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NSA MID SOUTH
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TECHNICAL MEMORANDUM PRELIMINARY RISK EVALUATION SOLID WASTE MANAGEMENT UNIT 7 BUILDING N-126 PLATING SHOP DRY WELL MILLINGTON SUPPACT TN
12/21/2005
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TECHNICAL MEMORANDUM

To: Bill Hill, NAVFAC EFD SOUTH
Jennifer Tufts, USEPA Region 4
Roger Donovan, TDEC
Rob Williamson, NSA Mid-South
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Jack Carmichael, USGS

From: Brian Mulhearn, EnSafe Inc.

Date: December 21, 2005

Re: Preliminary Risk Evaluation
SWMU 7 — Building N-126 Plating Shop Dry Well
NSA Mid-South

INTRODUCTION

This memorandum documents the preliminary risk evaluation (PRE) for the Solid Waste Management Unit (SWMU) 7 — Building N-126 Plating Shop Dry Well Statement of Basis. Building N-126 was the Aircraft Intermediate Maintenance Department, which included a plating shop that disposed of plating wastes in a 10 foot square by 6-foot deep gravel-filled dry well. To evaluate whether past operations and disposal practices impacted soil and groundwater, the dry well was designated as SWMU 7, prompting its characterization within the RCRA program.

During the SWMU 7 RCRA Facility Investigation (RFI), the BCT decided that a baseline risk assessment was not warranted at SWMU 7 for two reasons: (1) corrective measures were planned and agreed upon to mitigate risks posed by chlorinated solvents in the fluvial deposits groundwater, and (2) remedial goals for fluvial deposits groundwater were pre-determined. Fluvial deposits groundwater at SWMU 7 and the entire Northside of the base were subsequently designated as Area of Concern A (AOC A), which is undergoing corrective measures.

Soil and groundwater data collected during the SWMU 7 RFI were used to develop this PRE to identify and evaluate site risks. This memorandum was developed to help clarify the decision-making process for SWMU 7 soil and loess groundwater.

HUMAN HEALTH RISK ASSESSMENT

USEPA Region 9 PRGs have been used to evaluate SWMU 7 data for the NSA Mid-South SB's in accordance with USEPA *Supplemental Guidance to RAGS* (USEPA 2005) and *Guidance on Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease* (USEPA 1994).

Data Sources

The source of data for the SWMU 7 PRE can be found in the following documents:

- *RCRA Facility Investigation Report; Naval Support Activity Mid-South. AOC A. Northside Fluvial Groundwater.* Revision 02 (EnSafe, February 17, 2000).
- *RCRA Facility Investigation Report Addendum; Naval Support Activity Mid-South. Area of Concern A. Northside Fluvial Groundwater.* Revision 0 (EnSafe, February 17, 2000).

The soil data set is based on the initial soil/groundwater investigation immediately around Building N-126 and a subsequent step-out of soil borings/monitoring wells (sample locations are shown of Figure 1). The groundwater data-set is from the SWMU 7 monitoring wells constructed in the loess (see Figure 2) and several groundwater monitoring events listed in Table 1.

Figure 1 SWMU 7 at NSA Mid-South in Millington, Tennessee

Calculation of Risk Estimates

The maximum detected concentration for any chemical detected at SWMU 7 was used as the exposure point concentration (EPC). The EPC was compared to screening values that are based on either cancer risk or other toxic effects. Tables show EPCs and screening comparisons, as well as excess cancer risks and hazard quotients calculated based on the screening values (all tables are provided in Attachment 1). Cancer risks for individual chemicals were estimated by taking a ratio between the EPC and the value from the U.S. Environmental Protection Agency (USEPA) Region 9 Preliminary Remediation Goal Table (PRG) table and multiplying this fraction by 1E-06. The sum of cancer risk for each water-bearing zone and soil were compared to USEPA's acceptable risk range of 1 per 1,000,000 to 1 per 10,000. Hazard quotients for individual chemicals were estimated by taking a ratio between the EPC and the value from the Region 9 Preliminary Remediation Goals (PRG) table. The sum of hazard quotients (the hazard index) was calculated for the loess water-bearing zone, and hazard indices were compared to USEPA's threshold of 1.0. Residential and industrial land-use scenarios were considered.

Risk Characterization — Groundwater

Tables 1 and 2 provide the PRE for loess groundwater based on a hypothetical residential land-use scenario where residents are assumed to install wells and use the loess groundwater as drinking water. This assumption is considered extremely conservative because of the loess groundwater low yield and the availability of a public drinking water supply.

As shown in Table 1, the hazard index for the loess groundwater is 6.6, and the cancer risk is 8.9 in 10,000. Primary contributors to the hazard index are TCE, vanadium, and chromium. Primary contributors to risk in the loess groundwater are TCE and arsenic. Secondary contributors in loess groundwater include 1,2-dichloroethane, benzene, and chloroform.

Metals in Loess Groundwater

Site metal concentrations in the loess groundwater are within the same order of magnitude of background concentrations. The maximum vanadium concentration reported in SWMU 7 loess (0.0386 mg/L) is similar to the reference concentration (0.0409 mg/L), both of which are above the vanadium tap water screening PRG (0.0365 mg/L). Similarly, the maximum chromium concentration (0.153 mg/L) is similar to the reference concentration (0.239 mg/L, both of which are above the PRG (0.110 mg/L) and the maximum contaminant level (MCL; 0.100 mg/L). Groundwater arsenic concentrations are also less than corresponding background arsenic concentrations. Comparisons to site background indicate arsenic, chromium, and vanadium are generally consistent with loess groundwater concentrations collected from background locations. For example, SWMU 7 loess groundwater arsenic cancer risk was estimated to be 1.1 in 10,000. Risk based on background arsenic concentrations in loess groundwater was estimated to be 1.6 in 10,000.

Revised Risk and Hazard Estimates After Considering Background

Refined risk estimates were used to account for the naturally occurring concentrations of arsenic, chromium, and vanadium by removing these metals from the calculations. Table 2 was developed to show the PRE calculations excluding arsenic, chromium, and vanadium. The hazard index for the loess groundwater is 5 and the cancer risk is 8 in 10,000. The primary contributor to both the hazard index and cancer risk is TCE.

As shown in Table 2, refined residential hazard indices and risk estimates exceed USEPA's upper bound thresholds of 1.0 and 1E-04 for loess groundwater. The RFI found TCE was limited to a single loess well (007G01LS); therefore, TCE may pose a risk to populations who would use loess groundwater as tap water, assuming a drinking water well would be installed at the location where TCE was detected. This assumption is considered extremely conservative because of the loess groundwater low yield and the availability of a public drinking water supply.

Vapor Intrusion Scenario

Vapor Intrusion is the migration of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in buried wastes and/or contaminated groundwater can emit vapors that may migrate through subsurface soils and into indoor air spaces of overlying buildings in ways similar to that of radon gas seeping into homes. In accordance with USEPA Guidance *Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*, exposure pathway was evaluated by screening volatile compounds in groundwater (USEPA 2005). Table 3 shows comparisons to USEPA screening values that were developed based on the vapor intrusion pathway.

Table 3 indicates TCE in loess groundwater is above the USEPA target groundwater concentration used to gauge whether the contaminants could pose an indoor air quality/inhalation hazard to future site occupants (USEPA 2005). USEPA based their target groundwater concentrations on 1E-4 risk and a residential scenario, so these comparisons are conservative relative to the expected industrial-only land use at this site.

Groundwater Risk Summary

Groundwater risks were evaluated for the residential and default industrial worker scenarios. Risks were identified based on loess groundwater for residential, industrial, and vapor intrusion scenarios. The primary contaminated area is the area around wall 007G01LS. Institutional controls would mitigate risks posed by the ingestion pathway for residential and industrial scenarios. However, future planning and additional controls may be necessary to mitigate risks posed by TCE and the vapor intrusion pathway.

Risk Characterization — Soil

Surface soil data were evaluated using residential and industrial PRGs. Subsurface soil was evaluated using a construction worker scenario, as discussed below.

Surface Soil

Table 4 provides the PRE for the SWMU 7 surface soil based on hypothetical residential and industrial land-use scenarios.

The hazard index for a hypothetical resident is 7 and the cancer risk is 8 in 100,000. The primary contributor to the hazard index is the PCB Aroclor 1260 while the primary contributors to risk are Aroclor 1260 and arsenic. Aroclor 1260 is a chemical of concern (COC) for a residential use scenario based on the estimated hazard index.

The hazard index for a hypothetical industrial worker is 0.9 and the cancer risk is 2 in 100,000, which are both below the USEPA respective thresholds for hazard and risk. No COCs are present under an industrial use scenario.

Subsurface Soil

Subsurface soil data were evaluated assuming a construction worker scenario because construction activities could result in worker exposure. USEPA does not maintain screening PRGs for the construction worker scenario. Consequently, PRGs were derived by accounting for the differences in exposure. The soil ingestion rate construction workers would differ from soil ingestion rates for other scenarios, as would other exposure parameters. Default industrial worker exposure model parameters were changed to address these differences when calculating screening values based on a construction worker scenario. Prior to the SWMU 60 RFI (May 28, 1999), a default hypothetical construction worker scenario and exposure assumptions were agreed upon for NSA Mid-South, so the default exposure assumptions were used in this memorandum for consistency.

A six month exposure frequency and an exposure duration of one year were assumed based on recommendations from USEPA Region 4, TDEC, and the USEPA Region 4 risk assessment review contractor (120 days per year for one year). A higher soil ingestion rate (e.g., 480 mg/day) was assumed to occur during heavy construction activities. The ingestion rate was assumed to diminish (e.g., 200 mg/day) over time as the construction project was completed, so a weighted average approach was used as recommended by USEPA. A weighted average of 340 mg/day was determined to be the default construction worker ingestion rate for NSA Mid-South, assuming half of the exposure time would occur at the higher ingestion rate of 480 mg/day. The modified ingestion rate, exposure duration, and exposure frequency were substituted into exposure models to estimate a construction worker PRG. Additional details and calculations are shown in Attachment 1.

Hypothetical default site workers and construction worker PRGs developed for SWMU 7 were used to evaluate subsurface soil (see Table 5). Each scenario has been characterized separately.

- *Hypothetical Default Site Worker Scenario*
  The hazard index for a hypothetical default site worker is 0.14, and the cancer risk is 7.5 in 1,000,000. No COCs were identified for the hypothetical default site worker scenario.

— *Hypothetical Construction Worker Scenario*
Subsurface soil concentrations do not approach industrial land use PRGs, with the exception of arsenic. However, benzene, carbon tetrachloride, TCE, MCPP, PCE and arsenic were carried through the construction worker calculations as an example for the construction worker scenario for different types of compounds. The hazard index for the construction worker scenario is 0.07, and the cancer risk was estimated to be 4.3 in 10,000,000. No COCs were identified for the hypothetical default site construction worker scenario.

Soil Risk Summary

Soil risks were evaluated for the residential, default industrial, and construction worker scenarios. Excess risk was identified based on the residential scenario and PCB Aroclor 1260 in surface soil. The area of contamination is isolated to sample 007S0007 (detected in only one of 15 samples), and institutional controls would mitigate risks posed by the ingestion pathway for this scenario.

REFERENCES

Voluntary Corrective Action Report; RCRA Facility Investigation; Naval Support Activity Memphis; SWMU 3, 7, 17, 18, 19, 67, and Apron Area Gasoline Pits; Revision 2 (EnSafe, May 1999).

U.S. Environmental Protection Agency. (2005). *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance).* EPA530-D-02-004. November 2002 and updates. Retrieved September 2005 from http://www.epa.gov/epaoswer/hazwaste/ca/eis/vapor.htm.

Guidance on Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease (USEPA 1994).

RCRA Facility Investigation Report, AOC A — Northside Fluvial Groundwater (Revision 2), Millington, TN. February 17, 2000. (EnSafe 2000)

Tables

Table 1
SWMU 7 NSA Mid-South
Preliminary Risk Evaluation of Loess Groundwater

Sample ID	Parameter	Initial		Intermediate		Event 1		Event 3	Max	EPC (µg/L)		MCL (µg/L)	Reference Concentration (µg/L)	Tap Water PRG b, nc (µg/L)	Tap Water PRG b,ca (µg/L)	*SWMU 7 Risk Estimates* PRG Hazard Quotient c	*SWMU 7 Risk Estimates* Cancer Risk	*Background Risk Estimates* PRG Hazard Quotient c	*Background Risk Estimates* Cancer Risk
007G03LS	Acetone	120		ND		NS		NS	120	120	nc	—	—	5.5E+03	—	2.19E-02	—	—	—
007G01LS	1,1-DCA	46		79		NS		NS	79	79	nc	—	—	8.1E+02	—	9.74E-02	—	—	—
007G01LS	1,1-DCE	1	J	4	J	NS		NS	4	4	nc	7	—	3.4E+02	—	1.18E-02	—	—	—
007G01LS	1,2-DCA	3	J	4	J	NS		NS	4	4	ca	5	—	1.0E+01	1.2E-01	3.97E-01	**3.25E-05**	—	—
007G01LS	1,2-DCE	19		34		NS		NS	34	34	nc	70	—	6.1E+01	—	5.59E-01	—	—	—
007G01LS	Benzene	7	J	8	J	NS		NS	8	8	ca	**5**	—	4.39E+01	3.5E-01	1.82E-01	**2.26E-05**	—	—
007G01LS	PCE	ND		2	J	NS		NS	2	2	ca	5	—	6.1E+01	1.0E-01	3.29E-02	**1.92E-05**	—	—
007G01LS	TCE	9	J	19		NS		NS	19	19	ca	**5**	—	9.5E+00	2.8E-02	**2.00E+00**	**6.78E-04**	—	—
007G03LS	BEHP	2	J	NS		NS		NS	2	2	ca	—	—	7.3E+02	4.8E+00	2.74E-03	4.16E-07	—	—
007G05LS	Ethylbenzene	ND		1	J	ND		NS	1	1	nc	700	—	1.3E+03	—	7.46E-04	—	—	—
007G06LS	Phenol	ND		NS		21		NS	21	21	nc	—	—	1.1E+04	—	1.92E-03	—	—	—
007G09LS	Chloroform	2	J	3	J	ND		NS	3	3	ca	80	—	7.98E+01	1.66E-01	3.76E-02	**1.81E-05**	—	—
007G09LS	Di-n-butylphthalate	ND		NS		2	J	NS	2	2	nc	—	—	3.6E+03	—	5.48E-04	—	—	—
007G09LS	TPH - DRO	NS		NS		120		NS	120	120	nc	—	—	100	—	—	—	—	—
007G03LS	Barium	229	J	NS		NS		NS	229	229	nc	2,000	442	2.6E+03	—	8.96E-02	—	1.73E-01	—
007G06LS	Arsenic	5.2	J	2.2	J	NS		NS	5.2	5.2	ca	10	7.3	1.09E+01	4.48E-02	4.75E-01	**1.16E-04**	6.67E-01	**1.63E-04**
007G06LS	Cobalt	19.4	J	5.5	J	NS		NS	19.4	19.4	nc	—	17.8	7.3E+02	—	2.66E-02	—	2.44E-02	—
007G06LS	Copper	39.2		16.2	J	NS		NS	39.2	39.2	nc	1,300	38.8	1.5E+03	—	2.68E-02	—	2.66E-02	—
007G06LS	Vanadium	38.6	J	13.7	J	NS		NS	38.6	**38.6**	nc	—	40.9	3.6E+01	—	**1.06E+00**	—	**1.12E+00**	—
007G06LS	Zinc	107		38.6		NS		NS	107	107	nc	—	154.6	1.09E+04	—	9.77E-03	—	1.41E-02	—
007G06LS	Lead	21		ND		NS		NS	21	**21**	nc	15	17.5	NA	—	—	—	—	—
007G07LS	Nickel	124		40	J	NS		NS	124	**124**	nc	100	173.5	7.30E+02	—	1.70E-01	—	2.38E-01	—
007G07LS	Tin	ND		25.6	J	NS		NS	25.6	25.6	nc	—	—	2.19E+04	—	1.17E-03	—	—	—
007G07LS	Chromium	153		54		NS		NS	153	**153**	nc	100	239	1.1E+02	—	**1.40E+00**	—	**2.18E+00**	—
															TOTAL	**6.6**	**[illegible]**	**4.4**	**1.8E-04**

Notes:

a — Treatment Technology Action Level
b — USEPA Region 9 Tap Water Preliminary Remediation Goals (3/2005) were used as PRGs
c — The noncarcinogen PRG for arsenic was used to calculate the hazard quotient for arsenic
nc — Noncarcinogen
ca — Carcinogen
MCL — Maximum contaminant level (USEPA, 1996)
EPC — Exposure Point Concentration
NS — Not Sampled
ND — Not Detected
Bold text indicates an EPC exceeds an MCL or reference concentration, a hazard quotient is greater than 1.0, or excess cancer risk is greater than 1E-06.
Groundwater monitoring data are from the following sampling events; Initial (March 1995), Intermediate (May 1995), and Event 1 (December 1995), Event 3 (August 1996)

Table 2
SWMU 7 NSA Mid-South
Preliminary Risk Evaluation of Post-RFI Groundwater Monitoring — Removing Arsenic,Vanadium and Chromium

Sample ID	Parameter	Initial		Intermediate		Event 1		Event 3	Max	EPC (µg/L)		MCL (µg/L)	Reference Concentration (µg/L)	Tap Water PRG b, nc (µg/L)	Tap Water PRG b,ca (µg/L)	*SWMU 7 Risk Estimates* PRG Hazard Quotient c	*SWMU 7 Risk Estimates* Cancer Risk	*Background Risk Estimates* PRG Hazard Quotient c	*Background Risk Estimates* Cancer Risk
007G03LS	Acetone	120		ND		NS		NS	120	120	nc	—	—	5.5E+03	—	2.19E-02	—	—	—
007G01LS	1,1-DCA	46		79		NS		NS	79	79	nc	—	—	8.1E+02	—	9.74E-02	—	—	—
007G01LS	1,1-DCE	1	J	4	J	NS		NS	4	4	nc	7		3.4E+02	—	1.18E-02	—	—	—
007G01LS	1,2-DCA	3	J	4	J	NS		NS	4	4	ca	5	—	1.0E+01	1.2E-01	3.97E-01	**3.25E-05**	—	—
007G01LS	1,2-DCE	19		34		NS		NS	34	34	nc	70	—	6.1E+01	—	5.59E-01	—	—	—
007G01LS	Benzene	7	J	8	J	NS		NS	8	8	ca	5	—	4.39E+01	3.5E-01	1.82E-01	**2.26E-05**	—	—
007G01LS	PCE	ND		2	J	NS		NS	2	2	ca	5	—	6.1E+01	1.0E-01	3.29E-02	**1.92E-05**	—	—
007G01LS	TCE	9	J	19		NS		NS	19	19	ca	5	—	9.5E+00	2.8E-02	**2.00E+00**	**6.78E-04**	—	—
007G03LS	BEHP	2	J	NS		NS		NS	2	2	ca	—	—	7.3E+02	4.8E+00	2.74E-03	4.16E-07	—	—
007G05LS	Ethylbenzene	ND		1	J	ND		NS	1	1	nc	700	—	1.3E+03	—	7.46E-04	—	—	—
007G06LS	Phenol	ND		NS		21		NS	21	21	nc	—	—	1.1E+04	—	1.92E-03	—	—	—
007G09LS	Chloroform	2	J	3	J	ND		NS	3	3	ca	80	—	7.98E+01	—	3.76E-02	—	—	—
007G09LS	Di-n-butylphthalate	ND		NS		2	J	NS	2	2	nc	—	—	3.6E+03	—	5.48E-04	—	—	—
007G09LS	TPH - DRO	NS		NS		120		NS	120	120	nc	—	—	100	—	—	—	—	—
007G03LS	Barium	229	J	NS		NS		NS	229	229	nc	2,000	442	2.6E+03	—	8.96E-02	—	1.73E-01	—
007G06LS	Arsenic	5.2	J	2.2	J	NS		NS	5.2	5.2	ca	10	7.3	1.09E+01	4.48E-02	—	—	6.67E-01	**1.63E-04**
007G06LS	Cobalt	19.4	J	5.5	J	NS		NS	19.4	19.4	nc	—	17.8	7.3E+02	—	2.66E-02	—	2.44E-02	—
007G06LS	Copper	39.2		16.2	J	NS		NS	39.2	39.2	nc	1,300	38.8	1.5E+03	—	2.68E-02	—	2.66E-02	—
007G06LS	Vanadium	38.6	J	13.7	J	NS		NS	38.6	38.6	nc	—	40.9	3.6E+01	—	—	—	**1.12E+00**	—
007G06LS	Zinc	107		38.6		NS		NS	107	107	nc	—	154.6	1.09E+04	—	9.77E-03	—	1.41E-02	—
007G06LS	Lead	21		ND		NS		NS	21	**21**	nc	15	17.5	NA	—	—	—	—	—
007G07LS	Nickel	124		40	J	NS		NS	124	**124**	nc	100	173.5	7.30E+02	—	1.70E-01	—	2.38E-01	—
007G07LS	Tin	ND		25.6	J	NS		NS	25.6	25.6	nc	—	—	2.19E+04	—	1.17E-03	—	—	—
007G07LS	Chromium	153		54		NS		NS	153	**153**	nc	100	239	1.1E+02	—	—	—	**2.18E+00**	—
															Total	3.7	7.5E-04	4.4	1.8E-04

Notes:

a — Treatment Technology Action Level
b — USEPA Region 9 Tap Water Preliminary Remediation Goals (3/2005) were used as PRGs
c — The noncarcinogen PRG for arsenic was used to calculate the hazard quotient for arsenic
nc — Noncarcinogen
ca — Carcinogen
MCL — Maximum contaminant level (USEPA, 1996)
EPC — Exposure Point Concentration
NS — Not Sampled
ND — Not Detected
Bold text indicates an EPC exceeds an MCL or reference concentration, a hazard quotient is greater than 1.0, or excess cancer risk is greater than 1E-06.
Groundwater monitoring data are from the following sampling events: Initial (March 1995), Intermediate (May 1995), and Event 1 (December 1995), Event 3 (August 1996)

Table 3
SWMU 7 NSA Mid-South
Screening Evaluation of Loess Groundwater for the Vapor Intrusion Pathway

Sample ID	Parameter	Initial		Intermediate		Event 1		Event 3	Max	EPC (µg/L)		MCL (µg/L)	Reference Concentration (µg/L)	Screening Value b (µg/L)	Notes
007G03LS	Acetone	120		ND		NS		NS	120	120	nc	—	—	2.20E+05	Volatile; below screening value
007G01LS	1,1-DCA	46		79		NS		NS	79	79	nc	—	—	2.20E+03	Volatile; below screening value
007G01LS	1,1-DCE	1	J	4	J	NS		NS	4	4	nc	7		1.90E+02	Volatile; below screening value
007G01LS	1,2-DCA	3	J	4	J	NS		NS	4	4	ca	5	—	2.30E+02	Volatile; below screening value
007G01LS	1,2-DCE	19		34		NS		NS	34	34	nc	70	—	—	Not listed in EPA guidance
007G01LS	Benzene	7	J	8	J	NS		NS	8	8	ca	**5**	—	1.40E+02	Volatile; below screening value
007G01LS	PCE	ND		2	J	NS		NS	2	2	ca	5	—	1.10E+02	Volatile; below screening value
007G01LS	TCE	9	J	19		NS		NS	19	19	ca	**5**	—	5.30E+00	Volatile; above screening value
007G03LS	BEHP	2	J	NS		NS		NS	2	2	ca	—	—	—	Not sufficiently toxic or volatile
007G05LS	Ethylbenzene	ND		1	J	ND		NS	1	1	nc	700	—	7.00E+02	Volatile; below screening value
007G06LS	Phenol	ND		NS		21		NS	21	21	nc	—	—	—	Not sufficiently volatile
007G09LS	Chloroform	2	J	3	J	ND		NS	3	3	ca	80	—	8.00E+01	Volatile; below screening value
007G09LS	Di-n-butylphthalate	ND		NS		2	J	NS	2	2	nc	—	—	—	Not sufficiently toxic or volatile
007G09LS	TPH - DRO	NS		NS		120		NS	120	120	nc	—	—	—	Not sufficiently toxic or volatile
007G03LS	Barium	229	J	NS		NS		NS	229	229	nc	2,000	442	—	Not sufficiently volatile
007G06LS	Arsenic	5.2	J	2.2	J	NS		NS	5.2	5.2	ca	10	7.3	—	Not sufficiently volatile
007G06LS	Cobalt	19.4	J	5.5	J	NS		NS	19.4	19.4	nc	—	17.8	—	Not sufficiently volatile
007G06LS	Copper	39.2		16.2	J	NS		NS	39.2	39.2	nc	1,300	38.8	—	Not sufficiently volatile
007G06LS	Vanadium	38.6	J	13.7	J	NS		NS	38.6	38.6	nc	—	40.9	—	Not sufficiently volatile
007G06LS	Zinc	107		38.6		NS		NS	107	107	nc	—	154.6	—	Not sufficiently volatile
007G06LS	Lead	21		ND		NS		NS	21	21	nc	15	17.5	—	Not sufficiently volatile
007G07LS	Nickel	124		40	J	NS		NS	124	124	nc	100	173.5	—	Not sufficiently volatile
007G07LS	Tin	ND		25.6	J	NS		NS	25.6	25.6	nc	—	_	—	Not sufficiently volatile
007G07LS	Chromium	153		54		NS		NS	153	153	nc	100	239	—	Not sufficiently volatile

Notes:

a — Treatment Technology Action Level
b — USEPA Target Groundwater Concentrations from their Vapor Intrusion Guidance were used as Screening Values (USEPA Table 2a)
MCL — Maximum contaminant level (USEPA; 1996)
EPC — Exposure Point Concentration
NS — Not Sampled
ND — Not Detected
Bold text indicates an EPC exceeds an MCL or reference concentration; highlighted text indicates a chemical of potential concern for the vapor intrusion pathway
Groundwater monitoring data are from the following sampling events: Initial (March 1995), Intermediate (May 1995), and Event 1 (December 1995), Event 3 (August 1996)

Table 4
SWMU 7 NSA Mid-South
Preliminary Risk Evaluation of Surface Soil

				Residential PRGs [a]		*Industrial PRGs* [a]		*SWMU 7 Residential Risk Estimate*				*SWMU 7 Industrial Risk Estimate*			
								Residential Risk		*Background*		*Industrial*		*Background*	
Parameter	EPC (mg/kg)	Endpoint	Background Reference Conc.	PRG (Hazard)	PRG (Cancer)	PRG (Hazard)	PRG (Cancer)	PRG Hazard Quotient	Cancer Risk	PRG Hazard Quotient	Cancer Risk	PRG Hazard Quotient	Cancer Risk	PRG Hazard Quotient	Cancer Risk
Acetone	1.1	nc	—	1.41E+04	—	5.42E+04	—	7.79E-05	—	—	—	2.03E-05	—	—	—
Methyl ethyl ketone (2-Butanone)	0.069	nc	—	2.23E+04	—	1.13E+05	—	3.09E-06	—	—	—	6.09E-07	—	—	—
Benzene	0.008	ca	—	3.29E+01	6.43E-01	1.17E+02	1.41E+00	2.43E-04	1.24E-08	—	—	6.85E-05	5.68E-09	—	—
Bromomethane	0.006	nc	—	3.90E+00	—	1.31E+01	—	1.54E-03	—	—	—	4.59E-04	—	—	—
Chloromethane	0.006	nc	—	4.69E+01	—	1.56E+02	—	1.28E-04	—	—	—	3.85E-05	—	—	—
Ethylbenzene	0.014	nc	—	1.86E+03	—	7.42E+03	—	7.51E-06	—	—	—	1.89E-06	—	—	—
Toluene	0.17	nc	—	6.56E+02	—	2.21E+03	—	2.59E-04	—	—	—	7.68E-05	—	—	—
Xylenes	0.049	nc	—	2.71E+02	—	8.97E+02	—	1.81E-04	—	—	—	5.46E-05	—	—	—
2-Methylnaphthalene [b]	0.082	nc	—	5.6E+01	—	1.9E+02	—	1.47E-03	—	—	—	4.37E-04	—	—	—
Acenaphthene	0.12	nc	—	3.68E+03	—	2.92E+04	—	3.26E-05	—	—	—	4.11E-06	—	—	—
Anthracene	0.31	nc	—	2.19E+04	—	2.38E+05	—	1.42E-05	—	—	—	1.30E-06	—	—	—
Benz[a]anthracene [c]	1.2	ca	—	—	6.21E-01	—	2.11E+00	—	**1.93E-06**	—	—	—	5.69E-07	—	—
Benzo[a]pyrene [c]	1.2	ca	—	—	6.21E-02	—	2.11E-01	—	**1.93E-05**	—	—	—	**5.69E-06**	—	—
Benzo[b]fluoranthene [c]	1.2	ca	—	—	6.21E-01	—	2.11E+00	—	**1.93E-06**	—	—	—	5.69E-07	—	—
Benzo(g,h,i)perylene [c]	0.71	nc	—	2.3E+03	—	2.9E+04	—	3.07E-04	—	—	—	2.44E-05	—	—	—
Benzo(k)fluoranthene [c]	0.99	ca	—	—	6.2E+00	—	2.1E+01	—	1.59E-07	—	—	—	4.69E-08	—	—
bis(2-ethylhexyl)phthalate (DEHP)	0.25	ca	—	—	3.47E+01	—	1.23E+02	—	7.20E-09	—	—	—	2.03E-09	—	—
Carbazole	0.16	ca	—	—	2.43E+01	—	8.62E+01	—	6.58E-09	—	—	—	1.86E-09	—	—
Chrysene [c]	1.2	ca	—	—	6.21E+01	—	2.11E+02	—	1.93E-08	—	—	—	5.69E-09	—	—
Dibenz[ah]anthracene [c]	0.24	ca	—	—	6.21E-02	—	2.11E-01	—	**3.86E-06**	—	—	—	**1.14E-06**	—	—
Dibenzofuran	0.072	nc	—	1.45E+02	—	1.56E+03	—	4.96E-04	—	—	—	4.61E-05	—	—	—
Fluoranthene	2.8	nc	—	2.29E+03	—	2.20E+04	—	1.22E-03	—	—	—	1.27E-04	—	—	—
Fluorene	0.19	nc	—	2.75E+03	—	2.63E+04	—	6.92E-05	—	—	—	7.23E-06	—	—	—
Indeno[1,2,3-cd]pyrene [c]	0.61	ca	—	—	6.21E-01	—	2.11E+00	—	9.82E-07	—	—	—	2.89E-07	—	—
Naphthalene	0.22	nc	—	5.59E+01	—	1.88E+02	—	3.93E-03	—	—	—	1.17E+03	—	—	—
Phenanthrene [c]	1.6	nc	—	2.3E+03	—	2.3E+03	—	6.91E-04	—	—	—	6.91E-04	—	—	—
2,4,5-Trichlorophenol	0.0017	nc	—	6.11E+03	—	6.16E+04	—	2.78E-07	—	—	—	2.76E-08	—	—	—
2,4,5-Trichlorophenoxyacetic Acid	0.0038	nc	—	6.11E+02	—	6.16E+03	—	6.22E-06	—	—	—	6.17E-07	—	—	—
2,4-DB	0.059	nc	—	4.89E+02	—	4.92E+03	—	1.21E-04	—	—	—	1.20E-05	—	—	—
Dicamba	0.0086	nc	—	1.83E+03	—	1.85E+04	—	4.69E-06	—	—	—	4.66E-07	—	—	—
Guthion	0.28	NA	—	NA	NA	—	—	—	—	—	—	—	—	—	—
DDD	0.0056	ca	—	—	2.44E+00	—	9.95E+00	—	2.30E-09	—	—	—	5.63E-10	—	—
DDE	0.012	ca	—	—	1.72E+00	—	7.02E+00	—	6.98E-09	—	—	—	1.71E-09	—	—
DDT	0.038	ca	—	—	1.72E+00	—	7.02E+00	—	2.21E-08	—	—	—	5.41E-09	—	—
Dieldrin	0.42	ca	0.262	3.06E+00	3.04E-02	3.08E+01	1.08E-01	1.37E-01	**1.38E-05**	8.58E-02	**8.62E-06**	1.36E-02	**3.90E-06**	8.51E-03	**2.43E-06**
Heptachlor epoxide	0.0042	ca	—	7.94E-01	5.34E-02	8.00E+00	1.89E-01	5.29E-03	7.86E-08	—	—	5.25E-04	2.22E-08	—	—
Aroclor 1260 [d]	6.8	ca	—	1.1E+00	2.2E-01	1.1E+01	7.4E-01	**6.05E+00**	**3.07E-05**	—	—	6.40E-01	**9.14E-06**	—	—
Methylene chloride	0.002	ca	—	1.95E+03	9.11E+00	9.27E+03	2.05E+01	1.02E-06	2.20E-10	—	—	2.16E-07	9.74E-11	—	—
Arsenic	14	ca	13.1	2.16E+01	3.90E-01	2.56E+02	1.59E+00	6.47E-01	**3.59E-05**	6.05E-01	**3.36E-05**	5.47E-02	**8.80E-06**	5.12E-02	**8.24E-06**
Barium	272	nc	191	5.37E+03	—	6.66E+04	—	5.06E-02	—	3.55E-02	—	4.09E-03	—	2.87E-03	—
Beryllium	0.65	ca	0.96	1.5E+02	1.1E+03	1.9E+03	2.2E+03	4.21E-03	6.17E-10	6.22E-03	9.11E-10	3.35E-04	2.90E-10	4.95E-04	4.28E-10
Cadmium	4.2	nc	—	3.70E+01	1.40E+03	6.66E+04	2.99E+03	1.13E-01	2.99E-09	—	—	6.31E-05	1.41E-09	—	—
Chromium	24.1	ca	26.4	—	3.01E+01	—	1.94E+03	—	8.01E-07	—	8.77E-07	—	1.24E-08	—	1.36E-08
Cobalt	18.6	nc	15	9.03E+02	—	4.51E+02	—	2.06E-02	—	1.66E-02	—	4.12E-02	—	3.32E-02	—
Copper	22.5	ca	23.6	—	3.13E+03	—	4.09E+04	—	7.19E-09	—	7.54E-09	—	5.50E-10	—	5.77E-10
Lead	132	nc	28.7	4.0E+02	—	8.0E+02	—	3.30E-01	—	7.18E-02	—	1.65E-01	—	3.59E-02	—
Mercury	0.12	nc	1.1	6.11E+00	—	4.09E+04	—	1.96E-02	—	1.80E-01	—	2.94E-06	—	2.69E-05	—
Nickel	23.7	nc	—	1.56E+03	—	2.04E+04	—	1.52E-02	—	—	—	1.16E-03	—	—	—
Selenium	0.55	nc	—	3.91E+02	—	6.16E+01	—	1.41E-03	—	—	—	8.93E-03	—	—	—
							TOTAL	7.81E+00	1.19E-04	1.00E+00	4.91E-05	8.13E-01	1.02E-05	1.12E-01	1.07E-05

Notes:

a — USEPA Region 9 Preliminary Remediation Goals (3/2005) were used as PRGs
b — No PRG exists for parameter. Naphthalene PRG used as a surrogate
c — No PRG exists for parameter. Pyrene PRG used as a surrogate
d — No PRG exists for parameter. High risk PCBs (e.g. Aroclor 1254) PRG used as surrogate.

nc — Noncarcinogen
ca — Carcinogen
EPC — Exposure Point Concentration

Bold text indicates an EPC exceeds contains a hazard quotient greater than 1.0 or excess cancer risk is greater than 1E-06

Table 5
SWMU 7 NSA Mid-South
Preliminary Risk Evaluation of Subsurface Soil

							SWMU 7 Industrial Risk Estimate				*SWMU 7 Construction Worker Risk Estimate*			
			Industrial PRGs[a]		*Contruction Worker PRGs*[b]		*Industrial*		*Background*		*Construction Worker Risk*		*Background*	
Parameter	EPC (mg/kg)	Background Reference Conc.[c,d]	PRG (Hazard)	PRG (Cancer)	PRG (Hazard)	PRG (Cancer)	PRG Hazard Quotient	Cancer Risk	PRG Hazard Quotient	Cancer Risk	PRG Hazard Quotient	Cancer Risk	PRG Hazard Quotient	Cancer Risk
2-Butanone (MEK)	0.019	—	1.13E+05	—	—	—	1.65E-07	—	—	—	—	—	—	—
2-Hexanone	0.015	—	—	—	—	—	—	—	—	—	—	—	—	—
2-Methyl-2-Pentanone (MIBK)	0.000017	—	4.70E+04	—	—	—	3.62E-10	—	—	—	—	—	—	—
Acetone	0.00022	—	5.43E+04	—	—	—	4.05E-09	—	—	—	—	—	—	—
Benzene	0.000029	—	1.17E+02	1.41E+00	9.81E+02	3.12E+02	2.48E-07	2.06E-11	—	—	2.96E-08	9.29E-14	—	—
Bromomethane	0.000004	—	1.31E+01	—	—	—	3.06E-07	—	—	—	—	—	—	—
Carbon tetrachloride	0.000003	—	7.32E+00	5.49E-01	1.72E+02	1.32E+02	4.10E-07	5.46E-12	—	—	1.75E-08	2.27E-14	—	—
Chloromethane	0.000006	—	1.56E+02	—	—	—	3.85E-08	—	—	—	—	—	—	—
1,2-Dichloroethylene (cis)	0.000002	—	1.46E+02	—	—	—	1.37E-08	—	—	—	—	—	—	—
1,1-Dichloroethane	0.000003	—	1.74E+03	6.01E+00	—	—	1.73E-09	4.99E-13	—	—	—	—	—	—
Ethylbenzene	0.000002	—	7.42E+03	—	—	—	2.70E-10	—	—	—	—	—	—	—
Toluene	0.000009	—	2.21E+03	—	—	—	4.07E-09	—	—	—	—	—	—	—
Trichloroethylene (TCE)	0.000012	—	1.08E+02	1.15E-01	7.36E+01	4.29E+01	1.11E-07	1.05E-10	—	—	1.63E-07	2.80E-13	—	—
1,1,1-Trichloroethane	0.000108	—	6.95E+03	—	—	—	1.55E-08	—	—	—	—	—	—	—
Tetrachloroethylene (PCE)	0.000002	—	1.29E+02	1.31E+00	2.45E+03	3.18E+01	1.55E-08	1.53E-12	—	—	8.15E-10	6.29E-14	—	—
Xylenes	0.000005	—	8.97E+02	—	—	—	5.57E-09	—	—	—	—	—	—	—
bis(2-ethylhexyl)phthalate (DEHP)	0.000055	—	1.23E+04	1.23E+02	—	—	4.47E-09	4.47E-13	—	—	—	—	—	—
Petroleum Hydrocarbons, TPH	750	—	—	—	—	—	—	—	—	—	—	—	—	—
2,4,5-TP Silvex	0.0016	—	4.92E+03	—	—	—	3.25E-07	—	—	—	—	—	—	—
2,4-D	0.12	—	7.68E+03	—	—	—	1.56E-05	—	—	—	—	—	—	—
MCPP	3	—	6.16E+02	—	5.24E+02	NA	5.36E-03	—	—	—	6.29E-03	—	—	—
Arsenic	**11.9**	20.4	2.56E+02	1.59E+00	1.78E+02	2.76E+01	4.65E-02	**7.48E-06**	7.97E-02	**1.28E-05**	6.70E-02	4.31E-07	1.15E-01	7.39E-07
Barium	216	289	6.66E+04	—	—	—	3.24E-03	—	4.34E-03	—	—	—	—	—
Beryllium	0.79	1.02	1.94E+03	2.24E+03	—	—	4.07E-04	3.52E-10	5.26E-04	4.55E-10	—	—	—	—
Cadmium	21.4	6.8	4.51E+02	2.99E+03	—	—	4.74E-02	7.16E-09	1.51E-02	2.28E-09	—	—	—	—
Chromium	23.9	28.6	1.30E+06	—	—	—	1.84E-05	—	2.20E-05	—	—	—	—	—
Cobalt	10.2	15.3	1.33E+04	1.92E+03	—	—	7.65E-04	5.31E-09	1.15E-03	7.96E-09	—	—	—	—
Copper	20.6	33.9	4.09E+04	—	—	—	5.04E-04	—	8.29E-04	—	—	—	—	—
Lead	26.9	25.1	—	—	—	—	—	—	—	—	—	—	—	—
Mercury	0.15	0.38	3.07E+02	—	—	—	4.89E-04	—	1.24E-03	—	—	—	—	—
Nickel	28	24.5	2.04E+04	—	—	—	1.37E-03	—	1.20E-03	—	—	—	—	—
Vanadium	34.8	46.3	1.02E+03	—	—	—	3.41E-02	—	4.53E-02	—	—	—	—	—
Zinc	73.1	111.8	3.06E+05	—	—	—	2.39E-04	—	3.65E-04	—	—	—	—	—
						TOTAL	1.49E-01	7.58E-06	1.90E-01	1.28E-05	7.37E-02	4.31E-07	1.15E-01	7.39E-07

Notes:

a — USEPA Region 9 Preliminary Remediation Goals (3/2005) were used as PRGs
b — Chemicals with EPCs greater than Industrial PRGs will be evalutated for the construction worker scenario
c — EnSafe/Allen & Hoshall. Assemblies A-D Background Reference Concentration Technical Memorandum, Naval Support Activity Memphis, September 11, 1996.
d — EnSafe/Allen & Hoshall. Addendum to the September 18, 1996 Assemblies A through D Background Reference Concentrations (nickel only)
EPC — Exposure Point Concentration
Bold text indicates an EPC exceeds contains a hazard quotient greater than 1.0 or excess cancer risk is greater than 1E-06.

Table 6
Summary Toxicity Values
NSA Mid-South, Millington, TN

		Toxicity Values									
CAS No.	**Chemical**	**SFo 1/(mg/kg-d)**		**RfDo (mg/kg-d)**		**SFi 1/(mg/kg-d)**		**RfDi (mg/kg-d)**		**VOC**	**skin abs. soils**
71-43-2	Benzene	5.5E-02	i	4.0E-03	i	2.7E-02	i	8.6E-03	i	y	0.8
56-23-5	Carbon tetrachloride	1.3E-01	i	7.0E-04	i	5.3E-02	i	7.0E-04	r	y	0.8
79-01-6	Trichloroethylene (TCE)	4.0E-01	n	3.0E-04	n	4.0E-01	n	1.0E-02	n	y	0.8
127-18-4	Tetrachloroethylene (PCE)	5.4E-01	c	1.0E-02	i	2.1E-02	c	1.0E-02	c	y	0.8
16484-77-8	MCPP	NA		1.0E-03	i	NA		1.0E-03	r		0.1
7440-38-2	Arsenic	1.5E+00	i	3.0E-04	i	1.5E+01	i	3.0E-04	r		0.03

Notes:

SFo — Oral slope factor; USEPA Region 9
RfDo — Oral reference dose; USEPA Region 9
SFi — Inhalation slope factor; USEPA Region 9
RfDi — Inhalation reference dose; USEPA Region 9
VOC — Volatile organic compound
i — EPA IRIS database
c — California EPA toxicological value
n — EPA NCEA
r — Route-extrapolation
NA — Not Applicable/Not Available
y — Chemical is volatile
skin abs. soils — Fraction skin absorption from soil

Attachment 1
Figures

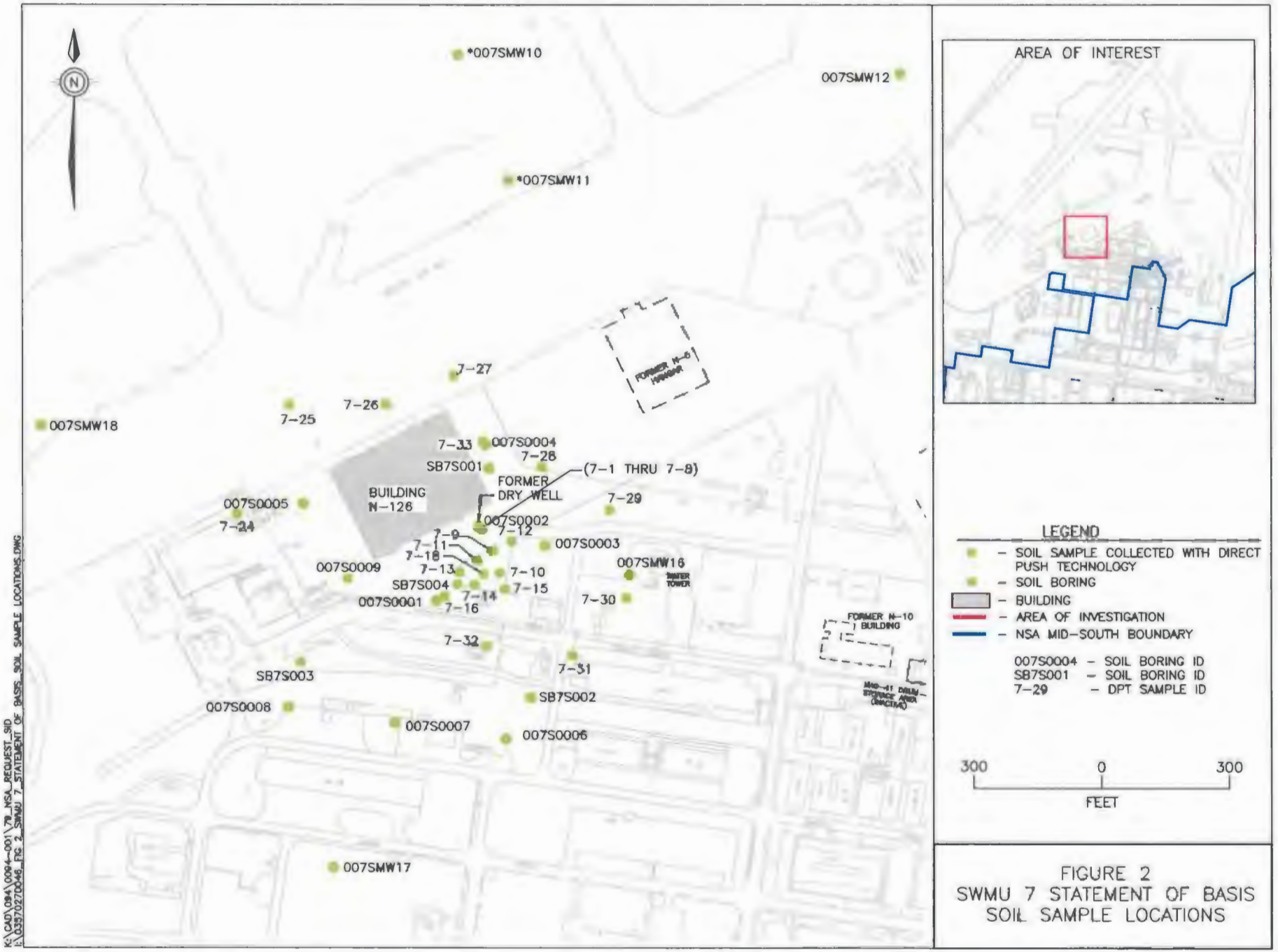

FIGURE 2
SWMU 7 STATEMENT OF BASIS
SOIL SAMPLE LOCATIONS

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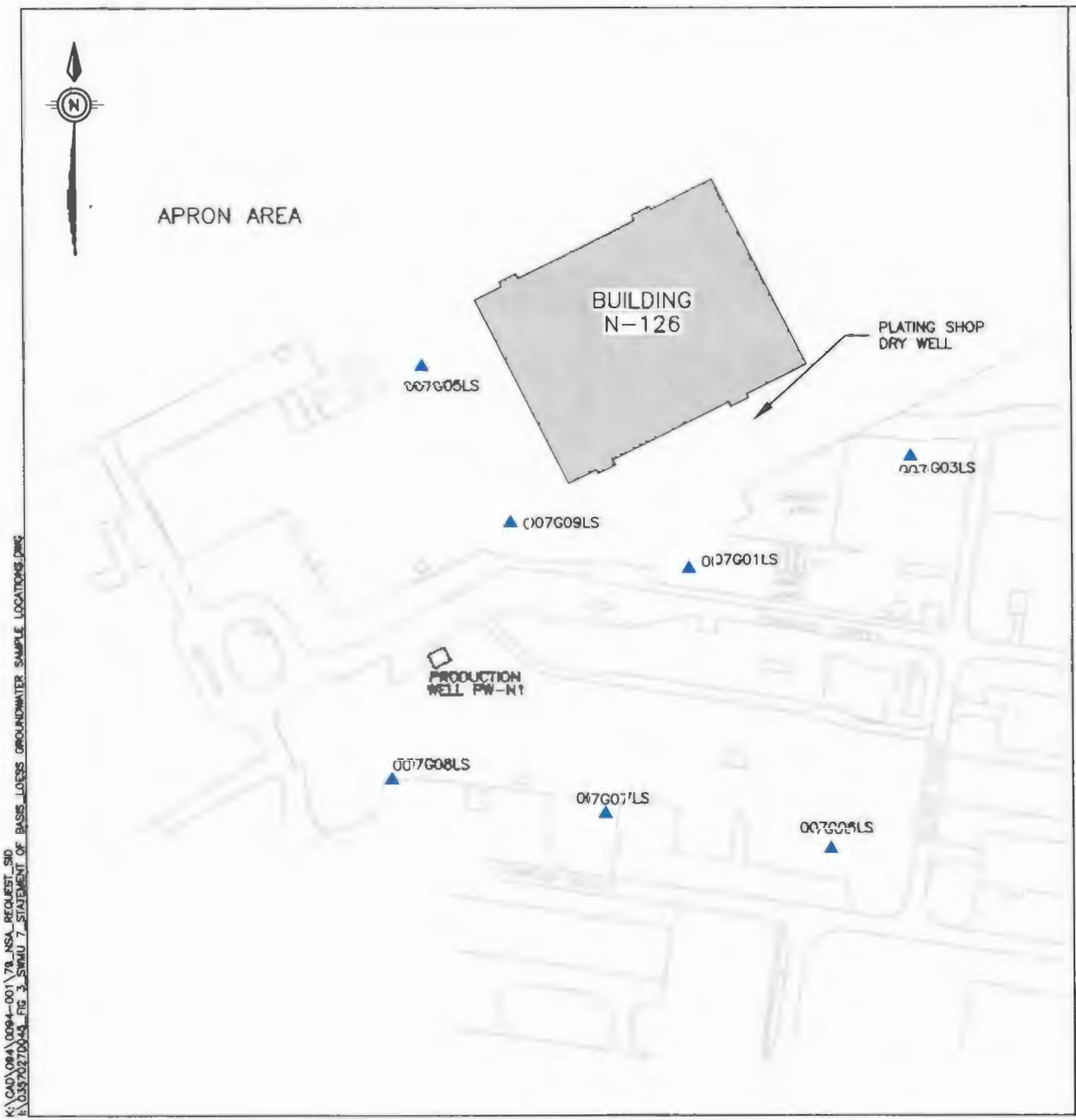
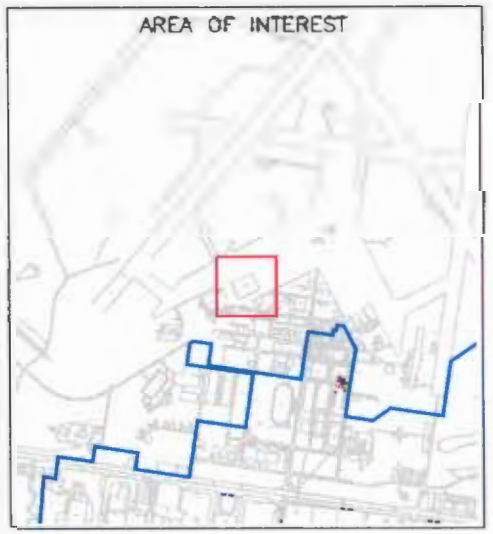
K:\0357027046_FIG 2_SWMU 7_STATEMENT OF BASIS_SOIL SAMPLE LOCATIONS.DWG





LEGEND

- LOESS MONITORING WELL
- BUILDING
- AREA OF INVESTIGATION
- NSA MID-SOUTH BOUNDARY

175 0 175
FEET

FIGURE 3
SWMU 7 STATEMENT OF BASIS
LOESS GROUNDWATER
GROUNDWATER SAMPLE LOCATIONS

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K:\03570270043_FIG 3_SWMU 7_STATEMENT OF BASIS_LOESS GROUNDWATER SAMPLE LOCATIONS.DWG