NA				
				Benzo(a)pyrene	1.6E+00	mg/kg	5.6E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.1E-06	1.6E-06	mg/kg/day	NA	NA	NA				
				Benzo(b)fluoranthene	3.1E+00	mg/kg	1.1E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	7.9E-07	3.0E-06	mg/kg/day	NA	NA	NA				
				Dibenz(a,h)anthracene	5.4E-01	mg/kg	1.9E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.4E-06	5.3E-07	mg/kg/day	NA	NA	NA				
				Indeno(1,2,3-cd)pyrene	1.0E+00	mg/kg	3.5E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.6E-07	9.8E-07	mg/kg/day	NA	NA	NA				
				Heptachlor Epoxide	1.2E-01	mg/kg	4.1E-08	mg/kg/day	9.1E+00	1/(mg/kg-day)	3.8E-07	1.2E-07	mg/kg/day	1.3E-05	mg/kg/day	8.9E-03				
				Aluminum	6.3E+03	mg/kg	2.2E-03	mg/kg/day	NA	NA	NA	6.2E-03	mg/kg/day	1.0E+00	mg/kg/day	6.2E-03				
				Antimony	1.8E+01	mg/kg	6.5E-06	mg/kg/day	NA	NA	NA	1.8E-05	mg/kg/day	4.0E-04	mg/kg/day	4.5E-02				
				Arsenic	3.4E+01	mg/kg	1.2E-05	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.8E-05	3.3E-05	mg/kg/day	3.0E-04	mg/kg/day	1.1E-01				
				Cadmium	3.3E+00	mg/kg	1.1E-06	mg/kg/day	NA	NA	NA	3.2E-06	mg/kg/day	1.0E-03	mg/kg/day	3.2E-03				
				Chromium	3.7E+01	mg/kg	1.3E-05	mg/kg/day	NA	NA	NA	3.6E-05	mg/kg/day	3.0E-03	mg/kg/day	1.2E-02				
				Copper	2.8E+03	mg/kg	9.7E-04	mg/kg/day	NA	NA	NA	2.7E-03	mg/kg/day	4.0E-02	mg/kg/day	6.8E-02				
				Iron	2.6E+04	mg/kg	9.0E-03	mg/kg/day	NA	NA	NA	2.5E-02	mg/kg/day	3.0E-01	mg/kg/day	8.4E-02				
				Lead	7.4E+02	mg/kg	2.6E-04	mg/kg/day	NA	NA	NA	7.3E-04	mg/kg/day	NA	NA	NA				
				Manganese	2.8E+02	mg/kg	9.7E-05	mg/kg/day	NA	NA	NA	2.7E-04	mg/kg/day	2.0E-02	mg/kg/day	1.4E-02				
				Mercury	1.1E+01	mg/kg	3.8E-06	mg/kg/day	NA	NA	NA	1.1E-05	mg/kg/day	3.0E-04	mg/kg/day	3.5E-02				
				Nickel	6.7E+01	mg/kg	2.3E-05	mg/kg/day	NA	NA	NA	6.5E-05	mg/kg/day	2.0E-02	mg/kg/day	3.3E-03				
				Silver	5.8E+01	mg/kg	2.0E-05	mg/kg/day	NA	NA	NA	5.7E-05	mg/kg/day	5.0E-03	mg/kg/day	1.1E-02				
				Vanadium	2.6E+01	mg/kg	9.3E-06	mg/kg/day	NA	NA	NA	2.6E-05	mg/kg/day	1.0E-03	mg/kg/day	2.6E-02				
				Zinc	1.7E+03	mg/kg	5.9E-04	mg/kg/day	NA	NA	NA	1.7E-03	mg/kg/day	3.0E-01	mg/kg/day	5.5E-03				
				Exp. Route Total															4.3E-01	
							Dermal Absorption	Benzo(a)anthracene	1.5E+00	mg/kg	4.4E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	3.2E-07	1.2E-06	mg/kg/day	NA	NA	NA
								Benzo(a)pyrene	1.6E+00	mg/kg	4.8E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	3.5E-06	1.3E-06	mg/kg/day	NA	NA	NA
								Benzo(b)fluoranthene	3.1E+00	mg/kg	9.3E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	6.8E-07	2.6E-06	mg/kg/day	NA	NA	NA
								Dibenz(a,h)anthracene	5.4E-01	mg/kg	1.6E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.2E-06	4.5E-07	mg/kg/day	NA	NA	NA
								Indeno(1,2,3-cd)pyrene	1.0E+00	mg/kg	3.0E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.2E-07	8.4E-07	mg/kg/day	NA	NA	NA
								Heptachlor Epoxide	1.2E-01	mg/kg	2.7E-08	mg/kg/day	9.1E+00	1/(mg/kg-day)	2.5E-07	7.7E-08	mg/kg/day	1.3E-05	mg/kg/day	5.9E-03
								Aluminum	6.3E+03	mg/kg	1.5E-04	mg/kg/day	NA	NA	NA	4.1E-04	mg/kg/day	1.0E+00	mg/kg/day	4.1E-04
Antimony	1.8E+01	mg/kg	4.3E-07					mg/kg/day	NA	NA	NA	1.2E-06	mg/kg/day	6.0E-05	mg/kg/day	2.0E-02				
Arsenic	3.4E+01	mg/kg	2.3E-06					mg/kg/day	1.5E+00	1/(mg/kg-day)	3.5E-06	6.5E-06	mg/kg/day	3.0E-04	mg/kg/day	2.2E-02				
Cadmium	3.3E+00	mg/kg	7.5E-09					mg/kg/day	NA	NA	NA	2.1E-08	mg/kg/day	2.5E-05	mg/kg/day	8.4E-04				
Chromium	3.7E+01	mg/kg	8.5E-07					mg/kg/day	NA	NA	NA	2.4E-06	mg/kg/day	5.0E-04	mg/kg/day	4.7E-03				
Copper	2.8E+03	mg/kg	6.4E-05					mg/kg/day	NA	NA	NA	1.8E-04	mg/kg/day	4.0E-02	mg/kg/day	4.5E-03				

TABLE 7.3.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Industrial Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal Absorption	Iron	2.6E+04	mg/kg	5.9E-04	mg/kg/day	NA	NA	NA	1.7E-03	mg/kg/day	3.0E-01	mg/kg/day	5.5E-03
				Lead	7.4E+02	mg/kg	1.7E-05	mg/kg/day	NA	NA	NA	4.8E-05	mg/kg/day	NA	NA	NA
				Manganese	2.8E+02	mg/kg	6.4E-06	mg/kg/day	NA	NA	NA	1.8E-05	mg/kg/day	8.0E-04	mg/kg/day	2.2E-02
				Mercury	1.1E+01	mg/kg	2.5E-07	mg/kg/day	NA	NA	NA	7.0E-07	mg/kg/day	2.1E-05	mg/kg/day	3.3E-02
				Nickel	6.7E+01	mg/kg	1.5E-06	mg/kg/day	NA	NA	NA	4.3E-06	mg/kg/day	8.0E-04	mg/kg/day	5.4E-03
				Silver	5.8E+01	mg/kg	1.3E-06	mg/kg/day	NA	NA	NA	3.7E-06	mg/kg/day	2.0E-04	mg/kg/day	1.9E-02
				Vanadium	2.6E+01	mg/kg	6.1E-07	mg/kg/day	NA	NA	NA	1.7E-06	mg/kg/day	2.6E-05	mg/kg/day	6.6E-02
				Zinc	1.7E+03	mg/kg	3.9E-05	mg/kg/day	NA	NA	NA	1.1E-04	mg/kg/day	3.0E-01	mg/kg/day	3.6E-04
			Exp. Route Total								9.6E-06					2.1E-01
			Exposure Point Total								3.4E-05					6.4E-01
			Exposure Medium Total								3.4E-05					6.4E-01
	Surface Soil										3.4E-05					6.4E-01
Groundwater	Groundwater	NNSY	Ingestion	1,1,2,2-Tetrachloroethane	5.7E-01	ug/l	2.0E-06	ug/l	2.0E-01	1/(mg/kg-day)	4.0E-07	5.6E-06	mg/kg/day	6.0E-02	mg/kg/day	9.3E-05
				Benzene	4.9E-01	ug/l	1.7E-06	ug/l	5.5E-02	1/(mg/kg-day)	9.4E-08	4.8E-06	mg/kg/day	4.0E-03	mg/kg/day	1.2E-03
				Chloroform	6.0E-01	ug/l	2.1E-06	ug/l	NA	NA	NA	5.9E-06	mg/kg/day	1.0E-02	mg/kg/day	5.9E-04
				Trichloroethene	2.0E-01	ug/l	7.0E-07	ug/l	1.1E-02	1/(mg/kg-day)	7.7E-09	2.0E-06	mg/kg/day	6.0E-03	mg/kg/day	3.3E-04
				Vinyl chloride	9.0E-01	ug/l	3.1E-06	ug/l	1.4E+00	1/(mg/kg-day)	4.4E-06	8.8E-06	mg/kg/day	3.0E-03	mg/kg/day	2.9E-03
				2-Methylnaphthalene	3.5E+00	ug/l	1.2E-05	ug/l	NA	NA	NA	3.4E-05	mg/kg/day	4.0E-03	mg/kg/day	8.6E-03
				Butylbenzylphthalate	2.4E+01	ug/l	8.6E-05	ug/l	1.9E-03	1/(mg/kg-day)	1.6E-07	2.4E-04	mg/kg/day	2.0E-01	mg/kg/day	1.2E-03
				bis(2-Ethylhexyl)phthalate	1.4E+01	ug/l	4.8E-05	ug/l	1.4E-02	1/(mg/kg-day)	6.8E-07	1.4E-04	mg/kg/day	2.0E-02	mg/kg/day	6.8E-03
				Aldrin	3.0E-02	ug/l	1.1E-07	ug/l	1.7E+01	1/(mg/kg-day)	1.8E-06	3.0E-07	mg/kg/day	3.0E-05	mg/kg/day	9.9E-03
				Dieldrin	3.2E-02	ug/l	1.1E-07	ug/l	1.6E+01	1/(mg/kg-day)	1.8E-06	3.2E-07	mg/kg/day	5.0E-05	mg/kg/day	6.3E-03
				Heptachlor epoxide	4.0E-02	ug/l	1.4E-07	ug/l	9.1E+00	1/(mg/kg-day)	1.3E-06	3.9E-07	mg/kg/day	1.3E-05	mg/kg/day	3.0E-02
				beta-BHC	2.9E-02	ug/l	1.0E-07	ug/l	1.8E+00	1/(mg/kg-day)	1.8E-07	2.8E-07	mg/kg/day	NA	NA	NA
				Antimony	6.5E+00	ug/l	2.3E-05	ug/l	NA	NA	NA	6.4E-05	mg/kg/day	4.0E-04	mg/kg/day	1.6E-01
				Arsenic	2.1E+01	ug/l	7.4E-05	ug/l	1.5E+00	1/(mg/kg-day)	1.1E-04	2.1E-04	mg/kg/day	3.0E-04	mg/kg/day	6.9E-01
				Cadmium	1.8E+00	ug/l	6.2E-06	ug/l	NA	NA	NA	1.7E-05	mg/kg/day	5.0E-04	mg/kg/day	3.4E-02
				Cobalt	9.2E+01	ug/l	3.2E-04	ug/l	NA	NA	NA	9.0E-04	mg/kg/day	2.0E-02	mg/kg/day	4.5E-02
				Iron	4.0E+04	ug/l	1.4E-01	ug/l	NA	NA	NA	3.9E-01	mg/kg/day	3.0E-01	mg/kg/day	1.3E+00
				Manganese	5.4E+02	ug/l	1.9E-03	ug/l	NA	NA	NA	5.2E-03	mg/kg/day	2.0E-02	mg/kg/day	2.6E-01
				Nickel	5.8E+01	ug/l	2.0E-04	ug/l	NA	NA	NA	5.6E-04	mg/kg/day	2.0E-02	mg/kg/day	2.8E-02
				Selenium	1.1E+01	ug/l	3.8E-05	ug/l	NA	NA	NA	1.1E-04	mg/kg/day	5.0E-03	mg/kg/day	2.1E-02
			Exp. Route Total								1.2E-04					2.6E+00
			Exposure Medium Total								1.2E-04					2.6E+00
			Groundwater Total								1.2E-04					2.6E+00
			Total of Receptor Risks Across All Media								1.6E-04					3.3E+00
			Total of Receptor Hazards Across All Media													3.3E+00

\* Surface and subsurface soil combined.

TABLE 7.4.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Industrial Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				Non-Cancer Hazard Calculations									
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Soil*	Soil*	NNSY	Ingestion	Benzo(a)anthracene	4.3E+00	mg/kg	1.5E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.1E-06	4.2E-06	mg/kg/day	NA	NA	NA				
				Benzo(a)pyrene	2.0E+00	mg/kg	7.0E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	5.1E-06	2.0E-06	mg/kg/day	NA	NA	NA				
				Benzo(b)fluoranthene	2.4E+00	mg/kg	8.3E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	6.1E-07	2.3E-06	mg/kg/day	NA	NA	NA				
				Benzo(k)fluoranthene	2.2E+00	mg/kg	7.7E-07	mg/kg/day	7.3E-02	1/(mg/kg-day)	5.6E-08	2.2E-06	mg/kg/day	NA	NA	NA				
				Dibenz(a,h)anthracene	1.5E+00	mg/kg	5.1E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	3.8E-06	1.4E-06	mg/kg/day	NA	NA	NA				
				Indeno(1,2,3-cd)pyrene	1.6E+00	mg/kg	5.5E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	4.0E-07	1.5E-06	mg/kg/day	NA	NA	NA				
				Heptachlor Epoxide	2.2E-02	mg/kg	7.7E-09	mg/kg/day	9.1E+00	1/(mg/kg-day)	7.0E-08	2.2E-08	mg/kg/day	1.3E-05	mg/kg/day	1.7E-03				
				Aluminum	7.6E+03	mg/kg	2.7E-03	mg/kg/day	NA	NA	NA	7.4E-03	mg/kg/day	1.0E+00	mg/kg/day	7.4E-03				
				Antimony	5.5E+00	mg/kg	1.9E-06	mg/kg/day	NA	NA	NA	5.3E-06	mg/kg/day	4.0E-04	mg/kg/day	1.3E-02				
				Arsenic	2.7E+01	mg/kg	9.3E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.4E-05	2.6E-05	mg/kg/day	3.0E-04	mg/kg/day	8.7E-02				
				Cadmium	2.8E+00	mg/kg	9.8E-07	mg/kg/day	NA	NA	NA	2.7E-06	mg/kg/day	1.0E-03	mg/kg/day	2.7E-03				
				Chromium	3.4E+01	mg/kg	1.2E-05	mg/kg/day	NA	NA	NA	3.4E-05	mg/kg/day	3.0E-03	mg/kg/day	1.1E-02				
				Copper	2.5E+03	mg/kg	8.8E-04	mg/kg/day	NA	NA	NA	2.5E-03	mg/kg/day	4.0E-02	mg/kg/day	6.1E-02				
				Iron	1.8E+04	mg/kg	6.4E-03	mg/kg/day	NA	NA	NA	1.8E-02	mg/kg/day	3.0E-01	mg/kg/day	6.0E-02				
				Lead	4.8E+02	mg/kg	1.7E-04	mg/kg/day	NA	NA	NA	4.7E-04	mg/kg/day	NA	NA	NA				
				Manganese	2.6E+02	mg/kg	9.2E-05	mg/kg/day	NA	NA	NA	2.6E-04	mg/kg/day	2.0E-02	mg/kg/day	1.3E-02				
				Mercury	1.7E+01	mg/kg	6.1E-06	mg/kg/day	NA	NA	NA	1.7E-05	mg/kg/day	3.0E-04	mg/kg/day	5.7E-02				
				Nickel	6.2E+01	mg/kg	2.2E-05	mg/kg/day	NA	NA	NA	6.0E-05	mg/kg/day	2.0E-02	mg/kg/day	3.0E-03				
				Silver	1.6E+01	mg/kg	5.6E-06	mg/kg/day	NA	NA	NA	1.6E-05	mg/kg/day	5.0E-03	mg/kg/day	3.1E-03				
				Vanadium	2.2E+01	mg/kg	7.7E-06	mg/kg/day	NA	NA	NA	2.2E-05	mg/kg/day	1.0E-03	mg/kg/day	2.2E-02				
				Zinc	2.9E+03	mg/kg	1.0E-03	mg/kg/day	NA	NA	NA	2.9E-03	mg/kg/day	3.0E-01	mg/kg/day	9.6E-03				
				Exp. Route Total									2.5E-05					3.5E-01		
							Dermal Absorption	Benzo(a)anthracene	4.3E+00	mg/kg	1.3E-06	mg/kg/day	7.3E-01	1/(mg/kg-day)	9.4E-07	3.6E-06	mg/kg/day	NA	NA	NA
								Benzo(a)pyrene	2.0E+00	mg/kg	6.0E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.4E-06	1.7E-06	mg/kg/day	NA	NA	NA
								Benzo(b)fluoranthene	2.4E+00	mg/kg	7.2E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	5.2E-07	2.0E-06	mg/kg/day	NA	NA	NA
								Benzo(k)fluoranthene	2.2E+00	mg/kg	6.8E-07	mg/kg/day	7.3E-02	1/(mg/kg-day)	4.8E-08	1.9E-06	mg/kg/day	NA	NA	NA
								Dibenz(a,h)anthracene	1.5E+00	mg/kg	4.4E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	3.2E-06	1.2E-06	mg/kg/day	NA	NA	NA
								Indeno(1,2,3-cd)pyrene	1.6E+00	mg/kg	4.7E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	3.4E-07	1.3E-06	mg/kg/day	NA	NA	NA
Heptachlor Epoxide	2.2E-02	mg/kg	5.1E-09					mg/kg/day	9.1E+00	1/(mg/kg-day)	4.6E-08	1.4E-08	mg/kg/day	1.3E-05	mg/kg/day	1.1E-03				
Aluminum	7.6E+03	mg/kg	1.8E-04					mg/kg/day	NA	NA	NA	4.9E-04	mg/kg/day	1.0E+00	mg/kg/day	4.9E-04				
Antimony	5.5E+00	mg/kg	1.3E-07					mg/kg/day	NA	NA	NA	3.5E-07	mg/kg/day	6.0E-05	mg/kg/day	5.9E-03				
Arsenic	2.7E+01	mg/kg	1.8E-06					mg/kg/day	1.5E+00	1/(mg/kg-day)	2.8E-06	5.1E-06	mg/kg/day	3.0E-04	mg/kg/day	1.7E-02				
Cadmium	2.8E+00	mg/kg	6.5E-09					mg/kg/day	NA	NA	NA	1.8E-08	mg/kg/day	2.5E-05	mg/kg/day	7.2E-04				
Chromium	3.4E+01	mg/kg	7.9E-07					mg/kg/day	NA	NA	NA	2.2E-06	mg/kg/day	5.0E-04	mg/kg/day	4.4E-03				
Copper	2.5E+03	mg/kg	5.8E-05	mg/kg/day	NA	NA	NA	1.6E-04	mg/kg/day	4.0E-02	mg/kg/day	4.1E-03								

TABLE 7.4.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Industrial Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal Absorption	Iron	1.8E+04	mg/kg	4.3E-04	mg/kg/day	NA	NA	NA	1.2E-03	mg/kg/day	3.0E-01	mg/kg/day	4.0E-03
				Lead	4.8E+02	mg/kg	1.1E-05	mg/kg/day	NA	NA	NA	3.1E-05	mg/kg/day	NA	NA	NA
				Manganese	2.6E+02	mg/kg	6.1E-06	mg/kg/day	NA	NA	NA	1.7E-05	mg/kg/day	8.0E-04	mg/kg/day	2.1E-02
				Mercury	1.7E+01	mg/kg	4.0E-07	mg/kg/day	NA	NA	NA	1.1E-06	mg/kg/day	2.1E-05	mg/kg/day	5.4E-02
				Nickel	6.2E+01	mg/kg	1.4E-06	mg/kg/day	NA	NA	NA	4.0E-06	mg/kg/day	8.0E-04	mg/kg/day	5.0E-03
				Silver	1.6E+01	mg/kg	3.7E-07	mg/kg/day	NA	NA	NA	1.0E-06	mg/kg/day	2.0E-04	mg/kg/day	5.2E-03
				Vanadium	2.2E+01	mg/kg	5.1E-07	mg/kg/day	NA	NA	NA	1.4E-06	mg/kg/day	2.6E-05	mg/kg/day	5.5E-02
				Zinc	2.9E+03	mg/kg	6.8E-05	mg/kg/day	NA	NA	NA	1.9E-04	mg/kg/day	3.0E-01	mg/kg/day	6.3E-04
			Exp. Route Total								1.2E-05					1.8E-01
			Exposure Point Total								3.7E-05					5.3E-01
			Exposure Medium Total								3.7E-05					5.3E-01
			Soil*								3.7E-05					5.3E-01
Groundwater	Groundwater	NNSY	Ingestion	1,1,2,2-Tetrachloroethane	5.7E-01	ug/l	2.0E-06	ug/l	2.0E-01	1/(mg/kg-day)	4.0E-07	5.6E-06	mg/kg/day	6.0E-02	mg/kg/day	9.3E-05
				Benzene	4.9E-01	ug/l	1.7E-06	ug/l	5.5E-02	1/(mg/kg-day)	9.4E-08	4.8E-06	mg/kg/day	4.0E-03	mg/kg/day	1.2E-03
				Chloroform	6.0E-01	ug/l	2.1E-06	ug/l	NA	NA	NA	5.9E-06	mg/kg/day	1.0E-02	mg/kg/day	5.9E-04
				Trichloroethene	2.0E-01	ug/l	7.0E-07	ug/l	1.1E-02	1/(mg/kg-day)	7.7E-09	2.0E-06	mg/kg/day	6.0E-03	mg/kg/day	3.3E-04
				Vinyl chloride	9.0E-01	ug/l	3.1E-06	ug/l	1.4E+00	1/(mg/kg-day)	4.4E-06	8.8E-06	mg/kg/day	3.0E-03	mg/kg/day	2.9E-03
				2-Methylnaphthalene	3.5E+00	ug/l	1.2E-05	ug/l	NA	NA	NA	3.4E-05	mg/kg/day	4.0E-03	mg/kg/day	8.6E-03
				Butylbenzylphthalate	2.4E+01	ug/l	8.6E-05	ug/l	1.9E-03	1/(mg/kg-day)	1.6E-07	2.4E-04	mg/kg/day	2.0E-01	mg/kg/day	1.2E-03
				bis(2-Ethylhexyl)phthalate	1.4E+01	ug/l	4.8E-05	ug/l	1.4E-02	1/(mg/kg-day)	6.8E-07	1.4E-04	mg/kg/day	2.0E-02	mg/kg/day	6.8E-03
				Aldrin	3.0E-02	ug/l	1.1E-07	ug/l	1.7E+01	1/(mg/kg-day)	1.8E-06	3.0E-07	mg/kg/day	3.0E-05	mg/kg/day	9.9E-03
				Dieldrin	3.2E-02	ug/l	1.1E-07	ug/l	1.6E+01	1/(mg/kg-day)	1.8E-06	3.2E-07	mg/kg/day	5.0E-05	mg/kg/day	6.3E-03
				Heptachlor epoxide	4.0E-02	ug/l	1.4E-07	ug/l	9.1E+00	1/(mg/kg-day)	1.3E-06	3.9E-07	mg/kg/day	1.3E-05	mg/kg/day	3.0E-02
				beta-BHC	2.9E-02	ug/l	1.0E-07	ug/l	1.8E+00	1/(mg/kg-day)	1.8E-07	2.8E-07	mg/kg/day	NA	NA	NA
				Antimony	6.5E+00	ug/l	2.3E-05	ug/l	NA	NA	NA	6.4E-05	mg/kg/day	4.0E-04	mg/kg/day	1.6E-01
				Arsenic	2.1E+01	ug/l	7.4E-05	ug/l	1.5E+00	1/(mg/kg-day)	1.1E-04	2.1E-04	mg/kg/day	3.0E-04	mg/kg/day	6.9E-01
				Cadmium	1.8E+00	ug/l	6.2E-06	ug/l	NA	NA	NA	1.7E-05	mg/kg/day	5.0E-04	mg/kg/day	3.4E-02
				Cobalt	9.2E+01	ug/l	3.2E-04	ug/l	NA	NA	NA	9.0E-04	mg/kg/day	2.0E-02	mg/kg/day	4.5E-02
				Iron	4.0E+04	ug/l	1.4E-01	ug/l	NA	NA	NA	3.9E-01	mg/kg/day	3.0E-01	mg/kg/day	1.3E+00
				Manganese	5.4E+02	ug/l	1.9E-03	ug/l	NA	NA	NA	5.2E-03	mg/kg/day	2.0E-02	mg/kg/day	2.6E-01
				Nickel	5.8E+01	ug/l	2.0E-04	ug/l	NA	NA	NA	5.6E-04	mg/kg/day	2.0E-02	mg/kg/day	2.8E-02
				Selenium	1.1E+01	ug/l	3.8E-05	ug/l	NA	NA	NA	1.1E-04	mg/kg/day	5.0E-03	mg/kg/day	2.1E-02
			Exp. Route Total								1.2E-04					2.6E+00
			Exposure Medium Total								1.2E-04					2.6E+00
			Groundwater Total								1.2E-04					2.6E+00
Total of Receptor Risks Across All Media											1.6E-04	Total of Receptor Hazards Across All Media				3.1E+00

TABLE 7.1.CTE  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 CENTRAL TENDANCY  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RFC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	NNSY	Ingestion	Benzo(a)anthracene	1.1E+00	mg/kg	NA	NA	NA	NA	NA	4.6E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	7.3E-01	mg/kg	NA	NA	NA	NA	NA	3.0E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	8.4E-01	mg/kg	NA	NA	NA	NA	NA	3.4E-06	mg/kg/day	NA	NA	NA
				Benzo(k)fluoranthene	7.3E-01	mg/kg	NA	NA	NA	NA	NA	3.0E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	5.4E-01	mg/kg	NA	NA	NA	NA	NA	2.2E-06	mg/kg/day	NA	NA	NA
				Indeno(1,2,3-cd)pyrene	6.3E-01	mg/kg	NA	NA	NA	NA	NA	2.6E-06	mg/kg/day	NA	NA	NA
				Heptachlor Epoxide	5.0E-03	mg/kg	NA	NA	NA	NA	NA	2.1E-08	mg/kg/day	1.3E-05	mg/kg/day	1.6E-03
				Aluminum	6.5E+03	mg/kg	NA	NA	NA	NA	NA	2.7E-02	mg/kg/day	1.0E+00	mg/kg/day	2.7E-02
				Antimony	1.2E+00	mg/kg	NA	NA	NA	NA	NA	5.0E-06	mg/kg/day	2.0E-04	mg/kg/day	2.5E-02
				Arsenic	1.5E+01	mg/kg	NA	NA	NA	NA	NA	6.3E-05	mg/kg/day	3.0E-04	mg/kg/day	2.1E-01
				Cadmium	1.3E+00	mg/kg	NA	NA	NA	NA	NA	5.3E-06	mg/kg/day	1.0E-03	mg/kg/day	5.3E-03
				Chromium	2.6E+01	mg/kg	NA	NA	NA	NA	NA	1.1E-04	mg/kg/day	2.0E-02	mg/kg/day	5.3E-03
				Copper	7.3E+02	mg/kg	NA	NA	NA	NA	NA	3.0E-03	mg/kg/day	4.0E-02	mg/kg/day	7.5E-02
				Iron	1.7E+04	mg/kg	NA	NA	NA	NA	NA	7.0E-02	mg/kg/day	3.0E-01	mg/kg/day	2.3E-01
				Lead	4.8E+02	mg/kg	NA	NA	NA	NA	NA	2.0E-03	mg/kg/day	NA	NA	NA
				Manganese	1.5E+02	mg/kg	NA	NA	NA	NA	NA	6.1E-04	mg/kg/day	2.0E-02	mg/kg/day	3.0E-02
				Mercury	5.5E+00	mg/kg	NA	NA	NA	NA	NA	2.2E-05	mg/kg/day	3.0E-04	mg/kg/day	7.5E-02
Nickel	3.4E+01	mg/kg	NA	NA	NA	NA	NA	1.4E-04	mg/kg/day	2.0E-02	mg/kg/day	7.0E-03				
Silver	2.4E+00	mg/kg	NA	NA	NA	NA	NA	9.8E-06	mg/kg/day	5.0E-03	mg/kg/day	2.0E-03				
Vanadium	1.9E+01	mg/kg	NA	NA	NA	NA	NA	7.9E-05	mg/kg/day	1.0E-03	mg/kg/day	7.9E-02				
Zinc	1.0E+03	mg/kg	NA	NA	NA	NA	NA	4.3E-03	mg/kg/day	3.0E-01	mg/kg/day	1.4E-02				
Exp. Route Total										0.0E+00				7.9E-01		

TABLE 7.1.CTE  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 CENTRAL TENDANCY  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
			Demal Absorption	Benzo(a)anthracene	1.1E+00	mg/kg	NA	NA	NA	NA	NA	4.1E-07	mg/kg/day	NA	NA	NA	
				Benzo(a)pyrene	7.3E-01	mg/kg	NA	NA	NA	NA	NA	2.7E-07	mg/kg/day	NA	NA	NA	
				Benzo(b)fluoranthene	8.4E-01	mg/kg	NA	NA	NA	NA	NA	3.1E-07	mg/kg/day	NA	NA	NA	
				Benzo(k)fluoranthene	7.3E-01	mg/kg	NA	NA	NA	NA	NA	2.7E-07	mg/kg/day	NA	NA	NA	
				Dibenz(a,h)anthracene	5.4E-01	mg/kg	NA	NA	NA	NA	NA	2.0E-07	mg/kg/day	NA	NA	NA	
				Indeno(1,2,3-cd)pyrene	6.3E-01	mg/kg	NA	NA	NA	NA	NA	2.3E-07	mg/kg/day	NA	NA	NA	
				Heptachlor Epoxide	5.0E-03	mg/kg	NA	NA	NA	NA	NA	1.8E-09	mg/kg/day	1.3E-05	NA	1.4E-04	
				Aluminum	6.5E+03	mg/kg	NA	NA	NA	NA	NA	1.8E-04	mg/kg/day	1.0E+00	mg/kg/day	1.8E-04	
				Antimony	1.2E+00	mg/kg	NA	NA	NA	NA	NA	3.5E-08	mg/kg/day	3.0E-05	mg/kg/day	1.2E-03	
				Arsenic	1.5E+01	mg/kg	NA	NA	NA	NA	NA	1.3E-06	mg/kg/day	3.0E-04	mg/kg/day	4.3E-03	
				Cadmium	1.3E+00	mg/kg	NA	NA	NA	NA	NA	3.6E-08	mg/kg/day	2.5E-05	mg/kg/day	1.5E-03	
				Chromium	2.6E+01	mg/kg	NA	NA	NA	NA	NA	7.2E-07	mg/kg/day	5.0E-04	mg/kg/day	1.4E-03	
				Copper	7.3E+02	mg/kg	NA	NA	NA	NA	NA	2.1E-05	mg/kg/day	4.0E-02	mg/kg/day	5.2E-04	
				Iron	1.7E+04	mg/kg	NA	NA	NA	NA	NA	4.8E-04	mg/kg/day	3.0E-01	mg/kg/day	1.6E-03	
				Lead	4.8E+02	mg/kg	NA	NA	NA	NA	NA	1.3E-05	mg/kg/day	NA	mg/kg/day	NA	
				Manganese	1.5E+02	mg/kg	NA	NA	NA	NA	NA	4.2E-06	mg/kg/day	8.0E-04	mg/kg/day	5.2E-03	
				Mercury	5.5E+00	mg/kg	NA	NA	NA	NA	NA	1.5E-07	mg/kg/day	2.1E-05	mg/kg/day	7.4E-03	
				Nickel	3.4E+01	mg/kg	NA	NA	NA	NA	NA	9.7E-07	mg/kg/day	8.0E-04	mg/kg/day	1.2E-03	
				Silver	2.4E+00	mg/kg	NA	NA	NA	NA	NA	6.7E-08	mg/kg/day	2.0E-04	mg/kg/day	3.4E-04	
				Vanadium	1.9E+01	mg/kg	NA	NA	NA	NA	NA	5.4E-07	mg/kg/day	2.6E-05	mg/kg/day	2.1E-02	
				Zinc	1.0E+03	mg/kg	NA	NA	NA	NA	NA	2.9E-05	mg/kg/day	3.0E-01	mg/kg/day	9.8E-05	
			Exp. Route Total								0.0E+00					4.6E-02	
			Exposure Point Total								0.0E+00					8.3E-01	
			Exposure Medium Total								0.0E+00					8.3E-01	
Soil*											0.0E+00					8.3E-01	
											Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	8.3E-01

\* Surface and subsurface soil combined.

Table 7.2.CTE Supplement A  
 Calculation of DAevent  
 Resident Adult, Groundwater  
 NNSY Site 10

Chemical of Potential Concern	Groundwater Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ <sub>event</sub> ) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm <sup>2</sup> -event)	Eq
1,1,2,2-Tetrachloroethane	5.22E-01	6.9E-03	3.4E-02	9.3E-01	2.2E+00	1.0E+00	0.25	4.8E-09	2
Benzene	5.25E-01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	0.25	5.9E-09	2
Chloroform	5.06E-01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.25	3.4E-09	2
Trichloroethene	4.95E-01	1.2E-02	5.3E-02	5.8E-01	1.4E+00	1.0E+00	0.25	6.3E-09	2
Vinyl chloride	5.49E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.25	2.1E-09	2
2-Methylnaphthalene	2.87E+00	1.4E-01	6.5E-01	6.6E-01	2.6E+00	1.0E+00	0.25	4.6E-07	2
Butylbenzylphthalate	6.60E+00	5.4E-02	3.7E-01	5.9E+00	1.4E+01	1.0E+00	0.25	1.2E-06	2
bis(2-Ethylhexyl)phthalate	4.70E+00	2.5E-02	1.9E-01	1.7E+01	4.0E+01	8.0E-01	0.25	5.3E-07	2
Aldrin	1.46E-02	1.4E-03	1.0E-02	1.2E+01	2.9E+01	1.0E+00	0.25	9.7E-11	2
Dieldrin	1.87E-02	1.2E-02	9.0E-02	1.5E+01	3.5E+01	8.0E-01	0.25	9.5E-10	2
Heptachlor epoxide	1.52E-02	8.6E-03	6.5E-02	1.3E+01	3.2E+01	8.0E-01	0.25	5.3E-10	2
beta-BHC	1.27E-02	2.8E-02	1.8E-01	4.5E+00	1.1E+01	1.0E+00	0.25	1.0E-09	2
Antimony	4.19E+00	1.0E-03	NA	NA	NA	NA	0.25	1.0E-09	1
Arsenic	1.41E+01	1.0E-03	NA	NA	NA	NA	0.25	3.5E-09	1
Cadmium	6.30E-01	1.0E-03	NA	NA	NA	NA	0.25	1.6E-10	1
Cobalt	9.21E+00	4.0E-04	NA	NA	NA	NA	0.25	9.2E-10	1
Iron	2.03E+04	1.0E-03	NA	NA	NA	NA	0.25	5.1E-06	1
Manganese	3.39E+02	1.0E-03	NA	NA	NA	NA	0.25	8.5E-08	1
Nickel	6.51E+00	2.0E-04	NA	NA	NA	NA	0.25	3.3E-10	1
Selenium	5.02E+00	1.0E-03	NA	NA	NA	NA	0.25	1.3E-09	1

Inorganics: DAevent (mg/cm<sup>2</sup>-event) =  
 Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm<sup>3</sup> (eq 1)

Organics: DAevent (mg/cm<sup>2</sup>-event) =

$$\text{If } t_{\text{event}} \leq t^*, \text{ then } DA_{\text{event}} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{\text{event}} \times t_{\text{event}}}{\pi}} \quad (\text{eq 2})$$

$$\text{If } t_{\text{event}} \geq t^*, \text{ then } DA_{\text{event}} = FA \times K_p \times C_w \left[ \frac{t_{\text{event}}}{1+B} + 2 \times \tau_{\text{event}} \left( \frac{1+3B+3B^2}{(1+B)^2} \right) \right] \quad (\text{eq 3})$$

Notes:

Permeability constants (Kp), B, lag time, and t\* from EPA 2001, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Interim)*. EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below. Parameters B, tau, t\* were calculated for 2-methylnaphthalene, and beta-BHC.

NA - not applicable.

Heptachlor used as surrogate for Heptachlor Epoxide.

TABLE 9.1.RME  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
REASONABLE MAXIMUM EXPOSURE  
NNSY Site 10

Scenario Timeframe: Current  
Receptor Population: Construction Worker  
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Shallow Groundwater - Vapors in Excavation Trench	1,1,2,2-Tetrachloroethane	N/A	2.4E-09	N/A	2.4E-09	N/A	N/A	NA	N/A	0.0E+00
			Benzene	N/A	3.8E-10	N/A	3.8E-10	Blood	N/A	1.1E-04	N/A	1.1E-04
			Chloroform	N/A	1.2E-09	N/A	1.2E-09	Liver, Kidney	N/A	7.7E-05	N/A	7.7E-05
			Trichloroethene	N/A	2.0E-09	N/A	2.0E-09	N/A	N/A	3.5E-05	N/A	3.5E-05
			Vinyl chloride	N/A	4.1E-10	N/A	4.1E-10	Liver	N/A	6.8E-05	N/A	6.8E-05
			2-Methylnaphthalene	N/A	NA	N/A	0.0E+00	N/A	N/A	NA	N/A	0.0E+00
Chemical Total				N/A	6.5E-09	NA	6.5E-09		N/A	2.9E-04	NA	2.9E-04
Receptor Total							5.9E-06	Receptor HI Total			2.4E+00	

\* Surface and Subsurface Soil combined

Total Kidney HI Across All Media =	5.8E-01
Total Liver HI Across All Media =	7.8E-02
Total Blood HI Across All Media =	2.8E-01
Total CNS HI Across All Media =	3.0E-01
Total Gastrointestinal HI Across All Media =	6.3E-01
Total Vascular HI Across All Media =	4.6E-01
Total Skin HI Across All Media =	4.8E-01
Total NOAEL HI Across All Media =	1.5E-02
Total Whole Body HI Across All Media =	2.6E-02
Total Fetus HI Across All Media =	2.3E-03
Total Reproductive System HI Across All Media =	1.4E-02
Total Respiratory System (Lung) HI Across All Media =	2.8E-02

TABLE 7.2.CTE  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 CENTRAL TENDANCY  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Resident  
 Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations								
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Soil*	Soil*	NNSY	Ingestion	Benzo(a)anthracene	1.1E+00	mg/kg	4.7E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	3.4E-07	4.8E-06	mg/kg/day	NA	NA	NA				
				Benzo(a)pyrene	7.3E-01	mg/kg	3.1E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.2E-06	3.1E-06	mg/kg/day	NA	NA	NA				
				Benzo(b)fluoranthene	8.4E-01	mg/kg	3.5E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.6E-07	3.6E-06	mg/kg/day	NA	NA	NA				
				Benzo(k)fluoranthene	7.3E-01	mg/kg	3.1E-07	mg/kg/day	7.3E-02	1/(mg/kg-day)	2.2E-08	3.1E-06	mg/kg/day	NA	NA	NA				
				Dibenz(a,h)anthracene	5.4E-01	mg/kg	2.3E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.7E-06	2.3E-06	mg/kg/day	NA	NA	NA				
				Indeno(1,2,3-cd)pyrene	6.3E-01	mg/kg	2.7E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.0E-07	2.7E-06	mg/kg/day	NA	NA	NA				
				Heptachlor Epoxide	5.0E-03	mg/kg	2.1E-09	mg/kg/day	9.1E+00	1/(mg/kg-day)	1.9E-08	2.1E-08	mg/kg/day	1.3E-05	mg/kg/day	1.6E-03				
				Aluminum	6.5E+03	mg/kg	2.7E-03	mg/kg/day	NA	NA	NA	2.8E-02	mg/kg/day	1.0E+00	mg/kg/day	2.8E-02				
				Antimony	1.2E+00	mg/kg	5.1E-07	mg/kg/day	NA	NA	NA	5.2E-06	mg/kg/day	4.0E-04	mg/kg/day	1.3E-02				
				Arsenic	1.5E+01	mg/kg	6.4E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	9.6E-06	6.5E-05	mg/kg/day	3.0E-04	mg/kg/day	2.2E-01				
				Cadmium	1.3E+00	mg/kg	5.4E-07	mg/kg/day	NA	NA	NA	5.5E-06	mg/kg/day	1.0E-03	mg/kg/day	5.5E-03				
				Chromium	2.6E+01	mg/kg	1.1E-05	mg/kg/day	NA	NA	NA	1.1E-04	mg/kg/day	3.0E-03	mg/kg/day	3.6E-02				
				Copper	7.3E+02	mg/kg	3.1E-04	mg/kg/day	NA	NA	NA	3.1E-03	mg/kg/day	4.0E-02	mg/kg/day	7.8E-02				
				Iron	1.7E+04	mg/kg	7.1E-03	mg/kg/day	NA	NA	NA	7.2E-02	mg/kg/day	3.0E-01	mg/kg/day	2.4E-01				
				Lead	4.8E+02	mg/kg	2.0E-04	mg/kg/day	NA	NA	NA	2.0E-03	mg/kg/day	NA	mg/kg/day	NA				
				Manganese	1.5E+02	mg/kg	6.2E-05	mg/kg/day	NA	NA	NA	6.3E-04	mg/kg/day	2.0E-02	mg/kg/day	3.2E-02				
				Mercury	5.5E+00	mg/kg	2.3E-06	mg/kg/day	NA	NA	NA	2.3E-05	mg/kg/day	3.0E-04	mg/kg/day	7.8E-02				
				Nickel	3.4E+01	mg/kg	1.4E-05	mg/kg/day	NA	NA	NA	1.5E-04	mg/kg/day	2.0E-02	mg/kg/day	7.3E-03				
				Silver	2.4E+00	mg/kg	1.0E-06	mg/kg/day	NA	NA	NA	1.0E-05	mg/kg/day	5.0E-03	mg/kg/day	2.0E-03				
				Vanadium	1.9E+01	mg/kg	8.1E-06	mg/kg/day	NA	NA	NA	8.2E-05	mg/kg/day	1.0E-03	mg/kg/day	8.2E-02				
				Zinc	1.0E+03	mg/kg	4.4E-04	mg/kg/day	NA	NA	NA	4.4E-03	mg/kg/day	3.0E-01	mg/kg/day	1.5E-02				
				<b>Exp. Route Total</b>											<b>1.4E-05</b>				<b>8.4E-01</b>	
							Dermal Absorption	Benzo(a)anthracene	1.1E+00	mg/kg	6.9E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	5.1E-08	7.0E-07	mg/kg/day	NA	NA	NA
								Benzo(a)pyrene	7.3E-01	mg/kg	4.5E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	3.3E-07	4.5E-07	mg/kg/day	NA	NA	NA
								Benzo(b)fluoranthene	8.4E-01	mg/kg	5.2E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	3.8E-08	5.2E-07	mg/kg/day	NA	NA	NA
								Benzo(k)fluoranthene	7.3E-01	mg/kg	4.5E-08	mg/kg/day	7.3E-02	1/(mg/kg-day)	3.3E-09	4.6E-07	mg/kg/day	NA	NA	NA
								Dibenz(a,h)anthracene	5.4E-01	mg/kg	3.4E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.4E-07	3.4E-07	mg/kg/day	NA	NA	NA
Indeno(1,2,3-cd)pyrene	6.3E-01	mg/kg	3.9E-08					mg/kg/day	7.3E-01	1/(mg/kg-day)	2.9E-08	3.9E-07	mg/kg/day	NA	NA	NA				
Heptachlor Epoxide	5.0E-03	mg/kg	3.1E-10					mg/kg/day	9.1E+00	1/(mg/kg-day)	2.8E-09	3.1E-09	mg/kg/day	1.3E-05	mg/kg/day	2.4E-04				
Aluminum	6.5E+03	mg/kg	3.1E-05	mg/kg/day	NA	NA	NA	3.1E-04	mg/kg/day	1.0E+00	mg/kg/day	3.1E-04								
Antimony	1.2E+00	mg/kg	5.8E-09	mg/kg/day	NA	NA	NA	5.8E-08	mg/kg/day	6.0E-05	mg/kg/day	9.7E-04								

TABLE 7.2.CTE  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 CENTRAL TENDANCY  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Resident  
 Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Arsenic	1.5E+01	mg/kg	2.2E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.3E-07	2.2E-06	mg/kg/day	3.0E-04	mg/kg/day	7.3E-03
				Cadmium	1.3E+00	mg/kg	6.1E-09	mg/kg/day	NA	NA	NA	6.2E-08	mg/kg/day	2.5E-05	mg/kg/day	2.5E-03
				Chromium	2.6E+01	mg/kg	1.2E-07	mg/kg/day	NA	NA	NA	1.2E-06	mg/kg/day	5.0E-04	mg/kg/day	2.4E-03
				Copper	7.3E+02	mg/kg	3.5E-06	mg/kg/day	NA	NA	NA	3.5E-05	mg/kg/day	4.0E-02	mg/kg/day	8.7E-04
				Iron	1.7E+04	mg/kg	8.1E-05	mg/kg/day	NA	NA	NA	8.1E-04	mg/kg/day	3.0E-01	mg/kg/day	2.7E-03
				Lead	4.8E+02	mg/kg	2.3E-06	mg/kg/day	NA	NA	NA	2.3E-05	mg/kg/day	NA	NA	NA
				Manganese	1.5E+02	mg/kg	7.0E-07	mg/kg/day	NA	NA	NA	7.1E-06	mg/kg/day	8.0E-04	mg/kg/day	8.8E-03
				Mercury	5.5E+00	mg/kg	2.6E-08	mg/kg/day	NA	NA	NA	2.6E-07	mg/kg/day	2.1E-05	mg/kg/day	1.2E-02
				Nickel	3.4E+01	mg/kg	1.6E-07	mg/kg/day	NA	NA	NA	1.6E-06	mg/kg/day	8.0E-04	mg/kg/day	2.0E-03
				Silver	2.4E+00	mg/kg	1.1E-08	mg/kg/day	NA	NA	NA	1.1E-07	mg/kg/day	2.0E-04	mg/kg/day	5.7E-04
				Vanadium	1.9E+01	mg/kg	9.2E-08	mg/kg/day	NA	NA	NA	9.2E-07	mg/kg/day	2.0E-05	mg/kg/day	3.5E-02
				Zinc	1.0E+03	mg/kg	4.9E-06	mg/kg/day	NA	NA	NA	5.0E-05	mg/kg/day	3.0E-01	mg/kg/day	1.7E-04
				Exp. Route Total							1.0E-06					7.7E-02
				Exposure Point Total							1.5E-05					9.1E-01
				Exposure Medium Total							1.5E-05					9.1E-01
				Sussurface Soil							1.5E-05					9.1E-01
Groundwater	Groundwater	NNSY	Ingestion	1,1,2,2-Tetrachloroethane	5.2E-01	ug/l	2.8E-06	ug/l	2.0E-01	1/(mg/kg-day)	5.5E-07	2.2E-05	mg/kg/day	6.0E-02	mg/kg/day	3.7E-04
				Benzene	5.2E-01	ug/l	2.8E-06	ug/l	5.5E-02	1/(mg/kg-day)	1.5E-07	2.2E-05	mg/kg/day	4.0E-03	mg/kg/day	5.6E-03
				Chloroform	5.1E-01	ug/l	2.7E-06	ug/l	NA	NA	NA	2.2E-05	mg/kg/day	1.0E-02	mg/kg/day	2.2E-03
				Trichloroethene	5.0E-01	ug/l	2.6E-06	ug/l	1.1E-02	1/(mg/kg-day)	2.9E-08	2.1E-05	mg/kg/day	6.0E-03	mg/kg/day	3.5E-03
				Vinyl chloride	5.5E-01	ug/l	2.9E-06	ug/l	1.4E+00	1/(mg/kg-day)	4.1E-06	2.3E-05	mg/kg/day	3.0E-03	mg/kg/day	7.8E-03
				2-Methylnaphthalene	2.9E+00	ug/l	1.5E-05	ug/l	NA	NA	NA	1.2E-04	mg/kg/day	4.0E-03	mg/kg/day	3.1E-02
				Butylbenzophthalate	6.6E+00	ug/l	3.5E-05	ug/l	1.9E-03	1/(mg/kg-day)	6.7E-08	2.8E-04	mg/kg/day	2.0E-01	mg/kg/day	1.4E-03
				bis(2-Ethylhexyl)phthalate	4.7E+00	ug/l	2.5E-05	ug/l	1.4E-02	1/(mg/kg-day)	3.5E-07	2.0E-04	mg/kg/day	2.0E-02	mg/kg/day	1.0E-02
				Aldrin	1.5E-02	ug/l	7.7E-08	ug/l	1.7E+01	1/(mg/kg-day)	1.3E-06	6.2E-07	mg/kg/day	3.0E-05	mg/kg/day	2.1E-02
				Dieldrin	1.9E-02	ug/l	1.0E-07	ug/l	1.6E+01	1/(mg/kg-day)	1.6E-06	8.0E-07	mg/kg/day	5.0E-05	mg/kg/day	1.6E-02
				Heptachlor epoxide	1.5E-02	ug/l	8.1E-08	ug/l	9.1E+00	1/(mg/kg-day)	7.4E-07	6.5E-07	mg/kg/day	1.3E-05	mg/kg/day	5.0E-02
				beta-BHC	1.3E-02	ug/l	6.8E-08	ug/l	1.8E+00	1/(mg/kg-day)	1.2E-07	5.4E-07	mg/kg/day	NA	NA	NA
				Antimony	4.2E+00	ug/l	2.2E-05	ug/l	NA	NA	NA	1.8E-04	mg/kg/day	4.0E-04	mg/kg/day	4.5E-01
				Arsenic	1.4E+01	ug/l	7.5E-05	ug/l	1.5E+00	1/(mg/kg-day)	1.1E-04	6.0E-04	mg/kg/day	3.0E-04	mg/kg/day	2.0E+00
				Cadmium	6.3E-01	ug/l	3.3E-06	ug/l	NA	NA	NA	2.7E-05	mg/kg/day	5.0E-04	mg/kg/day	5.4E-02
				Cobalt	9.2E+00	ug/l	4.9E-05	ug/l	NA	NA	NA	3.9E-04	mg/kg/day	2.0E-02	mg/kg/day	2.0E-02
				Iron	2.0E+04	ug/l	1.1E-01	ug/l	NA	NA	NA	8.7E-01	mg/kg/day	3.0E-01	mg/kg/day	2.9E+00
				Manganese	3.4E+02	ug/l	1.8E-03	ug/l	NA	NA	NA	1.4E-02	mg/kg/day	2.0E-02	mg/kg/day	7.2E-01
				Nickel	6.5E+00	ug/l	3.5E-05	ug/l	NA	NA	NA	2.8E-04	mg/kg/day	2.0E-02	mg/kg/day	1.4E-02
				Selenium	5.0E+00	ug/l	2.7E-05	ug/l	NA	NA	NA	2.1E-04	mg/kg/day	5.0E-03	mg/kg/day	4.3E-02
				Exp. Route Total							1.2E-04					6.3E+00



Table 7.2.CTE Supplement B  
 Calculation of DAevent  
 Resident Child, Groundwater  
 NNSY Site 10

Chemical of Potential Concern	Groundwater Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ <sub>event</sub> ) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm <sup>2</sup> -event)	Eq
1,1,2,2-Tetrachloroethane	5.22E-01	6.9E-03	3.4E-02	9.3E-01	2.2E+00	1.0E+00	0.3	5.3E-09	2
Benzene	5.25E-01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	0.3	6.4E-09	2
Chloroform	5.06E-01	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.3	3.7E-09	2
Trichloroethene	4.95E-01	1.2E-02	5.3E-02	5.8E-01	1.4E+00	1.0E+00	0.3	6.9E-09	2
Vinyl chloride	5.49E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.3	2.3E-09	2
2-Methylnaphthalene	2.87E+00	1.4E-01	6.5E-01	6.6E-01	2.6E+00	1.0E+00	0.3	5.0E-07	2
Butylbenzylphthalate	2.45E+01	5.4E-02	3.7E-01	5.9E+00	1.4E+01	1.0E+00	0.3	4.9E-06	2
bis(2-Ethylhexyl)phthalate	4.70E+00	2.5E-02	1.9E-01	1.7E+01	4.0E+01	8.0E-01	0.3	5.8E-07	2
Aldrin	1.46E-02	1.4E-03	1.0E-02	1.2E+01	2.9E+01	1.0E+00	0.3	1.1E-10	2
Dieldrin	1.87E-02	1.2E-02	9.0E-02	1.5E+01	3.5E+01	8.0E-01	0.3	1.0E-09	2
Heptachlor epoxide	1.52E-02	8.6E-03	6.5E-02	1.3E+01	3.2E+01	8.0E-01	0.3	5.8E-10	2
beta-BHC	1.27E-02	2.8E-02	1.8E-01	4.5E+00	1.1E+01	1.0E+00	0.3	1.1E-09	2
Antimony	4.19E+00	1.0E-03	NA	NA	NA	NA	0.3	1.3E-09	1
Arsenic	1.41E+01	1.0E-03	NA	NA	NA	NA	0.3	4.2E-09	1
Cadmium	6.30E-01	1.0E-03	NA	NA	NA	NA	0.3	1.9E-10	1
Cobalt	9.21E+00	4.0E-04	NA	NA	NA	NA	0.3	1.1E-09	1
Iron	2.03E+04	1.0E-03	NA	NA	NA	NA	0.3	6.1E-06	1
Manganese	3.39E+02	1.0E-03	NA	NA	NA	NA	0.3	1.0E-07	1
Nickel	6.51E+00	2.0E-04	NA	NA	NA	NA	0.3	3.9E-10	1
Selenium	5.02E+00	1.0E-03	NA	NA	NA	NA	0.3	1.5E-09	1

Inorganics: DAevent (mg/cm<sup>2</sup>-event) =  
 Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm<sup>3</sup> (eq 1)

Organics: DAevent (mg/cm<sup>2</sup>-event) =

$$\text{If } t_{\text{event}} \leq t^*, \text{ then } DA_{\text{event}} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{\text{event}} \times t_{\text{event}}}{\pi}} \quad (\text{eq 2})$$

$$\text{If } t_{\text{event}} \geq t^*, \text{ then } DA_{\text{event}} = FA \times K_p \times C_w \left[ \frac{t_{\text{event}}}{1+B} + 2 \times \tau_{\text{event}} \left( \frac{1+3B+3B^2}{(1+B)^2} \right) \right] \quad (\text{eq 3})$$

Notes:

Permeability constants (Kp), B, lag time, and t\* from EPA 2001, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Interim)*. EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below. Parameters B, tau, t\* were calculated for 2-methylnaphthalene, and beta-BHC.

NA - not applicable.

Heptachlor used as surrogate for Heptachlor Epoxide.

TABLE 7.3.CTE  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 CENTRAL TENDENCY  
 NNSY Site 10

Scenario Timeframe: Future  
 Receptor Population: Industrial Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Groundwater	Groundwater	NNSY	Ingestion	1,1,2,2-Tetrachloroethane	5.2E-01	ug/l	5.8E-07	ug/l	2.0E-01	1/(mg/kg-day)	1.2E-07	4.5E-06	mg/kg/day	6.0E-02	mg/kg/day	7.5E-05		
				Benzene	5.2E-01	ug/l	5.8E-07	ug/l	5.5E-02	1/(mg/kg-day)	3.2E-08	4.5E-06	mg/kg/day	4.0E-03	mg/kg/day	1.1E-03		
				Chloroform	5.1E-01	ug/l	5.6E-07	ug/l	NA	NA	NA	4.3E-06	mg/kg/day	1.0E-02	mg/kg/day	4.3E-04		
				Trichloroethene	5.0E-01	ug/l	5.5E-07	ug/l	1.1E-02	1/(mg/kg-day)	6.0E-09	4.2E-06	mg/kg/day	6.0E-03	mg/kg/day	7.1E-04		
				Vinyl chloride	5.5E-01	ug/l	6.0E-07	ug/l	1.4E+00	1/(mg/kg-day)	8.5E-07	4.7E-06	mg/kg/day	3.0E-03	mg/kg/day	1.6E-03		
				2-Methylnaphthalene	2.9E+00	ug/l	3.2E-06	ug/l	NA	NA	NA	2.5E-05	mg/kg/day	4.0E-03	mg/kg/day	6.1E-03		
				Butylbenzylphthalate	6.6E+00	ug/l	7.3E-06	ug/l	1.9E-03	1/(mg/kg-day)	1.4E-08	5.7E-05	mg/kg/day	2.0E-01	mg/kg/day	2.8E-04		
				bis(2-Ethylhexyl)phthalate	4.7E+00	ug/l	5.2E-06	ug/l	1.4E-02	1/(mg/kg-day)	7.3E-08	4.0E-05	mg/kg/day	2.0E-02	mg/kg/day	2.0E-03		
				Aldrin	1.5E-02	ug/l	1.6E-08	ug/l	1.7E+01	1/(mg/kg-day)	2.7E-07	1.2E-07	mg/kg/day	3.0E-05	mg/kg/day	4.2E-03		
				Dieldrin	1.9E-02	ug/l	2.1E-08	ug/l	1.6E+01	1/(mg/kg-day)	3.3E-07	1.6E-07	mg/kg/day	5.0E-05	mg/kg/day	3.2E-03		
				Heptachlor epoxide	1.5E-02	ug/l	1.7E-08	ug/l	9.1E+00	1/(mg/kg-day)	1.5E-07	1.3E-07	mg/kg/day	1.3E-05	mg/kg/day	1.0E-02		
				beta-BHC	1.3E-02	ug/l	1.4E-08	ug/l	1.8E+00	1/(mg/kg-day)	2.5E-08	1.1E-07	mg/kg/day	NA	NA	NA		
				Antimony	4.2E+00	ug/l	4.6E-06	ug/l	NA	NA	NA	3.6E-05	mg/kg/day	4.0E-04	mg/kg/day	9.0E-02		
				Arsenic	1.4E+01	ug/l	1.5E-05	ug/l	1.5E+00	1/(mg/kg-day)	2.3E-05	1.2E-04	mg/kg/day	3.0E-04	mg/kg/day	4.0E-01		
				Cadmium	6.3E-01	ug/l	6.9E-07	ug/l	NA	NA	NA	5.4E-06	mg/kg/day	5.0E-04	mg/kg/day	1.1E-02		
				Cobalt	9.2E+00	ug/l	1.0E-05	ug/l	NA	NA	NA	7.9E-05	mg/kg/day	2.0E-02	mg/kg/day	3.9E-03		
				Iron	2.0E+04	ug/l	2.2E-02	ug/l	NA	NA	NA	1.7E-01	mg/kg/day	3.0E-01	mg/kg/day	5.8E-01		
				Manganese	3.4E+02	ug/l	3.7E-04	ug/l	NA	NA	NA	2.9E-03	mg/kg/day	2.0E-02	mg/kg/day	1.5E-01		
				Nickel	6.5E+00	ug/l	7.2E-06	ug/l	NA	NA	NA	5.6E-05	mg/kg/day	2.0E-02	mg/kg/day	2.8E-03		
				Selenium	5.0E+00	ug/l	5.5E-06	ug/l	NA	NA	NA	4.3E-05	mg/kg/day	5.0E-03	mg/kg/day	8.6E-03		
Exp. Route Total										2.5E-05						1.3E+00		
Exposure Medium Total										2.5E-05						1.3E+00		
Groundwater Total										2.5E-05						1.3E+00		
										Total of Receptor Risks Across All Media		2.5E-05	Total of Receptor Hazards Across All Media					1.3E+00

\* Surface and subsurface soil combined.

TABLE 9.3.RME  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
REASONABLE MAXIMUM EXPOSURE  
NNSY Site 10

Scenario Timeframe: Future  
Receptor Population: Industrial Worker  
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	NNSY	Benzo(a)anthracene	3.7E-07	N/A	3.2E-07	6.9E-07	N/A	NA	N/A	NA	0.0E+00
			Benzo(a)pyrene	4.1E-06	N/A	3.5E-06	7.6E-06	N/A	NA	N/A	NA	0.0E+00
			Benzo(b)fluoranthene	7.9E-07	N/A	6.8E-07	1.5E-06	N/A	NA	N/A	NA	0.0E+00
			Dibenz(a,h)anthracene	1.4E-06	N/A	1.2E-06	2.6E-06	N/A	NA	N/A	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	2.6E-07	N/A	2.2E-07	4.7E-07	N/A	NA	N/A	NA	0.0E+00
			Heptachlor epoxide	3.8E-07	N/A	2.5E-07	6.3E-07	Liver	8.9E-03	N/A	5.9E-03	1.5E-02
			Aluminum	NA	N/A	NA	0.0E+00	CNS	6.2E-03	N/A	4.1E-04	6.6E-03
			Antimony	NA	N/A	NA	0.0E+00	Blood	4.5E-02	N/A	2.0E-02	6.5E-02
			Arsenic	1.8E-05	N/A	3.5E-06	2.1E-05	Skin/Vascular	1.1E-01	N/A	2.2E-02	1.3E-01
			Cadmium	NA	N/A	NA	0.0E+00	Kidney	3.2E-03	N/A	8.4E-04	4.0E-03
			Chromium	NA	N/A	NA	0.0E+00	NOAEL	1.2E-02	N/A	4.7E-03	1.7E-02
			Copper	NA	N/A	NA	0.0E+00	Gastrointestinal	6.8E-02	N/A	4.5E-03	7.2E-02
			Iron	NA	N/A	NA	0.0E+00	Gastrointestinal, Blood, Liver	8.4E-02	N/A	5.5E-03	9.0E-02
			Lead	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00
			Manganese	NA	N/A	NA	0.0E+00	CNS	1.4E-02	N/A	2.2E-02	3.6E-02
			Mercury	NA	N/A	NA	0.0E+00	Immune System	3.5E-02	N/A	3.3E-02	6.8E-02
			Nickel	NA	N/A	NA	0.0E+00	Decreased Body Weight	3.3E-03	N/A	5.4E-03	8.7E-03
			Silver	NA	N/A	NA	0.0E+00	Skin	1.1E-02	N/A	1.9E-02	3.0E-02
			Vanadium	NA	N/A	NA	0.0E+00	Kidney	2.6E-02	N/A	6.6E-02	9.2E-02
			Zinc	NA	N/A	NA	0.0E+00	Blood	5.5E-03	N/A	3.6E-04	5.9E-03
Chemical Total				2.5E-05	N/A	9.6E-06	3.4E-05		4.3E-01	N/A	2.1E-01	6.4E-01
Medium Total							3.4E-05				6.4E-01	

TABLE 9.3.RME  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
REASONABLE MAXIMUM EXPOSURE  
NNSY Site 10

Scenario Timeframe: Future  
Receptor Population: Industrial Worker  
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient					
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total	
Groundwater	Groundwater	Shallow Groundwater	1,1,2,2-Tetrachloroethane	4.0E-07	N/A	N/A	4.0E-07	Liver and Kidney	9.3E-05	N/A	N/A	9.3E-05	
			Benzene	9.4E-08	N/A	N/A	9.4E-08	Blood	1.2E-03	N/A	N/A	1.2E-03	
			Chloroform	NA	N/A	N/A	0.0E+00	Liver	5.9E-04	N/A	N/A	5.9E-04	
			Trichloroethene	2.8E-07	N/A	N/A	2.8E-07	Liver, Kidney, Fetus	6.5E-03	N/A	N/A	6.5E-03	
			Vinyl chloride	4.4E-06	N/A	N/A	4.4E-06	Liver	2.9E-03	N/A	N/A	2.9E-03	
			2-Methylnaphthalene	NA	N/A	N/A	0.0E+00	Lung	8.6E-03	N/A	N/A	8.6E-03	
			Butylbenzophthalate	1.6E-07	N/A	N/A	1.6E-07	Liver	1.2E-03	N/A	N/A	1.2E-03	
			bis(2-Ethylhexyl)phthalate	6.8E-07	N/A	N/A	6.8E-07	Liver	6.8E-03	N/A	N/A	6.8E-03	
			Aldrin	1.8E-06	N/A	N/A	1.8E-06	Liver	9.9E-03	N/A	N/A	9.9E-03	
			Dieldrin	1.8E-06	N/A	N/A	1.8E-06	Liver	6.3E-03	N/A	N/A	6.3E-03	
			Heptachlor epoxide	1.3E-06	N/A	N/A	1.3E-06	Liver	3.0E-02	N/A	N/A	3.0E-02	
			beta-BHC	1.8E-07	N/A	N/A	1.8E-07	NA	NA	N/A	N/A	0.0E+00	
			Antimony	NA	N/A	N/A	0.0E+00	Blood	1.6E-01	N/A	N/A	1.6E-01	
			Arsenic	1.1E-04	N/A	N/A	1.1E-04	Skin/Vascular	6.9E-01	N/A	N/A	6.9E-01	
			Cadmium	NA	N/A	N/A	0.0E+00	Kidney	3.4E-02	N/A	N/A	3.4E-02	
			Cobalt	NA	N/A	N/A	0.0E+00	Blood	4.5E-02	N/A	N/A	4.5E-02	
			Iron	NA	N/A	N/A	0.0E+00	Gastrointestinal, Blood, Liver	1.3E+00	N/A	N/A	1.3E+00	
			Manganese	NA	N/A	N/A	0.0E+00	CNS	2.6E-01	N/A	N/A	2.6E-01	
			Nickel	NA	N/A	N/A	0.0E+00	Decreased body weight	2.8E-02	N/A	N/A	2.8E-02	
			Selenium	NA	N/A	N/A	0.0E+00	Whole body	2.1E-02	N/A	N/A	2.1E-02	
Chemical Total				1.2E-04	NA	N/A	1.2E-04		2.6E+00	NA	N/A	2.6E+00	
Medium Total								1.2E-04					2.6E+00
Receptor Total								1.6E-04	Receptor HI Total				3.3E+00



TABLE 9.4.RME  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
REASONABLE MAXIMUM EXPOSURE  
NNSY Site 10

Scenario Timeframe: Future  
Receptor Population: Industrial Worker  
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	NNSY	Benzo(a)anthracene	1.1E-06	N/A	9.4E-07	2.0E-06	N/A	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	5.1E-06	N/A	4.4E-06	9.5E-06	N/A	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	6.1E-07	N/A	5.2E-07	1.1E-06	N/A	NA	NA	NA	0.0E+00
			Benzo(k)fluoranthene	5.6E-08	N/A	4.8E-08	1.0E-07	N/A	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	3.8E-06	N/A	3.2E-06	7.0E-06	N/A	NA	NA	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	4.0E-07	N/A	3.4E-07	7.4E-07	N/A	NA	NA	NA	0.0E+00
			Heptachlor epoxide	7.0E-08	N/A	4.6E-08	1.2E-07	Liver	1.7E-03	NA	1.1E-03	2.8E-03
			Aluminum	NA	N/A	NA	0.0E+00	CNS	7.4E-03	NA	4.9E-04	7.9E-03
			Antimony	NA	N/A	NA	0.0E+00	Blood	1.3E-02	NA	5.9E-03	1.9E-02
			Arsenic	1.4E-05	N/A	2.8E-06	1.7E-05	Skin/Vascular	8.7E-02	NA	1.7E-02	1.0E-01
			Cadmium	NA	N/A	NA	0.0E+00	Kidney	2.7E-03	NA	7.2E-04	3.5E-03
			Chromium	NA	N/A	NA	0.0E+00	NOAEL	1.1E-02	NA	4.4E-03	1.6E-02
			Copper	NA	N/A	NA	0.0E+00	Gastrointestinal	6.1E-02	NA	4.1E-03	6.5E-02
			Iron	NA	N/A	NA	0.0E+00	Gastrointestinal, Blood, Liver	6.0E-02	NA	4.0E-03	6.4E-02
			Lead	NA	N/A	NA	0.0E+00	N/A	NA	NA	NA	0.0E+00
			Manganese	NA	N/A	NA	0.0E+00	CNS	1.3E-02	NA	2.1E-02	3.4E-02
			Mercury	NA	N/A	NA	0.0E+00	Immune System	5.7E-02	NA	5.4E-02	1.1E-01
			Nickel	NA	N/A	NA	0.0E+00	Decreased Body Weight	3.0E-03	NA	5.0E-03	8.0E-03
			Silver	NA	N/A	NA	0.0E+00	Skin	3.1E-03	NA	5.2E-03	8.3E-03
			Vanadium	NA	N/A	NA	0.0E+00	Kidney	2.2E-02	NA	5.5E-02	7.7E-02
			Zinc	NA	N/A	NA	0.0E+00	Blood	9.6E-03	NA	6.3E-04	1.0E-02
Chemical Total				2.5E-05	N/A	1.2E-05	3.7E-05		3.5E-01	N/A	1.8E-01	5.3E-01
Medium Total							3.7E-05				5.3E-01	

TABLE 9.4.RME  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
REASONABLE MAXIMUM EXPOSURE  
NNSY Site 10

Scenario Timeframe: Future  
Receptor Population: Industrial Worker  
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient					
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total	
Groundwater	Groundwater	Shallow Groundwater	1,1,2,2-Tetrachloroethane	4.0E-07	N/A	N/A	4.0E-07	Liver and Kidney	9.3E-05	N/A	N/A	9.3E-05	
			Benzene	9.4E-08	N/A	N/A	9.4E-08	Blood	1.2E-03	N/A	N/A	1.2E-03	
			Chloroform	NA	N/A	N/A	0.0E+00	Liver	5.9E-04	N/A	N/A	5.9E-04	
			Trichloroethene	2.8E-07	N/A	N/A	2.8E-07	Liver, Kidney, Fetus	6.5E-03	N/A	N/A	6.5E-03	
			Vinyl chloride	4.4E-06	N/A	N/A	4.4E-06	Liver	2.9E-03	N/A	N/A	2.9E-03	
			2-Methylnaphthalene	NA	N/A	N/A	0.0E+00	Lung	8.6E-03	N/A	N/A	8.6E-03	
			Butylbenzylphthalate	1.6E-07	N/A	N/A	1.6E-07	Liver	1.2E-03	N/A	N/A	1.2E-03	
			bis(2-Ethylhexyl)phthalate	6.8E-07	N/A	N/A	6.8E-07	Liver	6.8E-03	N/A	N/A	6.8E-03	
			Aldrin	1.8E-06	N/A	N/A	1.8E-06	Liver	9.9E-03	N/A	N/A	9.9E-03	
			Dieldrin	1.8E-06	N/A	N/A	1.8E-06	Liver	6.3E-03	N/A	N/A	6.3E-03	
			Heptachlor epoxide	1.3E-06	N/A	N/A	1.3E-06	Liver	3.0E-02	N/A	N/A	3.0E-02	
			beta-BHC	1.8E-07	N/A	N/A	1.8E-07	N/A	NA	N/A	N/A	0.0E+00	
			Antimony	NA	N/A	N/A	0.0E+00	Blood	1.6E-01	N/A	N/A	1.6E-01	
			Arsenic	1.1E-04	N/A	N/A	1.1E-04	Skin/Vascular	6.9E-01	N/A	N/A	6.9E-01	
			Cadmium	NA	N/A	N/A	0.0E+00	Kidney	3.4E-02	N/A	N/A	3.4E-02	
			Cobalt	NA	N/A	N/A	0.0E+00	Blood	4.5E-02	N/A	N/A	4.5E-02	
			Iron	NA	N/A	N/A	0.0E+00	Gastrointestinal, Blood, Liver	1.3E+00	N/A	N/A	1.3E+00	
			Manganese	NA	N/A	N/A	0.0E+00	CNS	2.6E-01	N/A	N/A	2.6E-01	
			Nickel	NA	N/A	N/A	0.0E+00	Decreased body weight	2.8E-02	N/A	N/A	2.8E-02	
			Selenium	NA	N/A	N/A	0.0E+00	Whole body	2.1E-02	N/A	N/A	2.1E-02	
<b>Chemical Total</b>				1.2E-04	NA	N/A	1.2E-04		2.6E+00	0.0E+00	0.0E+00	2.6E+00	
<b>Medium Total</b>									2.6E+00				
<b>Receptor Total</b>								1.6E-04	Receptor HI Total				3.1E+00



TABLE 9.1.CT  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
CENTRAL TENDANCY  
NNSY Site 10

Scenario Timeframe: Current  
Receptor Population: Construction Worker  
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient					
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total	
Soil*	Soil*	NNSY											
			Benzo(a)anthracene	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00	
			Benzo(a)pyrene	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00	
			Benzo(b)fluoranthene	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00	
			Benzo(k)fluoranthene	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00	
			Dibenz(a,h)anthracene	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00	
			Indeno(1,2,3-cd)pyrene	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00	
			Heptachlor Epoxide	NA	N/A	NA	0.0E+00	Liver	1.6E-03	N/A	1.4E-04	1.7E-03	
			Aluminum	NA	N/A	NA	0.0E+00	CNS	2.7E-02	N/A	1.8E-04	2.7E-02	
			Antimony	NA	N/A	NA	0.0E+00	Blood	2.5E-02	N/A	1.2E-03	2.6E-02	
			Arsenic	NA	N/A	NA	0.0E+00	Skin/Vascular	2.1E-01	N/A	4.3E-03	2.1E-01	
			Cadmium	NA	N/A	NA	0.0E+00	Kidney	5.3E-03	N/A	1.5E-03	6.8E-03	
			Chromium	NA	N/A	NA	0.0E+00	NOAEL	5.3E-03	N/A	1.4E-03	6.7E-03	
			Copper	NA	N/A	NA	0.0E+00	Gastrointestinal	7.5E-02	N/A	5.2E-04	7.5E-02	
			Iron	NA	N/A	NA	0.0E+00	Gastrointestinal	2.3E-01	N/A	1.6E-03	2.3E-01	
			Lead	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00	
			Manganese	NA	N/A	NA	0.0E+00	CNS	3.0E-02	N/A	5.2E-03	3.6E-02	
			Mercury	NA	N/A	NA	0.0E+00	Kidney	7.5E-02	N/A	7.4E-03	8.2E-02	
			Nickel	NA	N/A	NA	0.0E+00	Whole Body	7.0E-03	N/A	1.2E-03	8.2E-03	
			Silver	NA	N/A	NA	0.0E+00	Skin	2.0E-03	N/A	3.4E-04	2.3E-03	
			Vanadium	NA	N/A	NA	0.0E+00	Kidney	7.9E-02	N/A	2.1E-02	1.0E-01	
			Zinc	NA	N/A	NA	0.0E+00	Blood	1.4E-02	N/A	9.8E-05	1.4E-02	
<b>Chemical Total</b>				0.0E+00	N/A	0.0E+00	0.0E+00		7.9E-01	0.0E+00	4.6E-02	8.3E-01	
<b>Medium Total</b>												8.3E-01	
<b>Receptor Total</b>								0.0E+00	<b>Receptor HI Total</b>				8.3E-01

\* Surface and Subsurface Soil combined

Total Kidney HI Across All Media =	1.9E-01
Total Liver HI Across All Media =	1.7E-03
Total Blood HI Across All Media =	4.1E-02
Total CNS HI Across All Media =	6.2E-02
Total Gastrointestinal HI Across All Media =	3.1E-01
Total Vascular HI Across All Media =	2.1E-01
Total Skin HI Across All Media =	2.2E-01
Total NOAEL HI Across All Media =	6.7E-03
Total Whole Body HI Across All Media =	8.2E-03

TABLE 9.2.CT  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
CENTRAL TENDANCY  
NNSY Site 10

Scenario Timeframe: Future  
Receptor Population: Resident  
Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	NNSY	Benzo(a)anthracene	3.4E-07	N/A	5.1E-08	4.0E-07	N/A	NA	N/A	NA	0.0E+00
			Benzo(a)pyrene	2.2E-06	N/A	3.3E-07	2.6E-06	N/A	NA	N/A	NA	0.0E+00
			Benzo(b)fluoranthene	2.6E-07	N/A	3.8E-08	3.0E-07	N/A	NA	N/A	NA	0.0E+00
			Benzo(k)fluoranthene	2.2E-08	N/A	3.3E-09	2.6E-08	N/A	NA	N/A	NA	0.0E+00
			Dibenz(a,h)anthracene	1.7E-06	N/A	2.4E-07	1.9E-06	N/A	NA	N/A	NA	0.0E+00
			Indeno(1,2,3-cd)pyrene	2.0E-07	N/A	2.9E-08	2.2E-07	N/A	NA	N/A	NA	0.0E+00
			Heptachlor Epoxide	1.9E-08	N/A	2.8E-09	2.2E-08	Liver	1.6E-03	N/A	2.4E-04	1.9E-03
			Aluminum	NA	N/A	NA	0.0E+00	CNS	2.8E-02	N/A	3.1E-04	2.8E-02
			Antimony	NA	N/A	NA	0.0E+00	Blood	1.3E-02	N/A	9.7E-04	1.4E-02
			Arsenic	9.6E-06	N/A	3.3E-07	1.0E-05	Skin/Vascular	2.2E-01	N/A	7.3E-03	2.2E-01
			Cadmium	NA	N/A	NA	0.0E+00	Kidney	5.5E-03	N/A	2.5E-03	8.0E-03
			Chromium	NA	N/A	NA	0.0E+00	NOAEL	3.6E-02	N/A	2.4E-03	3.9E-02
			Copper	NA	N/A	NA	0.0E+00	Gastrointestinal	7.8E-02	N/A	8.7E-04	7.9E-02
			Iron	NA	N/A	NA	0.0E+00	Gastrointestinal, Blood, Liver	2.4E-01	N/A	2.7E-03	2.4E-01
			Lead	NA	N/A	NA	0.0E+00	N/A	NA	N/A	NA	0.0E+00
			Manganese	NA	N/A	NA	0.0E+00	CNS	3.2E-02	N/A	8.8E-03	4.0E-02
			Mercury	NA	N/A	NA	0.0E+00	Immune System	7.8E-02	N/A	1.2E-02	9.0E-02
			Nickel	NA	N/A	NA	0.0E+00	Decreased Body Weight	7.3E-03	N/A	2.0E-03	9.3E-03
			Silver	NA	N/A	NA	0.0E+00	Skin	2.0E-03	N/A	5.7E-04	2.6E-03
			Vanadium	NA	N/A	NA	0.0E+00	Kidney	8.2E-02	N/A	3.5E-02	1.2E-01
			Zinc	NA	N/A	NA	0.0E+00	Blood	1.5E-02	N/A	1.7E-04	1.5E-02
Chemical Total				1.4E-05	N/A	1.0E-06	1.5E-05		8.4E-01	0.0E+00	7.7E-02	9.1E-01
Medium Total							1.5E-05					9.1E-01

TABLE 9.2.CT  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
CENTRAL TENDANCY  
NNSY Site 10

Scenario Timeframe: Future  
Receptor Population: Resident  
Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Groundwater	1,1,2,2-Tetrachloroethane	5.5E-07	N/A	4.6E-08	6.0E-07	Liver and Kidney	3.7E-04	N/A	2.5E-05	4.0E-04
			Benzene	1.5E-07	N/A	1.5E-08	1.7E-07	Blood	5.6E-03	N/A	4.5E-04	6.1E-03
			Chloroform	NA	N/A	NA	0.0E+00	Liver	2.2E-03	N/A	1.0E-04	2.3E-03
			Trichloroethene	1.1E-06	N/A	1.2E-07	1.2E-06	Liver, Kidney, Fetus	7.1E-02	N/A	6.4E-03	7.7E-02
			Vinyl chloride	4.1E-06	N/A	1.4E-07	4.2E-06	Liver	7.8E-03	N/A	2.1E-04	8.0E-03
			2-Methylnaphthalene	NA	N/A	NA	0.0E+00	Lung	3.1E-02	N/A	3.5E-02	6.6E-02
			Butylbenzylphthalate	6.7E-08	N/A	2.7E-07	3.4E-07	Liver	1.4E-03	N/A	6.9E-03	8.3E-03
			bis(2-Ethylhexyl)phthalate	3.5E-07	N/A	3.5E-07	7.0E-07	Liver	1.0E-02	N/A	8.2E-03	1.8E-02
			Aldrin	1.3E-06	N/A	7.9E-08	1.4E-06	Liver	2.1E-02	N/A	1.0E-03	2.2E-02
			Dieldrin	1.6E-06	N/A	7.2E-07	2.3E-06	Liver	1.6E-02	N/A	5.9E-03	2.2E-02
			Heptachlor epoxide	7.4E-07	N/A	2.3E-07	9.6E-07	Liver	5.0E-02	N/A	1.3E-02	6.3E-02
			beta-BHC	1.2E-07	N/A	8.9E-08	2.1E-07	N/A	NA	N/A	NA	0.0E+00
			Antimony	NA	N/A	NA	0.0E+00	Blood	4.5E-01	N/A	5.9E-03	4.5E-01
			Arsenic	1.1E-04	N/A	2.6E-07	1.1E-04	Skin/Vascular	2.0E+00	N/A	4.0E-03	2.0E+00
			Cadmium	NA	N/A	NA	0.0E+00	Kidney	5.4E-02	N/A	2.1E-03	5.6E-02
			Cobalt	NA	N/A	NA	0.0E+00	Blood	2.0E-02	N/A	1.6E-05	2.0E-02
			Iron	NA	N/A	NA	0.0E+00	Gastrointestinal, Blood, Liver	2.9E+00	N/A	5.7E-03	2.9E+00
			Manganese	NA	N/A	NA	0.0E+00	CNS	7.2E-01	N/A	3.6E-02	7.6E-01
Nickel	NA	N/A	NA	0.0E+00	Decreased body weight	1.4E-02	N/A	1.4E-04	1.4E-02			
Selenium	NA	N/A	NA	0.0E+00	Whole body	4.3E-02	N/A	8.5E-05	4.3E-02			
Chemical Total				1.2E-04	NA	2.3E-06	1.2E-04		6.4E+00	0.0E+00	1.3E-01	6.5E+00
Medium Total							1.2E-04					6.5E+00
Receptor Total							1.4E-04	Receptor HI Total			7.5E+00	

TABLE 9.2.CT  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
CENTRAL TENDANCY  
NNSY Site 10

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifetime (cancer) and Child (non-cancer)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal

\* Surface and Subsurface Soil combined

Total Kidney HI Across All Media =	2.6E-01
Total Liver HI Across All Media =	3.4E+00
Total Blood HI Across All Media =	6.5E+00
Total CNS HI Across All Media =	8.3E-01
Total Gastrointestinal HI Across All Media =	3.2E+00
Total Vascular HI Across All Media =	2.2E+00
Total Skin HI Across All Media =	2.2E+00
Total NOAEL HI Across All Media =	3.9E-02
Total Whole Body HI Across All Media =	4.3E-02
Total Fetus HI Across All Media =	7.7E-02
Total Decreased Body Weight HI Across All Media =	2.3E-02
Total Immune System HI Across All Media =	9.0E-02
Total Respiratory System (Lung) HI Across All Media =	6.6E-02

TABLE 9.3.CT  
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs  
CENTRAL TENDANCY  
NNSY Site 10

Scenario Timeframe: Future  
Receptor Population: Industrial Worker  
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Groundwater	1,1,2,2-Tetrachloroethane	1.2E-07	N/A	N/A	1.2E-07	Liver and Kidney	7.5E-05	N/A	N/A	7.5E-05
			Benzene	3.2E-08	N/A	N/A	3.2E-08	Blood	1.1E-03	N/A	N/A	1.1E-03
			Chloroform	NA	N/A	N/A	0.0E+00	Liver	4.3E-04	N/A	N/A	4.3E-04
			Trichloroethene	2.2E-07	N/A	N/A	2.2E-07	Liver, Kidney, Fetus	1.4E-02	N/A	N/A	1.4E-02
			Vinyl chloride	8.5E-07	N/A	N/A	8.5E-07	Liver	1.6E-03	N/A	N/A	1.6E-03
			2-Methylnaphthalene	NA	N/A	N/A	0.0E+00	Lung	6.1E-03	N/A	N/A	6.1E-03
			Butylbenzophthalate	1.4E-08	N/A	N/A	1.4E-08	Liver	2.8E-04	N/A	N/A	2.8E-04
			bis(2-Ethylhexyl)phthalate	7.3E-08	N/A	N/A	7.3E-08	Liver	2.0E-03	N/A	N/A	2.0E-03
			Aldrin	2.7E-07	N/A	N/A	2.7E-07	Liver	4.2E-03	N/A	N/A	4.2E-03
			Dieldrin	3.3E-07	N/A	N/A	3.3E-07	Liver	3.2E-03	N/A	N/A	3.2E-03
			Heptachlor epoxide	1.5E-07	N/A	N/A	1.5E-07	Liver	1.0E-02	N/A	N/A	1.0E-02
			beta-BHC	2.5E-08	N/A	N/A	2.5E-08	N/A	NA	N/A	N/A	0.0E+00
			Antimony	NA	N/A	N/A	0.0E+00	Blood	9.0E-02	N/A	N/A	9.0E-02
			Arsenic	2.3E-05	N/A	N/A	2.3E-05	Skin/Vascular	4.0E-01	N/A	N/A	4.0E-01
			Cadmium	NA	N/A	N/A	0.0E+00	Kidney	1.1E-02	N/A	N/A	1.1E-02
			Cobalt	NA	N/A	N/A	0.0E+00	Blood	3.9E-03	N/A	N/A	3.9E-03
			Iron	NA	N/A	N/A	0.0E+00	Gastrointestinal, Blood, Liver	5.8E-01	N/A	N/A	5.8E-01
			Manganese	NA	N/A	N/A	0.0E+00	CNS	1.5E-01	N/A	N/A	1.5E-01
			Nickel	NA	N/A	N/A	0.0E+00	Decreased body weight	2.8E-03	N/A	N/A	2.8E-03
			Selenium	NA	N/A	N/A	0.0E+00	Whole body	8.6E-03	N/A	N/A	8.6E-03
<b>Chemical Total</b>				<b>2.5E-05</b>	<b>NA</b>	<b>N/A</b>	<b>2.5E-05</b>		<b>1.3E+00</b>	<b>NA</b>	<b>N/A</b>	<b>1.3E+00</b>
<b>Medium Total</b>							<b>2.5E-05</b>					<b>1.3E+00</b>
<b>Receptor Total</b>							<b>2.5E-05</b>		<b>Receptor HI Total</b>			<b>1.3E+00</b>

Total Kidney HI Across All Media =	2.5E-02
Total Liver HI Across All Media =	6.2E-01
Total Blood HI Across All Media =	6.7E-01
Total CNS HI Across All Media =	1.5E-01
Total Gastrointestinal HI Across All Media =	5.8E-01
Total Vascular HI Across All Media =	4.0E-01
Total Skin HI Across All Media =	4.0E-01
Total Whole Body HI Across All Media =	8.6E-03
Total Fetus HI Across All Media =	1.4E-02
Total Decreased Body Weight HI Across All Media =	2.8E-03
Total Respiratory System (Lung) HI Across All Media =	6.1E-03

Table 2.1  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Dry Dock 8

Scenario Timeframe: Future  
 Medium: Soil\*  
 Exposure Medium: Soil\*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Soil* at Site 10, Dry Dock 8	67-64-1	Acetone	0.005 J	0.022	MG/KG	10-SO16-02	6/8	0.011 - 0.02	0.022	N/A	7.039 N	N/A	N/A	NO	BSL
	75-15-0	Carbon disulfide	0.005 J	0.005 J	MG/KG	10-SO16-02	1/8	0.011 - 0.02	0.005	N/A	782 N	N/A	N/A	NO	BSL
	75-09-2	Methylene chloride	0.038	0.054	MG/KG	10-SO16-02	2/8	0.011 - 0.02	0.054	N/A	85.2 C	N/A	N/A	NO	BSL
	91-57-6	2-Methylnaphthalene	0.13 J	0.13 J	MG/KG	SSP-LDFL1927-SB09-01	1/8	0.35 - 0.63	0.13	N/A	31.3 N	N/A	N/A	NO	BSL
	101-55-3	4-Bromophenyl-phenylether	0.12 J	0.12 J	MG/KG	10-SO16-02	1/8	0.35 - 0.63	0.12	N/A	39.10714 N	N/A	N/A	NO	BSL
	83-32-9	Acenaphthene	0.066 J	0.066 J	MG/KG	10-SO16-00	1/8	0.35 - 0.63	0.066	N/A	469 N	N/A	N/A	NO	BSL
	120-12-7	Anthracene	0.084 J	0.084 J	MG/KG	10-SO16-00	1/8	0.35 - 0.63	0.084	N/A	2,346 N	N/A	N/A	NO	BSL
	56-55-3	Benzo(a)anthracene	0.039 J	0.23 J	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.23	N/A	0.875 C	N/A	N/A	NO	BSL
	50-32-8	Benzo(a)pyrene	0.041 J	0.21 J	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.21	N/A	0.0875 C	N/A	N/A	YES	ASL
	205-99-2	Benzo(b)fluoranthene	0.057 J	0.27 J	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.27	N/A	0.875 C	N/A	N/A	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	0.043 J	0.22 J	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.22	N/A	235 N	N/A	N/A	NO	BSL
	207-08-9	Benzo(k)fluoranthene	0.064 J	0.2 J	MG/KG	10-SO16-00	2/8	0.35 - 0.63	0.2	N/A	8.75 C	N/A	N/A	NO	BSL
	105-60-2	Caprolactam	0.28 J	0.28 J	MG/KG	10-SO16-00	1/8	0.35 - 0.63	0.28	N/A	3,911 N	N/A	N/A	NO	BSL
	218-01-9	Chrysene	0.052 J	0.32 J	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.32	N/A	87.5 C	N/A	N/A	NO	BSL
	84-74-2	Di-n-butylphthalate	0.28 J	0.28 J	MG/KG	10-SO16-02	1/8	0.35 - 0.63	0.28	N/A	782 N	N/A	N/A	NO	BSL
	132-64-9	Dibenzofuran	0.044 J	0.044 J	MG/KG	10-SO16-00	1/8	0.35 - 0.63	0.044	N/A	15.6 N	N/A	N/A	NO	BSL
	206-44-0	Fluoranthene	0.091 J	0.61	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.61	N/A	313 N	N/A	N/A	NO	BSL
	86-73-7	Fluorene	0.042 J	0.042 J	MG/KG	SSP-LDFL1927-SB09-01	1/8	0.35 - 0.63	0.042	N/A	313 N	N/A	N/A	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.04 J	0.15 J	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.15	N/A	0.875 C	N/A	N/A	NO	BSL
	85-01-8	Phenanthrene	0.081 J	0.39	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.39	N/A	235 N	N/A	N/A	NO	BSL
	129-00-0	Pyrene	0.078 J	0.69	MG/KG	10-SO16-00	3/8	0.35 - 0.63	0.69	N/A	235 N	N/A	N/A	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	0.097 J	0.19 J	MG/KG	SSP-LDFL1927-SB09-01	2/8	0.35 - 0.63	0.19	N/A	45.6 C	N/A	N/A	NO	BSL
	7429-90-5	Aluminum	404	11,800	MG/KG	10-SO16-02	8/8	6.9 - 45.57	11800	N/A	7,821 N	N/A	N/A	YES	ASL
	7440-38-2	Arsenic	1.4	6.7	MG/KG	10-SO16-02	6/8	0.83 - 2.27	6.7	N/A	0.426 C	N/A	N/A	YES	ASL
	7440-39-3	Barium	2.8 J	38.3	MG/KG	10-SO16-02	7/8	0.099 - 45.57	38.3	N/A	548 N	N/A	N/A	NO	BSL
	7440-41-7	Beryllium	0.037 J	1.4	MG/KG	10-SO16-02	8/8	0.023 - 1.13	1.4	N/A	15.6 N	N/A	N/A	NO	BSL
	7440-43-9	Cadmium	0.085 J	0.81	MG/KG	10-SO16-02	3/8	0.06 - 1.13	0.81	N/A	7.82 N	N/A	N/A	NO	BSL
	7440-70-2	Calcium	212 J	7,190 J	MG/KG	10-SO16-00	7/8	12.1 - 1139.35	7190	N/A	N/A	N/A	N/A	NO	NUT
	7440-47-3	Chromium	1.4	26.4	MG/KG	10-SO16-02	8/8	0.17 - 2.27	26.4	N/A	23.5 N	N/A	N/A	YES	ASL
	7440-48-4	Cobalt	0.47 J	19.7	MG/KG	10-SO16-02	8/8	0.21 - 11.39	19.7	N/A	156 N	N/A	N/A	NO	BSL
	7440-50-8	Copper	1.6 J	16.8	MG/KG	10-SO16-00	7/8	0.79 - 5.69	16.8	N/A	313 N	N/A	N/A	NO	BSL
	7439-89-6	Iron	717	24,000	MG/KG	10-SO16-02	8/8	3.8 - 22.78	24000	N/A	2,346 N	N/A	N/A	YES	ASL
	7439-92-1	Lead	1.7	60	MG/KG	SSP-LDFL1927-SB09-01	8/8	0.62 - 0.94	60	N/A	400	N/A	N/A	NO	BSL
	7439-95-4	Magnesium	71.2 J	3,680	MG/KG	10-SO16-02	8/8	13.2 - 1139.35	3680	N/A	N/A	N/A	N/A	NO	NUT
	7439-96-5	Manganese	6	235	MG/KG	10-SO16-02	8/8	0.099 - 3.41	235	N/A	156 N	N/A	N/A	YES	ASL
	7439-97-6	Mercury	0.056 J	0.35	MG/KG	SSP-LDFL1927-SB09-01	4/8	0.019 - 0.11	0.35	N/A	0.782143 N	N/A	N/A	NO	BSL

Table 2.1  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Dry Dock 8

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-02-0	Nickel	0.69 J	28.5	MG/KG	10-SO16-02	6/8	0.31 - 9.11	28.5	N/A	156 N	N/A	N/A	NO	BSL
	7440-09-7	Potassium	183 J	2,300	MG/KG	10-SO16-02	7/8	11.6 - 1139.35	2300	N/A	N/A	N/A	N/A	NO	NUT
	7782-49-2	Selenium	0.65 J	0.65 J	MG/KG	SSP-LDFL1927-SB09-01	1/8	0.59 - 1.13	0.65	N/A	39.1 N	N/A	N/A	NO	BSL
	7440-23-5	Sodium	115 J	534 J	MG/KG	10-SO16-02	5/8	13.7 - 1139.35	534	N/A	N/A	N/A	N/A	NO	NUT
	7440-62-2	Vanadium	1.8 J	24.3	MG/KG	10-SO16-02	8/8	0.23 - 11.39	24.3	N/A	7.82 N	N/A	N/A	YES	ASL
	7440-66-6	Zinc	4.8 J	97.8	MG/KG	SSP-LDFL1927-SB09-01	7/8	4 - 6	97.8	N/A	2,346 N	N/A	N/A	NO	BSL

- \* Surface soil & subsurface soil combined
- [1] Minimum/Maximum detected concentrations.
- [2] Maximum concentration is used for screening.
- [3] Background values not available.
- [4] Risk-Based Concentration Table, October 25, 2005, U.S. EPA Region III, Jennifer Hubbard.  
 RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.  
 RBC value for cadmium-food used as surrogate for cadmium.  
 RBC value for chromium VI used for total chromium.  
 RBC value for 4-Methylphenol used as surrogate for 4-Bromophenyl-phenylether  
 The soil value of 400 mg/kg is from Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.  
 RBC value for manganese-nonfood used as surrogate for manganese.  
 RBC value for mercuric chloride used as surrogate for mercury.  
 RBC for aluminum, cobalt, and dibenzofuran withdrawn from October 2005 RBC table due to expiration of NCEA provisional toxicity value. Value is from the April 2005 RBC Table.
- [5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)  
 Deletion Reason: No Toxicity Information (NTX)  
 Essential Nutrient (NUT)  
 Below Screening Level (BSL)

COPC = Chemical of Potential Concern  
 ARAR/TBC = Applicable or Relevant and Appropriate Requirement/  
 To Be Considered  
 J = Estimated Value  
 K = Biased High  
 L = Biased Low  
 C = Carcinogenic  
 N = Noncarcinogenic

Table 2.2  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Dry Dock 8

Scenario Timeframe: Future  
 Medium: Soil\*  
 Exposure Medium: Soil\*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Emissions from Soil* at Site 10, Dry Dock 8	67641	Acetone	3.07E-04 J	1.35E-03	ug/m3	10-SO16-02	6/8	N/A	1.35E-03	N/A	3.29E+02 N	N/A	N/A	NO	BSL
	75150	Carbon disulfide	3.23E-03 J	3.23E-03 J	ug/m3	10-SO16-02	1/8	N/A	3.23E-03	N/A	7.30E+01 N	N/A	N/A	NO	BSL
	75092	Methylene chloride	1.18E-02	1.67E-02	ug/m3	10-SO16-02	2/8	N/A	1.67E-02	N/A	3.79E+00 C	N/A	N/A	NO	BSL
	91576	2-Methylnaphthalene	1.73E-03 J	1.73E-03 J	ug/m3	SSP-LDFL1927-SB09-01	1/8	N/A	1.73E-03	N/A	1.46E+00 N	N/A	N/A	NO	BSL
	101553	4-Bromophenyl-phenylether	9.09E-08 J	9.09E-08 J	ug/m3	10-SO16-02	1/8	N/A	9.09E-08	N/A	3.91E+01 N	N/A	N/A	NO	BSL
	83329	Acenaphthene	2.33E-04 J	2.33E-04 J	ug/m3	10-SO16-00	1/8	N/A	2.33E-04	N/A	2.19E+01 N	N/A	N/A	NO	BSL
	120127	Anthracene	8.30E-05 J	8.30E-05 J	ug/m3	10-SO16-00	1/8	N/A	8.30E-05	N/A	1.10E+02 N	N/A	N/A	NO	BSL
	56553	Benzo(a)anthracene	3.21E-06 J	1.89E-05 J	ug/m3	10-SO16-00	3/8	N/A	1.89E-05	N/A	8.58E-03 C	N/A	N/A	NO	BSL
	50328	Benzo(a)pyrene	1.32E-06 J	6.76E-06 J	ug/m3	10-SO16-00	3/8	N/A	6.76E-06	N/A	2.02E-03 C	N/A	N/A	NO	BSL
	205992	Benzo(b)fluoranthene	9.53E-06 J	4.51E-05 J	ug/m3	10-SO16-00	3/8	N/A	4.51E-05	N/A	8.58E-03 C	N/A	N/A	NO	BSL
	191242	Benzo(g,h,i)perylene	8.75E-06 J	4.48E-05 J	ug/m3	10-SO16-00	3/8	N/A	4.48E-05	N/A	1.10E+01 N	N/A	N/A	NO	BSL
	207089	Benzo(k)fluoranthene	1.30E-06 J	4.06E-06 J	ug/m3	10-SO16-00	2/8	N/A	4.06E-06	N/A	8.58E-02 C	N/A	N/A	NO	BSL
	105602	Caprolactam	6.30E-04 J	6.30E-04 J	ug/m3	10-SO16-00	1/8	N/A	6.30E-04	N/A	1.83E+02 N	N/A	N/A	NO	BSL
	218019	Chrysene	1.50E-05 J	9.26E-05 J	ug/m3	10-SO16-00	3/8	N/A	9.26E-05	N/A	8.58E-01 C	N/A	N/A	NO	BSL
	84742	Di-n-butylphthalate	2.69E-05 J	2.69E-05 J	ug/m3	10-SO16-02	1/8	N/A	2.69E-05	N/A	3.65E+01 N	N/A	N/A	NO	BSL
	132649	Dibenzofuran	1.69E-04 J	1.69E-04 J	ug/m3	10-SO16-00	1/8	N/A	1.69E-04	N/A	7.30E-01 N	N/A	N/A	NO	BSL
	206440	Fluoranthene	2.30E-05 J	1.54E-04	ug/m3	10-SO16-00	3/8	N/A	1.54E-04	N/A	1.46E+01 N	N/A	N/A	NO	BSL
	86737	Fluorene	6.34E-05 J	6.34E-05 J	ug/m3	SSP-LDFL1927-SB09-01	1/8	N/A	6.34E-05	N/A	1.46E+01 N	N/A	N/A	NO	BSL
	193395	Indeno(1,2,3-cd)pyrene	5.70E-07 J	2.14E-06 J	ug/m3	10-SO16-00	3/8	N/A	2.14E-06	N/A	8.58E-03 C	N/A	N/A	NO	BSL
	85018	Phenanthrene	1.65E-05 J	7.94E-05	ug/m3	10-SO16-00	3/8	N/A	7.94E-05	N/A	1.10E+01 N	N/A	N/A	NO	BSL
	129000	Pyrene	1.59E-05 J	1.40E-04	ug/m3	10-SO16-00	3/8	N/A	1.40E-04	N/A	1.10E+01 N	N/A	N/A	NO	BSL
	117817	bis(2-Ethylhexyl)phthalate	4.19E-07 J	8.21E-07 J	ug/m3	SSP-LDFL1927-SB09-01	2/8	N/A	8.21E-07	N/A	4.47E-01 C	N/A	N/A	NO	BSL
	7429905	Aluminum	3.06E-04	8.94E-03	ug/m3	10-SO16-02	8/8	N/A	8.94E-03	N/A	3.65E-01 N	N/A	N/A	NO	BSL
	7440382	Arsenic	1.06E-06	5.08E-06	ug/m3	10-SO16-02	6/8	N/A	5.08E-06	N/A	4.15E-04 C	N/A	N/A	NO	BSL
	7440393	Barium	2.12E-06 J	2.90E-05	ug/m3	10-SO16-02	7/8	N/A	2.90E-05	N/A	5.11E-02 N	N/A	N/A	NO	BSL
	7440417	Beryllium	2.80E-08 J	1.06E-06	ug/m3	10-SO16-02	8/8	N/A	1.06E-06	N/A	7.45E-04 C	N/A	N/A	NO	BSL
	7440439	Cadmium	6.44E-08 J	6.14E-07	ug/m3	10-SO16-02	3/8	N/A	6.14E-07	N/A	9.94E-04 C	N/A	N/A	NO	BSL
	7440702	Calcium	1.61E-04 J	5.45E-03 J	ug/m3	10-SO16-00	7/8	N/A	5.45E-03	N/A	N/A	N/A	N/A	NO	NUT
	7440473	Chromium	1.06E-06	2.00E-05	ug/m3	10-SO16-02	8/8	N/A	2.00E-05	N/A	1.53E-04 C	N/A	N/A	NO	BSL
	7440484	Cobalt	3.56E-07 J	1.49E-05	ug/m3	10-SO16-02	8/8	N/A	1.49E-05	N/A	6.39E-04 C	N/A	N/A	NO	BSL
	7440508	Copper	1.21E-06 J	1.27E-05	ug/m3	10-SO16-00	7/8	N/A	1.27E-05	N/A	1.46E+01 N	N/A	N/A	NO	BSL
	7439896	Iron	5.43E-04	1.82E-02	ug/m3	10-SO16-02	8/8	N/A	1.82E-02	N/A	1.10E+02 N	N/A	N/A	NO	BSL
	7439921	Lead	1.29E-06	4.55E-05	ug/m3	SSP-LDFL1927-SB09-01	8/8	N/A	4.55E-05	N/A	N/A	N/A	N/A	NO	NTX
	7439954	Magnesium	5.39E-05 J	2.79E-03	ug/m3	10-SO16-02	8/8	N/A	2.79E-03	N/A	N/A	N/A	N/A	NO	NUT
	7439965	Manganese	4.55E-06	1.78E-04	ug/m3	10-SO16-02	8/8	N/A	1.78E-04	N/A	5.22E-03 N	N/A	N/A	NO	BSL
	7439976	Mercury	4.24E-08 J	2.65E-07	ug/m3	SSP-LDFL1927-SB09-01	4/8	N/A	2.65E-07	N/A	3.14E-02 N	N/A	N/A	NO	BSL

Table 2.2  
 OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
 NNSY Site 10 Dry Dock 8

Scenario Timeframe: Future Medium: Soil* Exposure Medium: Soil*
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Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440020	Nickel	5.23E-07 J	2.16E-05	ug/m3	10-SO16-02	6/8	N/A	2.16E-05	N/A	7.30E+00 N	N/A	N/A	NO	BSL
	7440097	Potassium	1.39E-04 J	1.74E-03	ug/m3	10-SO16-02	7/8	N/A	1.74E-03	N/A	N/A	N/A	N/A	NO	NUT
	7782492	Selenium	4.92E-07 J	4.92E-07 J	ug/m3	SSP-LDFL1927-SB09-01	1/8	N/A	4.92E-07	N/A	1.83E+00 N	N/A	N/A	NO	BSL
	7440235	Sodium	8.71E-05 J	4.05E-04 J	ug/m3	10-SO16-02	5/8	N/A	4.05E-04	N/A	N/A	N/A	N/A	NO	NUT
	7440622	Vanadium	1.36E-06 J	1.84E-05	ug/m3	10-SO16-02	8/8	N/A	1.84E-05	N/A	3.65E-01 N	N/A	N/A	NO	BSL
	7440666	Zinc	3.64E-06 J	7.41E-05	ug/m3	SSP-LDFL1927-SB09-01	7/8	N/A	7.41E-05	N/A	1.10E+02 N	N/A	N/A	NO	BSL

\* Surface soil & subsurface soil combined

[1] Minimum/Maximum calculated air concentrations from soil concentrations. Air concentrations calculated as  $C_{air} = C_{soil} * 1000 * (1/PEF + 1/VF)$   
 VF only included in calculation for VOCs. VF calculated on Table 2.2 Supplement. PEF = 1.32E9 m3/kg.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 25, 2005, U.S. EPA Region III, Jennifer Hubbard.

RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.

RBC value for chromium VI used for total chromium.

RBC for aluminum, cobalt, and dibenzofuran withdrawn from October 2005 RBC table due to expiration of NCEA provisional toxicity value.

Value is from the April 2005 RBC Table.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/  
 To Be Considered

J = Estimated Value

K = Biased High

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

**Table 2.2A**  
**Calculation of Volatilization Factor**  
**Soil Scenarios**  
**NNSY Site 10 Dry Dock 8**

Chemical	Diffusivity in Air (D <sub>i</sub> ) (cm <sup>2</sup> /s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D <sub>w</sub> ) (cm <sup>2</sup> /s)	Soil Organic Carbon Partition Coeff. (K <sub>oc</sub> ) (cm <sup>3</sup> /g)	Soil Water Partition Coeff. (K <sub>d</sub> = K <sub>oc</sub> × F <sub>oc</sub> ) (g/cm <sup>3</sup> )	Solubility in Water (S) (mg/L)	Apparent Diffusivity (D <sub>A</sub> ) (cm <sup>2</sup> /s)	Volatilization Factor (VF) (m <sup>3</sup> /kg)	
<b>Volatile Organics</b>									
Acetone	1.24E-01	1.59E-03	1.14E-05	5.75E-01	3.45E-03	1.00E+06	1.02E-04	1.63E+04	
Carbon disulfide	1.04E-01	1.24E+00	1.00E-05	4.57E+01	2.74E-01	1.19E+03	1.13E-02	1.55E+03	
Methylene chloride	1.01E-01	8.98E-02	1.17E-05	1.17E+01	7.02E-02	1.30E+04	2.58E-03	3.23E+03	
2-Methylnaphthalene	5.60E-02	2.07E-02	7.84E-06	2.13E+03	1.28E+01	2.54E+01	4.80E-06	7.50E+04	
4-Bromophenylphenylether		4.87E-03		4.16E+03	2.50E+01	1.45E+00	0.00E+00	0.00E+00	
Acenaphthene	4.21E-02	6.36E-03	7.69E-06	7.08E+03	4.25E+01	4.24E+00	3.36E-07	2.83E+05	
Anthracene	3.24E-02	2.67E-03	7.74E-06	2.95E+04	1.77E+02	4.34E-02	2.63E-08	1.01E+06	
Benzo(a)anthracene	5.10E-02	1.37E-04	9.00E-06	3.98E+05	2.39E+03	9.00E-06	1.80E-10	1.23E+07	
Benzo(a)pyrene	4.30E-02	4.63E-05	9.00E-06	1.02E+06	6.12E+03	1.62E-03	2.67E-11	3.18E+07	
Benzo(b)fluoranthene	2.26E-02	4.55E-03	5.56E-06	1.23E+06	7.38E+03	1.50E-03	7.47E-10	6.01E+06	
Benzo(g,h,i)perylene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06	
Benzo(k)fluoranthene	2.26E-02	3.40E-05	5.56E-06	1.23E+06	7.38E+03	8.00E-04	1.03E-11	5.11E+07	
Caprolactum	6.54E-02	1.03E-06	8.99E-06	5.74E+01	3.44E-01	7.72E+05	1.37E-07	4.45E+05	
Carbazole	3.90E-02	6.26E-07	7.03E-06	3.39E+03	2.03E+01	7.48E+00	2.25E-09	3.47E+06	
Di-n-butylphthalate	4.38E-02	3.85E-08	7.86E-06	3.39E+04	2.03E+02	1.12E+01	2.46E-10	1.05E+07	
Dibenzofuran	6.19E-02	3.98E-03	1.00E-05	5.48E+03	3.29E+01	5.65E+00	4.00E-07	2.60E+05	
Fluoranthene	3.02E-02	6.60E-04	6.35E-06	1.07E+05	6.42E+02	2.06E-01	1.72E-09	3.97E+06	
Fluorene	3.63E-02	2.61E-03	7.88E-06	1.38E+04	8.28E+01	1.98E+00	6.15E-08	6.63E+05	
Indeno(1,2,3-cd)pyrene	1.90E-02	6.56E-05	5.66E-06	3.47E+06	2.08E+04	2.20E-05	4.92E-12	7.41E+07	
Phenanthrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06	
Pyrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06	
bis(2-Ethylhexyl)phthalate	3.51E-02	4.18E-06	3.66E-06	1.51E+07	9.06E+04	3.40E-01	3.43E-13	2.81E+08	

$$\text{Volatilization factor (VF)} = \frac{Q/C * (3.14 * D_A * T)^{1/2} * 10^{-4} \text{ m}^2/\text{cm}^2}{2 * r_b * D_A} \quad (\text{m}^3/\text{kg})$$

$$\text{Apparent Diffusivity (D}_A\text{)} = \frac{[(Q_a^{10/3} * D_i * H' + Q_w^{10/3} * D_w)/n^2]}{(r_b * K_d + Q_w + Q_a * H')} \quad (\text{cm}^2/\text{s})$$

$$\text{Soil Saturation Concentration (C}_{\text{sat}}\text{)} = S/r_b * (K_d * r_b + Q_w + H' * Q_a)$$

Parameters	Values
Q/C - Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m <sup>2</sup> -s per kg/m <sup>3</sup> )	90.24
T - Exposure interval(s)	9.5E+08
r <sub>b</sub> - Soil bulk density (g/cm <sup>3</sup> )	1.5
Q <sub>a</sub> - Air-filled soil porosity (L <sub>air</sub> /L <sub>water</sub> ) = n - Q <sub>w</sub>	0.28
n - Total soil porosity (L <sub>pore</sub> /L <sub>soil</sub> ) = 1 - (r <sub>s</sub> /r <sub>s</sub> )	0.43
Q <sub>w</sub> - Water-filled soil porosity (L <sub>water</sub> /L <sub>soil</sub> )	0.15
r <sub>s</sub> - Soil particle density (g/cm <sup>3</sup> )	2.65
f <sub>oc</sub> - fraction organic carbon in soil (g/g)	0.006

need to use correct Q/C for where site is located

Equations and chemical properties from USEPA, 1996. *Soil Screening Guidance: User's Guide*. EPA/540/R-96/018.

Table 3.1  
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY  
NNSY Site 10 Dry Dock 8

Scenario Timeframe: Future  
Medium: Soil\*  
Exposure Medium: Soil\*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T/NP)			Maximum Concentration (Qualifier)		Exposure Point Concentration			
									Value	Units	Statistic	Rationale
Soil* at Site 10, Dry Dock 8	Benzo(a)pyrene	mg/kg	1.85E-01	2.43E-01	N	2.10E-01	J	2.10E-01	mg/kg	Max	(2,3)	
	Aluminum	mg/kg	3.25E+03	7.01E+03	T	1.18E+04		7.01E+03	mg/kg	95% Gamma	(1, 4, 5)	
	Arsenic	mg/kg	2.20E+00	4.26E+00	T	6.70E+00		6.70E+00	mg/kg	95% Gamma	(1, 4, 5)	
	Chromium	mg/kg	8.00E+00	1.62E+01	T	2.64E+01		2.64E+01	mg/kg	95% Gamma	(1, 4, 5)	
	Iron	mg/kg	5.76E+03	1.35E+04	T	2.40E+04		2.40E+04	mg/kg	95% Gamma	(1, 4, 5)	
	Manganese	mg/kg	5.03E+01	1.25E+02	T	2.35E+02		2.35E+02	mg/kg	95% Cheb	(1)	
	Vanadium	mg/kg	9.10E+00	1.42E+01	N	2.43E+01		2.43E+01	mg/kg	95% UCL-N	(3)	

\* Surface soil & subsurface soil combined.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Options: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data using H-Statistic (95% UCL-T); 95% UCL Chebyshev MVUE (95% Cheb); 95% UCL based on Approximate Gamma Distribution (95% Gamma).

- (1) Shapiro-Wilk W Test indicates data are log-normally distributed.
- (2) 95% UCL (or mean) exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
- (3) Shapiro-Wilks W Test indicates data are normally distributed.
- (4) Anderson-Darling test indicates data are gamma distributed.
- (5) K-Smirnov test indicates data are gamma distributed.

N - Normal  
T- Log-Normal  
NP - Non-Parametric

TABLE 7.1.RME  
 CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10 Dry Dock 8

Scenario Timeframe: Current  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RIC**		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil*	Soil*	NNSY	Ingestion	Benzo(a)pyrene	2.1E-01	mg/kg	1.4E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.0E-07	9.9E-07	mg/kg/day	NA	NA	NA	
				Aluminum	7.0E+03	mg/kg	4.7E-04	mg/kg/day	NA	NA	NA	3.3E-02	mg/kg/day	1.0E+00	mg/kg/day	3.3E-02	
				Arsenic	6.7E+00	mg/kg	4.5E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	6.7E-07	3.1E-05	mg/kg/day	3.0E-04	mg/kg/day	1.0E-01	
				Chromium	2.6E+01	mg/kg	1.8E-06	mg/kg/day	NA	NA	NA	1.2E-04	mg/kg/day	2.0E-02	mg/kg/day	6.2E-03	
				Iron	2.4E+04	mg/kg	1.6E-03	mg/kg/day	NA	NA	NA	1.1E-01	mg/kg/day	3.0E-01	mg/kg/day	3.8E-01	
				Manganese	2.4E+02	mg/kg	1.6E-05	mg/kg/day	NA	NA	NA	1.1E-03	mg/kg/day	2.0E-02	mg/kg/day	5.5E-02	
				Vanadium	2.4E+01	mg/kg	1.6E-06	mg/kg/day	NA	NA	NA	1.1E-04	mg/kg/day	7.0E-03	mg/kg/day	1.6E-02	
			Exp. Route Total								7.8E-07					5.9E-01	
			Absorption	Benzo(a)pyrene	2.1E-01	mg/kg	3.8E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.8E-08	2.6E-07	mg/kg/day	NA	NA	NA	
				Aluminum	7.0E+03	mg/kg	9.7E-06	mg/kg/day	NA	NA	NA	6.8E-04	mg/kg/day	1.0E+00	mg/kg/day	6.8E-04	
				Arsenic	6.7E+00	mg/kg	2.8E-08	mg/kg/day	1.5E+00	1/(mg/kg-day)	4.2E-08	1.9E-06	mg/kg/day	3.0E-04	mg/kg/day	6.5E-03	
				Chromium	2.6E+01	mg/kg	3.7E-08	mg/kg/day	NA	NA	NA	2.6E-06	mg/kg/day	5.0E-04	mg/kg/day	5.1E-03	
				Iron	2.4E+04	mg/kg	3.3E-05	mg/kg/day	NA	NA	NA	2.3E-03	mg/kg/day	3.0E-01	mg/kg/day	7.7E-03	
				Manganese	2.4E+02	mg/kg	3.3E-07	mg/kg/day	NA	NA	NA	2.3E-05	mg/kg/day	8.0E-04	mg/kg/day	2.8E-02	
		Vanadium		2.4E+01	mg/kg	3.4E-08	mg/kg/day	NA	NA	NA	2.4E-06	mg/kg/day	1.8E-04	mg/kg/day	1.3E-02		
		Exp. Route Total								6.9E-08					6.1E-02		
		Exposure Point Total								8.5E-07						6.5E-01	
		Exposure Medium Total								8.5E-07						6.5E-01	
		Subsurface Soil Total								8.5E-07						6.5E-01	
		Total of Receptor Risks Across All Media										8.5E-07	Total of Receptor Hazards Across All Media				6.5E-01

\* Surface and subsurface soil combined.

\*\*Subchronic values used if available, otherwise used chronic value.

TABLE 9.1.RME  
 SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCS  
 REASONABLE MAXIMUM EXPOSURE  
 NNSY Site 10 Dry Dock 8

Scenario Timeframe: Current  
 Receptor Population: Construction Worker  
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Dry Dock 8	Benzo(a)pyrene	1.0E-07	N/A	2.8E-08	1.3E-07	N/A	NA	N/A	NA	0.0E+00
			Aluminum	NA	N/A	NA	0.0E+00	CNS	3.3E-02	N/A	6.8E-04	3.4E-02
			Arsenic	6.7E-07	N/A	4.2E-08	7.2E-07	Skin/Vascular	1.0E-01	N/A	6.5E-03	1.1E-01
			Chromium	NA	N/A	NA	0.0E+00	NOAEL	6.2E-03	N/A	5.1E-03	1.1E-02
			Iron	NA	N/A	NA	0.0E+00	Gastrointestinal	3.8E-01	N/A	7.7E-03	3.8E-01
			Manganese	NA	N/A	NA	0.0E+00	CNS	5.5E-02	N/A	2.8E-02	8.4E-02
			Vanadium	NA	N/A	NA	0.0E+00	Kidney	1.6E-02	N/A	1.3E-02	2.9E-02
Chemical Total				7.8E-07	N/A	6.9E-08	8.5E-07		5.9E-01	0.0E+00	6.1E-02	6.5E-01
Medium Total							8.5E-07					6.5E-01
Receptor Total							8.5E-07				Receptor HI Total	6.5E-01

\* Surface and subsurface soil combined.

Total Kidney HI Across All Media =	2.9E-02
Total CNS HI Across All Media =	1.2E-01
Total Gastrointestinal HI Across All Media =	3.8E-01
Total Vascular HI Across All Media =	1.1E-01
Total Skin HI Across All Media =	1.1E-01
Total NOAEL HI Across All Media =	1.1E-02