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DRAFT DECISION DOCUMENT FIREFIGHTER TRAINING AREA AND AUTO CRAFT BUILDING AREA FORT STORY VA

3/1/2003

MALCOLM PIRNIE

DRAFT

DECISION DOCUMENT

Firefighter Training Area
Auto Craft Building Area

INSTALLATION RESTORATION PROGRAM
FORT STORY, VIRGINIA

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

AND

U.S. ARMY TRANSPORTATION CENTER
FORT EUSTIS, VIRGINIA

CONTRACT DACA31-00-D-0043
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This Decision Document (DD) has been modeled after the USEPA Record of Decision format for CERCLA National Priorities List (NPL) sites. The USEPA guidance document entitled *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, EPA 540-R-98-031, July 1999, has been utilized for preparation of this document.

1.1 SITE NAME AND LOCATION

This DD has been prepared for two sites at Fort Story, Virginia. The sites are known as Site 04 – Firefighter Training Area (FTA) and Site 07 – Auto Craft Building Area. The FTA site is located in a sandy flat area situated adjacent to the northern flank of the central sand ridge in the southwestern section of Fort Story along Hospital Road and Hospital Circle while the Auto Craft site is located in the sand flat area south of the coastal dune complex at the junction of Atlantic Avenue and Cebu Road.

1.2 STATEMENT OF BASIS AND PURPOSE

This DD presents the Selected Remedy (No Action) for environmental media at the FTA and Auto Craft sites on the U.S. Army installation designated as Fort Story, Virginia. The Selected Remedy (No Action) was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The U.S. Army, as owner/operator and the "Lead Agency" (terms that are defined in the NCP), and the Virginia Department of Environmental Quality (VDEQ) as a "Support Agency," prepared this decision based upon the Administrative Record for the site. The VDEQ has reviewed and with the Army, jointly selects the remedy in accordance with CERCLA.

1.3 DESCRIPTION OF SELECTED REMEDY

No CERCLA action is necessary for the FTA and Auto Craft sites.

No Action is necessary at the FTA site based on the limited contamination detected at the site, the trends that indicate that the TPH and VOC concentrations in soil and groundwater are decreasing due to numerous fate mechanisms, and the results of the baseline risk assessment that did not identify receptors and potentially exposed populations.

No Action is necessary at the Auto Craft site based on the limited contamination detected, the trends which indicate that the TPH concentrations in soil and groundwater are decreasing due to numerous fate mechanisms, the groundwater detects are less than the USEPA MCL, and the results of the baseline risk assessment which did not identify receptors and potentially exposed populations.

1.4 STATUTORY DETERMINATIONS

None of the CERCLA §121 statutory determinations are necessary in this section since no remedy is being selected.

Based on the conclusions (as stated in Section 1.3 above) of the baseline risk assessment provided in the *Final Remedial Investigation Report*, dated December 2002, prepared by Malcolm Pirnie, Inc., no remedial action is necessary to ensure protection of human health and the environment. Because this No Action remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a five-year review will not be required.

AUTHORIZING SIGNATURES

E. Douglas Earle Colonel, U.S. Army Garrison Commander	XXXXXXXX Director, XXXXX Virginia Department of Environmental Quality

2.1 SITE NAME, LOCATION, AND DESCRIPTION

This Decision Document (DD) presents the U.S. Army's selected remedy (No Action) for two sites at Fort Story, Virginia. The sites are known as Site 04 – Firefighter Training Area (FTA) and Site 07 – Auto Craft Building Area. The U.S. Army, as owner/operator of the Post, has assumed the role of lead agency; while the Virginia Department of Environmental Quality (VDEQ) have assumed the role of support agency.

Fort Story is located in southeastern Virginia within the city of Virginia Beach, Virginia. Fort Story occupies an area of approximately 1,451 acres and is situated on Cape Henry which roughly divides the waters of the Chesapeake Bay to the north and the Atlantic Ocean to the east.

Fort Story currently trains army personnel in amphibious and Logistics Over-the-Shore (LOTS) operations. Fort Story is the only available facility that has the necessary natural terrain features and beaches, sand, surf, variable tide conditions (bay and ocean) and hinterlands, all of which are normally experienced by amphibious and LOTS operations. In addition, Fort Story contains beach training areas, tactical training areas and a series of trails throughout the installation. The deep water ship anchorage, off-road driving areas and soil of sufficient bearing strength for the heavy vehicles are indispensable in amphibious training, LOTS training and the testing of new equipment, doctrines and techniques. From 1914 until the present, activities at Fort Story have included the following:

- Utilization as a coastal artillery garrison
- Headquarters of the Harbor Defense Command
- Location of a convalescent hospital during World War II
- Amphibious operations training facility

The FTA site is located in a sandy flat area situated adjacent to the northern flank of the central sand ridge in the southwestern section of Fort Story along Hospital Road and Hospital Circle. A former underground storage tank fuel farm was located adjacent to the southeast corner of the site. **Figure 2-1** provides the location of the site while a plan of the FTA site is presented on **Figure 2-2**.

The Auto Craft Building is located in the sand flat area south of the coastal dune complex at the junction of Atlantic Avenue and Cebu Road. The location of the site is provided on **Figure 2-1** while a plan of the site is presented on **Figure 2-3**.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section summarizes the site history and site investigations. No federal or state enforcement activities have been undertaken at either site.

2.2.1 Site History

FTA

A temporary hospital facility was located on the site until 1960 when its operations were relocated and the structure demolished. From 1960 through 1978, the area adjacent to the southern boundary along U.S. Route 60 was used as a wildlife game preserve. The site was cleared and used for fire training exercises in the latter part of 1978. Prior to 1980, these exercises consisted of extinguishing JP-4 aviation fuel, which was released and ignited directly to the surface soils of the site. The releases were reportedly extinguished by a mixture of firefighting foam and water.

A concrete pit was constructed in 1980 and used for firefighting training exercises. The 40 foot square by 2 foot deep pit was used on a monthly basis. Procedures included:

- Filling the pit with several inches of water and 75 to 400 gallons of ignitable materials (i.e., JP-4, contaminated fuels and hydraulic fluid).
- Igniting the mixture and allowing it to burn.
- Extinguishing the fire with 50 to 150 gallons of firefighting foam.
- Allowing the residues of the fuel and extinguishing mixtures to evaporate naturally.

Additionally, during 1980 through 1986, many installation personnel reportedly used the area as an unauthorized dumping site. In June 1988, firefighting training activities were discontinued at this site. The site is currently free of any surface debris or surficial evidence of buried debris. The northern section of the site is currently used as a heavy equipment (i.e., front end loaders, trucks) operation training area while a ramp located in the southeast corner of the site is used for equipment loading and unloading.

Auto Craft Building Area

Two solvent dip tanks were used for the storage of spent degreasing solvents and waste oils when the building was in use. Previously, waste oil generated at the site was piped out of the building and into the adjacent UST. The UST has subsequently been removed.

Prior to its use as the Auto Craft Building, the site was used as a motor pool for wheeled vehicles. During the winter of 1989 and 1990, a portion of the building was destroyed by fire. A portion of the building's concrete foundation and some debris remain in the area. A previous investigation indicated that waste solvents were poured directly on the ground to control weed growth along the fence surrounding the site. A visual inspection by JMM in 1990 verified the presence of an apparent petroleum-based product around the area and distinctive petroleum odor at the site. The site is currently used as a vehicle impoundment area.

2.2.2 Previous Investigations

A summary of previous investigations conducted at the two sites is provided below.

JMM Preliminary Assessment/Site Investigation

Preliminary assessment/site investigation (PA/SI) activities were conducted in 1991 and 1992 by James M. Montgomery, Inc. JMM conducted the PA/SI to determine the presence of significant contamination at eight sites including the following:

- Landfill 1
- Landfill 2
- Firefighter Training Area
- Underground Fuel Storage Tank Farm
- LARC 60 Maintenance Area
- Auto Craft Building Area
- Drainage Outfall Line
- NIKE Facility

For the eight sites investigated by JMM, three were recommended for no further action: Landfill 1, Drainage Outfall Line and the NIKE Facility. Further confirmatory investigation was recommended at Landfill 2. A remedial investigation/feasibility study (RI/FS) was recommended at the remaining four sites: FTA, Underground Fuel Storage Tanks, LARC 60 area and Auto Craft Building. The Underground Fuel Storage Tanks were removed in October 1994.

A summary of site-specific investigations and findings are provided as follows:

Firefighter Training Area

Soil gas samples were collected at the intersections of a 100-foot by 100-foot grid having seven rows and six columns. Results of the survey indicate that potentially contaminated areas of the site include the north central site location, as indicated by detectable levels of benzene, and the extreme southeastern corner of the site, as indicated by elevated levels of benzene, 1,1,1-trichloroethane (1,1,1-TCA) and total hydrocarbons.

Several analytes were detected in soil samples at levels above the trigger levels. Media-specific trigger levels were developed for each of the analytes detected. The trigger levels were based on statistically significant site background data and regulatory standards promulgated by the U.S. EPA or the Commonwealth of Virginia for the chemicals of concern. The highest concentration was associated with the area adjacent to the fire training pit (FTP), as well as an area located in the southeast corner of the site. Total fuel hydrocarbons, copper, and lead were detected above trigger levels at the site. Numerous analytes without trigger levels were detected at the site including xylenes and semivolatiles.

As with soil samples, numerous analytes were detected in groundwater above trigger levels with the major areas of contamination associated with the FTP and the southeast corner of the site. Benzene, total fuel hydrocarbons, phenol, 1,2-dichloroethane (1,2-DCA), 1,1,1-TCA and 1,1-dichloroethene (1,1-DCE) were detected above trigger levels.

Auto Craft Building Area

Several analytes were detected in soil at levels above the trigger levels. Total fuel hydrocarbons, zinc, and lead were detected above trigger levels at the site. Total fuel hydrocarbons were the only analyte detected above trigger levels in groundwater.

IT Removal Actions

In 1994, IT Corporation conducted a rapid response removal action at the FTA. Their removal action consisted of the following:

- Removal and disposal of water contained in the Fire Training Pit (FTP). This water was removed by a vacuum truck and disposed of by PetroChem, Inc. of Norfolk, Virginia. Approximately 6,800 gallons of water was removed and disposed of as oil-contaminated.

- Removal and containerization of FTP materials including concrete, electrical parts and miscellaneous debris. The concrete FTP was approximately 40 feet by 40 feet with a 20-foot square gravel pit on the interior. The interior pit was approximately 4 feet deep with 2 feet of gravel at the surface of the pit. The gravel was removed and placed on the concrete apron and then pressure washed to remove any residual fuel or petroleum contamination. The wash water was collected with a vacuum truck and disposed of by PetroChem. The concrete, gravel and miscellaneous material was loaded into five roll offs (approximately 100 cubic yards) and transported to the BFI landfill in Chesapeake, Virginia.

- Excavation of the contaminated soil surrounding the concrete pad of the FTP until a Total Petroleum Hydrocarbon (TPH) action level of 50 parts per million (ppm) was met. Approximately 550 tons of soil was excavated and staged at the site in three bermed holding cells on 6-mil polyethylene.

- Transportation of the excavated soils to the LARC 60 area for treatment.

  - Backfilling of the excavation with clean gravel. A total of 547 tons of stone was placed as backfill in the excavated pit and the area was regraded. An additional area approximately 40 feet long by 5 feet wide was excavated on the eastern edge of the area due to high TPH concentrations detected during confirmation sampling. This soil was transported to the LARC 60 for treatment.

Malcolm Pirnie Remedial Investigation

Malcolm Pirnie conducted a remedial investigation of the FTA and Auto Craft sites with a final report prepared in December 2002. A summary of the investigations that comprised the RI is provided in **Section 2.5.2**.

2.3 COMMUNITY PARTICIPATION

The Malcolm Pirnie Final Remedial Investigation (RI) report (dated December 2002) for the FTA site and Auto Craft site at Fort Story, Virginia was made available to the public on **DATE TO BE DETERMINED LATER (RI REPORT CURRENTLY BEING PLACED ON ADMIN RECORD CD)**. It can be found in the Administrative Record file and the information repository maintained at the Grissom Library 366 DeShazor Drive, Newport News, VA; the Christopher Newport University Library, 1 University Place, Newport News, VA; and the Groninger Library on Fort Eustis.

The National Contingency Plan (NCP) requires public participation in the selection of a remedy for a site. However, because, no potential human health or ecological risk were identified during the remedial investigation phase, no remedy analysis and selection (typically conducted during the feasibility study phase) was warranted, and therefore, no public participation was required.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

No response action warranted at these two sites.

2.5 SITE CHARACTERISTICS

The following section provides an overview of the site's physical characteristics, such as geology, and describes the nature and extent of site contamination.

2.5.1 Physical Site Characteristics

Surface Topography and Hydrology

FTA Site

The FTA is located in a sandy flat area situated adjacent to the northern flank of the central sand ridge in the southwestern section of Fort Story along Hospital Road and Hospital Circle. A former underground storage tank fuel farm was located adjacent to the southeast corner of the site.

The FTA is located in a sandy flat area with little or no topographic elevation relief which is situated adjacent to the northern flank of the central sand ridge in the southwestern section of Fort Story.

Surface runoff on the majority of the site within the bounds of Hospital Circle does not drain outside of this area. The elevation of Hospital Circle is 1 to 3 feet higher than the area inside of the road. A low point is located in the northeast corner of the site where runoff from areas within and outside of the site ponds during high rain events. As observed during field investigations, seepage is slow in this area with several days required for the standing water to percolate into the soils. Surface runoff from the southeast corner and the area immediately south of the site adjacent to the road drains into a lowland area south of the site. A berm is located along the perimeter of the southwest boundary of the site preventing any runoff from that area to enter the lowland area.

Auto Craft Site

The Auto Craft Building is located in the sand flat area south of the coastal dune complex at the junction of Atlantic Avenue and Cebu Road.

The Auto Craft Building Area is located in the sand flat area south of the coastal dune complex at the junction of Atlantic Avenue and Cebu Road. Approximately 2 to 3 feet of topographic relief is present on the site. The area of the former building and the parking lot south of the building are located on an area of about 15 feet MSL while the grassy areas north and northwest of the building have an elevation of about 12 to 13 feet MSL.

Surface runoff from the paved area around the former building drains into either storm drains located in the grassy area north of the building or into a small drainage ditch between Cebu Road and the paved area. This ditch drains into the grassy area and storm drains previously mentioned.

Geology and Hydrogeology

FTA Site

Geology and hydrogeology data was obtained through current drilling activities and from previous investigations. Six permanent monitoring wells and two piezocone borings from the current investigation along with three permanent monitoring wells and nine soil borings from the previous investigations were reviewed to evaluate the site geology. The site is underlain by sand deposits of the Kennon Formation and Columbia Group of Holocene and Pleistocene in age respectively. The upper forty feet of sediments were described with respect to lithology and sedimentary features during drilling activities. Based on lithology, the sediments can be separated into four layers as follows:

DEPTH (BLS)	USCS SOIL TYPE	DESCRIPTION
0 - 2	SM	Sand to silty sand.
2 - 18	SP	Medium sand, rounded to subrounded, moderately well sorted, with trace amounts heavy minerals, grading to coarse to very coarse sand at approximately 18 feet BLS.
18 - 40	SW	Interlayers of coarse to very coarse sand and gravel, heavy minerals, well sorted within layers, rounded to subrounded.
40 - 46	SM	Sharp contact with overlying unit. Fine sand to silty sand, some shell fragments, non-cohesive, non-plastic.

Notes: BLS – Below land surface and USCS – U.S. Soil Conservation Service

Previous investigations described a silty sand present from 0 to 2 feet below land surface (BLS) across the site which extended to a depth of 4 feet in the eastern area of the site. The sand was subrounded to subangular, usually poorly graded and medium to coarse grained at depths greater than 4 feet, which corresponds to the sand layers encountered 2 to 18 ft BLS in the current investigations.

Previous investigations reported that the water table elevations ranged from 8.5 feet National Geodetic Vertical Datum (NGVD) of 1929 in the northern portion of the site to less than 8.3 feet NGVD in the southern portion. The water table was encountered approximately six (6) feet BLS during drilling activities. Based on water elevations measured in the on-site wells, the water table occurs at 7.5 to 7.8 feet NGVD.

Based on measured water levels, groundwater flows from the southeast to the northwest, as opposed to the groundwater flow direction reported in the PA/SI which was from the north to the south. The change in the groundwater flow direction is based on groundwater level data collected from existing and newly installed wells. The flow direction estimated during the PA/SI was based on data collected from monitoring wells (MW-110 (destroyed), MW-111, and MW-112) that were located along a line perpendicular to the direction of groundwater flow. There were no wells located outside of this general line. New monitoring wells were installed upgradient and downgradient of the site with water level data used to better estimate groundwater flow direction. The additional well data along with water level data from other wells indicate groundwater flow direction to be to the northeast. However, it should be noted that there is minimal gradient in the southern end of the site where data indicates only a 0.02-foot gradient over a 200-foot horizontal distance (4MW-4 to MW-112). Previously reported estimated hydraulic conductivity values at the site ranged from 1.17 x 10^{-2} to 1.37 x 10^{-2} centimeters per second (cm/sec) with an average value of 1.24 x 10^{-2} cm/sec. **Figure 2-4** presents the water table elevations and flow direction.

To evaluate possible tidal influence on water table elevations, water levels for monitoring wells 4MW-1, 4MW-4, and MW-112 were recorded by a data logger from May 19 through May 22, 1995. No measurable amount of precipitation was recorded by the rain gauge, though the inside of the gauge was moist. Over the test period, groundwater levels varied no more than 0.08 feet. Data indicate a generally lowering water table, but do not suggest any changes in groundwater elevation that are attributable to tidal influence.

Auto Craft Site

Most of the site's upper surface is covered by asphalt pavement that is constructed on top of the native sediments. Data was obtained during drilling activities of the current investigation and during previous investigations. Boring logs for three permanent monitoring wells and two piezocone borings from the current investigation and two monitoring wells and eight soil borings from the previous investigations were reviewed to evaluate the site geology.

The site is underlain by Holocene and Pleistocene Age sand deposits of the Kennon Formation and the Columbia Group. During drilling activities, the upper forty-two feet of sediments were described with respect to lithology and sedimentary features. Based on lithology, the sediments can be separated into four layers as follows:

DEPTH (BLS)	USCS SOIL TYPE	DESCRIPTION
0 – 2		Asphalt and black sand.
2 – 18	SM	Fine sand with heavy minerals.
18 - 34	SP	Medium sand, with fine sand and heavy minerals; grades into layers of coarse to very coarse sand and fine sand or very coarse sand with gravel.
34 - 44	SP	Interlayers of coarse to very coarse sand and fine sand and very coarse sand and gravel.

Previous investigations encountered fine to medium grained sand that was subrounded and poorly graded. The PA/SI reported penetrations of clay and silt layers approximately 2 feet thick and horizontally discontinuous in the northern part of the site at depths of 5 feet.

Depths to groundwater at the site varied from 7.8 to 10.9 feet below surface, which is similar to the range from 7.8 feet to 10.3 feet below ground surface encountered during the PA/SI. Water table elevations at the site ranged from 4.4 to 4.7 NGVD whereas the PA/SI established that water table elevations ranged from 5.3 feet NGVD near the building to 5.1 feet NGVD. **Figure 2-5** presents a contoured water table elevation map. The PA/SI established that the lateral hydraulic gradient at the site is directed to the northeast. This direction was confirmed during the current study based on water table elevations measured on May 17, 1995. During the PA/SI, in-situ aquifer tests established estimated, hydraulic conductivity values, which range d from 3.23×10^{-3} to 7.11×10^{-3} centimeters per second (cm/sec) with an average value of 5.17×10^{-3} cm/sec.

To evaluate possible tidal influence on water table elevations, water levels for monitoring wells 7MW-1, 7MW-2, and MW-119 were recorded by a data logger from May 22 through May 23, 1995. No precipitation occurred during the specified time period over which water levels were recorded. Over the study, water table elevations varied no more than 0.08 feet. Data indicate a generally lowering water table over the monitored time period, but do not indicate any trends in groundwater elevation that are attributable to tidal influence. The initially higher water table elevation recorded of 7.5 feet MSL decreased to 7.4 feet MSL at the end of the monitored period. The initial water levels reflect a series of precipitation events that preceded the tidal study. The decrease in water elevations reflects the infiltration of precipitation and the return of the water table to equilibrium.

2.5.2 Remedial Investigation Sampling Activities

The following sections outline the specific RI field activities performed at the Firefighter Training Area and Auto Craft Building Area at Fort Story. Initial specific activities, which were conducted in February and April 1995, were based on the Scopes of Services for the project dated 17 August 1994. Additional soil and groundwater analysis was conducted in February and June 2000 to further identify the extent of contamination and to assess any trends in groundwater contamination.

FTA Site

There were three major areas of concern (AOCs) at the FTA site: (1) Northern Area where 2 locations of stained soils are present, (2) Former Fire Training Pit (FTP) Area in the southwest corner of the site, and (3) Solvent Plume Area located in southeast corner of the site. The layout for the sampling points were centered around these three areas with upgradient, on-site and downgradient soil and groundwater sampling being conducted at each AOC. The FTP and adjacent soils were previously excavated, treated and disposed of off-site. Extensive sampling of soil and groundwater was required in that area to verify clean-up of soils and assess any current groundwater impacts. **Figures 2-6 and 2-7** provide the sampling locations for this site. The locations of the new permanent monitoring wells were established in the field based on the results of the on-site GC and off-site laboratory analysis of DPT groundwater samples, and the location of existing monitoring wells. **Table 2-1** summarizes our field investigations for this site.

For the 1999 samples, (1) all samples were analyzed for TCL, VOCs, and SVOCs, and TPH Heavy and Light fractions and (2) TAL analysis was conducted on all sediment samples and for approximately 20 percent of soil and groundwater samples because of their infrequent detection in previous investigations. For the 2000 samples, (1) four monitoring wells (4MW-1, MW-111, MW-112, and MW-114A) were sampled for the first time for pesticides and PCBs, (2) the same four wells were sampled for TCL VOCs and TAL metals (total and dissolved fractions), and (3) eight soil samples were analyzed for pesticides and PCBs for the first time.

Although PCBs and pesticides were detected in the PA/SI investigation, they were detected at concentrations less than trigger levels established during that study and were not selected as contaminants of concern for the initial investigations in 1995. However, although they were not sampled for during the initial field investigations, soil and groundwater samples were collected in March and June 2000 and analyzed for pesticides and PCBs to assess their presence or absence at the site due to a concern by the Virginia Department of Environmental Quality concerning their omission from the field sampling program.

The soil and groundwater samples for TAL analysis were distributed among upgradient, on-site and downgradient, and at various subsurface soil depths. For those groundwater samples collected from monitoring wells, which were analyzed for TAL compounds, both total and dissolved fractions were analyzed. A summary of field activities conducted by media is provided below:

Soils

- Twenty-two soil borings were advanced at the site with samples collected from two subsurface depths (44 subsurface samples) to assess the vertical and lateral extent of contamination in surface and subsurface soils. The locations of these borings included six in the Northern Area, eight in the Former FTP Area, and eight in the Solvent Plume Area.

- Twenty-two surface soil samples were collected from the same locations as the borings mentioned above. An additional six surface soil samples were collected at the Northern Area of the site in areas of visible soil staining for a total of 28 surface soil samples collected during the 1995 field investigations.

- Eight additional surface soil samples were collected throughout the site in 2000 to assess the presence/absence of pesticides and PCBs.

Groundwater

- Groundwater samples were collected by DPT from twenty-four (24) locations to assess the nature and extent of contamination in groundwater.

- Groundwater was collected at approximately 10 to 15 feet below land surface for 23 of the points. One DPT location was sampled at a depth of 20 to 21 feet below land surface to assess the vertical extent of contamination at the Solvent Plume Area.

- On-site GC analysis of DPT groundwater samples was conducted for select VOCs and TPH light.

- Six monitoring wells were installed and developed as part of this field investigation. Three shallow wells, one shallow/deep well cluster and one deep well located adjacent to an existing shallow well were installed.

- Groundwater samples were collected from four existing and six new monitoring wells. Existing wells were redeveloped prior to sampling.

- Groundwater samples were collected from four monitoring wells in 2000 to assess the presence/absence of pesticides and PCBs and to further define the extent of VOC and metal contamination.

Sediment

- Four sediment samples were collected from within the drainage area located to the south of the site.

Auto Craft Site

Potential impacted areas at the site including the former USTs located north of the former building and other downgradient locations. **Figures 2-8 and 2-9** provide the sampling locations for this site. The locations of the new permanent monitoring wells were established based on the on-site GC and off-site analytical results of the DPT groundwater samples, and the location of existing monitoring wells. **Table 2-2** summarizes our field investigations for this site.

All samples were analyzed for TCL VOCs and SVOCs, and TPH Heavy and Light fractions. TAL analysis was conducted for approximately 20 percent of soil and 50 percent of groundwater samples because of their infrequent detection in previous investigations. The soil and groundwater samples for TAL analysis were distributed among upgradient, on-site and downgradient, and various subsurface soil sampling depths. For those groundwater samples collected from monitoring wells, which were analyzed for TAL compounds, both total and dissolved fractions were conducted. A summary of field activities by media is provided below:

Soil

- Six soil boring locations were installed for the site with samples collected from 3 depths to assess the vertical and lateral extent of contamination in surface and subsurface soils.

Groundwater

- Groundwater samples were collected by DPT from six locations to assess the nature and extent of contamination in groundwater.

- Groundwater was collected at approximately 10 to 15 feet below land surface for the points.

- On-site GC analysis of DPT groundwater samples was conducted for select VOCs and TPH light.

- Three groundwater monitoring wells were installed and developed as part of this field investigation. Two shallow wells and one deep well located adjacent to an existing shallow well were installed.

- Groundwater samples were collected from two existing and two new monitoring wells. Existing monitoring wells were redeveloped prior to sampling.

2.5.3 Nature and Extent of Contamination

FTA Site

Analytical data for the FTA field investigations are presented in **Tables 2-3 through 2-6**.

Soil

A summary of the nature and extent of soil contamination is provided as follows:

- Volatile organics (VOCs) such as toluene, acetone, and MEK and metals were detected in most surface and subsurface soils collected at the FTA while SVOCs were only detected in several soil samples located in the Solvent Plume Area of the site.

- TPH as Heavy Oils was detected in some of the surface and subsurface soil samples located in the Solvent Plume Area of the site. TPH as Heavy Oils exceeded the Virginia TPH Action Limit of 100 mg/kg in only 3 of 72 soil samples collected.

- However, except for arsenic in most soil samples and iron in only one soil sample, all contaminants were detected at levels lower than the EPA Region III risk-based screening criteria.

Groundwater

A summary of the nature and extent of groundwater contamination is provided as follows:

<u>Northern Area</u>

- PCE was detected in only one groundwater sample (DPT #2 at 6.4 *ug/l*) in the Northern Area.

- Although detected in total samples above the EPA action level and EPA RBC, dissolved lead and arsenic were detected at concentrations less than the action level and RBC that indicates that lead and arsenic are associated with the sediment in the groundwater sample.

Former FTP Area

- VOCs detected in the Former FTP Area included acetone, carbon disulfide, xylene, and ethylbenzene. The apparent trend of lateral distribution of xylene indicates minimal migration in groundwater. However, no VOCs were detected in the one well (MW-111) sampled in this area during the 2000 sampling event.

- TPH as Gasoline and Diesel Fuel were present in samples from several locations in this area higher concentrations present in the samples collected at shallow depths. No other shallow or deep groundwater sample from the FTP Area contained measurable concentrations of these compounds so no apparent trends in lateral distribution were discernible.

- Although detected in total samples, dissolved arsenic was not detected which indicates that arsenic is associated with the sediment in the groundwater sample. MW-111 was sampled in 2000 and analyzed for total and dissolved metals. No metal concentrations (total or dissolved) were detected in this well above EPA RBCs for tap water or the EPA action level for lead.

Solvent Plume Area

- PCE was detected in only one groundwater sample (DPT #11) in the Solvent Plume Area. Degradation products (1,1-DCA and 1,1,1-TCA) of PCE were detected at several locations. The distribution of the VOCs with respect to depth and lateral distance did not exhibit any trends in concentration values.

- In the 2000 sampling event, total arsenic was detected at 3.4 ug/l at MW-114A, which is above the EPA RBC for tap water, but dissolved arsenic was not detected in the well.

Sediment

A summary of the nature and extent of sediment contamination is provided as follows:

- TPH as Heavy Oils was detected in most of the sediment samples located in the drainage area south of the site. The TPH contamination may be the result of surface transport from the Solvent Plume Area or former UST fuel farm during precipitation events. The only expected hazardous constituent of TPH compounds detected was toluene but at concentrations lower than risk screening criteria.

Auto Craft Site

Analytical data for the FTA field investigations are presented in **Tables 2-7 through 2-9**.

Soil

A summary of the nature and extent of soil contamination is provided as follows:

- Acetone, methylene chloride, MEK, styrene, toluene and TCE were detected in surface and subsurface soil samples collected at the site. Concentrations of the VOCs varied from surface to deeper depths with no apparent trends. The lateral extent of VOC contamination was not defined because VOCs were detected in all of the surface soil samples collected in this area, but below risk screening criteria.

- Numerous PAHs believed to be the results of asphalt leaching in the upgradient area of the site are present in the shallow soils under the asphalt pad. PAHs were not detected in any other soil locations at the site.

- TPH as Heavy Oils was detected in soils with concentrations decreasing with depth in the borings where TPH was detected. The lateral extent of TPH contamination is limited to the area adjacent to and northeast of the former building which are areas where surface transport of contaminants during heavy precipitation events could occur.

- Numerous metals were detected in soils with concentrations typically decreasing with depth.. Arsenic, iron, and manganese concentrations exceeded the EPA RBCs for residential soils but were less than the EPA RBCs for industrial soils.

Groundwater

A summary of the nature and extent of groundwater contamination is provided as follows:

- Chloroform was the only VOC detected at the Auto Craft Area. The sample from 7MW-3 contained 11 *ug/l*. Because one sample only contained a detectable concentration of a compound, there was no discernible pattern of contaminant distribution with respect to depth and lateral distance.

- Several total and dissolved metals were detected in groundwater samples. Total arsenic and total iron exceeded the EPA RBCs for tap water in one DPT location each while total and dissolved iron and manganese exceeded the EPA RBCs for tap water in one monitoring well (7MW-3).

2.5.4 Fate and Transport of Contaminants

FTA Site

A summary of the fate and transport for compounds at the FTA is provided below:

Former FTP Area

- The concentrations detected in groundwater are an order of magnitude lower than those detected during the PA/SI roughly five years ago. The excavation of the contaminated soils in this area has decreased the potential for impact to groundwater quality through leachate generation. Also, the lowered concentrations in groundwater indicate that the compounds are biodegrading or otherwise attenuating.

- The low concentration of total arsenic detected in groundwater at Well 4MW-2S was adsorbed onto sediments contained in the sample. Arsenic strongly sorbs onto soils and sediments at normal pH especially when in the presence of iron, manganese, and aluminum oxides. Arsenic is soluble in water but the nondetection of it in the dissolved arsenic analysis confirms that it is not dissolved in groundwater at the Former FTP.

Solvent Plume Area

- TPH as Heavy Oils was detected in the southwest corner of the FTA and in the drainage ditch south of the site. Because TPH as Heavy Oils adsorbs very strongly onto soil and has a low aqueous solubility, the adsorbed compounds likely move with the sediments during storm runoff into the drainage ditch. TPH as Heavy Oils have a low volatility and do not readily volatilize into the atmosphere. These compounds are subject to biodegradation, but at a low rate.

- Chlorinated solvent concentrations have decreased greatly since the PA/SI sampling in 1990 and this decrease should continue.

- No PAHs were detected in the sediment samples indicating that these compounds along with most BTEX constituents are not present in areas with TPH compounds detected due to various fate mechanisms such as volatilization, dispersion, and biodegradation.

Auto Craft Site

A summary of the fate and transport for compounds at the Auto Craft site is provided below:

- TPH as Heavy Oils was detected in the shallow (1 to 4 feet) soils in the drainage swale north of the site. Because TPH as Heavy Oils adsorbs very strongly onto soil and has a low aqueous solubility, the adsorbed compounds move with the soil/sediments during storm runoff into the drainage swale.

- Since TPH as Heavy Oils has a low solubility it would not be expected to leach or dissolve in groundwater. This is further supported because TPH as Heavy Oils was not detected in any downgradient monitoring wells.

- In the groundwater system, the PA/SI detected TPH as Heavy Ends in well MW-119 at 0.7 *mg/l* but the RI sample for MW-119 did not contain detectable concentrations of any TPH compounds. Although TPH as Heavy Oils still persist in the soils, it is not leaching to groundwater.

- Chloroform was detected in the deep well (7MW-3) of the shallow/deep cluster downgradient of the former building location. Chloroform has a high aqueous solubility (8,220 *mg/l*, see Table 5-1) and the concentration detected was 0.011 *mg/l* which is well below the aqueous solubility. Thus the chloroform is in a dissolved state. Since chloroform was detected in only one downgradient well, no conclusions could be made with respect to transport in groundwater. Since the compound is in a dissolved state, it would be expected to migrate with groundwater.

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

This section provides a characterization of current and future site uses, and identifies the potentially exposed populations at or near the site with regard to the current situation and potential future conditions.

2.6.1 FTA Site

Current Situation

The site is currently used as a training area for heavy equipment operations and for unloading and loading of heavy equipment on the loading rack in the southeast corner of the site. Fort Story personnel are present at the site for approximately two days per week. However, because the only surface and subsurface soils COPC identified were arsenic and iron due to exceedence of the residential soils criteria and not the industrial soils criteria, no adverse exposures for Fort Story personnel are anticipated. Although the site is not in a restricted area and not fenced, potential exposures to the general public and/or trespassers would not be significant because their presence on the site would not be expected to be for only a short time and not routine. During the four weeks that the investigations were conducted at the site, a few public and/or off-duty personnel were observed at the site walking their dogs or jogging. However, their time spent on-site was limited to less than 30 minutes during their visit. Therefore, exposures to surface and subsurface soils, under current conditions should not exceed risk-based limits.

Groundwater is not used in the vicinity of the site for drinking, process, or production purposes. The chief potable water supply in the region is the surface water reservoir system operated by the City of Norfolk. The system includes in-town lakes located near the Norfolk International Airport and other reservoirs (Lake Prince, Western Branch and Burnt Mills) located in Suffolk, Virginia. The in-town lakes are located over 5 miles from Fort Story while the Suffolk lakes are located over 20 miles from the facility. As previously stated in Section 3.1.5, several housing communities located within 1 mile of Fort Story are developing drinking water wells in the shallow aquifer, however, none of these communities are located downgradient of the site. Groundwater use at Fort Story is restricted to withdrawal from a single well located approximately 4,000 feet (cross groundwater flow gradient) from the site at the LARC 60 Maintenance Area; the water is obtained for non-potable uses only. Migration potential is minimal due to the very low vertical gradient present across the FTA site. There has been little or no migration of contaminants in the groundwater over the past 5 years based on a comparison of data from Montgomery-Watson's study in 1990 and data from Malcolm Pirnie's studies in 1995 and 2000. VOC concentrations have decreased substantially due to numerous subsurface mechanisms such as biodegradation, volatilization, and dispersion. Therefore, exposures to groundwater, under current conditions will not exceed risk-based limits since there are no current uses of the groundwater.

In addition to the discussion for surface and subsurface soils provided above, there are no expected exposures to the sediment located in the lowlying-wooded area south of the site. Therefore, exposures to sediment, under current conditions will not exceed risk-based limits.

Future Land Use

Although construction or excavation activities could be conducted in the future, neither surface nor subsurface soil contaminant concentrations exceeded industrial screening criteria. Therefore, no significant exposures during these activities would be expected because these activities are typically very short term and contaminant concentrations were below screening criteria.

Based on master planning issues for Fort Story, the facility is expected to remain government property. However, due to periodic base closure reviews by the federal government, there is the potential for Fort Story to be closed with subsequent development of the land as commercial or residential properties. Therefore, as for future conditions, potentially exposed populations include residential exposures to the contaminated media at the FTA site.

2.6.2 Auto Craft Site

Current Situation

The fenced, paved area of the site is currently used as a vehicle impoundment area. The grassy areas located north of the site are unused properties. Fort Story personnel are present at the site for approximately one day per week for only a few minutes. However, because the only surface and subsurface soil COPCs identified were several PAHs, arsenic, iron, and manganese due to exceedence of the residential soils criteria and not the industrial soils criteria, no adverse exposures for Fort Story personnel are anticipated. Although the grassy areas north of the site are not fenced, potential exposures to the general public and/or trespassers would not be significant because their presence on the site would not be expected to be for only a short time and not routine. There is a sidewalk located along Atlantic Avenue but during our field investigations, little pedestrian traffic was observed. Therefore, exposures to surface and subsurface soils, under current conditions should not exceed risk-based limits.

Groundwater is not used in the vicinity of the site for drinking, process, or production purposes. The chief potable water supply in the region is the surface water reservoir system operated by the City of Norfolk. The system includes in-town lakes located near the Norfolk International Airport and other reservoirs (Lake Prince, Western Branch and Burnt Mills) located in Suffolk, Virginia. The in-town lakes are located over 5 miles from Fort Story while the Suffolk lakes are located over 20 miles from the facility. As previously stated in Section 3.1.5, several housing communities located within 1 mile of Fort Story are developing drinking water wells in the shallow aquifer, however, none of these communities are located downgradient of the site. Groundwater use at Fort Story is restricted to withdrawal from a single well located approximately 4,500 feet (cross groundwater flow gradient) from the site at the LARC 60 Maintenance Area of which water is obtained for non-potable uses only. Therefore, exposures to groundwater, under current conditions should not exceed risk-based limits since there are current uses of the groundwater.

Future Land Use

Although construction or excavation activities could be conducted in the future, except for PAHs resulting from asphalt leaching, neither surface nor subsurface soil contaminant concentrations exceeded industrial screening criteria. Therefore, no significant exposures during these activities would be expected because these activities are typically very short term and contaminant concentrations were below screening criteria.

Based on master planning issues for Fort Story, the facility is expected to remain government property. However, due to periodic base closure reviews by the federal government, there is the potential for Fort Story to be closed with subsequent development of the land as commercial or residential properties. In addition, there are several undeveloped areas adjacent to the site where additional base housing could be constructed. Therefore, as for future conditions, potentially exposed populations include residential exposures to the surface and subsurface soils and groundwater at the Auto Craft site.

2.7 SUMMARY OF SITE RISKS

2.7.1 FTA Site

FTA Human Health Risk Assessment

Identification of Chemicals of Concern

Arsenic and iron in surface and subsurface soil, antimony and manganese in groundwater, and arsenic, iron, and thallium in sediment are the COPCs identified during the hazard identification of the FTA media. Hazard identification (including the identification of the COPCs) is presented in **Tables 2-10 through 2-13**. Potential risk associated with each COPC was further evaluated in the exposure assessment section.

Exposure Assessment Summary

This section describes the complete exposure pathways by which the potential receptors may be exposed to the COPCs in the soil, sediment, and groundwater via a specific exposure route.

Conceptual Site Model

A conceptual site model was prepared for the site to assess reasonable exposure scenarios and pathways of exposure. **Figure 2-10** presents a conceptual site model that demonstrates the potential exposure pathways.

Potential Receptors and Exposure Pathways Summary

Because no contaminants in soils or sediment exceeded EPA RBCs for industrial soils and groundwater is not utilized at the site, no risk-based limits would be exceeded for the current situation.

The potential exposure pathways for future land use at the FTA site include:

- Residential exposure (adults and children) to **contaminated groundwater** through ingestion of drinking water and dermal contact with chemicals while bathing or showering. Inhalation is not considered a significant pathway for groundwater because the identified COPCs (antimony and manganese) are not considered volatile compounds.

- Residential exposure (adults and children) to **contaminated soil** through ingestion of and dermal contact with chemicals.

- Residential exposure (adults and children) to **contaminated sediment** through ingestion of and dermal contact with chemicals.

Toxicity Assessment Summary

The toxicity assessment, also termed the dose-response assessment, serves to characterize the relationship between the magnitude of exposure and the potential that an adverse effect will occur. It involves (1) determining whether exposure to a chemical can cause an increase in the incidence of a particular adverse health effect and (2) characterizing the nature and strength of the evidence of causation. The toxicity information is then quantitatively evaluated and the relationship between the dose of the contaminant received and the incidence of adverse effects in the exposed population is evaluated.

The USEPA and other regulatory agencies have performed toxicity assessments for numerous chemicals and the guidance they provide is used when available. These include verified reference doses (RfDs) for the evaluation of noncarcinogenic effects from chronic exposure and cancer potency slopes (CPSs) for the evaluation of cancer risk from lifetime exposure. Each of these are discussed below.

Sources of toxicological guidance information, in order of preference, include: (1) IRIS (Integrated Risk Information System) which is a USEPA database containing current health risk and regulatory information for many chemicals (USEPA, 1992a); (2) USEPA Health Effects Summary Tables (HEAST) which are tabular presentations of toxicity data (USEPA, 1991c); and (3) Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles which contain general toxicity information and levels of exposure associated with lethality, cancer, genotoxicity, neurotoxicity, development and reproductive toxicity, immunotoxicity and systemic toxicity.

Non-Carcinogenic Effects

The potential for non-cancer health effects associated with chemical exposure is evaluated by comparing an estimated intake (such as chronic daily intake or CDI) over a specified time period with a RfD derived for a similar exposure period. The RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations that are likely to be without an appreciable risk of deleterious effects during a lifetime. RfDs often have an uncertainty spanning perhaps an order of magnitude or greater. Chronic RfDs, used in this report, are specifically developed to be protective of long-term exposure to a chemical.

The RfDs for the COPC used for the characterization of chronic non-cancer risk via oral exposure routes are presented in **Table 2-14**, along with the confidence level of the chronic RfD, the critical effect, the basis and source of the RfD and any uncertainty of modifying factors used in the derivation of the RfD.

The ratio of the estimate of the CDI to the health-protective criterion (CDI/RfD) is called the hazard quotient (USEPA, 1989a). The hazard quotient assumes that there is a level of exposure (i.e., the RfD) below which it is unlikely for even sensitive subpopulations to experience adverse health effects. If the hazard quotient exceeds 1.0, there may be concern for potential non-cancer effects. The greater the hazard quotient above 1.0, the greater the level of concern.

Carcinogenic Effects

Regardless of the mechanism of effect, risk assessment methods generally derive from the hypothesis that thresholds for cancer induction by carcinogens do not exist and that the dose-response relationship is linear at low doses. Such risk assessment methods require extrapolation from high dose animal studies to evaluate low dose exposures to humans. In the absence of adequate information to the contrary, a linearized, multistage, non-threshold low dose extrapolation model is recommended by the USEPA as the most appropriate method for assessing chemical carcinogens. The USEPA emphasizes that this procedure leads to a plausible upper limit to the risk that is consistent with some proposed mechanisms of carcinogenesis.

Through application of this approach, the USEPA has derived estimates of incremental excess cancer risk from lifetime exposure to potential carcinogens. This is accomplished by establishing the carcinogenic potency of the chemical through critical evaluation of the various test data and the fitting of those dose-response data to a low dose extrapolation model. The CPS (which describes the dose-response relationship at low doses) is expressed as a function of intake [i.e., per $(mg/kg\text{-}day)^{-1}$]. This expression incorporates standard pharmacological considerations such as body weight. CPSo data for the COPC are presented in **Table 2-15** and are used to estimate finite, upper limits of risk at low dose levels administered over a lifetime. The weight-of-evidence classification for carcinogenicity, the type of cancer associated with each COPC and the basis and source of the CPSo are also presented in **Table 2-15**.

To arrive at an estimate of incremental cancer risk, the following equation is used (USEPA, 1989a):

Risk = CDI x CPS
where:

Risk = a unitless probability (e.g., 2×10^{-5} or 2 in 100 thousand) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
CPS = Cancer Potency Slope expressed in $(mg/kg\text{-}day)^{-1}$

This linear equation is valid only at low risk levels (i.e., below estimated risks of 0.01). This approach does not necessarily give a realistic prediction of risk. The true value of the risk at trace ambient concentrations is unknown, and may be as low as zero.

Risk Characterization

The final step in the HHRA is the characterization of risk. Here the toxicity and exposure assessments are summarized and combined into quantitative and qualitative expressions of risk. Potential noncarcinogenic effects are characterized by comparing intakes and toxicity values, while carcinogenic risks are characterized by estimating the probability that an individual will develop cancer over a lifetime of exposure.

Potential non-cancer health effects, those associated with long-term chronic exposure to surface soils and groundwater at the site for potential future residential populations are presented. Carcinogenic risks are similarly presented for the COPC, for each pathway of concern and for each potential exposed population. The cumulative impact of exposure from the various pathways evaluated is estimated, for the residential populations (adults and children) including ingestion of chemicals in surface soils and ingestion of, dermal contact with and inhalation of volatilized chemicals in groundwater.

Qualitative and Quantitative Risk Assessment

Potential non-cancer health effects, those associated with long-term chronic exposure to surface soils and groundwater at the site for potential future residential populations are presented. Carcinogenic risks are similarly presented for the COPC, for each pathway of concern and for each potential exposed population. The cumulative impact of exposure from the various pathways evaluated is estimated, for the residential populations (adults and children) including ingestion of chemicals in surface soils and ingestion of, dermal contact with and inhalation of volatilized chemicals in groundwater.

Non-Cancer Risk: **Table 2-16** presents the chemical-specific hazard quotients for each pathway involving surface soils and groundwater. In addition, the total pathway risk, also referred to as the hazard index, which is the sum of the chemical-specific hazard quotients for each pathway are presented in **Table 2-16**. The total exposure risk incorporates all the appropriate exposure pathways for the residential populations. To assess the overall potential for adverse non-cancer effects posed by the chemicals of potential concern, the hazard quotients for the chemicals are summed for each of the pathways through which on-site exposure may occur. As shown in **Table 2-16**, the total exposure hazard index for ingestion of and dermal contact with chemicals in soils and groundwater is 0.60 for adults and 0.66 for children which are less than the criterion of 1.0 for adults and children. Thus, adverse non-carcinogen health effects in these residential populations (adult and children) are unlikely.

Cancer Risks: **Table 2-17** presents estimated chemical-specific and total pathway cancer risks calculated for ingestion of and dermal contact with chemicals in soil and groundwater. The estimated total exposure cancer risks are also noted in this table, incorporating all the appropriate exposure pathways for the residential populations. The estimated cancer risk for exposure to chemicals in soils and groundwater is about 1.5 in 1 million for adults and 2.7 in 1 million for children. These values are within but on the lower end of the USEPA Superfund remediation goal of 10^{-4} (1 in ten thousand) to 10^{-6} (1 in one million) which serves as the target for site cleanup. The ingestion of and dermal contact with arsenic in soils are the greatest exposure pathways for adults and children.

Uncertainties

Some uncertainty is inherent in the process of conducting predictive, quantitative health risk assessments. Environmental sampling and analysis, fate and transport modeling and human exposure modeling are all prone to uncertainty, as are the available toxicity values used to characterize risk. Such uncertainty is generally related to the limitations of the sampling in terms of the number and distribution of samples and analytical information in terms of systematic or random errors used to characterize a site, the estimation procedures and the input variables and assumptions used in the assessment.

There are uncertainties in every step of the risk assessment process; uncertainties that relate to this human health evaluation may be noted. Selection of the chemicals of potential concern provides uncertainty since the selection process relies heavily on professional judgment. If different chemicals of concern were chosen or if some were excluded the estimates of risk would be affected.

Model input parameters and assumptions that tend to overestimate exposure were used in the exposure assessment. For example, the "representative" concentrations used in some of the analyses were the maximum concentration detected. This may overestimate risk. Also, frequent exposure to contaminants is considered even though exposures may occur infrequently or not at all. Additional uncertainties are inherent in the exposure assessment for individual chemicals and exposure routes.

There is also some uncertainty in the derivation of health effects criteria in the toxicity assessment. In most cases, the criteria are derived from the extrapolation from laboratory animal data to the human condition. This may have the effect of either overestimating or underestimating the risk.

For the FTA site, some important uncertainties that may influence the results of the HHRA include:

- Although a limited data set for arsenic in soils at the site was available, arsenic concentrations in soils are consistent with Fort Story and USGS regional background soils data.

- Limited data set for dissolved manganese in groundwater. Only four dissolved groundwater samples were collected and analyzed for metals at the site. Therefore, the maximum concentration of 81 ug/l was used in the risk analysis, which may bias the results high. Additional groundwater analysis for dissolved manganese would present a larger data set and provide for a more accurate analysis of risk.

- Dissolved data is a function of filtering efficiency in the field. Some of the monitoring well samples were very turbid and required extensive settling prior to filtering. In monitoring well 4MW-2S where the 81 ug/l dissolved manganese result was detected, the sample collected was extremely turbid (310 NTUs) which may impact filter efficiency due to the passing of some turbid under the filter into the sample container. Dissolved results may be biased high based on the filtering limitations.

Summary and Conclusions

A summary of the risk for future residential land use is provided below:

- The total exposure hazard index for ingestion of soils and ingestion of, dermal contact with, and inhalation of chemicals in groundwater is less than the criterion of 1.0 for adults and children.
- The estimated cancer risk for exposure to chemicals in soils and groundwater is about 1.5 in 1 million for adults and 2.7 in 1 million for children. The greatest component for adults and children exposures is ingestion of and dermal contact with arsenic in soils, which accounts for 100 percent of the cancer risk. However, as previously stated, arsenic concentrations are consistent with background.
  - Potential risk is only present for the future scenario of residential development at the site, and not for the current situation or future situations involving industrial activities.

Concentrations of volatile organics decreased by about one order of magnitude from the 1991 PA/SI sampling event to the 1995 RI sampling event and then to the 2000 sampling event with natural attenuation expected to continue this trend. No organics were detected above the USEPA MCLs during the 2000 sampling event.

Because arsenic was detected in site soils at concentrations consistent with the background soils as previously discussed, the risk associated with it is not related to site-specific activities such as spills, leaks, or industrial activities. Therefore, upon removal of arsenic as a COPC, the risk levels become less than the criterion of 1.0 and 10^{-6}, and no further action related to this site (based on human health risk) is warranted.

FTA Ecological Risk Assessment (ERA)

Identification of Chemicals of Concern

This section presents lists of chemicals detected in the site surface soil and sediment samples that are considered COPCs. Groundwater was not addressed in this assessment, as it does not have a complete exposure pathway at the site. The compounds identified as COPCs are considered to be those with the greatest potential significance to aquatic and wildlife receptors. Most chemicals detected in the various media are retained as COPCs. A summary of the COPCs is summarized as follows:

Surface Soil - Toluene, Acetone, Fluoranthene, Pyrene, Chromium, Copper, Lead, and Zinc
Sediment – Toluene, Aluminum, Barium, Cobalt, Iron, Lead, Manganese, Thallium, and Vanadium

Exposure Assessment

The following summarizes the ecological setting, target receptors, and potential exposure pathways.

Ecological Setting and Species Summary

Following is a brief description of the habitat requirements and diet of the terrestrial endpoint species selected for the FTA Site. A CSM for the FTA site is provided on **Figure 2-11**. In addition, the reasons for selection of these species are discussed.

- **Herbaceous Vegetation.** Plants that occur in pine/oak woodland and disturbed areas of the northeastern United States are likely to occur at the Site. These plants include herbaceous species that serve as an important food source for songbirds, small mammals, and larger herbivores. The measurement endpoints for terrestrial vegetation are published phytotoxicity reference values for each contaminant.

- **Soil/Sediment Invertebrates.** Invertebrates that are common in sandy soils in Southeastern Virginia are likely to occur within and adjacent to the site. In addition, sediment invertebrates that favor intermittent streams and pools or damp soils are likely to occur within the drainage area adjacent to the site. These invertebrates are an important food source for ground gleaning birds and small mammals. The measurement endpoints for soil/sediment invertebrates are published toxicity reference values for each contaminant.

- **Killdeer (*Charadrius vociferus*).** The Killdeer is common in Virginia, migrating out of the area in winter months. A typical density measured during the breeding season is 3.9 pairs per 100 acres, yielding an approximate home range of 25.6 acres per pair (10.36 hectares). Breeding Killdeer prefer open meadows, edges of pasture, and dry uplands. In all areas, sparse or closely cropped vegetation is required. Preferred food items include insects (especially beetles and grasshoppers), centipedes, spiders, worms, and seeds (Degraaf and Rudis, 1986).

  The Killdeer has been selected to represent the ground-gleaning insectivorous bird community at the FTA site. Although the Killdeer is considered an insectivorous bird and may not represent other avian species that concentrate on seeds and worms, it represents avian food-chain exposure most likely at the site. The FTA site does not provide suitable forage habitat for avian species that prefer worms. Insectivorous birds such as the Killdeer are more likely to frequent the site.

Measurement endpoints for the Killdeer are derived from avian toxicity data taken from published dose-response studies that relate contaminant exposure or uptake to effects on individual organisms.

- **White-footed Mouse (*Peromyscus leucopus*).** This common small mammal occurs throughout Virginia and occupies home ranges from 0.054 to 0.072 hectares. It is found in a variety of habitats including interiors and edges of deciduous and coniferous forests, scrub areas, clearings, pastures, stream-side thickets, and buildings. The White-footed Mouse consumes arthropods, seeds, and other vegetation. It is active throughout the year and usually nests off the ground. (USEPA, 1993).

  The White-footed Mouse has been selected to represent the small mammal community at the FTA site. As a receptor with an omnivorous diet, the mouse is representative of herbivorous and insectivorous small mammals present within the boundaries of the site. Due to the scarcity of vegetation on the site itself, larger herbivores such as rabbits are unlikely to make significant use of the area.

  Measurement endpoints for the White-footed Mouse are derived from rodent toxicity data taken from published dose-response studies that relate contaminant exposure or uptake to effects on individual organisms.

- **Gray Fox (*Urocyon cinereoargenteus*).** Gray Foxes are present throughout the United States, except in the northwest and northern prairies. Foxes are secretive and nocturnal, and will often climb trees to evade predators. Gray foxes prey on small mammals but will also eat insects, fruits, acorns, birds, and eggs. The home range of this species varies from 57 and 855 hectares (USEPA, 1993). This species is similar in size and habits of the Red Fox (*Vulpes vulpes*).

  The Gray Fox has been selected to represent the terrestrial carnivore community at the Site. Although the Merlin and Red-tailed Hawk may also represent other potential endpoint species in the carnivore category, their home ranges are typically much larger than that of the fox, and their use of the FTA site is likely to be restricted.

  Measurement endpoints for the fox are derived from mammalian toxicity data taken from published dose-response studies that relate contaminant exposure or uptake to effects on individual organisms.

<u>Exposure Pathways</u>

Several ecologically relevant migration pathways for contaminants exist at the site. Wildlife may have incidental contact with or ingestion of contaminants while foraging, nesting, or engaging in other activities in the site. Chemical contaminants can also adversely affect plants and animals in surrounding habitats via the food chain.

Upon their release, some site contaminants are persistent and may be transformed to more bioavailable forms and mobilized in the food chain. Mobilization of contaminants in the terrestrial food chain could occur through the following pathways:

- Root uptake from contaminated soil by herbaceous plants,
- Bioaccumulation from vegetation or animal prey at the base of the food chain by wildlife.
- Contact and absorption, incidental ingestion, and feeding on contaminated food by invertebrates, and
- Drinking of contaminated surface water by wildlife

Based on these pathways, the following general classes of ecological receptors potentially might be exposed to contaminants at the Fort Story sites.

- Terrestrial plants growing within and adjacent to the sites,
- Terrestrial invertebrates likely to occur in surface soils and benthic invertebrates occurring within the sediments,
- Birds that forage or nest within the areas,
- Small mammals that reside and/or feed in the vicinity of the areas, and
- Other higher trophic level wildlife species (e.g., carnivores) that feed within the vicinity of the sites.

Ecological Effects Assessment

<u>Ecological Effects Summaries</u>

Toxicity profiles summarizing the potential adverse ecological effects of each COPC were derived from the literature, and are included as Appendix K of the Final RI Report. The profiles provide discussions of the acute and chronic toxicity of the COPCs to plants and animals. Effects on growth, reproduction, and survival of terrestrial species are given, where available. Also included are significant fate and transport characteristics of the chemicals. These summaries, in addition to established criteria, were used to identify the critical effects of COPCs.

Toxicity Reference Values

Toxicity reference values (TRVs) were derived for plants, soil/sediment invertebrates and other wildlife as described below.

Terrestrial Plants and Invertebrates - The TRVs used to evaluate the toxicity of a given COPC to terrestrial plants and soil invertebrates were derived from the available literature. Values were applied to both soil and sediment since toxicity values for sediment were unavailable. Phytotoxic values represent the lowest values from toxicity studies conducted in the field or in greenhouse and growth chamber settings. Soil TRVs based on microbial heterotroph and earthworm toxicity represent data provided by toxicity studies in the field or in laboratory settings (Will and Suter, 1994b).

Wildlife - TRVs for mammals and birds chosen as receptor species were derived based on methodology presented by Opresko et al.. This general method is based on USEPA methodology for deriving human toxicity values from animal data. In this method, experimentally derived No Observed Adverse Effect Levels (NOAELs) or Lowest Observed Adverse Effect Levels (LOAELs) are used to estimate NOAELs for wildlife by adjusting the dose according to differences in body size. NOAELs for laboratory species, obtained from the literature, were converted to receptor species NOAELs as follows:

$$NOAEL_r = NOAEL_t \, (bw_t / bw_r)^{-}$$

Where: $NOAEL_r$ = receptor species NOAEL
$NOAEL_t$ = test species NOAEL
bw_r = receptor body weight
bw_t = test species body weight

The test species and receptor species NOAELs for the FTA site are provided for each of the COPC in **Table 2-18.**

Ecological Risk Characterization

Hazard Quotients

The levels of chromium in the soil and aluminum, lead, thallium, and vanadium in sediment were found to exceed phytotoxicity values. The levels of iron in the soil and aluminum and iron in the sediment were found to exceed invertebrate toxicity values. Phytotoxicity and invertebrate toxicity values were not available for acetone, flouranthene or pyrene. Phytotoxicity values were not available for iron. Invertebrate toxicity values were not available for toluene.

The hazard quotients (HQs) indicate if the maximum concentrations of the COPCs are likely to pose a risk to Killdeer, White-footed Mouse, or Gray Fox at the FTA site. HQs greater than 1 were calculated for aluminum, barium, lead, thallium, and vanadium for the White-footed Mouse. HQs greater than 1 were calculated for aluminum for the Gray Fox. No HQs were greater than 1 for the Killdeer. An HQ greater than 1 means that the total estimated exposure exceeds the species toxicity reference values. These results indicate that there is a potential for risk of exposure for the White-footed Mouse and the Gray Fox to the maximum concentrations of the contaminants whose HQs exceeded 1. Avian toxicity values were not available for toluene, fluoranthene, pyrene or thallium. Therefore, the potential risks of these COPCs to the Killdeer were not evaluated.

A summary of the exposure estimates and HQs for the FTA site is presented in **Table 2-19.**

<u>Summary of Risks</u>

At the FTA site, potential risks of exposure to aluminum, barium, lead, thallium, and vanadium in sediment was identified for small mammals. The potential risk of exposure to aluminum in sediment was identified for terrestrial carnivores. In addition, potential risks of exposure to chromium in the soil and aluminum, lead, thallium, and vanadium in sediment were identified for plants. The potential risks of exposure to iron in the soil and sediment and aluminum in the sediment were found for soil/sediment invertebrates. These risks of adverse effects were identified for the maximum exposure scenario.

<u>Uncertainties</u>

Areas of uncertainty for the FTA site include the following:

- Uncertainty associated with environmental sampling is generally related to the limitations of the sampling program in terms of the number and distribution of samples, while uncertainty associated with the analysis of the samples is generally related to systematic or random errors.

- The principal uncertainties in the exposure assessment have to do with quantitative estimates of exposure parameters such as BAFs. These parameters typically are chemical, species, and site specific. Generally, the reasonable worst case was assumed to provide a conservative estimate.

- Another point of uncertainty lies in the assumption that each of the wildlife receptor species feeds only upon food items found in the study areas.

- The assumption that soil and sediment invertebrate uptake of compounds would be equal to published Earthworm Uptake Factors may also result in an over- or underestimation of potential risk.

- Uncertainty arises when using any published toxicity results as TRVs

In general, the risk assessment is likely to overestimate rather than underestimate the risks of adverse ecological effects at the sites, because of the conservative nature of the assumptions used. Overall, a generally conservative approach was taken in the evaluation to minimize the possibility of actual risk being greater than that predicted. Conservative steps taken include:

- The selection of COPC based on exceedence or lack of EPA Region III BTAG criteria and exceedence of site-specific and regional background data.

- The comparison of maximum chemical concentrations in site media with maximum background concentrations

- The use of maximum chemical concentrations, where appropriate.

- The use of average body weights and feeding rates and minumum home ranges for the endpoint species.

Ecological Significance

The FTA site is a potential source of environmental contamination in soil and sediments. These potential effects are considered to have minimal ecological significance for the following reasons:

- In many cases, wildlife risks were identified for the maximum exposure case. The average concentrations are more representative of exposure for mobile species of wildlife, such as the White-footed Mouse.

- The FTA site is currently disturbed by military activities occurring on the base. Therefore, the site can support only a few individuals, and the potential impacts to plant or animal populations as a whole are minimal.

- The ecosystems in the general vicinity of the site do not appear to be impacted or stressed due to chemical contamination.

- Apex predators and wildlife with large home ranges are not likely to be adversely affected due to the comparatively limited extent of contamination.

2.7.2 Auto Craft Site

Auto Craft Human Health Risk Assessment

Identification of Chemicals of Concern

The COPCs identified for the Auto Craft site are presented as follows:

- Surface and subsurface soil: Benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, arsenic, iron, and manganese

- Groundwater: Chloroform, iron, and manganese

Hazard identification (including the identification of the COPCs) is presented in **Tables 2-20 through 2-22**. Potential risk associated with the COPC was further evaluated in the exposure assessment section.

Exposure Assessment Summary

This section describes the complete exposure pathways by which the potential receptors may be exposed to the COPCs in the soil, sediment, and groundwater via a specific exposure route.

<u>Conceptual Site Model</u>

A conceptual site model was prepared for the site to assess reasonable exposure scenarios and pathways of exposure. **Figure 2-12** presents a conceptual site model that demonstrates the potential exposure pathways.

<u>Potential Receptors and Exposure Pathways Summary</u>

Because no contaminants in soils exceeded EPA RBCs for industrial soils and groundwater is not utilized at the site, no risk-based limits would be exceeded for the current situation.

The potential exposure pathways for future land use at the Auto Craft site include:

- Residential exposure (adults and children) to **contaminated groundwater** through ingestion of drinking water, dermal contact with and inhalation of volatilized chemicals while bathing or showering.

- Residential exposure (adults and children) to **contaminated soil** through ingestion of and dermal contact with chemicals.

Toxicity Assessment Summary

Non-Carcinogenic Effects

The RfDs for the COPC used for the characterization of chronic non-cancer risk via oral exposure routes are presented in **Table 2-23**, along with the confidence level of the chronic RfD, the critical effect, the basis and source of the RfD and any uncertainty of modifying factors used in the derivation of the RfD.

Carcinogenic Effects

The CPS (which describes the dose-response relationship at low doses) is expressed as a function of intake [i.e., per $(mg/kg\text{-}day)^{-1}$]. This expression incorporates standard pharmacological considerations such as body weight. CPSo data for the COPC are presented in **Table 2-24** and are used to estimate finite, upper limits of risk at low dose levels administered over a lifetime. The weight-of-evidence classification for carcinogenicity, the type of cancer associated with each COPC and the basis and source of the CPSo are also presented in **Table 2-24**.

Risk Characterization

Potential non-cancer health effects, those associated with long-term chronic exposure to surface soils and groundwater at the site for potential future residential populations are presented. Carcinogenic risks are similarly presented for the COPC, for each pathway of concern and for each potential exposed population. The cumulative impact of exposure from the various pathways evaluated is estimated, for the residential populations (adults and children) including ingestion of chemicals in surface soils and ingestion of, dermal contact with and inhalation of volatilized chemicals in groundwater.

Qualitative and Quantitative Risk Assessment

Potential non-cancer health effects, those associated with long-term chronic exposure to surface soils and groundwater at the site for potential future residential populations are presented. Carcinogenic risks are similarly presented for the COPC, for each pathway of concern and for each potential exposed population. The cumulative impact of exposure from the various pathways evaluated is estimated, for the residential populations (adults and children) including ingestion of chemicals in surface soils and ingestion of, dermal contact with and inhalation of volatilized chemicals in groundwater.

Non-Cancer Risk: **Table 2-25** presents the chemical-specific hazard quotients for each pathway involving surface soils and groundwater. In addition, the total pathway risk, also referred to as the hazard index, which is the sum of the chemical-specific hazard quotients for each pathway are presented in **Table 2-25**. The total exposure risk incorporates all the appropriate exposure pathways for the residential populations. As shown in **Table 2-25**, the total exposure hazard index for ingestion of soils and ingestion of and dermal contact with chemicals in groundwater is greater than the criterion of 1.0 for both adults and children. Thus, adverse non-carcinogen health effects in this residential population (adults and children) are likely. The majority of this risk is associated with inhalation of chloroform in groundwater. The hazard quotient (1.7) for the ingestion of iron in groundwater for children was just above the criterion of 1.0 also.

Cancer Risks: **Table 2-26** presents estimated chemical-specific and total pathway cancer risks calculated for ingestion of soils and ingestion of, dermal contact with, and inhalation of chemicals in groundwater. The estimated total exposure cancer risks are also noted in this table, incorporating all the appropriate exposure pathways for the residential populations. The estimated cancer risk for exposure to chemicals in surface soils and groundwater is about 6 in 100,000 (6×10^{-5}) for adults and 5 in 100,000 (5×10^{-5}) for children. These values are within the USEPA Superfund remediation goal of 10^{-4} (1 in ten thousand) to 10^{-6} (1 in one million), which serves as the target for site cleanup. The greatest component for adult exposure is inhalation of chloroform in groundwater. For child exposures, both ingestion of arsenic in soils and inhalation of chloroform in groundwater were within the USEPA remediation goal.

Uncertainties

For the Auto Craft site, some important uncertainties that may influence the results of the HHRA include:

- Limited data set for arsenic and manganese in soils at the site. Only 1 surface soil sample was analyzed for metals. However, these levels were consistent with background soils data.

- Limited data set for dissolved manganese in groundwater. Only 2 dissolved groundwater samples were collected and analyzed for metals at the site. Therefore, the maximum concentration of 80 ug/ for manganese was used in the risk analysis, which may bias the results high. Additional groundwater analysis for dissolved metals would present a larger data set and provide for a more accurate analysis of risk.

- Dissolved data is a function of filtering efficiency in the field. Some of the monitoring well samples were very turbid and required extensive settling prior to filtering. Dissolved results may be biased high based on the filtering limitations.

- VOC estimates for non-carcinogenic and cancer risk may be biased high because of the use of 2.5 ug/l (which is 1/2 the PQL) in the UCL calculations. Chloroform was detected infrequently (1 of 10 samples). Analysis with a lower PQL may more accurately estimate VOC concentrations and subsequent risk. It should be noted that the chloroform concentration (11 ug/l) detected was less than the USEPA MCL (100 ug/l) for total trihalomethanes indicating that the level present in the groundwater would meet acceptable criteria for a drinking water distribution system.

Summary and Conclusions

A summary of the risk for future residential land use is provided below:

- The total exposure hazard index for adults and children was greater than the criterion of 1.0 with inhalation of chloroform exceeding the criterion for adults and children with ingestion of iron exceeding the criterion for children as well.

- The estimated cancer risk for exposure to chemicals in surface soils and groundwater is about 6 in 100,000 for adults. The greatest component for adults exposures is inhalation of chloroform in groundwater (92 percent of total risk) which was within the USEPA remediation goal.

- The estimated cancer risk for exposure to chemicals in surface soils and groundwater is about 5 in 100,000 for children. The greatest components for child exposures are ingestion of arsenic (although levels are consistent with background) in soils (5 percent of total risk) and inhalation of chloroform (86 percent of total risk) in groundwater.

- Potential risk above acceptable criteria is only present for the future scenario of residential development at the site, and not for the current situation or future situations involving industrial activities.

- Because residential development would not be expected at the site for many years even if base closure were to occur in the future, the concentration of chloroform in groundwater due to natural attenuation would be expected to decrease. It currently is below the USEPA MCL for total trihalomethanes.

- Additional sampling as previously discussed in the Uncertainties Section may also present sufficient data for a more accurate analysis of risk for metals in groundwater and surface soils for future residential development.

Because arsenic was detected in site soils at concentrations consistent with the background soils as previously discussed, the risk associated with it is not related to site-specific activities such as spills, leaks, or industrial activities. Chloroform was only detected in one groundwater sample at the site and in a concentration (11 ug/L) below the USEPA MCL for total trihalomethanes. Therefore, upon removal of arsenic and chloroform as COPCs, the risk levels become less than the criterion of 1.0 and 10^{-6}, and no further action related to this site (based on human health risk) is warranted.

Auto Craft Ecological Risk Assessment

Identification of Chemicals of Concern

This section presents lists of chemicals detected in the site surface soil samples that are considered COPCs. Groundwater was not addressed in this assessment, as it does not have a complete exposure pathway at the site. The compounds identified as COPCs are considered to be those with the greatest potential significance to wildlife receptors. Most chemicals detected in the various media are retained as COPCs.

The COPCs for surface soils at the Auto Craft site include the following: acenaphthene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, butylbenzylphthalate, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, chromium, copper, iron, lead, nickel, and zinc

Exposure Assessment

The following summarizes the ecological setting, target receptors, and potential exposure pathways.

<u>Ecological Setting and Species Summary</u>

Following is a list of the terrestrial endpoint species selected for the Auto Craft Site. A CSM for the Auto Craft site is provided on **Figure 2-12**. Since the species selected are similar to those selected for the FTA site, their habitat descriptions are not repeated here.

- Herbaceous Vegetation
- Soil Invertebrates

- Killdeer
- White-footed Mouse
- Gray Fox

Exposure Pathways

Same description as the FTA site.

Ecological Effects Assessment

Same discussion as the FTA site.

The test species and receptor species NOAELs for the Auto Craft site are provided for each of the COPC in **Table 2-18.**

Ecological Risk Characterization

Hazard Quotients

The levels of chromium, lead and zinc in the soil were found to exceed the phytotoxicity values. The levels of iron in the soil were found to exceed invertebrate toxicity values. Phytotoxicity and invertebrate toxicity values were not available for PAHs. Phytotoxicity values were unavailable for iron.

The HQs for the average exposure case for the SVOCs and the maximum exposure case for metals are summarized in **Table 2-27**. The levels of zinc were found to exceed both Killdeer and White-footed Mouse toxicity values (HQ>1). Therefore, there is a potential for risk to the maximum concentrations of zinc to the White-footed Mouse and the Killdeer at the Auto Craft Site. The wildlife HQs were less than 1 for all other compounds where TRVs were available. These results indicate that the mean concentrations of the SVOCs and the maximum concentrations of metals (except zinc) are unlikely to pose a risk to the Killdeer, White-footed Mouse, or Gray Fox at the Auto Craft Site. Avian toxicity values were not available for PAHs or iron. Mammalian toxicity values were not available for iron. Therefore, the potential risks of these COPCs were not evaluated.

Summary of Risks

At the Auto Craft site, potential risks of exposure to zinc were identified for ground-gleaning birds and small mammals. Potential risks of exposure to chromium, lead and zinc were identified for plants growing in the area. Potential risks of exposure to iron were identified for soil invertebrates. These risks of adverse effects were identified based on the maximum exposure scenario for all contaminants to plants and invertebrates and metals to wildlife. The risks of adverse effects were identified for average exposure conditions for semi-volatile organic compounds to wildlife.

Uncertainties

Same as discussion for FTA site.

Ecological Significance

The Auto Craft site is a potential source of environmental contamination in soil and sediments. These potential effects are considered to have minimal ecological significance for the following reasons:

- In many cases, wildlife risks were identified for the maximum exposure case. The average concentrations are more representative of exposure for mobile species of wildlife, such as the White-footed Mouse.

- The Auto Craft site is currently disturbed by military activities occurring on the base. Therefore, the site can support only a few individuals, and the potential impacts to plant or animal populations as a whole are minimal.

- The ecosystems in the general vicinity of the site do not appear to be impacted or stressed due to chemical contamination.

- Apex predators and wildlife with large home ranges are not likely to be adversely affected due to the comparatively limited extent of contamination.

2.8 DOCUMENTATION OF SIGNIFICANT CHANGES

No significant changes have occurred since finalization of the Remedial Investigation Report that included the conclusions of the baseline risk assessment that provides the basis for No Action required at the FTA and Auto Craft sites.

This section details Public, State, and Federal comments, subsequent responses, as well as resolutions regarding general concerns about the site.

The following terms are presented in the order they appear in the DD.

ROD	**Record of Decision**
DD	**Decision Document**
CERCLA	**Comprehensive Environmental Response, Compensation, and Liability Act**
SARA	**Superfund Amendments and Reauthorization Act**
NCP	**National Oil and Hazardous Substances Pollution Contingency Plan**
VDEQ	**Virginia Department of Environmental Quality**
RI	**Remedial Investigation**
BNAs	**Base-neutral Acid Extractable Compounds**
TFH-H	**Total Fuel Hydrocarbons-Heavy Fraction**
USEPA	**United States Environmental Protection Agency**
MCLs	**Maximum Contaminant Levels**
RCRA	**Resource Conservation and Recovery Act**
VOCs	**Volatile Organic Compounds**
PAHs	**Polynuclear Aromatic Hydrocarbons**
SVOCs	**Semi-Volatile Organic Compounds**
ARARs	**Applicable or Relevant and Appropriate Requirement**
TRC	**Technical Review Committee**
TAL	**Target Analyte List**
CPT	**Cone Penetrometer Test**
COPC	**Constituents of Special Concern**
HHRA	**Human Health Risk Assessment**
IRIS	**Integrated Risk Information System**
SF	**Slope Factor**
NCP	**National Contingency Plan**
HQ	**Hazard Quotient**
NOAEL	**No Observed Effects Level**
USFWS	**United States Fish and Wildlife Service**
NOAA	**National Oceanic and Atmospheric Administration**
ER-L	**NOAA – Effects Range- Low**
ER-M	**NOAA – Effects Range – Median**
UCL	**Upper Confidence Limits**
EEQ	**Environmental Effects Quotient**
OSHA	**Occupational Safety and Health Administration**

Decision Document
FTA and Auto Craft Sites
Fort Story, Virginia

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TABLE 2-1
SUMMARY OF FTA FIELD INVESTIGATIONS

Location	Soil Borings/ Soil Samples	Surface Soil Samples	Sediment Samples	DPT Groundwater Samples	Monitoring Well Samples	Monitoring Wells Installed
1995 FIELD ACTIVITIES						
Northern Area						
Upgradient of Northern Area	2/4	2	0	2	1	1
Northern Area	4/8	10	0	2	0	0
Former FTP Area						
Upgradient of Former FTP	1/2	1	0	1	0	0
Former FTP Area	7/14	7	0	1	2	2
Downgradient of Former FTP	0	0	0	7	2	1
Solvent Plume Area						
Upgradient of Solvent Plume Area	2/4	2	0	2	0	0
Solvent Plume Area	3/6	3	0	4	2	1
Downgradient of Solvent Plume Area	3/6	3	0	5	3	1
Drainage Area South of Solvent Plume	0/0	0	4	0	0	0
1995 Totals	22/44	28	4	24	10	6
2000 SAMPLING EVENT						
Northern Area						
Upgradient of Northern Area	0	1	0	0	1	0
Northern Area	0	1	0	0	0	0
Former FTP Area						
Former FTP Area	0	2	0	0	1	0
Solvent Plume Area						
Solvent Plume Area	0	2	0	0	2	0
Drainage Area South of Solvent Plume	0	2	0	0	0	0
2000 Totals	0	8	0	0	4	0

TABLE 2-2
SUMMARY OF AUTO CRAFT FIELD INVESTIGATIONS

Location	Soil Borings/ Soil Samples	Surface Soil Samples	DPT Groundwater Samples	Monitoring Well Samples	Monitoring Wells Installed
Upgradient of Auto Craft Bldg	1/2	1	1	0	1
Downgradient of Auto Craft Bldg	5/10	5	5	4	2
Totals	6/12	6	6	4	3

TABLE 2-3
SOIL RESULTS - FTA SITE

Parameters	SB04-001			SB04-002			SB04-003			SB04-004			SB04-005			EPA RBC Criteria(1)
	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	
VOCs (ug/kg)																
Acetone	<28	39J	<29	<28	72J	<30	220DJ	70J	110J	<26	51J	<28	<26	<28	41J	20,000,000/780,000
Methylene Chloride	<5.7	<5.7	<5.8	<5.6	<5.7	<6.1	<5.6	<5.7	<5.8	<5.3	<5.5	<5.7	<5.3	<5.6	<6	760,000/85,000
Methyl ethyl ketone	<28	31J	<29	<28	<29	<30	28	<28	<.29	<26	69J	36J	<26	32J	110J	100,000,000/4,700,000
Styrene	<5.7	<5.7	<5.8	<5.6	<5.7	<6.1	<5.6	<5.7	<5.8	<5.3	<5.5	<5.7	<5.3	<5.6	<6	41,000,000/1,600,000
Toluene	21	8.6	7.4	68	18	<6.1	99	9.2	10	19	14	<5.7	24	14	16J	41,000,000/1,600,000
Xylenes	<5.7	<5.7	<5.8	<5.6	<5.7	<6.1	<5.6	<5.7	<5.8	<5.3	<5.5	<5.7	<5.3	<5.6	<6	100,000,000/16,000,000
SVOCs (ug/kg)																
Benzo(b)fluoranthene	BDL(2)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7,800/870
Benzo(k)fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78,000,8,700
Bis(2-EH)phthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	410,000/46,000
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	780,000/87,000
Di-n-butylphthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20,000,000/780,000
Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8,200,000/310,000
Naphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4,100,000/1,600
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6,100,000/230,000
TPH (mg/kg)																
TPH as Gasoline	<.28	<.28	<.29	<.28	<.29	<.30	<.28	<.28	<.29	<.26	<.27	<.28	<.26	<.28	<.3	100 (4)
TPH as Kerosene	<11	<11	<12	<11	<11	<12	<11	<11	<12	<10	<11	<11	<10	<11	<12	100
TPH as Diesel Fuel	<11	<11	<12	<11	<11	<12	<11	<11	<12	<10	<11	<11	<10	<11	<12	100
TPH as Heavy Oils	<37	<37	<38	<36	<38	<40	<37	<37	<38	<34	<36	<36	<35	<37	<39	100
TPH as Fuel Oil	<37	<37	<38	<36	<38	<40	<37	<37	<38	<34	<36	<36	<35	<37	<39	100
Total Metals (mg/kg)																
Aluminum	420K	350K	360K	NT(3)	NT	NT	NT	NT	NT	NT	NT	NT	850K	770K	590K	100,000/7,800
Arsenic	<1.1	<1.1	<1.2	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.5**	<1.1	<1.2	3.8/0.43
Barium	3.9	2.5	3.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	9.0	8.4	8.4	14,000/550
Calcium	71	<58	<57	NT	NT	NT	NT	NT	NT	NT	NT	NT	150	260	99	-
Chromium	1.7	1.9	6.7	NT	NT	NT	NT	NT	NT	NT	NT	NT	2.3	3.1	4.1	610/23
Cobalt	<1.1	<1.1	<1.2	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.1	<1.1	<1.2	4,100/160
Copper	3.5	<2.8	<2.9	NT	NT	NT	NT	NT	NT	NT	NT	NT	5.7	3.8	<3.0	8,200/310
Iron	1200K	740K	1100K	NT	NT	NT	NT	NT	NT	NT	NT	NT	3,200K	3,200K	1,300K	120,000/4,700
Lead	7	3.6	4.8	NT	NT	NT	NT	NT	NT	NT	NT	NT	33K	12	7	1,200/400
Magnesium	88	<57	<58	NT	NT	NT	NT	NT	NT	NT	NT	NT	100	86	69	-
Manganese	10	6.7	9.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	34	26	11	4,100/160
Mercury	<0.011	<0.011	<0.012	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 0.011	<0.011	<0.012	-
Nickel	<4.5	<4.5	<4.7	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 4.2	< 4.4	< 4.8	4,100,000/160,000
Potassium	<110	<110	120	NT	NT	NT	NT	NT	NT	NT	NT	NT	<110	<110	<120	-
Sodium	< 57	< 57	< 58	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 52	< 56	< 60	-
Vanadium	1.8	1.5	1.4	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.1	2.2	2.1	1,400/55
Zinc	18	5.9	6.6	NT	NT	NT	NT	NT	NT	NT	NT	NT	14	14	13	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Industrial/Residential Soils
(2) BDL - Below detection limit
(3) NT - Not tested
(4) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value
D - Concentration from secondary dilution
E - Concentration exceeded linear range of calibration
K - Representative value may be biased high

TABLE 2-3
SOIL RESULTS - FTA SITE

Parameters	SB04-006			SB04-007			SB04-008			SB04-009			SB04-010			EPA RBC Criteria(1)
	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	
VOCs (ug/kg)																
Acetone	<26	27J	<29	<26	320D	170J	<27	47J	53J	<27	110J	36J	<27	<26	79J	20,000,000/780,000
Methylene Chloride	<5.3	<5.4	<5.7	<5.2	<5.3	<5.6	<5.4	<5.3	<5.5	<5.4	3.1 J	5.6 J	<5.4	<5.3	<5.7	760,000/85,000
Methyl ethyl ketone	<26	48J	<29	<26	<26	<28	<27	<26	<27	<27	35J	57J	<27	<26	<28	100,000,000/4,700,000
Styrene	<5.3	<5.4	<5.7	<5.2	<5.3	<5.6	<5.4	<5.3	<5.5	<5.4	2 J	<5.4	<5.4	<5.3	<5.7	41,000,000/1,600,000
Toluene	<5.3	11	<5.7	<5.2	35	31	34	17	15	18	7.1	<5.4	<5.4	8.6	6.3	41,000,000/1,600,000
Xylenes	<5.3	<5.4	<5.7	<5.2	<5.3	<5.6	<5.4	<5.3	<5.5	<5.4	<5.4	<5.4	<5.4	<5.3	<5.7	100,000,000/16,000,000
SVOCs (ug/kg)																
Benzo(b)fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7,800/870
Benzo(k)fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78,000,8,700
Bis(2-EH)phthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	410,000/46,000
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	780,000/87,000
Di-n-butylphthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1,300	BDL	BDL	BDL	20,000,000/780,000
Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8,200,000/310,000
Naphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	45	BDL	BDL	BDL	4,100,000/1,600
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6,100,000/230,000
TPH (mg/kg)																
TPH as Gasoline	<.26	<.27	<.27	<.26	<.26	<.28	<.27	<.26	<.27	<.27	<.26	<.27	<.27	<.26	<.28	100 (4)
TPH as Kerosene	<11	<11	<11	<10	<10	<11	<11	<10	<11	<11	<10	<11	<11	<10	<11	100
TPH as Diesel Fuel	<11	<11	<11	<10	<10	<11	<11	<10	<11	<11	<10	<11	<11	<10	<11	100
TPH as Heavy Oils	<35	<35	<38	<34	<34	<37	<35	<34	<36	<36	<34	<36	<35	<35	<37	100
TPH as Fuel Oil	<35	<35	<38	<34	<34	<37	<35	<34	<36	<36	<34	<36	<35	<35	<37	100
Total Metals (mg/kg)																
Aluminum	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	980K	450K	350K	100,000/7,800
Arsenic	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.6**	**1.5**	**1.2**	3.8/0.43
Barium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	12	3.3	2.2	14,000/550
Calcium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	370	85	<57	-
Chromium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.1	1.8	2.7	610/23
Cobalt	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 1.1	< 1.1	< 1.1	4,100/160
Copper	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	4.3	<2.6	<2.8	8,200/310
Iron	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	2100K	940K	960K	120,000/4,700
Lead	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	33K	9.5K	3.6K	1,200/400
Magnesium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	190	55	<57	-
Manganese	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	25	8.2	7.2	4,100/160
Mercury	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.011	<.011	<.011	-
Nickel	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 4.3	< 4.2	< 4.5	4,100,000/160,000
Potassium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	160	<110	<110	-
Sodium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 54	< 53	< 57	-
Vanadium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.7	1.9	1.3	1,400/55
Zinc	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	22	8.3	5.9	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Industrial/Residential Soils
(2) BDL - Below detection limit
(3) NT - Not tested
(4) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value
D - Concentration from secondary dilution
E - Concentration exceeded linear range of calibration
K - Representative value may be biased high

TABLE 2-3
SOIL RESULTS - FTA SITE

Parameters	SB04-011			SB06-012			SB04-013			SB04-014			SB04-015			EPA RBC Criteria(1)
	0 to 1 ft	2 to 4 ft	6 to 8ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	
VOCs (ug/kg)																
Acetone	<35	210J	120J	<26	150D	36	140J	1500E	420D	<26	150J	60J	<26	700D	210J	20,000,000/780,000
Methylene Chloride	<6.9	<5.4	<5.5	<5.2	<5.3	<5.7	<5.3	<5.4	<5.6	<5.3	<5.2	<5.6	<5.2	<5.2	<5.6	760,000/85,000
Methyl ethyl ketone	<35	<27	<27	<26	<26	<29	<26	<27	<28	<26	<26	<28	<26	<26	<28	100,000,000/4,700,000
Styrene	<6.9	<5.4	<5.5	<5.2	<5.3	<5.7	<5.3	<5.4	<5.6	<5.3	<5.2	<5.6	<5.2	<5.2	<5.6	41,000,000/1,600,000
Toluene	19	31	18	24	55	17	21	<5.4	13	20	34	5.8	140	<5.2	<5.6	41,000,000/1,600,000
Xylenes	<6.9	<5.4	<5.5	<5.2	<5.3	<5.7	<5.3	<5.4	<5.6	<5.3	<5.2	<5.6	<5.2	<5.2	<5.6	100,000,000/16,000,000
SVOCs (ug/kg)																
Benzo(b)fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7,800/870
Benzo(k)fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78,000,8,700
Bis(2-EH)phthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	410,000/46,000
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	780,000/87,000
Di-n-butylphthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20,000,000/780,000
Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8,200,000/310,000
Naphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4,100,000/1,600
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6,100,000/230,000
TPH (mg/kg)																
TPH as Gasoline	<.35	<.27	<.27	<.26	<.26	<.29	<.26	<.27	<.28	<.26	<.26	<.28	<.26	<.26	<.28	100 (4)
TPH as Kerosene	<14	<11	<11	<10	<10	<11	<10	<11	<11	<10	<10	<11	<10	<10	<11	100
TPH as Diesel Fuel	<14	<11	<11	<10	<10	<11	<10	<11	<11	<10	<10	<11	<10	<10	<11	100
TPH as Heavy Oils	<45	<35	<36	<34	<35	<38	<35	<36	<37	<34	<34	<36	<34	<34	<37	100
TPH as Fuel Oil	<45	<35	<36	<34	<35	<38	<35	<36	<37	<34	<34	<36	<34	<34	<37	100
Total Metals (mg/kg)																
Aluminum	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	490K	610	250K	100,000/7,800
Arsenic	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.2**	**0.98**	**1.4**	3.8/0.43
Barium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	8	3	2.6	14,000/550
Calcium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<52	37	<56	-
Chromium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	5.8	14	2.4	610/23
Cobalt	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 1.0	0.44 J	< 1.1	4,100/160
Copper	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	13	0.63 J	<2.8	8,200/310
Iron	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**5,400J**	940J	890J	120,000/4,700
Lead	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	15K	6.7K	1.8K	1,200/400
Magnesium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	62	44	<56	-
Manganese	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	32	8.9	5.7	4,100/160
Mercury	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 0.01	0.20	< 0.011	-
Nickel	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 4.2	0.57 J	< 4.5	4,100,000/160,000
Potassium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 100	27 J	< 110	-
Sodium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 52	9.9	< 56	-
Vanadium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.8	2.9	3.7	1,400/55
Zinc	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	15	4.2	2.3	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Industrial/Residential Soils
(2) BDL - Below detection limit
(3) NT - Not tested
(4) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value
D - Concentration from secondary dilution
E - Concentration exceeded linear range of calibration
K - Representative value may be biased high

TABLE 2-3
SOIL RESULTS - FTA SITE

Parameters	SB04-016			SB04-017			SB04-018			SB04-019			SB04-020			EPA RBC Criteria(1)
	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	
VOCs (ug/kg)																
Acetone	<5.4	130J	140J	<26	4400D	1700E	<26	<29	<27	<26	190J	<28	<26	<26	<32	20,000,000/780,000
Methylene Chloride	5 J	<5.6	<5.4	<5.3	<5.4	<5.4	<5.3	<5.7	<5.4	6.4	<5.3	<5.6	<5.2	<5.1	<6.4	760,000/85,000
Methyl ethyl ketone	<27	<28	<27	<26	<27	<27	<26	<29	<27	<26	<26	<28	<26	<26	<32	100,000,000/4,700,000
Styrene	3 J	<5.6	<5.4	<5.3	<5.4	<5.4	<5.3	<5.7	<5.4	<5.3	<5.3	<5.6	<5.2	<5.1	<6.4	41,000,000/1,600,000
Toluene	85	6.9	9.1	8.3	11	<5.4	20	9.3	6.4	21	<5.3	13	15	12	22	41,000,000/1,600,000
Xylenes	7	<5.6	<5.4	<5.3	<5.4	<5.4	<5.3	<5.7	<5.4	<5.3	<5.3	<5.6	<5.2	<5.1	<6.4	100,000,000/16,000,000
SVOCs (ug/kg)																
Benzo(b)fluoranthene	97 J	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7,800/870
Benzo(k)fluoranthene	86 J	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78,000,8,700
Bis(2-EH)phthalate	110 J	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	410,000/46,000
Chrysene	94 J	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	780,000/87,000
Di-n-butylphthalate	150 JB	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20,000,000/780,000
Fluoranthene	75 J	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8,200,000/310,000
Naphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4,100,000/1,600
Pyrene	64 J	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6,100,000/230,000
TPH (mg/kg)																
TPH as Gasoline	<.27	<.28	<.27	<.26	<.27	<.27	<.26	<.29	<.27	<.26	<.26	<.28	<.26	<.26	<.32	100 (4)
TPH as Kerosene	<11	<11	<11	<10	<11	<11	<11	<11	<11	<520	<52	<11	<10	<10	<13	100
TPH as Diesel Fuel	<11	<11	<11	<10	<11	<11	<11	<11	<11	<520	<52	<11	<10	<10	<13	100
TPH as Heavy Oils	<35	<37	<36	<34	<35	<35	<35	<38	<36	**5,300**	**300**	48	<34	<34	<42	100
TPH as Fuel Oil	<35	<37	<36	<34	<35	<35	<35	<38	<36	<1700	<170	<36	<34	<34	<42	100
Total Metals (mg/kg)																
Aluminum	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	640K	420K	NT	100,000/7,800
Arsenic	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.4**	**1.2**	NT	3.8/0.43
Barium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	9.2	5.1	NT	14,000/550
Calcium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	150	190	NT	-
Chromium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	2.5	2.2	NT	610/23
Cobalt	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 1.0	< 1.0	NT	4,100/160
Copper	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.2	<2.6	NT	8,200/310
Iron	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1600J	1200J	NT	120,000/4,700
Lead	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	31K	12K	NT	1,200/400
Magnesium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	120	<100	NT	-
Manganese	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	19	12	NT	4,100/160
Mercury	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.013	< 0.01	NT	-
Nickel	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 4.1	< 4.1	NT	4,100,000/160,000
Potassium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<100	<100	NT	-
Sodium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	< 52	< 51	NT	-
Vanadium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.1	2.2	NT	1,400/55
Zinc	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	22	11	NT	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Industrial/Residential Soils
(2) BDL - Below detection limit
(3) NT - Not tested
(4) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value
D - Concentration from secondary dilution
E - Concentration exceeded linear range of calibration
K - Representative value may be biased high

TABLE 2-3
SOIL RESULTS - FTA SITE

Parameters	SB04-021			SB04-022			SS04-023	SS04-024	SS04-025	SS04-026	SS04-027	SS04-028	EPA RBC Criteria(1)
	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	0 to 1 ft	0 to 1 ft	0 to 1 ft	0 to 1 ft	0 to 1 ft	
VOCs (ug/kg)													
Acetone	<27	<26	<26	<26	18000DJ	480DJ	<29	<27	134	<26	<26	<26	20,000,000/780,000
Methylene Chloride	<5.5	<5.2	<5.3	<5.2	<5.3	<5.3	<5.7	<5.5	<5.7	<5.3	<5.3	<5.3	760,000/85,000
Methyl ethyl ketone	<27	<5.2	<26	<26	<26	<26	<29	<27	<29	<26	<26	<26	100,000,000/4,700,000
Styrene	<5.5	<5.2	<5.3	<5.2	<5.3	<5.3	<5.7	<5.5	<5.7	<5.3	<5.3	<5.3	41,000,000/1,600,000
Toluene	19	<5.2	16	22	17	7	13	40	18	17	39J	12	41,000,000/1,600,000
Xylenes	<5.5	<5.2	<5.3	<5.2	<5.3	<5.3	<5.7	<5.5	<5.7	<5.3	<5.3	<5.3	100,000,000/16,000,000
SVOCs (ug/kg)													
Benzo(b)fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7,800/870
Benzo(k)fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78,000,8,700
Bis(2-EH)phthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	410,000/46,000
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	780,000/87,000
Di-n-butylphthalate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20,000,000/780,000
Fluoranthene	BDL	BDL	BDL	650	1100	600	BDL	BDL	BDL	BDL	BDL	BDL	8,200,000/310,000
Naphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4,100,000/1,600
Pyrene	BDL	BDL	BDL	720	700	440	BDL	BDL	BDL	BDL	BDL	BDL	6,100,000/230,000
TPH (mg/kg)													
TPH as Gasoline	<.27	<.26	<.26	<.26	<.26	<.26	<.29	<.27	<.29	<.26	<.26	<.26	100 (4)
TPH as Kerosene	<11	<10	<10	<10	<10	<10	<11	<11	<11	<11	<11	<11	100
TPH as Diesel Fuel	<11	<10	<10	<10	<10	<10	<11	<11	<11	<11	<11	<11	100
TPH as Heavy Oils	48	<34	<35	66	**150**	95	<38	<36	<38	<35	<35	<35	100
TPH as Fuel Oil	<36	<34	<35	<34	<34	<34	<38	<38	<38	<35	<35	<35	100
Total Metals (mg/kg)													
Aluminum	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	100,000/7,800
Arsenic	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	3.8/0.43
Barium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	14,000/550
Calcium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	-
Chromium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	610/23
Cobalt	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	4,100/160
Copper	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	8,200/310
Iron	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	120,000/4,700
Lead	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1,200/400
Magnesium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	-
Manganese	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	4,100/160
Mercury	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	-
Nickel	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	4,100,000/160,000
Potassium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	-
Sodium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	-
Vanadium	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1,400/55
Zinc	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Industrial/Residential Soils
(2) BDL - Below detection limit
(3) NT - Not tested
(4) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value
D - Concentration from secondary dilution
E - Concentration exceeded linear range of calibration
K - Representative value may be biased high

TABLE 2-3
SOIL RESULTS (2000 Sampling) - FTA SITE

Parameters	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	EPA RBC Criteria(1)
	0 to 6 in.	0 to 6 in.	0 to 6 in.	0 to 6 in.	0 to 6 in.	0 to 6 in.	0 to 6 in.	0 to 6 in.	
PCBs (ug/kg)									
Aroclor-1016	< 36	< 35	< 34	< 35	< 36	< 37	< 36	< 40	82,000/5,500
Aroclor-1221	< 73	< 70	< 70	< 72	< 73	< 74	< 74	< 82	2,900/320
Aroclor-1232	< 36	< 35	< 34	< 35	< 36	< 37	< 36	< 40	2,900/320
Aroclor-1242	< 36	< 35	< 34	< 35	< 36	< 37	< 36	< 40	2,900/320
Aroclor-1248	< 36	< 35	< 34	< 35	< 36	< 37	< 36	< 40	2,900/320
Aroclor-1254	< 36	< 35	< 34	< 35	< 36	< 37	< 36	< 40	2,900/320
Aroclor-1260	< 36	< 35	< 34	< 35	< 36	< 37	< 36	< 40	2,900/320
Pesticides (ug/kg)									
Aldrin	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	340/38
alpha-BHC	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	910/100
beta-BHC	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	3,200/350
delta-BHC	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	-
gamma-BHC (Lindane)	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	4,400/490
alpha-Chlordane	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	0.36 JP	< 1.8	< 1.7	16,000/1,800
gamma-Chlordane	< 1.8	< 1.7	< 8.8	0.30 J	< 1.8	< 1.8	0.84 J	0.45 J	16,000/1,800
DDD	< 3.4	< 3.4	< 17	< 3.3	< 3.4	< 3.5	< 3.5	< 3.3	24,000/2,700
DDE	0.37 J	0.72 J	9.0 J	0.61 J	< 3.4	0.58 J	2.6 J	0.91 J	17,000/1,900
DDT	0.90 J	1.2 J	24	1.7 J	1.5 J	1.8 J	7.8	2.8 J	17,000/1,900
Dieldrin	< 3.4	< 3.4	< 17	< 3.3	< 3.4	< 3.5	< 3.5	< 3.3	360/40
Endosulfan I	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	1,200,000/47,000
Endosulfan II	< 3.4	< 3.4	< 17	< 3.3	< 3.4	< 3.5	< 3.5	< 3.3	1,200,000/47,000
Endosulfan sulfate	< 3.4	< 3.4	< 17	< 3.3	< 3.4	< 3.5	< 3.5	< 3.3	-
Endrin	< 3.4	< 3.4	< 17	< 3.3	< 3.4	< 3.5	< 3.5	< 3.3	61,000/2,300
Endrin aldehyde	< 3.4	< 3.4	< 17	< 3.3	< 3.4	< 3.5	< 3.5	< 3.3	-
Endrin ketone	< 3.4	< 3.4	< 17	< 3.3	< 3.4	< 3.5	< 3.5	< 3.3	-
Heptachlor	< 1.8	< 1.7	< 8.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	1,300/140
Heptachlor epoxide	< 1.8	< 1.7	0.94 JP	< 1.7	< 1.8	< 1.8	< 1.8	< 1.7	630/70
Methoxyclor	< 18	< 17	< 88	< 17	< 18	< 18	< 18	< 17	1,000,000/39,000
Toxaphene	< 180	< 170	< 880	< 170	< 180	< 180	< 180	< 170	5,200/580

Notes:
(1) EPA Region III RBCs for Industrial/Residential Soils (Sept 2001)
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated concentration
P - Greater than 25% difference for detected levels in two GC columns

TABLE 2-4
SEDIMENT RESULTS
FIREFIGHTER TRAINING AREA

Parameters	Sample ID and Results				EPA RBC Criteria(1)
	SD04-001	SD04-002	SD04-003	SD04-004	
VOCs (ug/kg)					
Toluene	180	40	23	93	41,000,000/1,600,000
SVOCs (ug/kg)	BDL(2)	BDL	BDL	BDL	
TPH (mg/kg)					
TPH as Gasoline	< 0.34	< 0.36	< 0.26	< 0.27	100(3)
TPH as Kerosene	< 27	< 14	< 11	< 11	100
TPH as Diesel Fuel	< 27	< 14	< 11	< 11	100
TPH as Heavy Oils	**350**	**180**	< 35	**130**	100
TPH as Fuel Oil	< 89	< 47	< 35	< 35	100
Total Metals (mg/kg)					
Aluminum	7,600 K	560 K	160 K	160 K	100,000/7,800
Arsenic	**2.5**	< 1.4	< 1.1	< 1.1	3.8/0.43
Barium	110	6.5	3.6	2.4	14,000/550
Calcium	120	120	64	77	-
Chromium	21	< 1.4	< 1.1	< 1.1	610/23
Cobalt	2.6	< 1.4	< 1.1	< 1.1	4,100/160
Copper	26	< 3.6	< 2.7	< 2.7	8,200/310
Iron	**17,000 J**	440 J	230 J	280 J	120,000/4,700
Lead	210 K	15 K	7.2 K	4.3 K	1,200/400
Magnesium	960	< 71	< 53	< 54	-
Manganese	42	< 1.4	3.1	1.7	4,100/160
Mercury	0.051	0.017	< 0.011	< 0.011	61/2.3
Nickel	9.4	< 5.7	< 4.3	< 4.3	41,000/1,600
Potassium	260	< 140	< 110	< 110	-
Sodium	180	87	< 53	< 54	-
Thallium	< 1.4	**1.4**	< 1.1	< 1.1	14/0.55
Vanadium	18	2.0	< 1.1	< 1.1	1,400/55
Zinc	76	6	< 2.1	< 2.2	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration for Industrial/Residential Soils (Sept 2001)
(2) BDL - Below detection limit
(3) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria
J - Estimated value
K - Representative value may be biased high

TABLE 2-5
MONITORING WELL GROUNDWATER RESULTS
FIREFIGHTER TRAINING AREA

Parameters	Well ID and Results										EPA RBC Criteria(1)
	4MW-1	4MW-2S	4MW-2D	4MW-3	4MW-4	4MW-5	MW-111	MW-112	MW-113A	MW-114A	
VOCs (ug/l)											
Acetone	<25 / 10 J	<25	<25	<25	28	<25	<25 / <5	<25 / <5	<25	<25 / 15 J	370
Carbon Disulfide	<5 / <5	<5	7.0 J	8.3 J	<5	<5	5.0 J / <5	<5 / <5	<5	<5 / < 5	100
1,1-Dichloroethane	<5 / <5	<5	<5	<5	<5	<5	<5 / <5	<5 / 0.6 J	<5	<5 / 0.86 J	81
Ethylbenzene	<5 / <5	<5	47	<5	<5	<5	<5 / <5	<5 / <5	<5	<5 / < 5	130
Xylenes	<5 / <10	200	25	<5	<5	<5	<5 / <10	<5 / <10	<5	<5 / < 10	1,200
SVOCs (ug/l)											
Naphthalene	<10	11	<10	<10	<10	<10	<10	<10	<10	<10	150
Pest/PCBs	BDL	NT (3)	NT	NT	NT	NT	BDL	BDL	NT	BDL	
TPH (mg/l)											
TPH as Gasoline	<0.05	<0.25	0.66	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.0 (2)
TPH as Diesel Fuel	<0.30	<0.30	**2.0**	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	1.0 (2)
TPH as Heavy Oils	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0 (2)
TPH as Fuel Oil	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0 (2)
TPH as Kerosene	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	1.0 (2)
Total Metals (ug/l)											
Aluminum	17,000 R / 470	7,000 R	NT	NT	NT	NT	NT / 580	670 R / < 6	NT	NT / 920	3,700
Antimony	< 50 / < 2.7	< 50	NT	NT	NT	NT	NT / < 2.7	< 50 / < 2.7	NT	NT / < 2.7	1.5
Arsenic	**10** / < 3	**12**	NT	NT	NT	NT	NT / < 3	< 10 / < 3	NT	NT / **3.4**	0.045
Barium	110 / 18	110	NT	NT	NT	NT	NT / 19	< 10 / 6.1	NT	NT / 13	260
Beryllium	< 5 / < 0.1	< 5	NT	NT	NT	NT	NT / < 0.10	< 5 / < 0.10	NT	NT / < 0.10	73
Cadmium	< 5 / < 0.5	< 5	NT	NT	NT	NT	NT / < 0.50	< 5 / < 0.50	NT	NT / < 0.50	18
Calcium	13,000 / 6,200	18,000	NT	NT	NT	NT	NT / 9,300	15,000 / 19,000	NT	NT / 11,000	-
Chromium	30 / < 0.70	14	NT	NT	NT	NT	NT / < 0.70	< 10 / < 0.70	NT	NT / 1.2	110
Cobalt	< 10 / < 0.9	< 10	NT	NT	NT	NT	NT / < 0.90	< 10 / < 0.90	NT	NT / < 0.90	73
Copper	< 25 / 21	< 25	NT	NT	NT	NT	NT / 4.7	< 25 / 3.1	NT	NT / 1.3	140
Iron	15,000 R / 280	12,000R	NT	NT	NT	NT	NT / 280	1,700 R / 320	NT	NT / **4,100**	2,200
Lead	**52** / 4	12	NT	NT	NT	NT	NT / 2.8	< 5 / < 2.4	NT	NT / < 2.4	15 (4)
Magnesium	3,000 / 980	3,000	NT	NT	NT	NT	NT / 1,200	5,900 / 4,900	NT	NT / 8,700	-
Manganese	**150** / 3.7	**120**	NT	NT	NT	NT	NT / 7.9	12 / 4.2	NT	NT / 24	73
Mercury	< 0.2 / < 0.1	< 0.2	NT	NT	NT	NT	NT / < 0.10	< 0.2 / < 0.10	NT	NT / < 0.10	-
Nickel	< 40 / < 1.1	< 40	NT	NT	NT	NT	NT / < 1.1	< 40 / < 1.1	NT	NT / 2.2	73
Potassium	3400 / 1,300	3,600	NT	NT	NT	NT	NT / 3,000	2,100 / 1,800	NT	NT / 2,600	-
Selenium	10 R / < 3.4	10 R	NT	NT	NT	NT	NT / < 3.4	10 R / < 3.4	NT	NT / < 3.4	18
Silver	< 10 / < 0.5	< 10	NT	NT	NT	NT	NT / < 0.50	< 10 / < 0.50	NT	NT / < 0.50	18
Sodium	5,800 / 5,500	3,800	NT	NT	NT	NT	NT / 7,200	7,700 / 6,700	NT	NT / 36,000	270,000
Thallium	< 10 / < 4.3	< 10	NT	NT	NT	NT	NT / < 4.3	< 10 / < 4.3	NT	NT / < 4.3	2.6
Vanadium	**28** / 0.81	16	NT	NT	NT	NT	NT / < 0.70	< 10 / 1.6	NT	NT / 2.6	26
Zinc	160 / 83	160	NT	NT	NT	NT	NT / 20	< 20 / 18	NT	NT / 73	1,100

TABLE 2-5
MONITORING WELL GROUNDWATER RESULTS
FIREFIGHTER TRAINING AREA

Parameters	Well ID and Results										EPA RBC Criteria(1)
	4MW-1	4MW-2S	4MW-2D	4MW-3	4MW-4	4MW-5	MW-111	MW-112	MW-113A	MW-114A	
Dissolved Metals (ug/l)											
Aluminum	< 200 R / 200	250 R	NT	NT	NT	NT	NT / 410	120 R / 64	NT	NT / 590	3,700
Antimony	< 50 / **3.8**	< 50	NT	NT	NT	NT	NT / < 2.7	< 50 / **5.7**	NT	NT / < 2.7	1.5
Arsenic	< 10 / < 3	< 10	NT	NT	NT	NT	NT / < 3	< 10 / < 3	NT	NT / < 3	0.045
Barium	52 / 17	140	NT	NT	NT	NT	NT / 18	21 / 6.2	NT	NT / 12	260
Beryllium	< 5 / < 0.10	< 5	NT	NT	NT	NT	NT / < 0.10	< 5 / < 0.10	NT	NT / < 0.10	73
Cadmium	< 5 / < 0.50	< 5	NT	NT	NT	NT	NT / < 0.50	< 5 / < 0.50	NT	NT / < 0.50	18
Calcium	12,000 / 5,900	18,000	NT	NT	NT	NT	NT / 8,800	16,000 / 18,000	NT	NT / 10,000	-
Chromium	< 10 / < 0.70	< 10	NT	NT	NT	NT	NT / 1.3	< 10 / 0.99	NT	NT / 1.7	110
Cobalt	< 10 / < 0.90	< 10	NT	NT	NT	NT	NT / < 0.90	< 10 / < 0.90	NT	NT / 1.2	73
Copper	< 25 / 7.9	< 25	NT	NT	NT	NT	NT / 2.7	25 / 2.6	NT	NT / < 0.90	140
Iron	< 50 R / 130	3,600 R	NT	NT	NT	NT	NT / 180	280 R / 140	NT	NT / 2,100	2,200
Lead	< 5 / 4.6	< 5	NT	NT	NT	NT	NT / 4.5	< 5 / < 2.4	NT	NT / < 2.4	15 (4)
Magnesium	1,700 / 920	2,500	NT	NT	NT	NT	NT / 1,100	5,800 / 4,900	NT	NT / 8,400	-
Manganese	< 10 / 2.5	**81**	NT	NT	NT	NT	NT / 6.5	11 / 4.7	NT	NT / 23	73
Mercury	< 0.2 / < 0.10	< 0.2	NT	NT	NT	NT	NT / < 0.10	< 0.2 / < 0.10	NT	NT / < 0.10	-
Nickel	< 40 / < 1.1	< 40	NT	NT	NT	NT	NT / < 1.1	< 40 / < 1.1	NT	NT / 3	73
Potassium	1,700 / 1,300	2,900	NT	NT	NT	NT	NT / 3,000	2,200 / 2,000	NT	NT / 2,600	-
Selenium	< 10 / < 3.4	< 10	NT	NT	NT	NT	NT / < 3.4	< 10 / < 3.4	NT	NT / < 3.4	18
Silver	< 10 / < 0.50	< 10	NT	NT	NT	NT	NT / < 0.50	< 10 / < 0.50	NT	NT / < 0.50	18
Sodium	6,600 / 5,100	4,700	NT	NT	NT	NT	NT / 6,700	8,400 / 6,800	NT	NT / 36,000	270,000
Thallium	< 10 / < 4.3	< 10	NT	NT	NT	NT	NT / < 4.3	< 10 / < 4.3	NT	NT / < 4.3	2.6
Vandium	< 10 / 1.4	< 10	NT	NT	NT	NT	NT / 1.2	< 10 / 1.8	NT	NT / 1.4	26
Zinc	44 / 70	120	NT	NT	NT	NT	NT / 13	21 / 15	NT	NT / 65	1,100
Miscellaneous (mg/l)											
TSS	NT / < 5	NT	NT	NT	NT	NT	NT / < 5	NT / < 5	NT	NT / < 5	-
TDS	NT / 62	NT	NT	NT	NT	NT	NT / 91	NT / 120	NT	NT / 220	-

Notes:
(1) EPA Region III Risk-based Concentration Table Criteria for Tap Water (Sept 2001)
(2) Virginia Groundwater Standard for Petroleum Hydrocarbons
(3) NT - Not tested
(4) USEPA Action Level for Lead in Drinking Water
Result / Result = 1995 sampling result / 2000 sampling result (select wells for VOCs and metals only)
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

R - Data rejected based on data validation results
J - Estimated value

TABLE 2-6
DPT GROUNDWATER RESULTS
FIREFIGHTER TRAINING AREA

Parameters	Sample ID and Results								EPA RBC Criteria(1)
	GW04-016	GW04-017	GW04-018	GW04-019	GW04-020	GW04-021	GW04-022	GW04-023	
VOCs (ug/l)									
Benzene	<5 / <5(2)	<5 / <5	<5	NT (3) / <5	NT / <5	NT / <5	NT / <5	NT / <5	0.32
1,1-DCA	<5	<5	<5	NT	NT	NT	NT	NT	80
cis 1,2-DCE	<5 / <5	<5 / <5	<5	NT / <5	NT / <5	NT / <5	NT / <5	NT / <5	6.1
Tetrachloroethene	<5 / <5	<5 / <5	<5	NT / <5	NT / <5	NT / <5	NT / <5	NT / <5	1.1
1,1,1-TCA	<5	<5	<5	NT	NT	NT	NT	NT	320
Trichloroethene	<5 / <5	<5 / <5	<5	NT / <5	NT / <5	NT / <5	NT / <5	NT / <5	1.6
Vinyl chloride	<10 / 83R	<10 / 6.7R	<10	NT / <5	NT / <5	NT / <5	NT / <5	NT / <5	0.015
SVOCs (ug/l)	BDL (4)	BDL	NT	NT	NT	NT	NT	NT	
TPH (mg/l)									
TPH as Gasoline	<0.05 / <0.5	<0.05 / <0.5	<0.5	NT / <0.5	NT / <0.5	NT / <0.5	NT / <0.5	NT / <0.5	1.0 (5)
TPH as Diesel Fuel	<0.30	<0.30	NT	NT	NT	NT	NT	NT	1.0 (5)
TPH as Heavy Oils	<1.0	<1.0	NT	NT	NT	NT	NT	NT	1.0 (5)
TPH as Fuel Oil	<1.0	<1.0	NT	NT	NT	NT	NT	NT	1.0 (5)
TPH as Kerosene	<0.30	<0.30	NT	NT	NT	NT	NT	NT	1.0 (5)
Total Metals (mg/l)	NT	NT	NT	NT	NT	NT	NT	NT	

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Tap Water
(2) <20 / <10 = Savannah Lab result / Earth Tech on-site GC result
(3) NT - Not tested
(4) BDL - Below detection limit
(5) Virginia Groundwater Standard for Petroleum Hydrocarbons
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

R - rejected value, on-site GC results for vinyl chloride not confirmed by Savannah Lab GC/MS analysis

TABLE 2-6
DPT GROUNDWATER RESULTS
FIREFIGHTER TRAINING AREA

Parameters	Sample ID and Results								EPA RBC Criteria(1)
	GW04-009	GW04-010	GW04-011	GW04-012	GW04-013	GW04-014 (10 ft depth)	GW04-014 (20 ft depth)	GW04-015	
VOCs (ug/l)									
Benzene	<5 / <10 (2)	<5 / <10	<5 / <10	**10 / <10**	<5 / <5	NT(3) / <5	NT / <5	<5 / <10	0.32
1,1-DCA	<5	20J	<5	<5	<5	NT	NT	<5	80
cis 1,2-DCE	<5 / <10	<5 / <10	<5 / <10	<5 / <10	<5 / <5	NT / <5	NT / <5	<5 / <10	6.1
Tetrachloroethene	<5 / <10	<5 / <10	**78J / <10**	<5 / <10	<5 / <5	NT / <5	NT / <5	<5 / <10	1.1
Toluene	< 5	< 5	< 5	20	< 5	NT	NT	< 5	75
1,1,1-TCA	<5	31J	9.4J	<5	<5	NT	NT	<5	320
Trichloroethene	<5 / <10	<5 / <10	<5 / <10	<5 / <10	<5 / <5	NT / <5	NT / <5	<5 / <10	1.6
Vinyl chloride	<10 / <10	<10 / <10	<10 / <10	<10 / <10	<10 / 12 R	NT / 26R	NT / 6.6R	<10 / 12R	0.015
SVOCs (ug/l)									
Bis(2-EH)phthalate	< 10	< 10	< 10	1.0 J	< 10	NT	NT	< 10	4.8
TPH (mg/l)									
TPH as Gasoline	<0.05 / <0.5	<0.05 / <0.5	<0.05 / <0.5	<0.05 / <0.5	<0.05 / <0.5	NT / <0.5	NT / <0.5	<0.05 / <0.5	1.0 (5)
TPH as Diesel Fuel	<0.30	<0.30	<0.30	<0.30	<0.30	NT	NT	<0.30	1.0 (5)
TPH as Heavy Oils	<1.0	<1.0	<1.0	<1.0	<1.0	NT	NT	<1.0	1.0 (5)
TPH as Fuel Oil	<1.0	<1.0	<1.0	<1.0	<1.0	NT	NT	<1.0	1.0 (5)
TPH as Kerosene	<0.30	<0.30	<0.30	<0.30	<0.30	NT	NT	<0.30	1.0 (5)
Total Metals (mg/l)	NT	NT	NT	NT	NT	NT	NT	NT	

Notes:

(1) EPA Region III Risk-based Concentration Criteria for Tap Water

(2) <20 / <10 = Savannah Lab result / Earth Tech on-site GC result

(3) NT - Not tested

(4) Virginia Groundwater Standard for Petroleum Hydrocarbons

Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

R - rejected value, on-site GC results for vinyl chloride not confirmed by Savannah lab GC/MS analysis

J - Estimated value

TABLE 2-6
DPT GROUNDWATER RESULTS - FTA

Parameters	Sample ID and Results								EPA RBC Criteria(1)
	GW04-001	GW04-002	GW04-003	GW04-004	GW04-005	GW04-006	GW04-007	GW04-008	
VOCs (ug/l)									
Acetone	<25	<25	<25	<25	<25	27 J	<25	<25	370
Benzene	<5 / <10(2)	<5 / <5	<5 / <5	<5 / <10	<5 / <10	<5 / <10	<5 / <10	<5 / <10	0.32
cis 1,2-DCE	<5 / <10	<5 / <5	<5 / <5	<5 / <10	<5 / <10	<5 / <10	<5 / <10	<5 / <10	6.1
Tetrachloroethene	<5 / <10	**6.4 / <5**	<5 / <5	<5 / <10	<5 / <10	<5 / <10	<5 / <10	<5 / <10	1.1
Trichloroethene	<5 / <10	<5 / <5	<5 / <5	<5 / <10	<5 / <10	<5 / <10	<5 / <10	<5 / <10	1.6
Vinyl chloride	<10 / <10	<10 / 7R	<10 / 7.4R	<10 / <10	<10 / <10	<10 / >50R	<10 / <10	<10 / <10	0.015
Xylenes	<5	<5	<5	<5	<5	46 J	<5	<5	1,200
SVOCs (ug/l)									
Fluorene	<10	<10	<10	<10	<10	15	<10	<10	24
2-Methylnaphthalene	<10	<10	<10	<10	<10	**120**	<10	<10	12
Naphthalene	<10	<10	<10	<10	<10	**60**	<10	<10	0.65
Phenanthrene	<10	<10	<10	<10	<10	18	<10	<10	-
TPH (mg/l)									
TPH as Gasoline	<0.05 / <0.5	<0.05 / <0.5	<0.05 / <0.5	<0.05 / <0.5	<0.05 / <0.5	**2.0 / 13.0**	<0.05 / <0.5	<0.05 / <0.5	1.0 (3)
TPH as Diesel Fuel	<0.30	<0.30	<0.30	<0.30	<0.30	**7.2**	<0.30	<0.30	1.0 (3)
TPH as Heavy Oils	<1.0	<1.0	<1.0	<1.0	**1.4**	<5.0	<1.0	<1.0	1.0 (3)
TPH as Fuel Oil	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<1.0	<1.0	1.0 (3)
TPH as Kerosene	<0.30	<0.30	<0.30	<0.30	<0.30	<1.5	<0.30	<0.30	1.0 (3)
Total Metals (ug/l)									
Aluminum	**4,700 J**	**11,000 J**	NT (4)	NT	NT	NT	**3,600**	**5,100**	3,700
Barium	24 J	55	NT	NT	NT	NT	40	110	260
Calcium	3,200	4,200	NT	NT	NT	NT	3,200	3,900	-
Chromium	17	13	NT	NT	NT	NT	19	< 10	110
Copper	< 25	32	NT	NT	NT	NT	< 25	< 25	140
Iron	**4,300**	**4,800**	NT	NT	NT	NT	**4,100**	**4,900**	2,200
Lead	**18**	**23**	NT	NT	NT	NT	6.1	**24**	15 (5)
Magnesium	920	1,300	NT	NT	NT	NT	1,500	870	-
Manganese	50	68	NT	NT	NT	NT	53	60	73
Potassium	1,600	2,100	NT	NT	NT	NT	3,100	1,700	-
Sodium	2,100	2,900	NT	NT	NT	NT	3,500	2,600	270,000 (6)
Zinc	190	190	NT	NT	NT	NT	190	61	1,100

Notes:

(2) <20 / <10 = Savannah Lab result / Earth Tech on-site GC result
(3) Virginia Groundwater Standard for Petroleum Hydrocarbons
(4) NT - Not tested
(5) USEPA Action Level for Drinking Water
(6) Virginia Groundwater Quality Standard
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

R - Rejected value, on-site GC results for vinyl chloride not confirmed by Savannah Lab GC/MS analysis
J - Estimated value

TABLE 2-7
SOIL RESULTS - AUTO CRAFT SITE

Parameters	SB07-001			SB07-002			SB07-003			EPA RBC Criteria(1)
	0 to 1 ft	5 to 7 ft	9 to 11 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	5 to 7 ft	9 to 11 ft	
VOCs (ug/kg)										
Acetone	<26	<26	<26	<27	31	<27	<26	<26	<27	20,000,000/780,000
Ethylbenzene	<5.2	1.6 J	<5.2	<5.5	<5.2	<5.4	<5.2	<5.3	<5.4	20,000,000/780,000
Methylene Chloride	41	<5.2	<5.2	<5.5	<5.2	<5.4	<5.2	<5.3	<5.4	760,000/85,000
Methyl ethyl ketone	55	<26	<26	<27	58J	69	<26	<26	100	100,000,000/4,700,000
Styrene	<5.2	4.8 J	<5.2	<5.5	<5.2	<5.4	<5.2	<5.3	<5.4	41,000,000/1,600,000
Toluene	11	7 J	<5.2	34	<5.2	12	7.9	<5.3	<5.4	41,000,000/1,600,000
Trichloroethene	33	<5.2	<5.2	<5.5	<5.2	<5.4	<5.2	<5.3	<5.4	520,000/58,000
Xylenes	<5.2	16	<5.2	<5.5	<5.2	<5.4	<5.2	<5.3	<5.4	41,000,000/1,600,000
SVOCs (ug/kg)										
Acenaphthene	440	70 J	<340	<360	<340	<350	<340	<350	<360	12,000,000/470,000
Anthracene	<340	250 J	<340	<360	<340	<350	<340	<350	<360	61,000,000/2,300,000
Benzo(a)anthracene	**2,500**	620 J	<340	<360	<340	<350	<340	<350	<360	7,800/870
Benzo(b)fluoranthene	**4,100**	**1,100**	<340	<360	<340	<350	<340	<350	<360	7,800/870
Benzo(k)fluoranthene	490	770	<340	<360	<340	<350	<340	<350	<360	78,000/8,700
Benzo(g,h,i)perylene	2,000	<340	<340	<360	<340	<350	<340	<350	<360	-
Benzo(a)pyrene	**3,400**	**940**	<340	<360	<340	<350	<340	<350	<360	780/87
Butylbenzylphthalate	<340	230 J	<340	<360	<340	<350	<340	<350	<360	41,000,000/1,600,000
Chrysene	2,000	520 J	<340	<360	<340	<350	<340	<350	<360	780,000/88,000
Dibenz(a,h)anthracene	<340	80 J	<340	<360	<340	<350	<340	<350	<360	780/87
Fluoranthene	5,800	900	<340	<360	<340	<350	<340	<350	<360	8,200,000/310,000
Fluorene	<340	65 J	<340	<360	<340	<350	<340	<350	<360	8,200,000/310,000
Indeno(1,2,3-cd)pyrene	**1,500**	260 J	<340	<360	<340	<350	<340	<350	<360	7,800/870
Naphthalene	<340	8.2 J	<340	<360	<340	<350	<340	<350	<360	4,100,000/160,000
Phenanthrene	1,300	890	<340	<360	<340	<350	<340	<350	<360	-
Pyrene	11,000E	1,600	<340	<360	<340	<350	<340	<350	<360	6,100,000/230,000
TPH (mg/kg)										
TPH as Gasoline	<0.26	<0.26	<0.26	<0.27	<0.26	<0.27	<0.26	<0.26	<0.27	100(3)
TPH as Kerosene	<100	<10	<10	<11	<10	<11	<10	<10	<11	100
TPH as Diesel Fuel	<100	<10	<10	<11	<10	<11	<10	<10	<11	100
TPH as Heavy Oils	<340	**160**	<34	<36	<34	<36	**220**	<35	<36	100
TPH as Fuel Oil	<340	<34	<34	<36	<34	<36	<34	<35	<36	100

TABLE 2-7
SOIL RESULTS - AUTO CRAFT SITE

Parameters	SB07-001			SB07-002			SB07-003			EPA RBC Criteria(1)
	0 to 1 ft	5 to 7 ft	9 to 11 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	5 to 7 ft	9 to 11 ft	
Total Metals (mg/kg)										
Aluminum	NT(2)	NT	500K	NT	NT	NT	NT	NT	NT	100,000/7,800
Arsenic	NT	NT	**1.1**	NT	NT	NT	NT	NT	NT	3.8/0.43
Barium	NT	NT	2.8	NT	NT	NT	NT	NT	NT	14,000/550
Beryllium	NT	NT	< 0.52	NT	NT	NT	NT	NT	NT	410/16
Cadmium	NT	NT	< 0.52	NT	NT	NT	NT	NT	NT	100/3.9
Calcium	NT	NT	84	NT	NT	NT	NT	NT	NT	-
Chromium	NT	NT	4.0	NT	NT	NT	NT	NT	NT	610/23
Cobalt	NT	NT	<1.0	NT	NT	NT	NT	NT	NT	4,100/160
Copper	NT	NT	<2.6	NT	NT	NT	NT	NT	NT	8,200/310
Iron	NT	NT	1,300L	NT	NT	NT	NT	NT	NT	120,000/4,700
Lead	NT	NT	1.7J	NT	NT	NT	NT	NT	NT	1,200/400
Magnesium	NT	NT	130	NT	NT	NT	NT	NT	NT	-
Manganese	NT	NT	14	NT	NT	NT	NT	NT	NT	4,100/160
Mercury	NT	NT	<0.01	NT	NT	NT	NT	NT	NT	-
Nickel	NT	NT	< 4.1	NT	NT	NT	NT	NT	NT	4,100/160
Potassium	NT	NT	130	NT	NT	NT	NT	NT	NT	-
Sodium	NT	NT	<52	NT	NT	NT	NT	NT	NT	-
Vanadium	NT	NT	2.3	NT	NT	NT	NT	NT	NT	1,400/55
Zinc	NT	NT	4.5	NT	NT	NT	NT	NT	NT	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Industrial/Residential Soils
(2) NT - Not tested
(3) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value
K - Reported value may be biased high
L - Reported value may be biased low

TABLE 2-7
SOIL RESULTS - AUTO CRAFT SITE

Parameters	SB07-004			SB07-005			SB07-006			EPA RBC Criteria(1)
	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	9 to 11 ft	
VOCs (ug/kg)										
Acetone	<27	<26	<26	<26	<26	<26	<26	<26	<26	20,000,000/780,000
Ethylbenzene	<5.4	<5.2	<5.3	<5.3	<5.3	<5.3	<5.2	<5.2	<5.2	20,000,000/780,000
Methylene Chloride	<5.4	<5.2	<5.3	<5.3	<5.3	<5.3	<5.2	<5.2	<5.2	760,000/85,000
Methyl ethyl ketone	<27	<26	<26	<26	<26	<26	<26	<26	<26	100,000,000/4,700,000
Styrene	<5.4	<5.2	<5.3	<5.3	<5.3	<5.3	<5.2	<5.2	6.0	41,000,000/1,600,000
Toluene	13	8.5	14	13	<5.3	<5.3	10	<5.2	14	41,000,000/1,600,000
Trichloroethene	<5.4	<5.2	<5.3	<5.3	<5.3	<5.3	<5.2	<5.2	<5.2	520,000/58,000
Xylenes	<5.4	<5.2	<5.3	<5.3	<5.3	<5.3	<5.2	<5.2	<5.2	41,000,000/1,600,000
SVOCs (ug/kg)										
Acenaphthene	<360	<340	<350	<350	<350	<350	<340	<340	<340	12,000,000/470,000
Anthracene	<360	<340	<350	<350	<350	<350	<340	<340	<340	61,000,000/2,300,000
Benzo(a)anthracene	<360	<340	<350	<350	<350	<350	<340	<340	<340	7,800/870
Benzo(b)fluoranthene	<360	<340	<350	<350	<350	<350	<340	<340	<340	7,800/870
Benzo(k)fluoranthene	<360	<340	<350	<350	<350	<350	<340	<340	<340	78,000/8,700
Benzo(g,h,i)perylene	<360	<340	<350	<350	<350	<350	<340	<340	<340	-
Benzo(a)pyrene	<360	<340	<350	<350	<350	<350	<340	<340	<340	780/87
Butylbenzylphthalate	550	<340	<350	<350	<350	<350	<340	<340	<340	41,000,000/1,600,000
Chrysene	<360	<340	<350	<350	<350	<350	<340	<340	<340	780,000/88,000
Dibenz(a,h)anthracene	<360	<340	<350	<350	<350	<350	<340	<340	<340	780/87
Fluoranthene	<360	<340	<350	<350	<350	<350	<340	<340	<340	8,200,000/310,000
Fluorene	<360	<340	<350	<350	<350	<350	<340	<340	<340	8,200,000/310,000
Indeno(1,2,3-cd)pyrene	<360	<340	<350	<350	<350	<350	<340	<340	<340	7,800/870
Naphthalene	<360	<340	<350	<350	<350	<350	<340	<340	<340	4,100,000/160,000
Phenanthrene	<360	<340	<350	<350	<350	<350	<340	<340	<340	-
Pyrene	<360	<340	<350	<350	<350	<350	<340	<340	<340	6,100,000/230,000
TPH (mg/kg)										
TPH as Gasoline	<0.27	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	100(3)
TPH as Kerosene	<11	<10	<10	<53	<11	<10	<52	<21	<10	100
TPH as Diesel Fuel	<11	<10	<10	<53	<11	<10	<52	<21	<10	100
TPH as Heavy Oils	<35	<34	<35	**370**	<35	<35	**390**	**330**	72	100
TPH as Fuel Oil	<35	<34	<35	<180	<35	<35	<170	<69	<34	100

TABLE 2-7
SOIL RESULTS - AUTO CRAFT SITE

Parameters	SB07-004			SB07-005			SB07-006			EPA RBC Criteria(1)
	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	6 to 8 ft	0 to 1 ft	2 to 4 ft	9 to 11 ft	
Total Metals (mg/kg)										
Aluminum	5200K	940	NT	NT	440K	NT	NT	NT	NT	100,000/7,800
Arsenic	**1.3**	**1.5**	NT	NT	**1.1**	NT	NT	NT	NT	3.8/0.43
Barium	82	7.9	NT	NT	5.7	NT	NT	NT	NT	14,000/550
Beryllium	< 0.54	0.058	NT	NT	< 0.53	NT	NT	NT	NT	410/16
Cadmium	< 0.54	0.18	NT	NT	< 0.53	NT	NT	NT	NT	100/3.9
Calcium	1200	200	NT	NT	<53	NT	NT	NT	NT	-
Chromium	8.6	4.1 J	NT	NT	2.3	NT	NT	NT	NT	610/23
Cobalt	4.4	0.79	NT	NT	<1.1	NT	NT	NT	NT	4,100/160
Copper	18	5.0	NT	NT	<2.7	NT	NT	NT	NT	8,200/310
Iron	**9,100 L**	2,200	NT	NT	1200L	NT	NT	NT	NT	120,000/4,700
Lead	95J	11J	NT	NT	8.4J	NT	NT	NT	NT	1,200/400
Magnesium	2400	230	NT	NT	96	NT	NT	NT	NT	-
Manganese	**170**	25	NT	NT	10	NT	NT	NT	NT	4,100/160
Mercury	0.022	0.10	NT	NT	0.011	NT	NT	NT	NT	-
Nickel	4.8	1.1	NT	NT	< 4.2	NT	NT	NT	NT	4,100/160
Potassium	2700	180	NT	NT	<110	NT	NT	NT	NT	-
Sodium	64.0	20	NT	NT	<53	NT	NT	NT	NT	-
Vanadium	18.0	4.4	NT	NT	1.8	NT	NT	NT	NT	1,400/55
Zinc	64.0	14.0	NT	NT	5.4	NT	NT	NT	NT	61,000/2,300

Notes:
(1) EPA Region III Risk-based Concentration Criteria for Industrial/Residential Soils
(2) NT - Not tested
(3) Virginia DEQ Petroleum Program Reporting Level
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value
K - Reported value may be biased high
L - Reported value may be biased low

TABLE 2-8

MONITORING WELL GROUNDWATER RESULTS
AUTO CRAFT BUILDING AREA

Parameters	Well ID and Results					EPA RBC Criteria(1)
	7MW-1	7MW-2	7MW-3	MW-119	MW-120	
VOCs (ug/l)						
Chloroform	NT(2)	<5	**11**	<5	<5	0.15
SOCs (ug/l)	NT	BDL(3)	BDL	BDL	BDL	
TPH (mg/l)						
TPH as Gasoline	NT	<0.05	<0.05	<0.05	<0.05	1.0(4)
TPH as Diesel Fuel	NT	<0.30	<0.30	<0.30	<0.30	1.0(4)
TPH as Heavy Oils	NT	<1.0	<5.0	<1.0	<1.0	1.0(4)
TPH as Fuel Oil	NT	<1.0	<5.0	<1.0	<1.0	1.0(4)
TPH as Kerosene	NT	<0.30	<1.5	<0.30	<0.30	1.0(4)
Total Metals (ug/l)						
Aluminum	NT	NT	240	540	NT	3,700
Barium	NT	NT	12	< 10	NT	260
Calcium	NT	NT	6,400	30,000	NT	-
Iron	NT	NT	**9,700**	790	NT	2,200
Magnesium	NT	NT	5,200	3,700	NT	-
Manganese	NT	NT	**91**	< 10	NT	73
Potassium	NT	NT	1,600	2,600	NT	-
Sodium	NT	NT	16,000	12,000	NT	-
Zinc	NT	NT	< 20	22	NT	1,100
Dissolved Metals (ug/l)						
Calcium	NT	NT	5,800	31,000	NT	-
Iron	NT	NT	**8,100**	110	NT	2,200
Magnesium	NT	NT	4,600	3.7	NT	-
Manganese	NT	NT	**80**	< 10	NT	73
Potassium	NT	NT	15,000	2,100	NT	-
Sodium	NT	NT	15,000	11,000	NT	-

Notes:

(1) EPA Region III Risk-based Concentration Criteria for Tap Water

(2) NT - Not tested

(3) BDL - Below detection limit

(4) Virginia Groundwater Standard for Petroleum Hydrocarbons

Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

J - Estimated value

TABLE 2-9
DPT GROUNDWATER RESULTS
AUTO CRAFT BUILDING AREA

Parameters	Sample ID and Results						EPA RBC Criteria(1)
	GW07-001	GW07-002	GW07-003	GW07-004	GW07-005	GW07-006	
VOCs (ug/l)							
Methylene chloride	< 5	< 5	< 5	< 5	3.9 B	< 5	4.1
Vinyl chloride	<10 / <30(2)	<10 / <50	<10 / <50	<10 / 8.9R(6)	<10 / 7.2R	<10 / NT(3)	0.015
SOCs (ug/l)							
Bis(2-EH)phthalate	< 10	< 10	< 10	< 10	**8 J**	< 10	4.8
Di-n-butylphthalate	< 10	< 10	< 10	< 10	5 JB	< 10	270
TPH (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	
Total Metals (ug/l)							
Aluminum	360	< 200	NT	NT	630	NT	3,700
Arsenic	< 10	< 10	NT	NT	**56**	NT	0.045
Barium	14	21	NT	NT	12	NT	260
Calcium	36,000	17,000	NT	NT	18,000	NT	-
Iron	1,800	**3,600**	NT	NT	1,600	NT	2,200
Lead	< 5	< 5	NT	NT	< 5	NT	15 (5)
Magnesium	3,000	7,400	NT	NT	2,800	NT	-
Manganese	42	14	NT	NT	24	NT	73
Mercury	< 0.20	< 0.20	NT	NT	< 0.20	NT	-
Potassium	1,800	8,200	NT	NT	3,500	NT	-
Sodium	9,900	9,900	NT	NT	12,000	NT	-
Zinc	35	< 20	NT	NT	8.4	NT	1,100

Notes:

(1) EPA Region III Risk-based Concentration Criteria for Tap Water
(2) <10 / <50 = Savannah Lab result / Earth Tech on-site GC result
(3) NT - Not tested
(4) BDL - Below detection limit
(5) USEPA Action Level for Drinking Water
(6) R - rejected value, on-site GC results for vinyl chloride not confirmed by Savannah Lab GC/MS analysis
Shaded/bolded text identifies compounds with concentrations greater than the EPA risk screening criteria

TABLE 2-10
HAZARD ASSESSMENT FOR SURFACE SOILS - FTA SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
VOCs (ug/kg)							
Acetone	3/28	134 - 290	-	20,000,000	780,000	D	
Methylene Chloride	2/28	5.0 - 6.4	-	760,000	85,000	B2	
Methyl ethyl ketone	1/28	28	-	100,000,000	4,700,000	D	
Styrene	1/28	3	-	41,000,000	1,600,000	D	
Toluene	24/28	8.3 - 140	-	41,000,000	1,600,000	D	
Xylenes	1/28	7	-	100,000,000	16,000,000	D	
SVOCs (ug/kg)							
Benzo(b)fluoranthene	1/28	97	-	7,800	880	B2	
Benzo(k)fluoranthene	1/28	86	-	78,000	8,800	B2	
Bis(2-EH)phthalate	1/28	110	-	410,000	46,000	B2	
Chrysene	1/28	94	-	780,000	88,000	B2	
Di-n-butylphthalate	1/28	150	-	20,000,000	780,000	D	
Fluoranthene	1/28	650	-	8,200,000	310,000	D	
Pyrene	1/28	720	-	6,100,000	230,000	D	
TPH (mg/kg)							
Total TPH	3/28	48 - 5,300	100	-	-	-	
PCBs (ug/kg)							
Aroclors	0/8	-	-	2,900	320	B2	
Pesticides (ug/kg)							
Chlordane (alpha)	1/8	0.36	-	16,000	1,800	B2	
Chlordane (gamma)	3/8	0.30 - 0.84	-	16,000	1,800	B2	
DDE	7/8	0.37 - 9.0	-	17,000	1,900	B2	
DDT	8/8	0.60 - 24	-	17,000	1,900	B2	
Heptachlor epoxide	1/8	0.94	-	630	70	B2	

TABLE 2-10
HAZARD ASSESSMENT FOR SURFACE SOILS - FTA SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
Total Metals (mg/kg)							
Aluminum	5/5	420 - 980	-	100,000	7,800	-	
Arsenic	4/5	1.2 - 1.6	-	3.8	0.43	A	**Yes**
Barium	5/5	3.9 - 12	-	14,000	550	-	
Calcium	4/5	71 - 370	-	-	-	-	
Chromium	5/5	1.7 - 5.8	-	610	23	-	
Copper	5/5	3.2 - 13	-	8,200	310	D	
Iron	5/5	1,200 - 5,400	-	120,000	4,700	-	**Yes**
Lead	5/5	7 - 33	-	1,200	400	B2	
Magnesium	5/5	62 - 190	-	-	-	-	
Manganese	5/5	10 - 34	-	4,100	160	D	
Mercury	2/5	0.011 - 0.013	-	-	-	-	
Potassium	1/5	160	-	-	-	-	
Vanadium	5/5	1.8 - 3.7	-	1,400	55	D	
Zinc	5/5	14 - 22	-	61,000	2,300	D	

Notes:
(1) Virginia Department of Environmental Quality Petroleum Program Manual (March 1995)
(2) EPA Region III RBC Criteria for Industrial/Residential Soils (Sept 2001)
(3) Weight of Evidence Classification:
A = Human carcinogen
B1 = Probable human carcinogen, limited human data
B2 = Probable human carcinogen, sufficient evidence in animals or no evidence in humans
C = Possible human carcinogen
D = Not classified as to carcinogenicity

TABLE 2-11
HAZARD ASSESSMENT FOR GROUNDWATER
FIREFIGHTER TRAINING AREA

Parameters	Frequency of Detection	Range of Detection	ARARs				TBC Criteria		EPA Carcinogen Class(7)	Potential Concern?
			EPA MCLs(1)	EPA Secondary MCLs(2)	Virginia GW Stds(3)	Va GW Protection Levels(4)	Virginia GW Criteria(5)	EPA RBC Criteria(6) Tap Water		
VOCs (ug/l)										
Acetone	2/10	10 - 15	-	-	-	-	-	370	D	
Carbon disulfide	2/10	7.0 - 8.3	-	-	-	1,000	-	100	-	
1,1-Dichloroethane	2/10	0.60 - 0.86	-	-	-	-	-	81	C	
Ethylbenzene	1/10	47	700	-	-	-	-	130	D	
Xylenes	2/10	25 - 200	10,000	-	-	-	-	1,200	D	
SVOCs (ug/l)										
Naphthalene	1/10	11	-	-	-	-	-	150	D	
TPH (mg/l)										
Total TPH	1/10	2	-	-	1	1	-	-	-	
Dissolved Metals (ug/l)										
Aluminum	4/4	64 - 590	-	50 - 200	-	-	-	3,700	-	
Antimony	2/5	3.8 - 5.7	6	-	-	-	-	1.5	-	Yes
Barium	5/5	6.2 - 140	1,000	-	1,000	1,000	-	260	-	
Calcium	5/5	5,900 - 18,000	-	-	-	-	-	-	-	
Chromium	3/5	0.99 - 1.7	100	-	50	50	-	11	-	
Cobalt	1/5	1.2	-	-	-	-	-	73	-	
Copper	1/3	0.025	1,300	-	1,000	1,000	-	140	D	
Iron	4/4	130 - 2,100	-	300	-	-	300	2,200	-	
Lead	2/5	4.5 - 4.6	15	-	-	-	-	-	-	
Magnesium	5/5	920 - 8,400	-	-	-	-	-	-	-	
Manganese	5/5	2.5 - 81	-	50	-	-	50	73	D	Yes
Nickel	1/5	3	-	-	-	-	-	73	-	
Potassium	5/5	1,300 - 3,000	-	-	-	-	-	-	-	
Sodium	5/5	4,700 - 36,000	-	-	270,000	270,000	100,000	-	-	
Vanadium	4/5	1.2 - 1.8	-	-	-	-	-	26	-	
Zinc	5/5	13 - 120	-	5,000	50	50	-	1,100	D	

Notes:
(1) U.S. EPA Maximum Contaminant Levels for Drinking Water (40 CFR 141)
(2) U.S. EPA Secondary Maximum Contaminant Levels for Drinking Water (40 CFR 143)
(3) Virginia Groundwater Quality Standards
(4) Virginia Groundwater Protection Levels from Solid Waste Regulations
(5) Virginia Water Quality Criteria for Groundwater
(6) EPA Region III Risk-based Concentration Table for Tap Water (Sept 2001)

(7) Weight-of-Evidence Classifications
A = Human carcinogen
B1 = Probable human carcinogen, limited human data
B1 = Probable human carcinogen, sufficient data in animals
C = Possible human carcinogen
D = Not classified as to carcinogenicity

TABLE 2-12
HAZARD ASSESSMENT FOR SEDIMENT
FIREFIGHTER TRAINING AREA

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class(3)	Potential Concern?
			Virginia Petroleum Program(1)	EPA Region III RBC Criteria			
				Industrial Soils(2)	Residential Soils(2)		
VOCs (ug/kg)							
Toluene	4/4	23 - 180	-	41,000,000	1,600,000	D	
SVOCs (ug/kg)		BDL					
TPH (mg/kg)							
Total TPH	3/4	130 - 350	100	-	-	-	
Total Metals (mg/kg)							
Aluminum	4/4	160 - 7600	-	100,000	7,800	-	
Arsenic	1/4	2.5	-	3.8	0.43	A	**Yes**
Barium	4/4	2.4 - 110	-	14,000	550	-	
Calcium	4/4	64 - 120	-	-	-	-	
Chromium	1/4	21	-	610	23	-	
Cobalt	1/4	2.6	-	4100	160	-	
Copper	1/4	26	-	8,200	310	D	
Iron	4/4	230 - 17,000	-	120,000	4,700	-	**Yes**
Lead	4/4	4.3 - 210	-	1,200	400	B2	
Magnesium	1/4	960	-	-	-	-	
Manganese	3/4	1.7 - 42	-	4,100	160	D	
Mercury	2/4	0.017 - 0.051	-	61	2.3	D	
Nickel	1/4	9.4	-	41,000	1,600	-	
Potassium	1/4	260	-	-	-	-	
Sodium	2/4	87 - 180	-	-	-	-	
Thallium	1/4	1.4	-	14	0.55	-	**Yes**
Vanadium	2/4	2 - 18	-	1,400	55	D	
Zinc	2/4	6 - 76	-	61,000	2,300	D	

Notes:
(1) Virginia Department of Environmental Quality Petroleum Program Manual (March 1995)
(2) EPA Region III RBC Criteria for Industrial/Residential Soils (Sept 2001)
(3) Weight-of-Evidence Classification:
A = Human carcinogen
B1 = Probable human carcinogen, limited human data
B2 = Probable human carcinogen, sufficient evidence in animals or no evidence in humans
C = Possible human carcinogen
D = Not classified as to carcinogenicity

TABLE 2-13
HAZARD ASSESSMENT FOR SURFACE AND SUBSURFACE SOILS - FTA SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
VOCs (ug/kg)							
Acetone	34/72	27 - 18,000	-	20,000,000	780,000	D	
Methylene Chloride	4/72	3.1 - 6.4	-	760,000	85,000	B2	
Methyl ethyl ketone	9/72	28 - 110	-	100,000,000	4,700,000	D	
Styrene	2/72	2 - 3	-	41,000,000	1,600,000	D	
Toluene	59/72	6.4 - 140	-	41,000,000	1,600,000	D	
Xylenes	1/72	7	-	100,000,000	16,000,000	D	
SVOCs (ug/kg)							
Benzo(b)fluoranthene	1/72	97	-	7,800	870	B2	
Benzo(k)fluoranthene	1/72	86	-	78,000	8,700	B2	
Bis(2-EH)phthalate	1/72	110	-	410,000	46,000	B2	
Chrysene	1/72	94	-	780,000	87,000	B2	
Di-n-butylphthalate	2/72	150 - 1,300	-	20,000,000	780,000	D	
Fluoranthene	3/72	600 - 1,100	-	8,200,000	310,000	D	
Naphthalene	1/72	45	-	4,100,000	160,000	D	
Pyrene	3/72	440 - 720	-	6,100,000	230,000	D	
TPH (mg/kg)							
Total TPH	3/28	48 - 5,300	100	-	-	-	
PCBs (ug/kg)							
Aroclors	0/8	-	-	2,900	320	B2	
Pesticides (ug/kg)							
Chlordane (alpha)	1/8	0.36	-	16,000	1,800	B2	
Chlordane (gamma)	3/8	0.30 - 0.84	-	16,000	1,800	B2	
DDE	7/8	0.37 - 9.0	-	17,000	1,900	B2	
DDT	8/8	0.60 - 24	-	17,000	1,900	B2	
Heptachlor epoxide	1/8	0.94	-	630	70	B2	

TABLE 2-13
HAZARD ASSESSMENT FOR SURFACE AND SUBSURFACE SOILS - FTA SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
Total Metals (mg/kg)							
Aluminum	14/14	250 - 980	-	100,000	7,800	-	
Arsenic	9/14	0.98 - 1.6	-	3.8	0.43	A	**Yes**
Barium	14/14	2.2 - 12	-	14,000	550	-	
Calcium	9/14	37 - 370	-	-	-	-	
Chromium	14/14	1.6 - 6.7	-	610	23	-	
Cobalt	1/14	0.44	-	4,100	160	-	
Copper	6/14	0.63 - 13	-	8,200	310	D	
Iron	14/14	740 - 5,400	-	120,000	4,700	-	**Yes**
Lead	14/14	1.8 - 33	-	1,200	400	B2	
Magnesium	9/14	44 - 190	-	-	-	-	
Manganese	14/14	5.7 - 34	-	4,100	160	D	
Mercury	3/14	0.011 - 0.20	-	-	-	-	
Nickel	1/14	0.57	-	4,100,000	160,000	-	
Potassium	3/14	27 - 160	-	-	-	-	
Vanadium	14/14	1.1 - 3.7	-	1,400	55	D	
Zinc	14/14	2.3 - 22	-	61,000	2,300	D	

Notes:
(1) Virginia Department of Environmental Quality Petroleum Program Manual (March 1995)
(2) EPA Region III RBC Criteria for Industrial/Residential Soils (Sept 2001)
(3) Weight of Evidence Classification:
A = Human carcinogen
B1 = Probable human carcinogen, limited human data
B2 = Probable human carcinogen, sufficient evidence in animals or no evidence in humans
C = Possible human carcinogen
D = Not classified as to carcinogenicity

TABLE 2-14
TOXICITY VALUES: NON-CARCINOGENIC EFFECTS
ORAL ROUTE

COPC	Chronic RfDo (mg/kg-day)	Adjusted RfD (1) (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/ Source	Uncertainty Factor	Modifying Factors
Antimony	4.00E-04	8.00E-06	Low	Lung irritation, CVS	Oral/IRIS	1000	1
Arsenic	3.00E-04	1.23E-04	Low	Perpigmentation, keratosis	Oral/IRIS	3	1
Iron	3.00E-01	4.50E-02	Medium	Hemosiderosis		10	1
Manganese	2.30E-02	9.20E-04	Medium	CNS effects	IRIS	1	1
Thallium	7.00E-05	1.05E-05	Medium	Increased SGOT	IRIS	1	1

Notes:
(1) RfD adjusted for dermal exposures by using absorption efficiency factors
(Adjusted RfD = RfDo x absorption efficiency factor)

TABLE 2-15
TOXICITY VALUES: CARCINOGENIC EFFECTS FOR ORAL ROUTES

COPC	CPSo $(mg/kg\text{-}day)^{-1}$	Adjusted CPS[1] $(mg/kg\text{-}day)^{-1}$	Weight of Evidence Class	Type of Cancer	SF Basis	SF Source
Antimony	---	---	D			
Arsenic	1.50E+00	3.66E+00	A	Skin and lung	Oral	IRIS
Iron	---	---	D			
Manganese	---	---	D			
Thallium	---	---	D			

Notes:

(1) CPS adjusted for dermal exposures by using absorption efficiency factors
(Adjusted CPS = CPSo/absorption efficiencey factor)

(2) IRIS - Integrated Risk Information System (USEPA database)

(3) HEAST - Health Effects Assessment Summary Table

TABLE 2-16
CHRONIC HAZARD INDEX ESTIMATES (NONCANCER EFFECTS)
RESIDENTIAL POPULATION

Exposure Pathway	COPC	CDI (mg/kg-day)	RfD Adjusted For Absorption	RfD (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
ADULTS						
Ingestion of COPC in Soil	Arsenic	1.92E-06	No	3.00E-04	6.40E-03	
	Iron	4.98E-03	No	3.00E-01	1.66E-02	
	Thallium	8.22E-07	No	7.00E-05	1.17E-02	3.47E-02
Dermal Contact with COPC in Soil	Arsenic	4.42E-07	Yes	1.23E-04	3.59E-03	
	Iron	3.58E-04	Yes	4.50E-02	7.96E-03	
	Thallium	5.92E-08	Yes	1.05E-05	5.64E-03	1.72E-02
Ingestion of COPC in Groundwater	Antimony	1.56E-04	No	4.00E-04	3.90E-01	
	Manganese	2.22E-03	No	2.30E-02	9.65E-02	4.87E-01
Dermal Contact with COPC in Groundwater	Antimony	4.54E-07	Yes	8.00E-06	5.68E-02	
	Manganese	6.46E-06	Yes	9.20E-04	7.02E-03	6.38E-02
					Total Exposure Hazard Index	**6.02E-01**
CHILDREN						
Ingestion of COPC in Soil	Arsenic	1.79E-05	No	3.00E-04	5.97E-02	
	Iron	4.65E-02	No	3.00E-01	1.55E-01	
	Thallium	7.67E-06	No	7.00E-05	1.10E-01	3.24E-01
Dermal Contact with COPC in Soil	Arsenic	1.19E-06	Yes	1.23E-04	9.67E-03	
	Iron	9.64E-04	Yes	4.50E-02	2.14E-02	
	Thallium	1.59E-07	Yes	1.05E-05	1.51E-02	4.62E-02
Ingestion of COPC in Groundwater	Antimony	5.35E-05	No	4.00E-04	1.34E-01	
	Manganese	7.61E-04	No	2.30E-02	3.31E-02	1.67E-01
Dermal Contact with COPC in Groundwater	Antimony	8.79E-07	Yes	8.00E-06	1.10E-01	
	Manganese	1.25E-05	Yes	9.20E-04	1.36E-02	1.23E-01
					Total Exposure Hazard Index	**6.61E-01**

Notes:
CDI = Chronic Daily Intake
RfD = Reference dose
Hazard Quotient = CDI/RfD

TABLE 2-17
CANCER RISK ESTIMATES
RESIDENTIAL POPULATION

Exposure Pathway	COPC	CDI (mg/kg-day)	CPS Adjusted For Absorption	CPS $(mg/kg\text{-}day)^{-1}$	Chemical Risk	Total Pathway Risk
ADULTS						
Ingestion of COPC in Soil	Arsenic	6.58E-07	No	1.50E+00	9.87E-07	
	Iron	1.71E-03	---	---	---	
	Thallium	2.82E-07	---	---	---	9.87E-07
Dermal Contact with COPC in Soil	Arsenic	1.51E-07	Yes	3.66E+00	5.53E-07	
	Iron	1.23E-04	---	---	---	
	Thallium	2.03E-08	---	---	---	5.53E-07
Ingestion of COPC in Groundwater	Antimony	5.35E-05	---	---	---	
	Manganese	7.61E-04	---	---	---	0.00E+00
Dermal Contact with COPC in Groundwater	Antimony	1.56E-07	---	---	---	
	Manganese	2.21E-06	---	---	---	0.00E+00
				Total Exposure Hazard Index		**1.54E-06**
CHILDREN						
Ingestion of COPC in Soil	Arsenic	1.53E-06	No	1.50E+00	2.30E-06	
	Iron	3.98E-03	---	---	---	
	Thallium	6.58E-07	---	---	---	2.30E-06
Dermal Contact with COPC in Soil	Arsenic	1.02E-07	Yes	3.66E+00	3.73E-07	
	Iron	8.26E-05	---	---	---	
	Thallium	1.36E-08	---	---	---	3.73E-07
Ingestion of COPC in Groundwater	Antimony	3.12E-05	---	---	---	
	Manganese	4.44E-04	---	---	---	0.00E+00
Dermal Contact with COPC in Groundwater	Antimony	7.53E-08	---	---	---	
	Manganese	1.07E-06	---	---	---	0.00E+00
				Total Exposure Hazard Index		**2.67E-06**

Notes:
CDI = Chronic Daily Intake
CPS - Cancer Potency Slope
Risk = CDI x CPS

TABLE 2-18
NOAELs FOR BIRDS AND MAMMALS: ENVIRONMENTAL ASSESSMENT
FORT STORY, VIRGINIA

COPC	NOAELs[1] (mg/kg BW-day)					
	Test Species (Avian)	**Killdeer**	**Northern Bobwhite**	**Test Species (Mammal)**	**White-footed Mouse**	**Gray Fox**
Acetone	NA	NA	NA	10 (rat)	24.96	4.27
Toluene	NA	NA	NA	25.98 (rat)	28.78	4.97
PAHs	NA	NA	NA	1(mus)[2]	1.11	0.19
Aluminum	109.7 (rd)	130.5	107.01	1.93 (mus)	2.12	0.363
Barium	20.8 (chicks)	22.79	18.68	5.1 (rat)	12.73	2.18
Chromium	1 (bd)	2.39	-	2,737 (rat)	6,832.3	1,168.7
Cobalt	NA	NA	-	NA	NA	NA
Copper	47 (ck)	71.80	58.86	11.71 (mk)[3]	41.26	7.13
Iron	NA	NA	NA	NA	NA	NA
Lead	3.85 (ak)	4.21	3.45	8 (rat)	19.94	3.44
Manganese	977 (jq)	1,208.2	990.46	88 (rat)	219.67	37.58
Nickel	77.4 (duckling)	157.96	-	40 (rat)	99.85	17.07
Thallium	NA	NA	NA	0.0074 (rat)	0.018	0.003
Vanadium	11.4 (ma)[4]	26.61	21.81	0.21 (rat)	0.52	0.09
Zinc	3 (ma)[4]	7.0	5.74	160 (rat)	398.72	68.88

Notes:
NA = Not Available
[1] NOAELs for laboratory species converted to receptor species NOAELs as follows (Opresko et al., 1994):

$$NOAEL_r = NOAEL_t (bw_t/bw_r)^{-}$$

Where: $NOAEL_r$ = receptor NOAEL
$NOAEL_t$ = test species NOAEL
bw_r = receptor body weight
bw_t = test species body weight

Body weights of test species (kg):

American Kestrel (ak) = 0.12
Black Duck (bd) = 1.25
Chicken (ck) = 0.328
Chicken (chicks) = 0.121
Japanese Quail (jq) = 0.174
Mallard (ma) = 1.17
Mallard Duckling (duckling) = 0.782
Mink (mk) = 1.0
Mouse (mus) = 0.03
Rat = 0.35
Ringed Dove (rd) = 0.155

[2] Value is for Benzo(a)pyrene
[3] Source: Heaton, 1992
[4] Source: Opresko et al., 1994
Source unless otherwise noted:
Opresko et al., 1995.

TABLE 2-19
SUMMARY OF EXPOSURE ESTIMATES AND HAZARD QUOTIENTS
FTA SITE, FORT STORY, VIRGINIA

Chemical	Killdeer			White-footed Mouse			Gray Fox		
	EE total (mg/kg BW-day)	NOAEL (mg/kg BW-day)	HQ	EE total (mg/kg BW-day)	NOAEL (mg/kg BW-day)	HQ	EE total (mg/kg BW-day)	NOAEL (mg/kg BW-day)	HQ
Acetone	4.87E-04	NA	NA	6.95E-03	2.50E+01	2.79E-04	6.89E-05	4.27E+00	1.61E-05
Toluene	2.54E-03	NA	NA	3.56E-02	2.88E+01	1.24E-03	2.55E-04	4.97E+00	5.13E-05
Fluoranthene	6.13E-03	NA	NA	5.52E-02	1.11E+00	4.98E-02	3.26E-04	1.91E-01	1.71E-03
Pyrene	6.79E-03	NA	NA	6.11E-02	1.11E+00	5.52E-02	3.61E-04	1.91E-01	1.89E-03
Aluminum	9.81E+01	1.31E+02	7.52E-01	9.04E+02	2.12E+00	4.27E+02	5.29E+00	3.63E-01	1.46E+01
Barium	1.44E+00	2.28E+01	6.32E-02	1.44E+01	1.27E+01	1.13E+00	8.90E-02	2.18E+00	4.08E-02
Chromium	1.42E-02	2.39E+00	5.96E-03	8.64E-02	6.83E+03	1.26E-05	5.60E-04	1.17E+03	4.80E-07
Cobalt	3.36E-02	NA	NA	3.15E-01	NA	NA	1.86E-03	NA	NA
Copper	3.86E-01	7.18E+01	5.37E-03	4.09E+00	4.15E+01	9.86E-02	2.52E-02	7.09E+00	3.56E-03
Iron	2.19E+02	NA	NA	2.02E+03	NA	NA	1.18E+01	NA	NA
Lead	2.60E+00	4.21E+00	6.17E-01	2.45E+01	1.99E+01	1.23E+00	1.46E-01	3.44E+00	4.24E-02
Manganese	5.55E-01	1.21E+03	4.60E-04	5.87E+00	2.20E+02	2.67E-02	3.72E-02	3.76E+01	9.90E-04
Thallium	1.81E-02	NA	NA	1.67E-01	1.80E-02	9.26E+00	9.75E-04	3.20E-03	3.05E-01
Vanadium	2.32E-01	2.66E+01	8.73E-03	2.14E+00	5.20E-01	4.12E+00	1.26E-02	9.00E-02	1.40E-01
Zinc	1.53E+00	7.00E+00	2.18E-01	1.74E+01	3.99E+02	4.35E-02	1.18E-01	6.83E+01	1.73E-03

Notes:
BW = Body Weight
NA = Not Available
EE_{total} =Total Estimated Exposure from Soil + Food
NOAEL = No Observed Adverse Effects Level
HQ = Hazard Quotient
Shading indicates Hazard Quotients greater than 1

TABLE 2-20
HAZARD ASSESSMENT FOR SURFACE SOILS - AUTO CRAFT BUILDING SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
VOCs (ug/kg)							
Methylene Chloride	1/6	41	-	760,000	85,000	B2	
Methyl ethyl ketone	1/6	55	-	100,000,000	4,700,000	D	
Toluene	6/6	7.9 - 34	-	41,000,000	1,600,000	D	
Trichloroethene	1/6	33	-	520,000	58,000	D	
SVOCs (ug/kg)							
Acenaphthene	1/6	440	-	12,000,000	470,000	D	
Benzo(a)anthracene	1/6	2,500	-	7,800	870	B2	**Yes**
Benzo(b)fluoranthene	1/6	4,100	-	7,800	880	B2	**Yes**
Benzo(k)fluoranthene	1/6	490	-	78,000	8,800	B2	
Benzo(g,h,I)perylene	1/6	2,000	-	-	-	D	
Benzo(a)pyrene	1/6	3,400	-	780	87	B2	**Yes**
Butyllbenzylphthalate	1/6	550	-	41,000,000	1,600,000	D	
Chrysene	1/6	2,000	-	780,000	88,000	B2	
Fluoranthene	1/6	5,800	-	8,200,000	310,000	D	
Indeno(1,2,3-cd)pyrene	1/6	1,500	-	7,800	870	B2	**Yes**
Phenanthrene	1/6	1,300	-	-	-	D	
Pyrene	1/6	11,000	-	6,100,000	230,000	D	
TPH (mg/kg)							
Total TPH	3/6	220 - 390	100	-	-	-	

TABLE 2-20
HAZARD ASSESSMENT FOR SURFACE SOILS - AUTO CRAFT BUILDING SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
Total Metals (mg/kg)							
Aluminum	1/1	5,200	-	100,000	7,800	-	
Arsenic	1/1	1.3	-	3.8	0.43	A	**Yes**
Barium	1/1	82	-	14,000	550	-	
Calcium	1/1	1200	-	-	-	-	
Chromium	1/1	8.6	-	610	23	-	
Cobalt	1/1	4.4	-	4,100	160	D	
Copper	1/1	18	-	8,200	310	D	
Iron	1/1	9,100	-	120,000	4,700	-	**Yes**
Lead	1/1	95	-	1,200	400	B2	
Magnesium	1/1	2,400	-	-	-	-	
Manganese	1/1	170	-	4,100	160	D	**Yes**
Mercury	1/1	0.022	-	-	-	-	
Nickel	1/1	4.8	-	4,100	160	D	
Potassium	1/1	2,700	-	-	-	-	
Sodium	1/1	64	-	-	-	-	
Vanadium	1/1	18	-	1,400	55	D	
Zinc	1/1	64	-	61,000	2,300	D	

Notes:
(1) Virginia Department of Environmental Quality Petroleum Program Manual (March 1995)
(2) EPA Region III RBC Criteria for Industrial/Residential Soils (Sept 2001)
(3) Weight of Evidence Classification:
A = Human carcinogen
B1 = Probable human carcinogen, limited human data
B2 = Probable human carcinogen, sufficient evidence in animals or no evidence in humans
C = Possible human carcinogen
D = Not classified as to carcinogenicity

TABLE 2-21
HAZARD ASSESSMENT FOR GROUNDWATER
AUTOCRAFT BUILDING AREA

Parameters	Frequency of Detection	Range of Detection	ARARs				TBC Criteria		EPA Carcinogen Class(7)	Potential Concern?
			EPA MCLs(1)	EPA Secondary MCLs(2)	Virginia GW Stds(3)	Va GW Protection Levels(4)	Virginia GW Criteria(5)	EPA RBC Criteria(6) Tap Water		
VOCs (ug/l)										
Chloroform	1/4	11	100	-	-	-	-	0.15	B2	**Yes**
SVOCs (ug/l)	0/4	-								
TPH (mg/l)										
Total TPH	0/4	-								
Dissolved Metals (ug/l)										
Calcium	2/2	5,800 - 31,000	-	-	-	-	-	-	-	
Iron	2/2	110 - 8,100	-	300	-	-	300	2,200	-	**Yes**
Magnesium	2/2	3.7 - 4,600	-	-	-	-	-	-	-	
Manganese	1/2	80	-	50	-	-	50	73	D	**Yes**
Potassium	2/2	2,100 - 15,000	-	-	-	-	-	-	-	
Sodium	2/2	11,000 - 15,000	-	-	270,000	270,000	100,000	-	-	

Notes:

(1) U.S. EPA Maximum Contaminant Levels for Drinking Water (40 CFR 141)
(2) U.S. EPA Secondary Maximum Contaminant Levels for Drinking Water (40 CFR 143)
(3) Virginia Groundwater Quality Standards
(4) Virginia Groundwater Protection Levels from Solid Waste Regulations
(5) Virginia Water Quality Criteria for Groundwater
(6) EPA Region III Risk-based Concentration Table for Tap Water (Sept 2001)

(7) Weight-of-Evidence Classifications
A = Human carcinogen
B1 = Probable human carcinogen, limited human data
B1 = Probable human carcinogen, sufficient data in animals
C = Possible human carcinogen
D = Not classified as to carcinogenicity

TABLE 2-22
HAZARD ASSESSMENT FOR SURFACE AND SUBSURFACE SOILS - AUTO CRAFT BUILDING SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
VOCs (ug/kg)							
Acetone	1/18	31	-	20,000,000	780,000	D	
Ethylbenzene	1/18	1.6	-	20,000,000	780,000	D	
Methylene Chloride	1/18	41	-	760,000	85,000	B2	
Methyl ethyl ketone	4/16	55 - 100	-	100,000,000	4,700,000	D	
Styrene	2/18	4.8 - 6	-	41,000,000	1,600,000	D	
Toluene	11/18	7 - 34	-	41,000,000	1,600,000	D	
Trichloroethene	1/18	33	-	520,000	58,000	D	
Xylenes	1/18	16	-	41,000,000	1,600,000	D	
SVOCs (ug/kg)							
Acenaphthene	2/18	70 - 440	-	12,000,000	470,000	D	
Anthracene	1/18	250	-	61,000,000	2,300,000	D	
Benzo(a)anthracene	2/18	620 - 2500	-	7,800	870	B2	**Yes**
Benzo(b)fluoranthene	2/18	1,100 - 4,100	-	7,800	880	B2	**Yes**
Benzo(k)fluoranthene	2/18	490 - 770	-	78,000	8,800	B2	
Benzo(g,h,l)perylene	1/18	2,000	-	-	-	D	
Benzo(a)pyrene	2/18	940 - 3,400	-	780	87	B2	**Yes**
Butyllbenzylphthalate	2/18	550	-	41,000,000	1,600,000	D	
Chrysene	2/18	520 - 2,000	-	780,000	88,000	B2	
Fluoranthene	2/18	900 - 5,800	-	8,200,000	310,000	D	
Fluorene	1/18	65	-	8,200,000	310,000	D	
Indeno(1,2,3-cd)pyrene	2/18	260 - 1,500	-	7,800	870	B2	**Yes**
Naphthalene	1/18	8.2	-	4,100,000	160,000	D	
Phenanthrene	2/18	890 - 1,300	-	-	-	D	
Pyrene	2/18	1,600 - 11,000	-	6,100,000	230,000	D	
TPH (mg/kg)							
Total TPH	5/18	160 - 390	100	-	-	-	

TABLE 2-22
HAZARD ASSESSMENT FOR SURFACE AND SUBSURFACE SOILS - AUTO CRAFT BUILDING SITE

Parameter	Frequency of Detection	Range of Detection	TBC Criteria			EPA Carcinogen Class (3)	Potential Concern?
			Virginia Petroleum Program (1)	EPA RBC Criteria			
				Industrial Soils (2)	Residential Soils (2)		
Total Metals (mg/kg)							
Aluminum	4/4	500 - 5,200	-	100,000	7,800	-	
Arsenic	4/4	1.1 - 1.5	-	3.8	0.43	A	**Yes**
Barium	4/4	2.8 - 82	-	14,000	550	-	
Beryllium	1/4	0.058	-	410	16	D	
Cadmium	1/4	0.18	-	100	3.9	D	
Calcium	3/4	84 - 1,200	-	-	-	-	
Chromium	4/4	2.3 - 8.6	-	610	23	-	
Cobalt	2/4	0.79 - 4.4	-	4,100	160	D	
Copper	2/4	5 -18	-	8,200	310	D	
Iron	4/4	1,200 - 9,100	-	120,000	4,700	-	**Yes**
Lead	4/4	1.7 - 95	-	1,200	400	B2	
Magnesium	4/4	96 - 2,400	-	-	-	-	
Manganese	4/4	10 - 170	-	4,100	160	D	**Yes**
Mercury	3/4	0.011 - 0.1	-	-	-	-	
Nickel	2/4	1.1 - 4.8	-	4,100	160	D	
Potassium	3/4	130 - 2,700	-	-	-	-	
Sodium	2/4	20 - 64	-	-	-	-	
Vanadium	4/4	1.8 - 18	-	1,400	55	D	
Zinc	4/4	4.5 - 64	-	61,000	2,300	D	

Notes:
(1) Virginia Department of Environmental Quality Petroleum Program Manual (March 1995)
(2) EPA Region III RBC Criteria for Industrial/Residential Soils (Sept 2001)
(3) Weight of Evidence Classification:
A = Human carcinogen
B1 = Probable human carcinogen, limited human data
B2 = Probable human carcinogen, sufficient evidence in animals or no evidence in humans
C = Possible human carcinogen
D = Not classified as to carcinogenicity

TABLE 2-23
TOXICITY VALUES: NON-CARCINOGENIC EFFECTS
ORAL ROUTE
AUTO CRAFT BUILDING AREA

COPC	Chronic RfDo (mg/kg-day)	Adjusted RfD (1) (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/ Source	Uncertainty Factor	Modifying Factors
METALS							
Arsenic	3.00E-04	1.23E-04	Low	Perpigmentation, keratosis	Oral/IRIS	3	1
Iron	3.00E-01	4.50E-02	Medium	Hemosiderosis	Oral	10	1
Manganese	2.30E-02	9.20E-04	Medium	CNS effects	IRIS	1	1
VOCs							
Chloroform	1.00E-02	2.00E-03	Medium	Fatty cyst formation	Oral/IRIS	1000	1
SVOCs							
Benzo(a)anthracene	---	---	---	---	---	---	---
Benzo(b)fluoranthene	---	---	---	---	---	---	---
Benzo(a)pyrene	---	---	---	---	---	---	---
Inden(1,2,3-cd)pyrene	---	---	---	---	---	---	---

Notes:
(1) RfD adjusted for dermal exposures by using absorption efficiency factors
(Adjusted RfD = RfDo x absorption efficiency factor)

TABLE 2-24
TOXICITY VALUES: CARCINOGENIC EFFECTS FOR ORAL ROUTES
AUTO CRAFT BUILDING AREA

COPC	CPSo $(mg/kg\text{-}day)^{-1}$	Adjusted CPS[(1)] $(mg/kg\text{-}day)^{-1}$	Weight of Evidence Class	Type of Cancer	SF Basis	SF Source
METALS						
Arsenic	1.50E+00	3.66E+00	A	Skin and lung	Oral	IRIS
Iron	---	---	D			
Manganese	---	---	D			
VOCs						
Chloroform	6.10E-03	3.05E-02	B2	Tumors	Oral	IRIS
SVOCs						
Benzo(a)anthracene	7.30E-01	2.35E+00	B2	Stomach tumors in mice	Oral	IRIS
Benzo(b)fluoranthene	7.30E-01	2.35E+00	B2	Stomach tumors in mice	Oral	IRIS
Benzo(a)pyrene	7.30E+00	2.35E+01	B2	Stomach tumors in mice	Oral	IRIS
Inden(1,2,3-cd)pyrene	7.30E-01	2.35E+00	B2	Stomach tumors in mice	Oral	IRIS

Notes:
(1) CPS adjusted for dermal exposures by using absorption efficiency factors
(Adjusted CPS = CPSo/absorption efficiencey factor)
(2) IRIS - Integrated Risk Information System (USEPA database)
(3) HEAST - Health Effects Assessment Summary Table

TABLE 2-25
CHRONIC HAZARD INDEX ESTIMATES (NONCANCER EFFECTS)
RESIDENTIAL POPULATION

Exposure Pathway	COPC	CDI (mg/kg-day)	RfD Adjusted For Absorption	RfD (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
ADULTS						
Ingestion of COPC In Soil	Arsenic	2.05E-06	No	3.00E-04	6.83E-03	
	Iron	1.11E-02	No	3.00E-01	3.70E-02	
	Manganese	2.33E-04	No	2.30E-02	1.01E-02	
	Benzo(a)anthracene	2.40E-07	No	---	--	
	Benzo(b)fluoranthene	2.40E-07	No	---	---	
	Benzo(a)pyrene	2.40E-07	No	---	---	
	Indeno(1,2,3-cd)pyrene	2.40E-07	No	---	---	5.40E-02
Dermal Contact with COPC in Soil	Arsenic	4.73E-07	Yes	1.23E-04	3.85E-03	
	Iron	7.99E-04	Yes	4.50E-02	1.78E-02	
	Manganese	1.68E-05	Yes	9.20E-04	1.83E-02	
	Benzo(a)anthracene	1.73E-07	Yes	---	--	
	Benzo(b)fluoranthene	1.73E-07	Yes	---	---	
	Benzo(a)pyrene	1.73E-07	Yes	---	---	
	Indeno(1,2,3-cd)pyrene	1.73E-07	Yes	---	---	3.99E-02
Ingestion of COPCs in Groundwater	Chloroform	3.01E-04	No	1.00E-02	3.01E-02	
	Iron	2.22E-01	No	3.00E-01	7.40E-01	
	Manganese	2.19E-03	No	2.30E-02	9.52E-02	8.65E-01
Dermal Contact with COPCs in Groundwater	Chloroform	7.81E-06	Yes	2.00E-03	3.91E-03	
	Iron	6.46E-04	Yes	4.50E-02	1.44E-02	
	Manganese	6.38E-06	Yes	9.20E-04	6.93E-03	2.52E-02
Inhalation of COPCs in Groundwater	Chloroform	1.99E-03	No	8.60E-05	2.31E+01	
	Iron	0.00E+00	No	---	---	
	Manganese	0.00E+00	No	---	---	2.31E+01
					Total Exposure Hazard Index	**2.41E+01**

TABLE 2-25
CHRONIC HAZARD INDEX ESTIMATES (NONCANCER EFFECTS)
RESIDENTIAL POPULATION

Exposure Pathway	COPC	CDI (mg/kg-day)	RfD Adjusted For Absorption	RfD (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
CHILDREN						
Ingestion of COPC In Soil	Arsenic	1.92E-05	No	3.00E-04	6.40E-02	
	Iron	1.04E-01	No	3.00E-01	3.47E-01	
	Manganese	2.17E-03	No	2.30E-02	9.43E-02	
	Benzo(a)anthracene	2.24E-06	No	---	--	
	Benzo(b)fluoranthene	2.24E-06	No	---	---	
	Benzo(a)pyrene	2.24E-06	No	---	---	
	Indeno(1,2,3-cd)pyrene	2.24E-06	No	---	---	5.05E-01
Dermal Contact with COPC in Soil	Arsenic	1.27E-06	Yes	1.23E-04	1.03E-02	
	Iron	2.15E-03	Yes	4.50E-02	4.78E-02	
	Manganese	4.51E-05	Yes	9.20E-04	4.90E-02	
	Benzo(a)anthracene	4.64E-07	Yes	---	--	
	Benzo(b)fluoranthene	4.64E-07	Yes	---	---	
	Benzo(a)pyrene	4.64E-07	Yes	---	---	
	Indeno(1,2,3-cd)pyrene	4.64E-07	Yes	---	---	1.07E-01
Ingestion of COPCs in Groundwater	Chloroform	7.03E-04	No	1.00E-02	7.03E-02	
	Iron	5.18E-01	No	3.00E-01	1.73E+00	
	Manganese	5.11E-03	No	2.30E-02	2.22E-01	2.02E+00
Dermal Contact with COPCs in Groundwater	Chloroform	1.37E-05	Yes	1.00E-02	1.37E-03	
	Iron	1.14E-03	Yes	4.50E-02	2.53E-02	
	Manganese	1.12E-05	Yes	9.20E-04	1.22E-02	3.89E-02
Inhalation of COPCs in Groundwater	Chloroform	5.59E-03	No	8.60E-05	6.50E+01	
	Iron	0.00E+00	No	---	---	
	Manganese	0.00E+00	No	---	---	6.50E+01
					Total Exposure Hazard Index	**6.77E+01**

Notes:
CDI = Chronic Daily Intake
RfD = Reference dose
Hazard Quotient = CDI/RfD

TABLE 2-26
CANCER RISK ESTIMATES
RESIDENTIAL POPULATION

Exposure Pathway	COPC	CDI (mg/kg-day)	CPS Adjusted For Absorption	CPS $(mg/kg\text{-}day)^{-1}$	Chemical Risk	Total Pathway Risk
ADULTS						
Ingestion of COPC in Soil	Arsenic	7.05E-07	No	1.50E+00	1.06E-06	
	Iron	3.80E-03	No	---	---	
	Manganese	7.98E-05	No	---	---	
	Benzo(a)anthracene	8.22E-08	No	7.30E-01	6.00E-08	
	Benzo(b)fluoranthene	8.22E-08	No	7.30E-01	6.00E-08	
	Benzo(a)pyrene	8.22E-08	No	7.30E+00	6.00E-07	
	Indeno(1,2,3-cd)pyrene	8.22E-08	No	7.30E-01	6.00E-08	1.84E-06
Dermal Contact with COPC in Soil	Arsenic	1.62E-07	No	3.66E+00	5.94E-07	
	Iron	2.74E-04	No	---	---	
	Manganese	5.75E-06	No	---	---	
	Benzo(a)anthracene	5.92E-08	No	2.35E+00	1.39E-07	
	Benzo(b)fluoranthene	5.92E-08	No	2.35E+00	1.39E-07	
	Benzo(a)pyrene	5.92E-08	No	2.35E+01	1.39E-06	
	Indeno(1,2,3-cd)pyrene	5.92E-08	No	2.35E+00	1.39E-07	2.40E-06
Ingestion of COPCs in Groundwater	Chloroform	1.03E-04	No	6.10E-03	6.28E-07	
	Iron	7.61E-02	No	---	0.00E+00	
	Manganese	7.51E-04	No	---	0.00E+00	6.28E-07
Dermal Contact with COPCs in Groundwater	Chloroform	2.68E-06	Yes	3.05E-02	8.17E-08	
	Iron	2.21E-04	Yes	---	0.00E+00	
	Manganese	2.19E-06	Yes	---	0.00E+00	8.17E-08
Inhalation of COPCs in Groundwater	Chloroform	6.82E-04	No	8.10E-02	5.52E-05	
	Iron	0.00E+00	No	---	0.00E+00	
	Manganese	0.00E+00	No	---	0.00E+00	5.52E-05
				Total Exposure Hazard Index		**6.02E-05**

TABLE 2-26
CANCER RISK ESTIMATES
RESIDENTIAL POPULATION

Exposure Pathway	COPC	CDI (mg/kg-day)	CPS Adjusted For Absorption	CPS $(mg/kg\text{-}day)^{-1}$	Chemical Risk	Total Pathway Risk
CHILDREN						
Ingestion of COPC in Soil	Arsenic	1.64E-06	No	1.50E+00	2.47E-06	
	Iron	8.88E-03	No	---	---	
	Manganese	1.86E-04	No	---	---	
	Benzo(a)anthracene	1.92E-07	No	7.30E-01	1.40E-07	
	Benzo(b)fluoranthene	1.92E-07	No	7.30E-01	1.40E-07	
	Benzo(a)pyrene	1.92E-07	No	7.30E+00	1.40E-06	
	Indeno(1,2,3-cd)pyrene	1.92E-07	No	7.30E-01	1.40E-07	4.29E-06
Dermal Contact with COPC in Soil	Arsenic	1.09E-07	No	3.66E+00	3.99E-07	
	Iron	1.84E-04	No	---	---	
	Manganese	3.86E-06	No	---	---	
	Benzo(a)anthracene	3.98E-08	No	2.35E+00	9.35E-08	
	Benzo(b)fluoranthene	3.98E-08	No	2.35E+00	9.35E-08	
	Benzo(a)pyrene	3.98E-08	No	2.35E+01	9.35E-07	
	Indeno(1,2,3-cd)pyrene	3.98E-08	No	2.35E+00	9.35E-08	1.62E-06
Ingestion of COPCs in Groundwater	Chloroform	6.03E-05	No	6.10E-03	3.68E-07	
	Iron	4.44E-02	No	---	0.00E+00	
	Manganese	4.38E-04	No	---	0.00E+00	3.68E-07
Dermal Contact with COPCs in Groundwater	Chloroform	1.18E-06	Yes	3.05E-02	3.60E-08	
	Iron	9.73E-05	Yes	---	0.00E+00	
	Manganese	9.61E-07	Yes	---	0.00E+00	3.60E-08
Inhalation of COPCs in Groundwater	Chloroform	4.79E-04	No	8.10E-02	3.88E-05	
	Iron	0.00E+00	No	---	0.00E+00	
	Manganese	0.00E+00	No	---	0.00E+00	3.88E-05
				Total Exposure Hazard Index		**4.51E-05**

Notes:
CDI = Chronic Daily Intake
CPS - Cancer Potency Slope
Risk = CDI x CPS

TABLE 2-27
SUMMARY OF EXPOSURE ESTIMATES AND HAZARD QUOTIENTS
AUTO CRAFT SITE, FORT STORY, VIRGINIA

Chemical	Killdeer			White-footed Mouse			Gray Fox		
	EE_{total}	NOAEL	HQ	EE_{total}	NOAEL	HQ	EE_{total}	NOAEL	HQ
	mg/kg BW-day			mg/kg BW-day			mg/kg BW-day		
Acenaphthene	6.42E-04	NA	NA	1.43E-02	1.11E+00	1.29E-02	2.93E-05	1.91E-01	1.53E-04
Benz(a)anthracene	5.16E-03	NA	NA	1.15E-01	1.11E+00	1.03E-01	2.35E-04	1.91E-01	1.23E-03
Benzo(b)fluoranthene	8.46E-03	NA	NA	1.88E-01	1.11E+00	1.70E-01	3.86E-04	1.91E-01	2.02E-03
Benzo(k)fluoranthene	6.99E-04	NA	NA	1.55E-02	1.11E+00	1.40E-02	3.19E-05	1.91E-01	1.67E-04
Benzo(g,h,i)perylene	4.13E-03	NA	NA	9.17E-02	1.11E+00	8.27E-02	1.88E-04	1.91E-01	9.86E-04
Benzo(a)pyrene	7.01E-03	NA	NA	1.56E-01	1.11E+00	1.41E-01	3.20E-04	1.91E-01	1.68E-03
Butylbenzylphthalate	7.76E-04	NA	NA	1.72E-02	1.11E+00	1.56E-02	3.54E-05	1.91E-01	1.85E-04
Chrysene	4.13E-03	NA	NA	9.17E-02	1.11E+00	8.27E-02	1.88E-04	1.91E-01	9.86E-04
Fluoranthene	1.20E-02	NA	NA	2.98E-02	1.11E+00	2.69E-02	6.12E-05	1.91E-01	3.20E-04
Indeno(1,2,3-cd)pyrene	2.60E-03	NA	NA	5.78E-02	1.11E+00	5.21E-02	1.19E-04	1.91E-01	6.21E-04
Phenanthrene	2.10E-03	NA	NA	4.68E-02	1.11E+00	4.22E-02	9.60E-05	1.91E-01	5.03E-04
Pyrene	2.27E-02	NA	NA	3.30E-02	1.11E+00	2.98E-02	6.78E-05	1.91E-01	3.55E-04
Chromium	4.83E-03	2.39E+00	2.02E-03	7.24E-02	6.83E+03	1.06E-05	1.63E-04	1.17E+03	1.40E-07
Copper	1.17E-01	5.07E+01	2.30E-03	3.06E+00	4.13E+01	7.41E-02	6.54E-03	7.13E+00	9.18E-04
Iron	2.57E+01	NA	NA	5.85E+02	NA	NA	8.57E-01	NA	NA
Lead	2.57E-01	4.21E+00	6.11E-02	5.98E+00	1.99E+01	3.00E-01	8.94E-03	3.44E+00	2.60E-03
Nickel	2.53E-02	1.58E+02	1.60E-04	7.09E-01	9.99E+01	7.10E-03	1.58E-03	1.71E+01	9.27E-05
Zinc	1.32E+02	6.12E+00	2.15E+01	3.25E+03	3.99E+02	8.16E+00	6.02E-03	6.89E+01	8.75E-05

Notes:
BW = Body Weight
NA = Not Available
EE_{total} =Total Estimated Exposure from Soil + Food
NOAEL = No Observed Adverse Effects Level
HQ = Hazard Quotient
Shading indicates Hazard Quotients greater than 1

Decision Document
FTA and Auto Craft Sites
Fort Story, Virginia

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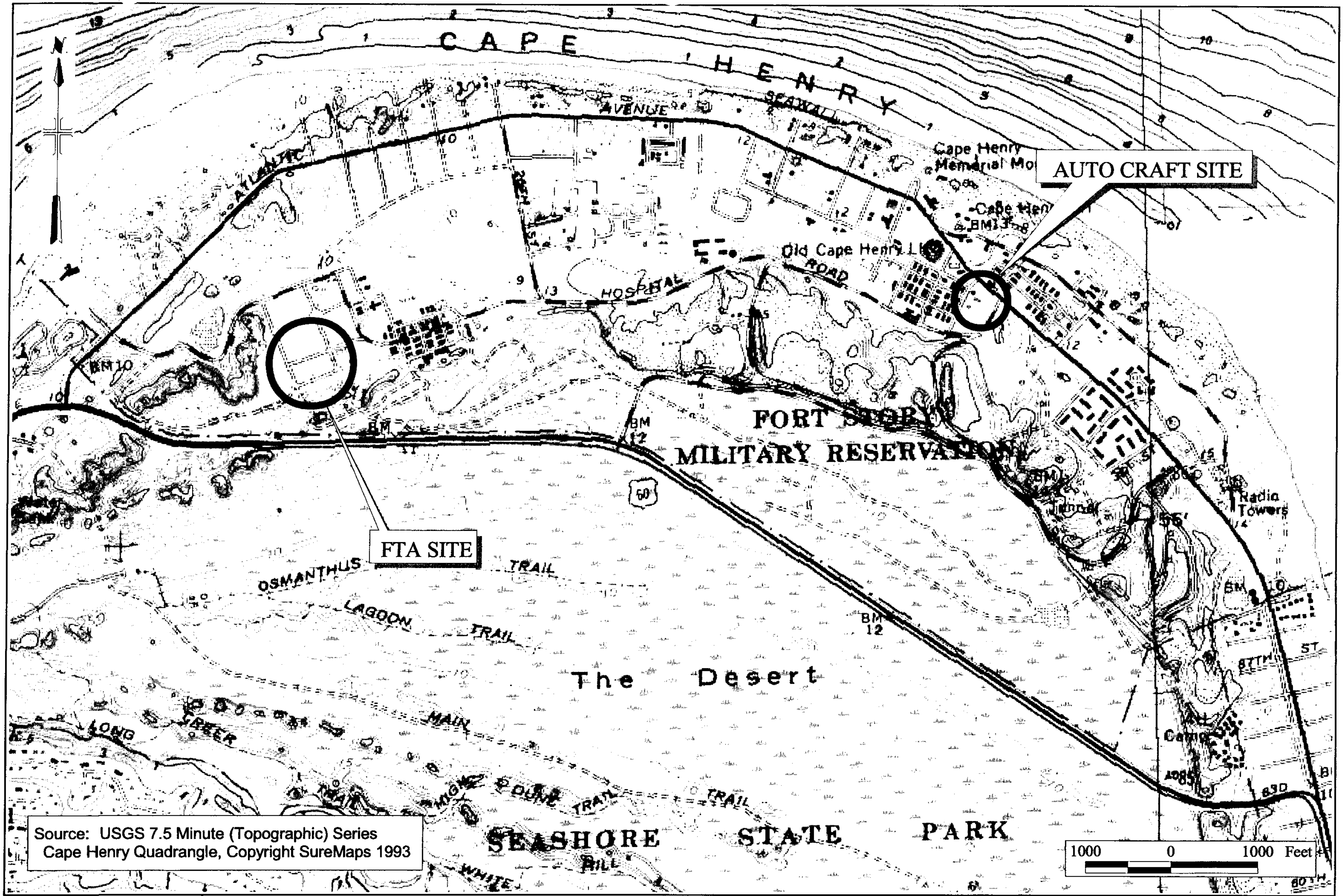


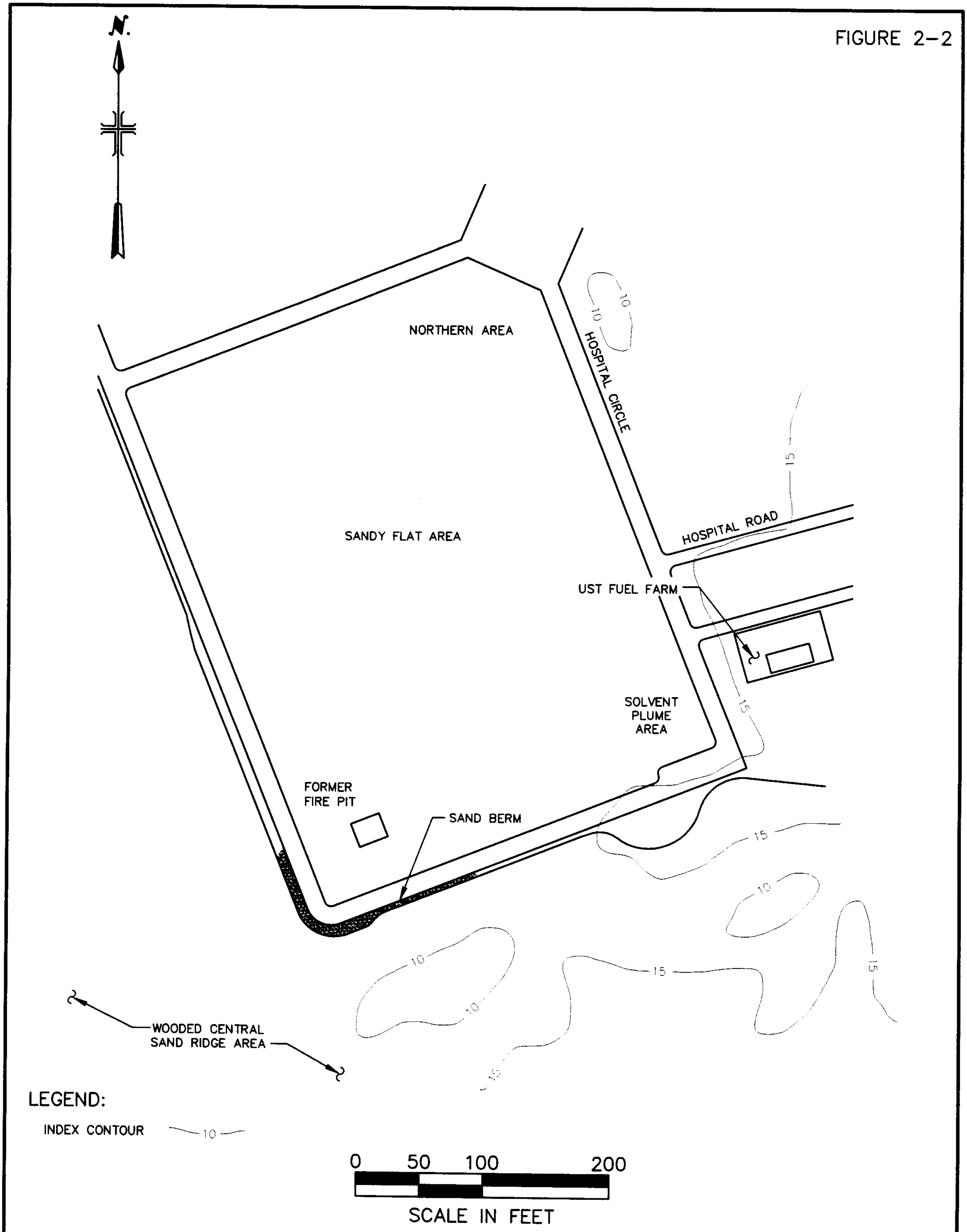
MALCOLM PIRNIE

FORT STORY, VIRGINIA
DECISION DOCUMENT
SITE LOCATION MAP

FEBRUARY 2003

FIGURE 2-1

FIGURE 2-2



MALCOLM PIRNIE

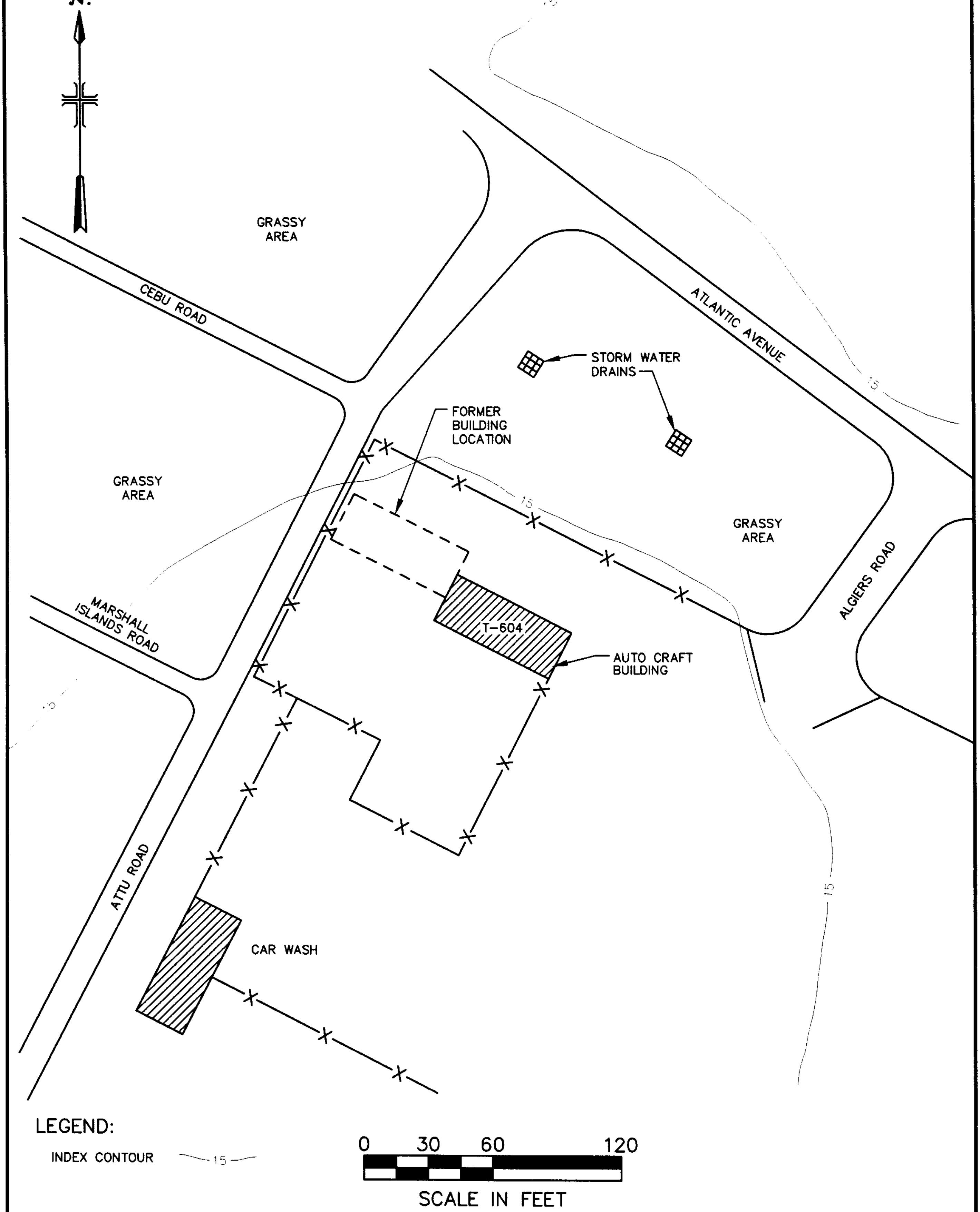
FORT STORY, VIRGINIA
DECISION DOCUMENT

FTA SITE MAP

MALCOLM PIRNIE, INC.

FEBRUARY 2003

FIGURE 2-3



MALCOLM PIRNIE

FORT STORY, VIRGINIA
DECISION DOCUMENT
AUTO CRAFT SITE MAP

MALCOLM PIRNIE, INC.

FEBRUARY 2003

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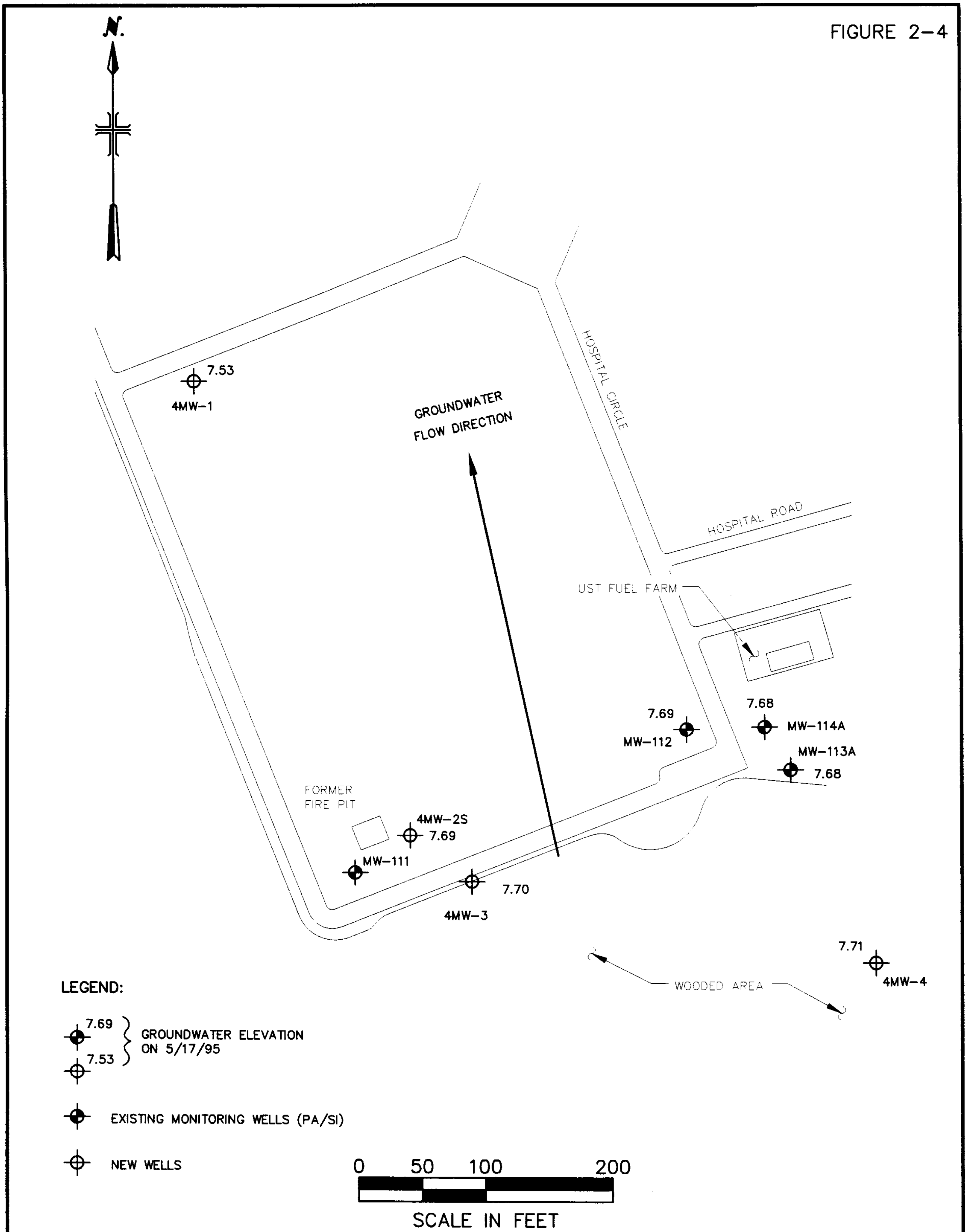

MALCOLM PIRNIE

FORT STORY, VIRGINIA
DECISION DOCUMENT

FTA SITE WATER TABLE ELEVATIONS

MALCOLM PIRNIE, INC.

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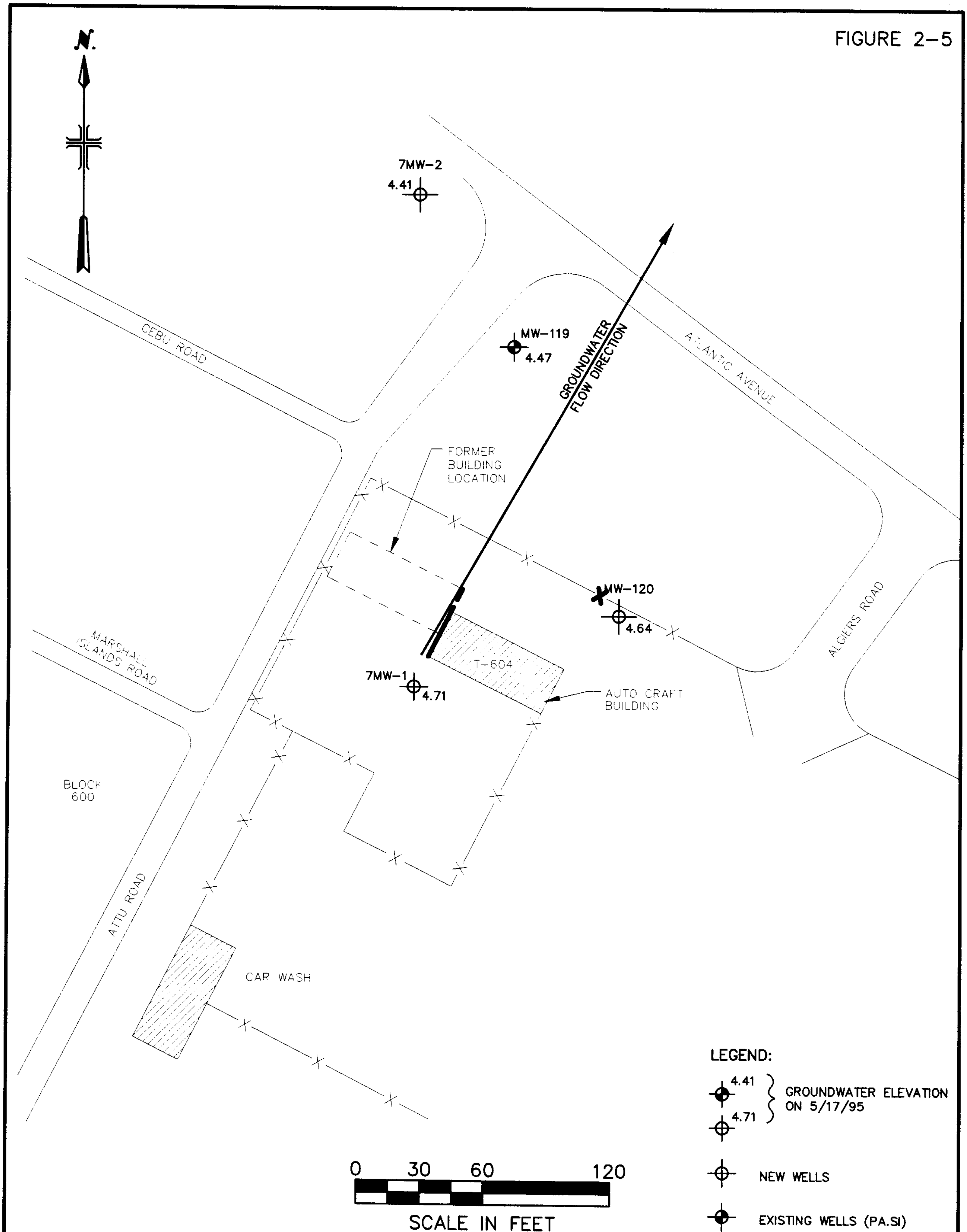

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DECISION DOCUMENT

AUTO CRAFT SITE WATER TABLE ELEVATION MAP

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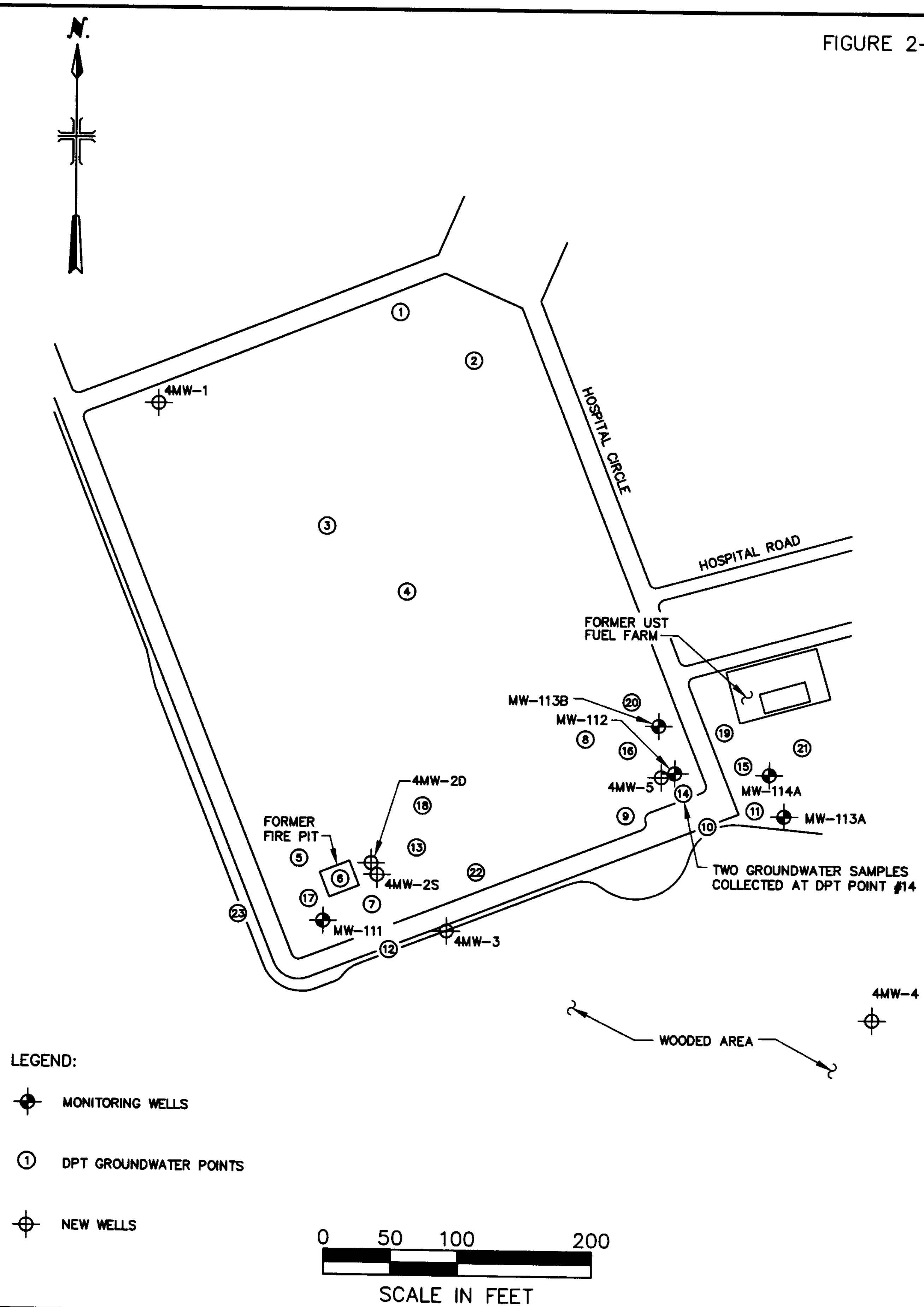
File: L:\0285 - rmy Corps of Engineers\917 - USACE 80th Div RI_F\Cadd\April 2002 - FTA-# FIG2-5.DWG Scale: 1:720 Date: 02/27/2003 Time: 14:38

FIGURE 2-6



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FTA GROUNDWATER SAMPLING LOCATIONS

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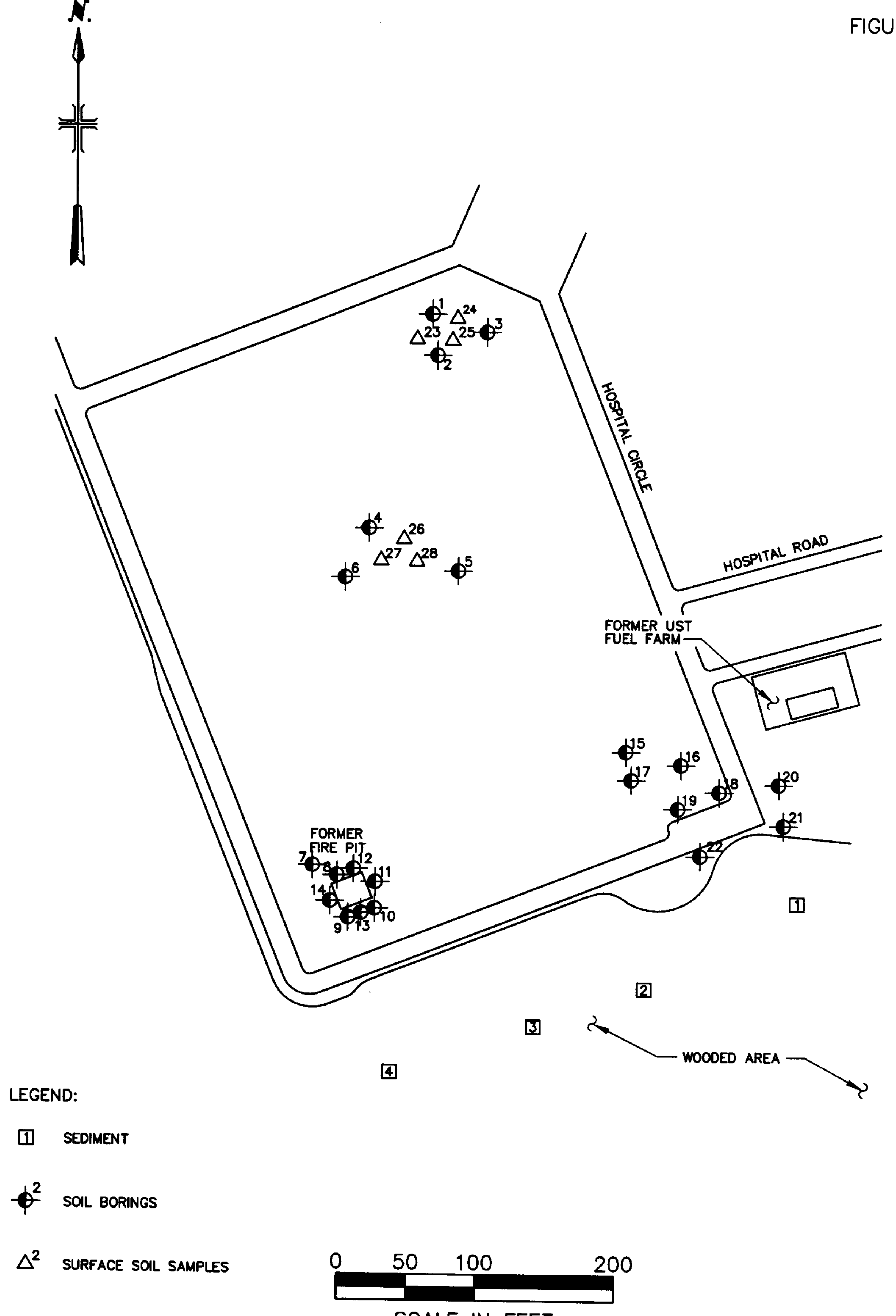
FIGURE 2-7



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FTA SOIL AND SEDIMENT SAMPLING LOCATIONS

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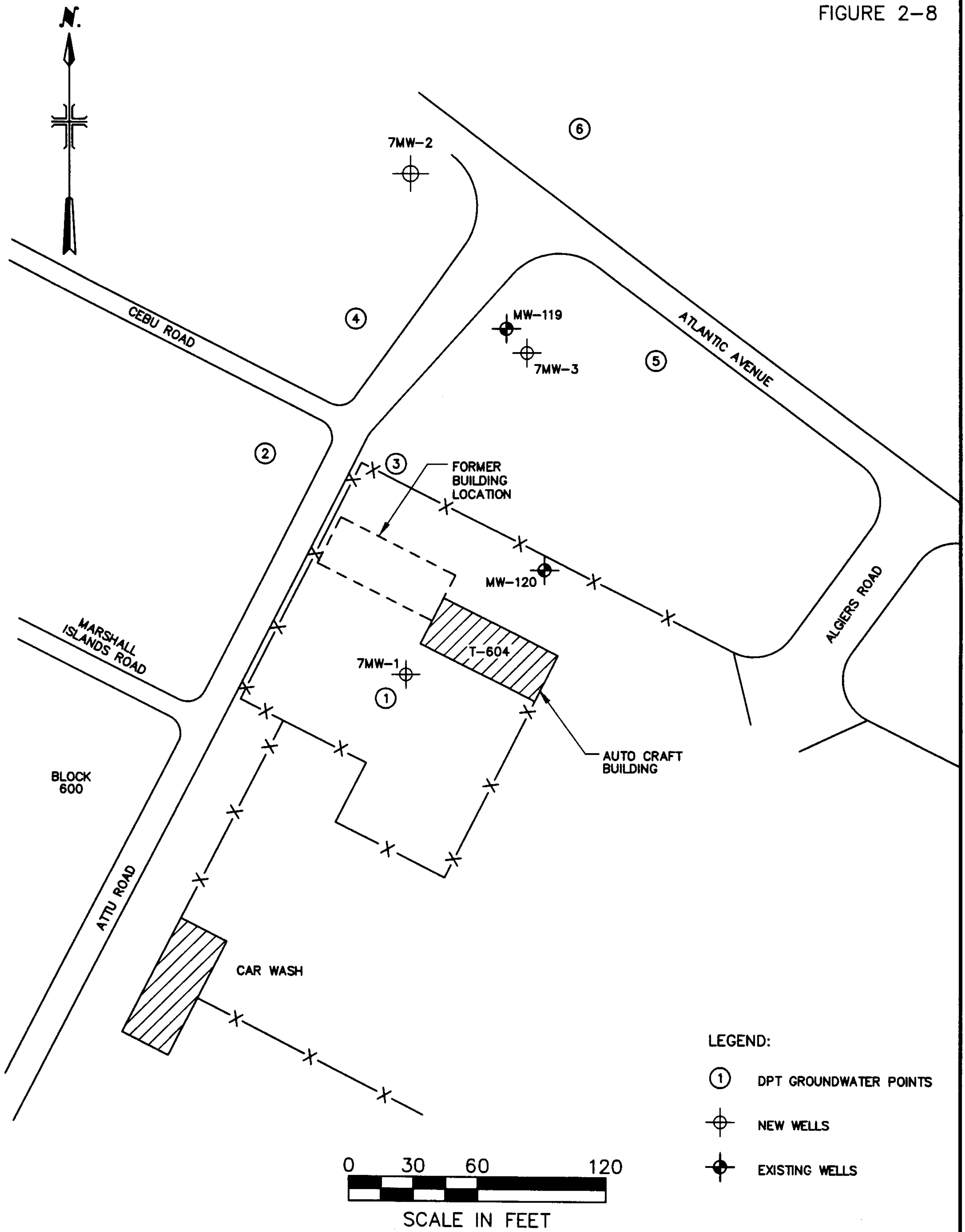
FIGURE 2-8



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AUTO CRAFT GROUNDWATER SAMPLING LOCATIONS

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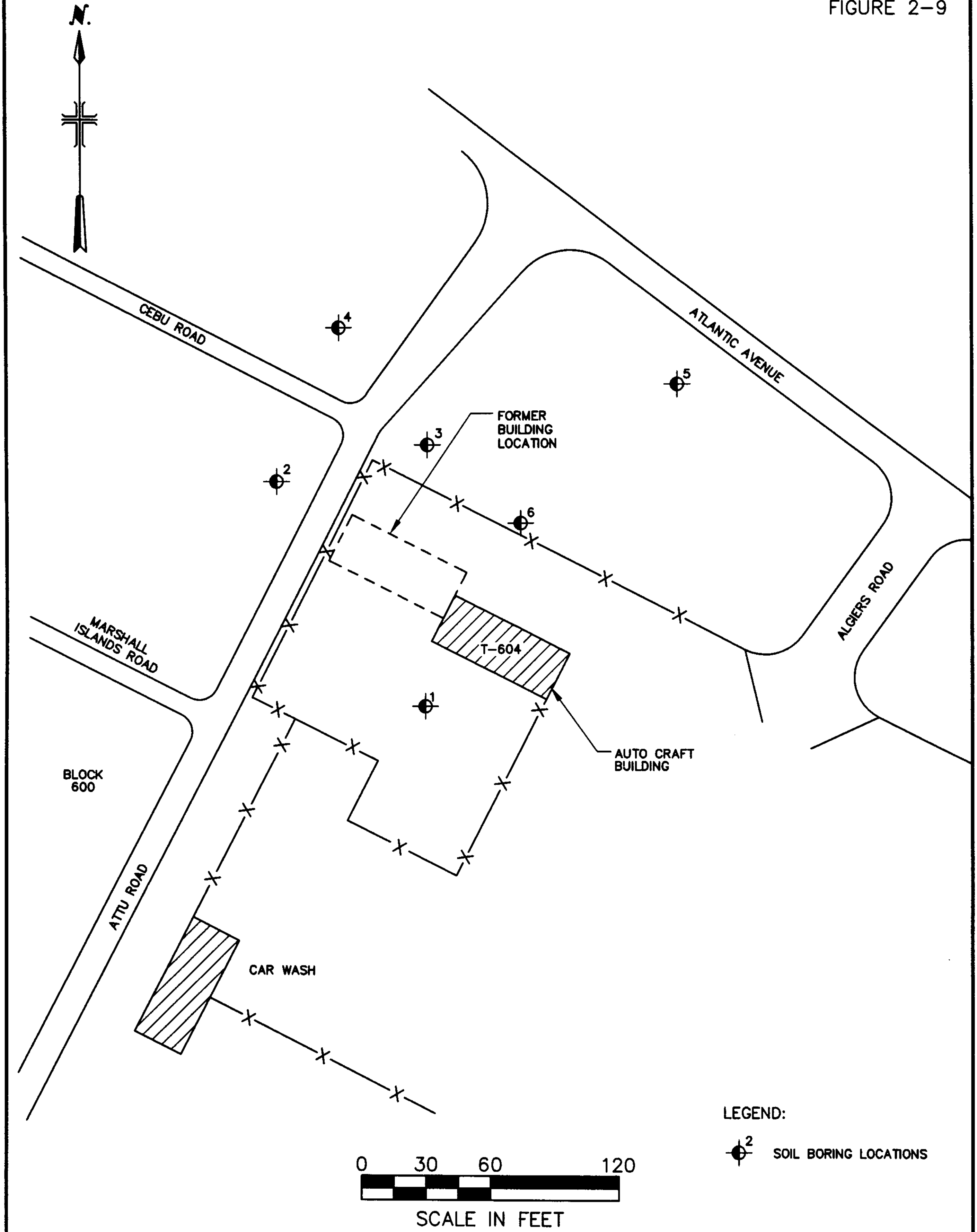

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DECISION DOCUMENT
AUTO CRAFT SOIL SAMPLING LOCATIONS

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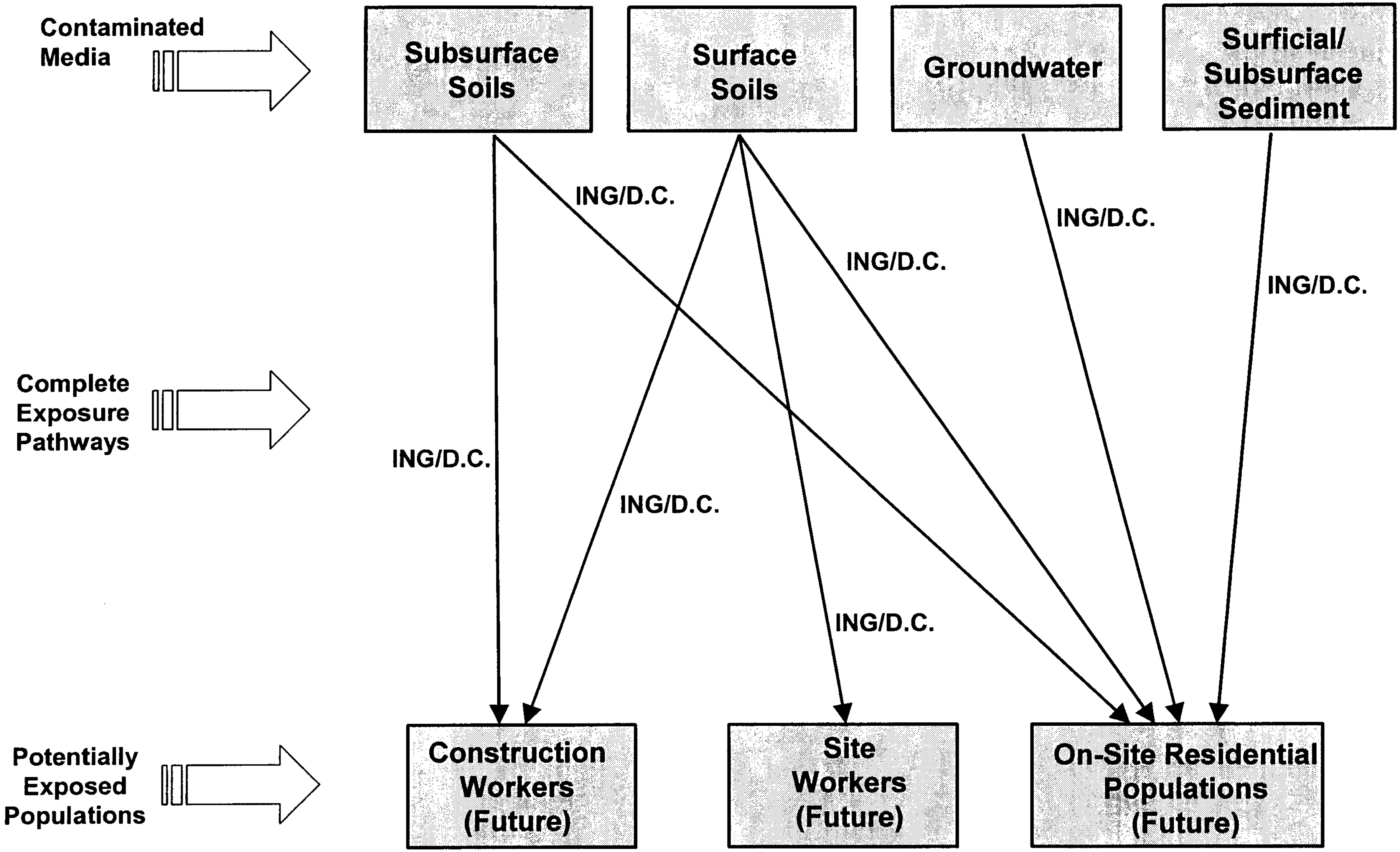

Legend

ING - Ingestion
D.C. - Dermal Contact

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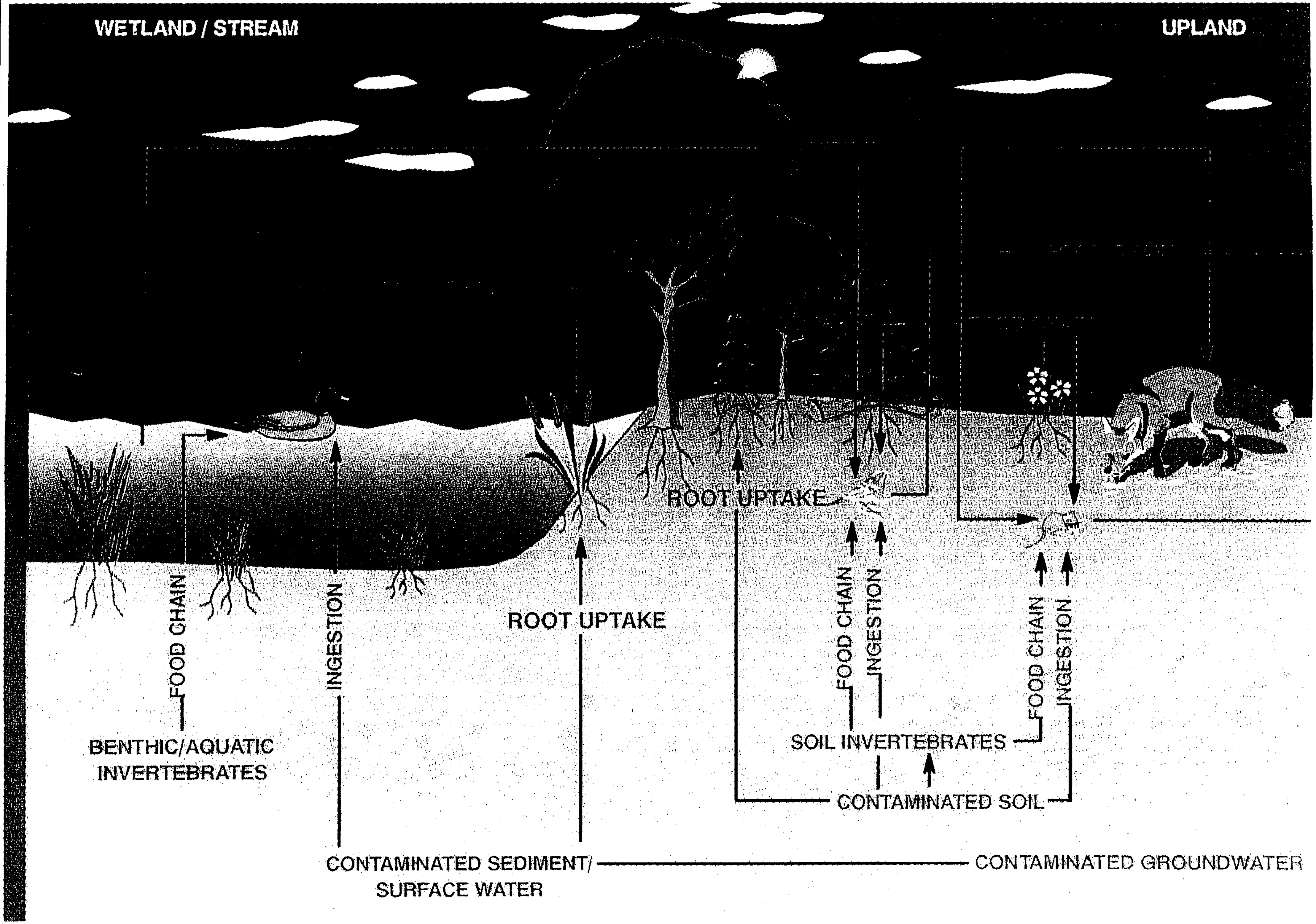
FTA Site
Fort Story, Virginia
Decision Document

Conceptual Site Model

Figure 2-10



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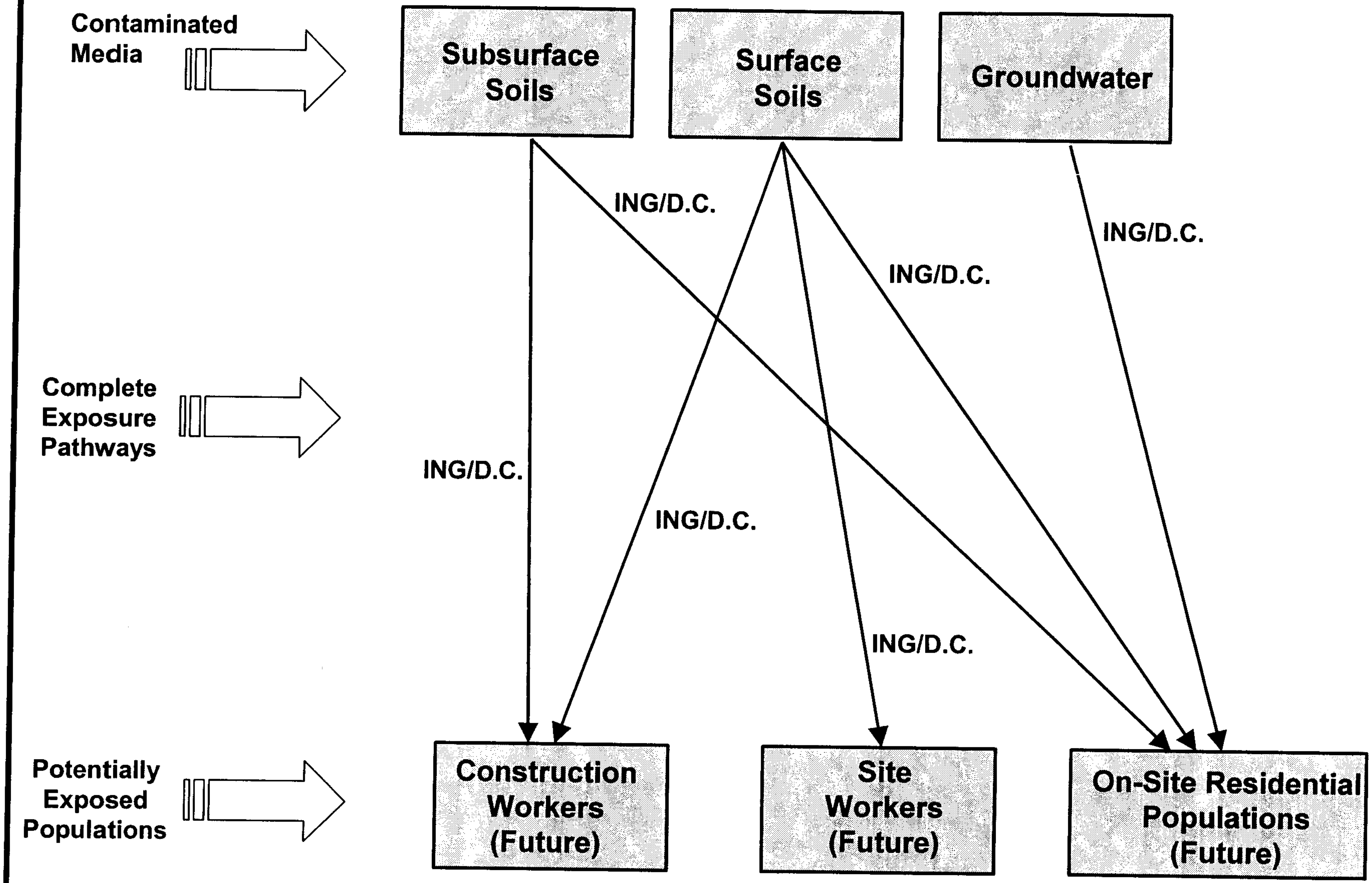
FTA and Auto Craft Sites

Conceptual Site Model – Ecological Receptors

Figure 2-11



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Auto Craft Site
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Conceptual Site Model

Figure 2-12