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TECHNICAL MEMORANDUM OF RISK ASSESSMENT EVALUATION for SITE 2 – ANTENNA FIELD LANDFILL SOIL AND GROUNDWATER (OU 5 AND OU 9)

NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, PENNSYLVANIA

Naval Facilities Engineering Command Mid-Atlantic

Contract No. N62472-03-D-0057
Contract Task Order 003

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NAVAL AIR STATION JOINT RESERVE BASE (NAS JRB) WILLOW GROVE, PENNSYLVANIA

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION - NAVY (CLEAN) PROGRAM

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EXECUTIVE SUMMARY

This technical memorandum presents a review and limited update of the human health risk assessment (HHRA) of soils, groundwater, surface water, and sediment originally prepared in 1997 as part of the Remedial Investigation Report for Site 2 - Antenna Field Landfill (TtNUS, 2004). The review identifies changes in the risk assessment methodology since the 1997 HHRA was prepared and discusses, in general, the impact the changes would have on the risk estimates presented in the 1997 HHRA. The review concentrates on changes in the methodology for evaluating risks to occupational workers and hypothetical residents since these receptors were identified as the critical receptors in the 1997 HHRA. A general discussion of the changes in risk assessment methodology and of the impact of those changes on risk estimates is also provided for the other receptors (excavation workers, adolescent trespassers, and future child recreational users) evaluated in the 1997 HHRA for Site 2.

Review of 1997 HHRA Methodology versus Current HHRA Methodology

The following items summarize the major differences between the 1997 HHRA methodology and the methodology used to prepare the updated HHRA:

- Risks have been calculated for hypothetical residents exposed to surface water and sediment, which were not evaluated in the 1997 HHRA. Current Region 3 risk-based concentrations (RBCs) were used in the toxicity screening to select chemicals of potential concern (COPCs) for soil, surface water, and sediment. Current Region 3 risk-based concentrations (RBCs) and United States Environmental Protection Agency (USEPA) Maximum Contaminant Levels (MCLs) were used in the toxicity screening to select COPCs for groundwater. The list of COPCs evaluated in the updated HHRA includes all COPCs identified in the 1997 HHRA except for beryllium in surface soil, subsurface soil, and sediment. In addition a few additional inorganic compounds were retained as COPCs for subsurface soil and sediment.

- The most significant changes in the exposure assessment protocol (1997 versus current) are those associated with the evaluation of the dermal route of exposure (e.g., the soil adherence factor), the soil ingestion factor assumed for the typical occupational worker, the calculation of the exposure point concentration (EPC), and the quantitative evaluation of the dermal absorption of polynuclear aromatic hydrocarbons (PAHs) in soils. In some cases, the current recommended soil adherence factor is an order of magnitude lower than previously recommended values. In contrast, the current recommended soil ingestion rate for the occupational worker is two-times previously recommended values. EPCs for soil, surface water, and sediment calculated per current methodology are essentially the same or higher than those calculated for the 1997 HHRA.

There are no changes in the EPCs for groundwater. The dermal absorption of PAHs was not evaluated in the 1997 HHRA; but, was evaluated in the updated HHRA. However, these changes do not result insignificant differences between the risks estimates presented in the 1997 HHRA and those calculated in the updated HHRA.

- Significant changes in toxicity criteria were noted for beryllium between the 1997 HHRA and the updated HHRA. Beryllium was evaluated as a carcinogen in the 1997 HHRA. In 1998 USEPA withdrew the oral cancer slope factor for beryllium and as a result beryllium is no longer evaluated as a carcinogen for the ingestion and dermal contact exposure pathways. In addition, the oral absorption efficiency for dieldrin has changed from 0.5 to 1 and, as a result, dieldrin is less toxic via the dermal contact exposure pathway. As a result of these changes, the risk estimates for exposures to beryllium and dieldrin in soil in this updated HHRA are lower than those presented in the 1997 HHRA.

Updated Risk Estimates for Worker and Hypothetical Future Residents

Risk estimates for the hypothetical future resident and the occupational worker exposed to soils and groundwater were recalculated and presented in this technical memorandum. In addition, risks were calculated for exposures to surface water and sediment by hypothetical future residents.

The cancer risk estimates for the occupational worker under the reasonable maximum exposure (RME) scenario exposed to soil (2×10^{-5}) were less then those estimated in the 1997 HHRA (1×10^{-4}). Cancer risk estimates for a hypothetical future lifelong resident under the RME scenario exposed to soil (8×10^{-5}) were also less than those estimated in the 1997 HHRA (3×10^{-4}). The lower cancer risk estimates for the occupational worker and hypothetical future resident exposed to soil are due to the changes in the toxicity criteria for beryllium and dieldrin. The cancer risk estimates for exposures to groundwater by the hypothetical future lifelong resident under the RME scenario in this evaluation (2×10^{-5}) are the same as those estimated in the 1997 HHRA. Cancer risk estimates for hypothetical future lifelong residents exposed to surface water (5×10^{-6}) and sediment (2×10^{-5}) were within the USEPA's target risk range of 10^{-4} to 10^{-6}.

Target-organ specific non-cancer risk estimates (hazard indices [HIs]) developed for the hypothetical future child resident under the RME scenario equal two when the HIs developed for all environmental media evaluated for the receptor are summed. However, target-organ specific HIs calculated for the individual environmental media evaluated do not exceed one for the occupational worker or the hypothetical future resident (adult or child) under the RME scenario. Given the conservative nature of the updated HHRA, these results indicate that adverse non-carcinogenic health effects are not anticipated

under the conditions established for this HHRA. HIs under the RME scenario for the occupational worker and child resident exposed to soil and child resident and adult resident exposed to groundwater are essentially the same as those presented in the 1997 HHRA. The HI for the adult resident under the RME scenario exposed to soil is approximately 40 percent lower in this evaluation as compared to the HI presented in the 1997 HHRA. The differences in the HI for adult residents exposed to soil between this evaluation and those presented in the 1997 HHRA are a consequence of the changes in exposure assumptions and changes in toxicity criteria.

1.0 INTRODUCTION

This technical memorandum presents a review and limited update of the HHRA originally prepared in 1997 as part of the Remedial Investigation Report for Site 2 – Antenna Field Landfill (TtNUS, 2004). The review identifies changes in the risk assessment methodology since the 1997 HHRA was prepared and discusses, in general, the impact the changes would have on the risk estimates presented in the 1997 HHRA. The review concentrates on the changes in the methodology for evaluating risks to occupational workers and hypothetical residents since these receptors were identified as the critical receptors in the 1997 HHRA. Therefore, changes in risk assessment methodology and the impact of these changes on the risk estimates for occupational workers and hypothetical residents hypothetically exposed to soils and groundwater are discussed in detail in the following subsections. In addition, the risk estimates for occupational workers and hypothetical residents exposed to soils and groundwater are re-calculated following current risk assessment guidance. Risks are also calculated for hypothetical residents exposed to surface water and sediment, which were not evaluated in the 1997 HHRA. A general discussion of the changes in risk assessment methodology and impact of those changes on risk estimates is also provided for the other receptors (excavation workers, adolescent trespassers, and future child recreational users) evaluated in the 1997 HHRA for Site 2.

2.0 REVIEW OF THE 1997 RISK ASSESSMENT

The 1997 HHRA for Site 2 was reviewed to evaluate if the use of current risk assessment methodology (versus the methodology available in 1997) would significantly impact the risk assessment results presented in the 1997 HHRA. For example, after the 1997 HHRA was prepared the USEPA extensively revised the guidance for evaluating the dermal route of exposure (USEPA, 2004a) and for calculating EPCs (USEPA, 2002a; Singh et. al., 2004). In addition, USEPA updated some of the toxicity criteria (Reference Doses [RfDs] and cancer slope factors [CSFs]) used in quantitative risk assessment and the toxicity screening criteria used to select the COPCs. The impacts of these changes on the risk estimates presented in the 1997 HHRA are discussed below.

2.1 TOXICITY SCREENING CRITERIA AND SELECTION OF COPCS

USEPA Region 3 RBCs available in 1997 were used as the basis of the COPC toxicity screening levels in the 1997 HHRA. Residential RBCs were used to select the COPCs for surface soil and industrial RBCs were used to select COPCs for subsurface soil. Tap water RBCs and USEPA MCLs were used to select COPCs for groundwater. A chemical was retained as a COPC in groundwater if the maximum detected concentration exceeded the lesser of the USEPA Region 3 RBC and USEPA MCL. Ten times the tap water and residential soil RBCs were used to select COPCs for surface water and sediment, respectively. The 10-times adjustment of the screening levels (RBC for tap water) for surface water was used because surface water in the vicinity of Site 2 is not used for domestic purposes (e.g. bathing, cooking and drinking). The adjustment of the screening levels by a factor of 10 was used for sediment COPC screening because exposures to sediments (particularly those under water) are anticipated to be less than exposures to soil.

USEPA Region 3 updates its RBC table twice a year; consequently the RBC table has undergone numerous revisions since the 1997 HHRA. In addition, the USEPA Region 3 RBC table now includes USEPA soil screening levels (SSLs) for the migration of chemicals from soil to groundwater. Soil contaminant levels are now routinely compared to these screening levels as an initial evaluation of the potential for contaminant migration to groundwater. Per current Navy policy (Navy 2004), inorganic concentrations in site media were also compared to site-specific background concentrations; inorganics detected at concentrations less than background were not selected as COPCs in the 1997 HHRA and are not included as COPCs in this updated HHRA. However, per current Navy guidance, inorganics that exceed toxicity screening criteria but are not selected as COPCs because site concentrations do not exceed background concentrations are further evaluated qualitatively in the risk characterization section of the HHRA (see Section 3.5).

Updated COPC selection tables for surface soil, subsurface soil, groundwater, surface water, and sediment are presented in Attachment A. Toxicity screening levels based on the USEPA Region 3 RBCs for residential exposures to soil were used to select COPCs for both surface and subsurface soil. In addition USEPA SSLs (USEPA, 2002b) for the transfer of contaminants from soil to air were used to determine if the inhalation pathway was potentially significant and required evaluation in this updated HHRA. Chemical concentrations in surface and subsurface soil were compared to the USEPA Region 3 SSLs for the migration of chemicals from soil to groundwater. USEPA Region 3 SSLs for transfers from soil to groundwater were not used to select COPCs for quantitative evaluation of the direct contact routes of exposure in the HHRA but were presented to allow a qualitative evaluation of the potential for chemical migration from soil to groundwater. Chemicals with concentrations exceeding the SSLs may potentially migrate from the soil to groundwater in sufficient quantities to adversely impact groundwater quality. USEPA Region 3 RBCs for tap water and USEPA MCLs (USEPA, 2004b) were used to select COPCs for groundwater. A chemical was retained as a COPC in groundwater if the maximum detected concentration exceeded the lesser of the USEPA Region 3 RBC and USEPA MCL. Ten times the USEPA Region 3 RBCs for tap water and residential exposures to soil were used to select COPCs for surface water and sediment, respectively. As noted above, inorganics eliminated in the 1997 HHRA on the basis of the comparison of site concentrations to background concentrations were also not selected as COPCs in this updated HHRA.

Surface Soil

Dioxins/furans, carcinogenic PAHs, pesticides and several inorganics were retained as COPCs in the 1997 HHRA for Site 2. Table 2.1 in Attachment A presents the updated COPC selection table for direct contact exposures to surface soil. The following chemicals were detected in surface soil at maximum concentrations exceeding toxicity screening levels based on the USEPA Region 3 RBCs for residential exposures and were selected as COPCs for surface soil at Site 2:

- Semivolatile organic compounds (SVOCs) [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene]
- Pesticides [dieldrin]
- Inorganics [aluminum, arsenic, chromium, iron, manganese, and vanadium]

Concentrations of antimony also exceeded the RBC-based toxicity screening levels but were within background levels; therefore antimony is not retained as a COPC for direct contact with surface soil.

A comparison of the maximum detected surface soil concentrations to the USEPA SSLs for chemical migration from soil to air is also presented in Table 2-1 in Attachment A. The concentrations of all

chemicals in surface soil were less than the USEPA SSLs for soil to air. Therefore, exposures through inhalation of fugitive dust and volatile emissions from surface soil at Site 2 are not considered to be significant and were not evaluated quantitatively in the updated HHRA.

Table 2.2 in Attachment A presents a comparison of the maximum detected surface soil concentrations to screening levels based on USEPA Region 3 SSLs for chemical migration from soil to groundwater (Dilution and attenuation factor [DAF] = 20). The following chemicals were detected in surface soil at maximum concentrations exceeding the COPC screening levels for migration from soil to groundwater:

- SVOCs [benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene]
- Pesticides [dieldrin]
- Inorganics [arsenic, barium, chromium, manganese, and vanadium]

However, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dieldrin, and vanadium were not detected in groundwater samples. Additionally, the maximum detected concentrations of arsenic, barium, and chromium were not detected in the Site 2 groundwater samples at concentrations exceeding Safe Drinking Water Act (SDWA) primary MCLs and manganese was not detected in groundwater at concentrations exceeding screening levels based on the Region 3 RBC for tap water.

Subsurface Soil

Carcinogenic PAHs and several inorganics were retained as COPCs for subsurface soil in the 1997 HHRA for Site 2. Table 2.3 in Attachment A presents the updated COPC selection table for direct contact exposures to subsurface soil. The following chemicals were detected in subsurface soil at maximum concentrations exceeding toxicity screening levels based on the USEPA Region 3 RBCs for residential exposures and were selected as COPCs for subsurface soil at Site 2.

- SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene]
- Inorganics [aluminum, arsenic, chromium, iron, lead, manganese, and vanadium]

Concentrations of antimony also exceeded the RBCs-based toxicity screening levels but were within background levels; therefore antimony is not retained as a COPC for direct contact with subsurface soil.

A comparison of the maximum detected subsurface soil concentrations to screening levels based on USEPA SSLs for chemical migration from soil to air is also presented in Table 2.3 in Attachment A. The concentrations of all chemicals in subsurface soil were less than the USEPA SSLs for soil to air.

Therefore, exposures through inhalation of fugitive dust and volatile emissions from subsurface soil at Site 2 are not considered to be significant and were not evaluated quantitatively in the updated HHRA.

Table 2.4 in Attachment A presents a comparison of the maximum detected subsurface soil concentrations to screening levels based on USEPA Region 3 SSLs for chemical migration from soil to groundwater. The following chemicals were detected in subsurface soil at maximum concentrations exceeding the COPC screening levels for migration from soil to groundwater:

- SVOCs [2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, dibenzo(a,h)anthracene, dibenzofuran, and naphthalene]
- Inorganics [arsenic, barium, chromium, manganese, and vanadium]

Of the chemicals detected at concentrations exceeding the USEPA Region 3 SSLs for chemical migration from soil to groundwater only arsenic and barium were detected in groundwater samples collected at Site 2. However, as noted below, neither arsenic nor barium were detected at concentrations exceeding SDWA primary MCLs.

Groundwater

Trichloroethene, bis(2-ethylhexyl)phthalate, arsenic, barium, chromium, and iron were retained as COPCs for groundwater in the 1997 HHRA for Site 2. As displayed in Attachment A Table 2.5, these chemicals were also selected as COPCs for this updated HHRA because they were detected in groundwater at maximum concentrations exceeding toxicity screening levels based on the USEPA Region 3 RBCs for tap water or USEPA MCLs. Concentrations of trichloroethene, arsenic, barium, and chromium exceeded the USEPA Region 3 RBCs but were less than the USEPA SDWA primary MCLs.

Surface Water

Dieldrin, arsenic, and manganese were retained as COPCs for surface water in the 1997 HHRA for Site 2. As summarized in Attachment A, Table 2.6, these same chemicals were selected as COPCs based on a comparison of the maximum detected surface water concentrations to screening levels based on updated USEPA Region 3 RBCs for tap water.

Sediment

Carcinogenic PAHs and several inorganics were retained as COPCs for sediment in the 1997 HHRA for Site 2. A comparison of the maximum detected sediment concentrations to screening levels based on

10-times the USEPA Region 3 RBCs for residential exposures to soil is presented in Table 2.7, Attachment A. The following chemicals were detected in sediment at maximum concentrations exceeding toxicity screening levels and were selected as COPCs for sediment at Site 2.

- SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene]
- Pesticides [dieldrin]
- Inorganics [arsenic, iron, lead, and manganese]

2.2 EXPOSURE FACTOR ASSUMPTIONS

Tables 1 through 10 present a comparison of the exposure assumptions for occupational workers, child residents, and adult residents used in the 1997 HHRA versus those currently recommended by USEPA guidance. The most significant change in the exposure assumptions are those used to evaluate the dermal route of exposure. The exposure assumptions used in the 1997 HHRA were based on recommendations provided in USEPA's Dermal Exposure Assessment: Principles and Applications, January 1992 and USEPA Region 3's Assessing Dermal Contact with Soil, December 1995. The updated dermal exposure assumptions are based on recommendations in USEPA's Supplemental Guidance for Dermal Risk Assessment, July 2004 and USEPA Region 3's Updated Dermal Exposure Assessment Guidance, June 2003.

2.2.1 Exposures to Soil

The skin surface area assumed available for contact (SA) for the occupational worker decreased slightly from 3,508 cm^2 (1997 HHRA) to 3,300 cm^2 (current guidance). In the 1997 HHRA, the SA for the child resident was a weighted value calculated for the exposure duration of the receptor (743.8 cm^2-yr/kg) and was equivalent to approximately 27 percent of the total body surface area. The current guidance recommends a value of 2,800 cm^2 which is equivalent to approximately 42 percent of the total body surface area of a child. For the adult resident, a SA of 3,508 cm^2 or 19 percent of the total body surface area was used in the 1997 HHRA. Current USEPA guidance recommends a value of 5,700 cm^2 or approximately 31 percent of the total body surface area.

A soil to skin adherence factor (SSAF) of 1 mg/cm^2-event was used for all receptors in the 1997 HHRA for both the RME and central tendency exposures (CTE) scenarios. Current USEPA guidance recommends a value of 0.2 mg/cm^2-event for the occupational worker and child resident and 0.07 mg/cm^2-event for the adult resident under the RME scenario, and 0.02 mg/cm^2-event for the occupational worker, 0.04 mg/cm^2-event for the child resident, and 0.01 mg/cm^2-event for the adult resident under the CTE scenario.

Table 11 presents a comparison of the dermal absorption factors (DABS) used in the 1997 HHRA and those currently recommended by USEPA. There have been minor changes in the DABS values for PAHs and arsenic. Previous guidance recommended a DABS of 0.1 for PAHs while current guidance recommends a value of 0.13. The DABS for arsenic has changed from 0.032 to 0.03.

The changes in the recommended skin surface areas and dermal absorption factors for occupational workers, child residents, and adult residents are relatively minor and would not have a significant impact on the estimated risks presented in the 1997 HHRA. However, the current recommended values for the skin to soil adherence factors are five to 10-times lower than those used in the 1997 HHRA. Consequently, use of the updated soil adherence factors would result in lower risks than those presented in the 1997 HHRA. These same conclusions apply to the receptors not evaluated in detail in this technical memorandum (excavation workers, adolescent trespassers, and future child recreational users). Changes in skin surface areas would not result in significant changes to the estimated risks whereas the revised soil adherence factors would result in lower risks than those presented in the 1997 HHRA.

The only other significant change in exposure assumptions was the incidental soil ingestion rate for occupational workers. Previous guidance recommended a value of 50 mg/day. Current guidance recommends a value of 100 mg/day, which is twice as high as the previous value (USEPA 2002b, 2005a). Consequently, the change in the incidental soil ingestion rate for the occupational worker would result in the risk estimates two times those presented in the 1997 HHRA.

The methodology used to calculate the particulate emission factors (PEFs) for estimating inhalation exposures has also changed. The PEF presented in the 1997 HHRA was calculated following methodology presented in USEPA's Rapid Assessment of Exposures to Particulate Emissions from Surface Contamination Sites, February 1985. Current guidance recommends methodology presented in USEPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December, 2002. A PEF of $4.24 \times 10^{+9}$ m^3/kg, calculated based on the current guidance, results in ambient air concentrations approximately 30-times lower than the PEF of $1.38 \times 10^{+8}$ calculated based on the older guidance. However, the PEF methodology utilized does not impact the risk assessment conclusions because, in the 1997 HHRA, risk estimates for the inhalation route of exposure were approximately three orders of magnitude lower than risks for the incidental ingestion and dermal contact routes of exposure.

2.2.2 Exposures to Groundwater

In the 1997 HHRA, the SA for the child resident was a weighted value calculated for the exposure duration of the receptor (2,728 cm^2-yr/kg). The current guidance recommends a value of 6,600 cm^2 as the total body surface area of a child. For the adult resident, a SA of 18,150 cm^2 was used for the total body surface area in the 1997 HHRA. Current guidance recommends a value of 18,000 cm^2 for the total body surface area.

The equations used to estimate the absorbed dose per event (DA_{event}) for organics have been updated since the 1997 HHRA was prepared. The most significant change to the equations is the addition of a fraction absorbed (FA) term to the equations. This term accounts for the slow absorption rates of high molecular weight chemicals. For the chemicals retained as COPCs in groundwater in the 1997 HHRA, trichloroethene has a FA equal to 1 and bis(2-ethylhexyl)phthalate has an FA of 0.8. Consequently, risks from dermal exposures to bis(2-ethylhexyl)phthalate in groundwater would be lower based on the updated dermal guidance.

The 1997 HHRA only evaluated risks from inhalation of volatiles for adult residents. Current guidance recommends evaluating the inhalation pathway for both child and adult residents. Consequently, the evaluation of the inhalation pathway for both child and adult residents will result in higher risks for the lifelong resident.

2.2.3 Exposures to Surface Water and Sediments

In the 1997 HHRA, child and adult residents were only evaluated for exposures to surface soil and groundwater. Exposures to surface water and sediment were not evaluated for these receptors. Under current USEPA and Navy guidance, child and adult residents are typically evaluated for exposures to surface water and sediment unless surface water and sediment is inaccessible. Surface water and sediment at Site 2 are accessible, therefore exposures to surface water and sediment by child and adult residents were evaluated in Section 3.

Exposure factors for child and adult residents hypothetically contacting surface water and sediment are presented in Attachment A. There are no default exposure assumptions for exposures to surface water and sediment. Consequently, it was assumed that child and adult residents would be exposed to surface water and sediment four hours a day for one day a week (52 days/year) under the RME scenario and two hours a day for one day every other week (26 days/year) under the CTE scenario. Surface water incidental ingestion rates of 0.05 L/hour and 0.01 L/hour were assumed for the child and adult residents, respectively, under the RME and CTE scenarios (USEPA IV, 2000). Incidental sediment ingestion rates

of 100 mg/day and 50 mg/day were assumed for the child resident and 50 mg/day and 25 mg/day for the adult resident under the RME and CTE scenarios, respectively. The incidental ingestion rates for exposures to sediment are lower than the incidental ingestion rates for exposure to soil since exposure to sediment is anticipated to occur less frequently than exposure to soil. The skin areas available for contact, sediment adherence factors, receptor body weights, and exposure durations used to evaluate exposure to soil were also used to evaluate exposure to sediment.

2.3 TOXICITY VALUES

Tables 12 and 13 present a comparison of the RfDs and CSFs used in the 1997 HHRA versus current values. The most significant changes in toxicity values are for trichloroethene and beryllium.

Toxicity criteria for trichloroethene are not currently published on the USEPA's Integrated Risk Information System (IRIS) database. The 1997 HHRA was prepared using a provisional oral RfD and inhalation CSF and a withdrawn oral CSF for trichloroethene. The USEPA has published draft toxicity values based on the USEPA's Trichloroethylene Health Risk Assessment: Synthesis and Characterization (USEPA, 2001a). However, these values are still undergoing peer review. The toxicity criteria developed by the California EPA (CA EPA, 2002) were used for trichloroethene in this updated HHRA because the draft USEPA criteria have not been finalized. The current CA EPA oral RfD for trichloroethene is 0.5 mg/kg/day; the oral RfD used in the 1997 HHRA was 0.006 mg/kg/day. Previously an inhalation RfD was not available for trichloroethene, however, the current CA EPA published value is 0.17 mg/kg/day. For noncarcinogenic exposures, these changes in toxicity values result in higher non-cancer risk estimates for trichloroethene exposure via inhalation and lower risk estimates for trichloroethene exposure via ingestion and dermal contact. The current oral and inhalation CA EPA CSFs for trichloroethene are 0.013 $(mg/kg/day)^{-1}$ and 0.007 $(mg/kg/day)^{-1}$, respectively. The oral and inhalation CSFs used in the 1997 HHRA were 0.011 $(mg/kg/day)^{-1}$ and 0.006 $(mg/kg/day)^{-1}$, respectively. Overall these changes do not have a significant impact on the risk estimates presented for trichloroethene in the 1997 HHRA since risks from exposures to trichloroethene were within acceptable levels.

Beryllium was evaluated as a carcinogen via the oral and dermal routes of exposure in the 1997 HHRA. However, in 1998 USEPA withdrew the oral cancer slope factor for beryllium and, as a result, the EPA Region 3 RBC for tap water increased significantly. Consequently, beryllium was not selected as a COPC for this updated HHRA. An inhalation RfD of 0.000057 mg/kg/day is also now available for beryllium (USEPA, 2005b). However, beryllium is not a volatile chemical; the availability of an inhalation RfD has no impact on the HHRA evaluation of beryllium concentrations in groundwater.

The RfD for hexavalent chromium has changed; the oral RfD was revised from 0.005 mg/kg/day to 0.003 mg/kg/day (USEPA, 2005b). In addition, the recommended oral absorption efficiency for hexavalent chromium was revised from 0.01 to 0.025 (USEPA, 2004a) which results in the new dermal RfD of 0.000075 mg/kg/day. Also, an inhalation RfD of 0.00003 mg/kg/day is now available for hexavalent chromium (USEPA, 2005b). These changes indicate that chromium is considered slightly more toxic for exposures via the incidental ingestion and inhalation routes of exposure and slightly less toxic via the dermal contact route of exposure than previously determined. Overall these changes do not significantly impact the risk estimates presented for chromium in the 1997 HHRA. Chromium is not a volatile chemical; the availability of an inhalation RfD has no impact on the HHRA evaluation of chromium concentrations in groundwater.

The RfD for vanadium has changed; the oral RfD was revised from 0.007 mg/kg/day to 0.001 mg/kg/day (USEPA, 2005b). In addition, the recommended oral absorption efficiency for vanadium was revised from 0.02 to 0.026 (USEPA, 2004a) which results in a new dermal RfD of 0.000026 mg/kg/day. These changes indicate that vanadium is slightly more toxic for exposures via the incidental ingestion and dermal contact route of exposure than previously determined. Overall these changes do not have a significant impact on the risk estimates presented for vanadium in the 1997 HHRA.

The oral CSF for 2,3,7,8-TCDD has changed from $1.56 \times 10^{+5}$ $(mg/kg/day)^{-1}$ to $1.5 \times 10^{+5}$ $(mg/kg/day)^{-1}$ (USEPA, 1997) and the inhalation CSF was revised from $1.16 \times 10^{+5}$ $(mg/kg/day)^{-1}$ to $1.5 \times 10^{+5}$ $(mg/kg/day)^{-1}$. In addition, the recommended oral absorption efficiency has changed from 0.5 to 1 (USEPA, 2004a), which results in the dermal CSF changing from $3.12 \times 10^{+5}$ $(mg/kg/day)^{-1}$ to $1.5 \times 10^{+5}$ $(mg/kg/day)^{-1}$. Risks from exposures to the other dioxin/furan congeners were evaluated in the 1997 HHRA using toxicity equivalency factors (TEFs) published in USEPA's Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and Dibenzofurans (CDDs and CDFs) and the 1989 Update, March 1989. However, in 1998, the World Health Organization (WHO) derived new TEFs (WHO, 1998), which the USEPA is considering adopting. A comparison of USEPA and WHO TEFs are presented in Table 14. The TEFs for the OCDD and OCDF congeners decreased from 0.001 to 0.0001 and the TEF for the 2,3,7,8-PeCDD congeners increased from 0.5 to 1. Overall these changes do not have a significant impact on the risks from dioxins/furans presented in the 1997 HHRA.

The recommended oral absorption efficiencies for bis(2-ethylhexyl)phthalate, dieldrin, aluminum, and arsenic have increased making these chemicals less toxic for exposures via the dermal route. The recommended oral absorption efficiencies for barium and manganese have decreased making these chemicals more toxic for exposures via the dermal route.

Previous USEPA Region 3 guidance did not recommend the quantitative evaluation of dermal exposures to PAHs in soil. However, current USEPA (2004a) and USEPA Region 3 (2003) guidance now recommends that risks for dermal exposures to PAHs in soil be quantified using the toxicity criteria and absorption factors recommended in the most current guidance for the evaluation of the dermal exposure pathway. This change results in an increase in the cancer risk estimates for dermal exposure to PAHs in soil.

2.4 METHODOLOGY USED TO ESTIMATE EXPOSURE POINT CONCENTRATIONS

Exposure point concentrations in the 1997 HHRA were calculated following USEPA's Supplemental Guidance to Risk Assessment Guidance for Superfund (RAGS): Calculating the Concentration Term (USEPA, 1992a). In accordance with this guidance the Student-t upper confidence limit (UCL) was used as the EPC if the data was normally distributed and the H-statistic based UCL (H-UCL) was used as the EPC if the data was lognormally distributed. If the distribution of the data could not be determined then the data was assumed to be lognormally distributed and the H-UCL was selected as the EPC. USEPA has updated the guidance for calculating EPCs (USEPA, 2002a; Singh et. al., 2004). The updated guidance continues to recommend the Student-t UCL for normally distributed data and the H-UCL for lognormally distributed data but also includes EPC recommendations for data that follow a gamma distribution and for cases where the data distribution can not be determined (i.e., the non parametric case). Table 15 presents a comparison of the EPCs presented in the 1997 HHRA, calculated in accordance with the old EPC guidance, and the EPCs calculated following the new EPC guidance. For soils, sediment, and surface water, the EPCs calculated according to the new guidance are essentially the same or higher as those calculated with the old guidance. There are no changes in the EPCs for groundwater.

3.0 UPDATED RISK CHARACTERIZATION

The cancer risks and hazard indices were recalculated for occupational workers, child residents, and adult residents exposed to surface soil and groundwater incorporating the changes in risk assessment methodology and exposure assumptions discussed in Section 2. In addition, risks were calculated for exposures to surface water and sediment by child and adult residents. Incremental lifetime cancer risks (ILCRs) and hazard indices (HIs) under the RME and CTE scenarios are summarized in Tables 16 and 17. The results of the risk assessment in RAGS Part D format (USEPA, 2001) are included in Attachment A and sample calculations are included in Attachment B.

3.1 NONCARCINOGENIC RISKS

The cumulative HI for occupational workers (HI = 0.5) under the RME scenario is less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated under the defined exposure conditions.

The HI for child residents (HI = 4) exposed to surface soil and groundwater (HI = 2) under the RME scenario exceed unity although the hazard quotients (HQs) for the individual target organs are all less than or equal to unity for the individual media. HIs for child residents exposed to surface water and sediment are all less than unity.

The cumulative HI for adult residents exposed to all media (HI = 2) under the RME scenario exceed unity, although the HIs for exposures to surface soil, groundwater, surface water, and sediment were all less than unity.

Cumulative HIs for the occupational workers and adult residents under the CTE scenario are less than or equal to unity, indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions. The cumulative HI for child residents exposed to all media under the CTE scenario exceeds unity, although the HIs for exposures to the individual media (surface soil, groundwater, surface water, and sediment) were all less than unity.

3.2 CARCINOGENIC RISKS

Cumulative ILCRs for the occupational worker (ILCR = 2×10^{-5}), child resident (ILCR = 8×10^{-5}), and adult resident (ILCR = 5×10^{-5}) under the RME scenario are within USEPA's target risk range of 10^{-4} to 10^{-6}. The cumulative ILCR of 1×10^{-4} for lifelong residents is equal to the upper bound of the target risk range. Arsenic and benzo(a)pyrene are the primary contributors to the cancer risk estimates.

Cumulative ILCRs for the occupational work (ILCR = 2 x 10^{-6}), child resident (ILCR = 8 x 10^{-6}), adult resident (ILCR = 4 x 10^{-6}), and lifelong resident (1 x 10^{-5}) under the CTE scenario are within the USEPA's target risk range of 10^{-4} to 10^{-6}.

3.3 RISKS FROM LEAD

Lead was identified as a COPC in sediment at Site 2. There are no human health sediment criteria available for lead so the Office of Solid Waste and Emergency Response (OSWER) soil screening level of 400 mg/kg for residential land use (USEPA, 1994) was used to screen the lead concentrations in sediment. The OSWER screening level is protective of child residents exposed to lead in soil on a daily basis. Lead was detected in 19 of 19 sediment samples, but was only detected in one sediment sample (687 J mg/kg – 02SD04-D) at a concentration which exceeded the screening criteria. The detected concentrations of lead in the remaining samples ranged from 6.6 J mg/kg to 389 mg/kg. The average concentration of lead in sediment was 105 mg/kg, which is less than the screening criteria. No adverse health effects are expected from exposures to lead in sediment since concentrations of lead in only one sample exceed that screening criteria, the average concentration of lead is less than the screening criteria, and potential receptors are anticipated to be exposed to lead in sediment on an infrequent basis.

3.4 RISKS FROM EXPOSURES TO SUBSURFACE SOIL

Excavation workers were the only receptors evaluated for exposures to subsurface soil in the 1997 HHRA. A qualitative discussion was presented in the 1997 HHRA addressing the possibility that hypothetical residents might be exposed to subsurface soil brought to the surface as a result of an excavation. The evaluation concluded that potential ILCRs for hypothetical residents would be within USEPA's target cancer risk range but HIs for child residents would exceed the acceptable level of 1. It is unlikely that hypothetical residents would be exposed to subsurface soil. Additionally, in the event that subsurface soil was brought to the surface during excavation activities there is uncertainty associated with the amount of soil brought to the surface and uncertainty associated with how the subsurface soil would be mixed with surface soil. Because of this uncertainty, cancer and non-cancer risk estimates for exposures to subsurface soil by occupational workers and hypothetical residents were developed using a simple risk screening tool (the risk ratio technique), the EPCs described previously, and the USEPA Region 3 RBCs. The USEPA Region 3 RBCs represent the 1 x 10^{-6} cancer risk level for carcinogenic effects and a HI of 1 for non-cancer effects. Thus, risk estimates may be developed using the EPCs and USEPA Region 3 RBCs, and using the following simple ratio technique:

$$\frac{\text{USEPA Region 3 RBC}}{\text{EPC for COPC}} = \frac{\text{Hazard Index of 1 or Cancer Risk Estimate of } 1 \times 10^{-6}}{\text{Hazard Index or Cancer Risk Estimate}}$$

Tables 18 and 19 provide a risk evaluation of the subsurface soil contamination assuming an occupational worker or hypothetical resident are exposed to the subsurface soil contamination (i.e., subsurface soils excavated to the surface). The ILCRs for occupation workers (ILCR = 2×10^{-5}) and hypothetical residents (ILCR = 8×10^{-5}) are within USEPA's target risk range. HIs for occupational workers and hypothetical future residents developed on a target organ specific basis are less than 1 indicating that potential adverse non-carcinogenic health effects are not anticipated under the defined exposure conditions. Lead was also identified as a COPC in subsurface soil. The mean concentration of lead (79 mg/kg) is less the industrial screening level of 800 mg/kg (USEPA, 2004) and OSWER soil screening level of 400 mg/kg for residential land (USEPA, 1994).

3.5 QUALITATIVE RISK EVALUATION OF CHEMICALS ELIMINATED AS COPCS BASED ON BACKGROUND

Antimony and cadmium were detected in soils at concentrations exceeding the conservative screening levels established for COPC selection but were not selected as COPCs because study area concentrations did not exceed background concentrations. The following table provides a qualitative risk evaluation of these chemicals by comparing the maximum detected concentrations to the USEPA Region 3 RBCs for residential soil exposure.

Parameter	Maximum Surface Soil Concentration (mg/kg)	Maximum Subsurface Soil Concentration (mg/kg)	Region 3 Residential RBC (mg/kg)
Antimony	5.8	26.6	31
Cadmium	NA	13.4	39

NA – Not Applicable – not selected as a COPC for subsurface soil.

The RBCs presented for antimony and cadmium in the preceding table are based on the potential for non-cancer health effects (the values are 10-times the COPC screening levels used in this HHRA because the COPC screening levels for non-carcinogens are established at a HI of 0.1). The maximum detected concentration of antimony in surface soil is approximately one-fifth of the residential RBC and the maximum detected concentration in subsurface soil is approximately five-sixths of the residential RBC. The maximum detected concentration of cadmium in subsurface soil is approximately one-third of the residential RBC. Based on this discussion, the elimination of antimony and cadmium from the

quantitative risk assessment of COPCs in soils has limited impact on the results and conclusions of the risk assessment for Site 2.

3.6 COMPARISON OF RESULTS

Table 20 presents a comparison of the cancer risks and hazard indices from the 1997 HHRA and those calculated in this evaluation. For exposures to soil, ILCRs for occupational workers are lower in this evaluation (ILCR = 2×10^{-5}) as compared to those estimated in the 1997 HHRA (ILCR = 1×10^{-4}). In addition, the ILCRs for the lifelong resident are lower in this evaluation (ILCR = 8×10^{-5}) as compared to those estimated in the 1997 HHRA (ILCR = 3×10^{-4}). The reduction in the cancer risk estimates is attributable primarily to changes in the recommended CSFs/gastrointestinal absorption factors for beryllium and dieldrin and to changes in the soil adherence factors. Beryllium was evaluated as a carcinogen in the 1997 HHRA. In 1998 USEPA withdrew the oral cancer slope factors for beryllium and as a result beryllium is no longer evaluated as a carcinogen for the ingestion and dermal contact exposure pathways. The oral absorption efficiency for dieldrin has changed from 0.5 to 1 and as a result dieldrin is considered less toxic via the dermal contact exposure pathway than previously reported. For exposures to groundwater, the ILCRs for lifelong residents estimated in this evaluation are essentially the same as those presented in the 1997 HHRA.

For exposures to soil, HIs for the occupational worker and child resident estimated in this evaluation are essentially the same as those presented in the 1997 HHRA, while the HI for the adult resident is slightly lower in this evaluation as compared to the HI presented in the 1997 HHRA. For exposures to groundwater, the HIs for child and adult residents estimated in this evaluation are essentially the same as those presented in the 1997 HHRA. The slight differences in the HIs between this evaluation and those presented in the 1997 HHRA are a consequence of the changes in exposure assumptions and changes in toxicity criteria.

The ILCRs for exposures to soil are lower in this evaluation than those presented in the 1997 HHRA. As noted above, the primary reason for the decrease in the ILCRs for exposure to soil is changes in the toxicity criteria for beryllium and dieldrin. HIs present in the 1997 HHRA and those estimated in this evaluation are similar. Although ILCRs and HIs for exposures to soil were not recalculated for the excavation workers, adolescent and adult trespassers, and future child and adult recreational users, updated cancer and non-cancer risk estimates for these receptors also would be expected to be lower than those presented in the 1997 HHRA. ILCRs and HIs for exposures to soil for these receptors in the 1997 HHRA did not exceed USEPA risk benchmarks (i.e., USEPA's target cancer risk range and an HI of 1) and would not exceed USEPA risk benchmarks if recalculated using the current risk assessment methodology described in this memorandum.

ILCRs and HIs for exposures to sediment were not recalculated for adolescent and adult trespassers and future child and adult recreational users. If the risks had been recalculated they would be expected to be lower than those presented in the 1997 HHRA because of changes in the toxicity parameters for beryllium and dieldrin and the changes in the dermal exposure guidance. ILCRs and HIs for exposures to sediment for these receptors in the 1997 HHRA were within USEPA's target risk range and would therefore still be within USEPA's target risk range if they were recalculated.

3.7 UNCERTAINTY ASSOCIATED WITH TOXICITY CRITERIA FOR TRICHLOROETHENE

As noted in Section 2.3, toxicity criteria (i.e., RfDs, CSFs) for trichloroethene are not currently published on the USEPA's IRIS database or in USEPA's Health Effects Assessment Summary Tables (HEAST). The toxicity criteria developed by the California EPA (CA EPA, 2002) were used to evaluate trichloroethene in this risk assessment because the USEPA draft toxicity values published in a recent technical document (USEPA, 2001b) are currently undergoing peer review. A range of CSFs [0.02 – 0.4 $(mg/kg/day)^{-1}$], as opposed to a single recommended value, is presented in this recent draft guidance. The draft CSFs are 2 to 30 times higher than the CA EPA CSF [0.013 $(mg/kg/day)^{-1}$]. The draft oral RfD is 0.0003 mg/kg/day as compared to the CA EPA RfD of 0.5 mg/kg/day. ILCRs and HIs for exposures to trichloroethene in groundwater under the RME and CTE scenarios were within acceptable levels (i.e., did not exceed the upper bound of the USEPA target cancer risk range or an HI of 1) for hypothetical child and adult residents evaluated using the CA EPA toxicity criteria. For exposures to trichloroethene in groundwater under the RME and CTE scenarios, ILCRs for hypothetical lifelong residents and HIs for hypothetical child and adult residents would also be within acceptable levels if the upper range of the draft USEPA toxicity values were used in the calculations.

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USEPA, 1992a. Supplemental Guidance to RAGS: Calculating the Concentration Term. 9285.7-081, Office of Solid Waste and Emergency Response, Washington, D.C. May.

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications, Interim Report. EPA/600/8-91/011B. Office of Health and Environmental Assessment, Washington, D.C., January.

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TABLES

TABLE 1
COMPARISON OF EXPOSURE ASSUMPTIONS
OCCUPATIONAL WORKERS EXPOSED TO SOIL - REASONABLE MAXIMUM EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Incidental Ingestion					
IR-S	Ingestion Rate (mg/day)	**50**	USEPA, 1991	**100**	USEPA, 2002 USEPA III, 2005
FI	Fraction Ingested (unitless)	1	USEPA, 1991	1	USEPA, 1991
EF	Exposure Frequency (days/year)	250	USEPA, 1991	250	USEPA, 1991
ED	Exposure Duration (years)	25	USEPA, 1989 USEPA, 1991	25	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1991	70	USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	9125	USEPA, 1989	9125	USEPA, 1989
Dermal Contract					
SA	Skin Surface Available for Contact (cm^2)	**3508**	USEPA, 1992	**3300**	USEPA III, 2003 USEPA, 2004
SSAF	Soil to Skin Adherence Factor (mg/cm^2/event)	**1**	USEPA, 1992 USEPA III, 1995	**0.2**	USEPA III, 2003 USEPA, 2004
DABS	Absorption Factor (unitless)	Chemical Specific	USEPA III, 1995	Chemical Specific	USEPA III, 2003 USEPA, 2004
EF	Exposure Frequency (days/year)	250	USEPA, 1991	250	USEPA, 1991
ED	Exposure Duration (years)	25	USEPA, 1989 USEPA, 1991	25	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1991	70	USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	9125	USEPA, 1989	9125	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	**0.83**	USEPA, 1991	**2.5**	USEPA, 2002
ET	Exposure Time (hours/day)	8	(2)	8	(2)
EF	Exposure Frequency (days/year)	250	USEPA, 1991	250	USEPA, 1991
ED	Exposure Duration (years)	25	USEPA, 1989 USEPA, 1991	25	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1991	70	USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	9125	USEPA, 1989	9125	USEPA, 1989
PEF	Particulate Emission Factor (m^3/kg)	**1.38E+08**	Calculated from USEPA, 1984	**4.24E+09**	Calculated from USEPA, 2002.

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-6.
2 - Length of typical work day.
USEPA, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. PB85-192219.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
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USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.
USEPA Region III, 1995: Assessing Dermal Contact with Soil. EPA/903-K-95-003.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
USEPA Region III, 2005:Risk-Based Concentration Table, April.

Values that have changed from the previous HHRA are shaded.

TABLE 2
COMPARISON OF EXPOSURE ASSUMPTIONS
OCCUPATIONAL WORKERS EXPOSED TO SOIL - CENTRAL TENDENCY EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Incidental Ingestion					
IR-S	Ingestion Rate (mg/day)	50	USEPA, 1991	50	USEPA, 1993
FI	Fraction Ingested (unitless)	1	USEPA, 1991	1	USEPA, 1991
EF	Exposure Frequency (days/year)	**250**	USEPA, 1991	**219**	USEPA, 1993
ED	Exposure Duration (years)	9	USEPA, 1989 USEPA, 1991	9	USEPA, 1993
BW	Body Weight (kg)	70	USEPA, 1991	70	USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	3285	USEPA, 1989	3285	USEPA, 1989
Dermal Contract					
SA	Skin Surface Available for Contact (cm^2)	**3508**	USEPA, 1992	**3300**	USEPA III, 2003 USEPA, 2004
SSAF	Soil to Skin Adherence Factor ($mg/cm^2/event$)	**1**	USEPA, 1992 USEPA III, 1995	**0.02**	USEPA III, 2003 USEPA, 2004
DABS	Absorption Factor (unitless)	Chemical Specific	USEPA III, 1995	Chemical Specific	USEPA III, 2003 USEPA, 2004
EF	Exposure Frequency (days/year)	**250**	USEPA, 1991	**219**	USEPA, 1993
ED	Exposure Duration (years)	9	USEPA, 1989 USEPA, 1991	9	USEPA, 1993
BW	Body Weight (kg)	70	USEPA, 1991	70	USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	3285	USEPA, 1989	3285	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	**0.83**	USEPA, 1991	**2.5**	USEPA, 2002
ET	Exposure Time (hours/day)	8	(1)	8	(1)
EF	Exposure Frequency (days/year)	**250**	USEPA, 1991	**219**	USEPA, 1993
ED	Exposure Duration (years)	9	USEPA, 1989 USEPA, 1991	9	USEPA, 1993
BW	Body Weight (kg)	70	USEPA, 1991	70	USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	3285	USEPA, 1989	3285	USEPA, 1989
PEF	Particulate Emission Factor (m^3/kg)	**1.38E+08**	Calculated from USEPA, 1984	**4.24E+09**	Calculated from USEPA, 2002.

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-7.
2 - Length of typical work day.
USEPA, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. PB85-192219.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
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USEPA Region III, 2005:Risk-Based Concentration Table, April.

Values that have changed from the previous HHRA are shaded.

TABLE 3
COMPARISON OF EXPOSURE ASSUMPTIONS
CHILD RESIDENTS EXPOSED TO SOIL - REASONABLE MAXIMUM EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Incidental Ingestion					
IR-S	Ingestion Rate (mg/day)	200	USEPA, 1991	200	USEPA, 1991
FI	Fraction Ingested (unitless)	1	USEPA, 1991	1	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	6	USEPA, 1989 USEPA, 1991	6	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2190	USEPA, 1989	2190	USEPA, 1989
Dermal Contract					
SA	Skin Surface Available for Contact	**743.8 cm^2-yr/kg**	USEPA, 1989	**2800 cm^2**	USEPA III, 2003 USEPA, 2004
SSAF	Soil to Skin Adherence Factor (mg/cm^2/event)	**1**	USEPA, 1992	**0.2**	USEPA III, 2003 USEPA, 2004
DABS	Absorption Factor (unitless)	Chemical Specific	USEPA III, 1995	Chemical Specific	USEPA III, 2003 USEPA, 2004
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	6	USEPA, 1989 USEPA, 1991	6	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2190	USEPA, 1989	2190	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	**0.83**	USEPA, 1989	**0.625**	USEPA, 1997
ET	Exposure Time (hours/day)	24	USEPA, 1991	24	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	6	USEPA, 1989 USEPA, 1991	6	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2190	USEPA, 1989	2190	USEPA, 1989
PEF	Particulate Emission Factor (m^3/kg)	**1.38E+08**	Calculated from USEPA, 1984	**4.24E+09**	Calculated from USEPA, 2002.

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-12.
USEPA, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. PB85-192219.
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USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
USEPA Region III, 2005:Risk-Based Concentration Table, April.

Values that have changed from the previous HHRA are shaded.

TABLE 4
COMPARISON OF EXPOSURE ASSUMPTIONS
CHILD RESIDENTS EXPOSED TO SOIL - CENTRAL TENDENCY EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Incidental Ingestion					
IR-S	Ingestion Rate (mg/day)	100	USEPA, 1991	100	USEPA, 1993
FI	Fraction Ingested (unitless)	1	USEPA, 1991	1	USEPA, 1991
EF	Exposure Frequency (days/year)	**350**	USEPA, 1991	**234**	USEPA, 1993
ED	Exposure Duration (years)	2	USEPA, 1989 USEPA, 1991	2	USEPA, 1993
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	730	USEPA, 1989	730	USEPA, 1989
Dermal Contract					
SA	Skin Surface Available for Contact	**245.5 cm^2-yr/kg**	USEPA, 1989	**2800 cm^2**	USEPA III, 2003 USEPA, 2004
SSAF	Soil to Skin Adherence Factor (mg/cm^2/event)	**1**	USEPA, 1992	**0.04**	USEPA III, 2003 USEPA, 2004
DABS	Absorption Factor (unitless)	Chemical Specific	USEPA III, 1995	Chemical Specific	USEPA III, 2003 USEPA, 2004
EF	Exposure Frequency (days/year)	**350**	USEPA, 1991	**234**	USEPA, 1993
ED	Exposure Duration (years)	2	USEPA, 1989 USEPA, 1991	2	USEPA, 1993
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	730	USEPA, 1989	730	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	**0.83**	USEPA, 1989	**0.625**	USEPA, 1997
ET	Exposure Time (hours/day)	24	USEPA, 1991	24	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	**2**	USEPA, 1989	**6**	USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	**730**	USEPA, 1989	**2190**	USEPA, 1989
PEF	Particulate Emission Factor (m^3/kg)	**1.38E+08**	Calculated from USEPA, 1984	**4.24E+09**	Calculated from USEPA, 2002.

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-13.
USEPA, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. PB85-192219.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 1992: Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.
USEPA Region III, 1995: Assessing Dermal Contact with Soil. EPA/903-K-95-003.
USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
USEPA Region III, 2005:Risk-Based Concentration Table, April.

Values that have changed from the previous HHRA are shaded.

TABLE 5
COMPARISON OF EXPOSURE ASSUMPTIONS
ADULT RESIDENTS EXPOSED TO SOIL - REASONABLE MAXIMUM EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Incidental Ingestion					
IR-S	Ingestion Rate (mg/day)	100	USEPA, 1991	100	USEPA, 1991
FI	Fraction Ingested (unitless)	1	USEPA, 1991	1	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	24	USEPA, 1989 USEPA, 1991	24	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	8760	USEPA, 1989	8760	USEPA, 1989
Dermal Contract					
SA	Skin Surface Available for Contact (cm^2)	**3508**	USEPA, 1996	**5700**	USEPA III, 2003 USEPA, 2004
SSAF	Soil to Skin Adherence Factor (mg/cm^2/event)	**1**	USEPA, 1992	**0.07**	USEPA III, 2003 USEPA, 2004
DABS	Absorption Factor (unitless)	Chemical Specific	USEPA III, 1995	Chemical Specific	USEPA III, 2003 USEPA, 2004
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	24	USEPA, 1989 USEPA, 1991	24	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	8760	USEPA, 1989	8760	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	0.83	USEPA, 1989	0.83	USEPA, 1997
ET	Exposure Time (hours/day)	24	USEPA, 1991	24	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	24	USEPA, 1989 USEPA, 1991	24	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	8760	USEPA, 1989	8760	USEPA, 1989
PEF	Particulate Emission Factor (m^3/kg)	**1.38E+08**	Calculated from USEPA, 1984	**4.24E+09**	Calculated from USEPA, 2002.

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-12.
USEPA, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. PB85-192219.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 1992: Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.
USEPA Region III, 1995: Assessing Dermal Contact with Soil. EPA/903-K-95-003.
USEPA, 1996: Exposure Factors Handbook. EPA 600/P-95/002.
USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
USEPA Region III, 2005:Risk-Based Concentration Table, April.

Values that have changed from the previous HHRA are shaded.

TABLE 6
COMPARISON OF EXPOSURE ASSUMPTIONS
ADULT RESIDENTS EXPOSED TO SOIL - CENTRAL TENDENCY EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Incidental Ingestion					
IR-S	Ingestion Rate (mg/day)	50	USEPA, 1991	50	USEPA, 1993
FI	Fraction Ingested (unitless)	1	USEPA, 1991	1	USEPA, 1991
EF	Exposure Frequency (days/year)	**350**	USEPA, 1991	**234**	USEPA, 1993
ED	Exposure Duration (years)	7	USEPA, 1989 USEPA, 1991	7	USEPA, 1993
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2555	USEPA, 1989	2555	USEPA, 1989
Dermal Contract					
SA	Skin Surface Available for Contact (cm^2)	**3508**	USEPA, 1996	**5700**	USEPA III, 2003 USEPA, 2004
SSAF	Soil to Skin Adherence Factor (mg/cm^2/event)	**1**	USEPA, 1992	**0.01**	USEPA III, 2003 USEPA, 2004
DABS	Absorption Factor (unitless)	Chemical Specific	USEPA III, 1995	Chemical Specific	USEPA III, 2003 USEPA, 2004
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	7	USEPA, 1989 USEPA, 1991	7	USEPA, 1993
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1993
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2555	USEPA, 1989	2555	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	0.83	USEPA, 1989	0.83	USEPA, 1997
ET	Exposure Time (hours/day)	24	USEPA, 1991	24	USEPA, 1991
EF	Exposure Frequency (days/year)	**350**	USEPA, 1991	**234**	USEPA, 1993
ED	Exposure Duration (years)	7	USEPA, 1989 USEPA, 1991	7	USEPA, 1993
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2555	USEPA, 1989	2555	USEPA, 1989
PEF	Particulate Emission Factor (m^3/kg)	**1.38E+08**	Calculated from USEPA, 1984	**4.24E+09**	Calculated from USEPA, 2002.

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-13.
USEPA, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. PB85-192219.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 1992: Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.
USEPA Region III, 1995: Assessing Dermal Contact with Soil. EPA/903-K-95-003.
USEPA, 1996: Exposure Factors Handbook. EPA 600/P-95/002.
USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
USEPA Region III, 2005:Risk-Based Concentration Table, April.

Values that have changed from the previous HHRA are shaded.

TABLE 7
COMPARISON OF EXPOSURE ASSUMPTIONS
CHILD RESIDENTS EXPOSED TO GROUNDWATER - REASONABLE MAXIMUM EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value(1)	Rationale/ Reference	New Value	Rationale/ Reference
Ingestion					
IR-GW	Ingestion Rate of Groundwater (L/day)	1	USEPA, 1991	1	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	6	USEPA, 1989 USEPA, 1991	6	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2190	USEPA, 1989	2190	USEPA, 1989
Dermal Contract					
DAevent	Dermally Absorbed Dose per Event (mg/cm^2-event)	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 2004
SA	Skin Surface Available for Contact	**2728 cm^2-yr/kg**	USEPA, 1989	**6600 cm^2**	USEPA, 2004
EV	Event Frequency (events/day)	1	USEPA, 1992	1	USEPA, 2004
ET	Exposure Time (hours/day)	0.33	USEPA, 1992	0.33	USEPA, 2004
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	6	USEPA, 1989 USEPA, 1991	6	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2190	USEPA, 1989	2190	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	Not Evaluated		**0.6**	USEPA, 1989
Ra	Air Exchange Rate (1/min)			**0.017**	Foster & Chrostowski 1987
Ds	Shower Duration (min)			**15**	Professional Judgment
Dt	Total Time in Bathroom (min)			**20**	Professional Judgment
EF	Exposure Frequency (days/year)			**350**	USEPA, 1991
ED	Exposure Duration (years)			**6**	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)			**15**	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)			**25550**	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)			**2190**	USEPA, 1989

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-24.
Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 1992: Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.
USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Values that have changed from the previous HHRA are shaded.

TABLE 8
COMPARISON OF EXPOSURE ASSUMPTIONS
CHILD RESIDENTS EXPOSED TO GROUNDWATER - CENTRAL TENDENCY EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Ingestion					
IR-GW	Ingestion Rate of Groundwater (L/day)	0.7	USEPA, 1991	0.7	USEPA, 1997
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	2	USEPA, 1989 USEPA, 1991	2	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	730	USEPA, 1989	730	USEPA, 1989
Dermal Contract					
DAevent	Dermally Absorbed Dose per Event (mg/cm^2-event)	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 2004
SA	Skin Surface Available for Contact	**850 cm^2-yr/kg**	USEPA, 1989	**6600 cm^2**	USEPA, 2004
EV	Event Frequency (events/day)	1	USEPA, 1992	1	USEPA, 2004
ET	Exposure Time (hours/day)	0.33	USEPA, 1992	0.33	USEPA, 2004
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	2	USEPA, 1989 USEPA, 1991	2	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	15	USEPA, 1989 USEPA, 1991	15	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	730	USEPA, 1989	730	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	Not Evaluated		**0.6**	USEPA, 1989
Ra	Air Exchange Rate (1/min)			**0.017**	Foster & Chrostowski 1987
Ds	Shower Duration (min)			**15**	Professional Judgment
Dt	Total Time in Bathroom (min)			**20**	Professional Judgment
EF	Exposure Frequency (days/year)			**350**	USEPA, 1991
ED	Exposure Duration (years)			**2**	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)			**15**	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)			**25550**	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)			**730**	USEPA, 1989

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-25.
Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 1992: Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.
USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Values that have changed from the previous HHRA are shaded.

TABLE 9
COMPARISON OF EXPOSURE ASSUMPTIONS
ADULT RESIDENTS EXPOSED TO GROUNDWATER - REASONABLE MAXIMUM EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Ingestion					
IR-GW	Ingestion Rate of Groundwater (L/day)	2	USEPA, 1991	2	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	24	USEPA, 1989 USEPA, 1991	24	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	8760	USEPA, 1989	8760	USEPA, 1989
Dermal Contract					
DAevent	Dermally Absorbed Dose per Event (mg/cm^2-event)	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 2004
SA	Skin Surface Available for Contact (cm^2)	**18150**	USEPA, 1989	**18000**	USEPA, 2004
EV	Event Frequency (events/day)	1	USEPA, 1992	1	USEPA, 2004
ET	Exposure Time (hours/day)	0.25	USEPA, 1992	0.25	USEPA, 2004
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	24	USEPA, 1989 USEPA, 1991	24	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	8760	USEPA, 1989	8760	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	**0.83**	USEPA, 1989	**0.6**	USEPA, 1989
Ra	Air Exchange Rate (1/min)	0.017	Foster & Chrostowski 1987	0.017	Foster & Chrostowski 1987
Ds	Shower Duration (min)	15	Professional Judgment	15	Professional Judgment
Dt	Total Time in Bathroom (min)	20	Professional Judgment	20	Professional Judgment
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	24	USEPA, 1989 USEPA, 1991	24	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	8760	USEPA, 1989	8760	USEPA, 1989

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-24.
Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 1992: Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Values that have changed from the previous HHRA are shaded.

TABLE 10
COMPARISON OF EXPOSURE ASSUMPTIONS
ADULT RESIDENTS EXPOSED TO GROUNDWATER - CENTRAL TENDENCY EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Parameter Code	Parameter Definition	Old Value[1]	Rationale/ Reference	New Value	Rationale/ Reference
Ingestion					
IR-GW	Ingestion Rate of Groundwater (L/day)	1.4	USEPA, 1991	1.4	USEPA, 1991
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	7	USEPA, 1989 USEPA, 1991	7	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2555	USEPA, 1989	2555	USEPA, 1989
Dermal Contract					
DAevent	Dermally Absorbed Dose per Event (mg/cm^2-event)	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 2004
SA	Skin Surface Available for Contact (cm^2)	**18150**	USEPA, 1989	**18000**	USEPA, 2004
EV	Event Frequency (events/day)	1	USEPA, 1992	1	USEPA, 2004
ET	Exposure Time (hours/day)	0.25	USEPA, 1992	0.25	USEPA, 2004
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	7	USEPA, 1989 USEPA, 1991	7	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2555	USEPA, 1989	2555	USEPA, 1989
Inhalation					
IR	Inhalation Rate (m^3/hr)	**0.83**	USEPA, 1989	**0.6**	USEPA, 1989
Ra	Air Exchange Rate (1/min)	0.017	Foster & Chrostowski 1987	0.017	Foster & Chrostowski 1987
Ds	Shower Duration (min)	15	Professional Judgment	15	Professional Judgment
Dt	Total Time in Bathroom (min)	20	Professional Judgment	20	Professional Judgment
EF	Exposure Frequency (days/year)	350	USEPA, 1991	350	USEPA, 1991
ED	Exposure Duration (years)	7	USEPA, 1989 USEPA, 1991	7	USEPA, 1989 USEPA, 1991
BW	Body Weight (kg)	70	USEPA, 1989 USEPA, 1991	70	USEPA, 1989 USEPA, 1991
AT-C	Averaging Time (Cancer) (days)	25550	USEPA, 1989	25550	USEPA, 1989
AT-N	Averaging Time (Non-Cancer) (days)	2555	USEPA, 1989	2555	USEPA, 1989

Notes:
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-25.
Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 1992: Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.
USEPA, 2002: Supplement Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Values that have changed from the previous HHRA are shaded.

TABLE 11
ABSORPTION FACTORS FOR THE DERMAL PATHWAY
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Chemical	Absorption Factors For Dermal Pathway	
	Old Value[1]	New Value[2,3]
PAHs	**0.1**	**0.13**
Dieldrin	0.1	0.1
Aluminum	0.01	0.01
Arsenic	**0.032**	**0.03**
Chromium	0.01	0.01
Iron	0.01	0.01
Manganese	0.01	0.01
Vanadium	0.01	0.01

1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 3-3.
2 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
3 - U.S. EPA Region 3, 2004: Updated Dermal Exposure Assessment Guidance. Philadelphia PA, June.
Values that have changed from the previous HHRA are shaded.

TABLE 12
COMPARISON OF REFERENCE DOSES
SITE 2 - ANTENNA LANDFILL AREA
NASJRB WILLOW, GROVE PENNSYLVANIA

Chemical of Potential Concern	Oral Absorption Efficiency		Oral RfD		Dermal RfD[2]		Inhalation RfD	
	Old	New[1]	Old mg/kg/day	New mg/kg/day	Old mg/kg/day	New mg/kg/day	Old mg/kg/day	New mg/kg/day
Volatiles Organic Compounds								
Trichloroethene	1	1	6.0E-03 E	**5.0E-01 CA**	6.0E-03	**5.0E-01**	NA	**1.7E-01 CA**
Semivolatile Organic Compounds								
Benzo(a)anthracene	1	1	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	1	1	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	1	1	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	1	1	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	1	1	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1	1	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	0.55	**1**	2.0E-02 I	2.0E-02 I	3.64E-02	**2.0E-02**	NA	NA
Pesticides/PCBs								
Dieldrin	0.5	**1**	5.0E-05 I	5.0E-05 I	1.0E-04	**5.0E-05**	NA	NA
Inorganics								
Aluminum	0.27	**1**	1.0E+00 E	1.0E+00 E	3.7E+00	**1.0E+00**	NA	**1.0E-03 P**
Arsenic	0.95	**1**	3.0E-04 I	3.0E-04 I	3.16E-04	**3.0E-04**	NA	NA
Barium	1	**0.7**	7.0E-02 I	7.0E-02 I	7.0E-02	**4.9E-02**	1.43E-04 A	1.4E-04 A
Beryllium	0.01	**0.007**	5.0E-03 I	**2.0E-03 I**	5.0E-01	**1.4E-05**	NA	**5.7E-06 I**
Chromium	0.01	**0.025**	5.0E-03 I	**3.0E-03 I**	5.0E-01	**7.5E-05**	NA	**3.0E-05 I**
Iron	1	1	3.0E-01 E	3.0E-01 E	3.0E-01	3.0E-01	NA	NA
Manganese (Water)	1	**0.04**	2.3E-02 I	2.3E-02 I	2.3E-02	**9.2E-04**	NA	NA
Manganese (Food)	1	**0.04**	1.4E-01 I	1.4E-01 I	1.4E-01	**5.6E-03**	1.43E-05 I	1.4E-05 I
Vanadium	0.02	**0.026**	7.0E-03 H	**1.0E-03 E**	3.5E-01	**2.6E-05**	NA	NA

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency.

A = Alternative value from HEAST.
CA = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.
E = NCEA Provisional value.
H = Health Effects Assessment Summary Tables (HEAST), July 1997.
I = Integrated Risk Information System (IRIS), June 2005.
P = Provisional EPA peer reviewed value.

Values that have changed from the previous HHRA are shaded.

TABLE 13
COMPARISON OF CANCER SLOPE FACTORS
SITE 2 - ANTENNA LANDFILL AREA
NASJRB WILLOW, GROVE PENNSYLVANIA

Chemical of Potential Concern	Oral Absorption Efficiency		Oral CSF		Dermal CSF[2]		Inhalation CSF	
	Old	New[1]	Old (mg/kg/day)$^{-1}$	New (mg/kg/day)$^{-1}$	Old (mg/kg/day)$^{-1}$	New (mg/kg/day)$^{-1}$	Old (mg/kg/day)$^{-1}$	New (mg/kg/day)$^{-1}$
Volatiles Organic Compounds								
Trichloroethene	1	1	1.1E-02 W	1.3E-02 CA	1.1E-02	1.3E-02	6.0E-03 E	7.0E-03 CA
Semivolatile Organic Compounds								
Benzo(a)anthracene	1	1	7.3E-01 [3]	7.3E-01 [3]	7.3E-01	7.3E-01	6.1E-01 [3]	NA
Benzo(a)pyrene	1	1	7.3E+00 I	7.3E+00 I	7.3E+00	7.3E+00	6.1E+00 W	3.1E+00 E
Benzo(b)fluoranthene	1	1	7.3E-01 [3]	7.3E-01 [3]	7.3E-01	7.3E-01	6.1E-01 [3]	NA
Benzo(k)fluoranthene	1	1	7.3E-02 [3]	7.3E-02 [3]	7.3E-02	7.3E-02	6.1E-02 [3]	NA
Dibenzo(a,h)anthracene	1	1	7.3E+00 [3]	7.3E+00 [3]	7.3E+00	7.3E+00	6.1E+00 [3]	NA
Indeno(1,2,3-cd)pyrene	1	1	7.3E-01 [3]	7.3E-01 [3]	7.3E-01	7.3E-01	6.1E-01 [3]	NA
Bis(2-ethylhexyl)phthalate	0.55	1	1.4E-02 I	1.4E-02 I	7.70E-03	1.4E-02	NA	NA
Pesticides/PCBs								
Dieldrin	0.5	1	1.6E+01 I	1.6E+01 I	8.0E+00	1.6E+01	1.6E+01 I	1.6E+01 I
Inorganics								
Aluminum	0.27	1	NA	NA	NA	NA	NA	NA
Arsenic	0.95	1	1.5E+00 I	1.5E+00 I	1.43E+00	1.5E+00	1.5E+01 I	1.5E+01 I
Barium	1	0.7	NA	NA	NA	NA	NA	NA
Beryllium	0.01	0.007	4.3E+00 I	NA	4.3E-02	NA	8.4E+00 I	8.4E+00 I
Chromium	0.01	0.025	NA	NA	NA	NA	4.2E+01 I	4.2E+01 I
Iron	1	1	NA	NA	NA	NA	NA	NA
Manganese (Water)	1	0.04	NA	NA	NA	NA	NA	NA
Manganese (Food)	1	0.04	NA	NA	NA	NA	NA	NA
Vanadium	0.02	0.026	NA	NA	NA	NA	NA	NA

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency.
3 - U.S. EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.

CA = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.
E = NCEA Provisional value.
H = Health Effects Assessment Summary Tables (HEAST), July 1997.
I = Integrated Risk Information System (IRIS), June 2005.
W = Withdrawn from IRIS or HEAST.

Values that have changed from the previous HHRA are shaded.

TABLE 14
COMPARISON OF DIOXIN/FURAN CONGENERS
TOXICITY EQUIVALENCY FACTORS (TEFs)
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW, GROVE PENNSYLVANIA

Dioxin/Furan Congener	TEFs	
	Old Value[1]	New Value[2]
2,3,7,8-TCDD	1	1
2,3,7,8-PeCDD	**0.5**	**1**
2,3,7,8-HxCDD	0.1	0.1
2,3,7,8-HpCDD	0.01	0.01
OCDD	**0.001**	**0.0001**
2,3,7,8-TCDF	0.1	0.1
1,2,3,7,8-PeCDF	0.05	0.05
2,3,4,7,8-PeCDF	0.5	0.5
2,3,7,8-HxCDF	0.1	0.1
2,3,7,8-HpCDF	0.01	0.01
OCDF	**0.001**	**0.0001**

Notes:
1 - USEPA, 1989. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -Dibenzofurans (CDDs and CDFs) and 1989 Update. EPA/625/3-89/016. March.
Old values are from the Remedial Investigation Report for Site 5 - Fire Training Area, February 2002, Table 3-5.
2 - World Health Organization, 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife; Environmental Health Perspectives; Volume 106, Number 12. December.

Values that have changed from the previous HHRA are shaded.

TABLE 15
COMPARISON OF EXPOSURE POINT CONCENTRATIONS
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW, GROVE PENNSYLVANIA

Chemical	Exposure Point Concentrations							
	Surface Soil		Groundwater		Surface Water		Sediment	
	Old Value[1]	New Value[2]	Old Value[1]	New Value[2]	Old Value[1]	New Value[2]	Old Value[1]	New Value[2]
Trichloroethene	NA	NA	2[3]	2[3]	NA	NA	NA	NA
Benzo(a)anthracene	1.43[4]	1.48[5]	NA	NA	NA	NA	2.49[4]	7.17[6]
Benzo(a)pyrene	1.34[4]	1.43[5]	NA	NA	NA	NA	2.66[4]	7.54[6]
Benzo(b)fluoranthene	2.38[4]	7.22[6]	NA	NA	NA	NA	3.67[4]	9.46[6]
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	1.96[4]	NA
Bis(2-Ethylhexyl)Phthalate	NA	NA	6.39[8]	6.39[8]	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.317[4]	0.387[9]	NA	NA	NA	NA	0.466[4]	0.464[7]
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.734[4]	1.65[9]	NA	NA	NA	NA	1.43[4]	NA
Dieldrin	0.57[4]	0.405[6]	NA	NA	0.0896[4]	0.18[5]	1.76[4]	1.3[10]
Aluminum	14900[4]	16043[8]	NA	NA	NA	NA	NA	NA
Arsenic	7[4]	6.94[7]	0.848[4]	0.836[8]	1.5[4]	1.8[3]	4.47[4]	4.33[8]
Barium	NA	NA	483[8]	483[8]	NA	NA	NA	NA
Chromium	32[4]	65.8[5]	15.2[4]	18.5[5]	NA	NA	NA	NA
Iron	22400[4]	24091[8]	3190[3]	4148[7]	NA	NA	24700[4]	35375[11]
Lead	NA	NA	NA	NA	NA	NA	NA	105[12]
Manganese	796[4]	767[7]	NA	NA	2780[4]	3891[6]	1260[4]	1067[7]
Vanadium	40[8]	46.8[8]	NA	NA	NA	NA	NA	NA

Notes:
All concentrations are in mg/kg.
NA - This chemical was not identified as a COPC in the previous risk assessment.
UCL = Upper Confidence Limit.
COPC = Chemical of Potential Concern.
MVUE - Minimum Variance Unbiased Estimate
1 - Old values are from the Remedial Investigation Report for Site 2 - Antenna Field Landfill, October 2004, Appendix J.
2 - Calculated according to USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites.
3 - Maximum detected concentration.
4 - Land's H-UCL.
5 - 95% Chebyshev(MVUE) UCL
6 - 99% Chebyshev(Mean, Std) UCL.
7 - Approximate Gamma 95% UCL.
8 - Student-t UCL.
9 - 99% Chebyshev(Mean, Std) UCL.
10 - 99% Chebyshev(MVUE) UCL
11 - 95% Chebyshev(Mean, Std) UCL
12 - Arithmetic mean.

TABLE 16

SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Occupational Worker	Surface Soil	Incidental Ingestion	1E-05	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene, Dieldrin, Arsenic	0.2	- -
		Dermal Contact	8E-06	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene	0.2	- -
		Total	2E-05	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Dieldrin, Arsenic	0.5	- -
Child Residents	Surface Soil	Incidental Ingestion	4E-05	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Dieldrin, Arsenic	3	- -
		Dermal Contact	1E-05	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene, Dieldrin	1	- -
		Total	5E-05	- -	Benzo(a)pyrene	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Dieldrin, Arsenic	4	- -
	Groundwater	Ingestion	8E-06	- -	- -	Arsenic	2	- -
		Dermal Contact	4E-07	- -	- -	- -	0.1	- -
		Inhalation	4E-08	- -	- -	- -	0.00009	- -
		Total	8E-06	- -	- -	Arsenic	2	- -
	Surface Water	Incidental Ingestion	9E-07	- -	- -	- -	0.3	- -
		Dermal Contact	1E-06	- -	- -	- -	0.5	- -
		Total	2E-06	- -	- -	Dieldrin	0.8	- -
	Sediment	Incidental Ingestion	8E-06	- -	- -	Benzo(a)pyrene, Dieldrin	0.2	- -
		Dermal Contact	5E-06	- -	- -	Benzo(a)pyrene	0.08	- -
		Total	1E-05	- -	- -	Benzo(a)pyrene, Dieldrin	0.3	- -
		Total All Media	8E-05				7	

TABLE 16

SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an HI > 1
Adult Residents	Surface Soil	Incidental Ingestion	2E-05	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene, Dieldrin, Arsenic	0.3	- -
		Dermal Contact	7E-06	- -	- -	Benzo(a)pyrene	0.2	- -
		Total	2E-05	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Dieldrin, Arsenic	0.5	- -
	Groundwater	Ingestion	1E-05	- -	- -	Arsenic	0.8	- -
		Dermal Contact	9E-07	- -	- -	- -	0.05	- -
		Inhalation	4E-08	- -	- -	- -	0.00009	- -
		Total	1E-05	- -	- -	Bis(2-ethylhexyl)phthalate, Arsenic	0.9	- -
	Surface Water	Incidental Ingestion	2E-07	- -	- -	- -	0.01	- -
		Dermal Contact	2E-06	- -	- -	Dieldrin	0.2	- -
		Total	3E-06	- -	- -	Dieldrin	0.2	- -
	Sediment	Incidental Ingestion	3E-06	- -	- -	Benzo(a)pyrene	0.02	- -
		Dermal Contact	3E-06	- -	- -	Benzo(a)pyrene	0.01	- -
		Total	7E-06	- -	- -	Benzo(a)pyrene	0.03	- -
		Total All Media	5E-05				2	
Lifelong Residents (Child and Adult)	Surface Soil	Incidental Ingestion	6E-05	- -	Benzo(a)pyrene, Arsenic	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Dieldrin	NA	- -
		Dermal Contact	2E-05	- -	- -	Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Dieldrin, Arsenic	NA	- -
		Total	8E-05	- -	Benzo(a)pyrene, Arsenic	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Dieldrin	NA	- -
	Groundwater	Ingestion	2E-05	- -	- -	Arsenic	NA	- -
		Dermal Contact	1E-06	- -	- -	- -	NA	- -
		Inhalation	7E-08	- -	- -	- -	NA	- -
		Total	2E-05	- -	Arsenic	Bis(2-ethylhexyl)phthalate	NA	- -
	Surface Water	Incidental Ingestion	1E-06	- -	- -	- -	NA	- -
		Dermal Contact	4E-06	- -	- -	Dieldrin	NA	- -
		Total	5E-06	- -	- -	Dieldrin	NA	- -
	Sediment	Incidental Ingestion	1E-05	- -	- -	Benzo(a)pyrene, DIeldrin	NA	- -
		Dermal Contact	8E-06	- -	- -	Benzo(a)pyrene, DIeldrin	NA	- -
		Total	2E-05	- -	- -	Benzo(a)pyrene, Dieldrin	NA	- -
		Total All Media	1E-04				NA	

TABLE 17

SUMMARY OF CANCER RISKS AND HAZARD INDICES
CENTRAL TENDENCY EXPOSURES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an HI > 1
Occupational Worker	Surface Soil	Incidental Ingestion	2E-06	- -	- -	- -	0.1	- -
		Dermal Contact	3E-07	- -	- -	- -	0.02	- -
		Total	2E-06	- -	- -	- -	0.1	- -
Child Residents	Surface Soil	Incidental Ingestion	5E-06	- -	- -	- -	1	- -
		Dermal Contact	5E-07	- -	- -	- -	0.2	- -
		Total	5E-06	- -	- -	- -	1	- -
	Groudwater	Ingestion	2E-06	- -	- -	Arsenic	1	- -
		Dermal Contact	1E-07	- -	- -	- -	0.1	- -
		Inhalation	1E-08	- -	- -	- -	0.00009	- -
		Total	2E-06	- -	- -	Arsenic	1	- -
	Surface Water	Incidental Ingestion	8E-08	- -	- -	- -	0.08	- -
		Dermal Contact	2E-07	- -	- -	- -	0.1	- -
		Total	2E-07	- -	- -	- -	0.2	- -
	Sediment	Incidental Ingestion	7E-07	- -	- -	- -	0.05	- -
		Dermal Contact	2E-07	- -	- -	- -	0.008	- -
		Total	8E-07	- -	- -	- -	0.06	- -
		Total All Media	8E-06				3	
Adult Residents	Surface Soil	Incidental Ingestion	2E-06	- -	- -	- -	0.1	- -
		Dermal Contact	2E-07	- -	- -	- -	0.02	- -
		Total	2E-06	- -	- -	- -	0.1	- -
	Groundwater	Ingestion	2E-06	- -	- -	Arsenic	0.4	- -
		Dermal Contact	1E-07	- -	- -	- -	0.02	- -
		Inhalation	1E-08	- -	- -	- -	0.00009	- -
		Total	2E-06	- -	- -	Arsenic	0.4	- -
	Surface Water	Incidental Ingestion	1E-08	- -	- -	- -	0.003	- -
		Dermal Contact	2E-07	- -	- -	- -	0.04	- -
		Total	2E-07	- -	- -	- -	0.05	- -
	Sediment	Incidental Ingestion	2E-07	- -	- -	- -	0.005	- -
		Dermal Contact	6E-08	- -	- -	- -	0.0008	- -
		Total	3E-07	- -	- -	- -	0.006	- -
		Total All Media	4E-06				0.6	
Lifelong Residents (Child and Adult)	Surface Soil	Incidental Ingestion	6E-06	- -	- -	Benzo(a)pyrene, Arsenic	NA	- -
		Dermal Contact	7E-07	- -	- -	- -	NA	- -
		Total	7E-06	- -	- -	Benzo(a)pyrene, Arsenic	NA	- -
	Groundwater	Ingestion	4E-06	- -	- -	Arsenic	NA	- -
		Dermal Contact	3E-07	- -	- -	- -	NA	- -
		Inhalation	2E-08	- -	- -	- -	NA	- -
		Total	4E-06	- -	- -	Arsenic	NA	- -
	Surface Water	Incidental Ingestion	9E-08	- -	- -	- -	NA	- -
		Dermal Contact	4E-07	- -	- -	- -	NA	- -
		Total	5E-07	- -	- -	- -	NA	- -
	Sediment	Incidental Ingestion	9E-07	- -	- -	- -	NA	- -
		Dermal Contact	2E-07	- -	- -	- -	NA	- -
		Total	1E-06	- -	- -	- -	NA	- -
		Total All Media	1E-05				NA	

TABLE 18
SUMMARY OF OCCUPATIONAL WORKERS RISKS AND HAZARDS INDICES FOR EXPOSURES TO SUBSURFACE SOIL
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		EPC[1] (mg/kg)	RBC - Industial[2] (mg/kg)	Estimated ILCR	Primary Target Organs[3]	RBC - Industial[2] (mg/kg)	Estimated HQ
Semivolatile Organic Compounds							
56-55-3	Benzo(a)anthracene	4.77	3.9	1E-06	--	NA	--
50-32-8	Benzo(a)pyrene	4.14	0.39	1E-05	--	NA	--
205-99-2	Benzo(b)fluoranthene	3.85	3.9	1E-06	--	NA	--
53-70-3	Dibenzo(a,h)anthracene	0.361	0.39	9E-07	--	NA	--
193-39-5	Indeno(1,2,3-cd)pyrene	1.30	3.9	3E-07	--	NA	--
Inorganics							
7429-90-5	Aluminum	12889	NA	--	CNS	100000	0.1
7440-38-2	Arsenic[4]	5.29	1.9	3E-06	Skin, CVS	310	0.02
7440-47-3	Chromium[5]	39.0	NA	--	Fetotoxicity, GS, Bone	3100	0.01
7439-89-6	Iron	20678	NA	--	[6]	310000	0.07
7439-96-5	Manganese	733	NA	--	CNS	20000	0.04
7440-62-2	Vanadium	31.1	NA	--	Kidney	1000	0.03
			Total Carcinogenic Risk	**2E-05**		**Total HI**	**0.3**

Target Organ HIs

Total Fetotoxicity HI =	0.01
Total GS HI =	0.01
Total Bone HI =	0.01
Total Central Nervous System (CNS) HI =	0.2
Total Kidney HI =	0.03
Total None Available (NA) HI =	0.07

Footnotes:
NA - Not applicable. The U.S. EPA has not established a cancer slope factor (CSF) or reference dose (RfD) for this chemical.
1 - Exposure Point Concentration (EPC) is the 95 percent UCL calculated according to USEPA's ProUCL guidance.
2 - USEPA Region 3 Risk-Based Concentration (RBC) Table, April 2005.
3 - Primary Target Organs are from IRIS and NCEA.
4 - The noncarcinogen RBC for arsenic was calculated using the guidance presented in USEPA Region 3 Risk-Based Concentration (RBC) Table, April 2005.
5 - RBC for hexavalent chromium is presented.
6 - The RfD for iron is based on the average daily intake for an adult and not on any adverse health effects.

TABLE 19
SUMMARY OF HYPOTHETICAL FUTURE RESIDENT RISKS AND HAZARDS INDICES FOR EXPOSURES TO SUBSURFACE SOIL
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		EPC[1] (mg/kg)	RBC - Residential[2] (mg/kg)	Estimated ILCR	Primary Target Organs[3]	RBC - Residential[2] (mg/kg)	Estimated HQ
Semivolatile Organic Compounds							
56-55-3	Benzo(a)anthracene	4.77	0.87	5E-06	--	NA	--
50-32-8	Benzo(a)pyrene	4.14	0.087	5E-05	--	NA	--
205-99-2	Benzo(b)fluoranthene	3.85	0.87	4E-06	--	NA	--
53-70-3	Dibenzo(a,h)anthracene	0.361	0.087	4E-06	--	NA	--
193-39-5	Indeno(1,2,3-cd)pyrene	1.30	0.87	1E-06	--	NA	--
Inorganics							
7429-90-5	Aluminum	12889	NA		CNS	78000	0.2
7440-38-2	Arsenic[4]	5.29	4.30E-01	1E-05	Skin, CVS	23	0.2
7440-47-3	Chromium[5]	39.0	NA	--	Fetotoxicity, GS, Bone	230	0.2
7439-89-6	Iron	20678	NA	--	[6]	23000	0.9
7439-96-5	Manganese	733	NA	--	CNS	1600	0.5
7440-62-2	Vanadium	31.1	NA	--	Kidney	78	0.4
			Total Carcinogenic Risk	**8E-05**		**Total HI**	**2**

Target Organ HIs

Total Fetotoxicity HI =	0.2
Total GS HI =	0.2
Total Bone HI =	0.2
Total Central Nervous System (CNS) HI =	0.6
Total Kidney HI =	0.4
Total None Available (NA) HI =	0.9

Footnotes:
1 - Exposure Point Concentration (EPC) is the 95 percent UCL calculated according to U.S. EPA's ProUCL guidance.
2 - USEPA Region 3 Risk-Based Concentration (RBC) Table, April 2005.
3 - Primary Target Organs are from IRIS and NCEA.
4 - RBC for hexavalent chromium is presented.
5 - NA - Not applicable. The U.S. EPA has not established a cancer slope factor (CSF) or reference dose (RfD) for this chemical.
6 - The RfD for iron is based on the average daily intake for an adult and not on any adverse health effects.

TABLE 20
COMPARISON OF CANCER RISKS AND HAZARD INDICES
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE

Receptor Group	Cancer Risk		Hazard Index	
	Old Value[1]	New Value	Old Value[1]	New Value
	Surface Soil			
Occupational Worker	1E-04	2E-05	0.6	0.5
Child Resident	NR	5E-05	4	4
Adult Resident	NR	2E-05	0.9	0.5
Lifelong Resident	3E-04	8E-05	NA	NA
	Groundwater			
Child Resident	NR	8E-06	2	2
Adult Resident	NR	1E-05	0.7	0.9
Lifelong Resident	2E-05	2E-05	NA	NA

Notes:
NR - Not reported, only results for the lifelong resident were presented in the RI report.
NA - Not applicable for this receptor.
1 - Old values are from the Remedial Investigation Report for Site 2 Antenna Field Landfill, October 2004, Table 4-25 & 4-27.

ATTACHMENT A

RAGS PART D TABLES

LIST OF TABLES
RAGS PART D TABLE 2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Table No.

2.1 Direct Contact With Surface Soil
2.2 Migration From Surface Soil to Groundwater
2.3 Direct Contact With Subsurface Soil
2.4 Migration From Subsurface Soil to Groundwater
2.5 Groundwater
2.6 Surface Water
2.7 Sediment

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	EPA Region 3 RBC (Residential)[5]	EPA SSL Soil to Air Residential[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
Site 2	**Dioxins/Furans**													
	3268-87-9	1,2,3,4,6,7,8,9-OCDD	11420 K	12640 K	ng/kg	02SS08	2/2	---	12640	NA	43000 C[8]	430000 C[8]	No	BSL
	39001-02-0	1,2,3,4,6,7,8,9-OCDF	1.1	3.5	ng/kg	02SS11	2/2	---	3.5	NA	43000 C[8]	430000 C[8]	No	BSL
	35822-46-9	1,2,3,4,6,7,8-HPCDD	54.1	84.1	ng/kg	02SS11	2/2	---	84.1	NA	430 C[8]	4300 C[8]	No	BSL
	67562-39-4	1,2,3,4,6,7,8-HPCDF	0.79	3.9	ng/kg	02SS11	2/2	---	3.9	NA	430 C[8]	4300 C[8]	No	BSL
	39227-28-6	1,2,3,4,7,8-HXCDD	0.51	1.6	ng/kg	02SS11	2/2	---	1.6	NA	43 C[8]	430 C[8]	No	BSL
	70648-26-9	1,2,3,4,7,8-HXCDF	0.29	1.3	ng/kg	02SS11	2/2	---	1.3	NA	43 C[8]	430 C[8]	No	BSL
	57653-85-7	1,2,3,6,7,8-HXCDD	0.69	1.8	ng/kg	02SS11	2/2	---	1.8	NA	43 C	430 C[8]	No	BSL
	57117-44-9	1,2,3,6,7,8-HXCDF	0.1	0.45	ng/kg	02SS11	2/2	---	0.45	NA	43 C[8]	430 C[8]	No	BSL
	19408-74-3	1,2,3,7,8,9-HXCDD	1.3	3	ng/kg	02SS11	2/2	---	3	NA	43 C[8]	430 C[8]	No	BSL
	40321-76-4	1,2,3,7,8-PECDD	0.43	0.43	ng/kg	02SS08-D	1/2	0.4 - 0.7	0.43	NA	4.3 C[8]	43 C[8]	No	BSL
	57117-41-6	1,2,3,7,8-PECDF	0.47	0.47	ng/kg	02SS11	1/2	0.1	0.47	NA	86 C[8]	860 C[8]	No	BSL
	60851-34-5	2,3,4,6,7,8-HXCDF	0.39	0.88	ng/kg	02SS11	2/2	---	0.88	NA	43 C[8]	430 C[8]	No	BSL
	57117-31-4	2,3,4,7,8-PECDF	0.62	0.62	ng/kg	02SS11	1/2	0.1 - 0.4	0.62	NA	8.6 C[8]	86 C[8]	No	BSL
	1746-01-6	2,3,7,8-TCDD	0.12	0.12	ng/kg	02SS08	1/2	0.2	0.12	NA	4.3 C	43 C	No	BSL
	51207-31-9	2,3,7,8-TCDF	0.24	0.49	ng/kg	02SS08-D	1/2	0.9	0.49	NA	43 C[8]	430 C[8]	No	BSL
		2,3,7,8-TCDD Equivalents	2.3	3	ng/kg	02SS11	2/2	---	3	NA	4.3 C	43 C	No	BSL
	37871-00-4	Total HPCDD	118	215	ng/kg	02SS11	2/2	---	215	NA	NA	NA	No	NTX
	38998-75-3	Total HPCDF	0.79	6.2	ng/kg	02SS11	2/2	---	6.2	NA	NA	NA	No	NTX
	34465-46-8	Total HXCDD	13.2	33.6	ng/kg	02SS11	2/2	---	33.6	NA	NA	NA	No	NTX
	55684-94-1	Total HXCDF	1.3	4.8	ng/kg	02SS11	2/2	---	4.8	NA	NA	NA	No	NTX
	36088-22-9	Total PECDD	0.82	2.5	ng/kg	02SS08-D	2/2	---	2.5	NA	NA	NA	No	NTX
	30402-15-4	Total PECDF	2.2	3.9	ng/kg	02SS11	2/2	1.4	3.9	NA	NA	NA	No	NTX
	41903-57-5	Total TCDD	0.14	0.9	ng/kg	02SS11	2/2	---	0.9	NA	NA	NA	No	NTX
	55722-27-5	Total TCDF	0.24	1.8	ng/kg	02SS11	2/2	---	1.8	NA	NA	NA	No	NTX
	Semivolatile Organic Compounds													
	83-32-9	Acenaphthene	43 J	86 J	ug/kg	02SS18	2/18	390 - 4200	86	NA	470000 N	NA	No	BSL
	120-12-7	Anthracene	35 J	2200 J	ug/kg	02SS13	6/18	390 - 820	2200	NA	2300000 N	NA	No	BSL
	56-55-3	**Benzo(a)anthracene**	35 J	8800	ug/kg	02SS13	15/18	390 - 470	8800	NA	**870 C**	NA	**Yes**	ASL
	50-32-8	**Benzo(a)pyrene**	48 J	8200	ug/kg	02SS13	15/18	390 - 470	8200	NA	**87 C**	NA	**Yes**	ASL
	205-99-2	**Benzo(b)fluoranthene**	88 J	11000	ug/kg	02SS13	13/18	390 - 470	11000	NA	**870 C**	NA	**Yes**	ASL
	191-24-2	Benzo(g,h,i)perylene	57 J	4600	ug/kg	02SS13	12/18	390 - 820	4600	NA	230000 N[9]	NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	99 J	5200 J	ug/kg	02SS13	11/18	390 - 820	5200	NA	8700 C	NA	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	430 J	430 J	ug/kg	02SS03	1/18	390 - 4200	430	NA	46000 C	NA	No	BSL
	86-74-8	Carbazole	95 J	180 J	ug/kg	02SS15, 02SS18	3/18	390 - 4200	180	NA	32000 C	NA	No	BSL
	218-01-9	Chrysene	60 J	9400	ug/kg	02SS13	16/18	390 - 470	9400	NA	87000 C	7500000 C	No	BSL
	84-74-2	di-n-butyl phthalate	300 J	300 J	ug/kg	02SS18	1/18	390 - 4200	300	NA	780000 N	NA	No	BSL
	53-70-3	**Dibenzo(a,h)anthracene**	57 J	760 J	ug/kg	02SS13	5/18	390 - 820	760	NA	**87 C**	NA	**Yes**	ASL
	132-64-9	Dibenzofuran	52 J	53 J	ug/kg	02SS15	2/18	390 - 4200	53	NA	16000 N	NA	No	BSL
	206-44-0	Fluoranthene	97 J	16000	ug/kg	02SS13	17/18	420	16000	NA	310000 N	NA	No	BSL
	86-73-7	Fluorene	48 J	48 J	ug/kg	02SS09	1/18	390 - 4200	48	NA	310000 N	NA	No	BSL
	193-39-5	**Indeno(1,2,3-cd)pyrene**	64 J	4900	ug/kg	02SS13	12/18	390 - 470	4900	NA	**870 C**	NA	**Yes**	ASL
	85-01-8	Phenanthrene	52 J	6700	ug/kg	02SS13	16/18	390 - 420	6700	NA	230000 N[9]	NA	No	BSL
	129-00-0	Pyrene	84 J	14000	ug/kg	02SS13	17/18	420	14000	NA	230000 N	NA	No	BSL
	Pesticides													
	319-85-7	Beta-BHC	2.6 J	2.6 J	ug/kg	02SS15	1/18	2 - 2.5	2.6	NA	350 C	6000 C	No	BSL
	60-57-1	**Dieldrin**	8.6	570	ug/kg	02SS03	8/18	3.9 - 4.8	570	NA	**40 C**	1100 C	**Yes**	ASL
	Inorganics													
	7429-90-5	**Aluminum**	8890	41900	mg/kg	02SS05	18/18	---	41900	Yes	**7800 N**	686000 N	**Yes**	ASL
	7440-36-0	Antimony	5.2	5.8	mg/kg	02SS12	4/18	4.7 - 5.8	5.8	No	**3.1 N**	NA	No	BKG
	7440-38-2	**Arsenic**	3.8 K	12.6	mg/kg	02SS03	18/18	---	12.6	Yes	**0.43 C**	745 C	**Yes**	ASL
	7440-39-3	Barium	63.7	330	mg/kg	02SS05	18/18	---	330	Yes	550 N	68600 N	No	BSL
	7440-41-7	Beryllium	0.76	2.3	mg/kg	02SS05	18/18	---	2.3	Yes	16 N	1330 C	No	BSL
	7440-70-2	Calcium	341	15700	mg/kg	02SS08	18/18	---	15700	Yes	NA	NA	No	NUT
	7440-47-3	**Chromium**	11.9	179	mg/kg	02SS05	18/18	---	179	Yes	**23 N[10]**	267 C	**Yes**	ASL
	7440-48-4	Cobalt	6.3	67.5	mg/kg	02SS05	18/18	---	67.5	Yes	160 N	1140 C	No	BSL
	7440-50-8	Copper	9.8 K	87	mg/kg	02SS05	18/18	---	87	Yes	310 N	NA	No	BSL
	7439-89-6	**Iron**	12600	63200	mg/kg	02SS05	18/18	---	63200	Yes	**2300 N**	NA	**Yes**	ASL
	7439-92-1	Lead	9.3 L	81.1	mg/kg	02SS18	18/18	---	81.1	Yes	400 [11]	NA	No	BSL
	7439-95-4	Magnesium	1100	7360	mg/kg	02SS08	18/18	---	7360	Yes	NA	NA	No	NUT
	7439-96-5	**Manganese**	247	1180	mg/kg	02SS05	18/18	---	1180	Yes	**160 N[12]**	6860 N	**Yes**	ASL

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects(2)	Concentration Used for Screening(3)	Above Background Concentration(4)	EPA Region 3 RBC (Residential)(5)	EPA SSL Soil to Air Residential(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
	7440-02-0	Nickel	9.1 K	71.2	mg/kg	02SS05	18/18	---	71.2	Yes	160 N	NA	No	BSL
	7440-09-7	Potassium	397	1690	mg/kg	02SS04	16/18	369 - 413	1690	Yes	NA	NA	No	NUT
	7440-23-5	Sodium	112	208	mg/kg	02SS08	8/18	94.1 - 116	208	Yes	NA	NA	No	NUT
	7440-28-0	Thallium	0.27	0.27	mg/kg	02SS04	1/18	0.24 - 0.29	0.27	No	0.55 N	NA	No	BSL, BKG
	7440-62-2	**Vanadium**	20.1	160	mg/kg	02SS05	18/18	---	160	Yes	**7.8 N**	NA	**Yes**	ASL
	7440-66-6	Zinc	22.3	96.2	mg/kg	02SS02	18/18	---	96.2	No	2300 N	NA	No	BSL, BKG

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - The statistical analysis presented in the Remedial Investigation Report of Site 2 - Antenna Field Area, October, 2004 was used to determine whether site concentrations were above background concentrations.
5 - The EPA Region 3 risk-based soil COPC screening level for residential land use is presented. The noncarcinogenic values (denoted with a "N" flag) are divided by 10 to correspond to a target hazard quotient of 0.1 , or an incremental cancer risk of 1.0E-06 for carcinogens (denoted with a "C" flag) (USEPA Region III, April 2005).
6 - EPA Soil Screening Levels. EPA Internet Site at http://risk.lsd.ornl.gov/calc_start.htm (SSLs for noncarcinogens are divided by 10).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be above site background. Chemicals selected as COPCs are indicated by shaded chemical names.
8 - Values are based on the criteria for 2,3,7,8-TCDD and adjusted using the World Health Organization (WHO) Toxicity Equivalent Factors (TEFs) (USEPA, 1998).
9 - The value for pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
10 - The screening criteria for residential land use for hexavalent chromium is presented. The RBC for residential land use for trivalent chromium is 120,000 mg/kg.
11 - OSWER soil screening level for residential land use (USEPA, July 1994). Value was developed using the USEPA Integrated Exposure Uptake Biokinetic Model (IEUBK) (USEPA, February 1994).
12 - The RBC for residential land use calculated using the RfDo for manganese nonfood is presented. The RBC for residential land use calculated using the RfDo for manganese food is 11,000 mg/kg.

Associated Samples:

02SS01	02SS09
02SS01-D	02SS10
02SS02	02SS11
02SS03	02SS12
02SS04	02SS13
02SS05	02SS14
02SS06	02SS15
02SS07	02SS16
02SS08	02SS17
02SS08-D	02SS18

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
K = Value estimated with a high bias
L = Value estimated with a low bias
N = Noncarcinogen
NA = Not Applicable/Not Available
RBC = Risk Based Concentration
SSL = Soil Screening Level

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background

For elimination as a COPC:
BKG = Below Background
BSL = Below Screening Level
NUT = Essential Nutrient
NTX = No Toxicity Data

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	Region 3 Soil Screening Level DAF 20[5]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Site 2	**Dioxins/Furans**														
	3268-87-9	1,2,3,4,6,7,8,9-OCDD	11420 K	12640 K	ng/kg	02SS08	2/2	---	12640	NA	86000 C[7]	NA	NA	No	BSL
	39001-02-0	1,2,3,4,6,7,8,9-OCDF	1.1	3.5	ng/kg	02SS11	2/2	---	3.5	NA	86000 C[7]	NA	NA	No	BSL
	35822-46-9	1,2,3,4,6,7,8-HPCDD	54.1	84.1	ng/kg	02SS11	2/2	---	84.1	NA	860 C[7]	NA	NA	No	BSL
	67562-39-4	1,2,3,4,6,7,8-HPCDF	0.79	3.9	ng/kg	02SS11	2/2	---	3.9	NA	860 C[7]	NA	NA	No	BSL
	39227-28-6	1,2,3,4,7,8-HXCDD	0.51	1.6	ng/kg	02SS11	2/2	---	1.6	NA	86 C[7]	NA	NA	No	BSL
	70648-26-9	1,2,3,4,7,8-HXCDF	0.29	1.3	ng/kg	02SS11	2/2	---	1.3	NA	86 C[7]	NA	NA	No	BSL
	57653-85-7	1,2,3,6,7,8-HXCDD	0.69	1.8	ng/kg	02SS11	2/2	---	1.8	NA	86 C[7]	NA	NA	No	BSL
	57117-44-9	1,2,3,6,7,8-HXCDF	0.1	0.45	ng/kg	02SS11	2/2	---	0.45	NA	86 C[7]	NA	NA	No	BSL
	19408-74-3	1,2,3,7,8,9-HXCDD	1.3	3	ng/kg	02SS11	2/2	---	3	NA	86 C[7]	NA	NA	No	BSL
	40321-76-4	1,2,3,7,8-PECDD	0.43	0.43	ng/kg	02SS08-D	1/2	0.4 - 0.7	0.43	NA	8.6 C[7]	NA	NA	No	BSL
	57117-41-6	1,2,3,7,8-PECDF	0.47	0.47	ng/kg	02SS11	1/2	0.1	0.47	NA	172 C[7]	NA	NA	No	BSL
	60851-34-5	2,3,4,6,7,8-HXCDF	0.39	0.88	ng/kg	02SS11	2/2	---	0.88	NA	86 C[7]	NA	NA	No	BSL
	57117-31-4	2,3,4,7,8-PECDF	0.62	0.62	ng/kg	02SS11	1/2	0.1 - 0.4	0.62	NA	17.2 C[7]	NA	NA	No	BSL
	1746-01-6	2,3,7,8-TCDD	0.12	0.12	ng/kg	02SS08	1/2	0.2	0.12	NA	8.6 C	NA	NA	No	BSL
	51207-31-9	2,3,7,8-TCDF	0.24	0.49	ng/kg	02SS08-D	1/2	0.9	0.49	NA	86 C[7]	NA	NA	No	BSL
		2,3,7,8-TCDD Equivalents	2.3	3	ng/kg	02SS11	2/2	---	3	NA	8.6 C	NA	NA	No	BSL
	37871-00-4	Total HPCDD	118	215	ng/kg	02SS11	2/2	---	215	NA	NA	NA	NA	No	NTX
	38998-75-3	Total HPCDF	0.79	6.2	ng/kg	02SS11	2/2	---	6.2	NA	NA	NA	NA	No	NTX
	34465-46-8	Total HXCDD	13.2	33.6	ng/kg	02SS11	2/2	---	33.6	NA	NA	NA	NA	No	NTX
	55684-94-1	Total HXCDF	1.3	4.8	ng/kg	02SS11	2/2	---	4.8	NA	NA	NA	NA	No	NTX
	36088-22-9	Total PECDD	0.82	2.5	ng/kg	02SS08-D	2/2	---	2.5	NA	NA	NA	NA	No	NTX
	30402-15-4	Total PECDF	2.2	3.9	ng/kg	02SS11	2/2	1.4	3.9	NA	NA	NA	NA	No	NTX
	41903-57-5	Total TCDD	0.14	0.9	ng/kg	02SS11	2/2	---	0.9	NA	NA	NA	NA	No	NTX
	55722-27-5	Total TCDF	0.24	1.8	ng/kg	02SS11	2/2	---	1.8	NA	NA	NA	NA	No	NTX
	Semivolatile Organic Compounds														
	83-32-9	Acenaphthene	43 J	86 J	ug/kg	02SS18	2/18	390 - 4200	86	NA	10000 N	NA	NA	No	BSL
	120-12-7	Anthracene	35 J	2200 J	ug/kg	02SS13	6/18	390 - 820	2200	NA	47000 N	NA	NA	No	BSL
	56-55-3	**Benzo(a)anthracene**	35 J	8800	ug/kg	02SS13	15/18	390 - 470	8800	NA	**1500 C**	NA	NA	**Yes**	ASL
	50-32-8	**Benzo(a)pyrene**	48 J	8200	ug/kg	02SS13	15/18	390 - 470	8200	NA	**370 C**	NA	NA	**Yes**	ASL
	205-99-2	**Benzo(b)fluoranthene**	88 J	11000	ug/kg	02SS13	13/18	390 - 470	11000	NA	**4500 C**	NA	NA	**Yes**	ASL
	191-24-2	Benzo(g,h,i)perylene	57 J	4600	ug/kg	02SS13	12/18	390 - 820	4600	NA	NA	NA	NA	No	NTX
	207-08-9	Benzo(k)fluoranthene	99 J	5200 J	ug/kg	02SS13	11/18	390 - 820	5200	NA	45000 C	NA	NA	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	430 J	430 J	ug/kg	02SS03	1/18	390 - 4200	430	NA	2900000 C	NA	NA	No	BSL
	86-74-8	Carbazole	95 J	180 J	ug/kg	02SS15, 02SS18	3/18	390 - 4200	180	NA	470 C	NA	NA	No	BSL
	218-01-9	Chrysene	60 J	9400	ug/kg	02SS13	16/18	390 - 470	9400	NA	150000 C	NA	NA	No	BSL
	84-74-2	di-n-butyl phthalate	300 J	300 J	ug/kg	02SS18	1/18	390 - 4200	300	NA	500000 N	NA	NA	No	BSL
	53-70-3	Dibenzo(a,h)anthracene	57 J	760 J	ug/kg	02SS13	5/18	390 - 820	760	NA	1400 C	NA	NA	No	BSL
	132-64-9	Dibenzofuran	52 J	53 J	ug/kg	02SS15	2/18	390 - 4200	53	NA	380 N	NA	NA	No	BSL
	206-44-0	Fluoranthene	97 J	16000	ug/kg	02SS13	17/18	420	16000	NA	630000 N	NA	NA	No	BSL
	86-73-7	Fluorene	48 J	48 J	ug/kg	02SS09	1/18	390 - 4200	48	NA	14000 N	NA	NA	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	64 J	4900	ug/kg	02SS13	12/18	390 - 470	4900	NA	13000 C	NA	NA	No	BSL
	85-01-8	Phenanthrene	52 J	6700	ug/kg	02SS13	16/18	390 - 420	6700	NA	NA	NA	NA	No	NTX
	129-00-0	Pyrene	84 J	14000	ug/kg	02SS13	17/18	420	14000	NA	68000 N	NA	NA	No	BSL
	Pesticides														
	319-85-7	Beta-BHC	2.6 J	2.6 J	ug/kg	02SS15	1/18	2 - 2.5	2.6	NA	3.1 C	NA	NA	No	BSL
	60-57-1	**Dieldrin**	8.6	570	ug/kg	02SS03	8/18	3.9 - 4.8	570	NA	**2.2 C**	NA	NA	**Yes**	ASL
	Inorganics														
	7429-90-5	Aluminum	8890	41900	mg/kg	02SS05	18/18	---	41900	Yes	NA	NA	NA	NA	NTX
	7440-36-0	Antimony	5.2	5.8	mg/kg	02SS12	4/18	4.7 - 5.8	5.8	No	**1.3 N**	NA	NA	No	BKG
	7440-38-2	**Arsenic**	3.8 K	12.6	mg/kg	02SS03	18/18	---	12.6	Yes	**0.026 C**	NA	NA	**Yes**	ASL
	7440-39-3	**Barium**	63.7	330	mg/kg	02SS05	18/18	---	330	Yes	**210 N**	NA	NA	**Yes**	ASL
	7440-41-7	Beryllium	0.76	2.3	mg/kg	02SS05	18/18	---	2.3	Yes	120 N	NA	NA	No	BSL
	7440-70-2	Calcium	341	15700	mg/kg	02SS08	18/18	---	15700	Yes	NA	NA	NA	No	NUT
	7440-47-3	**Chromium**	11.9	179	mg/kg	02SS05	18/18	---	179	Yes	**4.2 N[8]**	NA	NA	**Yes**	ASL
	7440-48-4	Cobalt	6.3	67.5	mg/kg	02SS05	18/18	---	67.5	Yes	NA	NA	NA	No	NTX
	7440-50-8	Copper	9.8 K	87	mg/kg	02SS05	18/18	---	87	Yes	1100 N	NA	NA	No	BSL
	7439-89-6	Iron	12600	63200	mg/kg	02SS05	18/18	---	63200	Yes	NA	NA	NA	No	NTX
	7439-92-1	Lead	9.3 L	81.1	mg/kg	02SS18	18/18	---	81.1	Yes	NA	NA	NA	No	NTX
	7439-95-4	Magnesium	1100	7360	mg/kg	02SS08	18/18	---	7360	Yes	NA	NA	NA	No	NUT
	7439-96-5	**Manganese**	247	1180	mg/kg	02SS05	18/18	---	1180	Yes	**95 N**	NA	NA	**Yes**	ASL

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects(2)	Concentration Used for Screening(3)	Above Background Concentration(4)	Region 3 Soil Screening Level DAF 20(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
	7440-02-0	Nickel	9.1 K	71.2	mg/kg	02SS05	18/18	---	71.2	Yes	NA	NA	NA	No	NTX
	7440-09-7	Potassium	397	1690	mg/kg	02SS04	16/18	369 - 413	1690	Yes	NA	NA	NA	No	NUT
	7440-23-5	Sodium	112	208	mg/kg	02SS08	8/18	94.1 - 116	208	Yes	NA	NA	NA	No	NUT
	7440-28-0	Thallium	0.27	0.27	mg/kg	02SS04	1/18	0.24 - 0.29	0.27	No	0.36 N	NA	NA	No	BSL, BKG
	7440-62-2	**Vanadium**	20.1	160	mg/kg	02SS05	18/18	---	160	Yes	**73 N**	NA	NA	**Yes**	ASL
	7440-66-6	Zinc	22.3	96.2	mg/kg	02SS02	18/18	---	96.2	No	1400 N	NA	NA	No	BSL, BKG

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - The statistical analysis presented in the Remedial Investigation Report of Site 2 - Antenna Field Area, October, 2004 was used to determine whether site concentrations were above background concentrations.
5 - USEPA Region III Soil Screening Level (SSL) for Groundwater Migration (value based on a Dilution and Attenuation Factor [DAF] = 20). (USEPA Region III, April 2005). The SSLs for noncarcinogenic compounds are divided by 10.
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be above site background. Chemicals selected as COPCs are indicated by shaded chemical names.
7 - Values are based on the criteria for 2,3,7,8-TCDD and adjusted using the World Health Organization (WHO) Toxicity Equivalent Factors (TEFs) (USEPA, 1998).
8 - Value is for hexavalent chromium.

Associated Samples:

02SS01	02SS09
02SS01-D	02SS10
02SS02	02SS11
02SS03	02SS12
02SS04	02SS13
02SS05	02SS14
02SS06	02SS15
02SS07	02SS16
02SS08	02SS17
02SS08-D	02SS18

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
K = Value estimated with a high bias
L = Value estimated with a low bias
N = Noncarcinogen
NA = Not Applicable/Not Available
RBC = Risk Based Concentration
SSL = Soil Screening Level

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background

For elimination as a COPC:
BKG = Below Background
BSL = Below Screening Level
NUT = Essential Nutrient
NTX = No Toxicity Data

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	EPA Region 3 RBC (Residential)[5]	EPA SSL Soil to Air Residential[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
Site 2	**Dioxins/Furans**													
	3268-87-9	1,2,3,4,6,7,8,9-OCDD	3380	9590	ng/kg	02TP05B	2/2	---	9590	NA	43000 C[8]	430000 C[8]	No	BSL
	39001-02-0	1,2,3,4,6,7,8,9-OCDF	2.9 J	2.9 J	ng/kg	02TP05B	1/2	0.64	2.9	NA	43000 C[8]	430000 C[8]	No	BSL
	35822-46-9	1,2,3,4,6,7,8-HPCDD	13.6	64	ng/kg	02TP05B	2/2	---	64	NA	430 C[8]	4300 C[8]	No	BSL
	67562-39-4	1,2,3,4,6,7,8-HPCDF	0.84	2.2	ng/kg	02TP05B	2/2	---	2.2	NA	430 C[8]	4300 C[8]	No	BSL
	39227-28-6	1,2,3,4,7,8-HXCDD	0.89	0.89	ng/kg	02TP05B	1/2	0.48	0.89	NA	43 C[8]	430 C[8]	No	BSL
	70648-26-9	1,2,3,4,7,8-HXCDF	0.17	0.33	ng/kg	02TP05B	2/2	---	0.33	NA	43 C[8]	430 C[8]	No	BSL
	57653-85-7	1,2,3,6,7,8-HXCDD	1.2	1.2	ng/kg	02TP05B	1/2	0.41	1.2	NA	43 C[8]	430 C[8]	No	BSL
	19408-74-3	1,2,3,7,8,9-HXCDD	1.8 J	1.8 J	ng/kg	02TP05B	1/2	0.41	1.8	NA	43 C[8]	430 C[8]	No	BSL
	40321-76-4	1,2,3,7,8-PECDD	0.44	0.44	ng/kg	02TP05B	1/2	0.48	0.44	NA	4.3 C[8]	43 C[8]	No	BSL
	60851-34-5	2,3,4,6,7,8-HXCDF	0.4	0.4	ng/kg	02TP08D	1/2	0.35	0.4	NA	43 C[8]	430 C[8]	No	BSL
	51207-31-9	2,3,7,8-TCDF	0.27	0.27	ng/kg	02TP05B	1/2	0.21	0.27	NA	43 C[8]	430 C[8]	No	BSL
		2,3,7,8-TCDD Equivalents	0.5	3	ng/kg	02TP05B	2/2	---	3	NA	4.3 C	43 C	No	BSL
	37871-00-4	Total HPCDD	38.9	151	ng/kg	02TP05B	2/2	---	151	NA	NA	NA	No	NTX
	38998-75-3	Total HPCDF	0.84	2.2	ng/kg	02TP05B	2/2	---	2.2	NA	NA	NA	No	NTX
	34465-46-8	Total HXCDD	2.7	22.7	ng/kg	02TP05B	2/2	---	22.7	NA	NA	NA	No	NTX
	55684-94-1	Total HXCDF	1.4	1.4	ng/kg	02TP05B	1/2	0.52	1.4	NA	NA	NA	No	NTX
	36088-22-9	Total PECDD	1.4	1.4	ng/kg	02TP05B	1/2	0.5	1.4	NA	NA	NA	No	NTX
	55722-27-5	Total TCDF	0.78	0.78	ng/kg	02TP05B	1/2	0.2	0.78	NA	NA	NA	No	NTX
	Volatile Organic Compounds													
	78-93-3	2-Butanone	21	36 J	ug/kg	02TP06C	3/36	11 - 13	36	NA	4700000 N	24000000 sat	No	BSL
	67-64-1	Acetone	16 J	90 J	ug/kg	02TP06C	12/36	11 - 13	90	NA	7000000 N	NA	No	BSL
	Semivolatile Organic Compounds													
	91-57-6	2-Methylnaphthalene	49 J	5100 J	ug/kg	02TP05C	6/36	380 - 430	5100	NA	31000 N	NA	No	BSL
	83-32-9	Acenaphthene	95 J	8100	ug/kg	02TP05C	6/36	380 - 430	8100	NA	470000 N	NA	No	BSL
	208-96-8	Acenaphthylene	63 J	700	ug/kg	02TP05C	4/36	380 - 770	700	NA	470000 N[9]	NA	No	BSL
	120-12-7	Anthracene	38 J	11000	ug/kg	02TP05C	7/36	380 - 430	11000	NA	2300000 N	NA	No	BSL
	56-55-3	**Benzo(a)anthracene**	72 J	11000	ug/kg	02TP09A	9/36	380 - 430	11000	NA	**870 C**	NA	**Yes**	ASL
	50-32-8	**Benzo(a)pyrene**	53 J	10000	ug/kg	02TP09A	9/36	380 - 430	10000	NA	**87 C**	NA	**Yes**	ASL
	205-99-2	**Benzo(b)fluoranthene**	180 J	9400	ug/kg	02TP09A	7/36	380 - 430	9400	NA	**870 C**	NA	**Yes**	ASL
	191-24-2	Benzo(g,h,i)perylene	100 J	4700 J	ug/kg	02TP09A	7/36	380 - 430	4700	NA	230000 N[10]	NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	140 J	7900	ug/kg	02TP09A	7/36	380 - 430	7900	NA	8700 C	NA	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	110 J	190 J	ug/kg	02TP07B	11/36	110 - 430	190	NA	46000 C	NA	No	BSL
	86-74-8	Carbazole	130 J	7100 J	ug/kg	02TP05C	6/36	380 - 430	7100	NA	32000 C	NA	No	BSL
	218-01-9	Chrysene	56 J	11000	ug/kg	02TP09A	10/36	380 - 430	11000	NA	87000 C	7500000 C	No	BSL
	84-74-2	di-n-butyl phthalate	61 J	61 J	ug/kg	02TP07B	1/36	43 - 770	61	NA	780000 N	NA	No	BSL
	53-70-3	**Dibenzo(a,h)anthracene**	160 J	1500 J	ug/kg	02TP09A	4/36	380 - 770	1500	NA	**87 C**	NA	**Yes**	ASL
	132-64-9	Dibenzofuran	89 J	7700	ug/kg	02TP05C	7/36	380 - 430	7700	NA	16000 N	NA	No	BSL
	206-44-0	Fluoranthene	80 J	27000	ug/kg	02TP05C	11/36	380 - 430	27000	NA	310000 N	NA	No	BSL
	86-73-7	Fluorene	120 J	12000	ug/kg	02TP05C	6/36	380 - 430	12000	NA	310000 N	NA	No	BSL
	193-39-5	**Indeno(1,2,3-cd)pyrene**	52 J	5700 J	ug/kg	02TP09A	9/36	380 - 430	5700	NA	**870 C**	NA	**Yes**	ASL
	91-20-3	Naphthalene	84 J	8900	ug/kg	02TP05C	4/36	380 - 430	8900	NA	160000 N	17000 N	No	BSL
	85-01-8	Phenanthrene	67 J	48000	ug/kg	02TP05C	13/36	380 - 430	48000	NA	230000 N[10]	NA	No	BSL
	129-00-0	Pyrene	64 J	23000	ug/kg	02TP05C	12/36	380 - 430	23000	NA	230000 N	NA	No	BSL
	Pesticides													
	72-54-8	4,4'-DDD	3.3 J	19	ug/kg	02TP07B	2/35	3.8 - 4.3	19	NA	2700 C	NA	No	BSL
	11097-69-1	Aroclor-1254	41 J	41 J	ug/kg	02TP09B	1/35	38 - 43	41	NA	320 C	NA	No	BSL
	Inorganics													
	7429-90-5	**Aluminum**	6000	30600	mg/kg	02TP03D	36/36	---	30600	Yes	**7800 N**	686000 N	**Yes**	ASL
	7440-36-0	Antimony	13.6 K	26.6 K	mg/kg	02TP07B	2/16	4.6 - 4.9	26.6	No	**3.1 N**	NA	No	BKG
	7440-38-2	**Arsenic**	1.1 L	14.8	mg/kg	02TP09B	36/36	---	14.8	Yes	**0.43 C**	745 C	**Yes**	ASL
	7440-39-3	Barium	32	390	mg/kg	02TP07D	36/36	---	390	Yes	550 N	68600 N	No	BSL
	7440-41-7	Beryllium	0.58	1.8	mg/kg	02TP08D-D	36/36	---	1.8	Yes	16 N	1330 C	No	BSL
	7440-43-9	Cadmium	5.1	13.4	mg/kg	02TP09B	2/36	1.1 - 1.3	13.4	No	**3.9 N[11]**	1780 C	No	BKG
	7440-70-2	Calcium	270	12800	mg/kg	02TP07B	33/36	573 - 773	12800	Yes	NA	NA	No	NUT
	7440-47-3	**Chromium**	6	179	mg/kg	02TP03D	36/36	---	179	Yes	**23 N[12]**	267 C	**Yes**	ASL
	7440-48-4	Cobalt	5.8	46.8	mg/kg	02TP03D	36/36	---	46.8	Yes	160 N	1140 C	No	BSL
	7440-50-8	Copper	2.6	195	mg/kg	02TP07D	36/36	---	195	Yes	310 N	NA	No	BSL
	7439-89-6	**Iron**	9750	55900	mg/kg	02TP03D	36/36	---	55900	Yes	**2300 N**	NA	**Yes**	ASL
	7439-92-1	**Lead**	1.8	1530	mg/kg	02TP07B	36/36	---	1530	Yes	**400 [13]**	NA	**Yes**	ASL
	7439-95-4	Magnesium	887	4200	mg/kg	02TP09A	36/36	---	4200	Yes	NA	NA	No	NUT

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	EPA Region 3 RBC (Residential)[5]	EPA SSL Soil to Air Residential[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
	7439-96-5	**Manganese**	214 L	3080	mg/kg	02TP07D	36/36	---	3080	Yes	**160 N[14]**	6860 N	**Yes**	ASL
	7439-97-6	Mercury	0.33	0.33	mg/kg	02TP09B	1/36	0.11 - 0.13	0.33	No	2.3 N[15]	2.9 sat	No	BSL, BKG
	7440-02-0	Nickel	7 K	46.2	mg/kg	02TP03D	36/36	---	46.2	Yes	160 N	NA	No	BSL
	7440-09-7	Potassium	386	1530	mg/kg	02TP02B	34/36	368 - 378	1530	Yes	NA	NA	No	NUT
	7782-49-2	Selenium	1.4 K	1.4 K	mg/kg	02TP09B	1/36	0.23 - 1.3	1.4	No	39 N	NA	No	BSL, BKG
	7440-22-4	Silver	1.3	9	mg/kg	02TP09B	2/36	1.1 - 1.3	9	No	39 N	NA	No	BSL, BKG
	7440-23-5	Sodium	98	241	mg/kg	02TP09B	31/36	93.5 - 98.3	241	Yes	NA	NA	No	NUT
	7440-28-0	Thallium	0.24	0.53	mg/kg	02TP03D	25/36	0.23 - 0.25	0.53	No	0.55 N	NA	No	BSL, BKG
	7440-62-2	**Vanadium**	10.7	135	mg/kg	02TP03D	36/36	---	135	Yes	**7.8 N**	NA	**Yes**	ASL
	7440-66-6	Zinc	14.8 L	811	mg/kg	02TP09B	36/36	---	811	No	2300 N	NA	No	BSL, BKG

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - The statistical analysis presented in the Remedial Investigation Report of Site 2 - Antenna Field Area, October, 2004 was used to determine whether site concentrations were above background concentrations.
5 - The EPA Region 3 risk-based soil COPC screening level for residential land use is presented. The noncarcinogenic values (denoted with a "N" flag) are divided by 10 to correspond to a target hazard quotient of 0.1 , or an incremental cancer risk of 1.0E-06 for carcinogens (denoted with a "C" flag) (USEPA Region III, April 2005).
6 - EPA Soil Screening Levels. EPA Internet Site at http://risk.lsd.ornl.gov/calc_start.htm (SSLs for noncarcinogens are divided by 10).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be above site background. Chemicals selected as COPCs are indicated by shaded chemical names.
8 - Values are based on the criteria for 2,3,7,8-TCDD and adjusted using the World Health Organization (WHO) Toxicity Equivalent Factors (TEFs) (USEPA, 1998).
9 - Acenaphthene is used as a surrogate for acenaphthylene.
10 - The value for pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
11 - The RBC for residential land use calculated using the RfDo for cadmium water is presented. The RBC for residential land use calculated using the RfDo for cadmium food is 78 mg/kg.
12 - The screening criteria for residential land use for hexavalent chromium is presented. The RBC for residential land use for trivalent chromium is 120,000 mg/kg.
13 - OSWER soil screening level for residential land use (USEPA, July 1994). Value was developed using the USEPA Integrated Exposure Uptake Biokinetic Model (IEUBK) (USEPA, February 1994).
14 - The RBC for residential land use calculated using the RfDo for manganese nonfood is presented. The RBC for residential land use calculated using the RfDo for manganese food is 11,000 mg/kg.
15 - The value of mercuric chloride is presented.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
K = Value estimated with a high bias
L = Value estimated with a low bias
N = Noncarcinogen
NA = Not Applicable/Not Available
RBC = Risk Based Concentration
SSL = Soil Screening Level
sat - Soil Saturation Limit

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background

For elimination as a COPC:
BKG = Below Background
BSL = Below Screening Level
NUT = Essential Nutrient
NTX = No Toxicity Data

Associated Samples:

02TP01A	02TP03B	02TP05B-D	02TP07D
02TP01A-D	02TP03C	02TP05C	02TP08A
02TP01B	02TP03C-D	02TP05D	02TP08B
02TP01C	02TP03D	02TP06A	02TP08C
02TP01D	02TP04A	02TP06B	02TP08D
02TP02A	02TP04B	02TP06C	02TP08D-D
02TP02B	02TP04C	02TP06D	02TP09A
02TP02C	02TP04D	02TP07A	02TP09B
02TP02D	02TP05A	02TP07B	02TP09C
02TP03A	02TP05B	02TP07C	02TP09D

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	Region 3 Soil Screening Level DAF 20[5]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Site 2	**Dioxins/Furans**														
	3268-87-9	1,2,3,4,6,7,8,9-OCDD	3380	9590	ng/kg	02TP05B	2/2	---	9590	NA	86000 C[7]	NA	NA	No	BSL
	39001-02-0	1,2,3,4,6,7,8,9-OCDF	2.9 J	2.9 J	ng/kg	02TP05B	1/2	0.64	2.9	NA	86000 C[7]	NA	NA	No	BSL
	35822-46-9	1,2,3,4,6,7,8-HPCDD	13.6	64	ng/kg	02TP05B	2/2	---	64	NA	860 C[7]	NA	NA	No	BSL
	67562-39-4	1,2,3,4,6,7,8-HPCDF	0.84	2.2	ng/kg	02TP05B	2/2	---	2.2	NA	860 C[7]	NA	NA	No	BSL
	39227-28-6	1,2,3,4,7,8-HXCDD	0.89	0.89	ng/kg	02TP05B	1/2	0.48	0.89	NA	86 C[7]	NA	NA	No	BSL
	70648-26-9	1,2,3,4,7,8-HXCDF	0.17	0.33	ng/kg	02TP05B	2/2	---	0.33	NA	86 C[7]	NA	NA	No	BSL
	57653-85-7	1,2,3,6,7,8-HXCDD	1.2	1.2	ng/kg	02TP05B	1/2	0.41	1.2	NA	86 C[7]	NA	NA	No	BSL
	19408-74-3	1,2,3,7,8,9-HXCDD	1.8 J	1.8 J	ng/kg	02TP05B	1/2	0.41	1.8	NA	86 C[7]	NA	NA	No	BSL
	40321-76-4	1,2,3,7,8-PECDD	0.44	0.44	ng/kg	02TP05B	1/2	0.48	0.44	NA	8.6 C[7]	NA	NA	No	BSL
	60851-34-5	2,3,4,6,7,8-HXCDF	0.4	0.4	ng/kg	02TP08D	1/2	0.35	0.4	NA	86 C[7]	NA	NA	No	BSL
	51207-31-9	2,3,7,8-TCDF	0.27	0.27	ng/kg	02TP05B	1/2	0.21	0.27	NA	86 C[7]	NA	NA	No	BSL
		2,3,7,8-TCDD Equivalents	0.5	3	ng/kg	02TP05B	2/2	---	3	NA	8.6 C	NA	NA	No	BSL
	37871-00-4	Total HPCDD	38.9	151	ng/kg	02TP05B	2/2	---	151	NA	NA	NA	NA	No	NTX
	38998-75-3	Total HPCDF	0.84	2.2	ng/kg	02TP05B	2/2	---	2.2	NA	NA	NA	NA	No	NTX
	34465-46-8	Total HXCDD	2.7	22.7	ng/kg	02TP05B	2/2	---	22.7	NA	NA	NA	NA	No	NTX
	55684-94-1	Total HXCDF	1.4	1.4	ng/kg	02TP05B	1/2	0.52	1.4	NA	NA	NA	NA	No	NTX
	36088-22-9	Total PECDD	1.4	1.4	ng/kg	02TP05B	1/2	0.5	1.4	NA	NA	NA	NA	No	NTX
	55722-27-5	Total TCDF	0.78	0.78	ng/kg	02TP05B	1/2	0.2	0.78	NA	NA	NA	NA	No	NTX
	Volatile Organic Compounds														
	78-93-3	2-Butanone	21	36 J	ug/kg	02TP06C	3/36	11 - 13	36	NA	2900 N	NA	NA	No	BSL
	67-64-1	Acetone	16 J	90 J	ug/kg	02TP06C	12/36	11 - 13	90	NA	2200 N	NA	NA	No	BSL
	Semivolatile Organic Compounds														
	91-57-6	**2-Methylnaphthalene**	49 J	5100 J	ug/kg	02TP05C	6/36	380 - 430	5100	NA	**440 N**	NA	NA	**Yes**	ASL
	83-32-9	Acenaphthene	95 J	8100	ug/kg	02TP05C	6/36	380 - 430	8100	NA	10000 N	NA	NA	No	BSL
	208-96-8	Acenaphthylene	63 J	700	ug/kg	02TP05C	4/36	380 - 770	700	NA	NA	NA	NA	No	BSL
	120-12-7	Anthracene	38 J	11000	ug/kg	02TP05C	7/36	380 - 430	11000	NA	47000 N	NA	NA	No	BSL
	56-55-3	**Benzo(a)anthracene**	72 J	11000	ug/kg	02TP09A	9/36	380 - 430	11000	NA	**1500 C**	NA	NA	**Yes**	ASL
	50-32-8	**Benzo(a)pyrene**	53 J	10000	ug/kg	02TP09A	9/36	380 - 430	10000	NA	**370 C**	NA	NA	**Yes**	ASL
	205-99-2	**Benzo(b)fluoranthene**	180 J	9400	ug/kg	02TP09A	7/36	380 - 430	9400	NA	**4500 C**	NA	NA	**Yes**	ASL
	191-24-2	Benzo(g,h,i)perylene	100 J	4700 J	ug/kg	02TP09A	7/36	380 - 430	4700	NA	NA	NA	NA	No	NTX
	207-08-9	Benzo(k)fluoranthene	140 J	7900	ug/kg	02TP09A	7/36	380 - 430	7900	NA	45000 C	NA	NA	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	110 J	190 J	ug/kg	02TP07B	11/36	110 - 430	190	NA	2900000 C	NA	NA	No	BSL
	86-74-8	**Carbazole**	130 J	7100 J	ug/kg	02TP05C	6/36	380 - 430	7100	NA	**470 C**	NA	NA	**Yes**	ASL
	218-01-9	Chrysene	56 J	11000	ug/kg	02TP09A	10/36	380 - 430	11000	NA	150000 C	NA	NA	No	BSL
	84-74-2	di-n-butyl phthalate	61 J	61 J	ug/kg	02TP07B	1/36	43 - 770	61	NA	500000 N	NA	NA	No	BSL
	53-70-3	**Dibenzo(a,h)anthracene**	160 J	1500 J	ug/kg	02TP09A	4/36	380 - 770	1500	NA	**1400 C**	NA	NA	**Yes**	ASL
	132-64-9	**Dibenzofuran**	89 J	7700	ug/kg	02TP05C	7/36	380 - 430	7700	NA	**380 N**	NA	NA	**Yes**	ASL
	206-44-0	Fluoranthene	80 J	27000	ug/kg	02TP05C	11/36	380 - 430	27000	NA	630000 N	NA	NA	No	BSL
	86-73-7	Fluorene	120 J	12000	ug/kg	02TP05C	6/36	380 - 430	12000	NA	14000 N	NA	NA	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	52 J	5700 J	ug/kg	02TP09A	9/36	380 - 430	5700	NA	13000 C	NA	NA	No	BSL
	91-20-3	**Naphthalene**	84 J	8900	ug/kg	02TP05C	4/36	380 - 430	8900	NA	**15 N**	NA	NA	**Yes**	ASL
	85-01-8	Phenanthrene	67 J	48000	ug/kg	02TP05C	13/36	380 - 430	48000	NA	NA	NA	NA	No	NTX
	129-00-0	Pyrene	64 J	23000	ug/kg	02TP05C	12/36	380 - 430	23000	NA	68000 N	NA	NA	No	BSL
	Pesticides														
	72-54-8	4,4'-DDD	3.3 J	19	ug/kg	02TP07B	2/35	3.8 - 4.3	19	NA	11000 C	NA	NA	No	BSL
	11097-69-1	Aroclor-1254	41 J	41 J	ug/kg	02TP09B	1/35	38 - 43	41	NA	1100 C	NA	NA	No	BSL
	Inorganics														
	7429-90-5	Aluminum	6000	30600	mg/kg	02TP03D	36/36	---	30600	Yes	NA	NA	NA	No	NTX
	7440-36-0	Antimony	13.6 K	26.6 K	mg/kg	02TP07B	2/16	4.6 - 4.9	26.6	No	**1.3 N**	NA	NA	No	BKG
	7440-38-2	**Arsenic**	1.1 L	14.8	mg/kg	02TP09B	36/36	---	14.8	Yes	**0.026 C**	NA	NA	**Yes**	ASL
	7440-39-3	**Barium**	32	390	mg/kg	02TP07D	36/36	---	390	Yes	**210 N**	NA	NA	**Yes**	ASL
	7440-41-7	Beryllium	0.58	1.8	mg/kg	02TP08D-D	36/36	---	1.8	Yes	120 N	NA	NA	No	BSL
	7440-43-9	Cadmium	5.1	13.4	mg/kg	02TP09B	2/36	1.1 - 1.3	13.4	No	**2.7 N**	NA	NA	No	BKG
	7440-70-2	Calcium	270	12800	mg/kg	02TP07B	33/36	573 - 773	12800	Yes	NA	NA	NA	No	NUT
	7440-47-3	**Chromium**	6	179	mg/kg	02TP03D	36/36	---	179	Yes	**4.2 N**	NA	NA	**Yes**	ASL
	7440-48-4	Cobalt	5.8	46.8	mg/kg	02TP03D	36/36	---	46.8	Yes	NA	NA	NA	No	NTX
	7440-50-8	Copper	2.6	195	mg/kg	02TP07D	36/36	---	195	Yes	1100 N	NA	NA	No	BSL
	7439-89-6	Iron	9750	55900	mg/kg	02TP03D	36/36	---	55900	Yes	NA	NA	NA	No	NTX
	7439-92-1	Lead	1.8	1530	mg/kg	02TP07B	36/36	---	1530	Yes	NA	NA	NA	No	NTX
	7439-95-4	Magnesium	887	4200	mg/kg	02TP09A	36/36	---	4200	Yes	NA	NA	NA	No	NUT
	7439-96-5	**Manganese**	214 L	3080	mg/kg	02TP07D	36/36	---	3080	Yes	**95 N**	NA	NA	**Yes**	ASL

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects(2)	Concentration Used for Screening(3)	Above Background Concentration(4)	Region 3 Soil Screening Level DAF 20(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
	7439-97-6	Mercury	0.33	0.33	mg/kg	02TP09B	1/36	0.11 - 0.13	0.33	No	NA	NA	NA	No	BKG
	7440-02-0	Nickel	7 K	46.2	mg/kg	02TP03D	36/36	---	46.2	Yes	NA	NA	NA	No	NTX
	7440-09-7	Potassium	386	1530	mg/kg	02TP02B	34/36	368 - 378	1530	Yes	NA	NA	NA	No	NUT
	7782-49-2	Selenium	1.4 K	1.4 K	mg/kg	02TP09B	1/36	0.23 - 1.3	1.4	No	1.9 N	NA	NA	No	BSL, BKG
	7440-22-4	Silver	1.3	9	mg/kg	02TP09B	2/36	1.1 - 1.3	9	No	**3.1 N**	NA	NA	No	BKG
	7440-23-5	Sodium	98	241	mg/kg	02TP09B	31/36	93.5 - 98.3	241	Yes	NA	NA	NA	No	NUT
	7440-28-0	Thallium	0.24	0.53	mg/kg	02TP03D	25/36	0.23 - 0.25	0.53	No	**0.36 N**	NA	NA	No	BKG
	7440-62-2	**Vanadium**	10.7	135	mg/kg	02TP03D	36/36	---	135	Yes	**73 N**	NA	NA	**Yes**	ASL
	7440-66-6	Zinc	14.8 L	811	mg/kg	02TP09B	36/36	---	811	No	1400 N	NA	NA	No	BSL, BKG

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - The statistical analysis presented in the Remedial Investigation Report of Site 2 - Antenna Field Area, October, 2004 was used to determine whether site concentrations were above background concentrations.
5 - USEPA Region III Soil Screening Level (SSL) for Groundwater Migration (value based on a Dilution and Attenuation Factor [DAF] = 20). (USEPA Region III, April 2005). The SSLs for noncarcinogenic compounds are divided by 10.
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be above site background. Chemicals selected as COPCs are indicated by shaded chemical names.
7 - Values are based on the criteria for 2,3,7,8-TCDD and adjusted using the World Health Organization (WHO) Toxicity Equivalent Factors (TEFs) (USEPA, 1998).
8 - Value is for hexavalent chromium.

Associated Samples:

02TP01A	02TP03B	02TP05B-D	02TP07D
02TP01A-D	02TP03C	02TP05C	02TP08A
02TP01B	02TP03C-D	02TP05D	02TP08B
02TP01C	02TP03D	02TP06A	02TP08C
02TP01D	02TP04A	02TP06B	02TP08D
02TP02A	02TP04B	02TP06C	02TP08D-D
02TP02B	02TP04C	02TP06D	02TP09A
02TP02C	02TP04D	02TP07A	02TP09B
02TP02D	02TP05A	02TP07B	02TP09C
02TP03A	02TP05B	02TP07C	02TP09D

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
K = Value estimated with a high bias
L = Value estimated with a low bias
N = Noncarcinogen
NA = Not Applicable/Not Available
RBC = Risk Based Concentration
SSL = Soil Screening Level
sat = Soil Saturation Limit

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background

For elimination as a COPC:
BKG = Below Background
BSL = Below Screening Level
NUT = Essential Nutrient
NTX = No Toxicity Data

TABLE 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	EPA Region 3 RBCs for Tap Water[5]	Potential ARAR/TBC[6]	Potential ARAR/TBC Source[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
Site 2	**Volatile Organic Compounds**														
	79-01-6	**Trichloroethene**	2 J	2 J	ug/L	02MW03I, 02MW03I-D	1/7	10	2	NA	**0.026 C**	5	MCL	**Yes**	ASL
	Semi-Volatile Organic Compounds														
	117-81-7	**Bis(2-Ethylhexyl)Phthalate**	1 J	8 J	ug/L	02MW01I	3/6	10	8	NA	**4.8 C**	**6**	MCL	**Yes**	ASL
	Inorganics														
	7429-90-5	Aluminum	69.7	964	ug/L	02MW01I	5/7	50	964	NA	3700 N	NA	NA	No	BSL
	7440-38-2	**Arsenic**	1.3	1.3		02MW02S	1/7	1	1.3	NA	**0.045 C**	10	MCL	**Yes**	ASL
	7440-39-3	**Barium**	105	674	ug/L	02MW04S	7/7	---	674	NA	**260 N**	2000	MCL	**Yes**	ASL
	7440-70-2	Calcium	10600	48700	ug/L	02MW01I	7/7	---	48700	NA	NA	NA	NA	No	NUT
	7440-47-3	**Chromium**	23.4	23.4	ug/L	02MW04S	1/7	5	23.4	NA	**11 N[8]**	100	MCL[9]	**Yes**	ASL
	7439-89-6	**Iron**	50.7	3190	ug/L	02MW02S	6/7	50	3190	NA	**1100 N**	NA	NA	**Yes**	ASL
	7439-92-1	Lead	1.5	1.5	ug/L	02MW02S	1/7	1 - 4	1.5	NA	15 [10]	15	MCL[11]	No	BSL
	7439-95-4	Magnesium	3420	15100	ug/L	02MW04I	7/7	---	15100	NA	NA	NA	NA	No	NUT
	7439-96-5	Manganese	8.1	66.2	ug/L	02MW02S	5/7	5	66.2	NA	73 N[12]	NA	NA	No	BSL
	7440-02-0	Nickel	20.6	20.6	ug/L	02MW04S	1/7	20	20.6	NA	73 N	NA	NA	No	BSL
	7440-09-7	Potassium	1500	3440	ug/L	02MW04S	3/7	1500	3440	NA	NA	NA	NA	No	NUT
	7440-23-5	Sodium	8150	16600	ug/L	02MW01I	7/7	---	16600	NA	NA	NA	NA	No	NUT
	7440-66-6	Zinc	10.3	15.1	ug/L	02MW04S	3/7	5 - 5.6	15.1	NA	1100 N	NA	NA	No	BSL

Footnotes
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data are available for groundwater.
5 - The EPA Region 3 tap water screening level is presented. Value represents the risk based tap water screening level divided by 10 to correspond to a target hazard quotient of 0.1 for noncarcinogens (denoted with a "N" flag), or an incremental cancer risk of 1.0E-6 for carcinogens (denoted with a "C" flag) (USEPA Region III, April 2005).
6 - USEPA Primary Drinking Water Standard (USEPA, Winter 2004). The values presented are based on MCLs or SMCLs and are presented for reference purposes only.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
Chemicals selected as COPCs are indicated by shaded chemical names.
8 - The RBC for tap water for hexavalent chromium is presented. The RBC for trivalent chromium is 55,000 ug/L.
9 - Value presented is for total chromium.
10 - No RBC is available. The Action Level promulgated under the Safe Drinking Water Act is used for screening purposes.
11 - The MCL for this parameter is actually a treatment technique. The SDWA action level (at the tap) has been presented.
12 - The RBC for tap water calculated using the RfDo for manganese nonfood is presented.

Associated Samples
02MW01I
02MW01S
02MW02S
02MW03I
02MW03I-D
02MW03SI
02MW04I
02MW04S

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
MCL = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
RBC = Risk Based Concentration

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background

For elimination as a COPC:
BSL = Below Screening Level
NUT = Essential Nutrient

TABLE 2.6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	EPA Region 3 RBCs for Tap Water[5]	Potential ARAR/TBC	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Site 2	**Semi-Volatile Organic Compounds**														
	1117-81-7	Bis(2-ethylhexyl)phthalate	10 J	10 J	ug/L	02SW04B	1/17	4 - 10	10	NA	48 C	NA	NA	No	BSL
	84-74-2	di-n-Butyl Phthalate	30 J	30 J	ug/L	02SW04B	1/17	10	30	NA	3700 N	NA	NA	No	BSL
	Pesticides														
	60-57-1	**Dieldrin**	0.04 J	0.46	ug/L	02SP02L	3/17	0.1	0.46	NA	**0.042 C**	NA	NA	**Yes**	ASL
	Inorganics														
	7429-90-5	Aluminum	157	1890	ug/L	02SP02L	6/17	50 - 666	1890	NA	37000 N	NA	NA	No	BSL
	7440-38-2	**Arsenic**	1 K	1.8 K	ug/L	02SP02L	2/17	1 - 10	1.8	NA	**0.45 C**	NA	NA	**Yes**	ASL
	7440-39-3	Barium	8	188	ug/L	02SW07	17/17	---	188	Yes	2600 N	NA	NA	No	BSL
	7440-41-7	Beryllium	4	4	ug/L	02SW04B	1/17	1 - 4	4	No	73 N	NA	NA	No	BSL, BKG
	7440-70-2	Calcium	6710	52200	ug/L	02SP02L	17/17	---	52200	Yes	NA	NA	NA	No	NUT
	7440-47-3	Chromium	7	11	ug/L	02SW12	2/17	5 - 7	11	No	110 N[7]	NA	NA	No	BSL, BKG
	7440-48-4	Cobalt	5	5	ug/L	02SP02L	1/17	5 - 10	5	No	730 N	NA	NA	No	BSL, BKG
	7439-89-6	Iron	209	6100	ug/L	02SP02L	13/17	167 - 287	6100	Yes	11000 N	NA	NA	No	BSL
	7439-92-1	Lead	1.2	10.5	ug/L	02SP02L	14/17	1	10.5	Yes	15 [8]	NA	NA	No	BSL
	7439-95-4	Magnesium	2200	18500	ug/L	02SP02L	17/17	---	18500	Yes	NA	NA	NA	No	NUT
	7439-96-5	**Manganese**	13.5	4150	ug/L	02SP04L	17/17	---	4150	Yes	**730 N[9]**	NA	NA	**Yes**	ASL
	7440-09-7	Potassium	1660	186000	ug/L	02SW04B	12/17	1500 - 2710	186000	No	NA	NA	NA	No	NUT, BKG
	7440-23-5	Sodium	3440	53400	ug/L	02SW04B	8/17	4450	53400	Yes	NA	NA	NA	No	NUT
	7440-66-6	Zinc	11.2	27	ug/L	02SW04B, 02SW11	7/17	5 - 25	27	Yes	11000 N	NA	NA	No	BSL

Footnotes
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - The statistical analysis presented in the Remedial Investigation Report of Site 2 - Antenna Field Area, October, 2004 was used to determine whether site concentrations were above background concentrations.
5 - The EPA Region 3 tap water screening level is presented. For noncarcinogens the actual RBC is presented which corresponds to an HI of 1. For carcinogens the RBC has been multiplied by 10 to correspond to a cancer risk level of 1E-5. (USEPA Region III, April 2005).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be above site background. Chemicals selected as COPCs are indicated by shaded chemical names.
7 - The RBC for tap water for hexavalent chromium is presented. The RBC for trivalent chromium is 55,000 ug/L.
8 - No RBC is available. The Action Level promulgated under the Safe Drinking Water Act is used for screening purposes.
9 - The RBC for tap water calculated using the RfDo for manganese nonfood is presented.

Associated Samples

02SP01L	02SW07
02SP02L	02SW08
02SP03L	02SW09
02SP04L	02SW10
02SW01	02SW11
02SW01-D	02SW12
02SW02	02SW13
02SW04	02SW14
02SW04B	02SW15

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
K = Value estimated with a high bias
MCL = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
RBC = Risk Based Concentration

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background

For elimination as a COPC:
BKG = Below Background
BSL = Below Screening Level
NUT = Essential Nutrient

TABLE 2.7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects[2]	Concentration Used for Screening[3]	Above Background Concentration[4]	EPA Region 3 RBC (Residential)[5]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Site 2	**Volatile Organic Compounds**														
	108-88-3	Toluene	13	13	ug/kg	02SD13	1/19	5 - 20	13	NA	16000000 N	NA	NA	No	BSL
	Semivolatile Organic Compounds														
	121-14-2	2,4-Dinitrotoluene	1100	1100	ug/kg	02SD02	1/19	360 - 4500	1100	NA	160000 N	NA	NA	No	BSL
	606-20-2	2,6-Dinitrotoluene	79 J	79 J	ug/kg	02SD02	1/19	360 - 4500	79	NA	78000 N	NA	NA	No	BSL
	91-57-6	2-Methylnaphthalene	170 J	170 J	ug/kg	02SD04-D	1/19	360 - 4500	170	NA	310000 N	NA	NA	No	BSL
	83-32-9	Acenaphthene	38 J	2300 J	ug/kg	02SD04	5/19	360 - 4500	2300	NA	4700000 N	NA	NA	No	BSL
	208-96-8	Acenaphthylene	170 J	170 J	ug/kg	02SD07	1/19	360 - 4500	170	NA	4700000 N[7]	NA	NA	No	BSL
	120-12-7	Anthracene	45 J	6100 J	ug/kg	02SD04	13/19	430 - 820	6100	NA	23000000 N	NA	NA	No	BSL
	56-55-3	**Benzo(a)anthracene**	180 J	12000 J	ug/kg	02SD04	15/19	430 - 820	12000	NA	**8700 C**	NA	NA	**Yes**	ASL
	50-32-8	**Benzo(a)pyrene**	160 J	12000 J	ug/kg	02SD04	15/19	430 - 820	12000	NA	**870 C**	NA	NA	**Yes**	ASL
	205-99-2	**Benzo(b)fluoranthene**	140 J	15000 J	ug/kg	02SD04	15/19	430 - 820	15000	NA	**8700 C**	NA	NA	**Yes**	ASL
	191-24-2	Benzo(g,h,i)perylene	75 J	4900	ug/kg	02SD15	14/19	430 - 2500	4900	NA	2300000 N[8]	NA	NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	190 J	9500 J	ug/kg	02SD04	13/19	430 - 820	9500	NA	87000 C	NA	NA	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	37 J	2600 J	ug/kg	02SD04	8/19	390 - 4500	2600	NA	460000 C	NA	NA	No	BSL
	85-68-7	Butyl Benzyl Phthalate	53 J	69 J	ug/kg	02SD14	2/19	360 - 4500	69	NA	3400000 C	NA	NA	No	BSL
	86-74-8	Carbazole	170 J	1800 J	ug/kg	02SD15	2/6	550 - 660	1800	NA	320000 C	NA	NA	No	BSL
	218-01-9	Chrysene	86 J	14000 J	ug/kg	02SD04	16/19	430 - 820	14000	NA	870000 C	NA	NA	No	BSL
	53-70-3	**Dibenzo(a,h)anthracene**	43 J	2000 J	ug/kg	02SD15	10/19	390 - 820	2000	NA	**870 C**	NA	NA	**Yes**	ASL
	132-64-9	Dibenzofuran	44 J	1600 J	ug/kg	02SD04	4/19	360 - 4500	1600	NA	160000 N	NA	NA	No	BSL
	206-44-0	Fluoranthene	140 J	28000 J	ug/kg	02SD04	16/19	430 - 820	28000	NA	3100000 N	NA	NA	No	BSL
	86-73-7	Fluorene	49 J	3600 J	ug/kg	02SD04	8/19	360 - 4500	3600	NA	3100000 N	NA	NA	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	87 J	6300 J	ug/kg	02SD04	14/19	430 - 820	6300	NA	8700 C	NA	NA	No	BSL
	86-30-6	n-Nitrosodiphenylamine	620	620	ug/kg	02SD02	1/19	360 - 4500	620	NA	1300000 C	NA	NA	No	BSL
	91-20-3	Naphthalene	250 J	250 J	ug/kg	02SD04-D	1/19	360 - 4500	250	NA	1600000 N	NA	NA	No	BSL
	85-01-8	Phenanthrene	220 J	27000 J	ug/kg	02SD04	15/19	430 - 820	27000	NA	2300000 N[8]	NA	NA	No	BSL
	129-00-0	Pyrene	130 J	24000 J	ug/kg	02SD04	16/19	430 - 820	24000	NA	2300000 N	NA	NA	No	BSL
	Pesticides														
	309-00-2	Aldrin	19	19	ug/kg	02SD01	1/19	2.2 - 60	19	NA	380 C	NA	NA	No	BSL
	5103-71-9	alpha-Chlordane	7 J	7 J	ug/kg	02SD15	1/19	2.2 - 600	7	NA	18000 C[9]	NA	NA	No	BSL
	60-57-1	**Dieldrin**	40	2400	ug/kg	02SP02S	9/19	4.5 - 120	2400	NA	**400 C**	NA	NA	**Yes**	ASL
	959-98-8	Endosulfan I	12	12	ug/kg	02SD01	1/19	2.2 - 60	12	NA	470000 N	NA	NA	No	BSL
	5103-74-2	gamma-Chlordane	11	11	ug/kg	02SD15	1/19	2.2 - 600	11	NA	18000 C[9]	NA	NA	No	BSL
	Inorganics														
	7429-90-5	Aluminum	4330	19400	mg/kg	02SD13	19/19	---	19400	Yes	78000 N	NA	NA	No	BSL
	7440-36-0	Antimony	6.9	18.9	mg/kg	02SD15	4/19	5.1 - 13.6	18.9	No	31 N	NA	NA	No	BSL, BKG
	7440-38-2	**Arsenic**	1.7 J	7.3	mg/kg	02SD14	19/19	---	7.3	Yes	**4.3 C**	NA	NA	**Yes**	ASL
	7440-39-3	Barium	55.2	704 K	mg/kg	02SD04	19/19	---	704	Yes	5500 N	NA	NA	No	BSL
	7440-41-7	Beryllium	0.63	10.5 K	mg/kg	02SD04-D	7/19	0.59 - 1.2	10.5	Yes	160 N	NA	NA	No	BSL
	7440-43-9	Cadmium	1.6 L	2.3 L	mg/kg	02SD09	3/19	0.71 - 2.4	2.3	No	39 N[10]	NA	NA	No	BSL, BKG
	7440-70-2	Calcium	749	49500	mg/kg	02SD04-D	19/19	---	49500	No	NA	NA	NA	NA	NUT, BKG
	7440-47-3	Chromium	10	145	mg/kg	02SD04-D	18/19	10.9	145	Yes	230 N[11]	NA	NA	No	BSL
	7440-48-4	Cobalt	3.6	98.1	mg/kg	02SD04-D	19/19	---	98.1	Yes	1600 N	NA	NA	No	BSL
	7440-50-8	Copper	9.5	980 K	mg/kg	02SD04-D	16/19	6.9 - 8.5	980	Yes	3100 N	NA	NA	No	BSL
	57-12-5	Cyanide	3	3	mg/kg	02SD14	1/6	0.63 - 0.98	3	No	1600 N[12]	NA	NA	No	BSL, BKG
	7439-89-6	**Iron**	7670 J	75600 J	mg/kg	02SD09	19/19	---	75600	Yes	**23000 N**	NA	NA	**Yes**	ASL
	7439-92-1	**Lead**	6.6 J	687 J	mg/kg	02SD04-D	19/19	---	687	Yes	**400 [13]**	NA	NA	**Yes**	ASL
	7439-95-4	Magnesium	618	27400	mg/kg	02SD04-D	19/19	---	27400	No	NA	NA	NA	NA	NUT, BKG
	7439-96-5	**Manganese**	125 J	3580	mg/kg	02SD15	19/19	---	3580	Yes	**1600 N[14]**	NA	NA	**Yes**	ASL
	7439-97-6	Mercury	0.12	0.12	mg/kg	02SD06	1/19	0.09 - 0.2	0.12	No	23 N[15]	NA	NA	No	BSL, BKG
	7440-02-0	Nickel	5.7	379 J	mg/kg	02SD04-D	18/19	15.9	379	Yes	1600 N	NA	NA	No	BSL
	7440-09-7	Potassium	650	1260	mg/kg	02SD04	12/19	423 - 1190	1260	No	NA	NA	NA	NA	NUT, BKG
	7782-49-2	Selenium	2.1 K	2.1 K	mg/kg	02SD04-D	1/19	0.25 - 10	2.1	No	390 N	NA	NA	No	BSL, BKG
	7440-23-5	Sodium	141	1890 K	mg/kg	02SD04	4/19	132 - 1350	1890	No	NA	NA	NA	NA	NUT, BKG
	7440-28-0	Thallium	0.36	0.45 J	mg/kg	02SD06	2/19	0.25 - 0.65	0.45	No	5.5 N	NA	NA	No	BSL, BKG
	7440-62-2	Vanadium	11.8	38.6	mg/kg	02SD13	19/19	---	38.6	No	78 N	NA	NA	No	BSL, BKG
	7440-66-6	Zinc	36.2	4390 J	mg/kg	02SD04-D	19/19	---	4390	Yes	23000 N	NA	NA	No	BSL

TABLE 2.7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample with Maximum Concentration	Frequency of Detection	Range of Nondects(2)	Concentration Used for Screening(3)	Above Background Concentration(4)	EPA Region 3 RBC (Residential)(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - The statistical analysis presented in the Remedial Investigation Report of Site 2 - Antenna Field Area, October, 2004 was used to determine whether site concentrations were above background concentrations.
5 - The EPA Region 3 risk-based soil COPC screening level for residential land use is presented. For carcinogens the RBC has been multiplied by 10 to correspond to a cancer risk level of 1E-5. (USEPA Region III, April 2005).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be above site background. Chemicals selected as COPCs are indicated by shaded chemical names.
7 - Acenaphthene is used as a surrogate for acenaphthylene.
8 - The value for pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
9 - The value for chlordane is used as a surrogate for alpha- and gamma-chlordane.
10 - The RBC for residential land use calculated using the RfDo for cadmium water is presented. The RBC for residential land use calculated using the RfDo for cadmium food is 78 mg/kg.
11 - The screening criteria for residential land use for hexavalent chromium is presented. The RBC for residential land use for trivalent chromium is 120,000 mg/kg.
12 - The value of free cyanide is presented.
13 - OSWER soil screening level for residential land use (USEPA, July 1994). Value was developed using the USEPA Integrated Exposure Uptake Biokinetic Model (IEUBK) (USEPA, February 1994).
14 - The RBC for residential land use calculated using the RfDo for manganese nonfood is presented. The RBC for residential land use calculated using the RfDo for manganese food is 11,000 mg/kg.
15 - The value of mercuric chloride is presented.

Associated Samples:

02SD05	02SD07
02SD06	02SD08
02SP01S	02SD09
02SP02S	02SD10
02SP03S	02SD10-D
02SP04S	02SD11
02SD01	02SD12
02SD02	02SD13
02SD03	02SD14
02SD04	02SD15
02SD04-D	

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
K = Value estimated with a high bias
L = Value estimated with a low bias
N = Noncarcinogen
NA = Not Applicable/Not Available
RBC = Risk Based Concentration

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background

For elimination as a COPC:
BKG = Below Background
BSL = Below Screening Level
NUT = Essential Nutrient
NTX = No Toxicity Data

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MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

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3.2.RME	Subsurface Soil
3.3.RME	Groundwater
3.4.RME	Surface Water
3.5.RME	Sediment

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NASJRB WILLOW GROVE

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site 2	Benzo(a)anthracene	mg/kg	0.826	1.48 (L)	8.8	1.48	mg/kg	95% Chebyshev(MVUE) UCL	W-Test (1)
	Benzo(a)pyrene	mg/kg	0.812	1.43 (L)	8.2	1.43	mg/kg	95% Chebyshev(MVUE) UCL	W-Test (1)
	Benzo(b)fluoranthene	mg/kg	1.20	7.22 (NP)	11	7.22	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (2)
	Dibenzo(a,h)anthracene	mg/kg	0.230	0.387 (NP)	0.76 J	0.387	mg/kg	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (3)
	Indeno(1,2,3-cd)pyrene	mg/kg	0.506	1.65 (NP)	4.9	1.65	mg/kg	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (3)
	Dieldrin	mg/kg	0.071	0.405 (NP)	0.57	0.405	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (2)
	Aluminum	mg/kg	13050	16043 (NP)	41900	16043	mg/kg	Student-t UCL	W-, A-D, & K-S Test (4)
	Arsenic	mg/kg	6.15	6.94 (G)	12.6	6.94	mg/kg	Approximate Gamma 95% UCL	A-D & K-S Test (5)
	Chromium	mg/kg	26.5	65.8 (NP)	179	65.8	mg/kg	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (3)
	Iron	mg/kg	19508	24091 (NP)	63200	24091	mg/kg	Student-t UCL	W-, A-D, & K-S Test (4)
	Manganese	mg/kg	663	767 (G)	1180	767	mg/kg	Approximate Gamma 95% UCL	A-D & K-S Test (5)
	Vanadium	mg/kg	33.8	46.8 (NP)	160	46.8	mg/kg	Student-t UCL	W-, A-D, & K-S Test (4)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the average value was used in the calculation.
G = Gamma.
J = Estimated.
L = Lognormal.
NP = Non-parametric.
1 - The Shapiro-Wilks W test indicates that the data are log-normally distributed. The ProUCL guidance recommends that the 95% Chebyshev(MVUE) UCL be used as the exposure point concentration.
2 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 99% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
3 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 95% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
4 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the Student-t UCL be used as the exposure point concentration.
5 - The Anderson-Darling and Kolmogorov-Smirnov tests indicate that the data follows a gamma distribution. The ProUCL guidance recommends that the approximate gamma UCL be used as the exposure point concentration.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site 2	Benzo(a)anthracene	mg/kg	0.875	4.77 (NP)	11	4.77	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (1)
	Benzo(a)pyrene	mg/kg	0.778	4.14 (NP)	10	4.14	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (1)
	Benzo(b)fluoranthene	mg/kg	0.749	3.85 (NP)	9.4	3.85	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (1)
	Dibenzo(a,h)anthracene	mg/kg	0.280	0.361 (NP)	1.5 J	0.361	mg/kg	Student-t UCL	W-, A-D, & K-S Test (2)
	Indeno(1,2,3-cd)pyrene	mg/kg	0.506	1.3 (NP)	5.7 J	1.30	mg/kg	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (3)
	Aluminum	mg/kg	11752	12889 (G)	30600	12889	mg/kg	Approximate Gamma 95% UCL	A-D & K-S Test (4)
	Arsenic	mg/kg	3.31	5.29 (NP)	14.8	5.29	mg/kg	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (3)
	Chromium	mg/kg	18.6	39 (NP)	179	39.0	mg/kg	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (3)
	Iron	mg/kg	18501	20678 (NP)	55900	20678	mg/kg	Student-t UCL	W-, A-D, & K-S Test (2)
	Lead	mg/kg	79.0	579 (NP)	1530	79.0	mg/kg	Arithmetic Mean	(5)
	Manganese	mg/kg	622	733 (G)	3080	733	mg/kg	Approximate Gamma 95% UCL	A-D & K-S Test (4)
	Vanadium	mg/kg	25.5	31.1 (NP)	135	31.1	mg/kg	Student-t UCL	W-, A-D, & K-S Test (2)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the average value was used in the calculation.
G = Gamma.
J = Estimated.
NP = Non-parametric
1 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 99% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
2 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the Student-t UCL be used as the exposure point concentration.
3 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 95% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
4 - The Anderson-Darling and Kolmogorov-Smirnov tests indicate that the data follows a gamma distribution. The ProUCL guidance recommends that the approximate gamma UCL be used as the exposure point concentration.
5 - Mean concentration is used as exposure point concentration for evaluating exposures to lead.
U.S. EPA, 1994:Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for lead in Children

TABLE 3.3.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site 2	Trichloroethene	ug/L	4.57	5.4 (NP)	2 J	2	ug/L	Maximum Concentration	W-, A-D, & K-S Test (1)
	Bis(2-Ethylhexyl)Phthalate	ug/L	4.33	6.39 (N)	8 J	6.39	ug/L	Student-t UCL	W-Test (2)
	Arsenic	ug/L	0.614	0.836 (NP)	1.3	0.836	ug/L	Student-t UCL	W-, A-D, & K-S Test (3)
	Barium	ug/L	336	483 (N)	674	483	ug/L	Student-t UCL	W-Test (2)
	Chromium	ug/L	5.49	18.5 (NP)	23.4	18.5	ug/L	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (4)
	Iron	ug/L	1022	4148 (G)	3190	4148	ug/L	Approximate Gamma 95% UCL	A-D, & K-S Test (5)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the average value was used in the calculation.
G = Gamma.
J = Estimated.
N = Normal.
NP = Non-parametric.
1 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the Student-t or Modified-t UCL be used as the exposure point concentration. The Student-t or Modified-t UCL are greater than the maximum detected concentration therefore the maximum detected concentration is used as the exposure point concentration.
2 - The Shapiro-Wilks W test indicates that the data are normally distributed. The ProUCL guidance recommends that the Student-t UCL be used as the exposure point concentration.
3 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the Student-t UCL be used as the exposure point concentration.
4 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 95% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
5 - The Anderson-Darling and Kolmogorov-Smirnov tests indicate that the data follows a gamma distribution. The ProUCL guidance recommends that the approximate gamma UCL be used as the exposure point concentration.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.4.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site 2	Dieldrin	ug/L	0.075	0.18 (NP)	0.46	0.180	ug/L	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (1)
	Arsenic	ug/L	1.16	2.26 (NP)	1.8 K	1.80	ug/L	Maximum Concentration	W-, A-D, & K-S Test (2)
	Manganese	ug/L	646	3891 (NP)	4150	3891	ug/L	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (3)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the average value was used in the calculation.
K = Estimated with high biased.
NP = Non-parametric.
1 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 95% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
2 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 95% Chebyshev(Mean, Std) UCL be used as the exposure point concentration. The 95% Chebyshev(Mean, Std) UCL is greater than the maximum detected concentration therefore the maximum detected concentration is used as the exposure point concentration.
3 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 99% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.5.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site 2	Benzo(a)anthracene	mg/kg	1.34	7.17 (NP)	9.05 J	7.17	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (1)
	Benzo(a)pyrene	mg/kg	1.44	7.54 (NP)	9.3 J	7.54	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (1)
	Benzo(b)fluoranthene	mg/kg	1.80	9.46 (NP)	11.5 J	9.46	mg/kg	99% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (1)
	Dibenzo(a,h)anthracene	mg/kg	0.305	0.464 (G)	2 J	0.464	mg/kg	Approximate Gamma 95% UCL	A-D & K-S Test (2)
	Dieldrin	mg/kg	0.216	1.3 (L)	2.4	1.30	mg/kg	99% Chebyshev(MVUE) UCL	W-Test (3)
	Arsenic	mg/kg	3.76	4.33 (N)	7.3	4.33	mg/kg	Student-t	W-Test (4)
	Iron	mg/kg	19319	35375 (NP)	75600 J	35375	mg/kg	95% Chebyshev(Mean, Std) UCL	W-, A-D, & K-S Test (5)
	Lead	mg/kg	105	165 (G)	496.5 J	105	mg/kg	Arithmetic Mean	(6)
	Manganese	mg/kg	723	1067 (G)	3580	1067	mg/kg	Approximate Gamma 95% UCL	A-D & K-S Test (2)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the average value was used in the calculation.
G = Gamma.
J = Estimated.
L = Lognormal
N = Normal.
NP = Non-parametric.
1 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 99% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
2 - The Anderson-Darling and Kolmogorov-Smirnov tests indicate that the data follows a gamma distribution. The ProUCL guidance recommends that the approximate gamma UCL be used as the exposure point concentration.
3 - The Shapiro-Wilks W test indicates that the data are log-normally distributed. The ProUCL guidance recommends that the 99% Chebyshev(MVUE) UCL be used as the exposure point concentration.
4 - The Shapiro-Wilks W test indicates that the data are normally distributed. The ProUCL guidance recommends that the Student-t UCL be used as the exposure point concentration.
5 - The Shapiro-Wilks, Anderson-Darling, and Kolmogorov-Smirnov tests indicate that the data is non-parametric. The ProUCL guidance recommends that the 95% Chebyshev(Mean, Std) UCL be used as the exposure point concentration.
6 - Mean concentration is used as exposure point concentration for evaluating exposures to lead.
U.S. EPA, 1994:Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for lead in Children

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

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4.12 Intermediate Variables For Calculating DA(Event)

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

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	Occupational Worker	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 2002b, 2005	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	250	days/year	USEPA, 1991	
				ED	Exposure Duration	25	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	
Dermal	Occupational Worker	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2003, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2003, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2003, 2004	
				EF	Exposure Frequency	250	days/year	USEPA, 1991	
				ED	Exposure Duration	25	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA Region III, 2005:Risk-Based Concentration Table, April.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.49E-07 Cancer Dermal Intake = 2.31E-06

Noncancer Ingestion Intake = 9.78E-07 Noncancer Dermal Intake = 6.46E-06

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

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	Resident	Child	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2003, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2003, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2003, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.10E-06 Cancer Dermal Intake = 3.07E-06

Noncancer Ingestion Intake = 1.28E-05 Noncancer Dermal Intake = 3.58E-05

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 2	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1	L/day	USEPA, 1991	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1991	BW x AT
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.33	hours/day	USEPA, 2004	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	See text for calculation of DAevent.
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 5.48E-06 Cancer Dermal Intake = 3.62E+01

Noncancer Ingestion Intake = 6.39E-05 Noncancer Dermal Intake = 4.22E+02

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	Site 2	S	Volatile Chemical Generation Rate	Derived	mg/m3-min shower	Foster&Chrostowski 1987	Intake (mg/kg/day) =
				IRsh	Inhalation Rate of volatiles in shower	0.6	m3/hr	USEPA, 1989	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	S x IR x K x EF x ED
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	BW x AT x Ra x CF
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				Ra	Air Exchange Rate	0.017	min-1	Foster&Chrostowski 1987	
				CF	Conversion Factor	60	min/hr		
				Ds	Shower Duration	15	min	Professional judgment	
				Dt	Total Time in Bathroom	20	min	Professional judgment	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	2,190	days	USEPA, 1989	

Sources

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.

Unit Intake Calculations

Inhalation Intake = (IRsh x EF x ED)/(BW x AT x Ra x CF)

Cancer Inhalation Intake = 3.29E-03 Noncancer Inhalation Intake = 3.84E-02

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 2	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.05	L/hour	USEPA 4, 2000	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	4	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	52	events/year	(1)	BW x AT
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	(1)	DAevent x EV x EF x ED x SA
				ET	Exposure Time	4	hours/event	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	See text for calculation of DAevent.
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assumes child is exposed to surface water one day a week.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA Region 4, 2000: Supplement Guidance to RAGS: Region 4 Bulletins.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.63E-07 Cancer Dermal Intake = 2.28E+00

Noncancer Ingestion Intake = 1.90E-06 Noncancer Dermal Intake = 2.66E+01

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	(1)	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	6	years	USEPA, 1989, 1991	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Sources:

1 - Professional judgment. Assumes child is exposed to sediment one day a week.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 8.14E-08 Cancer Dermal Intake = 4.56E-07

Noncancer Ingestion Intake = 9.50E-07 Noncancer Dermal Intake = 5.32E-06

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

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	Resident	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2003, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2003, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2003, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 4.70E-07 Cancer Dermal Intake = 1.87E-06

Noncancer Ingestion Intake = 1.37E-06 Noncancer Dermal Intake = 5.47E-06

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 2	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	USEPA, 1991	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1991	BW x AT
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.25	hours/day	USEPA, 2004	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	See text for calculation of DAevent.
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 9.39E-06 Cancer Dermal Intake = 8.45E+01

Noncancer Ingestion Intake = 2.74E-05 Noncancer Dermal Intake = 2.47E+02

TABLE 4.9.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Site 2	S	Volatile Chemical Generation Rate	Derived	mg/m3-min shower	Foster&Chrostowski 1987	Chronic Daily Intake (CDI) (mg/kg-day)=
				IRsh	Inhalation Rate of volatiles in shower	0.6	m3/hr	USEPA, 1989	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	S x IRsh x K x EF x ED
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	BW x AT x Ra x CF
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				Ra	Air Exchange Rate	0.017	min-1	Foster&Chrostowski 1987	
				CF	Conversion Factor	60	min/hr		
				Ds	Shower Duration	15	min	Professional judgment	
				Dt	Total Time in Bathroom	20	min	Professional judgment	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	8760	days	USEPA ,1989	

Sources

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.

Unit Intake Calculations

Inhalation Intake = (IRsh x EF x ED)/(BW x AT x Ra x CF)

Cancer Inhalation Intake = 2.82E-03 Noncancer Inhalation Intake = 8.22E-03

TABLE 4.10.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 2	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2000	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	4	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	52	events/year	(1)	BW x AT
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	(1)	DAevent x EV x EF x ED x SA
				ET	Exposure Time	4	hours/event	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	See text for calculation of DAevent.
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assumes adult is exposed to surface water one day a week.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA Region 4, 2000: Supplement Guidance to RAGS: Region 4 Bulletins.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.79E-08 Cancer Dermal Intake = 3.98E+00

Noncancer Ingestion Intake = 8.14E-08 Noncancer Dermal Intake = 1.16E+01

TABLE 4.11.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(1)	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	USEPA, 1989, 1991	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assumes adult is exposed to sediment one day a week.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.49E-08 Cancer Dermal Intake = 2.78E-07

Noncancer Ingestion Intake = 1.02E-07 Noncancer Dermal Intake = 8.12E-07

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

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	Occupational Worker	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	219	days/year	USEPA, 1993	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	
Dermal	Occupational Worker	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2003, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.02	mg/cm2/event	USEPA, 2003, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2003, 2004	
				EF	Exposure Frequency	219	days/year	USEPA, 1993	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 5.51E-08 Cancer Dermal Intake = 7.27E-08

Noncancer Ingestion Intake = 4.29E-07 Noncancer Dermal Intake = 5.66E-07

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

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	Resident	Child	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED	Exposure Duration	2	years	USEPA, 1993	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2003, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2003, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2003, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED	Exposure Duration	2	years	USEPA, 1993	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.22E-07 Cancer Dermal Intake = 1.37E-07

Noncancer Ingestion Intake = 4.27E-06 Noncancer Dermal Intake = 4.79E-06

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 2	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	0.7	L/day	USEPA, 1997	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1991	BW x AT
				ED	Exposure Duration	2	years	USEPA, 1993	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.33	hours/day	USEPA, 2004	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	2	years	USEPA, 1993	See text for calculation of DAevent.
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.28E-06 Cancer Dermal Intake = 1.21E+01

Noncancer Ingestion Intake = 4.47E-05 Noncancer Dermal Intake = 4.22E+02

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	Site 2	S	Volatile Chemical Generation Rate	Derived	mg/m3-min shower	Foster&Chrostowski 1987	Intake (mg/kg/day) =
				IRsh	Inhalation Rate of volatiles in shower	0.6	m3/hr	USEPA, 1989	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	S x IR x K x EF x ED
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	BW x AT x Ra x CF
				ED	Exposure Duration	2	years	USEPA, 1993	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				Ra	Air Exchange Rate	0.017	min-1	Foster&Chrostowski 1987	
				CF	Conversion Factor	60	min/hr		
				Ds	Shower Duration	10	min	Professional judgment	
				Dt	Total Time in Bathroom	15	min	Professional judgment	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	730	days	USEPA, 1989	

Sources

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.

Unit Intake Calculations

Inhalation Intake = (IRsh x EF x ED)/(BW x AT x Ra x CF)

Cancer Inhalation Intake = 1.10E-03 Noncancer Inhalation Intake = 3.84E-02

TABLE 4.5.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES
NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 2	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.05	L/hour	USEPA 4, 2000	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	26	events/year	(1)	BW x AT
				ED	Exposure Duration	2	years	USEPA, 1993	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	(1)	DAevent x EV x EF x ED x SA
				ET	Exposure Time	2	hours/event	(1)	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	2	years	USEPA, 1993	See text for calculation of DAevent.
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assumes child is exposed to surface water one day every other week.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA Region 4, 2000: Supplement Guidance to RAGS: Region 4 Bulletins.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.36E-08 Cancer Dermal Intake = 3.80E-01

Noncancer Ingestion Intake = 4.75E-07 Noncancer Dermal Intake = 1.33E+01

TABLE 4.6.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(1)	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	2	years	USEPA, 1993	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.00E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	2	years	USEPA, 1993	
				BW	Body Weight	15	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Sources:

1 - Professional judgment. Assumes child is exposed to sediment one day every other week.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 6.78E-09 Cancer Dermal Intake = 1.52E-08

Noncancer Ingestion Intake = 2.37E-07 Noncancer Dermal Intake = 5.32E-07

TABLE 4.7.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

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	Resident	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED	Exposure Duration	7	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2003, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2003, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2003, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED	Exposure Duration	7	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA Region III, 2003: Updated Dermal Exposure Assessment Guidance.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 4.58E-08 Cancer Dermal Intake = 5.22E-08

Noncancer Ingestion Intake = 4.58E-07 Noncancer Dermal Intake = 5.22E-07

TABLE 4.8.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 2	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.4	L/day	USEPA, 1991	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1991	BW x AT
				ED	Exposure Duration	7	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.17	hours/day	USEPA, 2004	BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1991	
				ED	Exposure Duration	7	years	USEPA, 1989, 1991	See text for calculation of DAevent.
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.28E-06 Cancer Dermal Intake = 1.65E+01

Noncancer Ingestion Intake = 1.28E-05 Noncancer Dermal Intake = 1.65E+02

TABLE 4.9.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Site 2	S	Volatile Chemical Generation Rate	Derived	mg/m3-min shower	Foster&Chrostowski 1987	Chronic Daily Intake (CDI) (mg/kg-day)=
				IRsh	Inhalation Rate of volatiles in shower	0.6	m3/hr	USEPA, 1989	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	S x IRsh x K x EF x ED
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	BW x AT x Ra x CF
				ED	Exposure Duration	7	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				Ra	Air Exchange Rate	0.017	min-1	Foster&Chrostowski 1987	
				CF	Conversion Factor	60	min/hr		
				Ds	Shower Duration	15	min	Professional judgment	
				Dt	Total Time in Bathroom	20	min	Professional judgment	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	2555	days	USEPA ,1989	

Sources

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.

Unit Intake Calculations

Inhalation Intake = (IRsh x EF x ED)/(BW x AT x Ra x CF)

Cancer Inhalation Intake = 8.22E-04 Noncancer Inhalation Intake = 8.22E-03

TABLE 4.10.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES
NASJRB WILLOW GROVE

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 2	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2000	
				CF	Conversion factor	0.001	ug/mg	--	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	26	events/year	(1)	BW x AT
				ED	Exposure Duration	7	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	5,000	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	2	hours/event	(1)	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	7	years	USEPA, 1993	See text for calculation of DAevent.
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assumes adult is exposed to surface water one day every other week.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA Region 4, 2000: Supplement Guidance to RAGS: Region 4 Bulletins.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.04E-09 Cancer Dermal Intake = 5.09E-01

Noncancer Ingestion Intake = 2.04E-08 Noncancer Dermal Intake = 5.09E+00

TABLE 4.11.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	25	mg/day	(2)	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	26	days/year	(2)	
				ED	Exposure Duration	7	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	Site 2	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.00E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,000	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(2)	
				ED	Exposure Duration	7	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assumes adult is exposed to sediment one day every other week.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.54E-09 Cancer Dermal Intake = 5.09E-09

Noncancer Ingestion Intake = 2.54E-08 Noncancer Dermal Intake = 5.09E-08

TABLE 4.12
INTERMEDIATE VARIABLES FOR CALCULATING DA(EVENT)
SITE 2 - ANTENNA FIELD LANDFILL
NASJRB WILLOW, GROVE PENNSYLVANIA

Chemical of Potential Concern	Media	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Volatile Organic Compounds												
Trichloroethene	Groundwater	NA	1	1.2E-02	cm/hr	(1)	hr	5.8E-01	hr	1.4E+00	hr	5.1E-02
Semivolatile Organic Compounds												
Benzo(a)anthracene	Soil, Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	Soil, Sediment	0.13	NA	NA	NA	(1)	hr	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	Soil, Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	Soil	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	Groundwater	NA	0.8	2.5E-02	cm/hr	(1)	hr	1.7E+01	hr	4.0E+01	hr	1.9E-01
Dibenzo(a,h)anthracene	Soil, Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	Soil	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides												
Dieldrin	Soil, Surface Water, Sediment	0.1	0.8	1.2E-02	cm/hr	(1)	hr	1.5E+01	hr	3.5E+01	hr	9.2E-02
Inorganics												
Aluminum	Soil	0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Soil, Groundwater, Surface Water, Sediment	0.03	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Barium	Groundwater	0.01	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Chromium VI	Soil, Groundwater	0.01	1	2.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Iron	Soil, Groundwater, Sediment	0.01	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Manganese	Soil, Surface Water, Sediment	0.01	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Vanadium	Soil	0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
All values from EPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.
1 - T(event) is 0.33 hr for the child resident and 0.25 hr for the adult resident for exposures to groundwater.
T(event) is 4 hr child and adult resident under the RME scenario and 2 hr under the CTE scenario for exposures to surface water.

FA = Fraction Absorbed Water
Kp = Dermal Permeability Coefficient of Compound in Water
T(event) = Event Duration
Tau = Lag Time
T* = Time to Reach Steady-State
B = Dimensionless Ratio of the Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis
NA = Not applicable.

LIST OF TABLES
RAGS PART D TABLE 5
NON-CANCER TOXICITY DATA

Table No.

5-1 Non-Cancer Toxicity Data - Oral/Dermal
5-2 Non-Cancer Toxicity Data - Inhalation

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
NASJRB WILLOW GROVE, PENNSYLVANIA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds										
Trichloroethene	Chronic	5.0E-01	mg/kg/day	1	5.0E-01	mg/kg/day	Liver	NA	CA EPA	12/2002
Semivolatile Organic Compounds										
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000/1	IRIS	6/3/2005
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides										
Dieldrin	Chronic	5.0E-05	mg/kg/day	1	5.0E-05	mg/kg/day	Liver	100/1	IRIS	6/3/2005
Metals										
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	NCEA	4/7/2005
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	6/3/2005
Barium	Chronic	7.0E-02	mg/kg/day	0.07	4.9E-03	mg/kg/day	Kidney	3/1	IRIS	6/3/2005
Chromium VI	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	Fetotoxicity, GS, Bone	300/3	IRIS	6/3/2005
Iron	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	NA	NA	NCEA	4/7/2005
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	3/1	IRIS	6/3/2005
Vanadium	Chronic	1.0E-03	mg/kg/day	0.026	2.6E-05	mg/kg/day	Kidney	300	NCEA	5/2000

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

Definitions:
CNS = Central Nervous System.
CVS = Cardiovascular System.
CA EPA = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.
EPA 3 = USEPA Region 3 Risk-Based Concentration Table, April 7, 2005.
GS = Gastrointestinal System
IRIS = Integrated Risk Information System
NA = Not Applicable
NCEA = National Center for Environmental Assessment - USEPA Region 3 RBC Table, April 7, 2005.

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
NASJRB WILLOW GROVE, PENNSYLVANIA

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds									
Trichloroethene	Chronic	6.0E-01	mg/m^3	1.7E-01	(mg/kg/day)	Liver	NA	CA EPA	12/2002
Semivolatile Organic Compounds									
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides									
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals									
Aluminum	Chronic	3.5E-03	mg/m^3	1.0E-03	(mg/kg/day)	CNS	300	NCEA	7/26/2001
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	Chronic	5.0E-04	mg/m^3	1.4E-04	(mg/kg/day)	Fetotoxicity	1000/1	HEAST	7/1997
Chromium VI	Chronic	1.0E-04	mg/m^3	2.9E-05	(mg/kg/day)	Lungs	300/1	IRIS	6/3/2005
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	1.4E-05	(mg/kg/day)	CNS	1000/1	IRIS	6/3/2005
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - Extrapolated RfD = RfC *$20m^3$/day / 70 kg

Definitions:
CA EPA = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.
CNS = Central Nervous System.
HEAST = Health Effects Assessment Summary Tables, July 1997.
IRIS = Integrated Risk Information System
NA = Not Applicable
NCEA = National Center for Environmental Assessment - USEPA Region 3 RBC Table, April 7, 2005.

LIST OF TABLES
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CANCER TOXICITY DATA

Table No.

6-1 Cancer Toxicity Data - Oral/Dermal
6-2 Cancer Toxicity Data - Inhalation

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
NASJRB WILLOW GROVE, PENNSYLVANIA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds								
Trichloroethene	1.3E-02	$(mg/kg/day)^{-1}$	1	1.3E-02	$(mg/kg/day)^{-1}$	C	CA EPA	12/2002
Semivolatile Organic Compounds								
Benzo(a)anthracene	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	EPA(1)	7/1993
Benzo(a)pyrene	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	6/3/2005
Benzo(b)fluoranthene	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	EPA(1)	7/1993
Benzo(k)fluoranthene	7.3E-02	$(mg/kg/day)^{-1}$	1	7.3E-02	$(mg/kg/day)^{-1}$	B2	EPA(1)	7/1993
Bis(2-ethylhexyl)phthalate	1.4E-02	$(mg/kg/day)^{-1}$	1	1.4E-02	$(mg/kg/day)^{-1}$	B2	IRIS	6/3/2005
Dibenzo(a,h)anthracene	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	EPA(1)	7/1993
Indeno(1,2,3-cd)pyrene	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	EPA(1)	7/1993
Pesticides								
Dieldrin	1.6E+01	$(mg/kg/day)^{-1}$	1	1.6E+01	$(mg/kg/day)^{-1}$	B2	IRIS	6/3/2005
Metals								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	6/3/2005
Barium	NA	NA	NA	NA	NA	D	IRIS	6/3/2005
Chromium VI	NA	NA	NA	NA	NA	D	IRIS	6/3/2005
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	B2	IRIS	6/3/2005
Manganese	NA	NA	NA	NA	NA	D	IRIS	6/3/2005
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.

EPA 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.

EPA(1) = U.S. EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.

CA EPA = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.

IRIS = Integrated Risk Information System.

NA = Not Available.

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
NASJRB WILLOW GROVE, PENNSYLVANIA

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds							
Trichloroethene	2.0E-03	$(mg/m^3)^{-1}$	7.0E-03	$(mg/kg/day)^{-1}$	C	CA EPA	12/2002
Semivolatile Organic Compounds							
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	8.9E-01	$(mg/m^3)^{-1}$	3.1E+00	$(mg/kg/day)^{-1}$	B2	NCEA	4/7/2005
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	4.0E-03	$(mg/m^3)^{-1}$	1.4E-02	$(mg/kg/day)^{-1}$	B2	NCEA	4/7/2005
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA
Pesticides							
Dieldrin	4.6E+00	$(mg/m^3)^{-1}$	1.6E+01	$(mg/kg/day)^{-1}$	B2	IRIS	6/3/2005
Metals							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E+00	$(mg/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS	6/3/2005
Barium	NA	NA	NA	NA	D	IRIS	6/3/2005
Chromium VI	1.2E+01	$(mg/m^3)^{-1}$	4.2E+01	$(mg/kg/day)^{-1}$	A	IRIS	6/3/2005
Iron	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	B2	IRIS	6/3/2005
Manganese	NA	NA	NA	NA	D	IRIS	6/3/2005
Vanadium	NA	NA	NA	NA	NA	NA	NA

Notes:

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:

EPA 3 = U.S. EPA Region 3 RBC Table, April 7, 2005.

IRIS = Integrated Risk Information System.

NA = Not Available.

NCEA = National Center for Environmental Assessment

CA EPA = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.

EPA 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.

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RAGS PART D TABLE 7
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

Table No.

REASONABLE MAXIMUM EXPOSURES

7.1.RME Occupational Workers
7.2.RME Child Residents
7.3.RME Adult Residents

CENTRAL TENDENCY EXPOSURES

7.1.CTE Occupational Workers
7.2.CTE Child Residents
7.3.CTE Adult Residents

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Occupational 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	
Surface Soil	Surface Soil	Site 2	Ingestion	Benzo(a)anthracene	1.48	mg/kg	5.2E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	3.8E-07	1.4E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	5.0E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	3.6E-06	1.4E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	2.5E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.8E-06	7.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	1.4E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	9.9E-07	3.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	5.8E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	4.2E-07	1.6E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	1.4E-07	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	2.3E-06	4.0E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.008
				Aluminum	16043	mg/kg	5.6E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.02
				Arsenic	6.94	mg/kg	2.4E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.6E-06	6.8E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium	65.8	mg/kg	2.3E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.4E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.02
				Iron	24091	mg/kg	8.4E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.4E-02	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.08
				Manganese	767	mg/kg	2.7E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.5E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.03
				Vanadium	46.8	mg/kg	1.6E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.6E-05	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.05
			Exp. Route Total								1.3E-05					0.2
			Dermal	Benzo(a)anthracene	1.48	mg/kg	4.4E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	3.2E-07	1.2E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	4.3E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	3.1E-06	1.2E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	2.2E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.6E-06	6.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	1.2E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	8.5E-07	3.2E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	4.9E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	3.6E-07	1.4E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	9.3E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	1.5E-06	2.6E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.005
				Aluminum	16043	mg/kg	3.7E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.001
				Arsenic	6.94	mg/kg	4.8E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.2E-07	1.3E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.004
				Chromium	65.8	mg/kg	1.5E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.2E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.06
				Iron	24091	mg/kg	5.6E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.005
				Manganese	767	mg/kg	1.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.0E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.05
				Vanadium	46.8	mg/kg	1.1E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.0E-06	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.1
			Exp. Route Total								8.5E-06					0.2
		Exposure Point Total									2.2E-05					0.5
	Exposure Medium Total										2.2E-05					0.5
Medium Total											2.2E-05					0.5
										Total of Receptor Risks Across All Media	2.2E-05				Total of Receptor Hazards Across All Media	0.5

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
Receptor Age: Child

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	
Surface Soil	Surface Soil	Site 2	Ingestion	Benzo(a)anthracene	1.48	mg/kg	1.6E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.2E-06	1.9E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	1.6E-06	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.1E-05	1.8E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	7.9E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	5.8E-06	9.2E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	4.2E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	3.1E-06	4.9E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	1.8E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.3E-06	2.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	4.4E-07	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	7.1E-06	5.2E-06	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.1
				Aluminum	16043	mg/kg	1.8E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.1E-01	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.2
				Arsenic	6.94	mg/kg	7.6E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-05	8.9E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.3
				Chromium	65.8	mg/kg	7.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.4E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.3
				Iron	24091	mg/kg	2.6E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.1E-01	(mg/kg/day)	3.0E-01	(mg/kg/day)	1.0
				Manganese	767	mg/kg	8.4E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.8E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.4
				Vanadium	46.8	mg/kg	5.1E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.0E-04	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.6
			Exp. Route Total								4.1E-05					2.9
			Dermal	Benzo(a)anthracene	1.48	mg/kg	5.9E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	4.3E-07	6.9E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	5.7E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	4.2E-06	6.7E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	2.9E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.1E-06	3.4E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	1.5E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.1E-06	1.8E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	6.6E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	4.8E-07	7.7E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	1.2E-07	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	2.0E-06	1.4E-06	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.03
				Aluminum	16043	mg/kg	4.9E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.7E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.006
				Arsenic	6.94	mg/kg	6.4E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	9.6E-07	7.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium	65.8	mg/kg	2.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.4E-05	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.3
				Iron	24091	mg/kg	7.4E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.6E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.03
				Manganese	767	mg/kg	2.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.7E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.3
				Vanadium	46.8	mg/kg	1.4E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.7E-05	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.6
			Exp. Route Total								1.1E-05					1.3
		Exposure Point Total									5.3E-05					4.3
	Exposure Medium Total										5.3E-05					4.3
Medium Total											5.3E-05					4.3
Groundwater	Groundwater	Site 2	Ingestion	Trichloroethene	2.00	ug/L	1.1E-05	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	1.4E-07	1.3E-04	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.0003
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	3.5E-05	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	4.9E-07	4.1E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.02
				Arsenic	0.836	ug/L	4.6E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.9E-06	5.3E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				Barium	483	ug/L	2.6E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.1E-02	(mg/kg/day)	7.0E-02	(mg/kg/day)	0.4
				Chromium	18.5	ug/L	1.0E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-03	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.4
				Iron	4148	ug/L	2.3E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.7E-01	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.9
			Exp. Route Total								7.5E-06					1.9
			Dermal	Trichloroethene	2.00	ug/L	1.0E-06	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	1.3E-08	1.2E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.00002
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	3.0E-05	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	4.2E-07	3.5E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.02
				Arsenic	0.836	ug/L	1.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.5E-08	1.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Barium	483	ug/L	5.8E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.7E-05	(mg/kg/day)	4.9E-03	(mg/kg/day)	0.01
				Chromium	18.5	ug/L	4.4E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.2E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.07
				Iron	4148	ug/L	5.0E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.8E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.002
			Exp. Route Total								4.5E-07					0.1
		Exposure Point Total									8.0E-06					2.0
	Exposure Medium Total										8.0E-06					2.0

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
Receptor Age: Child

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	
Groundwater	Air	Site 2	Inhalation	Trichloroethene	0.002	mg/m3	5.1E-06	(mg/kg/day)	7.0E-03	$(mg/kg/day)^{-1}$	3.6E-08	1.5E-05	(mg/kg/day)	1.7E-01	(mg/kg/day)	0.00009
				Bis(2-Ethylhexyl)Phthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.5E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Barium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-04	(mg/kg/day)	--
				Chromium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	4.2E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	2.9E-05	(mg/kg/day)	--
				Iron	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								3.6E-08					0.00009
		Exposure Point Total									3.6E-08					0.00009
	Exposure Medium Total										3.6E-08					0.00009
Medium Total											8.0E-06					2.0
Surface Water	Surface Water	Site 2	Ingestion	Dieldrin	0.180	ug/L	2.9E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	4.7E-07	3.4E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.007
				Arsenic	1.80	ug/L	2.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.4E-07	3.4E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
				Manganese	3891	ug/L	6.3E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.4E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.3
			Exp. Route Total								9.1E-07					0.3
			Dermal	Dieldrin	0.180	ug/L	8.5E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	1.4E-06	9.9E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.02
				Arsenic	1.80	ug/L	1.6E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.5E-08	1.9E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0006
				Manganese	3891	ug/L	3.5E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.1E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.4
			Exp. Route Total								1.4E-06					0.5
		Exposure Point Total									2.3E-06					0.8
	Exposure Medium Total										2.3E-06					0.8
Medium Total											2.3E-06					0.8
Sediment	Sediment	Site 2	Ingestion	Benzo(a)anthracene	7.17	mg/kg	5.8E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	4.3E-07	6.8E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	6.1E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	4.5E-06	7.2E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	7.7E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	5.6E-07	9.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	3.8E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.8E-07	4.4E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	1.1E-07	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	1.7E-06	1.2E-06	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.02
				Arsenic	4.33	mg/kg	3.5E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.3E-07	4.1E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
				Iron	35375	mg/kg	2.9E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.4E-02	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.1
				Lead	105	mg/kg	8.5E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	8.7E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.04
			Exp. Route Total								8.0E-06					0.2
			Dermal	Benzo(a)anthracene	7.17	mg/kg	4.2E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	3.1E-07	5.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	4.5E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	3.3E-06	5.2E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	5.6E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	4.1E-07	6.5E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	2.7E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.0E-07	3.2E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	5.9E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	9.5E-07	6.9E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.01
				Arsenic	4.33	mg/kg	5.9E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	8.9E-08	6.9E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Iron	35375	mg/kg	1.6E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.9E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.006
				Lead	105	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	4.9E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.7E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.06
			Exp. Route Total								5.2E-06					0.08
		Exposure Point Total									1.3E-05					0.3
	Exposure Medium Total										1.3E-05					0.3
Medium Total											1.3E-05					0.3
										Total of Receptor Risks Across All Media	7.6E-05			Total of Receptor Hazards Across All Media		7.3

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
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	
Surface Soil	Surface Soil	Site 2	Ingestion	Benzo(a)anthracene	1.48	mg/kg	7.0E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	5.1E-07	2.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	6.7E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	4.9E-06	2.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	3.4E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.5E-06	9.9E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	1.8E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.3E-06	5.3E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	7.7E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	5.7E-07	2.3E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	1.9E-07	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	3.0E-06	5.5E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.01
				Aluminum	16043	mg/kg	7.5E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.2E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.02
				Arsenic	6.94	mg/kg	3.3E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.9E-06	9.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.03
				Chromium	65.8	mg/kg	3.1E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.0E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.03
				Iron	24091	mg/kg	1.1E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.3E-02	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.1
				Manganese	767	mg/kg	3.6E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.04
				Vanadium	46.8	mg/kg	2.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.4E-05	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.06
			Exp. Route Total								1.8E-05					0.3
			Dermal	Benzo(a)anthracene	1.48	mg/kg	3.6E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.6E-07	1.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	3.5E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.5E-06	1.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	1.8E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.3E-06	5.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	9.4E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	6.9E-07	2.7E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	4.0E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.9E-07	1.2E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	7.6E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	1.2E-06	2.2E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.004
				Aluminum	16043	mg/kg	3.0E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.8E-04	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.0009
				Arsenic	6.94	mg/kg	3.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.9E-07	1.1E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.004
				Chromium	65.8	mg/kg	1.2E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.05
				Iron	24091	mg/kg	4.5E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.004
				Manganese	767	mg/kg	1.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.2E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.04
				Vanadium	46.8	mg/kg	8.8E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.6E-06	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.10
			Exp. Route Total								6.9E-06					0.2
		Exposure Point Total									2.5E-05					0.5
	Exposure Medium Total										2.5E-05					0.5
Medium Total											2.5E-05					0.5
Groundwater	Groundwater	Site 2	Ingestion	Trichloroethene	2.00	ug/L	1.9E-05	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	2.4E-07	5.5E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.0001
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	6.0E-05	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	8.4E-07	1.8E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.009
				Arsenic	0.836	ug/L	7.9E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.2E-05	2.3E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.08
				Barium	483	ug/L	4.5E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-02	(mg/kg/day)	7.0E-02	(mg/kg/day)	0.2
				Chromium	18.5	ug/L	1.7E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.1E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.2
				Iron	4148	ug/L	3.9E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-01	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.4
			Exp. Route Total								1.3E-05					0.8
			Dermal	Trichloroethene	2.00	ug/L	2.1E-06	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	2.7E-08	6.0E-06	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.00001
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	6.1E-05	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	8.5E-07	1.8E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.009
				Arsenic	0.836	ug/L	1.8E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.7E-08	5.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Barium	483	ug/L	1.0E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.0E-05	(mg/kg/day)	4.9E-03	(mg/kg/day)	0.006
				Chromium	18.5	ug/L	7.8E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.3E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.03
				Iron	4148	ug/L	8.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.6E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.0009
			Exp. Route Total								9.0E-07					0.05
		Exposure Point Total									1.4E-05					0.9
	Exposure Medium Total										1.4E-05					0.9

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
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	
Groundwater	Air	Site 2	Inhalation	Trichloroethene	0.002	mg/m3	5.1E-06	(mg/kg/day)	7.0E-03	$(mg/kg/day)^{-1}$	3.6E-08	1.5E-05	(mg/kg/day)	1.7E-01	(mg/kg/day)	0.00009
				Bis(2-Ethylhexyl)Phthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.5E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Barium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-04	(mg/kg/day)	--
				Chromium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	4.2E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	2.9E-05	(mg/kg/day)	--
				Iron	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								3.6E-08					0.00009
		Exposure Point Total									3.6E-08					0.00009
	Exposure Medium Total										3.6E-08					0.00009
Medium Total											1.4E-05					0.9
Surface Water	Surface Water	Site 2	Ingestion	Dieldrin	0.180	ug/L	5.0E-09	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	8.0E-08	1.5E-08	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.0003
				Arsenic	1.80	ug/L	5.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.5E-08	1.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
				Manganese	3891	ug/L	1.1E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.2E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.01
			Exp. Route Total								1.6E-07					0.01
			Dermal	Dieldrin	0.180	ug/L	1.5E-07	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	2.4E-06	4.3E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.009
				Arsenic	1.80	ug/L	2.9E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.3E-08	8.4E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
				Manganese	3891	ug/L	6.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.8E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.2
			Exp. Route Total								2.4E-06					0.2
		Exposure Point Total									2.6E-06					0.2
	Exposure Medium Total										2.6E-06					0.2
Medium Total											2.6E-06					0.2
Sediment	Sediment	Site 2	Ingestion	Benzo(a)anthracene	7.17	mg/kg	2.5E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.8E-07	7.3E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	2.6E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.9E-06	7.7E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	3.3E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.4E-07	9.6E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	1.6E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.2E-07	4.7E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	4.5E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	7.3E-07	1.3E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.003
				Arsenic	4.33	mg/kg	1.5E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.3E-07	4.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.001
				Iron	35375	mg/kg	1.2E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.01
				Lead	105	mg/kg	3.7E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	3.7E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.005
			Exp. Route Total								3.4E-06					0.02
			Dermal	Benzo(a)anthracene	7.17	mg/kg	2.6E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.9E-07	7.6E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	2.7E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.0E-06	8.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	3.4E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.5E-07	1.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	1.7E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.2E-07	4.9E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	3.6E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	5.8E-07	1.1E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.002
				Arsenic	4.33	mg/kg	3.6E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.4E-08	1.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Iron	35375	mg/kg	9.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.9E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.0010
				Lead	105	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	3.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.7E-06	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.009
			Exp. Route Total								3.2E-06					0.01
		Exposure Point Total									6.6E-06					0.03
	Exposure Medium Total										6.6E-06					0.03
Medium Total											6.6E-06					0.03
										Total of Receptor Risks Across All Media	4.8E-05			Total of Receptor Hazards Across All Media		1.6

TABLE 7.1.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Occupational 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	
Surface Soil	Surface Soil	Site 2	Ingestion	Benzo(a)anthracene	1.48	mg/kg	8.2E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	6.0E-08	6.3E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	7.9E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	5.8E-07	6.1E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	4.0E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.9E-07	3.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	2.1E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.6E-07	1.7E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	9.1E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	6.6E-08	7.1E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	2.2E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	3.6E-07	1.7E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.003
				Aluminum	16043	mg/kg	8.8E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.9E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.007
				Arsenic	6.94	mg/kg	3.8E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.7E-07	3.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.010
				Chromium	65.8	mg/kg	3.6E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.8E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.009
				Iron	24091	mg/kg	1.3E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-02	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.03
				Manganese	767	mg/kg	4.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.3E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.01
				Vanadium	46.8	mg/kg	2.6E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.0E-05	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.02
			Exp. Route Total								2.1E-06					0.10
			Dermal	Benzo(a)anthracene	1.48	mg/kg	1.4E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.0E-08	1.1E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	1.4E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	9.9E-08	1.1E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	6.8E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	5.0E-08	5.3E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	3.7E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.7E-08	2.8E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	1.6E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.1E-08	1.2E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	2.9E-09	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	4.7E-08	2.3E-08	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.0005
				Aluminum	16043	mg/kg	1.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.1E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00009
				Arsenic	6.94	mg/kg	1.5E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.3E-08	1.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Chromium	65.8	mg/kg	4.8E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.7E-07	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.005
				Iron	24091	mg/kg	1.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.0005
				Manganese	767	mg/kg	5.6E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.3E-06	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.005
				Vanadium	46.8	mg/kg	3.4E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.6E-07	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.01
			Exp. Route Total								2.7E-07					0.02
		Exposure Point Total									2.3E-06					0.1
	Exposure Medium Total										2.3E-06					0.1
Medium Total											2.3E-06					0.1
										Total of Receptor Risks Across All Media	2.3E-06				Total of Receptor Hazards Across All Media	0.1

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
Receptor Age: Child

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	
Surface Soil	Surface Soil	Site 2	Ingestion	Benzo(a)anthracene	1.48	mg/kg	1.8E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.3E-07	6.3E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	1.7E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.3E-06	6.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	8.8E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	6.4E-07	3.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	4.7E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	3.4E-07	1.7E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	2.0E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.5E-07	7.1E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	4.9E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	7.9E-07	1.7E-06	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.03
				Aluminum	16043	mg/kg	2.0E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.9E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.07
				Arsenic	6.94	mg/kg	8.5E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.3E-06	3.0E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.10
				Chromium	65.8	mg/kg	8.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.8E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.09
				Iron	24091	mg/kg	2.9E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-01	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.3
				Manganese	767	mg/kg	9.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.3E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.1
				Vanadium	46.8	mg/kg	5.7E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.0E-04	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.2
			Exp. Route Total								4.6E-06					1.0
			Dermal	Benzo(a)anthracene	1.48	mg/kg	2.6E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.9E-08	9.2E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	2.5E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.9E-07	8.9E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	1.3E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	9.4E-08	4.5E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	6.9E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	5.0E-08	2.4E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	2.9E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.1E-08	1.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	5.5E-09	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	8.9E-08	1.9E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.004
				Aluminum	16043	mg/kg	2.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.7E-04	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.0008
				Arsenic	6.94	mg/kg	2.8E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.3E-08	1.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Chromium	65.8	mg/kg	9.0E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.1E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.04
				Iron	24091	mg/kg	3.3E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.004
				Manganese	767	mg/kg	1.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.7E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.04
				Vanadium	46.8	mg/kg	6.4E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.2E-06	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.09
			Exp. Route Total								5.0E-07					0.2
		Exposure Point Total									5.1E-06					1.2
	Exposure Medium Total										5.1E-06					1.2
Medium Total											5.1E-06					1.2
Groundwater	Groundwater	Site 2	Ingestion	Trichloroethene	2.00	ug/L	2.6E-06	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	3.3E-08	8.9E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.0002
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	8.2E-06	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	1.1E-07	2.9E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.01
				Arsenic	0.836	ug/L	1.1E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-06	3.7E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.1
				Barium	483	ug/L	6.2E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.2E-02	(mg/kg/day)	7.0E-02	(mg/kg/day)	0.3
				Chromium	18.5	ug/L	2.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.3E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.3
				Iron	4148	ug/L	5.3E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.9E-01	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.6
			Exp. Route Total								1.8E-06					1.3
			Dermal	Trichloroethene	2.00	ug/L	3.4E-07	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	4.4E-09	1.2E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.00002
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	1.0E-05	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	1.4E-07	3.5E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.02
				Arsenic	0.836	ug/L	3.3E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.0E-09	1.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Barium	483	ug/L	1.9E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.7E-05	(mg/kg/day)	4.9E-03	(mg/kg/day)	0.01
				Chromium	18.5	ug/L	1.5E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.2E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.07
				Iron	4148	ug/L	1.7E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.8E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.002
			Exp. Route Total								1.5E-07					0.1
		Exposure Point Total									1.9E-06					1.4
	Exposure Medium Total										1.9E-06					1.4

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
Receptor Age: Child

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	
Groundwater	Air	Site 2	Inhalation	Trichloroethene	0.002	mg/m3	1.5E-06	(mg/kg/day)	7.0E-03	(mg/kg/day)$^{-1}$	1.0E-08	1.5E-05	(mg/kg/day)	1.7E-01	(mg/kg/day)	0.00009
				Bis(2-Ethylhexyl)Phthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.5E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Barium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-04	(mg/kg/day)	--
				Chromium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	4.2E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.9E-05	(mg/kg/day)	--
				Iron	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.0E-08					0.00009
		Exposure Point Total									1.0E-08					0.00009
	Exposure Medium Total										1.0E-08					1.4
Medium Total											1.9E-06					2.9
Surface Water	Surface Water	Site 2	Ingestion	Dieldrin	0.180	ug/L	2.4E-09	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	3.9E-08	8.5E-08	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.002
				Arsenic	1.80	ug/L	2.4E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3.7E-08	8.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Manganese	3891	ug/L	5.3E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.8E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.08
			Exp. Route Total								7.6E-08					0.08
			Dermal	Dieldrin	0.180	ug/L	1.0E-08	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	1.6E-07	3.5E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.007
				Arsenic	1.80	ug/L	1.4E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2.1E-09	4.8E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Manganese	3891	ug/L	3.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.1
			Exp. Route Total								1.6E-07					0.1
		Exposure Point Total									2.4E-07					0.2
	Exposure Medium Total										2.4E-07					0.2
Medium Total											2.4E-07					0.2
Sediment	Sediment	Site 2	Ingestion	Benzo(a)anthracene	7.17	mg/kg	4.9E-08	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	3.6E-08	1.7E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	5.1E-08	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	3.7E-07	1.8E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	6.4E-08	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	4.7E-08	2.2E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	3.1E-09	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	2.3E-08	1.1E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	8.8E-09	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	1.4E-07	3.1E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.006
				Arsenic	4.33	mg/kg	2.9E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4.4E-08	1.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Iron	35375	mg/kg	2.4E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	8.4E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.03
				Lead	105	mg/kg	7.1E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.5E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	7.2E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.5E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.01
			Exp. Route Total								6.6E-07					0.05
			Dermal	Benzo(a)anthracene	7.17	mg/kg	1.4E-08	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	1.0E-08	5.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	1.5E-08	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	1.1E-07	5.2E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	1.9E-08	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	1.4E-08	6.5E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	9.2E-10	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	6.7E-09	3.2E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	2.0E-09	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	3.2E-08	6.9E-08	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.001
				Arsenic	4.33	mg/kg	2.0E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3.0E-09	6.9E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Iron	35375	mg/kg	5.4E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.9E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.0006
				Lead	105	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	1.6E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.7E-06	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.006
			Exp. Route Total								1.7E-07					0.008
		Exposure Point Total									8.4E-07					0.06
	Exposure Medium Total										8.4E-07					0.06
Medium Total											8.4E-07					0.06
										Total of Receptor Risks Across All Media	8.1E-06			Total of Receptor Hazards Across All Media		4.3

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
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	
Surface Soil	Surface Soil	Site 2	Ingestion	Benzo(a)anthracene	1.48	mg/kg	6.8E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	4.9E-08	6.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	6.5E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	4.8E-07	6.5E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	3.3E-07	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	2.4E-07	3.3E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	1.8E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.3E-07	1.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	7.6E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	5.5E-08	7.6E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	1.9E-08	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	3.0E-07	1.9E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.004
				Aluminum	16043	mg/kg	7.3E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.3E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.007
				Arsenic	6.94	mg/kg	3.2E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.8E-07	3.2E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
				Chromium	65.8	mg/kg	3.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.0E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.01
				Iron	24091	mg/kg	1.1E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-02	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.04
				Manganese	767	mg/kg	3.5E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.5E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.01
				Vanadium	46.8	mg/kg	2.1E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.1E-05	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.02
			Exp. Route Total								1.7E-06					0.1
			Dermal	Benzo(a)anthracene	1.48	mg/kg	1.0E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	7.3E-09	1.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	1.43	mg/kg	9.7E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	7.1E-08	9.7E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	7.22	mg/kg	4.9E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	3.6E-08	4.9E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.387	mg/kg	2.6E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.9E-08	2.6E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	1.65	mg/kg	1.1E-08	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	8.2E-09	1.1E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	0.405	mg/kg	2.1E-09	(mg/kg/day)	1.6E+01	$(mg/kg/day)^{-1}$	3.4E-08	2.1E-08	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.0004
				Aluminum	16043	mg/kg	8.4E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.4E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00008
				Arsenic	6.94	mg/kg	1.1E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-08	1.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Chromium	65.8	mg/kg	3.4E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.4E-07	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.005
				Iron	24091	mg/kg	1.3E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.0004
				Manganese	767	mg/kg	4.0E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.0E-06	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.004
				Vanadium	46.8	mg/kg	2.4E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.4E-07	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.009
			Exp. Route Total								1.9E-07					0.02
		Exposure Point Total									1.9E-06					0.1
	Exposure Medium Total										1.9E-06					0.1
Medium Total											1.9E-06					0.1
Groundwater	Groundwater	Site 2	Ingestion	Trichloroethene	2.00	ug/L	2.6E-06	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	3.3E-08	2.6E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.00005
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	8.2E-06	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	1.1E-07	8.2E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.004
				Arsenic	0.836	ug/L	1.1E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-06	1.1E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.04
				Barium	483	ug/L	6.2E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.2E-03	(mg/kg/day)	7.0E-02	(mg/kg/day)	0.09
				Chromium	18.5	ug/L	2.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.4E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.08
				Iron	4148	ug/L	5.3E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.3E-02	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.2
			Exp. Route Total								1.8E-06					0.4
			Dermal	Trichloroethene	2.00	ug/L	3.3E-07	(mg/kg/day)	1.3E-02	$(mg/kg/day)^{-1}$	4.3E-09	3.3E-06	(mg/kg/day)	5.0E-01	(mg/kg/day)	0.000007
				Bis(2-Ethylhexyl)Phthalate	6.39	ug/L	9.8E-06	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	1.4E-07	9.8E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.005
				Arsenic	0.836	ug/L	2.3E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.5E-09	2.3E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00008
				Barium	483	ug/L	1.4E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-05	(mg/kg/day)	4.9E-03	(mg/kg/day)	0.003
				Chromium	18.5	ug/L	1.0E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.01
				Iron	4148	ug/L	1.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.0004
			Exp. Route Total								1.4E-07					0.02
		Exposure Point Total									1.9E-06					0.4
	Exposure Medium Total										1.9E-06					0.4

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe:
Receptor Population: Resident
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	
Groundwater	Air	Site 2	Inhalation	Trichloroethene	0.002	mg/m3	1.5E-06	(mg/kg/day)	7.0E-03	(mg/kg/day)$^{-1}$	1.0E-08	1.5E-05	(mg/kg/day)	1.7E-01	(mg/kg/day)	0.00009
				Bis(2-Ethylhexyl)Phthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.5E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Barium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-04	(mg/kg/day)	--
				Chromium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	4.2E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.9E-05	(mg/kg/day)	--
				Iron	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.0E-08					0.00009
		Exposure Point Total									1.0E-08					0.00009
	Exposure Medium Total										1.0E-08					0.4
Medium Total											1.9E-06					0.8
Surface Water	Surface Water	Site 2	Ingestion	Dieldrin	0.180	ug/L	3.7E-10	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	5.9E-09	3.7E-09	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.00007
				Arsenic	1.80	ug/L	3.7E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	5.5E-09	3.7E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0001
				Manganese	3891	ug/L	7.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	7.9E-05	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.003
			Exp. Route Total								1.1E-08					0.003
			Dermal	Dieldrin	0.180	ug/L	1.3E-08	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	2.1E-07	1.3E-07	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.003
				Arsenic	1.80	ug/L	1.8E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2.7E-09	1.8E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00006
				Manganese	3891	ug/L	4.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.0E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.04
			Exp. Route Total								2.2E-07					0.04
		Exposure Point Total									2.3E-07					0.05
	Exposure Medium Total										2.3E-07					0.05
Medium Total											2.3E-07					0.05
Sediment	Sediment	Site 2	Ingestion	Benzo(a)anthracene	7.17	mg/kg	1.8E-08	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	1.3E-08	1.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	1.9E-08	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	1.4E-07	1.9E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	2.4E-08	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	1.8E-08	2.4E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	1.2E-09	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	8.6E-09	1.2E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	3.3E-09	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	5.3E-08	3.3E-08	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.0007
				Arsenic	4.33	mg/kg	1.1E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.7E-08	1.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Iron	35375	mg/kg	9.0E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.0E-04	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.003
				Lead	105	mg/kg	2.7E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.7E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	2.7E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.7E-05	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.001
			Exp. Route Total								2.5E-07					0.005
			Dermal	Benzo(a)anthracene	7.17	mg/kg	4.7E-09	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	3.5E-09	4.7E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	7.54	mg/kg	5.0E-09	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	3.6E-08	5.0E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	9.46	mg/kg	6.3E-09	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	4.6E-09	6.3E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.464	mg/kg	3.1E-10	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	2.2E-09	3.1E-09	(mg/kg/day)	NA	(mg/kg/day)	--
				Dieldrin	1.30	mg/kg	6.6E-10	(mg/kg/day)	1.6E+01	(mg/kg/day)$^{-1}$	1.1E-08	6.6E-09	(mg/kg/day)	5.0E-05	(mg/kg/day)	0.0001
				Arsenic	4.33	mg/kg	6.6E-10	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	9.9E-10	6.6E-09	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00002
				Iron	35375	mg/kg	1.8E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.8E-05	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.00006
				Lead	105	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	1067	mg/kg	5.4E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.4E-07	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.0006
			Exp. Route Total								5.8E-08					0.0008
		Exposure Point Total									3.1E-07					0.006
	Exposure Medium Total										3.1E-07					0.006
Medium Total											3.1E-07					0.006
										Total of Receptor Risks Across All Media	4.4E-06			Total of Receptor Hazards Across All Media		1.0

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SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

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REASONABLE MAXIMUM EXPOSURES

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9.2.RME Child Residents
9.3.RME Adult Residents
9.4.RME Lifelong Residents

CENTRAL TENDENCY EXPOSURES

9.1.CTE Occupational Workers
9.2.CTE Child Residents
9.3.CTE Adult Residents
9.4.CTE Lifelong Residents

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	4E-07	--	3E-07	--	7E-07	NA	--	- -	--	--
			Benzo(a)pyrene	4E-06	--	3E-06	--	7E-06	NA	--	- -	--	--
			Benzo(b)fluoranthene	2E-06	--	2E-06	--	3E-06	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	1E-06	--	8E-07	--	2E-06	NA	--	- -	--	--
			Indeno(1,2,3-cd)pyrene	4E-07	--	4E-07	--	8E-07	NA	--	- -	--	--
			Dieldrin	2E-06	--	1E-06	--	4E-06	Liver	0.008	- -	0.005	0.01
			Aluminum	- -	--	- -	--	- -	CNS	0.02	- -	0.001	0.02
			Arsenic	4E-06	--	7E-07	--	4E-06	Skin, CVS	0.02	- -	0.004	0.03
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.02	- -	0.06	0.08
			Iron	- -	--	- -	--	- -	None Reported	0.08	- -	0.005	0.08
			Manganese	- -	--	- -	--	- -	CNS	0.03	- -	0.05	0.08
			Vanadium	- -	--	- -	--	- -	Kidney	0.05	- -	0.1	0.2
			Chemical Total	1E-05	--	8E-06	--	2E-05		0.2	--	0.2	0.5
		Exposure Point Total						2E-05					0.5
	Exposure Medium Total							2E-05					0.5
Medium Total								2E-05					0.5
Receptor Total							Receptor Risk Total	2E-05				Receptor HI Total	0.5

Total CNS HI	0.10
Total CVS HI	0.03
Total GS HI	0.08
Total Kidney HI	0.2
Total Liver HI	0.01
Total Skin HI	0.03
Total Fetotoxicity HI	0.08
Total Bone HI	0.08
Total None Reported HI	0.08

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	1E-06	--	4E-07	--	2E-06	NA	--	- -	--	--
			Benzo(a)pyrene	1E-05	--	4E-06	--	2E-05	NA	--	- -	--	--
			Benzo(b)fluoranthene	6E-06	--	2E-06	--	8E-06	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	3E-06	--	1E-06	--	4E-06	NA	--	- -	--	--
			Indeno(1,2,3-cd)pyrene	1E-06	--	5E-07	--	2E-06	NA	--	- -	--	--
			Dieldrin	7E-06	--	2E-06	--	9E-06	Liver	0.1	- -	0.03	0.1
			Aluminum	- -	--	- -	--	- -	CNS	0.2	- -	0.006	0.2
			Arsenic	1E-05	--	1E-06	--	1E-05	Skin, CVS	0.3	- -	0.02	0.3
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.3	- -	0.3	0.6
			Iron	- -	--	- -	--	- -	None Reported	1	- -	0.03	1
			Manganese	- -	--	- -	--	- -	CNS	0.4	- -	0.3	0.7
			Vanadium	- -	--	- -	--	- -	Kidney	0.6	- -	0.6	1
			Chemical Total	4E-05	--	1E-05	--	5E-05		3	--	1	4
		Exposure Point Total						5E-05					4
	Exposure Medium Total							5E-05					4
Medium Total								5E-05					4
Groundwater	Groundwater	Site 2	Trichloroethene	1E-07	--	1E-08	--	2E-07	Liver	0.0003	- -	0.00002	0.0003
			Bis(2-Ethylhexyl)Phthalate	5E-07	--	4E-07	--	9E-07	Liver	0.02	- -	0.02	0.04
			Arsenic	7E-06	--	1E-08	--	7E-06	Skin, CVS	0.2	- -	0.0004	0.2
			Barium	- -	--	- -	--	- -	Kidney	0.4	- -	0.01	0.5
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.4	- -	0.07	0.5
			Iron	- -	--	- -	--	- -	None Reported	0.9	- -	0.002	0.9
			Chemical Total	8E-06	--	4E-07	--	8E-06		2	- -	0.1	2
		Exposure Point Total						8E-06					2
	Exposure Medium Total							8E-06					2
	Air	Site 2	Trichloroethene	--	4E-08	--	--	4E-08	Liver	- -	0.00009	- -	0.00009
			Bis(2-Ethylhexyl)Phthalate	--	- -	--	--	- -	Liver	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Barium	--	- -	--	--	- -	Fetotoxicity	- -	--	- -	--
			Chromium	--	- -	--	--	- -	Lungs	- -	--	- -	--
			Iron	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	4E-08	--	--	4E-08		- -	0.00009	- -	0.00009
		Exposure Point Total						4E-08					0.00009
	Exposure Medium Total							4E-08					0.00009
Medium Total								8E-06					2

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SIte 2	Dieldrin	5E-07	--	1E-06	--	2E-06	Liver	0.007	- -	0.02	0.03
			Arsenic	4E-07	--	2E-08	--	5E-07	Skin, CVS	0.01	- -	0.0006	0.01
			Manganese	- -	--	- -	--	- -	CNS	0.3	- -	0.4	0.7
			Chemical Total	9E-07	--	1E-06	--	2E-06		0.3	- -	0.5	0.8
		Exposure Point Total						2E-06					0.8
	Exposure Medium Total							2E-06					0.8
Medium Total								2E-06					0.8
Sediment	Sediment	Site 2	Benzo(a)anthracene	4E-07	--	3E-07	--	7E-07	NA	--	- -	--	--
			Benzo(a)pyrene	4E-06	--	3E-06	--	8E-06	NA	--	- -	--	--
			Benzo(b)fluoranthene	6E-07	--	4E-07	--	1E-06	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	3E-07	--	2E-07	--	5E-07	NA	--	- -	--	--
			Dieldrin	2E-06	--	9E-07	--	3E-06	Liver	0.02	- -	0.01	0.04
			Arsenic	5E-07	--	9E-08	--	6E-07	Skin, CVS	0.01	- -	0.002	0.02
			Iron	- -	--	- -	--	- -	None Reported	0.1	- -	0.006	0.1
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese	- -	--	- -	--	- -	CNS	0.04	- -	0.06	0.1
			Chemical Total	8E-06	--	5E-06	--	1E-05		0.2	- -	0.08	0.3
		Exposure Point Total						1E-05					0.3
	Exposure Medium Total							1E-05					0.3
Medium Total								1E-05					0.3
Receptor Total							Receptor Risk Total	8E-05				Receptor HI Total	7

Total CNS HI	2
Total CVS HI	0.5
Total GS HI	1
Total Kidney HI	2
Total Liver HI	0.2
Total Skin HI	0.5
Total Fetotoxicity HI	1
Total Bone HI	1
Total None Reported HI	2

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	5E-07	--	3E-07	--	8E-07	NA	--	- -	--	--
			Benzo(a)pyrene	5E-06	--	3E-06	--	7E-06	NA	--	- -	--	--
			Benzo(b)fluoranthene	2E-06	--	1E-06	--	4E-06	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	1E-06	--	7E-07	--	2E-06	NA	--	- -	--	--
			Indeno(1,2,3-cd)pyrene	6E-07	--	3E-07	--	9E-07	NA	--	- -	--	--
			Dieldrin	3E-06	--	1E-06	--	4E-06	Liver	0.01	- -	0.004	0.02
			Aluminum	- -	--	- -	--	- -	CNS	0.02	- -	0.0009	0.02
			Arsenic	5E-06	--	6E-07	--	5E-06	Skin, CVS	0.03	- -	0.004	0.04
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.03	- -	0.05	0.08
			Iron	- -	--	- -	--	- -	None Reported	0.1	- -	0.004	0.1
			Manganese	- -	--	- -	--	- -	CNS	0.04	- -	0.04	0.09
			Vanadium	- -	--	- -	--	- -	Kidney	0.06	- -	0.10	0.2
			Chemical Total	2E-05	--	7E-06	--	2E-05		0.3	--	0.2	0.5
		Exposure Point Total						2E-05					0.5
	Exposure Medium Total							2E-05					0.5
Medium Total								2E-05					0.5
Groundwater	Groundwater	Site 2	Trichloroethene	2E-07	--	3E-08	--	3E-07	Liver	0.0001	- -	0.00001	0.0001
			Bis(2-Ethylhexyl)Phthalate	8E-07	--	9E-07	--	2E-06	Liver	0.009	- -	0.009	0.02
			Arsenic	1E-05	--	3E-08	--	1E-05	Skin, CVS	0.08	- -	0.0002	0.08
			Barium	- -	--	- -	--	- -	Kidney	0.2	- -	0.006	0.2
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.2	- -	0.03	0.2
			Iron	- -	--	- -	--	- -	None Reported	0.4	- -	0.0009	0.4
			Chemical Total	1E-05	--	9E-07	--	1E-05		0.8	- -	0.05	0.9
		Exposure Point Total						1E-05					0.9
	Exposure Medium Total							1E-05					0.9
	Air	Site 2	Trichloroethene	--	4E-08	--	--	4E-08	Liver	- -	0.00009	- -	0.00009
			Bis(2-Ethylhexyl)Phthalate	--	- -	--	--	- -	Liver	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Barium	--	- -	--	--	- -	Fetotoxicity	- -	--	- -	--
			Chromium	--	- -	--	--	- -	Lungs	- -	--	- -	--
			Iron	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	4E-08	--	--	4E-08		- -	0.00009	- -	0.00009
		Exposure Point Total						4E-08					0.00009
	Exposure Medium Total							4E-08					0.00009
Medium Total								1E-05					0.9

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Site 2	Dieldrin	8E-08	--	2E-06	--	2E-06	Liver	0.0003	- -	0.009	0.009
			Arsenic	8E-08	--	4E-08	--	1E-07	Skin, CVS	0.0005	- -	0.0003	0.0008
			Manganese	- -	--	- -	--	- -	CNS	0.01	- -	0.2	0.2
			Chemical Total	2E-07	--	2E-06	--	3E-06		0.01	- -	0.2	0.2
		Exposure Point Total						3E-06					0.2
	Exposure Medium Total							3E-06					0.2
Medium Total								3E-06					0.2
Sediment	Sediment	Site 2	Benzo(a)anthracene	2E-07	--	2E-07	--	4E-07	NA	--	- -	--	--
			Benzo(a)pyrene	2E-06	--	2E-06	--	4E-06	NA	--	- -	--	--
			Benzo(b)fluoranthene	2E-07	--	2E-07	--	5E-07	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	1E-07	--	1E-07	--	2E-07	NA	--	- -	--	--
			Dieldrin	7E-07	--	6E-07	--	1E-06	Liver	0.003	- -	0.002	0.005
			Arsenic	2E-07	--	5E-08	--	3E-07	Skin, CVS	0.001	- -	0.0004	0.002
			Iron	- -	--	- -	--	- -	None Reported	0.01	- -	0.0010	0.01
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese	- -	--	- -	--	- -	CNS	0.005	- -	0.009	0.01
			Chemical Total	3E-06	--	3E-06	--	7E-06		0.02	- -	0.01	0.03
		Exposure Point Total						7E-06					0.03
	Exposure Medium Total							7E-06					0.03
Medium Total								7E-06					0.03
Receptor Total							Receptor Risk Total	5E-05				Receptor HI Total	2

Total CNS HI	0.3
Total CVS HI	0.1
Total GS HI	0.3
Total Kidney HI	0.4
Total Liver HI	0.05
Total Skin HI	0.1
Total Fetotoxicity HI	0.3
Total Bone HI	0.3
Total None Reported HI	0.5

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong(Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	2E-06	--	7E-07	--	2E-06					
			Benzo(a)pyrene	2E-05	--	7E-06	--	2E-05					
			Benzo(b)fluoranthene	8E-06	--	3E-06	--	1E-05					
			Dibenzo(a,h)anthracene	4E-06	--	2E-06	--	6E-06					
			Indeno(1,2,3-cd)pyrene	2E-06	--	8E-07	--	3E-06					
			Dieldrin	1E-05	--	3E-06	--	1E-05					
			Aluminum	- -	--	- -	--	- -					
			Arsenic	2E-05	--	2E-06	--	2E-05					
			Chromium	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Vanadium	- -	--	- -	--	- -					
			Chemical Total	6E-05	--	2E-05	--	8E-05					
		Exposure Point Total						8E-05					
	Exposure Medium Total							8E-05					
Medium Total								8E-05					
Groundwater	Groundwater	Site 2	Trichloroethene	4E-07	--	4E-08	--	4E-07					
			Bis(2-Ethylhexyl)Phthalate	1E-06	--	1E-06	--	3E-06					
			Arsenic	2E-05	--	4E-08	--	2E-05					
			Barium	- -	--	- -	--	- -					
			Chromium	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Chemical Total	2E-05	--	1E-06	--	2E-05					
		Exposure Point Total						2E-05					
	Exposure Medium Total							2E-05					
	Air	Site 2	Trichloroethene	--	7E-08	--	--	7E-08					
			Bis(2-Ethylhexyl)Phthalate	--	- -	--	--	- -					
			Arsenic	--	- -	--	--	- -					
			Barium	--	- -	--	--	- -					
			Chromium	--	- -	--	--	- -					
			Iron	--	- -	--	--	- -					
			Chemical Total	--	7E-08	--	--	7E-08					
		Exposure Point Total						7E-08					
	Exposure Medium Total							7E-08					
Medium Total								2E-05					

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong(Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Site 2	Dieldrin	5E-07	--	4E-06	--	4E-06					
			Arsenic	5E-07	--	7E-08	--	6E-07					
			Manganese	- -	--	- -	--	- -					
			Chemical Total	1E-06	--	4E-06	--	5E-06					
		Exposure Point Total						5E-06					
	Exposure Medium Total							5E-06					
Medium Total								5E-06					
Sediment	Sediment	Site 2	Benzo(a)anthracene	6E-07	--	5E-07	--	1E-06					
			Benzo(a)pyrene	6E-06	--	5E-06	--	1E-05					
			Benzo(b)fluoranthene	8E-07	--	7E-07	--	1E-06					
			Dibenzo(a,h)anthracene	4E-07	--	3E-07	--	7E-07					
			Dieldrin	2E-06	--	2E-06	--	4E-06					
			Arsenic	8E-07	--	1E-07	--	9E-07					
			Iron	- -	--	- -	--	- -					
			Lead	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Chemical Total	1E-05	--	8E-06	--	2E-05					
		Exposure Point Total						2E-05					
	Exposure Medium Total							2E-05					
Medium Total								2E-05					
Receptor Total							Receptor Risk Total	1E-04					

TABLE 9.1.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	6E-08	--	1E-08	--	7E-08	NA	--	- -	--	--
			Benzo(a)pyrene	6E-07	--	1E-07	--	7E-07	NA	--	- -	--	--
			Benzo(b)fluoranthene	3E-07	--	5E-08	--	3E-07	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	2E-07	--	3E-08	--	2E-07	NA	--	- -	--	--
			Indeno(1,2,3-cd)pyrene	7E-08	--	1E-08	--	8E-08	NA	--	- -	--	--
			Dieldrin	4E-07	--	5E-08	--	4E-07	Liver	0.003	- -	0.0005	0.004
			Aluminum	- -	--	- -	--	- -	CNS	0.007	- -	0.00009	0.007
			Arsenic	6E-07	--	2E-08	--	6E-07	Skin, CVS	0.010	- -	0.0004	0.01
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.009	- -	0.005	0.01
			Iron	- -	--	- -	--	- -	None Reported	0.03	- -	0.0005	0.03
			Manganese	- -	--	- -	--	- -	CNS	0.01	- -	0.005	0.02
			Vanadium	- -	--	- -	--	- -	Kidney	0.02	- -	0.01	0.03
			Chemical Total	2E-06	--	3E-07	--	2E-06		0.10	- -	0.02	0.1
		Exposure Point Total						2E-06					0.1
	Exposure Medium Total							2E-06					0.1
Medium Total								2E-06					0.1
Receptor Total							Receptor Risk Total	2E-06				Receptor HI Total	0.1

Total CNS HI	0.03
Total CVS HI	0.01
Total GS HI	0.01
Total Kidney HI	0.03
Total Liver HI	0.004
Total Skin HI	0.01
Total Fetotoxicity HI	0.01
Total Bone HI	0.01
Total None Reported HI	0.03

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	1E-07	--	2E-08	--	2E-07	NA	--	- -	--	--
			Benzo(a)pyrene	1E-06	--	2E-07	--	1E-06	NA	--	- -	--	--
			Benzo(b)fluoranthene	6E-07	--	9E-08	--	7E-07	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	3E-07	--	5E-08	--	4E-07	NA	--	- -	--	--
			Indeno(1,2,3-cd)pyrene	1E-07	--	2E-08	--	2E-07	NA	--	- -	--	--
			Dieldrin	8E-07	--	9E-08	--	9E-07	Liver	0.03	- -	0.004	0.04
			Aluminum	- -	--	- -	--	- -	CNS	0.07	- -	0.0008	0.07
			Arsenic	1E-06	--	4E-08	--	1E-06	Skin, CVS	0.10	- -	0.003	0.1
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.09	- -	0.04	0.1
			Iron	- -	--	- -	--	- -	None Reported	0.3	- -	0.004	0.3
			Manganese	- -	--	- -	--	- -	CNS	0.1	- -	0.04	0.2
			Vanadium	- -	--	- -	--	- -	Kidney	0.2	- -	0.09	0.3
			Chemical Total	5E-06	--	5E-07	--	5E-06		1.0	- -	0.2	1
		Exposure Point Total						5E-06					1
	Exposure Medium Total							5E-06					1
Medium Total								5E-06					1
Groundwater	Groundwater	Site 2	Trichloroethene	3E-08	--	4E-09	--	4E-08	Liver	0.0002	- -	0.00002	0.0002
			Bis(2-Ethylhexyl)Phthalate	1E-07	--	1E-07	--	3E-07	Liver	0.01	- -	0.02	0.03
			Arsenic	2E-06	--	5E-09	--	2E-06	Skin, CVS	0.1	- -	0.0004	0.1
			Barium	- -	--	- -	--	- -	Kidney	0.3	- -	0.01	0.3
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.3	- -	0.07	0.3
			Iron	- -	--	- -	--	- -	None Reported	0.6	- -	0.002	0.6
			Chemical Total	2E-06	--	1E-07	--	2E-06		1	- -	0.1	1
		Exposure Point Total						2E-06					1
	Exposure Medium Total							2E-06					1
	Air	Site 2	Trichloroethene	--	1E-08	--	--	1E-08	Liver	- -	0.00009	- -	0.00009
			Bis(2-Ethylhexyl)Phthalate	--	- -	--	--	- -	Liver	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Barium	--	- -	--	--	- -	Fetotoxicity	- -	--	- -	--
			Chromium	--	- -	--	--	- -	Lungs	- -	--	- -	--
			Iron	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	1E-08	--	--	1E-08		- -	0.00009	- -	0.00009
		Exposure Point Total						1E-08					0.00009
	Exposure Medium Total							1E-08					0.00009
Medium Total								2E-06					1

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Site 2	Dieldrin	4E-08	--	2E-07	--	2E-07	Liver	0.002	- -	0.007	0.009
			Arsenic	4E-08	--	2E-09	--	4E-08	Skin, CVS	0.003	- -	0.0002	0.003
			Manganese	- -	--	- -	--	- -	CNS	0.08	- -	0.1	0.2
			Chemical Total	8E-08	--	2E-07	--	2E-07		0.08	- -	0.1	0.2
		Exposure Point Total						2E-07					0.2
	Exposure Medium Total							2E-07					0.2
Medium Total								2E-07					0.2
Sediment	Sediment	Site 2	Benzo(a)anthracene	4E-08	--	1E-08	--	5E-08	NA	--	- -	--	--
			Benzo(a)pyrene	4E-07	--	1E-07	--	5E-07	NA	--	- -	--	--
			Benzo(b)fluoranthene	5E-08	--	1E-08	--	6E-08	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	2E-08	--	7E-09	--	3E-08	NA	--	- -	--	--
			Dieldrin	1E-07	--	3E-08	--	2E-07	Liver	0.006	- -	0.001	0.008
			Arsenic	4E-08	--	3E-09	--	5E-08	Skin, CVS	0.003	- -	0.0002	0.004
			Iron	- -	--	- -	--	- -	None Reported	0.03	- -	0.0006	0.03
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese	- -	--	- -	--	- -	CNS	0.01	- -	0.006	0.02
			Chemical Total	7E-07	--	2E-07	--	8E-07		0.05	- -	0.008	0.06
		Exposure Point Total						8E-07					0.06
	Exposure Medium Total							8E-07					0.06
Medium Total								8E-07					0.06
Receptor Total							Receptor Risk Total	8E-06				Receptor HI Total	3

Total CNS HI	0.4
Total CVS HI	0.2
Total GS HI	0.5
Total Kidney HI	0.6
Total Liver HI	0.09
Total Skin HI	0.2
Total Fetotoxicity HI	0.5
Total Bone HI	0.5
Total None Reported HI	1.0

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	5E-08	--	7E-09	--	6E-08	NA	--	- -	--	--
			Benzo(a)pyrene	5E-07	--	7E-08	--	5E-07	NA	--	- -	--	--
			Benzo(b)fluoranthene	2E-07	--	4E-08	--	3E-07	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	1E-07	--	2E-08	--	1E-07	NA	--	- -	--	--
			Indeno(1,2,3-cd)pyrene	6E-08	--	8E-09	--	6E-08	NA	--	- -	--	--
			Dieldrin	3E-07	--	3E-08	--	3E-07	Liver	0.004	- -	0.0004	0.004
			Aluminum	- -	--	- -	--	- -	CNS	0.007	- -	0.00008	0.007
			Arsenic	5E-07	--	2E-08	--	5E-07	Skin, CVS	0.01	- -	0.0004	0.01
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.01	- -	0.005	0.01
			Iron	- -	--	- -	--	- -	None Reported	0.04	- -	0.0004	0.04
			Manganese	- -	--	- -	--	- -	CNS	0.01	- -	0.004	0.02
			Vanadium	- -	--	- -	--	- -	Kidney	0.02	- -	0.009	0.03
			Chemical Total	2E-06	--	2E-07	--	2E-06		0.1	- -	0.02	0.1
		Exposure Point Total						2E-06					0.1
	Exposure Medium Total							2E-06					0.1
Medium Total								2E-06					0.1
Groundwater	Groundwater	Site 2	Trichloroethene	3E-08	--	4E-09	--	4E-08	Liver	0.00005	- -	0.000007	0.00006
			Bis(2-Ethylhexyl)Phthalate	1E-07	--	1E-07	--	3E-07	Liver	0.004	- -	0.005	0.009
			Arsenic	2E-06	--	4E-09	--	2E-06	Skin, CVS	0.04	- -	0.00008	0.04
			Barium	- -	--	- -	--	- -	Kidney	0.09	- -	0.003	0.09
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	0.08	- -	0.01	0.09
			Iron	- -	--	- -	--	- -	None Reported	0.2	- -	0.0004	0.2
			Chemical Total	2E-06	--	1E-07	--	2E-06		0.4	- -	0.02	0.4
		Exposure Point Total						2E-06					0.4
	Exposure Medium Total							2E-06					0.4
	Air	Site 2	Trichloroethene	--	1E-08	--	--	1E-08	Liver	- -	0.00009	- -	0.00009
			Bis(2-Ethylhexyl)Phthalate	--	- -	--	--	- -	Liver	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Barium	--	- -	--	--	- -	Fetotoxicity	- -	--	- -	--
			Chromium	--	- -	--	--	- -	Lungs	- -	--	- -	--
			Iron	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	1E-08	--	--	1E-08		- -	0.00009	- -	0.00009
		Exposure Point Total						1E-08					0.00009
	Exposure Medium Total							1E-08					0.00009
Medium Total								2E-06					0.4

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Site 2	Dieldrin	6E-09	--	2E-07	--	2E-07	Liver	0.00007	- -	0.003	0.003
			Arsenic	5E-09	--	3E-09	--	8E-09	Skin, CVS	0.0001	- -	0.00006	0.0002
			Manganese	- -	--	- -	--	- -	CNS	0.003	- -	0.04	0.04
			Chemical Total	1E-08	--	2E-07	--	2E-07		0.003	- -	0.04	0.05
		Exposure Point Total						2E-07					0.05
	Exposure Medium Total							2E-07					0.05
Medium Total								2E-07					0.05
Sediment	Sediment	Site 2	Benzo(a)anthracene	1E-08	--	3E-09	--	2E-08	NA	--	- -	--	--
			Benzo(a)pyrene	1E-07	--	4E-08	--	2E-07	NA	--	- -	--	--
			Benzo(b)fluoranthene	2E-08	--	5E-09	--	2E-08	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	9E-09	--	2E-09	--	1E-08	NA	--	- -	--	--
			Dieldrin	5E-08	--	1E-08	--	6E-08	Liver	0.0007	- -	0.0001	0.0008
			Arsenic	2E-08	--	1E-09	--	2E-08	Skin, CVS	0.0004	- -	0.00002	0.0004
			Iron	- -	--	- -	--	- -	None Reported	0.003	- -	0.00006	0.003
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese	- -	--	- -	--	- -	CNS	0.001	- -	0.0006	0.002
			Chemical Total	2E-07	--	6E-08	--	3E-07		0.005	- -	0.0008	0.006
		Exposure Point Total						3E-07					0.006
	Exposure Medium Total							3E-07					0.006
Medium Total								3E-07					0.006
Receptor Total							Receptor Risk Total	4E-06				Receptor HI Total	0.6

Total CNS HI	0.07
Total CVS HI	0.05
Total GS HI	0.1
Total Kidney HI	0.1
Total Liver HI	0.02
Total Skin HI	0.05
Total Fetotoxicity HI	0.1
Total Bone HI	0.1
Total None Reported HI	0.2

TABLE 9.4.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Site 2	Benzo(a)anthracene	2E-07	--	3E-08	--	2E-07					
			Benzo(a)pyrene	2E-06	--	3E-07	--	2E-06					
			Benzo(b)fluoranthene	9E-07	--	1E-07	--	1E-06					
			Dibenzo(a,h)anthracene	5E-07	--	7E-08	--	5E-07					
			Indeno(1,2,3-cd)pyrene	2E-07	--	3E-08	--	2E-07					
			Dieldrin	1E-06	--	1E-07	--	1E-06					
			Aluminum	- -	--	- -	--	- -					
			Arsenic	2E-06	--	6E-08	--	2E-06					
			Chromium	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Vanadium	- -	--	- -	--	- -					
			Chemical Total	6E-06	--	7E-07	--	7E-06					
		Exposure Point Total						7E-06					
	Exposure Medium Total							7E-06					
Medium Total								7E-06					
Groundwater	Groundwater	Site 2	Trichloroethene	7E-08	--	9E-09	--	8E-08					
			Bis(2-Ethylhexyl)Phthalate	2E-07	--	3E-07	--	5E-07					
			Arsenic	3E-06	--	9E-09	--	3E-06					
			Barium	- -	--	- -	--	- -					
			Chromium	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Chemical Total	4E-06	--	3E-07	--	4E-06					
		Exposure Point Total						4E-06					
	Exposure Medium Total							4E-06					
	Air	Site 2	Trichloroethene	--	2E-08	--	--	2E-08					
			Bis(2-Ethylhexyl)Phthalate	--	- -	--	--	- -					
			Arsenic	--	- -	--	--	- -					
			Barium	--	- -	--	--	- -					
			Chromium	--	- -	--	--	- -					
			Iron	--	- -	--	--	- -					
			Chemical Total	--	2E-08	--	--	2E-08					
		Exposure Point Total						2E-08					
	Exposure Medium Total							2E-08					
Medium Total								4E-06					

TABLE 9.4.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURES

NASJRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Site 2	Dieldrin	4E-08	--	4E-07	--	4E-07					
			Arsenic	4E-08	--	5E-09	--	5E-08					
			Manganese	- -	--	- -	--	- -					
			Chemical Total	9E-08	--	4E-07	--	5E-07					
		Exposure Point Total						5E-07					
	Exposure Medium Total							5E-07					
Medium Total								5E-07					
Sediment	Sediment	Site 2	Benzo(a)anthracene	5E-08	--	1E-08	--	6E-08					
			Benzo(a)pyrene	5E-07	--	1E-07	--	7E-07					
			Benzo(b)fluoranthene	6E-08	--	2E-08	--	8E-08					
			Dibenzo(a,h)anthracene	3E-08	--	9E-09	--	4E-08					
			Dieldrin	2E-07	--	4E-08	--	2E-07					
			Arsenic	6E-08	--	4E-09	--	6E-08					
			Iron	- -	--	- -	--	- -					
			Lead	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Chemical Total	9E-07	--	2E-07	--	1E-06					
		Exposure Point Total						1E-06					
	Exposure Medium Total							1E-06					
Medium Total								1E-06					
Receptor Total							Receptor Risk Total	1E-05					

ATTACHMENT B

SAMPLE CALCULATIONS

CALCULATION WORKSHEET

CLIENT: WILLOW GROVE, PENNSYLVANIA		**JOB NUMBER:** 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FUTURE ON-SITE ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	**CHECKED BY:**	**DATE:** 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from incidental ingestion of surface soil.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1.0E-6 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Cs	=	6.94	mg/kg	Chemical: Arsenic
IR	=	100	mg/day	
EF	=	350	days/year	
ED	=	24	years	
FI	=	1		
CF	=	1.0E-06	kg/mg	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	8760	days	
CSFo	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDo	=	3.0E-04	(mg/kg/day)	

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FUTURE ON-SITE ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY:	DATE: 05/31/2005

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{6.94 \text{ mg/kg} \times 100 \text{ mg/day} \times 350 \text{ days/year} \times 24 \text{ years} \times 1 \times 1.0E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 25550 \text{ days}}$$

IEXc = 3.26E-06 mg/kg/day

ILCR = 3.26E-06 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 4.9E-06

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{6.94 \text{ mg/kg} \times 100 \text{ mg/day} \times 350 \text{ days/year} \times 24 \text{ years} \times 1 \times 1.0E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 8760 \text{ days}}$$

IEXnc = 9.51E-06 mg/kg/day

$$HQ = \frac{9.51E\text{-}06 \text{ mg/kg/day}}{3.0E\text{-}04 \text{ (mg/kg/day)}} = \text{Hazard Quotient}$$

HQ = 0.032

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FUTURE ON-SITE ADULT RESIDENT		
BASED ON: U.S. EPA, JULY 2004		
BY: R. JUPIN	CHECKED BY: T. Jackson	DATE: 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with surface soil.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
CF	=	conversion factor (1.0E-6 kg/mg)
SA	=	skin surface available for contact (cm^2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDd	=	dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDd (mg/kg/day)

ASSUMPTIONS:

Cs	=	6.94	mg/kg	Chemical: Arsenic
CF	=	1.0E-06	kg/mg	
SA	=	5700	cm^2/day	
AF	=	0.07	mg/cm^2	
ABS	=	0.03		
EF	=	350	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	8760	days	
CSFd	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDd	=	3.0E-04	(mg/kg/day)	

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FUTURE ON-SITE ADULT RESIDENT		
BASED ON: U.S. EPA, JULY 2004		
BY: R. JUPIN	CHECKED BY:	DATE: 05/31/2005

EXAMPLE CARCINOGENIC CALCULATION

$$DEXc = \frac{6.94 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.03 \times 350 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}}$$

DEXc = 3.90E-07 mg/kg/day

ILCR = 3.90E-07 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 5.9E-07

EXAMPLE NONCARCINOGENIC CALCULATION

$$DEXnc = \frac{6.94 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.03 \times 350 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 8760 \text{ days}}$$

DEXnc = 1.14E-06 mg/kg/day

$$HQ = \frac{1.14E\text{-}06 \text{ mg/kg/day}}{3.00E\text{-}04 \text{ (mg/kg/day)}} = \text{Hazard Quotient}$$

HQ = 0.0038

CALCULATION WORKSHEET

CLIENT: WILLOW GROVE, PENNSYLVANIA		**JOB NUMBER:** 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	**CHECKED BY:** T. Jackson	**DATE:** 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from ingestion of groundwater.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IF \times EF \times ED}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Cgw	=	2	ug/L	Chemical: Trichloroethene
IR	=	2	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	8760	days	
CSFo	=	1.3E-02	$(mg/kg/day)^{-1}$	
RfDo	=	5.0E-01	(mg/kg/day)	

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY: T. Jackson	DATE: 05/31/2005

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{2\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 24\ years}{70\ kg \times 25550\ days}$$

IEXc = 1.88E-05 mg/kg/day

ILCR = 1.88E-05 mg/kg/day x 1.30E-02 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 2.4E-07

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{2\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 24\ years}{70\ kg \times 8760\ days}$$

IEXnc = 5.48E-05 mg/kg/day

$$HQ = \frac{5.48E\text{-}05\ mg/kg/day}{5.0E\text{-}01\ (mg/kg/day)} = \text{Hazard Quotient}$$

HQ = 0.00011

CLIENT: WILLOW GROVE, PENNSYLVANIA		**JOB NUMBER:** 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	**CHECKED BY:**	**DATE:** 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with groundwater.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed does per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ((mg/kg/day)$^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: T. Jupin	DATE: 05/31/2005

Where:

Kp	=	permeability coefficient from water (cm/hr)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.002	mg/L	Chemical: Trichloroethene
Kp	=	1.16E-02	cm/hr	
FA	=	1	unitless	
tevent	=	0.25	hr/event	
CF	=	0.001	L/cm^3	
t*	=	1.39	hr/event	
τ	=	0.58	hr/event	
B	=	0.051		

tevent < t*, therefore,

$$DAevent = (2 \times 0.0116\ cm/hr)\ (1)\ (0.002\ mg/L)\ (0.001\ L/cm3) \times \sqrt{\frac{6 \times 0.581\ hr/event \times 0.25\ hr/event}{\pi}}$$

DAevent = 2.44E-08 mg/cm^2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	18000	cm^2/day
EV	=	1	event/day
ED	=	24	years
EF	=	350	days/year
BW	=	70	kg
ATc	=	25550	days
ATnc	=	8760	days
CSFd	=	1.3E-02	(mg/kg/day)$^{-1}$
RfDd	=	5.0E-01	(mg/kg/day)

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: T. Jackson	DATE: 05/31/2005

EXAMPLE CARCINOGENIC CALCULATION

$$DADc = \frac{2.44E\text{-}08 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 24 \text{ years} \times 350 \text{ days/year} \times 18000 \text{ cm2/day}}{70 \text{ kg} \times 25550 \text{ days}}$$

DADc = 2.07E-06 mg/kg/day

DADc = 2.07E-06 mg/kg/day x 1.30E-02 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 2.7E-08

EXAMPLE NONCARCINOGENIC CALCULATION

$$DADnc = \frac{2.44E\text{-}08 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 24 \text{ years} \times 350 \text{ days/year} \times 18000 \text{ cm2/day}}{70 \text{ kg} \times 8760 \text{ days}}$$

DADnc = 6.03E-06 mg/kg/day

HQ = 6.03E-06 mg/kg/day / 5.00E-01 (mg/kg/day) = Hazard Quotient

HQ = 0.000012

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES WHILE SHOWERING BY AN ADULT RESIDENT		
BASED ON: U.S. EPA, 1989 AND FOSTER AND CHROSTOWSKI, 1987		
BY: R. JUPIN	CHECKED BY: J. Jackson	DATE: 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from inhalation of volatiles while showering by an adult resident.

EQUATIONS:

$$\text{Intake} = \frac{S \times IRsh \times K \times EF \times ED}{BW \times AT \times Ra \times CF}$$

Where:

$$K = Ds + \frac{\exp(-Ra \times Dt) - \exp[Ra \times (Ds - Dt)]}{Ra}$$

$S = Cwd \times FR/SV$ $\quad$ $Cwd = Cw \times [1-\exp(-Kal \times ts/60d)]$

$Kal = Kl \times [(T1 \times Us)/(Ts \times U1)^{-0.5}$ $\quad$ $Kl = 1/[1/k1 + RT/(H \times kg)]$

$k1 = 20\ cm/hr \times (44/MW)^{0.5}$ $\quad$ $kg = 3000\ cm/hr \times (18/MW)^{0.5}$

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFi (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDi (mg/kg/day)

Where:

Intake	=	estimated exposure intake (mg/kg/day)
S	=	volatile chemical generation rate (mg/m3-min - shower)
IRsh	=	inhalation rate (m3/hr)
EF	=	exposure frequency (showers/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
Ra	=	air exchange rate (1/min)
Ds	=	shower duration (min)
Dt	=	total time in bathroom (min)
FR	=	shower water flow rate (L/min)
SV	=	shower room air volume (m3)
ts	=	shower droplet drop time (sec)
d	=	shower droplet diameter (mm)
MW	=	molecular weight of compound (g/mole)
H	=	Henry's Law constant (atm-m3/mole)
T1	=	calibration water temperature (K)
Ts	=	shower water temperature (K)
U1	=	water viscosity at T1 (cp)
Us	=	water viscosity at Ts (cp)
CSFi	=	inhalation carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDi	=	inhalation noncarcinogenic reference dose (mg/kg/day)

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES WHILE SHOWERING BY AN ADULT RESIDENT		
BASED ON: U.S. EPA, 1989 AND FOSTER AND CHROSTOWSKI, 1987		
BY: R. JUPIN	CHECKED BY: J. Jackson	DATE: 05/31/2005

ASSUMPTIONS: Chemical: Trichloroethene

IRsh	=	0.6	m3/hr
EF	=	350	showers/year
ED	=	24	years
BW	=	70	kg
ATc	=	25550	days
Atn	=	8760	days
Ra	=	0.0167	1/min
CF	=	60	min/hr
Ds	=	15	min
Dt	=	20	min
FR	=	10	L/min
SV	=	12	m3
Cw	=	0.002	mg/L
ts	=	2	sec
d	=	1	mm
MW	=	131.4	g/mole
H	=	1.03E-02	atm-m3/mole
RT	=	2.40E-02	atm-m3/mole
T1	=	293	K
Ts	=	320	K
U1	=	0.982	centipoise
Us	=	0.616	centipoise
CSFi	=	7.00E-03	(mg/kg/day)-1
RfDi	=	1.70E-01	(mg/kg/day)

EXAMPLE CALCULATION:

k1 = 20 cm/hr x (44 g/mole / 131.4 g/mole)^0.5

k1 = **11.57 cm/hr**

kg = 3000 cm/hr x (18 g/mole / 131.4 g/mole)^0.5

kg = **1110.35 cm/hr**

Kl = 1/[1/11.6 cm/hr + 2.40E-02 atm-m3/mole/(1.03E-02 atm-m3/mole x 1110.3 cm/hr)]

Kl = **1.13E+01 cm/hr**

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES WHILE SHOWERING BY AN ADULT RESIDENT		
BASED ON: U.S. EPA, 1989 AND FOSTER AND CHROSTOWSKI, 1987		
BY: R. JUPIN	CHECKED BY: T. Jackson	DATE: 05/31/2005

Kal = 1.13E+01 cm/hr x [(293 K x 0.616 centipoise)/(320 K x 0.982 centipoise)]^-0.5

Kal = **14.9 cm/hr**

Cwd = 0.002 mg/L x [1 - exp((-14.9 cm/hr x 2 sec)/(60 x 1 mm))]

Cwd = **7.83E-04 mg/L**

S = 7.83E-04 mg/L x 10 L/min / 12 m3

S = **6.53E-04 mg/m3-min-shower**

$$K = 15\text{ min} + \frac{\exp(-0.0167\text{ 1/min} \times 20\text{ min}) - \exp[0.0167\text{ 1/min} \times (15\text{ min} - 20\text{ min})]}{0.0167\text{ 1/min}}$$

K = **2.79 min**

CARCINOGENIC INTAKE:

$$\text{Intake} = \frac{6.53\text{E-04 mg/m3-min-shower} \times 0.6\text{ m3/hr} \times 2.79\text{ min} \times 350\text{ showers/year} \times 24\text{ years}}{70\text{ kg} \times 25550\text{ days} \times 0.0167\text{ 1/min} \times 60\text{ min/hr}}$$

intake = **5.13E-06 mg/kg-day**

Risk = 0.007 (mg/kg/day)-1 x 5.13E-06 mg/kg-day

Risk = **3.6E-08**

NONCARCINOGENIC INTAKE:

$$\text{Intake} = \frac{6.53\text{E-04 mg/m3-min-shower} \times 0.6\text{ m3/hr} \times 2.79\text{ min} \times 350\text{ showers/year} \times 24\text{ years}}{70\text{ kg} \times 8760\text{ days} \times 0.0167\text{ 1/min} \times 60\text{ min/hr}}$$

intake = **1.50E-05 mg/kg-day**

HQ = 1.50E-05 mg/kg-day / 1.70E-01 (mg/kg/day)

HQ = **0.000088**

CALCULATION WORKSHEET

CLIENT: WILLOW GROVE, PENNSYLVANIA		**JOB NUMBER:** 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SURFACE WATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	**CHECKED BY:** T. Jackson	**DATE:** 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from incidental ingestion of surface water.

EQUATION:

$$IEX = \frac{Csw \times CF \times CRsw \times ET \times EF \times ED}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Csw	=	exposure point concentration in surface water (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
CRsw	=	contact rate (L/hour)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Csw	=	0.18	ug/L	Chemical: Dieldrin
CRsw	=	0.01	L/hr	
CF	=	1.0E-03	mg/ug	
ET	=	4	hours	
EF	=	52	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	8760	days	
CSFo	=	1.6E+01	$(mg/kg/day)^{-1}$	
RfDo	=	5.0E-05	(mg/kg/day)	

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SURFACE WATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY:	DATE: 05/31/2005

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{0.18\ ug/L \times 1.0E\text{-}03\ mg/ug \times 0.01\ L/hr \times 4\ hours \times 52\ days/year \times 24\ years}{70\ kg \times 25550\ days}$$

IEXc = 5.02E-09 mg/kg/day

ILCR = 5.02E-09 mg/kg/day x 1.60E+01 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 8.0E-08

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{0.18\ ug/L \times 1.0E\text{-}03\ mg/ug \times 0.01\ L/hr \times 4\ hours \times 52\ days/year \times 24\ years}{70\ kg \times 8760\ days}$$

IEXnc = 1.47E-08 mg/kg/day

$$HQ = \frac{1.47E\text{-}08\ mg/kg/day}{5.00E\text{-}05\ (mg/kg/day)} = \text{Hazard Quotient}$$

HQ = 0.00029

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SURFACE WATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: T. Jackson	DATE: 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with surface water.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed does per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ((mg/kg/day)$^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SURFACE WATER ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: T. Jackson	DATE: 05/31/2005

Where:

Kp	=	permeability coefficient from water (cm/hr)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Csw	=	0.00018	mg/L	Chemical: Dieldrin
Kp	=	1.22E-02	cm/hr	
FA	=	0.8	unitless	
tevent	=	4	hr/event	
CF	=	0.001	L/cm^3	
t*	=	35.09	hr/event	
τ	=	14.62	hr/event	
B	=	0.092		

tevent < t*, therefore,

$$DAevent = (2 \times 0.0122\ cm/hr)\ (0.8)\ (0.00018\ mg/L)\ (0.001\ L/cm3) \times \sqrt{\frac{6 \times 14.62\ hr/event \times 4\ hr/event}{\pi}}$$

DAevent = 3.71E-08 mg/cm^2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	5700	cm^2/day
EV	=	1	event/day
ED	=	24	years
EF	=	52	days/year
BW	=	70	kg
ATc	=	25550	days
ATnc	=	8760	days
CSFd	=	1.6E+01	(mg/kg/day)$^{-1}$
RfDd	=	5.0E-05	(mg/kg/day)

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EXAMPLE CARCINOGENIC CALCULATION

$$DADc = \frac{3.71E\text{-}08 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 24 \text{ years} \times 52 \text{ days/year} \times 5700 \text{ cm2/day}}{70 \text{ kg} \times 25550 \text{ days}}$$

DADc = 1.48E-07 mg/kg/day

DADc = 1.48E-07 mg/kg/day x 1.60E+01 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 2.4E-06

EXAMPLE NONCARCINOGENIC CALCULATION

$$DADnc = \frac{3.71E\text{-}08 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 24 \text{ years} \times 52 \text{ days/year} \times 5700 \text{ cm2/day}}{70 \text{ kg} \times 8760 \text{ days}}$$

DADnc = 4.31E-07 mg/kg/day

HQ = 4.31E-07 mg/kg/day / 5.00E-05 (mg/kg/day) = Hazard Quotient

HQ = 0.0086

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SEDIMENT ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY: T. Jackson	DATE: 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from incidental ingestion of sediment.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in sediment (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1.0E-6 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Cs	=	4.33	mg/kg	Chemical: Arsenic
IR	=	50	mg/day	
EF	=	52	days/year	
ED	=	24	years	
FI	=	1		
CF	=	1.0E-06	kg/mg	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	8760	days	
CSFo	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDo	=	3.0E-04	(mg/kg/day)	

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SEDIMENT ADULT RESIDENT		
BASED ON: U.S. EPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY:	DATE: 05/31/2005

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{4.33 \text{ mg/kg} \times 50 \text{ mg/day} \times 52 \text{ days/year} \times 24 \text{ years} \times 1.0E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 25550 \text{ days}}$$

IEXc = 1.51E-07 mg/kg/day

ILCR = 1.51E-07 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 2.3E-07

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{4.33 \text{ mg/kg} \times 50 \text{ mg/day} \times 52 \text{ days/year} \times 24 \text{ years} \times 1.0E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 8760 \text{ days}}$$

IEXnc = 4.41E-07 mg/kg/day

HQ = 4.41E-07 mg/kg/day / 3.00E-04 (mg/kg/day) = Hazard Quotient

HQ = 0.0015

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SEDIMENT ADULT RESIDENT		
BASED ON: U.S. EPA, JULY 2004		
BY: R. JUPIN	CHECKED BY: T. Jupin	DATE: 05/31/2005

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with sediment.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in sediment (mg/kg)
CF	=	conversion factor (1.0E-6 kg/mg)
SA	=	skin surface available for contact (cm^2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDd	=	dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDd (mg/kg/day)

ASSUMPTIONS:

Cs	=	4.33	mg/kg	Chemical: Arsenic
CF	=	1.0E-06	kg/mg	
SA	=	5700	cm^2/day	
AF	=	0.07	mg/cm^2	
ABS	=	0.03		
EF	=	52	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	8760	days	
CSFd	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDd	=	3.0E-04	(mg/kg/day)	

CLIENT: WILLOW GROVE, PENNSYLVANIA		JOB NUMBER: 2192
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BY: R. JUPIN	CHECKED BY: J Jackson	DATE: 05/31/2005

EXAMPLE CARCINOGENIC CALCULATION

$$DEXc = \frac{4.33 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.03 \times 52 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}}$$

DEXc = 3.62E-08 mg/kg/day

ILCR = 3.62E-08 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 5.4E-08

EXAMPLE NONCARCINOGENIC CALCULATION

$$DEXnc = \frac{4.33 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.03 \times 52 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 8760 \text{ days}}$$

DEXnc = 1.05E-07 mg/kg/day

HQ = 1.05E-07 mg/kg/day / 3.00E-04 (mg/kg/day) = Hazard Quotient

HQ = 0.00035