Picatinny Arsenal Installation Restoration Program

Picatinny Arsenal is an Official Hawk Watch Site

25 SITES
FOCUSED FEASIBILITY STUDY
PICATINNY ARSENAL ARSENAL, NEW JERSEY

VOLUME 1
REPORT

Prepared By:

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Shaw™ Shaw Environmental, Inc.
111 Howard Boulevard, Suite 110
Mt. Arlington, NJ 07856

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6. AUTHOR(S)

H. Fettig, K. Gerdes, Gerard Maresca

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Shaw Environmental, Inc.
111 Howard Boulevard, Suite 110
Mount Arlington, New Jersey 07856

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

CENAB, Contracting Division
Environmental Acquisition Br.
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13. ABSTRACT (*Maximum 200 words*)

This report presents the methodology and results of the focused feasibility study (FFS) conducted to address surface soil, subsurface soil, sediment, and surface water at 26 sites (collectively referred to as the "25 Sites" which was the originally intended number of sites to be included) at Picatinny, Rockaway Township, New Jersey. The FFS concentrates on chemical concentrations in soil; however, surface water and sediment are also addressed at a limited number of sites with surface water and sediment data which have not been specifically addressed in another feasibility study (such as the *Green Pond and Bear Swamp Brooks FFS[IT, 2001c]*). Groundwater was either not investigated, was not deemed an area of concern, or is being addressed as part of another site, such as Area D Groundwater (PICA Site 076) or Mid-Valley Groundwater (PICA Site 204). Groundwater data from the sites was evaluated in conjunction with soil analytical results to determine any potential impact to groundwater sources in soil.

Sites included in this FFS have been assessed during the Remedial Investigation or Installation Action Plan process as requiring limited remedial action based on the following criteria: 1) Human health risk within or below the target risk range of 10^{-4} to 10^{-6}, noncancer hazards below the target threshold of 1.0, and no substantive impact to ecological receptors identified; 2) minimal and marginal exceedences of LOCs; and 3) sites with existing engineering controls. Remedial alternatives evaluated at the "25 Sites" include: no action, land use controls and maintenance of existing engineering controls, excavation with off-site disposal, and long-term monitoring of sediment.

14. SUBJECT TERMS

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/g ....micrograms per gram
µg/L ....micrograms per liter
µrem/hr.............microrems per hour
1,1,1-TCA.........1,1,1-Trichloroethane
2,4,6-TNT 2,4,6-trinitrotoluene
AA.....................Area of Attainment
AASF ....Army Aviation Support Facility
ACE ....Army Corps of Engineers
ANL ....Argonne National Laboratory
AOC..................Area of Concern
ARAR ....Applicable or Relevant and Appropriate Requirement
ARDEC.............Armament, Research, Development, and Engineering Center
AST ....Aboveground Storage Tank
AWQC ....Ambient Water Quality Criteria
bgs....................below ground surface
BNA ....Base Neutral/Acid Extractable
BSB ....Bear Swamp Brook
CERCLA...........Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR ....Code of Federal Regulations
COC ....Contaminant of Concern
COPC ....Constituent of Potential Concern
CRL ....Certified Reporting Limit
CY ....cubic yards
DCSCC.............Direct Contact Soil Cleanup Criteria
DEH..................Division of Engineering and Housing
DNT ....Dinitrotoluene
DSERTS...........Defense Site Environmental Restoration Tracking System
DU ....Depleted Uranium
EAO..................Environmental Affairs Office
EBS ....Environmental Baseline Survey
EC ....Engineering Control
EEQ..................Environmental Effects Quotient
EQL ....Estimated Quantitation Limit
EqP...................Equilibrium Partitioning
ERA ....Ecological Risk Assessment
ER-L ....Effects Range-Low
FFS...................Focused Feasibility Study
FS.....................Feasibility Study
ft ....feet
GIS ....Geographic Information System
GP/BSB ....Green Pond and Bear Swamp Brooks
GPB..................Green Pond Brook
GRA..................General Response Action
GSD..................Geometric Standard Deviation
HHRA ....Human Health Risk Assessment
HI......................Hazard Index
HQ ....Hazard Quotient
IC......................Institutional Control
ICF KE..............ICF Kaiser Engineers, Inc.
IGW ....Impact to Groundwater
ISQG ....Interim Sediment Quality Guideline
IT ....IT Corporation
lb.......................pound

LOC..................Level of Concern
LUC..................Land Use Control
LUCRD.............Land Use Control Remedial Design
MCL..................Maximum Contaminant Level
MDI...................Mean Dietary Intake
mg/kg................milligrams per kilogram
mg/L.................milligrams per liter
mr/hr.................millirems/hour
msl....................mean sea level
NCP..................National Oil and Hazardous Substances Pollution Contingency Plan
NFA..................No Further Action
NJDEP..............New Jersey Department of Environmental Protection
NJNR................NJDEP Nonresidential
NOAA...............National Oceanic and Atmospheric Administration
NRDCSCC.......Nonresidential Direct Contact Soil Cleanup Criteria
NWT.................New World Technology
NYSDEC..........New York State Department of Environmental Conservation
PA/SI................Preliminary Assessment/Site Inspection
PAH..................Polycyclic Aromatic Hydrocarbon
PCB..................Polychlorinated Biphenyl
PCE..................Tetrachloroethene
pCi/g.................picocuries per gram
pCi/L.................picocuries per liter
PEL...................Potential Effects Level
PP.....................Priority Pollutant
ppb...................parts per billion
ppm..................parts per million
PRG..................Preliminary Remediation Goal
PVC..................Polyvinyl Chloride
RA....................Remedial Alternative
RAO..................Remedial Action Objective
RBC..................Risk-Based Concentration
RCRA...............Resource Conservation and Recovery Act
RDX..................Hexahydro-1,3,5-trinitro-syn-triazine
RG....................Remediation Goal
RI......................Remedial Investigation
RME.................Reasonable Maximum Exposure
ROD.................Record of Decision
RRSE...............Relative Risk Site Evaluation
SARA................Superfund Amendments and Reauthorization Act
SCC..................Soil Cleanup Criteria
SCL..................Site Cleanup Level
SF.....................Square Feet
Shaw................Shaw Environmental, Inc.
SLERA..............Screening Level Ecological Risk Assessment
SQB..................Sediment Quality Benchmark
SQL..................Sample Quantitation Limit
SRT..................Stockpile Reliability Testing
SSL...................Soil Screening Level
SVOC...............Semivolatile Organic Compound
TAL...................Target Analyte List
TBC..................To-Be-Considered
TCE..................Trichloroethene
TCL...................Target Compound List
TCLP................Toxicity Characteristic Leachate Procedure
TERC................Total Environmental Restoration Contract

TOC..................Total Organic Carbon
TPH ....Total Petroleum Hydrocarbons
USAAMC..........U.S. Army Armament, Munitions, and Chemical Command
USACE.............U.S. Army Corps of Engineers
USACHPPM.....U.S. Army Center for Health Promotion and Preventive Medicine
USEPA .............U.S. Environmental Protection Agency
USGS ...............U.S. Geological Survey
UST ....Underground Storage Tank
UXO..................Unexploded Ordnance
VOC..................Volatile Organic Compound

EXECUTIVE SUMMARY

This report presents the methodology and results of the Focused Feasibility Study (FFS) conducted to address contamination in surface and subsurface soil at 26 sites within Picatinny, Rockaway Township, New Jersey. Although 26 sites are addressed in the current document, the collective sites have continued to be referenced as the "25 Sites" to maintain consistency with previous correspondence, and earlier drafts of the document. The FFS concentrates on chemical concentrations in the soil. However, surface water and sediment are also addressed at a limited number of sites with surface water and sediment data. Groundwater at the sites was either not investigated, was not deemed an area of concern, or is being addressed as part of another site such as Area D Groundwater (PICA Site 076) or the Mid-Valley Groundwater (PICA 204). Shaw Environmental, Inc. (Shaw) was tasked by the U.S. Army Corps of Engineers (USACE), Baltimore District, to conduct this FFS under the Total Environmental Restoration Contract (TERC), Contract Number DACA31-95-D-0083, Task Order 17.

The scope of this FFS is the evaluation of alternatives for remediation of surface soil, subsurface soil, sediment, and surface water at 26 sites. During initial discussions with the regulators regarding this report, this FFS was referred to as the 25 Sites FS, because 25 sites was the maximum number of sites intended for this document. It was expected that some sites may be eliminated during the initial review. The table of the candidate sites was reviewed by the U.S. Environmental Protection Agency (USEPA) in November 2004 and no sites were eliminated following their review and comment. In order to maintain consistency, the title of the report has remained the same.

The FFS includes sites that have been assessed during the remedial investigation as requiring only land use controls or no further action for the chemical levels detected at these sites. The sites are included in various Phases and Areas at Picatinny. **Table ES-1** provides information on each site. Criteria used for the selection of the sites were as follows:

1. Sites with human health risks within or below the target cancer risk range of 10^{-4} to 10^{-6}; hazard indices below the target threshold level of 1; or sites for which no risk assessment was performed due to limited chemical detections above levels of concern (LOCs). In addition, no unacceptable ecological risks were identified associated with chemical concentrations detected at the sites.
2. Sites with minimal and marginal level of concern exceedences that could be eliminated by a small-scale removal action.
3. Sites with existing engineering controls (ECs) (e.g., vegetative cover, pavement, fence) present at the site. These existing engineering controls eliminate most exposure pathways thereby mitigating unacceptable risks.

Remedial action objectives (RAOs) were developed individually for each of the 26 sites which were determined to require a remedial action. Based on a review of the sample data, available human health risk assessments (HHRAs) and ecological risk assessments (ERAs), no action is required at five of the sites evaluated in this FFS (presented on **Table 3-16** along with a HHRA summary for each site). The criteria for the determination of no action are as follows:

1. A risk assessment based on a residential land use scenario has been performed that documents that risk levels are acceptable for unrestricted use. In addition, no unacceptable risk to environmental receptors was identified in the ERA.
2. In the event that an HHRA has not been performed which evaluates the unrestricted use scenario, no action is required if site contaminants are less than USEPA Residential Soil Regional Screening Levels; or site-specific background threshold values if demonstrated to be greater than the PRGs.

In this FFS, a list of COCs were developed for each media type based on the results of the HHRA and ERA, as well as the Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered (TBC) guidance. COCs that contributed to the majority of site-specific human health or ecological risk were determined to be Risk-Driver COCs. COCs that only exceeded NJDEP Nonresidential Soil Remediation Standards (NRSRS) were determined to be Non-Risk Driver COCs.

SCLs were developed for surface soil, subsurface soil, sediment, and surface water constituents that were considered as Risk-Driver COCs, based on relevant HHRA and ERA results, ARARs, and TBC guidance. SCLs for Non-Risk Driver COCs were set at the NJDEP NRSRS.

Based on the list of COCs and RAOs, No Action is required at five sites. These five sites were eliminated from the evaluation of other remedial alternatives (RAs). An additional five sites were determined to pose no unacceptable risk for the current and reasonably anticipated future land use (i.e. industrial). Since the unrestricted land use scenario was not evaluated, sample concentrations for these five sites were compared to the USEPA Residential Soil Regional Screening Levels. Sample concentrations were found in excess of the residential screening levels at each of the five sites (however all results were below NJDEP residential soil criteria). Remedial Action Objectives (RAOs) were identified at these five sites based on the continued management of human health risk that drive the formulation and development of response actions. Specifically, the response action for these sites is for land use controls (LUCs) to be implemented to ensure no excess risks to allowed receptor populations. RAOs and Areas of Attainment (AA) were identified for the remaining 16 sites.

In order to address the contamination identified at these 16 sites, RAs were established for each media type. Three RAs have been identified to encompass soil contamination within each site. The following RAs have been developed for soil contamination within the 16 sites:

Alternative S-1: No action;

Alternative S-2: Maintenance of existing ECs and implementation of institutional controls (ICs); and,

Alternative S-3: Excavation and off-site disposal of soil AAs with implementation of land-use and access restrictions and ICs.

For sediment contamination at PICA Site 208, the following RA was evaluated:

Alternative SD-1: Long-term chemical monitoring of sediment and implementation of land-use and access restrictions and ICs.

The soil, sediment, and surface water alternatives were screened against seven of the nine National Oil and Hazardous Substances Pollution Contingency Plan criteria, in which each RA must be assessed. The acceptability or performance of each alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified. The detailed criteria are: protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness, implementability, and cost. The final two criteria, State and community acceptance, are "modifying criteria" which are evaluated at later stages of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 process. The costs for each alternative are provided in **Table ES-2**.

Table ES-1
25 Sites Feasibilty Study Site Summary Table
Picatinny, New Jersey

Study Area	PICA Site (Consolidation)	RI Site, Building, and Description	LOC Exceedances	Risk Results	Comments	Reference
D	94	69, Building 92 - Surveillance Laboratory	**Groundwater:** 1 exceedance for TCE **Surface Soil:** No samples collected **Subsurface Soil:** 1 exceedance for arsenic below NRSRS (only one sample collected)	No risk assessment performed. CHPPM concluded the site posed a low relative risk with groundwater the only medium of concern. A risk management evaluation determined that it was likely that the risk was < 1E-6 and the HI was < 1.	CHPPM's RRSE, Phase I RMP & 2 RCRA closures including UST removal. GW contamination addressed under Area D GW (PICA 076/120).	*Phase I Risk Management Plan (IT, 2000)*
D	96	117, Building 22 - Precision Machine Shop	**Surface Soil Samples:** 2 exceedances for PAHs 1 exceedence for arsenic below NRSRS	**HHRA** Risks within 1E-4 to 1E-6 for the three modeled receptors HI equal to or < 1 for the three receptors **ERA** Marginal to poor habitat, no elevated hazards (HQs < 1).	None	*Phase I RI Report* (Dames and Moore, 1998)
D	98	123, Building 64 - Metal Plating Shop	**Surface Soil Samples:** 1 exceedance for Total PCBs 1 exceedence forbenzo(a)pyrene 1 exceedence for arsenic below NRSRS **Subsurface Soil Samples:** 1 exceedance for Total PCBs	**HHRA** Phase I RI - Risks within 1E-04 to 1E-06 for all populations. HI < 1 for all populations. **ERA** Soils found to be toxic to earthworms.	PCB exceedance in subsurface soil associated with BSB. PAH & metals exceedances reported in SD from adjacent BSB (partially removed in 2000 as part of Site 122 RA).	*Phase I 2A/3A RI Report* (Shaw, 2003)
D	190	187, Building 67 - Oil and Acid Storage	**Surface Soil Samples:** No exceedances. **Subsurface Soil Samples:** No exceedances. **Groundwater:** 10 exceedances for metals in 2 unfiltered samples. 1 exceedance for manganese in 1 filtered sample.	**HHRA** Risks within or below 1E-04 to 1E-06. HI < 1 for all populations. **ERA** No ERA conducted.	None	*Phase I 2A/3A RI Report* (Shaw, 2003)
D	207	None, Building 63 - Lumber and Pipe Storage Shed	**Surface Soil Samples:** 1 exceedance for arsenic (36 ppm) 1 exceedence for arsenic below NRSRS	No risk assessment performed. CHPPM concluded the site posed a low relative risk with soil the only medium of concern.	CHPPM's RRSE included 6 SS samples.	*Relative Risk Site Evaluation for Picatinny Arsenal* (USACHPPM, 1998)
F	101	60, Building 163, Photography Lab	**Surface Soil Samples:** No exceedances	**HHRA** Risks within 1E-4 to 1E-6 for industrial research worker and below 1E-6 for the construction excavation worker. HI < 1 for both receptors. **ERA** Neither small mammal studies nor earthworm bioassays found any substantive impacts in these areas. No significant COPC bioaccumulation in small mammals.	Approved UST closure in 1991. GW addressed under Area H/Mid-Valley GW (PICA 204).	*Phase I 2A/3A RI Report* (Shaw, 2003)
F	114	145, Building 477, Explosive & Propellant Mix Area	**Groundwater Sample:** exceedances for several metals (primariy Hydropunch and unfiltered samples) 2 exceedences for RDX and 1 for TNT in 1 MW **Surface Soil Samples:** 3 exceedances for arsenic below NRSRS **Subsurface Soil Samples:** 1 exceedance for 2,4-DNT (20 ppm), 2,6-DNT (10 ppm) & thallium (179 ppm) **Surface Water Samples:** 1 exceedance for several metals **Sediment Samples:** 1 exceedance for copper	**HHRA** Risks within 1E-4 to 1E-6 for all populations. HI > 1 (Hazard driver = manganese inhalation but manganese concentrations < LOC).	Source of SW/SD contamination (settling tank) removed in 2003. GW being addressed in Mid-Valley RI/FS.	*Phase I Additional RI Report* (IT, 1999)

Table ES-1
25 Sites Feasibilty Study Site Summary Table
Picatinny, New Jersey

Study Area	PICA Site (Consolidation)	RI Site, Building, and Description	LOC Exceedances	Risk Results	Comments	Reference
G	(29)	52, 95, 96; Building 305 - Petroleum Leak Area, Laundry Facility & Waste Oil Storage	**Surface Soil Samples:** Several exceedences for PAHs Several exceedences for arsenic (5 above NRSRS) 1 exceedence for DDD, dieldrin, lead, manganese and Aroclor1260 2 exceedences for DDT **Subsurface Soil Samples:** 1 exceedance for thallium 2 exceedences for benzo(a)pyrene	**HHRA** Phase I RI - Risk within 1E-04 to 1E-06 for all populations. HI < 1 for populations in Sites 52 and 96. HI = 1 for Site 95, future construction/excavation workers. **ERA** Veery, woodcock, and barred owl may be at risk due to metals and pesticides. No COPC-related impacts to flora. No potential impacts to soil-dwelling invertebrates.	No soil exceedances detected in Phase I 2A/3A RI. Contamination identified during the Dames and Moore Phase I RI was delineated during the Phase I 2A/3A RI.	*Phase I 2A/3A RI Report* (Shaw, 2003)
G	(29)	134, Building 302, Maintenance and Service Shops	**Surface Soil Samples:** 2 exceedences for benzo(b)fluoranthene. 1 exceedance for lead. **Subsurface Soil Samples:** No exceedences	**HHRA** Phase I RI - Risk within or below 1E-04 to 1E-06. HI < 1 for all populations. **ERA** This area offers little real risk to wild populations or communities.	PAH and lead contamination in SS excavated and removed in 2003; post-excavation samples were clean.	*Phase I 2A/3A RI Report* (Shaw, 2003)
G	(29)	136, Building 355, Metallurgy Lab	**Surface Soil Samples:** 3 exceedences for arsenic (1 above NRSRS)	**HHRA** No carcinogenic COPCs selected. HI = 1.1 for industrial research worker (hazard driver = mercury in surface soil). HI = 16 for construction worker (hazard driver = mercury in surface soil). **ERA** No ERA conducted.	No soil exceedances detected in Phase I 2A/3A RI. Mercury contamination identified during the Dames and Moore Phase I RI was delineated during the Phase I 2A/3A RI and removed in 2003. Post-excavation results indicate no residual contamination.	*Phase I 2A/3A RI Report* (Shaw, 2003)
G	(29)	185, Building 350, Former Laboratory	**Surface Soil Samples:** 1 exceedences for arsenic above NRSRS (from within concrete vault) **Groundwater Samples:** 2 exceedances for lead	**HHRA** No COPCs identified and no human health risks or hazards were quantified. **ERA** No ERA conducted.	One SS sample collected during RI - no exceedances. Soil exposure not evaluated in HHRA because the soil was collected from a concrete vault covered with a concrete lid, so human contact is not a viable exposure pathway. GW contamination to be addressed under CEA. Acid drain filter removed as part of sump & dry well investigation.	*Phase I 2A/3A RI Report* (Shaw, 2003)
J	158	175, Building 3801, Helicopter Maintenance	**Groundwater Samples:** 1 exceedance for methylene chloride **Surface Soil Samples:** No exceedances **Subsurface Soil Samples**: No exceedances **Surface Water Samples**: No exceedances **Sediment Samples**: No exceedances	**HHRA** No COPCs were identified: no risks or hazards were quantified. **ERA** No ERA conducted.	No LOC exceedances in soil, SW or SD. Former heliport has being closed and mission reassigned.	*Phase II RI Report, (Shaw, 2003)*
K	(161)	172,Parking Lot across from Building 3328	**Surface Soil Samples:** No exceedances **Subsurface Soil Samples:** No exceedances	**HHRA** No COPCs were identified and no risks or hazards were quantified . **ERA** No ERA conducted.	No LOC exceedances in soil. Site is an asphalt parking lot surrounded by a fence.	*Phase II RI Report, (Shaw, 2003)*
K	(161)	173, Building 3404, Chemical Lab	**Groundwater Samples:** 1 exceedance for aluminum, iron and lead **Surface Soil Samples:** exceedances for PAHs in 2 samples **Subsurface Soil Samples:** 1 exceedance for arsenic (21.1 ppm) several exceedences for PAHs	**HHRA** Risks within 1E-04 to 1E-06 for site worker and excavation worker. HI < 1 for both workers. **ERA** No ERA conducted.	Marginal individual soil exceedances.	*Phase II RI Report, (Shaw, 2003)*

Table ES-1
25 Sites Feasibilty Study Site Summary Table
Picatinny, New Jersey

Study Area	PICA Site (Consolidation)	RI Site, Building, and Description	LOC Exceedances	Risk Results	Comments	Reference
K	(161)	174, Former Building 3420, Former Sewage Treatment Plant	**Groundwater Sample:** No exceedances **Surface Soil Samples:** No exceedances **Subsurface Soil Samples:** No exceedances **Surface Water Samples:** 1 exceedance for aluminum 2 exceedences for arsein and sodium **Sediment Samples:** exceedances for PAHs & metals in 4 samples exceedences for DDD, DDE, and DDT in 3 samples	**HHRA** Risks within 1E-04 to 1E-06 for site worker. HI < 1 for site worker. **ERA** Sediment biaoassay did not suggest that significant toxicity exists for benthic macroinvertebrates. Little potential risk to mammalian and avian species based on foodchain analyses.	No soil exceedances. Sumps removed in 2003.	*Phase II RI Report, (Shaw, 2003)*
K	(161)	186, Building 3316, Firehouse	**Groundwater Samples:** 3 exceedances for iron, 2 exceedences for manganese and sodium, 1 exceedance for aluminum, chromium, lead, nickel, silver, n-nitrosodimethylamine & PCE	**HHRA** No carcinogenic COPCs identified: no risks were quantified. HI < 1 for construction/excavation worker. **ERA** No ERA conducted.	No soil characterization performed at the site. Only GW samples collected; no site-related exceedances in the GW.	*Phase II RI Report, (Shaw, 2003)*
L	176	176, Little League Baseball Field	**Subsurface Soil Samples:** 1 exceedance for benzo(a)pyrene	**HHRA** No COPCs were identified and no risks or hazards were quantified. Evaluation of future residential exposure to an adult and a child indicate potential risks are within USEPA's target cancer risk range of 1E-4 to 1E-6. The estimated total hazards for the adult and child resident are less than USEPA's target noncancer hazard threshold of 1.	Additional sampling requested by the regulators following the PA/SI was completed during the Phase III 2A/3A RI.	*Phase III 2A/3A RI Report* (Shaw, 2003)
L	177	177, Sanitary Sewer Line Breaks/Leaks	**Subsurface Soil Samples:** 1 exceedance for benzo(a)pyrene	**HHRA** No COPCs were identified and no risks or hazards were quantified.	Additional sampling requested by the regulators following the PA/SI was completed during the Phase III 2A/3A RI. Subsurface soil contamination identified at specific sites as part of the sewer line renovation such as Sites 31, 100 & 108 are being evaluated as part of the site-specific RIs.	*Phase III 2A/3A RI Report* (Shaw, 2003)
N	(53)	7, Building 1242, Munitions and Propellant Test Area	**Surface Soil Samples:** No exceedances.	No HHRA performed.	Former testing area. 5 SS samples collected during PA/SI, no LOC exceedances. Low relative risk perceived at site.	*Phase III PA/SI Report* (ICFKE, 1998)
N	(53)	10, Former Chemical Burial Area	**Groundwater:** 3 exceedances for aluminum 2 exceedances for manganese **Surface Soil:** No exceedances **Subsurface Soil:** No exceedances	**HHRA** Risks within or below 1E-4 to 1E-6 for industrial research workers and construction excavation workers (risk driver = arsenic in surface soil). HI < 1 for industrial research workers and construction excavation workers. Residential risks within the target risk range for adult and child separately but equal to 1E-4 for the two receptors together (risk driver = arsenic in soil and GW). However, no arsenic concentrations > LOCs. HI equal to or < 1 for adult and child resident.	None	*Phase III-1A RI Report* (IT, 2002)
O	183	164, Building 1217, General Purpose Magazine	**Surface Soil Samples:** No exceedances.	No HHRA performed.	3 SS samples collected during PA/SI, no LOC exceedances.	*Phase III PA/SI Report* (ICFKE, 1998)
P	(69)	27, Former Building T-90, Salt Storage Area	**Groundwater:** 1 exceedance for sodium **Surface Soil:** 1 exceedence for beryllium	One COPC (sodium in GW), no slope factor or reference dose exists, no risk/hazard quantified.	Sodium detected at 13,300,000 ppb in GW (LOC = 50,000 ppb) related to former salt storage at the site. Beryllium detected at 270 ppm in PA/SI sample. 9 SS samples collected during RI analyzed for Be, no LOC exceedances.	*Phase III-1A RI Report* (IT, 2002)

Table ES-1
25 Sites Feasibilty Study Site Summary Table
Picatinny, New Jersey

Study Area	PICA Site (Consolidation)	RI Site, Building, and Description	LOC Exceedances	Risk Results	Comments	Reference
P	(69)	119, Buildings 46, 47, & 48, Propellant Storage Buildings	**Surface Soil Samples:** 2 exceedances for benzo(a)pyrene 1 exceedence for benz(a)anthracene & benzo(b)fluoranthene	No HHRA performed.	No formal RI or HHRA, only PA/SI (2 SS samples). Benzo(a)pyrene exceedances (up to 1.8 ppm) detected in both samples during PA/SI. Additional PAH exceedances of residential criteria. PAHs related to inactive railroad bed.	*Phase III PA/SI Report* (ICFKE, 1998)
P	(69)	120, Building 50, Propellant Storage	**Surface Soil Samples:** 1 exceedance for 3 PAHs	No HHRA performed.	No formal RI or HHRA, only PA/SI (1 SS sample). Benzo(a)pyrene and two other PAHs were detected above LOCs in the sample. Additional PAH exceedances of residential criteria. PAHs related to inactive railroad bed.	*Phase III PA/SI Report* (ICFKE, 1998)
P	(69)	121, Building 57, Chemical Storage	**Surface Soil Samples:** 1 exceedance for 4 PAHs	No HHRA performed.	No formal RI or HHRA, only PA/SI (2 SS samples). Benzo(a)pyrene (18 ppm) and three other PAHs were detected above LOCs in the sample collected along the former railroad bed. Additional PAH exceedance of residential criterion. PAHs related to the inactive railroad bed.	*Phase III PA/SI Report* (ICFKE, 1998)
P	(69)	Former PICA 208, DU Scrap Storage Area (Former Dog Pound)	**Groundwater Samples:** 3 exceedances for arsenic 2 exceedances for aluminum & lead 3 exceedances for iron & manganese **Surface Soil Samples:** several exceedences for arsenic (2 above NRSRS) several exceedances for thorium-232 **Sediment Samples:** 2 exceedances for several PAHs several exceedances for metals **Surface Water Samples:** 1 exceedance for several metals 3 exceedances for iron & manganese	**HHRA** Risks within or below 1E-4 to 1E-6 for industrial research workers, construction excavation workers, and on-site youth visitors. HI < 1 for all three populations.	Arsenic may be related to routine application of pesticides or historic fill (i.e., coal clinkers) used in this marshy area. Additional investigation of the elevated radiological concentrations is proposed for 2005.	*Phase III 2A/3A RI Report* (Shaw, 2003)

RI/FS - Remedial Investigation/Feasibility Study, RC - Response Complete, IRA - Interim Removal Action, RD/RA - Remedial Design/Remedial Action, LTM - Long-term Monitoring, HHRA - Human Health Risk Assessment, ERA - Ecological Risk Assessment, IC - Institutional Controls, EC - Engineering Controls, LOC - Level of Concern, GW - groundwater, SD - sediment, SS - surface soil, SW - surface water, TECUP - Toxic & Energetic Cleanup Program.

Table ES-2
Cost Summary For Remedial Alternatives, "25 Sites"
Picatinny, New Jersey

Remedial Alternative	Description	Capital Cost(1)	Discounted O&M (2)	Total Present Worth	Duration (Construction and O&M)
BASELINE COST FOR IMPLEMENTATION OF LAND USE AND ACCESS RESTRICTIONS AND ICs FOR SOIL AND SEDIMENT AT THE 25 SITES		$32,200.00	$37,222.34	**$69,422.34**	30 years
Site 117					
Alternative 117-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 117-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 117-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$55,171.11		**$55,171.11**	3 days (30 years LUCs)
Site 123					
Alternative 123-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 123-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 123-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$58,528.22		**$58,528.22**	5 days (30 years LUCs)
PICA Site 207					
Alternative 207-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 207-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 207-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$56,785.81		**$56,785.81**	2 days (30 years LUCs)
Site 145					
Alternative 145-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 145-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$21,405.60	**$21,405.60**	30 years
Alternative 145-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$80,555.54		**$80,555.54**	5 days (30 years LUCs)
Sites 52, 95, and 96					
Alternative 52-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 52-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 52-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$646,653.04		**$646,653.04**	3 weeks (30 years LUCs)
Site 134					
Alternative 134-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 134-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 134-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$59,005.18		**$59,005.18**	5 days (30 years LUCs)
Site 136					
Alternative 136-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 136-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 134-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$54,324.37		**$54,324.37**	5 days (30 years LUCs)

Table ES-2
Cost Summary For Remedial Alternatives, "25 Sites"
Picatinny, New Jersey

Remedial Alternative	Description	Capital Cost(1)	Discounted O&M (2)	Total Present Worth	Duration (Construction and O&M)
BASELINE COST FOR IMPLEMENTATION OF LAND USE AND ACCESS RESTRICTIONS AND ICs FOR SOIL AND SEDIMENT AT THE 25 SITES		$32,200.00	$37,222.34	**$69,422.34**	30 years
Site 175					
Alternative 175-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 175-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 175-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$82,038.38		**$82,038.38**	5 days (30 years LUCs)
Site 173					
Alternative 173-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 173-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 173-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$436,774.80		**$436,774.80**	2 weeks (30 years LUCs)
Site 176					
Alternative 176-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 176-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 176-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$64,155.08		**$64,155.08**	5 days (30 years LUCs)
Site 177					
Alternative 177-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 177-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 177-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$60,840.93		**$60,840.93**	5 days (30 years LUCs)
Site 27					
Alternative 27-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 27-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 27-3	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$56,785.81		**$56,785.81**	3 days (30 years LUCs)
Sites 119, 120, 121					
Alternative 119-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 119-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
PICA Site 208					
Alternative 208-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 208-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 208-3	LONG TERM CHEMICAL MONITORING OF SEDIMENT AND LUCs		$63,566.31	**$63,566.31**	5 years (30 years LUCs)
Alternative 208-4	EXCAVATION OF SOIL AREA OF ATTAINMENT WITH OFF-SITE DISPOSAL AND LUCs	$107,376.70		**$107,376.70**	6 days (30 years LUCs)

Table ES-2
Cost Summary For Remedial Alternatives, "25 Sites"
Picatinny, New Jersey

Remedial Alternative	Description	Capital Cost[1]	Discounted O&M [2]	Total Present Worth	Duration (Construction and O&M)
BASELINE COST FOR IMPLEMENTATION OF LAND USE AND ACCESS RESTRICTIONS AND ICs FOR SOIL AND SEDIMENT AT THE 25 SITES		$32,200.00	$37,222.34	**$69,422.34**	30 years

(1) Capital costs for the implementation of ICs are evaluated in the baseline cost for ICs at the 25 Sites. As SCLs are based on a non-residential use scenario, the baseline costs for ICs must be added to the costs presented for the site specific remedial alternatives with the exception of the No Action alternative.

(2) Present worth O&M with discount rate of 7%.

1.0 INTRODUCTION AND PURPOSE

This report presents the methodology and results of a focused feasibility study (FFS) conducted to address surface and subsurface soil contamination at **26** sites at Picatinny, Rockaway Township, New Jersey. During initial discussions with the regulators regarding this report, this FFS was referred to as the 25 Sites Feasibility Study (FS), because 25 was the intended number of sites. In order to maintain consistency, the title of the report has remained the same despite the addition of one site. The FFS will concentrate on chemical concentrations detected in the soil. However, surface water and sediment will also be addressed at the limited number of sites with surface water and sediment data. Groundwater will not be evaluated in this FFS. Shaw Environmental, Inc. (Shaw) was tasked by the U.S. Army Corps of Engineers (USACE), Baltimore District, to conduct the FFS under the Total Environmental Restoration Contract (TERC), Contract Number DACA31-95-D-0083, Task Order 17.

This FFS was performed in accordance with U.S. Environmental Protection Agency (USEPA) guidance (USEPA, 1988) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) 300]; the National Environmental Policy Act of 1969; the President's Council on Environmental Quality regulations (40 CFR 1500 – 1508); and the New Jersey Department of Environmental Protection (NJDEP) guidance documents (NJDEP, 2006 and 2009a).

This FFS includes **26** sites that have been assessed during the remedial investigation (RI) or Installation Action Plan process as requiring no further action, LUCs, maintenance of existing engineering controls (ECs) with institutional controls (ICs), or limited removal actions for the chemical levels detected in the soil at these sites. Thus, in order to streamline the FFS approach for this document, only four remedial alternatives (RAs) will be evaluated for the sites: no further action, LUCs (i.e., ICs) and maintenance of existing ECs (as applicable), long-term monitoring for surface water and sediment AAs in addition to LUCs, and removal of soil AAs with off-site disposal. **Table 1-1** summarizes all sites included in this document, and **Figure 2-2** presents site locations.

The remaining FFS sections are organized as follows:

- Section 2.0 – Site Background

  This section provides a regional environmental setting as well as a site summary for each site. Each site summary within this document contains a text summary of the site history, previous investigations, nature and extent of contamination, results of human health and ecological risk assessments, data tables, and pertinent site figures and photographs.

- Section 3.0 – Remedial Action Objectives (RAOs) and Identification of Applicable or Relevant and Appropriate Requirements (ARARs)

  This section provides a statement of RAOs, a summary of ARARs, guidance To-Be-Considered (TBC) in the definition of contaminants of concern (COCs), areas of attainment (AAs), and their respective site cleanup levels (SCLs).

- Section 4.0 – Identification and Screening of Remedial Alternatives

  This section identifies general response actions (GRAs) applicable to the RAOs presented in Section 3.0 which are broken down into technologies and process options screened on implementability, effectiveness, and relative cost. A detailed evaluation of the alternatives retained from the initial screening process is presented utilizing the nine NCP evaluation criteria [40 CFR 300.430(e)].

Table 1-1

Focused Feasibility Study for 25 Sites

Study Area	ANL RI Concept Plan Site Number	Consolidated DSERTS/ PICA Site Number	Building Numbers	Site Description	Current Relative Risk Status [3]
D	69	94	Building 92	Surveillance Laboratory	3A
	117	96	Building 22	Precision Machine Shop	2A
	123	98	Building 64	Metal Plating Shop	2A
	187	190	Building 67	Oil & Acid Storage	3A
	NA	207	Building 276	Explosives loading facility	3A
F	60	101	Building 163	Photography Laboratory	2A
	145	114	Building 477	Explosive & Propellant Mix Area	1A
G	52	29	Building 305	Petroleum Leak Area	2A
	95	29	Building 336	Laundry Facility	2A
	96	29	Buildings 301 & 301-A	Paint Shop and Waste Oil Storage	3A
	134	29	Building 302	Maintenance & Service Shops	3A
	136	29	Building 355	Metallurgy Laboratory	2A
	185	29	Building 350	Former Laboratory	3A
J	175	158	Building 3801	Helicopter Maintenance	3A
K	172	161	Adjacent to Building 3328	Parking lot	3A
	173	161	Building 3404	Solid propellant test laboratory	1A
	174	161	Building 3420	Former sewage treatment plant	3A
	186	161	Building 3316	Fire house, former vehicle maintenance facility	2A
L	176	176	--	Little League Baseball Field	2A
	177[1]	177	--	Sanitary Sewer Line Breaks/Leaks	3A
N	7	53	Building 1242	Munitions & Propellant Test Area	3A
	10	53	--	Former chemical burial area	1A
O	164	183	Building 1217	General Purpose Magazine	3A
P	27	69	Former Building T-90	Salt Storage Area	1A
	119	69	Buildings 46, 47 & 48	Propellant Storage	2A
	120	69	Building 50	Propellant Storage	2A
	121	69	Building 57	Chemical Storage	2A
	PICA 208[2]	69	NA	DU Scrap Storage Area	2A

[1] – Site 177 was established for the investigation of known sewer line breaks or leaks. These breaks/leaks are located throughout Picatinny.
[2] – PICA Site 208, commonly referred to as the former Dog Pound, does not have a RI Site number. The former Dog Pound is referred to in this report individually as PICA Site 208.
[3] – Relative risk is DOD's approach to prioritizing funding for investigative and remedial actions at DOD facilities with numerous sites. Relative risk is not an absolute expression of risk and is not intended as a substitute for a baseline health risk assessment.

2.0 SITE BACKGROUND

2.1 REGIONAL AND LOCAL FEATURES

2.1.1 Location and Physiography

Picatinny is located in north central New Jersey approximately four miles north of the city of Dover in Rockaway Township, Morris County (**Figure 2-1**). Major roadways adjacent to the site include State Route 15, which skirts the southern boundary of the installation, and Interstate 80, which is located one mile to the southeast of the main gate. The sites included in this FFS are located throughout Picatinny within several areas as shown on **Figure 2-2**.

Picatinny is located in the New Jersey Highlands physiographic province, which ranges from 12 – 18 miles wide and is located between the Appalachian Piedmont physiographic province to the southeast and the Valley and Ridge province to the northwest (**Figure 2-3**). The New Jersey Highlands is the southernmost extension of the New England sub-province (Reading Prong) of the Appalachian Highland physiographic province (Gill and Vecchioli, 1985). The area is characterized by broad, rounded, or flat-topped northeast-southwest trending ridges, and deep and generally narrow valleys that are controlled by the northeast-trending folds and faults of the underlying bedrock.

The valley in which Picatinny resides has a broad and relatively flat floor, which slopes gently to the southwest. Elevations within the valley floor range from approximately 800 feet (ft) mean sea level (msl) at the northeastern boundary to approximately 700 ft msl at the southwestern boundary. The valley varies from 1,000 to 4,000 ft in width. A topographic map of the Installation, with the FFS sites labeled, is provided on **Figure 2-2**. The main valley of Picatinny is bounded to the northwest by Green Pond and Copperas Mountains and to the southeast by an unnamed ridge. Green Pond and Copperas Mountains are rugged and steeply sloped with a maximum elevation of about 1,250 ft msl. The southeastern ridge is less steep with a maximum elevation of about 1,150 ft msl and contains small elevated plateaus. Marshy areas at the southern end of Picatinny and north of Lake Denmark are very flat with minor relief.

2.1.2 Climatology

Northern New Jersey has a continental temperate climate, which is controlled by weather patterns from the continental interior. The prevailing winds blow from the northwest from October to April and from the southwest from May to September (Gill and Vecchioli, 1985). The average monthly temperature ranges from a high of approximately 72°F in July to approximately 27°F in January/February (National Oceanic and Atmospheric Administration [NOAA], 1982). The average date of the last freeze of spring and the first freeze of fall are May 2 and October 8, respectively (Eby, 1976). Located approximately 8 miles southeast of Picatinny, the average annual precipitation at the Boonton monitoring station from 1980 to 1990 was 47.19 inches. The least amount of precipitation occurs during February (2.79 inches) while the greatest amount of precipitation occurs during June (5.41 inches) (NOAA, 1982).

2.1.3 Surface Water Hydrology

Picatinny is located in the upper part of the Passaic River drainage basin. Green Pond Brook (GPB), which is the primary drainage feature of Picatinny, joins the Rockaway River approximately one mile south of Picatinny. From this confluence, the Rockaway River flows east through the Boonton Reservoir, an 8.5-billion gallon water source for Jersey City. The Rockaway River then flows southeast, merging with the Passaic River, which discharges into Newark Bay at Elizabeth, New Jersey.

At Picatinny, surface water generally flows down to the valley axis via a number of small, unnamed streams and ditches, and then to the southwest via Burnt Meadow Brook and GPB. A map detailing surface water drainage features and directions at Picatinny is provided on **Figure 2-4**. The northeast portion of Picatinny is drained by Burnt Meadow Brook, which has an average width of 3 to 4 ft and a maximum depth of 1 foot. Burnt Meadow Brook discharges into Lake Denmark in the northeastern portion of the installation (USATHAMA, 1976). Lake Denmark discharges by a continuation of Burnt Meadow Brook into GPB, the principal drainage feature for Picatinny. GPB then flows southwestward into Picatinny Lake. Located in the geographic center of Picatinny, Picatinny Lake is approximately 5,300 ft long, an average of 1,000 ft wide (108 acres), with a maximum depth of 20 ft (165 million gallons) (USATHAMA, 1976). GPB, with a width of 10 to 30 ft and a maximum depth of 5 ft, continues southwestward from Picatinny Lake through the center of the valley, and discharges into the Rockaway River about one mile southeast of Picatinny.

Three gauging stations are located on GPB: just north of Picatinny Lake, at the Picatinny Lake outfall, and approximately 100 ft upstream of the southwestern border of Picatinny. Base flow discharge data indicate that GPB is a gaining stream (Vowinkel et al., 1985).

2.1.4 Soils

The natural soils at Picatinny are predominately derived from glacial deposits and are acidic and highly permeable. In general, the soils on the rocky slopes of valley are composed mostly of stony loam and sandy clay loam, whereas the soils in the central valley contain loam, silt, sand, and gravel pan soils, with muck and peat developing in swampy areas.

2.1.5 Geology

Four bedrock formations underlie Picatinny: Precambrian Basement and three lower Paleozoic sedimentary formations – the Hardyston Quartzite, the Leithsville Formation, and the Green Pond Conglomerate (**Figure 2-4**). The overlying valley fill is composed of Pleistocene glacial deposits and minor amounts of recent alluvium. The bedrock in the northwestern portion of the valley is composed of lower Paleozoic sedimentary rocks, which unconformably overlie the Middle Proterozoic basement rocks, and are faulted by a series of northeast trending faults (i.e., Tanners Brook-Green Pond Fault, Picatinny Fault, Berkshire Valley Fault, and the Gorge Fault – which splays off of the Tanners Brook-Green Pond Fault).

Unconsolidated sediments overlie the Precambrian and lower Paleozoic age bedrock at Picatinny. The unconsolidated glacial materials consist mostly of till and stratified drift deposited during the Wisconsin glacial event. There are also minor amounts of recent alluvium. Following deglaciation, Holocene deposits of silt, clay and finally peat formed in floodplains and ice-blocked depressions along GPB (U.S. Geological Survey [USGS], 1993).

The nature and thickness of the glacial deposits vary substantially at Picatinny. Relatively impermeable till is found both in the moraines and in patches against the sides and bottom of the valley. Stratified drift, deposited by the retreating glaciers behind the moraines, fills the valley underlying Picatinny. The drift is thickest above the axis of the valley, and thins rapidly off axis, pinching out against the valley slopes. Seismic studies indicate that the maximum drift thickness (along the valley axis) varies from about 50 ft near Picatinny Lake to over 300 ft near the southwestern boundary of Picatinny (Lacombe et al., 1986).

Classification of the glacial deposits into separate and homogeneous units is complex at Picatinny. The USGS (1993) reported the glacial deposits as five permeable layers represented as aquifers and three low permeability layers represented as confining units in the southern portion (Phase I area) of the base, south of Picatinny Lake. In contrast, Dames and Moore (1995) reported three permeable layers in the Phase I area (Areas A through G). For the Phase II Area (Areas H through K), IT Corporation (IT) separated the glacial deposits into two permeable units.

2.1.6 Hydrogeology

The principal source of groundwater in the Green Pond Valley is local precipitation. The low-permeability and the steep slopes of Green Pond Mountain and Copperas Mountain to the northwest and the unnamed ridge to the southeast restrict the infiltration of precipitation into these mountains. Most of the precipitation that falls on the mountains flows overland to their bases and into the highly permeable glacial sediments. The small amount of precipitation that enters these ridges flows down through shallow fractures to the glacial sediments in the valley. Effectively, all discharge from the groundwater system flows to surface water bodies, primarily the Rockaway River and GPB (USGS, 1991).

Groundwater occurs in both the valley glacial materials and in the bedrock at Picatinny. South of Picatinny Lake, where the hydrogeology has been studied in detail, the bedrock and glacial sediments at Picatinny were divided into a sequence of six permeable layers and five intervening, low-permeability layers on the basis of the general hydraulic properties of the sediments (USGS, 1991). Sand units exceeding 10 ft in thickness can act as pathways for contaminants and, therefore, were designated as permeable layers. Confining units, such as thick clay units, are not present at Picatinny; however, units containing clay and/or silt that impede the flow of groundwater are present. The thickness of the weathered zone determined from drilling logs ranges from 24 ft at well 27-84 near Picatinny Lake to 136 ft at well 27-250 near the southern boundary of Picatinny. The bedrock beneath the glacial sediments at Picatinny weathers to a clay, which fills the fractures in the bedrock and impedes the flow of water. Therefore, the weathered zone of the bedrock was designated as a low-permeability layer.

North of Picatinny Lake, where the glacial sediments are less thick, the hydrogeology is less complicated. The unconsolidated sediments can generally be divided into one or two layers with no significant, continuous, low-permeability unit. Bedrock in this area is also less weathered than bedrock encountered south of Picatinny Lake. In Area J, a bedrock investigation conducted as part of the Group 3 RI determined that fractures are very tight and decrease with depth. Due to the lack of fractures in the bedrock beyond 100 ft below ground surface (bgs), groundwater may exist under confined conditions in the deeper fractured zones (IT, 2001d).

2.2 SITE 69, BUILDING 92, SURVEILLANCE LABORATORY

2.2.1 Site History

Site 69 consists of Building 92 and is located in Area D, an industrial area of Picatinny (**Figure 2-6**). The building is surrounded by paved streets and buildings on three sides, with the Installation golf course located directly to the southwest. Building 92 houses a physics laboratory and administrative offices. From 1969 until 1982, Building 92 conducted quality assurance testing of painted and anodized coatings. Laboratory wastewater, which included metals, spent acids and solvents, were discharged to a concrete underground storage tank (UST) formerly located outside the building. In 1989, fuel oil was detected in the UST. Absorbent pads were used to collect the oil.

Building 92 also houses the Stockpile Reliability Testing (SRT) area, a controlled clean room where optical disks are cleaned and checked for quality. Review of environmental files indicated that the SRT was also used to test LANCE missiles which contained explosive squibs. The LANCE missiles were disassembled and the explosive squibs checked for continuity. According to the Division of Engineering and Housing (DEH) building drawing, Building 92 also housed a radiation calibration facility. According to Picatinny personnel, activities within this portion of the building included calibrating radiac meters and running an x-ray defractometer. The sealed americium-241, cobalt-60, strontium-ytterbium 90, lead-210, bismuth-210, promethium-147 and alpha wedge sources associated with the building were routinely leak tested. Results were well below the allowable 0.005 microcuries level. The americium-241 and cobalt-60 sources were eventually disposed of through the DOD. The check sources and wedges are currently stored in the Health Physics Laboratory in Building 320. No closeout or closure surveys have been conducted.

2.2.2 Previous Investigations

2.2.2.1 Resource Conservation and Recovery Act (RCRA) Closures, 1991 & 1992

In 1991, four areas within Building 92 required decontamination as part of the closure activities. Closure activities included the construction of an enclosure area to confine vapors and protect non-targeted areas. Wipe samples were collected and analyzed for metals to verify successful decontamination. According to Army and NJDEP correspondence, the closure for the targeted areas inside Building 92 was deemed complete.

In 1992, closure activities included waste removal from the concrete UST, tank and piping decontamination, and UST removal and disposal. Waste from the UST was analyzed for metals. Four subsurface soil samples were collected from the tank excavation, and one chip sample was collected from inside the UST. The soil samples were analyzed for volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), and metals. The chip sample was analyzed for Toxicity Characteristic Leachate Procedure (TCLP) VOCs, TCLP semivolatile organic compounds (SVOCs), TCLP metals, pesticides/PCBs, and TPH.

Cadmium, chromium, and lead were detected in the waste sample, which may be related to the dissolution of metals by acid. TPH were the only compounds detected in the chip sample. With the exception of arsenic, no exceedences of the current levels of concern (LOCs) were identified in the soil samples. Arsenic was detected above the USEPA Industrial Regional Screening Level (IRSL) of 1.6 mg/kg in all four subsurface soil samples, but below the NJDEP NRSRS of 19 mg/kg, which is based on natural background. Only arsenic concentrations that exceeded the Picatinny background level for subsurface soil (8.57 mg/kg) are presented on **Figure 2-6**. However, NJDEP stated that the soils data exceeded the proposed NJDEP Cover Soil Sample value and that further action would be required under CERCLA.

2.2.2.2 USACHPPM Relative Risk Site Evaluation (RRSE), 1997

A Geoprobe rig was used to collect a subsurface soil sample and groundwater sample at the most potentially contaminated portion of the former UST excavation (**Figure 2-6**). The groundwater sample was analyzed for VOCs, SVOCs, and metals. Trichloroethene (TCE) was detected in the groundwater sample at 3.9 micrograms per liter (µg/L), which exceeds the LOC of 1.0 µg/L. The TCE is believed to be related to the Area D groundwater plume. The subsurface soil sample was collected of the soil immediately below the former excavation's fill. The soil sample was analyzed for VOCs, SVOCs, pesticides, PCBs, TPH, and metals to satisfy the State UST closure requirements. Arsenic was detected in the soil sample above the IRSL of 1.6 mg/kg, but below the NRSRS of 19 mg/kg and the Picatinny subsurface soil background level of 8.57 mg/kg. All other sample concentrations were below their respective LOCs.

2.2.3 Nature and Extent of Contamination

Subsurface soil and groundwater samples have been collected at Site 69 as part of previous investigations (i.e., RCRA closures, RRSE). Chip, wipe and waste samples were also collected to satisfy RCRA closure requirements. The chip, wipe and waste samples were handled under RCRA.

The 1991 RCRA Closure Verification Investigation for Building 92 identified four AOCs within Building 92. The four areas were decontaminated and correspondence from the Army and NJDEP in April and December, 1992 indicated that closure had been completed for the targeted areas inside Building 92. Therefore, no investigation or remedial activities have or will be conducted under CERCLA for the interior of Building 92.

The 1992 RCRA Closure Verification Investigation for Building 92 consisted of the removal of a concrete UST and its contents, decontamination of the UST and piping, and disposal of the UST. A letter from the NJDEP, dated December 8, 1992 stated that soil sampling data exceeded NJDEP criteria and that further action under CERCLA was necessary. Potential contamination associated with the former UST is evaluated in this FFS.

The groundwater contamination has been addressed as part of the Area D groundwater plume. The soil contamination is the focus of this FFS. Below is a brief discussion of the soil data collected at Site 69.

2.2.3.1 Subsurface Soil

It should be noted that no surface soil samples have been collected at the site, because the primary contaminant source was the former concrete UST. All five subsurface soil samples were collected beneath the former concrete UST. The target analytes from the five samples are noted in Sections 2.2.2.1 and 2.2.2.2. Two VOCs, 20 metals, and TPH were detected in the samples. Only arsenic was detected above LOCs; however, only one sample exceeded the Picatinny subsurface soil background level (8.57 mg/kg), and all detected arsenic concentrations were below the NJDEP NRSRS based on natural background (19 mg/kg). Analytical results are provided on Tables 7.7-3, 7.7-4, D-2, and D-3, in **Appendix A**.

2.2.4 Summary of Risk Assessments

Because no RI sampling was conducted at Site 69 during the Phase I RI, no formal human health risk assessment (HHRA) or ecological risk assessment (ERA) has been performed. However, in 1997 U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) conducted an RRSE of the site (USACHPPM, 1997). USACHPPM concluded that the site posed a “low potential risk” from groundwater contamination. The TCE detected in the groundwater at Site 69 is part of the larger Area D groundwater plume. The subsurface soil data collected to satisfy New Jersey UST closure requirements could not be evaluated under RRSE guidelines (ODUSD, 1995).

Based on the available subsurface soil data, Site 69 risks and hazards were estimated for one potentially exposed receptor population: future construction/excavation workers that may be exposed to subsurface soils. As part of the Phase I Risk Management Plan (IT, 2000), risks and hazards at Site 69 were evaluated by comparing concentrations with human health risk-based screening concentrations used in the Dames and Moore (1998) Phase I Risk Assessment. Analytical data used in the Site 69 screening include results from four soil borings composited together and reported in USACHPPM (1997). The evaluation is presented in **Table 2-1**.

As presented in the table, none of the detected inorganic constituents in soil exceeded the risk-based screening criteria, thus no significant risks to human health are estimated. Risks are assumed to be less than 1E-06 and hazards are assumed to be less than 1.0.

An ERA was not completed for Site 69 because the site is a building in the industrial area of Picatinny with limited habitat. Also, only subsurface soil and shallow groundwater samples were collected from the site, and there are no complete exposure pathways by which ecological receptors could contact either subsurface soil or groundwater; thus, no unacceptable ecological risks were identified for Site 69.

Table 2-1
Phase I Risk Management Plan Risks and Hazards Evaluation for Site 69

Inorganic	Site 69 Subsurface Soil Concentration (mg/kg)	Screening Criterion (mg/kg)	Above Screening Criterion?
Arsenic	4.1	20	No
Antimony	0.69	3.1	No
Barium	34	550	No
Chromium	8.6	39	No
Copper	13	310	No
Lead	19	400	No
Nickel	13	160	No
Zinc	37	2,300	No

2.3 SITE 117, BUILDING 22, FORMER PRECISION MACHINE SHOP

2.3.1 Site History

Building 22 was built in 1918, and is located in the middle of the central manufacturing area, along Bear Swamp Brook (BSB) in Area D (**Figure 2-7**). Precision machining activity was conducted at Building 22 until 1986 (Dames and Moore, 1998). Activities conducted at Building 22 included machining of depleted uranium (DU) and machining of other metals such as aluminum, copper, etc. to manufacture appurtenances for antitank weapons, rocket launchers and explosive antitank shells. The nature and quantity of wastes generated and the former waste management practices at Building 22 are unknown. However, the RI Concept Plan (Argonne National Laboratory [ANL], 1991) indicates that due to the machining operations, waste oils, solvents, and depleted radioactive material may have been generated at Building 22. Additionally, Building 22A, adjacent to and west of Building 22, may have been used for the storage of raw materials and wastes such as solvents and pneumatic/hydraulic oils prior to their usage/disposal. Limited information is available on any past spills and release incidents that occurred at Site 117; however, a memorandum, prepared in April 1990, indicates the floor of Building 22 was contaminated with numerous chemicals/materials due to frequent spills.

Since 1986, Building 22 has not been used for any active purpose. Reportedly, Building 22 was cleaned with the cessation of precision machining activity. However, during the RI site reconnaissance, waste oils, machines (e.g., lathe machines); a DU storage container, waste boxes, and computer equipment were observed to be stored at the building. Building 22 was also involved with the machining and storage of depleted uranium from approximately 1965 to 1988. Routine swipes of the area indicated activities less than the lower level of detection.

2.3.2 Previous Investigations

A radiation area survey for Building 22 conducted in September 1968, identified lathe heads and radioactive waste at the building as sources of radiation. A radiation meter reading of 5 millirems/hour (mr/hr) was recorded inside Building 22, while a reading of 0.03 mr/hr was recorded outside the building. The survey recommended the decontamination of the lathe head and the removal of radioactive waste.

U.S. Army Armament, Munitions, and Chemical Command (USAAMC) Environmental Baseline Study, 1993 does not identify any waste streams currently associated with Building 22. However, as of November 1993, this report identified 200 pounds (lbs) of DU to have been stored at Building 22. During site reconnaissance, DU storage containers were observed at Building 22.

Foster Wheeler Water Discharge Investigation Report, 1991 is a compilation of investigations performed for all Armament, Research, Development, and Engineering Center (ARDEC) buildings within Picatinny to identify various water discharges emanating from the buildings. Dye tests performed at Building 22 could not identify any discharge from Building 22 to BSB. However, during this investigation, three partially buried pipes appeared to emanate from Building 22 and drain into the BSB. It is possible that these pipes may have at one time, connected floor drains of Building 22 to the surface waters of BSB.

2.3.3 Nature and Extent of Contamination

As part of the Phase I RI (Dames and Moore, 1998), a radiological survey and surface soil sampling were conducted at Site 117 (**Figure 2-7**). The radiological survey did not identify any areas with unacceptably high radiation levels. The maximum radiation level measured was 7 microrems per hour (μrem/hr), which was only 2 μrem/hr above the background level of 5 μrem/hr and within the range of fluctuation for the background level. Analytical results of the sampling are provided on Table 4.5-2 in **Appendix A**. Only compounds detected in at least one sample are presented in the table.

2.3.3.1 Surface Soil

As part of the Phase I RI (Dames and Moore, 1998), four surface soil samples were collected at Site 117. Samples were analyzed for VOCs, polycyclic aromatic hydrocarbons (PAHs), metals, explosives, pesticides, PCBs, and radiological parameters. Concentrations of two PAHs, benz(a)anthracene and benzo(b)fluoranthene, exceeded LOCs in sample SS117-3A as shown on **Figure 2-7**. Arsenic was detected above its USEPA IRSL and the Picatinny surface soil background level of 9.23 mg/kg, in sample SS117-2A, but below the NJDEP NRSRS of 19 mg/kg. Radiological concentrations for gross alpha, gross beta and total uranium exceeded the background levels established in the *Picatinny Arsenal Facility-Wide Background Investigation* (IT, 2002), but there are no NRSRS values or *New Jersey Soil Remediation Standards for Radioactive Materials* for these parameters. The only gamma radionuclide identified in the samples, cesium-137 was detected at concentrations below the background level.

Two surface soil samples (SS117-5A and SS117-6A) and one subsurface soil sample (SS117SS4C) were collected in October 2006 in order to delineate beryllium detected in sample SS117-4A (Note: The concentration in SS117-4A is below LOCs currently established for beryllium). Beryllium was not detected in two of the three samples (Detection Limit = 0.60 mg/kg). The beryllium concentration identified in SS117-5A was below the LOC.

2.3.4 Summary of Risk Assessments

Table 2-2 summarizes the human health risk and hazard for Site 117. Carcinogenic risk falls within USEPA's target risk range of 1E-4 to 1E-6 for all three exposure scenarios. Noncarcinogenic hazard equals the target threshold value of 1 for future construction/excavation workers. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

Table 2-2
Summary of Site 117 Estimated Risks and Hazards

Receptor (Current and Future)	Estimated Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Outdoor Maintenance Worker	3E-06	Beryllium	Surface Soil
Industrial Research Worker	4E-05	Beryllium	Surface Soil
Construction Worker	2E-05	Beryllium	Total Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Outdoor Maintenance Worker	0.1	NR - hazards acceptable	NR - hazards acceptable
Industrial Research Worker	0.1	NR - hazards acceptable	NR - hazards acceptable
Construction Worker	1.0	NR - hazards acceptable	NR - hazards acceptable

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

The ERA indicates several metals and pesticides have accumulated in small mammal tissues. However, the small mammal population survey suggests no apparent impact. Elevated levels of aluminum and lead were detected in plants, but do not appear to have adversely affected the plant community. Soil was found to be slightly toxic to earthworms. Poor habitat quality, the small area of the site (0.25 acre) and high human activity preclude significant exposure to most ecological receptors. Therefore, there are no unacceptable ecological risks at Site 117 based upon reasonably anticipated exposure scenarios.

2.4 SITE 123, BUILDING 64, FORMER METAL PLATING SHOP

2.4.1 Site History

Building 64 is located along the southern bank of BSB, between Third and Fourth Streets in Area D (**Figure 2-8**). Since its construction in 1942, Building 64 has housed various divisions within Picatinny including the Ordnance Facility that conducted metal plating operations. Available documents indicate that Building 64 may also have been used as: an ordnance shipping building, a cutting oils storage area, a nuclear material operation building, and a mechanical shop for performing drilling, metal cutting operations, as well as encapsulation and decapsulation of electronic and mechanical components. Available records indicate that metal plating operations at Building 64 were conducted until mid-1961. Layouts of the metal plating rooms indicated the use of a neutralization tank and a chemical storage area. The wastewater generated from batch dumps, floor drainage, and rinse waters were reportedly treated in this neutralization tank. After the termination of the plating operations, all plating tanks were reportedly drained and washed.

Nuclear material operations involved testing beta cells and irradiated electronic components and storing plutonium-238 batteries from approximately 1962 to 1990. The RPO routinely leak tested the batteries until they were ultimately disposed of through the Oak Ridge National Laboratory. Activities were well below the allowable 0.005 microcuries level. The beta cells and irradiated electronic components were probably turned-in as radioactive waste.

According to Picatinny personnel, Building 64 was also used for handling materials containing beryllium and DU. The materials were reportedly brought into the building in bags that contained dust, which was released due to the shaking movement of the bags. The released dust settled on the floor, providing potential pathway for migration to areas outside the building during routine cleaning operations. A safety report prepared in July 1968 (Larson, 1968) indicates that the DU (U-238) waste material was stored in Room 3 of Building 64. Radioactive material storage occurred at least until 1968.

Documents indicate that various chemicals including solvents and corrosives were used in the plating operations conducted at Building 64. These include: sodium dichromate, caustic soda, chromic acid, phosphoric acid, oxalic acid, sulfuric acid, degreasing solvents (i.e., chlorinated solvents such as TCE, 1,1,1-trichloroethane [1,1,1-TCA]) and cadmium/cyanide based compounds. Although the nature and the quantity of wastewater are not known, it is likely that some of the above noted chemicals were constituents in the wastewater.

No information is available on the disposal methodology of the treated wastewaters. During an interview conducted by ANL, Picatinny personnel reported that when Building 64 was used as a metal plating shop, flow in BSB adjacent to Site 123 was green and brownish red (ANL, 1991). Additionally, available documents from July 1960 indicate that the neutralization system located outside Building 64 was leaking (Wilford, 1960). The above information suggests that release of wastewater into BSB occurred during this period.

2.4.2 Previous Studies

The only previous study conducted at the site is the Dames and Moore Phase I RI.

2.4.2.1 Dames and Moore Phase I RI, 1998

A total of six surface soil samples were collected at Site 123 during the Phase I RI and analyzed for VOCs, SVOCs, metals plus cyanide, and radiological parameters. One sample was also analyzed for pesticides/PCBs, and explosives. Additionally, two surface water samples and four sediment samples have been collected from BSB in the vicinity of Site 123. Two surface water and two sediment samples were collected as part of the Phase I assessment of GPB and its tributaries, and two additional samples were collected during the GPB and BSB Data Gap Investigation for the *Green Pond and Bear Swamp Brooks (GP/BSB) FFS* (IT, 2001e). The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals plus cyanide, TPH, explosives, and radiological parameters. The analytical results indicated that PAHs and metals were detected above the associated criteria value in both upstream and downstream sediment samples. Radiological concentrations for gross alpha and total uranium exceeded the background levels established in the *Picatinny Arsenal Facility-Wide Background Investigation* (IT, 2002) in one sample SS123-2A, but there are no NRSRS values or *New Jersey Soil Remediation Standards for Radioactive Materials* for these parameters. The only gamma radionuclide identified in the samples, cesium-137 was detected at concentrations below the background level. Existing contamination in BSB was evaluated in the *GP/BSB FFS* and the *Proposed Plan for GP/BSB* (Shaw, 2003d). In addition, a portion of the contaminated sediment and soil adjacent to the site (387 cubic yards [CY]) were removed and disposed of off-site during the Site 122 PCB Removal Action (IT, 2000d). Annual chemical and biological monitoring selected in the Record of Decision (ROD) (Shaw, 2004) will be conducted to protect the environment from the remaining contamination. Therefore, the sediment adjacent to Site 123 need not be addressed in this FFS.

As part of Phase I RI, a radiological monitoring survey was conducted at Site 123 due to past beryllium and DU handling operations conducted at Building 64. The purpose of the survey was twofold: (1) to identify any areas with unacceptably high levels of radiation for personnel exposure during the RI activities; and, (2) to identify areas with radiation levels above background, so that these areas could be sampled during the Phase I RI. The radiation survey was conducted utilizing micron microrem meters, which have a minimum scale reading of 1 μrem/hr. The radiological survey results for Site 123 did not identify any areas of concern (AOCs) in the exclusion zone. The maximum radiation level measured was 8 μrem/hr (3 μrem/hr above background), which did not exceed the cutoff level and was within the expected range of fluctuation for the background level. The summary of results for Site 123 is given in **Table 2-3** below:

Table 2-3
Phase I RI Radiological Monitoring Survey Results for Site 123

Site	Average 1 Meter μrem/hr[1,2,3]	Maximum 1 Meter μrem/hr[1,2]	Average 1 Centimeter μrem/hr[1,2,3]	Maximum 1 Centimeter μrem/hr[1,2]	Average Background 1 Meter μrem/hr[2,3]	Average Background 1 Centimeter μrem/hr[2,3]
123	5 ~ 2	8	5 ~ 2	7	5 ~ 2	5 ~ 1

Notes: (1) Includes background. (2) Shown to one significant figure. (3) Errors given at 2 sigma.

2.4.3 Nature and Extent of Contamination

As part of the Phase I 2A/3A RI, sampling activities included a soil-gas survey, surface and subsurface soil samples. Table 8-7 in **Appendix A** lists all the samples collected at Site 123 as part of the Phase I 2A/3A RI and their corresponding analyses. The soil-gas survey was conducted to investigate TPH contamination identified in this area during the Site 122 excavations (IT, 2002) and to investigate contamination at potential source areas recommended by NJDEP. Since no contamination was identified at any potential source areas from the survey, soil sampling was not deemed necessary to characterize these locations. Concentrations of chlorinated compounds and petroleum-related compounds were low to moderate in the soil-gas modules. Sample concentrations exceeding Picatinny LOCs are presented on **Figure 2-8**.

2.4.3.1 Surface Soil

A total of eight surface soil samples were collected at Site 123 as part of the Phase I RI and the Phase I 2A/3A RI to characterize entrance/exit areas (SS123-4), loading areas/shed (SS123-2 and 123SS-6) the drainage ditches/discharge outlets (SS123-1, SS123-3, SS123-5, and 123SS-8) and the area downgradient of the concrete pad (123SS-7). Analytical results of the sampling are presented on Tables 7.12-2 through 7.12-7 and Table 8-7 in **Appendix A**. Benzo(a) pyrene and arsenic exceeded LOCs in sample 123SS-7A and Aroclor 1254 exceeded LOCs in sample 123SS-8A. Benzo(a)pyrene was detected slightly above its NRSRS (0.2 mg/kg) and equal to its IRSL (0.21 mg/kg) in 123SS-7A. Arsenic also exceeded its IRSL (1.6 mg/kg), and the Picatinny background level in surface soil (9.23 mg/kg), but is below the NRSRS for arsenic which is based on natural background. Aroclor 1254 exceeded its IRSL (0.74 mg/kg) as well as the NRSRS for total PCBs (1 mg/kg).

2.4.3.2 Subsurface Soil

Nine subsurface soil samples were collected at Site 123 as part of the Phase I 2A/3A RI. No subsurface soil samples were collected during the Phase I RI. Four samples (123TP-2B to 123TP-5B) were collected from a trench excavated on the western side of Building 64 between the building and BSB. Four samples (123SB-6B to 123SB-9B) were collected to investigate elevated soil gas concentrations identified during the soil-gas survey. The remaining sample (123SB-2B) was collected to investigate potential contamination from former chemical storage within Building 64. The analytical results for the subsurface soil results are presented on Table 8-8 in **Appendix A**.

The only LOC exceedences in the subsurface soil samples were for PCBs detected in sample 123TP-5B. Aroclor 1248 and Aroclor 1260 were detected at concentrations of 6.30 mg/kg and 0.980 mg/kg, respectively. The IRSL for both PCBs is 0.74 mg/kg. The total PCB concentration reported in the sample was 7.28 mg/kg, which exceeds the NRSRS for total PCBs (1 mg/kg). This sample was collected 2 ft bgs from the sidewall of the trench adjacent to the brook in the location where oil-staining was originally identified. Although the soil was black due to a high organic content, there was no evidence of a sheen or odor in the sample. The high PCB level may be a remnant from the Site 122 PCB removal action since this sample was collected approximately at the excavation boundary.

2.4.4 Summary of Risk Assessments

Table 2-4 summarizes the human health risk and hazard for Site 123. The estimated reasonable maximum exposure (RME) risks for the realistic exposure scenarios are within USEPA's target cancer risk range of 1E-04 to 1E-06 and the estimated total hazards are less than USEPA's target noncancer hazard threshold of 1.0. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

Table 2-4
Summary of Site 123 Estimated Risks and Hazards

Receptor (Current and Future)	Est. Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Industrial Research Worker	7.6E-05	Aroclor 1248	Surface Soil
Outdoor Maintenance Worker	1.3E-05	Aroclor 1248	Surface Soil
Construction Worker	2.0E-06	Aroclor 1248	Total Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.32	NR – hazards acceptable	NR – hazards acceptable
Outdoor Maintenance Worker	0.20	NR – hazards acceptable	NR – hazards acceptable
Construction Worker	0.41	NR – hazards acceptable	NR – hazards acceptable

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

Site 123 was evaluated along with adjacent Sites 117 and 122 during the Phase I ERA (Dames and Moore, 1998). This Assessment Area consisted of an approximate 1,300-ft reach of BSB. The area includes the perennially flowing channel of the brook and the adjacent vegetated banks and flats between rows of operational laboratories and production facilities. The relatively small size of usable habitat and very high human use of the area presently tend to reduce risks to wild terrestrial species here, particularly the woodcock and barred owl. Findings from the Phase I ERA indicated that aluminum, iron and lead exceeded background levels in some plant tissue. Low impact to earthworm survival was observed for Site 117 soil (5% mortality was significantly different from representative control, but not considered relevant from an ecological standpoint). No earthworm toxicity was observed in soil collected from Site 122 (Site 123 was not specifically addressed). Samples from Site 122 had the highest number and highest concentrations of metallic and organic constituents of potential concern (COPCs) measured in small mammal tissue; however, the small mammal populations displayed little structural perturbations.

2.5 SITE 187, BUILDING 67, OIL AND ACID STORAGE

2.5.1 Site History

Building 67 (**Figure 2-9**) was constructed in 1957 and consists of a covered, open loading area and an enclosed storage facility, all on a concrete slab. The building is used to temporarily store waste chemicals turned in for disposal; it also receives and stores Picatinny's chemical shipments. Building 67 has performed this mission since at least 1966. The concrete floor is pitted, and Installation files indicate several spill and cleanup actions occurred at Building 67. The Directorate of Public Works' drawing DP-54705 shows floor drains discharging into four dry wells at the west side of Building 67 and one dry well at the northeast corner of the building. During the Phase I 2A/3A RI field operations, scaled drawing DP-54705 was used in the field in an attempt to identify the dry wells. No evidence of the dry wells west of Building 67 could be found. A recent addition to Building 7, Armament Technology Facility, overlies one suspected location and a fire hydrant is located at the supposed location of another dry well. Based on the field reconnaissance, it appears that the three northwestern dry wells never existed, because there is no evidence of the dry wells at the locations depicted on the Department of Public Works drawing or the immediate vicinity.

The outdoor retention berms were built in the early 1990s and contain drainpipes. Before construction of the berms, storm water drained into BSB. A new concrete loading dock ramp was installed on the northeastern end of Building 67 in 1996, and the surrounding area was landscaped.

2.5.2 Previous Studies

The following investigations have been conducted at Site 187:

1. 1994 – Dames and Moore conducted a Preliminary Assessment/Site Inspection (PA/SI); and,
2. 1998 – USACHPPM conducted an RRSE.

These investigations are summarized in the next two subsections.

2.5.2.1 Dames and Moore PA/SI, 1994

Given the long history of chemical storage in this building and the occurrence of occasional spills/releases, it was concluded that contaminants may have been released to the environment. As a result, the PA/SI recommended that surface soil samples be collected at the outlet pipes for the bermed areas and also from the loading area at the southwestern end of the building.

2.5.2.2 USACHPPM RRSE, 1998

USACHPPM performed an RRSE of Site 187 in 1997. Geoprobe groundwater samples (PICA-67-1W to PICA-67-3W) were collected in the downgradient vicinity of two dry wells (the location at the northeast corner and one suspected drywell location at the northwest corner of the building) and the loading bay in Building 67. Concentrations of lead and arsenic in excess of regulatory criteria were found in the samples collected at Building 67, downgradient from the facility and its former hazardous waste tank (**Figure 2-9**). Lead concentrations above the LOC of 5 µg/L were reported in samples 67-1W (55 µg/L), 67-2W (12 µg/L), and 67-3W (31 µg/L). The arsenic exceedence was identified in sample 67-1W (18 µg/L).

Two soil samples were collected from 0-2 ft bgs, proximal to a large area of stained soil and decreased vegetation near the Building 67 loading bay. The soil samples collected from this location were comprised of sandy gravel and road fill debris. Analytical results did not indicate elevated levels of metals in either sample above LOCs. Trace levels of the pesticide DDT and PCB Aroclor 1260 were detected in sample PICA-67-1S. Soil sample PICA-67-2S contained detectable levels of 1,2,4-trichlorobenzene, and the PCB Aroclor 1260. 1,2,4-Trichlorobenzene was detected above its IRSL (99 mg/kg), but below its NRSRS (820 mg/kg). Concentrations of bis(2-ethylhexyl)phthalate in sample PICA-67-2S were measured in excess of both the NRSRS (140 mg/kg) and IRSL (120 mg/kg). However, this compound was also detected in the associated rinse blank. The analytical results can be found on Tables D-7 and D-8 in **Appendix A**.

The RRSE scored the site a medium risk. The groundwater hazard was medium and the surface soil hazard was low.

2.5.3 Nature and Extent of Contamination

As part of the Phase I 2A/3A RI, sampling activities were conducted at Site 187 included groundwater, surface soil and subsurface soil samples. Metals contamination identified in the groundwater has been evaluated as part of the Area D Groundwater FS (Shaw, 2003a) and Proposed Plan (Shaw, 2003b). However, the analytical results do not suggest that Site 187 is a source of the groundwater contamination. Groundwater analytical results are provided on Tables D-7 and 8-12 in **Appendix A**, and constituents detected above LOCs are presented on **Figure 2-9**.

2.5.3.1 Surface Soil

Seven surface soil samples have been collected at Site 187 as part of the USACHPPM RRSE and the Phase I 2A/3A RI to investigate potential contamination on the eastern side of Building 67. Analytical results of the sampling are provided on Tables D-8 and 8-13 in **Appendix A**. All chemical concentrations detected in the surface soil samples (with the exception of 67-2S) were below their respective LOCs including sample 187SB-6A. This sample was collected at the location of USACHPPM sample 67-2S, which had a bis(2-ethylhexyl)phthalate concentration of 12,000 mg/kg and a 1,2,4-trichlorobenzene concentration of 260 mg/kg. The RRSE noted that sample 67-2S contained severe matrix effects which confounded the SVOC analysis. Sample 187SB-6A contained an estimated bis(2-ethylhexyl)phthalate concentration of 0.022 mg/kg; 1,2,4-trichlorobenzene was not detected in the sample (RL = 0.35 mg/kg).

2.5.3.2 Subsurface Soil

Two subsurface soil samples were collected from two soil borings drilled to investigate potential contamination at suspected dry wells. The two subsurface soil samples were collected from 0 to 6 inches above the saturated zone. A third subsurface soil sample (187SB-6C) was collected from 2 to 3 ft bgs beneath USACHPPM sample 67-2S. Sample 187SB-4B was also analyzed for pesticides. The analytical results for the subsurface soil samples are provided on Table 8-14 in **Appendix A**. All chemical concentrations detected in the subsurface soil samples were below their respective LOCs.

2.5.4 Summary of Risk Assessments

Table 2-5 summarizes the human health risk and hazard for Site 187. The estimated RME risks and hazards for the realistic exposure scenarios are within or below USEPA's target cancer risk range of 1E-04 to 1E-06 and below USEPA's target noncancer hazard threshold of 1 for the evaluated receptors. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

Table 2-5
Summary of Site 187 Estimated Risks and Hazards

Receptor (Current and Future)	Estimated Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Industrial Research Worker	9.0E-06	Arsenic	Surface Soil
Construction Excavation Worker	3.4E-07	NR - risks acceptable	NR - risks acceptable
Adult Resident	1.7E-05	Arsenic	Soil
Child Resident	1.5E-05	Arsenic	Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.056	NR - hazards acceptable	NR - hazards acceptable
Construction Excavation Worker	0.052	NR - hazards acceptable	NR - hazards acceptable
Adult Resident	0.11	NR - hazards acceptable	NR - hazards acceptable
Child Resident	0.39	NR - hazards acceptable	NR - hazards acceptable

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

The estimated total cancer risks for the hypothetical future residential scenarios are within USEPA's target risk range of 1E-04 to 1E-06 (**Table 2-5**). The residential noncancer hazards are below the threshold of 1 for both populations.

The drainage channel indicated on **Figure 2-9** (labeled as a grassy ditch) that crosses through Site 187 is not exposed in the area of Site 187. Significant transport of the low level compounds from the soil of Site 187 to BSB via this channel is also unlikely, because the site is entirely paved with the exception of the grassy ditch. Additionally, BSB in the area of Site 187 has been addressed previously through an FFS (IT, 2001). Though there is a limited potential for risk to birds from elevated lead in soil if they were to feed extensively in the area, the screening-level hazard quotient (HQ) is relatively low; the area of contamination is limited to the loading area (less than 0.1 acre); and the site (total size about 0.7 acres) is located in a well-used area and offers little habitat for ecological receptors. Thus, the Screening Level Ecological Risk Assessment (SLERA) (Shaw, 2005) concluded that no further ERA is warranted for Site 187.

2.5.5 Facility-Wide Investigation of Sumps and Dry Wells

In November 2003, one sample was collected from 2.0 to 2.5 ft bgs at the location of the suspected dry well on the northeast side of Building 67. The sample was analyzed for VOCs, SVOCs, pesticides, PCBs and metals, as recommended by USACHPPM based on site history (USACHPPM, 1997). There were no LOCs exceeded in the sample. The sample location was filled with clean soil from an approved on-base borrow source, and the depression associated with the suspected dry well was graded to level with the surrounding ground surface. Based on the results of the investigation, the suspected dry well at the northeast corner of Building 67 can be eliminated as a potential source of contamination.

2.6 PICA SITE 207, BUILDING 63, FACILITY ENGINEERING LUMBER AND PIPE SHED

2.6.1 Site History

The Facility Engineering Lumber and Pipe Shed, Building 63 (**Figure 2-10**) was built in 1942 and has always been used for lumber and transformer storage. Floor plans dated 1981 show that transformers and material described as toxic lumber were stored outside between Building 63 and First Avenue. No evidence of releases inside Building 63 or the adjacent transformer pad TR-63 was found. Installation spill files contain no spill reports for Building 63. Potential releases to soil from leaking transformers stored near the building include PCBs. Potential soil contaminants at the lumber storage area include metals and PCBs. The former transformer storage area is covered by sod, and the former lumber storage area is covered by 2 to 4 inches of gravel.

2.6.2 Previous Investigations

The only investigation conducted at Site 207 was performed by USACHPPM in 1997. The RRSE conducted by USACHPPM is summarized in the following section.

2.6.3 Nature and Extent of Contamination

Four composite surface soil samples were collected from under the dying sod at Building 63's former transformer storage area (**Figure 2-10**). Each composite sample was taken from 25 percent of the former transformer storage area. Two composite surface soil samples were collected from under the gravel at Building 63's former lumber storage area. Each composite sample was taken from 50 percent of the former lumber storage area.

2.6.3.1 Surface Soil

Six surface soil samples were collected at Site 207 as part of the USACHPPM RRSE. Analytical results of the sampling are presented on Table D-12 in **Appendix A**. Soil samples collected from the former transformer storage area were analyzed for PCBs. No PCBs were detected in the soil samples. Two surface soil samples from the former lumber storage area were analyzed for heavy metals. All metal detections except arsenic were below their respective LOCs. Arsenic was detected in sample 63-6S at a concentration of 36 mg/kg, which exceeds the NRSRS of 19 mg/kg. Arsenic was also detected in sample 63-5S, at a concentration of 16 mg/kg which is above both the IRSL (1.6 mg/kg) and the Picatinny background surface soil level (9.23 mg/kg), but below the New Jersey NRSRS based on natural background.

2.6.4 Summary of Risk Assessments

The USACHPPM report categorized the relative risks associated with exposure of personnel to contaminants in the soil at Building 63 as low. Soil was considered the only medium of concern. The report also pointed out that personnel working in Building 63's outdoor storage areas do not come into contact with the soil due to the 2 to 4 inch gravel cap. The gravel barrier severs the exposure pathway to soil. In addition, the entire site is fenced (see site photograph, **Appendix B**).

No ecological investigation has been performed at Building 63. There is a limited potential for risk to terrestrial species from elevated arsenic in soil if they were to feed extensively in the area. However, the area of contamination is limited to a small portion of the former lumber storage area (less than 0.1 acre); and the site is located in a well-used area and offers little habitat for ecological receptors.

2.7 SITE 60, BUILDING 163, PHOTOGRAPHY LABORATORY

2.7.1 Site History

Building 163 was constructed in 1942 as a high explosives laboratory. The building has been used as a photography laboratory since 1961. Building 163, located in Area F, is presented on **Figure 2-11**.

The photography laboratory in Building 163 generates approximately eight gallons each of developer and bleach/fixer per month as well as four gallons each of black-and-white fixer and stop bath solution.

Prior to 1984, these waste streams were drained, via a 2-inch polyvinyl chloride (PVC) pipe, from two sinks within Building 163 to a 1,000-gallon concrete UST located adjacent to the north corner of the Building. The UST was not used after 1984 and was removed in 1991. The photo processing containers are no longer stored at Building 163.

2.7.2 Previous Studies

2.7.2.1 Weston RCRA Closure Verification Investigation, 1991

Weston Environmental conducted RCRA closure activities of the 1,000-gallon concrete UST at Site 60 from February 6 to February 22, 1991. Closure activities involved the excavation of the tank and associated piping. Excavated soils were shipped offsite for disposal. The area was backfilled with soil, clean fill, and topsoil. Six subsurface soil samples, one rinseate sample, and two chip samples were collected and analyzed to verify that closure was complete. The subsurface soil samples were collected from the immediate vicinity of the UST. Soil samples were analyzed for Target Compound List (TCL) VOCs, metals following TCLP extraction, Priority Pollutant (PP) metals, and cyanide. One sample was also analyzed for SVOCs and PCBs. The chip samples collected from the inside walls of the UST were analyzed for PP metals. Analytical results are provided on Tables 9.2-2 and 9.2-4 in **Appendix A**. An NJDEP letter dated December 1992 stated the closure has been completed; therefore, no further investigation or remedial activities regarding the former UST are required under CERCLA. The remainder of Site 60 is evaluated in this FFS.

2.7.2.2 Dames and Moore Phase I RI, 1998

Due to the above mentioned RCRA closure, no environmental samples were collected during the Phase I RI to investigate Site 60. However, groundwater samples were collected from the monitoring well cluster MWF-3A and MWF-3B, located in the vicinity of Site 60. MWF-3A contained tetrachloroethene (PCE) concentrations that exceeded comparison criteria, but may be associated with an upgradient source adjacent to Site 104. Hexahydro-1,3,5-trinitro-syn-triazine (RDX) was detected slightly above the LOC in MWF-3B (and below the LOC in subsequent sampling). Aluminum, iron, and manganese were detected in unfiltered groundwater samples above their comparison criteria in both wells. Only manganese exceeded its comparison criterion in the filtered samples. Aluminum, iron, and manganese are naturally occurring minerals which have been detected frequently in sampling of Picatinny groundwater. Similar to other groundwater sites at Picatinny, the contribution of these metals is likely due to site geology. Groundwater contamination at Site 60 and in Area F is being evaluated in the Mid-Valley Groundwater FS (Shaw, 2005), which focuses in particular on explosives and VOCs. Analytical results are provided on Tables 9.2-6 through 9.2-13 in **Appendix A**.

As part of a soil gas survey at nearby Site 104 (Buildings 161 and 162), four soil gas points were placed around Building 163. In addition, three points were installed in the vicinity of Buildings 164 and 164B. PCE was the only compound detected. It was identified in two samples near Building 164 at concentrations of 1.2 µg/L and 0.6 µg/L. However, because PCE was not detected in the four soil gas samples collected around Building 163, it is unlikely that Building 163 is the source of PCE in soil gas.

2.7.3 Nature and Extent of Contamination

As part of the Phase I 2A/3A RI conducted at Site 60, eight surface soil samples were collected from four locations in 2000 (**Figure 2-11**). Samples were collected near doorways, an outdoor storage area, and the discharge point for building drainage. The Phase I 2A/3A sampling locations are not associated with the former 1,000-gallon UST closed under RCRA in 1991.

2.7.3.1 Surface Soil

Samples 60SS-1A through 60SS-4A were collected from a depth of 0-1 ft bgs and samples 60SS-1B through 60SS-4B were collected at depths of 1-2 ft bgs. Analytical results are provided on Table 9-3 in **Appendix A**. All samples were analyzed for baseline explosives. Sample 60SS-1 was additionally analyzed for VOCs, SVOCs, and metals.

With the exception of arsenic, no VOCs, SVOCs, or metals were identified above comparison criteria in sample 60SS-1A. Arsenic (2.30 mg/kg) was detected above the IRSL (1.6 mg/kg), but below the Picatinny background level for surface soil (9.23 mg/kg), and the NRSRS (19 mg/kg) based on natural background. No explosives were detected in any of the surface soil samples collected at Site 60. Therefore, it was concluded that the soil in the vicinity of Building 163 is not a source of the explosives contamination in groundwater.

2.7.4 Summary of Risk Assessments

The estimated RME total cancer risks for exposed workers are within or below USEPA's target cancer risk range of 1E-04 to 1E-06 (**Table 2-6**). The estimated total hazards for the industrial research worker and construction excavation worker scenarios are below USEPA's target noncancer hazard threshold of 1. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

Table 2-6
Summary of Site 60 Estimated Risks and Hazards

Receptor (Current and Future)	Estimated Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Industrial Research Worker	1.9E-06	Arsenic	Surface Soil
Construction Excavation Worker	1.4E-07	NR - risks acceptable	NR - risks acceptable
Adult Resident	4.1E-06	Arsenic	Soil
Child Resident	4.9E-06	Arsenic	Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.012	NR - hazards acceptable	NR - hazards acceptable
Construction Excavation Worker	0.022	NR - hazards acceptable	NR - hazards acceptable
Adult Resident	0.026	NR - hazards acceptable	NR - hazards acceptable
Child Resident	0.13	NR - hazards acceptable	NR - hazards acceptable

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

The estimated risks and hazards for the hypothetical future residential scenarios are also within USEPA's target cancer risk range of 1E-04 to 1E-06 and below USEPA's target noncancer hazard threshold of 1 (**Table 2-6**).

An ERA was conducted for Site 60 during the Phase I RI. The Phase I ERA evaluated ecological risk based on Exposure Assessment Areas, in which adjoining areas or sites were grouped together based on physical characteristics. The Site 60 Assessment Area included Sites 61, 104, 124, and 126 (Dames and Moore, 1998). Results of the ERA indicated that Site 60 is urbanized, highly maintained and subject to constant human use, so real risks to ecological receptors are minimized. Additionally, the small size of the site (about 0.4 acre) suggests that only a limited number of receptors could exist at the site and potential effects would be immeasurable. Neither the small mammal studies nor the earthworm bioassays found any substantive impacts in the assessment areas. Data from the small mammal bioaccumulation study indicates no significant COPC bioaccumulation.

2.8 SITE 145, BUILDING 477, EXPLOSIVES AND PROPELLANT MIXING AREA

2.8.1 Site History

Building 477 was constructed in 1945 for use in medium caliber projectile loading activities. According to Picatinny personnel, the building was converted to a laboratory in the early 1960s for mixing and drying explosives, propellants, and pyrotechnics. The 1991 ANL RI Concept Plan indicated that Building 477 was still a laboratory. The location of Building 477 is presented on **Figure 2-12**.

Historically, explosives contaminated wastewater was generated daily at Building 477 from the washdown of machines and walls following loading activities and from dust control devices. The wastewater was discharged to a sand filter. This sand filter was located near the northeast corner of the building and was contained within a stone masonry settling pit, which drained to GPB (**Figure 2-12**). In 2004, the wooden filter box and its contents were removed from the settling pit.

2.8.2 Previous Studies

2.8.2.1 Dames and Moore Phase I RI, 1995

Dames and Moore personnel collected surface soil, subsurface soil, and groundwater samples at Site 145 as part of the Phase I RI.

Six surface soil samples were collected to evaluate potential contamination from past activities at Site 145. Sample SS145-1 was collected from the area within the blast wall at the southeast corner of Building 477. Sample SS145-2 was collected from an area of stressed vegetation identified near the west end of the building. Sample SS145-3 was collected near the settling tank outfall. Samples SS145-4 and SS145-5 were collected on the north side of the building in the area of minor dumping identified by Picatinny personnel. Additionally, the surface sample from soil boring SB145-1, which was collected from a depth of 0 to 2 ft by the settling tank, is also considered to be a surface soil sample. **Figure 2-12** presents the six surface soil sampling locations. The surface soil samples were analyzed for TCL VOCs, Target Analyte List (TAL) metals plus cyanide, and explosives. Additionally, SB145-1 was also analyzed for TCL base neutral/acid extractables (BNAs). The analytical results for the surface soil samples are presented on Tables 9.17-2 and 9.17-3 in **Appendix A**. The table only presents the compounds which were detected in the samples collected at Site 145. No VOCs or SVOCs were detected in the surface soil samples. Nitrocellulose was the only explosive detected. It was detected in all six samples with a maximum concentration of 237 mg/kg. No LOC has been established for this compound. With the exception of arsenic, all metals concentrations were below their respective LOCs. Detected arsenic concentrations ranged from 4.04 mg/kg (SS145-1) to 11.2 mg/kg (SS145-3) which exceeds the IRSL (1.6 mg/kg) but are below the NJDEP NRSRS based on natural background. Only the SS145-3 result exceeded the Picatinny background level for arsenic in surface soil (9.23 mg/kg).

Two subsurface soil samples were collected from SB145-1, which was drilled next to the settling tank. Subsurface sampling intervals were 2 to 4 ft and 6 to 8 ft bgs. The samples were analyzed for TCL VOCs, TCL BNAs, TAL metals plus cyanide, and explosives. The analytical results for the subsurface soil samples from SB145-1 are presented on Tables 9.17-6 through 9.17-8 in **Appendix A**. No VOCs were detected in the subsurface samples. SVOCs were detected at concentrations below LOCs. Dinitrotoluene (DNT) isomers were detected in sample SB145-1D at concentrations above the NRSRS of 3 mg/kg. The 2,4-DNT and 2,6-DNT concentrations identified in the sample were 20 mg/kg and 10 mg/kg, respectively. The 2,4-DNT concentration also exceeded its IRSL (5.5 mg/kg). Thallium was the only metal detected in excess of the LOC. Sample SB145-1C has a thallium concentration of 179 mg/kg (NRSRS = 79 mg/kg). There is no IRSL value for thallium.

Groundwater samples were collected from three wells near Site 145 during the Phase I RI. USGS installed monitoring well 271725 northeast of Building 477 to monitor the unconfined/water table aquifer. Dames and Moore installed the monitoring well pair MWF-4A and MWF-4B during the Phase I RI as part of the overall hydrogeologic investigation of Area F. Monitoring wells MWF-4A and MWF-4B are located immediately downgradient of Building 477. **Figure 2-12** illustrates the Site 145 monitoring well locations along with sample results for all groundwater constituents detected above LOCs. Generally, the highest concentrations of metals as well as the only RDX detections were observed in monitoring well 271725, which is located cross-gradient to Site 145. Therefore, Dames and Moore claimed that the RDX and metals detected in the groundwater samples from this well may be related to upgradient sources rather than Site 145. Additionally, when corresponding analysis of filtered samples was performed, only iron and manganese were detected above LOCs in MWF-4B (iron and manganese are naturally occurring minerals prevalent in Picatinny groundwater). Groundwater at the site is currently being addressed in the Mid-Valley Groundwater FS (Shaw, 2005). Analytical results of groundwater samples collected from Site 145 are provided in **Appendix A**.

Based on the results of the Dames and Moore Phase I RI, two AOCs were identified at the site.

1. Settling tank and tile drain on the north side of Building 477; and,
2. Groundwater downgradient (northwest) of the settling tank and tile drain.

2.8.2.2 Phase I Additional RI, 1998

In order to further characterize these two AOCs, two surface soil, one surface water/sediment, and two shallow groundwater samples were collected at the site as part of the Phase I Additional RI (IT, 1999). The soil and sediment samples were analyzed on-site for explosives and analyzed off-site for metals. The surface water and groundwater samples were analyzed off-site for explosives and metals. A discussion of the results from this investigation is presented in the following section.

2.8.3 Nature and Extent of Contamination

2.8.3.1 Surface Soil

In order to characterize the potential for contamination associated with the settling tank and tile drain, two surface soil, one surface water/sediment sample, and one shallow groundwater sample were collected.

The two surface soil samples, 145SS-6 and 145SS-7, were collected along the length of the approximately 60-ft long tile drain to assess the potential for contamination from its historic conveyance of wastewater. The soil samples were collected six inches below the invert of the drainage pipe. No explosives were detected at concentrations greater than the estimated quantitation limit (EQL) in 145SS-6 and 145SS-7. With the exception of arsenic, no metals were present at concentrations greater than their respective LOC. Arsenic concentrations detected in samples 145SS-6 and 145SS-7 (11.6 mg/kg and 9.79 mg/kg) exceed the IRSL (1.6 mg/kg) and the Picatinny surface soil background level (9.23 mg/kg); but are below the NJDEP NRSRS which is based on natural background in New Jersey. The analytical results for the two surface soil samples are presented on Table 9-36 in **Appendix A**.

2.8.3.2 Surface Water and Sediment

One surface water/sediment sample, 145SW/SD-1, was collected at the outfall location of the tile drain. The analytical results for surface water sample 145SW-1 can be found on Table 9-37, while the results for sediment sample 145SD-1 are contained on Table 9-38 (**Appendix A**). No explosives were detected at a concentration above surface water LOCs. The following metals were detected at concentrations greater than their respective LOCs in 145SW-1: aluminum (33,200 μg/L), arsenic (8.4 μg/L), cadmium (2.5 μg/L), chromium (101 μg/L), copper (2,230 μg/L), iron (45,900 μg/L), lead (298 μg/L), manganese (1,090 μg/L), mercury (2.97 μg/L), nickel (62.5 μg/L), vanadium (63.3 μg/L), and zinc (489 μg/L).

No explosives were detected in 145SD-1 at concentrations greater than the reporting limits. The only metal detected in 145SD-1 at a concentration above sediment LOCs was copper (110 mg/kg).

2.8.4 Summary of Risk Assessments

A revised HHRA was completed as part of the Additional Phase I RI to incorporate the additional samples collected by ICF Kaiser Engineers, Inc. (ICF KE) in 1997 into the Dames and Moore data set. This revised HHRA followed the same approach utilized by Dames and Moore in the Phase I RI (Dames and Moore, 1998). The additional information was used to recalculate the hazards to three receptor populations: current outdoor maintenance workers exposed to constituents in shallow soil, future industrial/research workers exposed to constituents in shallow soil, and future construction workers exposed to constituents in total soil.

To incorporate the new analytical data into the existing HHRA for Site 145, the new analytical data were merged with the existing data set. Once the data were merged together, statistical calculations were conducted to determine the mean, distribution type, and 95% upper confidence levels (UCL) of the mean concentration for each detected constituent.

Hazard indices (HIs) based on historic data are presented in **Table 2-7** for the maintenance worker, the industrial/research worker, and the construction worker. Shallow and total soil HIs were scaled by determining the ratio between the historic EPC, presented in the Phase I RI, and the new, revised EPC. The resulting ratio was multiplied by the historic HI for each COPC to determine the revised HI. **Table 2-7** also presents the revised HIs. The noncarcinogenic hazard exceeded the HI criterion of 1 for construction/excavation workers at 20. The hazard resulted primarily from manganese via the inhalation pathway. However, all manganese concentrations detected in the soil were below both its NRSRS (5,900 mg/kg) and IRSL (23,000 mg/kg). A review of other sites at Picatinny has shown that the hazard attributed to manganese has been overestimated in the Phase I RI (Shaw 2005d, 2005e). Carcinogenic risk could not be computed because the selected contaminants lacked slope factors.

No ecological investigation was conducted at Building 477 during the Phase I RI. However, Site 145 is located adjacent to the Site 138 Assessment Area. The results from the Site 138 ecological investigation indicated no observable impacts to the plant community or small mammal population. A low impact was observed during the earthworm bioassay. Modeled risks were found to be high for the veery and woodcock, which have home ranges that could overlap Site 145.

Table 2-7
Site 145, Building 477, Results of Revised Human Health Risk Assessment

Scenario	Historic HI	Revised HI	Hazard Driver
Maintenance Worker	0.003	Not Revised	NA
Industrial/Research Worker	0.03	Not Revised	NA
Construction Worker	30	20	Manganese (inhalation)

2.8.5 Facility-Wide Investigation of Sumps and Dry Wells

In 2004, the wooden filter box and its contents were removed from the settling pit. Post-excavation samples were collected from the earthen bottom of the settling tank/pit (145B-1 and 145B-2) and directly outside the settling tank adjacent to the discharge line to the tile drain (145SS-SWW-1) (**Figure 2-12**). Samples were analyzed for explosives and metals. Explosives concentrations were below LOCs. A sample collected of the filter box's contents (145SS-1B-1) had concentrations of arsenic (11.1 mg/kg) and lead (4,270 mg/kg) above LOCs. The sample collected within the settling pit (145B-1) contained arsenic (30.9 mg/kg) and lead (5,690 mg/kg) in excess of LOCs. The arsenic concentration in 145B-1 was the only sample to exceed its NJDEP NRSRS based on natural background. A sidewall sample collected on the downgradient side of the stone settling pit did not have any metals or explosives concentrations above LOCs (with the exception of arsenic detected below the NRSRS). As a result of the elevated metals concentrations detected in 145B-1, one foot of soil was removed from the settling pit and disposed off-site. The subsequent post-excavation sample (145B-2) collected at the effluent point had an arsenic concentration (10.2 mg/kg) in excess of the IRSL and Picatinny background; but did not contain any other metals exceeding LOCs. The remainder of the site is evaluated further in this FFS.

2.9 SITES 52, 95, AND 96, BUILDINGS 305, 336, 301, AND 301A – PETROLEUM LEAK AREA, LAUNDRY AND WASTE OIL STORAGE FACILITY

Sites 52, 95, and 96 are located adjacent to each other in the south-central portion of Area G. Due to the proximity of the three sites, the RI field program conducted for these three sites overlapped each other. As a result, Sites 52, 95, and 96 have been combined and discussed as a group.

2.9.1 Site History

Site 52 encompasses Building 305 and the swampy area on the south side of the building where a petroleum leak occurred in 1986. Building 305, built in 1880, is divided into two sections, northern and southern. Building 305 is presented on **Figure 2-13**.

Originally constructed in 1880, the northern section is presently being used as a garage for conducting vehicle maintenance operations. Prior to 1986, at least three aboveground and underground gasoline and diesel storage tanks were associated with the Building 305 garage. In 1986, all storage tanks were decommissioned when a petroleum release occurred from one of the tanks. Available documents indicate that the northern section of Building 305 may have been used in the past for various purposes, including as an explosive manufacturing area during World Wars I and II, as an ice production facility, and as a storage area for drums containing waste oil and solvents.

The southern section of Building 305 was constructed in 1948 and has been used as a refrigeration unit. The southern section has also been used for the storage of photographic films and paper. Historic aerial photographs covering Site 52 indicate that drums, potentially containing oil/solvents, have been stored at the outdoor drum storage area located to the northwest of Building 305.

Site 95 encompasses the area occupied by former Building 336, which was constructed in June 1956 to serve as a laundry facility for explosive-contaminated clothing (**Figure 2-13**). This building had a total floor area of approximately 6,000 ft^2 and was built on a concrete foundation.

Laundry operations at Building 336 were terminated in 1979 and the building was demolished in October 1982. During its operational period, the washwater generated at Building 336 was discharged into a holding tank to settle the explosive residues. The clarified washwater from the holding tanks was then emptied onto the ground and flowed along a drainage ditch which discharged into the swampy discharge pond located at Site 52.

The exact nature and quantity of washwater generated at the laundry facility is unknown. Additionally, various chemicals including explosives may have been present in the washwater generated at the laundry facility. These chemicals included chlorine, sodium hydroxide, potassium hydroxide, ammonium sulfate, ammonium sulfamate, yellow phosphorus, sodium fluorosilicate, sodium nitrite, sodium bifluoride, and hydrofluoric acid. PCE, a common dry-cleaning solvent, could have also been used at Building 336.

Site 96 encompasses Buildings 301 and 301-A (**Figure 2-13**). Building 301 is a one-story, rectangular, wooden frame structure (840 ft^2 floor area) built on concrete piers. Building 301 was built in 1943 as a post-engineering storehouse. Although the type of material stored in the past is unknown, it is highly likely that hydraulic oils, solvents, paints, and paint thinners utilized at Buildings 302 and 305 were stored at Building 301. Building 301 is being used as a sign shop and houses a paint booth area. Waste paints and aerosols are drummed and stored at a satellite storage pad located approximately 20 to 25 ft southwest of Building 301.

Building 301-A is a one-story, rectangular, wooden frame structure (415 ft^2 floor area) with a concrete foundation. The building was constructed in 1943 as an oil house and is presently used for the same purpose. Building 301-A was originally constructed to store drums of used and unused oils. These oils were primarily generated or used at Buildings 302 and 305. In the past, drums of waste oil and solvents have been stored north of Building 301-A. An asphalt storage pad was installed at this drum storage location in 1968. According to Picatinny personnel, this storage pad area was also used by the laundry facility (Building 336) for temporary storage of explosive-contaminated clothing. Picatinny personnel also indicated that drums of hydraulic oil located at the storage pad area have leaked in the past and may have impacted soil at Site 96. No drums are being stored on the asphalt pad area at this time.

2.9.2 Previous Studies

Below is a list of previous studies that have been conducted at Site 52.

1. 1958 through 1984 – Groundwater monitoring of well 305A was conducted;
2. 1986 – A petroleum spill occurred and a cleanup action was implemented;

3. 1989 – Dames and Moore conducted a Site Investigation; and,
4. 1998 – Dames and Moore conducted a Phase I RI.

Except for the Phase I RI, no other previous studies were conducted at Site 95 or Site 96. Each of the above mentioned studies are summarized in the following subsections.

2.9.2.1 Groundwater Monitoring, 1958-1984

Well 305A, a 6-inch diameter former production well, was installed near Building 305 in 1938. It is screened at a depth of 70 to 90 ft bgs. Available documents indicate that the well was sampled at least seven times between 1958 and 1984. VOC analysis was performed on only two of these samples (July 1983 and January 1984). Metals and/or other routine inorganic parameter analyses were performed on all samples except for the July 1983 sample. A summary of analytical results can be found in **Appendix A**. Groundwater sample concentrations exceeding LOCs are presented on **Figure 2-14**.

TCE was detected at a concentration of 1.7 µg/L (LOC = 1.0 µg/L) in the sample collected in 1984. No other VOCs were detected in the two groundwater samples analyzed for VOCs.

With the exception of arsenic, iron and manganese, no metals were detected above their respective LOCs. Arsenic was detected above its LOC of 3 µg/L, at a concentration of 7 µg/L in the 1984 sample. Fluoride, chloride, and sulfate were also detected in groundwater samples collected from well 305A. Concentrations of these compounds were well below LOCs.

Groundwater analytical results from well 305A indicate a possible source of VOCs within or surrounding Area G. Since well 305A was a pumping well, it was difficult to determine the exact source area.

2.9.2.2 Petroleum Spill Cleanup Action, 1986

On February 20, 1986, a petroleum spill incident occurred at Site 52. The spill involved a release of approximately 400 gallons of diesel fuel into a swampy area south of Building 305 (ANL, 1991). The spill occurred when a stopcock on one of the underground diesel fuel tanks was accidentally left open. The spilled diesel fuel impacted an area approximately 150 ft x 150 ft and also impacted surface water/sediment along a drainage ditch that eventually discharges into GPB. As an interim emergency response, the spill was contained using booms and absorbent materials. Also, to abate the active source of petroleum contamination, Picatinny's Environmental Technology and Energy Resource Office (ET & ERO), currently known as Environmental Affairs Directorate (EAD), removed the leaking tanks. During their investigation, ET & ERO personnel noted several tanks adjacent to Building 305 that contained oil, kerosene, and fuel oil, which either were or had been leaking. As a result, all tanks in the vicinity of the spill area were removed from service. In the four months that followed the release incident, the following tasks were performed to remediate the situation: (1) all spilled oily materials from GPB and the associated drainage ditch were collected and disposed of offsite; (2) GPB and the drainage ditch were dredged to remove oily materials which were subsequently disposed of offsite; (3) earthen embankments were constructed along the drainage ditch to prevent further migration of contaminants; (4) soil samples were collected from the spilled area to define the extent of contamination; (5) the upper six inches of visibly contaminated soil was excavated and disposed of offsite; and, (6) soil samples from borings were collected to define the vertical extent of migration. A summary of analytical results and a map depicting the location of the spill can be found in **Appendix A**.

Analytical results of soil collected from the petroleum leak area indicated high levels of explosives in soil. These explosives were traced back to the drainage ditch running alongside former Building 336 (Site 95), which was used as a laundry facility in the past to clean explosive-contaminated clothes. As a response to the explosives contamination, a drainage collection system was installed to capture petroleum and explosive-impacted sediments. The contaminated surface water/sediment was pumped at regular intervals into a tank truck for off-site disposal.

The cleanup action at the petroleum leak area of Site 52 was completed in June 1986. Confirmatory soil samples collected after the cleanup indicated TPH concentrations were below the NJDEP recommended action level. Excavation areas, sample locations and results are provided in **Appendix A**.

2.9.2.3 Dames and Moore Site Investigation, 1989

As a follow-up to the 1986 petroleum spill cleanup, ten surface soil samples and three surface water and sediment samples were collected at Site 52. These samples were analyzed for VOCs, SVOCs, metals, pesticides/PCBs, and TPH. A summary of analytical results and sample locations can be found in **Appendix A**.

Soil – No VOCs were detected in any of the soil samples. A total of 13 SVOCs were detected in the 10 soil samples collected. Ten of these 13 SVOCs are identified as PAHs. Five of these detected PAHs [benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene] are also carcinogenic in nature and are referred to as cPAHs. High concentrations of most cPAHs and PAHs were detected in samples SS52-6, SS52-7, and SS52-9 located in the former petroleum spill area. Among the cPAHs, benz(a)anthracene was detected at concentrations ranging from 0.76 mg/kg to 11 mg/kg (LOC = 2 mg/kg). Benzo(a)pyrene was detected in nine of the 10 samples at concentrations ranging from 0.95 mg/kg to 13 mg/kg (LOC = 0.2 mg/kg). Benzo(b)fluoranthene was detected at concentrations ranging from 1.2 mg/kg in SS52-3 to 12 mg/kg in SS52-6 (LOC = 2 mg/kg). Benzo(k)fluoranthene and chrysene concentrations were detected below their respective LOCs. The detected concentrations of all SVOCs (PAHs) indicate an impact to surface soil due to past activities.

A total of 11 metals were detected in the 10 surface soil samples collected from the petroleum leak area. All metals concentrations were less than their respective LOC. TPH was detected at concentrations that ranged from 65 mg/kg in SS52-10 to 1,790 mg/kg in SS52-1.

Surface Water – Dames & Moore reported that although three surface water samples were collected during the 1988 Site Investigation, analytical results for only two of the samples were available. No additional information regarding the third sample was provided. No VOCs or SVOCs were detected in the two surface water samples. Elevated concentrations of aluminum, (2,490 and 78,000 µg/L), chromium (18 and 1,250 µg/L), copper (38 and 1,580 µg/L), iron (16,000 and 690,000 µg/L), lead (214 and 1,720 µg/L), manganese (1,310 and 14,000 µg/L), sodium (670,000 and 58,000 µg/L), and zinc (1,230 and 5,300 µg/L) were detected in both samples. Barium (1,860 µg/L), nickel (256 µg/L) and vanadium (57.6 µg/L) were also detected above LOCs in sample SW52-3. No pesticides or TPH were detected in surface water at the site.

Sediment – Similar to the surface water samples, analytical results for only two of the sediment samples are available. Only one VOC, acetone, was detected in both sediment samples at low concentrations (0.095 and 0.7 mg/kg). Seven SVOCs, including benzo(a)anthracene (2.1 mg/kg), benzo(a)pyrene (1.7 mg/kg), benzo(b)fluoranthene (1.5 mg/kg), chrysene (2.6 mg/kg), fluoranthene (3.0 mg/kg), and pyrene (2.9 mg/kg) were detected only in SD52-2, which was collected downstream of the site along the drainage ditch adjacent to GPB. The SVOC concentrations exceed LOCs.

Elevated concentrations of aluminum (3,260 and 7,400 mg/kg), barium (147 and 230 mg/kg), calcium (17,000 and 25,000 mg/kg), magnesium (5,400 mg/kg), manganese (1,270 mg/kg), sodium (441 and 1,280 mg/kg), and zinc (324 and 358 mg/kg) were detected in at least one of the two sediment samples. Only the zinc concentration exceeds the current LOC.

2.9.2.4 Dames and Moore Phase I RI, 1998

Samples of soil gas, surface soil, subsurface soil, sediment, surface water, and groundwater were collected from these three sites during the Phase I RI. All samples were analyzed for VOCs, SVOCs, explosives, and metals plus cyanide. Select samples from each media were also analyzed for pesticides and PCBs.

A total of 213 soil gas samples were collected at Sites 52, 95 and 96. The survey covered the entire area. Analysis of the soil gas samples revealed relatively high levels of PCE. Low to moderate levels of TCE; 1,1-DCE; 1,1,1-TCA and chloroform were also detected. Additionally, low levels of non-halogenated petroleum-based VOCs were reported in the samples. The low concentrations, however, probably do not represent significant residual petroleum hydrocarbon contamination. Based on the soil gas survey results, the locations of surface soil samples were determined.

No VOCs were detected in surface soil above comparison criteria. Two BNAs [benz(a)anthracene and benzo(b)fluoranthene], two metals, (arsenic and lead), and two pesticides (DDT and dieldrin) were detected above their comparison criteria in the twenty surface soil samples.

In surface water, five metals (aluminum, arsenic, iron, lead, and manganese) exceeded comparison criteria. The pesticides, DDE and DDD as well as PCB Aroclor 1260 were detected at concentrations above the comparison criteria. In sediment, seven SVOCs (2-methyl naphthalene, anthracene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene), ten metals (arsenic, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc), four pesticides (dieldrin, DDD, DDE, and DDT), and two PCBs (Aroclor-1016 and Aroclor-1260) exceeded their comparison criteria.

In the groundwater samples collected from the unconfined aquifer utilizing a groundwater probe, one BNA (1,2,4-trichlorobenzene), and fifteen unfiltered metals (aluminum, iron, lead, manganese, arsenic, barium, beryllium, cadmium, chromium, cobalt, nickel, copper, sodium, thallium, and vanadium) exceeded their criteria values. Additionally, several exceedences of the criteria values were noted in the groundwater samples collected from the off-site, downgradient monitoring wells. An evaluation of area-wide groundwater conditions in Area G indicates that TCE and PCE exceeded their comparison criteria. Aluminum, arsenic, iron, lead, manganese, and sodium also exceeded their comparison criteria in groundwater throughout Area G.

2.9.3 Nature and Extent of Contamination

Sampling activities for the Phase I 2A/3A RI were conducted at Sites 52, 95, and 96 between September 2000 and December 2000 and included:

1. Collecting two surface soil samples at Site 95;
2. Collecting four surface soil samples from four soil borings at Site 52; and,
3. Collecting eight subsurface soil samples from four soil borings at Site 52.

The chemical results of the Phase I 2A/3A RI have been summarized in this section by sample media. Analytical data tables for the results are provided in **Appendix A**. Only those analytes detected are presented on the tables. **Figure 2-13** shows the Phase I 2A/3A sampling locations at Sites 52, 95, and 96.

2.9.3.1 Surface Soil

Surface soil samples were collected from two locations at Site 95 and analyzed for PAHs and metals. Four surface soil samples were collected from 0-2 ft bgs at four soil boring locations in Site 52. The samples from Site 52 were analyzed for VOCs, SVOCs, metals, and pesticides. Analytical results for the surface soil samples collected at Sites 52 and 95 are provided in **Appendix A**.

The two surface soil samples collected at Site 95 (95SS-5A and 95SS-6B) did not contain concentrations of PAHs in excess of LOCs. Manganese was the only metal detected above LOCs, at a concentration of 22,900 mg/kg, in sample 95SS-6B. The manganese concentration exceeded its NRSRS (5,900 mg/kg), but not its IRSL (23,000 mg/kg). Arsenic concentrations were detected above its IRSL (1.6 mg/kg), but below the NRSRS (19 mg/kg) and the Picatinny background value for surface soil (9.23 mg/kg). Likewise, the surface soil samples collected from the soil borings at Site 52 did not have concentrations of VOCs, SVOCs, pesticides, or metals above their respective LOCs. Toluene and cis-1,2-dichloroethene were detected in sample 52SB-3A at concentrations below 1.0 mg/kg. Low levels of PAHs were identified in samples 52SB-1A and 52SB-4A. Pesticides were only detected in 52SB-3A.

2.9.3.2 Subsurface Soil

Subsurface soil samples were collected from 4 to 6 ft bgs and directly above the water table in four soil borings. The samples were analyzed for VOCs, SVOCs, pesticides, and metals. Analytical results for the subsurface soil samples are provided in **Appendix A**.

TCE was the only VOC detected in the samples. TCE was detected at an estimated concentration below the EQL and LOCs in one sample from 4 to 6 ft bgs. Benzo(a)pyrene was detected above its NRSRS (0.2 mg/kg) and IRSL (0.21 mg/kg) in 52SB-4B (0.49 mg/kg) and 52SB-4C (0.4 mg/kg), All other SVOCs detected in the samples were at levels below LOCs. The most common SVOCs identified were PAHs and bis(2-ethylhexyl)phthalate. DDT and DDE were detected in some samples at estimated concentrations below LOCs. All metal concentrations were also below LOCs.

2.9.4 Summary of Risk Assessments

As part of the Phase I 2A/3A RI, estimated cancer risks, noncancer hazards, and lead hazards were re-calculated using data from both the Phase I RI investigation (Dames and Moore, 1998) and the Phase I 2A/3A data. Chemicals were selected if the constituent was a risk or hazard driver identified in the Dames and Moore HHRA (i.e., it contributed a majority of the total estimated cancer risk or total noncancer hazard). However, constituents that had a cancer risk less than or equal to 1E-06 or a noncancer hazard less than or equal to 1 were not selected as COPCs. Lead was classified as a site COPC at a concentration above 400 mg/kg. Chemicals were also selected if during the recent sampling events, the maximum constituent concentration was above the LOC used by Picatinny to screen media chemical analytical data.

Estimated cancer risks, noncancer hazards, and lead hazards quantified for realistic exposure scenarios are summarized for current/future industrial research workers, current outdoor maintenance workers, current/future construction workers, and current/future on-site youth visitor (**Table 2-8**). For the current/future industrial research worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. For the current outdoor maintenance worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. For the current/future construction worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. For the on-site youth visitor, routes of exposure evaluated included: incidental ingestion and dermal contact with surface water and incidental ingestion and dermal contact with sediment.

A summary of estimated risks and hazards for the realistic exposure scenarios is as follows:

Table 2-8
Summary of Site 52-95-96 Estimated Risks and Hazards

Receptor (Current and Future)	Est. Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Industrial Research Worker	2.1E-05	Aroclor 1260	Surface Soil
Outdoor Maintenance Worker	2.7E-06	Aroclor 1260	Surface Soil
Construction Worker	3.7E-06	Arsenic	Total Soil
On-Site Youth Visitor	8.0E-05	Benzo(a)pyrene	Sediment
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.032	Arsenic	Surface Soil
Outdoor Maintenance Worker	0.0037	Arsenic	Surface Soil
Construction Worker	0.17	Arsenic	Total Soil
On-Site Youth Visitor	0.3	Manganese	Surface Water

The estimated RME risks for the realistic exposure scenarios are within USEPA's target cancer risk range of 1E-04 to 1E-06 and the estimated total hazards are less than USEPA's target noncancer hazard threshold of 1.0. Risk drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6. Noncancer hazard drivers presented in the Phase I 2A/3A HHRA were those contributing the most to the estimated total noncancer hazard. However since none of the exposure scenarios exceeded the hazard threshold of 1.0, the noncancer hazard drivers presented in **Table 2-8** are not COPCs.

The adult lead model results (**Table 2-9**) indicate lead concentrations in soil are not a concern, as the average lead concentrations are below the lead model-derived PRGs for heterogeneous and homogeneous receptor populations.

Table 2-9
Summary of Site 52-95-96 Adult Lead Model Results

Receptor	Media	Media Lead Concentration (Avg. mg/kg)	Lead Model PRGs (mg/kg) (GSDs = 2.1-1.8)	Exceedence?
Industrial Research Worker	Surface Soil	122	778 - 1,354	No
Construction Worker	Total Soil	84.9	162 - 282	No

The Phase I ERA determined that the veery, woodcock and barred owl may be at risk due to metals and pesticide exposure. However, by considering the size of the Site 52/96 Assessment Area relative to the home range of these species, all modeled risks are substantially reduced. Since Assessment Area 52/96 is within a high-human-use, industrialized part of Picatinny, little habitat value can be attributed for these species.

Results of the small mammal trapping conducted during the Phase I ERA indicate that Sites 52, 95, and 96 have the potential in terms of food resources and protective cover to support a viable population of white-footed mice. Sites that had several mice in breeding condition such as Sites 52, 95, and 96 indicate that resources were adequate for individuals to reproduce. Because female offspring will often establish territories in the same vicinity, the possibility that individuals will persist in the area for an extended time is increased (Xia and Millar, 1985).

No COPC-related impacts were noted on the flora. Plant tissue was however, found to contain measurable lead, nitrophenol, bis(2-ethylhexyl)phthalate and several pesticides, including p,p'-DDE. Earthworm bioassays did not reveal potential impacts to soil-dwelling invertebrates. Only minor levels of pesticides were found in small mammals. Although mice were not specifically tested for toxicological response to soil-related COPCs, the population data suggest a mixed age class of mice exist at Sites 52, 95, and 96 and that they are capable of reproducing. The Phase I ERA concluded that this site probably offers little real risk to wild populations or communities.

2.10 SITE 134, BUILDING 302, SERVICE SHOPS

2.10.1 Site History

Building 302 was constructed in 1905 as a maintenance and service shop. Initially, three separate warehouse buildings (former Buildings 61, 62 and 63) occupied the Building 302 area. These three warehouses were combined together and were referred to as 302A, B, and C. In 1937, two wings were added to the east side of the building and the building was renamed Building 302. In the years that followed, small warehouse structures (Buildings 302-B, 302-C, and 302-E) were constructed along the eastern boundary of Site 134 as auxiliary storage sheds for Building 302.

Building 302 has housed two different divisions of the ARDEC – the DEH and the Logistic Management Division. These divisions operated and maintained various shops including a tin shop, paint shop, machine shop, and millwright shop. Vehicle maintenance operations have been conducted in the millwright shop, which is located in the northern corner of Building 302. The location of Building 302 is presented on **Figure 2-15**.

Building 302, with a floor area of approximately 37,757 ft^2 is a two-story brick wall building with a concrete foundation. The building is equipped with asphalt flooring and roof trusses covered with lumber planks. Historically, Building 302 has been primarily used as storage and machine shop building. Available documents also indicate that portions of this building may have been used as a laundry facility to wash explosive contaminated clothing. The various activities conducted at Building 302 require the storage of solvents, paints, oils, rags, acids, tar products, aerosol cans, and plumbing accessories.

Detailed information on the past waste management practices adopted at Building 302 is not available. Due to the nature of activities conducted at Building 302, the wastes generated have predominantly included waste oils (lubricating, hydraulic, transformer), solvents, and paints. According to Picatinny personnel, in the past (at least until early 1980s), a disposal pit adjacent to Building 303 was used to bury waste oil and metal parts. This disposal pit area was reportedly covered with asphalt.

Available documents indicate that wastes generated at Building 302 have also been drummed. In the past (at least until mid-1980s), these drums were stored on the grounds adjacent to Building 305. In addition, washwater generated at Building 302 was collected in two large above ground holding tanks that were reportedly located adjacent to the southeastern perimeter of the building. The washwater was regularly emptied into a wetland area located southeast of the building. This wetland area empties into a drainage ditch, which discharges into GPB.

Spill records exist for three spills that occurred at Building 302. The first record addresses a vehicle transmission fluid spill that occurred at Building 302. The DEH personnel reportedly cleaned this spill. The second record addresses an herbicide spill that occurred from a contractor's tank truck at Site 134. According to Picatinny personnel, an oil spill also occurred at the facility in 1989-90 when an air compressor located adjacent to Building 302 malfunctioned. The oil flowed into the drainage path and ultimately discharged into GPB.

2.10.2 Previous Studies

2.10.2.1 USAAMCC Environmental Baseline Survey (EBS), 1993

An EBS conducted in November 1993 identified insecticides, oils, solvents, diluted acids, and paints as the prevailing waste streams associated with Building 302. A Picatinny memorandum dated July 21, 1981, indicated that drums of toxic, flammable, and unknown chemical wastes were stored at the former disposal pit location. Reportedly, some of these drums were in an accelerated state of deterioration. Additionally, oil saturated rags and tarpaulins were being stored at this location. According to the memorandum, a large number of drums and oily rags were removed from the former pit location and the area was "cleaned."

2.10.2.2 Dames and Moore Phase I RI, 1998

Environmental samples collected during the Phase I RI consisted of six surface soil, seven subsurface soil, two sediment, and one groundwater samples. These samples were collected to address the results of the EBS and the three spills mentioned in the previous section. All the samples were analyzed for VOCs, SVOCs, explosives, pesticides/PCBs, and metals plus cyanide. A soil-gas survey was also performed at the site and two samples had high levels of PCE.

TCE was detected in two samples collected at elevated soil-gas locations. The two samples were collected from 1.0 to 1.5 ft bgs and had TCE concentrations of 10 mg/kg and 11 mg/kg. Beryllium was detected in one surface soil sample at a concentration of 2.44 mg/kg. Thallium was detected in one subsurface sample at a concentration of 49.4 mg/kg; however it was not detected in duplicate sample analysis. TCE, beryllium, and thallium concentrations do not exceed current LOCs. Benzo(b)fluoranthene was detected above its IRSL (2.1 mg/kg) and NRSRS (2 mg/kg) in surface soil samples SS134-1A (3.3 mg/kg) and SS134-3A (2.7 mg/kg). Two VOCs (PCE and TCE), four unfiltered metals, and three filtered metals were detected at concentrations exceeding their criteria in groundwater samples (from one well) collected downgradient of Site 134. An evaluation of area-wide groundwater conditions in Area G indicates that TCE and PCE exceeded their comparison criteria throughout the area. Of the four metals, aluminum, iron and manganese are naturally occurring minerals commonly detected in groundwater at Picatinny. Concentrations of these metals are likely due to site geology. Sodium has also been detected above its comparison criteria in area groundwater. Groundwater in Area G is currently being evaluated as part of the Mid-Valley Groundwater FS (Shaw, 2005).

Four SVOCs [benz(a)anthracene, chrysene, phenanthrene, and pyrene], six metals (copper, iron, lead, mercury, silver, and zinc), four pesticides (dieldrin, DDD, DDE, and DDT), and two PCBs (PCB-1016 and PCB-1260) were detected at concentrations above their comparison criteria in the sediment samples. The two sediment samples (SD96-1 and SD96-2) were collected at Site 96. Site 96 has been evaluated in conjunction with Sites 52 and 95. All sediment samples collected from Sites 52, 95, and 96 were evaluated in the GP/BSB FFS.

2.10.3 Nature and Extent of Contamination

Field activities for the Phase I 2A/3A RI were conducted at Site 134 between September 2000 and April 2001 and included:

1. Collecting one surface soil sample from a surface soil location;
2. Collecting three surface soil samples and six subsurface soil samples from three soil borings; and,
3. Collecting four surface soil samples and one subsurface soil sample at three drainage ditch locations.

The chemical results of the Phase I 2A/3A RI have been summarized in this section by sample media. Analytical data tables for the results are provided on Tables 10-16 and 10-17 in **Appendix A**. Only those analytes detected are presented on the tables. **Figure 2-15** shows the Phase I 2A/3A sampling locations at Site 134.

2.10.3.1 Surface Soil

Eight surface soil samples were collected at Site 134 during the Phase I 2A/3A RI. Three samples (134SD-1 to 134SD-3), collected from narrow intermittent drainage ditches, were analyzed for SVOCs, metals, pesticides, and PCBs. These samples were originally labeled as sediment samples, but due to the lack of surface water at these drainage swales, the samples are more accurately characterized as soil samples. An additional sample, 134SS-1, was collected at the end of the brick-lined drainage channel subsequent to these three samples and analyzed for the same parameters. Sample 134SD-2B was collected from 1-2 ft bgs beneath sample 134SD-2 and analyzed for the same parameters. Two surface soil samples (134SB-4A and 134SB-5A), collected in relation to elevated soil-gas samples, were analyzed only for VOCs. The remaining sample (134SB-6A), which was collected downgradient of a possible former washwater tank, was analyzed for VOCs, SVOCs, metals, and explosives.

PCE was the only VOC identified in the samples. It was detected at a concentration of 1.5 mg/kg in sample 134SB-4A, which is below the NRSRS (5 mg/kg) and IRSL (2.6 mg/kg) values for PCE. Benzo(a)pyrene exceeded its IRSL (0.21 mg/kg) and NRSRS (0.2 mg/kg) in all four samples collected from the drainage ditches. The benzo(a)pyrene concentrations in these samples ranged from 0.63 mg/kg in 134SD-2B to 15.0 mg/kg in 134SD-1. Dibenz(a,h)anthracene exceeded its IRSL (0.21 mg/kg) and NRSRS (0.2 mg/kg) in three of the four samples collected from the drainage ditches. Dibenz(a,h)anthracene concentrations in these three samples ranged from 0.4 mg/kg in 134SD-3 to 2.1 mg/kg in 134SD-1. Benzo(b)fluoranthene exceeded its IRSL (2.1 mg/kg) and NRSRS (2 mg/kg) in samples 134SD-1 (21.0 mg/kg), 134SD-2 (4.50 mg/kg) and 134SD-3 (3.2 mg/kg). Benz(a)anthracene exceeded its IRSL (2.1 mg/kg) and NRSRS (2 mg/kg) in samples 134SD-1 (14 mg/kg) and 134SD-2 (3.15 mg/kg). Sample 134SD-1 also had an indeno(1,2,3-cd)pyrene concentration of 8.7 mg/kg, exceeding its IRSL (2.1 mg/kg) and NRSRS (2 mg/kg).No other SVOCs were detected above LOCs.

Pesticides, 4,4'-DDE; 4,4'-DDD; 4,4'-DDT; and endrin ketone were detected in the same samples, but all concentrations were below LOCs. Aroclor 1260 was the only PCB congener identified in the samples. It was detected in all four samples analyzed for PCBs. The PCB concentrations ranged from 0.017 mg/kg to 0.38 mg/kg. The IRSL for Aroclor 1260 is 0.74 mg/kg, and the NRSRS for total PCBs is 1.0 mg/kg. No explosives were detected in sample 134SB-6A. Lead was detected in excess of its IRSL and NRSRS (both LOC values are 800 mg/kg) at sample 134SD-2. This sample had an average lead concentration of 1,245 mg/kg (average of 134SD-2 and a duplicate sample 134SD-2 DUP). The lead analytical result for sample 134SD-2B, collected directly below 134SD-2, was rejected during data validation. No other metals were detected at concentrations above LOCs in the surface soil samples.

2.10.3.2 Subsurface Soil

Seven subsurface soil samples were collected at Site 134 during this investigation. The subsurface soil samples were collected beneath four surface soil locations. Subsurface soil samples were collected from 4-6 ft bgs and 10-12 ft bgs at three soil boring locations. The remaining subsurface soil sample (134SD-2C) was collected from 5.0 to 5.9 ft bgs beneath sample 134SD-2. No VOCs, pesticides, or explosives were detected in the samples. Several PAHs and phthalates were reported during the SVOC analyses, but all concentrations were below LOCs. Aroclor 1260 was detected in one sample at a concentration of 0.042 mg/kg. Lead was detected in 134SB-6B at a concentration of 795 mg/kg. PCBs and lead concentrations detected in subsurface soil are below current LOCs. Subsurface soil sample 134SB-6C, collected below 134SB-6B, contained a lead concentration of 434 mg/kg. The lead concentration detected in 134SD-2C, collected from 5.0 to 5.9 ft bgs beneath sample 134SD-2, was only 34.2 mg/kg. The LOC for lead is 800 mg/kg.

2.10.4 Summary of Risk Assessments

As part of the Phase I 2A/3A RI, estimated cancer risks, noncancer hazards, and lead hazards were re-calculated for the site using data from both the Phase I RI investigation (Dames and Moore, 1998) and the recent data. Chemicals were selected if the constituent was a risk or hazard driver identified in the Dames and Moore (1998) HHRA, i.e., it contributed a majority of the total estimated cancer risk or total noncancer hazard. However, constituents that had a cancer risk less than or equal to 1E-6 or a noncancer hazard less than or equal to 1 were not selected as COPCs. Lead was classified as a site COPC at a concentration above 400 mg/kg. Chemicals were also selected if during the recent sampling events, the maximum constituent concentration was above the LOC used by Picatinny to screen media chemical analytical data.

Estimated cancer risks, noncancer hazards, and lead hazards quantified for realistic exposure scenarios are summarized for current/future industrial research workers, current outdoor maintenance workers and current/future construction workers. For the current/future industrial research worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. For the current outdoor maintenance worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. For the current/future construction worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. A summary of estimated risks and hazards for the realistic exposure scenarios is presented **in Table 2-10**.

The estimated RME risks for the realistic exposure scenarios are within USEPA's target cancer risk range of 1E-04 to 1E-06 and the estimated total hazards are below USEPA's target noncancer HI of 1.0. Risk drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6. Noncancer hazard drivers presented in the Phase I 2A/3A HHRA were those contributing the most to the estimated total noncancer hazard. However since none of the exposure scenarios exceeded the hazard threshold of 1.0, the noncancer hazard drivers presented in **Table 2-10** are not COPCs.

Table 2-10
Summary of Site 134 Estimated Risks and Hazards

Receptor (Current and Future)	Est. Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Industrial Research Worker	1.2E-05	Benzo(a)pyrene	Surface Soil
Outdoor Maintenance Worker	1.2E-06	Benzo(a)pyrene	Surface Soil
Construction Worker	1.4E-06	Benzo(a)pyrene	Total Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.01	Copper	Surface Soil
Outdoor Maintenance Worker	0.001	Copper	Surface Soil
Construction Worker	0.025	Copper	Total Soil

The adult lead model results (**Table 2-11**) indicate lead concentrations in total soil may be a concern for construction workers, as the average lead concentration exceeds the lead model-derived PRG for heterogeneous receptor populations.

Table 2-11
Summary of Site 134 Adult Lead Model Results

Receptor	Media	Media Lead Concentration (Avg. mg/kg)	Lead Model PRGs (mg/kg) (GSDs = 2.1-1.8)	Exceedence?
Industrial Research Worker	Surface Soil	333	778 - 1,354	No
Construction Worker	Total Soil	242	162 - 282	Yes, for GSD = 2.1

During the Phase I ERA, Building 302 was included as part of the Assessment Area of adjacent Sites 52 and 96. The ERA concluded that this area (including Building 302) offers little real risk to wildlife populations or communities.

2.10.5 Facility-Wide Investigation of Sumps and Dry Wells

From November to December 2003, as part of the facility-wide investigation of sumps and dry wells, surface soil was excavated from the three drainage ditches to remove the chemical contamination (see site photographs, **Appendix B**). Soil was removed to a depth of 1 foot bgs along the entire length and width of each channel. Post-excavation samples were collected from the sidewalls and bottoms of each excavation as well as the excavated soil piles and analyzed for SVOCs, copper and lead. One bottom sample 134EX1-B-4, collected from Ditch 2 (**Figure 2-15**), had a lead concentration of 719 mg/kg. An additional 6 inches of soil were removed from the ditch and another bottom sample collected. Sample 134EX1-B-4B had a lead concentration of 12.4 mg/kg. Final post-excavation results did not identify any SVOC, lead or copper concentrations in excess of their respective LOCs. Following the receipt of regulatory approval for the soil reuse, approximately 21 CY of soil were removed from the three drainage ditches and transported to the 3500 building area of Picatinny to increase the existing grade for a proposed construction project. Excavated soil was re-used as fill with the approval of the NJDEP and USEPA and capped by the concrete slab foundation of the Building 3518 addition. Waste characterization sampling of the re-used soil identified low level exceedences of Picatinny LOCs at concentrations deemed acceptable for re-use by the NJDEP and USEPA, where the direct contact pathway with the soil would be severed by the building foundation. LUCs will be put in place at Building 3518 to ensure the building continues to serve as an effective cap over the contaminated soil. The remainder of Site 134, not associated with the three drainage ditches addressed in the investigation of sumps and dry wells, is further evaluated in this FFS.

2.11 SITE 136, BUILDING 355, METALLURGY LABORATORY

2.11.1 Site History

Building 355 was constructed in 1940 as a storehouse, although the types of materials stored are unknown. Building 355 is a one-story hollow tile wall building built on a reinforced concrete foundation with a floor area of approximately 24,800 ft^2. The building has a composite concrete/asbestos tile floor and a gable roof covered with corrugated asbestos steel sheeting. Building 355 is presented on **Figure 2-16**.

Since the late 1960s, Building 355 has primarily housed the engineering division, the research and development division, physical sciences laboratories, and metallurgical laboratories. Various tests are performed in the metallurgical laboratory within Building 355. These tests include salt spray exposure tests, fracture tests, and mechanical tests. Additionally, Building 355 houses a photography and x-ray laboratory for the analysis of fractured materials. Small quantities (approximately 10 gallons per year) of corrosive wastewater and waste oil are generated at Building 355. These wastes are temporarily stored at a satellite waste-accumulation area within Building 355 and later transported by waste haulers to an offsite disposal location. According to Picatinny personnel, mechanical testing conducted at Building 355 included fracture testing of DU specimens from approximately 1982 to 1993. However, the DU materials to be tested were reportedly always stored in Building 315 (Site 135). Although Building 355 is still active as a metallurgy laboratory, no DU testing is being conducted. Picatinny's Radiation Protection Office performed monthly and quarterly radiological surveys of Building 355 during the period that the DU testing was conducted. As part of the surveys, wipe samples were collected and analyzed for gross alpha and gross beta. Contamination was rarely detected during the surveys, but when identified, contamination was cleaned up in accordance with Nuclear Regulatory Commission procedures. The surveys have not been performed since the DU testing was discontinued.

2.11.2 Previous Studies

2.11.2.1 Foster Wheeler Water Discharge Investigation, 1990

The Foster Wheeler Water Discharge Investigation was conducted in July 1990 for all ARDEC buildings within Picatinny to identify various water discharges emanating from the buildings (Dames and Moore, 1998). The investigation report indicated that most of the wastewater generated at Building 355 was reportedly discharged into sanitary sewers. However, drainpipes from Room 5 (metal polishing room), Room 33 (photography room), and Room 37 (atomic adsorption room) were noted to be discharging steam onto the ground surface outside the building.

2.11.2.2 USAAMCC EBS, 1993

An EBS was conducted at Site 136 in November 1993. The survey identified solvents, mixed acids, etching solutions, resins, DU-contaminated salt water and sulfur-based cutting fluids as waste streams generated at Building 355.

2.11.2.3 Dames and Moore Phase I RI, 1998

Environmental samples collected during the Phase I RI included six surface soil samples and two rounds of groundwater samples from two monitoring wells. Surface soil samples were analyzed for VOCs, SVOCs, metals and cyanide. Two samples were also analyzed for PCBs/pesticides and explosives. Groundwater samples were analyzed for VOCs, SVOCs, metals (filtered metals in Round 1), cyanide, explosives, and pesticides/PCBs.

Surface soil criteria exceedences included two metals, arsenic and mercury. The mercury concentrations detected in sample SS136-6 were 180 mg/kg at 0.0 to 0.5 ft bgs and 800 mg/kg at 0.0 to 1.0 ft bgs (NRSRS = 65 mg/kg, IRSL = 34 mg/kg). All of the detected arsenic concentrations exceeded the IRSL (1.6 mg/kg), and results from four out of the six locations exceeded the surface soil background level for Picatinny. However, arsenic concentrations in SS136-5A (19.7 mg/kg) and SS136-6BD (19.4 mg/kg), collected from 0.0 to 1.0 ft bgs, were the only samples to exceed the NJDEP NRSRS (19 mg/kg). Several criteria exceedences were noted in the groundwater samples collected upgradient and downgradient of Site 136. An evaluation of area-wide groundwater conditions in Area G indicates that TCE and PCE exceeded their comparison criteria throughout the area. Aluminum, arsenic, iron, lead, manganese, and sodium also exceeded their comparison criteria in groundwater throughout the area. Analysis of filtered groundwater samples indicated only manganese (MWG-3A) and lead (MW101-1) were detected above criteria. Manganese, along with aluminum and iron are naturally occurring minerals detected throughout Picatinny groundwater due to site geology. Monitoring well MW101-1 was installed to evaluate groundwater quality at Site 101 and was evaluated in the FS for Sites 31 and 101. Groundwater in Area G is currently being evaluated as part of the Mid-Valley Groundwater FS (Shaw, 2005).

2.11.3 Nature and Extent of Contamination

Field activities for the Phase I 2A/3A RI were conducted at Site 136 in August 2000 and included:

1. Collecting four surface soil samples.

The chemical analytical results of the Phase I 2A/3A RI are summarized in the following subsection. Analytical data tables for the results are provided in **Appendix A**. Only those analytes detected in at least one sample are presented on the table. **Figure 2-16** depicts the Phase I 2A/3A sampling locations at Site 136.

2.11.3.1 Surface Soil

Four surface soil samples were collected at Site 136 during the Phase I 2A/3A RI in an effort to delineate the extent of contamination identified in the Dames and Moore RI. Three samples (136SS-7A, 136SS-8A, and 136SS-9A) were collected from 0-1 ft bgs around former sample SS136-6, while sample 136SS-10B was collected from 1-2 ft bgs at the location of SS136-6. All four samples were analyzed solely for mercury. The analytical results for the four samples are presented on Table 10-22 in **Appendix A**.

Mercury concentrations in the four samples ranged from 0.25 mg/kg in 136SS-8A to 33.5 mg/kg in 136SS-10B, which is below the NRSRS of 65 mg/kg and the IRSL of 34 mg/kg. The mercury concentrations in the three samples collected from 0-1 ft bgs were below 1.0 mg/kg.

2.11.4 Summary of Risk Assessments

The HHRA results from the Phase I RI (Dames and Moore, 1998) showed the non-carcinogenic hazard exceeds the HI criterion of 1 for future industrial research workers and future construction excavation workers at 1 and 20 (rounded to one significant figure per USEPA risk assessment guidance), respectively. The hazard driver is mercury via the inhalation and ingestion pathways. Carcinogenic risk does not exceed 10^{-6} for any population. Since the non-carcinogenic hazard exceeds the target level of 1, the non-carcinogenic hazard was re-evaluated using the sample results from the Phase I 2A/3A RI.

Estimated noncancer hazards quantified for realistic exposure scenarios are summarized as follows for current/future industrial research workers and current/future construction workers. For the current/future industrial research worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. For the current/future construction worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. A summary of estimated hazards for the realistic exposure scenarios is as follows:

Table 2-12
Summary of Site 136 Estimated Risks and Hazards

Receptor (Current and Future)	Est. Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Industrial Research Worker	None (no carcinogenic COPCs selected)	NR - risks acceptable	NR - risks acceptable
Construction Worker		NR - risks acceptable	NR - risks acceptable
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Industrial Research Worker	1.1	Mercury	Surface Soil
Construction Worker	16	Mercury	Total Soil

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

The estimated RME risks for the realistic exposure scenarios are below USEPA's target cancer risk range of 1E-04 to 1E-06, as no carcinogenic COPCs were selected for the site. The estimated total hazards for the industrial research worker are equal to USEPA's target noncancer hazard threshold of 1 (rounded to one significant figure), while the estimated total hazards for the construction worker are greater than USEPA's target noncancer hazard threshold of 1, with the hazard driver being mercury. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

No ERA was performed at Site 136 during the Phase I RI; the majority of the site is paved and located in a highly urbanized part of Picatinny. Thus, very little suitable habitat exists at Site 136. However, a SLERA was conducted for the site. The maximum detected chemical concentrations in each media were compared to ecological LOCs applicable for that media. Based on the lack of habitat and removal of the sole COPC (i.e., mercury), as documented in the next section, the SLERA concluded no further ecological work is warranted for Site 136.

2.11.5 Interim Remedial Action

Because of the analytical and HHRA results, an interim removal action for mercury in soil was performed at Site 136 in November 2003. Contaminated soil was removed from two excavations (see

Figure 2-16 and site photographs). Excavation 1 covered an area of 6 ft by 6 ft to a depth of 2.5 ft. Excavation 2 was approximately 7 ft by 2.5 ft to a depth of 1.5 ft. One sidewall sample and one bottom sample were collected from each excavation and analyzed for mercury. The initial post-excavation results from Excavation 1 were 6.3 mg/kg for the bottom sample and 18.3 mg/kg for the sidewall sample. Since the sidewall concentration exceeded the residential criterion for mercury at the time, an additional one foot of soil was removed from the northwest sidewall. The subsequent post-excavation result from the new sidewall sample was 4.6 mg/kg. The mercury concentrations of the sidewall and bottom samples from Excavation 2 were 0.11 mg/kg and 0.13 mg/kg, respectively. Approximately 4 CY of soil were removed from the site and staged at former Building 1033 to await final disposition. Based on the post-excavation results, the mercury contamination has been removed from the site. Since mercury was the only COPC identified at the site, the removal of the elevated mercury concentration results in an acceptable hazard level. As a result of the interim remedial action, there are no unacceptable risks or hazards identified at Site 136.

2.12 SITE 185, BUILDING 350, CONCEPTS AND APPLICATIONS LABORATORY

2.12.1 Site History

Site 185 encompasses Building 350, built between 1938 and 1940. Building 350 is attached to Building 352 by a long, narrow courtyard. Building 350 was used as the Concepts and Applications Laboratory, which included photography, electronics, dynamics, solid state, ceramics, and optical laboratories. An acid drain filter, located in the western portion of the building, discharged wastewater from the sinks, fume hoods, and floor drain into a storm sewer north of the building. Sometime prior to 1971, Building 350 was converted to office space, its current use. In 2003, the acid drain filter was excavated and removed from the site. Building 350 is presented on **Figure 2-17**.

Picatinny safety files indicate that no chemicals are used in Building 350. No spills or releases have been documented. According to the Foster Wheeler Discharge Report, the potential for contaminated discharge from Building 350 is low. The only floor drain in the building was dye tested and found to discharge to a storm sewer north of the building (Foster Wheeler, 1991).

2.12.2 Previous Studies

2.12.2.1 Dames and Moore PA/SI, 1994

During the SI, two transformer pads, TR 350 and TR 350A were observed on the northwest side of the building. TR 350 holds three individual transformers all labeled as non-PCB (< 50 parts per million [ppm]) transformers. TR 350A has one box-style transformer. As a result of the PA/SI, no sampling was recommended for Building 350.

2.12.2.2 USACHPPM RRSE, 1998

USACHPPM installed two groundwater monitoring wells, one next to the acid drain filter (350-1) and one downgradient of Building 350 (350-2). The wells were sampled for VOCs, SVOCs, metals, explosives, and pesticides. The analytical results indicated that the only contaminant of concern detected above its LOC was lead (**Appendix A**). Lead was detected at 14 µg/L in monitoring well 350-1 and at 16 µg/L in monitoring well 350-2. During purging of well 350-2, it was discovered that the screen was cracked.

One soil sample was also collected from under the acid drain filter's sludge. The sample was analyzed for VOCs, SVOCs, metals, explosives, and pesticides. The analytical results indicated that the only COC detected above current comparison criteria was arsenic, at a concentration of 2.9 mg/kg, which is above the IRSL of 1.6 mg/kg but below the NRSRS of 19 mg/kg based on natural background.

The RRSE calculated the relative risk for Site 185 to be low due to a low groundwater hazard. Soil was not evaluated.

2.12.3 Nature and Extent of Contamination

Field activities for the Phase I 2A/3A RI were conducted at Site 185 from November 2000 to October 2004 and included:

1. Collecting one groundwater sample from a monitoring well;

2. Collecting one surface soil sample from a concrete vault; and,
3. Abandoning one damaged monitoring well.

The groundwater sample, which was analyzed for lead, did not contain lead above the detection limit of 3.0 µg/L. The LOC for lead in groundwater is 5 µg/L. It is likely that prior exceedences of the LOC for lead were due to the sampling technique, particularly in the case of monitoring well 350-2 which had a cracked screen. For the Phase I 2A/3A RI, low-flow sampling methodology was employed.

2.12.3.1 Surface Soil

One surface soil sample (185SS-1A) was collected at Site 185 during the Phase I 2A/3A RI. The sample, which was collected within a concrete vault, was analyzed for VOCs, SVOCs, pesticides, PCBs, explosives and metals. The analytical results for the sample are presented on Table 10-26 in **Appendix A**.

In order to access the vault, a backhoe had to be used to remove the concrete lid. The arsenic concentration (20 mg/kg) slightly exceeded the NRSRS of 19 mg/kg.

2.12.4 Summary of Risk Assessments

Since the groundwater sample collected and analyzed for Site 185 did not document any constituent concentrations above analytical detection limits, no COPCs were selected, and no human health risks or hazards were quantified. The surface soil sample was collected subsequent to the risk screening process. Thus, soil exposure was not evaluated. However, since the surface soil sample is enclosed within a concrete vault covered by a heavy concrete lid, human contact with the soil concentrations identified in the soil sample is restricted.

No ERA has been performed at Site 185. The highly urbanized nature of the site would dissuade most species, even those adapted to urban areas. The soil sample collected within the concrete vault does not represent a route of ecological exposure, and there is no aquatic habitat at the site.

2.12.5 Interim Remedial Action

In November 2003, the acid drain filter was excavated along with approximately 5 CY of surrounding soil as part of a facility-wide investigation of sumps, dry wells and similar wastewater discharge points. The soil was excavated from an area approximately 8 ft by 4 ft to a depth of 4 ft (see site photographs, **Appendix B**). One sidewall sample and one bottom sample were collected from the excavation and analyzed for metals and explosives including nitrocellulose and nitroguanidine. A sample was also collected from the excavated soil pile and analyzed for the same parameters. All sample concentrations were below LOCs. The excavated soil was used to backfill the excavation. The concrete acid drain filter was demolished and disposed of off-site as non-hazardous debris.

2.13 SITE 175, BUILDING 3801, HELICOPTER SUPPORT FACILITY

2.13.1 Site History

Site 175 is frequently referred to as the Army Aviation Support Facility #2 (AASF #2), which is owned and operated by the New Jersey Army National Guard. The site, which is located in the southeastern portion of Picatinny in Area J, can be identified from aerial photographs as unimproved woodlands until the heliport was constructed in the late 1960s or early 1970s. Site 175 is a fenced area that includes a helicopter maintenance and aviation building (Building 3801), a heliport, and three aboveground storage tanks (ASTs) (**Figure 2-18**). In 2005, use of the site as a helicopter aviation and maintenance facility was discontinued. Currently, the site is used for truck maintenance and storage.

According to a 1988 Process Design Department Contract Form, Site 175 supported 26 helicopters. The helicopters used JP-4 (65% kerosene, 35% gasoline) fuel.

Helicopter parts were cleaned by dipping the parts into solvent or spraying the parts with circulating solvent. The contents of the solvent basin, located in Building 3801, were replaced approximately once a year.

The wastes generated during helicopter maintenance have been documented to include: helicopter waste oil (250 gallons per year), aviation fuel (360 gallons per year), and mineral spirit solvents

(PD 680) (30 gallons per year). All waste was reportedly liquid and was stored in 55-gallon drums. As of 1988, wastes generated at the site were documented as being removed by an AASF #2 hazardous waste disposal contractor for offsite disposal.

A 90-day outdoor drum storage area existed to the south of Building 3801. The drum storage area underwent RCRA Closure by Weston in October 1991.

Three ASTs exist at two locations within Site 175 (see the photographs at the end of this section). The first location includes two 10,000 JP-4 ASTs located southwest of Building 3801. The second location is northwest of Building 3801 and contains one #2 fuel oil 8,000-gallon AST. These ASTs were installed to replace three USTs previously at the site. According to Picatinny personnel, petroleum spills during product transfer and valve drips reportedly occurred at both locations frequently when the tanks were USTs. The two JP-4 USTs were upgraded to ASTs in 1994. The #2 fuel oil UST was upgraded to an AST in 1993.

The Picatinny transformer database identifies a 750-KVA transformer (TR-3801) located at the heliport. It is a vaulted transformer located between Building 3801 and the heliport. The transformer, which appears to be in excellent condition, is not PCB-contaminated according to the Picatinny transformer database.

Discharge from Building 3801 floor drains terminates at a rip-rap outside the southeast fence boundary. Runoff from the parking lot and heliport asphalt is discharged to two leaching pits located within the fence line at the southeast boundary.

2.13.2 Previous Studies

The 15,000-gal JP-4 fuel UST located west of Building 3801 failed a pressure test conducted in November 1988. Subsequently, a work request form, submitted by DEH, required the excavation and repair of the tank and backfilling of the excavation. According to Picatinny Environmental Office personnel, this work was completed.

In 1991, Weston conducted a closure of an outdoor 90-day storage area located to the south of Building 3801. The storage area was swept for unexploded ordnance (UXO) before closure activities started. Five surface soil samples were collected around and beneath the drum storage area and analyzed for VOCs, PAHs, PCBs, TPH and metals. PAH concentrations in the post-closure soil samples were greater than the proposed soil cleanup standards. A data summary table for the five surface soil samples is provided in **Appendix A**. According to a 1992 letter from the NJDEP to the Chief of the Picatinny EAO, this area within the site required further delineation of the vertical and horizontal extent of contamination before the NJDEP can consider proposed alternatives for the site. This additional investigation was conducted as part of the Phase II RI of the site.

2.13.3 Nature and Extent of Contamination

As part of the Phase II RI, sampling activities at Site 175 included the collection of surface soil samples, subsurface soil samples, one surface water sample, and one sediment sample. Table 12-2 (**Appendix A**) lists the samples collected at Site 175 during the Phase II RI and their corresponding analyses. The location of the samples is depicted on **Figure 2-18**.

2.13.3.1 Surface Soil

Seven of the ten surface soil samples collected at Site 175 were analyzed off-site during the Phase II RI; three samples collected from the monitoring well borings; three samples collected around the RCRA closure area; and one sample collected adjacent to the transformer pad were analyzed off-site. Seven surface soil samples from this site including three samples from the monitoring well borings and four samples collected around the transformer pad were analyzed on-site. Table 12-7 provides the results of the on-site analysis, while the results of the off-site analysis are provided in Table 12-4 (Round 1). Tables are provided in **Appendix A**.

No VOCs, SVOCs (including PAHs), hydrazines, or fuel-related compounds were detected in the surface soil samples analyzed off-site. On-site analysis of the samples also did not detect any target analytes.

The four samples collected adjacent to transformer pad TR-3501 (175SS-1A through 175SS-1D) did not contain PCBs above sample quantitation limits (SQLs).

The three samples collected adjacent to the RCRA closure area (90-day outdoor drum storage area) (175SS-2A, 175SS-3A, and 175SS-4A) did not contain PAHs above SQLs.

The one sample collected downgradient of the two horizontal leaching pits (175MW-3A) did not contain any VOCs, SVOCs, fuel-related compounds, or target analytes above SQLs.

2.13.3.2 Subsurface Soil

Five subsurface soil samples were collected from Site 175 and analyzed off-site as part of the Phase II RI. Five subsurface soil samples were analyzed on-site. Table 12-8 provides the results of the on-site analysis, while the results of the off-site analysis are provided in Table 12-4 (Round 1). Tables are included in **Appendix A**.

No VOCs were detected at concentrations above LOCs. No SVOCs, hydrazines, or fuel-related contaminants were detected in any of the samples. On-site analysis of the samples did not detect any target analytes.

The three samples (2-3 ft bgs) collected adjacent to the RCRA closure area (90-day outdoor drum storage area) (175SS-2C, 175SS-3C, and 175SS-4C) did not contain PAHs above SQLs.

The one sample collected downgradient of the two horizontal leaching pits (175MW-3B at 5-7 ft bgs) did not contain any target analytes above SQLs.

2.13.3.3 Sediment

One sediment sample was collected from Site 175 and analyzed both off-site and on-site. Results of the off-site analysis are provided in Table 12-5 (**Appendix A**). There were no detections above SQLs during on-site analysis.

No VOCs, SVOCs, or hydrazines were detected in the sediment sample analyzed off-site and on-site. TPH were identified in the sediment sample at a concentration of 706 mg/kg. No LOC has been established for this analyte in sediment.

2.13.3.4 Surface Water

One surface water sample was collected in conjunction with the sediment sample at the rip-rap open discharge point, east of Building 3801. Analytical results for the sample are presented in Table 12-6 (**Appendix A**).

No VOCs or SVOCs were detected in the surface water sample. TPH were identified in the surface water sample at a concentration of 468 μg/L. No LOC has been established for this analyte in surface water.

2.13.4 Summary of Risk Assessments

Based on the results of the screening evaluation, an HHRA was not performed for Site 175 as no COPCs were detected in site media above risk-based concentrations (RBCs) or other screening criteria. Therefore, human health risks and hazards are estimated to be acceptable.

Site 175 was not evaluated in the Phase II ERA, because the majority of this site is paved or mowed lawn. In addition, Building 3801 was an active heliport, which would have dissuaded most species. There were also no chemicals detected in the four surface soil samples collected prior to the Phase II ecological investigation.

2.14 SITE 172, PARKING AREA ACROSS FROM BUILDING 3328

Site 172 is located in the southeastern portion of Picatinny in Area K. Sites 172, 173 and 174 are located on an elevated ridge commonly referred to as Navy Hill.

2.14.1 Site History

According to the 1991 ANL RI Concept Plan (ANL, 1991), Picatinny personnel reported that oil was purposely applied to the parking area (**Figure 2-19**) to make it look old for an inspection. Reportedly, many types of oil were applied to the asphalt. It is possible that some of the oil used contained PCBs.

2.14.2 Previous Studies

No previous studies have been conducted at Site 172.

2.14.3 Nature and Extent of Contamination

As part of the Phase II RI, sampling activities at Site 172 included the collection of ten surface soil samples and ten subsurface soil samples from five locations. Table 13-8 (**Appendix A**) lists the samples collected at Site 172 during the Phase II RI and their corresponding analyses. The location of the samples is depicted on **Figure 2-19**.

2.14.3.1 Surface Soil

Five surface soil samples from Site 172 were analyzed off-site during the Phase II RI. Ten surface soil samples from this site were analyzed on-site. Table 13-10 provides the results of the on-site analysis, while the results of the off-site analysis are provided in Table 13-9 (**Appendix A**).

No VOCs were detected at concentrations above their certified reporting limits (CRLs) in the off-site analysis. No SVOCs were detected in excess of LOCs. The PCB Aroclor 1260 was detected in one sample (172SS-1C) at a concentration of 0.134 mg/kg, below both the NRSRS (1 mg/kg) and the IRSL (0.74 mg/kg). Diesel fuel was found in three of the five samples with a maximum concentration of 30.7 mg/kg. No LOC has been established for this analyte.

VOCs, SVOCs, pesticides, and explosives were detected during on-site analysis, but none of the detected concentrations exceed their LOCs.

2.14.3.2 Subsurface Soil

Ten subsurface soil samples were collected from Site 172 and analyzed on-site during the Phase II RI. No subsurface soil samples from this site were analyzed off-site. All subsurface soil samples were collected from the 2-4 ft bgs depth interval at the surface soil sample locations. Table 13-11 (**Appendix A**) provides the results of the on-site analysis.

Methylene chloride and 4,4'-DDT were the only compounds detected during on-site analysis of the subsurface soil samples. All concentrations were below their respective LOCs.

2.14.4 Summary of Risk Assessments

No organic or inorganic chemicals were detected at concentrations above first level RBCs in surface soil, the only sampled medium, at Site 172. The subsurface soil samples analyzed on-site were not included in the screening-level risk assessment, because on-site analytical data was solely intended for screening purposes. Therefore, the data was not validated and is not suitable for risk assessments. Since no COPCs were identified in the surface soil, no risks or hazards were quantified for the site.

Due to the low habitat quality of the site (i.e., the site is almost entirely asphalt pavement), the site was not evaluated for ecological risk.

2.15 SITE 173, BUILDING 3404, SOLID PROPELLANT TESTING LABORATORY

2.15.1 Site History

Originally built in 1952, Building 3404 (**Figure 2-20**) was used as a maintenance shop and a test laboratory for solid propellant until 1967. Documents from 1967 to 1987 refer to the building as the Materials Preservation and Protection Lab where flame retardants, mercury, solvents, acids, and wood preservatives were used. From approximately 1977 to 1987, the building was also used to store wood, paper, and cardboard boxes. In 1987, Building 3404 was emptied of its contents and renovated to provide equipment storage space for the New Jersey Army National Guard.

A site inspection in 1984 noted the following chemicals stored in Building 3404: Fireshield-Fire Retardant (1 gallon), pentachlorophenol (3 gallons), copper naphthenate (6 gallons), calcium chloride (7 kg), Accatent (Chapman) (2 quarts), acetone (5 gallons), toluene (5 gallons), mercury (5 pounds), ammonium phosphate (6 kg) and hydroxide (1.5 quart), magnesium perchlorate (1 pound), nitric acid (7 gallons), chloroform (4 pints), phosphoric acid (10 liters), and propyl-butyl-carbamate (5 gallons).

A RCRA closure report was drafted for Building 3404. According to Picatinny personnel, RCRA closure requirements were waived by the State of New Jersey because of renovations conducted inside the building by the New Jersey Army National Guard.

2.15.2 Previous Studies

No previous studies have been conducted at Site 173.

2.15.3 Nature and Extent of Contamination

As part of the Phase II RI, sampling activities at Site 173 included the collection of surface soil samples and subsurface soil samples. Table 13-3 (**Appendix A**) lists the samples collected at Site 173 during the Phase II RI and their corresponding analyses. The location of the samples is depicted on **Figure 2-20**.

2.15.3.1 Surface Soil

Three surface soil samples from Site 173 were analyzed off-site. Eight surface soil samples from this site were analyzed on-site. Table 13-15 provides the results of the off-site analysis, while the results of the on-site analysis are provided in Table 13-17. Tables are provided in **Appendix A**.

No VOCs were detected in the samples analyzed off-site. The SVOCs benz(a)anthracene and benzo(k)fluoranthene were each detected at a concentration of 5 micrograms per gram (µg/g) in sample 173SS-3A. The benz(a)anthracene concentration exceeds its IRSL and NRSRS (2.1 mg/kg and 2 mg/kg, respectively). This sample was collected upgradient of Building 3404 and was intended to be a background location. Since it was intended to be a background sample, sample 173SS-2A was also analyzed for asbestos. The sample contained 5% asbestos. Concentrations of the inorganics and anions detected in the surface soil samples collected from Site 173 were below their respective LOCs.

On-site analysis of surface soil samples from Site 173 revealed slightly higher levels of SVOCs than reported during off-site analysis. The following PAHs were identified in samples 173SS-3A and 173SS-3C at concentrations in excess of the LOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. The concentrations of the PAH exceedences ranged from 5.7 mg/kg to 76 mg/kg.

2.15.3.2 Subsurface Soil

Four subsurface soil samples were collected from Site 173 and analyzed off-site. Eleven subsurface soil samples from this site were analyzed on-site. Table 13-16 presents the results of the off-site analysis, while Table 13-18 provides the results of the on-site analysis (**Appendix A**).

VOC concentrations were slightly above the CRL and well below their respective LOCs. PAHs were not detected during off-site analysis of sample 173MW-2A, collected from 2-4 ft bgs. However, benzo(a)pyrene (0.25 mg/kg) and dibenz(a,h)anthracene (0.21 mg/kg) were detected slightly above the IRLS and NRSRS (0.21 mg/kg and 0.2 mg/kg, respectively, for both PAHs) in sample 173MW-2C, collected from 10-12 ft bgs. Explosives were not detected above the CRLs in the samples. A marginal exceedence was identified in sample 173MW-2A for arsenic (21.1 mg/kg). No other metal LOC exceedences were reported in the samples. Anions were detected in the samples; however, there are no LOCs established for the majority of these compounds. The concentrations of anions, fluoride and nitrate/nitrite did not exceed their LOCs.

On-site analysis of the samples identified 18 PAHs in sample 173SS-3B collected from 2-4 ft bgs. Out of the 18 PAH detections, 9 concentrations exceeded their respective LOCs. Several of the PAH concentrations exceeded the respective LOCs by more than an order of magnitude. The concentrations ranged from 420 mg/kg to 7,100 mg/kg. Low levels of pesticides and VOCs were also detected in this sample, but the concentrations did not exceed any LOCs. Sample 173MW-2A contained 18 PAHs, with six concentrations above their LOC; however, as mentioned above, no PAHs were detected in off-site analysis. Sample 173MW-2B, collected from 5-7 ft bgs, approximately 30 ft west of 173SS-3, contained 16 PAHs, with five above their LOCs. The pesticide toxaphene was the only constituent detected in sample 173SS-2B. The concentration of toxaphene (1.5 mg/kg) is below current LOCs (IRSL = 1.6 mg/kg, NRSRS = 3 mg/kg). 2,6-DNT was the only contaminant identified in sample 173MW-2C (1.3 mg/kg); the 2,6-DNT concentration is below the IRSL (620 mg/kg) and NRSRS (3 mg/kg).

2.15.4 Summary of Risk Assessments

Based on the results of the screening evaluation, a default HHRA was conducted for Site 173 because detected chemical concentrations in the soil exceeded RBCs.

The results of the default HHRA are summarized in Tables 13-20 and 13-21, which are provided in **Appendix A**. Table 13-20 indicates that the cumulative risk and cumulative HI from exposure to surface soil are within the target risk range of 1E-4 to 1E-6 and below the hazard target level of 1. In addition, the cumulative risk and cumulative HI from exposure to subsurface soil are also within the target risk range of 1E-4 to 1E-6 and below the hazard target level of 1 (Table 13-21).

Due to the small size of the site (< 0.5 acre), its urban setting, and low habitat quality, Site 173 was not evaluated for ecological risk.

2.16 SITE 174, BUILDING 3420, OLD SEWAGE TREATMENT PLANT

2.16.1 Site History

The current building at Site 174, designated "3420", is an active pumping station, and should not be confused with the old sewage treatment plant and supporting structures which have been demolished. A 1947 aerial photograph shows a pump station, at least two sludge holding tanks, and a square concrete structure partitioned into four sludge drying beds (**Figure 2-21**). Site 174 accepted and processed all the runoff and wastewaters from the 3300 and 3400 series buildings for an unknown period of time. It is likely that it received laboratory chemicals, metals, pyrotechnics, propellants, and high explosives that were conveyed through building discharge points and surface runoff. According to Picatinny inspection reports, sewage spills of up to 5,000 gallons were common at the site. Treated water from Site 174 was conveyed underground in 2-foot diameter concrete pipes. Brick-lined sumps, approximately three feet deep, connected the concrete pipes, which conveyed the water from the various stages of treatment. The treated water discharged to a stream northeast of the site, which eventually flows to GPB in the central valley of the Installation. The brick sumps and approximately 200 ft of associated piping were excavated and disposed of off-site in July 2003 as part of a facility-wide sump investigation (see Section 2.16.5).

2.16.2 Previous Studies

No previous studies have been conducted at Site 174.

2.16.3 Nature and Extent of Contamination

As part of the Phase II RI, sampling activities at Site 174 included the collection of surface soil, subsurface soil, surface water, sediment, and groundwater samples. Table 13-22 (**Appendix A**) lists the samples collected at Site 175 during the Phase II RI and their corresponding analyses. The location of the samples is depicted on **Figure 2-21**.

2.16.3.1 Surface Soil

Three surface soil samples were collected at Site 174 and analyzed off-site during the Phase II RI including one collected while advancing the borehole for monitoring well 174MW-1. Table 13-24 provides the results of the off-site analysis, while the results of the on-site analysis of five samples are provided in Table 13-28 (**Appendix A**).

SVOCs were not detected in the samples. VOCs, explosives, metals (with the exception of arsenic) and anions were detected at concentrations below their LOCs. Arsenic was detected at concentrations exceeding its IRSL (1.6 mg/kg), but below the Picatinny background level in surface soil (9.23 mg/kg) and the NJDEP NRSRS (19 mg/kg), which is based on natural background.

On-site analysis reported similar results as the off-site laboratory. All detected VOC and pesticide concentrations were below their respective LOCs.

As part of sediment delineation sampling conducted in August 2005 (see Section 2.16.3.3), sample 174SD-4 was collected from the intermittent stream downgradient of 174SW/SD-2. Since the stream is intermittent with very little surface water, it doesn't support benthic life year round. In addition, sample 174SD-4 had a % moisture content less than 50%; therefore results were compared to soil screening values. Silver and mercury concentrations exceeded ecological screening levels derived for soil. However, no concentrations exceeded the respective human health-based soil LOCs.

2.16.3.2 Subsurface Soil

Subsurface soil sample 174MW-1B was collected from 5-7 ft bgs, at the monitoring well location in Site 174. This sample was the only subsurface soil sample analyzed off-site from Site 174. Table 13-25 provides the results of the off-site analysis, while the results of the on-site analysis of nine samples are provided in Table 13-29 (**Appendix A**).

VOCs and explosives were not detected in the sample. The SVOC di-n-butylphthalate was detected at a concentration well below the LOC. Metals and anions were detected at concentrations below their LOCs.

On-site analysis of the subsurface soil samples detected very low concentrations of methylene chloride, a common laboratory contaminant, in three samples. All concentrations were below the methylene chloride IRSL and NRSRS (53 mg/kg and 97 mg/kg, respectively). No other analytes were detected in these samples.

2.16.3.3 Sediment

Three sediment samples were collected at Site 174 in conjunction with the surface water samples. Off-site analytical results for the samples are presented in Table 13-26. On-site analytical results for the samples are presented in Table 13-30. Tables are provided in **Appendix A**.

No VOCs were detected at concentrations above their respective LOCs. The SVOCs, phenanthrene (0.057 mg/kg) and pyrene (0.085 mg/kg), were detected at concentrations above their respective LOCs of 0.0419 mg/kg and 0.053 mg/kg in sample 174SD-2. This sample was collected from the intermittent stream that runs to the northeast, approximately 300 ft downgradient of the brick sump. Pyrene was also detected at an elevated level of 0.075 mg/kg in sample 174SD-3. The pesticides, 4,4'-DDD (0.055 mg/kg), 4,4'-DDE (0.0294 mg/kg), and 4,4'-DDT (0.0144 mg/kg) were detected in sample 174SD-2 at concentrations in excess of their LOCs. Explosives and dioxins/furans were not detected in the sediment samples. Sample 174SD-3, located in a drainage ditch upgradient of former Building 3420, contained concentrations of arsenic (35 mg/kg) and copper (31.6 mg/kg) above the LOCs (16 mg/kg and 28 mg/kg, respectively). Sample 174SD-1, collected at the brick sump, contained elevated concentrations of manganese (2,390 mg/kg) and nickel (54.3 mg/kg) above the LOCs (1,673 mg/kg and 39.6 mg/kg, respectively). Sample 174SD-2, approximately 300 ft downgradient of the brick sump, contained elevated concentrations of mercury (0.624 mg/kg) and silver (13.8 mg/kg) above the LOCs (0.249 mg/kg and 1 mg/kg, respectively). Anions were detected in the sediment samples, but the concentrations were below their LOCs. Six radiological parameters were detected in sample 174SD-2 (the only sample analyzed for radiological parameters). All radiological concentrations were below the background threshold values. There are no LOCs established for the radiological parameters in sediment. TPH was detected in sediment sample 174SD-2 at a concentration of 148 mg/kg (the other sediment samples were not tested for TPH); there is no LOC established for TPH in sediment.

VOCs, PCBs, and explosives were not detected during on-site analysis of sediment samples at Site 174. Concentrations of SVOCs did not exceed LOCs. The pesticide 4,4-DDT was detected at a concentration of 1.2 µg/g in sample 174SD-2. The LOC for 4,4-DDT in sediment is 0.00119 mg/kg. This compound was also detected above the LOC by the off-site analysis. In comments received on the Phase II Remedial Investigation Report, Rounds 1 and 2, Volume 5 – Area K Sites (Shaw, 2003), the NJDEP required additional sediment delineation in the small stream downgradient of 174SD-2. On August 10, 2005 three sediment samples were collected from the intermittent stream downstream of 174SD-2. Numerous PAH compounds were detected above sediment LOCs in samples 174SD-5 and

174SD-6. The pesticides DDD and DDT were detected in excess of their respective sediment LOCs in all three samples. DDD and DDT concentrations decreased with distance downstream. DDD concentrations ranged from 0.029 mg/kg at 174SD-6 to 0.23 mg/kg at 174SD-4. DDT concentrations ranged from 0.074 mg/kg at 174SD-6 to 5.2 mg/kg at 174SD-4. DDE was detected above the sediment LOC in 174SD-5 (0.37 mg/kg) and 174SD-6 (0.058 mg/kg). Silver and mercury concentrations exceeded their respective sediment LOCs at each location. Silver concentrations ranged from 4.5 mg/kg in 174SD-4 to 55.9 mg/kg in 174SD-5. The LOC for silver in sediment is 1.0 mg/kg. Mercury concentrations ranged from 0.48 mg/kg in 174SD-4 to 3.1 mg/kg in 174SD-5. The LOC for mercury in sediment is 0.249 mg/kg. Since the stream is intermittent with very little surface water, and does not support benthic life year round, concentrations from soil samples containing less than 50% moisture were compared to soil LOCs. Based on this analysis, sample 174SD-4 was determined to be representative of soil rather than sediment. Analytical results for 174SD-4 are discussed with respect to soil screening criteria are discussed in Section 2.16.3.1

Due to radiological parameters detected in surface water sample 174SW-2, collected from the same location as 174SD-2, the additional sediment samples were also analyzed for radiological parameters. There are currently no LOCs for radiological parameters in sediment. In the absence of New Jersey Soil Remediation Standards for Radioactive Materials, cesium-137 and radium-228 concentrations were compared to background concentrations provided by the Picatinny Facility-*Wide Background Study* (IT, 2002). The cesium-137 concentration of 2.54 picocuries per gram (pCi/g) in 174SD-5 exceeded the background value of 0.56 pCi/g. The cesium-137 concentration in sample 174SD-6 was above background, but within the total uncertainty of 0.18 pCi/g. Radium-226 did not exceed the background threshold of 1.13 pCi/g.

Three additional sediment samples were collected on March 15, 2006 in order to delineate silver and mercury concentrations (PAH and pesticide concentrations identified in previous sediment delineation samples is not believed to be related to Site 174). Samples 174SD-7 and 174SD-8 were collected from the unnamed intermittent stream downstream of sample 174SD-6, and sample 174SD-9 was collected following the confluence with Green Pond Brook (**Figure 2-21**). No constituents were detected above LOCs in samples 174SD-7, 174SD-8, and 174SD-9.

2.16.3.4 Surface Water

Three surface water samples were collected at Site 174 in conjunction with the sediment sampling. Analytical results for the samples are presented in Table 13-27 (**Appendix A**).

Toluene was detected in Sample 174SW-2 at a concentration well below its LOC. The sediment sample collected at this location also contained toluene. SVOCs, pesticides, explosives and dioxins/furans were not detected in the surface water samples. Aluminum, arsenic and sodium were detected at concentrations exceeding their LOCs in the surface water samples. Anions were detected in the surface water samples, but the concentrations were below their LOCs. Five radiological parameters were detected in sample 174SW-2 (the only sample analyzed for radiological parameters). Four of the five concentrations exceed the background threshold values; there are no LOCs established for these parameters. The radium-226 and cesium-137 levels exceeded their respective USEPA RBCs (EPA, 1991; Dinan, 1992). No fuel-related contaminants were detected in the surface water samples.

On August 10, 2005 one surface water sample was collected from the intermittent stream downgradient of sample location 174SW-2 and analyzed for radiological parameters. No radiological parameters were identified from gamma spectroscopy of surface water sample 174SW-6, which was collocated with sediment sample 174SD-6. Insufficient surface water was present at sample locations 174SD-4 and 174SD-5 to collect analytical samples.

2.16.4 Summary of Risk Assessments

A default HHRA was conducted for Site 174 because detected chemical concentrations in the soil exceeded the RBCs. Since no COPCs were identified in the subsurface soil during the screening level evaluation, risks and hazards associated with subsurface soil exposure were not quantified. Surface water and sediment exposures were not evaluated because the samples were collected from small ephemeral ditches, which are unlikely to be visited by workers or trespassers. It should also be noted that the site is located in a remote, inactive portion of the base, so human contact is unlikely.

The results of the default HHRA are summarized in Table 13-32, which is provided in **Appendix A**. Table 13-32 indicates that the cumulative risk from exposure to surface soil is within the target risk range of 1E-4 to 1E-6, and the cumulative HI from exposure to surface soil is below USEPA's noncancer hazard threshold of 1.

As part of the Phase II ERA (IT, 2000), a bioassay was performed with sediment collected from sample location 174SD-2. No significant differences were observed in % survival and % emergence of the test organisms between the site sample and the control and reference samples. The bioassay results did not suggest significant toxicity exists for benthic macroinvertebrates at Site 174. Based on environmental effects quotients (EEQs), the primary eco-risk drivers at Site 174 appear to be 4,4'-DDD; 4,4'-DDT, 4,4'-DDE, and silver in sediment. Based on the results of the food chain analysis, there appears to be little potential risk to mammalian and avian species from exposures to ecoCOPCs detected in soil samples at Site 174.

2.16.5 Facility-Wide Investigation of Sumps and Dry Wells

As noted in Section 2.16.1, three brick-lined sumps and approximately 200 ft of associated piping were excavated and disposed off-site as non-hazardous waste in July 2003 during the facility-wide sump investigation. Twenty post-excavation samples were collected from the excavation and analyzed for SVOCs, pesticides, and metals. Analytical results indicated that only arsenic was detected above LOCs in either the excavation or the spoils samples. Arsenic concentrations ranged from 1.4 mg/kg to 6.9 mg/kg (IRSL = 1.6 mg/kg) in the post-excavation sampling results. However, none of the results exceeded the Picatinny background levels (9.23 mg/kg and 8.57 mg/kg for surface and subsurface soil, respectively) or the NJDEP NRSRS of 19 mg/kg, which is based on natural background. Post-excavation sample locations and analytical results are provided on Figure 2-27 and Tables 3-29A and B in **Appendix A**. The remainder of the site not addressed in the sump and dry well investigation, including the results of surface water sampling, are evaluated further in this FFS.

2.17 SITE 186, BUILDING 3316, FIREHOUSE

2.17.1 Site History

Building 3316 (**Figure 2-22**), was constructed for use as a vehicle maintenance facility. Picatinny's firehouse is the former Lake Denmark Navy Depot Fire House. Horse stalls were replaced with vehicle garages in 1946. Both garage bays contained a grease pit that discharged directly into the underlying soil. Wash water from the primary vehicle bay flowed into a gutter-type drain before it entered a dry well reportedly located under or south of the bay's outdoor concrete ramp. Facility personnel interviews indicated that used oil was repeatedly dumped into the drywell before the site was repaved. The main bay's dry well is no longer used, since the new bay floor channels all wastewater into the sanitary sewer. Wastewater from the kitchen and perhaps clothes washing operations reportedly was discharged into a septic tank behind the firehouse and next to the Auto Craft Shop (Building 3315). Facility spill files contain no spill reports for Building 3316.

2.17.2 Previous Studies

In 1997, USACHPPM conducted an investigation of Building 3316 to determine the RRSE score for the site. The investigation included the installation and sampling of three groundwater monitoring wells (3316-1, 3316-2, and 3316-3, see **Figure 2-22**), but did not include any surface or subsurface soil sampling, nor sampling of any other media. The groundwater samples were analyzed for metals, VOCs, and SVOCs. The water sample collected from monitoring well 3316-3 was turbid as a result of natural soil fall back along the lower portion of the well screen. This soil contains fine material that entered the well during sampling and likely biased high the total metals sample concentrations.

Groundwater results indicated the presence of estimated levels of m/p-xylenes (1.5 μg/L) and PCE (1.1 μg/L) in a duplicate sample collected from 3316-1 (bedrock well). The PCE concentration slightly exceeded the LOC of 1.0 μg/L. No VOCs were detected in the other samples including the other sample from 3316-1. Nitrosodiphenylamine was the only SVOC detected in the sample. It was reported at 13 μg/L in 3316-2. The current LOC for Nitrosodiphenylamine is 10 μg/L. Silver (100 μg/L) was also detected in the groundwater sample collected from 3316-1, above its LOC of 40 μg/L. The metals chromium (170 μg/L), nickel (150 μg/L), and lead (5.3 μg/L) were detected in the turbid sample, MW-3316-3, above their respective LOCs (70 μg/L, 100 μg/L, and 5 μg/L).

The USACHPPM report gave the site an RRSE of "medium" due to "moderate" groundwater contamination. A copy of the analytical results has been provided in **Appendix A**.

2.17.3 Nature and Extent of Contamination

As part of the Phase II RI, sampling activities at Site 186 were conducted on May 31, 2001, and included the collection of three groundwater samples from three existing monitoring wells.

The chemical analytical results of the Phase II RI have been summarized in this section. Analytical data tables for the results are presented in **Appendix A**. Only those analytes detected in at least one sample are presented on the tables. **Figure 2-22** presents the sampling locations at Site 186.

2.17.3.1 Groundwater

Three groundwater samples were collected at Site 186 during the Phase II RI and analyzed for VOCs and metals. The three samples were collected from the monitoring wells located to the southwest (3316-1), southeast (3316-2), and north (3316-3) of the Firehouse. Two of the monitoring wells (3316-2 and 3316-3) were installed within the unconsolidated aquifer (no greater than 25 ft bgs), and one monitoring well (3316-1) was installed in the bedrock aquifer (approximately 71 ft bgs). Table 13-4 (**Appendix A**) provides the results of the analysis.

Only one VOC was detected slightly above its corresponding SQL in the groundwater samples. Tetrachloroethylene (PCE) was detected at an estimated concentration of 0.26 μg/L in the sample from monitoring well 3316-3. Several metals were detected slightly above their corresponding sample quantitation limit (SQL) in all three groundwater samples. Aluminum, chromium, iron, lead, manganese and sodium were the only metals detected above the corresponding LOC (200 μg/L, 70 μg/L, 300 μg/L, 5 μg/L, 50 μg/L, and 50,000 μg/L, respectively). Aluminum (12,900 μg/L) and lead (7.2 μg/L) were only detected in the sample collected from monitoring well 3316-3. Chromium exceeded its LOC (70 μg/L) only in the sample from 3316-3, at a concentration of 88 μg/L. Iron was detected above the LOC in all three samples (3316-1, 935 μg/L; 3316-2, 360 μg/L; 3316-3, 14,000 μg/L). Manganese was detected above the LOC in the samples from monitoring wells 3316-1 (555 μg/L) and 3316-3 (410 μg/L). Sodium was detected above the LOC in the samples from monitoring wells 3316-2 (306,000 μg/L) and 3316-3 (360,000 μg/L). Nickel (100 μg/L) was detected in the sample from monitoring well 3316-3 at the LOC.

2.17.4 Risk Assessment Results

Groundwater was the only media sampled at the site. For groundwater samples collected at Site 186, aluminum, chromium, iron, manganese, nickel, sodium, and vanadium were selected as COPCs. The following exposure pathway was quantitatively evaluated in the HHRA: dermal absorption exposure to chemicals in groundwater by construction/excavation workers.

Table 2-13
Summary of Site 186 Estimated Risks and Hazards

Receptor	Route of Exposure	Cancer Risk	Noncancer Hazard
Construction/Excavation Worker	Ingestion	0	Not applicable
	Dermal Contact	0	0.04
	Inhalation	0	Not applicable
	Total Risk or Hazard:	0	0.04

Since no carcinogenic COPCs were identified in the groundwater, the cumulative risk from groundwater exposure could not be quantified (**Table 2-13**). The cumulative HI from exposure to impacted site media is below the target hazard level of 1.0 for the construction/excavation worker (**Table 2-13**).

No ERA was performed at Site 186. The majority of this area is paved and is located within a high human-use part of PTA. Building 3316 is completely surrounded by pavement for either roads or vehicular parking. Thus, very little suitable habitat exists for most species.

2.18 SITE 176, LITTLE LEAGUE BASEBALL FIELD

The Little League Baseball Field (LLBF), approximately 120 ft x 200 ft, is located in the northern portion of Area L bordered on the southwest by Walsh Road and the west by Schrader Road (**Figure 2-23**).

2.18.1 Site History

This site reportedly has been used as a ball field for at least the last ten years. There is an inconsistency in the information regarding the dumping of the dredged material from GPB. According to reports, dredge spoil material may have been dumped at either the LLBF (Site 176), or the Softball Fields (Site 163), or both.

Reportedly, the material disposed on this site was dredged from GPB in 1982. GPB flows out of Picatinny Lake and ends where the brook leaves Picatinny property. The major tributary in this area is BSB, which flows through an industrial section of Picatinny and discharges in GPB near First Street. The southern part of Picatinny is drained by a network of ditches that also discharge into GPB. Fill deposits have been added, and dams and culverts that alter the natural setting of GPB and its tributaries have been constructed. GPB has received waste streams from most operations at Picatinny, including sewage and industrial wastewater discharges, storm runoff, and discharge from a contaminated groundwater plume. Consequently, the dredged material from the brook that may have been disposed of at the site is suspected to contain a variety of contaminants. Metals, explosives, BNAs, PCBs, and VOCs are of concern because wastewater discharges from numerous industrial operations and spills on the Picatinny facility could potentially contain these contaminants. Pesticides and herbicides are also of concern because GPB receives flow from a large drainage basin where pesticides and herbicides may have been applied.

Material in the dredge piles varies in composition, apparently due to the varying locations and times at which they were excavated. The GPB dredge piles are classified as Site 26, located in Area C of Picatinny. Cadmium, chromium, copper, lead, mercury, and zinc were detected at elevated levels, which exceeded regional ranges or concentrations typical at Picatinny. Elevated levels of these metals occurred at various locations within and around the piles, indicating variability due to source, and probable spillage and mixing with native material during stockpiling. The dredge pile was previously reported to contain munitions.

According to Picatinny personnel, Site 176 was used as a landfill for sediment dredged from GPB. In addition, for three years (specific timeframe unknown), materials were reportedly disposed of in pits at the site. However, it is unclear as to whether these materials were disposed of at this site or Site 163. If contaminated material was landfilled here, it is not known if uncontaminated soil was brought in to cover the graded landfill during the conversion of the site to a ball field.

2.18.2 Previous Studies

Three previous investigations have been carried out at the LLBF. In 1991, 18 soil samples were collected from the 6- to 12-inch horizon and analyzed for acid/base neutral compounds, metals, and PCBs. Four of the samples from the left field area had low levels of PCBs ranging from 0.17 ppm to 0.195 ppm. All other parameters were below detection limits, except for metals, which were reported within the range of levels for natural background. The samples were not analyzed for explosives.

Twelve additional samples were obtained from the LLBF in 1991 as part of an HHRA to determine potential risks to individuals using the field. TPH ranged from non-detect to 54 ppm. All other constituents were within background levels except for DDT (0.33 ppm) and DDE (0.033 ppm) in samples obtained from left field; and zinc (1,200 ppm) in a sample obtained from the left side of the infield. The elevated zinc level is possibly due to the galvanized backstop fence. The HHRA concluded that the risks to individuals playing at or using the field were negligible, both for carcinogenic and non-carcinogenic constituents.

The GPB dredge pile, which consists of the same material that was potentially deposited on the LLBF, has been investigated several times. If dredged material was used as fill in the LLBF area, the following chemical data could be indicative of the fill material. In 1984, two composite soil samples were analyzed for metals, oil and grease, and phenol. The results indicated the presence of arsenic (3.7 to 4 ppm), cadmium (5.3 to 8.3 ppm), chromium (31 to 49 ppm), cyanide (0.3 to 0.5 ppm), lead (12 to 17 ppm), mercury (0.13 to 0.21 ppm), silver (1.12 to 1.48 ppm), and oil and grease (138 to 174 ppm). In 1988, lead and copper were identified as compounds most indicative of site contamination. Explosives were not detected in soil samples collected at this time. In 1991, Picatinny analyzed ten samples from the dredge pile and found one sample contained PCBs at 5.40 ppm. TPH ranged from non-detect to 620 ppm, and NC/NG ranged from non-detect to 361 ppm. All other explosives were below detection limits.

In 1996, the PA/SI identified the following AOCs associated with the LLBF: the right and center fields, which are the most likely areas of dumping of dredge material, and the three soil piles located along the eastern edge of the site (ICF KE, 1998d).

During the PA/SI, four surface soil samples were collected at the LLBF. Surface soil samples LLBFSS-A, LLBFSS-B, and LLBFSS-C were collected in the right and right-center fields. Surface soil sample LLBFSS-D was collected in the area of the three soil piles outside of the fenced-in field area. **Figure 2-23** shows the location of these sampling points. Only arsenic was detected above LOCs, at concentrations of 2.4 mg/kg and 2.1 mg/kg in samples LLBFSS-B and LLBFSS-D, respectively. These arsenic concentrations exceeded the IRSL (1.6 mg/kg) but were below both the Picatinny background level (9.23 mg/kg) and the NJDEP NRSRS (19 mg/kg) based on natural background. Analytical results for the samples collected during the PA/SI can be found on Table 3-5 in **Appendix A**. Based upon this chemical analytical data and the historic data, the recommendation for Site 176 was for no further action (NFA).

2.18.3 Nature and Extent of Contamination

USEPA and NJDEP commented that the NFA recommendation proposed for Site 176 in the PA/SI was unacceptable, because the subsurface soil had not been characterized. Both regulatory agencies required subsurface soil sampling at this site to characterize potential subsurface contamination. Based on the regulatory comments, three subsurface soil samples were collected from three soil boring locations in October 2000 as part of the Phase III 2A/3A RI.

2.18.3.1 Surface Soil

A total of 34 surface soil samples have been collected at the LLBF and soil dredge piles over the course of three investigations. Samples have been analyzed for a combination of analytes including SVOCs, PCBs, pesticides, explosives, metals and TPH. With the exception of arsenic detected below both the Picatinny background level and the NRSRS based on natural background, no chemical concentrations have been reported above LOCs in these 34 samples.

2.18.3.2 Subsurface Soil

Three subsurface soil samples were collected at the LLBF to characterize the soil at Site 176 during the Phase III 2A/3A RI. All three of the subsurface samples were collected from 2-4 ft bgs. Soil borings 176SB-1B and 176SB-2B were located in the area most likely to be fill based on an aerial photography review. The third boring, 176SB-3B, was installed downgradient of the soil piles. All three boring locations are depicted on **Figure 2-23**. Subsurface soil samples were collected from 2-4 ft bgs, which was believed to be the cover soil/dredge spoil interface. Samples from deeper intervals were not collected due to the presence of groundwater at 5 ft bgs. The samples were analyzed for VOCs, SVOCs, PCBs, metals and explosives. The analytical results of the subsurface soil samples are presented on Table 8-45 in **Appendix A**.

Only benzo(a)pyrene and arsenic were detected above respective LOCs. Benzo(a)pyrene was detected at a concentration of 0.47 mg/kg in sample 176SB-1B exceeding its NRSRS (0.2 mg/kg) and IRSL (0.21 mg/kg). Arsenic concentrations ranged from 2.75 mg/kg to 3.8 mg/kg in the subsurface soil samples, exceeding the IRSL (1.6 mg/kg). However, arsenic concentrations were below the NJDEP NRSRS (19 mg/kg), based on natural background, and the Picatinny background level for subsurface soil (8.57 mg/kg). VOCs, PCBs, and explosives were not detected at concentrations above the reporting limits. Trace concentrations (<1.5 mg/kg) of several SVOCs were detected in the samples. Generally, these concentrations were below the reporting limit, but above the detection limit. Several metals were detected at levels above the reporting limit but all concentrations were below LOCs and generally indicative of background concentrations established during the *Picatinny Facility-Wide Background Study* (IT, 2002a).

Based on the soil description from the boring logs, there was no change in soil composition at the suspected cover soil/dredge spoil interface. The soil boring logs and the analytical data do not indicate that dredge material was used as fill at the LLBF or that the subsurface environment has been impacted.

2.18.4 Summary of Risk Assessments

As all media samples collected and analyzed for Site 176 did not document any constituent concentrations above conservative risk-based screening limits, no COPCs were selected, and no risks or hazards were quantified for realistic receptors (industrial research workers and construction excavation workers).

Evaluation of future residential exposure to an adult and a child indicate potential risks are within USEPA's target cancer risk range of 1E-04 to 1E-06 (**Table 2-14**). The estimated total hazards for the adult and child resident are less than USEPA's target noncancer hazard threshold of 1. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

Table 2-14
Summary of Site 176 Estimated Risks and Hazards

Receptor (Current and Future)	Estimated Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Adult Resident	1.2E-5	Benzo(a)pyrene	Mixed Surface and Subsurface Soil
Child Resident	8.6E-6	Benzo(a)pyrene	Mixed Surface and Subsurface Soil
Adult + Child Resident	2.1E-5	Benzo(a)pyrene	Mixed Surface and Subsurface Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Adult Resident	0.052	NR - Hazards acceptable	NR - Hazards acceptable
Child Resident	0.47	NR - Hazards acceptable	NR - Hazards acceptable

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil were compared to ecological toxicity screening values. However, no concentrations were reported above LOCs in the samples. Since exposure to elevated concentrations of contaminants by wildlife receptors is unlikely at the ball field, no additional ecological investigation is warranted for the site.

2.19 SITE 177, SANITARY SEWER LINE BREAKS/LEAKS

2.19.1 Site History

Site 177 is the Picatinny Sanitary Sewer Breaks/Leaks. The sanitary sewer system at Picatinny consists of vitrified clay, cast iron, asbestos cement and galvanized pipes. Due to the age of the facility, some of the sewer pipe is extremely old and therefore likely to have experienced cracks, sags, misalignments, and root infiltration. As a result, the soils and groundwater along the sewer lines may have become contaminated at points where the pipes cracked or leaked.

It should be noted that even before modern waste handling techniques were required, the sanitary sewer system at Picatinny was not routinely used to receive industrial waste. In many sections of the facility used for munitions production, there were no sanitary connections to the production buildings. Typically, the only building in a production area with a sanitary connection was the change house which did not routinely handle hazardous materials. However, it is possible that in the past the sanitary sewer system did receive hazardous material from other sources. A potential source would have been maintenance and laboratory facilities because these buildings were more likely to have sewer connections. The industrial waste inputs to the system are believed to be small scale. Another significant input to the system may have been from photograph developing operations. Historically, there are no complete records documenting the type and scale of these inputs.

Beginning in the late 1970s, an infiltration problem was identified in the sewer system. Picatinny moved to evaluate the scope of the problem and address it through re-lining pipes and replacing pipes. Many feet of pipes were replaced or upgraded during this process. As a result of this construction, rubble has been generated and subsequently deposited in the former location of Building 276 (Site 100, Area H, Phase II). This rubble consists primarily of broken concrete, asphalt, rocks and to a lesser extent soil, covering an area of approximately 20,000 sq. ft.

Due to the age and in some cases the type of material used in sewer line construction, there have been numerous spills and overflows of the sewer system. Many of the overflows, which occur at lift stations, are also the result of the age of the system. Due to a large amount of infiltration, rain events cause the system to receive flows beyond its capacity. In some cases, the pumps at lift stations fail and sewage is spilled onto the ground surface. Another common reason for spills is line blockage typically due to root intrusion. Over the years, there have been dozens of spills and overflows across the facility due to the above mentioned reasons. The standard operating procedure for handling sewage overflows, while repairs are being accomplished, is to attempt to divert the spill from waterways and to treat the area with disinfectant after the spill has been stopped. It should also be noted that due to infiltration, sewage at Picatinny is typically dilute.

2.19.2 Previous Studies

During the past twenty-five years, several assessments have been made of the condition of the sanitary sewer system at Picatinny. In 1979, Haven and Emerson Inc. provided Picatinny with an analysis of infiltration and inflow for the entire Picatinny sewer system. In 1981, Visu-Sewer issued a report on the cleaning and inspection of the Picatinny sewer system, with recommendations for upgrading the entire system. In 1984, Tectonic provided an assessment of the damage which occurred in sub-basins 6 and 7. In 1991, a report was written by Architectural Engineering and Construction, which provided recommendations for repairs and upgrades to Picatinny's sewer line system. In 1993, Gannett and Fleming (GF) performed a study of the sewer systems force main lines in order to provide suggestions for system repair and upgrade. The 1991 and 1993 reports were available for review, but the remainder of the reports were no longer in the Picatinny files.

The Architectural Engineering report written in 1991 details the inspection and cleaning of the majority of the sanitary sewer lines at Picatinny. Where possible, lines were inspected with a television camera. The contractor attempted to televise approximately 47,000 linear feet of sewer pipe. Due to pipe bends, offsets and collapses only approximately 20,000 liner feet were televised. The result of this survey indicated that while some of the sewer lines were in good condition, many of the lines had to be serviced or replaced. Many of these lines had experienced leaks due to root intrusion, cracking, and piping offset due to sagging. To a lesser extent, corrosion of the cast iron lines was noted as a difficulty. Of the seventy sections of the sewer line evaluated, approximately 80% had the possibility of experiencing some form of leak.

The GF study served to test the forced main sewer lines associated with 21 lift stations. The project tested a total of 22,000 ft of forced main sewer. Six of the 21 lift stations failed the forced main sewer test with the remainder of the lines passing the test. Forced main sewers which failed the test were associated with the following stations: 91-S, 121-F, 162-A, 3342, 908, and 1110. The report indicated that the leakage could have been caused by defective valves as well as leaking lines. Based upon this assessment, the contractor further recommended that the valves in the pump stations be replaced and the lines retested before replacing the lines (GF, 1993).

As part of the PA/SI performed in 1996 to evaluate this site, three surface samples were collected from the sewer excavation soil piles located at former Building 276. Surface soil samples 177SS-A, 177SS-B, and 177SS-C were collected from a random section of soil piles at the site. Three more surface soil samples were proposed to be collected from sewer-line excavations. Unfortunately, these surface soil samples could not be collected during the field activities, because no sewer line excavations were scheduled for the summer of 1996. Benzo[a]pyrene (1.4 mg/kg) was detected in surface soil sample 177SS-C at a concentration exceeding its comparison criteria. Arsenic was detected in all three samples at concentrations ranging from 2.7 mg/kg to 8.6 mg/kg, above its IRSL (1.6 mg/kg) but below the NJDEP NRSRS (19 mg/kg), based on natural background and the Picatinny background level in surface soil (9.23 mg/kg). Based upon low-level detections and the fact that the soils are being handled by the Picatinny EAO, the recommendation for Site 177 was NFA (ICF KE, 1998d).

The renovation of the Picatinny sanitary sewer system began in the mid-1990s through the New York District Army Corps of Engineers (ACE) and was completed in the late 1990s/early 2000. As part of the sanitary sewer renovations/replacement project, IT obtained soil samples at suspected areas of contamination, as observed during excavation. In addition to samples from the sewer line trench, soil piles staged from the excavation have been sampled. A total of 30 samples have been collected at the following sites/buildings: Site 137 (Area I), Site 150 (Area I), Building 321 (Area G), Site 31 (Area G); Building 241 (Site 64-Area H), Building 717 (Site 108-Area I), Building 303 (Area G), and Building 91 (Site 78-Area P). The resultant analytical information is summarized below.

PAHs were reported in the samples collected at Site 31, Building 717 and Building 321 at concentrations exceeding LOCs. PAH concentrations are likely attributable to site-specific actions at these locations and were investigated in each of the respective remedial investigations for Sites 31 and 101, Site 108 (Building 7171), and Site 210 (Building 321). BTEX compounds were detected in the soil pile samples from Building 321, but the concentrations were below regulatory criteria. Soil samples collected directly from the sewer line trench at Building 321 also did not contain any VOC concentrations above LOCs. However, the soil sample collected from the sewer trench at Building 321 did contain lead (2,840 mg/kg) and chromium (472 mg/kg). The lead concentration exceeds its LOC (800 mg/kg); however, there is currently no LOC for total chromium.No other compounds exceeded their regulatory criteria.

The AOCs associated with the Picatinny sanitary sewer system are the soil piles from previous sewer line excavations, which have been staged at former Building 276 and soil from sewer line excavations conducted in the mid to late 1990s.

2.19.3 Nature and Extent of Contamination

NJDEP commented that the proposed NFA for Site 177 was acceptable. However, USEPA requested that Picatinny follow the sampling plan proposed in the RI Concept Plan to evaluate areas of known breaks. The RI Concept Plan suggested six locations for soil borings because of the clear identification of crushed and cracked pipes at these locations or their location in relation to buildings with high levels of contamination (ANL, 1991). In response to USEPA's comments, Phase III 2A/3A RI sampling was conducted at Site 177 in June 2001, and included the collection of six subsurface soil samples.

2.19.3.1 Subsurface Soil

Six subsurface soil samples were collected at Site 177 to characterize the soil in areas of known sewer line breaks. The samples were analyzed for VOCs, SVOCs, TAL metals, and baseline explosives. Sampling locations were chosen based on suggestions by the New York District ACE, the sanitary sewer repair manager. **Table 2-15** lists each recommended sampling location along with an explanation. **Figures 2-24 through 2-27** depict the sampling locations. Soil samples were collected at the depth of the possible break/leak or the depth corresponding to the bottom of the pipe. Analytical results of the subsurface soil samples are presented in Table 8-47 (**Appendix A**).

Table 2-15
Site 177 Sampling Locations

Area	Site	Location	Rationale
J	2	Building 3519	An almond odor was noted during the sewer line replacement at ~10 ft bgs. Sample location 177SB-1
J	2	Former Building 3533 near Stillwell Pond	Stained surface soil (presumably railroad oil) observed by the pond across from the 3600 Area to 2 ft bgs. Sample location 177SB-5
L	36/171	Building 3100	Break in the terracotta pipe that follows the ground surface between Buildings 3109 and 3100. The break mainly occurred near or behind Building 3100 at shallow depths (< 5 ft bgs). Sample location 177SB-4
M	154	Buildings 617 and 620	Possible dumping of explosives into the septic system. Sample location 177SB-3
M	NA	Building 603	Break in the septic system behind Building 603. Manholes associated with the system were dry. Therefore it is believed the contents of the system leaked into the subsurface. Sample location 177SB-2
L	NA	Along Ford Avenue parallel to Farley Avenue	Breaks of entire length of pipe along Ford Avenue within the 1300 Enclosure. Sample location 177SB-6

Among these samples only benzo(a)pyrene and arsenic exceeded LOCs, and no baseline explosives were detected over the reporting limits. Benzo(a)pyrene was detected above its NRSRS and IRSL (0.2 mg/kg and 0.21 mg/kg, respectively) in sample 177SB-5. Arsenic concentrations ranged from 2.4 mg/kg to 7 mg/kg, exceeding its IRSL (1.6 mg/kg), but below the Picatinny background level in subsurface soil (8.57 mg/kg) and the NJDEP NRSRS (19 mg/kg) based on natural background. Trace levels of the VOCs carbon disulfide and 1,2-dichloroethane were reported in one sample, each at concentrations less than 0.6 mg/kg. Traces of several SVOCs were reported among the samples. The highest SVOC concentration was 2.1 mg/kg reported for bis(2-ethylhexyl)phthalate in sample 177SB-6 collected near the intersection of Upper X.H.E. Road and Ford Avenue. The only other SVOC reported over 1 mg/kg was fluoranthene in sample 177SB-5 (1.1 mg/kg) that was collected slightly south of Stillwell Pond. Several metals were reported but overall the metal concentrations are indicative of background concentrations established during the *Picatinny Facility-Wide Background Study* (IT, 2002a). These results do not indicate that leaks from crushed or cracked sanitary sewer pipes have impacted soil at these locations.

2.19.4 Summary of Risk Assessments

As all media samples collected and analyzed for realistic receptors (industrial research workers and construction excavation workers) at Site 177 did not document any constituent concentrations above conservative risk-based screening limits, no COPCs were selected, and no risks or hazards were quantified for the realistic receptors (industrial research workers and construction excavation workers).

The estimated risks from the future hypothetical exposure scenarios are within USEPA's target cancer risk range of 1E-4 to 1E-6 for the adult and child residents (**Table 2-16**). The estimated total hazards for the adult and child residents are below USEPA's target noncancer hazard threshold of 1 (**Table 2-16**). Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

Table 2-16
Summary of Site 177 Estimated Risks and Hazards

Receptor (Current and Future)	Estimated Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Adult Resident	8.7E-6	Benzo(a)pyrene	Mixed Surface and Subsurface Soil
Child Resident	6.3E-6	Benzo(a)pyrene	Mixed Surface and Subsurface Soil
Adult + Child Resident	1.5E-5	Benzo(a)pyrene	Mixed Surface and Subsurface Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard (RME unless noted)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Media Contributing Most to Noncancer Hazard**
Adult Resident	0.078	NR - Hazards acceptable	NR - Hazards acceptable
Child Resident	0.72	NR - Hazards acceptable	NR - Hazards acceptable

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil were compared to ecological toxicity screening values. Zinc was the only compound identified with an HQ above 1 (Zinc HQ = 18.5). However, due to the relatively low level of contamination with respect to background levels and the lack of significant exposure to wildlife due to contamination being in the subsurface, no additional ecological investigation is warranted for the site.

2.20 SITE 7, MUNITIONS PROPELLANT TEST AREA

The former range referred to as Building 1242 is located west of Lake Denmark in the northwest mountainous region of the Installation (**Figure 2-28**). The site is located on Green Pond Mountain and Copperas Mountain near the end of Gorge Road in an unused former testing area (Area N).

2.20.1 Site History

Site 7 covers about 37 acres, was constructed in 1964, and consists of two firing lines for the testing of recoilless rifles. There was a 900 yard firing line and a 500 meter firing line. The two lines shared a single firing point but had two separate impact areas. The impact area of the 900 yard range was a slug butt constructed of I-beams, a large corrugated pipe and sand. During site reconnaissance for the PA/SI, ICF KE and Picatinny personnel were unable to locate the 500 meter impact area. The firing point had a berm for the safety of the operators and a gun turret which functioned as a safe-house. The site served as an ammunition test range from the mid 1960s to the early 1970s. Currently, the site is overgrown with vegetation.

2.20.2 Previous Studies

The only previous study conducted at the Building 1242 test area is a PA/SI conducted for Phase III sites by ICF KE in 1996. This investigation is summarized in the Nature and Extent of Contamination section below.

2.20.3 Nature and Extent of Contamination

AOCs identified and investigated during the PA/SI included the potential for contamination resulting from operations at the firing point, the potential for leaks of fuel from the site's generator, and the potential for contamination resulting from the impact of ammunition at the slug butt at the end of the 900 yard range and the impact area of the 500 meter range.

2.20.3.1 Surface Soil

Five surface soil samples were collected at Site 7 as part of the SI in 1996. Surface soil sample 1242SS-A was collected from the firing point. Surface soil sample 1242SS-B was collected from the former location of the generator. Surface soil sample 1242SS-C was collected from the sand directly in front of the slug butt. Surface soil sample 1242SS-D was collected from the steel box in front of the slug butt. Surface soil sample 1242SS-E was proposed to be collected from the 500 meter impact area. Because this impact area could not be located on two separate occasions, the sampling point was re-located to directly in front of the door to the naval gun turret near the range area firing point. **Figure 2-28** shows the location of these sampling points. The samples were analyzed for VOCs, SVOCs, explosives, pesticides, PCBs, metals and anions. The analytical data is presented on Table 7-1 in **Appendix A**. With the exception of arsenic, all detected concentrations were below the LOCs. Arsenic was detected at concentrations ranging from 0.9 mg/kg to 3.7 mg/kg, exceeding the IRSL (1.6 mg/kg) in three samples. However, all arsenic results were below the NJDEP NRSRS (19 mg/kg), based on natural background and the Picatinny background level in surface soil (9.23 mg/kg).

2.20.4 Summary of Risk Assessments

The data from the Site 7 SI was utilized in the Army's Relative Risk System to characterize the site for future funding. Since no soil concentrations exceeded either the residential or industrial cleanup criteria, the recommendation for the site was no further action and no additional HHRA was warranted.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil were compared to ecological toxicity screening values. Based on the results of the SLERA, a potential risk may exist to wildlife given sufficient exposures. However, due to the relatively low level of contamination with respect to background levels and the limited area of contamination, no additional ecological investigation is warranted for the site.

2.21 SITE 10, CHEMICAL BURIAL PIT

2.21.1 Site History

The chemical burial pit is located adjacent to the Berkshire perimeter gate near the Installation boundary on the north side of the installation (**Figure 2-29**). Picatinny personnel indicated that containers of unknown chemicals were placed in the 25' x 25' x 5' pit. The containers were then covered with fill material, and concrete slab, either prefabricated or poured on-site, was placed over the fill. Other reports state that the pit was covered with rocks. Signs are present in the area, prohibiting excavation. Picatinny personnel stated that a mustard gas warning sign had been in place at the site. Exact dates of use of the chemical burial pit are not known, however, Picatinny personnel indicated that no material has been buried in the area for the past 30 years. Currently, the site is inactive. Another prominent site feature is an aboveground water line, coming from the southeast. This aboveground line was installed for fire safety and is empty until needed. Documentation regarding the chemical burial pit is limited, however, both cyanide and fluoroacetates have been repeatedly mentioned as chemicals buried in the pit.

2.21.2 Previous Studies

Four previous studies have investigated the Site 10 Area. A groundwater-monitoring program was initiated in 1981 to assess the groundwater at areas of potential contamination. A Site Assessment was performed at Site 10 in 1989 by Dames & Moore. An aerial photographic interpretation was also conducted for this site. A PA/SI was performed by ICF KE in 1996. Each of these investigations is discussed below.

2.21.2.1 Groundwater Monitoring Program

One groundwater monitoring well (W-2) was installed in 1981 down-gradient of the site to the southeast as part of a groundwater monitoring program for areas of potential contamination. W-2 has been sampled on five occasions between 1981 and 1998. General analytical parameters consisted of VOCs, metals, total organic carbon (TOC), and total dissolved solids.

Analytical results from the first sampling event (1981) reported the following constituents:

Constituent	Concentration	LOC
Benzene	1 µg/L	1 µg/L
Chloroform	1 µg/L	70 µg/L
Ethylbenzene	12 µg/L	700 µg/L
Toluene	17 µg/L	600 µg/L
Chromium	136 µg/L	70 µg/L
Lead	86 µg/L	5 µg/L
Nickel	91 µg/L	100 µg/L
Arsenic	33 µg/L	3 µg/L

In addition, dimethyl, trimethyl, and tetramethyl benzene isomers (20-175 µg/L) were detected during the 1981 sampling event. The following compounds were detected at elevated concentrations during the 1987 sampling event:

Constituent	Concentration	LOC
Trichloroethene (TCE)	291 µg/L	1 µg/L
trans-1,2-Dichloroethene (1,2-DCE)	3.7 µg/L	100 µg/L
1,1,1-Trichloroethane (1,1,1-TCA)	2.4 µg/L	30 µg/L

A 1988 NJDEP memo stated that 100 parts per billion (ppb) cyanide and 160 ppb various volatile organics had been detected in W-2. No other report mentioned the detection of cyanide in the well.

2.21.2.2 Site Investigation, Dames and Moore, 1989

From 1987 to 1989, Dames and Moore conducted a site investigation of the chemical burial pit to determine any impact to groundwater. Two additional monitoring wells (DM10-1 and DM10-2) were installed down-gradient of the site to the northeast. Samples were collected from all three wells (including W-2, relabeled as MW-2) in 1988 and analyzed for monofluoroacetate, cyanide, total phenols, VOCs, BNAs, and metals. Cyanide, phenols, and monofluoroacetate were not detected in any of the groundwater samples. Several Tentatively Identified Compounds were detected, but Dames and Moore attributed this to several BNAs detected in the method blank. Additionally, a review of the 1988 groundwater results (Table 2-19 in **Appendix A**) shows that methylene chloride was detected at or above the Federal Drinking Water Maximum Contaminant Level (MCL) of 5 µg/L in all three samples, ranging from 5 µg/L to 9 µg/L (the LOC for methylene chloride is 3 µg/L based on the NJDEP Groundwater Quality Standards). Methylene chloride is a common laboratory artifact. Dames and Moore provided three hypotheses for the lack of contamination in the groundwater at the site. The first is that the reported hazardous waste disposal never actually occurred. The second is that liquid wastes disposed of at the site were either very dilute or in very small quantities. The third is that the contaminants were greatly diluted and/or rapidly migrated in the fractured bedrock water table aquifer in the area with possible discharge into seeps around the ridge. A fourth possibility is that the containers may still be intact.

2.21.2.3 Aerial Photographic Interpretation

Aerial photographs taken in 1951 show the chemical burial pit area as forested, although the turnaround area associated with the pit is visible. The aboveground waterline may be present, however, it is not visible and the path of the line is not clear and no source is evident. Small cleared areas are present on the north and east sides of the turnaround area. The 1974 aerial photographs do not show any indications of the actual pit; however, the access road does appear to proceed further south. This road ends in a rounded area which may be the pit, however, site topography does not allow for easy personnel or vehicle access to that area. The potential water line proceeds below 20th Ave., but does not extend further.

2.21.2.4 PA/SI, ICF KE, 1996

During the 1996 site inspection, a dry water line, typically used for fire safety, was noted as terminating in the area of the chemical burial pit. The presence of the line in this area is unusual, given the lack of any other site, such as a test area, along this section of the Berkshire Trail. Bedrock outcrops were prevalent in the area. A level area was located immediately beyond the turnaround area for the chemical burial pit. Given the Picatinny personnel's description of the site, this level area may be indicative of the concrete slab used to cover the buried material. Further north of this level area is a mounded area surrounded by depressions, which may also be indicative of burial activities.

2.21.3 Nature and Extent of Contamination

Sampling activities associated with the Phase III-1A RI at Site 10 were conducted between November 1998 and July 1999. The Phase III-1A RI sampling program for Site 10 included:

1. Conducting a geophysical survey using electromagnetic and magnetometer methods in order to determine the extent of the burial pit boundaries;
2. Conducting a fracture trace analysis to determine preferential migration pathways for groundwater;
3. Analyzing 20 Gore-Sorber passive soil gas samples (10SG-1 to 10SG-20) in the vicinity of the chemical burial pit for TCL VOCs;
4. Collecting six surface soil samples (10TP-1A to 10TP-5A) and one subsurface soil sample (10TP-5B) from five test pit areas; and,
5. Collecting three groundwater samples (DM10-1, DM10-2, MW-2) from the Site 10 monitoring wells.

2.21.3.1 Geophysical Survey

A geophysical survey was conducted using electromagnetic (EM) and magnetometer methods in order to assess the extent of the burial pit. A grid was established across the suspected burial area as illustrated on Figure 2-2 (**Appendix A**). Magnetometer and EM readings were taken with 5 foot line spacing throughout the grid area. Although the boundaries of the chemical boundary pit were not detected, several smaller anomalies were identified throughout the survey area. These anomalies were interpreted to be metallic objects located approximately 3-5 ft bgs. The yellow/red areas on Figure 2-2 depict the locations of the anomalies.

Based on the results of the geophysical survey, which suggests the presence of numerous small disposal areas rather than one larger burial pit, and the close proximity to the suspected burial area, six shallow test pits were excavated to investigate the anomalies. The test pit locations are shown on **Figure 2-29**.

Undisturbed, natural soil material was encountered in test pits 10TP-2, 10TP-3, 10TP-4, 10TP-5, and 10TP-6. Depths of excavation in the aforementioned test pits ranged from 3 ft to 6 ft bgs with depth of excavation limited in these test pits due to backhoe refusal encountered at the top of bedrock. The undisturbed nature of soil material present within these test pits throughout the soil column to bedrock suggests no previous soil disturbances have occurred in these areas. Magnetometer screening during excavation operations by the onsite UXO technicians indicated the rock material in the area of the 5 test pits has a high iron concentration and gives a strong reading with the hand-held magnetometer. Therefore, it is likely the anomalies detected during the geophysical surveys can be attributed to the high density of coarse bedrock fragments present in the subsurface soil horizons within the test pit excavation areas and the shallow depth to the Green Pond Conglomerate bedrock.

The anomaly investigated by the excavation of test pit 10TP-1 is attributed to the presence of a 1-gallon paint can discovered in this location at a depth of 0.5-ft bgs. The excavation of 10TP-1 was initiated adjacent to a previously excavated area. Test pit 10TP-1 was expanded to include the previously excavated area (despite no indication from the geophysical survey that this area had been substantially disturbed) when natural, undisturbed material was identified to depth in the original test pit location. The paint can was discovered on the boundary of the previous excavation, photographed, returned to its original location and marked with a field stake. Two soil samples were collected in 10TP-1, one collected at a depth of 0-1 ft and the second collected directly below the location of the discovered paint can.

2.21.3.2 Soil-Gas Survey

A Gore-Sorber passive soil gas survey was conducted in order to investigate the presence of VOC contaminants in the vicinity of Site 10. The Gore-Sorber modules were installed in three rows, one row traversing the suspected location of the pit. The remaining two rows were biased to the most likely migration pathway, the location and orientation of the bedding planes outcrops, as suggested during the fracture trace analyses. The soil gas sample locations are indicated on **Figure 2-29**.

A total of 31 VOCs and SVOCs were included in the analytical program for all soil gas modules associated with Site 10. Nineteen of the analytical sequences included in the analytical program were either not detected or present at concentrations below the detection limit. Six analytical sequences (octane, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, combined masses of 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene, m-p-xylene, and ethylbenzene) were detected in a limited number (2 modules or less) of modules at concentrations less than 0.1 µg per module. The remaining six analytical sequences (chloroform, undecane, diesel range alkanes, toluene, benzene, and gasoline range aromatics) were all detected at concentrations greater than 0.1 µg per module but less than 1.0 µg per module. The total amount of the compounds detected in soil gas is very low relative to concentrations detected at other sites at Picatinny and can practically be considered negligible when evaluated in conjunction with the lack of groundwater contamination addressed in the following section.

2.21.3.3 Groundwater

Three groundwater samples were collected at Site 10 during RI field activities. Groundwater samples were collected from existing monitoring wells DM10-1, DM10-2 and W-2 and analyzed for VOCs, SVOCs, metals, anions, cyanide, explosives, PCBs, and TPH. Thiodiglycol, a common breakdown product of mustard gas, was also analyzed in groundwater collected from monitoring well DM10-2 based upon the reported possibility that mustard gas was previously disposed at the site. DM10-1 and DM10-2 are bedrock aquifer wells screened within the Green Pond Conglomerate unit. The third well (W-2) is an open hole from ground surface to a depth of 46 ft bgs.

Analytical results from the groundwater samples are presented in Table 2-4 in **Appendix A**. VOCs, SVOCs, cyanide, explosives, PCBs, TPH, and thiodiglycol were not detected in groundwater. Four anions (chloride, fluoride, phosphorus, and sulfate) were detected in one or more groundwater samples, however no anions were detected at concentrations greater than LOCs.

Only two metals, aluminum (LOC = 200 µg/L) and manganese (LOC = 50 µg/L), were reported at levels above their respective LOCs. In addition, arsenic was detected at a concentration equal to its LOC (3 mg/kg) in monitoring well DM10-2. Aluminum exceeded its LOC in all three samples, with concentrations of 390 µg/L (DM10-1), 570 µg/L (DM10-2), and 450 µg/L (MW-2). Manganese exceedences were reported in DM10-1 (58 µg/L) and MW-2 (87 µg/L).

Aluminum and manganese are common elements, which are reported at elevated concentrations in groundwater samples throughout the Installation. These analytes are not expected to be site-related. The source of these compounds is believed to be weathering of the local geological materials, which are rich in these elements (Sims, 1958). The fact that these wells are located in the bedrock increases the likelihood of elevated levels of these compounds.

2.21.3.4 Surface Soil

Five surface soil samples (10TP-1A to 10TP-5A) were collected at Site 10 during excavation of the test pit areas in order to evaluate the presence or absence of COPCs in the burial pit. Samples were analyzed for VOCs, SVOCs, metals, anions, cyanide, explosives, PCBs, and TPH. Analytical results are provided on Table 2-5 (**Appendix A**).

With the exception of arsenic; inorganics and anions were detected at levels below their respective LOCs. Arsenic was detected above its IRSL (1.6 mg/kg), but below the Picatinny background level in surface soil (9.23 mg/kg) and the NJDEP NRSRS (19 mg/kg). TPH were detected in all six of the surface soil samples. Concentrations ranged up to 39 mg/kg in sample 10TP-5A. There is no LOC for this analyte group. No other contaminants were detected in surface soil at Site 10.

2.21.3.5 Subsurface Soil

One subsurface soil sample, 10TP-5B, was collected at a depth of 3-4 ft at Test Pit 5 to evaluate the presence of chemicals in the burial pit. 10TP-5B was analyzed for VOCs, SVOCs, metals, anions, cyanide, explosives, PCBs, and TPH. TPH (concentration = 3.93 mg/kg), inorganics and anions, however, were the only constituents included in the analytical program that were detected. Only arsenic was detected above respective LOCs. The detected arsenic concentration (6.71 mg/kg) exceeded its IRSL (1.6 mg/kg), but not the Pictinny background level in subsurface soil (8.57 mg/kg) or its NJDEP NRSRS (19 mg/kg).

2.21.4 Summary of Risk Assessments

Table 2-17 indicates that the estimated risks and hazards for the realistic exposure scenarios are within or below USEPA's target cancer risk range of 1E-4 to 1E-6 and USEPA's target non-cancer hazard threshold of 1 (rounded to one significant figure).

Table 2-17
Summary of Site 10 Estimated Risks and Hazards

Receptor (Current and Future)	Estimated Total Cancer Risk	Risk Driver(s) (contributing to the majority of total risk)	Media Contributing Most to Risk
Industrial Research Worker (current)	1.0E-5	Arsenic	Surface Soil
Construction Excavation Worker	5.6E-7	NR - risks acceptable	NR - risks acceptable
Adult Resident	6.4E-5	Arsenic	Groundwater
Child Resident	4.3E-5	Arsenic	Mixed Surface & Subsurface Soil, Groundwater
Adult + Child Resident	1.1E-4	Arsenic	Mixed Surface & Subsurface Soil, Groundwater
Industrial Research Worker (future)	1.6E-5	Arsenic	Surface Soil
Receptor (Current and Future)	**Estimated Total Noncancer Hazard**	**Hazard Driver(s) (contributing to the majority of total hazard)**	**Media Contributing Most to Hazard**
Industrial Research Worker (current)	0.063	NR - hazards acceptable	NR - hazards acceptable
Construction Excavation Worker	0.089	NR - hazards acceptable	NR - hazards acceptable
Adult Resident	0.48	NR - hazards acceptable	NR - hazards acceptable
Child Resident	1.3	Arsenic	Groundwater
Industrial Research Worker (future)	0.12	NR - hazards acceptable	NR - hazards acceptable

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

The estimated risks and hazards for the hypothetical residential exposure scenarios are within USEPA's target cancer risk range of 1E-4 to 1E-6 and equal to or below USEPA's target noncancer hazard threshold of 1 (rounded to one significant figure). The majority of the total risk and hazard was attributable to arsenic which did not exceed Picatinny background levels in soil or the New Jersey NRSRS (based on natural background). In addition, the maximum arsenic concentration detected in groundwater was equal to its LOC. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil were compared to ecological toxicity screening values. Based on the results of the SLERA, there exists little potential for wildlife exposure to contaminants. Several inorganics were found above their screening values; however, all were within background levels for Picatinny. Thus, no additional ecological investigation is warranted for the site.

2.22 SITE 164, BUILDING 1217, GENERAL PURPOSE MAGAZINE

Building 1217 is located off the eastern side of Twenty-Fourth Avenue approximately 600 ft west of Lake Denmark in Area O (**Figure 2-30**). Area O is a large area in the northern section of Picatinny. The land within Area O is predominantly Lake Denmark.

2.22.1 Site History

Constructed in 1944, Building 1217 (**Figure 2-30**) was originally used as a storage magazine. It also functioned as a propellant processing facility in the mid-1980s, packaging surveillance propellant samples for testing at a separate facility.

Picatinny personnel indicated that the surveillance operation required opening a master container, removing a small aliquot of propellant, and then carrying the aliquot to one of the satellite buildings. Operations at Building 1217 originally consisted of taking the propellant sample from the building, loading it onto a railroad buggy, and transporting it to Building 1217-B to be packed into sample containers and later tested at a separate facility. In the mid-1980s, concerns raised by the safety office discontinued the practice of transporting the propellant to Building 1217-B. The propellant samples were subsequently packed in Building 1217

In 1990, Building 1217 was being used as a propellant storage facility. A 1992 General Safety Program Evaluation indicated no hazardous waste was generated at this building. All the propellant had been removed from the building by March 1996 and the building is currently empty.

Buildings 1217-A and 1217-B, originally packed surveillance propellant samples for testing. The buildings were located approximately 100 and 200 ft respectively from Building 1217. In 1964, the two buildings were combined into one building and moved 750 ft west of Building 1217. The combined building was not located during the 1996 site inspection.

2.22.2 Previous Studies

Two previous studies have been conducted at Site 164. A water discharge investigation was performed in 1990, and a PA/SI was performed in 1996 by ICF KE. The water discharge investigation is discussed below, and the PA/SI results are discussed in the Nature and Extent section (**Section 2.22.3**).

2.22.2.1 ARDEC Water Discharge Investigation, 1990

A water discharge investigation, conducted in 1990, did not identify significant environmental concerns regarding water discharge activities or other activities conducted at Building 1217 at the time of inspection. The only discharge noted from the building was roof drainage to the ground. It was noted that the building did not have any utility connections with the exception of electricity.

2.22.3 Nature and Extent of Contamination

The primary AOC at Site 164 identified during the PA/SI (ICF KE, 1998) is the area outside of Building 1217 and the associated satellite buildings where past material handling practices may have caused potential contamination. The ANL RI Concept Plan (ANL, 1991) reported propellant material was opened outside Building 1217.

2.22.3.1 Surface Soil

Three surface soil samples were collected at Site 164 as part of the PA/SI (**Figure 2-30**). Sample 1217SS-A was collected on the northern side of the building adjacent to the building's doorways to investigate potential contamination from past spills. Sample 1217SS-C was collected adjacent to the former location of Building 1217-B. Sample 1217SS-B was collected on the western side of Building 1217, downgradient of the building. Samples were analyzed for VOCs, SVOCs, explosives, pesticides, PCBs, metals, and anions.

Only arsenic was detected above residential or non-residential/industrial LOCs at concentrations ranging from 3.3 mg/kg to 8.50 mg/kg, exceeding the IRSL (1.6 mg/kg), but below the NJDEP NRSRS (19 mg/kg) based on natural background and the Picatinny surface soil background level (9.23 mg/kg). Analytical results are provided on Table 6-1 in **Appendix A**. Based on these results, the PA/SI recommended no further action for the site.

2.22.4 Summary of Risk Assessments

No HHRA has been conducted for Site 164. Since arsenic was detected below background concentrations and all remaining chemical concentrations in the three soil samples collected from locations with the most potential for contamination contained no exceedences of the most stringent LOCs (i.e., residential criteria), the associated risks are likely within or below USEPA's target risk range of 1E-4 to 1E-6, and the hazards are likely below the target level of 1.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil were compared to ecological toxicity screening values. Several inorganics were found above their screening values, but few of these were above the background levels for Picatinny. Thallium (1.3) and zinc (19.2) had HQs above the target level of 1. Based on the results of the SLERA, a potential risk may exist to wildlife given sufficient exposures, but the degree of contamination at the site is quite limited. Thus, no additional ecological investigation is warranted for the site.

2.23 SITE 27, FORMER BUILDING T-90, SALT STORAGE AREA

Site 27 is located adjacent to Shinkle Road in Area P of Picatinny and is bounded on the west and east by 4th Avenue and GPB, respectively (**Figure 2-31**).

2.23.1 Site History

Former Building T-90, previously used to store road salt and cinders, was located near the intersection of Shinkle Road and 4th Avenue. The building had no utility connections. The building, formerly a Quonset hut constructed of corrugated steel with an asphalt floor area of approximately 3,000 square feet, was demolished in 1983. A Dames & Moore site inspection in the early 1980s, reported that the walls of the structure had been badly corroded in numerous places providing an opportunity for the entrance of precipitation and therefore the leaching of the stored contents. Dames & Moore also noted visible salt encrustation in the soil surrounding the site. Activities that occurred at this site would have included the loading and mixing of road salt using heavy equipment. All road salt and cinders were removed in the late summer of 1983 and moved to a new salt storage dome. This site is currently inactive.

2.23.2 Previous Investigations

2.23.2.1 Dames and Moore Site Investigation, 1988

Dames and Moore conducted a site investigation (SI) in 1988. During their site investigation, they noted salt crystals on the soil surrounding Building T-90. Three soil samples were collected and analyzed for chloride. The chloride concentrations in the soil samples ranged from 25 to 377 mg/kg. One sediment sample was also collected from GPB and analyzed for chloride. GPB is located approximately 400 ft southeast of Site 27. The chloride concentration detected in the sediment sample was 263 mg/kg. All analytical results were rejected during data validation due to missed holding times or laboratory quality assurance/quality control errors.

Additionally, as a part of their site investigation, one groundwater monitoring well was installed (DM27-1) and sampled for chloride. No analytical results are available for this well because of missed holding times and laboratory quality control problems; but during development, water from the well appeared frothy and a conductivity reading of 33,000 µmhos was recorded. This high conductivity may be indicative of high chloride concentrations.

2.23.2.2 ICF KE PA/SI, 1996

ICF KE conducted a PA/SI in 1996. As part of this investigation, surface soil samples were collected in the vicinity of the former Quonset hut (Building T-90). Three surface soil samples were collected downgradient of the former building. An additional sample was collected across Fourth Avenue;

adjacent to the asphalt paved area. The four samples were analyzed for VOCs, SVOCs, explosives, pesticides/PCBs, TAL metals, and anions. Sample locations are displayed in black on **Figure 2-31** and analytical results are presented on Table 2-1 in **Appendix A**. Chloride was detected in all four samples at concentrations ranging from 17.5 mg/kg to 64.5 mg/kg. Beryllium was also detected in surface soil sample T90SS-B at a concentration of 270 mg/kg.

2.23.3 Nature and Extent of Contamination

Phase III-1A sampling activities at Site 27 were conducted between November 1998 and July 1999 and included:

1. Collection of one groundwater sample from the existing well DM27-1; and,
2. Collection of nine surface soil samples (27GR-1A to 27GR-9A) in the vicinity of previous surface soil sample T90SS-B and former building T90.

2.23.3.1 Surface Soil

Subsequent to the 1996 PA/SI sampling activities, the entire area in the vicinity of previous sample T90SS-B has been paved with asphalt. Nine surface soil samples (27GR-1 to 27GR-9) were collected in the vicinity of T90SS-B, of which three were collected from under the asphalt and six from the perimeter of the asphalt area. Beryllium was detected in all nine samples at concentrations ranging from 0.191 mg/kg in 27GR-1A to 0.993 mg/kg in 27GR-4A. No soil sample collected at Site 27 as part of the Phase III-1A RI contained beryllium at a concentration greater than the NRSRS (140 mg/kg) or IRSL (2,000 mg/kg).

The collection of nine subsurface soil samples was proposed as part of the work plan for analysis of beryllium in locations where beryllium was detected at concentrations greater than the LOC. As no surface soil samples exceeded the beryllium LOC, no subsurface soil samples were required. Results indicated that the beryllium contamination is limited to a small, isolated area in the vicinity of previous soil sample T90SS-B, currently covered by asphalt.

2.23.4 Summary of Risk Assessments

The estimated risks and hazards for the realistic and hypothetical exposure scenarios could not be calculated for the one COPC (sodium), as a cancer slope factor or noncancer reference dose does not exist. Beryllium, the only compound analyzed for in the Phase II-1A soil samples, did not exceed the screening criterion and therefore was not selected as a COPC. Sodium was selected as a COPC in groundwater for the site because the concentration measured in the one groundwater sample (13,300 milligrams per liter [mg/L]) was above the nutrient recommended daily allowance of 20 mg/L for individuals on a very restricted sodium diet.

It is likely that Site 27 groundwater would not be consumed, if it were available, due to its being unpalatable. Dermal contact with sodium in groundwater by a construction excavation worker, future residents, or industrial research worker is not expected to pose unacceptable health risks.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil were compared to ecological toxicity screening values. The maximum beryllium concentration detected in the soil during the Phase III RI (0.993 mg/kg) was well below the screening value of 38 mg/kg. Thus, no additional ecological investigation is warranted for the site.

2.24 SITE 119, BUILDINGS 46, 47, AND 48, STORAGE MAGAZINES

Site 119 consists of Buildings 46, 47, and 48. These buildings are nearly identical in structure and were all originally used to store propellant. These buildings are located along First Avenue in Area P near the western boundary of the Installation (**Figure 2-32**).

2.24.1 Site History

Constructed in 1940, Buildings 46, 47 and 48 were originally designed as magazines to store smokeless powder. The buildings also stored other types of propellant and explosives such as ammonium nitrate and DNT. In 1978, the explosive allowances for the buildings were cancelled as part of a Picatinny action to remove all explosive materials from the lower portion of the Installation. In early

1978, an inspection by the Safety Office determined explosives were no longer stored in the buildings. Presently, the buildings are used as a general warehouse to store general supplies and office furniture.

2.24.2 Previous Studies

A water discharge investigation, conducted in 1990, did not identify significant environmental concerns regarding water discharge activities or other activities conducted at the three buildings. The only discharge noted was roof drainage to the ground (ARDEC, 1990).

2.24.3 Nature and Extent of Contamination

Three samples were collected at Site 119 and analyzed off-site as part of the Phase III PA/SI in 1996. Analytical results of the sampling are provided on Table 4.1-2 in **Appendix A**. Only compounds detected above the reporting limit in at least one sample are presented in this table.

2.24.3.1 Surface Soil

One surface soil sample was collected in front (eastern side) of each building immediately adjacent to the loading dock (**Figure 2-32**). The samples were analyzed for VOCs, SVOCs, explosives, pesticides, PCBs, metals and anions. Explosives, PAHs, and inorganic compounds were detected in the surface soil samples. Concentrations of benzo(a)pyrene detected in samples 46SS-A and 47SS-A (1.1 and 1.8 mg/kg, respectively) exceeded the IRSL (0.21 mg/kg) and the NJDEP NRSRS (0.2 mg/kg). In addition, benz(a)anthracene and benzo(b)fluoranthene were detected above the IRSL and NRSRS (2.1 mg/kg and 2 mg/kg, respectively for both compounds) in sample 47SS-A. Arsenic was detected in sample 46SS-A at a concentration of 2.5 mg/kg, above the IRSL (1.6 mg/kg) but below the NJDEP NRSRS (19 mg/kg), based on natural background, and the Picatinny surface soil background level (9.23 mg/kg). All remaining detected concentrations were below LOCs. It should be noted that the samples were collected in the vicinity of the former rail line. PAHs are often associated with railroad activities, and it is likely that the railroad infrastructure at the site is the source of the detected PAHs rather than historic activities associated with Buildings 46, 47 and 48.

2.24.4 Summary of Risk Assessments

No HHRA has been conducted for Site 119. The analytical data from the PA/SI have not been validated and as such are unsuitable for risk characterization. Based on the benzo(a)pyrene exceedences reported in the surface soil samples, there is a potential risk from soil exposure at the site. However, the locations in which the low-level contamination was identified are unlikely to be disturbed and human contact with the contaminated soil is precluded by an existing vegetated cover surrounded by pavement.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil at Site 119 were compared to ecological toxicity screening values. The SLERA indicates a potential risk to wildlife may be present from PAHs as well as some metals. Since the site is located within an area of inactive railroad beds, it does not offer significant habitat for wildlife exposures.

The largest risks are presented by selenium and zinc. The HQ for selenium is based on exposures to the white-footed mouse, a small mammal with limited foraging range. Thus, localized impacts could occur to small mammals if the habitat was sufficient to provide for significant exposures. The HQ for zinc is based on exposures to the woodcock, a bird that feeds almost entirely on soil invertebrates such as worms and also ingests a significant amount of soil along with its prey. The woodcock is also mostly associated with wetland areas and would not be expected at this site. Screening values for other wildlife species are much higher (i.e., 1,600 mg/kg to 35,000 mg/kg). Though a potential risk should be acknowledged, based on the limited amount of contamination and the relatively low concentrations (selenium and zinc did not exceed LOCs), the SLERA concluded that additional ERA investigations are not warranted for Site 119.

2.25 SITE 120, BUILDING 50, STORAGE MAGAZINE

2.25.1 Site History

Building 50 was previously used to store smokeless powder and propellant, and to pack propellant surveillance samples. The building had 100,000-pound and 25,000-pound explosive allowances in 1956 and 1959, respectively for Class 2 and 2A explosives. A 1977 memorandum stated that the explosive allowance for Building 50 was exceeded (Class 7 explosives were being stored in the building) and that the propellant was to be removed. The explosive allowance for the majority of the buildings in this area of the Installation (Buildings 46-49 & 51-57) were cancelled in 1978, due to the implementation of Phase I ARRADCOM plan which proposed the movement of all explosive material from the lower portion of the Installation. In early 1978, the Safety Office inspected buildings 46-49 & 51-57, and at that time all of the inspected buildings contained no explosives. It is not known whether the omission of Building 50 was an oversight, the allowance had already been cancelled, or whether explosives were still in storage at Building 50. Currently, Building 50 is used as a general warehouse for general supplies and office furniture.

2.25.2 Previous Studies

A water discharge investigation conducted in 1990 did not identify significant environmental concerns regarding water discharge activities or other activities conducted at Building 50 at the time of the inspection. The only discharge noted from the building was roof drainage to the ground. Monitoring well "G" was installed in January 1982 approximately 20-25 ft north (upgradient) of Building 50. This well was installed to monitor groundwater from several known sources of contamination. It was not installed to monitor a release at Building 50. Since installation, no COCs have been detected from this well. In addition, Building 50 was mentioned in the 1989 Site Investigation in reference to Site 25, Sanitary Landfill. The report indicated that the shallow groundwater in the Building 50 area did not appear to be impacted by leached metals from the landfill.

Potential asbestos contamination in the form of dust on the floor of Building 50 was identified in a 1989 unsigned handwritten letter to USEPA. Investigation of the building was proposed at this time, however, it is unknown if this investigation was ever implemented. Asbestos samples were obtained from Building 50 in 1989, as indicated by a bulk sample data sheet. However, the results of the sampling are not listed, and no further documentation regarding asbestos sampling is available.

2.25.3 Nature and Extent of Contamination

As part of the PA/SI performed in 1996, surface soil sample 50SS-A, was collected on the eastern side of Building 50 between the loading dock and former railroad line (**Figure 2-33**). The sample was analyzed for VOCs, SVOCs, explosives, pesticides, PCBs, metals and anions. Analytical results of the sampling are presented on Table 4.2-2 in **Appendix A**. Only detected compounds are presented.

2.25.3.1 Surface Soil

PAHs and inorganic compounds were detected in the one surface soil sample. Detected concentrations of benz(a)anthracene (3.9 mg/kg), benzo(a)pyrene (3.7 mg/kg), benzo(b)fluoranthene (4.2 mg/kg), and arsenic (1.7 mg/kg) exceeded LOCs. Arsenic was detected above the IRSL (1.6 mg/kg), but below the NJDEP NRSRS (19 mg/kg), based on natural background, and the Picatinny surface soil background level (9.23 mg/kg). All remaining detected concentrations are below current LOCs (note: calcium, magnesium, potassium, and sodium do not have NRSRS or IRSL values). PAHs are often associated with railroad activities, and it is likely that the railroad infrastructure at the site is the source of the detected PAHs rather than historic activities associated with Building 50.

2.25.4 Summary of Risk Assessments

No HHRA has been conducted for Site 120. The analytical data from the PA/SI have not been validated and as such are unsuitable for risk characterization. Based on the PAH exceedences reported in the surface soil sample, there is a potential risk from soil exposure at the site. However, human contact with soil is unlikely at this site under the current industrial use and the source of the elevated chemical concentrations is likely the railroad infrastructure, which extends beyond the site boundaries.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil at Site 120 were compared to ecological toxicity screening values. The SLERA indicates a potential risk to wildlife may be present from PAHs as well as some metals. Since the site is located within an area of inactive railroad beds, it does not offer significant habitat for wildlife exposures. Additionally, Site 120 is of relatively small size (about 0.9 acres).

The largest risks are presented by selenium and zinc. The HQ for selenium is based on exposures to the white-footed mouse, a small mammal with limited foraging range. Thus, localized impacts could occur to small mammals if the habitat was sufficient to provide for significant exposures. The HQ for zinc is based on exposures to the woodcock, a bird that feeds almost entirely on soil invertebrates such as worms and also ingests a significant amount of soil along with its prey. The woodcock is also mostly associated with wetland areas and would not be expected at this site. Screening values for other wildlife species are much higher (i.e., 1,600 mg/kg to 35,000 mg/kg). Though a potential risk should be acknowledged, based on the limited amount of contamination and the relatively low concentrations (selenium and zinc did not exceed LOCs), the SLERA concluded that additional ERA investigations are not warranted for Site 120.

2.26 SITE 121, BUILDING 57, STORAGE MAGAZINE

2.26.1 Site History

Building 57 was constructed in 1941 to store smokeless powder. In 1964, it was converted into a packing and shipping building. The building is currently used for packing and shipping of non-hazardous materials. A 1974 explosive allowance stated that the class and type of material being stored at Building 57 consisted of small quantities of Class 1-7 explosives for overnight storage. The explosive weight was not to exceed 100 pounds. The explosive allowance for Building 57 was cancelled in 1978, and a safety inspection determined that the building did not contain any explosives. Two-25 KVA transformers are located inside Building 57. These two transformers were sampled in December 1987; however, the results of the transformer sampling are unknown.

2.26.2 Previous Investigations

A 1990 water discharge investigation did not identify significant environmental concerns regarding water discharge activities or other activities conducted at Building 57 at the time of the inspection. The only discharge noted from the building was roof drainage to the ground.

2.26.3 Nature and Extent of Contamination

As part of the PA/SI performed in 1996, two surface soil samples were collected from the Building 57 area. Surface soil sample 57SS-B was collected on the east side of Building 57 adjacent to the building's loading dock. Sample 57SS-A was collected on the west side of the building beneath the one-inch diameter PVC sink discharge pipe (**Figure 2-34**). The samples were analyzed for VOCs, SVOCs, explosives, pesticides, PCBs, metals and anions. Analytical results of the sampling are presented on Table 4.3-2 in **Appendix A**. Only detected compounds are presented. Compounds detected above their associated LOCs are indicated with bold face type and shading.

2.26.3.1 Surface Soil

PAHs and inorganic compounds were detected in sample 57SS-B and inorganic compounds were detected in sample 57SS-A. Detected concentrations of benz(a)anthracene (21 mg/kg), benzo(a)pyrene (18 mg/kg), benzo(b)fluoranthene (23 mg/kg), benzo(k)fluoranthene (23 mg/kg), and arsenic (3 mg/kg – 6.9 mg/kg) exceeded LOCs. Arsenic was detected above the IRSL (1.6 mg/kg), but below the NJDEP NRSRS (19 mg/kg), based on natural background, and the Picatinny surface soil background level (9.23 mg/kg). Remaining sample results were below current LOCs (note: calcium, magnesium, potassium, and sodium do not have NRSRS or IRSL values). PAHs are often associated with railroad activities, and it is likely that the railroad infrastructure at the site is the source of the detected PAHs rather than historic activities associated with Building 57.

2.26.4 Summary of Risk Assessments

No HHRA has been conducted for Site 121. The analytical data from the PA/SI have not been validated and as such are unsuitable for risk characterization. Based on the PAH exceedences reported in the surface soil samples, there is a potential risk from soil exposure at the site. However, human contact with soil is unlikely at this site under the current industrial use and the source of the elevated chemical concentrations is likely the railroad infrastructure, which extends beyond the site boundaries.

As part of the Phase III SLERA (Shaw, 2005), chemical concentrations in the soil at Site 121 were compared to ecological toxicity screening values. The SLERA indicates a potential risk to wildlife may be present from PAHs as well as some metals. Since the site is located within an area of inactive railroad beds, it does not offer significant habitat for wildlife exposures. Additionally, Site 121 is of relatively small size (about 0.9 acres).

The largest risks are presented by chromium and zinc. The HQ for chromium is based on hexavalent chromium toxicity. Generally, chromium in the environment is predominantly trivalent, which is much less toxic. The highest chromium concentration was not much greater than the background level. The HQ for zinc is based on exposures to the woodcock, a bird that feeds almost entirely on soil invertebrates such as worms and also ingests a significant amount of soil along with its prey. The woodcock is also mostly associated with wetland areas and would not be expected at this site. Screening values for other wildlife species are much higher (i.e., 1,600 mg/kg to 35,000 mg/kg). Though a potential risk should be acknowledged, based on the limited amount of contamination and the relatively low concentrations reported in the samples, the SLERA concluded that additional ERA investigations are not warranted for Site 121.

2.27 PICA SITE 208, FORMER DOG POUND

The former Dog Pound is located southeast of Building 70 at the intersection of two overgrown fire break/power line access roads in the swampy area just north of the Picatinny golf course (**Figure 2-35**). This site, which was discovered during an interview and follow-on site visit with a former Radiation Protection Officer (name unknown), is situated between Area E and Area P.

2.27.1 Site History

Facility 28A was a former building or fixture next to the site, but no evidence of this structure was found during the initial site survey. Used from 1953 to 1971, the former Dog Pound consisted of an asphalt pad surrounded by a chain link fence. It was used to temporarily store containers of: DU scrap from milling operations in Buildings 31 and 22, and radioactive waste from Building 91 and perhaps from other facilities. During the Phase III 2A/3A field activities, field personnel found no evidence of a chain link fence around the asphalt pad and the asphalt pad was severely cracked and overgrown with vegetation.

2.27.2 Previous Studies

2.27.2.1 USACHPPM RRSE, 1997

The Health Physics Team conducted a radiation survey of the asphalt pad and the access roads up to 100 ft from the pad. Radiation levels around and on the pad ranged from 6 to 10 μR/hr, which is below the off-post background radiation level (13 μR/hr) established by the team. Two anomalies were found on the northwest-southeast access road. The southeast anomaly peaked at 22 μR/hr and corresponded to a 2.5 foot by 5 foot elliptical pile of coal clinkers in the middle of the access road. The northwest anomaly peaked at 30 μR/hr and corresponded to a 3.5 foot by 9 foot elliptical pile of coal clinkers in the middle of the access road. Coal clinkers are a term used by USACHPPM in their investigation of the site. Coal clinkers are believed to be pieces of crushed coal used for fill in this marshy area. Surface soil samples were collected from each anomaly and analyzed for metals, gross alpha and gross beta radiation. The highest radiation level was 13.0 pCi/g from natural thorium in the coal clinkers. Further information on the radiation surveys can be found in USACHPPM's *Industrial Radiation Consultation Report* (USACHPPM, 1998c).

The Health Physics Team collected several grid-based soil samples for gross alpha and beta radiation determinations. A surface soil sample was collected from each anomaly and one background location 100 ft northeast of the site. Soil samples were analyzed for metals, gross alpha and beta radiation. Arsenic in PICA-DP-1 (identified as DP-1S on **Figure 2-35**) was identified as the only exceedence of regulatory criteria at a concentration of 57 mg/kg (USACHPPM, 1998b). Arsenic was also detected in samples DP-2S and DP-3S (17 mg/kg and 11 mg/kg, respectively), exceeding the IRSL (1.6 mg/kg) but below the NJDEP NRSRS (19 mg/kg) based on natural background. The Picatinny background level for arsenic in surface soil is 9.23 mg/kg. Soil analytical results are provided on Table 14 in **Appendix A**.

Groundwater samples were collected using the Geoprobe method at each soil sample location. Due to the swampy nature of the site, the water table was only 1.6 to 2.0 ft bgs and the water samples were highly turbid. The groundwater samples collected at the two anomalies contained concentrations of arsenic and lead in excess of regulatory criteria (USACHPPM, 1998b). The background sample did not contain any metal concentrations above the regulatory criteria (**Appendix A**).

2.27.2.2 New World Technology (NWT) Radiological Characterization Survey and Sampling, 2001

Following the Phase III 2A/3A field activities, NWT was contracted by the U.S. Army Operations Support Command, currently renamed the Joint Munitions Command, to perform a characterization survey and soil sampling of the Dog Pound subsequent to a request from the ARDEC Radiation Protection Office. The basis was USACHPPM's recommendation that a local regulator be contacted. That local regulator, the NJDEP, recommended that the extent and magnitude of the Th-232 contamination from the coal clinkers be determined.

The Dog Pound was divided into eight 10 meter by 10 meter grids. Each grid was 100% gamma scan surveyed using 2" by 2" NaI detectors coupled to data loggers. Ten surface soil samples were collected by NWT in 2001 at biased locations from each of the survey grids. The samples were submitted for analysis by gamma spectroscopy for thorium-232. Thorium-232 was the only analyte, because the highest levels of contamination identified during the USACHPPM radiation surveys were related to natural thorium in the coal clinkers used as fill for this area. The thorium levels ranged from 1.53 pCi/g to 8.7 pCi/g. These concentrations do not exceed the New Jersey's restricted use standard for thorium-232 with less than 2 ft of vertical extent (NJDEP, 2000). They do exceed the State standard for unrestricted use (2 pCi/g) and USEPA's lowest soil screening level (SSL) for thorium-232 (3.44 pCi/g) (USEPA, 2000). Due to the thorium-232 levels in excess of the State's restricted use standard, additional delineation sampling was conducted under CERCLA.

Relevant information from NWT's *Picatinny Radiological Remediation/Release Surveys and Sampling Project* (NWT, 2003) including a map of the grid layout, results of the gamma scan surveys, and soil sample locations and results are presented in **Appendix A** of this report.

2.27.2.3 Safety and Ecology Corporation (SEC) Radiological Characterization Survey and Sampling Plan, 2006

The NJDEP, in response to comments on the RI for the site, requested additional characterization to delineate the nature and extent of potential metals and thorium contamination. PTA's RPO also requested additional characterization of potential radiological contamination to support the unconditional radiological release of the site. The characterization survey and additional sampling were conducted in September 2006. The results of the characterization survey (CS) and additional sampling are summarized in the following section.

2.27.3 Nature and Extent of Contamination

Phase III 2A/3A RI sampling at PICA Site 208 consisted of collecting surface soil, surface water, sediment, and groundwater samples. The characterization survey involved a gamma survey and collection of soil, surface water and sediment samples.

Analytical results of the RI and CS are summarized below. Analytical data tables are presented in **Appendix A**. Only those analytes detected above the reporting limit in at least one sample are presented on the tables. **Figures 2-35** and **2-36** present the RI and CS sampling locations at PICA Site 208.

2.27.3.1 Radiological Survey

The characterization survey consisted of a gamma walkover survey that covered the entire accessible area along the fire break road between Fourth Avenue and Green Pond Brook. Gamma count rates (inclusive of ambient background) ranged from approximately 9,847 counts per minute (cpm) to 44,077 cpm. Background as measured in the field trailer was approximately 14,000 cpm. The average gamma count rate was 21,620 cpm. The maximum gamma count rates were recorded in the center of the access road, approximately 75 to 150 feet southeast of the asphalt pad. This particular area revealed significantly higher count rates than the other areas surveyed. **Figure 2-36** provides a color-graduated map of the count rates for the entire survey area. Other than the one area in the center of the road, the remaining portions of the survey area did not exhibit high gamma levels and the readings do not suggest the presence of elevated concentrations of radioactivity.

2.27.3.2 Groundwater

In order to confirm USACHPPM's groundwater results and monitor groundwater quality at the site, monitoring well DPMW-1 was installed within the former fenced area. The new monitoring well, which was screened from 1.5 to 11.5 ft bgs, was sampled along with two existing wells (70-1A and MW-12E), which are also screened in the shallow aquifer. The groundwater samples were analyzed for VOCs, SVOCs, explosives, metals, and radiological parameters. Analytical results for the groundwater samples are presented in Table 10-3 (**Appendix A**).

Acetone was the only VOC identified in the samples. It was reported at estimated concentrations well below the LOC. No SVOCs or explosives were detected in the samples. Most metals detected at the former Dog Pound site, including aluminum, iron and manganese, are commonly found at concentrations throughout Picatinny in excess of their LOCs. The source of these metals is the local geology; they are not site-related. Arsenic was detected above the LOC in one well located cross-gradient to the site. Arsenic was not detected in the upgradient well or the site well. Therefore, it is not believed to be a site contaminant. The source of the arsenic is expected to be related to historic fill in the area or routine application of pesticides/herbicides.

Four radiological parameters were identified in the groundwater. No gross alpha concentrations exceeded the MCL of 15 picocuries per liter (pCi/L). The maximum concentration of gross alpha was 5.0 pCi/L. There are no LOCs for the other three parameters - gross beta, radium-228 and uranium-234. All four parameters were detected at their maximum concentrations in the site well, DPMW-1. No radiological parameters were identified in the upgradient sample.

2.27.3.3 Surface Soil

Four surface soil samples were collected to delineate the horizontal extent of arsenic contamination near former soil sample DP-1S. This is the location where arsenic was reported at 57 mg/kg (USACHPPM, 1998b). The samples were analyzed for arsenic and the results are presented in Table 10-4 (**Appendix A**). Arsenic concentrations in the four samples ranged from 9.9 (DPSS-3A) to 13.5 mg/kg (DPSS-2A). These concentrations are above the IRSL (1.6 mg/kg) and the Picatinny background level for arsenic in surface soil (9.23 mg/kg), but below the NJDEP NRSRS (19 mg/kg) which is based on natural background.

Twelve surface soil samples were collected during the CS in order to characterize the fill used in this marshy area and any potential contamination related to the fill or past operations at the site. All samples were analyzed for TAL metals. Two surface soil samples (208SS-5 and 208SS-6) were collected beneath the asphalt pavement used as the staging area. Surface soil samples were also collected upgradient (208SS-1 to 208SS-4, 208SS-7 and 208SS-8) and downgradient (208SS-9 to 208SS-12) of the site along the entire stretch of the fire break/access road in order to delineate the horizontal extent of any metals contamination.

Only arsenic was identified above LOCs in the twelve samples. Arsenic was reported in excess of the NRSRS at 42.6 mg/kg in sample 208SS-9 (**Table 3-1 of Appendix A**). Arsenic concentrations in the soil ranged from 3.0 to 42.6 mg/kg. The average arsenic concentration 11.42 mg/kg was below the LOC.

Soil sample locations for radiological analysis were selected based on the results of the radiological survey. Locations were biased towards those areas exhibiting the highest gamma readings. The majority of the soil samples were taken in the yellow-shaded areas of **Figure 2-36** since the yellow shading represents the highest gamma readings. Representative samples were also taken in the green areas correlating to the lower gamma readings. A total of sixteen soil samples were collected and analyzed to determine the isotopic concentrations present at the site. Two samples, 208SS-5 and 208SS-6 were collected beneath the asphalt pad used for the temporary storage of containerized radiological waste. Fifteen of the sixteen soil samples and one field duplicate were taken to a depth of 6 inches; one sample RSS-1B was taken at the 6-12 inch depth interval. All samples were analyzed for alpha and gamma emitters.

Table 3-2 in Appendix A summarizes the radiological results of the characterization soil and sediment samples. Gross results (inclusive of background) with negative values were reported as 0.00. Net results (background subtracted) with negative values were reported as negative values. The majority of samples were non-detectable for barium-133, carbon-14, cobalt-60, cesium-137, and strontium-90. Radium-226, thorium-232, uranium-235 and uranium-238 were detected in all 16 samples. According to NJDEP comments on the CS, since there is no uncontaminated surface soil present, NJDEP's Limited Restricted Use Standards for Radioactive Materials (N.J.A.C. 7:28-12) should be utilized for this site. With the exception of thorium-232, the concentrations of these four radionuclides did not exceed their respective screening criterion. Assuming two feet of vertical extent, the maximum gross concentrations of radium-226 (3.48 pCi/g), uranium-235 (0.23 pCi/g) and uranium-238 (5.32 pCi/g) are below their NJDEP limited restricted use standards of 4 pCi/g, 27 pCi/g and 41 pCi/g, respectively. The net results for thorium-232 ranged from 0.00 pCi/g to 9.31 pCi/g. Eight of the 16 soil samples exceeded NJDEP's limited restricted use standard for thorium-232 of 3.0 pCi/g.

2.27.3.4 Sediment

To address the AOC noted by USACHPPM regarding the absence of barriers to prevent surface soil and coal clinkers from entering the adjacent drainage channel, five sediment samples were collected from the drainage channel to characterize sediment quality during the Phase III 2A/3A RI. Sample DPSD-1 was collected approximately 50 ft upgradient of the site. Samples DPSD-2 through DPSD-5 were collected downgradient of the site with DPSD-2 being the closest (approx. 20 ft), and DPSD-5 being the furthest (approx. 160 ft) from the site. These samples were analyzed for SVOCs, explosives, metals, and radiological parameters. Analytical results of the five sediment samples are presented in Table 10-5 (**Appendix A**).

The analytical results of these samples indicated estimated levels of several SVOCs in samples DPSD-2 and DPSD-4. The average concentrations of five SVOCs detected in sample DPSD-2 and its duplicate sample DPSD-2 DUP exceeded their respective LOCs. Ten SVOCs were identified in DPSD-4 at concentrations above LOCs. Trace levels of the explosive 2,4,6-trinitrotoluene (2,4,6-TNT) were detected in DPSD-1, DPSD-4 and the duplicate sample for DPSD-2 (DPSD-2 DUP). All concentrations were below the LOC for 2,4,6-TNT (79 mg/kg) which is based on the IRSL.

Metals exceedences of LOCs were reported in three of the five sediment samples. Upgradient sample DPSD-1 and DPSD-5, the most downgradient sample, did not contain any LOC exceedences. Sample DPSD-2 had three metals identified above LOCs. The average concentration reported for chromium (95.7 mg/kg), lead (39.3 mg/kg), and silver (2.45 mg/kg) exceeded the LOCs. Sample DPSD-3 contained exceedences for cadmium (3.00 mg/kg) and zinc (1,020 mg/kg). Sample DPSD-4 had eight metals exceedences. In addition to the five metals identified at elevated levels in the other two samples, sample DPSD-4 also contained arsenic (40.1 mg/kg), mercury (1.90 mg/kg), and vanadium (84.5 mg/kg) in excess of their respective LOCs (sample results were re-screened versus the NRSRS and IRSL in cases where the sediment LOC was based on New Jersey Direct Contact Soil Criteria or USEPA Industrial Soil Risk Based Concentrations). With the exception of zinc, the maximum concentrations of all eight metals were reported in DPSD-4.

Radiological parameters detected in sediment samples were gross alpha, gross beta, cesium-137, radium-226, radium-228, natural uranium (U_{nat}), uranium-234, uranium-235 and uranium-238. Gross alpha, gross beta and uranium were present in all five of the samples submitted for analysis. As previously noted for metals, sample DPSD-4 also contained the greatest number of detections of radiological parameters. There are currently no LOCs for radiological parameters in sediment. Thus, the concentrations were evaluated in comparison to New Jersey's soil standards for radioactive materials (NJDEP, 2000). In the absence of New Jersey standards for certain isotopes such as cesium-137 and radium-228, the concentrations were compared to USEPA's SSLs (EPA, 2000). No individual radiological concentrations exceeded the State standards for restricted use and the total concentration of radionuclides detected in each sample did not exceed the sum of the fractions rule threshold of 1 for restricted use. In addition, the cesium-137 and radium-228 were below USEPA's guidance level for direct ingestion, which is the most likely exposure pathway. A comparison of the reported concentrations in these samples to the background concentrations provided by the Picatinny Facility-*Wide Background Study* (IT, 2002a) indicates U_{nat} concentrations to be much higher in the samples than the background concentration of 1.51 mg/kg. The only sample containing an uranium concentration near the background level was DPSD-5 (1.91 mg/kg). All other concentrations were greater than the upgradient sample concentration of 48.0 mg/kg present in DPSD-1. Uranium-238 was present at concentrations above background (0.890 pCi/g) in three samples, DPSD-2, DPSD-3 and DPSD-4 at concentrations of 0.94 pCi/g, 0.96 pCi/g and 1.57 pCi/g, respectively. Uranium-235 (0.093 pCi/g), which was only detected in the upgradient sample DPSD-1, exceeded the background concentration of 0.076 pCi/g. Of the remaining parameter concentrations that exceeded background levels, all were in sample DPSD-4. These included cesium-137 (1.08 pCi/g), gross alpha (28.1 pCi/g), radium-226 (2.46 pCi/g), and uranium-234 (2.21 pCi/g). The background concentrations for these parameters are 0.56 pCi/g, 20 pCi/g, 1.13 pCi/g, and 1.25 pCi/g, respectively. Gross alpha concentrations ranged from 10.4 pCi/g (DPSD-5) to 28.1 pCi/g (DPSD-4). Gross beta concentrations ranged from 19.5 pCi/g (DPSD-3) to 30.5 pCi/g (DPSD-1). With the exception of the gross alpha concentrations reported for DPSD-4, none of the gross alpha or gross beta concentrations exceeded the background levels of 20.0 pCi/g and 30.7 pCi/g. It should be noted that thorium-232, which was identified at elevated levels in the soil, was not analyzed for in the radiological scan of the sediment samples.

As a result of the Phase III 2A/3A RI data, additional sediment samples were collected from the drainage ditches and Green Pond Brook during the CS in September 2006. Of the three sediment samples collected in the primary drainage channel (208SD-1 to 208SD-3), elevated metals concentrations were only detected in sample 208SD-1 located approximately 350 feet downgradient from the site (**Table 3-3 in Appendix A**). Eight metals were reported in excess of LOCs in 208SD-1. All concentrations were less than the concentrations reported at upgradient sample location DPSD-4 with the exception of copper. Copper which was detected at 122 mg/kg in 208SD-1 was not detected at elevated levels in any of the previous samples. Samples 208SD-2 and 208SD-3, collected in the primary drainage ditch downgradient from 208SD-1, did not contain any LOC exceedences. The two samples collected below the confluence of the primary drainage ditch and Green Pond Brook (208SD-4 and 208SD-5) contained several LOC exceedences. Cadmium, copper, mercury and silver were detected above their respective LOCs in both samples. Chromium, lead and zinc were also detected above LOCs in sample 208SD-5. The maximum concentrations of the metals identified in the two Green Pond Brook samples were reported in sample 208SD-5, the most downgradient sample. Sample DPSD-6, collected from the drainage canal which runs perpendicular to the primary channel, did not contain any LOC exceedences.

Sample RSD-1 was collected immediately downgradient of the soil sample which had the highest thorium-232 and radium-226 concentrations detected during the CS. The sediment sample did not contain levels of radioanalytes in excess of the NJDEP unrestricted use standards (**Table 3-4 in Appendix A**).

2.27.3.5 Surface Water

During the RI, samples of surface water were collected at four of the areas mentioned previously for sediment sampling. Proposed sample DPSW-3 could not be collected because no surface water was present in the drainage ditch at this location. The surface water samples were collected from the drainage channel and analyzed for SVOCs, explosives, metals, and radiological parameters. During the CS, one surface water sample (RSW-1) was collected in conjunction with sediment sample RSD-1 and analyzed for alpha and gamma isotopes. The analytical results for the surface water samples are presented in Table 10-6 for the RI samples and Table 5 for the CS sample (**Appendix A**).

The analytical results of these samples indicated SVOC and explosives concentrations below the reporting limits. Metals exceedences were identified in all samples except the most downgradient sample DPSW-5. Iron and manganese were detected above the LOCs in the other three samples. Iron concentrations ranged from 1,800 µg/L in DPSW-4 to 10,050 µg/L in DPSW-2 (LOC = 1,790 µg/L). Manganese levels ranged between 1,000 µg/L in DPSW-4 and 4,800 µg/L in DPSW-2 (LOC = 383 µg/L). The remaining metals elevated over the LOCs were all reported in sample DPSW-2. This is the sample collected immediately downgradient (approx. 25 ft southeast) of the Dog Pound site. The other metals detected above LOCs in DPSW-2 included aluminum (415 µg/L), arsenic (4.35 µg/L), and lead (4.70 µg/L). Several radiological parameters were detected in the samples. The only surface water standards for radionuclides are the EPA's Safe Drinking Water standards for a limited number of radionuclides. There are no standards for the uranium isotopes. Therefore, the uranium concentrations were compared to background levels. The uranium-234 concentrations reported in samples DPSW-2 (0.32 pCi/L) and DPSW-5 (0.26 pCi/L) exceed the background level of 0.16 pCi/L. Uranium-238 was detected in all samples except DPSW-4 at concentrations above the background level of 0.084 pCi/L. The uranium-238 levels ranged from 0.198 pCi/L in DPSW-5 to 0.255 pCi/L in DPSW-2. All results for sample RSW-1 were below the detection limit except for radium-226 and uranium-238. However, these two results were below their respective reporting limit.

2.27.4 Summary of Risk Assessments

Based on the USEPA-approved HHRA approach for Picatinny, estimated cancer risks, noncancer hazards, and radiological risks were quantified for the site. Estimated cancer risks, noncancer hazards, and radiological risks quantified for realistic exposure scenarios are summarized as follows for current/future industrial research workers, current/future construction excavation workers, and on-site youth visitors. For the current/future industrial research worker, routes of exposure evaluated included: incidental ingestion and dermal contact with soil, inhalation of dust particles, and volatilization of constituents in soil to ambient air followed by inhalation. For the current/future construction excavation worker, routes of exposure evaluated included incidental ingestion and dermal contact with soil, inhalation of dust particles, volatilization of constituents in soil to ambient air followed by inhalation, and dermal contact with constituents in groundwater. For the current/future on-site youth visitor, routes of exposure evaluated included: incidental ingestion and dermal contact with surface water and sediment, and exposure to radiological constituents in sediment. Hypothetical future scenario risks and hazards are also presented for future adult and child residents, and future site workers.

The estimated RME risks for the realistic exposure scenarios are within or below USEPA's target cancer risk range of 1E-4 to 1E-6 for the evaluated receptors. The chemical and radiological cancer risks have not been added together as USEPA (1989a) stipulates that they should not be considered to be additive. The estimated total hazards for the industrial research worker, the construction excavation worker, and on-site youth visitor scenarios are all below USEPA's target noncancer hazard threshold of 1.

Table 2-18
Summary of Site 208, Dog Pound Estimated Risks and Hazards

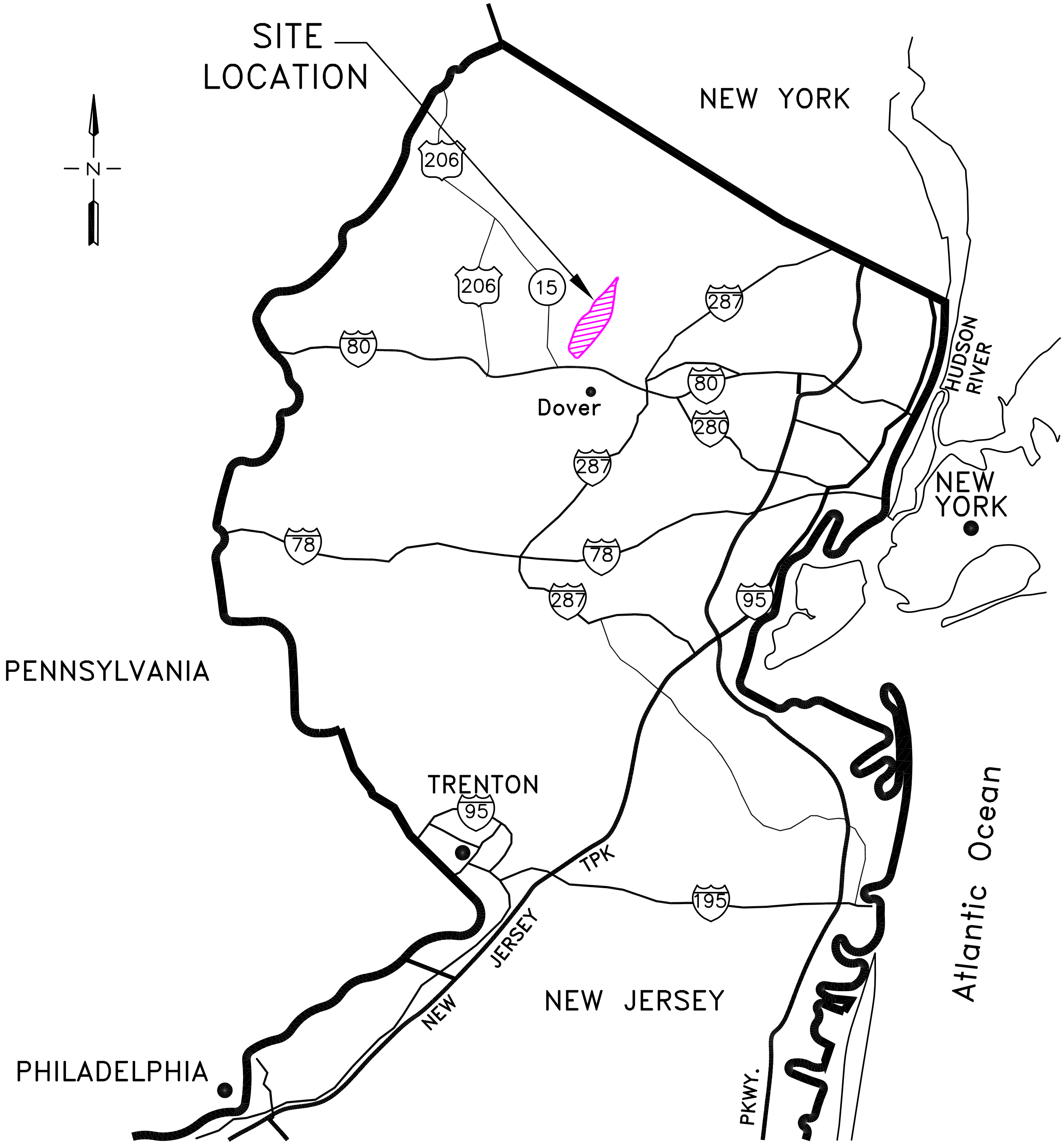
Receptor (Current and Future)	Estimated Total Cancer Risk (RME unless noted)	Cancer Risk Driver(s) (contributing most to total risk)	Media Contributing Most to Cancer Risk
Industrial Research Worker	1.1E-5	Arsenic	Surface Soil
Construction Excavation Worker	1.4E-8	NR - risks acceptable	NR - risks acceptable
On-Site Youth Visitor Chemical Risk	8.1E-6	Arsenic	Sediment
On-Site Youth Visitor Radiological Risk	2.0E-6	Radium-226	Sediment
Adult Resident Chemical Risks	3.7E-4	Arsenic	Groundwater
Child Resident Chemical Risks	2.7E-4	Arsenic	Groundwater
Adult + Child Resident Chemical Risks	6.4E-4	Arsenic	Groundwater
Adult Resident Radiological Risks	2.0E-5	Radium-226	Sediment
Child Resident Radiological Risks	4.0E-6	Radium-226	Sediment
Adult + Child Resident Radiological Risks	2.4E-5	Radium-226	Sediment

Receptor (Current and Future)	Estimated Total Noncancer Hazard (RME unless noted)	Noncancer Hazard Driver (contributing most to total hazard)	Media Contributing Most to Noncancer Hazard
Industrial Research Worker	0.068	NR - hazards acceptable	NR - hazards acceptable
Construction Excavation Worker	0.12	NR - hazards acceptable	NR - hazards acceptable
On-Site Youth Visitor	0.6	NR - hazards acceptable	NR - hazards acceptable
Adult Resident	8.6	Manganese	Groundwater
Child Resident	25	Manganese	Groundwater

NR = not relevant. Cancer risk drivers and/or noncancer hazard drivers not presented because risks and/or hazards acceptable.

The estimated RME chemical risks for the future hypothetical residential exposure scenarios are above USEPA's target cancer risk range of 1E-4 to 1E-6 for the adult and child residents. The radiological cancer risk for the combined adult and child resident is estimated to be within USEPA's target risk range. The estimated total hazards for the adult child and child resident are above USEPA's target noncancer hazard threshold of 1. Risk and hazard drivers are defined as those constituents contributing the most to an estimated total cancer risk greater than 1E-6 or estimated total noncancer hazard greater than 1.0.

Though elevated metals and PAHs exist in a limited area in the drainage stream channel, the drainage channel does not represent a significant aquatic habitat and the size of the affected area (approximately 0.14 acre of the 1.1 acre site) would not be expected to result in significant exposure to wildlife. The concentrations of arsenic in soil are relatively low compared to the screening value (i.e., HQ of 1.4). Thus, a baseline ERA is not recommended for Site 208.



SCALE
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DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 06/03/05	D. Schicho 11/15/04	-- --	SITEMAP 1-1.dwg

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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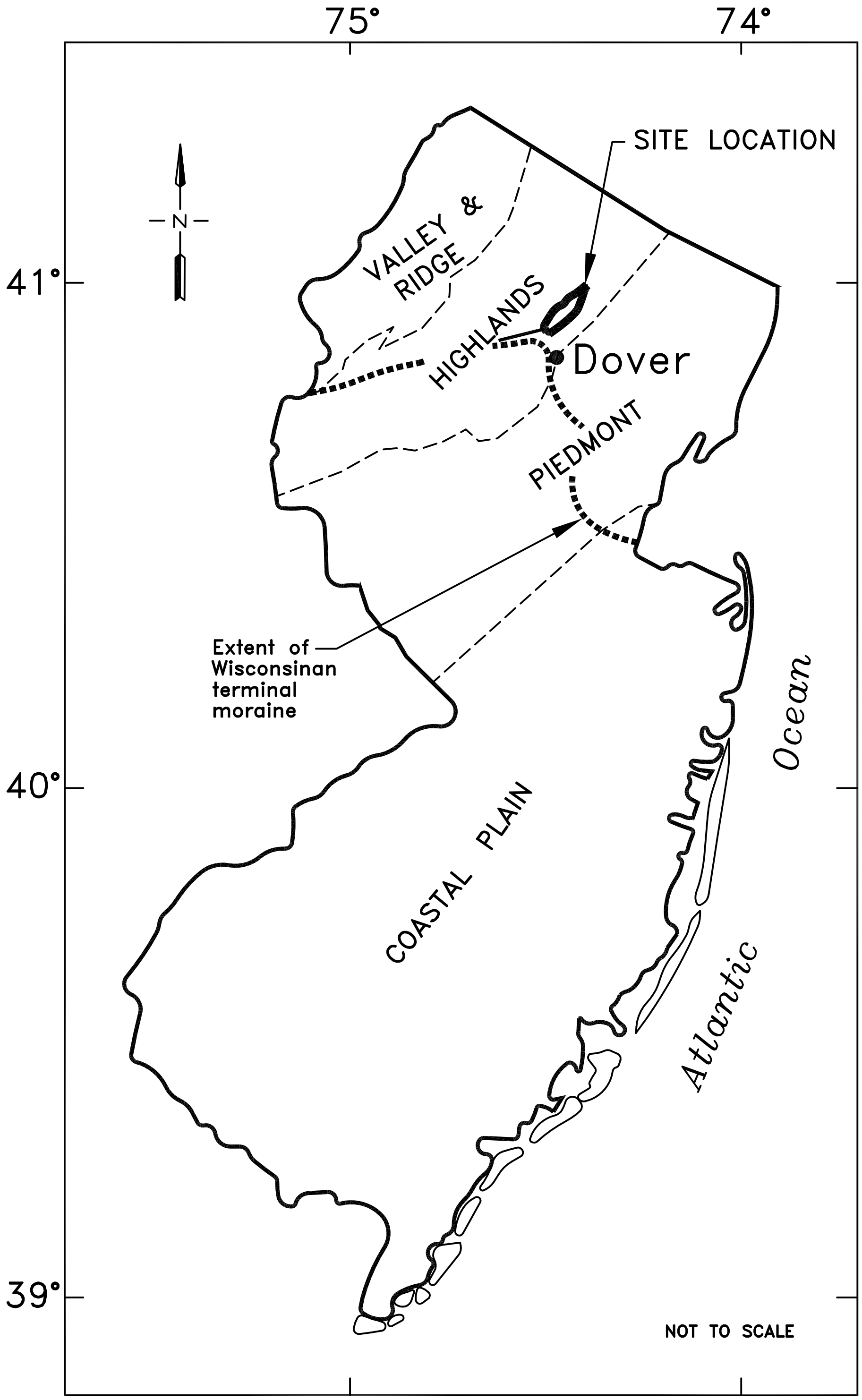
FIGURE 2-1

PICATINNY SITE LOCATION MAP

25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NEW JERSEY

OFFICE
Mt. Arlington, NJ
DRAWING NUMBER
25 Sites-FS-map.dwg
187
(PICA 190)
PICA 207
117
119
120
121
134
185
136
123
96
95
52
145
69
60
PICA
208
27
LAKE PICATINNY
10
7
164
173
174
176
175
172
186
(PICA 189)
LAKE DENMARK
P
E
D
H
M
G
F
I
N
O
L
K
J
LEGEND
RAILROAD
PAVED ROADWAY
COVERED WALKWAY
SWAMP
LAKE/POND
STREAM
DRAINAGE CANAL
SITE BOUNDARY
AREA BOUNDARY
PICATINNY BOUNDARY
BUILDING
FIELD STUDY SITE
SCALE
0 800 1600 2400 FEET
Picatinny Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Environmental, Inc.
DESIGNED BY: A. Smith
DRAWN BY: S. Wiafe
CHECKED BY: G. Maresca
APPROVED BY: --
SITE LOCATION MAP
25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NEW JERSEY
DATE: 07/14/05
SCALE: AS SHOWN
DRAWING NO. 25 Sites-FS-map
FIGURE NO. 2-2



Base from U.S. Geological Survey
1:24,000 topographic quadrangles.

After Harte et al, 1986.

From U.S.G.S., 1986a as modified from Sims, 1958;
and Bayley and others, 1914.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 2-3

PHYSIOGRAPHIC PROVINCES
OF NEW JERSEY

25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NJ

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
R. Gross 8/5/03	M. Magness 8/5/03	J. Anthony --	PROVINCES.dwg

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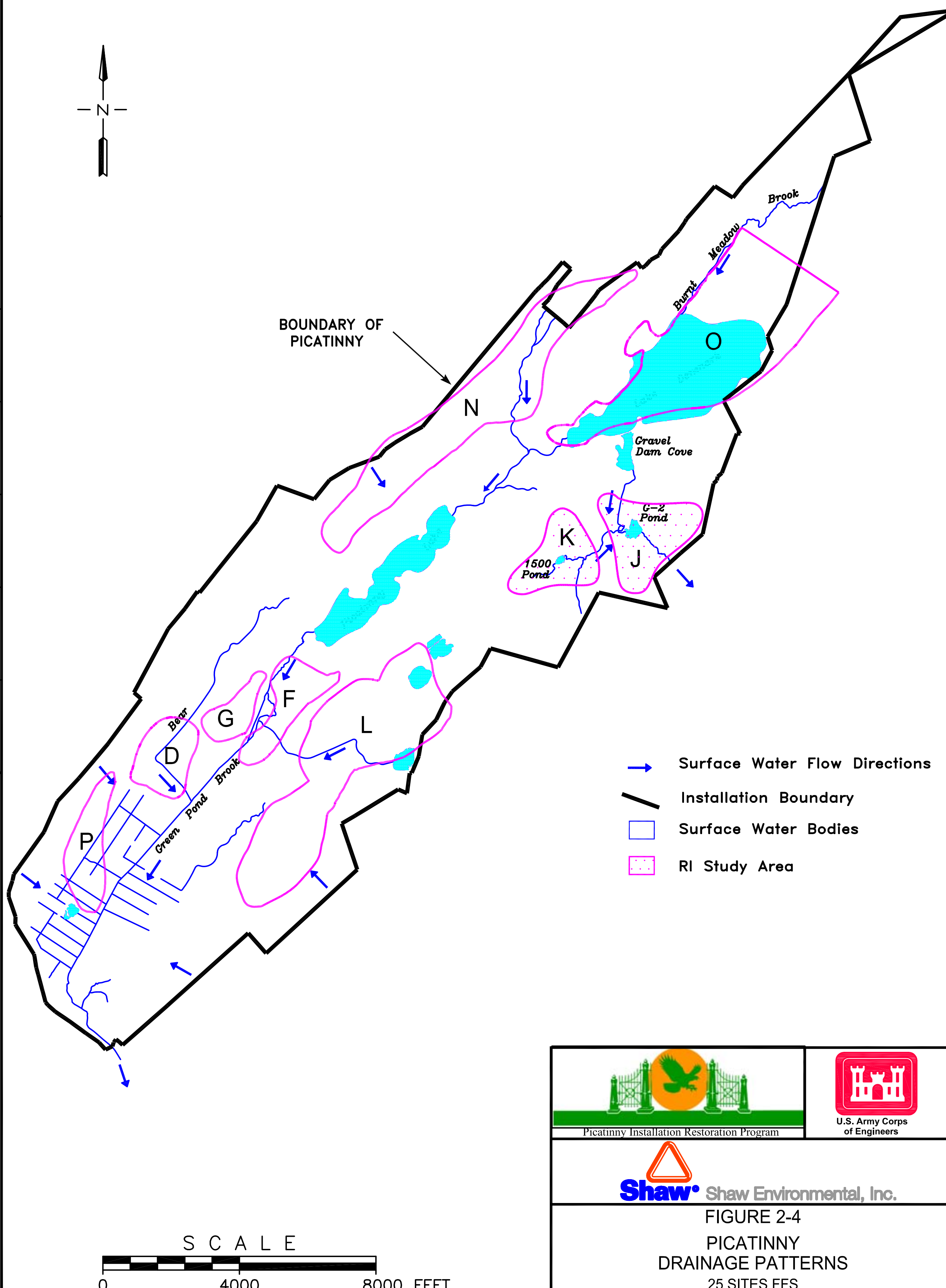
Plotted By: stephen.wiafe



Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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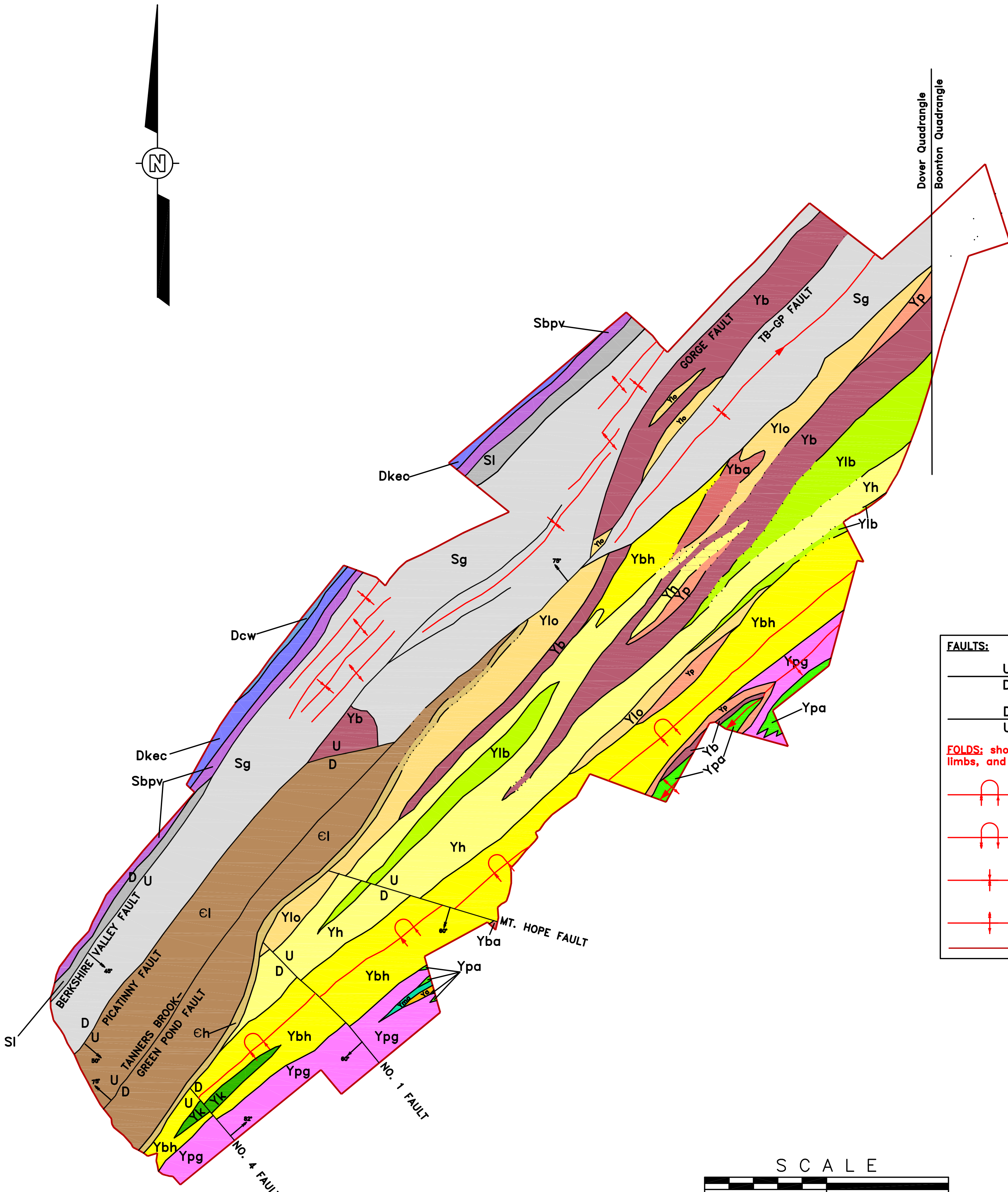
FIGURE 2-4

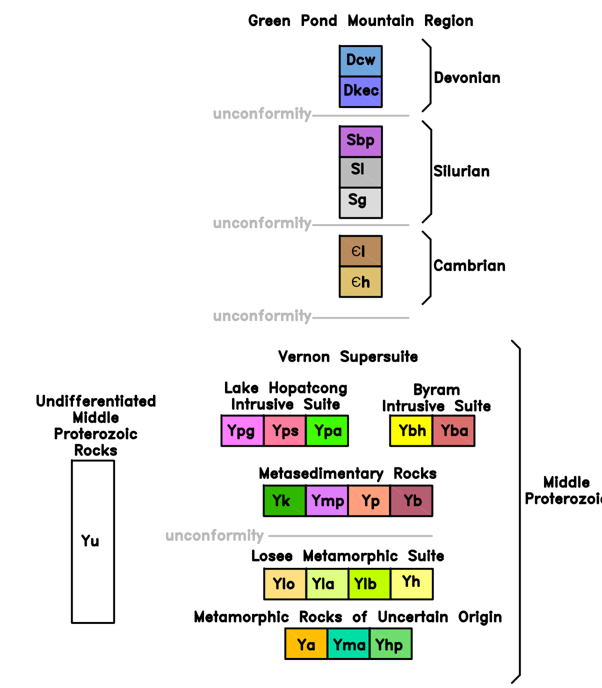
PICATINNY
DRAINAGE PATTERNS
25 SITES FFS
PICATINNY, DOVER, NEW JERSEY

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 8/17/05	K.erdes 4/11/06	-- --	draina081705.dwg



DESCRIPTION OF MAP UNITS

Unit	Description
Dcw	Cornwall Shale
Dkec	Kanouse Sandstone, and Connelly Conglomerate, undivided
Sbp	Berkshire Valley and Poxino Island Formations, undivided
Sl	Longwood Shale
Sg	Green Pond Conglomerate
Єl	Leithsville Formation
Єh	Hardyston Quartzite
Ybh	Hornblende granite
Yba	Microperthite alaskite
Ypg	Pyroxene granite
Ypa	Pyroxene alaskite
Yk	Potassic feldspar gneiss
Yb	Biotite-quartz-feldspar gneiss
Yp	Pyroxene gneiss
Ylo	Quartz-oligoclase gneiss
Yla	Albite-oligoclase alaskite
Ylb	Biotite-quartz-oligoclase gneiss
Yh	Hypersthene-quartz-plagioclase gneiss
Ya	Amphibolite
Yma	Microantiperthite



FAULTS:

Symbol	Description
U / D	Normal Fault – U=upthrown side, D=downthrown side. Arrow shows attitude of fault plane, if known.
D / U	Reverse Fault – U=upthrown side, D=downthrown side. Arrow shows attitude of fault plane, if known.

FOLDS: showing trace of axial surface, dip direction of limbs, and plunge direction

- Overturned Synform
- Overturned Antiform
- Synform
- Antiform
- icatinny Boundary

SCALE

0 3500 7000 FEET

GEOLOGICAL MAP BASED ON:
BEDROCK GEOLOGIC MAP OF THE DOVER QUADRANGLE
MORRIS COUNTY, NEW JERSEY BY RICHARD A. VOLKERT, 2002, IN REVIEW.
NEW JERSEY GEOLOGICAL SURVEY OPEN FILE.

Picatinny Arsenal Installation Restoration Program

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FIGURE NO. 2-5

PICATINNY
BEDROCK GEOLOGY MAP

25 SITES FFS
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWING NUMBER GEO1_091003.dwg

APPROVED BY G. Maresca 06/23/06

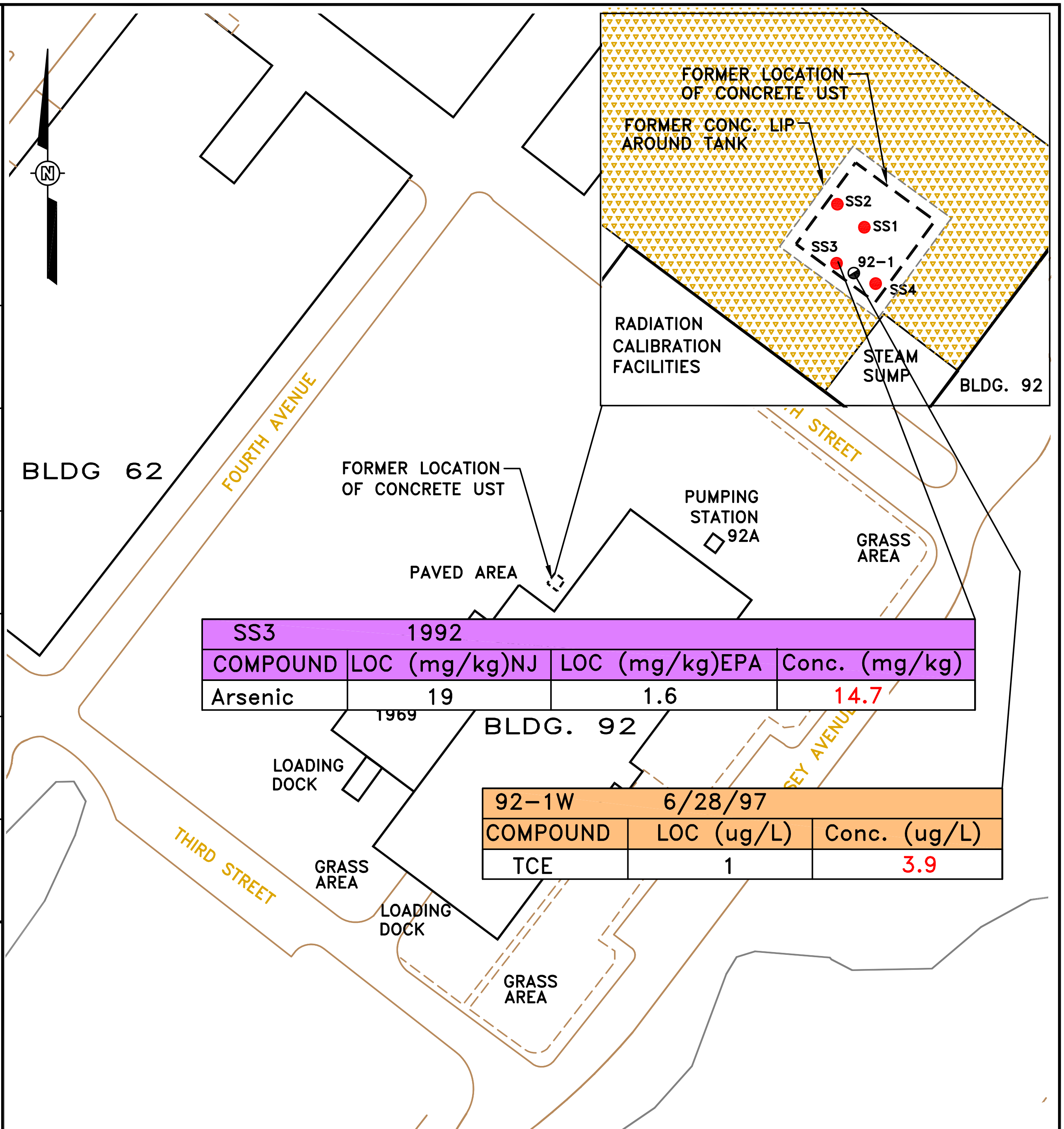
CHECKED BY G. Maresca 06/23/06

DRAWN BY A. Smith 06/23/06

03/03/03

PLOT DATE: 07/10/05

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 04/07/10	K. Gerdes 04/07/10	-- --	D69040710.dwg



SS3	1992		
COMPOUND	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	14.7

92-1W	6/28/97	
COMPOUND	LOC (ug/L)	Conc. (ug/L)
TCE	1	3.9

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

SCALE
0 100 200 FT.

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER (TR-732)
- BLAST WALL
- STORM SEWER
- SANITARY SEWER
- EARTH MOUND
- BUILDING
- FORMER CONCRETE UST
- COVERED WALKWAY
- SWAMP WATER
- 10' SURFACE CONTOUR
- PAVED ROADWAY
- UNPAVED ROADWAY
- PREVIOUS SUB-SURFACE SOIL SAMPLING LOCATION
- GEOPROBE SUBSURFACE SOIL & GROUNDWATER SAMPLE
- PAVED AREA

Picatinny Installation Restoration Program

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FIGURE NO. 2-6

SITE 69-BLDG. 92
LOC EXCEEDENCES
25 SITES FS
PICATINNY, DOVER, NJ

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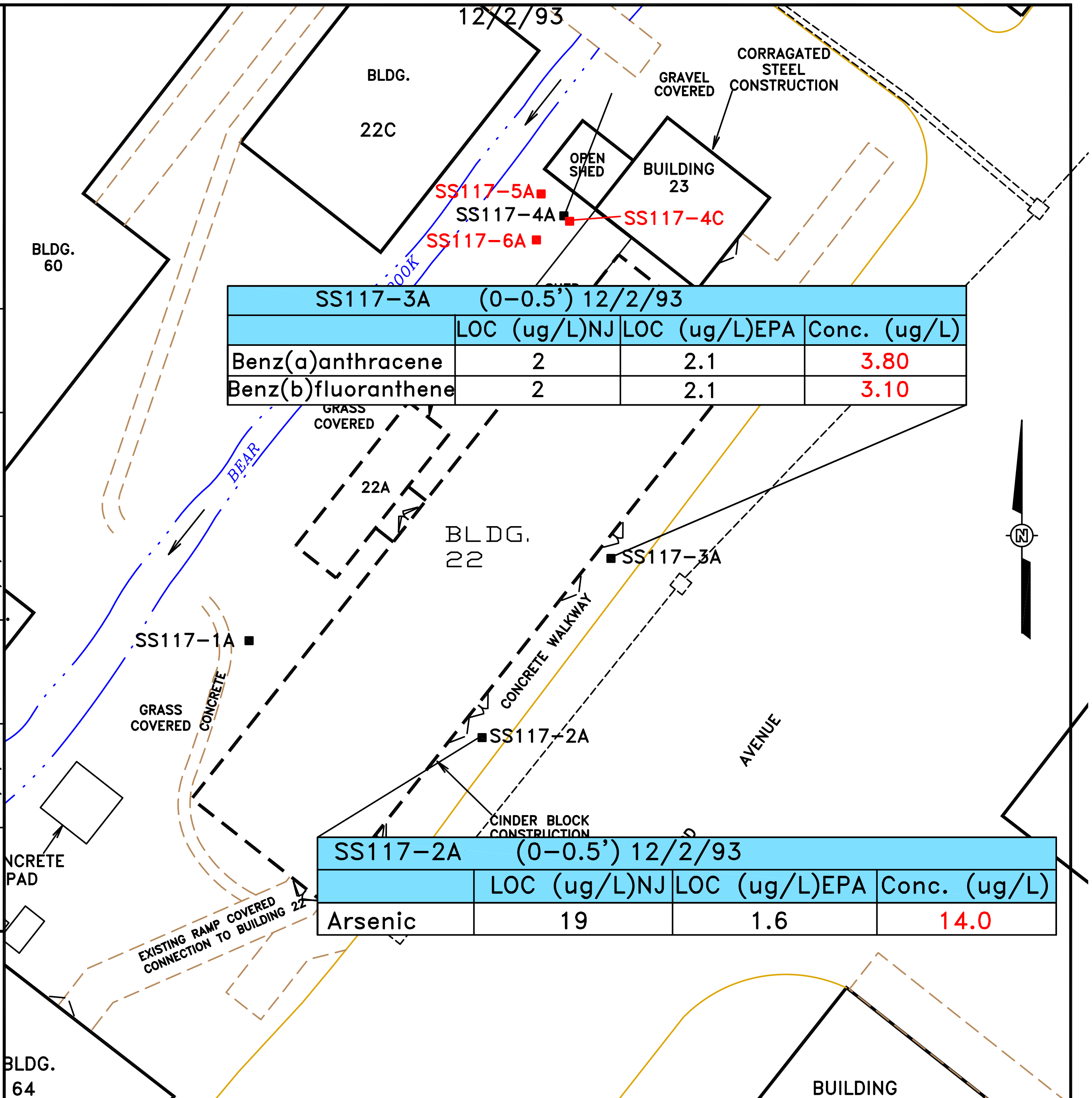
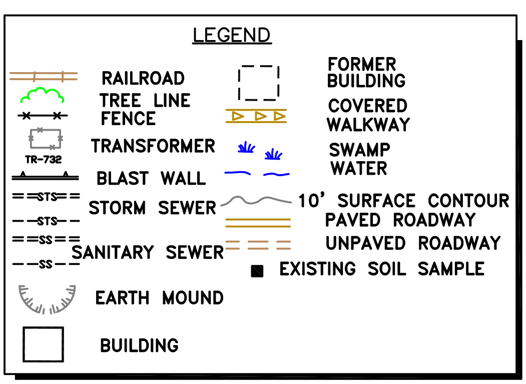
Plot Date/Time: Apr 22, 2010 - 5:01pm
Plotted By: stephen.wiafe



SS117-3A (0-0.5') 12/2/93			
	LOC (ug/L)NJ	LOC (ug/L)EPA	Conc. (ug/L)
Benz(a)anthracene	2	2.1	3.80
Benz(b)fluoranthene	2	2.1	3.10

SS117-2A (0-0.5') 12/2/93			
	LOC (ug/L)NJ	LOC (ug/L)EPA	Conc. (ug/L)
Arsenic	19	1.6	14.0

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.



SCALE
0 30 60 FEET

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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FIGURE No. 2-7

SITE 117
LOC EXCEEDENCES

25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NEW JERSEY

DRAWN BY: S. Wiafe 04/10/10
CHECKED BY: K. Gerdes 04/15/10
APPROVED BY: -- --
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Plot Date/Time: Apr 22, 2010 - 5:09pm
Plotted By: stephen.wiafe

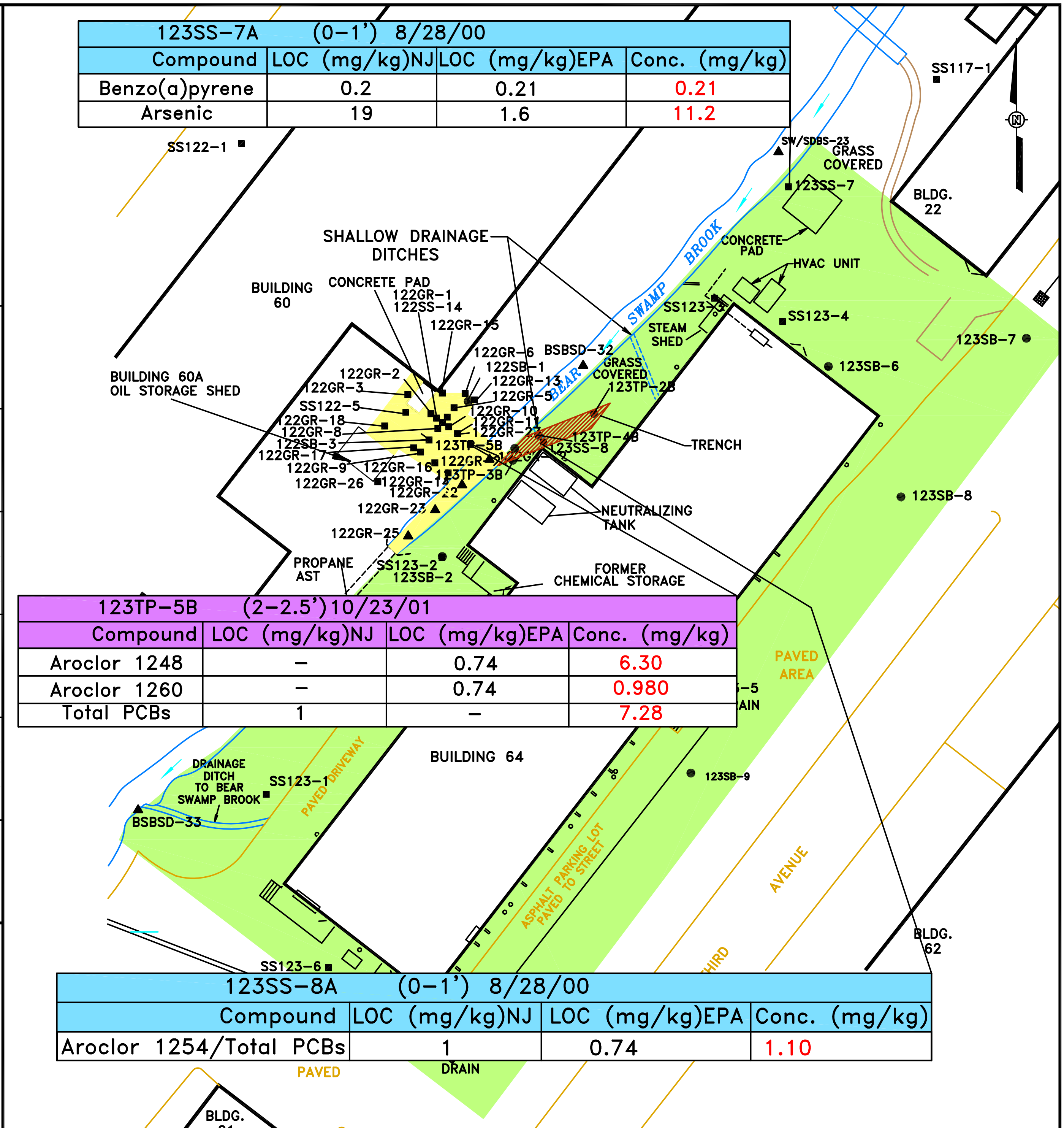
D123040710.dwg

DRAWING NUMBER

APPROVED BY -- --

CHECKED BY K. Gerdes 04/08/10

DRAWN BY S. Wiafe 04/08/10



123SS-7A (0-1') 8/28/00			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.21	0.21
Arsenic	19	1.6	11.2

123TP-5B (2-2.5') 10/23/01			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Aroclor 1248	–	0.74	6.30
Aroclor 1260	–	0.74	0.980
Total PCBs	1	–	7.28

123SS-8A (0-1') 8/28/00			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Aroclor 1254/Total PCBs	1	0.74	1.10

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

SCALE
0 40 80 FEET

RAILROAD
TREE LINE
FENCE
TR-732 TRANSFORMER
BLAST WALL
STS OR STS STORM SEWER
SS OR SS SANITARY SEWER
EARTH MOUND
BLDG. NO. BUILDING
BLDG. NO. FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER

SAMPLING LOCATIONS
- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL
- SOIL BORING
- TEST PIT
- HYDROPUNCH

SITE 122 PCB REMOVAL AREA

SITE 123 SOIL GAS SURVEY AREA

SURFACE WATER FLOW

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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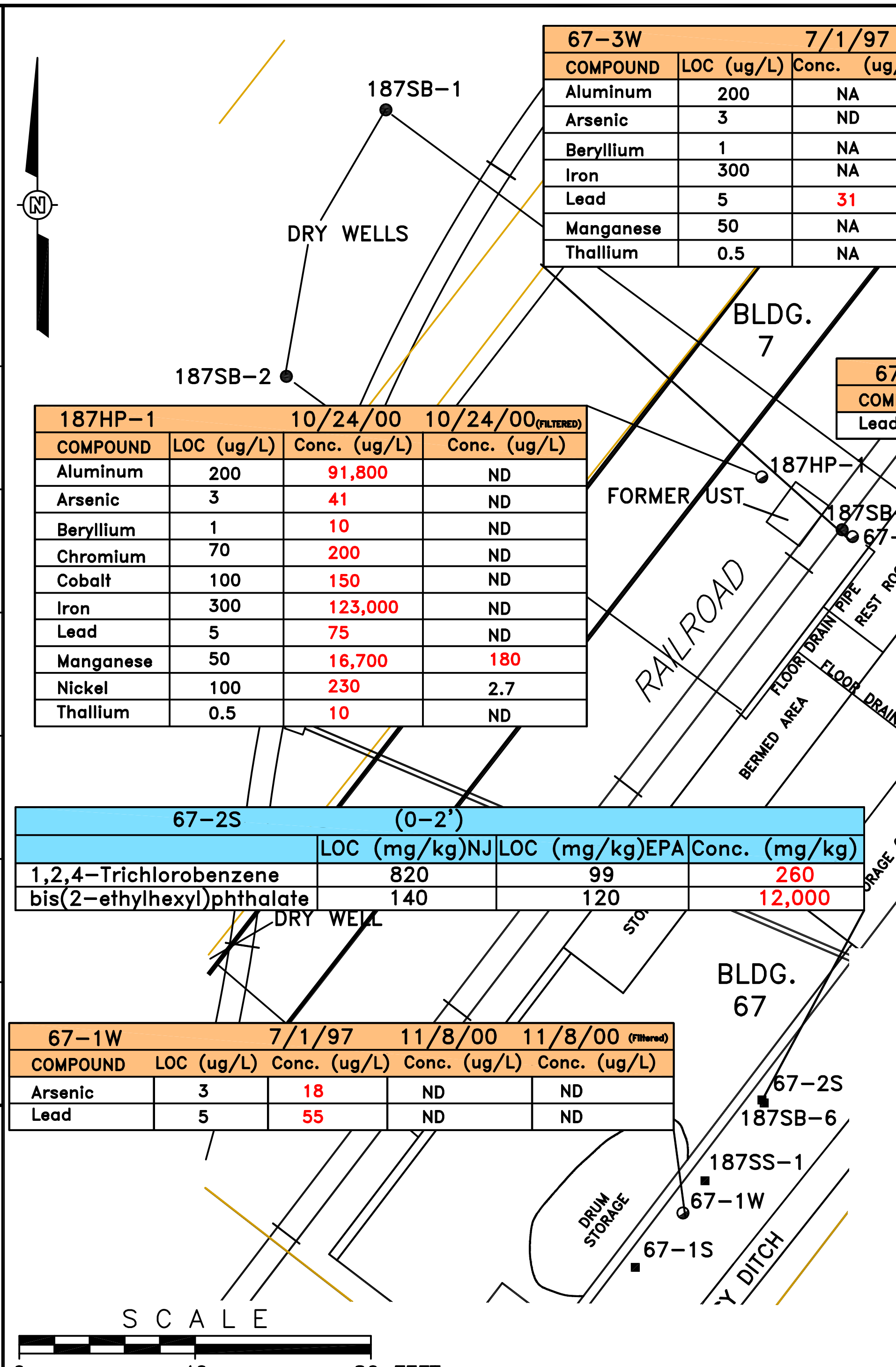
FIGURE NO. 2-8
SITE 123
BUILDING 64 - METAL PLATING SHOP
LOC EXCEEDENCES
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER D187040708.dwg

DRAWN BY	CHECKED BY	APPROVED BY
S. Wiafe 04/07/10	K. Gerdes 04/07/10	-- --



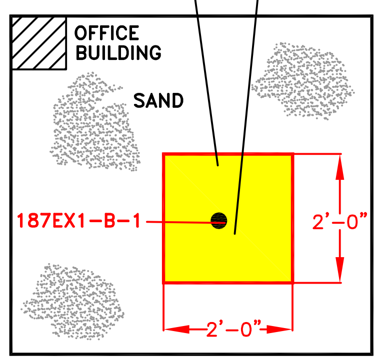
67-3W	7/1/97	10/24/00	10/24/00
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Aluminum	200	NA	57,050	98
Arsenic	3	ND	41	ND
Beryllium	1	NA	8.9	ND
Iron	300	NA	62,500	130
Lead	5	31	42.45	ND
Manganese	50	NA	10,150	17
Thallium	0.5	NA	8.0	ND

67-2W		7/1/97
COMPOUND	LOC (ug/L)	Conc (ug/L)
Lead	3	12

187HP-1		10/24/00	10/24/00 (FILTERED)
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Aluminum	200	91,800	ND
Arsenic	3	41	ND
Beryllium	1	10	ND
Chromium	70	200	ND
Cobalt	100	150	ND
Iron	300	123,000	ND
Lead	5	75	ND
Manganese	50	16,700	180
Nickel	100	230	2.7
Thallium	0.5	10	ND

67-2S	(0-2')		
	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
1,2,4-Trichlorobenzene	820	99	260
bis(2-ethylhexyl)phthalate	140	120	12,000

67-1W		7/1/97	11/8/00	11/8/00 (Filtered)
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Arsenic	3	18	ND	ND
Lead	5	55	ND	ND



DETAIL OF EXCAVATION

Note: Following Confirmatory Sampling the Excavation was backfilled with the Excavated Soil

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER (TR-732)
- BLAST WALL
- STORM SEWER (==STS== OR --STS--)
- SANITARY SEWER (==SS== OR --SS--)
- EXCAVATION
- # – NOT DETECTED IN DUPLICATE SAMPLE
- EARTH MOUND
- BUILDING (BLDG. NO.)
- FORMER BUILDING (BLDG. NO.)
- COVERED WALKWAY
- SWAMP
- WATER
- NA – NOT AVAILABLE
- ND– NOT DETECTED

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE NO. 2-9

SITE 187 - BUILDING 67
LOC EXCEEDENCES

25 SITES FS
PICATINNY, DOVER, NEW JERSEY

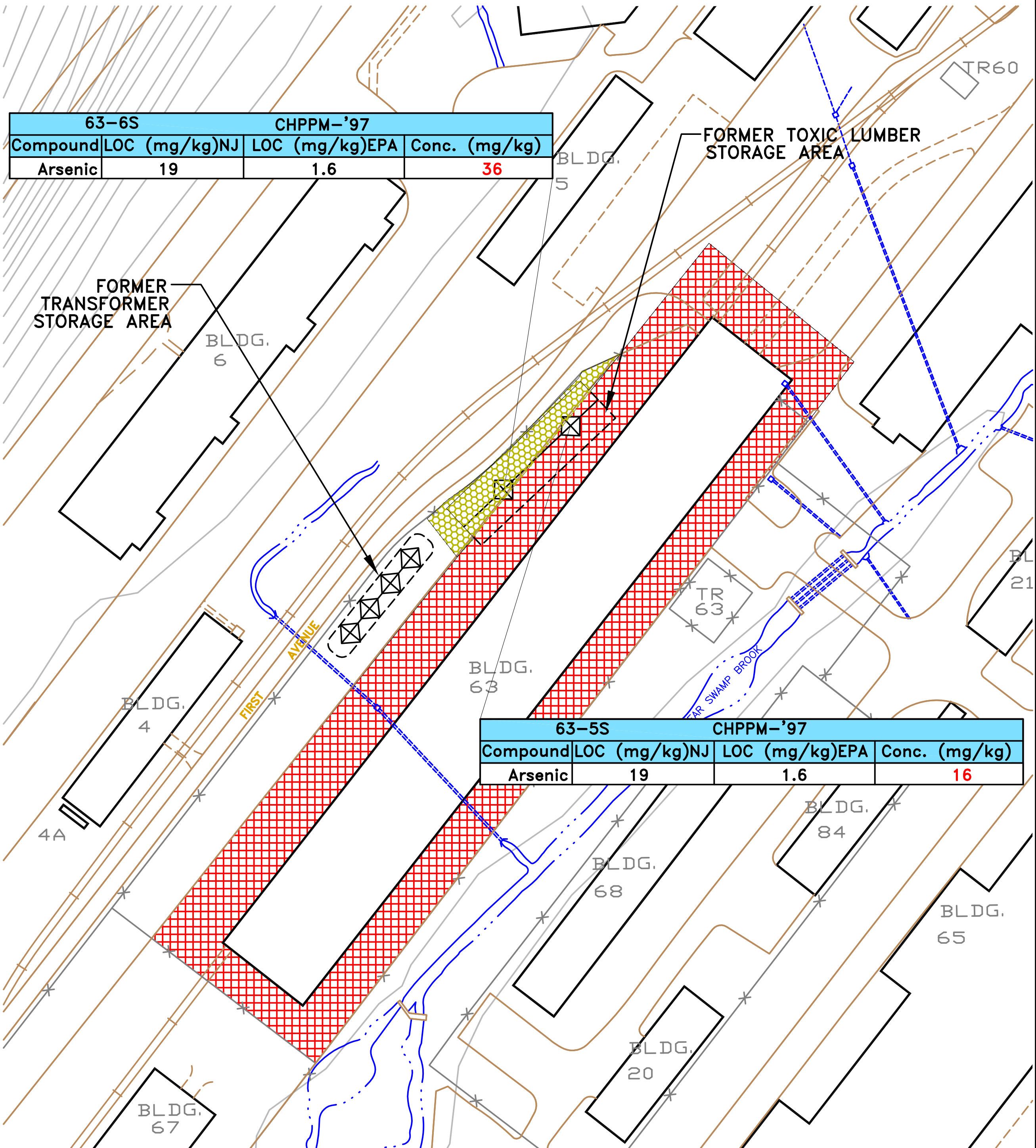
File: N:\cad\CAD drawings\Picatinny\Area-D\site187\D187040708.dwg
Plot Date/Time: Apr 22, 2010 - 5:14pm
Plotted By: stephen.wiafe

DRAWING NUMBER D052505.dwg

DRAWN BY	CHECKED BY	APPROVED BY
S. Wiafe 10/7/04	G. Maresca 10/7/04	-- --

63–6S		CHPPM–'97	
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	36

63–5S		CHPPM–'97	
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	16



NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- ==STS== / --STS-- STORM SEWER
- ==SS== / --SS-- SANITARY SEWER
- EARTH MOUND
- BUILDING
- FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER
- 10' SURFACE CONTOUR
- PAVED ROADWAY
- UNPAVED ROADWAY
- PAVEMENT
- GRAVEL

SCALE
0 100 200 FEET

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Shaw Environmental, Inc.

FIGURE No. 2-10
PICA 207 - BLDG 63
LOC EXCEEDENCES

25 SITES FS
PICATINNY, DOVER, NEW JERSEY

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Plot Date/Time: Apr 22, 2010 – 5:16pm
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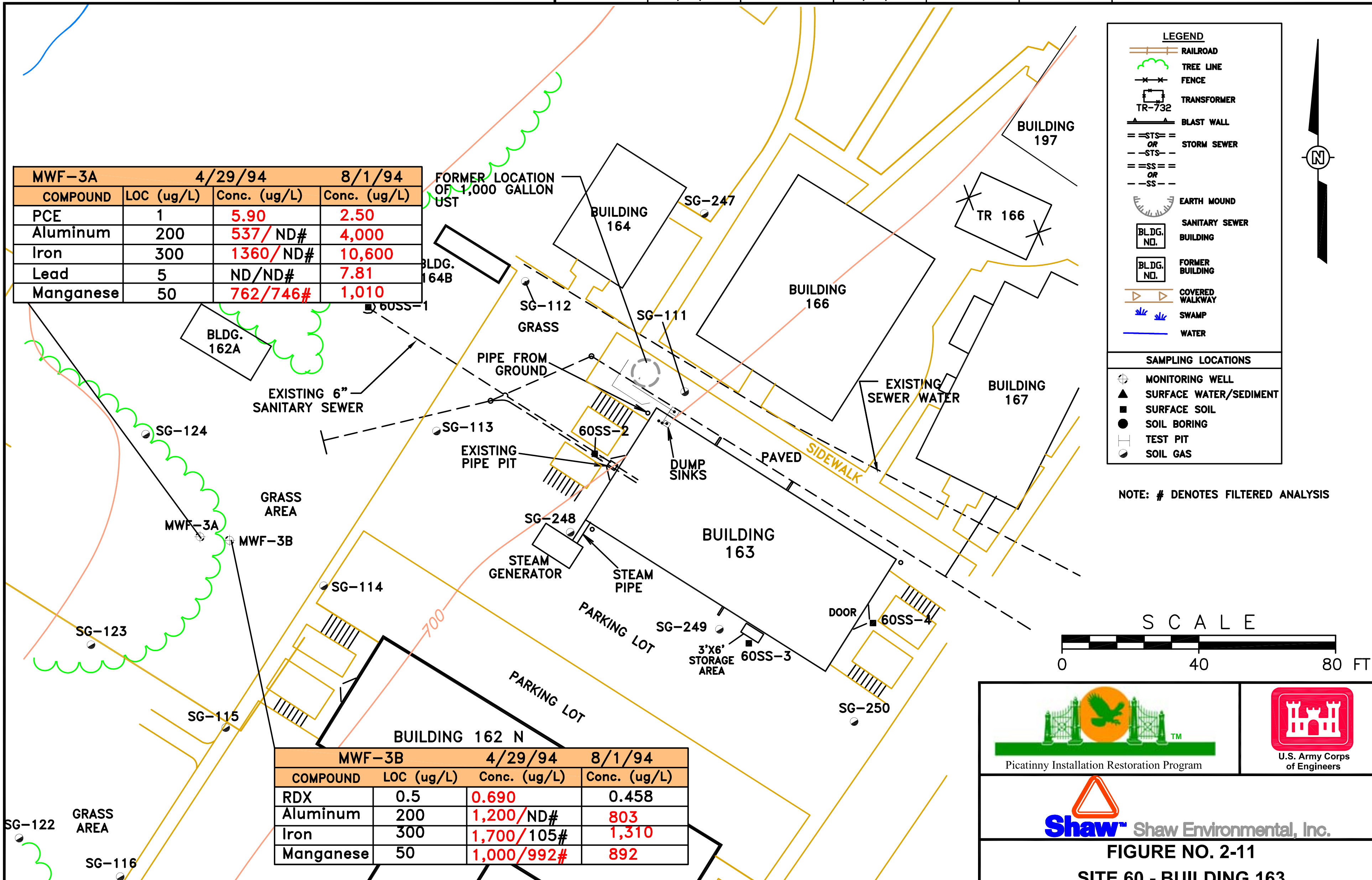
Plot Date/Time: Apr 22, 2010 – 5:20pm
Plotted By: stephen.wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	04/07/10	K. Gerdes	04/07/10	--	--	60040710.dwg



MWF-3A		4/29/94	8/1/94
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
PCE	1	5.90	2.50
Aluminum	200	537/ ND#	4,000
Iron	300	1360/ND#	10,600
Lead	5	ND/ND#	7.81
Manganese	50	762/746#	1,010

MWF-3B		4/29/94	8/1/94
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
RDX	0.5	0.690	0.458
Aluminum	200	1,200/ND#	803
Iron	300	1,700/105#	1,310
Manganese	50	1,000/992#	892

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

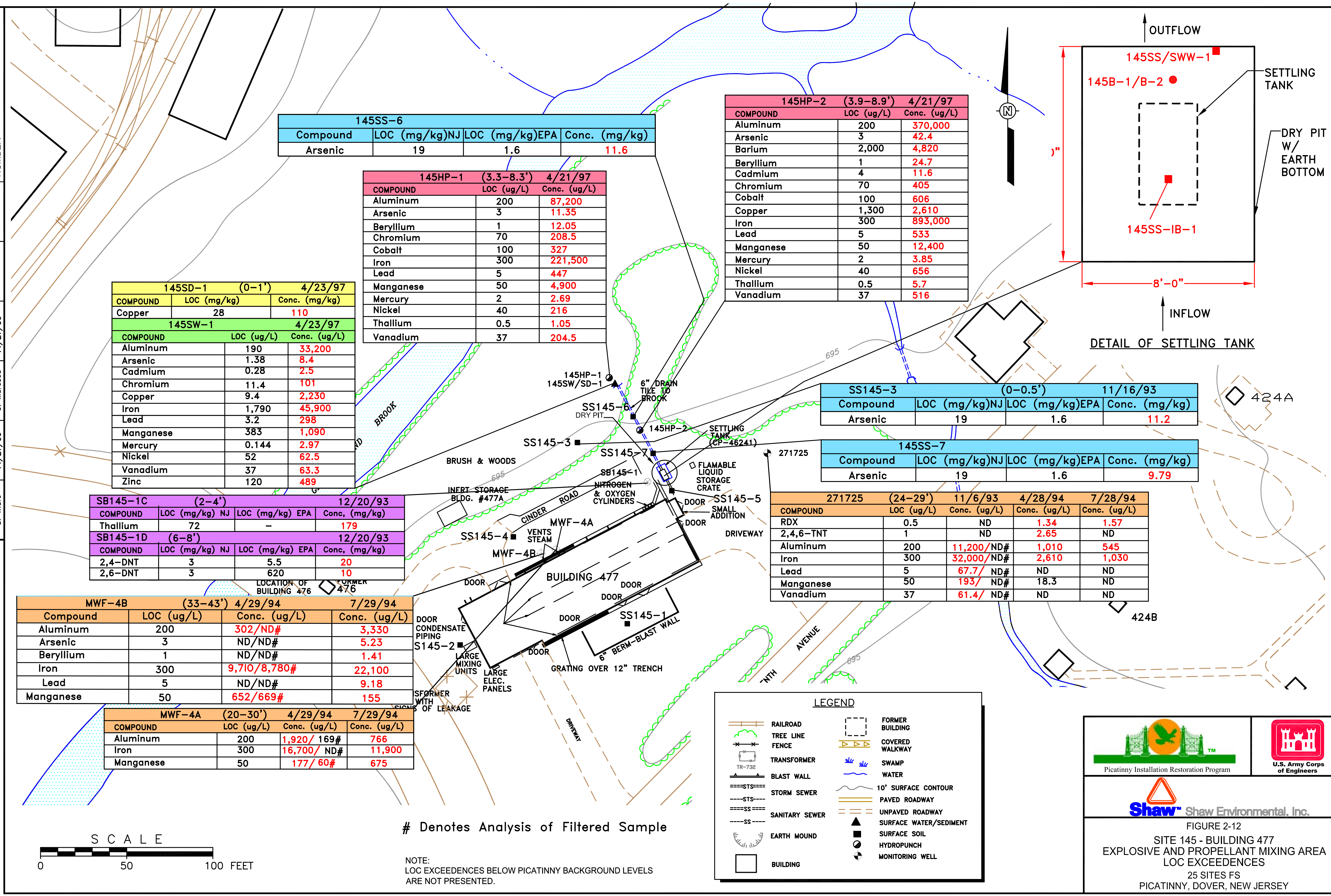
U.S. Army Corps of Engineers

Shaw™ Shaw Environmental, Inc.

FIGURE NO. 2-11

SITE 60 - BUILDING 163
LOC EXCEEDENCES

25 SITES FS
PICATINNY, DOVER, NEW JERSEY



145SS-6			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	11.6

145HP-1 (3.3-8.3') 4/21/97		
COMPOUND	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	87,200
Arsenic	3	11.35
Beryllium	1	12.05
Chromium	70	208.5
Cobalt	100	327
Iron	300	221,500
Lead	5	447
Manganese	50	4,900
Mercury	2	2.69
Nickel	40	216
Thallium	0.5	1.05
Vanadium	37	204.5

145HP-2 (3.9-8.9') 4/21/97		
COMPOUND	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	370,000
Arsenic	3	42.4
Barium	2,000	4,820
Beryllium	1	24.7
Cadmium	4	11.6
Chromium	70	405
Cobalt	100	606
Copper	1,300	2,610
Iron	300	893,000
Lead	5	533
Manganese	50	12,400
Mercury	2	3.85
Nickel	40	656
Thallium	0.5	5.7
Vanadium	37	516

145SD-1 (0-1') 4/23/97		
COMPOUND	LOC (mg/kg)	Conc. (mg/kg)
Copper	28	110

145SW-1 4/23/97		
COMPOUND	LOC (ug/L)	Conc. (ug/L)
Aluminum	190	33,200
Arsenic	1.38	8.4
Cadmium	0.28	2.5
Chromium	11.4	101
Copper	9.4	2,230
Iron	1,790	45,900
Lead	3.2	298
Manganese	383	1,090
Mercury	0.144	2.97
Nickel	52	62.5
Vanadium	37	63.3
Zinc	120	489

SB145-1C (2-4') 12/20/93			
COMPOUND	LOC (mg/kg) NJ	LOC (mg/kg) EPA	Conc. (mg/kg)
Thallium	72	–	179

SB145-1D (6-8') 12/20/93			
COMPOUND	LOC (mg/kg) NJ	LOC (mg/kg) EPA	Conc. (mg/kg)
2,4-DNT	3	5.5	20
2,6-DNT	3	620	10

MWF-4B (33-43')	LOC (ug/L)	4/29/94 Conc. (ug/L)	7/29/94 Conc. (ug/L)
Compound	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Aluminum	200	302/ND#	3,330
Arsenic	3	ND/ND#	5.23
Beryllium	1	ND/ND#	1.41
Iron	300	9,710/8,780#	22,100
Lead	5	ND/ND#	9.18
Manganese	50	652/669#	155

MWF-4A (20-30')	LOC (ug/L)	4/29/94 Conc. (ug/L)	7/29/94 Conc. (ug/L)
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Aluminum	200	1,920/ 169#	766
Iron	300	16,700/ ND#	11,900
Manganese	50	177/ 60#	675

SS145-3 (0-0.5') 11/16/93			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	11.2

145SS-7			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	9.79

271725 (24-29')		11/6/93	4/28/94	7/28/94
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)	Conc. (ug/L)
RDX	0.5	ND	1.34	1.57
2,4,6-TNT	1	ND	2.65	ND
Aluminum	200	11,200/ND#	1,010	545
Iron	300	32,000/ND#	2,610	1,030
Lead	5	67.7/ ND#	ND	ND
Manganese	50	193/ ND#	18.3	ND
Vanadium	37	61.4/ ND#	ND	ND

# Denotes Analysis of Filtered Sample

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

SCALE
0 50 100 FEET

LEGEND
- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER
- BLAST WALL
- STORM SEWER
- SANITARY SEWER
- EARTH MOUND
- BUILDING
- FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER
- 10' SURFACE CONTOUR
- PAVED ROADWAY
- UNPAVED ROADWAY
- SURFACE WATER/SEDIMENT
- SURFACE SOIL
- HYDROPUNCH
- MONITORING WELL

DRAWING NUMBER S145062005.dwg
APPROVED BY -- --
CHECKED BY G. Maresca 11/27/06
DRAWN BY S. Wiafe 11/27/06

Picatinny Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Shaw Environmental, Inc.

FIGURE 2-12
SITE 145 - BUILDING 477
EXPLOSIVE AND PROPELLANT MIXING AREA
LOC EXCEEDENCES
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\25 Sites FS\Fig 2-12.dwg
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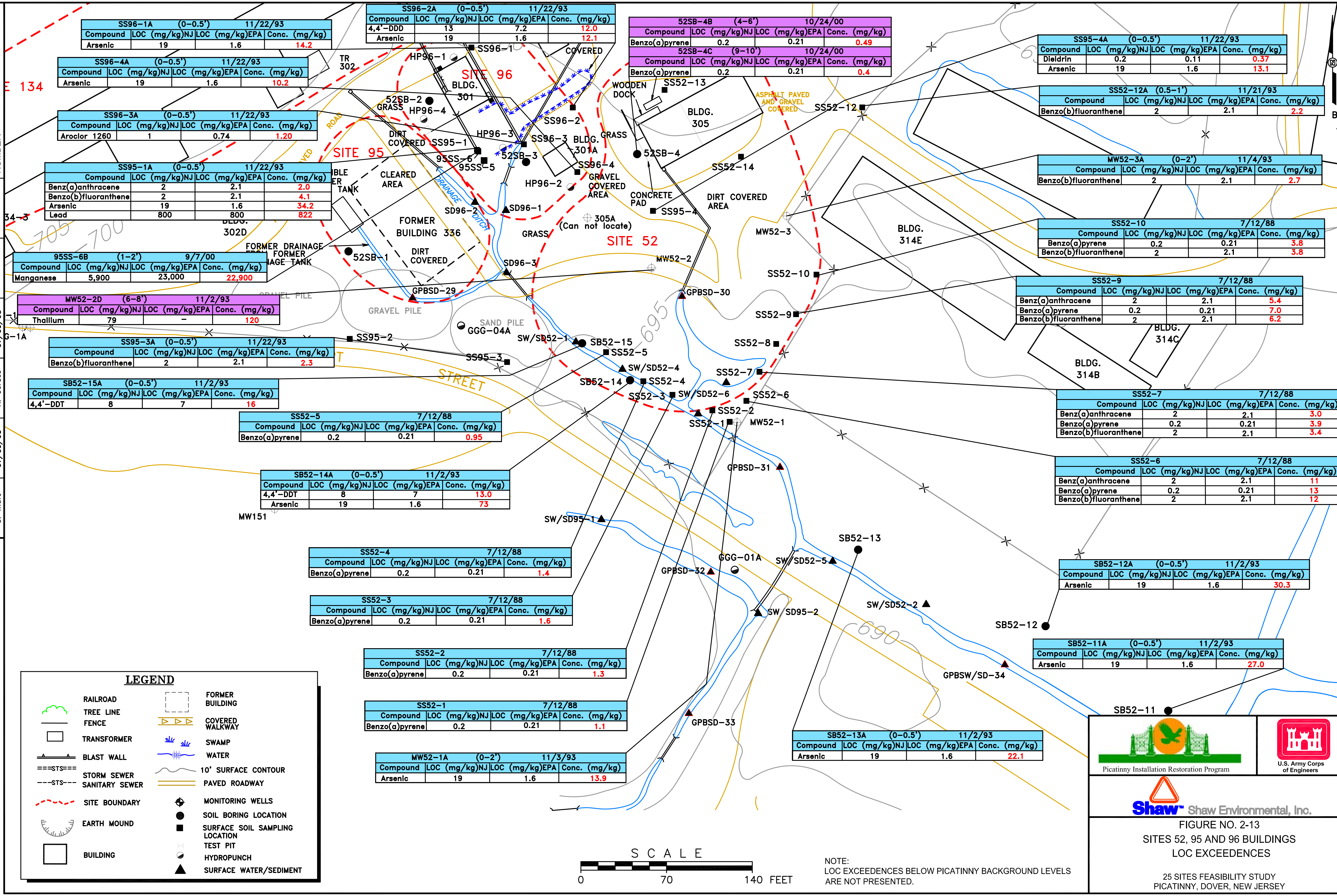
Plotted By: stephen.wiafe



Sample	Depth	Date	Compound	LOC (mg/kg) NJ	LOC (mg/kg) EPA	Conc. (mg/kg)
SS96-2A	(0–0.5')	11/22/93	4,4'–DDD	13	7.2	12.0
			Arsenic	19	1.6	12.1
SS96-1A	(0–0.5')	11/22/93	Arsenic	19	1.6	14.2
SS96-4A	(0–0.5')	11/22/93	Arsenic	19	1.6	10.2
SS96-3A	(0–0.5')	11/22/93	Aroclor 1260	1	0.74	1.20
SS95-1A	(0–0.5')	11/22/93	Benz(a)anthracene	2	2.1	2.0
			Benzo(b)fluoranthene	2	2.1	4.1
			Arsenic	19	1.6	34.2
			Lead	800	800	822
95SS-6B	(1–2')	9/7/00	Manganese	5,900	23,000	22,900
MW52-2D	(6–8')	11/2/93	Thallium	79	–	120
SS95-3A	(0–0.5')	11/22/93	Benzo(b)fluoranthene	2	2.1	2.3
SB52-15A	(0–0.5')	11/2/93	4,4'–DDT	8	7	16
SS52-5		7/12/88	Benzo(a)pyrene	0.2	0.21	0.95
SB52-14A	(0–0.5')	11/2/93	4,4'–DDT	8	7	13.0
			Arsenic	19	1.6	73
SS52-4		7/12/88	Benzo(a)pyrene	0.2	0.21	1.4
SS52-3		7/12/88	Benzo(a)pyrene	0.2	0.21	1.6
SS52-2		7/12/88	Benzo(a)pyrene	0.2	0.21	1.3
SS52-1		7/12/88	Benzo(a)pyrene	0.2	0.21	1.1
MW52-1A	(0–2')	11/3/93	Arsenic	19	1.6	13.9
52SB-4B	(4–6')	10/24/00	Benzo(a)pyrene	0.2	0.21	0.49
52SB-4C	(9–10')	10/24/00	Benzo(a)pyrene	0.2	0.21	0.4
SS95-4A	(0–0.5')	11/22/93	Dieldrin	0.2	0.11	0.37
			Arsenic	19	1.6	13.1
SS52-12A	(0.5–1')	11/21/93	Benzo(b)fluoranthene	2	2.1	2.2
MW52-3A	(0–2')	11/4/93	Benzo(b)fluoranthene	2	2.1	2.7
SS52-10		7/12/88	Benzo(a)pyrene	0.2	0.21	3.8
			Benzo(b)fluoranthene	2	2.1	3.8
SS52-9		7/12/88	Benz(a)anthracene	2	2.1	5.4
			Benzo(a)pyrene	0.2	0.21	7.0
			Benzo(b)fluoranthene	2	2.1	6.2
SS52-7		7/12/88	Benz(a)anthracene	2	2.1	3.0
			Benzo(a)pyrene	0.2	0.21	3.9
			Benzo(b)fluoranthene	2	2.1	3.4
SS52-6		7/12/88	Benz(a)anthracene	2	2.1	11
			Benzo(a)pyrene	0.2	0.21	13
			Benzo(b)fluoranthene	2	2.1	12
SB52-12A	(0–0.5')	11/2/93	Arsenic	19	1.6	30.3
SB52-11A	(0–0.5')	11/2/93	Arsenic	19	1.6	27.0
SB52-13A	(0–0.5')	11/2/93	Arsenic	19	1.6	22.1

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Environmental, Inc.

FIGURE NO. 2-13
SITES 52, 95 AND 96 BUILDINGS
LOC EXCEEDENCES

25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER G52041410.dwg
APPROVED BY – –
CHECKED BY K. Gerdes 07/09/05
DRAWN BY S. Wiafe 07/09/05

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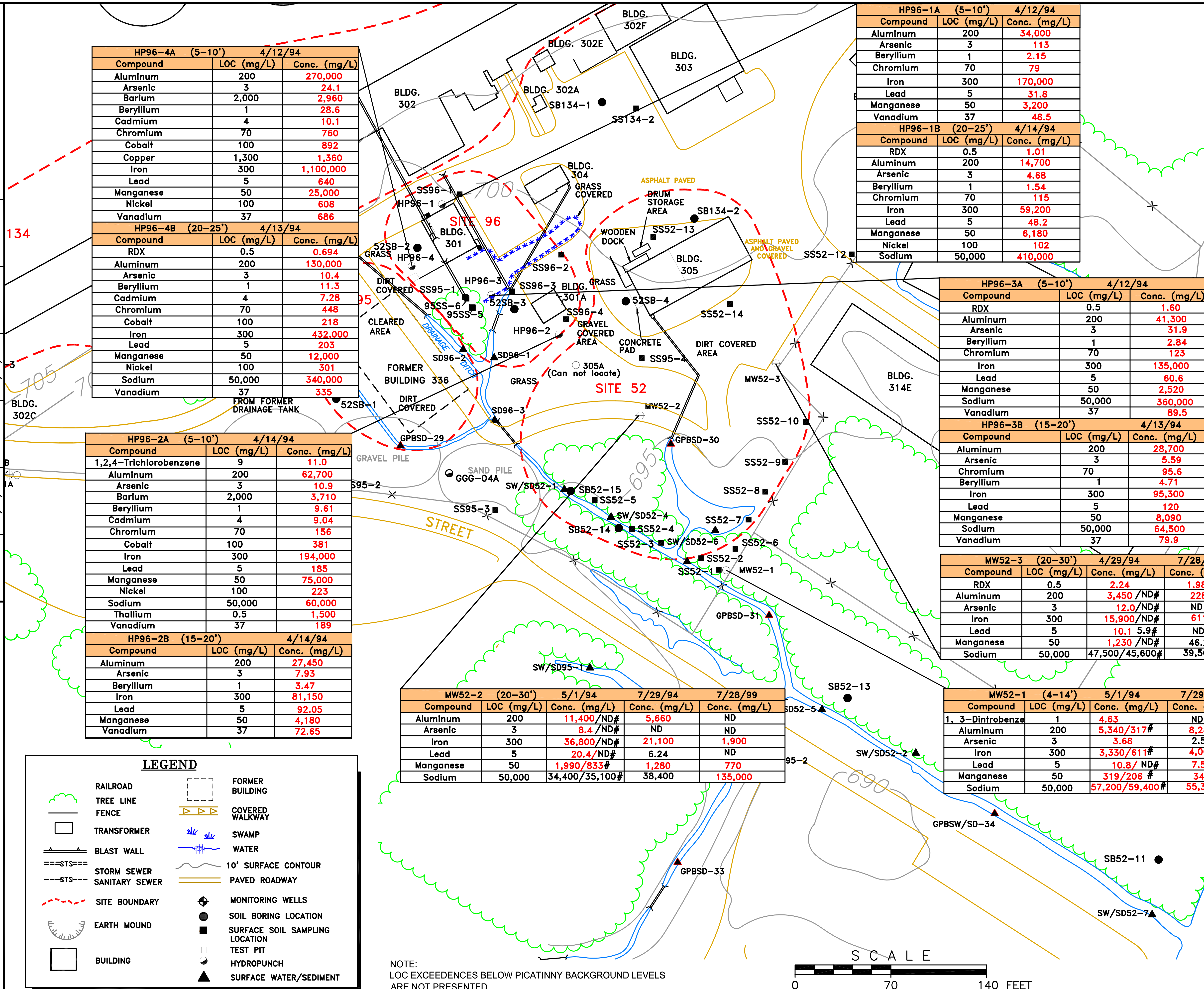
Plotted By: stephen.wiafe



HP96-4A (5-10') 4/12/94		
Compound	LOC (mg/L)	Conc. (mg/L)
Aluminum	200	270,000
Arsenic	3	24.1
Barium	2,000	2,960
Beryllium	1	28.6
Cadmium	4	10.1
Chromium	70	760
Cobalt	100	892
Copper	1,300	1,360
Iron	300	1,100,000
Lead	5	640
Manganese	50	25,000
Nickel	100	608
Vanadium	37	686

HP96-4B (20-25') 4/13/94		
Compound	LOC (mg/L)	Conc. (mg/L)
RDX	0.5	0.694
Aluminum	200	130,000
Arsenic	3	10.4
Beryllium	1	11.3
Cadmium	4	7.28
Chromium	70	448
Cobalt	100	218
Iron	300	432,000
Lead	5	203
Manganese	50	12,000
Nickel	100	301
Sodium	50,000	340,000
Vanadium	37	335

HP96-2A (5-10') 4/14/94		
Compound	LOC (mg/L)	Conc. (mg/L)
1,2,4-Trichlorobenzene	9	11.0
Aluminum	200	62,700
Arsenic	3	10.9
Barium	2,000	3,710
Beryllium	1	9.61
Cadmium	4	9.04
Chromium	70	156
Cobalt	100	381
Iron	300	194,000
Lead	5	185
Manganese	50	75,000
Nickel	100	223
Sodium	50,000	60,000
Thallium	0.5	1,500
Vanadium	37	189

HP96-2B (15-20') 4/14/94		
Compound	LOC (mg/L)	Conc. (mg/L)
Aluminum	200	27,450
Arsenic	3	7.93
Beryllium	1	3.47
Iron	300	81,150
Lead	5	92.05
Manganese	50	4,180
Vanadium	37	72.65

HP96-1A (5-10') 4/12/94		
Compound	LOC (mg/L)	Conc. (mg/L)
Aluminum	200	34,000
Arsenic	3	113
Beryllium	1	2.15
Chromium	70	79
Iron	300	170,000
Lead	5	31.8
Manganese	50	3,200
Vanadium	37	48.5

HP96-1B (20-25') 4/14/94		
Compound	LOC (mg/L)	Conc. (mg/L)
RDX	0.5	1.01
Aluminum	200	14,700
Arsenic	3	4.68
Beryllium	1	1.54
Chromium	70	115
Iron	300	59,200
Lead	5	48.2
Manganese	50	6,180
Nickel	100	102
Sodium	50,000	410,000

HP96-3A (5-10') 4/12/94		
Compound	LOC (mg/L)	Conc. (mg/L)
RDX	0.5	1.60
Aluminum	200	41,300
Arsenic	3	31.9
Beryllium	1	2.84
Chromium	70	123
Iron	300	135,000
Lead	5	60.6
Manganese	50	2,520
Sodium	50,000	360,000
Vanadium	37	89.5

HP96-3B (15-20') 4/13/94		
Compound	LOC (mg/L)	Conc. (mg/L)
Aluminum	200	28,700
Arsenic	3	5.59
Chromium	70	95.6
Beryllium	1	4.71
Iron	300	95,300
Lead	5	120
Manganese	50	8,090
Sodium	50,000	64,500
Vanadium	37	79.9

MW52-3 (20-30')		4/29/94	7/28/94	7/28/99
Compound	LOC (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)
RDX	0.5	2.24	1.98	ND
Aluminum	200	3,450 /ND#	228	ND
Arsenic	3	12.0/ND#	ND	ND
Iron	300	15,900/ND#	611	ND
Lead	5	10.1 5.9#	ND	ND
Manganese	50	1,230 /ND#	46.2	7.8
Sodium	50,000	47,500/45,600#	39,500	374,000

MW52-2 (20-30')		5/1/94	7/29/94	7/28/99
Compound	LOC (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)
Aluminum	200	11,400/ND#	5,660	ND
Arsenic	3	8.4 /ND#	ND	ND
Iron	300	36,800/ND#	21,100	1,900
Lead	5	20.4/ND#	6.24	ND
Manganese	50	1,990/833#	1,280	770
Sodium	50,000	34,400/35,100#	38,400	135,000

MW52-1 (4-14')		5/1/94	7/29/94	8/3/99
Compound	LOC (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)
1, 3-Dintrobenze	1	4.63	ND	ND
Aluminum	200	5,340/317#	8,280	590
Arsenic	3	3.68	2.55	ND
Iron	300	3,330/611#	4,000	1,700
Lead	5	10.8/ ND#	7.52	ND
Manganese	50	319/206 #	340	290
Sodium	50,000	57,200/59,400#	55,300	37,900

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Shaw Environmental, Inc.

FIGURE NO. 2-14
SITES 52, 95 AND 96 BUILDINGS
GROUNDWATER LOC EXCEEDENCES

25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER G52070905.dwg

APPROVED BY --
CHECKED BY K. Gerdes 07/09/05
DRAWN BY S. Wiafe 07/09/05

File: N:\cad\CAD drawings\Picatinny\Area-G\site52\G52070905.dwg
Plot Date/Time: Apr 22, 2010 - 5:30pm
Plotted By: stephen.wiafe

134SD-3 (0-1') 9/18/00			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.21	1.90
Benzo(b)fluoranthene	2	2.1	3.2
Dibenz(a,h)anthracene	0.2	0.21	0.4

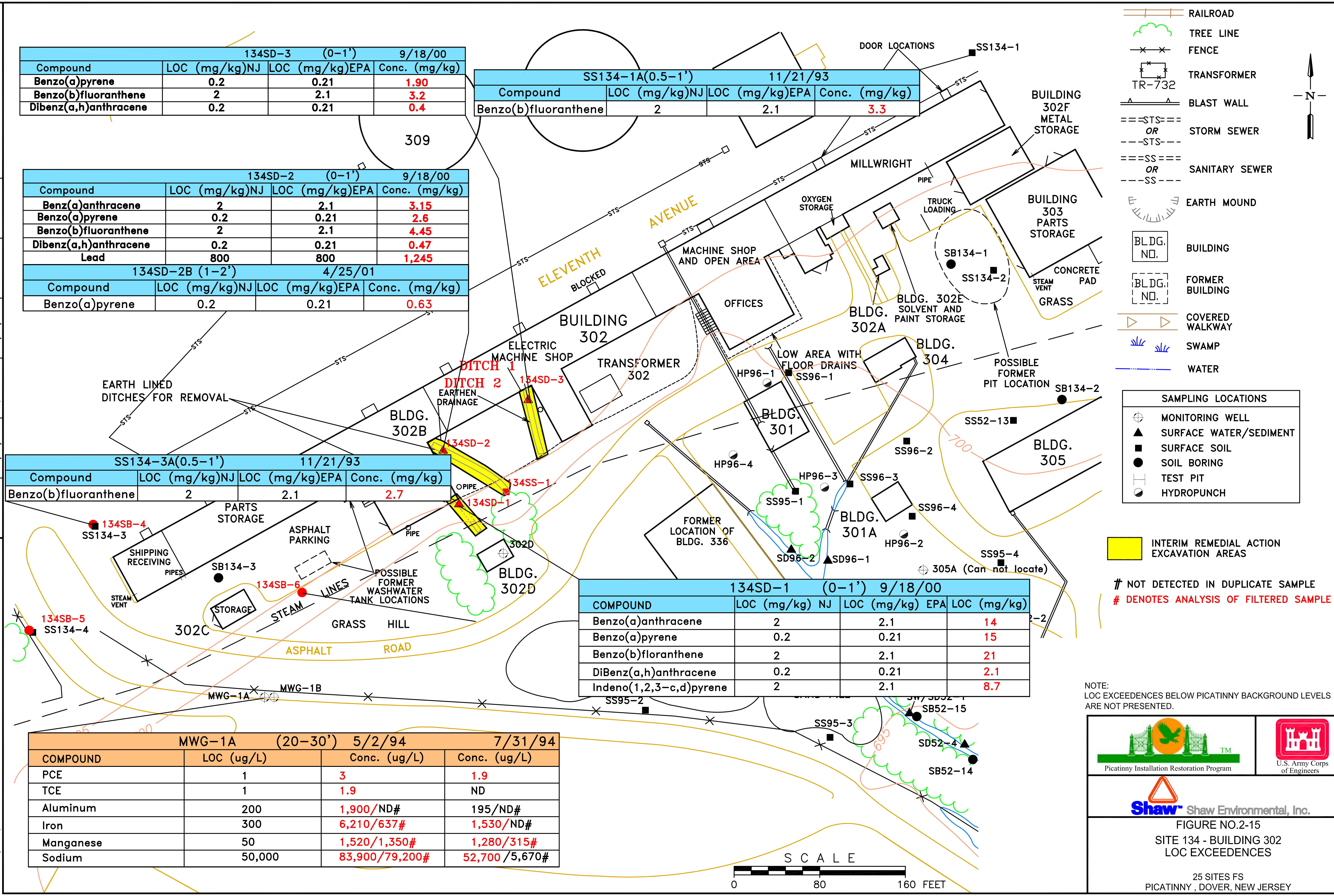
SS134-1A(0.5-1') 11/21/93			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(b)fluoranthene	2	2.1	3.3

134SD-2 (0-1') 9/18/00			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benz(a)anthracene	2	2.1	3.15
Benzo(a)pyrene	0.2	0.21	2.6
Benzo(b)fluoranthene	2	2.1	4.45
Dibenz(a,h)anthracene	0.2	0.21	0.47
Lead	800	800	1,245
134SD-2B (1-2') 4/25/01			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.21	0.63

SS134-3A(0.5-1') 11/21/93			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(b)fluoranthene	2	2.1	2.7

134SD-1 (0-1') 9/18/00			
COMPOUND	LOC (mg/kg) NJ	LOC (mg/kg) EPA	LOC (mg/kg)
Benzo(a)anthracene	2	2.1	14
Benzo(a)pyrene	0.2	0.21	15
Benzo(b)floranthene	2	2.1	21
DiBenz(a,h)anthracene	0.2	0.21	2.1
Indeno(1,2,3-c,d)pyrene	2	2.1	8.7

MWG-1A (20-30')		5/2/94	7/31/94
COMPOUND	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
PCE	1	3	1.9
TCE	1	1.9	ND
Aluminum	200	1,900/ND#	195/ND#
Iron	300	6,210/637#	1,530/ND#
Manganese	50	1,520/1,350#	1,280/315#
Sodium	50,000	83,900/79,200#	52,700/5,670#



NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE NO.2-15

SITE 134 - BUILDING 302

LOC EXCEEDENCES

25 SITES FS

PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER G134SD051105.dwg

DRAWN BY S. Wiafe 04/15/10

CHECKED BY K. Gerdes 04/15/10

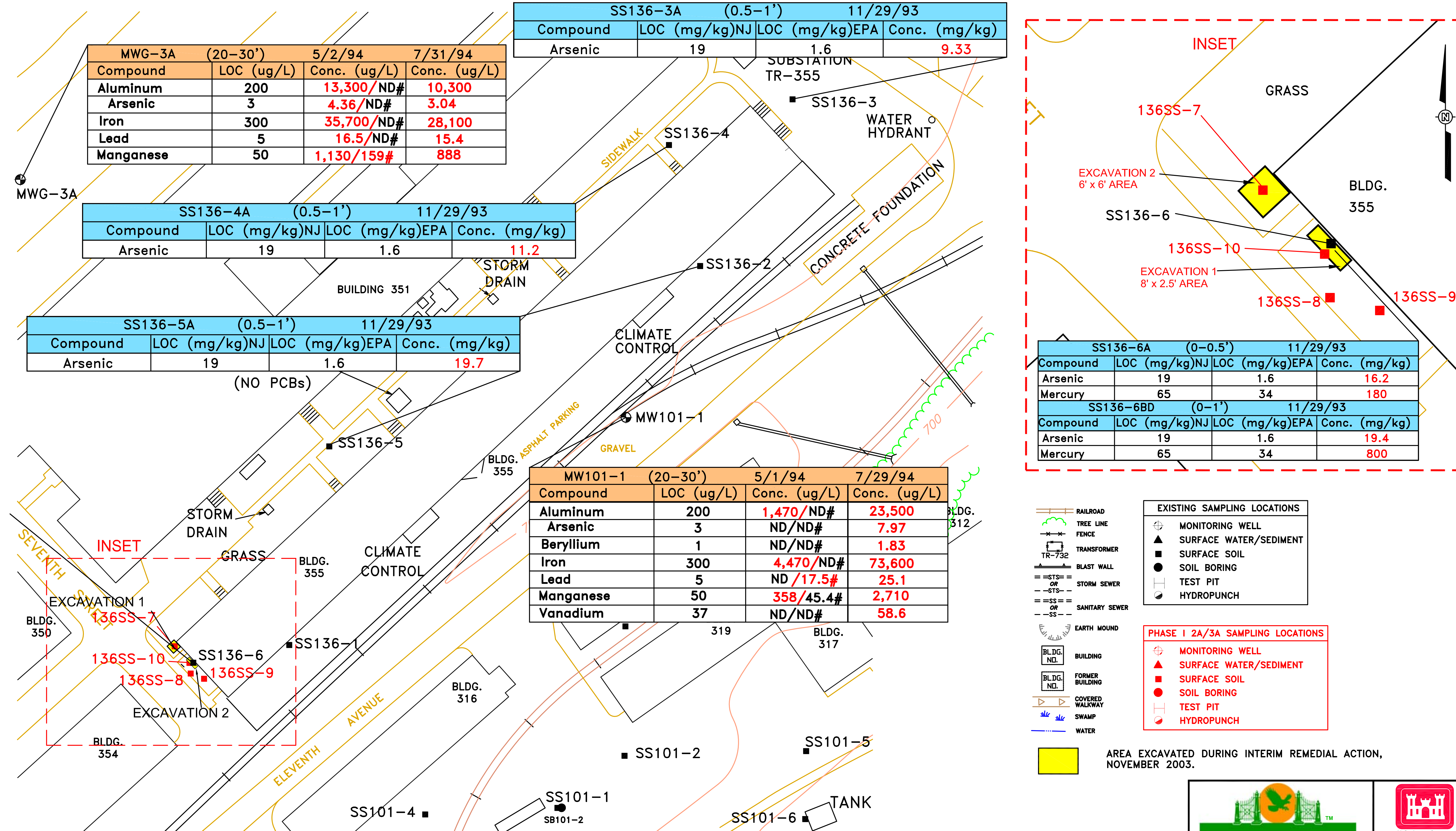
APPROVED BY - --

File: N:\cad\CAD drawings\Picatinny\Area-G\site134\G134SD051105.dwg Plot Date/Time: Apr 22, 2010 - 5:44pm Plotted By: stephen.wiafe

PLOT DATE: 05/20/03

File: N:\cad\CAD drawings\Picatinny\Area-G\site136\G136052505.dwg
Plot Date/Time: Apr 22, 2010 – 5:53pm
Plotted By: stephen.wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	05/27/05	K. Gerdes	05/27/05	--	--	G136052505



MWG-3A	(20-30')	5/2/94	7/31/94
Compound	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Aluminum	200	13,300/ND#	10,300
Arsenic	3	4.36/ND#	3.04
Iron	300	35,700/ND#	28,100
Lead	5	16.5/ND#	15.4
Manganese	50	1,130/159#	888

SS136-3A	(0.5-1')		11/29/93
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	9.33

SS136-4A	(0.5-1')		11/29/93
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	11.2

SS136-5A	(0.5-1')		11/29/93
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	19.7

MW101-1	(20-30')	5/1/94	7/29/94
Compound	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Aluminum	200	1,470/ND#	23,500
Arsenic	3	ND/ND#	7.97
Beryllium	1	ND/ND#	1.83
Iron	300	4,470/ND#	73,600
Lead	5	ND /17.5#	25.1
Manganese	50	358/45.4#	2,710
Vanadium	37	ND/ND#	58.6

SS136-6A	(0-0.5')		11/29/93
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	16.2
Mercury	65	34	180

SS136-6BD	(0-1')		11/29/93
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	19.4
Mercury	65	34	800

RAILROAD
TREE LINE
FENCE
TR-732 TRANSFORMER
BLAST WALL
STS OR STS STORM SEWER
SS OR SS SANITARY SEWER
EARTH MOUND
BLDG. NO. BUILDING
BLDG. NO. FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER

EXISTING SAMPLING LOCATIONS
- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL
- SOIL BORING
- TEST PIT
- HYDROPUNCH

PHASE I 2A/3A SAMPLING LOCATIONS
- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL
- SOIL BORING
- TEST PIT
- HYDROPUNCH

AREA EXCAVATED DURING INTERIM REMEDIAL ACTION, NOVEMBER 2003.

SCALE
0 50 100 FEET

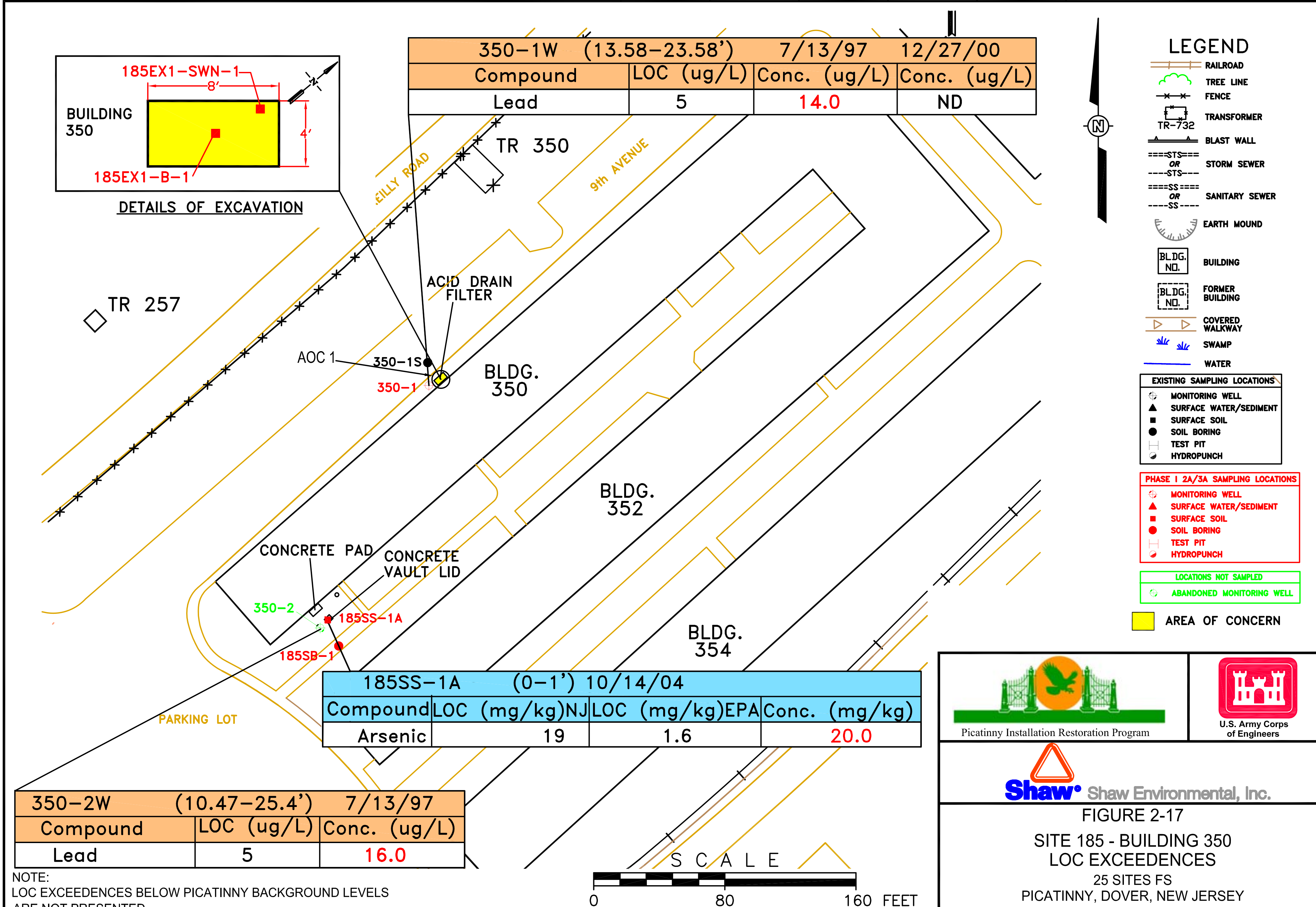
NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Shaw Environmental, Inc.

FIGURE No. 2-16
SITE 136 - BUILDING 355
METALLURGY LABORATORY
LOC EXCEEDENCES
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-G\site185\G185062305.dwg
Plot Date/Time: Apr 23, 2010 – 9:53am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	06/23/05	K. Gerdes	06/23/05	--	--	G185062305.dwg



350-1W (13.58-23.58')		7/13/97	12/27/00
Compound	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Lead	5	14.0	ND

185SS-1A (0-1') 10/14/04			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	20.0

350-2W (10.47-25.4')		7/13/97
Compound	LOC (ug/L)	Conc. (ug/L)
Lead	5	16.0

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

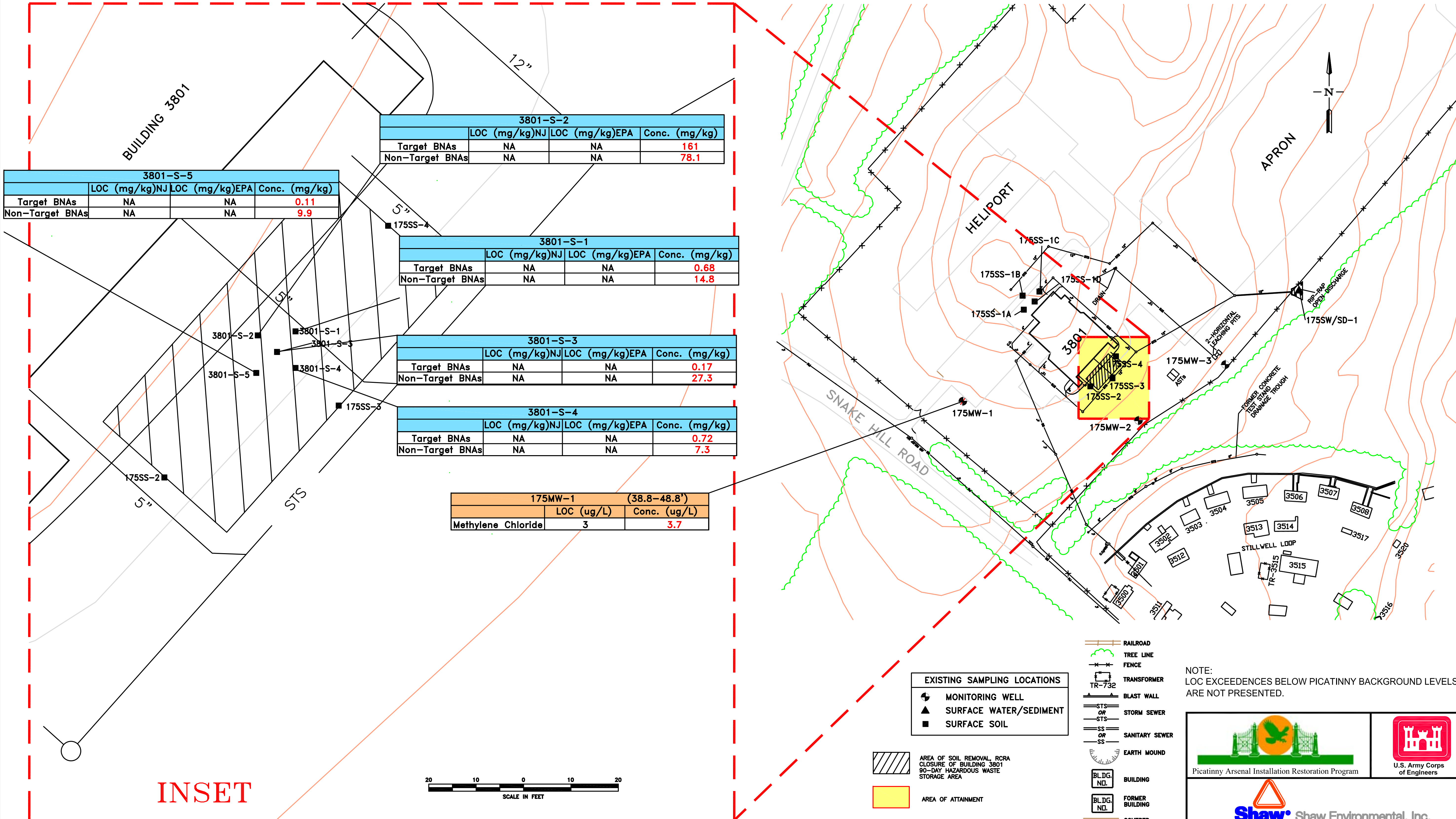
U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-17

SITE 185 - BUILDING 350
LOC EXCEEDENCES

25 SITES FS
PICATINNY, DOVER, NEW JERSEY



3801-S-5

	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Target BNAs	NA	NA	0.11
Non-Target BNAs	NA	NA	9.9

3801-S-2

	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Target BNAs	NA	NA	161
Non-Target BNAs	NA	NA	78.1

3801-S-1

	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Target BNAs	NA	NA	0.68
Non-Target BNAs	NA	NA	14.8

3801-S-3

	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Target BNAs	NA	NA	0.17
Non-Target BNAs	NA	NA	27.3

3801-S-4

	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Target BNAs	NA	NA	0.72
Non-Target BNAs	NA	NA	7.3

175MW-1 (38.8-48.8')

	LOC (ug/L)	Conc. (ug/L)
Methylene Chloride	3	3.7

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

NOTE:
TOPOGRAPHIC CONTOUR SOURCE IS THE IDENTIFICATION AND ANALYSIS OF WETLANDS, FLOODPLAINS, THREATENED AND ENDANGERED SPECIES AND ARCHAEOLOGICAL GEOMORPHOLOGY AT PICATINNY ARSENAL, NJ (WES, 1994), WHICH USED TOPOGRAPHIC CONTOURS DERIVED FROM 1948 SURVEY MAPS. THESE SURVEY MAPS WERE SCANNED TO CREATE ELECTRONIC FILES AND WERE MANUALLY REFINED. WHILE THESE CONTOURS DEPICT GENERAL TOPOGRAPHY WELL, THEY ARE NOT PRECISE IN SOME LOCATIONS.

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-18

SITE 175 - BUILDING 3801
LOC EXCEEDENCES

PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWING NUMBER 175103100.dwg
APPROVED BY -- --
CHECKED BY K. Gerdes 04/07/10
DRAWN BY S. Wafe 04/07/10

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Plotted By: stephen.Wafe

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Plot Date/Time: Apr 23, 2010 – 9:58am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
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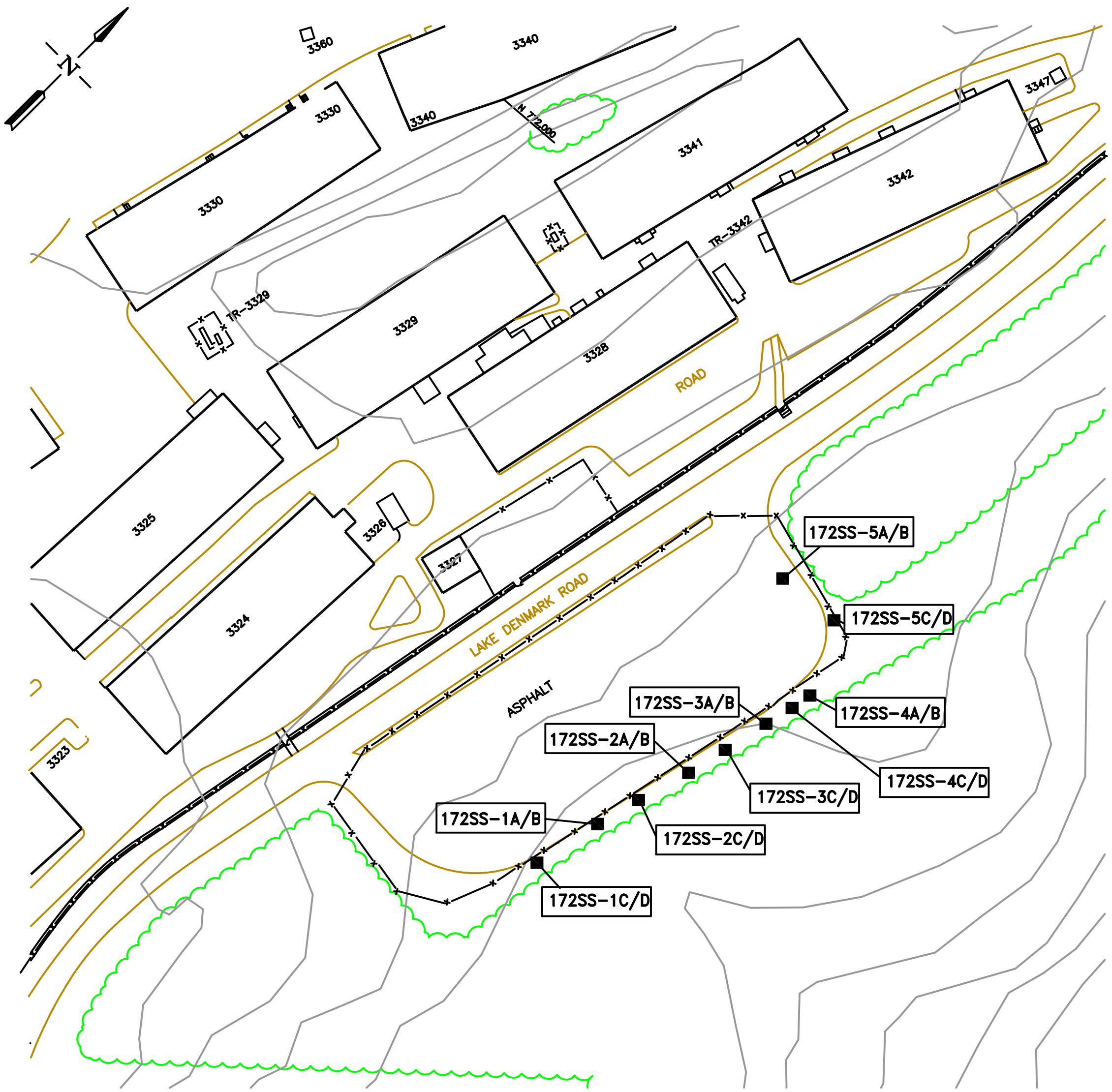


LEGEND
- SIDEWALK
- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER
- BLAST WALL
- STORM SEWER
- SANITARY SEWER
- EARTH MOUND
- BUILDING
- FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER
- 5' SURFACE CONTOUR
- PAVED ROADWAY
- UNPAVED ROADWAY
- MONITORING WELL
- SOIL BORING
- SURFACE WATER/SEDIMENT
- SURFACE SOIL

SCALE
1"=130'
0 65 130

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-19

SITE 172
PARKING LOT ACROSS FROM BLDG 3328
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

NOTE:
TOPOGRAPHIC CONTOUR SOURCE IS THE IDENTIFICATION AND ANALYSIS OF WETLANDS, FLOODPLAINS, THREATENED AND ENDANGERED SPECIES AND ARCHAEOLOGICAL GEOMORPHOLOGY AT PICATINNY, NJ (WES, 1994), WHICH USED TOPOGRAPHIC CONTOURS DERIVED FROM 1948 SURVEY MAPS. THESE SURVEY MAPS WERE SCANNED TO CREATE ELECTRONIC FILES AND WERE MANUALLY REFINED. WHILE THESE CONTOURS DEPICT GENERAL TOPOGRAPHY WELL, THEY ARE NOT PRECISE IN SOME LOCATIONS.

File: N:\cad\CAD drawings\Picatinny\Area-K\site173\PHASE2RISITEMAPS\173040810.dwg
Plot Date/Time: Apr 23, 2010 – 2:32pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	04/15/10	K. Gerdes	04/15/10	--	--	173040810.dwg

173MW-2 (31-41')		
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	345
Iron	300	410
Lead	5	7.04

173MW-2A			(2-4')
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	21.1

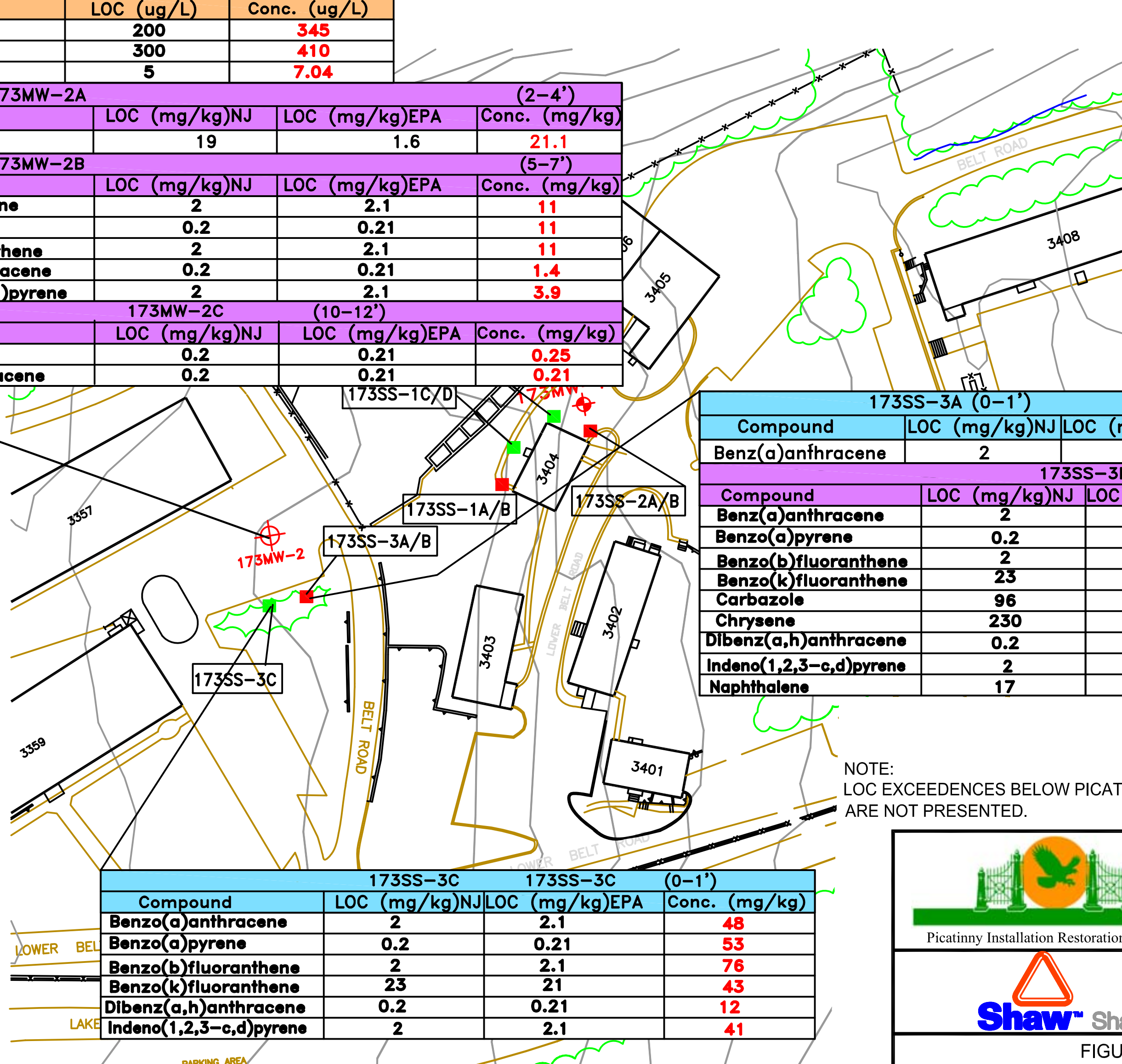
173MW-2B			(5-7')
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benz(a)anthracene	2	2.1	11
Benzo(a)pyrene	0.2	0.21	11
Benzo(b)fluoranthene	2	2.1	11
Dibenz(a,h)anthracene	0.2	0.21	1.4
Indeno(1,2,3-c,d)pyrene	2	2.1	3.9

173MW-2C		(10-12')	
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.21	0.25
Dibenz(a,h)anthracene	0.2	0.21	0.21

173SS-3A (0-1')			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benz(a)anthracene	2	2.1	5

173SS-3B			(2-4')
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	
Benz(a)anthracene	2	2.1	2,700
Benzo(a)pyrene	0.2	0.21	2,600
Benzo(b)fluoranthene	2	2.1	2,700
Benzo(k)fluoranthene	23	21	2,800
Carbazole	96	–	690
Chrysene	230	210	2,400
Dibenz(a,h)anthracene	0.2	0.21	420
Indeno(1,2,3-c,d)pyrene	2	2.1	1,200
Naphthalene	17	18	640

173SS-3C	173SS-3C		(0-1')
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(a)anthracene	2	2.1	48
Benzo(a)pyrene	0.2	0.21	53
Benzo(b)fluoranthene	2	2.1	76
Benzo(k)fluoranthene	23	21	43
Dibenz(a,h)anthracene	0.2	0.21	12
Indeno(1,2,3-c,d)pyrene	2	2.1	41



LEGEND

- SIDEWALK
- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER
- BLAST WALL
- STORM SEWER
- SANITARY SEWER
- EARTH MOUND
- BUILDING
- FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER
- 5' SURFACE CONTOUR
- PAVED ROADWAY
- UNPAVED ROADWAY
- MONITORING WELL
- MONITORING WELL BORING SOIL SAMPLES COLLECTED ONLY
- SOIL BORING
- SURFACE WATER/SEDIMENT
- SURFACE SOIL-OFFSITE ANALYSIS
- SURFACE SOIL-ONSITE ANALYSIS ONLY

LOC (mg/kg)

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

NOTE:
TOPOGRAPHIC CONTOUR SOURCE IS THE IDENTIFICATION AND ANALYSIS OF WETLANDS, FLOODPLAINS, THREATENED AND ENDANGERED SPECIES AND ARCHAEOLOGICAL GEOMORPHOLOGY AT PICATINNY ARSENAL, NJ (WES, 1994), WHICH USED TOPOGRAPHIC CONTOURS DERIVED FROM 1948 SURVEY MAPS. THESE SURVEY MAPS WERE SCANNED TO CREATE ELECTRONIC FILES AND WERE MANUALLY REFINED. WHILE THESE CONTOURS DEPICT GENERAL TOPOGRAPHY WELL, THEY ARE NOT PRECISE IN SOME LOCATIONS.

SCALE
0 120 240 FEET

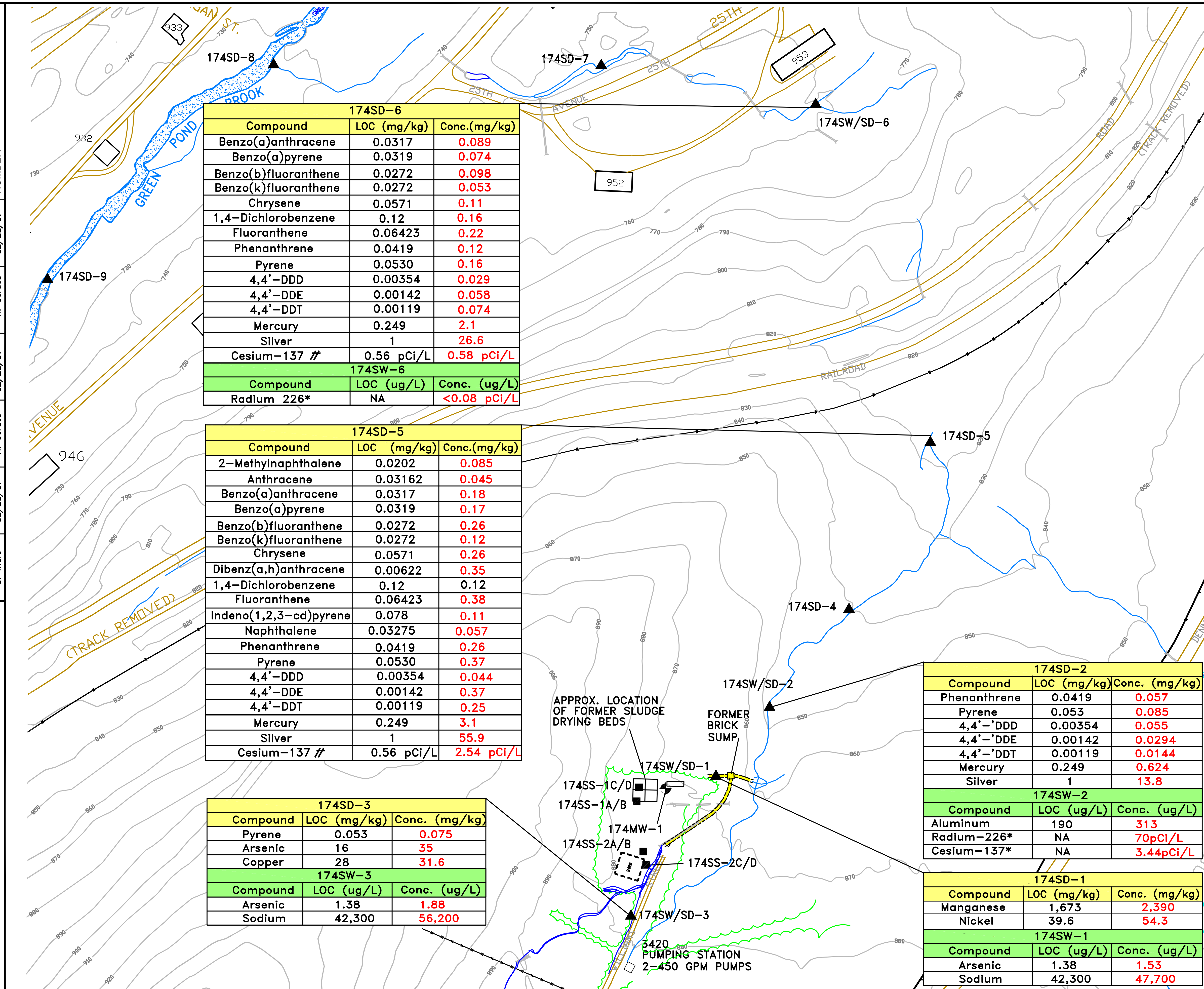
Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE NO. 2-20

SITE 173 - BUILDING 3404
LOC EXCEEDENCES
25 SITES FS
PICATINNY, DOVER, NEW JERSEY



174SD-6		
Compound	LOC (mg/kg)	Conc.(mg/kg)
Benzo(a)anthracene	0.0317	0.089
Benzo(a)pyrene	0.0319	0.074
Benzo(b)fluoranthene	0.0272	0.098
Benzo(k)fluoranthene	0.0272	0.053
Chrysene	0.0571	0.11
1,4-Dichlorobenzene	0.12	0.16
Fluoranthene	0.06423	0.22
Phenanthrene	0.0419	0.12
Pyrene	0.0530	0.16
4,4'-DDD	0.00354	0.029
4,4'-DDE	0.00142	0.058
4,4'-DDT	0.00119	0.074
Mercury	0.249	2.1
Silver	1	26.6
Cesium-137 #	0.56 pCi/L	0.58 pCi/L
174SW-6		
Compound	LOC (ug/L)	Conc. (ug/L)
Radium 226*	NA	<0.08 pCi/L

174SD-5		
Compound	LOC (mg/kg)	Conc.(mg/kg)
2-Methylnaphthalene	0.0202	0.085
Anthracene	0.03162	0.045
Benzo(a)anthracene	0.0317	0.18
Benzo(a)pyrene	0.0319	0.17
Benzo(b)fluoranthene	0.0272	0.26
Benzo(k)fluoranthene	0.0272	0.12
Chrysene	0.0571	0.26
Dibenz(a,h)anthracene	0.00622	0.35
1,4-Dichlorobenzene	0.12	0.12
Fluoranthene	0.06423	0.38
Indeno(1,2,3-cd)pyrene	0.078	0.11
Naphthalene	0.03275	0.057
Phenanthrene	0.0419	0.26
Pyrene	0.0530	0.37
4,4'-DDD	0.00354	0.044
4,4'-DDE	0.00142	0.37
4,4'-DDT	0.00119	0.25
Mercury	0.249	3.1
Silver	1	55.9
Cesium-137 #	0.56 pCi/L	2.54 pCi/L

174SD-3		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Pyrene	0.053	0.075
Arsenic	16	35
Copper	28	31.6
174SW-3		
Compound	LOC (ug/L)	Conc. (ug/L)
Arsenic	1.38	1.88
Sodium	42,300	56,200

174SD-2		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Phenanthrene	0.0419	0.057
Pyrene	0.053	0.085
4,4'-DDD	0.00354	0.055
4,4'-DDE	0.00142	0.0294
4,4'-DDT	0.00119	0.0144
Mercury	0.249	0.624
Silver	1	13.8
174SW-2		
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	190	313
Radium-226*	NA	70pCi/L
Cesium-137*	NA	3.44pCi/L

174SD-1		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Manganese	1,673	2,390
Nickel	39.6	54.3
174SW-1		
Compound	LOC (ug/L)	Conc. (ug/L)
Arsenic	1.38	1.53
Sodium	42,300	47,700

NOTES:

NA – NOT AVAILABLE
* RADIUM-226 AND CESIUM-137 DO NOT HAVE LOCs, HOWEVER, CONCENTRATIONS IN 174SW-2 EXCEEDED RBCs BASED ON USEPA GUIDANCE (1991) AMENDED BY THE DINAN (1992) MEMORANDUM, AND BACKGROUND CONCENTRATIONS.

THE LOC PRESENTED FOR CESIUM-137 IN SEDIMENT IS EQUAL TO THE BACKGROUND THRESHOLD VALUE FROM THE PICATINNY BACKGROUND STUDY REPORT.

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

RAILROAD
TREE LINE
FENCE
TR-732 TRANSFORMER
BLAST WALL
STORM SEWER
SANITARY SEWER
EARTH MOUND
BLDG. NO. BUILDING
BLDG. NO. FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER
SURFACE WATER/ SEDIMENT SAMPLE
SOIL SAMPLE
EXCAVATION

SCALE
0 160 320 FEET

Picatinny Arsenal Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Environmental, Inc.

FIGURE 2-21
SITE 174 - FORMER BUILDING 3420
LOC EXCEEDENCES
25 SITES FS
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWING NUMBER 174071700.dwg
APPROVED BY K. Gerdes 02/28/07
CHECKED BY K. Gerdes 02/28/07
DRAWN BY S. Wiafe 02/28/07

File: N:\cad\CAD drawings\Picatinny\Area-K\site174\PHASE2RISITEMAPS\174071700.dwg
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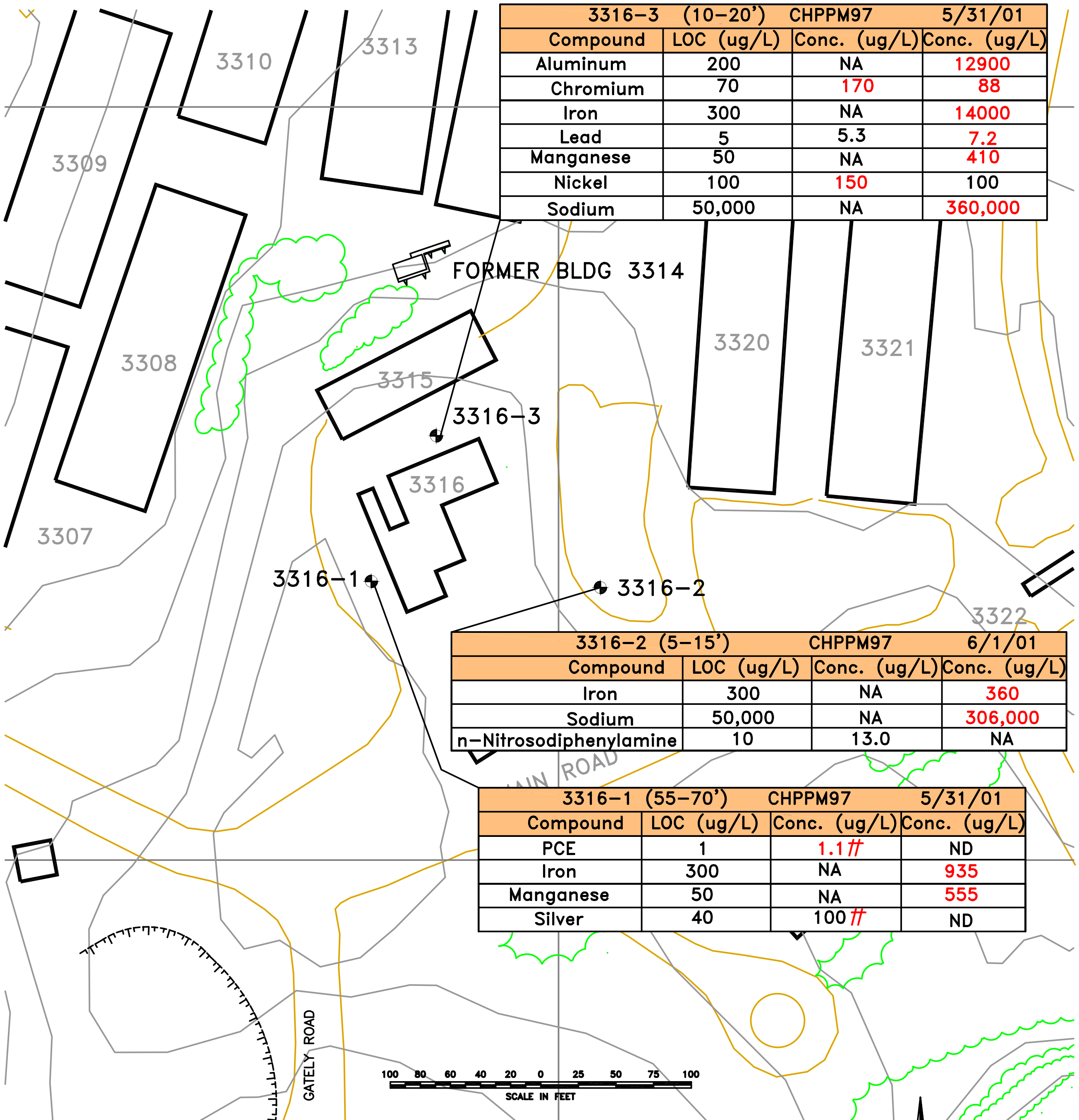
Plotted By: stephen.Wiafe



3316-3 (10-20')	CHPPM97		5/31/01
Compound	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Aluminum	200	NA	12900
Chromium	70	170	88
Iron	300	NA	14000
Lead	5	5.3	7.2
Manganese	50	NA	410
Nickel	100	150	100
Sodium	50,000	NA	360,000

3316-2 (5-15')		CHPPM97	6/1/01
Compound	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
Iron	300	NA	360
Sodium	50,000	NA	306,000
n-Nitrosodiphenylamine	10	13.0	NA

3316-1 (55-70')	CHPPM97		5/31/01
Compound	LOC (ug/L)	Conc. (ug/L)	Conc. (ug/L)
PCE	1	1.1 ##	ND
Iron	300	NA	935
Manganese	50	NA	555
Silver	40	100 ##	ND

= NOT DETECTED IN DUPLICATE SAMPLE

RAILROAD
TREE LINE
FENCE
TRANSFORMER TR-732
BLAST WALL
STORM SEWER (===STS=== OR ---STS---)
SANITARY SEWER (===SS=== OR ---SS---)
EARTH MOUND
BUILDING (BLDG. NO.)
FORMER BUILDING (BLDG. NO.)
COVERED WALKWAY
SWAMP
WATER

EXISTING SAMPLING LOCATIONS

- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL
- SOIL BORING
- TEST PIT
- HYDROPUNCH

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-22

SITE 186 - BUILDING 3316
FIREHOUSE-LOC EXCEEDANCES

25 SITES FS
PICATINNY, DOVER, NJ

DRAWING NUMBER 189040710.dwg

APPROVED BY -- --

CHECKED BY K. Gerdes 04/07/10

DRAWN BY S. Wiafe 04/07/10

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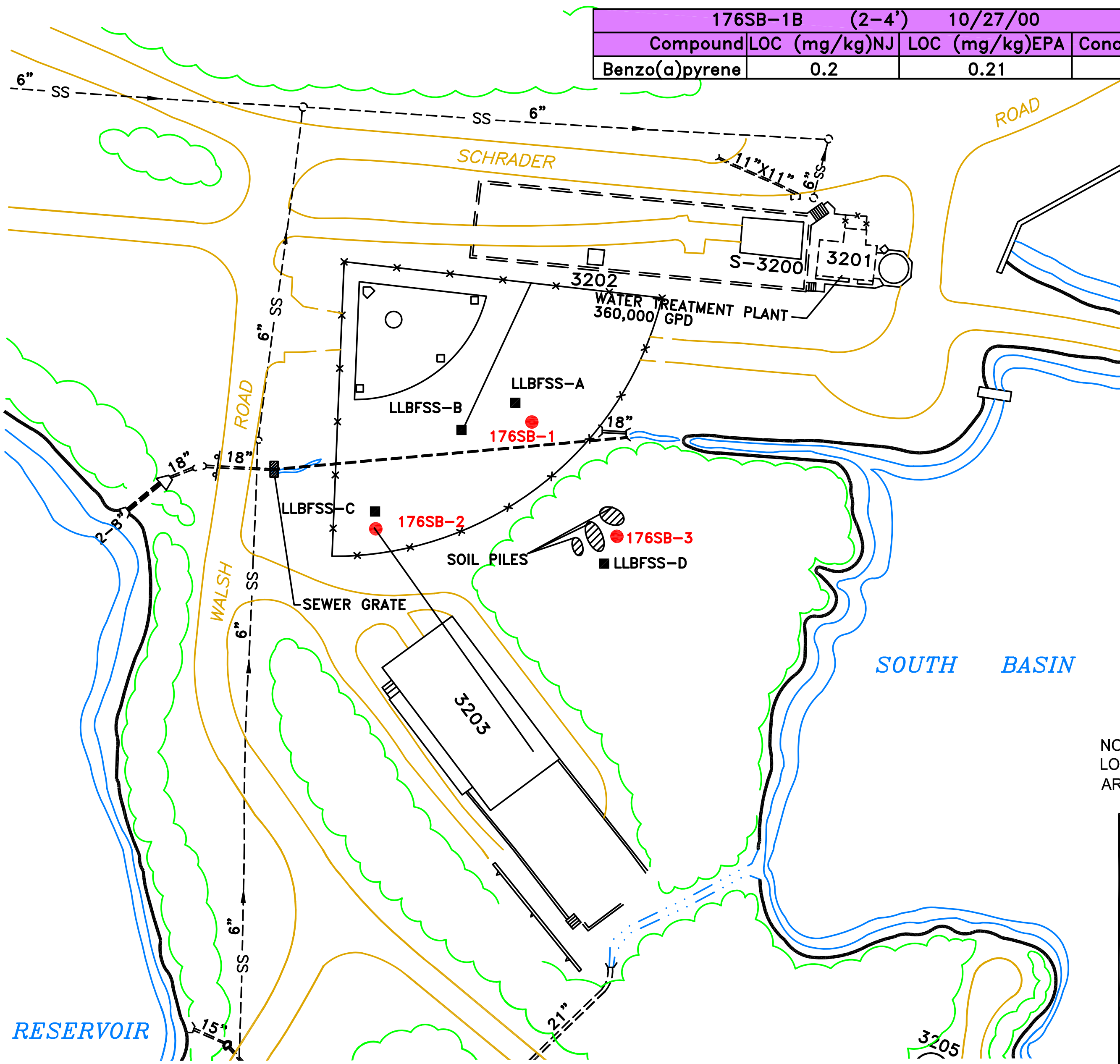
Plot Date/Time: Apr 23, 2010 - 10:06am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
Stephen Wiafe	04/09/10	K. GERDES	04/09/10	G. MARESCA	05/31/05	L176111202.dwg

176SB-1B (2-4') 10/27/00			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.21	0.47



LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

EXISTING SAMPLING LOCATIONS	
■	SURFACE SOIL
●	SOIL BORING

PHASE III 2A/3A RI SAMPLING LOCATIONS	
●	SOIL BORING

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

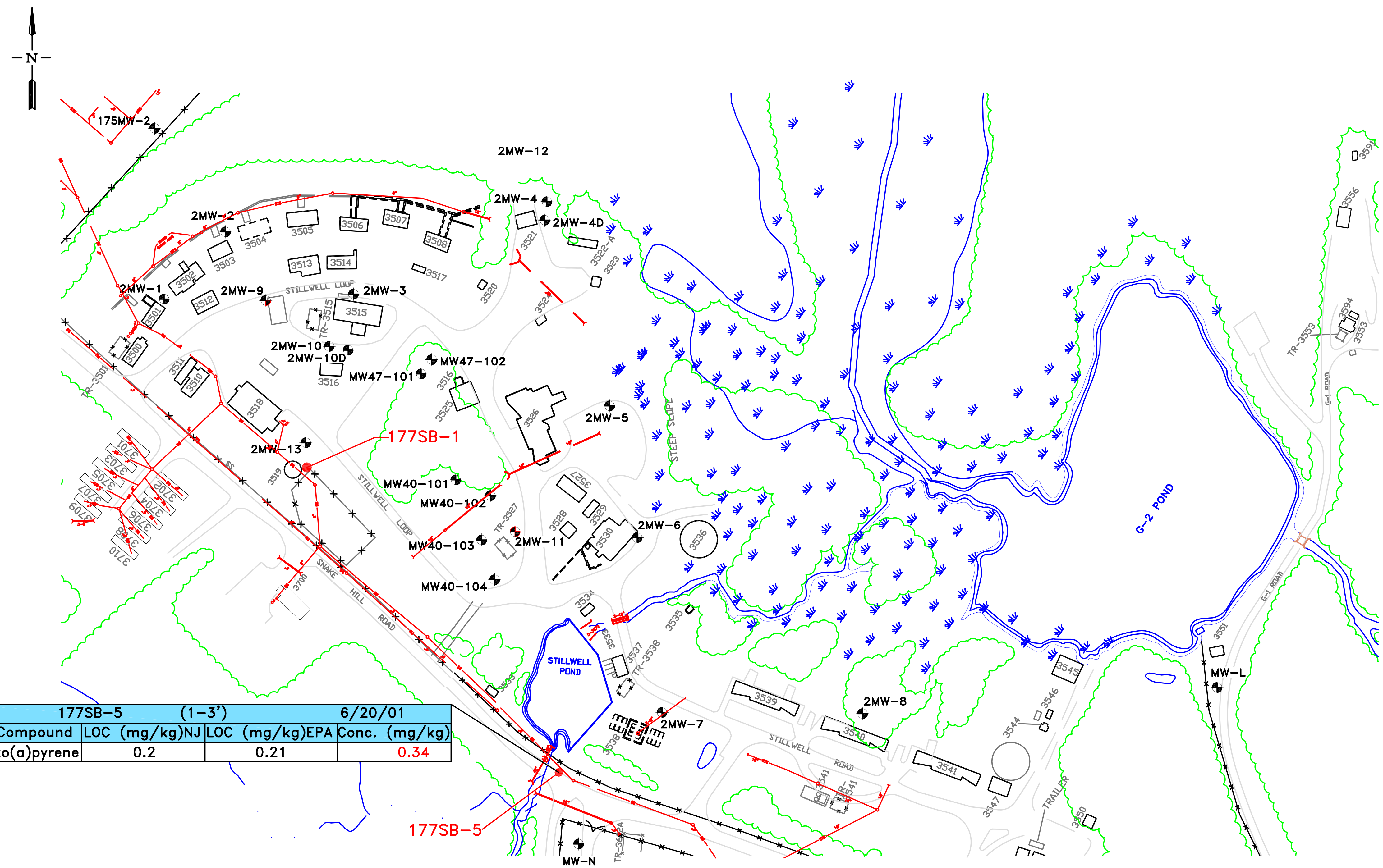
SCALE
0 100 200 FEET

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-23
SITE 176 -
LITTLE LEAGUE BASEBALL FIELD
SAMPLE LOCATIONS
25 SITES FS
PICATINNY, DOVER, NEW JERSEY



177SB-5	(1-3')		6/20/01
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.21	0.34

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

EXISTING SAMPLING LOCATIONS
SOIL BORING
MONITORING WELL

PHASE III 2A/3A RI SAMPLING LOCATIONS
SOIL BORING

200 150 100 50 0 100 200
SCALE IN FEET
1" = 200ft

NOTE:
TOPOGRAPHIC CONTOUR SOURCE IS THE IDENTIFICATION AND ANALYSIS OF WETLANDS, FLOODPLAINS, THREATENED AND ENDANGERED SPECIES AND ARCHAEOLOGICAL GEOMORPHOLOGY AT PICATINNY, NJ (WES, 1994), WHICH USED TOPOGRAPHIC CONTOURS DERIVED FROM 1948 SURVEY MAPS. THESE SURVEY MAPS WERE SCANNED TO CREATE ELECTRONIC FILES AND WERE MANUALLY REFINED. WHILE THESE CONTOURS DEPICT GENERAL TOPOGRAPHY WELL, THEY ARE NOT PRECISE IN SOME LOCATIONS.

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

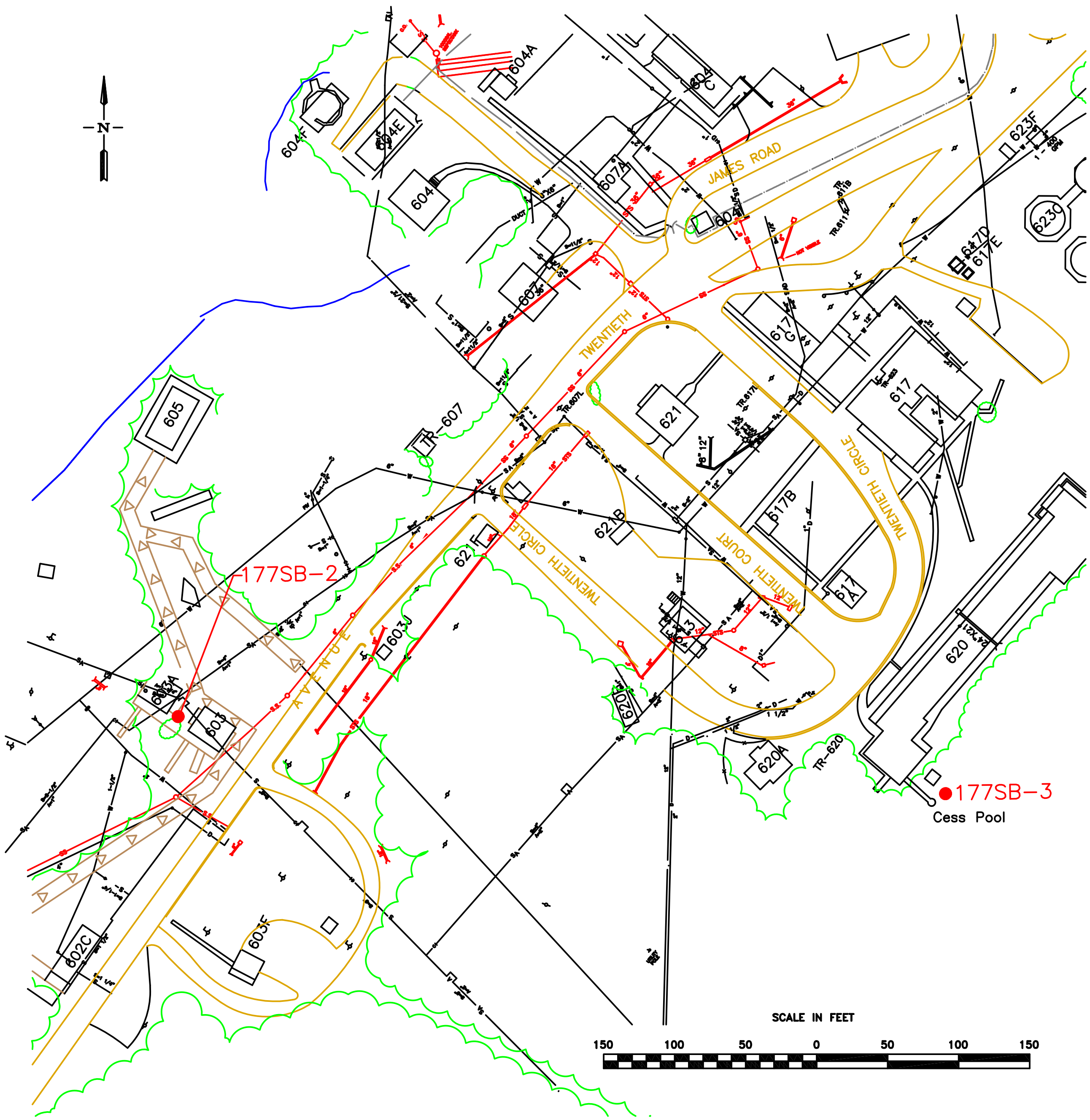
FIGURE 2-24

SITE 177 - 3500 BUILDING AREA
SEWER LINE INVESTIGATION

25 SITES FFS
PICATINNY, DOVER, NEW JERSEY

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 04/15/10	K. Gerdes 04/5/010	-- --	L177041510.dwg

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	L177010303C.dwg
S. Wiafe	04/15/10	K. Gerdes	04/15/10	G. MARESCA	04/15/10		



LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER (TR–732)
- BLAST WALL
- STORM SEWER (STS OR STS)
- SANITARY SEWER (SS OR SS)
- EARTH MOUND
- BUILDING (BLDG. NO.)
- FORMER BUILDING (BLDG. NO.)
- COVERED WALKWAY
- SWAMP
- WATER

EXISTING SAMPLING LOCATIONS
● SOIL BORING

PHASE III 2A/3A RI SAMPLING LOCATIONS
● SOIL BORING

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

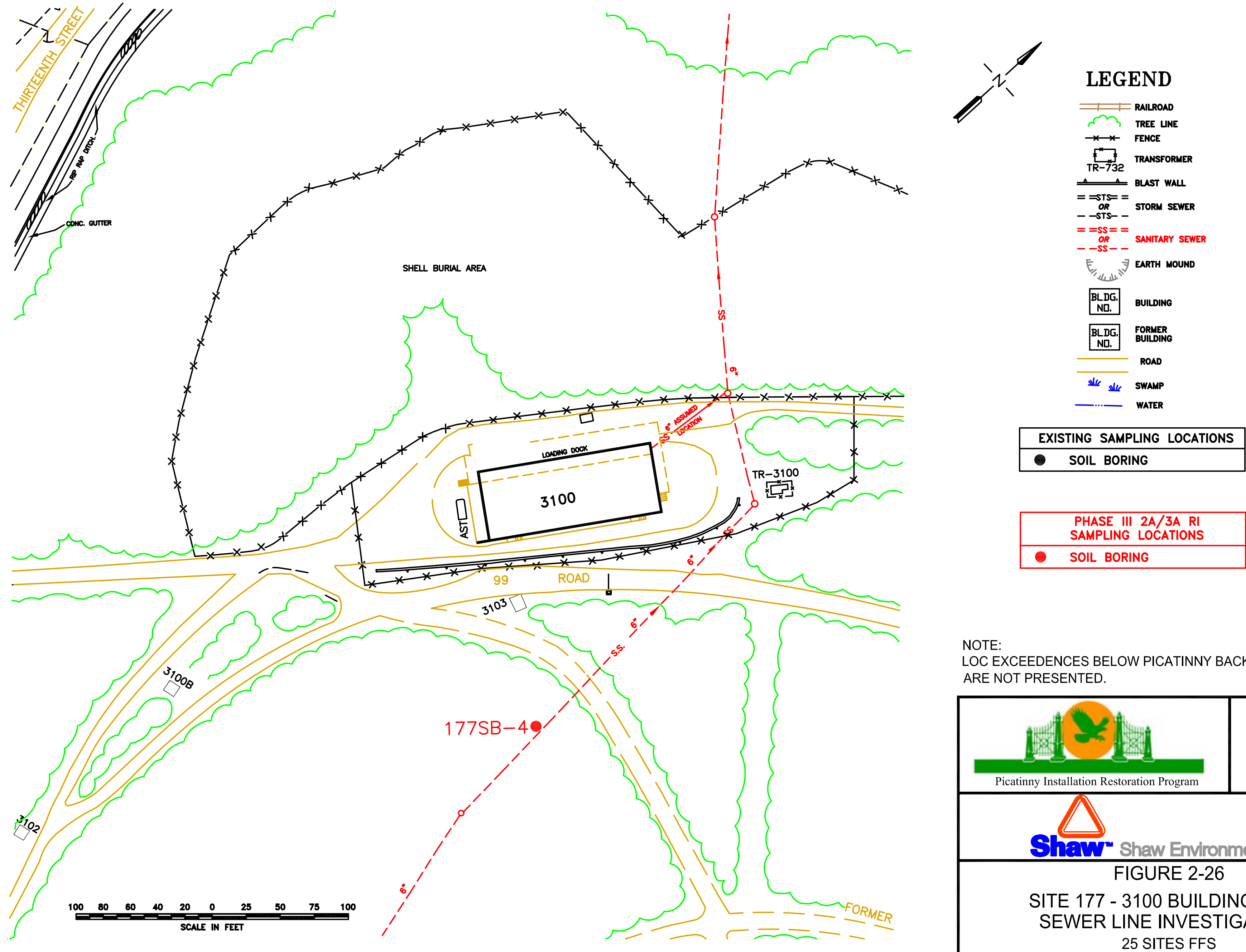
Shaw Shaw Environmental, Inc.

FIGURE 2-25

SITE 177 - 600 BUILDING AREA
SEWER LINE INVESTIGATION

25 SITES FFS
PICATINNY, DOVER, NEW JERSEY

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	L177010603.dwg
S. Wiafe	04/15/10	K. Gerdes	04/15/10	G. Maresca	04/15/10		



NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

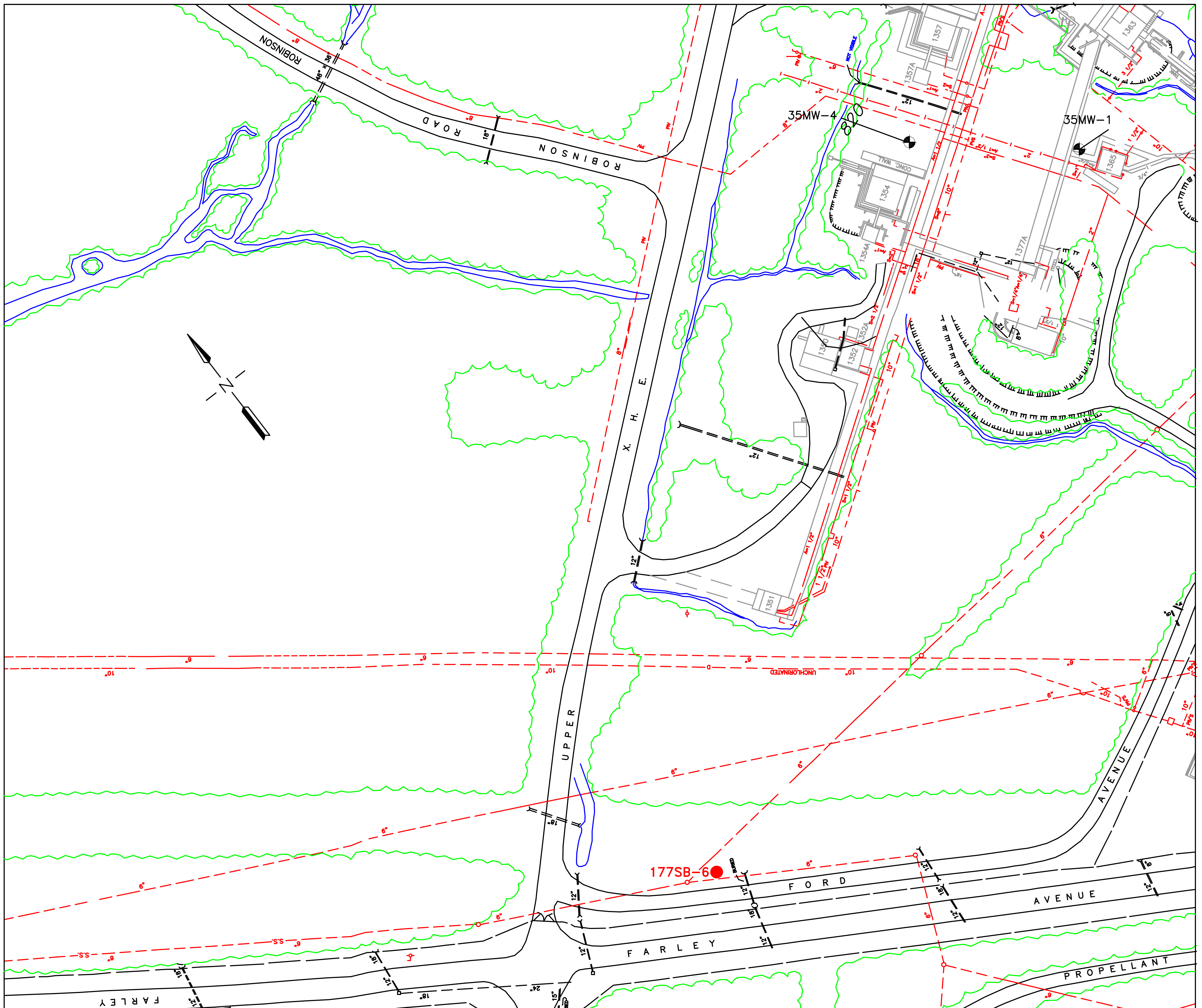
U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-26

SITE 177 - 3100 BUILDING AREA
SEWER LINE INVESTIGATION

25 SITES FFS
PICATINNY, DOVER, NEW JERSEY



200 150 100 50 0 100 200

SCALE IN FEET

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- ====STS==== OR ----STS---- STORM SEWER
- ====SS==== OR ----SS---- SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

EXISTING SAMPLING LOCATIONS
● SOIL BORING
MONITORING WELL

PHASE III 2A/3A RI SAMPLING LOCATIONS
● SOIL BORING

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-27

SITE 177 - 1300 BUILDING AREA
SEWER LINE INVESTIGATION

25 SITES FFS
PICATINNY, DOVER, NEW JERSEY

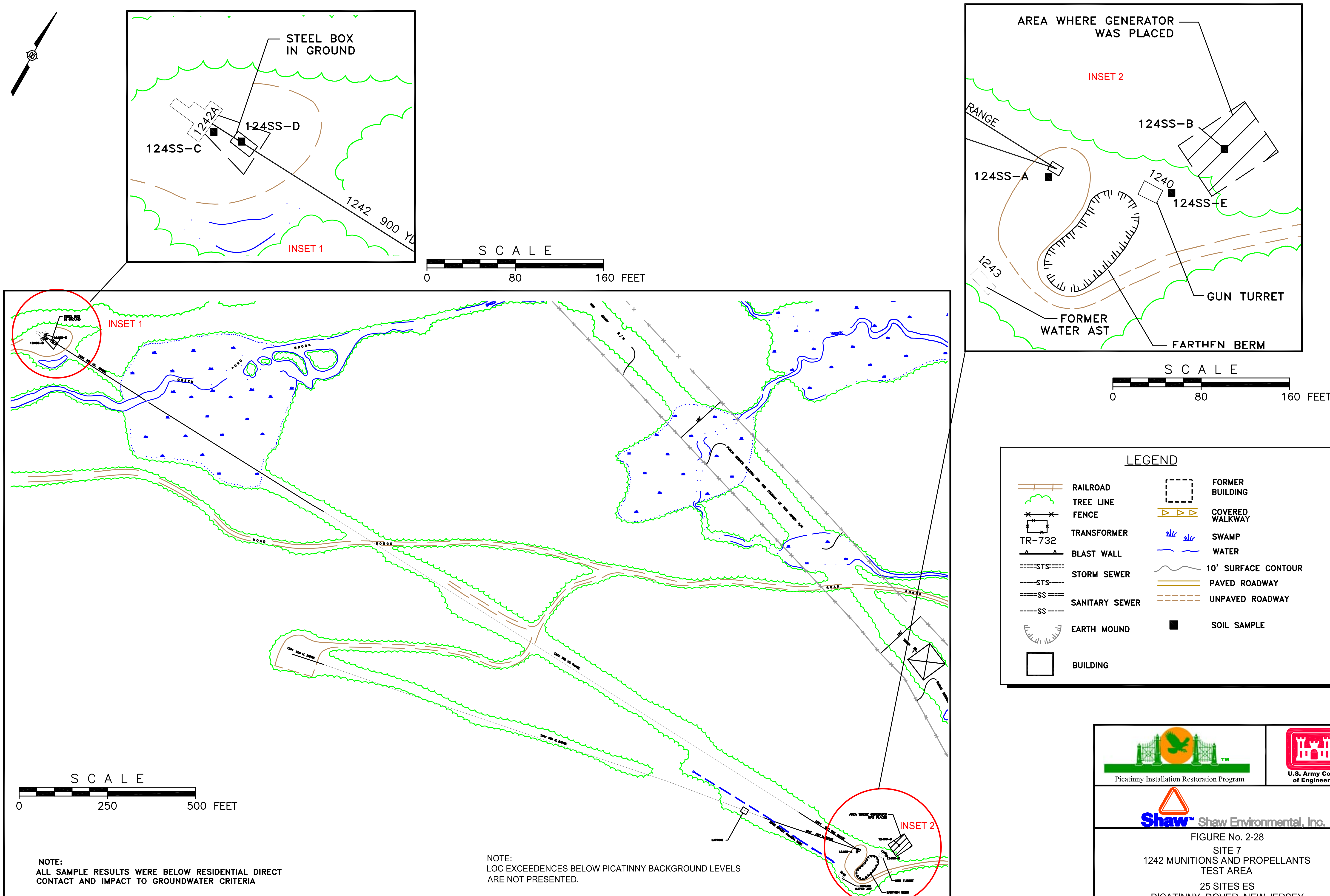
DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wolfe 04/15/10	K. Gerdes 04/15/10	G. MARESCA 07/03/5	L17701030303D.dwg

DRAWING NUMBER N7052505.dwg

APPROVED BY -- --

CHECKED BY K. Gerdes 04/09/10

DRAWN BY S. Wiafe 04/09/10



Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE No. 2-28

SITE 7

1242 MUNITIONS AND PROPELLANTS TEST AREA

25 SITES ES

PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\site7\N7052505.dwg
Plot Date/Time: Apr 23, 2010 - 11:19am
Plotted By: stephen.Wiafe

File: N:\cad\CAD drawings\Picatinny\25 Sites FS\Fig 2-29.dwg
Plot Date/Time: Apr 23, 2010 – 11:21am
Plotted By: stephen.Wiafe

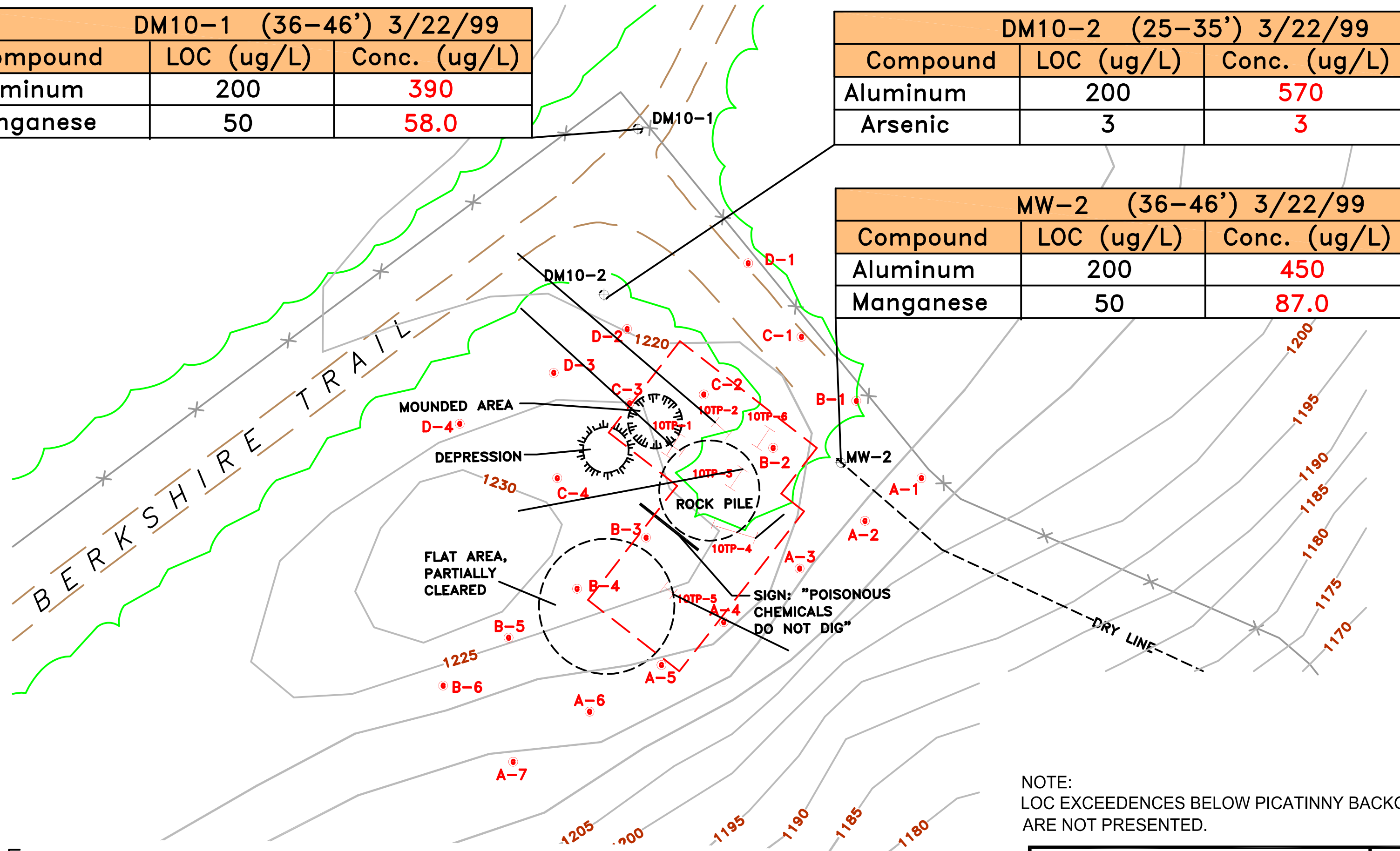
DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	04/15/10	K. Gerdes	04/15/10	--	--	10052505.dwg

Soil borings 10SB-1 and 10SB-2 will be located adjacent to the anomalies identified.

DM10-1 (36-46') 3/22/99		
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	390
Manganese	50	58.0

DM10-2 (25-35') 3/22/99		
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	570
Arsenic	3	3

MW-2 (36-46') 3/22/99		
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	450
Manganese	50	87.0



SCALE
0 50 100 FEET

RAILROAD
TREE LINE
FENCE
TRANSFORMER
TR-732
BLAST WALL
STORM SEWER
SANITARY SEWER
GEOPHYSICAL SURVEY LOCATION
EARTH MOUND
BUILDING
FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER

SAMPLING LOCATIONS
MONITORING WELL
SURFACE WATER/SEDIMENT
SURFACE SOIL
SOIL BORING
TEST PIT
HYDROPUNCH
GORE-SORBER

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

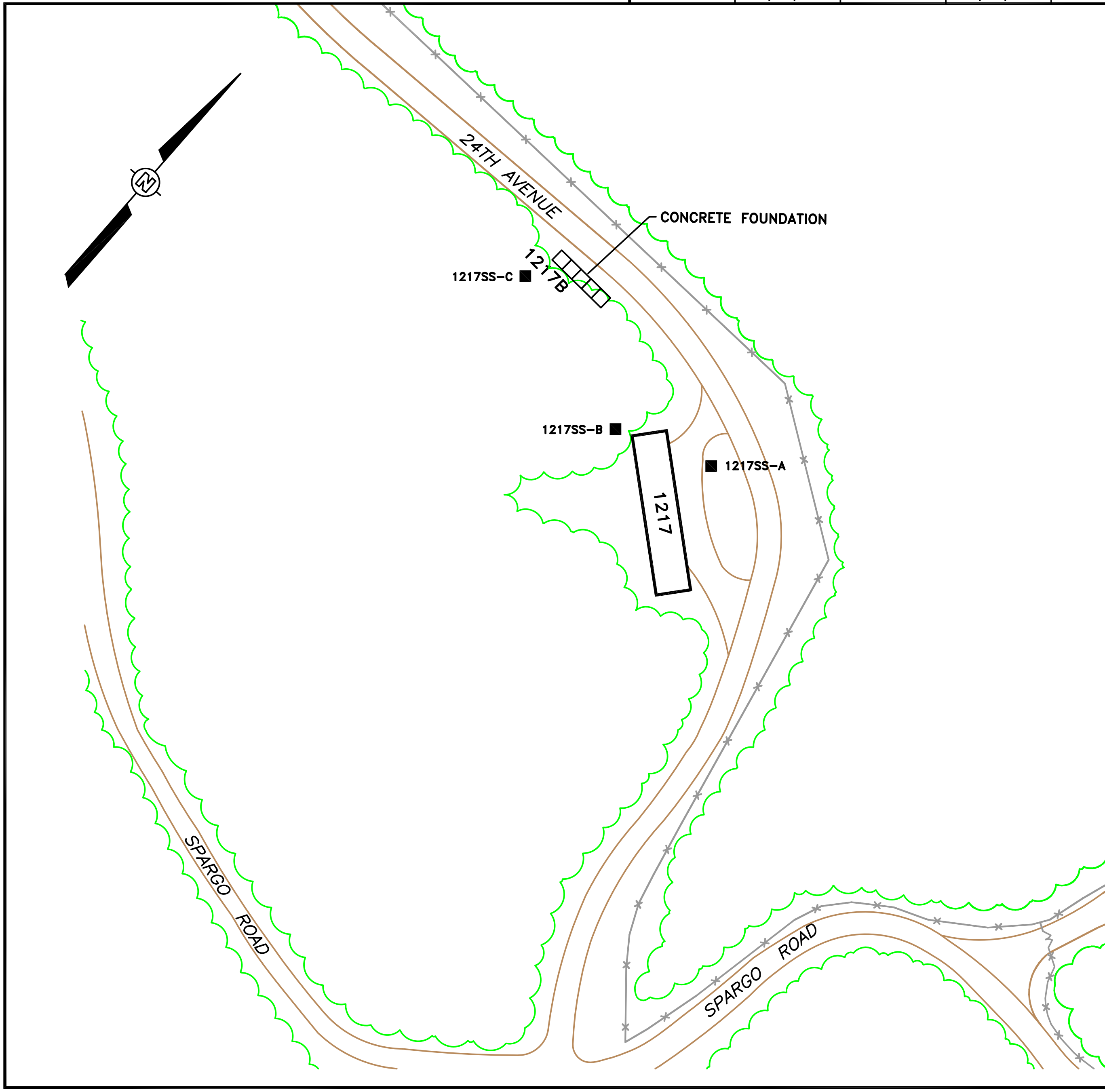
FIGURE NO. 2-29

SITE 10-CHEMEICAL BURIAL PIT
LOC EXCEEDENCES

25 SITES FS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-O\site164\O164062705.dwg
Plot Date/Time: Apr 23, 2010 – 11:23am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	O164062705.dwg
S. Wiafe	06/27/05	K. Gerdes	06/27/05	--	--		



Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

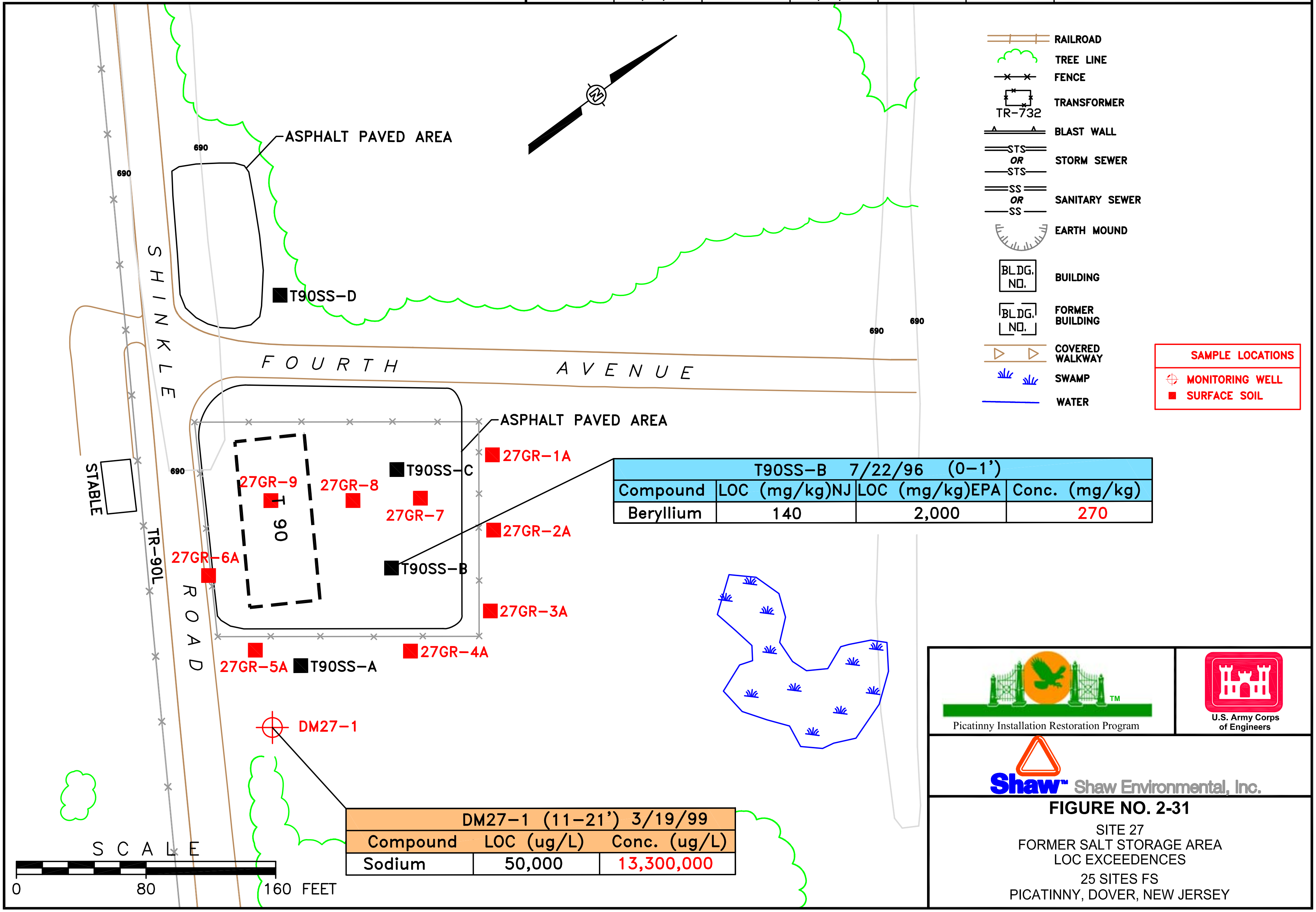
FIGURE 2-30

SITE 164 - BUILDING 1217, GENERAL PURPOSE MAGAZINE

25 SITES FS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-P\site27\27952505.dwg
Plot Date/Time: Apr 23, 2010 – 11:24am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	04/09/10	K. Gerdes	04/09/10	--	--	P27052505.dwg



T90SS-B 7/22/96 (0-1')			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Beryllium	140	2,000	270

DM27-1 (11-21') 3/19/99		
Compound	LOC (ug/L)	Conc. (ug/L)
Sodium	50,000	13,300,000

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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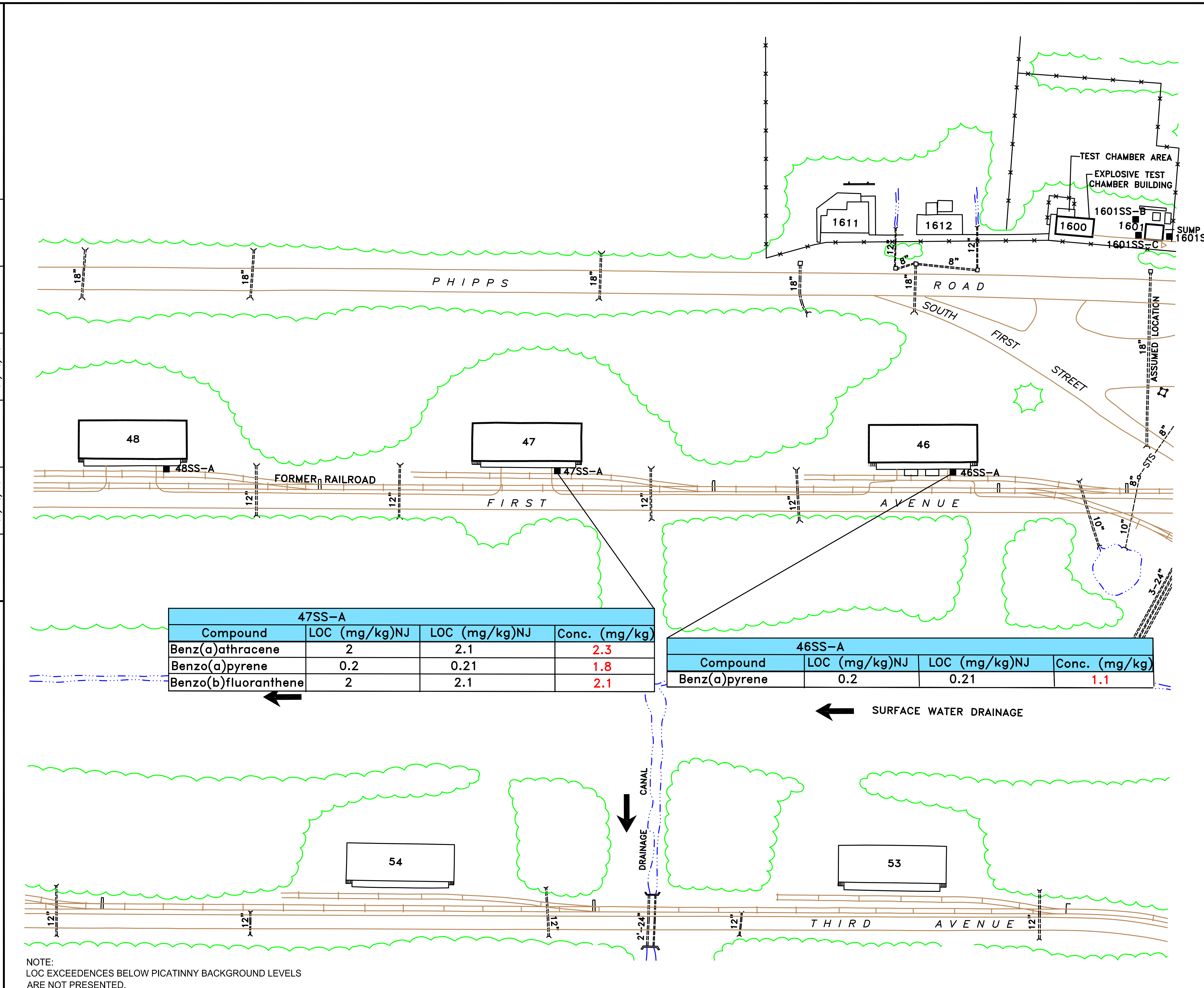
FIGURE NO. 2-31

SITE 27
FORMER SALT STORAGE AREA
LOC EXCEEDENCES

25 SITES FS
PICATINNY, DOVER, NEW JERSEY



47SS-A

Compound	LOC (mg/kg)NJ	LOC (mg/kg)NJ	Conc. (mg/kg)
Benz(a)athracene	2	2.1	2.3
Benzo(a)pyrene	0.2	0.21	1.8
Benzo(b)fluoranthene	2	2.1	2.1

46SS-A

Compound	LOC (mg/kg)NJ	LOC (mg/kg)NJ	Conc. (mg/kg)
Benz(a)pyrene	0.2	0.21	1.1

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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FIGURE NO. 2-32

SITE 119 - BUILDINGS 46,47 AND 48
STORAGE MAGAZINES
LOC EXCEEDENCES
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER P119-053105.dwg

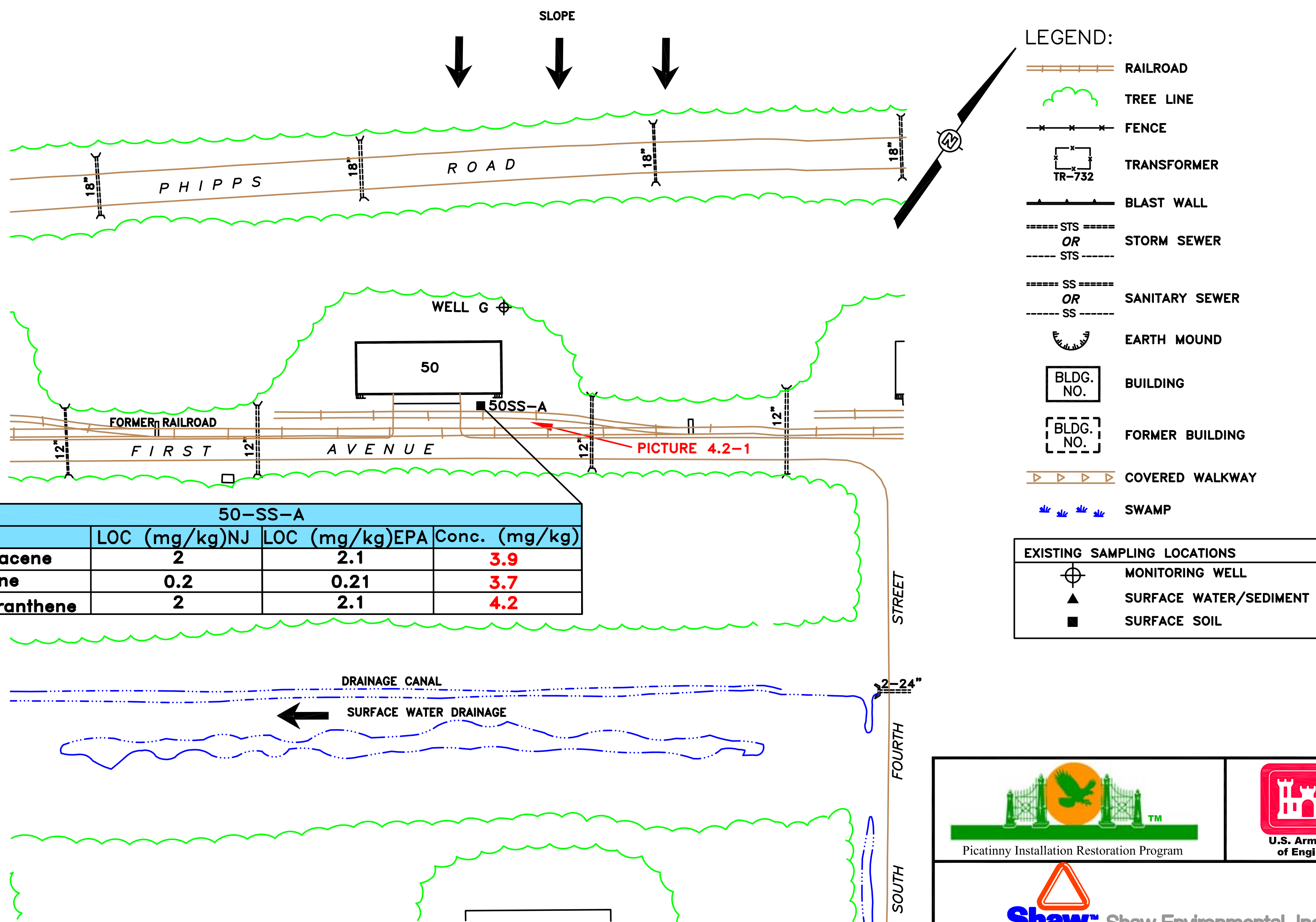
APPROVED BY

CHECKED BY K. Gerdes 04/15/10

DRAWN BY S. Wiafe 04/15/10

File: N:\cad\CAD drawings\Picatinny\Area-P\site120\P052505.dwg
Plot Date/Time: Apr 23, 2010 – 11:28am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	04/12/10	K, Gerdes	04/12/10	--	--	P052505.dwg



50-SS-A			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Benz(a)anthracene	2	2.1	3.9
Benzo(a)pyrene	0.2	0.21	3.7
Benzo(b)fluoranthene	2	2.1	4.2

SCALE

0 100 200 FEET

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

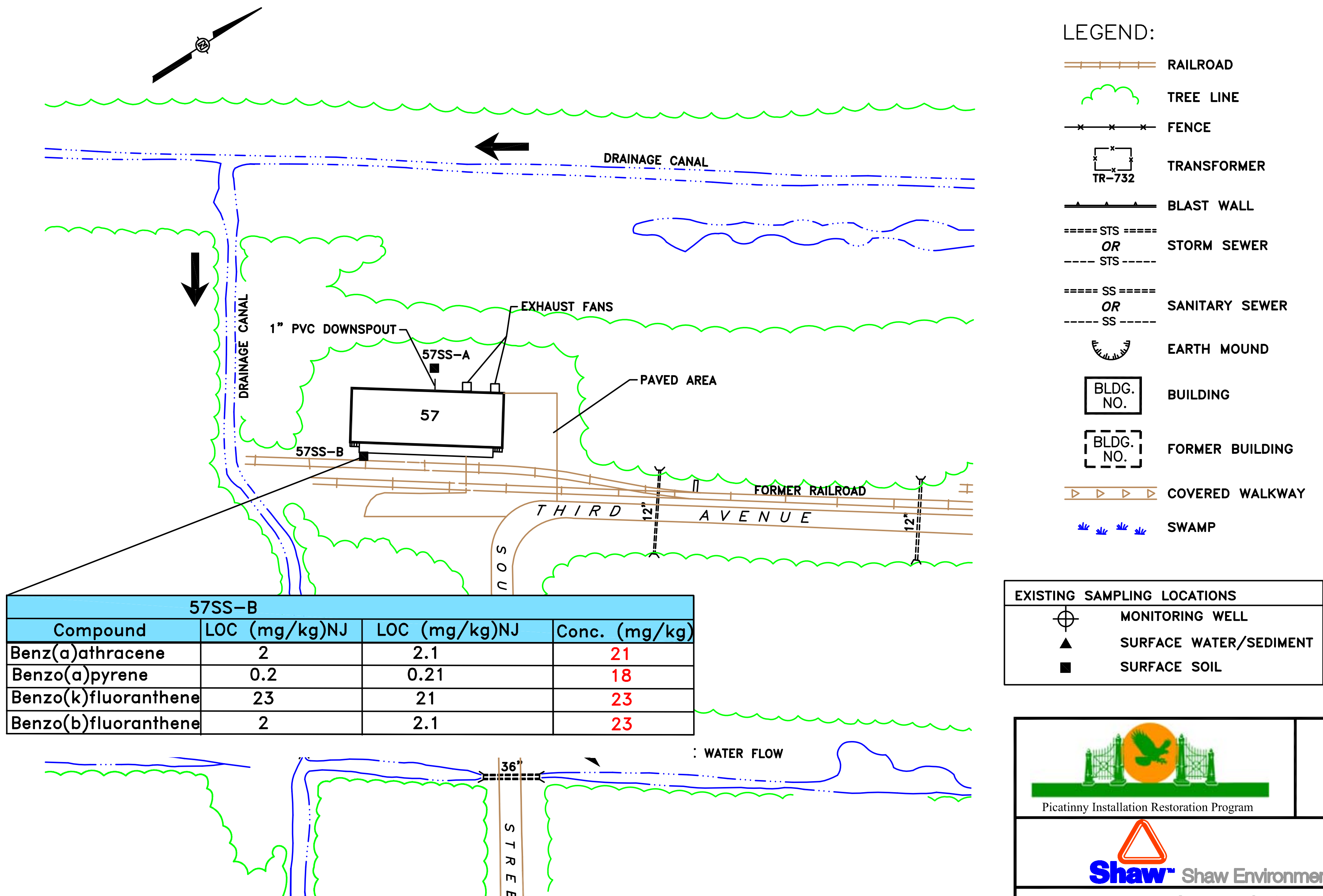
U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE NO. 2-33
SITE 120 - BUILDING 50
STORAGE MAGAZINE
LOC EXCEEDENCES
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-P\site121\P121052505.dwg
Plot Date/Time: Apr 23, 2010 – 11:30am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	04-15-10	K. Gerdes	04-15-10	--	--	P121052505.dwg



57SS-B			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)NJ	Conc. (mg/kg)
Benz(a)athracene	2	2.1	21
Benzo(a)pyrene	0.2	0.21	18
Benzo(k)fluoranthene	23	21	23
Benzo(b)fluoranthene	2	2.1	23

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS
ARE NOT PRESENTED.

3
0 1 2

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Shaw Environmental, Inc.

FIGURE NO. 2-34

SITE 121 - BUILDING 57
LOC EXCEEDENCES

25 SITES FS
PICATINNY, DOVER, NEW JERSEY

MW70-1A (7-17')		1/3/01
Compound	LOC (ug/L)	Conc. (ug/L)
Iron	300	5,100
Manganese	50	2,300

DPMW-1 (1.5-11.5')		1/3/01
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	760
Iron	300	13,500
Manganese	50	790

DPSS-1A (0-1')			10/5/00
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	11.4

208SS-8 (0-0.5')			9/13/06
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	15.4

208SS-5 (0-0.5')			9/13/06
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	9.8

DP-2W		
Compound	LOC (ug/L)	Conc. (ug/L)
Arsenic	3	8.4
Lead	5	33

DPSW-1		10/5/00
Compound	LOC (ug/L)	Conc. (ug/L)
Iron	1,790	2,700
Manganese	383	1,500

208SS-6 (0-0.5')			9/13/06
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	14

DP-1S CHPPM-'97			
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	57

DP-1W CHPPM-'97		
Compound	LOC (ug/L)	Conc. (ug/L)
Arsenic	3	12
Lead	5	42

DPSD-2 (0-1')		10/5/00
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	0.0317	0.11 #
Benzo(a)pyrene	0.0319	0.099
Benzo(b)fluoranthene	0.0272	0.15
Chrysene	0.0571	0.15 #
Fluoranthene	0.06423	0.21
Pyrene	0.053	0.185
Chromium	37.3	95.7
Lead	38.8	39.25
Silver	1	2.45

DPSW-2		10/5/00
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	190	415
Arsenic	1.38	7.2 #
Cadmium	0.28	0.45 #
Iron	1,790	10,050
Lead	3.2	4.7
Manganese	383	4,800

DPSS-4A (0-1')			10/5/00
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	13.1

DPSS-2A (0-1')			10/5/00
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	13.5

DPSS-3A (0-1')			10/5/00
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	9.9

MW-12E (10.5-20.5')		1/3/01
Compound	LOC (ug/L)	Conc. (ug/L)
Aluminum	200	500
Arsenic	3	16
Iron	300	2,300
Manganese	50	1,600

DPSD-3		10/5/00
Compound	LOC (mg/kg)	Conc. (mg/kg)
Cadmium	1.70	3.0
Zinc	171	1,020

DPSD-4 (0-1')		10/5/00
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	0.0317	0.59
Benzo(a)pyrene	0.0319	0.54
Benzo(b)fluoranthene	0.0272	0.99
Benzo(g,h,i)perylene	0.29	0.35
Benzo(k)fluoranthene	0.0272	0.32
Chrysene	0.0571	0.69
Fluoranthene	0.06423	1.3
Indeno(1,2,3-cd)pyrene	0.078	0.23
Phenanthrene	0.0419	0.49
Pyrene	0.053	1.1
Arsenic	16	40.1
Cadmium	1.70	6.2
Chromium	37.3	681
Lead	38.8	279
Mercury	0.249	1.9
Silver	1	23.1
Vanadium	72.4	84.5
Zinc	171	555

DPSW-4		10/5/00
Compound	LOC (ug/L)	Conc. (ug/L)
Iron	1,790	1,800
Manganese	383	1,000

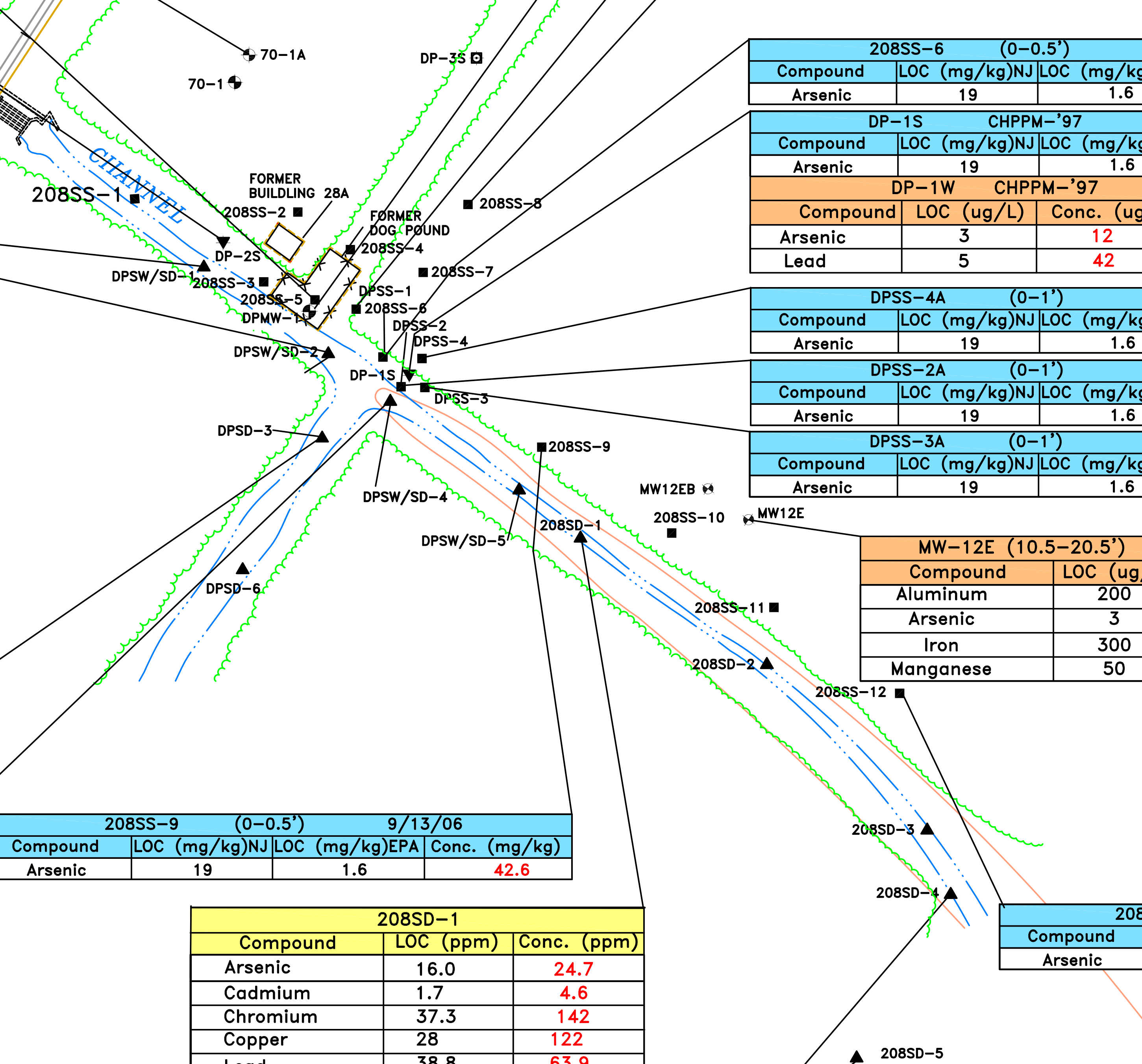
208SS-9 (0-0.5')			9/13/06
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	42.6

208SD-1		
Compound	LOC (ppm)	Conc. (ppm)
Arsenic	16.0	24.7
Cadmium	1.7	4.6
Chromium	37.3	142
Copper	28	122
Lead	38.8	63.9
Mercury	0.249	0.49
Silver	1.0	3.9
Zinc	171	341

208SD-4		
Compound	LOC (ppm)	Conc. (ppm)
Cadmium	1.7	2.6
Copper	28	46.2
Mercury	0.249	0.73
Silver	1.0	2.6

208SS-12 (0-0.5')			9/13/06
Compound	LOC (mg/kg)NJ	LOC (mg/kg)EPA	Conc. (mg/kg)
Arsenic	19	1.6	9.4

208SD-5		
Compound	LOC (ppm)	Conc. (ppm)
Cadmium	1.7	7.4
Chromium	37.3	48.6
Copper	28	122
Lead	38.8	105
Mercury	0.249	1.9
Silver	1.0	4.6
Zinc	171	293



LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- ==STS== OR --STS-- STORM SEWER
- ==SS== OR --SS-- SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

EXISTING SAMPLING LOCATIONS

- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL
- HAND AUGER SOIL SAMPLE GW SAMPLE COLLECTED W/ DISPOSABLE BAILER
- GEOPROBE SURFACE SOIL & GROUND-WATER SAMPLE

COMPOUND WAS NOT DETECTED IN DUPLICATE SAMPLE

DP-1W AND DP-2W WERE COLLECTED FROM THE LOCATIONS MARKED AS DP-1S AND DP-2S ON THE MAP.

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE No. 2-35

PICA 208 DSERTS - FORMER DOG POUND LOC EXCEEDENCES

25 SITES FS

PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER pDP041210.dwg

APPROVED BY -- --

CHECKED BY K. Gerdes 04/12/10

DRAWN BY S. Wiafe 04/12/10

File: N:\cad\CAD drawings\Picatinny\Area-P\pDP041210.dwg
Plot Date/Time: Apr 23, 2010 - 11:32am
Plotted By: stephen.Wiafe

Picatinny Arsenal
Former Dog Pound Area
Gamma Walkover Survey
9/11/06, 9/12/06, 9/13/06

Sample Location Chart

ID	Northing	Easting
RSS-1	764786.138	2025165.417
RSS-2	764881.019	2025043.183
RSS-3	764781.437	2025178.545
RSS-4	764781.972	2025163.756
RSS-5	764796.567	2025155.159
RSS-6	764791.858	2025167.405
RSS-7	764755.635	2025211.572
RSS-8	764765.362	2025216.019
RSS-9	764898.141	2025013.063
RSS-10	764985.294	2024910.270
RSS-11	764644.800	2025354.950
RSS-12	764546.060	2025467.470
RSS-13	764826.073	2025132.895
RSD-1	764764.116	2025152.273
RSW-1	764768.802	2025165.499
208SS-5	764850.052	2025088.141
208SS-6	764850.059	2025101.665

Legend (Std. Dev.)
- 9847 - 15733 (-2 - -1)
- 15734 - 21620 (-1 - 0)
- 21620 (Mean)
- 21621 - 27506 (0 - 1)
- 27507 - 33393 (1 - 2)
- 33394 - 39279 (2 - 3)
- 39280 - 47077 (> 3)

Instrument Data:
Ludlum 2221 s/n: 172020
Ludlum 44-20 s/n: PR183887
Cal Due Date: 9/5/07

Figure 2-36

Gamma Walkover Survey Results and Sampling Locations

3.0 REMEDIAL ACTION OBJECTIVES AND IDENTIFICATION OF ARARS

3.1 ALLOWABLE EXPOSURE BASED ON RISK ASSESSMENT (INCLUDING ARARS)

Potential ARARs that address the sites' surface soils, subsurface soils, surface water and sediment are identified in this section. ARAR identification is an integral part of the remediation process mandated under Section 121 (d) of CERCLA, as amended by SARA. ARARs are used to develop remedial action cleanup levels, determine the appropriate extent of site cleanup, and govern implementation and operation of the selected remedial action. Specifically, the preamble of CERCLA states, the purpose of the law is "to provide for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous waste disposal sites". Response actions that "clean up" hazardous substances at CERLCA sites must comply with state and federal standards and criteria that are legally applicable to the substance, pollutant, or contaminant; or that are relevant and appropriate under the circumstances [42 U.S.C. 9621(d)(2)(A)]. These ARARs include federal requirements and more stringent state requirements. Furthermore, the most stringent ARAR identified must be complied with [40 C.F.R. 300.400]. "More stringent" also include those state laws or programs that have no federal counterpart as "they add to the Federal law requirements that are specific to the environmental conditions in the State" (USEPA, 1988b). State requirements, however, must be adopted by formal means (i.e., promulgated) and applied universally throughout the state (i.e., not just to Superfund sites, but to all circumstances addressed in the requirement) [42 U.S.C. 9621(d)(2)(C)(iii)(I)].

3.1.1 ARAR Classification Requirements

In order to be classified as an ARAR, the NCP states that federal and/or state laws must meet one of the following two requirements: (1) applicability or (2) relevance and appropriateness. "Applicable" requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site" [40 C.F.R. ' 300.5]. "Relevant and appropriate" requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" [40 C.F.R. ' 300.5].

Once a federal or state law has been classified as applicable or relevant and appropriate its requirements must be distinguished between substantive and administrative. "Substantive" requirements are "those requirements that pertain directly to actions or conditions in the environment. "Administrative" requirements are "those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation". Compliance with administrative requirements is not mandated for on-site actions (USEPA, 1988b). For example, CERCLA specifically exempts on-site actions from federal, state, and local permitting requirements [42 U.S.C. ' 9621(e)(1)].

In addition, the NCP identifies a third category, termed "information to-be-considered" (TBC). TBCs are guidelines or advisories that are issued by the federal or state government, but which are neither legally binding nor promulgated (USEPA, 1990). However, these guidelines may be used when they are necessary to ensure protection of public health and the environment (USEPA, 1990). If ARARs do not address a particular circumstance at a CERCLA site, then TBCs can be used to establish remedial guidelines or targets. Even when TBCs are used, the requirements imposed on the remedy, including cost-effectiveness, still apply (55 Fed. Reg. 8745, March 8, 1990).

3.1.2 Types of ARARs

Selection of ARARs is dependent on the hazardous substances present at the site; site characteristics, the site location, and the actions selected to remediate the site. Thus, requirements may be chemical-, location-, or action-specific. These categories are not always mutually exclusive and there may be some conceptual overlapping.

Chemical-specific ARARs are generally health- or risk-based concentration values set for specific hazardous substances or other contaminants potentially found in environmental media. Chemical-specific ARARs provide protective SCLs or a basis for calculating cleanup levels for COCs in the designated media. Chemical-specific ARARs are also used to determine treatment and disposal requirements for a particular remedial activity and to assess the effectiveness of an RA. In the event that a chemical has more than one ARAR, the most stringent is applied.

Location-specific ARARs are made up of restrictions or requirements for substances or activities based primarily on their specific physical location (USEPA, 1988b). An RA may be restricted or precluded based on federal, state, or facility siting laws that address things such as proximity to wetlands, flood plains, or man-made features (such as existing landfills, disposal areas, and local historic buildings). Location-specific ARARs provide a basis for assessing restrictions during the formulation and evaluation of potential site-specific response actions.

Action-specific ARARs are generally technology or activity-based requirements for actions taken with respect to cleanup of hazardous substances at a site. These requirements are triggered by the particular activities that are selected to accomplish a remedy. Thus, action-specific requirements do not in themselves determine the RA; rather, they indicate how a selected alternative must be achieved.

3.1.3 Chemical-Specific ARARs and TBC Guidance

Findings from the 25 Sites' investigations have identified contaminated surface soils, subsurface soils, surface water, and sediment. Potential chemical-specific ARARs and TBCs for surface soils, subsurface soils, surface water, and sediment are developed for COPCs within this section.

Two jurisdictions, federal and state, can enact laws to protect human health and the environment. Localities (such as municipal governments) do not enact laws but usually govern by ordinances. The same holds true for facilities. CERCLA 121(d)(2)(A)(ii) discusses the consideration of environmental law or facility siting law; however, both are in the context of state laws which are more stringent. CERCLA, the mechanism under which remediation at this site is conducted, defines the role and importance of federal and state laws. Section 121 of CERCLA specifies that response actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to hazardous substances or particular circumstances at the site.

3.1.3.1 Surface and Subsurface Soils

ARARs

The federal government has not promulgated chemical-specific standards, requirements, criteria, and/or limitations that are applicable or relevant and appropriate for remediation of surface and subsurface soils at the "25 Sites". As described throughout Section 2, the promulgated NJDEP NRSRS were utilized to create screening levels for surface and subsurface soils. These standards will also be considered for the selection of SCLs for the "25 Sites." It should be noted that the NJDEP NRSRS were used solely as LOCs in Section 2, and include the standard for lead, standards based in the inhalation pathway, and standards based on the ingestion/dermal exposure pathway, without regard to their acceptance as potential ARARs.

The USEPA has defined its position regarding whether New Jersey's Soil Remediation Standards, including the NRSRS, are potential ARARs in a letter dated May 12, 2010 from the Director of the USEPA Emergency and Remedial Response Division to the NJDEP Site Remediation Program Assistant Commissioner (**Appendix C**). The numerical soil remediation standards based on evaluation of the ingestion/dermal exposure pathway are potential ARARs under CERCLA (with the exceptions of the standard for lead and when the future land use will be limited to recreation). In contrast, the standards based on the inhalation pathway are not potential ARARs. The NJDEP allows the development of alternative remediation standards for the inhalation pathway (as well as for lead and recreational land use) on a site-by-site basis at the discretion of the NJDEP. By allowing alternative remediation standards at the discretion of the NJDEP, these numerical soil remediation standards arguably do not meet the requirement of "general applicability" for ARARs [40 C.F.R. 400(g)(4)]. The NJDEP NRSRS for lead and the inhalation pathway have been have been used as TBC guidance for the "25 Sites," as described below.

Federal and State Surface and Subsurface Soil TBCs

TBC guidance includes advisories that have not been promulgated and thus are not enforceable. When compiling chemical specific criteria, TBCs are useful where ARARs do not exist for a specific chemical, or where such ARARs are not sufficient to be protective. In the absence of federal or state-promulgated ARARs, TBC guidance will be considered to provide a list of comparison criteria. Surface and subsurface soil TBCs for the "25 Sites" include the USEPA IRSLs and USEPA Residential RSLs, as well as NJDEP NRSRS for the inhalation pathway and lead. Please refer to **Table 3-1** for a listing of promulgated criteria and TBCs.

Table 3-1
Surface and Subsurface Soil Chemical-Specific TBCs and Promulgated Criteria

Chemical	Law/Regulation	Requirement of Law/Regulation
See **Table 3-2** for specific chemicals	NJDEP Soil Remediation Standards N.J.A.C. 7:26D Appendix 1	Promulgated Health Based Direct Contact Soil Remediation Standards for Residential and Non-Residential Direct Contact Exposure
See Appendix C for specific constituent values	USEPA Regional Screening Levels	These non-promulgated values are concentrations corresponding to fixed levels of risk (i.e., a hazard quotient of 1 or a lifetime excess cancer risk of 1x10-6) whichever occurs at a lower concentration. Values are calculated for both industrial and residential exposure scenarios.

A comparison of the surface and subsurface COPCs identified in Section 2.0 with the New Jersey criteria indicated that both inorganic and organic constituents exceed the NJDEP NRSRS (including natural background thresholds determined in the Background Study Report) or which were identified as a potential risk in either the HHRA or ERA. These constituents are provided in **Table 3-2**. No ecological risk drivers were identified for any of the subject sites.

3.1.3.2 Sediments

ARARs

Neither the federal government nor the state of New Jersey has promulgated standards, requirements, criteria, and/or limitations that are applicable or relevant and appropriate for the "25 Sites" area sediment. Because no chemical-specific ARARs for sediment have been identified, TBC guidance will be considered as comparison criterion for sediment. It is important to note that the Army is not obligated to correlate RGs with any TBC criterion presented within this FFS. Each of the TBC advisory sources is identified within **Table 3-3** and discussed below. Finally, **Table 3-4** provides a comprehensive list (with respect to the identified COPCs) of each TBC advisory criterion. Sediment COPCs are those constituents which exceeded their respective LOC for Picatinny (based on the evaluation of the following TBCs and natural background threshold determined in the Background Study Report) or which were identified as a potential risk in either the HHRA or ERA. The final COCs for the "25 Sites" are identified in Section 3.3.

Federal, State and "other" Sediment TBCs

Sediment TBCs, like all TBCs are non-promulgated advisories and therefore are not enforceable. TBCs are provided within this FFS to afford a more comprehensive list of comparison criteria. As identified in **Table 3-3** there are five TBC sources that will be considered within this FFS as well as site-specific background and/or risk based levels. Because there is overlap in the contaminants addressed within these TBCs sources, a preference for certain sources has been imposed. Each of these TBC advisories is briefly discussed below along with the order of preference that each will be assigned within this FFS.

Table 3-2
Promulgated Criteria for Soil (mg/kg)

Constituent of Potential Concern	NJ Soil Cleanup Criteria (1)	Applicable Site (Risk/Hazard Site (2) in Bold)
Inorganics		
• Arsenic	19	**187,** PICA 207, **60, 52/95/96,** 136, 185, **173, 174, 10, PICA 208**
• Beryllium	140 (230)(3)	**117,** 27
• Lead	800(3)	52/95/96, **134**
• Manganese	5,900 (160,000)(3)	**145,** 52/95/96
• Thallium	79	145, 52/95/96
Semivolatile Organic Compounds		
• Benz(a)anthracene	2	117, 52/95/96, 134, 173, 119, 120, 121
• Benzo(a)pyrene	0.2	123, 52/95/96, **134, 173, 176(4), 177,** 119, 120, 121
• Benzo(b)fluoranthene	2	117, 52/95/96, 134, 173, 119, 120, 121
• Benzo(k)fluoranthene	23	173, 121
• Dibenz(a,h)anthracene	0.2	134, 173
• Carbazole	96	173
• Chrysene	230	173
• Indeno(1,2,3-cd)pyrene	2	134, 173
• Naphthalene	17 (25,000)(3)	173
Pesticides and PCBs		
• Total PCBs	1	**123, 52/95/96**
• 4,4'-DDT	8	52/95/96
• Dieldrin	0.2	52/95/96
Explosives		
• 2,4-Dinitrotoluene	3	145
• 2,6-Dinitrotoluene	3	145
Radiologicals		
Thorium-232	3	PICA 208

Notes:

(1) Nonresidential Direct Contact Soil Remediation Standards (NJDEP, 2009b).
(2) Risk and Hazard Drivers Presented are defined as exceeding the lower bound (10^{-6}) of the USEPA target risk range or a hazard index >1.
(3) NJDEP NRSRS for lead, and those based on the inhalation pathway (beryllium, manganese and naphthalene) are not ARARs. Ingestion/dermal exposure values for beryllium, manganese and naphthalene are provided in parentheses). Note: Only beryllium at Site 27 exceeded both the NRSRS based on inhalation and the ingestion/dermal exposure value).
(4) Hypothetical Future Residential Risk Assessment.

Table 3-3
TBC Guidance for Sediment

Authority	Laws/Regulations	Requirement(s)
Interim Sediment Quality Guidance (ISQGs)	Canadian Environmental Quality Guidelines (CCME, 2002)	Provides provisional Lowest Effect Levels (LELs) for some constituents to evaluate ecological risks
New York Sediment Criteria	Benthic Aquatic Life Chronic Toxicity Sediment Criteria (NYSDEC, 1999)	Provides ecological guidelines recommended to support and maintain aquatic life based on biologic effects
Sediment Quality Benchmark (SQBs)	[ORNL, 1997 (Jones and Suter)]	Provides ecological screening levels for non-ionic organic contaminants based on sediment/water equilibrium partitioning
Other Criteria, Advisories and Guidance	NJDEP Soil Remediation Standards (nonresidential)	Industrial based cleanup criteria for soils.
Other Criteria, Advisories and Guidance	New Jersey Guide for Sediment Quality Evaluations (ER-Ls)	Provides sediment screening guidelines for evaluating ecological risks

The following TBC criteria were used in selecting the sediment LOC: Interim Sediment Quality Guidelines (ISQGs) as presented in the Canadian Environmental Quality Guidelines [Canadian Council of Ministers of the Environment (CCME), 2002], Benthic Aquatic Life Chronic Toxicity Sediment Criteria as presented in the New York State Department of Environmental Conservation (NYSDEC) Technical Guidance for Screening Contaminated Sediments (1999), and Sediment Quality Benchmarks (SQBs) from Jones and Suter (1997), Effects Range-Low (ER-Ls) from the NJDEP (1998), IRSLs and the NRSRS. The lower of the ISQG, New York Sediment Criteria, and SQB will be used as the LOC. In the absence of these values, the ER-L is used as the LOC. In the absence of ER-Ls, the lower of the IRSL and the NRSRS was used. The final LOC value is the higher of the LOC and sediment background.

Interim Sediment Quality Guidelines. ISQGs (CCME, 2002) represent Canadian Environmental Quality Guidelines initially published by CCME (1995), and include provisional lowest effect levels for some constituents (Persaud et al., 1993). These guidelines are numerical limits recommended to support and maintain aquatic life associated with bed sediments and were developed from the available scientific literature on the biological effects of sediment-associated chemicals. The methodology used in the development of these numerical limits included the modified National Status and Trends Program approach and the Spiked-Sediment Toxicity Test approach.

New York Sediment Criteria. Benthic Aquatic Life Chronic Toxicity Sediment Criteria, as presented in the NYSDEC Technical Guidance for Screening Contaminated Sediments (1999), are sediment criteria for non-polar organic constituents. They were estimated assuming one percent organic carbon is present in sediments, as the actual NYSDEC criteria are presented on a normalized organic carbon basis. The criteria themselves are based on equilibrium partitioning (EqP) from sediment to pore water, and target NYS Ambient Water Quality Criteria (AWQC) for the protection of aquatic life, if available, for the pore water. If NYS criteria were not available, USEPA AWQC were used.

Sediment Quality Benchmarks. SQBs from Jones and Suter (1997) are based on the sediment/water EqP approach, where the prediction of a bulk sediment chemical concentration criterion is a function of the sediment organic carbon and an associated AWQC. Sediment TOC concentrations of one percent are assumed for these SQBs. The EqP approach applies specifically to non-ionic organic contaminants; while variations of the equation have been developed for use with polar and ionic organic chemicals.

Table 3-4
TBCs for Sediment (mg/kg)

Constituents of Potential Concern	ISQGs (CCME 2003)	New York Sediment Criteria	SQBs (Jones and Suter 1997)	NJDEP Sediment Guideline (ER-Ls)	NJDEP NRSRS	Sediment Background	Site-Specific Risk Based PELs (1)
Total Metals							
• Arsenic	5.9	---	12.1	8.2	19	16.0	22
• Cadmium	0.6	---	0.592	1.2	78	1.70	34
• Chromium	37.3	---	56	81	---	23.8	247
• Copper	35.7	---	28	34	45,000	27.2	261
• Lead	35	---	34.2	47	800	38.8	2,500
• Mercury	0.17	---	---	0.15	65	0.249	13.2
• Manganese	---	---	1,673	---	5,900	832	NA
• Nickel	---	---	39.6	21	23,000	17.2	42
• Silver	---	---	---	1.0	5,700	0.801	36
• Vanadium	---	---	---	---	1,100	72.4	NA
• Zinc	123	---	159	150	110,000	171	456
Semivolatile Organic Compounds							
• Anthracene	0.0469	1.07	0.03162	0.085	30,000	---	11
• Benz(a)anthracene	0.0317	0.12	0.11	0.261	2	---	2.2
• Benzo(a)pyrene	0.0319	---	0.14	0.430	0.2	---	1.6
• Benzo(b)fluoranthene	---	---	0.0272	---	2	---	5.6
• Benzo(g,h,i)perylene	---	---	0.29	0.170	30,000	---	NA
• Benzo(k)fluoranthene	---	---	0.0272	0.240	23	---	2
• Dibenz(a,h)anthracene	0.00622	---	---	0.063	0.2	---	NA
• Chrysene	0.0571	---	0.5	0.384	230	---	2.6
• 1,4-Dichlorobenzene	---	0.12	0.34	---	13	---	NA
• Fluoranthene	0.111	10.2	0.06423	0.600	24,000	---	4
• Indeno(1,2,3-c,d)pyrene	---	---	0.078	0.200	2	---	NA
• 2-Methylnaphthalene	0.0202	0.34	---	0.070	2,400	---	3.25
• Naphthalene	0.0346	0.3	0.03275	0.16	17	---	NA
• Phenanthrene	0.0419	1.2	1.8	0.240	300,000	---	5.4
• Pyrene	0.0530	9.61	0.57	0.665	18,000	---	3.8
Pesticides							
• 4,4'DDD	0.00354	---	0.11	---	13	---	0.2
• 4,4'DDE	0.00142	---	---	0.0022	9		0.2
• 4,4'DDT	0.00119	0.01	0.34	0.0016	8	---	0.2

Constituents of Potential Concern	ISQGs (CCME 2003)	New York Sediment Criteria	SQBs (Jones and Suter 1997)	NJDEP Sediment Guideline (ER-Ls)	NJDEP NRSRS	Sediment Background	Site-Specific Risk Based PELs (1)

Notes:
ISQG = Interim Sediment Quality Guidelines
SQB = Sediment Quality Benchmark
NJDEP = New Jersey Department of Environmental Protection
ER-L = Effect Range-Low
EPA IRSLs are risk-based screening levels for soils based on industrial use.
(1) Potential Effects Levels from the GP/BSB FFS based on toxicity testing

RG = Remediation goal
--- = No value available
NA = no risk identified

New Jersey Guide for Sediment Quality. The New Jersey guide for sediment criteria provides several criteria including the ER-Ls as derived by Long and Morgan. The methodology used by NOAA (Long et al., 1995; Long and Morgan, 1990) for their NOAA ER-L threshold utilizes data obtained from several approaches, including:

- Background Approach: use of reference background values from various geographic areas, against which site contaminant levels are screened.
- Sediment/Water EqP Approach: prediction of a bulk sediment chemical concentration criterion as a function of the sediment organic carbon and an associated AWQC.

The NOAA benchmarks are based primarily on estuarine and marine data, but may be used for screening purposes in freshwater environments (Jones and Suter, 1997). The NOAA ER-L is the lower 10th percentile of the screened data; as such, the ER-L represents the low end of the range for which effects were observed or predicted.

New Jersey Soil Remediation Standards (nonresidential). Nonresidential health-protective chemical concentrations in soils were derived by the NJDEP.

Site-specific risk-based potential effects levels (PELs) are discussed in Section 3.3 and are provided on **Table 3-4** along with site-specific background levels for reference.

3.1.3.3 Surface Water

Federal and state promulgated standards exist for surface water; these standards are considered potential ARARs for the constituents which exceed the benchmark values in the ERA. The NJDEP SWQS are applicable to GPB which is defined as a FW2-Non Trout surface water. Furthermore, the USEPA AWQC are applicable until New Jersey is in complete compliance with the Clean Water Act, which requires review and acceptance of the NJ SWQS by the USEPA. Chemical-specific ARARs for surface water are highly dependent upon the use or potential use of the surface water as a resource. Accordingly, surface waters throughout the state of New Jersey have been assigned use designations. GPB and a series of ditches which flow into GPB are the surface water bodies of interest for the “25 Sites”. GPB is defined as a FW2-Non Trout (FW-NT) surface water (7:9B-1.15). The designated uses of FW2 surface waters as defined in NJAC 7:B-1.12 (c) are listed below.

Use Designations of FW2 Surface Waters

- Maintenance, migration and propagation of the natural and established biota;
- Primary and secondary contact recreation;
- Industrial and agricultural water supply;
- Public potable water supply after such treatment as required by law or regulation; and,
- Any other reasonable uses.

Federal ARARs have been promulgated in the Clean Water Act [CWA;42USC§9621(d)(2)(A)(ii)] while the state ARARs have been promulgated in the New Jersey SWQS (7:9B). These laws, any promulgated standard requirement, criteria, or limitation under the laws and the ARAR status of standard requirement, criteria, or limitation are provided in **Table 3-5** and are discussed below.

Table 3-5
Surface Water Chemical-Specific ARARs

Chemical	Law/Regulation	Requirement of Law/Regulation
See **Table 3-7** for specific chemicals	New Jersey Surface Water Quality Standards, NJAC 7:9B	Provides policy for the protection and enhancement of surface water resources, class designations and water quality standards.
	Federal Water Quality Standards, 40CFR131	Defines the water quality goals, designates use or used of the water and provides the criteria to protect surface water bodies.

Federal Surface Water ARARs

The CWA requires states to promulgate criteria that protect surface water within their state. Once promulgated, the USEPA is required to review the criteria and assess the appropriateness of the level of protection that is provided. The State of New Jersey and the USEPA have not yet completed this process. Because New Jersey/USEPA have not yet completed the process, 40 CFR 131.36(d)(3)(i) specifies four types of criteria as being applicable. The types of criteria are freshwater chronic and acute (for the protection of aquatic organisms), human health consumption of water and organisms, and human health consumption of organisms alone. The criteria associated with each COPC are presented in **Table 3-6**.

State Surface Water ARARs

To protect the designated use of FW2 class water bodies, New Jersey has promulgated criteria that are generally more stringent than federal ARARs established under the CWA (N.J.A.C. 7:9-6). The criteria are referred to as the New Jersey SWQS. The New Jersey SWQS are currently being reviewed by the USEPA; New Jersey will be in compliance with the CWA. Therefore, the federal CWA criteria for non-compliant states will no longer be applicable.

The New Jersey SWQS are incorporated into state law and are applicable to all surface waters within the state. Additionally, CERCLA Section 121 states that any promulgated standard requirement, Federal standard, requirement, criteria, or limitation is to be complied with at the conclusion of the remedial activities. Because SWQS have been promulgated, they will be considered as ARARs within this FFS. The SQWS associated with each COPC are presented in **Table 3-6**. The listed COPCs are those constituents which exceeded Picatinny LOCs as no additional potential risks were identified by either the HHRA or ERA.

Table 3-6
ARARs for Surface Water

Constituent of Potential Concern	USEPA Water Quality Criteria				NJDEP Surface Water Quality Criteria (FW-2)
	Acute	Chronic	Human Health Risk for Consumption of		SWQC
			Water and Organisms (a)	Organisms Only (a)	
Inorganics					
• Aluminum	750	87	---	---	---
• Arsenic	340 (b)	150 (b)	0.018 (c)	0.14 (c)	0.0170(c)
• Cadmium	2.1 (d)	0.28 (d)	---	---	10
• Chromium	16.3	11.4	---	---	160
• Copper	14 (d)	9.4 (d)	1,300	---	---
• Iron	---	1,000	300	---	---
• Lead	82 (d)	3.2 (d)	---	---	5
• Manganese	---	---	50	100	---
• Mercury	1.6 (e)	0.91 (e)	---	0.3	0.144
• Nickel	470 (d)	52 (d)	610	4,600	516
• Sodium	---	---	---	---	---
• Vanadium	---	---	---	---	---
• Zinc	120 (d)	120 (d)	7,400	26,000	---

Notes:
(a) Human Health based. Provided for reference only. Ingestion of water or organisms is not anticipated due to available water supply and existing fish advisory.
(b) Values are for Arsenic III
(c) USEPA Water Quality Criteria refers only to the inorganic form.
(d) Criteria are a function of hardness (mg/L) in the water column
(e) Values derived for inorganic mercury (II)
--- No value available

USEPA Region III Tap Water values were used in the initial screen as a LOC but are not included here as a potential ARAR or TBC. These values assume the water is a potential drinking water source. Use of GPB in this area as a drinking water source is not considered viable. Picatinny maintains its own potable water supply and distribution network to serve its entire population.

Based on the HHRA, no unacceptable risks were associated with surface water. However, the COPCs listed below exceeded the LOCs. In addition, no ecological risk was identified associated with surface water.

3.1.4 Location-Specific ARARs and TBC Guidance

Remedial action alternatives may be restricted or precluded by federal, state, and U.S. Army regulations based on its location within a site or its immediate environment. Location-specific ARARs are designed to protect the local area from potentially damaging response actions. For example, altering habitat of an endangered species to construct a treatment facility may jeopardize the survivability of the species. The converse is also true; location-specific ARARs also protect RAs from the environment. For example, locating a treatment facility within a flood plain without proper engineering precautions may result in structural damage during a flood. **Table 3-7** identifies the federal, state, and U.S. Army regulations that contain promulgated standards, requirements, criteria, or limitations that will be considered ARARs for this FFS. Within the table, location-specific ARAR "requirements" are grouped by site characteristics that have been observed within Sites 31 and 101 or characteristics that are likely to be encountered at the site. The promulgated standards and requirements and the impact each location-specific ARAR will have if encountered is also identified within **Table 3-7**.

3.1.5 Action-Specific ARARs and TBC Guidance

Action-specific ARARs are promulgated state or federal laws that set controls or restrictions on activities related to the management of hazardous materials. Within Section 4.0 of this FFS, several RAs for Sites 31 and 101 are developed. Each of the RAs, except No Action, will require several "actions" to transpire in the course of successfully instituting the alternative and may be controlled or restricted by action-specific ARARs. The action-specific ARARs and TBCs are organized by the associated actions and presented in **Table 3-8**. ARARs listed in Table 3-9 generally apply to RAs involving excavation of COCs, with the exception of the specified requirements in the NJ Technical Requirements for Site Remediation N.J.A.C. 7:26E Subchapter 8, Engineering and Institutional Controls.

By definition, ARARs pertain to on-site actions subject to promulgated state or federal laws. Legal requirements governing off-site actions, such as those pertaining to labeling and transportation of solid and/or hazardous waste do not qualify as ARARs; however, they are applicable requirements outside of the CERCLA ARARs process that must be met. Such requirements would be applicable to the transporter but would apply outside of the ARARs context. Off-site actions must comply with all applicable requirements. Such requirements would include:

- NJDEP – Division of Waste Management: NJAC 7:26 Subchapter 3, which requires that solid waste (investigation derived waste) for off-site transportation must obtain proper written approval from the state prior to transporting the waste. Once approved, the transporting vehicle has to be properly registered to handle the waste with appropriate placard.
- RCRA – Solid/Hazardous Waste Regulations: 40 CFR, Subparts A, B, C, and D and 40 CFR 263, Subparts A, B, and C; Directive #9330.2-07,49; and NJAC 7:26G-7 require vehicles transporting hazardous waste to be properly registered to handle and transport the waste to a regulated facility. In addition, waste must be properly packed and accompanied by proper emergency response spill procedures and manifests.
- U.S. Department of Transportation Hazardous Materials Transportation Regulations, 49 CFR 171-180 establishes classification, packaging, and labeling requirements for shipments of hazardous materials.

Table 3-7
Location-Specific ARARs and TBCs

Location	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Wetlands	Presence of wetlands as defined in Executive Order 11990 § 7 (c) and 40 CFR 6, Appendix A § 4 (j)	Whenever possible, federal agency actions must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. Agencies should particularly avoid new construction in wetland areas unless there are no practicable alternatives. Federal agencies shall incorporate wetlands protection consideration into planning, regulating, and decision-making processes.	ARAR Applicable to the substantive permit requirements if clearing and/or excavation activities encroach upon wetlands and/or transition areas identified in the Picatinny Facility-wide GIS at the “25 Sites”. Applicable or potentially applicable to sites within or adjacent to: Encroachment/Transition Areas: Sites 69, 117, 123, 187, PICA 207, 60, 145, and 176 Wetlands: Sites 52/95/96, 174, 7, 164, 27, 119, 120, 121, PICA 208
	Presence of wetlands as defined in the Clean Water Act Section 402 33 CFR 320.4 and NJAC 7:7A (the Freshwater Wetlands Protection Act, P.L. 1987)	To the extent possible, action must be taken to avoid degradation or destruction of wetlands. Discharges for which there are practicable alternatives with less adverse impacts or those that would cause or contribute to significant degradation are prohibited. If adverse impacts are unavoidable, action must be taken to enhance, restore, or create alternative wetlands.	
Floodplains	Protection of flood plains as defined in Executive Order 11988 § 6(c) and 40CFR 6, Appendix A §4 (d)	Federal agencies shall take action to reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values of flood plains. Federal agencies shall evaluate the potential effects of actions in flood plains and ensure consideration of flood hazards and flood plain management. If action is taken in flood plains, federal agencies shall consider alternatives to avoid adverse affects, and potential.	ARAR Based upon the Picatinny Facility-wide GIS, some of the “25 Sites” have been identified within or adjacent to: 500-yr floodplain: Site 60 10-yr floodplain: Sites 27, 121, 10 1-yr floodplain: Sites 145, 52/95/96, PICA 208
	Within 100 year flood plain as defined in 40 CFR 6, Appendix A §4 (d)	Facility must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by flooding.	

Table 3-7 (Continued)
Location-Specific ARARs and TBCs

Location	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Integrated Natural Resource Management Plan (INRMP)	Interagency agreement with the United States Army Environmental Center, as required by: - Sikes Act (16 U.S.C. 670a *et seq*) - Army Regulation 200-3 - Department of Defense Instruction 4715.3	The purpose of the INRMP is to ensure that natural resources conservation measures and Army mission activities are integrated and are consistent with federal stewardship requirements. Stated goals of the INRMP include minimizing habitat fragmentation and protecting unique or sensitive habitat; and protecting native species, rare and ecologically important species, and genetic diversity.	TBC Applicable to clearing and/or excavation activities which could affect the multipurpose uses of natural resources at Picatinny. Remedial activities at the “25 Sites” will be conducted in accordance with the INRMP.
Endangered Species Act (Rare, Threatened, or Endangered Species)	Presence of those species listed in the following acts and regulations: - Endangered Species Act (16 U.S.C. 1531 *et seq*) - Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*) - 40 CFR 6.302(h) - 50 CFR 402 - CWA § 404 - 50 CFR 17.11-17.12 - NJAS 23:2A - NJAC 7:25-4 as being rare, threatened, or endangered species.	Whenever possible, federal agency actions must avoid or minimize adverse impacts on rare, threatened, or endangered species and act to preserve and enhance their natural and beneficial values. Agencies should particularly avoid new construction in those areas containing these species unless there are no practicable alternatives. Federal agencies shall incorporate rare, threatened, or endangered species protection consideration into planning, regulating, and decision-making processes.	ARAR Applicable to sites located within the habitats identified in the Picatinny Facility-wide GIS. Sites 175, 172, 173, 174, 189, 176, 7, and 164 are located within the safety distance around Indiana Bat siting locations.

Table 3-8
Action-Specific ARARs and TBCs

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Generation of Hazardous Wastes and Testing of Excavated Materials	RCRA methods for identification and evaluation of solid and hazardous wastes - 40 CFR 261, Subparts A, B, C and D - 40 CFR 136, App. A (SW-846 including method 608, 8082 by gas chromatography for PCB wastes). - NJAC 26G-5.1 (incorporated by reference 40 CFR 261)	Specific requirements for identifying hazardous wastes. Establishes analytical requirements for testing and evaluating solid, hazardous, and water wastes	ARAR Applicable. TCLP analysis and testing results indicative of hazardous wastes.
Sampling and Analysis	Remediation Technical Requirements NJAC 7:26E-6.4(a)	Requirements for post remedial action sampling and analysis at remediation sites.	ARAR Applicable to the performance of sampling and analysis at excavation sites.
	Notice of Intent to implement a Performance Based Measurement System (PBMS) 62 FR 52098, Oct. 6, 1997 (FRL-5903-2)	Give the public an opinion on selecting any appropriate analytical test method to use in complying with USEPA regulations.	TBC Applies to analytical methods in regards to waste generation.
Soil Erosion and Sediment Control during Excavation	New Jersey Soil Erosion and Sediment Control Act, NJAC 7:13-3 and NJAC 2:90	Requirements for soil erosion and sediment controls.	ARAR Applicable to excavation, and clearing activities.
Military Munitions Identification, Treatment, and Disposal	40 CFR 266.200 – 266.206, Subpart M [reference 40 CFR 260-270]	Regulations which identify when military munitions become a solid waste and if hazardous.	ARAR Potentially applicable if UXO is discovered during excavation and/or clearing activities at the site.
	40 CFR 300.120	DOD will have removal response authority and Remedial Project Manager (RPM) will be the prime contact for incidents involving military weapons and munitions under control of DOD.	ARAR Potentially applicable if UXO is discovered during excavation and/or clearing activities at the site. DOD and RPM will be contacted.
	ER-1110-1-8153	Defines response actions and roles and responsibilities for UXO removal Adapts criterion of 10% explosive content as a measure of contaminated soil reactivity to differentiate between hazardous and explosive waste.	TBC Potentially applicable if UXO is discovered during excavation and/or any other access of personnel at site TBC Applies to explosive content in soil. Not applicable to UXO directly.

Table 3-8 (Continued)
Action-Specific ARARs and TBCs

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Military Munitions Identification, Treatment, and Disposal (continued)	EP-1110-1-18	Provides the procedures to implement an UXO removal action.	TBC Potentially applicable if UXO is discovered during excavation and/or any other access of personnel at site
	TM-9-1375-213-12	Defines the minimum safe distance between emitters of electromagnetic radiation in the radio frequency range and UXO clearance/demolition activities.	TBC Potentially applicable if UXO is discovered during excavation and/or any other access of personnel at site
	TM-5-855-1	Defines protective measures to be taken to reduce blast shock and fragmentation damage.	TBC Potentially applicable if UXO is discovered during excavation and/or any other access of personnel at site.
	DA PAM 385-61 DA PAM 385-64	Defines procedures for emergency decontamination of site workers and minimum safe distance for UXO removal.	TBC Potentially applicable if UXO is discovered during excavation and/or any other access of personnel at site
	TM-60-A-1-1-31	Provides UXO disposal requirements	TBC Potentially applicable if UXO is discovered during excavation and/or any other access of personnel at site
	DOD 6055.9-STD	Requires specialized personnel in detection, removal, and disposal of ordnance and explosives; stipulates required safety precautions and procedures for detonation/ disposal; establishes depth of remediation based on land use.	TBC Potentially applicable if UXO is discovered during excavation and/or any other access of personnel at site

Table 3-8 (Continued)
Action-Specific ARARs and TBCs

General Remediation and Institutional Controls	Technical Requirements for Site Remediation NJAC 7:26E-6.1(b)2,4	Specifies that revised applicable numerical remediation standards must be achieved if they decrease by an order of magnitude or more prior to issuance of an NFA and that remedial action must not cause an uncontrolled or unpermitted discharge or transfer of contaminants to another media.	ARAR Relevant and appropriate for on-site remediation activities.
	NJAC 7:26E-6.1(e)	Requires ICs whenever a restricted/limited use remedy is used at a site.	ARAR Relevant and Appropriate for on-site remedial activities.
	NJAC 7:26-6.4(b)	Specifies post-remedial site restoration requirements.	ARAR Applicable to on-site remedial activities involving excavation.
	NJAC 7:26-6.4(d)1	Provides requirements for reuse of excavated soil at the site.	ARAR Potentially applicable to on-site remedial activities if excavated soil is to be reused.
	NJAC 7:26-8.1(b)3 NJAC 7:26-8.5(a)1,2,3 NJAC 7:26-8.7(a)1,2,3	Specifies monitoring of engineering and institutional controls.	ARAR Relevant and appropriate for on-site remedial activities.
	New Jersey Soil Erosion and Sediment Control Act 40 CFR 122.26(c) NJAC 7:13-3 and 2:90. 40 CFR 122.26 (c)	Requires the implementation of soil and erosion and sediment control measures for activities disturbing over 5,000 square feet of surface area of land.	ARAR Applicable for site activities involving excavation, grading, or other soil disturbance activities exceeding 1 acre.
	USEPA OSWER Publication 9345.3-03FS, January 1992	Investigation-derived wastes generated from remedial activities (e.g., drilling mud, purged water, etc.) are required to be properly stored, managed and disposed. Guidance given in the publication includes waste material containment, collection, labeling, etc.	TBC for wastes generated during excavation activities and groundwater monitoring.

Table 3-8 (Continued)
Action-Specific ARARs and TBCs

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Discharge of Aqueous Waste to Surface Water	CWA Effluent Guidelines – National Pollutant Discharge Elimination System 40 CFR 401 40 CFR 122 and 125 40 CFR 136.1 – 136.4	Provides requirements for point source discharges of pollutants.	ARAR Applicable for discharge of storm water that may result from on-site *in situ* and/or excavation and clearing activities and the discharge of treated wash water to the drainage ditch, wetlands or surface water.
	New Jersey Water Pollution Control Act – New Jersey Pollutant Discharge Elimination System (NJPDES) (NJAC 7:14A)	Discharge of pollutants to surface water and groundwater from remediation sites is regulated via NJPDES requirements. NJPDES requirements include obtaining a discharge to surface water or groundwater permit equivalent and meeting substantive requirements of the permit. Requirements include effluent limitations, water quality based limitations, monitoring, and monitoring techniques.	ARAR Applicable to the substantive requirements of the permit program for storm water and treated wash water discharges to surface water.
Stream/Wetland Encroachment	33 CFR 320.4 Flood Hazard Area Control (NJAC 7:13-1.1 et seq.) Freshwater Wetland Protection Act Rule (NJAC 7:7A-9, NJSA 13:9A-1) All the regulations require equivalency permit and correlate with location specific requirements.	Equivalency permit required for the following activities: - Development or disturbances in floodplain and wetland area - Stream encroachment - Soil erosion and sediment control	ARAR Applicable to the substantive requirements of the permit program for remediation activities.

Table 3-8 (Continued)
Action-Specific ARARs and TBCs

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
On-Site Treatment, Storage, and Disposal	RCRA Treatment, Storage and Disposal of Hazardous Waste 40 CFR 264, Subparts A, B, C, D, E, G and I. 265, Subparts A, B, C, D, E, G and I NJAC 26G-8 and 9 (incorporation by reference)	Standards and requirements for facilities that treat, store, and dispose of hazardous waste. Requirements include: - General Facility Standards - Emergency Preparedness and Prevention - Contingency Plan and Emergency Procedures - Manifest System - Use and Management of Containers - Closure and Post Closure	ARAR Applicable to the substantive requirements if hazardous waste is treated or stored on site.
	RCRA Treatment, Storage and Disposal of Hazardous Waste 40 CFR 264, Subparts J, L, and X 40 CFR 265 Subparts J, L, and Q RCRA – New Jersey Hazardous Waste Regulations Incorporates the above regulations (NJAC 7:26G-8 and 9)	Provides requirements for handling waste at the following facility types: - Tank systems - Waste piles - Chemical, physical and biological treatment - Miscellaneous units	ARAR Potentially applicable to the substantive requirements for storage and treatment of wash water and soils from remediation activities. This would be applicable if wash water and/or excavated soils were identified as hazardous waste and treated on site.
	Air Quality Regulations New Jersey NJAC 7:27-13	Provides requirements applicable to ambient air pollution sources	ARAR Potentially applicable to the on-site generation and emission of ambient air pollutants. Air monitoring will be performed and if the following air quality standards are exceeded, then requirements are applicable. Primary air quality standard is 75 micrograms per cubic meter ($\mu g/m^3$)(not to exceed 260 $\mu g/m^3$ more than once) and secondary standard of 60 $\mu g/m^3$ (not to exceed 150 $\mu g/m^3$ more than once) both for geometric mean value of all 24-hour average concentration standard over 12 consecutive months.

Table 3-8 (Continued)
Action-Specific ARARs and TBCs

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Disposal Off Site	RCRA Land Disposal Restrictions 40 CFR 268, Subparts A, B, C, D, and E NJAC 7:26-11 *et seq.*	Identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise restricted waste may continue to be land disposed.	ARAR Applicable if hazardous waste is disposed of on site or transported off-site to a landfill.
	Toxic Substances Control Act (TSCA) Identification of alternate disposal methods, traditional (performance based) and risk-based methods for disposal. 40 CFR 761.50 (alternate disposal method) 40 CFR 761.75 (chemical waste landfill) 40 CFR 761.61 (self-implementing, traditional and risk based options) 40 CFR 761.77 (approval)	Applicable to disposal of material: 1) containing < 50 ppm PCBs; 2) managed under a 404 CWA or equivalent permit USACE under 33 CFR 320; 3) getting prior approval from USEPA based on risk assessment and site specifics.	ARAR Potentially applicable to disposal of < 50 ppm PCBs may be sent to a RCRA approved landfill.
	Procedures for Planning and Implementing Off-Site Response Actions 40 CFR 300.440(a)(4)	Requires the receiving facility meet acceptability requirements (as determined by the EPA Regional Office) prior to the facility's initial receipt of CERCLA waste.	ARAR Applicable if site contaminants are excavated and disposed off site.
Packaging, Labeling and Storage	RCRA Hazardous Waste Generation 40 CFR 262, Subparts A, B, C, D and E. NJAC 7:26G-6	Specifies requirements for hazardous waste packaging, labeling, manifesting, and storage.	ARAR Potentially applicable for the off-site transportation of hazardous waste.
	TSCA 40 CFR 761.40 and 40 CFR 761.45	Specifies requirements for labeling and shipping of PCBs.	ARAR Potentially applicable for labeling and transportation of PCBs off-site.

3.1.6 Non-Applicable ARARs

The following location-specific ARARs were considered, but found to be not applicable or relevant and appropriate for this FFS:

- Faults
- Wilderness Areas
- Wildlife Resources and Refuges
- Scenic Rivers
- Farmlands
- Coastal Zones

These potential areas are required to be reviewed as potential ARARs by CERCLA guidance documents.

3.2 IDENTIFICATION OF CONTAMINANTS OF CONCERN, SITE CLEANUP LEVELS, AND AREAS OF ATTAINMENT

This section describes the determination of COCs, SCLs, and AAs for each media at the "25 Sites". Previous sections of this report have identified lists of potential COCs, as follows:

COPCs – identified by screening versus LOCs. Results of this screening process are included in Section 2.0 (Nature and Extent of Contamination).

HHCOPCs – identified as potential risks in HHRAs.

COPECs – identified as potential risks in ERAs.

In the following sections, these contaminants are further evaluated with respect to the potential chemical-specific ARARs and TBCs presented in Section 3.2 and to refine the potential associated risks.

A COC is defined as a contaminant that poses significant human health and/or ecological risks at a particular site. The SCL is a level, determined based on the identification of potential ARARs and the potential risks posed to human health and ecological receptors, which is used to achieve the RAOs for a particular site. Lastly, an AA is defined as the area over which RAOs, thus the SCLs, are to be obtained.

3.2.1 Identification of COCs and SCLs

COCs are addressed within this section for each media covered within this FFS (i.e., surface soil and subsurface soil, sediment, and surface water). Surface water is not discussed in detail, as it is assumed that cleanup of sediment will address surface water COCs. The starting point for the development of the list of COCs is the entire list of contaminants that were detected in samples collected from the "25 Sites". For soils, the entire list of detected chemicals was compared with the current NJDEP NRSRS. In cases where a site exhibited no exceedences of the NRSRS, the site data was compared to the USEPA RSL (both industrial and residential) to determine if a recommendation of NFA was appropriate for the site. For sediment and surface water, the entire list of detected chemicals was compared with the current Picatinny LOCs (sediment LOCs based on human health based soil criteria were rescreened with respect to the NRSRS and IRSLs). All exceedences of Picatinny LOCs were then further screened by site-specific considerations. All available chemical concentrations detected at the "25 Sites" are presented in **Appendix A** in order to allow the reader to get a complete look at the data. These lists of compounds were also screened using the results of the HHRA and ERA.

3.2.1.1 Surface Soil

Based on comments from the NJDEP, COCs are defined as compounds that: 1) contributed to the majority of site-specific human health or ecological risk, which are referred to as "Risk-Driver COCs"; and, 2) exceeded the NJDEP NRSRS, which are referred to as "Non Risk-Driver COCs".

Below is a summary of the screening process used to identify COCs in surface soil (also depicted graphically in **Chart 3-1**).

- If the highest concentration detected was above the NJDEP NRSRS listed in **Appendix D** then the detected constituent was included as a COPC. The HHRA was examined to determine which COPCs contributed to the majority of carcinogenic risk of 1E-06 or the majority of the noncarcinogenic hazard of 1; these compounds were considered Risk-Driver COCs.

- Compounds identified as COCs in the HHRA and ecological contaminants of concern (ecoCOCs) were included as Risk-Driver COCs.
- Any compound included as a COPC because it exceeded the NJDEP criteria, but did not contribute to a major portion of the risk identified in the site-specific risk assessment were included as Non Risk-Driver COCs. These compounds were addressed as part of the AOCs.

In this FFS, HHRAs and ERAs were also used to develop the list of COCs to assure the protectiveness of the remedy. The results of this screening process for surface soil are presented in the following sections.

Surface Soil Human Health Risk Drivers

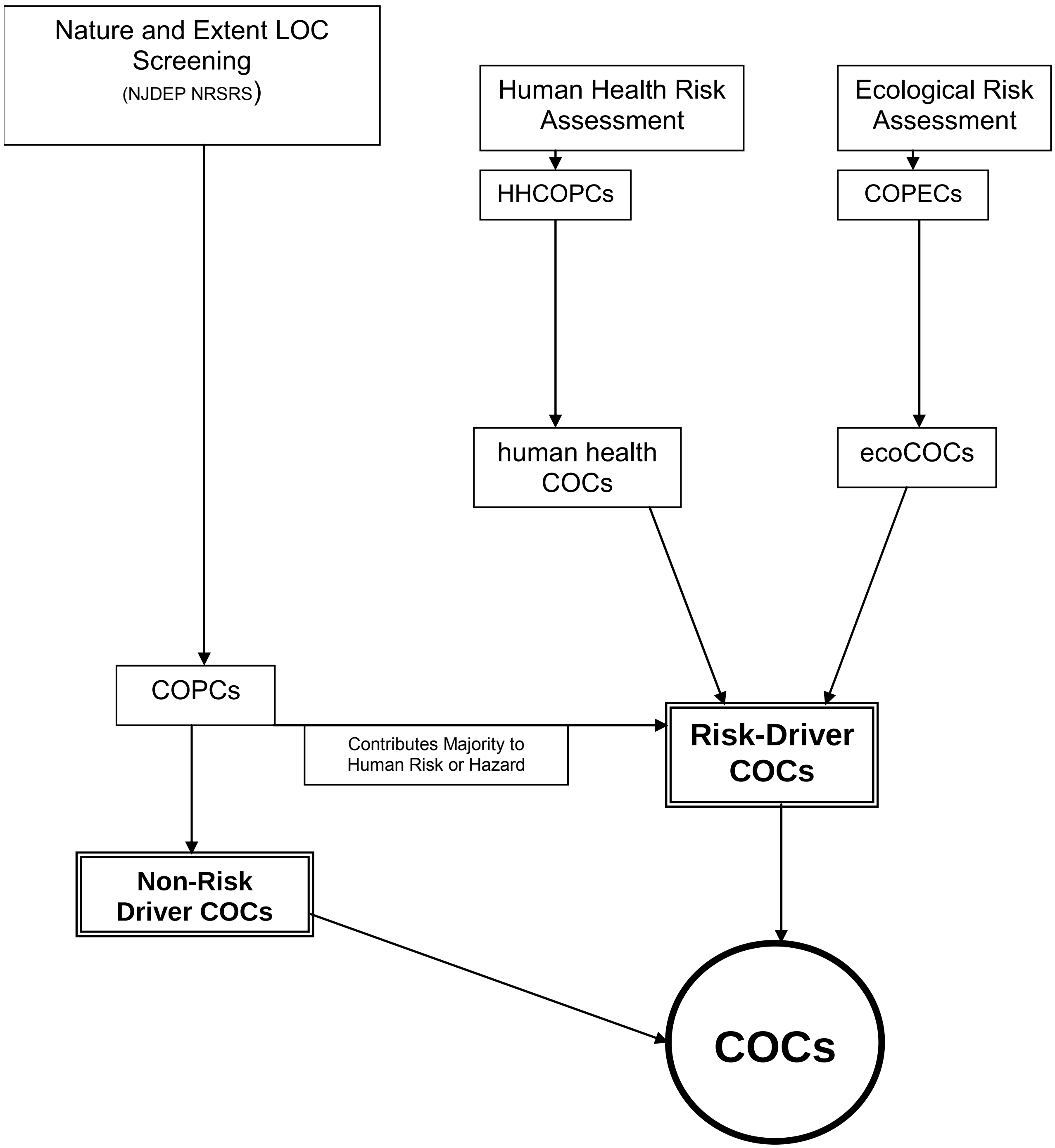
Based on the human health COCs identified in Section 2 for surface soils (from the HHRA), the following risk-based RGs were developed, from NJDEP (or USEPA RSLs, if no values were available from NJDEP), for non-residential direct contact exposure. In addition to the human health COCs identified in Section 2.5.1, all constituents detected above the NRSRS are presented on **Table 3-9**. .

Table 3-9
Human Health Risk-Driver Constituents in Surface Soil

Surface Soil Constituent	NJDEP Soil Remediation Standard (1) (mg/kg)	Risk-Driver? (Applicable Site)
Benz(a)anthracene	2	No
Benzo(a)pyrene	0.2	**Yes (134, 173, 176 (2), 177)**
Benzo(b)fluoranthene	2	No
Benzo(k)fluoranthene	23	No
Chrysene	230	No
Dibenz(a,h)anthracene	0.2	No
Indeno(1,2,3-cd)pyrene	2	No
Naphthalene	17 (25,000)(3)	No
Total PCBs	1	**Yes (123, 52/95/96)**
4,4'-DDT	8	No
Dieldrin	0.2	No
Arsenic	19	**Yes (187, 60, 52/95/96, 173, 174, 10, PICA 208)**
Beryllium	140 (230)(3)	**Yes (117)**
Lead	800(3)	**Yes (134)**
Manganese	5,900 (160,000)(3)	**Yes (145)**
Thallium	79	No

(1) Nonresidential Direct Contact Soil Remediation Standard (NJDEP, 2009b).
(2) Identified as a Risk-Driver for hypothetical future residential receptors only (within the USEPA target range of 10^{-6} to 10^{-4}).
(3) NJDEP NRSRS for lead, and those based on the inhalation pathway (beryllium, manganese and naphthalene) are not ARARs. Ingestion/dermal exposure values for beryllium, manganese and naphthalene are provided in parentheses). Note: Only beryllium at Site 27 exceeded both the NRSRS based on inhalation and the ingestion/dermal exposure value).

Chart 3-1. Schematic Representation of Surface Soil COC Development



Surface Soil Ecological Risk Drivers

Results of available ERAs, SLERAs, and evaluation of habit potential are provided for each site in Section 2.0. Based on the results of these assessments no unacceptable ecological risks have been identified for surface soil at the "25 Sites".

Surface Soil Constituents Above LOCs

Fourteen additional constituents were included as COCs because they exceeded NJDEP cleanup criteria. These included benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, 4,4'-DDT, Dieldrin, 2,4_DNT, 2,6-DNT, thallium, and thorium-232. These constituents are considered Non Risk-Driver COCs.

Final List of COCs and SCLs

The final list of COCs for surface soils for the "25 Sites" includes those which 1) may pose a human health risk by exceeding NJDEP NRSRS and 2) may pose a human health risk based on the site-specific risk assessment. The COCs are:

Table 3-10 Surface Soil COCs and SCLs

COC	SCL (mg/kg)
4,4'-DDT	8
Total PCBs	1
Arsenic	19
Beryllium	140 (230)[(1)]
Dieldrin	0.2
Lead	800[(1)]
Manganese	5,900 (160,000)[(1)]
Thallium	79
Benz(a)anthracene	2
Benzo(a)pyrene	0.2
Benzo(b)fluoranthene	2
Benzo(k)fluoranthene	23
Carbazole	96
Chrysene	230
Dibenz(a,h)anthracene	0.2
Indeno(1,2,3-cd)pyrene	2
Naphthalene	17 (25,000)[(1)]
2,4-DNT	3
2,6-DNT	3
Thorium-232	3

(1) NJDEP NRSRS for lead, and those based on the inhalation pathway (beryllium, manganese and naphthalene) are not ARARs. Ingestion/dermal exposure values for beryllium, manganese and naphthalene are provided in parentheses). Note: Only beryllium at Site 27 exceeded both the NRSRS based on inhalation and the ingestion/dermal exposure value).

Impact to Groundwater (IGW) COCs

Additionally, for subsurface soil, the detected concentrations were examined in light of compounds detected in groundwater. Compounds detected in subsurface soil that could potentially prove harmful to groundwater were identified to evaluate the potential for data gaps associated with groundwater protection. These IGW COPCs were developed utilizing soils and groundwater data on a site by site basis. Compounds were selected based on results that indicated that groundwater was already impacted. The starting point for this list was the entire groundwater data set for each of the “25 Sites”. The groundwater data set was screened against relevant criteria such as NJDEP MCLs and Quality Criteria that are included as Picatinny LOCs for groundwater. Due to the large amount of time since the release of contamination at these sites, it was assumed that if groundwater impact from a specific compound were to occur, it would already be evident in the groundwater analytical results. Therefore, if groundwater had not been impacted to date, future impacts are improbable.

Some compounds were eliminated as COPCs based on three additional considerations. The first consideration was the presence of a plume distribution. Contaminants that were not distributed as a plume were eliminated as a COPC. The second was the frequency of detection (FOD) of these compounds in subsurface soil. Compounds detected infrequently were removed from consideration (e.g., less than 5 percent FOD). The third was background soil concentrations. Inorganics detected in soil at concentrations below Picatinny-specific background soil concentrations (IT, 2002) were removed from consideration. Once the list was narrowed to this point, it was then determined if existing concentrations of groundwater COPCs (developed in this section) in soil posed a continued threat to groundwater. This determination was made through a comparison to NJDEP IGW criteria, where these values existed, or IGW criteria obtained from other available sources if New Jersey values were unavailable. If a compound was a COPC for groundwater and was above these soil screening values, it was considered a COPC for IGW. Conversely, if no soil concentrations were found above these screening values, the compound was excluded.

Based on a comparison of maximum detected groundwater concentrations and relevant human health based criteria (as discussed previously), the following constituents were initially selected at the respective sites, as the maximum detected concentration exceeded a groundwater LOC (**Table 3-11**).

Table 3-11
Groundwater Constituents above LOCs

Site 69	TCE
Site 187	Aluminum, Arsenic, Beryllium, Chromium, Cobalt, Iron, Lead, Manganese, Nickel, Thallium
Site 60	PCE, RDX, Aluminum, Iron, Lead, Manganese
Site 145	RDX, TNT, Aluminum, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Thallium, Vanadium
Sites 52, 95, and 96	1,3-Dinitrobenzene, 1,2,4-Trichlorobenzene, RDX, Aluminum, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Nickel, Sodium, Thallium, Vanadium
Sites134	PCE, TCE, Aluminum, Iron, Manganese, Sodium
Site 136	Aluminum, Arsenic, Beryllium, Iron, Lead, Manganese, Vanadium
Site 185	Lead
Site 175	Methylene Chloride
Site 173	Aluminum, Iron, Lead
Site 186	n-Nitrosodiphenylamine, PCE, Aluminum, Chromium, Iron, Lead, Manganese, Nickel, Silver, Sodium
Site 10	Aluminum, Arsenic, Manganese
Site 27	Sodium
PICA Site 208	Aluminum, Arsenic, Iron, Lead, Manganese

These constituents were evaluated for potential plume distribution at each site (**Table 3-12**).

Table 3-12
Distribution of COPCs in Groundwater

Constituent	FOD	Number of LOC Exceedences	Exhibit Potential Plume Distribution?	Comment
Site 69				
TCE	1/1	1	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Site 187				
Aluminum	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Arsenic	3/6	3	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.
Beryllium	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Chromium	5/5	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Cobalt	2/2	1	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Iron	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Lead	5/6	5	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Manganese	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Nickel	5/5	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Thallium	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Site 60				
PCE	2/4	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
RDX	2/4	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Aluminum	4/4	4	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Iron	4/4	4	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Lead	1/4	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Manganese	4/4	4	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Site 145				
RDX	2/9	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
TNT	1/9	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Aluminum	9/9	9	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Arsenic	4/9	3	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Barium	9/9	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Beryllium	3/9	3	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Cadmium	2/9	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.

Constituent	FOD	Number of LOC Exceedences	Exhibit Potential Plume Distribution?	Comment
Chromium	3/9	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Cobalt	2/9	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Copper	5/9	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Iron	9/9	9	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Lead	4/9	4	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.
Manganese	8/9	7	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Mercury	2/9	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Nickel	2/9	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Thallium	2/9	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Vanadium	3/9	3	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.
Sites 52, 95, and 96				
1,3-Dinitrobenzene	1/15	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
1,2,4-Trichlorobenzene	1/18	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
RDX	5/18	5	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.
Aluminum	15/18	15	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Arsenic	12/18	11	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Barium	17/18	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Beryllium	8/18	8	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.
Cadmium	3/18	3	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Chromium	10/18	7	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.
Cobalt	7/18	3	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Copper	12/18	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Iron	16/18	16	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Lead	13/18	13	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Manganese	17/18	15	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Nickel	8/18	4	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.

Constituent	FOD	Number of LOC Exceedences	Exhibit Potential Plume Distribution?	Comment
Sodium	17/18	9	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Thallium	1/18	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Vanadium	8/18	7	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Site 134				
PCE	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
TCE	1/2	1	No	Single low level exceedence followed by a subsequent non-detect
Aluminum	2/2	1	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Iron	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Manganese	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Sodium	2/2	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Site 136				
Aluminum	4/4	4	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Arsenic	3/4	3	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Beryllium	1/4	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Iron	4/4	4	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Lead	3/4	3	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Manganese	4/4	4	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Vanadium	2/4	1	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Site 185				
Lead	2/3	2	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Site 175				
Methylene Chloride	1/3	1	No	Single low level exceedence of a common laboratory contaminant.
Site 186				
n-Nitrosodiphenylamine	1/3	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
PCE	2/6	1	No	Single “exceedence” at the LOC followed by subsequent non-detect
Aluminum	3/3	1	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
Chromium	4/6	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Iron	3/3	3	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Lead	2/6	2	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Manganese	3/3	2	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume

Constituent	FOD	Number of LOC Exceedences	Exhibit Potential Plume Distribution?	Comment
Nickel	6/6	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Silver	1/6	1	No	As only one or two exceedences were noted, a distribution in a plume was not supported.
Sodium	3/3	2	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Site 10				
Aluminum	3/3	3	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Arsenic	1/3	1	No	Single “exceedence” at the LOC; a distribution in a plume was not supported.
Manganese	3/3	2	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Site 27				
Sodium	1/1	1	Yes	Due to limited groundwater data its distribution in a plume could not be ruled out.
PICA Site 208				
Aluminum	3/3	2	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Arsenic	3/6	3	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Iron	3/3	3	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume
Lead	2/6	2	Yes	Although the pattern of exceedences was not extremely localized, a plume distribution could not be ruled out.
Manganese	3/3	3	Yes	The pattern of exceedences was somewhat localized suggesting the existence of a plume

Constituents were eliminated based on a low frequency of detection (detected in only one or two groundwater samples in a sufficiently large data set). The remaining constituents were evaluated to determine whether their LOC exceedence pattern exhibited a potential plume distribution, as discussed in **Table 3-12**.

Based on this evaluation, 15 constituents (PCE, TCE, RDX, aluminum, arsenic, beryllium, chromium, cobalt, iron, lead, manganese, nickel, sodium, thallium, and vanadium) were determined to be potentially distributed in a groundwater plume and were retained for further evaluation. However; a review of groundwater sampling results shows that beryllium, chromium, cobalt, nickel, and thallium were only detected above groundwater LOCs in samples collected from Hydropunch or other temporary groundwater sampling points. Due to the high turbidity associated with samples of this nature, concentrations of naturally occurring minerals are not representative of groundwater in the aquifer; therefore, beryllium, chromium, cobalt, nickel, and thallium were excluded from the remaining impact to groundwater evaluation. Similarly, all the remaining inorganic constituents from Site 187 and lead at PICA Site 208 were eliminated from further impact to groundwater consideration. Similar to samples collected from temporary groundwater sampling points, samples collected from monitoring wells prior to 1996 were not collected using low flow sampling methodology yielding inorganic sample concentrations that are not representative of groundwater in the aquifer. Available corresponding filtered sample results indicated, in some cases, that the unfiltered concentrations were due to suspended solids rather than dissolved concentrations. As such, aluminum (from Sites 60, 145, 134, and 136), arsenic (from Site 52, 95, 96 and Site 136), iron (from Sites 60 and 136), lead and vanadium (both from Site145), and sodium (from Site 134) were removed from additional impact to groundwater analysis.

Next, the frequency of these 10 constituents detected in subsurface soil samples was evaluated, as infrequently detected constituents would not be a significant concern for leaching to groundwater. Detection frequency information is summarized in **Table 3-13**.

Based on the evaluation of FOD (**Table 3-13**), five subsurface soil constituents (aluminum, iron, lead, manganese, and sodium) are a potential concern for leaching to groundwater.

There are no criteria for groundwater protectiveness for any of these six constituents published or promulgated in the State of New Jersey. Therefore, USEPA guidance for groundwater protectiveness (based on partition theory associated with leaching from soil) was employed for these inorganic constituents, following the method presented in USEPA (1996a).

Table 3-13
Frequency of Detection for Potential Impact to Groundwater Constituents

Constituent	**Subsurface Soil FOD at Site:**										
	69	**60(1)**	**145**	**52,95,96**	**134**	**136(2)**	**185**	**186(3)**	**10**	**27(4)**	**PICA 208(5)**
PCE	---	NA	---	---	0/7	---	---	---	---	---	---
TCE	0/5	---	---	---	---	---	---	---	---	---	---
RDX	---	---	---	0/7	---	---	---	---	---	---	---
Aluminum	---	---	---	16/16	---	---	---	NA	1/1	---	NA
Arsenic	---	---	---	---	---	---	---	---	---	---	NA
Iron	---	---	2/2	16/16	7/7	---	---	NA	---	---	NA
Lead	---		---	---	---	NA	1/1	---	---	---	---
Manganese	---	NA	2/2	16/16	7/7	NA	---	NA	1/1	---	NA
Sodium	---	---	---	12/16	---	---	---	NA	---	NA	---
Vanadium	---	---	---	---	---	NA	---	---	---	---	---

--- Not identified in as having a potential plume distribution or not detected in site groundwater

NA = Not Applicable.

(1) No subsurface soil analyzed. Review of surface soil and area wide groundwater analytical data indicates that PCE detected in groundwater at Site 60 is associated with the Mid-Valley plume and not a result of site activities. Manganese in groundwater likely due to site geology

(2) No subsurface soil analyzed; and only mercury, which was subsequently excavated, was detected above levels of concern (LOCs) in surface soil. Elevated lead, manganese, and vanadium concentrations are likely due to both sample technique and site geology.

(3) No surface or subsurface soil analyzed. Aluminum, iron, and manganese groundwater concentrations are likely due to site geology. Sodium may be related to the use of road salt.

(4) No subsurface soil analyzed. Sodium was detected in all four surface soil samples for which it was analyzed; however at relatively low concentrations (140 – 350 mg/kg). Salt storage at the site ceased in 1983, eliminating the source of sodium in groundwater.

(5) No subsurface soil analyzed. Aluminum, iron, and manganese concentrations in groundwater likely due to site geology. Arsenic was detected above its LOC (based on NJDEP SRS for natural background) in surface soil.

However, it should be noted that partition theory for inorganics is much more complicated than for organics. Unlike organic compounds, for which Kd values are largely controlled by a single parameter (e.g., soil organic carbon), Kd values for metals are significantly affected by a variety of soil conditions. The most significant parameters are pH, oxidation-reduction conditions, iron oxide content, soil organic matter content, cation exchange capacity, and major ion chemistry. The number of significant influencing parameters, their variability in the field, and differences in experimental methods result in a wide range of Kd values for individual metals, reported in the literature to range over five orders of magnitude.

USEPA (1996a) does not present migration to groundwater SSLs for aluminum, iron, lead, manganese, or sodium. USEPA (1996a) suggests the use of a surrogate screening value for lead of 400 mg/kg. The surrogate value of 400 mg/kg for lead, however, is based on potential direct contact exposure for a future residential receptor. As neither direct contact with subsurface soils or future residential development is expected, the use of a surrogate SSL value of 400 mg/kg does not appear warranted for these sites. Thus, there is no readily available method to assess whether or not concentrations of the five inorganic constituents in soils are a continuing concern for groundwater protectiveness. It should be noted that many measured sample concentrations of these inorganics in subsurface soil at the "25 Sites" are above the Picatinny site-specific background soil concentrations. To be conservative, the following Picatinny LOCs may be used to protect groundwater resources from future leaching from soil:

- Aluminum: 990,000 mg/kg (Picatinny LOC)
- Iron: 720,000 mg/kg (Picatinny LOC)
- Lead: 800 mg/kg (Picatinny LOC)
- Manganese: 5,900 mg/kg (Picatinny LOC)

There is no NRSRS or IRSL established for sodium. However, the majority of sodium exceedences in Site 52,95,96 groundwater were collected from Hydropunch sampling points. In addition, although sodium has been detected in 12 of 16 subsurface soil samples collected from the site, only four sample results exceeded the Picatinny background value (316 mg/kg). As discussed in Section 2.9.2.4, sodium has exceeded comparison criteria in groundwater throughout Area G, and is included in the area-wide evaluation; therefore it is likely that sodium in groundwater at Site 52,95,96 is not related to site activities. As the maximum detected concentrations of aluminum, iron, and manganese in subsurface soil do not exceed these recommended surrogate groundwater-protective LOCs at any of the sites, only lead is retained. In addition, aluminum, iron, and manganese are naturally occurring minerals detected frequently in soil and groundwater throughout Picatinny. Concentrations of these inorganics are likely due to site geology. In conclusion, lead is the only recommended IGW COC in subsurface soil, with a proposed IGW value of 800 mg/kg.

Final COCs and SCLs

Based on human health risks and IGW concerns, the final list of COCs for subsurface soils is presented on **Table 3-14**. For the subsurface soil COCs, the NJDEP NRSRS or surrogate IGW LOC values were used as cleanup levels.

3.2.1.2 Sediment

A site-specific risk assessment for human health exposure to sediment was only performed for PICA Site 208 [Note: Sediment at Sites 52, 95, and 96 are not evaluated in this FFS as all available surface water and sediment results were evaluated in the GP/BSB FFS (IT, 2001b), which specifically addressed the surface water and sediment near the sites]. There are no ARARs which apply to sediment, although there are several TBCs. In addition, sediment PELs were estimated for the GP/BSB FFS. The PELs were designed to screen concentrations in sediment in order to determine where the weight of evidence indicates the greatest likelihood of risk to aquatic and benthic biota. The PELs were not developed as SCLs. Therefore, COCs are identified based on the results of the HHRA, ERA, and PELs that are available. The COC selection process is depicted graphically in **Chart 3-3**.

Human Health Risk COCs

No unacceptable risk to human health was identified due to exposure to COPCs in sediment at any of the sites evaluated in this FFS; therefore there are no human health-based sediment COCs.

Table 3-14
Subsurface Soil Cleanup Levels

Subsurface Soil Constituent	NJDEP Soil Remediation Standard (mg/kg) (1)	Leaching to Groundwater Level (mg/kg)	Site Cleanup Level (mg/kg)
Benz(a)anthracene	2	--	2
Benzo(a)pyrene	0.2	--	0.2
Benzo(b)fluoranthene	2	--	2
Benzo(k)fluoranthene	23	--	23
Carbazole	96	--	96
Chrysene	230	--	230
Dibenz(a,h)anthracene	0.2	--	0.2
Indeno(1,2,3-cd)pyrene	2	--	2
Naphthalene	17	--	17
Total PCBs	1	--	1
2,4-Dinitrotoluene	3	--	3
2,6-Dinitrotoluene	3	--	3
Arsenic	19	--	19
Lead	800	800	800
Thallium	79	--	79

(1) Nonresidential Soil Remediation Standard (NJDEP, 2009b).

Ecological Risk COCs

No unacceptable ecological risk was identified due to exposure to COPCs in sediment at any of the “25 Sites.” Therefore, no ecological risk driver COCs were identified based on the results of the site-specific ERAs. A baseline ERA was not conducted for PICA Site 208 since the drainage channel does not represent a significant aquatic habitat and the size of the affected area (approximately 0.14 acre of the 1.1 acre site) would not be expected to result in significant exposure to wildlife. However, site-specific sediment PELs were estimated for the Picatinny GP/BSB FFS (IT, 2001b), and may be applicable to the drainage ditches at PICA Site 208 which flow into GPB. Therefore, sediment COCs are identified based on the PELs that are available. It should be noted that this is a site-specific decision and does not apply to all sediment at Picatinny. As shown in **Table 3-15**, arsenic, chromium and zinc were selected as ecoCOCs in sediment.

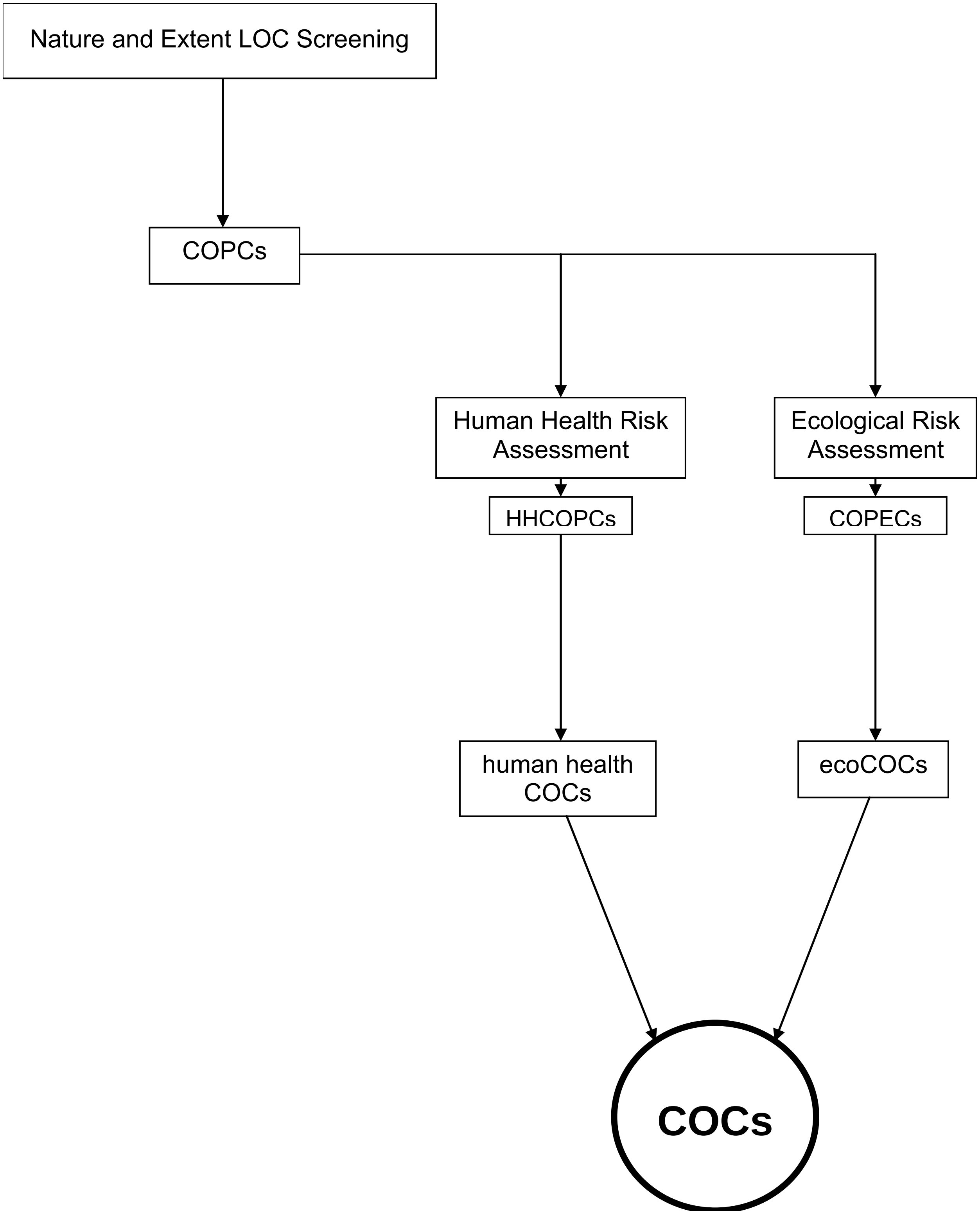
Cleanup Levels

Table 3-15 summarizes the COCs, RGs, and SCLs applicable to sediment at the “25 Sites”.

Table 3-15
Sediment Cleanup Levels

Constituent of Concern	Ecological Risk Based RG/PEL	Site Cleanup Level	Applicable to Site:
Arsenic	22 mg/kg	22 mg/kg	PICA 208
Chromium	247 mg/kg	247 mg/kg	PICA 208
Zinc	456 mg/kg	456 mg/kg	PICA 208

Chart 3-2. Schematic Representation of Sediment COC Development



3.2.1.3 Surface Water

Remediation of surface water is not evaluated in this FFS. No unacceptable risks were identified for surface water at any of the “25 Sites”. Twelve metals (aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, vanadium, and zinc) were detected above LOCs in one sample location at Site 145 (145SW-1). The sample location was collected from the outfall of the tile drain which previously received wastewater from the sand filter. As discussed in Section 2.8.5, the sand filter and its contents have been removed and contaminated soil from the earthen bottom of the remaining settling pit was excavated. Three metals (aluminum, arsenic, and sodium) were detected above LOCs and two radiological parameters (radium-226 and cesium-137) were detected above RBCs based on USEPA guidance (USEPA, 1991; Dinan, 1992) in a total of three surface water samples at Site 174. Arsenic and sodium were detected in two samples upgradient of the former brick sumps at relatively low levels. The maximum concentrations of arsenic and sodium were 1.88 mg/kg (LOC = 1.38 mg/kg) and 56,200 mg/kg (LOC = 42,300), respectively. Aluminum, radium-226, and cesium-137 were detected above LOCs/RBCs downgradient of the former brick sumps, which was removed in July 2003 along with approximately 200-ft of associated piping (see Section 2.16.5). No radiological parameters were detected in sample 174SW-6, collected to delineated radium-226 and cesium-137 in Site 174 surface water. Six metals were detected above LOCs in a total of three surface water samples at PICA Site 208. Iron and manganese exceeded criteria in all three samples, while aluminum, arsenic, cadmium, and lead exceeded their LOCs in only one sample (DPSW-2). However, arsenic and cadmium were not detected in duplicate sample analysis. As with groundwater, concentrations of aluminum, iron and manganese are naturally occurring minerals likely due to site geology. It is anticipated that remediation of soil and sediments, including the referenced sumps investigation and removals, will improve surface water quality at Sites 145, 174, and PICA 208.

3.2.2 Areas of Attainment

The complete list of COCs identified for the “25 Sites” are presented on **Tables 3-10, 3-14, and 3-15** for surface soil, subsurface soil, and sediment, respectively. **Table 3-16** presents a list of sites that did not exceed SCLs in any of the evaluated media and yielded no unacceptable risk for the unrestricted use scenario in the HHRA. In the event that the unrestricted use scenario was not evaluated in the HHRA, site soils data was compared to USEPA Residential Soil Regional Screening Levels. Based on a review of sample data, available HHRAs and ERAs, no action for soil, sediment, and surface water is proposed for these sites.

Table 3-16
Sites Proposed for No Action

Site ID	Summary of HHRA
Site 187	Residential receptors evaluated in the HHRA; risks within USEPA target range.
Site 60	Residential receptors evaluated in the HHRA; risks within USEPA target range.
Site 172	No HHRA conducted. Only 4,4’-DDT in sample 172SS-4A, at a concentration of 2.9 mg/kg, exceeded the USEPA IRSLs (1.7 mg/kg), in On-Site analysis. Pesticides were not analyzed off-site. 4,4’-DDT was not detected in any other sample. There is no evidence of pesticide storage or mixing ever occurring at Site 172. The low level exceedence of the PRG is consistent with the application of DDT as a pesticide per the instructions at the time of use. The evaluation of remedial alternatives is not warranted for Site 172.
Site 186	No soil samples were collected at this site; however groundwater analytical results do not indicate the presence of any soil contamination.
Site 164	No HHRA conducted; however, no constituents were detected above USEPA Residential Soil RSLs with the exception of arsenic in surface soil. Review of the arsenic data in comparison to background values from the Picatinny Background Study Report shows that all arsenic concentrations are below the Picatinny-specific background threshold.

Site data from Sites 69, 185, 174, 7, and 10 also did not exceed SCLs in any of the evaluated media, and the results of risk assessments did not indicate unacceptable levels of risk. No AAs have been established at these sites. However, either no HHRA was conducted or the unrestricted land use scenario was not evaluated as part of the HHRA. Because these sites exhibit exceedences of USEPA Residential Soil RSLs, LUCs will be maintained at Sites 69, 185, 174, 7, and10.

AAs for the remaining sites are presented in the following sections. Site photographs for each of these sites are provided in **Appendix B**. Where an AA is based on a single isolated sample location, the AA is assumed to encompass an area with a 10-ft radius. This arbitrary area assumption is made for the purpose of developing cost estimates and comparison of remedial alternatives. Removal areas and volumes for alternatives involving excavation will be based on field observations and verified through post-excavation confirmatory analysis. AAs for each of the remaining sites are as follows:

3.2.2.1 Site 117

- AA_{117S-1} is defined for benz(a)anthracene and benzo(b)fluoranthene in a single surface soil sample above their SCLs. As such it is assumed to encompass an area with a 10-ft radius from sample SS117-3A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**. AA_{117S-1} is shown on **Figure 3-1**.

3.2.2.2 Site 123

- AA_{123S-1} is defined for total PCBs above its SCL in samples 123TP-5B and 123SS-8A. AA_{123S-1} is estimated to encompass an area of 157 SF and a depth interval of 0-3 ft bgs, yielding a volume of approximately 18 CY. AA_{123S-1} is shown on **Figure 3-2**.
- AA_{123S-2} (**Figure 3-2**) is defined for benzo(a)pyrene detected above its SCL in sample 123SS-7A. It is estimated to encompass an area of 157 SF and a depth interval of 0-1 ft bgs, yielding a volume of approximately **6 CY**.

3.2.2.3 PICA Site 207

- AA_{207S-1} is defined for an isolated detection of arsenic above its SCL. As such, it is assumed to encompass an area with a 10-ft radius from sample 63-6S and a depth interval of 0-2 ft bgs, yielding a volume of approximately **23 CY**. AA_{207S-1} is shown on **Figure 3-3**.

3.2.2.4 Site 145

- AA_{145S-1} is defined for isolated exceedences of thallium, in the 2-4 ft bgs interval, and DNT, in the 6-8 ft bgs interval, above SCLs in soil boring SB145-1. As such, it is assumed to encompass an area with a 10-ft radius from sample SB145-1 and a depth interval of 0-10 ft bgs, yielding a volume of approximately **116 CY**. AA_{145S-1} is shown on **Figure 3-4**.

3.2.2.5 Sites 52, 95, and 96

- AA_{52S-1} encompasses an area of approximately **22,000 square feet (SF)**, located south of Building 305 in the area of the former petroleum leak (**Figure 3-5**). The depth interval is assumed to be 0-1 ft bgs based on available sample intervals, low level nature of the exceedences, and the previous soil removal conducted in 1986. The resulting volume is approximately **815 CY**. AA_{52S-1} is defined for benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, 4,4-DDT and arsenic.
- AA_{52S-2} encompasses an area of approximately **25,000 SF**, located along the northern side of the drainage ditch to the southeast of the sites (**Figure 3-5**). The depth interval is assumed to be 0-1 ft bgs based on available sample intervals (0-0.5 ft bgs) and low level nature of the exceedences. The resulting volume is approximately **926 CY**. AA_{52S-2} is defined for arsenic.
- AA_{52S-3} is defined for exceedences of arsenic, lead, manganese and benzo(b)fluoranthene above SCLs in adjacent sample locations (SS95-1A and 95SS-6B). Given the proximity of the samples, AA_{52S-3} is assumed to encompass an area with a 10-ft radius from sample SS95-1A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.
- AA_{52S-4} is defined for an isolated detection of Dieldrin above its SCL. As such, it is assumed to encompass an area with a 10-ft radius from sample SS95-4A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.
- AA_{52S-5} is defined for an isolated detection of thallium above its SCL in subsurface soil. As such, it is assumed to encompass an area with a 10-ft radius from sample MW52-2D and a

depth interval of 6-8 ft bgs (thallium was not detected in the 4-6 ft bgs interval). AA_{52S-5} has an approximate volume of **23 CY**.

- AA_{52S-6} is defined for benzo(a)pyrene detected above its SCL in two depth intervals from one soil boring. As such, it is assumed to encompass an area with a 10-ft radius from sample 52SB-4B and a depth interval of 2-10 ft bgs, yielding a volume of approximately **93 CY**.
- AA_{52S-7} is defined for an isolated detection of total PCBs above its SCL. As such, it is assumed to encompass an area with a 10-ft radius from sample SS96-3A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.
- AA_{52S-8} is defined for an isolated detection of benzo(b)fluoranthene above its SCL. As such, it is assumed to encompass an area with a 10-ft radius from sample SS95-3A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.

3.2.2.6 Site 134

- AA_{134S-1} is defined for an isolated detection of benzo(b)fluoranthene above its SCL (**Figure 3-6**). As such, it is assumed to encompass an area with a 10-ft radius from sample SS134-1A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.
- AA_{134S-2} is defined for an isolated detection of benzo(a)pyrene above its SCL in surface soil (**Figure 3-6**). As such, it is assumed to encompass an area with a 10-ft radius from sample SS134-3A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.
- No AAs are defined for interim remedial action areas excavated in November and December of 2003.

3.2.2.7 Site 136

- AA_{136S-1} is defined for an isolated detection of arsenic above its SCL (**Figure 3-7**). As such, it is assumed to encompass an area with a 10-ft radius from sample SS136-5A and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.

3.2.2.8 Site 175

- AA_{175S-1} is defined for detected BNAs in the RCRA closure area of the former 90 day hazardous waste storage area (**Figure 3-8**). Although there were no exceedences of SCLs (not specifically analyzed within the closure area), a 1992 letter from the NJDEP to the Chief of the Picatinny EAO stated that closure samples were above cleanup standards. The AA is defined as the former 90 day hazardous waste storage area, which is approximately 70 ft by 40 ft, yielding an area of **2,800 SF**, with a depth interval of 0-1 ft bgs, yielding a volume of **103 CY**.

3.2.2.9 Site 173

- AA_{173S-1} encompasses an area of approximately **3,500 SF**, located in the vicinity of 173MW-2 (**Figure 3-9**). The depth interval is assumed to be 0-12 ft bgs. The resulting volume is approximately **1,556 CY**. AA_{173S-1} is defined for arsenic, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and naphthalene.

3.2.2.10 Site 176

- AA_{176S-1} is defined for an isolated detection of benzo(a)pyrene above its SCL (**Figure 3-10**). As such, it is assumed to encompass an area with a 10-ft radius from sample 176SB-1B and a depth interval of 0-4 ft bgs, yielding a volume of approximately **47 CY**.

3.2.2.11 Site 177

- AA_{177S-1} is defined for an isolated detection of benzo(a)pyrene above its SCL (**Figure 3-11**). As such, it is assumed to encompass an area with a 10-ft radius from sample 177SB-5 and a depth interval of 0-3 ft bgs, yielding a volume of approximately **35 CY**.

3.2.2.12 Site 27

- AA_{27S-1} is defined for an isolated detection of beryllium above its SCL (**Figure 3-12**). As such, it is assumed to encompass an area with a 10-ft radius from sample T90SS-B and a depth interval of 0-2 ft bgs, yielding a volume of approximately **23 CY**.

3.2.2.13 Site 119

- AA_{119S-1} is defined for an isolated detections of benz(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene above SCLs (**Figure 3-13**). As such, it is assumed to encompass an area with a 10-ft radius from sample 47SS-A, and a depth interval of 0-2 ft bgs, yielding a volume of approximately **23 CY**.
- AA_{119S-2} is defined for an isolated detection of benzo(a)pyrene above its SCL (**Figure 3-13**). As such, it is assumed to encompass an area with a 10-ft radius from sample 46SS-A and a depth interval of 0-2 ft bgs, yielding a volume of approximately **23 CY**.

3.2.2.14 Site 120

- AA_{120S-1} is defined for benz(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene above SCLs in sample 50SS-A (**Figure 3-14**). As such, it is assumed to encompass an area with a 10-ft radius from sample 50SS-A and a depth interval of 0-2 ft bgs, yielding a volume of approximately **23 CY**.

3.2.2.15 Site 121

- AA_{121S-1} is defined for benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene above SCLs in sample 57SS-B (**Figure 3-15**). As such, it is assumed to encompass an area with a 10-ft radius from sample 50SS-A and a depth interval of 0-2 ft bgs, yielding a volume of approximately **23 CY**.

3.2.2.16 PICA Site 208

- AA_{208S-1} is defined for an isolated detection of arsenic in soil above its SCL in sample DP-1S, and thorium-232 above its SCL in adjacent samples RSS-1, RSS-1B, RSS-3, RSS-4 and RSS-5 (**Figure 3-16**). It is estimated to encompass an area of **1,071** SF and a depth interval of 0-2 ft bgs, yielding a volume of approximately **79 CY**.
- AA_{208S-2} is defined for an isolated detection of arsenic in soil above its SCL in sample 208SS-9, and thorium-232 above its SCL in adjacent samples RSS-7 and RSS-8 (**Figure 3-16**). It is estimated to encompass an area of **720** SF and a depth interval of 0-2 ft bgs, yielding a volume of approximately **53 CY**.
- AA_{208D-1} is defined for arsenic, chromium and zinc detected above SCLs in sediment samples DPSD-3 and DPSD-4. It is estimated to encompass an area of **1,858 SF** and a depth interval of 0-2 ft bgs, yielding a volume of approximately **137 CY**.
- AA_{208D-2} is defined for an isolated detection of arsenic in sediment above its SCL (**Figure 3-16**). As such, it is assumed to encompass an area with a 10-ft radius from sample 208SD-1 and a depth interval of 0-1 ft bgs, yielding a volume of approximately **12 CY**.

3.2.3 Area of Attainment Summary

The AAs identified in the preceding sections are summarized in **Table 3-17**. The COCs comprising each AA and an approximation of the dimensions are also presented.

Table 3-17
Summary of AAs for the "25 Sites"

AA	COCs	Area (SF)	Depth Interval (ft)	Volume (CY)
Site 117				
AA_{117S-1}	Benz(a)anthracene, Benzo(b)fluoranthene	314	0-1	12
Site 123				
AA_{123S-1}	Total PCBs	157	0-3	18
AA_{123S-2}	Benzo(a)pyrene	157	0-1	6
PICA Site 207				
AA_{207S-1}	Arsenic	314	0-2	23
Site 145				
AA_{145S-1}	2,4-DNT, 2,6-DNT, Thallium	314	0-10	116
Sites 52, 95, and 96				
AA_{52S-1}	Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, 4,4-DDT and Arsenic	22,000	0-1	815
AA_{52S-2}	Arsenic	25,000	0-1	926
AA_{52S-3}	Arsenic, Lead, Manganese and Benzo(b)fluoranthene	314	0-1	12
AA_{52S-4}	Dieldrin	314	0-1	12
AA_{52S-5}	Thallium	314	6-8	23
AA_{52S-6}	Benzo(a)pyrene	314	2-10	93
AA_{52S-7}	Total PCBs	314	0-1	12
AA_{52S-8}	Benzo(b)fluoranthene	314	0-1	12
Site 134				
AA_{134S-1}	Benzo(b)fluoranthene	314	0-1	12
AA_{134S-2}	Benzo(b)fluoranthene	314	0-1	12
Site 136				
AA_{136S-1}	Arsenic	314	0-1	12
Site 175				
AA_{175S-1}	BNAs	2,800	0-1	103
Site 173				
AA_{173S-1}	Arsenic, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Carbazole, Chrysene, Dibenz(a,h)anthracene, Indeno(1,2,3-c.d)pyrene, Naphthalene, Pyrene	3,500	0-12	1,556
Site 176				
AA_{176S-1}	Benzo(a)pyrene	314	0-4	47
Site 177				
AA_{177S-1}	Benzo(a)pyrene	314	0-3	35
Site 27				
AA_{27S-1}	Beryllium	314	0-2	23
Sites 119, 120, and 121				
AA_{119S-1}	Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene	314	0-2	23
AA_{119S-2}	Benzo(a)pyrene	314	0-2	23
AA_{120S-1}	Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene	314	0-2	23

AA	COCs	Area (SF)	Depth Interval (ft)	Volume (CY)
AA_{121S-1}	Benz(a)anthracene, Benzo(a)pyrene, Benzo(k)fluoranthene, Benzo(b)fluoranthene	314	0-2	23
PICA Site 208				
AA_{208S-1}	Arsenic, Thorium-232	1,071	0-2	79
AA_{208S-2}	Arsenic, Thorium-232	720	0-2	53
AA_{208D-1}	Arsenic, Chromium, Zinc	1,858	0-2	138
AA_{208D-2}	Arsenic	314	0-1	12

3.3 REMEDIAL ACTION OBJECTIVES

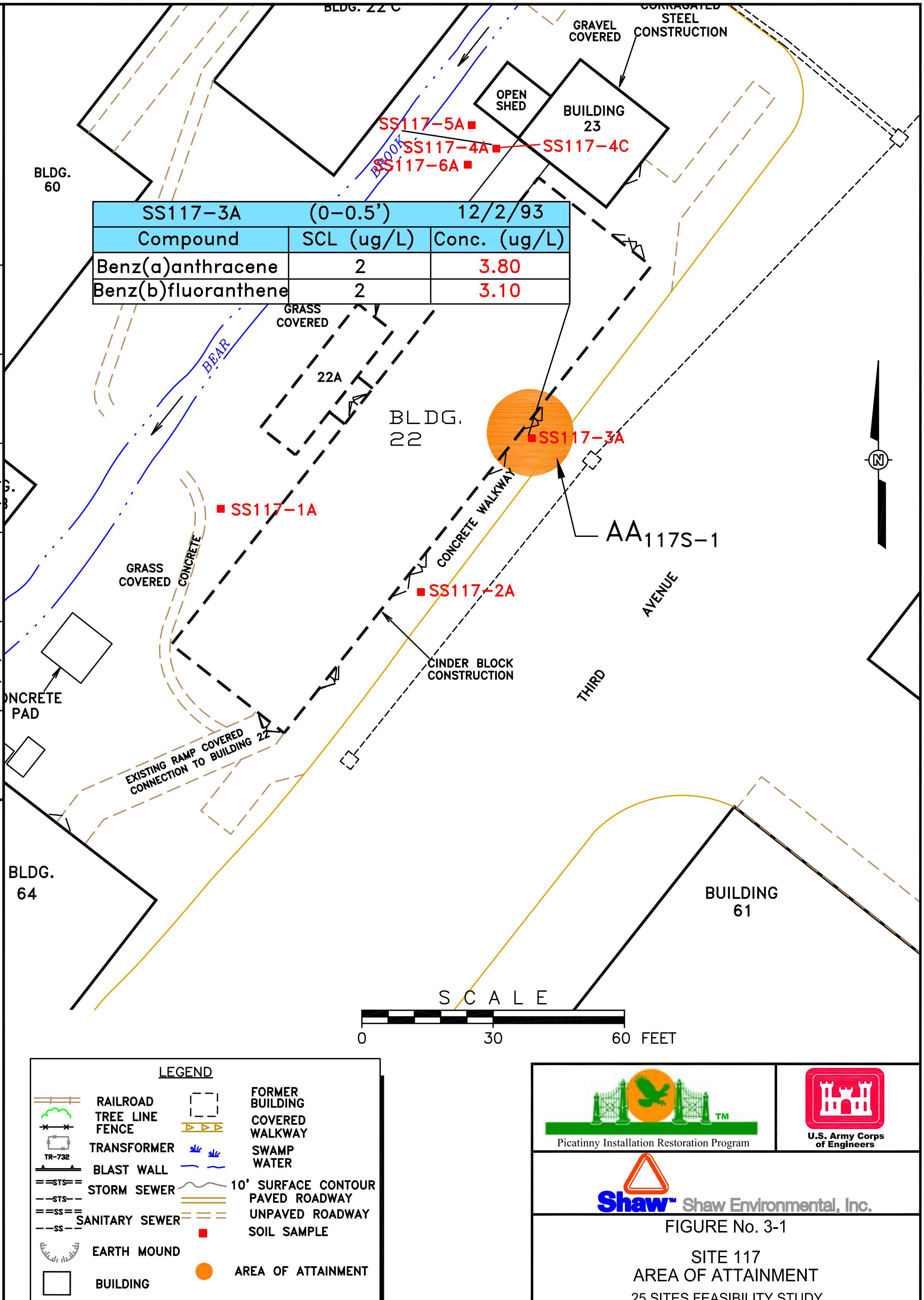
The RAOs for the 25 Sites FFS are based on the continued management of human health risk that drive the formulation and development of response actions. Such objectives are developed based on the criteria outlined in Section 300.430(e)(2) of the NCP and Section 12 of SARA.

The RAOs will be specific to surface and subsurface soils, sediment and surface water contaminated by sources originating from the 25 Sites FFS assessment areas. Surface and subsurface soils at these sites have risks and hazards that are within the target range under current and reasonably anticipated future land-use scenarios. Because risks or hazards identified for surface and subsurface soils do not allow for unrestricted use, a response action will be implemented following NCP guidance. Groundwater is not assessed in this document except to the extent that contaminated groundwater may be indicative of soil contamination which is adversely impacting groundwater.

The proposed RAO for the "25 Sites" is the following:

- Maintain a use consistent with the assumptions and results of the risk assessments which identified risk within the CERCLA generally accepted risk range for the current and reasonably anticipated future use (military/industrial) following the NCP guidance.

The 5-year review process and the annual land use certifications will be used to document continuing land use is industrial and the remedy remains protective. Additionally, the remedial design will specify notification requirements to the USEPA should land use change occur, or be planned, in accordance with the department of the Navy Principles



SS117-3A	(0-0.5')	12/2/93
Compound	SCL (ug/L)	Conc. (ug/L)
Benz(a)anthracene	2	3.80
Benz(b)fluoranthene	2	3.10

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY
D117052705.dwg	-- --	K. Gerdes 04/20/10	S. Wiafe 04/20/10

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Plot Date/Time: Apr 23, 2010 - 11:34am
Plotted By: stephen.Wiafe

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

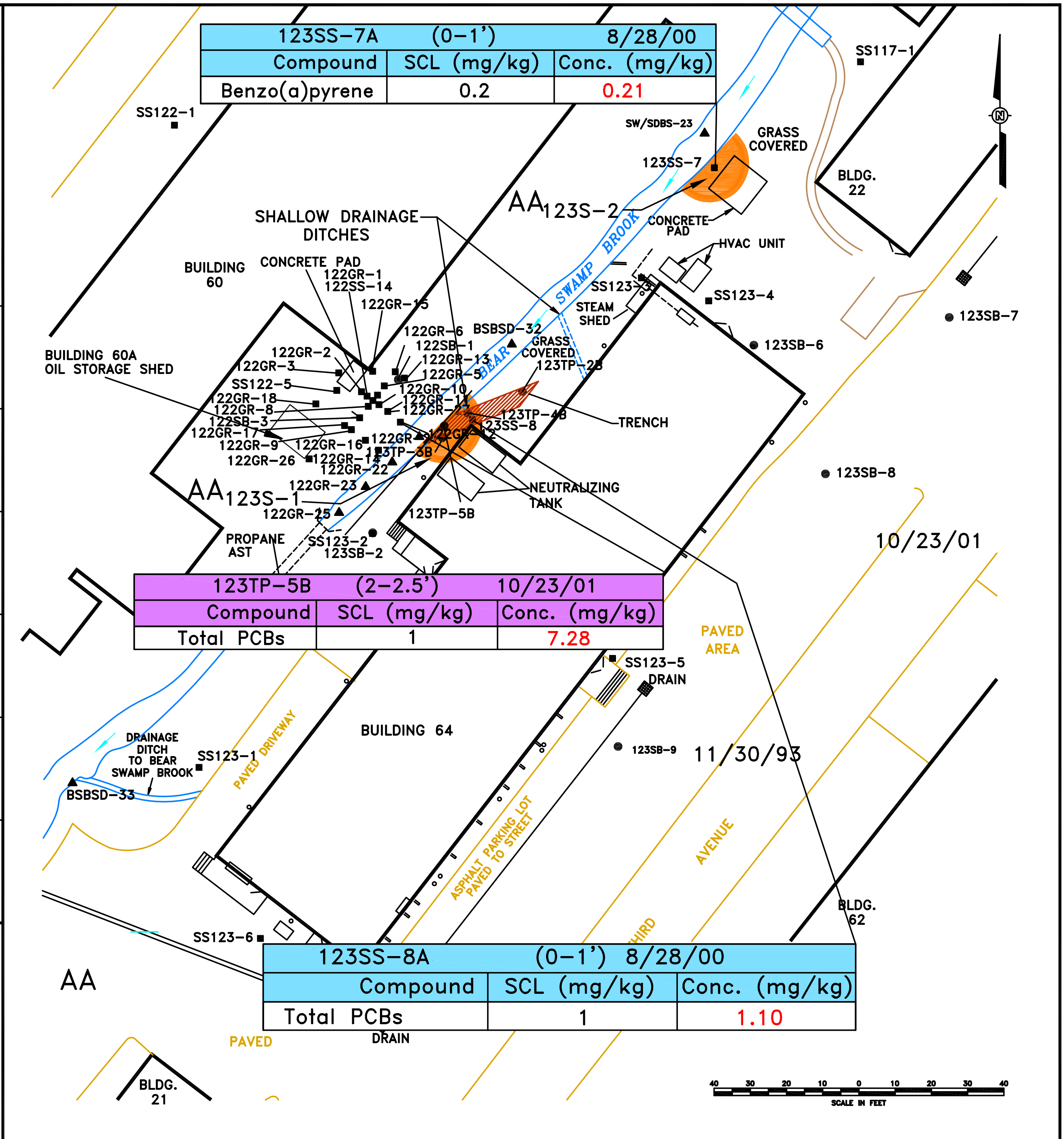
FIGURE No. 3-1

SITE 117
AREA OF ATTAINMENT

25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER D123072705.dwg

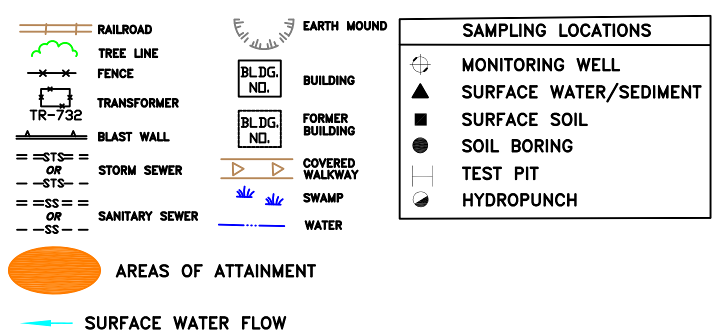
DRAWN BY	CHECKED BY	APPROVED BY
S. Wiafe 04/20/10	K. Gerdes 04/20/10	-- --



123SS-7A	(0-1')	8/28/00
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.21

123TP-5B	(2-2.5')	10/23/01
Compound	SCL (mg/kg)	Conc. (mg/kg)
Total PCBs	1	7.28

123SS-8A	(0-1')	8/28/00
Compound	SCL (mg/kg)	Conc. (mg/kg)
Total PCBs	1	1.10



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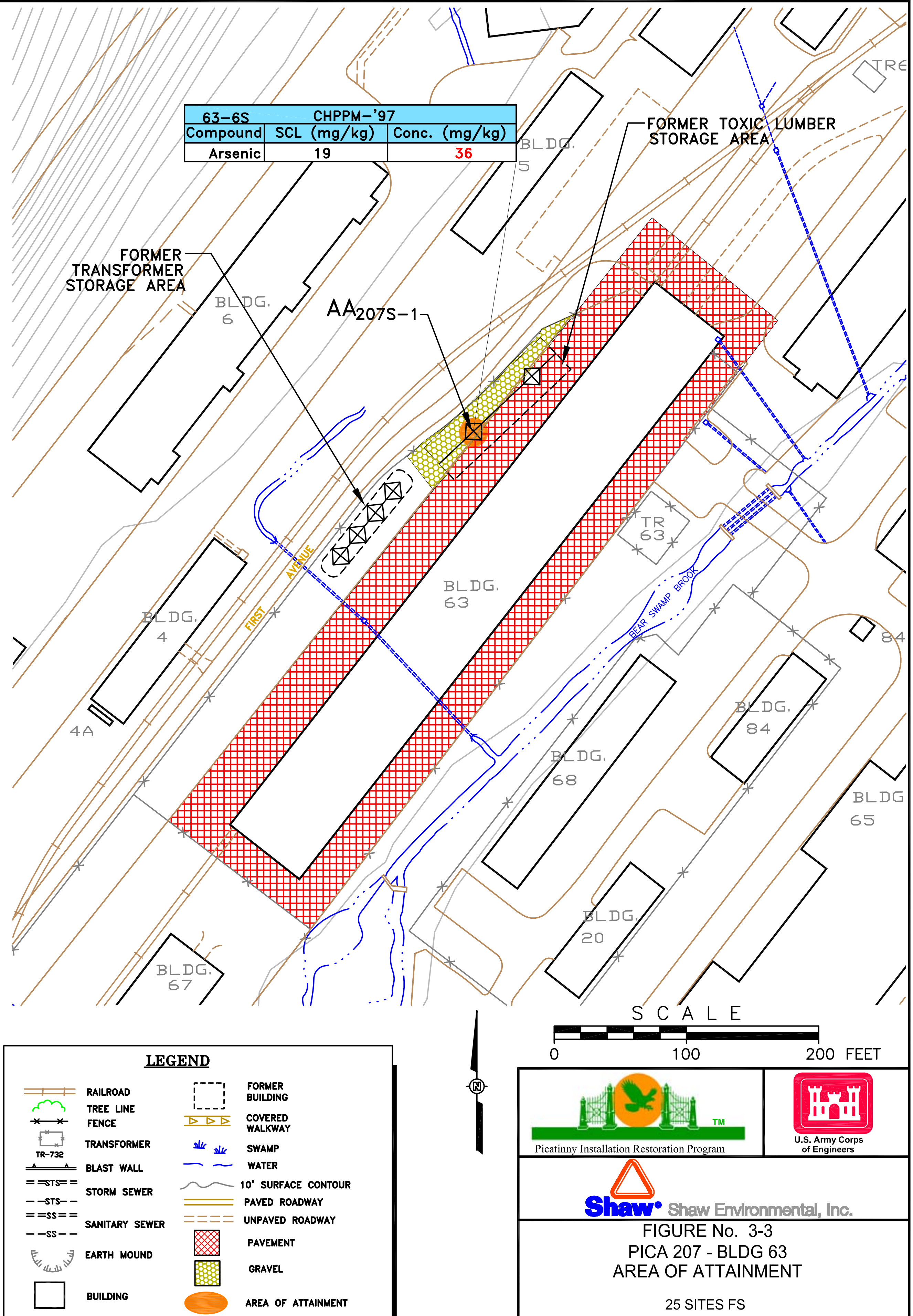
U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE NO. 3-2
SITE 123
BUILDING 64 - METAL PLATING SHOP
AREAS OF ATTAINMENT
25 SITES FS
PICATINNY, DOVER, NEW JERSEY



63-6S	CHPPM-'97	
Compound	SCL (mg/kg)	Conc. (mg/kg)
Arsenic	19	36

Picatinny Installation Restoration Program

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FIGURE No. 3-3
PICA 207 - BLDG 63
AREA OF ATTAINMENT

25 SITES FS
PICATINNY, DOVER, NEW JERSEY

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 04/20/10	K. Gerdes 04/20/10	-- --	D042010.dwg

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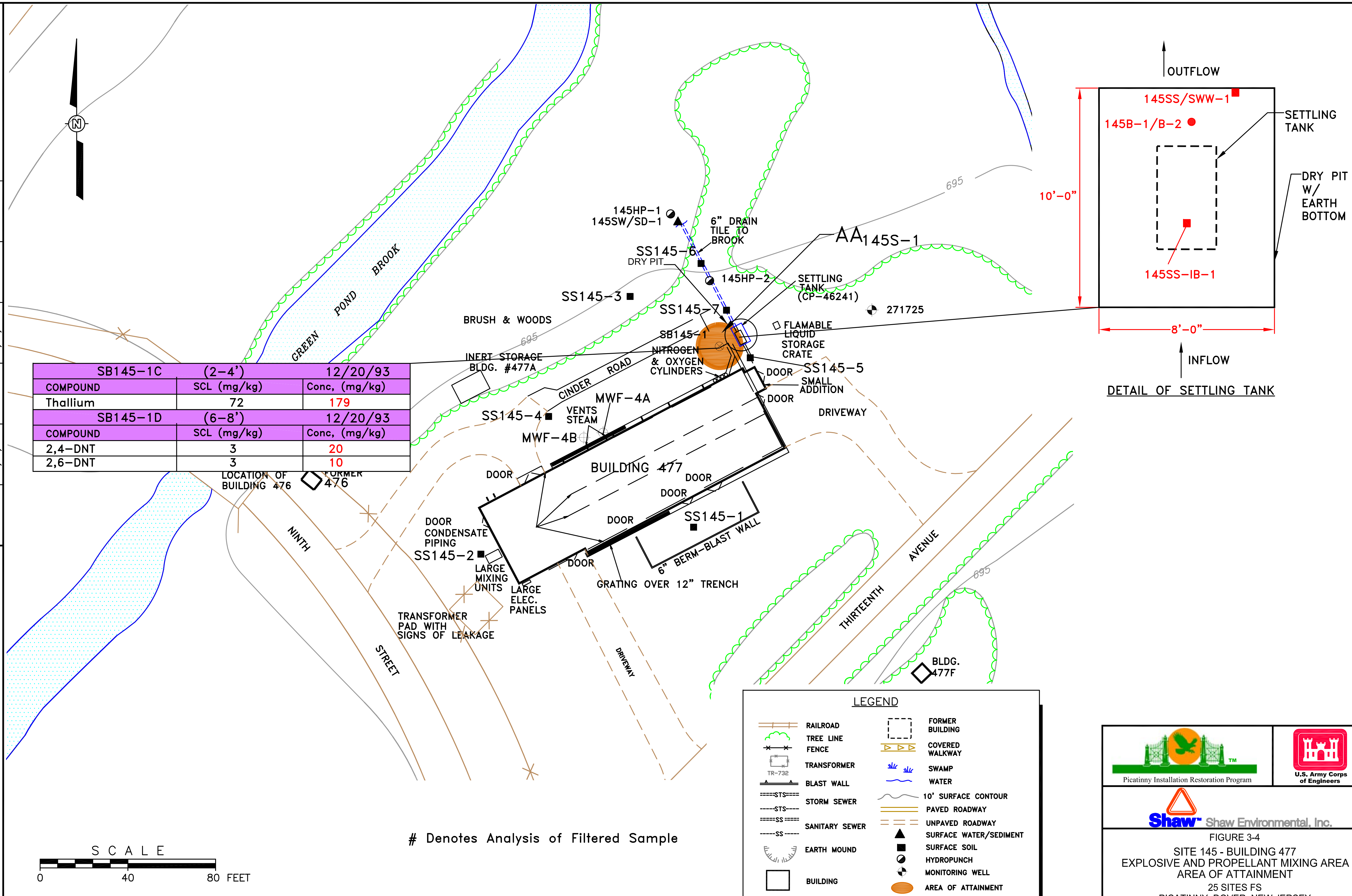
Plotted By: stephen.Wiafe



SB145-1C	(2-4')	12/20/93
COMPOUND	SCL (mg/kg)	Conc. (mg/kg)
Thallium	72	179

SB145-1D	(6-8')	12/20/93
COMPOUND	SCL (mg/kg)	Conc. (mg/kg)
2,4-DNT	3	20
2,6-DNT	3	10

# Denotes Analysis of Filtered Sample

DRAWING NUMBER S145062005.dwg
APPROVED BY --
CHECKED BY K. Gerdes 04/20/10
DRAWN BY S. Wiafe 04/20/10

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Plotted By: stephen.Wiafe

Picatinny Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Environmental, Inc.

FIGURE 3-4
SITE 145 - BUILDING 477
EXPLOSIVE AND PROPELLANT MIXING AREA
AREA OF ATTAINMENT
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

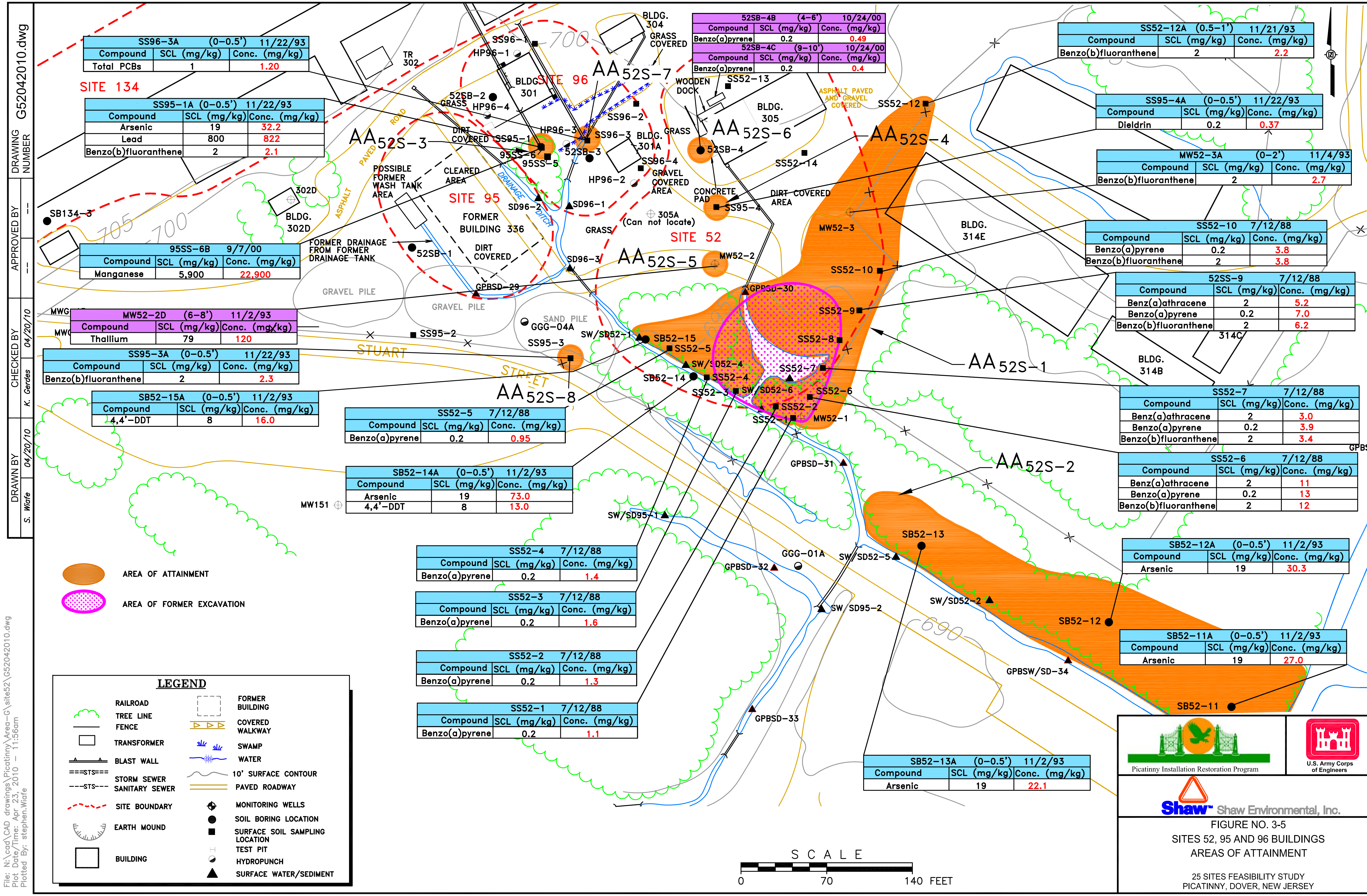
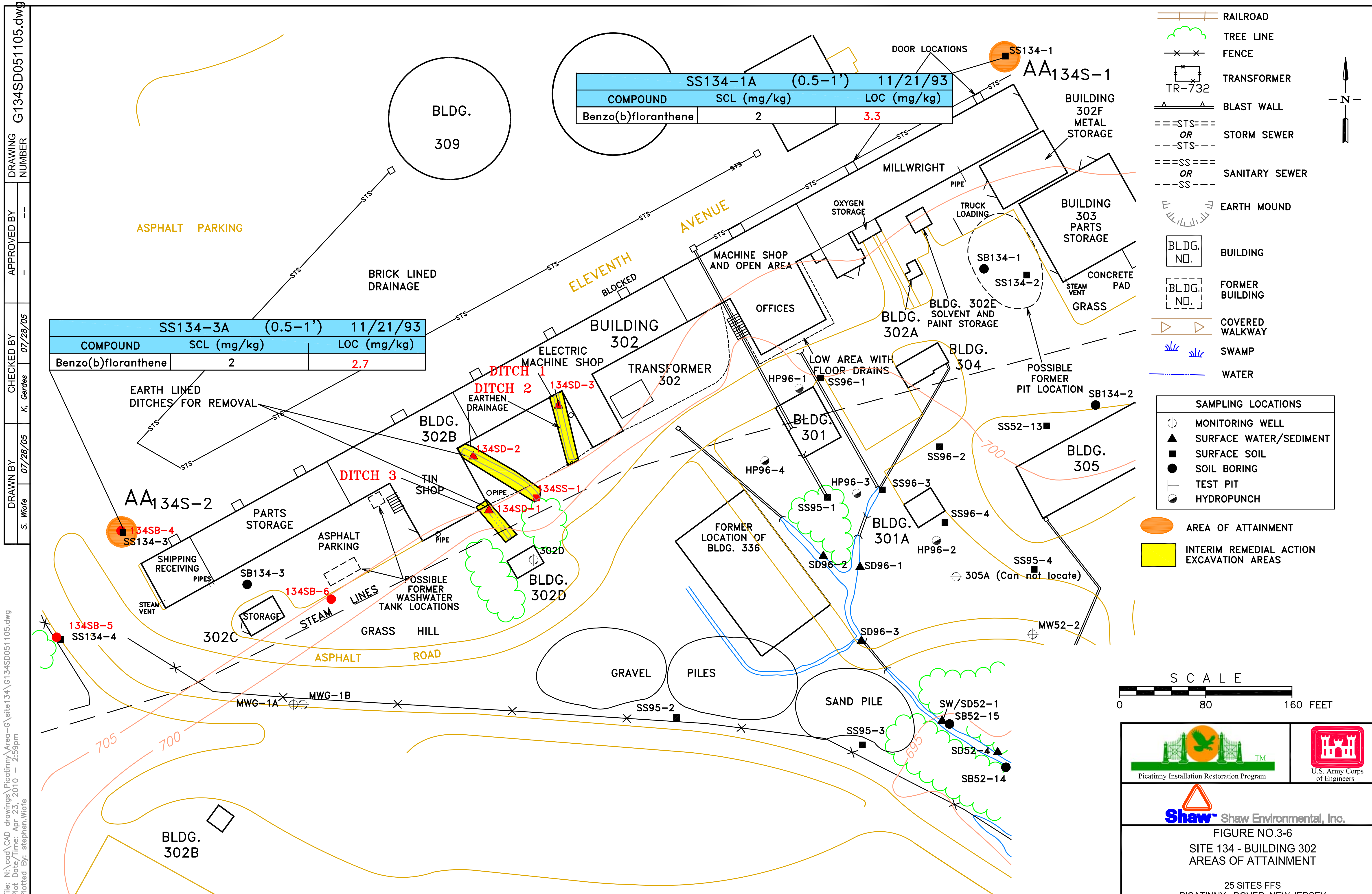


FIGURE NO. 3-5
SITES 52, 95 AND 96 BUILDINGS
AREAS OF ATTAINMENT

25 SITES FEASIBILITY STUDY
PICATINNY, DOVER, NEW JERSEY



SS134-1A	(0.5-1')	11/21/93
COMPOUND	SCL (mg/kg)	LOC (mg/kg)
Benzo(b)floranthene	2	3.3

SS134-3A	(0.5-1')	11/21/93
COMPOUND	SCL (mg/kg)	LOC (mg/kg)
Benzo(b)floranthene	2	2.7

FIGURE NO.3-6
SITE 134 - BUILDING 302
AREAS OF ATTAINMENT

25 SITES FFS
PICATINNY , DOVER, NEW JERSEY

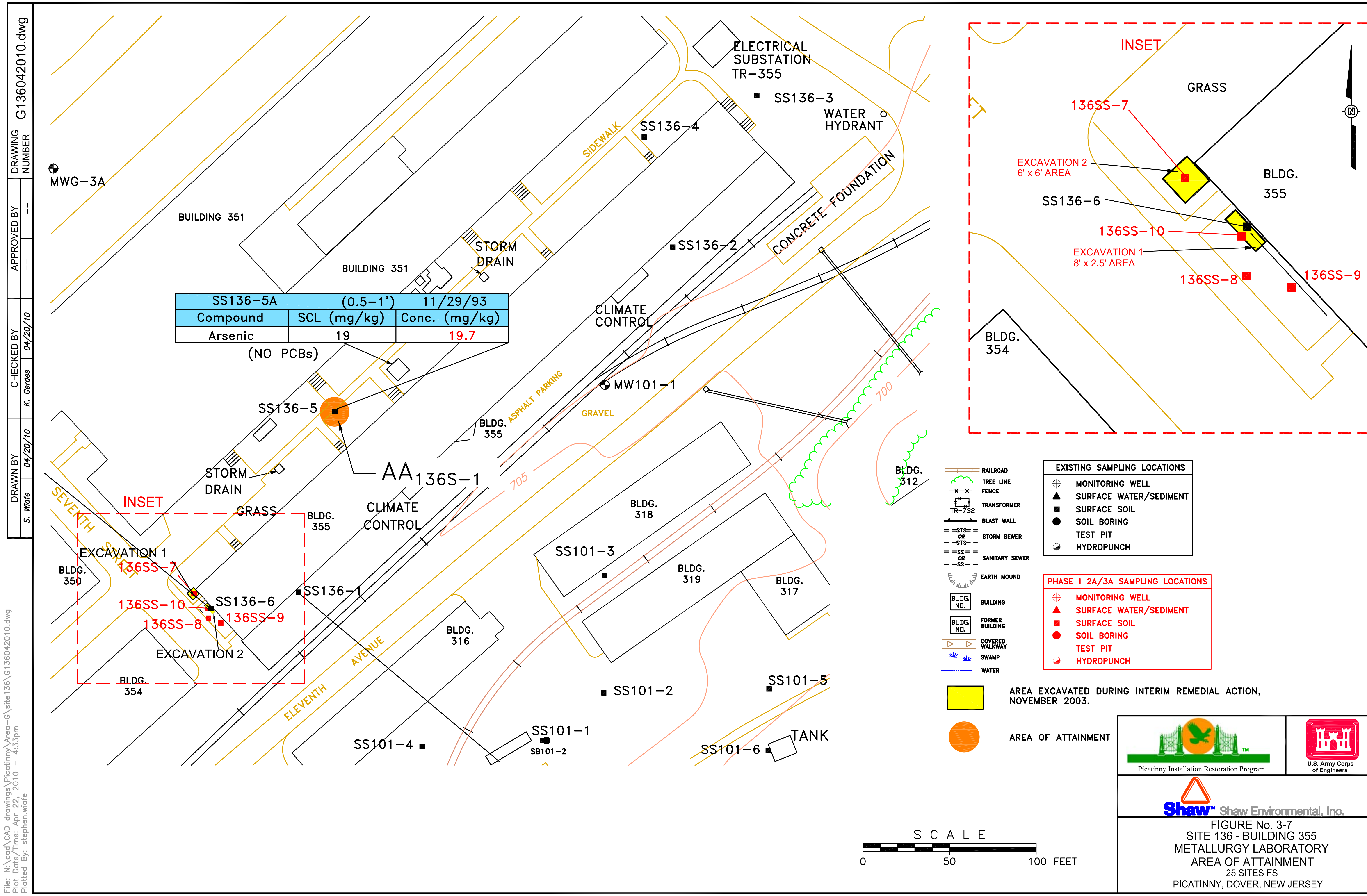
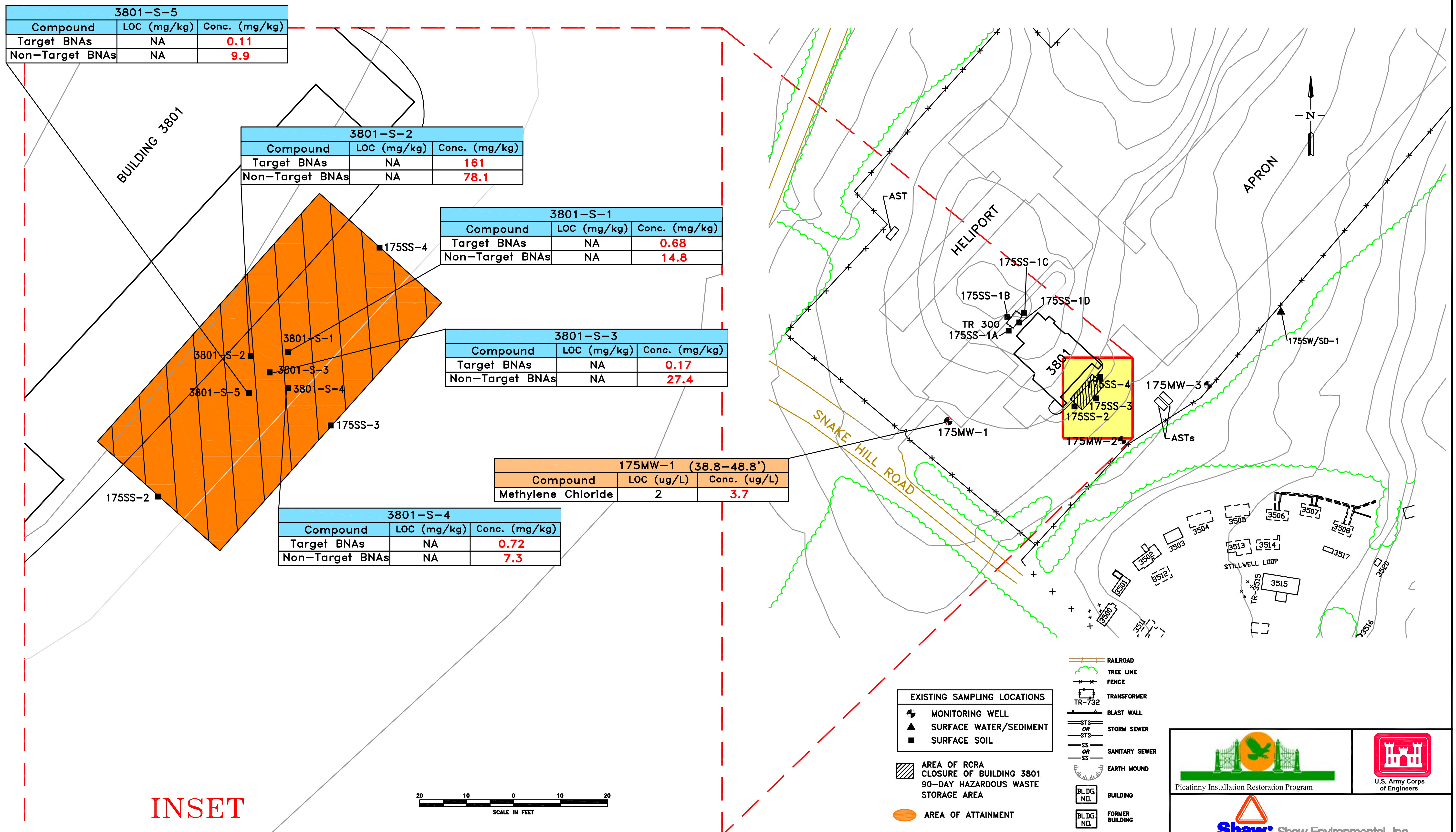


FIGURE No. 3-7
SITE 136 - BUILDING 355
METALLURGY LABORATORY
AREA OF ATTAINMENT
25 SITES FS
PICATINNY, DOVER, NEW JERSEY



3801-S-5		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Target BNAs	NA	0.11
Non-Target BNAs	NA	9.9

3801-S-2		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Target BNAs	NA	161
Non-Target BNAs	NA	78.1

3801-S-1		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Target BNAs	NA	0.68
Non-Target BNAs	NA	14.8

3801-S-3		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Target BNAs	NA	0.17
Non-Target BNAs	NA	27.4

175MW-1 (38.8-48.8')		
Compound	LOC (ug/L)	Conc. (ug/L)
Methylene Chloride	2	3.7

3801-S-4		
Compound	LOC (mg/kg)	Conc. (mg/kg)
Target BNAs	NA	0.72
Non-Target BNAs	NA	7.3

NOTE:
TOPOGRAPHIC CONTOUR SOURCE IS THE IDENTIFICATION AND ANALYSIS OF WETLANDS, FLOODPLAINS, THREATENED AND ENDANGERED SPECIES AND ARCHAEOLOGICAL GEOMORPHOLOGY AT PICATINNY ARSENAL, NJ (WES, 1994), WHICH USED TOPOGRAPHIC CONTOURS DERIVED FROM 1948 SURVEY MAPS. THESE SURVEY MAPS WERE SCANNED TO CREATE ELECTRONIC FILES AND WERE MANUALLY REFINED. WHILE THESE CONTOURS DEPICT GENERAL TOPOGRAPHY WELL, THEY ARE NOT PRECISE IN SOME LOCATIONS.

Picatinny Installation Restoration Program

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FIGURE 3-8
SITE 175 - BUILDING 3801
AREA OF ATTAINMENT
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER 175052505.dwg

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S. Wiafe 7/18/05	G. Maresca 7/18/05	-- --

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Plotted By: stephen.wiafe

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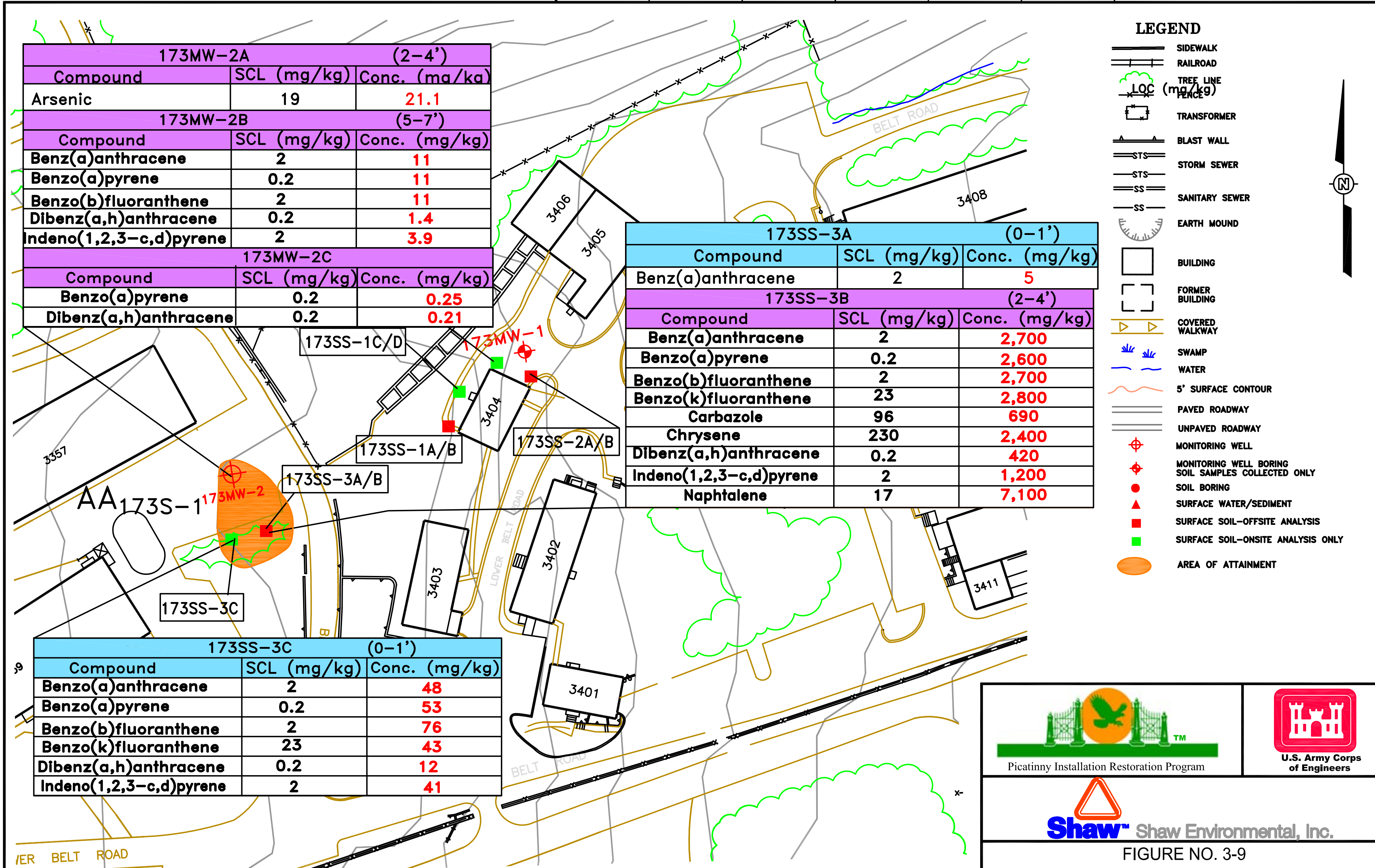

173MW-2A		(2-4')
Compound	SCL (mg/kg)	Conc. (mg/kg)
Arsenic	19	21.1

173MW-2B		(5-7')
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	2	11
Benzo(a)pyrene	0.2	11
Benzo(b)fluoranthene	2	11
Dibenz(a,h)anthracene	0.2	1.4
Indeno(1,2,3-c,d)pyrene	2	3.9

173MW-2C		
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.25
Dibenz(a,h)anthracene	0.2	0.21

173SS-3A		(0-1')
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	2	5

173SS-3B		(2-4')
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	2	2,700
Benzo(a)pyrene	0.2	2,600
Benzo(b)fluoranthene	2	2,700
Benzo(k)fluoranthene	23	2,800
Carbazole	96	690
Chrysene	230	2,400
Dibenz(a,h)anthracene	0.2	420
Indeno(1,2,3-c,d)pyrene	2	1,200
Naphtalene	17	7,100

173SS-3C		(0-1')
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benzo(a)anthracene	2	48
Benzo(a)pyrene	0.2	53
Benzo(b)fluoranthene	2	76
Benzo(k)fluoranthene	23	43
Dibenz(a,h)anthracene	0.2	12
Indeno(1,2,3-c,d)pyrene	2	41

NOTE:
TOPOGRAPHIC CONTOUR SOURCE IS THE IDENTIFICATION AND ANALYSIS OF WETLANDS, FLOODPLAINS, THREATENED AND ENDANGERED SPECIES AND ARCHAEOLOGICAL GEOMORPHOLOGY AT PICATINNY ARSENAL, NJ (WES, 1994), WHICH USED TOPOGRAPHIC CONTOURS DERIVED FROM 1948 SURVEY MAPS. THESE SURVEY MAPS WERE SCANNED TO CREATE ELECTRONIC FILES AND WERE MANUALLY REFINED. WHILE THESE CONTOURS DEPICT GENERAL TOPOGRAPHY WELL, THEY ARE NOT PRECISE IN SOME LOCATIONS.

SCALE
0 100 200 FEET

Picatinny Installation Restoration Program

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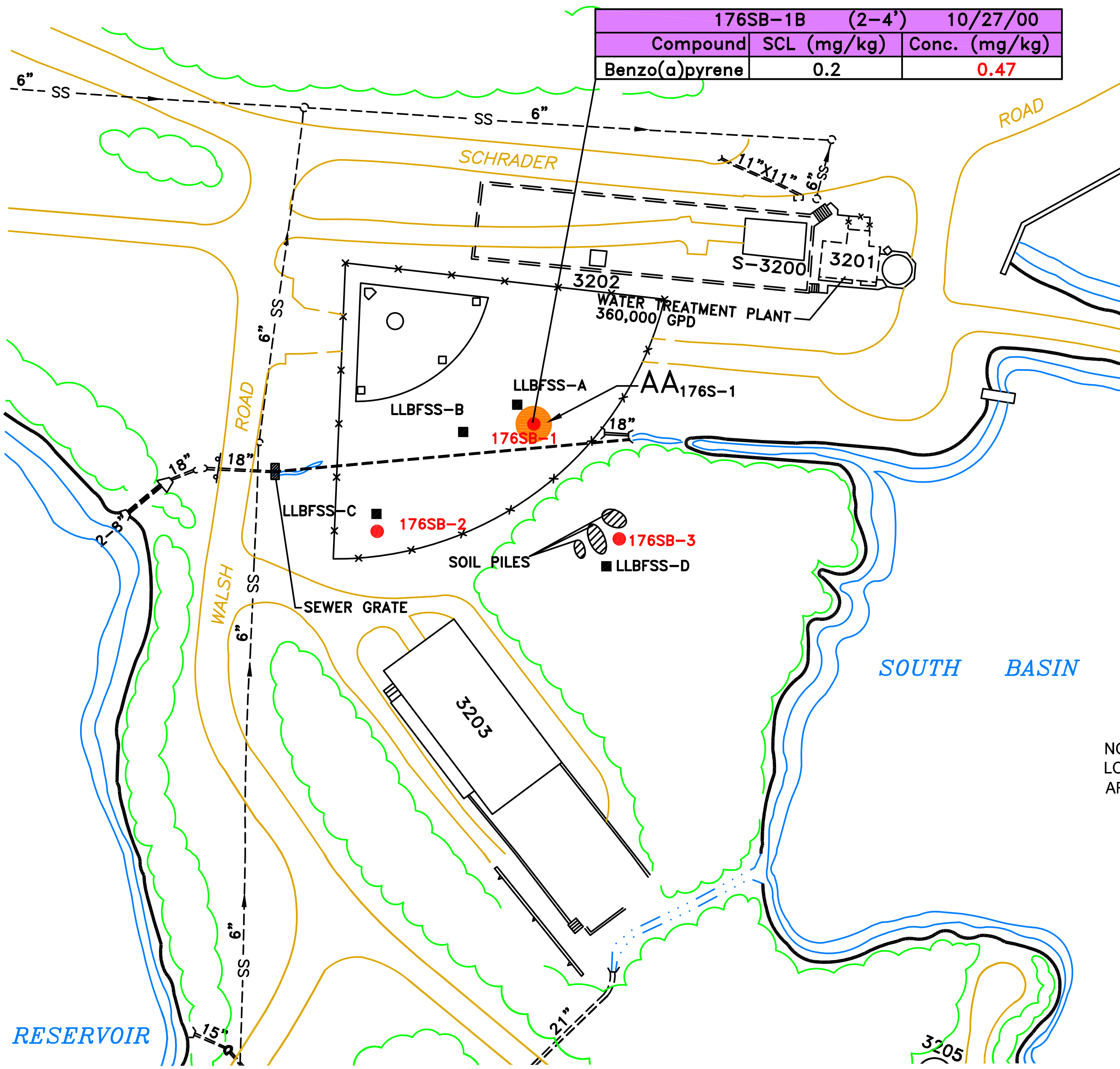
Shaw Environmental, Inc.

FIGURE NO. 3-9

SITE 173 - BUILDING 3404
AREA OF ATTAINMENT
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
Stephen Wiafe	04/09/10	K. GERDES	04/09/10	--	--	L176111202.dwg

176SB-1B	(2-4')	10/27/00
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.47



LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

EXISTING SAMPLING LOCATIONS
■ SURFACE SOIL
● SOIL BORING

PHASE III 2A/3A RI SAMPLING LOCATIONS
● SOIL BORING

AREA OF ATTAINMENT

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

SCALE
0 100 200 FEET

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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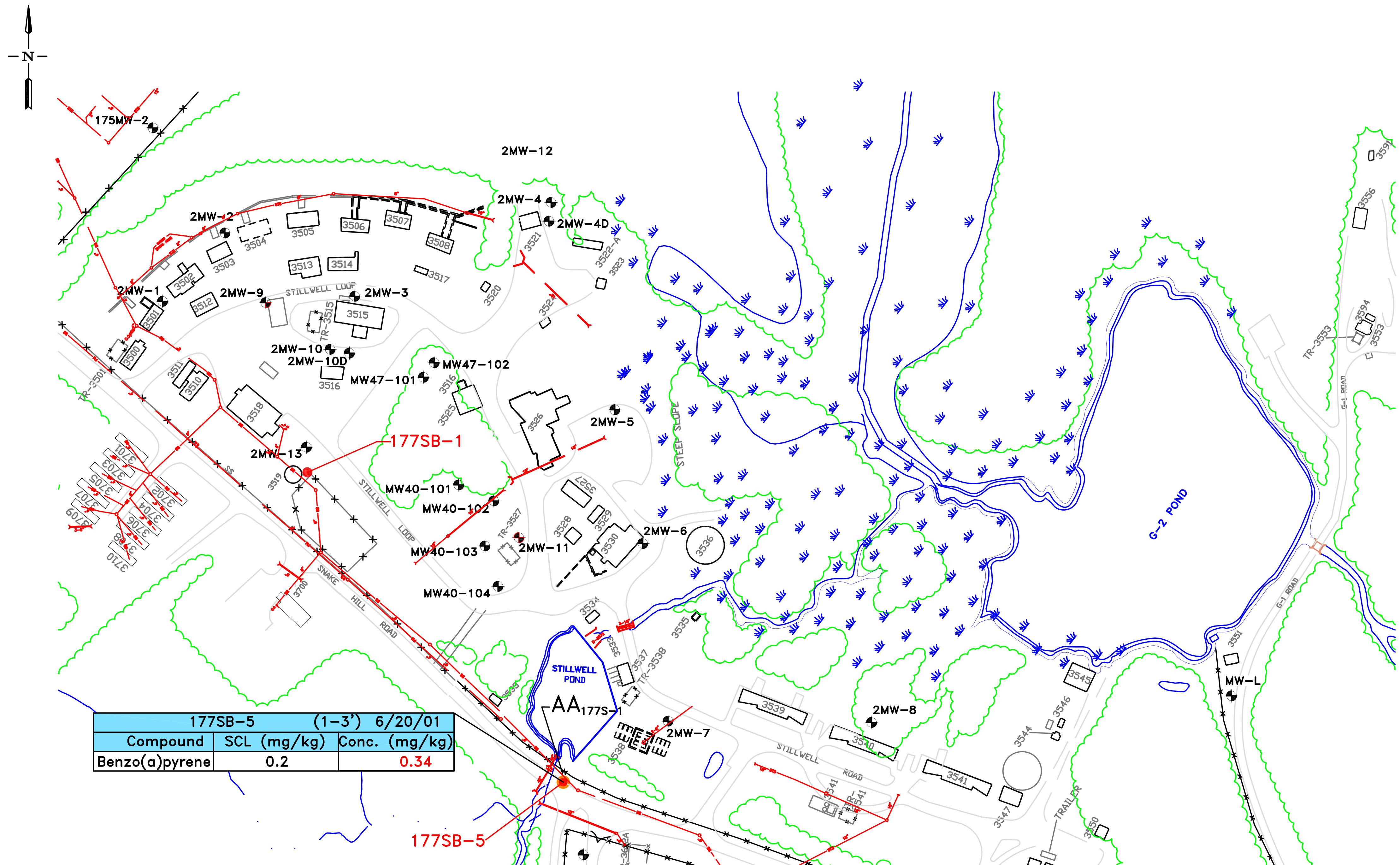
FIGURE 3-10
SITE 176 -
LITTLE LEAGUE BASEBALL FIELD
AREA OF ATTAINMENT
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wolfe 04/15/10	K. Gerdes 04/5/010	-- --	L177041510.dwg



177SB-5	(1-3') 6/20/01	
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.34

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

EXISTING SAMPLING LOCATIONS
- SOIL BORING
- MONITORING WELL

PHASE III 2A/3A RI SAMPLING LOCATIONS
- SOIL BORING

AREA OF ATTAINMENT

NOTE:
LOC EXCEEDENCES BELOW PICATINNY BACKGROUND LEVELS ARE NOT PRESENTED.

200 150 100 50 0 100 200
SCALE IN FEET
1" = 200ft

NOTE:
TOPOGRAPHIC CONTOUR SOURCE IS THE IDENTIFICATION AND ANALYSIS OF WETLANDS, FLOODPLAINS, THREATENED AND ENDANGERED SPECIES AND ARCHAEOLOGICAL GEOMORPHOLOGY AT PICATINNY, NJ (WES, 1994), WHICH USED TOPOGRAPHIC CONTOURS DERIVED FROM 1948 SURVEY MAPS. THESE SURVEY MAPS WERE SCANNED TO CREATE ELECTRONIC FILES AND WERE MANUALLY REFINED. WHILE THESE CONTOURS DEPICT GENERAL TOPOGRAPHY WELL, THEY ARE NOT PRECISE IN SOME LOCATIONS.

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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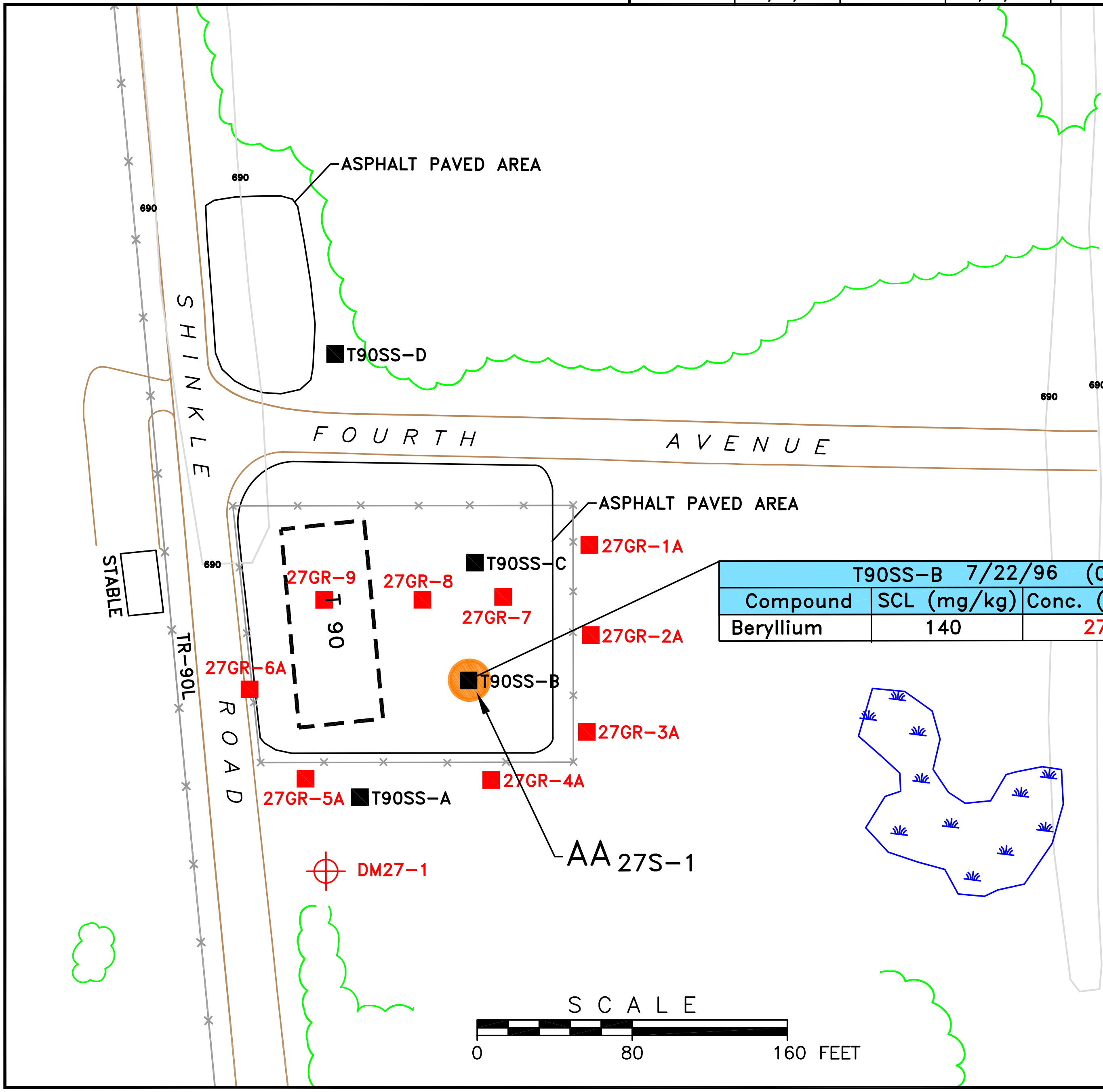
FIGURE 3-11
SITE 177 - SEWER LINE INVESTIGATION
AREA OF ATTAINMENT
25 SITES FFS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\25 Sites FS\Fig 3-9.dwg
Plot Date/Time: Apr 23, 2010 – 11:46am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	04/20/10	K. Gerdes	04/20/10	--	--	P27052505.dwg



T90SS-B 7/22/96 (0-1')		
Compound	SCL (mg/kg)	Conc. (mg/kg)
Beryllium	140	270

RAILROAD
TREE LINE
FENCE
TR-732 TRANSFORMER
BLAST WALL
STS OR STS STORM SEWER
SS OR SS SANITARY SEWER
EARTH MOUND
BLDG. NO. BUILDING
BLDG. NO. FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER
AREA OF ATTAINMENT

SAMPLE LOCATIONS
MONITORING WELL
SURFACE SOIL

Picatinny Installation Restoration Program

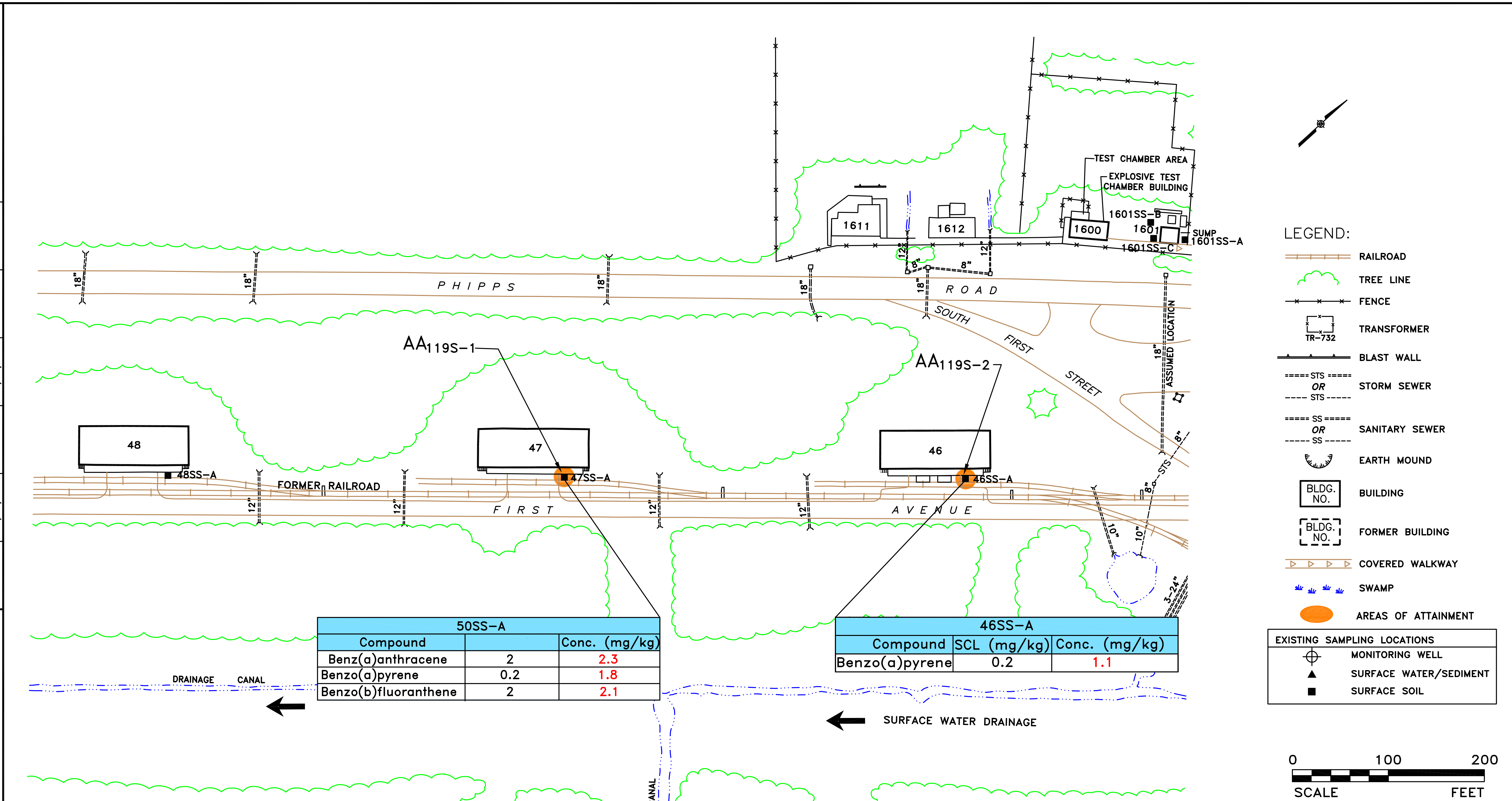
U.S. Army Corps of Engineers

Shaw™ Shaw Environmental, Inc.

FIGURE NO. 3-12

SITE 27
FORMER SALT STORAGE AREA
AREA OF ATTAINMENT

25 SITES FS
PICATINNY, DOVER, NEW JERSEY



50SS-A		
Compound		Conc. (mg/kg)
Benz(a)anthracene	2	2.3
Benzo(a)pyrene	0.2	1.8
Benzo(b)fluoranthene	2	2.1

46SS-A		
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	1.1

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE NO. 3-13

SITE 119 - BUILDINGS 46,47 AND 48
STORAGE MAGAZINES
AREAS OF ATTAINMENT
25 SITES FS
PLICATINNY, DOVER, NEW JERSEY

DRAWING NUMBER P119-053105.dwg

APPROVED BY

CHECKED BY K. Gerdes 04/20/10

DRAWN BY S. Wiafe 04/20/10

File: N:\cad\CAD drawings\Picatinny\25 Sites FS\Fig 3-10.dwg
Plot Date/Time: Apr 23, 2010 - 11:49am
Plotted By: stephen.Wiafe

File: N:\cad\CAD drawings\Picatinny\25 Sites FS\Fig 3-11.dwg
Plot Date/Time: Apr 23, 2010 – 11:50am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
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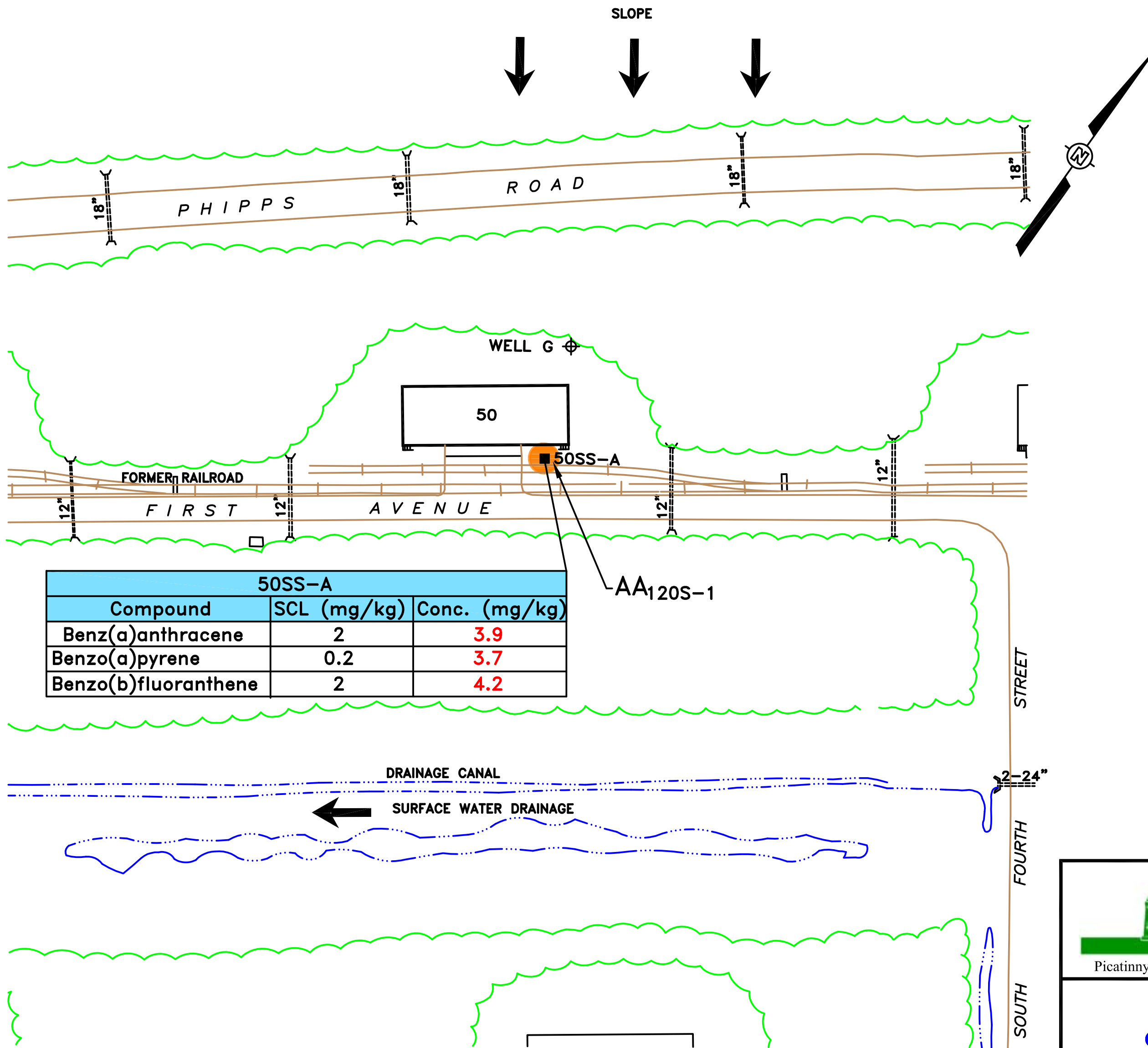

50SS-A		
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	2	3.9
Benzo(a)pyrene	0.2	3.7
Benzo(b)fluoranthene	2	4.2

LEGEND:

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- AREA OF ATTAINMENT

EXISTING SAMPLING LOCATIONS
- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL

SCALE
0 100 200 FEET

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE NO. 3-14
SITE 120 - BUILDING 50
STORAGE MAGAZINE
AREA OF ATTAINMENT
25 SITES FS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\25 Sites FS\Fig 3-12.dwg
Plot Date/Time: Apr 23, 2010 – 11:51am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
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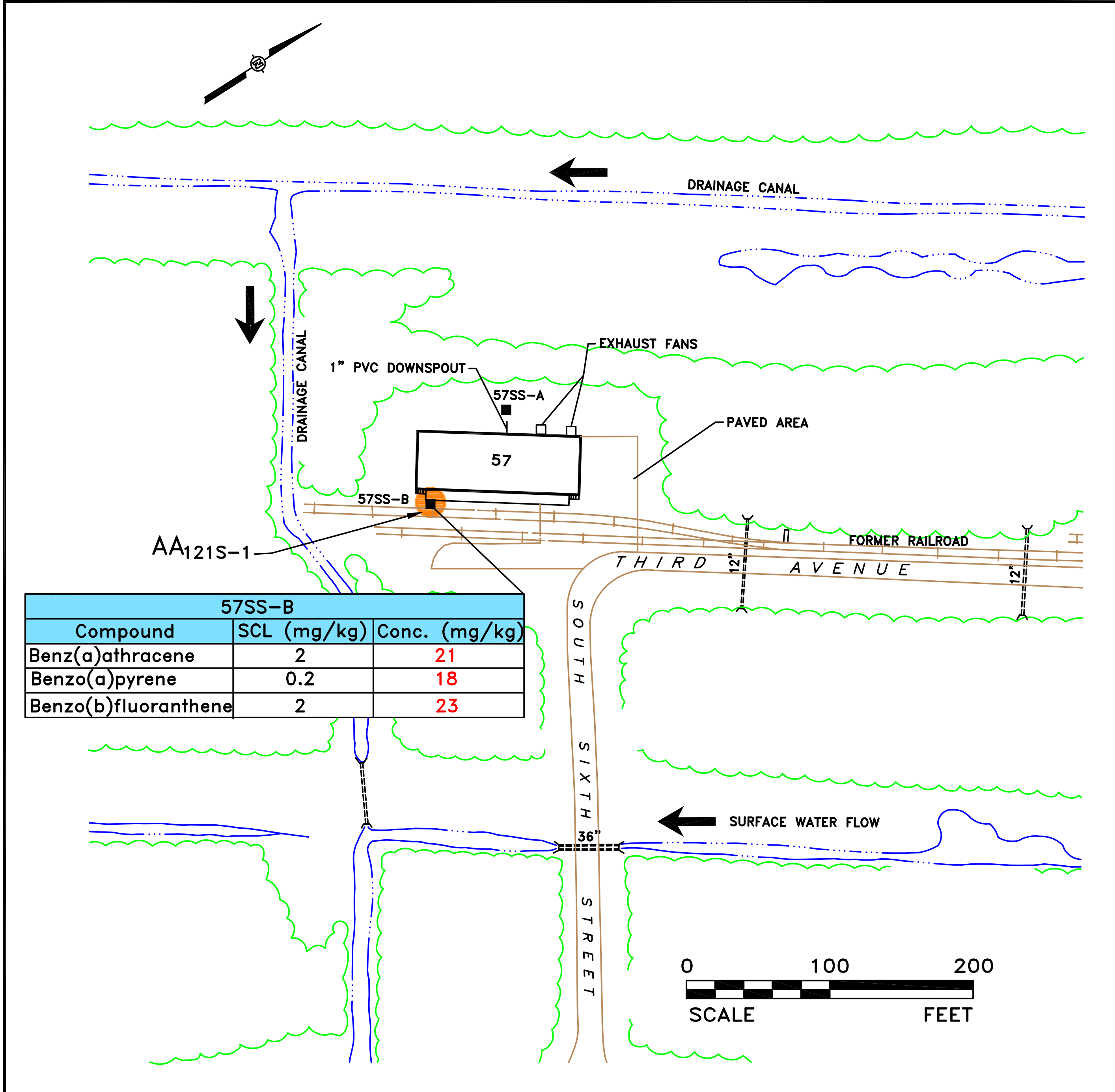

57SS-B		
Compound	SCL (mg/kg)	Conc. (mg/kg)
Benz(a)athracene	2	21
Benzo(a)pyrene	0.2	18
Benzo(b)fluoranthene	2	23

LEGEND:

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- AREA OF ATTAINMENT

EXISTING SAMPLING LOCATIONS
- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

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FIGURE NO. 3-15

SITE 121 - BUILDING 57
AREA OF ATTAINMENT

25 SITES FS
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-P\pDP042210.dwg
Plot Date/Time: Aug 19, 2010 – 2:04pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
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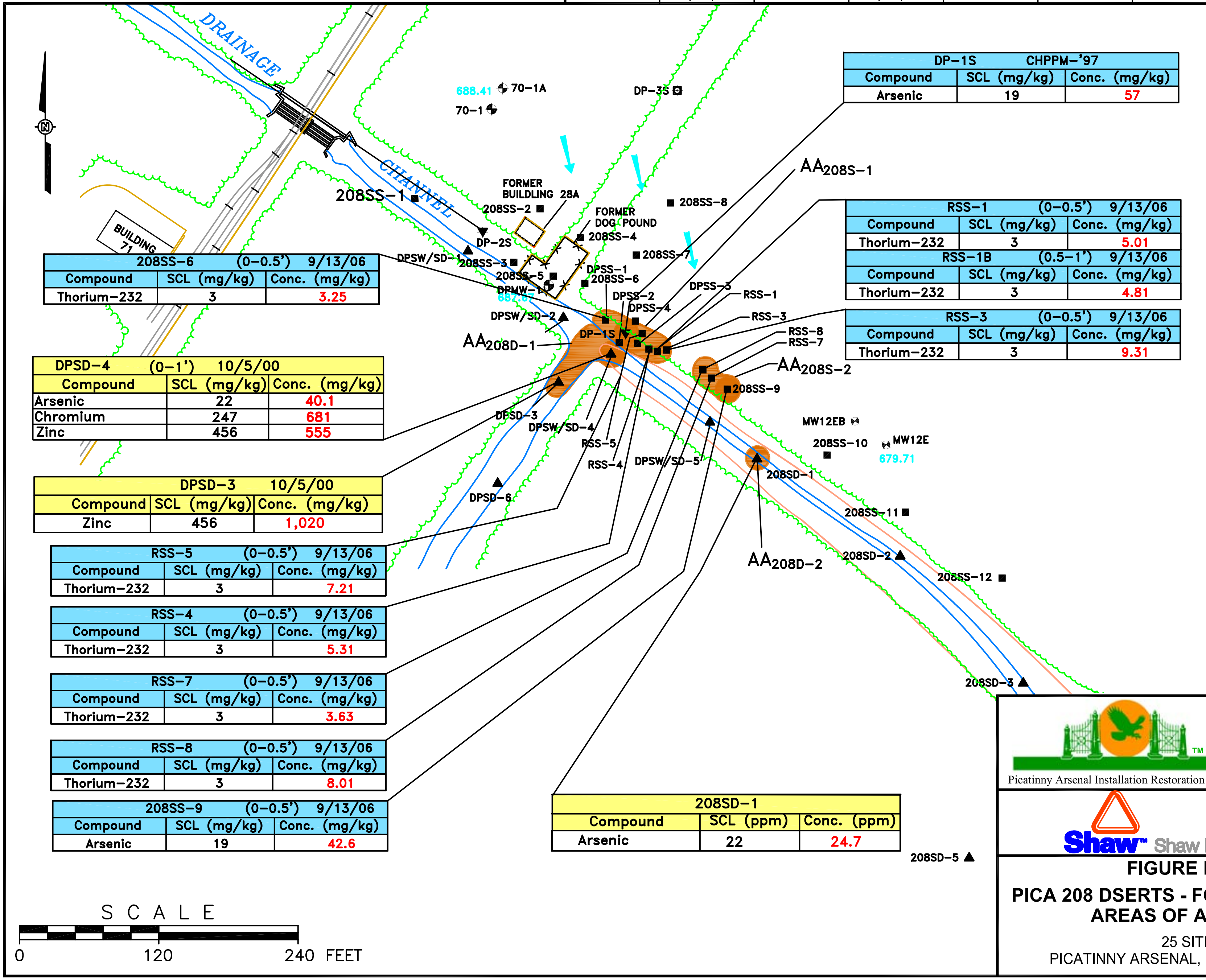

DP-1S	CHPPM-'97	
Compound	SCL (mg/kg)	Conc. (mg/kg)
Arsenic	19	57

RSS-1	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	5.01
RSS-1B	(0.5-1')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	4.81

RSS-3	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	9.31

208SS-6	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	3.25

DPSD-4	(0-1')	10/5/00
Compound	SCL (mg/kg)	Conc. (mg/kg)
Arsenic	22	40.1
Chromium	247	681
Zinc	456	555

DPSD-3	10/5/00	
Compound	SCL (mg/kg)	Conc. (mg/kg)
Zinc	456	1,020

RSS-5	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	7.21

RSS-4	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	5.31

RSS-7	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	3.63

RSS-8	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Thorium-232	3	8.01

208SS-9	(0-0.5')	9/13/06
Compound	SCL (mg/kg)	Conc. (mg/kg)
Arsenic	19	42.6

208SD-1		
Compound	SCL (ppm)	Conc. (ppm)
Arsenic	22	24.7

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- CONTOUR
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER
- GROUND WATER FLOW
- AREA OF ATTAINMENT

EXISTING SAMPLING LOCATIONS

- MONITORING WELL
- SURFACE WATER/SEDIMENT
- SURFACE SOIL
- HAND AUGER SOIL SAMPLE GW SAMPLE COLLECTED W/ DISPOSABLE BAILER
- GEOPROBE SURFACE SOIL & GROUND-WATER SAMPLE

SCALE

0 120 240 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw™ Shaw Environmental, Inc.

FIGURE NO. 3-16

PICA 208 DSERTS - FORMER DOG POUND AREAS OF ATTAINMENT

25 SITES FS

PICATINNY ARSENAL, DOVER, NEW JERSEY

4.0 SCREENING AND ANALYSIS OF REMEDIAL ALTERNATIVES

This section describes the identification and screening of applicable technologies and assembly of these technologies into RAs for the "25 Sites". As discussed in Section 1.0, only four remedial alternatives will be evaluated for the sites: no further action, LUCs (i.e., ICs) and maintenance of existing ECs (as applicable), long-term monitoring for surface water and sediment AAs in addition to LUCs, and removal of soil AAs and off-site disposal.

Discussions include: identification of GRAs and technologies associated with the GRAs; a brief description of each technology; and, an initial screening of technologies based on effectiveness, implementability, and cost. GRAs are broad classes of responses or remedial actions that can potentially achieve the RAOs. GRAs may encompass many remedial technologies and remedial technology process options. For example, in situ active restoration is a GRA, in situ biological treatment is a remedial technology, and methane sparging is a remedial technology process option. Technologies that pass the preliminary screening process are then used in the development of RAs as discussed at the end of this section.

In this FFS, similar to other sites at Picatinny, all RAs for the "25 Sites" would be implemented in conjunction with LUCs, if a non-restricted land use scenario is not achieved.

4.1 GENERAL RESPONSE ACTIONS

GRAs are broad categories of response actions that could be selected to achieve the RAOs for the media and COCs at the site. Some response actions are sufficiently broad in effect that they are capable of meeting the RAOs alone. However, in most cases, combinations of response actions are required to be effective in meeting all of the RAOs. The RAOs for the "25 Sites" involve preventing the exposure of potential human receptors to contaminated soil and sediments at each site. The GRAs that can potentially be used to achieve the RAOs are summarized in **Table 4-1**.

Key factors in evaluating the applicability of GRAs and associated technologies include the type and form of wastes, surficial geologic characteristics, and location-specific characteristics.

4.2 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

Presented below are general descriptions of potentially applicable technologies and process options for the "25 Sites". Remedial technologies are described generally and may be applicable to more than one response action. The term "process option" refers to specific processes within each technology type. Several broad technology types may be identified for each GRA, and numerous process options may exist for each technology. Even within process options there are additional levels of choice. For purposes of alternative development, this level of detail is left to the detailed remedial design phase as it makes minimal difference on the overall cost.

The technology identification and screening process was performed in accordance with the CERCLA FS guidance document (USEPA, 1988a), as specified by the NCP (40 CFR Part 300, Subpart F).

4.2.1 Identification and Screening of Technologies

A master list of potentially applicable technologies was developed and organized in terms of the GRA categories (**Table 4-1**). Initial screening of the identified technologies was based primarily on technical implementability considerations. Specific criteria employed in the screening process were as follows:

- Comparability with Site and Constituent Characteristics – A technology must be compatible with the specific site and constituent characteristics.
- Ability to Achieve RAOs – A technology must be capable of achieving the RAOs, either alone or as a component of a technology train.
- Cost – A technology should not be an order of magnitude more costly than other technologies providing comparable performance.

Table 4-1
GRAs and Technologies Applicable to RAOs for the "25 Sites"

General Response Action/ Technology Type	Applicability to Remedial Action Objectives
No Action	Action must be evaluated as the baseline for comparison of other response actions and alternatives as required by the NCP.
Land Use Controls	Application of administrative actions such as land-use and deed restrictions, which protect public health and the environment through management of potential risk. May incorporate existing engineering controls (ECs)
Containment	Isolation of contaminated media from the environment and potential receptors by blocking the exposure/transport mechanism.
Removal	Removal of the contaminant source from the site. Refers to the methods used to excavate and handle soils, sediments, wastes, and other solid materials. Required prior to implementation of ex-situ treatment or disposal options.
Treatment	Not evaluated in the FFS.
Disposal	Disposal of treated or untreated soil/sediments on site or at an off-site location would reduce the potential for exposure. Disposal involves placement of waste materials in designated facilities that have been designed and are operated for such purpose.

4.2.2 Evaluation of Technologies and Selection of Representative Technologies

Those technologies considered potentially applicable and relevant to meeting site RAOs and GRAs are described in detail below, and will be used in the development of RAs presented in Section 4.4.

No Action – Under the No Action alternative, no remedial activities will be conducted at the sites. Nevertheless, the No Action alternative has passed the technology screen in accordance with the requirements of Subpart F of the NCP, which specifies that it be fully evaluated as a basis for comparison with other RAs.

Land Use Controls – LUCs, which may include maintenance of existing ECs, would prevent or limit the use of, and access to, the contaminated media at the sites. These restrictions could include property access restrictions prohibiting fishing and swimming, restrictions on future construction activities, and/or a deed notification. Restrictions can be implemented that would limit property usage and specify any special considerations such as personal protective equipment required for future site activities. Land use restrictions and development controls can be an effective means of protecting public health by decreasing risk of exposure to contamination at a site. They do not, however, protect potential ecological receptors; however, no unacceptable ecological risk was identified at any of the sites. A description of the LUCs in place at Picatinny is provided in Section 4.4.2.1.

Long-Term Chemical and Biological Monitoring – Chemical and biological monitoring involves performing sampling of abiotic and biotic material at a determined frequency and analysis to observe contaminant concentration changes and potential impacts to aquatic life. Sampling is performed by collecting the material (soil, sediment, surface water, etc.) utilizing an appropriate collection method such as a shovel, hand auger or direct immersion of the sample container in water. Chemical monitoring involves collecting samples, such as surface water and sediment, for chemical constituents analysis (i.e., PAHs and metals) and biological monitoring involves collecting samples to be analyzed for biological constituents (i.e., benthic population surveys and toxicity testing) to observe changes in aquatic life (invertebrate organisms).

The chemical and biological sample collection techniques differ in one significant manner. Samples for chemical analysis are usually collected at a discrete point location to be unbiased in the type of material collected. On the other hand, samples for biological analysis are usually collected in a small area to specifically target the media that is most conducive for aquatic life.

Soil/Asphalt/Vegetative Cover (Existing) – In some cases, existing clean soil, pavement, and/or vegetation cover may physically cover and isolate the contaminated soil material, thus limiting the potential for direct contact by humans, airborne transport, and surface water runoff. The cover would be inspected periodically to confirm that it has not been damaged and to ensure that it is properly maintained.

Excavation – Excavation is defined as the mechanical process of physically removing material from the ground. Dredging is the removal or excavation of contaminated sediments specifically from a water body. Excavation can be accomplished by digging up contaminated media with a backhoe, excavator, or other suitable type of earth-moving equipment.

The backhoe and excavator are types of hydraulically powered equipment suitable for excavation and dredging operations. It may be mounted on tracked or wheeled vehicles, or even on pontoons. A backhoe enables relatively accurate removal and placement of sediments, reducing the amount of suspended sediments.

Off-Site Disposal – Contaminated soil and sediment present at the sites may be excavated and transported for off-site disposal in a RCRA subtitle D landfill (if the material is not classified as a hazardous waste). It is assumed, based on detected sample concentrations, that none of the media to be disposed would require disposal in a hazardous waste landfill (Subtitle C). Placement of the excavated material in a landfill would minimize the potential for leakage of contaminants and minimize threats to public health and the environment by permanently removing the contaminants from the sites.

4.3 REMEDIAL ALTERNATIVE SCREENING CRITERIA

Section 300.430(e) of the NCP lists nine criteria against which each RA must be assessed. The acceptability or performance of each alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified. The detailed criteria are as follows:

- Protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and,
- Community acceptance.

The NCP [Section 300.430(f)] states that the first two criteria, protection of human health and the environment and compliance with ARARs, are "threshold criteria" which must be met by the selected remedial action unless a waiver can be granted under Section 121(d)(4) of CERCLA. Criteria three through seven are "primary balancing criteria", and the trade-offs within this group must be balanced. The preferred alternative will be the alternative which is protective of human health and the environment, is ARAR-compliant, and provides the best combination of primary balancing attributes. Only the first seven criteria are evaluated in this report. The final two criteria, State and community acceptance, are "modifying criteria" which are evaluated following the comment period on the RI/FS reports and the proposed remedial plan. The nine NCP criteria are described in further detail in the following sections and summarized on **Figure 4-1**.

Overall Protection of Human Health and the Environment

This criterion involves an assessment based on a composite of factors addressed under other evaluation criteria, including long-term effectiveness, short-term effectiveness, and compliance with ARARs.

Figure 4-1: Nine Criteria for Detailed Analysis of Remedial Alternatives

THRESHOLD CRITERIA

1 Overall Protection of Human Health and the Environment

- How the Alternative Provides Human Health and Environmental Protection

2 Compliance with ARARs (or justification of a Waiver)

- Compliance with Chemical-Specific ARARs
- Compliance with Location-Specific ARARs
- Compliance with Action-Specific ARARs
- Compliance with Other Criteria, Advisories, and Guidance (TBC Guidance)

PRIMARY BALANCING CRITERIA

3 Long-Term Effectiveness and Permanence

- Magnitude of Residual Risk
- Adequacy and Reliability of Controls

4 Reduction of Toxicity, Mobility, or Volume through Treatment

- Treatment Process used and Materials Treated
- Amount of Hazardous Materials Destroyed or Treated
- Degree of Expected Reductions in Toxicity, Mobility or Volume
- Degree to which Treatment is Irreversible
- Type and Quantity of Residuals Remaining after Treatment

5 Short-Term Effectiveness

- Protection of Community during Remedial Actions
- Protection of Workers during Remedial Actions
- Environmental Impacts
- Time Unit Remedial Action Objectives are Achieved

6 Implementability

- Ability to Construct and Operate the Technology
- Reliability of the Technology
- Ease of Undertaking Additional Remedial Actions, if necessary
- Ability to Monitor Effectiveness of Remedy
- Coordination with Other Agencies
- Availability of Off-Site Treatment, Storage and Disposal Services, and Capacity
- Availability of Necessary Equipment, Materials, and Specialists
- Availability of Prospective Technologies

7 Cost

- Estimated Capital Costs
- Estimated Annual Operation and Maintenance Costs
- Estimated Present Worth Costs

MODIFYING CRITERIA[1]

8 State Acceptance

9 Community Acceptance

[1]These criteria are fully assessed following comment on the RI/FS Report and the Proposed Plan, and will be fully addressed in the ROD.

This criterion provides an evaluation of how the RA, as a whole, achieves RAOs and maintains protection of human health and the environment. A determination and declaration that this criterion will be met by the proposed remedial action must be made in the Decision Document; therefore, this is a threshold criterion, which must be met by the selected remedy. Ordinarily this criterion is satisfied if the potential risks posed at the sites are eliminated, reduced, or controlled through treatment, engineering controls, or ICs. According to the CERCLA definition, the site itself is protective of human health, even without remedial action. However, overall protection of the environment will be addressed individually for the RAs.

Compliance with ARARs

This criterion assesses the compliance of an alternative with all contaminant-specific, action-specific, and location-specific ARARs. Any TBCs are also taken into consideration including appropriate state or federal criteria, advisories, and guidance as they apply.

Long-Term Effectiveness and Permanence

This criterion examines the protection of human health and the environment after construction and implementation of the RA. This criterion addresses the long-term adequacy, reliability, and permanence of the RA. Components of this analysis include the following:

- The expected long-term reduction in risk posed by the sites;
- The level of effort needed to maintain the remedy and monitor the area for changes in site conditions; and,
- The compatibility of the remedy with the planned future use of the site.

Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion examines the effectiveness of the RA in reducing the toxicity, mobility, and volume of contaminants through treatment. The statutory preference for remedial technologies that significantly and permanently reduce the toxicity, mobility, or volume of the waste is addressed by this criterion. The following factors will be considered:

- The amount of hazardous materials that will be destroyed or treated;
- The degree of expected reduction in toxicity, mobility, or volume;
- The degree to which the treatment will be irreversible; and,
- The type and quantity of treatment residuals that will remain following treatment.

Short-Term Effectiveness

The effects of the remedial action alternative from construction and implementation to completion of the remedial action alternative are addressed under this criterion. The following factors will be addressed:

- Protection of the community during the remedial action, including the effects of dust from excavation, transportation of contaminated materials, and air-quality impacts from on-site treatment;
- Protection of workers during the remedial action;
- Environmental impacts of the remedial action; and,
- Time required to achieve RAOs.

Implementability

This criterion considers the technical and administrative feasibility of each alternative, as well as availability of required resources. Factors considered in assessing this criterion include construction, operation, and maintenance of the RA; required approvals and permits from regulatory agencies;

availability of required off-site treatment or disposal services; and availability of necessary equipment, materials, and personnel for implementation.

Cost

This criterion involves development and evaluation of the capital cost of construction, equipment, land, buildings, engineering services, and project administration, and operation and maintenance costs for labor, spare parts, materials, and administration. In addition, the present worth of each alternative is calculated using a discount rate of seven percent. Costs are then compared on a common, present-worth basis in terms of 2010 dollars. The level of detail employed in developing these estimates is considered appropriate for making choices between alternatives, but the estimates are not intended for use in detailed budgetary planning. Detailed cost calculations are presented in **Appendix E**, and are summarized in **Table 4-2**.

4.4 REMEDIAL ALTERNATIVES

The following section provides a detailed description of each RA for the “25 Sites”, and analysis of each alternative with respect to the NCP criteria. Remedial alternatives are not evaluated for the five sites listed on **Table 3-16** which do not require remedial action and therefore have no RAOs. Five additional sites (Sites 69, 185, 174, 7, and 10 are only addressed through LUCs in order to memorialize the risk assessment assumptions in accordance with the RAO for the “25 Sites.” The remedial alternatives evaluated for the remaining 16 sites are listed on **Table 4-2** along with a summary of estimated costs and remedial timeframes. Each of the soil RAs, with the exception of the “no action” alternative, involves the maintenance and enforcement of LUCs. As such, LUCs are considered supplemental to each of the remaining alternatives. A single LUCs plan would be prepared encompassing all of the “25 Sites” at which ICs would be required (including Sites 69, 185, 174, 7, and 10). A comparison of the alternatives for each site, based on the evaluation criteria, follows the analysis such that the most appropriate alternative can be selected.

4.4.1 No Action

According to the NCP, the level of protectiveness achieved must be compared to the required expenditure of time and materials as an integral portion of the remedy selection process. The No Action alternative is intended to serve as a baseline by which to compare the risk reduction effectiveness of other potential alternatives. In this alternative, no response actions would be performed. No efforts would be undertaken to contain, remove, monitor, or treat the contaminated soil at the sites. The sites would remain without any additional actions.

4.4.1.1 Evaluation of Screening Criteria

A summary of the screening criteria evaluation with respect to each of the applicable sites is presented on **Table 4-3**.

Overall Protection of Human Health and the Environment

The No Action alternative provides no control of exposure to the contaminated media and no reduction in risk to human health or the environment. As long as Picatinny is under military control, ICs and LUCs will be in place. To ensure the maintenance and enforcement of these controls, Picatinny has developed a series of interlocking protective measures to safeguard human health and the environment. The seven elements are Site Clearance and Soil Management Procedures; UXO Clearance Procedures; Master Plan Regulations; Picatinny Geographic Information System (GIS) Database; Picatinny Base Access Restrictions; Picatinny Safety Program; and Army Military Construction Program. Additional details of these elements can be found in Section 4.4.2.1.

Compliance with ARARs

ARARs are not identified for the No Action alternative (ARARs Question and Answers USEPA OSWER Directive 9234.2-01/FS-4, June 2004).

Table 4-2
Cost Summary For Remedial Alternatives, "25 Sites"
Picatinny, New Jersey

Remedial Alternative	Description	Capital Cost[(1)]	Discounted O&M [(2)]	Total Present Worth	Duration (Construction and O&M)
BASELINE COST FOR IMPLEMENTATION OF LAND USE AND ACCESS RESTRICTIONS AND ICs FOR SOIL AND SEDIMENT AT THE 25 SITES		$32,200.00	$37,222.34	**$69,422.34**	30 years
Site 117					
Alternative 117-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 117-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 117-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$55,171.11		**$55,171.11**	3 days (30 years LUCs)
Site 123					
Alternative 123-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 123-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 123-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$58,528.22		**$58,528.22**	5 days (30 years LUCs)
PICA Site 207					
Alternative 207-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 207-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 207-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$56,785.81		**$56,785.81**	2 days (30 years LUCs)
Site 145					
Alternative 145-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 145-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$21,405.60	**$21,405.60**	30 years
Alternative 145-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$80,555.54		**$80,555.54**	5 days (30 years LUCs)
Sites 52, 95, and 96					
Alternative 52-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 52-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 52-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$646,653.04		**$646,653.04**	3 weeks (30 years LUCs)
Site 134					
Alternative 134-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 134-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 134-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$59,005.18		**$59,005.18**	5 days (30 years LUCs)

Table 4-2
Cost Summary For Remedial Alternatives, "25 Sites"
Picatinny, New Jersey

Remedial Alternative	Description	Capital Cost(1)	Discounted O&M (2)	Total Present Worth	Duration (Construction and O&M)
BASELINE COST FOR IMPLEMENTATION OF LAND USE AND ACCESS RESTRICTIONS AND ICs FOR SOIL AND SEDIMENT AT THE 25 SITES		$32,200.00	$37,222.34	**$69,422.34**	30 years
Site 136					
Alternative 136-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 136-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 136-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$54,324.37		**$54,324.37**	5 days (30 years LUCs)
Site 175					
Alternative 175-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 175-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 175-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$82,038.38		**$82,038.38**	5 days (30 years LUCs)
Site 173					
Alternative 173-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 173-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 173-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$436,774.80		**$436,774.80**	2 weeks (30 years LUCs)
Site 176					
Alternative 176-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 176-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 176-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$64,155.08		**$64,155.08**	5 days (30 years LUCs)
Site 177					
Alternative 177-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 177-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 177-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$60,840.93		**$60,840.93**	5 days (30 years LUCs)
Site 27					
Alternative 27-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 27-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 27-3	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$56,785.81		**$56,785.81**	3 days (30 years LUCs)

Table 4-2
Cost Summary For Remedial Alternatives, "25 Sites"
Picatinny, New Jersey

Remedial Alternative	Description	Capital Cost[1]	Discounted O&M [2]	Total Present Worth	Duration (Construction and O&M)
BASELINE COST FOR IMPLEMENTATION OF LAND USE AND ACCESS RESTRICTIONS AND ICs FOR SOIL AND SEDIMENT AT THE 25 SITES		$32,200.00	$37,222.34	**$69,422.34**	30 years
Sites 119, 120, 121					
Alternative 119-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 119-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
PICA Site 208					
Alternative 208-1	NO ACTION	$0.00	$0.00	**$0.00**	None
Alternative 208-2	LUCs AND MAINTENANCE OF EXISTING ENGINEERING CONTROLS		$25,721.23	**$25,721.23**	30 years
Alternative 208-3	LONG TERM CHEMICAL MONITORING OF SEDIMENT AND LUCs		$63,566.31	**$63,566.31**	5 years (30 years LUCs)
Alternative 208-4	EXCAVATION OF SOIL AAs WITH OFF-SITE DISPOSAL AND LUCs	$107,376.70		**$107,376.70**	6 days (30 years LUCs)

(1) Capital costs for the implementation of LUCs are evaluated in the baseline cost for LUCs at the 25 Sites. As SCLs are based on a non-residential use scenario, the baseline costs for LUCs must be added to the costs presented for the site specific remedial alternatives with the exception of the No Action alternative.

(2) Present worth O&M with discount rate of 7%.

Long-Term Effectiveness and Permanence

The No Action alternative does not provide any controls for reduction of exposure or long-term management measures. All current and potential future risks would remain the same under this alternative.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not employ any treatment that would reduce the toxicity, mobility, or volume of COCs; therefore, it does not meet this criterion.

Short-Term Effectiveness

Implementation of this alternative does not pose any additional risks to the community, the workers, or the environment since there are no remedial activities associated with it.

Implementation

There are no implementability concerns posed by this option.

Cost

The present worth cost and capital cost of the No Action alternative are estimated to be **$0.00** since there would be no action taken at the site.

4.4.2 Land Use Controls and Maintenance of Existing Engineering Controls

The LUCs and Maintenance of Existing ECs alternative involves the enforcement and maintenance of existing ICs, such as land-use and access restrictions, and also includes maintenance of existing ECs, such as existing surface coil cover, vegetative cover, pavement, gravel cover, or site fence at applicable AAs. LUCs have been evaluated on a "25 Sites"-wide basis for contaminated media. Additional site-specific measures (such as site inspections and maintenance of existing ECs) and associated costs would be added for each site included in the LUC plan. For the purpose of this FFS, a 30-year timeframe is assumed in the cost estimate.

4.4.2.1 Description of Alternative

Property access restrictions as a component of LUCs, such as site security, and restrictions on future site activities, are already in place. Some restrictions are in place at Picatinny by virtue of it being an active military installation. Enforcement of these restrictions will ensure the protection of human health. However, in the event that Picatinny would be closed and declared excess property, the land use restrictions would be legally recorded (e.g., in zoning ordinances, property deeds, etc.) and incorporated into the provisions for the new land use. A change in land use would include the re-evaluation of clean-up requirements.

Because contamination would remain in place that either exceeds New Jersey NRSRS or which poses potential human health risk, as part of this alternative, land use and access restrictions would be required. The USEPA requires LUCs when site contaminant levels do not allow unrestricted use and unlimited exposure. As such, LUCs would be established to preclude activities that could lead to human exposure to environmental contaminants, by eliminating exposure pathways and/or restricting access by potential receptors. LUCs are administrative measures put in place to effect human activity, in order to preclude land use which could result in unacceptable risk. They can also serve to notify current and future users about the environmental conditions of the property. The ROD will detail the provisions and requirements of the LUC portion of this remedy necessary to assure that land use remains consistent with the remedy to protect human health and the environment. To properly plan and implement LUCs for this site, a Land Use Control Remedial Design (LUCRD) will be written and submitted as a primary document during the design stage of the project. The LUCRD will also detail the existing ECs (required by the NJDEP to address any exceedence of the NJDEP NRSRS) and maintenance procedures required to ensure the existing ECs remain effective. This plan will contain sufficient detail such that adherence to the plan will ensure the protectiveness of the remedy. Annual or biennial land use certification reports documenting that land use continues to be consistent with the assumptions in the risk assessment will be signed by the installation commander and provided to the NJDEP and USEPA.

According to the NCP, LUCs may be used during the conduct of the RI/FS and implementation of the remedial action and, where necessary, as a component of the completed remedy [40 CFR 300.430 (a) (1)(iii)(D)]. The use of LUCs shall not substitute for active response measures as the sole remedy unless such active measures are determined not to be practicable, based on the balancing of the tradeoffs among alternatives that is conducted during the selection of the remedy [40 CFR 300.430 (a)(1)(iii)(D)]. The NCP regulation specifies the conditions under which LUCs can be incorporated into a remedy, but it does not provide specific guidance on how to incorporate them into the remedy selection process. The USEPA direction entitled Land Use in CERCLA Remedy Selection Process provides insight into USEPAs position on LUCs (USEPA, 1995). USEPA specified that LUCs should be evaluated and implemented with the same degree of care as is given to other elements of the remedy. The directive states that in evaluating a remedy that includes an IC, USEPA should determine the type of IC to be used; the existence of the authority to implement the IC; and the appropriate entities' resolve and ability to implement the IC.

The four general categories of ICs screened for or already in use at Picatinny, and which provide layers of protection, are as follows: government controls, proprietary controls, enforcement and permitting and informational devices which assist with the management and implementation of LUCs. Most of these measures have been addressed in seven elements of the Land Use Restriction policy for Picatinny. The seven elements are Site Clearance and Soil Management Procedures, UXO Clearance Procedures, Master Plan Regulations, Picatinny Base Access Restrictions, Picatinny Safety Program, and Army Military Construction Program and Picatinny GIS database. The GIS will be a tool for the Army to document areas of contamination and restricted land use. Enforcement of these controls would preclude unacceptable human contact to site contaminants. All of these elements of Land Use Restriction are explained below. These controls have been developed with a consideration of all reasonably anticipated land uses at Picatinny; these include administrative and industrial military operations, and outdoor recreation/golf course. LUCs will be implemented using the Department of Navy Guidance as agreed between the Army and the USEPA.

ECs, including signage (warning signs) describing restrictions of site use at the major access points of sites included in this FS, to augment the existing perimeter fence surrounding Picatinny would be installed. Annual inspections will be performed to establish that all on-site LUCs are in good condition and to confirm that the land use of the site has not changed. The 5-year review process and the annual land use certifications/inspections will be used to document continuing land use is industrial and the remedy remains protective. Additionally, the remedial design will specify notification requirements to the EPA should land use change occur, or be planned, in accordance with the Department of Navy Principles.

<u>Site Clearance/Soil Management Procedures</u>

Picatinny initially established a Site Clearance/Soil Management Procedure on 2 August 1991. The procedure has been continually updated as requirements change. Currently, the Site Clearance Soil Management Procedure is specified in the Standard Operating Procedure (SOP) for Soil Management Procedures During Construction Activities, Picatinny Arsenal, July 2003 (Prepared by Johnson Controls, Inc., Risk Management Group Environmental Office). The SOP applies to all construction projects affecting soil movement at Picatinny and requires the approval by the Environmental Affairs Office. The SOP and the attached Soil Management Checklist are for use at all sites where activities will disturb the soils. This includes grubbing, grading, excavation, and significant heavy equipment traffic over unprotected soils. The procedure provides safeguards against inadvertent, unplanned exposure of potentially contaminated soils. The procedures include completion and submittal of an Environmental Work Request for Site Clearance/Soil Management Checklist prior to implementing the proposed work, no excavation of soil without approval of the Picatinny Installation Restoration Program (IRP) Project Manager, and no transportation of excavated soils off any site in this study without written approval from the USEPA Project Manager. This restriction does not include soil samples taken from the site for investigations.

<u>Munitions and Explosives of Concern (MEC) Clearance Procedures</u>

A series of explosions destroyed many of the structures at Picatinny on 10 July 1926. Unexploded ordnance and explosives were scattered over approximately one-third of Picatinny as a result of the explosions. Historical and current explosives testing and firing have resulted in the need to exercise care while conducting activities in many Picatinny areas. Picatinny, together with additional Army commands, has established procedures for the clearing of all Army property suspected of containing any potential MEC. Requirements for MEC work are outlined in the 30 July 1996 update for Personnel and Work Standards for Ordnance Response. The Picatinny Office of Chief of Safety, Public Safety and Environmental Affairs Directorate, is responsible for maintaining this procedure.

Master Plan Regulations, Army Regulation 210-20

The Army issued a new regulation, Master Planning for Army Installations, AR 21 0-20, on 13 July 1987 updating an earlier regulation dated 27 January 1976. AR 21 0-20 "establishes the requirement for an installation master plan and planning board and specifies procedures for developing, submitting for approval, updating, and implementing the installation master plan." This regulation provides for comprehensive planning at Army installations and not only allows, but requires incorporation of existing land-use and conditions into the master plan. The master plan regulations provide a framework for comprehensive planning through the use of component plans, which include, but are not limited to, the following:

- Natural Resources Plan
- Environmental Protection Plan
- Installation Layout Vicinity Plan
- Land-use Plan
- Future Development Plan

The overall objective is to provide each installation with a master plan through the integration of each component plan into the installation master plan. The component plans form a series of narrative, tabular and graphic plans. Their integration into an installation master plan provides many benefits as outlined in AR 210-20, including "the mechanism for ensuring that installation projects are sited to meet operational, safety, physical security, and environmental requirements."

Picatinny Office of the Chief Engineer in the Public Works Directorate is in charge of the master plan. A key component of the Picatinny master plan is the Arsenal Land Use map.

Picatinny GIS Database

Picatinny maintains a comprehensive base-wide GIS database. The database includes descriptions of existing land and environmental restrictions and locations of known contamination on base. This information will be made useable for rapid response and will permit rapid inquiries regarding sites within Picatinny. Existing wells, chemical contamination, building restrictions, MEC concerns, and many other lines of inquiry, will quickly be available to support the decision making process. Picatinny Office of the IRP Manager, Public Safety and Environmental Affairs Division, is responsible for maintaining this database, which has been delegated to ARCADIS until 2016.

Picatinny Base Access Regulations

Access regulations are in place at Picatinny. Picatinny is not closed to the public but access to the Arsenal is controlled. Trespassing and unauthorized activities on Picatinny are illegal. Picatinny Office of the Chief of Security Division, Public Safety and Environmental Affairs Division, is in charge of enforcing these regulations.

Picatinny Safety Program

Army regulation AR 385-10 outlines safety requirements for Army installations. Tactical Army Command (TACOM) Supplement 1 to AR385-10 provides Picatinny specific requirements for the Safety Program, IC6. AR 385-10 establishes an occupational safety and health program, and integrates "Hazard Risk Management into all command business processes." The Safety Program establishes the Hazard Communication (HAZCOM) Program and Hazardous Materials Information System (HMIS), maintains a central Material Safety Data Sheets (MSDS) file in the Installation Safety Office, and provides a safety review of all construction projects. The Safety Program also establishes "the appropriate medical surveillance program" for personnel working with hazardous materials or otherwise performing hazardous operations. The Installation Safety Office is the point of contact for the Safety Program, and has the authority to stop work where unsafe work conditions are present. Picatinny Office of the Chief of Safety, Public Safety and Environmental Affairs Division, is responsible for this program.

Army Military Construction Program Development and Execution

Army regulation AR 41 5-1 5 outlines pre-construction environmental survey procedures. Prior to construction activities, the Army categorizes the proposed construction site based on an environmental survey. Under this regulation, the Army must determine wetland status of the site, historical significance, and endangered species habitat identification. Picatinny Office of the Resident Engineer, USACE, New York District, coordinating with the Chief Engineer in the Public Works Directorate is responsible for maintaining this program.

4.4.2.2 Evaluation of Screening Criteria

A summary of the screening criteria evaluation with respect to each of the applicable sites is presented on **Table 4-3**.

Overall Protection of Human Health and the Environment

Potential human health and ecological exposures to COCs at the “25 Sites” are considered minimal. Land use and access restrictions and ICs are effective means to reduce human health exposure to contaminated soil, but will not address ecological risk. Existing ECs may inhibit exposure to some ecological receptors; however, no unacceptable ecological risks were identified during ERAs or SLERAs (Some sites were not assessed due to the evaluation that the site offered insufficient habitat to warrant additional investigation). Since the contamination would remain on site and undergo no treatment to reduce toxicity, mobility or volume, the Existing ECs and ICs alternative would not inhibit the potential migration of contaminants.

Compliance with ARARs

Through the implementation of LUCs and the maintenance of existing ECs, this alternative complies with chemical specific ARARs, consisting of the promulgated NJ Site Remediation Standards calculated for the ingestion/dermal exposure pathway (with the exception of the lead standard and in the case of future recreational land use). Action-specific and location-specific ARARs are not applicable since no active remediation would be implemented.

Long-Term Effectiveness and Permanence

LUCs and Existing ECs provide long-term effectiveness and permanence for the reduction of human health exposure to COCs at the “25 Sites”, as long as the LUCs and ECs remain in place. LUCs provide a lesser degree of mitigation for ecological risks; however, no unacceptable ecological risks were identified at the “25 Sites.”

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not employ any treatment that would reduce the toxicity, mobility, or volume of the COCs.

Short-Term Effectiveness

Implementation of this alternative does not pose any additional risks to the community, the workers, or the environment since there are no remedial activities associated with it.

Implementation

LUCs and Existing ECs are readily implementable.

Cost

Implementation costs of this alternative are provided for each site on **Table 4-2** which includes a baseline cost for the application of LUCs and Existing ECs across the 16 of the “25 Sites” carried into the evaluation of RAs. This baseline cost is supplementary to each of the RAs evaluated in this FFS, since SCLs are based on nonresidential criteria. A LUCRD will be prepared for the combined “25 Sites” at an estimated present worth cost of **$69,000**. Site-specific costs, such as site inspections and maintenance of ECs, are evaluated separately by site and media.

4.4.3 Excavation and Off-Site Disposal of Soil Areas of Attainment

The Excavation and Off-Site Disposal of Soil AAs involves the excavation of contaminated soil with concentrations greater SCLs, and confirmatory sampling of the limits of excavation. Excavated soil would be transported off-post for disposal in a RCRA D landfill (waste characterization sampling would be required to confirm waste class). The excavation would then be backfilled with soil from an approved source and revegetated. In addition, the property will be subject to land-use and access restrictions and ICs to prevent exposure to COCs remaining at the sites at concentrations in excess of residential criteria.

4.4.3.1 Description of Alternative

This RA would involve excavation of soil with COCs that pose unacceptable risk or exceed NJDEP NRSRS, identified in the AAs for the "25 Sites" presented in Section 3.2.2. The timeframes for the completion of site activities is presented in **Table 4-2** for the sites where excavation and disposal is evaluated. The major elements of this alternative are discussed in further detail below:

<u>Design and Permitting</u>

Once an RA has been selected and the Proposed Plan and ROD have been completed, a remedial design would be prepared. This would include, at a minimum, a site-specific work plan describing the remedial activities, quality assurance/control procedures, technical specifications, a soil erosion and sedimentation control plan, and a site health and safety plan. The design documents would be submitted for review and approval by the appropriate agencies prior to initiation of remedial activities.

The initial phases of the work would consist of the arrangement of the relevant permit equivalencies and preparation of a site-specific health and safety plan. Because the remedial action would be conducted under CERCLA, the substantive requirements of the permits, and permitting agencies, would be followed in lieu of obtaining formal permits for required activities. The health and safety plan would outline the physical and chemical hazards associated with the work to be performed at the site and would serve as the instrument of control for ensuring the health and safety of personnel at the site. The health and safety plan would also outline the air monitoring program that would be implemented during the excavation activities to ensure that a safe working environment is maintained. The health and safety plan will provide the action levels that will dictate the need for implementation of dust controls at the site.

Critical design elements and considerations would include work plan preparation, development of waste excavation and handling procedures, and design of erosion and sedimentation controls. Because this action would be performed under CERCLA, Picatinny is only required to file State and local permit equivalents. Permit equivalents will be filed for a storm water permit. Preparation of a Soil Erosion and Sedimentation Control Plan will also be required.

<u>Contractor and Material Procurement</u>

This would include preparation of bid packages for the remedial activities, solicitation of bids, bid review, and contractor selection. Materials and equipment required to complete the remedial activities would also be selected and procured.

<u>Mobilization and Site Preparation</u>

The first phase of this alternative would include mobilization of the required personnel, equipment, and facilities. Following mobilization, site preparation would occur. During the site preparation task, a small equipment decontamination area would be constructed to allow for the decontamination of equipment used on site during construction activities. Liquids generated during decontamination activities will be collected, sampled, analyzed, and disposed of at an appropriate permitted facility.

Material and waste staging areas would also be constructed during the site preparation phase to provide an area for storage of soils, materials, and miscellaneous equipment used during site activities. A "clean" access road may also be required to allow trucks hauling clean backfill and waste materials to enter and exit without requiring decontamination.

Prior to the commencement of site clearing activities, the soil and sediment and erosion controls that are required to meet applicable local, State, and Federal guidelines will be installed. These soil and sediment controls will be properly maintained during contaminated soil and sediment excavation, and will be removed once the disturbed areas have been restabilized. As required, the controls would consist of installation of silt fence, straw bale barriers, and diversion berms, as well as construction of a stabilized entrance through which vehicles will enter and exit the site. Erosion and sedimentation controls will be detailed in the site-specific Soil Erosion and Sedimentation Control Plan. Clearing and grubbing will consist of the removal of trees, shrubs, brush, and debris from the proposed excavation areas, as well as from the areas where support facilities will be located.

UXO Screening Survey

The Picatinny Safety Office has indicated that an UXO safety survey for intrusive activities will be required (Site 173 has been identified in the Picatinny GIS as sites requiring UXO avoidance). Based on the existing site use and the determination by the Picatinny Safety Office, there may be explosive ordnance disposal activities associated with this RA. A 40% mark up will be added to account for the UXO screening for certain construction activities, such as clearing and grubbing, excavation, and sampling for any site at which UXO avoidance is required. Safety distances may have to be established, implemented, and enforced during intrusive activities. The size of the safety zone "push back" would be determined by the size and type of the ordnance potentially expected at the site. "Push back" distances could potentially encompass on-post facilities, including roads and buildings, which could result in the restriction of some activities and workspace at Picatinny during implementation of this RA.

Contaminated Soil Excavation and Confirmatory Sampling

Soil would be excavated using a backhoe or excavator and loaded directly into dump trucks to be transported to a non-hazardous waste landfill. Prior to commencing excavation activities, waste characterization samples would be collected and analyzed to ensure proper disposal. Standard dust control techniques would be used during the excavation activities to mitigate the potential for release of contaminated dust. Pre-design sampling and visual observations will be used to determine the limits of the excavation.

Pre-design sampling would be conducted to determine the area of the RA. One sample would be collected from each sidewall of the planned excavation. Samples will be analyzed for all COCs identified in the AA. The excavation of contaminated soil and sediment will comply with the NJDEP Technical Requirements for Site Remediation set forth in N.J.A.C. 7:26E.

Backfill and Restoration

The excavated areas would be backfilled as soon as practicable with clean fill from an approved source. The excavated areas would be restored to the original contours. Run-off collection and retention would be considered during the design phase to comply with all location- and action-specific ARARs.

Site Cleanup and Demobilization

The final phase of the work would involve site cleanup and demobilization of all personnel, facilities, and equipment.

LUCs

The Excavation of Soil AAs and Off-Post Disposal alternative would be implemented in conjunction with LUCs (assumed to be a 30-year period for the purpose of cost analysis). Those constituents meeting unrestricted use requirements following remediation would not be required to be included in the LUCRD. Refer to Section 4.4.2.1 for the detailed description of LUCs.

4.4.3.2 Evaluation of Screening Criteria

A summary of the screening criteria evaluation with respect to each of the applicable sites is presented on **Table 4-3**.

Overall Protection of Human Health and the Environment

The Excavation and Off-Site Disposal alternative provides protection of human health and the environment through removal of contaminated soil that poses an unacceptable risk to human health or the environment or exceeds NJDEP NRSRS, from the sites. Thus, this alternative prevents further degradation of the site and eliminates the potential for exposure to contaminated soil.

Compliance with ARARs

The Excavation and Off-Site Disposal alternative complies with chemical specific ARARs (i.e. promulgated NJ Site Remediation Standards calculated for the ingestion/dermal exposure pathway, not inclusive of standards for lead or future recreational land use). In addition, this alternative would comply with all action- and location-specific ARARs.

Long-Term Effectiveness and Permanence

The Excavation and Off-Site Disposal alternative provides a permanent remedy for contaminated soil above SCLs which would be permanently removed from the site. However, potential long-term liability might exist because contaminated media would be disposed off-site untreated.

Reduction of Toxicity, Mobility, and Volume through Treatment

The Excavation and Off-Site Disposal alternative provides the greatest reduction of COC mobility. Both toxicity and volume at the site would be removed from the site. However, the toxicity and volume removed from the site would be transferred to the disposal facility rather than eliminated.

Short-Term Effectiveness

Site clearing and excavation activities would result in significant material handling and some dust generation, resulting in minimal short-term risks. The potential for exposure would be addressed through the use of suitable protective clothing and equipment, good construction practices, and standard dust suppression techniques.

Implementation

The Excavation and Off-Site Disposal alternative is readily implementable, involving standard construction techniques and equipment. Due to the reliance of this alternative on intrusive site work, the potential for UXO discovery (at Site 173) poses the greatest potential implementability concern.

Cost

Implementation costs for this alternative would be primarily attributed to activities directly associated with the removal and disposal of the contaminated material (such as site preparation, excavation, transportation, disposal, and site restoration). The costs specific to each site at which excavation has been evaluated are presented on **Table 4-2**. The application of LUCs is supplementary to each of the RAs. The costs specific to excavation and off-site disposal for each site are in addition to the baseline cost of LUCs, which is evaluated to address all of the sites considered in the evaluation of RAs.

4.4.4 Long-Term Monitoring of Sediment

The Long Term Monitoring alternative involves maintenance and enforcement of existing ICs and long-term chemical monitoring of sediment. Implementation of ICs involves the same components as discussed in Section 4.4.2.1. In addition, IC components for surface water include advisories or bans on fishing and other recreational uses of the surface water, community outreach, and education; however, such advisories and bans may not be relevant to the drainage ditches at Site PICA 208.

All environmental monitoring activities performed at the sites would be documented in a report, to be submitted for each event, including methodologies, sample results, and a discussion summarizing the findings.

4.4.4.1 Description of Alternative

Use Restrictions for GPB

Existing surface water use restrictions (e.g., fishing and swimming) are based upon the elimination or reduction of exposure pathways of human health to the contaminants in surface water at the sites. Recreational activities that surround GPB are limited; swimming is not permitted in any part of the brook, and fishing is only permitted in GPB, north of Picatinny Lake and just below the outfall of Picatinny Lake (Lyon's Pond). Although swimming is not permitted in any part of GPB, trespasser swimming could possibly occur in the more remote reaches of GPB near the Picatinny boundary. However, trespasser swimming in the vicinity of any of the subject sites is unlikely due to the shallow depth and intermittent nature of the GPB tributaries/drainage ditches in question. Additionally, public access to surface water at these sites is very limited because both sites are located within the installation boundary of Picatinny.

Long-Term Monitoring of Sediment (PICA Site 208)

Because the contaminated sediment would remain in place, chemical monitoring would be performed periodically for a 5-year period. The monitoring program may be terminated, extended, or its frequency may be reduced, as appropriate, if the results indicate a compliance or noncompliance with the exit strategy. For the purpose of this FFS, it is assumed that sampling would occur on an annual basis. Sediment samples at Site PICA 208 would be analyzed for arsenic and radium-226. The results of the chemical would be reviewed and compiled on a yearly basis. After a five-year period, the results of the monitoring would be assessed. The long-term monitoring would ensure early detection of potential contaminant migration from the site or to other media at concentrations that would be harmful to human health or the environment.

4.4.4.2 Evaluation of Screening Criteria

A summary of the screening criteria evaluation with respect to each of the applicable sites is presented on **Table 4-3**.

Overall Protection of Human Health and the Environment

The Long Term Monitoring alternative provides adequate control of exposure to the contaminated media and reduction in risk to human health. As long as Picatinny remains under military control, ICs and LUCs will be maintained. Furthermore, limitations on fishing and other recreational uses of surface water enhance the effectiveness of this alternative to protect human health.

However, long term monitoring affords no protection to ecological receptors. Long-term sediment monitoring would provide a mechanism to detect any increasing concentrations of COCs, so other mitigation measures could be implemented. Although the contamination would remain on site and undergo no treatment, monitoring would be an effective tool to evaluate the assumption that the RA to be selected at PICA Site 208 has a positive effect on sediment quality at this site. In addition, no unacceptable ecological risk has been identified at PICA Site 208.

Compliance with ARARs

There are no chemical-specific ARARs for sediment promulgated by the State of New Jersey or the Federal Government. Chemical-specific TBCs would not be met under the Long Term Monitoring as no active remediation would take place; however, TBCs would be considered in the evaluation of monitoring results at PICA Site 208. Sampling and analysis would be conducted in accordance with ARARs. Other action-specific and location-specific ARARs are not applicable since no active remediation would be implemented.

Long-Term Effectiveness and Permanence

Long Term Monitoring provides long-term effectiveness and permanence for the reduction of human health exposure to sediment at Site PICA 208 as long as the ICs remain in place, but does not provide mitigation of the potential ecological risks. Based on available data, the ecological risks appear to be limited. The monitoring program would provide a more thorough evaluation of the potential ecological risks, monitor any changes such that the risks could be properly managed, and provide useful information to evaluate the long-term effectiveness and permanence of the selected RA(s) at PICA Site 208.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not employ any treatment that would reduce the toxicity, mobility, or volume of COCs in sediment.

Short-Term Effectiveness

Implementation of this alternative does not pose any additional risks to the community, the workers, or the environment since there are no remedial activities associated with this alternative.

Implementation

The Long Term Monitoring alternative is readily implementable. The required sampling materials and laboratory services are readily available.

Cost

Implementation costs for this alternative would be primarily attributed to activities for sample collection, analysis, and reporting. The total costs for long term monitoring at Site PICA 208 are presented on **Table 4-2**. The application of ICs (baseline cost) is supplementary to each of the RAs.

4.4.5 Comparative Analysis of RAs

4.4.5.1 Site 117

There are no unacceptable risks to human health or ecological receptors at Site 117; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 117 is **Alternative 117-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.2 Site 123

There are no unacceptable risks to human health or ecological receptors at Site 123; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 123 is **Alternative 123-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.3 PICA Site 207

There are no unacceptable risks to human health or ecological receptors at Site PICA 207; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site PICA 207 is **Alternative 207-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.4 Site 145

There are no unacceptable risks to human health or ecological receptors at Site 145; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 145 is **Alternative 145-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.5 Sites 52, 95, and 96

There are no unacceptable risks to human health or ecological receptors at Sites 52, 95, and 96; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Sites 52, 95, and 96 is **Alternative 52-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.6 Site 134

There are no unacceptable risks to human health or ecological receptors at Site 134; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 134 is **Alternative 134-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.7 Site 136

There are no unacceptable risks to human health or ecological receptors at Site 136; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 136 is **Alternative 136-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.8 Site 175

There are no unacceptable risks to human health or ecological receptors at Site 175; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 175 is **Alternative 175-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.9 Site 173

There are no unacceptable risks to human health or ecological receptors at Site 173; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 173 is **Alternative 173-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.10 Site 176

There are no unacceptable risks to human health or ecological receptors at Site 176; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 176 is **Alternative 176-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.11 Site 177

There are no unacceptable risks to human health or ecological receptors at Site 177; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 177 is **Alternative 177-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.12 Site 27

There are no unacceptable risks to human health or ecological receptors at Site 27; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternative for Site 27 is **Alternative 27-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.13 Sites 119, 120, and 121

There are no unacceptable risks to human health or ecological receptors at Sites 119, 120, and 121; therefore all of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Based on the comparative analysis of RAs, the preferred remedial alternatives for Sites 119, 120, and 121 is **Alternative 119-2 (LUCs and Maintenance of Existing Engineering Controls)**.

4.4.5.14 PICA Site 208

All of the alternatives, with the exception of the No Action alternative, meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs at Site PICA 208. Excavation and off-site disposal of COCs above SCLs in soil provides better long-term effectiveness and permanence and reduction of mobility through transfer of contaminated soil to a disposal facility, while short-term effectiveness, implementability, and cost favor maintenance of existing ECs and ICs. Long-term monitoring of sediment provides marginally increased reliability for long-term effectiveness and permanence with respect to sediment contamination. However, the marginal benefit does not warrant the increased cost. Based on the comparative analysis of RAs, the preferred remedial alternatives for PICA Site 208 is **Alternative 208-2 (LUCs and Maintenance of Existing Engineering Controls)**.

Table 4-3
Comparative Analysis of Remedial Alternatives

Site ID	Remedial Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
Site 117	Alternative 117-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 117-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 117-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$55K
Site 123	Alternative123-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 123-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 123-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$59K
PICA Site 207	Alternative 207-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 207-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 207-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$57K
Site 145	Alternative 145-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 145-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$21K**
	Alternative 145-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$81K
Sites 52, 95, and 96	Alternative 52-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 52-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Low Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs (and TBCs for lead and manganese)**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity and Mobility Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 52-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs (and TBCs for lead and manganese)	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Can Be Mitigated; RAOs Achieved in Short Term	Standard Practices	$647K
Site 134	Alternative 134-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 134-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 134-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$59K
Site 136	Alternative 136-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 136-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 136-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$54K
Site 175	Alternative 175-1: No Action	Limited – Existing ECs	No ARARs or TBCs for Total BNAs	Poor; but May Be Adequate	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 175-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**No ARARs or TBCs for Total BNAs; Addresses RAOs by Preventing Potential Exposure**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 175-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	No ARARs or TBCs for Total BNAs; Meets RAOs by Removing Impacted Media	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$82K
Site 173	Alternative 173-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 173-2: LUCs and Maintenance of ECs	**Adequate for Human Health by Ensuring ECs Are Maintained (Highest PAH Concentrations in Subsurface Soil); Limited Ecological Risk Due to Minimal Habitat**	**Addresses RAOs for Potential Exposure to COCs above ARARs (and TBC for naphthalene)**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity and Mobility Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 173-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs (and TBC for naphthalene)	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Can Be Mitigated; RAOs Achieved in Short Term	Standard Practices	$437K

Site 176	Alternative 176-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 176-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 176-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$64K
Site 177	Alternative 177-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 177-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 177-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$61K
Site 27	Alternative 27-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 27-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Minimal Ecological Risk**	**Addresses RAOs for Potential Exposure to COCs above ARARs (and TBC for beryllium)**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
	Alternative 27-3: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors	Meets RAOs through Removal of COCs above ARARs (and TBC for beryllium)	Effective and Reliable	Complete Reduction at the Site; however Transferred to Disposal Facility.	Elevated Risk Easily Mitigated; RAOs Achieved in Short Term	Standard Practices	$57K
Sites 119, 120, and 121(1)	Alternative 119-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 119-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs Are Maintained. Low Ecological Risk Based on Limited Habitat Evaluation.**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; RAOs Achieved**	**Readily Implemented**	**$26K**
PICA Site 208	Alternative 208-1: No Action	Limited – Existing ECs	Does Not Address RAOs or ARARs	Poor	No Reduction	RAOs Would Not Be Achieved	Readily Implemented	$0.00
	Alternative 208-2: LUCs and Maintenance of ECs	**Effective for Human Health by Ensuring ECs and LUCs Are Maintained. Low Ecological Risk Based on Limited Habitat Evaluation**	**Addresses RAOs for Potential Exposure to COCs above ARARs**	**Risks Are Manageable with LUCs and ECs**	**No Reduction; Toxicity, Mobility, and Volume Are Minimal**	**No Additional Risk to Community; Does Not Ensure RAOs Are Achieved**	**Readily Implemented**	**$26K**
	Alternative 208-3: Long Term Chemical Monitoring of Sediment and LUCs	Effective for Human Health by Ensuring ECs Are Maintained. Low Ecological Risk Based on Limited Habitat Evaluation (Does Not Address Soil)	No Chemical-Specific ARARs for Sediment; Addresses RAOs for Potential Exposure to COCs above TBCs	Provides Greater Reliability in Managing Risks through LUCs and ECs	No Reduction; Toxicity, Mobility, and Volume Are Minimal	No Additional Risks to Community; RAOs Can Be Achieved by Incorporating Appropriate Action Levels	Readily Implemented	$64K
	Alternative 208-4: Excavation of Soil AA with Off-Site Disposal and LUCs	Greatest Protection of Human Health and Ecological Receptors (Does Not Address Sediment Other Than by Eliminating the Source in Soil)	Meets RAOs (for Soil) through Removal of COCs above ARARs	Effective and Reliable	Complete Reduction (for Soil) at the Site; however Transferred to Disposal Facility. May also Mitigate Sediment through Source Removal	Elevated Risk Easily Mitigated; RAOs (for Soil) Achieved in Short Term	Standard Practices	$107K

(1) Due to overall similarity (location, COCs, and site features) the remedial cost analysis for Sites 119, 120, and 121 have been combined.

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