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FOCUSED RISK ASSESSMENT FOR SURFACE SOIL AT STUDY AREA 39 AND STUDY AREA 40 NTC ORLANDO FL

4/11/1997

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ABB

April 11, 1997

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ATTN: **Mr. Wayne J. Hansel, P.E., Code 18B7**

Subject: NTC, Orlando - SAs 39 and 40
Focused Risk Assessment - Surface Soil
Contract: N62467-89-D-0317/CTO 107

Dear Mr. Hansel:

In response to a request from the Orlando Partnering Team, ABB Environmental Services, Inc. has completed a Focused Risk Assessment at Orlando Naval Training Center Study Areas 39 and 40. The purpose of the FRA was to evaluate the risks from potential exposures to surface soils at SAs 39 and 40 (the former coal storage yard and "bottle" landfill, respectively). Groundwater associated with SAs 39 and 40 is not considered in this focused risk assessment. The attached FRA summarizes the methodology and presents the risk characterization results. A list of acronyms, references, and an appendix to the memorandum are also attached.

If you have in questions or comments, please do not hesitate to contact John Kaiser at (407) 895 - 8845 or myself at (703) 769 - 8137.

Very Truly Yours,
ABB ENVIRONMENTAL SERVICES, INC.

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TECHNICAL MEMORANDUM
FOCUSED RISK ASSESSMENT
STUDY AREAS 39 AND 40
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

I. Introduction. In response to a request from the Orlando Partnering Team (OPT), ABB Environmental Services, Inc. (ABB-ES) has completed a Focused Risk Assessment (FRA) at Naval Training Center (NTC), Orlando Study Areas (SAs) 39 and 40. The purpose of the FRA was to evaluate the risks from potential exposures to surface soils at SAs 39 and 40 (the former coal storage yard and "bottle" landfill, respectively). Groundwater associated with SAs 39 and 40 is not considered in this focused risk assessment. This memorandum summarizes the FRA methodology and presents the risk characterization results.

This FRA is conducted in accordance with the following United States Environmental Protection Agency (USEPA) and Florida Department of Environmental Protection (FDEP) guidance:

- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A) (USEPA, 1989a),
- Guidance for Data Usability in Risk Assessment (Part A), Final (USEPA, 1992a),
- Region IV Risk Assessment Guidance (USEPA, 1995b)
- Soil Cleanup Goals for Florida (FDEP, 1995), and
- Applicability of Soil Cleanup Goals for Florida (FDEP, 1996a).

This FRA was conducted to assess whether or not contamination in the surface soil at SAs 39 and 40 poses potential health risks to individuals under the proposed reuse scenario - mixed office and residential in the absence of remediation. The FRA was conducted in a phased approach - if the future residential scenario resulted in unacceptable risks, then recreational and industrial land use scenarios were evaluated. This two-phase risk assessment was intended to assist decision makers in evaluating land reuse alternatives and determining the need for further remedial action alternatives (including no further action).

The FRA consists of five components: data evaluation, identification of chemicals of potential concern (CPCs), exposure assessment, toxicity assessment, and risk characterization (including uncertainty analysis) (USEPA, 1989a). Collectively, these components are used to identify site-related contaminants and estimate the potential magnitude of exposure and the risks resulting from the estimated exposure conditions.

II. Data Evaluation. The data evaluation involves numerous activities, including evaluating analytical methods; evaluating quantitation limits; evaluating quality of data with respect to qualifiers and codes; and developing a data set for use in risk assessment. A description of each of these activities is provided below.

Available Data. There were 33 surface soil sample locations evaluated in this FRA. The data are the result of samples collected as part of the Site Screening Investigation (ABB-ES, 1996) and the Additional Site Screening (ABB-ES, 1997). Samples were considered surface soil if the bottom of the sampling interval was less than 2 foot below land surface (bls). The samples were analyzed for Target Compound List volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, Target Analyte List inorganics, total petroleum hydrocarbons (TPH), and radionuclides. The samples evaluated in this FRA and detected analytes are presented in Table 1.

Evaluation of the Analytical Methods. The data used in this FRA are the result of analyses conducted under the Contract Laboratory Program (CLP) with documented QA/QC procedures. The analytical data were evaluated for usability in this FRA assessment by evaluating quantitation limits and evaluating qualified and coded data.

- *Evaluation of Quantitation Limits.* Sample Quantitation Limits (SQLs) were compared to USEPA Region III Risk-Based Concentration Values (RBCs) and Florida Soil Cleanup Goals (SCGs) for Residential Soils. The analyte-specific SQLs that are above RBCs and SCGs are benzo(a)pyrene and dibenz(a,h)anthracene (the SQLs are 2.5 to 370 ug/kg; the RBCs are 88 ug/kg, and the SCGs are 100 ug/kg) and arsenic (the SQL are 0.27 to 1 mg/kg; the RBC is 0.43 mg/kg, and the SCG is 0.8 mg/kg). The SQLs are adequate for this FRA because all three analytes whose SQLs exceeded a screening criteria were selected as CPCs.

- *Evaluation of Qualified and Coded Data.* Both the laboratory and data validators may assign qualifiers to analytical results. The qualifiers assigned by the data validators supersede the laboratory qualifiers. The validated data (detected values) with qualifiers are presented in Table 1. All positive detections (whether they are unqualified or qualified with a "J") were considered detected concentrations for this FRA. All nondetects (qualified with a "U" qualifier) were retained in the FRA data set as samples without positive detections. If all sample results for a given analyte in a given medium were nondetects, that analyte was not retained as a detected analyte for the purposes this FRA. Any sample results with an "R" validation qualifier was eliminated from this FRA data set because quality control indicated that the result was unusable.

Development of Data Set For Use In Risk Assessment. Data management concludes with the summarization of data and statistics generation for each data set. A summary table provides the chemical name, the frequency of detection, the minimum and maximum detected concentrations, the minimum and maximum quantitation limits, the mean, and the 95 percent upper confidence limit (for analytes with 10 or more samples). Table 2 presents the summary statistics for surface soils at SAs 39 and 40.

III. Identification of Contaminants of Potential Concern. Contaminants for which data of sufficient quality were available for use in this FRA and that were present at concentrations greater than background screening concentrations (inorganics only) are the starting point for the development of the list of CPCs. The final list of CPCs is a subset of all compounds detected in

the surface soil. CPCs were selected based on concentration and frequency of detection; physical, chemical, and toxicological characteristics; and comparison of detected values to background, associated blanks, and risk values.

In selecting CPCs, USEPA Region IV criteria were used (USEPA, 1995b). The CPCs included chemicals that were positively identified in at least one sample and exceeded background and screening values. Each criterion listed below was by itself justification for excluding an analyte:

- *Less than Background Screening Concentrations.* If the maximum detected concentration of an analyte was less than twice the arithmetic mean of the background concentration (inorganics only), the analyte was not selected as a CPC (USEPA, 1995b). The background screening values for surface soil are identified in the Background Sampling Report (ABB-ES, 1995).

- *Less than 5 Percent Frequency of Detection.* If an analyte had a frequency of detection (number of samples in which the analyte is detected divided by the number of samples analyzed for that analyte) less than 5 percent (USEPA, 1995b), it was not selected as a CPC. No chemicals were eliminated based on this selection criteria.

- *Less than Risk-Based Screening Concentrations, Standards, and Guidelines.* If the maximum detected concentration of the analyte in a medium was less than its corresponding adjusted USEPA Region III Risk-Based Concentration (RBC) (USEPA, 1996a), and less than Florida SCGs, then the analyte was not selected as a CPC (USEPA, 1995b). In the USEPA Region III RBC table, the target hazard quotient is 1 and the target cancer risk is 1×10^{-6}. All RBCs based on noncarcinogenic effects are adjusted for a target hazard quotient of 0.1 as per Region IV guidance (USEPA, 1995b). No RBC is available for lead in soil. Based on USEPA recommendation, a screening level of 400 mg/kg for lead under residential land use is used as the RBC for lead in soil (USEPA, 1994). No screening values are available for acenaphthylene, benzo(g,h,i)perylene, phenanthrene, and total petroleum hydrocarbons (TPH); toxicity data for pyrene was used as a surrogate based on chemical property similarities, toxicological similarities, and professional judgment. Screening values were not available for 1-methlynaphthalene and 2-methylnaphthalene; toxicity values for naphthalene were used as a surrogate based on chemical structural similarities and professional judgment.

- *Less than Essential Nutrient Screening Values.* If the maximum detected concentration of an essential nutrient (e.g., sodium, potassium, magnesium, and calcium) in surface soil was below a toxic level and consistent with or only slightly above its background concentration, the essential nutrient was not selected as a CPC. Essential nutrient values were developed by ABB-ES and are presented in the CPC screening tables (Tables 2 and 3).

If the analyte met any of the above criteria, was not a member of the same chemical class as other selected CPCs in soil, and was not a breakdown product of other CPCs in soil, then the analyte was not selected as a CPC. In situations where multiple screening values were available, a

chemical was excluded only if its maximum concentration was less than all of the corresponding screening values. After applying these criteria, with professional judgment, CPCs were identified for soil. Analytes that were not selected as CPCs are clearly identified in Tables 2 and 3.

Selection of Human Health Chemicals of Potential Concern. The first phase of this FRA was a screening of the analytes detected in the surface soil at SAs 39 and 40 against background, SCGs, and RBCs under a residential land use scenario. Three CPCs were selected for surface soil at SAs 39 and 40 because they exceeded residential screening values [two SVOCs (benzo(a)pyrene and dibenz(a,h)anthracene); and one inorganic (arsenic)]. Benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were retained because they are members of the carcinogenic PAH class and other chemicals in that class were selected as CPCs. Gross alpha and beta radioactivity were selected as CPCs since no background or screening criteria were available. Selection of gross alpha and beta radioactivity as CPCs was not intended to imply that the radioactivity is site-related, rather that radioactive disposals at the site could not confidently be ruled out. There is however, no evidence or records that indicate that the radioactivity detected is from past operations. Table 2 presents the residential CPC screening for surface soil at SAs 39 and 40.

The second phase of the FRA was to screen the analytes detected in the surface soil at SAs 39 and 40 under a recreational and an industrial land use scenario.

- The residential CPC screening table was used to identify CPCs for the recreational scenario (See Table 2).

- Table 3 presents the industrial CPC screening for surface soil at SAs 39 and 40. There were no CPCs identified for the industrial scenario (no chemicals were detected above the SCGs, RBCs, or background levels) except gross alpha and beta radioactivity. Gross alpha and beta radioactivity were selected as CPCs for the industrial scenario since no background or screening criteria were available; however, the potential risks from the radioactivity under an industrial scenario could not be quantified due to a lack of toxicity data. Selection of gross alpha and beta radioactivity as CPCs was not intended to imply that the radioactivity is site-related, rather that radioactive disposals at the site could not confidently be ruled out. There is however, no evidence or records that indicate that the radioactivity detected is from past operations.

IV. Exposure Assessment. The exposure assessment was conducted to estimate the pathways by which humans are potentially exposed, the magnitude of actual and/or potential human exposure, and the frequency and duration of exposure. This process involves several steps:

- characterization of the exposure setting in terms of physical characteristics and the populations that may potentially be exposed to site-related chemicals;

- identification of potential exposure pathways and receptors; and

- quantification of exposure for each population in terms of the amount of chemical either ingested, inhaled, or absorbed through the skin from all complete exposure pathways.

Exposure Setting Characterization. This FRA addressed potential future land uses that may occur when this property is transferred to the City of Orlando. The property is currently zoned office/residential. Potential future adult and child residents were evaluated in the FRA as a conservative estimate of potential risks to other receptors. If unacceptable risks were obtained under the future residential scenario then, using the phased risk evaluation approach, potential future recreational user and industrial scenario were evaluated. Risks for the industrial scenario were considered inconsequential since no CPCs were selected for that land use with the exception of gross alpha and beta (see previous discussion of radioactivity). Risks to potential future receptors were evaluated for incidental ingestion, dermal contact, and inhalation of particulates from surface soil.

Pathway and Receptor Identificatioon. The residential exposure scenario was evaluated due to the current residential/commercial zoning. Recreational exposure was assessed as a possible land reuse alternative. The industrial exposure scenario was considered inconsequential since no CPCs were selected except gross alpha and beta radioactivity. Table 4 contains the exposure parameters for the residential and recreational exposure scenarios.

Exposure Quantification. The final step of the exposure assessment was to quantify exposure (i.e., intake). Two scenarios were evaluated for a future resident, Reasonable Maximum Exposure (RME) and central tendency (CT) exposure. For the RME evaluation, the Exposure Point Concentration (EPC) was defined as the lesser of the 95 percent upper confidence limit (UCL) on the mean and the maximum detected concentration. The RME value provides a conservative and reasonable estimate of exposure. The lesser of the maximum detected concentration and the mean of the detected concentrations at the site was evaluated in the CT exposure scenario. The mean concentration coupled with CT exposure parameters provides a probable risk level (USEPA, 1995b). The mean and the 95% UCL on the mean for the analytes detected at SAs 39 and 40 are shown in Tables 2 and 3.

This quantification process involved developing assumptions regarding exposure conditions and exposure scenarios for each receptor to estimate the total amount of contaminants that a receptor may ingest, dermally absorb, or inhale from each exposure pathway. These exposure scenarios are based on several variables, which can be grouped into chemical-, population-, and assessment-related variables.

- In this FRA the chemical-related variable involved in the exposure quantification are the RME EPC and the CT mean values.

- Population-related variables describe the characteristics of a hypothetical individual receptor within each potentially exposed population. These variables include contact rates, such as exposure frequencies and ingestion rates, and physical characteristics of human bodies, such as body weights and surface areas. When applicable, contact rates used are USEPA standard exposure factor default values (USEPA, 1991 and USEPA,

1995b) or USEPA dermal guidance values (USEPA, 1992d). Parameters describing the physical characteristics of the exposed populations were identified from appropriate USEPA guidance (USEPA, 1989a; 1989b; 1995b) and are presented in Table 4.

- The assessment-related variable involved in exposure quantification is the averaging time. Averaging time reflects the duration of exposure and depends on the type of effect being evaluated. Exposure intake during a defined interval (e.g., a lifetime) is averaged over the entire period, resulting in an estimate of average daily intake. Two types of effects are evaluated in the FRA: carcinogenic and noncarcinogenic. According to USEPA guidance, the averaging time for carcinogenic effects is assumed to be a 70-year lifetime (USEPA, 1989a). The averaging time for noncarcinogenic effects is equivalent to the duration of exposure.

  Dermal absorption from soil was calculated in accordance with the USEPA *Dermal Exposure Assessment: Principles and Applications*, Interim Report (USEPA, 1992d). According to USEPA Region IV guidance (USEPA, 1995b), absorption factors for organics and inorganics are 1 percent and 0.1 percent, respectively. A soil adherence factor of 1 milligram of soil per square centimeter of skin (mg/cm^2) per event is used in the dermal intake equations (USEPA, 1995b).

V. Toxicity Assessment. The purpose of the toxicity assessment was to identify the adverse effects that may be associated with exposure to each CPC and to identify the relationship between the level of exposure and the severity or likelihood of adverse effects. Two steps are typically associated with toxicity assessment: hazard identification and dose-response assessment.

Hazard Identification. Hazard identification is the process of determining if exposure to an agent can cause a particular adverse health effect and, more importantly, if that effect will occur in humans. Characterizing the nature and strength of causation is a part of the hazard identification process. For a number of the chemicals at hazardous waste sites, potential toxic effects have already been identified. Consequently, the objectives of the hazard identification in the FRA are to (1) identify which of the contaminants detected at the site are potential hazards, and (2) briefly summarize their potential toxicity in nontechnical language (Appendix A).

Dose-response Assessment. A dose-response assessment is conducted to characterize and quantify the relationship between intake, or dose, of a CPC and the likelihood of a toxic effect or response. There are two categories of toxic effects evaluated in this FRA: carcinogenic and noncarcinogenic. Following USEPA guidance for risk assessments (USEPA, 1989a), these two types of endpoints (cancer and noncancer) were evaluated separately. As a result of the dose-response assessment, identified dose-response values were used to estimate the incidence of adverse effects as a function of human exposure to a chemical. There are two types of dose-response values: Cancer Slope Factors (CSFs) for carcinogens and Reference Doses (RfDs) for noncarcinogens. For some compounds (such as arsenic), both types of values have been developed by USEPA because the chemicals cause both carcinogenic and noncarcinogenic effects. In addition, because the toxicity and/or carcinogenicity of a compound can depend on the route of exposure (i.e., oral, inhalation, or dermal), unique dose-response values are developed for the

oral, dermal, and inhalation exposure routes. Toxicity information is not available for dermal exposure; therefore, it was necessary to adjust oral toxicity values that were based on administered doses so that they could be used for evaluation of absorbed doses. If there was no information available on oral absorption efficiency, the conservative default values (USEPA, 1995b) of 80 percent for volatiles, 50 percent for SVOCs, and 20 percent for inorganics were used.

Appendix A to this Technical Memorandum contains dose-response information for the CPCs. This information was used to estimate the excess lifetime cancer risk (ELCR) for carcinogens and the hazard index (HI) for all CPCs in the risk characterization. Dose-response values current as of January 1997 from the Integrated Risk Information System (IRIS) (USEPA, 1996b) and November 1995 from the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1995) were used in this FRA.

VI. Risk Characterization. Both carcinogenic and noncarcinogenic risks were estimated for each CPC. The chemical-specific risks for all carcinogenic and noncarcinogenic compounds were determined following the USEPA *Risk Assessment Guidance for Superfund* (USEPA, 1989a).

Two scenarios were evaluated for a future resident, RME and CT. The summary of the risks for these two scenarios provide a risk range that can be used by decision makers and risk managers to evaluate the need for further action at SAs 39 and 40 (USEPA, 1995b).

Using the RME and CT parameters defined in Table 4, the risks to future receptors were evaluated. The second phase of the FRA evaluated the potential risks to a recreational user of SAs 39 and 40.

Focused Risk Evaluation Results. The FRA carcinogenic results for the future resident (adult and child) are summed to determine a total receptor risk. The noncarciongenic results for the future residential adult and child receptor are considered separately. These risk results are then compared to the acceptable USEPA and Florida risk values.

- The USEPA guidelines, established in the National Oil and Hazardous Substances Contingency Plan (NCP), indicate that the total lifetime cancer risk due to exposure to the CPCs at a site, by each complete exposure pathway, should not exceed a range of 1 in 1,000,000 ($1x10^{-6}$) to 1 in 10,000 ($1x10^{-4}$) (USEPA, 1990a). FDEP has indicated that chemical-specific risks greater than one in one million ($1x10^{-6}$) warrant further consideration.

- An HQ less than 1 indicates that noncarcinogenic toxic effects are not expected to occur due to CPC exposure. HIs greater than 1 may be indicative of a possible noncarcinogenic toxic effects, but the circumstances must be evaluated on a case-by-case basis (USEPA, 1989a). As the HI increases, so does the likelihood that adverse effects might be associated with exposure.

Residential Risk Results. Risks to potential future residents are evaluated for incidental ingestion, dermal contact, and inhalation of particulates from surface soil. The cancer risk to potential future residents at SAs 39 and 40 (combined adult and child) based on the RME scenario is $1x10^{-5}$ and based on the CT scenario is $1x10^{-6}$. The RME residential risk is within the USEPA acceptable risk level but above the FDEP level of concern. The carcinogenic risk is driven primarily by benzo(a)pyrene, arsenic, and dibenz(a,h)anthracene. The noncancer HIs for potential future adult and child residents for both scenarios are each less than the target level of 1. The risk characterization results for a future resident (adult and child) are presented in Tables 5 through 12.

The risk from the radionuclides (gross alpha and gross beta) detected in the surface soil could not be quantitatively evaluated and there were no background or screening values available for qualitative comparison. However even if the background radioactivity levels are conservatively assumed to be zero; the detected concentrations 0.006 - 0.859 picocuries per gram (pCi/g) of gross alpha and 0.031 - 1.48 pCi/g for gross beta do not appear to be at a level of concern. This conclusion was based on a comparison of these concentrations to the standard of 5 pCi/g above background for radium-226 and thorium-232 in surface soil(40 CFR 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings*). Although the gross alpha and beta measures are indicators of general radioactive materials and not of specific nuclides, this comparison may provide decision makers with some regulatory comparison. Additionally, there is no evidence or records that indicate that the detected radioactivity is the result of past site activities.

Recreational User Risk Results. A future recreational exposure scenario was evaluated since the RME residential scenario was associated with cancer risks above 1×10^{-6}. Potential future adult and child recreational users were evaluated in the FRA as an alternative land use scenario for SAs 39 and 40. Risks to potential future recreational users are evaluated for incidental ingestion, dermal contact, and inhalation of particulates from surface soil. The RME cancer risk to potential future recreational users at SAs 39 and 40 (combined adult and child) based on the RME scenario is $7x10^{-7}$. Only the RME scenario was calculated because the total risk did not exceed $1x10^{-6}$. The noncancer HI for potential future adult and child recreational users are less than the target level of 1. The risk from radionuclides was not quantitatively evaluated; however, the detected gross alpha and beta concentrations do not appear to be a level of concern (see Residential Risk Results Section discussion of radionuclides). The risk characterization results for recreational users are presented in Tables 13 through 16.

Industrial Scenario Risk Results. There were no CPCs selected for the industrial scenario, indicating an acceptable risk level for potential future industrial land uses. The risk from radionuclides was not quantitatively evaluated due to a lack of toxicity data; however, the detected gross alpha and beta concentrations do not appear to be a level of concern (see Residential Risk Results Section discussion of radionuclides).

VII. Remedial Goal Options. Receptors with a total pathway estimated incremental lifetime cancer risk (ELCR) above 1 in 10,000 (1 in 1,000,000 or 1×10^{-6} per FDEP guidance) or with a total HI greater than 1 were identified. RGOs were therefore calculated only for the residential

RME scenario that resulted in an ELCR of greater than 1×10^{-6} . In accordance with USEPA Region IV guidance, RGOs are presented in a table of potential media cleanup levels (Table 17).

Table 17 includes selected summary statistics, background concentrations, detection quantitation limits, the Florida residential SCGs, and concentrations associated with RME residential cancer risk levels of 10^{-4}, 10^{-5}, and 10^{-6}. The concentrations at these risk levels are calculated using the site-specific RME daily dose equation used in this FRA. RGOs were not calculated for noncarinogenic CPCs, since the total hazard index was not greater than 1 for any potential receptor. The RGO table also includes a proposed treatment goal for each risk driver equal to the highest of the background level (inorganics only), the contract required detection limit/contract required quantitation limit, the Florida SCG, or the 1×10^{-6} RGO.

RGOs were identified for SAs 39 and 40 for a potential future resident RME scenario with ingestion of, dermal contact with, and inhalation exposure to benzo(a)pyrene, dibenz(a,h)anthracene, and arsenic in surface soils under the assumption that future residential development may occur.

VIII. Uncertainty. Since the cancer risk in SAs 39 and 40 surface soils is driven by arsenic, a naturally occurring metal, and PAHs, a chemical class common in urban areas, it is uncertain whether or not this risk to potential residents is actually due to past site operations.

Benzo(a)pyrene and dibenz(a,h)anthracene are common anthropogenic contaminants. The concentrations may be the result of runoff from roadways or may be contamination from burning of brush or garbage in the area. Additionally, the SQL for dibenz(a,h)anthracene is higher than the maximum detected value. The risk associated with dibenz(a,h)anthracene may, therefore be overestimated.

Arsenic is a naturally-occurring metal and the risks associated with background screening levels also exceed the FDEP acceptable levels. Therefore, the risks associated with site-related arsenic may be overestimated due to the elevated natural risk from arsenic.

IX. Conclusions. The potential future RME residential scenario results in a slightly elevated risk level of 1×10^{-5}. The potential future residential risk posed from the central tendency was at an acceptable risk level 1×10^{-6}. The risk range 1×10^{-5} to 1×10^{-6} presented by the RME and CT scenarios are useful as "information to provide perspective for the risk manager and compliance with Agency guidance" (USEPA, 1995b).

The RME residential risk is driven by arsenic and two carcinogenic PAHs. The arsenic and PAH contamination are not generally located in the same areas of SAs 39 and 40. Figure 1 presents the sample locations. Figure 2 presents the risk driver concentrations that are above the appropriate Florida residential SCGs. Due to the large size of the site and the definition of surface soil as the top 2 feet of soil, a comprehensive cleanup of the arsenic and PAHs at SAs 39 and 40 is economically impractical.

A reduction of the risk of either the arsenic or the PAH contamination to lower the overall surface soil pathway risk was therefore evaluated.

- A reduction of the arsenic to background levels of 1 mg/kg would result in a RME residential risk of 2.5×10^{-6}. This background arsenic level is above the FDEP residential SCG.

- Remediation of the benzo(a)pyrene and dibenz(a,h)anthracene to the residential Florida SCG would result in a risk level of 1.6×10^{-6}.

As it is not economical or practical to clean up to detection limits (PAHs) or background (arsenic) if doing so would result in minimal risk reduction. It may therefore be more reasonable to re-evaluate the land use alternatives. The recreational user RME scenario resulted in an acceptable risk level and would require no remediation; therefore this land use zoning alternative may be more practical. The industrial land use alternative also provides a viable land use alternative without remediation.

X. Recommendations. Although rezoning SAs 39 and 40 for either a recreational or industrial land use would not require remediation, the CT residential risk should be considered in making remedial decisions. The CT residential risk is within the USEPA acceptable risk range and meets the FDEP risk target level. CT and RME residential risks provide the risk managers and decision makers with a perspective of the true potential risk range to future residents.

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

	Definition
ABB-ES	ABB Environmental Services, Inc.
bls	below land surface
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CPC	contaminant of potential concern
CSF	cancer slope factor
CT	central tendency
ELCR	excessive lifetime cancer risk
EPC	exposure point concentration
FDEP	Florida Department of Environmental Protection
FRA	focused risk assessment
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
mg/kg	milligram per kilogram
mg/cm^2	milligrams per square centimeter
ug/kg	microgram per kilogram
NA	not applicable; not available
NC	not calculated
NCP	National Oil and Hazardous Substances Contingency Plan
ND	not detected
NE	not evaluated
NSC	no screening concentration available
NTC	Naval Training Center
OPT	Orlando Partnering Team
QA/QC	quality assurance/quality control
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl

ABBREVIATIONS, ACRONYMS, AND SYMBOLS (continued)

pCi/g	picoCuries per gram
PEF	particulate emission factor
RAGS	U.S. EPA Risk Assessment Guidance
RBC	USEPA Region III Risk-Based Concentration
RfD	reference dose
RGO	remedial goal option
RBC	risk-based concentration
RME	reasonable maximum exposure
SA	study area
SCG	Florida Soil Cleanup Goal
SQL	sample quantitation limit
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

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Table 1
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B00101	39B00201	39B00201D	39B00301	39B00401	39B00501	39B00901	39B01001
Collect Date	03/19/96	03/19/96	03/19/96	03/19/96	03/19/96	03/20/96	08/29/96	08/29/96
Volatile Organic Compounds (μg/kg)								
Carbon disulfide	--	4 J	3 J	1 J	--	2 J	--	--
Ethylbenzene	1 J	--	--	--	--	--	--	--
Methylene chloride	--	6 J	--	--	--	--	--	--
Tetrachloroethene	--	--	--	3 J	--	--	--	--
Toluene	--	1 J	--	--	5 J	7 J	--	--
Xylene (total)	3 J	--	--	1 J	--	--	--	--
Semivolatile Organic Compounds (μg/kg)								
2,4-Dinitrotoluene	--	--	--	--	0.295	--	--	--
1-Methylnaphthalene	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	150 J	170 J	--	210 J	350 J	--	--
Acenaphthene	--	--	--	--	--	60 J	--	--
Acenaphthylene	--	--	--	39 J	--	--	--	--
Anthracene	--	--	--	--	--	180 J	--	--
Benzo(a)anthracene	--	38 J	40 J	100 J	41 J	640	--	--
Benzo(a)pyrene	--	--	43 J	180 J	47 J	520	--	--
Benzo(b)fluoranthene	--	39 J	43 J	200 J	70 J	520	--	--
Benzo(g,h,i)perylene	--	49 J	49 J	150 J	65 J	300 J	--	--
Benzo(k)fluoranthene	--	37 J	37 J	140 J	49 J	530	--	--
Carbazole	--	--	--	--	--	120 J	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B00101	39B00201	39B00201D	39B00301	39B00401	39B00501	39B00901	39B01001
Collect Date	03/19/96	03/19/96	03/19/96	03/19/96	03/19/96	03/20/96	08/29/96	08/29/96
Semivolatile Organic Compounds (μg/kg) (Cont)								
Chrysene	--	62 J	68 J	160 J	79 J	690	--	--
Di-n-butylphthalate	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	47 J	--	110 J	--	--
Dibenzofuran	--	38 J	40 J	--	56 J	120 J	--	--
Fluoranthene	--	50 J	52 J	91 J	56 J	1,300	--	--
Fluorene	--	--	--	--	--	51 J	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	120 J	45 J	290 J	--	--
Naphthalene	--	59 J	67 J	--	110 J	210 J	--	--
Phenanthrene	--	140 J	150 J	--	150 J	1,100	--	--
Pyrene	42 J	69 J	91 J	120 J	67 J	1,400	--	--
bis(2-Ethylhexyl)phthalate	47 J	49 J	170 J	43 J	--	--	--	--
Pesticides/PCBs (μg/kg)								
4,4'-DDE	1.8 J	--	--	--	--	--	--	--
4,4'-DDT	7.9	--	--	--	--	--	--	--
Dieldrin	1.3 J	--	--	--	--	--	--	--
alpha-Chlordane	2.7 J	--	--	--	--	--	--	--
gamma-Chlordane	3.1	--	--	--	--	--	--	--
Inorganics (mg/kg)								
Aluminum	729 J	1,440 J	1,690 J	690 J	2,430 J	875 J	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B00101	39B00201	39B00201D	39B00301	39B00401	39B00501	39B00901	39B01001
Collect Date	03/19/96	03/19/96	03/19/96	03/19/96	03/19/96	03/20/96	08/29/96	08/29/96
Inorganics (mg/kg) (Cont.)								
Arsenic	0.36 B	4.7	4.8	0.32 B	6.7	2.3	--	--
Barium	4.7 BJ	17.7 BJ	22.8 BJ	6.6 BJ	21.8 BJ	17.5 BJ	--	--
Beryllium	0.03 B	0.12 B	0.23 B	0.05 B	0.18 B	0.14 B	--	--
Cadmium	--	--	--	0.51 B	--	--	--	--
Calcium	90,600	147,000	151,000	18,900	5,240	67,200	--	--
Chromium	3.5	6.9	7.5	1.7 B	2.9	3.7	--	--
Cobalt	--	2.4 B	4.8 B	--	0.79 B	2.1 B	--	--
Copper	1.9 B	6.1	7.2	1.4 B	4.4 B	4.8 B	--	--
Iron	335	5,770	7,840	422	2,820	1,930	--	--
Lead	14.5	21.5	24.3	17.6	11.5	23.9	--	--
Magnesium	702 B	1,060 B	1,040 B	136 B	97.6 B	983 B	--	--
Manganese	11.7	34.1	46	6.5	10.9	43.5	--	--
Mercury	--	--	0.07 B	0.05 B	--	--	--	--
Nickel	--	3.5 B	7.9 B	--	2.8 B	3.6 B	--	--
Selenium	0.39 BJ	0.44 BJ	0.4 BJ	--	0.39 J	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	83.9 B	114 B	35.7 B	--	76.2 B	--	--
Thallium	0.18 B	--	--	--	0.19 B	--	--	--
Vanadium	6.6 B	9.5 B	10 B	1.4 B	2.3 B	3.4 B	--	--
Zinc	6.1	24.8	36	7.9	20.8	21.6	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B00101	39B00201	39B00201D	39B00301	39B00401	39B00501	39B00901	39B01001
Collect Date	03/19/96	03/19/96	03/19/96	03/19/96	03/19/96	03/20/96	08/29/96	08/29/96
Inorganics (mg/kg) (Cont.)								
Gross Alpha	--	--	--	--	--	--	0.035	0.085
Gross Alpha, Uncertainty	--	--	--	--	--	--	0.049	0.056
Gross Beta	--	--	--	--	--	--	0.097	0.031
Gross Beta, Uncertainty	--	--	--	--	--	--	0.088	0.092
Total Petroleum Hydrocarbons	26.1	70.8	74.1	9.3	4.7	48.1	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B01101	39S00101	39S00201	39S00301	39S00301D	39S00401	39S00501	39S00501D
Collect Date	08/29/96	03/20/96	03/20/96	03/22/96	03/22/96	03/22/96	03/22/96	03/22/96
Volatile Organic Compounds (μg/kg)								
Carbon disulfide	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--
Toluene	--	42	6 J	--	--	27	75	86
Xylene (total)	--	6 J	1 J	--	--	--	5 J	5 J
Semivolatile Organic Compounds (μg/kg)								
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	44 J
Acenaphthene	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	52 J	66 J
Benzo(a)pyrene	--	--	--	--	--	--	57 J	78 J
Benzo(b)fluoranthene	--	--	--	--	--	--	91 J	92 J
Benzo(g,h,i)perylene	--	--	--	--	--	--	59 J	79 J
Benzo(k)fluoranthene	--	--	--	--	--	--	70 J	81 J
Carbazole	--	--	--	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B01101	39S00101	39S00201	39S00301	39S00301D	39S00401	39S00501	39S00501D
Collect Date	08/29/96	03/20/96	03/20/96	03/22/96	03/22/96	03/22/96	03/22/96	03/22/96
Semivolatile Organic Compounds (µg/kg) (Cont)								
Chrysene	--	--	--	--	--	--	87 J	110 J
Di-n-butylphthalate	--	--	--	40 J	--	170 J	--	73 J
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	73 J	91 J
Fluorene	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	49 J	56 J
Naphthalene	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	54 J	59 J
Pyrene	--	--	--	--	--	--	120 J	130 J
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	47 J	--	100 J
Pesticides/PCBs (µg/kg)								
4,4'-DDE	--	3.6	--	--	--	1.9 J	12	11
4,4'-DDT	--	--	--	--	--	--	14 NJ	13
Dieldrin	--	2.1 J	--	--	--	1.2 J	--	--
alpha-Chlordane	--	--	--	--	--	1.1 J	2.6 J	1.9 J
gamma-Chlordane	--	--	--	--	--	0.78 J	2.7 J	1.9 J
Inorganics (mg/kg)								
Aluminum	--	134 J	13.9 BJ	117	113	408	1,590	1,660

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B01101	39S00101	39S00201	39S00301	39S00301D	39S00401	39S00501	39S00501D
Collect Date	08/29/96	03/20/96	03/20/96	03/22/96	03/22/96	03/22/96	03/22/96	03/22/96
Inorganics (mg/kg) (Cont.)								
Arsenic	--	0.33 B	--	--	--	--	--	--
Barium	--	11.8 BJ	0.41 BJ	--	--	8.9 B	12.4 B	15.3 B
Beryllium	--	--	--	--	--	0.04 B	0.07 B	0.1 B
Cadmium	--	--	--	--	--	--	--	--
Calcium	--	2,700	148 B	357 B	492 B	8,720	27,200	27,000
Chromium	--	0.71 B	--	--	--	1.1 B	3.7	3.6
Cobalt	--	--	--	--	--	--	--	--
Copper	--	0.91 B	--	1.3 B	1.6 B	3.5 B	5 B	8.4
Iron	--	119	16.6 B	58.5	60.3	202	762	928
Lead	--	8.6	0.51 B	--	--	3.8	17.1	16.1
Magnesium	--	38.3 B	--	9.9 B	12.3 B	82.8 B	262 B	244 B
Manganese	--	5.1	0.38 B	0.61 B	0.61 B	5.1	11.4	14.1
Mercury	--	0.07 B	--	--	--	0.05 B	--	--
Nickel	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	0.33 J	0.31 J	--
Silver	--	0.96 B	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	1.2 B	1.9 B	2.1 B

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39B01101	39S00101	39S00201	39S00301	39S00301D	39S00401	39S00501	39S00501D
Collect Date	08/29/96	03/20/96	03/20/96	03/22/96	03/22/96	03/22/96	03/22/96	03/22/96
Inorganics (mg/kg) (Cont.)								
Zinc	--	10.9	2.5 B	4.5	5.6	8	24.3	30.6
Gross Alpha	0.596	--	--	--	--	--	--	--
Gross Alpha, Uncertainty	0.11	--	--	--	--	--	--	--
Gross Beta	0.68	--	--	--	--	--	--	--
Gross Beta, Uncertainty	0.133	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	--	--	--	--	--	4.7	26.5	29.8

Table (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S00601	39S00701	39S00801	39S00901	39S01001	39S01101	39S01101D	39S01801
Collect Date	03/22/96	03/22/96	03/22/96	08/29/96	08/29/96	08/29/96	08/29/96	12/02/96
Volatile Organic Compounds (µg/kg)								
Carbon disulfide	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--
Toluene	76	83	59	--	--	--	--	--
Xylene (total)	4 J	4 J	2 J	--	--	--	--	--
Semivolatile Organic Compounds (µg/kg)								
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--
1-Methylnaphthalene	--	--	--	--	--	--	--	6.5
2-Methylnaphthalene	--	--	48 J	--	--	--	--	10
Acenaphthene	--	--	--	--	--	--	--	--
Acenaphthylene	61 J	--	--	--	--	--	--	5.5
Anthracene	--	--	--	--	--	--	--	10
Benzo(a)anthracene	110 J	310 J	--	--	--	--	--	18
Benzo(a)pyrene	200 J	350 J	--	--	--	--	--	30
Benzo(b)fluoranthene	250 J	450	--	--	--	--	--	7.5
Benzo(g,h,i)perylene	220 J	190 J	--	--	--	--	--	5
Benzo(k)fluoranthene	190 J	380	--	--	--	--	--	7.5
Carbazole	--	61 J	--	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S00601	39S00701	39S00801	39S00901	39S01001	39S01101	39S01101D	39S01801
Collect Date	03/22/96	03/22/96	03/22/96	08/29/96	08/29/96	08/29/96	08/29/96	12/02/96
Semivolatile Organic Compounds (μg/kg) (Cont)								
Chrysene	290 J	540	44 J	--	--	--	--	20
Di-n-butylphthalate	100 J	--	200 J	--	--	--	--	--
Dibenz(a,h)anthracene	48 J	75 J	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	190 J	710 J	39 J	--	--	--	--	24
Fluorene	--	--	--	--	--	--	--	3
Indeno(1,2,3-cd)pyrene	160 J	210 J	--	--	--	--	--	7
Naphthalene	--	--	--	--	--	--	--	7.5
Phenanthrene	59 J	410 J	47 J	--	--	--	--	14
Pyrene	220 J	780	36 J	--	--	--	--	26
bis(2-Ethylhexyl)phthalate	41 J	--	--	--	--	--	--	--
Pesticides/PCBs (μg/kg)								
4,4'-DDE	--	5.3 J	2.3 J	--	--	--	--	--
4,4'-DDT	--	11	4.2 J	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--
alpha-Chlordane	--	20	--	--	--	--	--	--
gamma-Chlordane	--	18	--	--	--	--	--	--
Inorganics (mg/kg)								
Aluminum	1,110	3,460	476	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S00601	39S00701	39S00801	39S00901	39S01001	39S01101	39S01101D	39S01801
Collect Date	03/22/96	03/22/96	03/22/96	08/29/96	08/29/96	08/29/96	08/29/96	12/02/96
Inorganics (mg/kg)								
Arsenic	--	--	--	--	--	--	--	--
Barium	6.4 B	26.5 B	4.7 B	--	--	--	--	--
Beryllium	0.05 B	0.09 B	0.04 B	--	--	--	--	--
Calcium	43,000	37,600	4,580	--	--	--	--	--
Chromium	3.4	7.2	1.1 B	--	--	--	--	--
Cobalt	--	--	--	--	--	--	--	--
Copper	3.5 B	3.8 B	2 B	--	--	--	--	--
Iron	682	361	349	--	--	--	--	--
Lead	8.8	14.9	5.3	--	--	--	--	--
Magnesium	330 B	328 B	71.4 B	--	--	--	--	--
Manganese	10	9.4	5.6	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Vanadium	2.2 B	2.6 B	0.69 B	--	--	--	--	--
Zinc	30.3	21.3	8.8	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S00601	39S00701	39S00801	39S00901	39S01001	39S01101	39S01101D	39S01801
Collect Date	03/22/96	03/22/96	03/22/96	08/29/96	08/29/96	08/29/96	08/29/96	12/02/96
Inorganics (mg/kg) (Cont.)								
Gross Alpha	--	--	--	0.133	0.859	0.574	0.691	--
Gross Alpha, Uncertainty	--	--	--	0.066	0.142	0.102	0.137	--
Gross Beta	--	--	--	0.267	1.48	0.726	0.723	--
Gross Beta, Uncertainty	--	--	--	0.103	0.196	0.125	0.133	--
Total Petroleum Hydrocarbons	24.5	101	9.8	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S02501	39S02701	39S02901	39S03101	39S03901	39S04301	39S05101	39S05501
Collect Date	12/02/96	12/02/96	12/02/96	12/02/96	12/02/96	12/03/96	12/04/96	12/04/96
Volatile Organic Compounds (μg/kg)								
Carbon disulfide	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	--	--	--
Xylene (total)	--	--	--	--	--	--	--	--
Semivolatile Organic Compounds (μg/kg)								
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--
1-Methylnaphthalene	2.5	8	--	70	16	180	--	--
2-Methylnaphthalene	4.5	11	2.5	48	22	210	3	3.5
Acenaphthene	--	--	--	--	--	7.5	--	--
Acenaphthylene	16	36	3	12	70	140	--	4.5
Anthracene	39	60	12	14	130	140	6.5	9
Benzo(a)anthracene	20	6.5	2.5	20	110	170	2.5	4
Benzo(a)pyrene	43	70	4.5	48	220	300	--	5
Benzo(b)fluoranthene	10	18	--	13	75	120	--	4
Benzo(g,h,i)perylene	8.5	16	--	7.5	38	38	--	--
Benzo(k)fluoranthene	10	18	--	13	75	120	--	4

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC-Orlando
Orlando, Florida

Analyte	39S02501	39S02701	39S02901	39S03101	39S03901	39S04301	39S05101	39S05501
Collect Date	12/02/96	12/02/96	12/02/96	12/02/96	12/02/96	12/03/96	12/04/96	12/04/96
Semivolatile Organic Compounds (μg/kg) (Cont)								
Carbazole	--	--	--	--	--	--	--	--
Chrysene	26	32	3	24	140	180	2.5	4.5
Di-n-butylphthalate	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	10	12	--	--
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	23	20	3.5	18	140	140	2.5	8
Fluorene	--	3	--	4	3.5	8	2.5	--
Indeno(1,2,3-cd)pyrene	8.5	14	--	6	40	42	--	--
Naphthalene	4.5	8.5	3	17	14	100	3	3.5
Phenanthrene	10	16	4.5	60	55	180	7	13
Pyrene	44	70	4	28	180	180	3.5	8
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--
Pesticides/PCBs (μg/kg)								
4,4'-DDE	--	--	--	--	--	--	--	--
4,4'-DDT	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S02501	39S02701	39S02901	39S03101	39S03901	39S04301	39S05101	39S05501
Collect Date	12/02/96	12/02/96	12/02/96	12/02/96	12/02/96	12/03/96	12/04/96	12/04/96
Inorganics mg/kg								
Aluminum	--	--	--	--	--	--	--	--
Arsenic	--	--	--	--	--	2.7	--	--
Barium	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--
Calcium	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--
Cobalt	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--
Lead	--	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S02501	39S02701	39S02901	39S03101	39S03901	39S04301	39S05101	39S05501
Collect Date	12/02/96	12/02/96	12/02/96	12/02/96	12/02/96	12/03/96	12/04/96	12/04/96
Inorganics mg/kg (Cont.)								
Vanadium	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--
Gross Alpha	--	--	--	--	--	--	--	--
Gross Alpha, Uncertainty	--	--	--	--	--	--	--	--
Gross Beta	--	--	--	--	--	--	--	--
Gross Beta, Uncertainty	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	--	--	--	--	--	--	--	--

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S05901	39S06001	40B00101	40B00201	40B00301	40S00101	40S00201	40S00301
Collect Date	12/05/96	12/05/96	03/19/96	03/19/96	08/29/96	03/20/96	03/20/96	08/29/96
Volatile Organic Compounds (μg/kg)								
Carbon disulfide	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	1 J	--	--	2 J	--
Methylene chloride	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	21	190	--
Xylene (total)	--	--	--	3 J	--	1 J	8 J	--
Semivolatile Organic Compounds (μg/kg)								
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--
1-Methylnaphthalene	2.5	4.5	--	--	--	--	--	--
2-Methylnaphthalene	4	5.5	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--	--	--
Acenaphthylene	5.5	14	74 J	--	--	--	--	--
Anthracene	8	48	--	--	--	--	--	--
Benzo(a)anthracene	8.5	65	210 J	59 J	--	--	46 J	--
Benzo(a)pyrene	12	100	200 J	66 J	--	--	49 J	--
Benzo(b)fluoranthene	5.5	32	140 J	63 J	--	--	57 J	--
Benzo(g,h,i)perylene	--	14	160 J	66 J	--	--	51 J	--
Benzo(k)fluoranthene	5.5	32	210 J	71 J	--	--	43 J	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S05901	39S06001	40B00101	40B00201	40B00301	40S00101	40S00201	40S00301
Collect Date	12/05/96	12/05/96	03/19/96	03/19/96	08/29/96	03/20/96	03/20/96	08/29/96
Semivolatile Organic Compounds (μg/kg) (Cont)								
Chrysene	8.5	75	300 J	92 J	--	--	62 J	--
Di-n-butylphthalate	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	3	51 J	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	12	100	350 J	99 J	--	--	92 J	--
Fluorene	2.5	5.5	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	3.5	19	130 J	52 J	--	--	43 J	--
Naphthalene	4	6	--	--	--	--	--	--
Phenanthrene	16	60	300 J	46 J	--	--	63 J	--
Pyrene	12	100	530	140 J	--	--	91 J	--
bis(2-Ethylhexyl)phthalate	--	--	50 J	--	--	--	--	--
Pesticides/PCBs (μg/kg)								
4,4'-DDE	--	--	--	--	--	--	--	--
4,4'-DDT	--	--	--	5.1 J	--	--	--	--
Dieldrin	--	--	--	6.3 J	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--	13	--
gamma-Chlordane	--	--	--	--	--	--	8	--
Inorganics (mg/kg)								
Aluminum	--	--	255 J	764 J	--	28.6 BJ	1,080 J	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S05901	39S06001	40B00101	40B00201	40B00301	40S00101	40S00201	40S00301
Collect Date	12/05/96	12/05/96	03/19/96	03/19/96	08/29/96	03/20/96	03/20/96	08/29/96
Inorganics (mg/kg) (Cont.)								
Arsenic	--	--	0.51 B	0.9 B	--	--	1.1 B	--
Barium	--	--	12.2 B	8.9 BJ	--	1.8 BJ	8 BJ	--
Beryllium	--	--	--	--	--	--	--	--
Cadmium	--	--	--	--	--	0.61 B	--	--
Calcium	--	--	1,930	9,430	--	142 B	2,650	--
Chromium	--	--	1.1 B	2.7	--	--	2.7	--
Cobalt	--	--	--	--	--	--	--	--
Copper	--	--	6.2	4.6 B	--	0.99 B	3.7 B	--
Iron	--	--	462	400	--	35.8	740	--
Lead	--	--	242	43.5	--	4.2	19.1	--
Magnesium	--	--	73 B	114 B	--	6.4 B	74.9 B	--
Manganese	--	--	14.3	11.3	--	1.4 B	10.3	--
Mercury	--	--	--	0.03 B	--	0.05 B	0.07 B	--
Nickel	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--
Sivler	--	--	--	--	--	--	--	--
Sodium	--	--	--	28.6 B	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Vanadium	--	--	0.86 B	1.2 B	--	--	1.1 B	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	39S05901	39S06001	40B00101	40B00201	40B00301	40S00101	40S00201	40S00301
Collect Date	12/05/96	12/05/96	03/19/96	03/19/96	08/29/96	03/20/96	03/20/96	08/29/96
Inorganics (mg/kg) (Cont.)								
Zinc	--	--	42.8	20.4	--	9.5	46.7	--
Gross Alpha	--	--	--	--	0.011	--	--	0.006
Gross Alpha, Uncertainty	--	--	--	--	0.046	--	--	0.053
Gross Beta	--	--	--	--	0.183	--	--	0.039
Gross Beta, Uncertainty	--	--	--	--	0.092	--	--	0.09
Total Petroleum Hydrocarbons	--	--	20.3	7.4	--	--	10.2	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	40S00701	40S01001	40S01801	40S02401	40S02801
Collect Date	12/04/96	12/04/96	12/04/96	12/05/96	12/05/96
Volatile Organic Compounds (μg/kg)					
Carbon disulfide	--	--	--	--	--
Ethylbenzene	--	--	--	--	--
Methylene chloride	--	--	--	--	--
Tetrachlorethene	--	--	--	--	--
Toluene	--	--	--	--	--
Xylene (total)	--	--	--	--	--
Semivolatile Organic Compounds (μg/kg)					
2,4-Dinitrotoluene	--	--	--	--	--
1-Methylnaphthalene	5.5	4.5	18	--	--
2-Methylnaphthalene	9	8	30	4	4
Acenaphthene	3.5	3	--	--	--
Acenaphthylene	19	29	46	10	38
Anthracene	90	100	42	36	50
Benzo(a)anthracene	85	160	55	19	38
Benzo(a)pyrene	120	270	90	43	75
Benzo(b)fluoranthene	55	120	24	24	34
Benzo(g,h,i)perylene	43	46	12	24	9.5

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	40S00701	40S01001	40S01801	40S02401	40S02801
Collect Date	12/04/96	12/04/96	12/04/96	12/05/96	12/05/96
Semivolatile Organic Compounds (μg/kg) (Cont)					
Benzo(k)fluoranthene	55	120	24	24	34
Chrysene	100	160	60	23	50
Di-n-butylphthalate	--	--	--	--	--
Dibenz(a,h)anthracene	4	15	4	4	--
Dibenzofuran	--	--	--	--	--
Fluoranthene	95	150	42	18	60
Fluorene	4	3.5	2.5	3	2.5
Indeno(1,2,3-cd)pyrene	34	47	14	18	12
Naphthalene	14	8.5	24	5	4.5
Phenanthrene	95	55	27	20	20
Pyrene	120	220	65	32	100
bis(2-Ethylhexyl)phthalate	--	--	--	--	--
Pesticides/PCBs (μg/kg)					
4,4'-DDE	--	--	--	--	--
4,4'-DDT	--	--	--	--	--
Dieldrin	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	40S00701	40S01001	40S01801	40S02401	40S02801
Collect Date	12/04/96	12/04/96	12/04/96	12/05/96	12/05/96
Inorganics (mg/kg)					
Aluminum	--	--	--	--	--
Arsenic	2.2	1	--	--	3.1
Barium	--	--	--	--	--
Beryllium	--	--	--	--	--
Cadmium	--	--	--	--	--
Calcium	--	--	--	--	--
Chromium	--	--	--	--	--
Cobalt	--	--	--	--	--
Copper	--	--	--	--	--
Iron	--	--	--	--	--
Lead	--	--	--	--	--
Magnesium	--	--	--	--	--
Manganese	--	--	--	--	--
Mercury	--	--	--	--	--
Nickel	--	--	--	--	--
Selenium	--	--	--	--	--
Sodium	--	--	--	--	--
Sodium	--	--	--	--	--

See notes at end of table

Table 1 (Continued)
Summary of Analytical Results Surface Soils

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	40S00701	40S01001	40S01801	40S02401	40S02801
Collect Date	12/04/96	12/04/96	12/04/96	12/05/96	12/05/96
Inorganics (mg/kg) (Cont.)					
Thallium	--	--	--	--	--
Vanadium	--	--	--	--	--
Zinc	--	--	--	--	--
Gross Alpha	--	--	--	--	--
Gross Alpha, Uncertainty	--	--	--	--	--
Gross Beta	--	--	--	--	--
Gross Beta, Uncertainty	--	--	--	--	--
Total Petroleum Hydrocarbons	--	--	--	--	--

Notes:
SWMU = solid waste management unit.
RCRA = Resource Conservation and Recovery Act.
ug/kg = micrograms per kilogram.
DDT = dichlorodiphenyltrichloroethane.
J = estimated value.
PCBs = polychlorinated biphenyls.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
mg/kg = milligram per kilogram.

Table 2
Selection of Human Health Chemicals of Potential Concern
Based on a Residential Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Residential [5] SCG	USEPA Region III Residential RBC [6]	Exceeded Background Screening Conc.?	Selected as HHCPC? [7]
ORGANICS											
Volatiles (μg/kg)											
Carbon disulfide	3/17	1 - 3.5*	10 - 11.5	4.7	6.1	3.5	NA	5,200	780,000	NA	NO
Ethylbenzene	3/17	1 - 2	10 - 11.5	4.5	6.4	2	NA	1.4E+06	780,000	NA	NO
Methylene chloride	1/17	5.8*	10 - 11.5	5.3	NC	5.8	NA	16,000	85,000	NA	NO
Tetrachloroethene	1/17	3	10 - 11.5	5.1	5.4	3	NA	12,000	12,000	NA	NO
Toluene	12/17	3.3* - 190	10 - 11.5	36.8	117	117	NA	520,000	1.6E+06	NA	NO
Xylenes(total)	11/17	1 - 8	10 - 11.5	4.1	6.3	6.3	NA	1.3E+07	1.6E+07	NA	NO
Semivolatiles (μg/kg)											
Acenaphthene	4/33	3 - 60	2.5 - 370	88	1,998	60	NA	2.8E+06	470,000	NA	NO
Acenaphthylene	18/33	3 - 140	2.5 - 370	93.3	308	140	NA	670,000	230,000[8]	NA	NO
Anthracene	17/33	6.5 - 180	2.5 - 370	115	242	180	NA	2.0E+07	2.3E+06	NA	NO
Benzo(a)anthracene	26/33	2.5 - 640	2.5 - 370	109	305	305	NA	1,400	880	NA	YES[9]
Benzo(a)pyrene	25/33	4.5 - 520	2.5 - 370	134	380	380	NA	100	88	NA	YES
Benzo(b)fluoranthene	24/33	4 - 520	2.5 - 370	110	403	403	NA	1,400	880	NA	YES[9]
Benzo(g,h,i)perylene	22/33	5 - 300	2.5 - 370	84.7	399	300	NA	14,000	230,000[8]	NA	NO
Benzo(k)fluoranthene	24/33	4 - 530	2.5 - 370	105	388	388	NA	14,000	8,800	NA	YES[9]
Bis(2-ethylhexyl)phthalate	7/17	41 - 140*	340 - 370	130	191	140	NA	48,000	46,000	NA	NO
Carbazole	2/17	61 - 120	340 - 370	166	189	120	NA	42,000	32,000	NA	NO
Chrysene	27/33	2.5 - 690	2.5 - 370	132	354	354	NA	140,000	88,000	NA	YES[9]
Di-n-butylphthalate	5/17	100 - 200	340 - 370	165	181	181	NA	7.3E+06	780,000	NA	NO

See notes at end of table.

Table 2
Selection of Human Health Chemicals of Potential Concern
Based on a Residential Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Residential [5] SCG	USEPA Region III Residential RBC [6]	Exceeded Background Screening Conc.?	Selected as HHCPC? [7]
Dibenz(a,h)anthracene	12/33	3 - 110	2.5 - 370	75.6	804	110	NA	100	88	NA	YES
Dibenzofuran	3/17	39* - 120	340 - 370	157	204	120	NA	240,000	31,000	NA	NO
2,4-Dinitrotoluene	1/32	0.3	0.064 - 370	99	9,065,622	0.3	NA	130,000	16,000	NA	NO
Fluoranthene	27/33	2.5 - 1,300	2.5 - 370	150	358	358	NA	2.9E+06	310,000	NA	NO
Fluorene	14/33	2.5 - 51	2.5 - 370	88.4	907	51	NA	2.4E+06	310,000	NA	NO
Indeno(1,2,3-cd)pyrene	22/33	3.5 - 290	2.5 - 370	83.8	344	290	NA	1,400	880	NA	YES[9]
1-Methylnaphthalene	11/16	2.5 - 180	2.5 - 2.5	20.3	64.7	64.7	NA	930,000	310,000[10]	NA	NO
2-Methylnaphthalene	21/33	2.5 - 350	2.5 - 370	102	478	350	NA	960,000	310,000[10]	NA	NO
Naphthalene	19/33	3 - 210	2.5 - 370	92.9	399	210	NA	1.3E+06	310,000	NA	NO
Phenanthrene	26/33	4.5 - 1,100	2.5 - 370	129	257	257	NA	1.7E+06	230,000[8]	NA	NO
Pyrene	28/33	3.5 - 1,400	2.5 - 370	172	392	392	NA	2.2E+06	230,000	NA	NO
Pesticides (µg/kg)											
alpha-Chlordane	5/17	1.1 - 20	1.75 - 9.3	4	7.2	7.2	NA	800[11]	490[11]	NA	NO
gamma-Chlordane	5/17	0.78 - 18	1.75 - 9.3	3.6	6.4	6.4	NA	800[11]	490[11]	NA	NO
4,4'-DDE	6/17	1.8 - 12*	3.4 - 18	4.9	7.3	7.3	NA	3,000	1,900	NA	NO
4,4'-DDT	5/17	4.2 - 14*	3.4 - 18	5.7	9.1	9.1	NA	3,100	1,900	NA	NO
Dieldrin	4/17	1.2 - 6.3	3.4 - 18	4.2	6.4	6.3	NA	70	40	NA	NO
Other (µg/kg)											
Total Petroleum Hydrocarbons	13/17	4.7 - 101	1.7 - 1.8	21.8	133	101	NA	NSC	230,000[8]	NA	NO

See notes at end of table.

Table 2
Selection of Human Health Chemicals of Potential Concern
Based on a Residential Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Residential [5] SCG	USEPA Region III Residential RBC [6]	Exceeded Background Screening Conc.?	Selected as HHCPC? [7]
					RADIOACTIVITY						
Radioactive Materials (pCi/g)											
Gross alpha	8/8	0.006 - 0.859	NA	0.29	NC	0.86	NA	NSC	NSC	NA	YES
Gross beta	8/8	0.031 - 1.48	NA	0.44	NC	1.5	NA	NSC	NSC	NA	YES
					INORGANICS						
Metals (mg/kg)											
Aluminum	17/17	13.9 - 3,460	NA	927	5,541	3,460	2,088	75,000	7,800	NO	NO
Arsenic	13/33	0.32 - 6.7	0.27 - 1	1	1.6	1.6	1.0	0.8	0.43[12]	YES	YES
Barium	16/17	0.41 - 26.5	0.11 - 0.12	10.3	83.1	26.5	8.7	5,200	550	YES	NO
Beryllium	10/17	0.03 - 0.18	0.03 - 0.033	0.06	0.11	0.11	0.09	0.2[13]	0.15	YES	NO
Cadmium	2/17	0.51 - 0.61	0.37 - 0.4	0.23	0.28	0.28	0.98	37	3.9	NO	NO
Calcium	17/17	142 - 149,000*	NA	27,610	744,152	149,000	25,295	NSC	1.0E+06[14]	YES	NO
Chromium	14/17	0.71 - 7.2*	0.45 - 0.48	2.6	7.1	7.1	4.6	290[15]	39[15]	YES	NO
Cobalt	3/17	0.79 - 3.6*	0.31 - 0.33	0.51	0.77	0.77	ND	4.7E+06	470	NA	NO
Copper	16/17	0.91 - 6.7*	0.41 - 0.44	3.3	6.8	6.7	4.1	NSC	310	YES	NO
Iron	17/17	16.6 - 6,800*	NA	976	4,629	4,629	712	NSC	2,300	YES	NO
Lead	16/17	0.51 - 242	0.24 - 1.3	26.9	192	192	14.5	500	400[16]	YES	NO
Magnesium	16/17	6.4 - 1,050*	4.6 - 4.9	256	2,165	1,050	328	NSC	460,468[14]	YES	NO
Manganese	17/17	0.38 - 43.5	NA	11.7	39.7	39.7	8.1	370	180	YES	NO
Mercury	7/17	0.03 - 0.07	0.03 - 0.04	0.03	0.04	0.04	0.07	23	2.3	NO	NO
Nickel	3/17	2.8 - 5.7*	1.6 - 1.7	1.4	1.8	1.8	4.4	1,500	160	NO	NO

See notes at end of table.

Table 2
Selection of Human Health Chemicals of Potential Concern
Based on a Residential Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Residential [5] SCG	USEPA Region III Residential RBC [6]	Exceeded Background Screening Conc.?	Selected as HHCPC? [7]
Selenium	5/17	0.23* - 0.42*	0.27 - 0.29	0.2	0.25	0.25	0.95	390	39	NO	NO
Silver	1/17	0.96	0.45 - 0.48	0.28	0.32	0.32	1.8	390	39	NO	NO
Sodium	4/17	28.6 - 99*	2.7 - 2.9	15.1	53.5	53.5	91.4	NP	1.0E+06[14]	NO	NO
Thallium	2/17	0.18 - 0.19	0.18 - 0.19	0.1	0.11	0.11	2.0	NP	0.63[17]	NO	NO
Vanadium	13/17	0.69 - 9.8*	0.33 - 0.35	2.1	6.8	6.8	3.1	490	55	YES	NO
Zinc	17/17	2.5 - 46.7	NA	18.9	33.1	33.1	17.2	23,000	2,300	YES	NO

See notes at end of table.

Table 2
Selection of Human Health Chemicals of Potential Concern
Based on a Residential Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Residential [5] SCG	USEPA Region III Residential RBC [6]	Exceeded Background Screening Conc.?	Selected as HHCPC? [7]

Conc. = concentration
RBC = USEPA Region III Risk-Based Concentration.
SCG = Florida Soil Clean-up Goals.
CPC = chemical of potential concern.
EPC = exposure point concentration.
UCL = upper confidence limit.
NA = not available/not applicable.
NC = not calculated.
ND = not detected.
NSC = no screening concentration available.
* = value is the average of a sample and its duplicate.
DDE = dichlorodiphenyldichloroethylene.
DDT = dichlorodiphenyltrichloroethane.
μg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
pCi/g = picoCuries per gram.

[1]Frequency of detection is the number of samples in which the analyte is detected over the total number of samples analyzed.
[2]One-half the contract required quantitation limit/contract required detection limit (CRQL/CRDL) was used for nondetects in calculating the mean and the 95% upper confidence limit (UCL).
[3]Exposure point concentration (EPC) is the lesser of 95% UCL and maximum detected concentration.
[4]The background screening concentration is twice the mean of detected concentrations for inorganic analytes. The background concentrations were obtained from the NTC Orlando Background Sampling Report (ABB-ES, 1995).
[5]Florida Soil Clean-up Goals (SCG) Residential Scenario (FDEP, September, 1995 and January 19, 1996).
[6]The USEPA Region III Risk-Based Concentrations (RBC) for Soil Residential Scenario based on a cancer risk of 10^{-6} and a hazard quotient of 0.1.
[7]If the analyte's maximum detected concentration is less than or equal to the background screening concentration, or is less than or equal to the RBC and the Florida SCG, then the analyte was not selected as a CPC.
[8]Pyrene RBC is used as a surrogate for acenapthylene, benzo(g,h,i)perylene, phenanthrene, and total petroleum hydrocarbons.
[9]This carcinogenic PAH was retained as a CPC since another member of the carcinogenic polynuclear aromatic hydrocarbon class exceeded it's screening criteria.
[10]Naphthalene is used as a surrogate for 1-methylnaphthalene and 2-methylnaphthalene.
[11]RBC and SCG values are based on the general value for chlordane.
[12]RBC value is based on arsenic's properties as a carcinogen.
[13]Beryllium SCG value is based on dermal absorption of 0.0001.
[14]Values represent calculated acceptable levels of the essential nutrients: calcium, magnesium, and sodium.
[15]RBC and SCG are based on the Chromium VI isomer.
[16]RBC is not available for lead; value is from Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive 9355.4-12).
[17]RBC value for thallium is not available; RBC for thallium sulfate is used as a surrogate.

Table 3
Selection of Human Health Chemicals of Potential Concern
Based on an Industrial Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Industrial SCG[5]	USEPA Region III Industrial RBC[6]	Exceeded Background Screening Conc.?	Selected as HHCPC?[7]
ORGANICS											
Volatiles (µg/kg)											
Carbon disulfide	3/17	1 - 3.5*	10 - 11.5	4.7	6.1	3.5	NA	34,000	2.0E+07	NA	NO
Ethylbenzene	3/17	1 - 2	10 - 11.5	4.5	6.4	2	NA	1.0E+07	2.0E+07	NA	NO
Methylene chloride	1/17	5.8*	10 - 11.5	5.3	NC	5.8	NA	23,000	760,000	NA	NO
Tetrachloroethene	1/17	3	10 - 11.5	5.1	5.4	3	NA	28,000	110,000	NA	NO
Toluene	12/17	3.3* - 190	10 - 11.5	36.8	117	117	NA	3.5E+06	4.1E+07	NA	NO
Xylenes(total)	11/17	1 - 8	10 - 11.5	4.1	6.3	6.3	NA	9.2E+07	1.0E+08	NA	NO
Semivolatiles (µg/kg)											
Acenaphthene	4/33	3 - 60	2.5 - 370	88	1,998	60	NA	3.0E+07	1.2E+07	NA	NO
Acenaphthylene	18/33	3 - 140	2.5 - 370	93.3	308	140	NA	5.6E+06	6.1E+06[8]	NA	NO
Anthracene	17/33	6.5 - 180	2.5 - 370	115	242	180	NA	3.0E+08	6.1E+07	NA	NO
Benzo(a)anthracene	26/33	2.5 - 640	2.5 - 370	109	305	305	NA	4,900	7,800	NA	NO
Benzo(a)pyrene	25/33	4.5 - 520	2.5 - 370	134	380	380	NA	500	780	NA	NO
Benzo(b)fluoranthene	24/33	4 - 520	2.5 - 370	110	403	403	NA	5,000	7,800	NA	NO
Benzo(g,h,i)perylene	22/33	5 - 300	2.5 - 370	84.7	399	300	NA	50,000	6.1E+06[8]	NA	NO
Benzo(k)fluoranthene	24/33	4 - 530	2.5 - 370	105	388	388	NA	48,000	78,000	NA	NO
Bis(2-ethylhexyl)phthalate	7/17	41 - 140*	340 - 370	130	191	140	NA	110,000	410,000	NA	NO
Carbazole	2/17	61 - 120	340 - 370	166	189	120	NA	120,000	290,000	NA	NO
Chrysene	27/33	2.5 - 690	2.5 - 370	132	354	354	NA	500,000	780,000	NA	NO
Di-n-butylphthalate	5/17	100 - 200	340 - 370	165	181	181	NA	1.4E+08	2.0E+07	NA	NO
Dibenz(a,h)anthracene	12/33	3 - 110	2.5 - 370	75.6	804	110	NA	500	780	NA	NO

See notes at end of table.

Table 3
Selection of Human Health Chemicals of Potential Concern
Based on an Industrial Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Industrial[5] SCG	USEPA Region III Industrial RBC[6]	Exceeded Background Screening Conc.?	Selected as HHCPC?[7]
Dibenzofuran	3/17	39* - 120	340 - 370	157	204	120	NA	3.5E+06	8.2E+05	NA	NO
2,4-Dinitrotoluene	1/32	0.3	0.064 - 370	99	9,065,622	0.3	NA	2.0E+06	410,000	NA	NO
Fluoranthene	27/33	2.5 - 1,300	2.5 - 370	150	358	358	NA	4.8E+07	8.2E+06	NA	NO
Fluorene	14/33	2.5 - 51	2.5 - 370	88.4	907	51	NA	3.0E+07	8.2E+06	NA	NO
Indeno(1,2,3-cd)pyrene	22/33	3.5 - 290	2.5 - 370	83.8	344	290	NA	5,000	7,800	NA	NO
1-Methylnaphthalene	11/16	2.5 - 180	2.5 - 2.5	20.3	64.7	64.7	NA	8.4E+06	8.2E+06[9]	NA	NO
2-Methylnaphthalene	21/33	2.5 - 350	2.5 - 370	102	478	350	NA	8.8E+06	8.2E+06[9]	NA	NO
Naphthalene	19/33	3 - 210	2.5 - 370	92.9	399	210	NA	1.2E+07	8.2E+06	NA	NO
Phenanthrene	26/33	4.5 - 1,100	2.5 - 370	129	257	257	NA	2.1E+07	6.1E+06[8]	NA	NO
Pyrene	28/33	3.5 - 1,400	2.5 - 370	172	392	392	NA	4.1E+07	6.1E+06	NA	NO
Pesticides (µg/kg)											
alpha-Chlordane	5/17	1.1 - 20	1.75 - 9.3	4	7.2	7.2	NA	3,000[10]	4,400[10]	NA	NO
gamma-Chlordane	5/17	0.78 - 18	1.75 - 9.3	3.6	6.4	6.4	NA	3,000[10]	4,400[10]	NA	NO
4,4'-DDE	6/17	1.8 - 12*	3.4 - 18	4.9	7.3	7.3	NA	11,000	17,000	NA	NO
4,4'-DDT	5/17	4.2 - 14*	3.4 - 18	5.7	9.1	9.1	NA	12,000	17,000	NA	NO
Dieldrin	4/17	1.2 - 6.3	3.4 - 18	4.2	6.4	6.3	NA	300	360	NA	NO
Other (µg/kg)											
Total Petroleum Hydrocarbons	13/17	4.7 - 101	1.7 - 1.8	21.8	133	101	NA	NSC	6.1E+06[8]	NA	N0

See notes at end of table.

Table 3
Selection of Human Health Chemicals of Potential Concern
Based on an Industrial Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Industrial[5] SCG	USEPA Region III Industrial RBC[6]	Exceeded Background Screening Conc.?	Selected as HHCPC?[7]
RADIOACTIVITY											
Radioactive Materials (pCi/g)											
Gross alpha	8/8	0.006 - 0.859	NA	0.29	NC	0.86	NA	NSC	NSC	NA	YES
Gross beta	8/8	0.031 - 1.48	NA	0.44	NC	1.5	NA	NSC	NSC	NA	YES
INORGANICS											
Metals (mg/kg)											
Aluminum	17/17	13.9 - 3,460	NA	927	5,541	3,460	2,088	1.0E+06[11]	1.0E+05	NO	NO
Arsenic	13/33	0.32 - 6.7	0.27 - 1	1	1.6	1.6	1.0	3.7	3.8[12]	YES	NO
Barium	16/17	0.41 - 26.5	0.11 - 0.12	10.3	83.1	26.5	8.7	84,000	14,000	YES	NO
Beryllium	10/17	0.03 - 0.18	0.03 - 0.033	0.06	0.11	0.11	0.09	1.0[13]	1.3	YES	NO
Cadmium	2/17	0.51 - 0.61	0.37 - 0.4	0.23	0.28	0.28	0.98	600	100	NO	NO
Calcium	17/17	142 - 149,000*	NA	27,610	744,152	149,000	25,295	NSC	1.0E+06[14]	YES	NO
Chromium	14/17	0.71 - 7.2*	0.45 - 0.48	2.6	7.1	7.1	4.6	430[15]	1.0E+05[15]	YES	NO
Cobalt	3/17	0.79 - 3.6*	0.31 - 0.33	0.51	0.77	0.77	ND	110,000	12,000	NA	NO
Copper	16/17	0.91 - 6.7*	0.41 - 0.44	3.3	6.8	6.7	4.1	NSC	8,200	YES	NO
Iron	17/17	16.6 - 6,800*	NA	976	4,629	4,629	712	NSC	61,000	YES	NO
Lead	16/17	0.51 - 242	0.24 - 1.3	26.9	192	192	14.5	1,000	400[16]	YES	NO
Magnesium	16/17	6.4 - 1,050*	4.6 - 4.9	256	2,165	1,050	328	NSC	460,468[14]	YES	NO
Manganese	17/17	0.38 - 43.5	NA	11.7	39.7	39.7	8.1	5,500	4,700	YES	NO
Mercury	7/17	0.03 - 0.07	0.03 - 0.04	0.03	0.04	0.04	0.07	480	61	NO	NO
Nickel	3/17	2.8 - 5.7*	1.6 - 1.7	1.4	1.8	1.8	4.4	26,000	4,100	NO	NO
Selenium	5/17	0.23* - 0.42*	0.27 - 0.29	0.2	0.25	0.25	0.95	9,900	1,000	NO	NO

See notes at end of table.

Table 3
Selection of Human Health Chemicals of Potential Concern
Based on an Industrial Scenario
Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Industrial[5] SCG	USEPA Region III Industrial RBC[6]	Exceeded Background Screening Conc.?	Selected as HHCPC?[7]
Silver	1/17	0.96	0.45 - 0.48	0.28	0.32	0.32	1.8	9,000	1,000	NO	NO
Sodium	4/17	28.6 - 99*	2.7 - 2.9	15.1	53.5	53.5	91.4	NSC	1.0E+06[14]	NO	NO
Thallium	2/17	0.18 - 0.19	0.18 - 0.19	0.1	0.11	0.11	2.0	NSC	16[17]	NO	NO
Vanadium	13/17	0.69 - 9.8*	0.33 - 0.35	2.1	6.8	6.8	3.1	4,800	1,400	YES	NO
Zinc	17/17	2.5 - 46.7	NA	18.9	33.1	33.1	17.2	560,000	61,000	YES	NO

See notes at end of table.

Table 3
Selection of Human Health Chemicals of Potential Concern Based on an Industrial Scenario Surface Soil

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Chemical Name	Frequency of Detection[1]	Range of Detected Concentrations	Range of Reporting Limits	Mean[2]	95% UCL[2]	EPC[3]	Background Screening Conc.[4]	Florida Industrial[5] SCG	USEPA Region III Industrial RBC[6]	Exceeded Background Screening Conc.?	Selected as HHCPC?[7]

Conc. = concentration
RBC = USEPA Region III Risk-Based Concentration.
SCG = Florida Soil Clean-up Goals.
CPC = chemical of potential concern.
EPC = exposure point concentration.
UCL = upper confidence limit.
NA = not available/not applicable.
NC = not calculated.
ND = not detected.
NSC = no screening concentration available.
* = value is the average of a sample and its duplicate.
DDE = dichlorodiphenyldichloroethylene.
DDT = dichlorodiphenyltrichloroethane.
μg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
pCi/g = picoCuries per gram.

[1]Frequency of detection is the number of samples in which the analyte is detected over the total number of samples analyzed.
[2]One-half the contract required quantitation limit/contract required detection limit (CRQL/CRDL) was used for nondetects in calculating the mean and the 95% upper confidence limit (UCL).
[3]Exposure point concentration (EPC) is the lesser of 95% UCL and maximum detected concentration.
[4]The background screening concentration is twice the mean of detected concentrations for inorganic analytes. The background concentrations were obtained from the NTC Orlando Background Sampling Report (ABB-ES, 1995).
[5]Florida Soil Clean-up Goals (SCG) Industrial Scenario (FDEP, September, 1995 and January 19, 1996).
[6]The USEPA Region III Risk-Based Concentrations (RBC) for Soil Industrial Scenario based on a cancer risk of 10^{-6} and a hazard quotient of 0.1.
[7]If the analyte's maximum detected concentration is less than or equal to the background screening concentration, or is less than or equal to the RBC and the Florida SCG, then the analyte was not selected as a CPC.
[8]Pyrene RBC is used as a surrogate for acenapthylene, benzo(g,h,i)perylene, phenanthrene, and Total petroleum hydrocarbons.
[9]Naphthalene is used as a surrogate for 1-methylnaphthalene and 2-methylnaphthalene.
[10]RBC and SCG values are based on the general value for chlordane.
[11]Aluminum SCG value exceeds 1.0E+06.
[12]RBC value is based on arsenic's properties as a carcinogen.
[13]Beryllium SCG value is based on dermal absorption of 0.0001.
[14]Values represent calculated acceptable levels of the essential nutrients: calcium, magnesium, and sodium.
[15]Value is based on the chromium VI isomer.
[16]RBC is not available for lead; value is from Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive 9355.4-12).
[17]RBC value for thallium is not available; RBC for thallium sulfate is used as a surrogate.

Table 4a
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Resident (Adult and Child)

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 356\ days/year}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific		Chemical-specific	
Soil Ingestion Rate	IR_{soil}	200	100	mg/day	[2]
Fraction Ingested	FI	100%	100%	unitless	Assumption
Conversion Factor					
Inorganics	CF	1×10^{-6}	1×10^{-6}	kg/mg	
Organics	CF	1×10^{-9}	1×10^{-9}	kg/μg	
Exposure Frequency	EF	350	350	days/year	[2]
Exposure Duration	ED	6	24	years	[2]
Exposure Time [1]	ET	24	24	hours/day	[2]
Averaging Time	AT				
Cancer		70	70	years	[2]
Noncancer		6	24	years	[2]
Surface Area	SA		5750	cm^2	[3]
Age-weighted Surface Area	$SA_{soil/adj}$	766		cm^2-year/kg	[3]
Dose Absorbed per Unit Area per Event	DA_{event}	Chemical-specific		mg/cm^2-event	[3]
Particulate Emission Factor	PEF	1.24×10^9	1.24×10^9	m^3/kg	[4]

See notes at end of table.

Table 4a (Continued)
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Resident (Adult and Child)

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Inhalation Rate	IR_{air}	0.625	0.833	m^3/hour	[2]
Body Weight	BW	15	70	kg	[2]
Adherence Factor	AF	1	1	mg/cm^2-event	[3]
Absorption Fraction	ABS_d	Chemical-specific		unitless	[4]
Concentration in Air	CA	Chemical-specific		mg/m^3	[4]

References:

[1] Exposure Time is used only in the Inhalation of Particulates Scenario.
[2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
[3] USEPA, 1992d. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.
[4] USEPA, 1995b. USEPA Region IV Guidance Memorandum; November, 1995.

Table 4b
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
Central Tendency Resident (Adult and Child)

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 356\ days/year}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific		Chemical-specific	
Soil Ingestion Rate	IR_{soil}	100	50	mg/day	[2]
Fraction Ingested	FI	100%	100%	unitless	Assumption
Conversion Factor					
Inorganics	CF	1×10^{-6}	1×10^{-6}	kg/mg	
Organics	CF	1×10^{-9}	1×10^{-9}	kg/μg	
Exposure Frequency	EF	350	350	days/year	[2]
Exposure Duration	ED	2	7	years	[2]
Exposure Time [1]	ET	24	24	hours/day	[2]
Averaging Time	AT				
Cancer		70	70	years	[2]
Noncancer		6	24	years	[2]
Surface Area	SA		5750	cm^2	[3]
Age-weighted Surface Area	$SA_{soil/adj}$	766		cm^2-year/kg	[3]
Dose Absorbed per Unit Area per Event	DA_{event}	Chemical-specific		mg/cm^2-event	[3]
Particulate Emission Factor	PEF	1.24×10^9	1.24×10^9	m^3/kg	[4]

See notes at end of table.

Table 4b (Continued)
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
Central Tendency Resident (Adult and Child)

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Inhalation Rate	IR_{air}	0.625	0.833	m^3/hour	[2]
Body Weight	BW	15	70	kg	[2]
Adherence Factor	AF	1	1	mg/cm^2-event	[3]
Absorption Fraction	ABS_d	Chemical-specific		unitless	[4]
Concentration in Air	CA	Chemical-specific		mg/m^3	[4]

References:

[1] Exposure Time is used only in the Inhalation of Particulates Scenario.
[2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
[3] USEPA, 1992d. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.
[4] USEPA, 1995b. USEPA Region IV Guidance Memorandum; November, 1995.

Table 4c
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
Recreational User (Adult and Adolescent)

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 356\ days/year}$$

Parameter	Symbol	Adolescent Value (Age 6-16)	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific		Chemical-specific	
Particulate Emission Factor	PEF	1.24×10^9	1.24×10^9	m^3/kg	[4]
Dose Absorbed per Unit Area per Event	DA_{event}	Chemical-specific		mg/m^2-event	[3]
Soil Ingestion Rate	IR_{soil}	100	100	mg/day	Assumption
Fraction Ingested	FI	100%	100%	unitless	Assumption
Conversion Factor					
Inorganics	CF	1×10^{-6}	1×10^{-6}	kg/mg	
Organics	CF	1×10^{-9}	1×10^{-9}	kg/μg	
Exposure Frequency	EF	45	45	days/year	Assumption
Exposure Duration	ED	10	20	years	Assumption
Exposure Time [1]	ET	4	4	hours/day	Assumption
Averaging Time	AT				
Cancer		70	70	years	[2]
Non-cancer		10	20	years	Assumption

See notes at end of table.

Table 4c (Continued)
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
Recreational User (Adult and Adolescent)

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Parameter	Symbol	Adolescent Value (Age 6-16)	Adult Value	Units	Source
Surface Area	SA	Site-specific	5750	cm^2	[3]
Age-weighted Surface Area	$SA_{soil/adj}$	1136		cm^2-year/kg	[3]
Inhalation Rate	IR_{air}	0.833	0.833	m^3/hour	[2]
Body Weight	BW	40	70	kg	[2,5]
Adherence Factor	AF	1	1	mg/cm^2-event	[3]
Absorption Fraction	ABS_d	Chemical-specific		unitless	[4]
Concentration in Air	CA	Chemical-specific		mg/m^3	[4]

References:

[1] Exposure Time is used only in the Inhalation of Particulate Scenario.
[2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
[3] USEPA, 1992d. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.
[4] USEPA, 1995b. USEPA Region IV Guidance Memorandum; November, 1995.
[5] USEPA, 1989a. Exposure Factors Handbook; EPA/600/8-89/043; July 1989.

TABLE 5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1992b
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	Assumption
EXPOSURE DURATION	ED	24	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

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

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE\text{-}_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE\text{-}_{DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$DA_{event} = CS \times AF \times ABS_d \times CF$

Note: For noncarcinogenic effects, AT = ED.

TABLE 5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	1.4E-07	0.73	1.0E-07	0.01	8.2E-08	0.8	6.6E-08	1.7E-07
Benzo(a)pyrene	O	380	ug/kg	1.8E-07	7.3	1.3E-06	0.01	1.0E-07	8	8.2E-07	2.1E-06
Benzo(b)fluoranthene	O	403	ug/kg	1.9E-07	0.73	1.4E-07	0.01	1.1E-07	0.8	8.7E-08	2.3E-07
Benzo(k)fluoranthene	O	388	ug/kg	1.8E-07	0.073	1.3E-08	0.01	1.0E-07	0.08	8.4E-09	2.2E-08
Chrysene	O	354	ug/kg	1.7E-07	0.0073	1.2E-09	0.01	9.6E-08	0.008	7.6E-10	2.0E-09
Dibenz(a,h)anthracene	O	110	ug/kg	5.2E-08	7.3	3.8E-07	0.01	3.0E-08	8	2.4E-07	6.1E-07
Indeno(1,2,3-c,d)pyrene	O	290	ug/kg	1.4E-07	0.73	9.9E-08	0.01	7.8E-08	0.8	6.3E-08	1.6E-07
Arsenic	I	1.6	mg/kg	7.5E-07	1.5	1.1E-06	0.001	4.3E-08	1.5	6.5E-08	1.2E-06
SUMMARY CANCER RISK						**3E-06**				**1E-06**	**5E-06**

[1]Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[3] Calculated from oral CSFs.
ND = no data available.

TABLE 5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	4.2E-07	ND		0.01	2.4E-07	ND		
Benzo(a)pyrene	O	380	ug/kg	5.2E-07	ND		0.01	3.0E-07	ND		
Benzo(b)fluoranthene	O	403	ug/kg	5.5E-07	ND		0.01	3.2E-07	ND		
Benzo(k)fluoranthene	O	388	ug/kg	5.3E-07	ND		0.01	3.1E-07	ND		
Chrysene	O	354	ug/kg	4.8E-07	ND		0.01	2.8E-07	ND		
Dibenz(a,h)anthracene	O	110	ug/kg	1.5E-07	ND		0.01	8.7E-08	ND		
Indeno(1,2,3-c,d)pyrene	O	260	ug/kg	3.6E-07	ND		0.01	2.0E-07	ND		
Arsenic	I	1.6	mg/kg	2.2E-06	0.0003	7.3E-03	0.001	1.3E-07	0.00029	4.3E-04	7.7E-03
SUMMARY HAZARD INDEX						0.007				0.0004	0.008

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995).
[2] Calculated from oral RfDs.

TABLE 6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE 6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	2.3E-11	0.31	**7.2E-12**
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	2.9E-11	3.1	**8.9E-11**
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	3.1E-11	0.31	**9.5E-12**
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	2.9E-11	0.031	**9.1E-13**
Chrysene	O	354	ug/kg	2.85E-10	2.7E-11	0.0031	**8.3E-14**
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	8.3E-12	3.1	**2.6E-11**
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	2.2E-11	0.31	**6.8E-12**
Arsenic	I	1.6	mg/kg	1.29E-09	1.2E-10	15	**1.8E-09**
					SUMMARY CANCER RISK		**2E-09**

ND = no data available.

TABLE 6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	6.7E-11	ND	
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	8.4E-11	ND	
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	8.9E-11	ND	
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	8.6E-11	ND	
Chrysene	O	354	ug/kg	2.85E-10	7.8E-11	ND	
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	2.4E-11	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	6.4E-11	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	3.5E-10	ND	
					SUMMARY HAZARD INDEX		0E+00

ND = no data available.

TABLE 7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40
EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	766	cm²-year/kg	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992.

USEPA, 1989. Exposure Factors Handbook;EPA/600/8-89/043; May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", OSWER Directive 9285.6-03.
USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
USEPA, 1992b. USEPA Region IV Guidance Memorandum, February 10, 1992.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE\text{-}_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE\text{-}_{DERMAL} = (DA_{event} \times EF / AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE 7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	3.3E-07	0.73	2.4E-07	0.01	3.2E-08	0.8	2.6E-08	2.7E-07
Benzo(a)pyrene	O	380	ug/kg	4.2E-07	7.3	3.0E-06	0.01	4.0E-08	8	3.2E-07	3.4E-06
Benzo(b)fluoranthene	O	403	ug/kg	4.4E-07	0.73	3.2E-07	0.01	4.2E-08	0.8	3.4E-08	3.6E-07
Benzo(k)fluoranthene	O	388	ug/kg	4.3E-07	0.073	3.1E-08	0.01	4.1E-08	0.08	3.3E-09	3.4E-08
Chrysene	O	354	ug/kg	3.9E-07	0.0073	2.8E-09	0.01	3.7E-08	0.008	3.0E-10	3.1E-09
Dibenz(a,h)anthracene	O	110	ug/kg	1.2E-07	7.3	8.8E-07	0.01	1.2E-08	8	9.2E-08	9.7E-07
Indeno(1,2,3-c,d)pyrene	O	290	ug/kg	3.2E-07	0.73	2.3E-07	0.01	3.0E-08	0.8	2.4E-08	2.6E-07
Arsenic	I	1.6	mg/kg	1.8E-06	1.5	2.6E-06	0.001	1.7E-08	1.5	2.5E-08	2.7E-06
					SUMMARY CANCER RISK	**7E-06**				**5E-07**	**8E-06**

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[3] Calculated from oral CSFs.
ND = no data.

TABLE 7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	3.9E-06	ND		0.01	3.7E-07	ND		
Benzo(a)pyrene	O	380	ug/kg	4.9E-06	ND		0.01	4.7E-07	ND		
Benzo(b)fluoranthene	O	403	ug/kg	5.2E-06	ND		0.01	4.9E-07	ND		
Benzo(k)fluoranthene	O	388	ug/kg	5.0E-06	ND		0.01	4.7E-07	ND		
Chrysene	O	354	ug/kg	4.5E-06	ND		0.01	4.3E-07	ND		
Dibenz(a,h)anthracene	O	110	ug/kg	1.4E-06	ND		0.01	1.3E-07	ND		
Indeno(1,2,3-c,d)pyrene	O	260	ug/kg	3.3E-06	ND		0.01	3.2E-07	ND		
Arsenic	I	1.6	mg/kg	2.0E-05	0.0003	6.8E-02	0.001	2.0E-07	0.00029	6.8E-04	6.9E-02
SUMMARY HAZARD INDEX						0.07				0.0007	0.07

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[2] Calculated from oral RfDs.
ND = no data.

TABLE 8

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION IN AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.625	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE 8

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	2.0E-11	0.31	6.3E-12
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	2.5E-11	3.1	7.8E-11
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	2.7E-11	0.31	8.3E-12
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	2.6E-11	0.031	8.0E-13
Chrysene	O	354	ug/kg	2.85E-10	2.3E-11	0.0031	7.3E-14
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	7.3E-12	3.1	2.3E-11
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	1.9E-11	0.31	6.0E-12
Arsenic	I	1.6	mg/kg	1.29E-09	1.1E-10	15	1.6E-09
				SUMMARY CANCER RISK			2E-09

NE = not evaluated.

TABLE 8

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	2.4E-10	ND	
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	2.9E-10	ND	
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	3.1E-10	ND	
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	3.0E-10	ND	
Chrysene	O	354	ug/kg	2.85E-10	2.7E-10	ND	
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	8.5E-11	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	2.2E-10	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	1.2E-09	ND	
SUMMARY HAZARD INDEX							0E+00

ND = no data available.

TABLE 9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1989
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1992b
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	Assumption
EXPOSURE DURATION	ED	7	years	USEPA, 1989
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1989

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

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

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE\text{-}_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE\text{-}_{DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

Note: For noncarcinogenic effects, AT = ED.

TABLE 9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	109	ug/kg	7.5E-09	0.73	5.5E-09	0.01	8.6E-09	0.8	6.9E-09	1.2E-08
Benzo(a)pyrene	O	134	ug/kg	9.2E-09	7.3	6.7E-08	0.01	1.1E-08	8	8.4E-08	1.5E-07
Benzo(b)fluoranthene	O	110	ug/kg	7.5E-09	0.73	5.5E-09	0.01	8.7E-09	0.8	6.9E-09	1.2E-08
Benzo(k)fluoranthene	O	105	ug/kg	7.2E-09	0.073	5.3E-10	0.01	8.3E-09	0.08	6.6E-10	1.2E-09
Chrysene	O	132	ug/kg	9.0E-09	0.0073	6.6E-11	0.01	1.0E-08	0.008	8.3E-11	1.5E-10
Dibenz(a,h)anthracene	O	75.6	ug/kg	5.2E-09	7.3	3.8E-08	0.01	6.0E-09	8	4.8E-08	8.5E-08
Indeno(1,2,3-c,d)pyrene	O	83.8	ug/kg	5.7E-09	0.73	4.2E-09	0.01	6.6E-09	0.8	5.3E-09	9.5E-09
Arsenic	I	1	mg/kg	6.8E-08	1.5	1.0E-07	0.001	7.9E-09	1.5	1.2E-08	1.1E-07
SUMMARY CANCER RISK						**2E-07**				**2E-07**	**4E-07**

[1]Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[3] Calculated from oral CSFs.
ND = no data available.

TABLE 9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	109	ug/kg	7.5E-08	ND		0.01	8.6E-08	ND		
Benzo(a)pyrene	O	134	ug/kg	9.2E-08	ND		0.01	1.1E-07	ND		
Benzo(b)fluoranthene	O	110	ug/kg	7.5E-08	ND		0.01	8.7E-08	ND		
Benzo(k)fluoranthene	O	105	ug/kg	7.2E-08	ND		0.01	8.3E-08	ND		
Chrysene	O	132	ug/kg	9.0E-08	ND		0.01	1.0E-07	ND		
Dibenz(a,h)anthracene	O	75.6	ug/kg	5.2E-08	ND		0.01	6.0E-08	ND		
Indeno(1,2,3-c,d)pyrene	O	83.8	ug/kg	5.7E-08	ND		0.01	6.6E-08	ND		
Arsenic	I	1	mg/kg	6.8E-07	0.0003	2.3E-03	0.001	7.9E-08	0.00029	2.7E-04	2.6E-03
SUMMARY HAZARD INDEX						0.002				0.0003	0.003

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995).
[2] Calculated from oral RfDs.
ND = no data available.

TABLE 10

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.

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

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE 10

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo(a)anthracene	O	109	ug/kg	8.79E-11	8.3E-12	0.31	2.6E-12
Benzo(a)pyrene	O	134	ug/kg	1.08E-10	1.0E-11	3.1	3.1E-11
Benzo(b)fluoranthene	O	110	ug/kg	8.87E-11	8.3E-12	0.31	2.6E-12
Benzo(k)fluoranthene	O	105	ug/kg	8.47E-11	8.0E-12	0.031	2.5E-13
Chrysene	O	132	ug/kg	1.06E-10	1.0E-11	0.0031	3.1E-14
Dibenz(a,h)anthracene	O	75.6	ug/kg	6.10E-11	5.7E-12	3.1	1.8E-11
Indeno(1,2,3-cd)pyrene	O	83.8	ug/kg	6.76E-11	6.3E-12	0.31	2.0E-12
Arsenic	I	1	mg/kg	8.06E-10	7.6E-11	15	1.1E-09
				SUMMARY CANCER RISK			1E-09

ND = no data available.

TABLE 10

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	109	ug/kg	8.79E-11	2.4E-11	ND	
Benzo(a)pyrene	O	134	ug/kg	1.08E-10	3.0E-11	ND	
Benzo(b)fluoranthene	O	110	ug/kg	8.87E-11	2.4E-11	ND	
Benzo(k)fluoranthene	O	105	ug/kg	8.47E-11	2.3E-11	ND	
Chrysene	O	132	ug/kg	1.06E-10	2.9E-11	ND	
Dibenz(a,h)anthracene	O	75.6	ug/kg	6.10E-11	1.7E-11	ND	
Indeno(1,2,3-cd)pyrene	O	83.8	ug/kg	6.76E-11	1.9E-11	ND	
Arsenic	I	1	mg/kg	8.06E-10	2.2E-10	ND	
						SUMMARY HAZARD INDEX	0E+00

ND = no data available.

TABLE 11

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT - CENTRAL TENDENCY EXPSOURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1989
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm^2-event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm^2	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	2	years	USEPA, 1989
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	766	cm^2-year/kg	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm^2-event	USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	2	years	USEPA, 1989

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992.

USEPA, 1989. Exposure Factors Handbook;EPA/600/8-89/043; May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
USEPA, 1992b. USEPA Region IV Guidance Memorandum, February 10, 1992.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE\text{-}_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE\text{-}_{DERMAL} = (DA_{event} \times EF / AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE 11

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT - CENTRAL TENDENCY EXPSOURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	109	ug/kg	2.0E-08	0.73	1.5E-08	0.01	1.1E-08	0.8	9.2E-09	2.4E-08
Benzo(a)pyrene	O	134	ug/kg	2.4E-08	7.3	1.8E-07	0.01	1.4E-08	8	1.1E-07	2.9E-07
Benzo(b)fluoranthene	O	110	ug/kg	2.0E-08	0.73	1.5E-08	0.01	1.2E-08	0.8	9.2E-09	2.4E-08
Benzo(k)fluoranthene	O	105	ug/kg	1.9E-08	0.073	1.4E-09	0.01	1.1E-08	0.08	8.8E-10	2.3E-09
Chrysene	O	132	ug/kg	2.4E-08	0.0073	1.8E-10	0.01	1.4E-08	0.008	1.1E-10	2.9E-10
Dibenz(a,h)anthracene	O	75.6	ug/kg	1.4E-08	7.3	1.0E-07	0.01	7.9E-09	8	6.3E-08	1.6E-07
Indeno(1,2,3-c,d)pyrene	O	83.8	ug/kg	1.5E-08	0.73	1.1E-08	0.01	8.8E-09	0.8	7.0E-09	1.8E-08
Arsenic	I	1	mg/kg	1.8E-07	1.5	2.7E-07	0.001	1.0E-08	1.5	1.6E-08	2.9E-07
					SUMMARY CANCER RISK	6E-07				2E-07	8E-07

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[3] Calculated from oral CSFs.
ND = no data.

TABLE 11

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT - CENTRAL TENDENCY EXPSOURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	109	ug/kg	7.0E-07	ND		0.01	4.0E-07	ND		
Benzo(a)pyrene	O	134	ug/kg	8.6E-07	ND		0.01	4.9E-07	ND		
Benzo(b)fluoranthene	O	110	ug/kg	7.0E-07	ND		0.01	4.0E-07	ND		
Benzo(k)fluoranthene	O	105	ug/kg	6.7E-07	ND		0.01	3.9E-07	ND		
Chrysene	O	132	ug/kg	8.4E-07	ND		0.01	4.8E-07	ND		
Dibenz(a,h)anthracene	O	75.6	ug/kg	4.8E-07	ND		0.01	2.8E-07	ND		
Indeno(1,2,3-c,d)pyrene	O	83.8	ug/kg	5.4E-07	ND		0.01	3.1E-07	ND		
Arsenic	I	1	mg/kg	6.4E-06	0.0003	2.1E-02	0.001	3.7E-07	0.00029	1.3E-03	2.3E-02
					SUMMARY HAZARD INDEX	0.02				0.001	0.02

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[2] Calculated from oral RfDs.
ND = no data.

TABLE 12

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION IN AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.625	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE 12

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo(a)anthracene	O	109	ug/kg	8.79E-11	7.2E-12	0.31	2.2E-12
Benzo(a)pyrene	O	134	ug/kg	1.08E-10	8.9E-12	3.1	2.8E-11
Benzo(b)fluoranthene	O	110	ug/kg	8.87E-11	7.3E-12	0.31	2.3E-12
Benzo(k)fluoranthene	O	105	ug/kg	8.47E-11	7.0E-12	0.031	2.2E-13
Chrysene	O	132	ug/kg	1.06E-10	8.7E-12	0.0031	2.7E-14
Dibenz(a,h)anthracene	O	75.6	ug/kg	6.10E-11	5.0E-12	3.1	1.6E-11
Indeno(1,2,3-cd)pyrene	O	83.8	ug/kg	6.76E-11	5.6E-12	0.31	1.7E-12
Arsenic	I	1	mg/kg	8.06E-10	6.6E-11	15	9.9E-10
				SUMMARY CANCER RISK			1E-09

NE = not evaluated.

TABLE 12

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT - CENTRAL TENDENCY EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	109	ug/kg	8.79E-11	8.4E-11	ND	
Benzo(a)pyrene	O	134	ug/kg	1.08E-10	1.0E-10	ND	
Benzo(b)fluoranthene	O	110	ug/kg	8.87E-11	8.5E-11	ND	
Benzo(k)fluoranthene	O	105	ug/kg	8.47E-11	8.1E-11	ND	
Chrysene	O	132	ug/kg	1.06E-10	1.0E-10	ND	
Dibenz(a,h)anthracene	O	75.6	ug/kg	6.10E-11	5.8E-11	ND	
Indeno(1,2,3-cd)pyrene	O	83.8	ug/kg	6.76E-11	6.5E-11	ND	
Arsenic	I	1	mg/kg	8.06E-10	7.7E-10	ND	
						SUMMARY HAZARD INDEX	0E+00

ND = no data available.

TABLE 13

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm^2-event	USEPA, 1992
ABSORPTION FRACTION	ABS_d	chemical specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm^2	USEPA, 1992
DOSE ABSORBED PER EVENT	DAevent	chemical specific	mg/cm^2-event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-06	kg/mg	inorganics
	CF	1.00E-09	kg/ug	organics
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	Assumption

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

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

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; 1/92.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE\text{-}_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE\text{-}_{DERMAL} = \frac{DAevent \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$DAevent = AF \times ABS_d \times CF$

Note: For noncarcinogenic effects: AT = ED

TABLE 13

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	7.7E-09	0.73	5.6E-09	0.01	8.8E-09	0.8	7.1E-09	1.27E-08
Benzo(a)pyrene	O	380	ug/kg	9.6E-09	7.3	7.0E-08	0.01	1.1E-08	8	8.8E-08	1.58E-07
Benzo(b)fluoranthene	O	403	ug/kg	1.0E-08	0.73	7.4E-09	0.01	1.2E-08	0.8	9.3E-09	1.67E-08
Benzo(k)fluoranthene	O	388	ug/kg	9.8E-09	0.073	7.1E-10	0.01	1.1E-08	0.08	9.0E-10	1.61E-09
Chrysene	O	354	ug/kg	8.9E-09	0.0073	6.5E-11	0.01	1.0E-08	0.008	8.2E-11	1.47E-10
Dibenz(a,h)anthracene	O	110	ug/kg	2.8E-09	7.3	2.0E-08	0.01	3.2E-09	8	2.5E-08	4.57E-08
Indeno(1,2,3-c,d)pyrene	O	290	ug/kg	7.3E-09	0.73	5.3E-09	0.01	8.4E-09	0.8	6.7E-09	1.20E-08
Arsenic	I	1.6	mg/kg	4.0E-08	1.5	6.0E-08	0.001	4.6E-09	1.5	6.9E-09	6.73E-08
SUMMARY CANCER RISK						2E-07				1E-07	3E-07

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[2] Calculated from oral CSFs.

TABLE 13

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	2.7E-08	ND		0.01	3.1E-08	ND		
Benzo(a)pyrene	O	380	ug/kg	3.3E-08	ND		0.01	3.8E-08	ND		
Benzo(b)fluoranthene	O	403	ug/kg	3.5E-08	ND		0.01	4.1E-08	ND		
Benzo(k)fluoranthene	O	388	ug/kg	3.4E-08	ND		0.01	3.9E-08	ND		
Chrysene	O	354	ug/kg	3.1E-08	ND		0.01	3.6E-08	ND		
Dibenz(a,h)anthracene	O	110	ug/kg	9.7E-09	ND		0.01	1.1E-08	ND		
Indeno(1,2,3-c,d)pyrene	O	260	ug/kg	2.3E-08	ND		0.01	2.6E-08	ND		
Arsenic	I	1.6	mg/kg	1.4E-07	0.0003	4.7E-04	0.001	1.6E-08	0.00029	5.6E-05	5.3E-04
SUMMARY HAZARD INDEX						0.0005				0.00006	0.0005

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[2] Calculated from oral RfDs.
ND = No data available.

TABLE 14

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	4	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note: **For noncarcinogenic effects, AT = ED**

TABLE 14

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m^3)	INTAKE (mg/kg-day)	INHALATION CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	4.1E-13	0.31	1.3E-13
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	5.1E-13	3.1	1.6E-12
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	5.4E-13	0.31	1.7E-13
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	5.2E-13	0.031	1.6E-14
Chrysene	O	354	ug/kg	2.85E-10	4.8E-13	0.0031	1.5E-15
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	1.5E-13	3.1	4.6E-13
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	3.9E-13	0.31	1.2E-13
Arsenic	I	1.6	mg/kg	1.29E-09	2.2E-12	15	3.2E-11
						SUMMARY CANCER RISK	3E-11

NE = not evaluated.

TABLE 14

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	1.4E-12	ND	
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	1.8E-12	ND	
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	1.9E-12	ND	
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	1.8E-12	ND	
Chrysene	O	354	ug/kg	2.85E-10	1.7E-12	ND	
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	5.2E-13	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	1.4E-12	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	7.6E-12	ND	
				SUMMARY HAZARD INDEX			0E+00

ND = no data available.

TABLE 15

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1992
AGE-SPECIFIC SURFACE AREA	SA_i	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganics
	CF	1.00E-09	kg/mg	Organics
BODY WEIGHT	BW	45	kg	USEPA, 1995
AGE-SPECIFIC BODY WEIGHT	BW_i	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED_i	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	1013	cm²-year/kg	Per USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	Per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.
[2] In estimating the dermally absorbed dose for children age 7 through 16, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 10 age periods, age 7 through 16, per USEPA, 1992.

USEPA, 1989. Exposure Factors Handbook;EPA/600/8-89/043; May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{\text{-INGESTION}} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{\text{-DERMAL}} = AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM $(SA_i \times ED_i / BW_i)$

DA_{event} = $CS \times AF \times ABS_d \times CF$

Note: For noncarcinogenic effects: AT = ED.

TABLE 15

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1,3] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	1.2E-08	0.73	8.7E-09	0.01	5.4E-09	0.8	4.4E-09	1.31E-08
Benzo(a)pyrene	O	380	ug/kg	1.5E-08	7.3	1.1E-07	0.01	6.8E-09	8	5.4E-08	1.63E-07
Benzo(b)fluoranthene	O	403	ug/kg	1.6E-08	0.73	1.2E-08	0.01	7.2E-09	0.8	5.8E-09	1.73E-08
Benzo(k)fluoranthene	O	388	ug/kg	1.5E-08	0.073	1.1E-09	0.01	6.9E-09	0.08	5.5E-10	1.66E-09
Chrysene	O	354	ug/kg	1.4E-08	0.0073	1.0E-10	0.01	6.3E-09	0.008	5.1E-11	1.52E-10
Dibenz(a,h)anthracene	O	110	ug/kg	4.3E-09	7.3	3.1E-08	0.01	2.0E-09	8	1.6E-08	4.71E-08
Indeno(1,2,3-c,d)pyrene	O	290	ug/kg	1.1E-08	0.73	8.3E-09	0.01	5.2E-09	0.8	4.1E-09	1.24E-08
Arsenic	I	1.6	mg/kg	6.3E-08	1.5	9.4E-08	0.001	2.9E-09	1.5	4.3E-09	9.82E-08
					SUMMARY CANCER RISK	**3E-07**				**9E-08**	**4E-07**

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment for Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[3] Calculated from oral CSFs.
ND = no data.

TABLE 15

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	8.4E-08	ND		0.01	3.8E-08	ND		
Benzo(a)pyrene	O	380	ug/kg	1.0E-07	ND		0.01	4.7E-08	ND		
Benzo(b)fluoranthene	O	403	ug/kg	1.1E-07	ND		0.01	5.0E-08	ND		
Benzo(k)fluoranthene	O	388	ug/kg	1.1E-07	ND		0.01	4.8E-08	ND		
Chrysene	O	354	ug/kg	9.7E-08	ND		0.01	4.4E-08	ND		
Dibenz(a,h)anthracene	O	110	ug/kg	3.0E-08	ND		0.01	1.4E-08	ND		
Indeno(1,2,3-c,d)pyrene	O	260	ug/kg	7.1E-08	ND		0.01	3.2E-08	ND		
Arsenic	I	1.6	mg/kg	4.4E-07	0.0003	1.5E-03	0.001	2.0E-08	0.00029	6.9E-05	1.5E-03
SUMMARY HAZARD INDEX						0.001				0.00007	0.002

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).
[2] Calculated from oral RfDs.
ND = No data available.

TABLE 16

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.625	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	45	kg	USEPA, 1995
EXPOSURE TIME	ET	4	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA 1995. Supplemental Guidance to RAGS, Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogenic effects: AT = ED

TABLE 16

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)^-1	CANCER RISK
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	2.4E-13	0.31	7.5E-14
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	3.0E-13	3.1	9.3E-13
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	3.2E-13	0.31	9.9E-14
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	3.1E-13	0.031	9.5E-15
Chrysene	O	354	ug/kg	2.85E-10	2.8E-13	0.0031	8.7E-16
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	8.7E-14	3.1	2.7E-13
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	2.3E-13	0.31	7.1E-14
Arsenic	I	1.6	mg/kg	1.29E-09	1.3E-12	15	1.9E-11
						SUMMARY CANCER RISK	2E-11

NE = not evaluated.

TABLE 16

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RECREATIONAL USER - REASONABLE MAXIMUM EXPOSURE SCENARIO
NTC ORLANDO
STUDY AREAS 39 AND 40

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	305	ug/kg	2.46E-10	1.7E-12	ND	
Benzo(a)pyrene	O	380	ug/kg	3.06E-10	2.1E-12	ND	
Benzo(b)fluoranthene	O	403	ug/kg	3.25E-10	2.2E-12	ND	
Benzo(k)fluoranthene	O	388	ug/kg	3.13E-10	2.1E-12	ND	
Chrysene	O	354	ug/kg	2.85E-10	2.0E-12	ND	
Dibenz(a,h)anthracene	O	110	ug/kg	8.87E-11	6.1E-13	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	1.6E-12	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	8.8E-12	ND	
SUMMARY HAZARD INDEX							0E+00

ND = no data available.

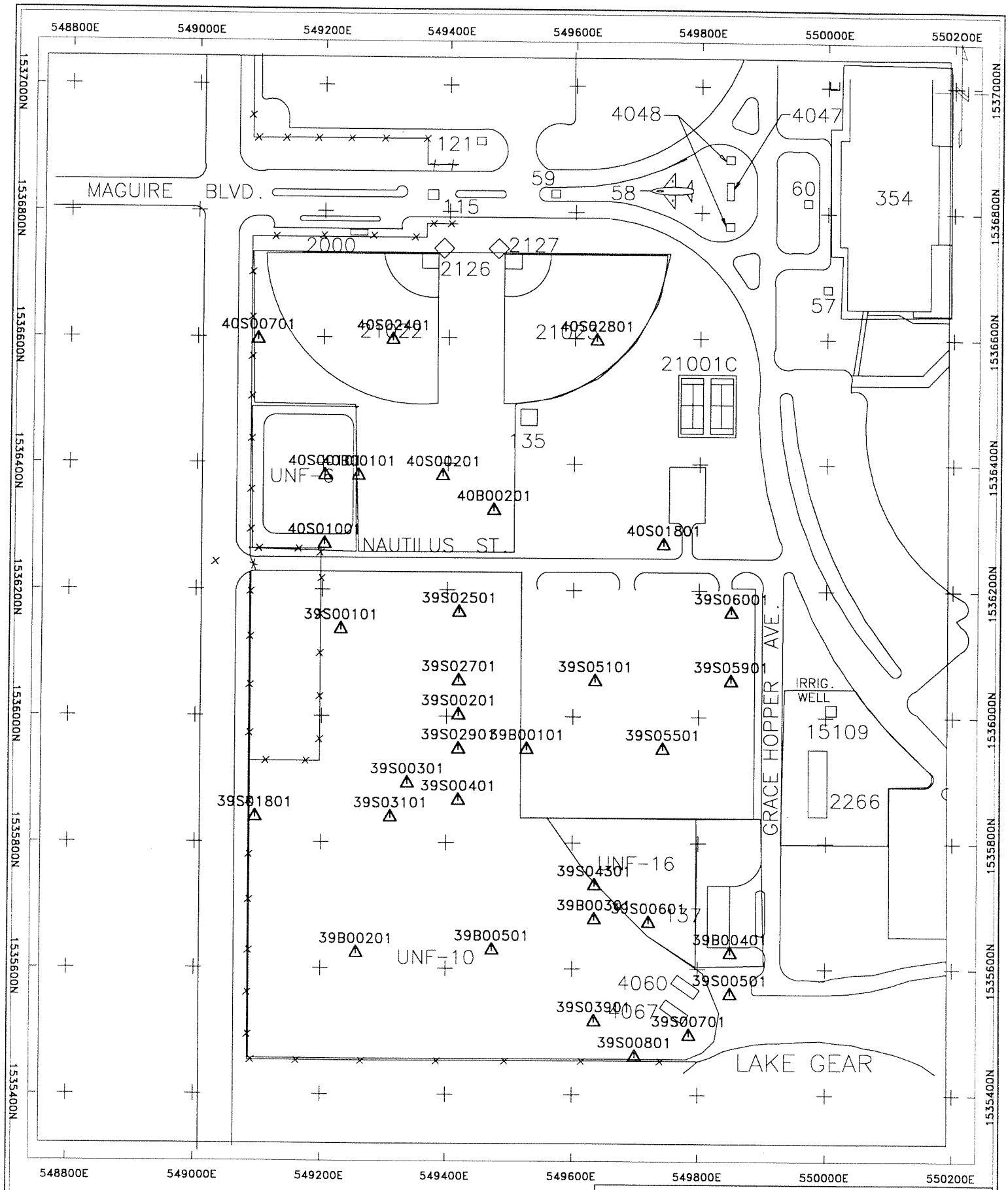
Table 17
Treatment Goals for Surface Soil at Study Areas 39 and 40

Focused Risk Assessment
NTC Orlando
Orlando, Florida

Analyte	Frequency of Detection[1]	Range of Detected Concentrations	EPC[2]	Available Action Levels						Treatment Goal[4]
				RGO ELCR 10^{-4}	RGO ELCR 10^{-5}	RGO ELCR 10^{-6}	Background Conc[3]	CRQL/CRDL	Florida SCG (Residential)	
Benzo(a)pyrene (mg/kg)	25/33	0.0045 - 0.52	0.38	6.9	0.69	0.069	NA	0.37	0.1	0.37
Dibenz(a,h)anthracene (mg/kg)	12/33	0.003 - 0.11	0.11	6.9	0.69	0.069	NA	0.37	0.1	0.37
Arsenic (mg/kg)	13/33	0.32 - 6.7	1.6	41	4.1	0.41	1	1	0.8	1

EPC = exposure point concentration
RGO = remedial goal option
ELCR = excess lifetime cancer risk
Conc = Concentration
CRQL/CRDL = contract-required quantitation limit/contract-required detection limit
SCG = Soil Cleanup Goals
mg/kg = milligrams per kilogram
NA = not applicable

[1]Frequency of detection is the number of samples in which the analyte was detected over the number of samples analyzed.
[2]The EPC is the lesser of the 95 percent upper confidence limit on the arithmetic mean of the maximum detected concentration.
[3]The background screening concentration is twice the arithmetic mean or detected concentation of inorganic analytes in background samples (ABB-ES, 1995).
[4]Treatment Goal is the highest of the 10^{-6} ELCR, background, CRQL/CRDL, or the Florida SCG (residential).



Scale 1:2400

100 0 100 200

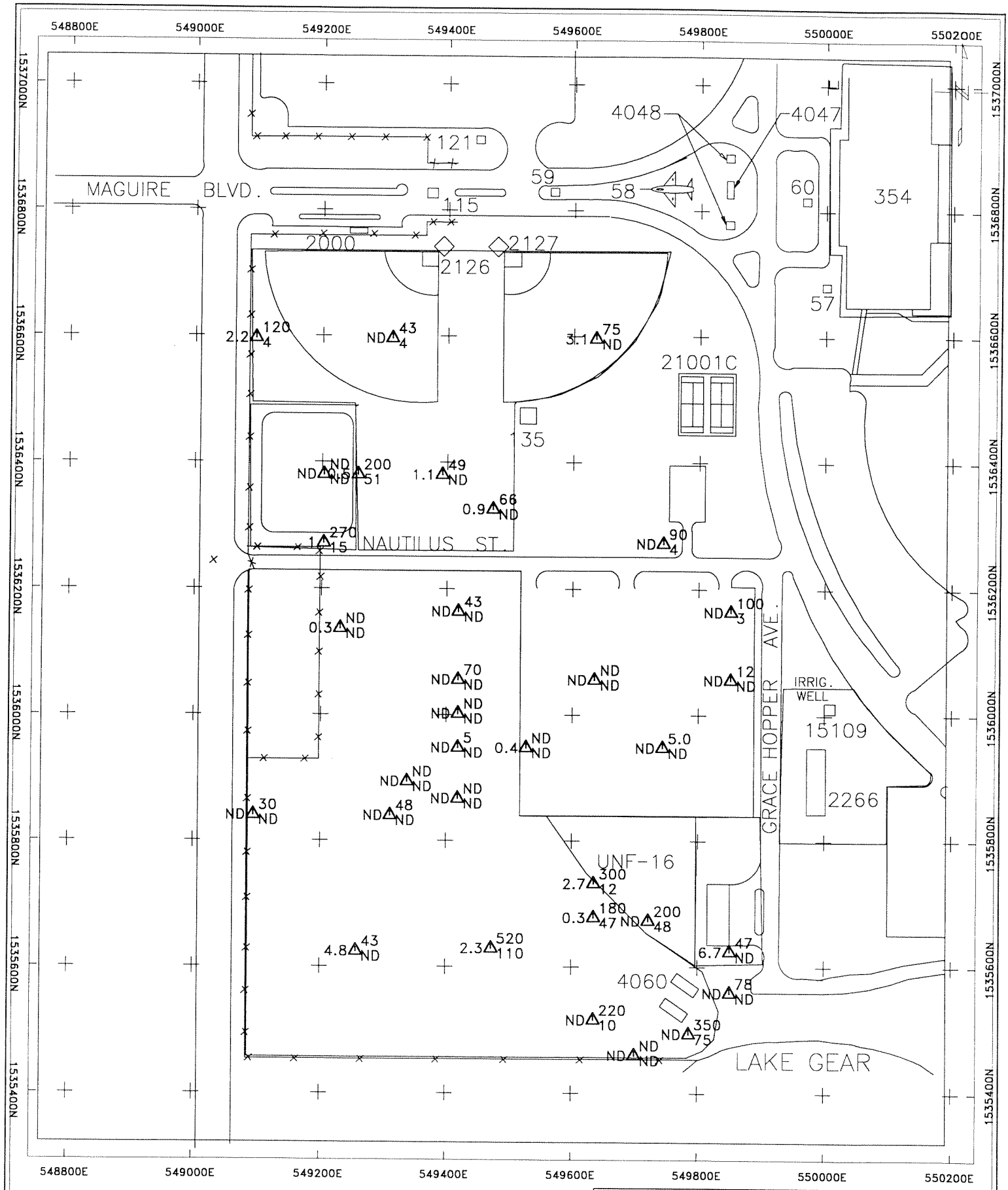
(feet)

SOUTHERN DIVISION

STUDY AREAS 39 AND 40
SURFACE SOIL SAMPLE LOCATIONS

ABB ENVIRONMENTAL SERVICES, INC.

FIGURE 1



Scale 1:2400

100 0 100 200 (feet)

NOTE: ARSENIC IS PLOTTED TO LEFT OF SYMBOL, BENZO(A)PYRENE TO UPPER RIGHT, AND DIBENZ-(A,H)ANTHRACENE TO LOWER RIGHT

SOUTHERN DIVISION

STUDY AREAS 39 AND 40
ARSENIC, BENZO(A)PYRENE AND
DIBENZ(A,H)ANTHRACENE CONCENTRATIONS

FIGURE 2

Appendix A

Toxicity Equivalency Factors for Carcinogenic Polynuclear Aromatic Hydrocarbons

Toxicity Profiles

Dose Response Tables

Toxicity Equivalency Factors for Carcinogenic Polynuclear Aromatic Hydrocarbons (PAHs). Carcinogenic PAHs are a class of compounds with very similar, complex heterocyclic structures. From this group of compounds, only one, benzo(a)pyrene, has a USEPA published CSF. For the other carcinogenic PAHs, the variable toxicity has been addressed by using Toxicity Equivalency Factors (TEFs) published by USEPA (USEPA, 1995b). The TEFs identify the relative potency of each compound relative to that of benzo(a)pyrene.

The TEFs are not CSFs themselves; nor are they used to calculate CSFs for the other PAHs. The TEFs are applied to carcinogenic PAH EPCs to determine the equivalent benzo(a)pyrene concentration. The benzo(a)pyrene equivalent EPC for each carcinogenic PAH is then multiplied by the CSF for benzo(a)pyrene to obtain an estimate of the cancer risk for these compounds. The TEFs are only used in estimating the cancer risk of these compounds and are not used to estimate the noncancer risks. The TEFs for the carcinogenic PAHs are provided below in Table A-1.

Table A-1
Toxicity Equivalency Factors for
Carcinogenic Polycyclic Aromatic Hydrocarbons

Focused Risk Assessment
Study Areas 39 and 40, NTC Orlando
Orlando, Florida

Polynuclear Aromatic Hydrocarbon	Toxicity Equivalency Factors
Benzo(a)anthracene	0.1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1
Indeno(1,2,3-c,d)pyrene	0.1

Source: U.S. Environmental Protection Agency (USEPA, 1995b).

Toxicity Profiles.

Arsenic. Arsenic has been used in pesticide formulations and has industrial uses in tanneries, as well as the glass and wine making industries. Toxicity depends on its chemical form. Arsenic is an irritant of the skin, mucous membranes, and gastrointestinal tract. Symptoms of acute toxicity include vomiting, diarrhea, convulsions, and a severe drop in blood pressure. Subchronic effects include hyperpigmentation, sensory-motor polyneuropathy, persistent headache, and lethargy. Chronic oral exposure has caused skin

lesions, peripheral vascular disease, and peripheral neuropathy. The USEPA has classified arsenic in Group A, human carcinogen, based on increased incidence of lung cancer in occupational studies.

References:
Agency for Toxic Substances and Disease Registry (ATSDR), 1992. "Toxicological Profile for Arsenic"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1992.

Benzo(a)anthracene. Benzo(a)anthracene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(a)anthracene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also product of pyrolysis in tobacco smoke.

Benzo(a)anthracene has produced skin tumors in laboratory animals after dermal application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. Although there are no human data that specifically link exposure to benzo(a)anthracene to human cancers, benzo(a)anthracene is a component of mixtures that have been associated with human cancer. As such, benzo(a)anthracene has been classified by USEPA as a B2, probable human carcinogen.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Benzo(a)pyrene. Benzo(a)pyrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. They are ubiquitous in nature and are also man made. Benzo(a)pyrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Human data demonstrating a causal relationship linking benzo(a)pyrene to carcinogenicity are lacking. However, multiple animal studies in many species demonstrate benzo(a)pyrene to be carcinogenic following administration by a variety of routes. The mechanism through which benzo(a)pyrene elicits its carcinogenic potential is well understood. Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. Benzo(a)pyrene has been classified by the EPA as a B2, probable human carcinogen.

References:
ATSDR, 1989. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

Clayton, George D. and Florence E. Clayton, editors, 1981. Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition; John Wiley & Sons; New York.

Integrated Risk Information System (IRIS), 1993. United States Environmental Protection Agency.

Benzo(b)fluoranthene. Benzo(b)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs

are ubiquitous in nature and are also manmade. Benzo(b)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(b)fluoranthene to human cancers, benzo(b)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal, or subcutaneous injection, and skin painting. Benzo(b)fluoranthene has produced positive results in several genotoxicity assays. It has been classified as a B2, probable human carcinogen, by the USEPA.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Benzo(k)fluoranthene. Benzo(k)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(k)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(k)fluoranthene to human cancers, benzo(k)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Benzo(k)fluoranthene is mutagenic in bacteria. Benzo(k)fluoranthene has been classified by USEPA as a B2, probable human carcinogen.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Chrysene. Chrysene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material. Although there are no human data that specifically link exposure to chrysene to human cancers, chrysene is a component of mixtures that have been associated with human cancer. These include coal tar, soot, coke oven emissions and cigarette smoke. Chrysene produced chromosomal abnormalities in hamsters and mouse germ cells after gavage exposure, positive responses in bacterial gene mutation assays, and transformed mammalian cells exposed in culture. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, chrysene has been classified as a B2, probable human carcinogen.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Dibenz(a,h)anthracene. Dibenz(a,h)anthracene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds, which contain two or more aromatic rings. PAHs

are ubiquitous in nature and are also manmade. Dibenz(a,h)anthracene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also product of pyrolysis in tobacco smoke.

Dibenz(a,h)anthracene is metabolized similarly to benzo(a)pyrene, and produces a similar mutagenic metabolite that is thought to be responsible for the mutagenic effects. Dibenz(a,h)anthracene has produced skin tumors in laboratory animals after dermal application. Dibenz(a,h)anthracene produced mutations in human cell cultures and in bacteria cells. Although there are no human data that specifically link exposure to dibenz(a,h)anthracene to human cancers, dibenz(a,h)anthracene is a component of mixtures that have been associated with human cancer. As such, dibenz(a,h)anthracene has been classified by USEPA as a B2, probable human carcinogen.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Agency for Toxic Substances and Disease Registry (ATSDR), 1993. "Toxicological Profile for Selected PCBs"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1991.

<u>Indeno(1,2,3-cd)pyrene</u>. Indeno(1,2,3-c,d)pyrene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material and is a component of cigarette smoke and smoke stack emissions. No carcinogenicity data specifically for indeno(1,2,3-c,d)pyrene are available in humans, however, toxic effects are attributable to mixtures of PAHs. Animal studies indicate that indeno(1,2,3-c,d)pyrene can induce skin tumors in mice, and may have some immunosuppressive effects. In mammalian cell cultures, indeno(1,2,3-c,d)pyrene was found to be genotoxic. It has been classified by the USEPA as a B2 carcinogen.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Table A-2
Oral Dose-Response Data for Carcinogenic Effects

Focused Risk Assessment
Study Areas 39 and 40
Orlando, Florida

Chemical	Weight of Evidence	Oral Slope Factor (mg/kg/day)(-1)	Source	Test Species	Exposure Route	Tumor Type	Study Source
SEMIVOLATILES							
Benzo(a)Anthracene	B2	7.3e-01	(1)				
Benzo(a)Pyrene	B2	7.3e+00	IRIS	Mouse	Oral-diet	Forestomach	IRIS
Benzo(b)Fluoranthene	B2	7.3e-01	(1)				
Benzo(k)Fluoranthene	B2	7.3e-02	(1)				
Chrysene	B2	7.3e-03	(1)				
Dibenz(a,h)Anthracene	B2	7.3e+00	(1)				
Indeno(1,2,3-cd)Pyrene	B2	7.3e-01	(1)				
INORGANICS							
Arsenic	A	1.5e+00	IRIS	Human	Oral-drinking water	Skin	IRIS

Notes:
Integrated Risk Information System (IRIS) on-line database search, current as of January 1997.
Health Effects Assessment Summary Tables (HEAST), current as of November 1995.
(1) USEPA, 1995b. Toxicity Equivalent Factors have been applied to the ingestion slope factor for benzo(a)pyrene for all PAHs classified as A or B carcinogens.

Weight of Evidence (route-specific):
A = Human carcinogen
B = Probable human carcinogen (B1 = limited human evidence; B2 = sufficient human evidence)
C = Possible human carcinogen
D = Not classifiable as to human carcinogenicity

Table A-3
Oral Dose-Response Data for Noncarcinogenic Effects

Focused Risk Assessment
Study Areas 39 and 40
Orlando, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	Oral RfD (mg/kg-day)	Source	Oral RfD (mg/kg-day)	Source						
SEMIVOLATILES										
Benzo(a)Anthracene	ND		ND							
Benzo(a)Pyrene	ND		ND							
Benzo(b)Fluoranthene	ND		ND							
Benzo(k)Fluoranthene	ND		ND							
Chrysene	ND		ND							
Dibenz(a,h)Anthracene	ND		ND							
Indeno(1,2,3-cd)Pyrene	ND		ND							
INORGANICS										
Arsenic	3.0e-04	IRIS	3.0e-04	HEAST	Oral-drinking water	Medium	Hyperpigmentation, keratosis	Human	3 D	IRIS

Notes:
ND = No Data
Health Effects Assessment Summary Tables (HEAST), current as of November 1995.
Environmental Criteria and Assessment Office (ECAO) of the USEPA in response to a specific request.

Uncertainty factors:
H = Variation in human sensitivity
A = Animal to human extrapolation
S = Extrapolation from subchronic to chronic NOAEL
L = Extrapolation from LOAEL to NOAEL
D = Inadequate data
M = Modifying factor

Table A-4
Dermal Dose-Response Data for Carcinogenic Effects

Focused Risk Assessment
Study Areas 39 and 40
Orlando, Florida

Compound	Weight of Evidence	Oral Slope Factor (mg/kg-day)-1	Oral Absorption Efficiency	Reference	Dermal Slope Factor (mg/kg-day)-1
SEMIVOLATILES					
Benzo(a)Anthracene	B2	7.3e-01	91%	(1)	8.0e-01
Benzo(a)Pyrene	B2	7.3e+00	91%	Hecht et al., 1979	8.0e+00
Benzo(b)Fluoranthene	B2	7.3e-01	91%	(1)	8.0e-01
Benzo(k)Fluoranthene	B2	7.3e-02	91%	(1)	8.0e-02
Chrysene	B2	7.3e-03	91%	(1)	8.0e-03
Dibenz(a,h)Anthracene	B2	7.3e+00	91%	(1)	8.0+00
Indeno(1,2,3-cd)Pyrene	B2	7.3e-01	91%	(1)	8.0e-01
INORGANICS					
Arsenic	A	1.5e+00	98%	Vahter, 1983	1.5e+00

Notes:

For documentation concerning oral slope factors, refer to Table A-2.
Hecht, S.S., Grabowski, W. and Groth, K. 1979. Analysis of Feces for B[a]P After Consumption of Charcoal-Broiled Beef by Rats and Humans. Food Cosmet. Toxicol. 17: 223-227.
Vahter, M. 1983. Metabolism of Arsenic. In: Fowler, B.A., ed. Biological and Environmental Effect of Arsenic. NY: Elsevier. pp. 171-198.

(1) The oral absorption efficiency of all PAHs is assumed to be identical to that of benzo(a)pyrene, based on structural analogy.

Weight of Evidence (route-specific):
- A = Human carcinogen
- B = Probable human carcinogen (B1 = limited human evidence; B2 = sufficient human evidence)
- C = Possible human carcinogen
- D = Not classifiable as to human carcinogenicity

Table A-5
Dermal Dose-Response Data for Noncarcinogenic Effects

Focused Risk Assessment
Study Areas 39 and 40
Orlando, Florida

	Chronic Oral RfD (mg/kg-day)	Subchronic Oral RfD (mg/kg-day)	Oral Absorption Efficiency	Reference	Dermal Chronic RfD (mg/kg-day)	Dermal Subchronic RfD (mg/kg-day)
SEMIVOLATILES						
Benzo(a)Anthracene	ND	ND	91%	(1)	ND	ND
Benzo(a)Pyrene	ND	ND	91%	Hecht et al., 1979	ND	ND
Benzo(b)Fluoranthene	ND	ND	91%	(1)	ND	ND
Benzo(k)Fluoranthene	ND	ND	91%	(1)	ND	ND
Chrysene	ND	ND	91%	(1)	ND	ND
Dibenz(a,h)Anthracene	ND	ND	91%	(1)	ND	ND
Indeno(1,2,3-cd)Pyrene	ND	ND	91%	(1)	ND	ND
INORGANICS						
Arsenic	3.0e-04	3.0e-04	98%	Vahter, 1983	2.9e-04	2.9e-04

Notes: ND = No Data

For documentation concerning chronic and subchronic oral RfDs, refer to Table A-3.
Hecht, S.S., Grabowski, W. and Groth, K. 1979. Analysis of Feces for B[a]P After Consumption of Charcoal-Broiled Beef by Rats and Humans. Food Cosmet. Toxicol. 17: 223-227.
Vahter, M. 1983. Metabolism of Arsenic. In: Fowler, B.A., ed. Biological and Environmental Effect of Arsenic. NY: Elsevier. pp. 171-198.

(1) The oral absorption efficiency of all PAHs is assumed to be identical to that of benzo(a)pyrene, based on structural analogy.

Table A-6
Inhalation Dose-Response Data for Carcinogenic Effects

Focused Risk Assessment
Study Areas 39 and 40
Orlando, Florida

Chemical	Weight of Evidence	Inhalation Slope Factor (mg/kg/day)(-1)	Source	Inhalation Unit Risk ($\mu g/m^3$)(-1)	Source	Test Species	Exposure Route	Tumor Type	Study Source
SEMIVOLATILES									
Benzo(a)Anthracene	B2	3.1	(1)	0.88	(1)				
Benzo(a)Pyrene	B2	3.1	(1)	0.88	(1)				
Benzo(b)Fluoranthene	B2	3.1	(1)	0.88	(1)				
Benzo(k)Fluoranthene	B2	3.1	(1)	0.88	(1)				
Chrysene	B2	3.1	(1)	0.88	(1)				
Dibenz(a,h)Anthracene	B2	3.1	(1)	0.88	(1)				
Indeno(1,2,3-cd)Pyrene	B2	3.1	(1)	0.88	(1)				
INORGANICS									
Arsenic	A	5.0e+01	HEAST	4.3e-03	IRIS	Human	Inhalation	Lung	IRIS

Notes:

NE = Not Evaluated
Integrated Risk Information System (IRIS) on-line database search, current as of January 1997.
Health Effects Assessment Summary Tables (HEAST), current as of November 1995.
(1) USEPA, 1995b.

Weight of Evidence (route-specific):
A = Human carcinogen
B = Probable human carcinogen (B1 = limited human evidence; B2 = sufficient human evidence)
C = Possible human carcinogen
D = Not classifiable as to human carcinogenicity

Table A-7
Inhalation Dose-Response Data for Noncarcinogenic Effects

Focused Risk Assessment
Study Areas 39 and 40
Orlando, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	RfC ($\mu g/m^3$)	Source	RfC ($\mu g/m^3$)	Source						
SEMIVOLATILES										
Benzo(a)Anthracene	ND		ND							
Benzo(a)Pyrene	ND		ND							
Benzo(b)Fluoranthene	ND		ND							
Benzo(k)Fluoranthene	ND		ND							
Chrysene	ND		ND							
Dibenz(a,h)Anthracene	ND		ND							
Indeno(1,2,3-cd)Pyrene	ND		ND							
INORGANICS										
Arsenic	ND		ND							

Notes:

ND = No Data
Integrated Risk Information System (IRIS) on-line database search, current as of February 1996.
Health Effects Assessment Summary Tables (HEAST), current as November 1995.

Uncertainty factors:
A = Animal to human extrapolation
H = Variation in human sensitivity
S = Extrapolation from subchronic to chronic NOAEL
L = Extrapolation from LOAEL to NOAEL
D = Inadequate data
M = Modifying factor