Final
Revision 1

Engineering Evaluation/Cost Analysis
Landfills and Fill Areas
Landfills 1, 2, 4 and Industrial Landfill

Parcels 78(6), 79(6), 81(5), 175(5)

Fill Area North of Landfill 2
Parcel 230(7)

McClellan, Anniston, Alabama

Prepared for:

The Anniston Calhoun County Fort McClellan Development Joint Powers Authority

Prepared by:

Matrix Environmental Services, LLC
180 Headquarters Drive, Building 61
Anniston, AL 36205

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Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

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EXECUTIVE SUMMARY

The U.S. Department of the Army (Army) submitted the Draft Final Engineering Evaluation/Cost Analysis (EE/CA) Landfills and Fill Areas, Parcels 78(6), 79(6), 80(6), 175(5), 230(7), 227(7), 126(7), 229(7), 231(7), 233(7), and 82(7), Ft McClellan, Calhoun County, Alabama (IT Corporation [IT], 2002) ("Army EE/CA") in March 2002 to summarize environmental conditions at multiple landfills and fill area sites at the former Fort McClellan (FTMC or McClellan) in Calhoun County, Alabama. The Army EE/CA was performed in accordance with U.S. Environmental Protection Agency (EPA) guidance for a non-time-critical removal action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and summarizes site characterization, provides human health and ecological risk assessments in accordance with CERCLA criteria. Sites for which the Army determined that risks associated with site activities existed, remedial action objectives were determined and potential remedial action alternatives were evaluated and analyzed.

The Anniston Calhoun County Fort McClellan Development Joint Powers Authority (JPA) has accepted responsibility for environmental closure for certain sites at McClellan from the Army via an Environmental Services Cooperative Agreement (ESCA) dated September 29, 2003, and has entered into a Cleanup Agreement (CA) with the Alabama Department of Environmental Management (ADEM) dated September 30, 2003. The JPA has prepared this Final EE/CA report in partial fulfillment of obligations described in the CA. Following the Army's submittal of the Draft Final EE/CA (IT, 2002), but prior to the JPA entering into the ESCA and CA, a meeting was held on March 24 to 26, 2003, between ADEM, the Army, Army contractors, EPA, the JPA, and JPA contractors regarding additional investigation and/or remediation activities that would be required by ADEM at each of the landfills and fill areas presented in the Army's Draft Final EE/CA (Appendix B). The meeting specified additional activities required at each landfill prior to finalization of the Army's EE/CA. At that meeting, it was understood that the JPA would assume the responsibility for completing the necessary tasks from the Army. Specifically the JPA's obligation includes updating the Army EE/CA with a minimal amount of additional investigation and submitting a Final EE/CA addressing Landfills 1, 2, 4 and the Industrial Landfill, and the Fill Area North of Landfill 2. This understanding was carried through negotiations with the Army and into both the ESCA between the Army and the JPA and the CA between ADEM and the JPA.

This EE/CA provides data to support recommended actions at five landfills/fill areas located at McClellan. This EE/CA summarizes site characterization information, provides human health and ecological risk assessment, and where applicable, identifies remedial action objectives, describes

potential remedial action alternatives, contains analysis of these alternatives, and recommends a remedial action alternative.

A summary of all validated data collected by the Army is included in Appendix A and the data collected by the JPA along with a Data Quality Summary is provided in Appendix K.

The screening criteria for evaluation of all the recent and historical analytical data are documented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000a) and include: site-specific screening levels (SSSL), ecological screening values (ESV), and background values for polynuclear aromatic hydrocarbons (PAHs). The SSSLs and ESVs were developed and selected by the Army in conjunction with EPA Region IV and ADEM, as a means of evaluating human health and ecological risks during site investigations being performed at McClellan. Background metals screening values are presented in the Final Background Metals Survey Report, FTMC, Alabama (Science Applications International Corporation [SAIC], 1998). Since acceptance of these screening values by ADEM, the values are used to determine environmental impacts as follows:

- Background values: Analyte concentrations in excess of twice the background are flagged as potential impacts and are evaluated relative to SSSLs and ESVs.
- SSSLs: Analyte concentrations that exceed residential SSSLs are flagged as exceeding human health risk factors.
- ESVs: Analyte concentrations that exceed ESVs are evaluated in conjunction with the presence of sensitive receptors and ecosystems to determine potential environmental risks.

Because of the negotiations between the Army and the regulatory agencies that went into establishing this screening process, the precedent set by prior application of this process, and the overall technical quality of the process, the JPA has chosen to continue screening data in this Final EE/CA using the established protocol.

Recommendations

Based on data presented in this Final EE/CA, the Army Draft Final EE/CA, human health and ecological risk assessment results, and evaluation of the alternatives, the JPA recommends the following actions:

- **Landfill No. 1, Parcel 78(6)**: Based on the results of the field investigations performed by the Army and the JPA, the current and proposed future land use, and the results of the risk assessments completed by the Army and supplemented by the JPA for Landfill No. 1, Parcel 78(6), no remediation is required. Protection of human health and the environment will be maintained through the implementation of Land Use Controls (LUCs).

The specific LUCs at Landfill 1 shall be in the form of monuments and signs designating the landfill boundaries and an appropriate notice to deed prohibiting excavation on Landfill 1. As part of the post closure activities required under Part VI of the CA, the JPA proposes to repair the existing soil cover in areas where the integrity of the existing cover has been compromised. In addition, the JPA will provide regular cover inspections and repair as necessary to ensure that a satisfactory cover remains in place, that no debris is exposed, and the integrity of the cover is maintained for the period of required post closure monitoring. Subsurface utilities may also be present on site. Access to subsurface utilities will be restricted so that intrusive work shall be conducted under a site-specific health and safety plan to ensure worker safety. A Corrective Measures Implementation Plan (CMIP) will be prepared in accordance with the requirements of the CA which will provided the details of the LUC implementation and the post closure maintenance and monitoring activities.

- **Landfill No. 2, Parcel 79(6)**: At Landfill No. 2, Parcel 79(6) the streamlined risk assessment indicates human health risks associated with chemical constituents exists in surface soils under a residential reuse scenario, although the human health risk for the planned reuse scenario is acceptable. The ecological risk assessment indicated potential ecological risk associated with Landfill No. 2; however, the uncertainty analysis for the ecological risk assessment identified several factors that could mitigate the potential ecological risks. The residential reuse scenario has been eliminated by deed restriction, therefore there is no justification for remediation. Based on the results of the field investigations, the current and proposed future land use, and the results of the risk assessments completed for Landfill No. 2, Parcel 79(6), the recommended remedy is LUCs.

- The specific LUCs include placing a deed notice that will prevent residential reuse of the property and excavation within the landfill, and installing signs and monuments to mark the boundaries of the fill. These LUCs are selected to fulfill the requirements of Section IV B of the CA. The residential use deed restriction LUC has been completed as part of the September 30, 2003 property transfer from the Army to the JPA. The remaining LUCs will be completed by the JPA.

- **Landfill No. 4, Parcel 81(5) and the Industrial Landfill, Parcel 175(5)**: Landfill No. 4 and the Industrial Landfill present no unacceptable human health or ecological risks. The JPA proposes no further action with regard to this EE/CA. Landfill No. 4 has been closed and will continue to be monitored in accordance with Alabama solid waste regulations. The Industrial Landfill permit has transferred to the JPA. Following completion of demolition activities associated with redevelopment of McClellan, the JPA will close the Industrial Landfill in accordance with permit requirements and Alabama solid waste regulations.

- **Fill Area North of Landfill No. 2, Parcel 230(7)**: Based on the results of the field investigations, the current and proposed future land use, and the results of the risk assessments completed for Fill Area North of Landfill No. 2, Parcel 230(7), no remediation is recommended. Protection of human health and the environment will be maintained through the implementation of LUCs.

  The specific LUCs include placing a deed notice that will prevent excavation within the landfill, and installing signs and monuments to mark the boundaries of the fill. Subsurface utilities may also be present on site. Access to subsurface utilities will be restricted so that intrusive work shall be conducted under a site-specific health and safety plan to ensure worker safety. These LUCs are selected to fulfill the requirements of Section IV B of the CA and will be implemented by the JPA.

These actions are compatible with land reuse plans, and are protective of human health and the environment. The JPA also proposes several additional actions at certain fill areas aimed at eliminating the potential for contact with debris and maintaining satisfactory conditions at the landfills into the future.

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The Anniston Calhoun County Ft McClellan Development Joint Powers Authority (JPA) is submitting this Final Engineering Evaluation/ Cost Analysis (EE/CA) report in partial fulfillment of obligations described in the Cleanup Agreement (CA) between JPA and the Alabama Department of Environmental Management (ADEM) dated September 30, 2003. The JPA has assumed from the U.S. Department of the Army (Army), the responsibility for environmental closure of certain sites at the former Fort McClellan (FTMC or McClellan), Anniston, Alabama. Transfer of these parcels to the JPA was conducted pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120(h)(3)(C). CERCLA § 120(h)(3)(C) allows federal agencies to transfer property before all necessary cleanup actions have been taken. The basis for the continuing effort at these parcels is execution of an Environmental Services Cooperative Agreement (ESCA) between the Army dated September 29, 2003, and CA between the JPA and ADEM that describe the responsibilities of the JPA in completing environmental closure for certain sites at McClellan.

The Army submitted the Draft Final EE/CA Landfills and Fill Areas, Parcels 78(6), 79(6), 80(6), 175(5), 230(7), 227(7), 126(7), 229(7), 231(7), 233(7), and 82(7), Ft McClellan, Calhoun County, Alabama (IT Corporation [IT], 2002)(Army EE/CA) in March 2002 to summarize environmental conditions at multiple landfills and fill area sites at McClellan. The Army EE/CA was performed in accordance with U.S. Environmental Protection Agency (EPA) guidance for a non-time-critical removal action under the CERCLA and summarizes site characterization, provides human health and ecological risk assessments in accordance with CERCLA criteria. Sites for which the Army determined risks associated with site activities existed, remedial action objectives were determined and potential remedial action alternatives were evaluated and analyzed.

Following the Army's submittal of the Draft Final EE/CA, the Army and the JPA entered into discussions regarding the transfer of certain contaminated parcels, including some of the landfills and fill areas included in the Army's Draft Final EE/CA. A meeting was held March 24 to 26, 2003 between ADEM, the Army, Army contractors, EPA, the JPA, and JPA contractors regarding transfer of environmental cleanup responsibility at certain landfills and fill areas at McClellan. In the meeting, consensus was reached amongst the parties for additional investigation and/or remediation, as well as reporting format that would be required by ADEM for each of the landfills and fill areas. Specifically, several of the landfills and fill areas required minimal additional sampling and would be carried through to this Final

EE/CA, and several of the landfills and fill areas would require individual Remedial Investigations (RIs) (or Resource Conservation and Recovery Act Facility Investigations [RFIs]) and will be submitted as separate reports. In addition, the Army retained responsibility for certain sites that were not transferred to the JPA. These requirements are detailed in both the ESCA and the CA.

Ten landfills and fill areas, consisting of 12 parcels, all of which are located on the Main Post of McClellan, were addressed in the Army EE/CA (IT, 2002). As described above, the JPA has assumed responsibility for investigation, remediation if necessary, and regulatory closure at some of these sites. This Final EE/CA includes five of the original landfill and fill area sites from the Army Draft Final EE/CA. The status of all the landfill and fill area sites included in the Army's Draft Final EE/CA is as follows:

- Landfill No. 1, Parcel 78(6) – This Final EE/CA
- Landfill No. 2, Parcel 79(6) – This Final EE/CA
- Landfill No. 3, Parcel 80(6) – Separate RFI with the Fill Area Northwest of Reilly Airfield will be prepared by the JPA
- Landfill No. 4, Parcel 81(5) – This Final EE/CA
- Industrial Landfill, Parcel 175(5) – This Final EE/CA
- Fill Area North of Landfill No. 2, Parcel 230(7) - This Final EE/CA
- Fill Area East of Reilly Airfield, Parcel 227(7), and the Former Post Garbage Dump, Parcel 126(7) – Separate RFI to be prepared by the JPA.
- Fill Area Northwest of Reilly Airfield, Parcel 229(7) – Separate RFI with Landfill 3 to be prepared by the JPA
- Fill Area at Range 30, Parcel 231(7) – Draft Site Investigation Report submitted to ADEM March 26,2004 by the Army
- Fill Area West of Iron Mountain Road and Range 19, Parcel 233(7), - In the Bravo area; environmental responsibility not yet transferred from the Army
- Stump Dump, Parcel 82(7) – In the Charlie area; not JPA property and an Army- retained responsibility

Those sites not carried through into this Final EE/CA have been removed in their entirety from this document. Because the Army Draft Final EE/CA (IT, 2002) has received much scrutiny from ADEM and much effort has been put into development and review of that document, it provides the basis for this Final EE/CA. Therefore, much of the text, data, and background material, including both human health and ecological risk assessments presented in this EE/CA are included verbatim from the Army Draft Final EE/CA (IT, 2002). Additional data collected by JPA have been added to the data previously

collected by the Army, and the revised data set has been evaluated to be consistent with background and Site Specific Screening Levels (SSSL) presented in the Army's Draft Final EE/CA. The basis for the metals background evaluation can be found in Final Background Metals Survey Report, FTMC, Alabama (SAIC, 1998) and the SSSL development procedure along with background evaluation for polynuclear aromatic hydrocarbons (PAH) is described in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* prepared by the Army (IT, 2000a). These methodologies for evaluation of human health and ecological risk have been previously approved by ADEM, and therefore have not been modified in any way in this Final EE/CA. In every case the data collected by the JPA has been used to confirm the recommendations provided in the Army Draft Final EE/CA (IT, 2002) and no revised risk analysis has been performed. The JPA acknowledges that the credit for authoring this material, as with much of this document, remains with IT and the Army. The JPA has made no substantial changes to the Army's Draft Final EE/CA content, format or organization, other than adding a description of the work conducted by the JPA where applicable.

1.2 SITE HISTORY

McClellan is located in the foothills of the Appalachian Mountains of northeastern Alabama, near 41 the cities of Anniston and Weaver in Calhoun County (Figure 1-1). McClellan is approximately 60 miles northeast of Birmingham, 75 miles northwest of Auburn, and 95 miles west of Atlanta, Georgia.

The U.S. government purchased 18,929 acres of land near Anniston in 1917 for use as an artillery range and a training camp due to the outbreak of World War I. The site was named Camp McClellan in honor of Major General George B. McClellan, a leader of the Union Army during the Civil War. Camp McClellan was used to train troops for World War I from 1917 until the armistice. It was then designated as a demobilization center. Between 1919 and 1929, Camp McClellan served as a training area for active army units and other civilian elements. Camp McClellan was re-designated as Fort McClellan in 1929 and continued to serve as a training area.

In 1940, the government acquired an additional 22,245 acres west of Fort McClellan. This tract of land was named Pelham Range. In 1941, the Alabama Legislature leased approximately 4,488 acres to the U.S. government to provide an access corridor from the Main Post to Talladega National Forest. This corridor provides access to additional woodlands for training.

The U.S. Army operated the Chemical Defense Training Facility (CDTF) at Fort McClellan from 1951 until the school was deactivated in 1973. The school was then reactivated in 1979 and was closed at the

time of base closure in 1999 (ESE, 1998). The Chemical Corps School offered advanced training in all phases of chemical, biological, and radiological warfare to personnel from all branches of the military.

- Main Post 18,929 acres
- Pelham Range 22,245 acres
- Choccolocco Corridor (formerly leased) 4,488 acres

In 1995, the U.S. Department of Defense announced that Fort McClellan would close by October 1999.

The Base Realignment and Closure (BRAC) Commission recommended closure of the installation, except for minimum essential land and facilities for a Reserve Component Enclave and essential facilities needed to provide support for the chemical demilitarization operation at Anniston Army Depot. Subsequently, the U.S. Department of Justice (DOJ) requested a transfer of some facilities and training area to their authority for ongoing training exercises. Fort McClellan transferred the CDTF and ancillary support facilities to the DOJ in 2000 to establish the Center for Domestic Preparedness (CFDP). A portion of the former Fort McClellan was transferred to the U.S. Fish and Wildlife Service, and is now the Mountain Long Leaf National Wildlife Refuge. The remaining property was transferred to the local redevelopment authority (JPA), and is now known simply as McClellan (Figure 1-2).

As previously stated, the JPA has assumed from the Army the responsibility for environmental closure of certain environmentally-impacted sites at McClellan. The basis for the continuing investigation and remediation efforts at these parcels is the execution of an ESCA and the CA that describe the responsibilities of all parties in completing the investigation and remediation of sites at McClellan.

1.3 REMEDIAL ACTION REQUIREMENTS

Based on the results of the Army EE/CA, (IT, 2002) only one landfill included in the study (Landfill No. 3) presents unacceptable health risks. Because the CERCLA and National Contingency Plan (NCP) do not mandate actions at sites that do not pose threats to human health and the environment, No Further Action is required for those sites at which contamination was not detected at levels associated with unacceptable risks to human health or the environment. CERCLA and the NCP define remedial actions to include "the cleanup or removal of released hazardous substances from the environment, such actions as may necessarily be taken in the event of the threat of release of hazardous substances into the environment, such action as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removed material, or the taking of such other actions as

may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release." The EPA has classified remedial actions into three types, based on the circumstances surrounding the release or threat of release: emergency, time-critical, and non-time-critical. The remedial actions selected for the fill areas fall within the non-time critical type because on-site action will be taken more than six months after commencement of the planning period.

All sites have been evaluated under the CERCLA guidance during the site investigations and based on the Army's determination nine of the sites do not meet the CERCLA criteria for response [NCP 300.400(a)], which mandates action:

- When there is a release of hazardous substance into the environment, or
- When there is a release into the environment of any pollutant or contaminant that may present an imminent and substantial danger to the public health or welfare.

Based on ESCA negotiations the JPA concurred with this determination for 5 of the 9 landfills or fill areas. As explained in Section 1.1 above those 5 sites are carried forward in this document.

1.4 EE/CA REQUIREMENTS

This EE/CA is being issued in accordance with the public involvement requirements included in both the ESCA and the CA. The public was encouraged to comment on the proposed remedial activities described in the EE/CA. Pursuant to the requirements of 40 CFR 300.415 and 300.820(b)(2), a minimum 30 day public comment period is required. A public comment period was held for the EE/CA from 21 March 2002 through 19 August 2002 (150 days), and the EE/CA was presented in a public meeting on 1 April 2002. A review of the administrative record is available at the JPA Offices and the following libraries.

Anniston Calhoun County Public Library

Reference Section

Anniston, Alabama 36201

Point of Contact: Ms. Sunny Addison

Telephone: (256) 237-8501

Fax: (256) 238-0474

Hours of Operation: Monday - Friday 9:00 a.m. - 6:30 p.m.

Saturday 9:00 a.m. - 4:00 p.m.

Sunday 1:00 p.m. - 5:00 p.m.

PUBLIC INFORMATION REPOSITORIES

FOR FTMC

Houston Cole Library

9th Floor

Jacksonville State University

700 Pelham Road

Jacksonville, Alabama 36265

Point of Contact: Ms. Rita Smith (256) 782-5249

Hours of Operation: Monday - Thursday 7:30 a.m. - 11:00 p.m.

Friday 7:30 a.m. - 4:30 p.m.

Saturday 9:00 a.m. - 5:00 p.m.

Sunday 3:00 p.m. - 11:00 p.m.

1.5 OBJECTIVE

The objective of the comparison presented in this Final EE/CA is to analyze the effectiveness, implementability, and cost of various alternatives that may satisfy the remedial action objectives and to assist in the development of a Corrective Measures Implementation Plan in accordance with the CA.

1.6 EE/CA REPORT ORGANIZATION

As stated previously, this Final EE/CA is consistent with the content, format, and organization of the Army's Draft Final EE/CA. Because the Draft Final EE/CA has undergone extensive review and comment, no attempt was made to change or reorganize content of that report, except to remove those sites not carried forward into this document, and to add a description of the JPA's sampling investigation and results. This Final EE/CA Report is organized as follows:

- Chapter 1.0, Introduction. Presents a brief history of the project to date and the organization of the EE/CA.
- Chapter 2.0, Regional Characterization. Discusses the regional settings including geology, hydrogeology, wetlands, meteorology, and floodplains.
- Chapter 3.0, Streamlined Human Health and Ecological Risk Assessments. Describes human health and ecological risk protocols used to evaluate human health and ecological risk at the sites.
- Chapter 4.0, Landfill No. 1, Parcel 78(6). Discusses site-specific information including general site descriptions, human health and ecological risk assessments, and recommended actions.

- Chapter 5.0, Landfill No. 2, Parcel 79(6). Discusses site-specific information including general site descriptions, human health and ecological risk assessments, remedial action alternatives, and recommended remedial actions.
- Chapter 6.0, Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5). Discusses site-specific information, including general site descriptions, human health and ecological risk assessments, and recommended actions.
- Chapter 7.0, Fill Area North of Landfill 2, Parcel 230(7). Discusses site-specific information including general site descriptions, human health and ecological risk assessments, remedial action alternatives, and recommended remedial actions.
- Chapter 8.0, Summary and Recommendations. Provides a summary of the information presented in this report and a brief overview of the recommended actions.
- Chapter 9.0, References. Lists the references used in preparing the EE/CA report.
- Attachment 1, List of Abbreviations and Acronyms.

2.0 REGIONAL ENVIRONMENTAL SETTING

This chapter provides a description of the regional environmental setting for McClellan. The understanding of the regional environmental setting is based in part on the results of previous investigations and fill area definition activities performed by IT in support of the Army EE/CA (IT, 2002).

2.1 FILL AREAS

The fill areas evaluated in this EE/CA are shown on Figure 2-1. Landfill and fill area boundaries are based on the results of the site investigation and fill area definition work carried out by IT between 1998 and 2000. The revised boundaries may not correspond to the original Community Environmental Response Facilitation Act (CERFA) parcel area due to changes based on the geophysical, trenching, and sampling data. Although CERFA Parcel numbers are no longer relevant, the parcel number association will be maintained with each site, even though the original parcel area may have been modified.

2.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

The regional geology and hydrogeology of McClellan are discussed in the following sections.

2.2.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian. Figure 2-2 presents the geologic map of the area that includes the fill areas.

The majority of Calhoun County, including McClellan, lies within the Appalachian fold and thrust structural belt (Valley and Ridge Province) where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold and thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust faulted with major structures and faults striking in a northeast-southwest direction. Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults and repetition of lithologic units is common in

vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992), and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group comprises of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984), but in Calhoun County it is either undifferentiated or divided into the Cochran and Nichols Formations and an upper undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish-gray siltstone and mudstone. Massive to laminated, greenish-gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Szabo et al., 1988). The Cochran and Nichols formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appears to dominate the unit and consists primarily of coarse-grained, vitreous quartzite, and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone which are locally interbedded with the coarse, clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of McClellan belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east and southwest of the Main Post and consists of interlayered bluish-gray or pale yellowish-gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on Ft McClellan (Osborne and Szabo, 1984). The character of the Shady Dolomite in the McClellan vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southwest of McClellan as mapped by Warman and Causey (1962) and Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Osborne and Szabo, 1984). The Rome Formation consists of variegated, thinly interbedded grayish-red-purple mudstone, shale, siltstone, and greenish-red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome

Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962), (Osborne and Szabo, 1984) and the northern portion of McClellan (Osborne et al., 1997). The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989). Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weathers to a chert residuum (Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thickly-bedded limestone with minor dolomite. The Little Oak Limestone consists of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped together as undifferentiated at McClellan and in other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark-gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at McClellan and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone, and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites and limestones and are mapped as one, undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish-gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomitic mudstone, and glauconitic limestone (Szabo, et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark- to light-gray limestone with abundant chert nodules and greenish-gray to grayish-red phosphatic shale with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian age, which consists of thin-

bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on McClellan, to the Ordovician Athens Shale on the basis of fossil data.

The Jacksonville Thrust Fault is the most significant structural geologic feature in the vicinity of McClellan, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City Fault (Osborne and Szabo, 1984). The Ordovician sequence comprising the Eden thrust sheet is exposed at McClellan through an eroded "window" or "fenster" in the overlying thrust sheet. Rocks within the window display complex folding, with the folds being overturned and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The McClellan window is framed on the northwest by the Rome Formation; north by the Conasauga Formation, northeast, east, and southwest by the Shady Dolomite; and southeast and southwest by the Chilhowee Group (Osborne et al., 1997).

2.2.2 Regional Hydrogeology

The hydrogeology of Calhoun County has been investigated by the Geologic Survey of Alabama (Moser and DeJarnette, 1992) and the U.S. Geological Survey (USGS) in cooperation with the General Services Administration (GSA) (Warman and Causey, 1962) and ADEM (Planert and Pritchette, 1989). Groundwater in the vicinity of McClellan occurs in residuum derived from bedrock decomposition within fractured bedrock along fault zones and from the development of karst frameworks. Groundwater flow direction is generally toward major surface water features. Figures provided in the following sections indicate the general direction for groundwater flow at each of the fill areas. Areas with well-developed residuum horizons may subtly reflect the surface topography, but the groundwater flow direction also may exhibit the influence of pre-existing structural fabrics or the presence of perched water horizons on unweathered ledges or impermeable clay lenses.

Precipitation and subsequent infiltration provide recharge to the groundwater flow system in the region. The main recharge areas for the aquifers in Calhoun County are located in the valleys. The ridges generally consist of sandstone, quartzite, and slate which are resistant to weathering, relatively unaffected by faulting, and therefore, relatively impermeable. The ridges have steep slopes and thin to no soil cover, which enhances runoff to the edges of the valleys (Planert and Pritchette 1989).

The thrust fault zones typical of the county form large storage reservoirs for groundwater. Points of discharge occur as springs, effluent streams, and lakes. Coldwater Spring is one of the largest springs in the State of Alabama, with a discharge of approximately 32 million gallons per day. This spring is the main source of water for the Anniston Water Department, from which serves McClellan. The spring is located approximately 5 miles southwest of Anniston and discharges from the brecciated zone of the Jacksonville Fault (Warman and Causey, 1962).

Shallow groundwater at McClellan occurs principally in the residuum developed from Cambrian sedimentary and carbonate bedrock units of the Weisner Formation, Shady Dolomite and locally in lower Ordovician carbonates. The residuum may yield adequate groundwater for domestic and livestock needs but may go dry during prolonged dry weather. Groundwater within the residuum serves as a recharge reservoir for the underlying bedrock aquifers. Bedrock permeability is locally enhanced by fracture zones associated with thrust faults and by the development of solution (karst) features.

Two major aquifers were identified by Planert and Pritchette (1989): the Knox-Shady aquifer and the Tuscumbia-Fort Payne aquifer. The continuity of these aquifers has been disrupted by the complex geologic structure of the region, such that each major aquifer occurs repeatedly in different areas. The Knox-Shady aquifer group occurs over most of Calhoun County and is the main source of groundwater in the county. It consists of the Cambrian-and-Ordovician aged quartzite and carbonates. The Conasauga Dolomite is the most utilized unit of the Knox-Shady aquifer, with twice as many wells drilled as any other unit (Moser and DeJamette, 1992).

Regional groundwater flow in the bedrock for the McClellan vicinity was described by the USGS (Scott, et al., 1987). Groundwater elevation ranged from 800 feet above mean sea level (msl) at McClellan to about 600 feet above msl to the west on Pelham Range based on water depths in wells completed across multiple formations. Groundwater elevation contours seem to suggest that regional groundwater flow is from McClellan toward the northwest. Scott et al., (1987) concluded that the groundwater surface broadly coincides with the surface topography and that the regional aquifers are hydraulically connected. Groundwater flow on a local scale may be more complex and affected by geologic structures such as the shallow thrust faults, rock fracture systems and karst development in soluble formations.
Shallow groundwater occurs in weathered residuum derived from the bedrock and thin sediment deposits that are very similar to the decomposed rock. The shallow groundwater more closely follows the local topography.

Surface water in the form of springs, small streams, and lakes or ponds is present on the base. Regionally, some springs are important sources of water supply (SAIC, 1999). All of the surface water on the base is fed at least in part by springs. Three major creeks (Cane, Cave, and South Branch of Cane Creek) and their tributaries drain the central portion of McClellan. Surface water drainage originates in the Choccolocco Mountains on the eastern boundary of the installation and flows west to northwest, leaving the base on the west and northwest side. The creeks are fed by springs that issue from various geologic strata.

2.2.3 Wetlands

Figure 2-3 indicates the areas that are identified as wetlands and as potential habitat for the gray bat. As indicated on the map, the following landfills or fill areas associated with this document are reportedly located in or adjacent to wetlands:

- Landfill No. 2, Parcel 79(6)
- Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5)
- Fill Area North of Landfill No. 2, Parcel 230(7)

2.3 METEOROLOGY

McClellan has a temperate continental, humid climate. The annual rainfall is distributed throughout the year but tends to be heavier during the winter and spring months. The average annual precipitation totals about 53 inches. Most flood producing storms are frontal type, and occur during the winter and spring. Summer thunderstorms sometimes cause serious local floods. Snow accumulation is generally 1 inch or less. Temperature extremes are a few degrees below freezing to just over 100 degrees Fahrenheit (°F). Summer temperatures of 90°F or more occur about 70 days per year, and the average annual temperature is 63°F. Frosts are common but usually of short duration.

Winds are typically light breezes with no persistent direction. Tornadoes are rare but do occur in the area. Humidity is moderate during cooler months to high during the warmer part of the year.

2.4 FLOODPLAIN

The floodplain map (Figure 2-4) indicates the Federal Emergency Management Agency "Special Flood Hazard Areas." These are based on an area with a 1 percent annual chance of inundation by flooding for which Base flood elevations or velocities may have been determined. As shown on the figure, the following sites associated with this document may be impacted:

- Landfill No. 2, Parcel 79(6)
- Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5)
- Fill Area North of Landfill No. 2, Parcel 230(7)

Current landfill cover elevations at Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5), would preclude floodwaters from overtopping the existing landfill. The map does not reflect the current elevation of the landfill and soil cover. Current flood levels do not reflect this higher elevation at the site.

3.0 STREAMLINED HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT PROCESS

3.1 INTRODUCTION

Because of the large size, multiple parcels, and complexity of McClellan, the Army, in cooperation with EPA Region IV and ADEM, developed a streamlined human health risk assessment (SRA) using SSSLs. The SSSLs are medium- and receptor-specific, risk-based screening concentrations that are used to quickly and efficiently screen sites for potential cancer risk and noncancer hazards from residual chemicals in environmental media. The SSSLs address all significant exposure pathways and are sufficiently site-specific with regard to exposure assumptions that they are used to estimate risk with as much precision as a typical baseline risk assessment. They reflect the protocol, documentation, and assumptions specified by EPA (1989, 2001) guidance. The exposure assumptions and SSSL methodology are described in detail in the Final Installation-Wide Work Plan (IT, 1998a). The SSSLs were updated with current toxicity values and compiled in the *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000a); which also presents brief descriptions of the physical and toxicological properties of the chemicals that may be identified as contaminants at McClellan.

This chapter also presents the results of the Screening-Level Ecological Risk Assessment (SLERA) developed by the Army (Section 3.3). The SLERA was conducted to determine ecological risks posed by site-related chemicals at each fill area.

As explained in Section 1 above this document is being submitted by the JPA in partial fulfillment of requirements in the CA and the specific investigations and additional environmental data included herein have not been used to revise any of the risk assessment calculations performed by the Army. The additional data collected by the JPA and included in this document are used to confirm the conclusions reached by the Army in the Army Draft Final EE/CA (IT, 2002) and to support the recommended alternatives for each subject site. The additional data along with a comparison to previously collected data are provided in the following sections of this EE/CA. The remainder of Section 3.0 is substantially unchanged from the Army Draft Final EE/CA (IT, 2002) since ADEM has already reviewed the approach and the JPA has not made any changes in the risk assessment approach. The JPA acknowledges the credit for authoring this material, as with much of this document, remains with IT and the Army.

3.2 STREAMLINED HUMAN HEALTH RISK ASSESSMENT PROTOCOL

The SRA completed by the Army consists of the steps described in the following sections.

3.2.1 Develop a Conceptual Site Exposure Model

A conceptual site exposure model (CSEM) identifies the potentially contaminated environmental media, contaminant migration pathways, exposure media, plausible receptors, and exposure routes. A minimum of two receptor scenarios was evaluated by the Army for each site or parcel in the fill areas. One is the most highly exposed receptor consistent with the future use of the parcel as proposed in the current revision of the Fort McClellan Comprehensive Reuse Plan, Implementation Strategy (EDAW, 1997). The second is the residential scenario, which is included to provide additional information to risk managers. The residential scenario is generally considered to be the most conservative of all exposure scenarios.

3.2.2 Select Site-Related Chemicals

Generally, chemicals are excluded from an SRA if they are essential nutrients, occur at such a low detection frequency that they are considered to be artifacts of sampling or laboratory analysis, or if they are present at concentrations comparable to background. Comparison with background is limited to metals, because data are not sufficient for quantifying anthropogenic background levels of organic chemicals. The background data utilized within the Army's SRA are presented in the Final Background Metals Survey Report (SAIC, 1998).

Background screening of metals may include several steps. The first step involves comparing the maximum detected concentration (MDC) from the site data with the background screening criterion (BSC), which is defined as two times the mean of the background data set. If the metal MDC is less than, or equal to, the BSC, the chemical is not selected as a site-related chemical.

If the MDC exceeds the BSC, the MDC is compared with the 95 percent upper tolerance limit (UTL) as a more refined statistical approach to comparing site data with background data. The UTL is the upper 95 percent confidence limit of the 95th quartile. The UTLs were calculated from the background metals data set and included in the Final Background Metals Survey Report (SAIC, 1998). If a metal exceeds the BSC but does not exceed the UTL it is not selected as a site-related chemical.

Comparison of the MDC with the BSC or UTL is a simple screen that relates the highest detection from site data to a reasonable upper bound for background. This comparison, however, does not relate the

entire site data set to the entire background data set, which provides a more appropriate comparison when exposure is expected to occur randomly and uniformly over the entire site. Therefore, if the MDC from site data exceeds the UTL, it may be prudent to use the Mann-Whitney U Test to compare the site data set with the background data set.

Metals in groundwater were routinely selected by the Army as site-related chemicals and chemicals of potential concern (COPC) because the MDCs exceeded their respective BSCs and UTLs. Also, the Mann-Whitney U Test was not performed because the Army concluded that the magnitude of the discrepancy suggested that the test would not support the de-selection of these metals as site-related chemicals. Metals samples were not filtered during collection and turbidity was a major problem during sampling. High turbidity in groundwater samples is a reliable indicator of high sediment content in the sample. The Army reported that metal concentrations from samples with high turbidity were often one to two orders of magnitude higher than concentrations from samples with low turbidity (IT, 2000b). Several metals detected in samples with high turbidity (beryllium, cadmium, chromium, lead, mercury, selenium) were reportedly undetected in samples with low turbidity. Metals whose concentrations were likely to have been inflated by turbidity were not de-selected as COPCs or removed from the risk assessment, but are identified in the Army EE/CA (IT, 2002).

Site-related chemicals are carried to the next step of the SRA.

3.2.3 Select Chemicals of Potential Concern

COPCs are the site-related chemicals that may contribute significantly to risk. They are selected by comparing the MDCs of site-related chemicals to their respective SSSLs. Because the SSSLs are receptor-specific, COPCs are also receptor-specific. In other words, a chemical may be selected as a COPC for residential exposure but not for recreational site use. This occurs because the SSSL for residential exposure is lower than that for recreational site use. In order to more accurately represent potential exposure concentrations over an entire site source-term concentrations (STC) are estimated for the COPCs. STCs are conservative estimates of the concentration of the COPC averaged over the entire site. COPCs are carried to the risk characterization step of the SRA.

3.2.4 Characterize Risk

The SSSL for each COPC is compared to the STC to estimate an incremental lifetime cancer risk (ILCR) or hazard index (HI) for each COPC in each environmental medium (IT, 1998a). The ILCRs and HIs are summed by receptor across all exposure routes and chemicals to yield a total ILCR or total HI for a given

receptor exposed to a given medium. The total ILCRs and HIs for each medium are summed to yield a total ILCR and a total HI for a given receptor exposed to all media. Total ILCR estimates for a receptor below l E-6 are considered to be negligible. ILCR estimates between 1 E-6 and 1 E-4 are considered to fall within a risk management range. ILCR estimates that exceed 1 E-4 are considered to be unacceptable and trigger estimation of remedial goal options (RGO). HI estimates for a receptor above the threshold level of 1 raise concern for the occurrence of adverse noncancer effects (EPA, 1989). However, adding HI values for all chemicals may overstate the potential for adverse effects. EPA (1989) believes that the assumption of additivity is valid only for chemicals that operate by the same mechanism of toxicity; therefore, the HI values may be segregated on the basis of mechanism of toxicity.

Mechanisms of toxicity data are available for very few chemicals; therefore, a target organ is used as a surrogate, assuming that chemicals that act on the same target organ may operate by the same mechanism of toxicity.

3.2.5 Identify Chemicals of Concern

Chemicals of concern (COC) are COPCs that contribute significantly to ILCR or HI for a receptor scenario with unacceptable risk levels; i.e., a total ILCR summed across all COPCs and media greater than lE-4 or a total HI greater than 1 (after segregation by target organ).

3.2.6 Develop Remedial Goal Options

RGOs are risk-specific concentrations developed for chemicals identified as COCs (EPA, 1995). The Army adopted cancer-based SSSLs as RGOs based on an ILCR of lE-6; RGOs were also developed for cancer risks of lE-5 and lE-4. The Army also adopted noncancer-based SSSLs as RGOs based on a noncancer HI of 0.1; RGOs were also developed for HI values of 1 and 3.

3.2.7 Uncertainty Analysis

A clear explanation of the sources of uncertainty and their potential impact on the numerical results and interpretation of a risk assessment is important to the application of the risk assessment results. This enhances the credibility of the assessment and facilitates its prudent application. Uncertainty is introduced at each stage of a risk assessment, including sampling, analysis, estimating exposure-point concentrations, establishing receptor scenarios, evaluating the toxicity of the detected chemicals, and combining the acquired data to estimate ILCR and HI values. Most of the sources of uncertainty, however, are common to all risk assessments, including analytical laboratory measurement variability, the imprecision (largely unknown) of models for estimating exposures, and the unknowns of

extrapolating toxicity data from animals to humans. These sources of uncertainty are discussed briefly in *Final Installation-Wide Work Plan, Revision 1* (IT, 1998a) and in much more detail in the *Interim Final Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)* (EPA, 1989).

No attempt is made to discuss in detail all the sources of uncertainty for each of the sites that are included in this EE/CA. Instead, the uncertainty analysis discussion for each of the sites will be limited to those issues that may have a significant impact on the numerical results or their use in decision-making. Particular care will be exercised to identify sources of uncertainty that could impart a non-conservative bias to the results. Sources of uncertainty that could impart an overly conservative bias may not be discussed unless they result in unacceptable risk estimates that could trigger further action.

One source of uncertainty common to many of the fill areas is the age of the data. Some sites have data no more recent than 1994. However, the majority of the landfills have not been operated for many years, so it is very unlikely that contamination would have increased since the samples were taken. Actually, levels of organic chemicals may have decreased due to natural degradation.

A very important source of uncertainty common to many of the parcels is the occurrence of high turbidity during groundwater sampling. High turbidity has been shown to increase the apparent concentrations of many metals in groundwater from one to two orders of magnitude (IT, 2000b). Generally metals were not expected to appear in groundwater as a result of site-related activities in the various fill areas investigated herein. Support is provided by the observation that extraordinarily high levels of metals were not observed in surface water or sediment. Many metals were selected as by the Army COPCs in groundwater, probably because of the high turbidity. They were not eliminated from the quantitation, but were carried through in order to preserve the integrity, completeness, and clarity of the risk assessment. However, they are generally dismissed in the narrative as arising from sample contamination with sediment.

3.3 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

In order to determine the potential for ecological risks posed by site-related chemicals at the landfills and fill areas, the Army completed a SLERA. This SLERA consisted of a description of the habitat(s) in and around the landfills and fill areas, a discussion of the constituents detected in samples collected from environmental media at the various landfills and fill areas, a discussion of the conceptual site models, an estimation of the screening-level risk, the identification of the constituents of potential ecological concern

(COPEC), an uncertainty analysis, a discussion of the different lines of evidence, and a summary of the results and conclusions.

3.3.1 Environmental Setting

Because the landfills occur at various locations throughout McClellan, the habitats vary from site-to-site. The major habitat types that occur at the landfills and fill areas and surrounding areas are the following:

- Coniferous forest
- Mixed deciduous/coniferous forest
- Forested bottomland
- Old-field succession
- Maintained lawn
- Emergent wetland
- Freshwater stream.

The following sections describe the habitat found at each of the landfills that are the subject of this EE/CA.

3.3.2 Ecological Site Conceptual Model

The ecological site conceptual model (ESCM) is a simplified, schematic diagram of possible exposure pathways and the means by which contaminants are transported from the primary contaminant source(s) to ecological receptors. Figures D-1 through D-9 in Appendix D provide ESCM models developed by the Army for these sites. The exposure scenarios include the sources, environmental transport, partitioning of the contaminants amongst various environmental media, potential chemical/biological transformation processes, and identification of potential routes of exposure for the ecological receptors. In this section the ESCM is described in relation to constituent fate and transport properties, the ecotoxicity of the various constituents, potential ecological receptors at the fill areas, and the complete exposure pathways expected to exist at the fill areas.

3.3.2.1 Chemical Fate and Transport

The environmental fate and transport of contaminants in the various media at the fill areas will govern the potential for exposures to ecological receptors. In general, contaminants in environmental media may be available for direct exposure (e.g., plants exposed to surface soil) and they may also have the potential to migrate to other environmental media or areas of the various sites. This section discusses the

mechanisms by which contaminants can be transported and the chemical properties that determine their transport.

Fate and Transport in Soil. Contaminants in surface soil at the fill areas have the potential to be transported from their source areas to other areas within their respective fill areas and to off-site locations by a number of mechanisms including: volatilization; dust entrainment; surface runoff; and infiltration to subsurface soil/groundwater.

Several Volatile Organic Compounds (VOCs) were identified in the upper soil horizons at several of the fill areas. These volatile constituents have a high potential to volatilize to the atmosphere and be transported from their source areas via air movement. The concentrations of VOCs detected in surface soil at the fill areas are low; therefore, this transport mechanism is expected to be insignificant with respect to other transport mechanisms active at these sites. Most of the metals and Semi-Volatile Organic Compounds (SVOCs) in the surface soil at the fill areas are not expected to volatilize to any great extent. Most of the metals and SVOCs in the surface soil at the fill areas are generally closely associated with particulate matter and would be transported from their source areas by fugitive dust generation and entrainment by the wind. Subsequent dispersion by atmospheric mixing could transport particulate-associated contaminants to other parts of the fill areas and to off-site locations. The generation of fugitive dust and subsequent transport by the wind is not a potentially a significant transport mechanism because none of the subject sites include significant areas of exposed waste material.

The transport of surface soil-associated contaminants by surface runoff is another potential transport mechanism. Surface soil contaminants may be solubilized by rainwater and subsequently transported to drainage ditches, low-lying areas, and nearby surface water bodies via surface runoff. The solubility of inorganics (metals) in rainwater is largely dependent upon the pH of the rainwater. Because the rainwater in this region is most likely slightly acidic, the metal constituents in surface soil are likely to solubilize to a small degree in the rainwater and be subject to minimal transport via runoff. Most of the SVOCs are strongly associated with soil particles and would not solubilize to a large extent.

Contaminants that may be more strongly bound to particulate matter in surface soil (i.e., SVOCs and some of the metals) may be entrained in surface water runoff and transported to drainage ditches, low-lying areas, and nearby surface water bodies via sediment transport. Many of the metals and SVOCs are strongly sorbed to soil particles and could be transported from their source areas via this mechanism.

Contaminants in surface soil may be transported vertically to subsurface soils and groundwater via solubilization in rainwater and infiltration. Migration in this manner is dependent upon contaminant solubility and frequency of rainfall. Although the soil types (sand, clay, stone, and gravel) in the vicinity of some of the fill areas are expected to promote relatively rapid infiltration of rainwater, the less soluble constituents (i.e., SVOCs) found at the fill areas are not likely to migrate to any great extent vertically due to their relatively low solubilities. Additionally, some of the fill areas are located near or adjacent to wetlands and other low-lying areas where the soil is high in organic matter. These highly organic soils would inhibit the infiltration of most organic compounds, as these compounds would be strongly bound to the organic carbon in the soil. Metals in soil at the fill areas may migrate vertically due to the slightly acidic nature of the rainwater in this area and the slightly increased solubility of metals that it produces.

The transfer of contaminants in surface soil to terrestrial plants through root uptake and terrestrial animals through ingestion and other pathways are potentially significant transfer mechanisms. Many metals are readily absorbed from soil by plants, but they are not biomagnified to a great extent through the food web. There are a few exceptions to this; namely arsenic and nickel, which may bioconcentrate and/or biomagnify (ATSDR, 1989; 1995). Many of the SVOCs have the potential to bioconcentrate in lower trophic level organisms (i.e., terrestrial invertebrates), but most higher trophic level animals have the ability to metabolize these compounds rapidly, precluding the potential for bioconcentration (Eisler, 1987). Pesticides (i.e., 4,4'-dichlorodiphenyltrichloroethane [4,4’-DDT] and 4,4'-dichlorodephenyl-dichloroethene [4,4’-DDE]) are known to bioconcentrate and biomagnify in a number of different ecosystems; thus, these processes are important in considering the fate and transport of pesticides at the fill areas.

VOCs in the surface soil at the fill areas are expected to volatilize and/or photolyze relatively rapidly (half-lives of 3 hours to 5 days) when exposed to sunlight (Burrows, et al., 1989). The other surface soil contaminants (metals and SVOCs) are expected to remain in the soil relatively unchanged by physical and/or chemical processes for much longer periods of time.

Fate and Transport in Surface Water. In general, contaminants present in the various surface water bodies associated with the fill areas are the result of erosion and runoff from the fill areas. Contaminants in surface water at the fill areas may be transported from their sources to other locations at the fill areas or to off-site locations by the following mechanisms: 1) volatilization; 2) transfer to groundwater; 3) transfer to sediment; and 4) flow downstream. VOCs in surface water would be expected to rapidly volatilize from the water-air interface and be dispersed in the atmosphere. Therefore, transport of volatile constituents in surface water is not expected to occur for any significant distance.

Depending on the local hydrogeology, significant surface water/groundwater exchange could take place. As such, contaminants in surface water at the fill areas could migrate to the groundwater. The metals detected in surface waters in the vicinity of the fill areas have the potential to migrate to groundwater. Contaminant transfer to sediments represents another significant transfer mechanism, especially where contaminants are in the form of suspended solids, or are hydrophobic substances (i.e., PAHs) that can become adsorbed to organic matter in the sediments. The metals detected in surface water have the potential to associate with suspended particulate matter.

Contaminants in surface water can be transported off-site via the various surface water bodies associated with the fill areas. Transfer of contaminants in surface water to aquatic organisms is also a potentially significant transfer pathway. Most of the metals detected in surface water are not highly bioconcentratable; therefore, transfer through the food web is expected to be minimal for these compounds. However, mercury and copper, which were detected in surface waters at low concentrations, have the potential to bioconcentrate from surface water to aquatic organisms.

Fate and Transport in Sediment. Contaminant transfer between sediment and surface water potentially represents a significant transfer mechanism; especially, when contaminants are in the form of suspended solids. Sediment/surface water transfer is reversible; sediments often act as temporary repositories for contaminants and gradually release contaminants to surface waters. This is especially true in surface water systems that are acidic. Sorbed or settled contaminants can be transported with the sediment to downstream locations. The substrate of the water bodies on or near the various fill areas ranges from gravel or cobbles (Cave Creek adjacent to Landfill No. 2, Parcel 79[6]) to organic muck. The very low organic content of the gravel and cobble create a substrate with very low binding capacity; therefore, constituents released to water bodies with this type of substrate via surface runoff or other transport mechanisms would most likely remain suspended in the surface water and be transported downstream and would not be sequestered in the stream substrate near the source. Conversely, water bodies with sediments containing high organic carbon content would tend to bind many constituents and sequester them in the sediment in close proximity to the source.

Although transfer of sediment-associated contaminants to bottom-dwelling biota also represents a potentially significant transfer mechanism, it is not expected to be a major mechanism at the fill areas. Lower trophic level organisms may accumulate metals and PAHs; however, higher trophic level organisms have the ability to metabolize PAHs and therefore reduce their accumulative properties. Most of the metals detected in sediment are not bioaccumulative. Mercury and copper may bioaccumulate to

some extent due to exposures to sediment. Although 4,4'-DDT and 4,4'-DDE were detected in sediment associated with two of the fill areas, these constituents were infrequently detected. These pesticides do have the potential to bioconcentrate and biomagnify in aquatic food chains and these transfer properties may contribute significantly to their overall fate and transport.

3.3.2.2 Ecotoxicity

The ecotoxicological properties of the constituents detected in the various environmental media at the fill areas are discussed in Appendix D.

3.3.2.3 Potential Receptors

Potential ecological receptors at the fill areas fall into two general categories: terrestrial and aquatic. Within these two general categories there are several major feeding guilds that could be expected to occur at the fill areas: herbivores, invertivores, omnivores, carnivores, and piscivores. All of these feeding guilds are expected to be directly exposed to various combinations of surface soil at the fill areas and surface water and sediment in the various water bodies near the fill areas via various activities (e.g., feeding, drinking, grooming, bathing, etc.). These feeding guilds may also be exposed to site-related chemicals via food web transfers.

In addition to the various feeding guilds described above, several receptor groups may be exposed directly to contaminants in the environmental media at the different landfills. These receptor groups include the following:

- Aquatic and terrestrial plants
- Aquatic and terrestrial invertebrates
- Fish.

These receptor groups interact directly with the environmental media with which they are associated and also act as integral food sources for a number of higher trophic level organisms and feeding guilds (i.e., herbivores feeding on terrestrial plants).

Herbivorous Feeding Guild. The major route of exposure for herbivores is through ingestion of plants that may have accumulated contaminants from the soil, surface water, or sediment. The vegetation at the various fill areas ranges from old-field grasses and sedges, to mature coniferous/deciduous forests. Because terrestrial herbivores by definition are grazers and browsers, they could be exposed to chemicals that have accumulated in the vegetative tissues of plants at the fill areas. Terrestrial herbivores may also

be exposed to site-related chemicals in soil through incidental ingestion of soil while grazing, grooming, or other activities.

Dermal absorption of PAHs from soil is a potential exposure pathway for herbivores at the fill areas; however, birds and mammals are less susceptible to dermal exposures because their feathers or fur prevents skin from coming into direct contact with the soil (EPA, 1993). Dermal absorption of metals from direct contact with soil is expected to be minimal due to the low dermal permeability of these compounds. Inhalation of VOCs from surface soil, surface water, and/or sediment is a potentially viable exposure pathway; however, volatile compounds were only detected sporadically in environmental media at the various fill areas. Inhalation of constituents sorbed to soil particles and inhaled as dust is a potential exposure pathway for herbivores.

Terrestrial herbivores may also be exposed to COPECs in surface water through ingestion of water in the surface water bodies that are adjacent to the various fill areas. Typical herbivorous species that could be expected to occur at the various fill areas and are commonly used as sentinel species in ecological risk assessment include eastern cottontail (*Sylvilagus floridanus*), eastern gray squirrel (*Sciurus carolinensis*), pine vole (*Pitymys pinetorum*), whitetail deer (*Odocoileus virginianus*), and wild turkey (*Meleagris gallopavo*).

Aquatic herbivores would have a greater potential for exposure to COPECs in surface water and/or sediment as they spend a majority of their lifetime in close proximity to water bodies. Aquatic herbivores could potentially be exposed to COPECs in surface water and/or sediment via direct contact, ingestion of surface water and sediment and ingestion of aquatic vegetation that may have accumulated site-related constituents. Metals are the major COPECs in surface water that could be ingested. Aquatic herbivores, such as muskrat (*Ondatra zibethicus)*, beaver (*Castor canadensis*), and mallard (*Anas platyrhynchos*) could also be exposed to site-related constituents in surface water and/or sediment in the surface water bodies adjacent to the various fill areas.

Invertivorous Feeding Guild. Invertivores specialize in eating insects and other invertebrates. As such, they may be exposed to site-related chemicals that have accumulated in insects and other invertebrates. Invertivores may also be exposed to site-related chemicals in soil through incidental ingestion of soil while probing for insects, grooming, or other activities. Ingestion of soil while feeding is potentially a major exposure pathway for invertivores since much of their food (i.e., earthworms and other invertebrates) lives on or below the soil surface.

Dermal absorption of PAHs from soil is a potential exposure pathway for invertivores at fill areas; however, birds and mammals are less susceptible to dermal exposures because their feathers or fur prevents skin from coming into direct contact with the soil (EPA, 1993). Dermal absorption of metals from direct contact with soil is expected to be minimal due to the low dermal permeability of these compounds. Inhalation of VOCs from surface soil, surface water, and/or sediment is a potentially viable exposure pathway; however, volatile compounds were only detected sporadically in environmental media at the various fill areas. Inhalation of constituents sorbed to soil particles and inhaled as dust is a potential exposure pathway for invertivores.

Terrestrial invertivores could also be exposed to COPECs in surface water and sediment in the various surface water bodies near the fill areas by utilizing them for drinking water. Typical invertivorous species that could be expected to occur at the fill areas and are commonly used as sentinel species in ecological risk assessment include American woodcock (*Philohela minor*), carolina wren (*Thryothorus ludovicianu*s), shorttail shrew (*Blarina brevicauda* or *Blarina carolinensis*), and eastern mole (*Scalopus aquaticus*).

Because aquatic invertivores spend a majority of their life closely associated with water bodies, the potential for exposure to COPECs in surface water and sediment is high for this feeding guild. Aquatic invertivores could potentially be exposed to COPECs in surface water and/or sediment via direct contact, ingestion of surface water and sediment and ingestion of aquatic invertebrates that may have accumulated site-related constituents from surface water and/or sediment. Aquatic invertivores could include the wood duck (*Aix sponsa*) and blacknose dace (*Rhinichthys atratulus*).

Omnivorous Feeding Guild. Omnivores consume both plant and animal material in their diet, depending upon availability. Therefore, they could be exposed to chemicals that have accumulated in the vegetative tissues of plants at the fill areas and also chemicals that may have accumulated in smaller animal tissues that the omnivores prey upon. They may also be exposed to surface water through ingestion of water in the various water bodies near the fill areas. Omnivores may also be exposed to site-related chemicals in soil through incidental ingestion of soil while feeding, grooming, or other activities.

Dermal absorption of PAHs from soil is a potential exposure pathway for omnivores at the fill areas; however, birds and mammals are less susceptible to dermal exposures because their feathers or fur prevents skin from coming into direct contact with the soil (EPA, 1993). Dermal absorption of metals from direct contact with soil is expected to be minimal due to the low dermal permeability of these compounds. Inhalation of VOCs from surface soil, surface water, and/or sediment is a potentially viable

exposure pathway; however, volatile compounds were only detected sporadically in environmental media at the various fill areas. Inhalation of constituents sorbed to soil particles and inhaled as dust is a potential exposure pathway for omnivores.

Terrestrial omnivores could be exposed to COPECs in surface water and sediment in the various surface water bodies near the fill areas by utilizing them for drinking water. Typical omnivorous species expected to occur at the fill areas and are commonly used as sentinel species in ecological risk assessment include red fox (*Vulpes vulpes*), white-footed mouse (*Peromyscus leucopus*), and American robin (*Turdus migratorius*).

Aquatic omnivores have a greater potential for exposure to COPECs in surface water and sediment because they spend a majority of their lifetime closely associated with water bodies. Aquatic omnivores could potentially be exposed to COPECs in surface water and/or sediment via direct contact, ingestion of surface water and sediment, ingestion of aquatic invertebrates, and ingestion of aquatic plants that may have accumulated site-related constituents from surface water and/or sediment. Aquatic omnivores, such as raccoon (*Procyon lotor*) and creek chub (*Semotilus atromaculatus*) could be exposed to COPECs in surface water and sediment in the various surface water bodies in the vicinity of the fill areas.

Carnivorous Feeding Guild. Carnivores are meat-eating animals and are; therefore, exposed to site-related chemicals through consumption of prey animals that may have accumulated contaminants in. their tissues. Carnivores are quite often top predators in a local food web and are often subject to exposure to contaminants that have biomagnified through the food web. Food web exposures for carnivores are based on the consumption of prey animals that have accumulated COPECs from various means. Smaller, herbivores, omnivores, invertivores, and other carnivores may consume soil, surface water, sediment, plant, and animal material as food and accumulate COPECs in their tissues. Subsequent ingestion of these prey animals by carnivorous animals would expose them to COPECs. Most metals are not accumulated in animal tissues to any great extent (Shugart, 1991; USAEHA, 1994). Therefore, food web exposures to these chemicals are expected to be minimal. PAHs have the potential to accumulate in lower trophic level organisms but not in higher trophic level organisms because they have mechanisms for metabolizing and excreting this class of compounds.

Carnivores may also be exposed to site-related chemicals in soil through incidental ingestion of soil while feeding, grooming, or other activities. These species may occupy the woodlands that surround the fill areas and the open old-field areas of some of the fill areas themselves.

Dermal absorption of PAHs from soil is a potential exposure pathway for carnivores at the fill areas; however, birds and mammals are less susceptible to dermal exposures because their feathers or fur prevents skin from coming into direct contact with the soil (EPA, 1993). Dermal absorption of metals from direct contact with soil is expected to be minimal due to the low dermal permeability of these compounds. Inhalation of VOCs from surface soil, surface water, and/or sediment is a potentially viable exposure pathway; however, volatile compounds were only detected sporadically in environmental media at the various fill areas. Inhalation of constituents sorbed to soil particles and inhaled as dust is a potential exposure pathway for carnivores.

Terrestrial carnivores could be exposed to COPECs in surface water in the various surface water bodies near the fill areas by utilizing them for drinking water. Metals and PAHs are the major COPECs in surface water and sediment that could be ingested. Typical carnivorous species expected to occur at the fill areas and are commonly used as sentinel species in ecological risk assessment include red-tailed hawk (*Buteo jamaicensis*), black vulture (*Coragyps atratus*), and bobcat (*Lynx rufus*).

Aquatic carnivores have a greater potential for exposure to COPECs in surface water and sediment because they spend the majority of their lifetime closely associated with water bodies. Aquatic carnivores could potentially be exposed to COPECs in surface water and sediment via direct contact, ingestion of surface water and sediment, and ingestion of prey animals that may have accumulated COPECs. Because the water bodies in the vicinity of the fill areas are generally small and shallow, they do not have the capability to support large aquatic carnivores. Carnivorous fish such as largemouth bass (*Micropterus salmoides*) and spotted gar (*Lepisosteus oculatus*) would not be expected to occur in the water bodies in the vicinity of the fill areas due to the habitat restrictions. Additionally, carnivorous mammals such as the mink (*Mustela vison*), which depends on larger fish to eat, would not be expected to occur in the vicinity of the fill areas, except possibly the Former Post Garbage Dump, Parcel 126(7); Fill Area East of Reilly Airfield, Parcel 227(7); and the Fill Area Northwest of Reilly Airfield, Parcel 229(7). The surface water bodies adjacent to these areas may be large enough to support aquatic carnivores.

Piscivorous Feeding Guild. Piscivores are specialists that feed mostly on fish. Therefore, they may be exposed to site-related chemicals that have accumulated in small fish that may inhabit the various water bodies in the vicinity of the fill areas. They may also be exposed to surface water and sediment in these water bodies through ingestion of drinking water and during feeding.

Dermal absorption of COPECs from surface water and sediment are a potential exposure pathway for piscivores at the fill areas. Absorption of metals from direct contact with sediment is expected to be

minimal due to the low dermal permeability of these compounds. Inhalation of volatiles from surface water and sediment is expected to be insignificant due to the fact that volatile compounds were detected infrequently in surface water and sediment. Also, it is expected that if volatile compounds were present in surface water, they would volatilize rapidly and disperse in the atmosphere.

Food web exposures for piscivores are based on the consumption of fish that have accumulated COPECs from surface water and sediment. Forage fish may consume surface water, sediment, benthic invertebrates, aquatic plants, and planktonic material as food and accumulate COPECs in their tissues. Subsequent ingestion of these forage fish by piscivorous animals would expose them to COPECs. However, most PAHs and metals are not accumulated in fish tissues to any great extent. Therefore, food web exposures to these chemicals are expected to be minimal.

SVOCs are readily metabolized by most fish species and are not accumulated to any extent. Mercury in surface water and/or sediment may accumulate in fish tissues and biomagnify through the aquatic food chains; therefore, food web exposure to mercury is potentially a significant exposure pathway for piscivorous animals at the fill areas.

Typical piscivorous species expected to occur near the fill areas and are commonly used as sentinel species in ecological risk assessment include great blue heron (Ardea herodias) and belted kingfisher (Ceryle alcyon). Larger, piscivorous fish species (e.g., smallmouth bass, spotted gar, etc.) and piscivorous mammals (e.g., mink) are not expected to occur in most of the creeks near the fill areas due to small size and ephemeral nature of these creeks. However, the creeks and ponds in the vicinity of the Former Post Garbage Dump, Parcel 126(7), Fill Area East of Reilly Airfield, Parcel 227(7), and the Fill Area Northwest of Reilly Airfield, Parcel 229(7) may support these larger piscivorous fish and mammal species.

3.3.2.4 Complete Exposure Pathways

For exposures to occur, complete exposure pathways must exist between the contaminant and the receptor. A complete exposure pathway requires the following four components:

- A source mechanism for contaminant release
- A transport mechanism
- A point of environmental contact
- A route of uptake at the exposure point (EPA, 1989).

If any of these four components are absent, then a pathway is generally considered incomplete. Potentially complete exposure pathways for each of the fill areas addressed in this EE/CA are depicted in the SCMs for each fill area as Figures D-1 through D-9 in Appendix D.

Ecological receptors may be exposed to constituents in soils via direct and/or secondary exposure pathways. Direct exposure pathways include soil ingestion, dermal absorption, and inhalation of COPECs adsorbed to fugitive dust. Significant exposure via dermal contact is limited to organic constituents, which are lipophilic and can penetrate epidermal barriers. Mammals are less susceptible to exposure via dermal contact with soils because their fur prevents skin from coming into direct contact with soil. However, soil ingestion may occur while grooming, preening, burrowing, or consuming plants, insects, or invertebrates resident in soil.

Ecological receptors may be exposed to constituents in surface water via direct contact or through consumption of water. Aquatic organisms inhabiting contaminated waters would be in constant contact with COPECs.

Exposure via inhalation of fugitive dust is limited to contaminants present in surface soils at areas that are devoid of vegetation. The inherent moisture content of the soil and the frequency of soil disturbance also play important roles in the amount of fugitive dust generated at a particular site.

Chemicals present in the sediment may result from erosion or adsorption of water-borne constituents onto sediment particles. If sediments are present in an area that is periodically inundated with water, then previous exposure pathways for soils would be applicable during dry periods. Water overlying sediments prevents contaminants from either volatilizing or being carried by wind erosion. Exposure via dermal contact may occur, especially for benthic organisms and wading birds. Some aquatic organisms consume sediment and ingest organic material from the sediment. Inadvertent ingestion of sediments may also occur as the result of feeding on benthic organisms and plants.

While constituents in soils may leach into groundwater, environmental receptors generally will not come into direct contact with constituents in groundwater since there is no direct exposure route.

Secondary exposure pathways involve constituents that are transferred through different trophic levels of the food chain and may be bioaccumulated. This may include constituents bioaccumulated from soil into plant tissues or into terrestrial species ingesting soils. These plants or animals may, in turn, be consumed by animals at higher trophic levels. Water-borne and sediment-borne COPECs may bioaccumulate into

aquatic organisms, aquatic plants, or animals which frequent surface waters and then be passed through the food chain to impact organisms at higher trophic levels.

Summaries of the potentially complete exposure pathways for the terrestrial and aquatic ecosystems at the fill areas are presented in Tables D-1 and D-2, respectively, in Appendix D.

3.3.3 Screening-Level Risk Estimation

A screening-level estimation of potential risk can be accomplished by comparing the exposure point concentration of each detected constituent in each environmental medium to a corresponding screening-level ecological toxicity value. In order to conduct the SLERA, the following steps must be followed:

- Determine appropriate screening assessment endpoints
- Determine the ecological toxicity values that are protective of the selected assessment endpoints
- Determine the exposure point concentrations of constituents detected at the site
- Calculate screening-level hazard quotients.

These steps are summarized below.

3.3.3.1 Ecological Screening Assessment Endpoints

Most ecological risk assessments focus on population measures as endpoints since population responses are better defined and predictable than are community or ecosystem responses. For SLERAs, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments.

Adverse effects on populations can be inferred from measures related to impaired reproduction, growth, and survival. Adverse effects on communities can be inferred from changes in community structure or function. Adverse effects on habitats can be inferred from changes in composition and characteristics that reduce ability of the habitat to support plant and animal populations and communities.

Because of the nature of the SLERA process, most of the screening assessment endpoints are generic in nature (i.e., protection of sediment benthic communities from adverse changes in structure or function).

The assessment endpoints identified for this SLERA were identified for each environmental medium and are summarized below:

Soil

- Protection of the terrestrial invertebrate community from adverse changes in structure and function.
- Protection of the terrestrial plant community from adverse changes in structure and function.

Surface Water

- Protection of the aquatic community from adverse changes in structure and function.

Sediment

- Protection of the benthic community from adverse changes in structure and function.

3.3.3.2 Ecological Screening Values

The ESVs used in this assessment represent the most conservative values available from various literature sources and have been selected to be protective of the assessment endpoints described above. These ESVs were selected specifically for in conjunction with EPA Region IV and are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000a). The ESVs used in this assessment are based on no-observed-adverse-effects-levels (NOAEL) when available. If a NOAEL-based ESV was not available for a certain COPEC, then the most health-protective value available from the scientific literature was used in this assessment.

For each environmental medium sampled at the fill areas (soil, surface water, and sediment), a hierarchy has been developed which presents an orderly method for selection of ESVs. The hierarchy for selecting ESVs for soil is as follows:

- EPA Region IV constituent-specific ESVs
- EPA Region IV ESVs for general class of constituents
- EPA Region V ecological data quality levels (EDQL)
- EPA Region III Biological Technical Assistance Group (BTAG) values
- ESVs from Talmage, et al., 1999.

The hierarchy for selecting ESVs for surface water is as follows:

- EPA Region IV constituent-specific ESVs
- National Oceanographic & Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQRT), chronic freshwater ambient water quality criteria

- EPA Region V EDQLs
- Office of Solid Waste and Emergency Response (OSWER) Ecotox Threshold values
- EPA Region III BTAG values
- Lowest chronic value from Suter and Tsao, 1996
- ESVs from Talmage, et al., 1999.

The hierarchy for selecting ESVs for sediment is as follows:

- EPA Region IV constituent-specific ESVs
- NOAA SQRTs, freshwater sediment threshold effects level (TEL)
- EPA Region V EDQLs
- OSWER ecotox threshold values
- EPA Region III BTAG values
- Lowest effect levels from Ontario Ministry of the Environment (1992) presented in Jones, et al., (1997)
- ESVs from Talmage, et al., 1999
- Sediment quality adverse effect threshold (AET) values from the Puget Sound Estuary Program.

3.3.3.3 Determination of Exposure Point Concentrations

Exposure point concentrations represent the chemical concentrations in environmental media that a receptor may contact. Because the exposure point concentration is a value that represents the most likely concentration to which receptors could be exposed, a value that reflects the central tendency of the data set is most appropriate to use. However, at the screening-level stage, the data sets are generally not robust enough for statistical analysis and the level of conservatism in the exposure estimates is high to account for uncertainties. Therefore, in the screening-level stage, the maximum detected constituent concentration in each environmental medium is used as the exposure point concentration. The use of the maximum detected constituent concentration as the exposure point concentration ensures that the exposures will not be under-estimated, and therefore, constituents will not be inadvertently eliminated from further assessment.

The statistical summaries (including the exposure point concentrations) for surface soil, surface water, and sediment at the various fill areas are presented in Tables D-3 through D-27 (Appendix D).

3.3.3.4 Screening-Level Hazard Quotients

In order to estimate whether constituents detected in environmental media at the site have the potential to pose adverse ecological risks, screening-level hazard quotients were developed. The screening-level hazard quotients were developed via a three-step process as follows:

- Comparison to naturally-occurring background concentrations
- Identification of essential macro-nutrients
- Comparison to ESVs.

A study of the natural geochemical composition associated with McClellan (SAIC, 1998) determined the mean concentrations of 24 metals in surface soil, surface water, and sediment samples collected from presumably unimpacted areas. Per agreement with EPA Region IV, the background threshold value (BTV) for each metal was calculated as two times the mean background concentration for that metal. The BTV for each metal was used to represent the upper boundary of the range of natural background concentrations expected at McClellan, and was used as the basis for evaluating metal concentrations measured in site samples.

In order to determine whether metals detected in site samples were the result of site-related activities or were indicative of naturally occurring conditions, the maximum metal concentrations measured in site samples were compared to their corresponding BTVs. Site sample metal concentrations less than or equal to the corresponding BTV represent the natural geochemical composition of media at McClellan, and not contamination associated with site activity. Site sample metal concentrations greater than the corresponding BTV represent contaminants that may be the result of site-related activities and require further assessment.

The EPA recognizes several constituents in abiotic media that are necessary to maintain normal function in many organisms. These essential macronutrients are iron, magnesium, calcium, potassium, and sodium. Most organisms have mechanisms designed to regulate nutrient fluxes within their systems; therefore, these nutrients are generally only toxic at very high concentrations. Essential macronutrients were only considered COPECs if they were present in site samples at concentrations ten times the naturally occurring background concentration.

Chemicals that exceeded their naturally occurring background concentrations and were not essential macronutrients were evaluated against the ESVs by calculating a screening-level hazard quotient (HQScreen) for each constituent in each environmental medium. A hazard quotient was calculated by

dividing the maximum detected constituent concentration in each environmental medium by its corresponding ESV as follows:

$$HQSCREEN = MDCC/ESV$$

where:

HQSCREEN	=	screening-level hazard quotient;
MDCC	=	maximum detected constituent concentration; and
ESV	=	ecological screening value.

A calculated HQScreen value of one indicated that the MDCC was equal to the chemical's conservative ESV and was interpreted in this assessment as a constituent that does not pose the potential for adverse ecological risk. An HQScreen value less than one indicated that the MDCC was less than the conservative ESV, and that the chemical is not likely to pose adverse ecological hazards to most receptors. Conversely, an HQScreen value greater than one indicated that the MDCC was greater than the ESV and that the chemical might pose adverse ecological hazards to one or more receptors.

In order to better understand the potential risks posed by chemical constituents at the fill areas, a mean hazard quotient was also calculated by comparing the arithmetic mean constituent concentration in each environmental medium to the corresponding ESV. The calculated screening-level hazard quotients for surface soil, surface water, and sediment at the fill areas are presented in Tables D-3 through D-27 (Appendix D).

3.3.4 Identification of Chemicals of Potential Ecological Concern

Chemicals were identified as COPECs if the following conditions were met:

- The maximum detected constituent concentration exceeded the BTV for metals
- The maximum detected constituent concentration was 10-times BTV if constituent is a macronutrient
- The maximum detected constituent concentration exceeded the ESV.

If a constituent in a given environmental medium did not meet these conditions, then it was not considered a COPEC at the given fill area and was not considered for further assessment. If a constituent met these conditions, then it was considered a COPEC. Identification of a constituent as a COPEC indicates that further assessment of that particular constituent in a given environmental medium at a given fill area is appropriate. It does not imply that a particular constituent poses risk to ecological receptors.

The COPECs that have been identified for surface soil, surface water, and sediment at the Iron Mountain Road ranges are presented in Tables D-3 through D-27 and summarized in Table D-28 and D-29 (Appendix D).

3.3.5 Uncertainty Analysis

Uncertainties are inherent in any risk assessment, and even more so in a SLERA due to the nature of the assessment process and the assumptions used in the process. A number of the major areas of uncertainty in this assessment are presented below.

A significant level of uncertainty is introduced into this assessment due to the sampling and analysis program conducted at the fill areas. The sampling and analysis program was designed to determine the presence or absence of contamination resulting from historical fill activities at these sites. The sampling and analysis program was not designed to determine the nature and extent of contamination at each of the fill areas. As such, the number of samples at each of the fill areas is relatively small.

An area of uncertainty that is inherent in a SLERA is the use of the maximum detected constituent concentration as the exposure point concentration for all receptors in a given medium. Most receptors have a home range large enough that precludes individuals from being exposed to the maximum constituent concentration for their entire lifetimes. Therefore, the actual exposure point concentration of a given constituent for most receptor species would be less than the MDC. The use of the maximum detected constituent concentrations as the exposure point concentrations for all receptors results in an overestimation of exposure for many receptors.

Additionally, there is no consideration given to the bioavailability of COPECs to different organisms. In this SLERA it is assumed that all constituents are 100 percent bioavailable to all receptor organisms. It is known that many constituents (particularly metals) have significantly lower bioavailabilities (i.e., 1 to 10 percent for some metals in soil) than the 100 percent that was assumed in this assessment. This assumption has the potential to greatly overestimate exposures to certain COPECs.

Several COPECs do not have ESVs. The lack of toxicity data for certain COPECs makes it impossible to determine the potential for ecological risk posed by those constituents. Risks may be underestimated due to this uncertainty.

The ESVs used in this assessment are all the most conservative values from the scientific literature and many are based on the most sensitive endpoint (NOAEL values) for the most sensitive species tested. A

less sensitive endpoint that is still protective of the ecological populations or communities of interest may be the lowest-observed-adverse-effect-level (LOAEL) or some other endpoint. The use of NOAEL-based ESVs may over-estimate potential for risks from certain COPECs. Additionally, certain ESVs may not be applicable to conditions at the fill areas. For instance, a number of the sediment ESVs are referenced from MacDonald (1994) which presents sediment benchmark values for coastal waters (saline) in Florida. The surface water bodies at the fill areas are fresh water and exhibit significantly different physical and chemical characteristics compared to those found in the coastal waters of Florida. Therefore, the use of sediment ESVs developed for the coastal water of Florida to determine risks in the freshwater streams of McClellan introduces a significant level of uncertainty. Similarly, the surface water and soil ESVs do not take into account site-specific conditions at the fill areas and thus, introduce a potentially significant level of uncertainty into the assessment.

Another area of uncertainty is the lack of consideration of synergism and/or antagonisms between COPECs. Although it is widely accepted that synergism and antagonisms occur between certain constituents under certain conditions, current science does not provide methods for assessing these potential synergism/antagonisms.

Although the SLERA process stipulates the use of maximum detected constituent concentrations and the most conservative ESVs for estimating HQscreen values, it is sometimes useful to incorporate additional lines-of-evidence when making risk management decisions at the screening-level stage. For this reason, an assessment of the COPECs was conducted using several additional lines-of-evidence including:

- Magnitude of the HQScreen
- Frequency of detection
- Habitat quality
- Constituent bioaccumulation potential.

These additional lines-of-evidence were used to focus risk management decisions on the COPECs that have the greatest potential to pose adverse ecological impacts. Generally speaking, the COPECs that were screened-out using these additional lines-of-evidence were those COPECs whose HQScreen was calculated to be less than ten, were infrequently detected in environmental media at a given fill area, were detected within ecological habitats that were degraded or did not provide unique or sensitive wildlife habitat, or do not bioaccumulate significantly in most ecological receptors.

The magnitude of an HQ can provide information regarding the potential for adverse effects to sensitive organisms. For instance, an HQ of 100 or 1,000 indicates a greater potential for adverse ecological effects than an HQ of 2 or 3. Because the ESVs are based on the most sensitive endpoints and the most sensitive organisms tested and not necessarily the organisms present at a given site at McClellan, the ESVs used in this assessment are very conservative. When available, ESVs are based on NOAELs. A less conservative toxicity value, the LOAEL, is the lowest concentration at which adverse ecological effects are observed. In general, if test data are not available to determine a LOAEL, then it can be estimated by applying a conversion factor of 10 to the NOAEL (Sample et al., 1996). Thus a NOAEL of 3 milligrams per kilogram (mg/kg) for a given chemical in soil can be converted to a LOAEL by multiplying the NOAEL by 10 to get a LOAEL of 30 mg/kg.

Another important factor in comparing constituent concentrations to ESVs is the fact that ESVs are designed to be protective of sensitive individual organisms. A less conservative, yet still protective approach is a comparison of constituent concentrations to ESVs protective of populations and/or communities. Because community or population-level ESVs are generally not available in the scientific literature, they are often estimated by applying a conversion factor of 10 to the NOAEL (Sample et al., 1996). Thus, a NOAEL based on effects to sensitive individual organisms can be converted to a population- or community-level NOAEL by multiplying the individual NOAEL by 10. Using the previous example, an ESV of 3 mg/kg can be converted to a LOAEL-based population-level ESV by applying a conversion factor of 10 to convert from a NOAEL to a LOAEL and a conversion factor of 10 to convert from an individual-based NOAEL to a population-based NOAEL.

Based on the example presented above, the ESVs used in this assessment may be over 100 times more protective than LOAEL-based population-level ESVs. Therefore, in this assessment using the additional lines-of-evidence, a conservative HQ value of 10 (greater than 1, but less than 100) was used as the cut-off for identifying constituents with the potential to pose adverse risks to ecological populations at the fill areas. Constituents whose MDCs resulted in an HQ of 10 or less were considered to pose insignificant risks to ecological populations at the fill areas, unless other lines of evidence indicated the potential for ecological risk.

Another line of evidence used in the additional lines-of-evidence assessment was the frequency of detection. If a constituent was infrequently detected in a given medium, it was not considered to be a wide-spread contaminant and was considered to pose insignificant risk to ecological populations and/or communities at the fill areas, unless other lines of evidence indicated the potential for ecological risk.

The presence or absence of unique or sensitive habitat at a particular site was used as a line-of-evidence for identifying constituents that have the potential to pose significant ecological risk. Wetlands and stream corridors were generally defined as sensitive habitat types at the fill areas. Additionally, the presence of mountain longleaf pine, white fringeless orchid, or gray bat habitat was considered a unique habitat. Constituents detected in these habitat types with maximum 9 concentrations exceeding their respective ESVs were considered COPECs, regardless of the magnitude of the ESV exceedance or frequency of detection. This approach is very conservative and is designed to be protective of the most sensitive individual organisms in these unique or sensitive habitats. Constituents detected at concentrations that exceeded their respective ESVs in habitat types not considered sensitive or unique were considered COPECs depending on a number of other lines-of-evidence.

The potential for bioaccumulation was also used as a line-of-evidence for selecting COPECs. If a constituent had a high potential for bioaccumulation (e.g., log Ko, value greater than 4.0), then it was considered a potential COPEC depending on a number of other lines-of-evidence.

3.3.6 Summary and Conclusions

The potential for ecological risks at the fill areas was determined through a SLERA. This ecological screening process consisted of the characterization of the ecological setting at the various fill areas, the development of a SCM for each fill area, a description of the fate and transport of constituents detected in various environmental media, a description of the ecotoxicity of the various constituents detected at the fill areas, a description of the ecological receptors, a description of the complete exposure pathways, the calculation of screening-level hazard quotients, and a description of the uncertainties within the process.

4.0 LANDFILL NO. 1, PARCEL 78(6)

4.1 SITE LOCATION

Landfill No. 1, Parcel 78(6), is located in the western portion of the Main Post, southeast of the former officer's housing area on Avery Drive (Figure 2-1). The site occupies the hillside between Avery Drive and 16th Avenue on Wygant Hill. The officers' housing area partially overlaps the northwestern boundary of the landfill. Figure 4-1 provides a detail map for Landfill No. 1 with surrounding features, boring, trenching, and sample locations.

4.1.1 Facility Type and Operational Status

Landfill No. 1, Parcel 78(6), is a former post sanitary landfill that operated from 1945 to 1947. Clearing for the landfill is documented on 1944 aerial photographs. Historical information regarding the content and operation of the landfill is limited; however, field work performed in support of the Army EE/CA allowed characterization of some of the fill material and former waste disposal practices at the site.

4.1.2 Investigations

Previous environmental work conducted at Landfill No. 1, Parcel 78(6), includes the following:

- Enhanced Preliminary Assessment (PA) (Roy F. Weston [Weston], 1990)
- Site Investigation (SAIC, 1993)
- RI (SAIC, 1995)
- RI Baseline Risk Assessment (SAIC, 2000)
- Site Investigation and Fill Area Definition Report (IT, 2001 a).
- Landfill and Fill Area EE/CA (IT, 2002)

4.1.2.1 Previous Investigations

Landfill No. I was identified in the preliminary site assessment as an area requiring environmental evaluation (AREE) (Weston, 1990). A geophysical survey conducted in 1992 over approximately 2 acres of the site found geophysical anomalies that were attributable to surface debris, and not to large-scale land filling (SAIC, 1993).

The estimated boundaries of the landfill were revised in 1993 based on a review of historical aerial photographs (SAIC, 1993). Geophysical surveys were conducted using electromagnetic (EM) and

magnetometer methods in an attempt to delineate the boundary of the landfill (SAIC, 1993). . An approximate landfill boundary for Landfill No. 1 was established based on the results of this survey. This boundary corresponded to the original CERFA Parcel 78(6) boundary.

SAIC collected groundwater samples from four monitoring wells (LF1-G01, LF1-G02, LF1-G03, and LF1-G04) at Landfill No. 1 in June and July 1994 and in January and February 1995. Additionally, one monitoring well (LF1-G01) was sampled in October 1997. The results of these sampling events are documented in previous reports (SAIC, 1995 and 1999).

IT sampled three monitoring wells (LF1-G01, LF1-G02, and LF1-G03) in February 1998. LF1-G04 was omitted from the sampling event conducted in 1998 because it reportedly contained a broken well screen. The results are summarized in the *Long-Term Monitoring Report – First Quarterly Report for Landfills 1, 2, and 3* (IT, 1999). Groundwater samples were analyzed for VOCs, SVOCs, pesticides and polychlorinated biphenyls (PCBs), metals, and nitroaromatic and nitramine explosives (explosives). Metals, VOCs, and SVOCs were detected above reporting limits. The VOCs and SVOCs that were detected above reporting limits were determined to be the result of sample collection techniques and laboratory methodology, and not the result of source contamination. The levels of metals were within the range of background concentrations for unfiltered groundwater at McClellan, with the exception of barium. Analytical data for Landfill No. 1 is presented in Appendix A.

4.1.2.2 EE/CA Fill Area Definition

IT conducted field activities from January through August 2000 for the delineation of the fill area at Landfill No. 1. These activities included a geophysical site survey, exploratory trenches, soil borings, and a visual site walk.

A total of 4,200 linear feet of geophysical survey was conducted at the landfill (Figure 4-2). Eleven exploratory trenches were excavated to determine the fill area boundary and to characterize the fill material. Two additional exploratory trenches were excavated to determine the cause of isolated anomalies identified during the geophysical survey conducted by SAIC in 1992. Three soil borings were drilled to determine the vertical extent of the fill material and collect samples for laboratory analysis. IT also conducted a site walk to search for leachate seeps along the toe of the landfill; however, none were observed.

Trenches were excavated to depths ranging from 4 to 10 feet below ground surface (bgs). Trench logs do not indicate the presence of groundwater in any of the trenches. The amount of soil cover found over the

waste during trenching operations ranged from 0 feet, 0.5 feet, and 1 foot (T78-4, T78-5, and T78-9, respectively) to a maximum of 8 feet (T78-8a). The remaining trenches had a minimum of 2 feet of cover over waste. Cover material generally consisted of clay with minor amounts of sand. Waste encountered in the trenches ranged in depth from two to seven feet in thickness. Native material (clays and shales) underlying the trenches occurred at most locations at a maximum of 10 feet bgs. Native material was not reached in several of the trenches excavated.

During the IT trenching operations at trench number "T78-1" in Landfill No. 1, the onsite geologist identified what was thought to be a grenade within the trench excavation. The field crew notified the IT site manager and requested unexploded ordnance (UXO) support at the trench site to examine the item. Before the UXO technician was able to fully examine the item, the walls of the trench collapsed, burying the observed item and preventing positive identification. The item is currently buried approximately 8 feet bgs. Additional fill material associated with trench T78-1 included glass bottles, broken plates, scrap metal, and pieces of coal.

Trenches T78-5 and T78-10 contained medical debris as well as typical waste encountered in the other trenches including glass bottles and jars, metal food containers, and jar lids. Medical items at trench T78-5 included three glass medical bottles with rubber septa. Trench T78-5 encountered gray green shale bedrock at 7 feet bgs. This was the only trench location where bedrock was encountered during trenching at Landfill No. 1. Medical items associated at T78-10 consisted of a glass syringe (no needle) and three medical bottles.

Fill material associated with trenches T78-2, T78-3, T78-4, T78-6, T78-7, and T78-8 included glass bottles, coal, scrap metal, metal food containers, wood pieces, broken plates, melted glass, black to gray ash, newspaper, leather boots, brick, and pieces of steel cable. Trench T78-9 fill material included the previously mentioned fill materials, as well as a piece of sheet metal identified as the cause of the geophysical anomaly detected at this trench location. Trench T78-10 fill material included the previously mentioned fill materials, as well as coiled steel wire, and miscellaneous scrap metal pieces identified as the cause of the geophysical anomaly detected at this trench location. Trenches T78-1 1, T78-12, and T78-13 fill material mainly consisted of ash, wood, glass, and some metal pieces at depths ranging from 3 to 8 feet bgs. Based on the results of the trenching activities, the estimated extent of waste fill at Landfill No. 1 was reduced from approximately 12 to 6.3 acres in size.

In March 2000, IT installed three direct-push soil borings at Landfill No.1 to determine the vertical extent of the fill material. Soil borings were installed at depths ranging from 14.8 to 18 feet bgs. Soil samples

were collected from the borings. A total of 21 metals were detected in the subsurface soil/fill material samples collected at Landfill No. 1. The concentrations of arsenic detected in the sample collected from location FA-78-SBOl and aluminum detected in the sample collected from FA-78-SB03 exceeded the background screening values and the SSSLs. The concentrations of 12 metals (aluminum, arsenic, beryllium, boron, cadmium, cobalt, iron, lead, manganese, mercury, nickel, and vanadium) exceeded background screening values in various samples. No other metals exceeded background screening values or SSSLs.

Nineteen VOCs were detected in the subsurface/fill material samples collected at Landfill No. 1, with two VOCs (methylene chloride and trichlorofluoromethane) detected in all four samples collected; however, none of the detected VOC concentrations exceeded the SSSLs.

Six SVOCs were detected in the subsurface/fill material samples collected at Landfill No. 1. One VOC (bis[2-ethylhexyl]phthalate) was detected in all four samples collected; however, none of the detected SVOC concentrations exceeded the SSSLs.

Three pesticides were detected in the subsurface soil/fill material samples collected at Landfill No. 1, with one pesticide (4,4'-DDE) detected in all four samples collected. None of the detected pesticide concentrations exceeded the SSSLs. No herbicides, explosives, or PCBs were detected in the subsurface soil/fill material samples collected.

IT has estimated the vertical and horizontal extent of fill material at Landfill No. 1 based on information gathered from previous site investigations and trenching and boring activities discussed in this report. The fill area at Landfill No. 1 covers an area of approximately 6.3 acres. The average depth of fill material estimated from the trench and boring log data is approximately 11.5 feet bgs.

4.1.2.3 JPA Investigation

Based on the agreement reached during the March 2003 landfill EE/CA meeting, the ESCA, and the requirements of the CA, the JPA performed an additional round of surface water and sediment sampling around Landfill 1. Samples were collected from surface water drainage channels around the landfill on April 8, 2004. Sample locations were selected to represent two locations upstream of the landfill and two locations downstream of the landfill. Figure 4-1 shows the locations of these samples. The purpose of these samples was to confirm the results of previous sampling at the landfill. Samples were analyzed for metals, SVOCS, PCBs and pesticides. All sample collection was performed according to the *Final Installation Wide Work Plan* (IT, 1998), the *Installation Wide Sampling and Analysis Plan* (MES, 2004)

and the *Site-Specific Field Sampling Plan for Landfill 1* (MES, 2004a). According to the EPA meeting minutes (Appendix B), dioxins were included in the analytical suite. Further review of waste material encountered during trenching at Landfill 1, documented in trench logs prepared by IT, did not indicate the presence of waste such as incinerator ash that would be expected to contain dioxins. For this reason the dioxin analysis for samples collected from Landfill 1 was eliminated.

4.1.3 Structures/Topography

The previous interpretation of the Landfill No. 1, Parcel 78(6) boundary was based on review of aerial photographs, available boring logs, and the results of geophysical surveys conducted by SAIC (SAIC; 1993, 1995, and 1999). IT completed additional geophysical surveys (Figure 4-2) and trenching studies to verify the lateral extent and depth of waste fill and to characterize the contents of the waste (IT, 2001a).

Based on results of the Fill Area definition study, described in Section 4.1.2.2, Landfill No. 1 acreage has been revised from 12 acres to approximately 6.3 acres. The landfill is adjacent to the floodplain of an unnamed intermittent stream that drains into a tributary of Remount Creek. Landfill No. 1 slopes steeply to the southeast toward 16th Avenue. Surface water runoff from Landfill No. 1 flows to the southeast toward a tributary of Remount Creek. The site is bounded on the north and east by roads, and on the south and west by densely wooded forest. Residential buildings and approximately 1.5 acres of maintained lawn make up the northern portion of the landfill area. The remainder of the site is densely wooded.

4.1.4 Hydrogeology

Four groundwater monitoring wells (LF1-G01 to LF1-G04) were installed around the boundary of Landfill No. 1, Parcel 78(6), during the 1995 RI study (SAIC, 1995). The boring depths ranged from 16 to 41.5 feet bgs and all borings encountered weathered shale at depths between 7 and 10 feet bgs. Monitoring well LF1-G01 was installed in the officers' housing area north (upgradient) of the landfill and encountered 10 feet of silt and clay soil overlying weathered shale. Monitoring wells LF1-G02 and LF1-G03 were installed southeast of the landfill and encountered weathered shale between 9 and 12 feet bgs. Monitoring well LF1-G04 was installed southwest of the landfill adjacent to a tributary stream and encountered weathered shale at 7 feet bgs. Three of the wells (LF1-G01, LF1-G03, and LF1-G04) monitor shallow intervals within the weathered shale underlying the landfill. Monitoring well LF1-G02 monitors the clay residuum and the upper portion of the weathered shale. The geology underlying Landfill No. 1 is shown on Figure 2-2.

Groundwater flow at the site is reported in the Army EE/CA as consistently to the southeast toward a stream tributary east of the site. Recorded depths to groundwater ranged from 0.2 to 30.8 feet bgs in March 2000. Water level measurements were performed in accordance with *the Installation- Wide Sampling and Analysis Plan* (IT, 2000c). Groundwater in well LF1-G02 was not observed under artesian conditions in March 2000. During RI activities in 1994 and 1995, SAIC (2000) reported that the groundwater conditions in this well were periodically artesian. The groundwater elevation measured at Landfill No. 1, Parcel 78(6), wells in March 2000 ranged between 765.2 and 737.4 feet above msl. The calculated average hydraulic gradient, based on the March 2000 data is 0.04 feet per foot (ft/ft). Hydraulic conductivity measurements were obtained by the Army in LFl-G02 (3.27x10 cm/sec) and LFl-G03 (4.08x10-5 cm/sec) (SAIC, 2000). Groundwater data collected by the JPA indicate groundwater flow at Landfill 1 is toward the southeast consistent with the Army data (Figure 4-3).

4.1.5 Surrounding Land Use and Populations

A residential housing area is located adjacent to Landfill No. 1, Parcel 78(6). Homes in this area were built circa 1958 according to *Asbestos Containing Building Materials Survey Miscellaneous Housing Units* (Reisz Engineering, 1998) and were used as residences for Fort McClellan staff and their families from 1958 to approximately September 1999. The current reuse plan for the area around Landfill 1 is residential. Reuse scenarios that will be evaluated for Landfill No. 1 include residential and recreational. None of Landfill No. 1 is compatible with building homes due to waste debris and potential subsidence issues. The land use for Landfill 1 is open space because the structural integrity of the fill material precludes placement of structures.

Former housing units 3335, 3337, and 3339, which were a part of the residential housing area, were demolished in 2005 due to concern over the proximity of these units to waste and/or fill materials. Specifically, unit 3335 appeared to be located over actual fill material, and unit 3337 was located within 30 feet of the limits of waste fill.

4.1.6 Sensitive Ecosystems

The ecological setting of Landfill No. 1, Parcel 78(6), is greatly defined by its proximity to a residential area and the fact that it is surrounded by relatively heavily traveled roads. The original ecological setting has been altered through historical anthropogenic activities. The terrestrial habitat at Landfill No. 1 is comprised of two types; maintained lawns and mixed coniferous and deciduous forest. There are no permanent aquatic features or aquatic habitat at Landfill No. 1. A more complete discussion of the environmental setting at Landfill No. 1 is presented in Section 4.3.1.

4.1.7 Analytical Data

The data collected for the Army EE/CA (IT, 2002) were used to identify compounds that exceeded the screening criteria as defined in the *Human Health and Ecological Screening Values, and PAH Background Summary Report* (IT, 2000c) and the *Final Background Metals Survey Report, FTMC, Alabama* (SAIC, 1998) and were therefore designated as COCs. The Army EE/CA data are provided in Appendix A. Table 4-1 summarizes the COCs identified for Landfill No. 1, Parcel 78(6) and indicated the media that were sampled during the JPA investigation. Appendix A contains a summary of validated historical and recent data for detected compounds at Landfill No. 1 and compares analyte concentrations against metals background values, SSSL, and ESV for the various sample media collected at the site.

Detailed evaluations of the results of the JPA investigation with respect to human health impacts and ecological health impacts are provided in Sections 4.2 and 4.3 respectively.

4.1.8 Potential Source of Contaminants

The location of the fill material in Landfill No. 1, Parcel 78(6), was interpreted from the geophysical data collected to date and from the trench excavations completed by IT in support of the Army's Draft Final EE/CA. The Detail Map, Figure 4-1, incorporates all of the historical and recent data in defining the extent of waste at Landfill No. 1.

The contents of the fill material directly observed in the trenches included glass bottles, coal, scrap metal, metal food containers, wood pieces, broken plates, melted glass, black to gray ash, newspaper, leather boots, brick, pieces of steel cable, glass medical bottles with septa, and one glass syringe (without needle). Groundwater was not encountered during the trenching operations at Landfill No. 1, Parcel 78(6). During trenching operations at trench T78-1 in Landfill No. 1 the on-site geologist identified what he thought to be a potential grenade within the trench excavation. The geologist recorded this event in the geologist's trench log shown in Appendix I of the Site Investigation and Fill Area Definition Report (IT, 2001 a). The field crew notified the IT site manager and requested UXO support at the trench site to examine the item. The UXO technician approached the trench site to make a positive identification of the item. Before the UXO technician was able to fully examine the item, the walls of the trench collapsed, burying the observed item and preventing positive identification. The item was buried at the trench bottom, approximately 8 feet bgs (IT, 2001 a). Though the item was never positively identified as a grenade by the UXO technician and there is no documentation or history of ordnance and explosives (OE) and/or UXO disposal at Landfill No. 1, the onsite geologist noted its presence on the trench log as a MK-II grenade. Because the object was observed during excavation along the bottom of the trench, and

was subsequently covered when the trench walls collapsed, future controls recommended for the site, which preclude access to the area, will mitigate potential hazards associated with the item. These controls may include, but are not limited to, concrete boundary markers, land-use controls (LUC), and deed notices limiting future use, activity, and excavation at the property.

Ponding of surface water in depressions has been observed at the southern end of Landfill No. 1, Parcel 78(6). Although the infiltration of surface water is a likely mechanism of groundwater impacts because of the percolation of surface water into the waste fill and the release of leachate to groundwater, releases from the landfill have not been directly observed, nor are they indicated by the analytical data collected to date. This landfill is over 50 years old and is considered mature (over 30 years old) with regard to leachate or landfill gas generation. The landfill gas survey conducted by IT in 2003 indicates that no methane was detected at Landfill 1; therefore additional soil gas investigation is not warranted. The apparent lack of these constituents supports the argument for no future impacts from Landfill No. 1. Groundwater monitoring has been discontinued at the site with the concurrence of the Ft McClellan BRAC Cleanup Team (BCT). This agreement is documented in excerpts from the BCT meeting minutes of August 1998, presented in Appendix F. Also the March 2003 meeting did not identify groundwater as an ongoing concern.

4.2 STREAMLINED HUMAN HEALTH RISK ASSESSMENT

Surface soil, surface water, sediment, and groundwater are the media evaluated for Landfill No. 1. The receptor scenarios determined to be applicable to Landfill No. 1 include the recreational site-user and the resident. SRA tables and figures are included in Appendix C. Figure C-1 presents the SCM for Landfill No. 1.

4.2.1 Surface Soil

Three surface soil samples, collected in April 1994, were utilized in the human health SRA (Table C1-1). These samples were analyzed for explosives, metals, pesticides, SVOCs, and VOCs. Several metals, SVOCs, and one pesticide, 4,4'-DDE, were detected. No explosives or VOCs were detected (Table C1-2).

After comparing the detected metals to background metal data and removing any metals that are considered to be essential nutrients, seven metals remained; aluminum, beryllium, boron, copper, iron, nickel, and zinc were determined to be site-related chemicals. No statistical comparison, such as the Mann-Whitney U Test, could be performed on these data sets to determine the differences between the population sets because there are an insufficient number of site samples (3); five samples are necessary

for the statistical test. All of the organic chemicals detected at the site were assumed to be site-related and were carried forward to the soil SSSL screening to determine if they were COPC.

Table Cl-3 presents those chemicals determined to be COPC; these include aluminum and iron for the resident only. All other site-related chemicals were not selected as COPC because their MDCs were below their respective soil SSSLs for the resident and recreational site-user. Both aluminum and iron were selected as COPC based on noncancer hazard only.

As shown in Table C1-4, the resulting noncancer HI for the resident from aluminum is 0.4, while the HI for iron is 3.41. Neither aluminum nor iron is considered to be a carcinogen. Because aluminum has an HI less than 1, it is not considered to be a COC in soil.

Iron would be considered a COC, however, due to concerns regarding the oral reference dose (RfD), iron is not selected as a COC. The appropriateness of the oral RfD for iron is controversial, especially for use with exposure to iron in soil. The oral RfD reflects estimates of iron intakes based on nutritional surveys, but identifies neither a NOAEL nor LOAEL for iron ingestion. As such, it is possible that a much higher level of dietary iron intake would be innocuous, although this possibility is not evaluated in the oral RfD documentation.

In addition, it is likely that the forms of iron present in the plant and animal products that comprise the diets evaluated in the nutritional survey are more bioavailable than those present in soil, sediment, or other non-aqueous environmental media. There are only two known instances of toxicity to iron following oral exposure. One involves acute ingestion of large quantities of soluble forms formulated to enhance bioavailability for their medicinal effects. The other is the occurrence of hemosiderosis in Bantu consuming Kaffir beer. It has been established, however, that the iron in the beer is present in a soluble form that is as bioavailable as the iron in ferric chloride. Presumably, high bioavailability is important in development of toxicity to ingested iron. Iron in soil would be subject to binding to other minerals (matrix effect), and the presence of other minerals would reduce the extent to which iron ingested in soil is absorbed.

For these reasons, EPA (1995) recommends not using the oral RfD to quantify risks; therefore, iron was not selected as a COC for surface soil at Landfill No. 1, Parcel 78(6). Therefore, the Army concluded that there are no COC for surface soil at Landfill No. 1 for the recreational site-user or the resident.

The JPA did not collect any additional soil samples so no modifications to the Army's evaluation are needed. There have been no COCs identified for surface soil at Landfill 1.

4.2.2 Surface Water

Two surface water samples collected in June 1994 were utilized for the human health SRA for Landfill No. 1, Parcel 78(6) (Table C1-5). One of the surface water samples was analyzed for explosives, herbicides, metals, pesticides, SVOCs, and VOCs, while the other sample was only analyzed for explosives and SVOCs. Several metals, one explosive compound, and two VOCs were detected. Table C 1-6 presents the results of the site-related background screening for metals. All metals were determined to be within background screening criteria; therefore, they are not site-related. 1,3-Dinitrobenzene, 1,1,1-trichlorethane, and chlorobenzene are determined to be site-related chemicals and are carried forward to the SSSL screening.

Table C1-7 presents the surface water SSSL screenings for the resident and recreational site-user. None of the site-related chemicals were determined to be COPC. All had MDCs less than their respective resident and recreational site-user SSSLs.

The JPA collected four additional surface water samples from the area around Landfill 1 and analyzed the samples for metals, SVOCS, PCBs and pesticides. The results of the sample analysis are shown in Table 4-2. Detected metals that exceeded background levels and the 95% UTL were essential nutrients (magnesium and sodium) and therefore removed from further consideration. No organic contaminants were detected. These data support the conclusion reached by the Army that no COCs have been identified for surface water at Landfill 1.

4.2.3 Sediment

Two sediment samples collected in 1994 were used in the human health SRA (Table C1-8). One sample was analyzed for explosives, metals, PCBs, pesticides, SVOCs, and VOCs, while the other sample was analyzed for only explosives and some SVOCs.

Table C1-9 presents the results of the background and essential nutrient screens. Only barium was determined to be site-related, no organics were detected in sediment. Barium was not selected as a COPC for either the resident or the recreational site-user (Table C1-10). Therefore, based upon these analytical data the Army concluded that sediment at Landfill No. 1, Parcel 78(6), is not anticipated to present a cancer risk or noncancer hazard to either a resident or recreational site-user.

The JPA collected four additional sediment samples from surface water drainage channels around Landfill 1 and analyzed samples for metals, SVOCS, PCBs and pesticides. Several metals and a few pesticides and SVOCs were detected in these samples. Data are provided in Table 4-3. Aluminum, calcium, copper, iron, magnesium, and zinc were detected at concentrations above their respective background and 95% UTLs. Calcium, iron, and magnesium are considered macronutrients. Because no available SSSL was found for calcium and magnesium and the concentrations of iron were less than the SSSL, these constituents were not identified as site-related. Of the metals detected that are not considered essential nutrients, aluminum, copper and zinc are identified as site-related chemicals. A total of seven pesticides and two SVOCs were detected; however, none of the concentrations exceeded the relevant SSSL values. Based on this evaluation, no COPCs and no COCs are identified for sediment at Landfill 1.

4.2.4 Groundwater

Six groundwater samples, collected in 1994, 1995, 1997, and 1998, were used in the human health SRA (Table C1-11). One sample was analyzed only for metals, three samples were analyzed for explosives, metals, PCBs, pesticides, SVOCs, and VOCs, while two samples were analyzed for chemical warfare agent breakdown products, explosives, aromatics, herbicides, organosulfans, metals, SVOCs, pesticides, PCBs, and VOCs.

Eleven metals, one pesticide, one SVOC, and one VOC were detected in groundwater at the site (Table C1-12). After the background and essential nutrient screens, only one metal (barium) was determined to be site-related. All organics were carried forward to the COPC selection.

Table C1-13 presents the COPC selection for groundwater; barium is the only chemical selected as a COPC. However, the resulting HI for the resident exposed to barium in groundwater is 0.6, less than the threshold of 1. Therefore, based upon these analytical data, the Army determined that groundwater at Landfill No. 1, Parcel 78(6), is not anticipated to present a cancer risk or noncancer hazard to a resident (Table C1-14).

The JPA did not collect any additional groundwater samples so no modifications to the Army's evaluation are needed. Because the Army's evaluation is based on the most protective scenario (residential use) and the Landfill 1 is proposed as recreational use there is no unacceptable cancer risk or non-cancer hazard associated with Landfill 1.

4.2.5 Uncertainty Analysis

Generally, the media evaluated at Landfill No. 1, Parcel 78(6), appear to be fairly clean. Aluminum was selected as a site-related chemical in surface soil (Table C 1-2); however, aluminum is ubiquitous and the most abundant metal in the earth's crust (ATSDR, 1999). Furthermore, its MDC is within the range of background for the Main Post (SAIC, 1998). Similarly, barium was selected as a site-related chemical in groundwater (Table C1-12), but its MDC is also within the range of background for the Main Post (SAIC, 1998), and barium is among the metals whose concentration may be dramatically elevated when groundwater samples are contaminated with sediment as indicated by high turbidity. It seems likely that these two metals are actually present as background chemicals, and that their selection as site-related imparts a conservative bias to the SRA.

It should be noted that data from seven groundwater samples (six when a field duplicate is dismissed) from three wells associated with Landfill No. 1, Parcel 78(6), were not included in the SRA (data not shown). Examination of the data reveals that the samples were taken in 1994 and 1995; however, more recent data from these wells were included in the SRA. Also, examination of the data suggests that their inclusion would have no significant impact on the results or interpretation of the SRA.

Perhaps the most significant source of uncertainty regarding Landfill No. 1, Parcel 78(6), is the absence of subsurface soil data. This has the potential for imparting a non-conservative bias to the SRA should future development involve excavation. However, the proposed reuse scenarios for this site preclude excavation into a former landfill so that direct contact with subsurface soil is unlikely. Therefore, the absence of subsurface soil data is not deemed to represent a significant source of uncertainty in this evaluation. This uncertainty can be easily addressed with the inclusion of LUCs prohibiting excavation on the landfill.

4.2.6 SRA Conclusion

Based on previous investigations together with the recent JPA investigation, none of the media evaluated at Landfill No. 1, Parcel 78(6) (i.e., surface soil, surface water, sediment, or groundwater) poses a cancer risk or noncancer hazard to the resident or recreational site-user above acceptable ranges or thresholds (Tables 4-2, 4-3 and Tables C1-15).

4.3 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

This section presents the SLERA for Parcel 78(6).

4.3.1 Ecological Setting

The ecological setting of Landfill No. 1, Parcel 78(6), is greatly defined by its close proximity to a residential area and the fact that it is surrounded by relatively heavily traveled roads. The original ecological setting has been altered through historical anthropogenic activities.

Landfill No. 1, Parcel 78(6), is located in the southwestern portion of the Main Post and encompasses a total area of approximately six acres. Three residential buildings and approximately one and one-half acres of maintained lawn make up the northern portion of the landfill area. The remainder of the site is comprised of mixed coniferous/deciduous forest. Landfill No. 1 is bounded on the north and south by asphalt roads, and on the east and west by mixed coniferous/deciduous forest. The topography of Landfill No. 1 is sloping from the northern portion to the south-southeast.

Terrestrial habitat at Landfill No. 1, Parcel 78(6), is comprised of two types; maintained lawns and mixed coniferous/deciduous forest. The maintained lawn area is in the northern portion of the site and surrounds the three residential buildings that are currently unoccupied. As stated previously, this maintained lawn area occupies approximately one and one-half acres.

The mixed coniferous/deciduous forest that occupies the remaining 4.8 acres of Landfill No. 1, Parcel 78(6), is best described as typic mesophytic forest. The canopy species, characteristic of this area, are tulip tree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), and northern red oak (*Quercus rubra*). The dominant understory species of this area are red maple (Acer rubrum), flowering dogwood (*Cornus florida*), witch hazel (*Hamamelis virginiana*), sweetgum (*Liquidambar styraciflua*), and sourwood (*Oxydendrum arboreum*). The shrub layer is dominated by mountain laurel *(Kalmia latifolia*), southern low blueberry (*Vaccinium pallidum*), southern wild raisin (*Viburnum nudum*), and yellowroot (*Xanthorhiza simplicissima*). Numerous muscadine grape (Vitis rotundifolia) vines are also present in this area.

Although there are several drainage ditches at Landfill No. 1, Parcel 78(6); most notably along the southern and eastern boundaries, these ditches do not exhibit vegetation characteristic of prolonged inundation and in fact these ditches were completely dry during the on-site ecological investigation at the site. These ditches most likely only transmit water during periods of significant rainfall. Therefore, these ditches are not considered aquatic habitat. A concrete-lined drainage ditch is also present in the

northeastern portion of the site; because it is concrete-lined it does not provide habitat for aquatic species. There are no other permanent aquatic features or aquatic habitat at Landfill No. 1.

Aquatic organisms are not present at Landfill No. 1, Parcel 78(6). In general, the terrain at McClellan supports large numbers of amphibians and reptiles. Jacksonville State University has prepared a report titled Amphibians and Reptiles of Fort McClellan, Calhoun County, Alabama (Cline and Adams, 1997). The report indicated that surveys in 1997 found 16 species of toads and frogs, 12 species of salamanders, 5 species of lizards, 7 species of turtles, and 17 species of snakes. Typical inhabitants of the area surrounding Landfill No. 1 are copperhead (*Agkistrodon contortix)*, king snake *(Lampropeltis getulus)*, black racer (*Coluber constrictor*), fence lizard (*Sceloporour undulatus*), and six-lined racerunner (*Cnemidophorous sexlineatus*) (Cline and Adams, 1997).

Terrestrial species that may inhabit the vicinity of Landfill No. 1, Parcel 78(6), include opossum, short-tailed shrew, raccoon, white-tail deer, red fox, coyote, gray squirrel, striped skunk, a number of species of mice and rats (e.g., white-footed mouse, eastern harvest mouse, cotton mouse, eastern woodrat, and hispid cotton rat), and eastern cottontail. Approximately 200 avian species reside at McClellan at least part of the year (ACOE, 1997). Common species expected to occur in the vicinity of Landfill No. 1 include northern cardinal (*Cardinalis cardinalis*), northern mockingbird (*Mimus polyglottus*), warblers (*Dendroica* spp.), indigo bunting (*Passerina cyanea*), red-eyed vireo (*Vireo olivaceus*), American crow (*Corvus brachyrhynchos)*, bluejay (*Cyanocitta cristata*), several species of woodpeckers (*Melanerpes* spp., *Picoices* spp.), and Carolina chickadee (Parus carolinensis). Game birds present in the vicinity of Landfill No. 1 may include northern bobwhite (*Colinus virginianus*), mourning dove (*Zenaida macroura*), and eastern wild turkey (*Meleagris gallopavo*). A variety of raptors (e.g., red-tailed hawk, sharp-shinned hawk, barred owl, and great horned owl) could also use portions of this area for a hunting ground, particularly the fringe area where the grasslands adjoin the forested areas.

4.3.2 Chemicals Detected

Chemicals detected in soil, sediment, and surface water at Landfill No. 1, Parcel 78(6), during the Army EE/CA are summarized in Appendix A and those detected during the JPA investigation in surface water and sediment are included in Tables 4-4 and 4-5. A Data Quality Summary of all data collected by the JPA for this Final EE/CA is included as Appendix K.

4.3.3 Chemicals of Potential Ecological Concern

COPECs are those constituents whose MDCs exceed both their respective ESVs, in the case of metals the BSC and in the case of macronutrients ten times the BSC. The COPEC screening and identification process developed by the Army was adopted by the JPA for the purposes of this evaluation. The COPECs that have been identified at Landfill No. 1, Parcel 78(6) from the Army Draft Final EE/CA (IT, 2002) data combined with the more recent sampling of:

- Surface Soil - aluminum, barium, beryllium, copper, nickel, zinc, 4,4'-DDE, fluoranthene, phenanthrene, and pyrene
- Surface Water - none
- Sediment - arsenic, calcium, copper, lead, nickel, magnesium, 4,4'-DDT, 4,4'-DDD, alpha-Chlordane, gamma-chlordane, dieldrin and bis(2-ethylhexyl)phthalate.

Metals concentrations in surface water did not exceed the background, 95% UTL, and nutrient screening levels for macronutrients or the background and 95% UTL for non-nutrient metals. Had concentrations exceeded the values indicated above, the concentrations would have been compared to the ESV. Because none of the concentrations met the aforementioned criteria, no COPECs were identified for surface water. Therefore, the results of the JPA sampling identified no COPECs in surface water and confirmed copper, alpha-chlordane, gamma-chlordane, dieldrin, and 4,4'-DDD as COPECs in sediment. The JPA data along with the COPEC screening criteria are provided in Tables 4-4 and 4-5.

4.3.4 SLERA Uncertainty Analysis

The following site-related constituents exceeded their respective ESVs in surface soil at Landfill No. 1, Parcel 78(6): aluminum, barium, beryllium, copper, iron, nickel, zinc, 4,4'-DDE, fluoranthene, phenanthrene, and pyrene (Table D-3). No constituents were detected in surface water samples at concentrations that exceeded the both ESVs and the background surface water concentrations during either the Army or JPA investigations. Therefore no COPECs are identified in surface water. A total of 6 metals and 4 organic compounds were detected by the Army in sediment samples at concentrations that exceeded their respective ESVs and the background sediment concentration (Table D-5). One additional organic compound (4,4'-DDD) was identified as a COPEC by the JPA.

PAHs were only detected in a single soil sample collected by the Army at Landfill No. 1, Parcel 78(6), and their concentrations only slightly exceeded their respective ESVs (HQs range between 1.9 and 2.8). The JPA did not collect any additional soil samples. All of the metals that exceeded their respective ESVs did so by less than an order of magnitude except for aluminum and iron which are indicative of

weathering processes of the natural minerals present in the soil. Iron is also a macro-nutrient that can be regulated by many organisms, thus rendering it non-toxic. The metals also have a low potential for significant bioaccumulation, which means they will not be transferred significantly through the food chain. Although these constituents in surface soil exceeded their respective ESVs, there are no sensitive ecosystems present at or in the near vicinity of Landfill No. 1. Therefore, it could be concluded that these constituents do not pose significant ecological risks to the terrestrial habitats at Landfill No. 1.

As presented in the detailed description of the ecological setting at Landfill No. 1, Parcel 78(6), (Section 4.3.1), the original ecological setting at the site has been greatly altered by anthropogenic activities. Several man-made drainage ditches are present at Landfill No. 1 but none of them exhibit vegetation characteristic of prolonged inundation and in fact these ditches are completely dry during significant portions of the year. Therefore, these ditches do not provide viable aquatic habitat for significant portions of the year and are not considered aquatic habitat for this assessment. Therefore the surface water and sediment samples collected from these ditches while indicative of environmental conditions during or shortly following a rainfall event do not represent exposure for aquatic organisms.

The COPECs identified for sediment at Landfill 1 include arsenic, copper, lead, magnesium, nickel, 4,4'-DDT, 4,4'-DDD, alpha and gamma-chlordane, dieldrin and bis(2-ethylhexyl)phthalate. All of these compounds except 4,4'-DDD were detected in locations that are not considered aquatic habitat; therefore, they are eliminated from consideration as COPECs. 4,4'-DDD was detected in the sample location selected as being upgradient of influence from Landfill 1 and is therefore not site-related and is eliminated as a COPEC for Landfill 1.

Based on the multiple lines-of-evidence provided in the previous paragraphs and summarized in Table D-29, no COPECs have been identified in surface soil, surface water, or sediment at Landfill No.1, Parcel 78(6).

4.3.5 SLERA Conclusions

Terrestrial habitat at Landfill No. 1, Parcel 78(6), exhibits characteristics of land that has been disturbed by man and the "aquatic habitat" consists of man-made drainage ditches that are dry during significant portions of the year. No sensitive or unique habitat exists at Landfill No. 1.

Although the MDCs of a number of constituents exceed their respective ESVs in surface soil (Table D-3) and sediment (Table D-5) at Landfill No. 1, Parcel 78(6), additional lines-of-evidence suggest that these COPECs may not pose significant risks to the terrestrial or aquatic ecosystems at McClellan. These

COPECs (Table D-28) have been identified through a very conservative screening process that utilizes ESVs based largely on NOAELs from the scientific literature and maximum detected constituent concentrations. If additional lines-of-evidence are considered, it can be concluded that there are no COPECs present at Landfill No. 1, Parcel 78(6).

4.4 RECOMMENDED ACTIONS

Based on the results of the field investigations performed by the Army and the JPA, the current and proposed future land use, and the results of the risk assessments completed by the Army and supplemented by the JPA for Landfill No. 1, Parcel 78(6), the no remediation is required. Protection of human health and the environment will be maintained through the implementation of LUCs.

The JPA proposes to implement LUCs at Landfill 1 pursuant to Section IVB of the CA in form of monuments and signs designating the landfill boundaries and an appropriate notice to deed prohibiting excavation on Landfill 1. As post closure activities in accordance with the requirement in Part VI of the CA, the JPA proposes to repair the existing soil cover in areas where the integrity of the existing cover has been compromised. In addition, the JPA will provide regular cover inspections and repair as necessary to ensure that a satisfactory cover remains in place, no debris is exposed and the integrity of the cover is maintained for the period of required post closure monitoring. Subsurface utilities may also be present on site. Access to subsurface utilities will be restricted so that intrusive work shall be conducted under a site-specific health and safety plan to ensure worker safety. A Corrective Measures Implementation Plan (CMIP) will be prepared in accordance with the requirements of the CA which will provided the details of the LUC implementation and the post closure maintenance and monitoring activities.

5.0 LANDFILL NO. 2, PARCEL 79(6)

5.1 SITE LOCATION

Landfill No. 2, Parcel 79(6), is located in the central portion of the Main Post at the southern base of Cemetery Hill, between 2nd Avenue and 10th Street, north of the Ammunition Supply Point (ASP) and is shown on Figure 2-1. The landfill boundary reflects the changes to the waste fill area based on the Army EE/CA investigation and fill area definition studies. The JPA did not perform any additional landfill definition activities. The landfill area is approximately 5.6 acres, as shown on Figure 5-1.

5.1.1 Facility Type and Operational Status

Although the dates of operation for this landfill are not known, an incinerator built northeast of this location in 1927 suggests that Landfill No. 2, Parcel 79(6), may have been operating at that time (ESE, 1998). Weston found that ash is a component of the waste fill (Weston, 1990). A crescent-shaped area marked as "Refuse Dump" appears on a 1937 map of Landfill No. 2. Reportedly, the landfill was used to dispose of construction debris. Aerial photographs dated 1944, 1954, 1957, 1961, and 1969 indicate that portions of the area were cleared for possible trench and fill operations. Landfill No. 2 operated as the Main Post sanitary landfill following closure of Landfill No. 1, Parcel 78(6), in 1947 and was active for an undetermined period (SAIC, 2000). Figure 5-1 shows the locations where JPA collected samples while Figure 5-2 shows sample locations, geophysical survey information, and trenching locations for Landfill No. 2.

A site walk by IT in August 1999 indicated the presence of fill material northwest of the extent of fill defined by SAIC. A map of the most recent geophysical survey on Figure 5-2 shows the extent of waste at Landfill No. 2, Parcel 79(6). Recent trenching data collected by the Army has confirmed the extent of waste shown in the figure.

5.2 INVESTIGATIONS

Previous environmental work conducted at Landfill No. 2, Parcel 79(6) includes the following:

- Enhanced PA (Weston, 1990)
- Site Investigation (SAIC, 1993)
- RI (SAIC, 1995)
- RI Baseline Risk Assessment (SAIC, 2000)

- Site Investigation and Fill Area Definition Report (IT, 2001a).
- Landfill and Fill Area EE/CA (IT, 2002)

5.2.1 Previous Investigations

Landfill No. 2 was identified in the preliminary site assessment as an AREE (Weston, 1990). The site area has been identified as the former location of an incinerator that was operated as early as 1927. A crescent-shaped "refuse dump" was also identified on a 1937 map of the Main Post of the FTMC (ESE, 1998). The landfill reportedly was used to dispose of unspecified "waste" during deactivation of the installation (USAEHA, 1986). Rusted drums, metal, small containers (5-gallon cans and bottles), assorted building materials, and machinery parts were observed at the site in October 1991. Demolition debris (asphalt, concrete, and glass) was exposed at the landfill by road-building operations during the site investigation in 1992 (SAIC, 1993).

SAIC acquired reconnaissance geophysical profile data from March 1994 to February 1995 over approximately 3.5 acres of the site and found geophysical anomalies attributable to buried metal. SAIC sampled the three existing monitoring wells (LF2-G01, LF2-G02, and LF2-G03) at Landfill No. 2 in June 1992, July 1994, January 1995, and October 1997. The results of these sampling events were summarized in previously published reports (SAIC, 1993, 1995, 1999). Additional groundwater sampling was conducted by IT personnel in February 1998 to determine if groundwater quality had been impacted from historical landfilling practices. The results were previously summarized in the *Long-Term Monitoring Report - First Quarterly Report for Landfills 1, 2, and 3 (IT,* 1999). Groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, and explosives. The analytical data indicated that all detected compounds were present in trace concentrations, within site background values, and at levels below risk-based concentrations (IT, 1998b).

IT conducted an SI at Landfill No. 2 from January through March 2000. A geophysical survey was conducted to determine the boundary of the fill area and to identify anomalies within the fill area that would require further characterization. The total area surveyed was approximately 497,800 square feet (11.4 acres) (Figure 5-2). Several anomalies were identified at Landfill No.2. These anomalies were caused by large-scale disposal areas, landfill pits, anomalous high conductivity areas, isolated buried metal objects, and areas of surface metal debris.

Surface soil samples were collected from five locations at Landfill No. 2. Twenty-three metals were detected in the surface soil samples collected. The concentrations of aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, and zinc

exceeded the background screening values and ESVs in most samples. Antimony, barium, chromium, copper, lead, manganese, and thallium were detected at concentrations that exceeded the SSSLs in most of the surface soil samples. Concentrations of aluminum, arsenic, and iron exceeded the SSSLs in all surface soil samples. All surface soil samples collected had concentrations of aluminum, chromium, iron, lead, manganese, vanadium, and zinc that exceeded the ESVs.

Six VOCs were detected in surface soil samples collected from three locations. None of the detected VOC concentrations exceeded the SSSLs or ESVs. Fifteen SVOCs were detected in the surface soil sample collected from location FA-79-SS01. Benzo(a)anthracene and benzo(a)pyrene were detected at concentrations that exceeded both the SSSLs and the ESVs. Benzo(b)fluoranthene, dibenz(a,h) anthracene, and indeno(1,2,3-cd)pyrene exceeded the SSSLs. Five other SVOCs detected (anthracene, chrysene, fluoranthene, phenanthrene, and pyrene) were present at concentrations exceeding the ESVs. No other surface soil samples collected contained detectable concentrations of SVOCs.

No pesticides or PCBs were detected in the surface soil samples collected. Analytical data for Landfill No. 2 can be found in Appendix A.

5.2.2 EE/CA Fill Area Definition

Field activities were conducted by IT personnel from January through March 2000, for the delineation of the fill area at Landfill No. 2. These activities included a geophysical site survey, exploratory trenches, one soil boring, and a site walk. Eight exploratory trenches were excavated to determine the extent of waste fill at Landfill No. 2, and to characterize the fill material. Four additional exploratory trenches were excavated to determine the cause of anomalies identified during the geophysical survey conducted by SAIC in 1992. Trenches were excavated to depths ranging from 3 to 18 feet bgs. Trench logs do not indicate the presence of groundwater in the trenches. One soil boring was advanced to determine the vertical extent of the fill material and collect samples for laboratory analysis. A site walk was conducted by IT to search for leachate seeps along the toe of the landfill; however, none were observed.

Trenches T79-9 and T79-10, which were located north of the initial delineation of the Landfill No. 2 area, both contained large quantities of metal at depths ranging from 0.2 to 2.5 feet bgs. This material included piping, sheet metal, cable, and miscellaneous metal pieces. Other fill material in these areas included ash, glass, and brick. Items found in trench T79-7 include a 100-pound bomb steel casing and the additional fill material. The fill material described in trench T79-7 between the depths of 3 and 18 feet bgs included a metal pipe, burned wood, concrete, numerous scrap metal pieces, coal, ash, glass, and rounded chert cobbles. Approximately half of the glass detected in this trench was melted.

Fill material associated with trenches T79-1 through T79-11 typically included ash, brick, glass, melted glass, wood pieces, concrete, pieces of broken plates, and scrap metal. Trench T79-3 also contained a 55-gallon drum lid, rounded stones (4- to 10-inch diameter), and stone tile pieces. Wire and nails were also found in Trenches T79-4 and T79-5. Steel cable, tin roofing, and a large amount of twisted or bent steel were found in Trench T79-6. Chert or sandstone cobbles and/or stones were found in several of the trenches (T79-2, T79-4A, T79-8, T79-10, and T79-11) and appear to be native materials. Trench T79-8 contained only native sand, clay, and chert and sandstone cobbles. No fill material was encountered in this trench.

The presence of ash and construction-type materials detected in many of the excavated trenches is consistent with the historical usage of the site as both an incinerator location and, later, as a construction-debris landfill. Based on the results of the trenching activities, the estimated extent of fill material at Landfill No. 2 was increased from approximately 3.4 to 5.6 acres. One soil boring (FA-79-SB01) was advanced in the middle of Landfill No. 2 to determine the vertical extent of the fill material. The termination depth of the boring was 14 feet bgs.

Twenty-two metals were detected in the subsurface soil sample collected. Sixteen of these metals had detectable concentrations exceeding background screening values. A total of ten metals (aluminum, antimony, arsenic, barium, chromium, iron, lead, manganese, thallium, and zinc) exceeded the SSSLs. Of these, seven metals (antimony, arsenic, barium, chromium, iron, lead, and zinc) exceeded both the background screening values and the SSSLs.

Five VOCs were detected in the subsurface soil sample collected; however, none of the detected VOC concentrations exceeded the SSSLs. Ten SVOCs were detected in the subsurface soil sample collected; however, none of the detected SVOC concentrations exceeded the SSSLs.

One pesticide was detected in the soil boring sample collected; however, the concentration did not exceed the SSSL. No herbicides, explosives, or PCBs were detected in the fill material sample collected. Analytical data for Landfill No. 2 can be found in Appendix A.

IT estimated the vertical and horizontal extent of fill material at Landfill No. 2 based on information gathered from previous site investigations and trenching and boring activities discussed in this report. The fill area at Landfill No. 2 covers an area of approximately 5.6 acres. The average depth of fill material estimated from the trench and boring log data is approximately 8 feet bgs.

5.2.3 Joint Powers Authority Investigation

Based on the agreement reached during the March 2003 landfill EE/CA meeting, the ESCA and the requirements of the CA, the JPA performed an additional round of surface water and sediment sampling from two locations within Cave Creek adjacent to Landfill No. 2. Samples were collected on April 6 and July 15, 2004. Sample locations were selected to represent one location upstream of Landfill No. 2 and one location downstream of Landfill No. 2. The purpose of these samples was to assess the potential presence of dioxins/furans in surface water and sediment.

Additionally, groundwater samples were collected from three existing monitoring wells at Landfill No. 2. Groundwater samples were submitted for analyses of for metals, SVOCS, PCBs and pesticides. The purpose of these samples was to confirm the results of previous groundwater sampling at the landfill. Samples were collected in accordance with the *Final Installation Wide Work Plan* (IT, 1998), the *Installation Wide Sampling and Analysis Plan* (MES, 2004) and the *Site-Specific Field Sampling Plan for Landfill 2* (MES, 2004b). Figure 5-1 shows the locations of these samples.

5.2.4 Structures/Topography

The landfill covers approximately 5.6 heavily wooded acres, a portion of which is within the floodplain of Cave Creek that flows to the southwest. A floodplain map is illustrated on Figure 2-4. Landfill No. 2, Parcel 79(6), is relatively flat with a slight grade to the south towards Cave Creek, which flows to the southwest along its southeastern border.

Other than existing groundwater monitoring wells, there are no structures on or near Landfill No. 2. Refuse and other evidence of past disposal practices are prevalent along the northern boundary of the cleared landfill area. Numerous mounds are present in the northern and eastern portions of Landfill No. 2, Parcel 79(6): evidence of previous landfilling activities. A geologic map of the fill area and the surrounding area is presented on Figure 2-2.

5.2.5 Hydrogeology

Three groundwater monitoring wells (LF2-G01, LF2-G02, and LF2-G03) were installed at Landfill No. 2, Parcel 79(6), during the 1992 site investigation (SAIC, 1993). Monitoring well LF2-G01 was installed upgradient (north) of the inferred landfill boundary and encountered 15 feet of silty sand and clayey soil. Downgradient wells LF2-G02 and LF2-G03 were installed southwest and southeast of the landfill, respectively, adjacent to the northern bank of Cave Creek. A potentiometric surface map based on March 2004 water levels is presented on Figure 5-3. Groundwater elevations at wells across Landfill No. 2

ranged from 789.43 feet above msl in well LF2-G01 to 785.96 feet above msl in well LF2-G02. A hydraulic conductivity measurement was obtained by the Army in LF2-G02 (2.89×10^{-5} cm/sec) (SAIC, 2000). The direction of groundwater flow trended south-southwest, which follows Cave Creek drainage.

5.2.6 Surrounding Land Use and Populations

The area surrounding Landfill No. 2, Parcel 79(6), is primarily woodland designated for passive recreational use in the current reuse plan. This area is located within the floodplain of Cave Creek and is unsuitable for any developed use. In addition the planned reuse scenario for the site is recreational. In order to be consistent and to provide a common baseline among sites at McClellan a residential exposure scenario will also be provided for comparison.

5.2.7 Sensitive Ecosystems

The landfill area was cleared and has since been colonized by early successional weeds, grasses, and sedges. The surrounding area is mixed coniferous/deciduous forest characteristic of a typic mesophytic forest. The original ecological setting has been altered through significant anthropogenic activities. Terrestrial habitat at Landfill No. 2, Parcel 79(6), is entirely made up of two general types; grasslands and typic mesophytic forest. Although there are no aquatic features within the area of Landfill No. 2, Cave Creek flows along the southeastern boundary of the site. The area is not defined as a sensitive ecosystem, although the area lies within the floodplain for Cave Creek. A more complete discussion of the Landfill No. 2 environmental setting is included in Section 5.3.1. Base maps indicate that portions of this landfill area occur within a larger wetland area; although, physical inspection of the site has shown that wetlands are not present in this area, with the possible exception of the area immediately adjacent to Cave Creek.

5.2.8 Analytical Data

The data collected for the Army EE/CA at Landfill No. 2 were used to identify compounds that exceed the screening criteria as defined in the *Human Health and Ecological Screening Values, and PAH Background Summary Report (IT,* 2000c) and the *Final Background Metals Survey Report, FTMC, Alabama* (SAIC, 1998) and were designated as COCs. Appendix A includes a summary of data presented in the Army EE/CA for detected compounds in subsurface soil, fill material, sediments, groundwater, surface soil, and surface water samples collected at Landfill No. 2. A comparison of the detected values from the Army EE/CA to metals background concentrations, SSSL, and ESV for the various sample media is also provided in Appendix A. Metals that exceed the BTV (two times background) and SSSL and organic compounds that exceed the SSSL are summarized for each sample medium in Table 5-1.

The JPA investigation at Landfill No. 2 was focused specifically on dioxins in surface water and sediment and on confirmation of groundwater quality with respect to metals, SVOCs, PCBs and pesticides. These data are evaluated against the appropriate background values, ESVs and SSSLs and are discussed in more detail in Sections 5.3 and 5.4.

The elevated metals concentrations for historical groundwater samples appear to be directly attributable to high turbidity in groundwater samples. An evaluation of this problem was completed and is presented in Appendix E. The JPA investigation analyzed groundwater samples for both total and dissolved metals in an effort to address the turbidity issues encountered previously by the Army.

5.2.9 Potential Source of Contaminants

The location of the fill material in Landfill No. 2, Parcel 79(6), was interpreted from the geophysical data collected to date and from the trench excavations completed by IT in support of the EE/CA. The Landfill No. 2, Parcel 79(6), detail map on Figure 5-2 incorporates all of the historical and recent data in defining the extent of waste at the site. The contents of the fill material directly observed in the trenches included ash, brick, glass, melted glass, wood pieces, concrete, pieces of broken plates, and scrap metal. Wire, nails, steel cable, tin roofing, and bent steel were also found. The presence of ash and construction-type materials detected in many of the trenches is consistent with the historic usage of Landfill No. 2, Parcel 79(6), as both an incinerator location and, later, as a construction-debris landfill (IT, 2001a). Groundwater was not encountered during trenching operations at Landfill No. 2.

The detail map on Figure 5-1 shows the current interpretation of the landfill boundary and, thus, the lateral extent of the potential source area for any releases from the landfill. Metals have exceeded background values and SSSLs in some subsurface soils and groundwater. One pesticide, aldrin, has been reported above the SSSL in groundwater. Surface soil samples collected contained concentrations of 11 metals above SSSL values. One surface soil sample out of the five samples indicated five VOCs above SSSLs. These samples were collected from within the landfill area.

Releases from the landfill have not been directly observed. Based on aerial photos, waste was likely last placed in Landfill 2 approximately 30 years ago. In general, landfill gas production peaks within 5 years and is considered complete within 30 years after the final placement of waste, although small amounts of gas may continue to be produced for up to 50 years after closure. A landfill gas survey was completed for Landfill 2. The results of this survey are available in the *Landfill Gas Investigation Report for Landfills and Fill Areas, Parcels 78(6), 79(6), 80(6), 227(7), 126(7), 229(7), and 82(7)* dated November 2003 completed by Shaw Environmental, Inc. This landfill is consequently mature with regard to leachate or

landfill gas generation. The apparent lack of these constituents, or indicator parameters, supports the argument for no future impacts from Landfill No. 2, Parcel 79(6). Groundwater monitoring has been discontinued at Landfill No. 2 with the concurrence of the FTMC BCT. This agreement is documented in excerpts from the BCT meeting minutes of August 1998, presented in Appendix F.

5.3 STREAMLINED HUMAN HEALTH RISK ASSESSMENT

Media evaluated at Landfill 2, Parcel 79(6), include surface soil, surface water, sediment, and groundwater. The receptor scenarios applicable to Parcel 79 include the recreational site-user and the resident. SRA tables and figures are included in Appendix C. Figure C-2 presents the CSEM for Parcel 79.

5.3.1 Surface Soil

Five surface soil samples were evaluated in the SRA (Table C2-1 in Appendix C). The samples were collected in March 2001 from 0 to 1 foot bgs. All samples were analyzed for metals, organophosphorous pesticides, PCBs, SVOCs, and VOCs. Twenty-three metals, 15 SVOCs (all PAHs), and three VOCs were detected (Table C2-2). Thirteen metals exceed either their background screening criteria or UTLs and were selected as site-related chemicals. These metals and all organic compounds were carried forward to the COPC selection step.

Eight metals and five PAHs were selected as COPC for the resident (Table C2-3). Only arsenic, lead and benzo(a)pyrene were selected as COPCs for the recreational site-user (Table C2-3). The HI for the resident of 11 is largely due to arsenic (HI = 2.24) and iron (HI = 6.82) (Table C22 4). Arsenic was detected in all five samples. Furthermore, the arsenic data set was determined to be normal (Table C2-3), suggesting that the concentrations identified are reasonably consistent with one another; i.e., the MDC does not appear to be an outlier. Therefore, arsenic is identified as a legitimate COC for the resident. Iron could also be selected as a COC; however, EPA Region IV takes the position that the oral RfD for iron is not a sufficient basis for selecting iron as a COC, especially in soil. The oral RfD reflects estimates of iron intakes based on nutritional surveys, but identifies neither a threshold nor a toxic effect level for ingestion. It is likely that a much higher level of iron intake would be innocuous, although this possibility is not evaluated in 10 the oral RfD documentation. The total HI from exposure to surface soil and groundwater for the resident is segregated by target organ in Table C2-5. The target organ analysis confirms that arsenic is the only COC that contributes to an unacceptable HI. RGOs are presented for the resident for lead and arsenic in surface soil (Table C2-6).

The ILCR for the resident of 2E-4, clearly above the risk management range, is largely due to arsenic, with significant contributions from the PAHs as well (Table C2-4). RGOs based upon target ILCR values of 1 E-6, 1 E-5 and 1 E-4 were calculated for arsenic and the PAHs in soil (Table C2-7).

No HI was estimated for the recreational site-user because no COPC were selected in surface soil for noncancer effects (Table C2-8). The total ILCR for the recreational site-user of 2E-6, due to arsenic and benzo(a)pyrene, is near the low end of the risk management range. COCs based on cancer are not identified and RGOs are not estimated.

It should be noted that lead was selected as a noncancer COPC in surface soil for both the resident and recreational site-user because the site MDC exceeds the SSSL of 400 mg/kg (Table C2-3). However, lead is not evaluated in the same manner as other COPC because there is no oral RfD for this metal or its compounds. The SSSL of 400 mg/kg reflects a screening level in soil for residential use. A reevaluation by the Army for a similar McClellan site confirms the 400 mg/kg level as a cleanup level for lead in soil for residential use (IT, 2001b). However, the SSSL of 400 mg/kg for lead in soil is unnecessarily restrictive for recreational site use. A cleanup level for lead of 7,600 mg/kg was developed for soil for recreational site use (IT, 2001b), which is adopted as the RGO for the recreational site-user for this site.

The JPA did not collect any additional soil samples so no modifications to the Army's evaluation are needed. Arsenic has been identified as a COC for surface soil at Landfill 2.

5.3.2 Surface Water

The surface water samples evaluated in the human health SRA are presented in Table C2-9. Two surface water samples, collected in 1994, were used in the SRA. One sample was analyzed for explosives, herbicides, PCBs, pesticides, metals, SVOCs, and VOCs. The other surface water sample was analyzed for explosives and SVOCs.

Only metals were detected in surface water (Table C2-10). No metals were determined to be site related after the comparison with background; thus no chemicals in surface water were carried through the SRA.

The JPA collected two surface water samples on April 6, 2004, for dioxins and furans. Five dioxin and furan compounds were detected. However, the data were qualified due to possible blank contamination. Samples were recollected from the same locations on July 15, 2004 in order to obtain useable data. The compounds detected in the July 15, 2004 samples were of a similar concentration

to the original results, but there were no method blank detections. Because of the greater reliability of the second sampling round results, the evaluation of COCs for Landfill 2 is based upon only the July results. These data are provided in Table 5-2. Refer to the Data Quality Summary located in Appendix K for a complete discussion of data quality. None of the detections exceeded the residential or fish consumption SSSL, therefore dioxins and furans are not COCs in surface water at Landfill 2.

5.3.3 Sediment

The two sediment samples evaluated in the human health SRA, collected in June 1994, are presented in Table C2-11. Only metals and one SVOC (benzyl alcohol) were detected in sediment at Parcel 79 (Table C2-12). Comparison with background revealed that none of the metals were site-related. Benzyl alcohol is the only chemical determined to be site-related and carried forward to the COPC selection step. The MDC for benzyl alcohol; however is less than the SSSL for benzyl alcohol in sediment for the resident or the recreational site-user (Table C2-13). Therefore, benzyl alcohol is not selected as a COPC in sediment.

The JPA collected two sediment samples on April 6, 2004 to analyze for dioxins and furans. Data from these samples are provided in Table 5-3. Seven dioxin and furan compounds were detected and no data quality issues were discovered. None of these analytes exceeded the recreational SSSL; therefore no COCs are carried through for sediment at Landfill 2.

5.3.4 Groundwater

Thirty groundwater samples, collected in 1992, 1994, 1995, 1997, and 1998, were used to evaluate a resident's exposure to groundwater from the site (Table C2-14). All groundwater data for this site were collected and analyzed by SAIC. SAIC provided this data to IT electronically, with no hard copy back-up. The electronic data set provided by SAIC included two sets of analytical results for some parameters for sample numbers U000354, U000355, and U000372. The IT Data Acquisition and Management Group theorizes that the two sets present results before and after dilution during the analytical process. The Data Group recommends using the lower set of values because dilution usually improves both the accuracy and precision of the analytical methods and results in lower values. The original laboratory data packages are not available for further clarification.

Sixteen metals, one SVOC, six pesticides, two VOCs, and two explosives were detected in groundwater at the site (Table C2-15). After background screening and essential nutrient removal, only metals beryllium, boron, chromium, and lead were determined to be site-related. All organic chemicals detected

in groundwater at the site were also selected as site-related chemicals and carried forward to the COPC selection.

Table C2-16 presents the COPC selection; four metals and one pesticide (aldrin) were selected as COPC for the resident. The metals were selected for their noncancer effects, while aldrin was selected as a COPC only based upon its cancer risk.

Table C2-17 presents the HI and ILCR for the resident exposed to the COPC in groundwater. The resulting HI (0.6) and ILCR (4E-6) are either below or well within the acceptable range/threshold for human health. COPC contributing an HI greater than 0.1 are included in the target organ table analysis (Table C2-5) because a resident would be simultaneously exposed to surface soil and groundwater.

Although no HI is calculated for lead, lead is considered to be a COC and an RGO is presented for lead in groundwater. Lead was determined to be a COC at the site using the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children (EPA, 1994). Using the average lead concentrations for surface soil and groundwater at the site, it was determined that 32 percent of children aged 0 to 84 months would have blood lead concentrations greater than 10µg lead per deciliter of blood (Appendix C, Attachment C-4). Lead, however, is among the metals that were not detected in groundwater samples that had low turbidity (IT, 2000b).

The JPA collected three groundwater samples on April 1 and 2, 2004. These samples were analyzed for metals, SVOCs, PCBs and pesticides and the data are provided in Table 5-4. Several metals (total and dissolved) were detected as well as bis(2-ethylhexyl)phthalate. Total and dissolved calcium, magnesium, and sodium were detected at concentrations above two times the background concentration. Neither calcium nor magnesium exceeded the 95% UTL; therefore these compounds are not carried through as COCs. Sodium did exceed the 95% UTL. Sodium is a macronutrient and was detected at a concentration less than ten times the background concentration; therefore this compound is not considered a COC. Bis(2-ethylhexyl)phthalate was detected in one location at a concentration above the residential or groundskeeper SSSL. Bis (2-ethyhexyl)phthalate is a common laboratory contaminant and was not detected in any other sample during the JPA investigation nor was it detected during the Army EE/CA investigation.

5.3.5 Uncertainty Analysis

Perhaps the most significant source of uncertainty regarding Landfill No. 2, Parcel 79(6), is the presence of lead in groundwater during the Army EE/CA investigation. It is unclear the extent to which elevated

turbidity at the time of sample collection may have inflated the apparent concentration of lead. The JPA investigation analyzed for both total and dissolved metals in an effort to deal with this issue. Lead was not detected in any of the total or dissolved samples collected during this event; therefore this uncertainty has been minimalized and lead was not confirmed as a COC at Landfill 2.

An additional source of uncertainty in groundwater arises from the single detection of bis (2-ethyhexyl)phthalate in one groundwater sample. This single detection exceeds the residential SSSL for groundwater and would therefore be considered a COC. This compound is often found as a laboratory or sample handling contaminant and it is likely not a true detection. The fact that it has not been detected in any previous sampling event in any well at Landfill 2 also suggests that this lone detection does not indicate concern regarding groundwater quality. These facts together with the planned reuse at Landfill 2 being recreational which limits the potential for contact with groundwater support eliminating bis (2-ethyhexyl)phthalate as a COC.

There is also some uncertainty resulting from the absence of subsurface soil data. This has the potential for imparting a non-conservative bias to the SRA should future development involve excavation. However, as explained for Landfill No. 1, Parcel 78(6), this does not represent a significant source of uncertainty in this evaluation. Nonetheless, should site reuse plans change, it may be necessary to take subsurface soil samples and re-visit the SRA.

5.3.6 SRA Conclusion

Total HI and ILCR estimates for the resident and recreational site-user summed across all media are presented in Table C2-18. The total HI and ILCR for the resident for exposure to surface soil are above acceptable limits; therefore, both cancer and noncancer RGOs were developed. Furthermore, lead in surface soil was selected as a COPC for residential exposure, and shown to be present at concentrations above the cleanup level for residential exposure. It is concluded that lead, arsenic, and several PAHs in surface soil pose unacceptable health risks should the site be developed for residential purposes.

Groundwater at the site was determined to not pose a noncancer hazard nor cancer risk to the resident. However, the residential exposure scenario is evaluated only to capture the upper bound on risk and to provide useful information to risk managers.

The total ILCR for the recreational site-user was near the low end of the risk management range. Noncancer-based COPC were not identified for the recreational site-user; therefore, an HI was not

estimated. It is concluded that the level of contamination in the media at Landfill No. 2, Parcel 79(6), does not pose an unacceptable risk or hazard under the planned passive recreation use scenario.

5.4 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

This section presents the SLERA for Parcel 79(6).

5.4.1 Environmental Setting

The ecological setting at Landfill No. 2, Parcel 79(6), is defined by the fact Landfill No. 2 was historically cleared of native vegetation and has subsequently been colonized by early successional weeds, grasses, and sedges. The original ecological setting has been altered through significant anthropogenic activities. As such, the topography and resultant habitat types are not characteristic of similar areas that have not been altered by man.

Landfill No. 2, Parcel 79(6), is located in the north-central portion of the Main Post and encompasses a total area of approximately 5.6 acres. Landfill No. 2 is relatively flat with a slight grade to the south towards Cave Creek, which flows along the southeast border of the site. The landfill area itself was cleared and has since been colonized by early successional weeds, grasses, and sedges. The surrounding area is mixed coniferous/deciduous forest characteristic of a typic mesophytic forest.

Refuse and other evidence of past disposal practices are prevalent along the northern boundary of the cleared landfill area. Numerous mounds are present in the northern and eastern portions of Landfill No. 2, Parcel 79(6), which are the result of historical landfilling activities that have taken place at the site.

Terrestrial habitat at Landfill No. 2, Parcel 79(6), is entirely made up of two general types; grasslands and typic mesophytic forest. The grasslands are comprised of areas that have historically been cleared and landfilled, and have since been colonized by early successional weeds, grasses, and sedges. The area surrounding the landfill itself is characteristic of a typic mesophytic forest.

The canopy species characteristic of this area are tulip tree *(Liriodendron tulipifera),* sweetgum *(Liquidambar styraciflua),* black gum *(Nyssa sylvatica),* shortleaf pine *(Pinus echinata),* loblolly pine *(Pinus taeda),* white oak *(Quercus alba),* and northern red *oak (Quercus rubra).* The dominant understory species of this area are red maple *(Acer rubrum),* flowering dogwood *(Cornus florida),* witch hazel *(Hamamelis virginiana),* sweetgum *(Liquidambar styraciflua),* and sourwood *(Oxydendrum arboreum).* The shrub layer is dominated by mountain laurel *(Kalmia latifolia),* southern low blueberry

(Vaccinium pallidum), southern wild raisin *(Viburnum nudum),* and yellowroot *(Xanthorhiza simplicissima).* Numerous muscadine grape *(Vitis rotundifolia)* vines, greenbriar *(Smilax rotundifolia)* and poison *ivy (Toxicodendron radicans)* are also present in this area.

Although there are no aquatic features within the area of Landfill No. 2, Parcel 79(6), itself, Cave Creek flows along the southeastern boundary of the site in a southwesterly direction. The substrate of Cave Creek is mostly bedrock with small areas of sand and gravel. The stream banks are approximately six feet high and the width of Cave Creek in this area is approximately two feet. The canopy above Cave Creek in this area is relatively high. Base maps also show that there may be wetlands associated with Cave Creek that adjoin this site, although physical inspection has not identified these areas.

In general, the terrain at McClellan supports large numbers of amphibians and reptiles. Jacksonville State University has prepared a report titled Amphibians and Reptiles of Fort McClellan, Calhoun County, Alabama (Cline and Adams, 1997). The report indicated that surveys in 1997 found 16 species of toads and frogs, 12 species of salamanders, 5 species of lizards, 7 species of turtles, and 17 species of snakes. Typical inhabitants of the area surrounding Landfill No. 2, Parcel 79(6), are copperhead (Agkistrodon contortix), king snake (Lampropeltis getulus), black racer (Coluber constrictor), fence lizard (Sceloporour undulatus), and six-lined racerunner (Cnemidophorous sexlineatus).

Terrestrial species that may inhabit the vicinity of Landfill No. 2, Parcel 79(6), include opossum, short-tailed shrew, raccoon, white-tail deer, red fox, coyote, gray squirrel, striped skunk, a number of species of mice and rats (e.g., white-footed mouse, eastern harvest mouse, cotton mouse, eastern woodrat, and hispid cotton rat), and eastern cottontail. Approximately 200 avian species reside at FTMC at least part of the year (ACOE, 1997). Common species expected to occur in the vicinity of Landfill No. 2 include northern cardinal *(Cardinalis cardinalis),* northern mockingbird *(Mimus polyglottus),* warblers *(Dendroica spp.),* indigo bunting *(Passerina cyanea),* red-eyed vireo *(Vireo olivaceus),* American crow *(Corvus brachyrhynchos),* bluejay *(Cyanocitta cristata),* several species of woodpeckers *(Melanerpes spp., Picoices spp.),* and Carolina chickadee *(Parus carolinensis).* Game birds present in the vicinity of Landfill No. 2 may include northern bobwhite *(Colinus virginianus),* mourning dove *(Zenaida macroura),* and eastern wild turkey *(Meleagris gallopavo).* A variety of raptors (e.g., red-tailed hawk, sharp-shinned hawk, barred owl, and great homed owl) could also use portions of this area for a hunting ground. Because of the presence of Cave Creek, piscivorous bird species may also be present in the vicinity of Landfill No. 2. These piscivorous birds may include great blue heron *(Ardea herodias),* green-backed heron *(Butorides striatus),* and belted kingfisher *(Ceryle alcyon).*

Although shallow (less than one foot deep) and relatively narrow, Cave Creek has the potential to support a variety of amphibious species and some small fish species. Bullfrog *(Rana catesbeiana)* and leopard frog *(Rana sphenocephala)* are examples of amphibians that may be found in Cave Creek in the vicinity of Landfill No. 2, Parcel 79(6). Fish species that may be found in Cave Creek in the vicinity of the site include blacknose dace *(Rhinichthys atratulus)*, creek chub *(Semotilus atromaculatus)*, stoneroller *(Campostoma anomalum)*, striped shiner *(Luxilus chrysocephalus)*, and various darters *(Etheostoma spp.)*.

Based on field observations, Cave Creek in the vicinity of the site provides low quality gray bat foraging habitat. Two major requirements for gray bat foraging habitat are contiguous forest cover and habitat for aquatic insects (one of the gray bat's preferred dietary items). These two requirements are met by Cave Creek in this area; therefore, gray bats could be expected to forage in this area.

5.4.2 Chemicals Detected

Chemicals detected by the Army in soil, sediment, and surface water at Landfill No. 2, Parcel 79(6), are summarized in Appendix A. Results of the JPA sampling are provided in Tables 5-5 and 5-6. A Data Quality Summary of all data collected by the JPA for this revised EE/CA is included as Appendix K.

5.4.3 Chemicals of Potential Ecological Concern

COPECs are those constituents whose MDCs exceed their respective ESVs. The COPECs that have been identified at Landfill No.2, Parcel 79(6), are the following:

- Surface Soil: antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, carbazole, chrysene, dibenzofuran, fluoranthene, phenanthrene, and pyrene
- Surface Water – none
- Sediment – none

5.4.4 SLERA Uncertainty Analysis

The following site-related constituents exceeded their respective ESVs in surface soil at Landfill No. 2, Parcel 79(6), as presented in Table D-6: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, carbazole, chrysene, dibenzofuran, fluoranthene, phenanthrene, and pyrene. No site-related constituents were detected in surface water and none of the site-related constituents in sediment exceeded their ESVs (Tables D-7 and D-8). A number of the metals detected in

soil had HQs less than 10 and do not bioaccumulate significantly (aluminum, antimony, arsenic, barium, beryllium, and nickel); therefore, they may not be considered COPECs. Calcium is a macro-nutrient that can be regulated by many organisms, thus rendering it non-toxic. Additionally, PAHs detected in surface soil at the site were detected infrequently (one out of five samples). Although the maximum concentrations of a number of constituents in surface soil exceed their respective ESVs, the terrestrial habitat at the site exhibits characteristics of disturbed land and cannot be classified as a unique or sensitive ecosystem. Therefore, it could be concluded that none of the constituents detected in surface soil at Landfill No. 2 would be expected to pose adverse ecological risk to terrestrial populations at McClellan.

5.4.5 SLERA Conclusions

Terrestrial habitat at Landfill No. 2, Parcel 79(6), exhibits characteristics of land that has been disturbed by man. Cave Creek flows along the southeastern boundary of Landfill No. 2 and potentially provides low quality foraging habitat for the gray bat, a federally-listed endangered species. The potential exists for erosion of contaminated soil into this sensitive habitat.

The following site-related constituents exceeded their respective ESVs in surface soil at Landfill No. 2, Parcel 79(6) as presented in Table D-6 and are considered COPECs: antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, carbazole, chrysene, dibenzofuran, fluoranthene, phenanthrene, and pyrene. No site-related constituents were detected in surface water and none of the site-related constituents in sediment exceeded their ESVs (Tables D-7 and D-8). These COPECs (Table D-28) have been identified through a very conservative screening process that utilizes ESVs based largely on NOAELs from the scientific literature and maximum detected constituent concentrations. If additional lines-of evidence are considered, it could be concluded that none of the constituents detected in surface soil are likely to pose adverse ecological risks to terrestrial populations at McClellan.

5.5 REMEDIAL ACTION OBJECTIVES

The potential risk to human health at Landfill No. 2 is associated with surface soils. To address this risk, the Army (IT, 2002) evaluated remedial action alternatives including No Action, LUCs, soil cover, and onsite disposal (consolidation into a secure landfill).

5.6 SCOPE OF REMEDIAL ACTION

The specific goals of remedial actions as defined in the Army EE/CA are to mitigate or eliminate any potential threat to public health, welfare, or the environment (posed by the presence of constituents of concern identified within the respective fill areas [see Appendix A] under CERCLA guidance for remedial actions). Based on the agreement reached between the JPA and the Army as reflected in the ESCA the JPAs objective is to reduce or eliminate future potential for adverse public impacts consistent with anticipated base reuse plans through land-use controls, physical barriers, and deed notices.

Upon selection of the most appropriate remedial action alternative, the scope of the remedial action will be detailed in a work plan. The scope for the work plan will include the details of the specific remedial action proposed by this EE/CA.

5.7 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

CERCLA specifies that remedial actions for the cleanup of hazardous substances must comply with the requirements under federal or more stringent state environmental laws that are applicable, or relevant and appropriate to the hazardous substances or particular circumstances at a site to the extent practicable. The assumption that human health and the environment are protected is inherent in the interpretation of applicable or relevant and appropriate requirements (ARAR). Action-specific and location-specific ARARs identified by the Army (IT, 2002) for each alternative are included in Tables 5-7 and 5-8 respectively.

5.8 SITE-SPECIFIC DESCRIPTION OF ALTERNATIVES

Based on current Landfill No. 2 data, surface soil presents an unacceptable risk to a potential resident. Although several chemicals exceeded their respective ESVs, the SLERA presented several additional lines-of-evidence that would address potential ecological risks. Because metals in soil do not tend to migrate and no groundwater impacts have been observed at Landfill No. 2, groundwater remedies are not necessary. Surface water and sediment samples did not exceed SSSLs, and the SRA does not indicate any noncancer hazards to humans.

The alternatives presented in this EE/CA are intended to mitigate risks through prevention of exposure to the surface soils. This objective is compatible with section 300.430(a)(iii)(13) of the NCP that contains the expectation that engineering controls, such as containment, will be used for a waste that poses relatively low threat where treatment is impractical. The NCP identifies municipal landfills as a type of site where treatment of waste may be impractical due to the size and heterogeneity of the contents (55 FR

8704). Because treatment is usually impractical, EPA generally considers containment to be the appropriate response action, or "presumptive remedy" for landfills (EPA 1996a). A description of each alternative and how it would be applied at Landfill No. 2, Parcel 79(6), is presented in the following sections.

5.8.1 No Action Alternative (Alternative 1)

The No Action Alternative maintains the present conditions at the site with no additional effort to reduce potential exposure. The No Action general response provides no remediation, monitoring, or security activities at the site to reduce risk to human health or the environment. The NCP (40 CFR 300.415) requires that the No Action response be carried through the detailed analysis as a baseline for comparison with other remedial action alternatives.

5.8.2 Land-Use Controls (Alternative 2)

This alternative consists of a LUC to restrict future residential reuse of the property. As part of the property transfer that occurred on September 30, 2003, the Army included land use restrictions to prevent residential reuse of the property. This alternative includes regular inspection of the property for a period of 20 years. There is no long-term groundwater monitoring included in this alternative.

5.8.3 Soil Cover with LUCs (Alternative 3)

This alternative would include the installation of a soil cover and the implementation of LUCs. All brush, timber, stumps, and vegetation would be cleared from Landfill No. 2, Parcel 79(6), to provide a clear base over which soil would be placed. Any required drainage features would be constructed to meet design requirements. An evaluation of wetland impact would be made prior to the start of any activity. The alternative includes a pull back (excavation) of the leading edge of the waste encroaching onto the wetlands and placement of this waste onto the existing waste, if wetland mitigation is required for any encroachment into the wetlands. Cover soil would then be placed over the original footprint so as not to intrude into the wetland area. The soil cover would have an area of 5.6 acres and would be sloped to prevent ponding on the waste fill area. Seeding of light vegetation (e.g., grass, forbs, and shrubs) will be conducted to promote growth of vegetation on the soil cover in order to minimize erosion. This alternative would also include decommissioning of three existing site monitoring wells in accordance with ADEM requirements. Concrete monuments would be installed around the perimeter of Landfill No. 2. As part of the property transfer, the Army has included deed restrictions preventing residential reuse within the boundary area. Additionally, a protective rip-rap and bedding layer would be placed along the slope of the landfill that is adjacent to Cave Creek. The rip-rap and bedding layer would be placed to

protect the landfill from a flood washing out the toe of the landfill. Due to the site's proximity to Cave Creek, inspection of the site after flood events is included in this alternative.

This alternative provides for 20 years of site maintenance, which includes periodic inspections, and maintenance for erosion control and maintenance of the shallow-rooted vegetative cover. Long-term groundwater monitoring is not included under this alternative.

5.8.4 On-Site Disposal in a Secure Landfill (Alternative 4)

This alternative would consist of disposal of all contaminated soil and waste debris to a waste consolidation cell at Landfill No. 4, Parcel 81(5). The total fill area covers 5.6 acres to an average depth of 8 feet bgs. An estimated 75 percent of the total fill area consists of the waste fill. The remaining 25 percent is native soil that would be segregated and used as backfill. Thus, approximately 54,200 cubic yards of fill would be transported from Landfill No. 2, Parcel 79(6), to Landfill No. 4. Prior to excavation, all brush, timber, and vegetation would be cleared from Landfill No. 2 (debris would be placed in the Industrial Landfill, Parcel 175[5]). The excavated area would be backfilled with soil from the borrow area just south of Landfill No. 4 as needed, and Landfill No. 2 grade would be restored to preexisting conditions. This alternative would also include decommissioning of three existing site monitoring wells in accordance with ADEM requirements. Long-term groundwater monitoring is not required for this site per previous agreements with BCT (Appendix F).

5.9 COMPARATIVE ANALYSIS

This chapter consists of the analysis and presentation of the relevant information needed to permit the selection of a site response action. During this analysis, each alternative is assessed against nine evaluation criteria. A comparison of the four alternatives considered for Landfill No. 2, Parcel 79(6), and their evaluation under the nine evaluation criteria is presented in Table 5-9. The SRA (Section 5.2) presented a cancer risk associated with surface soils to a potential resident, but acceptable risk for the proposed reuse. Data shows no impacts to groundwater at Landfill No. 2.

5.9.1 Overall Protection of Human Health and the Environment

The overall protection of human health and the environment analysis provides a summary of how each alternative reduces, eliminates, or controls the risk from potential exposure pathways, through use of land-use controls, treatment, or engineering controls. Any short-term or cross media impacts posed by the alternative are also considered. Alternative 1 would not provide any protection of human health and the environment, and Alternative 2 would provide limited protection. Alternative 3 would provide an

additional protective barrier. Alternative 4 provides the greatest protection of human health and the environment.

5.9.2 Compliance with ARARs

Under this criterion, the alternative is evaluated on how completely it will comply with ARARs, and if there will be further action required to comply with the ARARs. The need to justify a waiver from the ARARs is also evaluated. Action- and location-specific ARARs have been identified for the site and are discussed in Section 5.6. A summary of the ARARs for all of the alternatives is presented in Tables 5-7 and 5-8. There are no location- or action-specific ARARs associated with Alternative 1 as no actions are taken under this alternative. Alternatives 2, 3, and 4 would be designed to comply with all action- and location-specific ARARs. These alternatives entail actions to prevent contact with surface soils, thereby eliminating an exposure pathway to potential contaminants. Alternative 4 is anticipated to provide the greatest protection, followed by Alternative 3.

5.9.3 Long-Term Effectiveness and Permanence

The analysis of the long-term effectiveness and permanence provides an evaluation of the magnitude of residual risk and the adequacy and reliability of controls used to manage the remaining wastes (untreated waste and treatment residuals) on-site.

Alternative 1 will have no long-term effectiveness. Alternative 4 will have the greatest long-term effectiveness and permanence. Alternative 3 has a greater degree of long-term effectiveness and permanence than Alternative 2.

5.9.4 Reduction of Toxicity, Mobility or Volume

The evaluation of the reduction of toxicity, mobility, or volume through treatment discusses the anticipated performance of the treatment option an alternative utilizes. These criteria are evaluated due to the statutory preference for selecting a remedial action that employs treatment as a means to reduce the toxicity, mobility, or volume of materials. Aspects of this assessment include the amount of materials treated or destroyed; the degree of expected reduction in toxicity, mobility, or volume, the degree of irreversibility, and the type and quantity of residuals remaining on-site after treatment. The toxicity and volume of waste is not reduced under any of the four alternatives, and the mobility is not affected by Alternatives 1 and 2. However, under Alternative 3 the mobility of contaminants will be reduced by the soil cover, which will limit surface water infiltration. The mobility of the waste will be greatly reduced under Alternative 4 because the waste will be placed in an appropriate containment cell.

5.9.5 Short Term Effectiveness

Short-term effectiveness relates to the protection of the community and workers during remedial actions, and environmental impacts that would occur during the implementation of remedial actions.

Alternative 1 will have no short-term or long-term effectiveness. Alternative 4 will have the greatest long-term effectiveness and permanence, but the least short-term effectiveness due to risks posed to workers, the community, and the environment during the remedial action. Alternatives 2 and 3 have the same level of long-term effectiveness and permanence, but Alternative 3 has a slightly lower level of short-term effectiveness than Alternative 2 because some risks are posed to the workers, community, and the environment from truck traffic, site clearing, ecological impacts from the activity, and potential dust. Risks to workers and the community will be mitigated through appropriate health and safety measures. Minor impacts to the ecological community at McClellan will be of relatively short duration and the area will be returned to a useable condition following completion of the remedial actions.

5.9.6 Implementability

The discussion of implementability details the technical and administrative feasibility of implementing an alternative as well as the availability of the necessary materials, and technology; the reliability of the technology; the ability to obtain the necessary equipment, specialists, services and capacities; the ability to monitor the remedial performance and effectiveness; and the ability to obtain agency approval and any necessary permits.

Alternatives 1 and 2 are readily implementable. Some degree of complexity may be involved during implementation of Alternatives 3 and 4 associated with parcel clearance. Alternative 4 has more complexity due to excavation of all of the waste. These actions may mobilize more compounds into the environment.

5.9.7 Community Acceptance

The assessment of community acceptance evaluates the concerns and issues the public may have regarding each alternative. This assessment tries to evaluate the intended reuse option with the final site condition based on the action.

The community is not likely to accept Alternative 1, but may accept Alternatives 2, 3, and 4. The likelihood of residential use of the site has been eliminated by a deed restriction. Therefore the risk under

the probable reuse scenario is acceptable, and Alternatives 2, 3, and 4 will likely be acceptable to the community.

5.9.8 Cost

The cost estimates presented are based on a variety of information including quotes from vendors and local suppliers, generic unit costs, conventional cost estimating guides, and previous experience. The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The actual costs will depend on true labor and material costs, actual site conditions, competitive market conditions, final project scope, the implementation schedule, government regulatory fees and charges, and other variable factors. The cost evaluations are designed to determine relative cost impacts for each alternative.

Annual operation and maintenance (O&M) costs are post-construction expenses necessary to maintain the remedial action. These expenses include operating labor, maintenance materials and labor, energy, purchased services, periodic site reviews, and performance monitoring. The estimates include those costs that may have been incurred even after the initial remedial activity is complete.

A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, typically the current year. The present worth costs were determined based on a 5 percent interest rate, for a 30-year time frame. The engineering and design cost is assumed to be 10 percent of the total worth of capital cost. The sum of these costs is then presented as Net Present Worth (NPW).

The estimated costs are used for comparison of alternatives, and are expected to provide an accuracy of +50 percent to -30 percent. Since the costs of alternatives are developed for comparison among and between alternatives the JPA has not updated the estimated costs provided in the Army EE/CA (IT, 2002). Those original costs are presented in Table 5-9. The Army cost calculation sheets are provided in Appendix G.

5.9.9 Summary of Comparative Analysis of Alternatives

Each alternative was compared against nine evaluation criteria. The alternative was assigned a point value under each evaluation criteria. The point value ranges from 0 to 3. A description of the point rating system for each criterion is provided in Appendix H. The points for each alternative are added, resulting in a total point value for each alternative, thus providing a simple comparison of the alternatives. Table 5-

9 provides a summary of the criteria and costs for the four alternatives. The following costs and evaluation scores were determined by the Army (IT, 2002) for each alternative:

- Alternative 1: NPW = $0, Score = 13.5
- Alternative 2: NPW = $189,000, Score = 17.2
- Alternative 3: NPW = $1,018,000, Score = 17.7
- Alternative 4: NPW = $1,915,000, Score = 20.3.

Although Alternative 1 has the lowest NPW, it may not be accepted by the community and ADEM as an acceptable alternative. Alternatives 3 and 4 have the highest point scores; however, the costs are not justified by the slight increase in the score. Thus, Alternative 2 is proposed as the best and most cost-effective alternative. The uncertainty analysis supports the conservative nature of the ecological risk analysis and demonstrates that existing Landfill No. 2, Parcel 79(6), conditions may be factors that justify current conditions as an acceptable ecological risk level. The human health risks for a residential exposure scenario also are very conservative. Based on acceptable risk levels associated with the proposed reuse, Alternative 2 should be acceptable and cost effective.

5.10 RECOMMENDATIONS

At Landfill No. 2, Parcel 79(6) the streamlined risk assessment indicates human health risks associated with chemical constituents exists in surface soils under a residential reuse scenario, although the human health risk for the planned reuse scenario is acceptable. The ecological risk assessment indicated potential ecological risk associated with Landfill No. 2; however, the uncertainty analysis for the ecological risk assessment identified several factors that could mitigate the potential ecological risks. The residential reuse scenario has been eliminated by deed restriction, therefore there is no justification for remediation. Based on the results of the field investigations, the current and proposed future land use, and the results of the risk assessments completed for Landfill No. 2, Parcel 79(6), the recommended remedy is LUCs.

The specific LUCs include placing a deed notice that will prevent residential reuse of the property and excavation within the landfill, and installing signs and monuments to mark the boundaries of the fill. These LUCs are selected to fulfill the requirements of Section IV B of the CA. The residential use deed restriction LUC has been completed as part of the September 30, 2003 property transfer from the Army to the JPA. The remaining LUCs will be completed by the JPA.

As post closure activities in accordance with the requirement in Part VI of the CA, the JPA proposes to repair the existing soil cover in areas where the integrity of the existing cover has been compromised. In addition, the JPA will provide regular cover inspections and repair as necessary to ensure that a satisfactory cover remains in place, no debris is exposed and the integrity of the cover is maintained for the period of required post closure monitoring.

A CMIP will be prepared in accordance with the requirements of the CA which will provided the details of the LUC implementation and the post closure maintenance and monitoring activities.

6.0 LANDFILL NO. 4 AND THE INDUSTRIAL LANDFILL, PARCELS 81(5) AND 175(5)

6.1 SITE LOCATION

Landfill No. 4, Parcel 81(5), is located at the northern end of the Main Post, east of former Landfill No. 3, Parcel 80(6), and covers a total of 43.3 acres. The active Industrial Landfill, Parcel 175(5), is located on approximately 15.9 acres of Landfill No. 4 that was not previously used (ESE, 1998). Landfill No. 4 was permitted as the "FTMC Sanitary Landfill." A site location map is provided on Figure 2-1.

6.1.1 Facility Type and Operational Status

Landfill No. 4, Parcel 81(5), was opened in 1967 as the Main Post sanitary landfill and operated until April 1994. The landfill was unlined, was not equipped with a leachate collection system, and used trench and fill as the method of disposal. The landfill reportedly received all of the Main Post household garbage, construction and demolition debris, oil-contaminated soil, and dead animals used in the U.S. Army Chemical School demonstrations (Weston, 1990). One pound of waste Diazinon dust (pesticide) also was reportedly disposed at Landfill No. 4 and the Industrial Landfill (ESE, 1998). The landfill was closed in April 1994 because of changes in the permit requirements governing sanitary landfills. The regulations now require all sanitary landfills to be lined. FTMC decided it would be more cost effective to dispose trash off site at the Calhoun County transfer station than to upgrade the landfill. Figure 6-1 indicates the extent of the permitted landfill, the industrial landfill, retention ponds, and borrow area.

FTMC received a temporary permit in 1993 to dispose of industrial and construction debris at this location. An application was then filed for a permanent industrial landfill permit to dispose of waste on top of the filled trenches. ADEM advised FTMC to apply for a 30-ton/day-limit permit and use a previously unused section of the landfill property. This permit was issued in October 1995. The Industrial Landfill, Parcel 175(5), is shown on Figure 6-1 in the northeast corner of Landfill No. 4, Parcel 81(5). A revised permit for the Industrial Landfill allows 1,200 tons per day of disposal. This permit has been transferred to the JPA and a copy of the permit is included in Appendix I.

6.1.2 Previous Work

Previous environmental work conducted at Landfill No. 4 includes the Enhanced PA (Weston, 1990) and the Landfill and Fill Area EE/CA (IT, 2002)

6.1.2.1 Investigation

The Enhanced PA (Weston, 1990) identified Landfill No. 4, Parcel 81(5), as an AREE and provided general information regarding Landfill No. 4 and the Industrial Landfill operations and known or potential releases from Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5). Information reported in the PA was obtained from existing records and interviews with various FTMC personnel.

According to the PA report (Weston, 1990), past violations of state and federal requirements included standing water in trenches and lack of adequate compaction. Figure 3-2 of the PA report showed the locations of former monitoring wells A-1 through A-5 (2-inch wells installed in 1976) and wells W-1 through W-9 (4-inch wells installed in 1982). Groundwater data through 1983 indicated four metals, toluene, and chloride had exceeded drinking water standards or the established background levels at Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5). In 1982, one monitoring well (A-4) located within the waste fill boundary was actively venting landfill gas. Landfill gas data from the past five years are included in Appendix J. Groundwater analytical data collected from 1994 through 1998 is presented in Appendix A, Table A4-1

6.1.2.2 EE/CA Fill Area Definition

IT did not conduct intrusive fill area definition activities at Landfill No. 4 because the landfill boundaries are well-defined and contents are known.

6.1.2.3 Joint Powers Authority Investigation

Based on the agreement reached during the March 2003 landfill EE/CA meeting, ESCA, and the requirements of the CA, the JPA performed additional groundwater sampling from five locations surrounding Landfill No. 4 and the Industrial Landfill. Samples were collected on March 31, 2004. The purpose of these samples was to refine the characterization of regional groundwater contamination within the vicinity of the aforementioned landfills (SFSP, Matrix, 2004). Groundwater samples were submitted for analyses of for metals, SVOCs, and VOCs. Samples were collected according to the *Final Installation Wide Work Plan* (IT, 1998), the *Installation Wide Sampling and Analysis Plan* (MES, 2004) and the *Site-Specific Field Sampling Plan for Landfill 4* (MES,2004c). Figure 6-1 shows the locations of these samples.

6.1.3 Structures/Topography

The combined landfill area covers 59.2 acres of relatively flat land of which a portion is within the floodplain of Cave Creek (see Floodplain Map on Figure 2-4). A soil borrow area is located south of the landfill. The landfill currently rises above the surrounding grade by approximately 10 to 15 feet. With the exception of the Industrial Landfill, Parcel 175(5), Landfill No. 4, Parcel 81(5), is covered with an engineered, low-permeability clay cover that met the landfill closure requirements at the time of closure. The entire Landfill No. 4 is devoid of natural vegetation, but is currently covered with seeded grasses and vegetation. A concrete-lined drainage swale runs from east to west across most of Landfill No. 4 and the Industrial Landfill. Landfill No. 4 and the Industrial Landfill are bound on the north by mixed coniferous/deciduous forest and Reilly Airfield, on the east by mixed coniferous/deciduous forest, on the south by a borrow area, and on the west by a road and Landfill No. 3, Parcel 80(6). Much of the perimeter of Landfill No. 4 and the Industrial Landfill is enclosed by chain-link fence that restricts access to Landfill No. 4 and the Industrial Landfill. Surface water is diverted around the landfill by concrete ditches that drain into a settling pond at the southeastern end of the landfill. These structures are shown on the Landfill No. 4 and Industrial Landfill detail map (Figure 6-1). Drainage exits the site to the north into a culvert under Reilly Airfield.

The proposed borrow area, located just south of Landfill No. 4 is approximately 1200 x 600 feet and will yield approximately 660,000 cubic yards of soil. The total volume of soil was estimated without a borrow area investigation and assumes that all soils from ground surface to groundwater are suitable for use. The proposed borrow area will be set back 300 feet from the road on the east side and 100 feet from the roads on the west and south sides of the area. A 3:1 cut slope will be utilized on the east, west, and south sides of the borrow area. The floor of the borrow area will be designed to drain freely into the existing retention pond on the southeast corner of Landfill No. 4.

6.1.4 Hydrogeology

Five monitoring wells were installed within Landfill No. 4, Parcel 81(5), in 1976; ten additional wells were installed around the perimeter of the landfill in 1982. Soil boring and well installation records are not available for these wells. All of these wells were decommissioned prior to landfill closure. Five new wells (MW1-94, MW2-94, MW3-94, MW4-94, and MW5-94) were installed at Landfill No. 4 and the Industrial Landfill in 1994. None of the borings for these wells penetrated fill material (IT, 2001 a, Appendix F). A geologic map of Landfill No. 4 and the Industrial Landfill is presented on Figure 2-2.

Reported geotechnical soil properties measured in subsurface soils at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), show a range in hydraulic K of 3.9x10-8 cm/sec to 4.2x10-7 cm/sec. Underlying soils are classified generally as silts to silty and clayey sands (USAEHA, 1976).

A groundwater elevation map was constructed using March 2004 water level data and is presented on Figure 6-2. Wells MW-1, MW-2, MW-3, MW-4, and MW-5 were measured and had groundwater elevations ranging from 742.02 to 719 feet above msl. Gradient over Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), ranges from 0.01 to 0.02 ft/ft. Groundwater flow is generally to the northwest and north.

6.1.5 Surrounding Land Use and Populations

The area around Landfill No. 4, Parcel 81(5), is currently used primarily for waste disposal and borrow soil activities. The areas surrounding the landfill and borrow areas are currently used for passive recreation. There is no likelihood of residential use of Landfill No. 4 and the Industrial Landfill, and therefore no residential soil exposure scenario has been proposed for Landfill No. 4 and the Industrial Landfill. The groundwater from the site was evaluated using a residential exposure scenario as a conservative baseline. Because of the landfill closure requirements, it is unlikely that any reuse would be allowed until final closure is achieved.

6.1.6 Sensitive Ecosystems

The ecological setting at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), is defined by the fact that portions are currently active (i.e., active landfilling and earth-moving operations) and the remainder is characteristic of recent landfilling and earth-moving operations. The original ecological setting has been altered through significant anthropogenic activities. Consequently, the topography and resultant habitat types are not characteristic of areas that have not been altered by man. Although Base maps indicate the presence of wetlands in the area of Landfill No. 4 and the Industrial Landfill, due to the activity over the last 40 years, there are no apparent sensitive ecosystems associated with Landfill No. 4 and the Industrial Landfill. A complete description of the Landfill No. 4 and the Industrial Landfill environmental setting is included in Section 7.3.1.

6.1.7 Analytical Data

The summary tables of Army data for Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), identify compounds that exceed the screening criteria as defined in the *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000a) and the *Final*

Background Metals Survey Report, FTMC, Alabama (SAIC, 1998). Appendix A includes a summary of all detected compounds in samples collected at Landfill No. 4 and the Industrial Landfill by the Army and compares analyte concentrations against background values (metals only), SSSLs, and ESVs for the various sample media collected at Landfill No. 4 and the Industrial Landfill. Metals that exceed both the BTV (two times background) and the SSSL and organic compounds that exceed SSSL are identified as COCs and are summarized for each sample medium in Table 6-1. JPA results are not included in the table below. A summary of the most recent results obtained by the JPA can be found in Table 6-2.

6.1.8 Potential Source of Contaminants

The Industrial Landfill accepts industrial wastes including construction/demolition waste and rubbish. Construction debris includes, but is not limited to: masonry materials, sheet rock, roofing waste, insulation, rebar, scrap metal, paving materials, and wood products. In addition, there is a designated area for asbestos disposal (ESE, 1998). Sludges from the oil/water separators from the Main Post that do not have separate National Pollutant Discharge Elimination System (NPDES) permits are spread in one area of the Industrial Landfill. This type of sludge is classified as a "special waste" and is covered under the Industrial Landfill Permit No. 08-02R (ESE, 1998).

The extent of the landfill and the location of existing monitoring wells are shown on the groundwater elevation map on Figure 6-2. Available validated analytical data indicate that seven metals (antimony, arsenic, barium, cadmium, iron, lead, and magnesium) and one VOC, TCE, have exceeded their respective background values and SSSLs for metals and the SSSL for the VOC. Groundwater analytical results showed TCE exceeded the SSSL for one sampling event at one well. Subsequent samples over the next three events at the same well did not indicate elevated concentrations of TCE.

Metals observed in groundwater were associated with high turbidity. Subsequent evaluation of this issue indicates that elevated metals due to highly turbid samples are not representative of actual groundwater concentrations. Appendix E presents a discussion of the issues and the BCT's position regarding metals in these samples. Consequently, metals in groundwater are believed to be the result of high turbidity and not due to impacts to groundwater.

The JPA investigation analyzed groundwater samples for both total and dissolved metals in an effort to address the turbidity issues encountered previously by the Army.

6.2 STREAMLINED HUMAN HEALTH RISK ASSESSMENT

Groundwater was the only medium considered for the human health SRA for Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5). Landfill No. 4 was closed in 1995; in accordance with current ADEM solid waste regulations, a minimum of 2 feet of cover was placed over the landfill. Because the site is covered with clean soil, no exposure route exists for direct human contact with potentially contaminated media. No soil samples have been collected from Landfill No. 4 or the Industrial Landfill. SRA tables, figures, and attachments are included in Appendix C.

6.2.1 Groundwater

Sixty-five groundwater samples, collected between 1994 and 1998, were used to evaluate a resident's exposure to groundwater at these sites (Table C4-1). All of these samples were analyzed for metals and VOCs.

Based on the Army investigations (IT, 2002) twelve metals and one VOC (trichloroethene) were detected in the samples, as presented in Table C4-2. After the metals were screened against background, statistical testing was conducted, and the essential nutrients were removed, eight metals were determined to be site-related chemicals (Table C4-2). Antimony concentrations in site groundwater were found to be drawn from the same population as background antimony groundwater concentrations; therefore, antimony was not selected as a site-related chemical (Appendix C, Attachment C-7).

The chemicals determined to be site-related were compared to the residential groundwater SSSLs. All site-related metals, except beryllium, were selected as COPC (Table C4-3). All metals were selected for their noncancer effects.

Table C4-4 presents the HI and ILCR calculated for the resident exposed to groundwater at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5). The resulting HI (13) is above the acceptable threshold for noncancer hazard. When broken down by target organ, cadmium and manganese are the only metals that are determined to be COCs based upon their noncancer effects. The resulting HIs, when broken down by target organ, are cadmium (1.5) and manganese (2.5). RGOs are presented for these metals in Table C4-6. However, cadmium is among the metals detected only in groundwater samples compromised by high turbidity, and manganese is among those whose concentrations are one to two orders of magnitude higher in samples with high turbidity.

The JPA data indicate that barium, calcium, magnesium, and sodium were detected at concentrations greater than two times the background concentration; however, only sodium exceeded the 95% UTL. Sodium is a macronutrient and was detected at a concentration less than ten times the background concentration; therefore this compound is not considered a COC. The metals data analyzed for both total and dissolved values show good agreement indicating that the minor amount of turbidity observed in the samples is not adversely affecting sample results. The JPA data are provided in Table 6-2 and do not support the identification of any metals COCs in groundwater at Landfill 4 and the Industrial Landfill.

The only VOC detected by the JPA was chlorobenzene which was detected in one location, at a concentration less than the residential or groundskeeper SSSL. Therefore, it is not considered a COC. The JPA data do not confirm any groundwater COCs at Landfill 4.

6.2.2 Uncertainty Analysis

The Army (IT, 2002) identified a source of uncertainty in the selection of cadmium and manganese as COCs based on their concentrations in groundwater, but it is known that contamination with sediment as reflected by high turbidity exaggerates their apparent concentrations in groundwater. The JPA investigation analyzed for both total and dissolved metals in an effort to deal with this issue. Cadmium was not detected in any of the total or dissolved samples collected by the JPA and manganese was below the UTL; therefore this uncertainty has been minimalized.

Another source of uncertainty arises from the detection of TCE in one of 65 samples reported by the Army (IT, 2002). The reported concentration is greater than the reporting limits, so there appears to be little question of chemical identity or the reported concentration. The lack of identification of trichloroethene in the other 64 samples, however, suggests that a plume does not exist, or at least that concentrations are well below the reporting limit of 5 micrograms per liter (µg/L). The source of the TCE in this single sample and whether its concentration is increasing or decreasing imparts uncertainty and possibly a non-conservative bias to the SRA. The JPA investigation did not detect TCE in the groundwater and therefore further uncertainty surrounds the validity of the earlier results.

6.2.3 SRA Conclusions

It is unlikely that any receptors would be exposed to any potentially contaminated medium at Landfill No. 4, Parcel 81(5), or the Industrial Landfill, Parcel 175(5). Cadmium and manganese were identified as COCs in groundwater, but this is probably due to high turbidity of the samples. As a result of the JPA investigation, these COCs have been removed. With regard to TCE in groundwater, exposure is only

possible if the groundwater is developed as a source of potable water. Additionally, the TCE was present in only one of 65 samples collected from the period 1994 through 1998 and the JPA data did not detect TCE. TCE is therefore eliminated as a COC. Subsurface soil becomes a medium of interest only if the proposed site-use changes, and future development requiring excavation is planned.

6.3 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

This section presents the SLERA for Parcels 81(5) and 175(5).

6.3.1 Environmental Setting

The ecological setting at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), is defined by the fact that portions are currently active (e.g. active landfilling and earth-moving previous operations) and the remainder is characteristic of recent landfilling and earth-moving operations. The original ecological setting has been altered through significant anthropogenic activities. As such, the topography and resultant habitat types are not characteristic of similar areas that have not been altered by man.

Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), are located in the northwestern corner of the Main Post and encompass a total area of approximately 56 acres. Landfill No. 4 and the Industrial Landfill are almost entirely flat except for the northern and western boundaries, which exhibit a steep embankment formed by the placement of landfilled material. The entire Landfill No. 4 and the Industrial Landfill area is devoid of natural vegetation and a concrete-lined drainage swale runs from east-to-west across most of Landfill No. 4 and the Industrial Landfill. Landfill No. 4 and the Industrial Landfill are bounded on the north by mixed coniferous/deciduous forest and Reilly Airfield, on the east by mixed coniferous/deciduous forest, on the south by a borrow area, and on the west by Landfill No. 3, Parcel 80(6). The entire perimeter of Landfill No. 4 and the Industrial Landfill is enclosed by chain-link fence.

Terrestrial habitat at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), is restricted to grasslands where active landfilling is not taking place. Where landfilling and other earth-moving activities are taking place, no ecological habitat is present. The grasslands are comprised of areas that have historically been landfilled and have since been covered with soil and subsequently seeded. Therefore, there are no native plants present at Landfill No. 4 and the Industrial Landfill.

There is a small pond present in the southwest comer of Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), which serves as a retention basin for surface runoff from the landfill. This small

pond is relatively shallow, has a mud bottom with no submerged structure and no vegetation along its banks. This pond was completely dry during the ecological investigation of Landfill No. 4 and the Industrial Landfill (September 2000), but most likely holds water for significant periods of time during the year. Another pond is present just southeast of Landfill No. 4 and the Industrial Landfill between the landfill and the borrow area. This pond is also relatively shallow, has a mud bottom and no submerged structure. There is no vegetation along the banks of this pond either. A concrete-lined drainage ditch bisects Landfill No. 4 in an east-west direction, but provides no aquatic habitat because it is concrete-lined and does not hold any standing water. Base maps also show that there may be small, isolated wetlands (see Figure 2-4) that adjoin Landfill No. 4 and the Industrial Landfill, although physical inspection has not identified these areas.

The habitat present at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), is minimal due to the continued landfilling operations at the Industrial Landfill and the limited quality of the habitat that exists outside of the active landfilling area. The 6-foot-high chain-link fence that surrounds Landfill No. 4 and the Industrial Landfill also limits the access of larger animals onto Landfill No. 4 and the Industrial Landfill. Terrestrial species that may inhabit the grasslands of Landfill No. 4 and the Industrial Landfill include open field species such as a number of species of mice and rats (e.g., white-footed mouse, eastern harvest mouse, cotton mouse, eastern woodrat, and hispid cotton rat), eastern cottontail, and various song birds. Game birds present in the vicinity of Landfill No. 4 may include northern bobwhite (*Colinus virginianus*), mourning dove (*Zenaida macroura*), and eastern wild turkey (*Meleagris gallopavo*). A variety of raptors (e.g., red-tailed hawk, sharp-shinned hawk, barred owl, and great horned owl) could also use portions of this area for a hunting ground, particularly the fringe areas adjacent to the roads.

6.3.2 Chemicals Detected

Chemicals detected in environmental media at Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5), are summarized in Appendix A.

6.3.3 Chemicals of Potential Ecological Concern

Groundwater was the only medium sampled at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5). Because the site is covered with clean soil, no exposure route exists for direct contact of ecological receptors with potentially contaminated media. No soil, surface water, or sediment samples have been collected from Landfill No. 4 or the Industrial Landfill. Therefore, no COPECs have been identified at Landfill No. 4 or the Industrial Landfill.

6.3.4 SLERA Uncertainty Analysis

No surface soil, sediment, or surface water samples were collected at Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5). However, no sensitive ecological receptors have been identified at the sites. As described in Section 7.3.1, portions of Landfill No. 4 and the Industrial Landfill are currently active (e.g., active landfilling and earth-moving operations) and the remainder of Landfill No. 4 and the Industrial Landfill is characteristic of recent landfilling and earth-moving operations and is covered by grasslands.

If land use or receptor scenarios change for Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5), especially if landfilling operations cease and the area is left to re-colonize ecologically, it may be necessary to evaluate Landfill No. 4 and the Industrial Landfill in more detail.

6.3.5 SLERA Conclusions

No sensitive ecological receptors have been identified at Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5). As described in Section 7.3.1, portions of the sites are currently active (e.g., active landfilling and earth-moving operations) and the remainder of the sites are characteristic of recent landfilling and earth-moving operations and are covered by grasslands. There are two retention basins at the southwest and southeast corners of Landfill No. 4 and the Industrial Landfill; however, they provide poor quality aquatic habitat due to the fact that they are dry during portions of the year, support no aquatic vegetation, and have no submerged structure or vegetation along their banks. Therefore, no COPECs were identified at Landfill No. 4 and the Industrial Landfill.

6.4 RECOMMENDATIONS

Landfill 4 has been closed by the Army in accordance with ADEM Solid Waste Division requirements. The existing clay soil cover over Landfill No. 4 met all regulatory requirements for closure in 1994, and the JPA is continuing long-term groundwater monitoring to maintain compliance with the closure standards for Landfill No. 4. The Industrial Landfill permit has been transferred from the Army to the JPA. The JPA is considering using the Industrial Landfill for construction and demolition debris from other areas on the former installation. Following the JPA's use of the Industrial Landfill, it will ultimately require closure under ADEM Administrative Code 335-13-4-27 and the current permit. In addition, monuments will be used to define the perimeter of Landfill 4 and the Industrial Landfill.

7.0 FILL AREA NORTH OF LANDFILL NO. 2, PARCEL 230(7)

7.1 SITE LOCATION

The Fill Area North of Landfill No. 2, Parcel 230(7), is located in the north-central part of the McClellan Main Post, northeast of former Landfill No. 2. The fill area is located immediately east of an unimproved road extending north from the CDTF access road (ESE, 1998). This fill area falls within a "Possible Explosive Ordnance Impact Area" shown on Plate 10 of the FTMC Archive Search Report, Maps (USACE, 1999) known as the Anti Tank Range, Parcel 230 Q-X. Figure 2-1 shows the location of the fill area and surrounding area.

7.1.1 Facility Type and Operational Status

The Fill Area North of Landfill No. 2, Parcel 230(7), was identified from a ground scar on the 1961 aerial photo composite (ESE, 1998). Prior to the investigation and fill area definition work performed by IT, there was no documentation of the types of materials disposed at the Fill Area North of Landfill No. 2; however, rusted drum parts, other metal, and construction and demolition debris have been observed. It appears that materials were dumped down the slope, to the east, toward Cave Creek from the unimproved road. The Fill Area North of Landfill No. 2 is now overgrown with vegetation and has large trees growing between the base of the slope on the eastern side of the site and Cave Creek. Figure 7-1 indicates the features within the immediate vicinity around the site.

7.1.2 Previous Work

Previous environmental work addressing the Fill Area North of Landfill No. 2, Parcel 230(7), includes:

- Site-Specific Field Sampling Plan (IT, 1998b)
- Site Investigation and Fill Area Definition Report (IT, 2001 a)
- Landfill and Fill Area EE/CA (IT, 2002)

7.1.2.1 Previous Investigation

IT conducted an SI in 1999 at Parcel 230(7), which included a geophysical survey, trenching, environmental sampling and analysis, and monitoring well installation activities. Geophysical data analysis indicated several landfill pits ranging from low to moderate concentrations of buried metal, and numerous isolated buried metallic objects/debris exist within site boundaries. The total area surveyed was approximately 115,300 square feet (2.7 acres) (Figure 7-2).

Seven soil borings and three temporary groundwater monitoring wells were installed at the site as part of the SI. Borings PPMP-230-GP04 and PPMP-230-GPO6 appear to have penetrated the fill material. The boring log for location PPMP-230-GP04 indicated fill material was encountered between 5 and 7 feet with pieces of brick at about 5 feet bgs. The boring log for location PPMP-230-GPO6 indicated backfill material from 4 feet to 8 feet bgs. Fill material was not observed in any other SI borings drilled at the Fill Area North of Landfill No. 2 (see Figure 7-2).

Twenty metals were detected in the surface soil samples and nineteen metals were detected in the depositional soil samples collected. The concentrations of lead, mercury, selenium, and zinc exceeded the background screening values and ESVs in various samples. Arsenic and iron concentrations in all surface soil and depositional soil samples exceeded the SSSLs. The aluminum concentration in the surface soil sample collected from location PPMP-230-GPO7 also exceeded the SSSL. The concentrations of aluminum, arsenic, and iron were all within the background screening values. All surface soil and depositional soil samples collected had concentrations of aluminum, chromium, iron, and vanadium that exceeded the ESVs.

Twenty-two metals were detected in subsurface soil samples collected. The concentrations of four metals (arsenic, barium, iron, and lead) exceeded the background screening values and SSSLs in the sample collected from location PPMP-230-GP04 and chromium and iron exceeded both the background screening value and the SSSL in the sample collected from location PPMP- 230-GP05. Selenium exceeded the background screening value in the subsurface soil samples collected from locations PPMP-230-GP02, PPMP-230-GP03, PPMP-230-GP04, and PPMP-230-GP05. Fifteen metals detected in the subsurface soil sample collected from location PPMP-230 GP04 exceeded the background screening values.

Eleven VOCs were detected in the surface and depositional soil samples collected. None of the detected VOC concentrations exceeded the SSSLs. The surface sample collected from location PPMP-230-GP05 had a concentration of m,p-xylenes that exceeded the ESV. Six SVOCs were detected in one surface soil sample collected from location PPMP-230-GP04. None of the SVOCs detected exceeded the SSSLs.

Five VOCs were detected in subsurface soil samples collected; however, none exceeded the SSSLs. Eight SVOCs were detected in subsurface soil samples. One SVOC (benzo[a]pyrene) detected in the sample collected from location PPMP-230-GPO6 exceeded the SSSLs.

Two pesticides were detected in surface soil samples collected from locations PPMP-230-GP04 and PPMP-230-GPO6. None of the detected concentrations exceeded the SSSLs; however, all concentrations exceeded the ESVs. Pesticides were not detected in the three depositional soil samples collected. Three pesticides were detected in the subsurface soil sample collected from location PPMP-230-GP07; however, none of the detected pesticides exceeded the SSSLs. No herbicides, explosives, or PCBs were detected in the surface and depositional soil samples collected. In addition, no herbicides, explosives, or PCBs were detected in the subsurface soil samples collected.

Groundwater samples were collected from the three temporary wells at the Fill Area North of Landfill No. 2. Twelve metals were detected in the groundwater samples collected. Manganese exceeded the SSSLs and the background screening values in the three groundwater samples collected. Aluminum and iron exceeded the SSSLs and background screening values in the groundwater samples collected from locations PPMP-230-GP01 and PPMP-230-GP02. Barium was detected at a concentration exceeding both the SSSL and background screening value in the groundwater sample collected from location PPMP-230-GP02.

Several metals were detected at concentrations exceeding the SSSLs and background screening values. However, the majority of these metals were present in groundwater samples that had elevated turbidity levels at the time of sample collection. The elevated metals results in the groundwater samples collected from locations PPMP-230-GP01 and PPMP-230-GP02 are likely the result of high turbidity.

Eight metals were detected in the surface water samples collected. The surface water sample collected from location PPMP-230-SW/SD01 had a concentration of thallium exceeding the SSSL, ESV, and background screening value; however, the result was flagged with a "B" data qualifier. Two metals (aluminum and barium) exceeded the ESVs ; however, the aluminum result from location PPMP-230-SW/SD03 was flagged with a "B" data qualifier.

Seventeen metals were detected in the sediment samples collected. The sediment sample collected from location PPMP-230-SW/SD03 had a concentration of mercury exceeding the background screening value and the ESV. No other metals exceeded the ESVs, SSSLs, or background screening values.

Ten metals were detected in seep samples collected. The concentration of manganese in the sample collected from location PPMP-230-SEP02 exceeded the background screening value, SSSL, and ESV. Aluminum and barium concentrations exceeded the ESVs in all three samples. Iron and lead exceeded the ESVs in two of the seep samples collected; however, the lead results were all flagged with a "B" data

qualifier. Calcium was detected in the seep sample collected from location PPMP-230-SEP01 and potassium was detected in the seep sample collected from location PPMP-230-SEP03 at concentrations that exceeded the background screening values but not the SSSLs or ESVs. Analytical data for Parcel 230(7) is located in Appendix A.

7.1.2.2 EE/CA Fill Area Definition

Five exploratory trenches were excavated at the Fill Area North of Landfill No. 2 to characterize the horizontal and vertical extent of the fill area. A remote-controlled excavator was used for the trenching because of the potential for UXO. Trenches were excavated to depths ranging from 2 to 7 feet bgs. Trench logs do not indicate the presence of groundwater in the trenches. Trench location T230-1 was placed to characterize the eastern horizontal extent, location T230-2 and T230-3 were placed to characterize the northern horizontal extent, location T230-4 was placed to characterize the northwestern extent, and location T230-5 was placed to characterize the western extent of the fill area.

Fill materials observed in all of the trenches included: metal bars/pipes, wiring, glass bottles/jars, red bricks, light gray sand and clay, orange/red sand and clay, black clay pipe, piece of 100 pound concrete bomb, ceramic pieces, cement blocks, metal u-rings, pieces of a 55-gallon metal drum, gravel, asphalt, empty shotgun shell, burned wood, burned newspaper, burned roots, and tin foil. The trenches contained varying amounts of steel/metal material, which correspond to the varying concentrations of buried metal anomalies shown in the geophysics report. The anomalies shown as elevated conductivity on the geophysical report correspond to the trenches containing varying amounts of disturbed clay and low amounts of metal material.

Based on the results of the exploratory trenching at the Fill Area North of Landfill No. 2, the horizontal extent of the fill area has been defined. The approximate extent of the fill area at this parcel covers 2.4 acres.

One boring was installed to a depth of 18 feet bgs at the Fill Area North of Landfill No. 2. One fill material sample was collected for chemical analysis from the boring at location FA-230 SB01. Nineteen metals were detected in the fill material sample collected. Concentrations of aluminum, arsenic, and iron exceeded the SSSLs. Concentrations of beryllium, calcium, copper, lead, magnesium, potassium, and zinc exceeded the background screening values.

Sixteen SVOCs were detected in the fill material sample collected. Benzo(a)pyrene was detected at a concentration exceeding the SSSLs. None of the reported concentrations exceeded the ESVs. Four pesticides were detected in the fill material sample collected. Pesticides 4,4'-DDD, aldrin, and dieldrin exceeded the SSSLs. One PCB (Aroclor 1260) was detected in the fill material sample at a concentration exceeding the SSSL. Analytical data for Parcel 230(7) is located in Appendix A.

IT has estimated the vertical and horizontal extent of fill material at the Fill Area North of Landfill No. 2 based on information gathered from previous site investigations and trenching and boring activities discussed in this report. The fill area covers approximately 2.4 acres. The average depth of fill material estimated from the trench and boring log data is approximately 15 feet bgs with soil cover thickness ranging from 0-2 feet.

7.1.3 Joint Powers Authority Investigation

Because the Draft Final Army EE/CA (IT, 2002) recommended No Further Action and the March 2003 landfill EE/CA meeting concluded that no additional investigation was required, the JPA did not collect any additional samples at this site. The EE/CA results and recommendations in following sections are exactly as reported in the Draft Final Army EE/CA (IT, 2002).

7.1.4 Structures/Topography

The Fill Area North of Landfill No. 2, Parcel 230(7), encompasses a total area of approximately 2.4 acres of which a portion is located along the western edge of the floodplain of Cave Creek. A floodplain map is presented on Figure 2-4. The Fill Area North of Landfill No. 2 is bounded on the north by mixed deciduous forest, on the east by Cave Creek, on the south by an asphalt road, and on the west by a dirt road. That portion of the Fill Area North of Landfill No. 2 directly adjacent to the dirt road is relatively flat. The fill area slopes steeply to the east where it adjoins the floodplain of Cave Creek, which flows in a southerly direction. Refuse is also visible along the steep embankment that is adjacent to the creek floodplain. In some areas the refuse slope is directly adjacent to Cave Creek. Surface elevations range from approximately 830 feet above msl near the unimproved road to approximately 805 feet above msl near Cave Creek at the base of the slope.

The Fill Area North of Landfill No. 2, Parcel 230(7), geology is presented on Figure 2-2. The site lies primarily within Shady Dolomite (Cambrian), with a contact with the Chilhowee Group to the west that impinges on the southwestern portion of the site. The Chilhowee Group (Weisner Formation) is composed of an orthoquartzitic sandstone and quartzite. The eastern boundary of the Fill Area North of

Landfill No. 2, Parcel 230(7), is made up of alluvium from Cave Creek and tributaries to Cave Creek that join the creek east of the site.

7.1.5 Hydrogeology

Three shallow, temporary groundwater monitoring wells were installed near the toe of the waste fill as part of the SI conducted by IT. Monitoring well locations and groundwater elevation contours (based on March 2000 water level data) developed by the Army show that the groundwater gradient follows the topographic gradient of the creek and is approximately 0.02 ft/ft. Groundwater was encountered during drilling at depths of approximately 1.5 to 5.5 feet bgs. The shallow depth to groundwater reflects the proximity of the wells to Cave Creek. Groundwater elevations at the Fill Area North of Landfill No. 2, Parcel 230(7), ranged from 810.24 to 801.54 feet above msl in 2000.

Seeps have been reported along the base of the slope but were not observed by IT during a June 1998 site visit; however, the seeps were observed and sampled during the February 1999 sampling event.

The JPA sis not perform any additional sampling at this site therefore no recent groundwater elevation data are available. Because of the proximity to Cave Creek and the shallow depth to groundwater observed in March of 2000 the groundwater flow direction is not expected to vary.

7.1.6 Surrounding Land Use and Populations

The Fill Area North of Landfill No. 2, Parcel 230(7), is located in a restricted area that is within the former impact area for UXO. The site is adjacent to the DOJ CFDP training center, which is a restricted access area. The area is heavily overgrown with vegetation. Cave Creek flows along the eastern base of the fill area. The reuse scenario for Fill Area North of Landfill No. 2 is primarily for a recreational user, with a secondary scenario for residential to provide a comparison.

7.1.7 Sensitive Ecosystems

The ecological setting at the Fill Area North of Landfill No. 2, Parcel 230(7), is largely defined by the topography of the site, which is a result of filling activities that have historically occurred at the site. The original ecological setting has been altered through significant anthropogenic activities. Consequently, the topography and resultant habitat types may not be characteristic of similar areas that have not been altered by man. Although there are no aquatic features within the Fill Area North of Landfill No. 2, Cave Creek and its associated wetlands and floodplain are directly adjacent to the eastern boundary of the site. A complete description of the site environmental setting is presented in Section 7.3.1.

7.1.8 Analytical Data

The summary tables for the Fill Area North of Landfill No. 2, Parcel 230(7), identify compounds that exceed the screening criteria as defined in the *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000a) and the Final Background Metals Survey Report, FTMC, Alabama (SAIC, 1998). Appendix A provides a summary of detected compounds in samples collected at the Fill Area North of Landfill No. 2 and compares analyte concentrations against background values (for metals), SSSLs, and ESVs for the various sample media. Metals that exceed both the BTV (two times background) and SSSLs and organic compounds that exceed SSSLs are summarized for each sample medium in Table 7-1. Groundwater samples indicated high metal concentrations that were associated with the high turbidity of the samples. Appendix E provides the Army's discussion of the impacts of high turbidity on groundwater sample analytical results (IT, 2002).

7.1.9 Potential Source of Contaminants

The location of fill material at the site was interpreted from the geophysical data collected to date and from the trench excavations completed by IT in support of the EE/CA. The detail map shown on Figure 7-1 incorporates all of the historical and recent data in defining the extent of waste at the site. Locations for the more recent Army sampling points are also provided on Figure 7-1. An estimate of the depth of fill is based on the results of boring FA-230-SB01, drilled to a depth of 18 feet bgs. Fill material was encountered to a depth of 15 feet bgs.

The content of the fill material was observed in each of the five trenches excavated at the Fill Area North of Landfill No. 2, Parcel 230(7). The material included: metal bars/pipes and wiring, glass bottles/jars, red bricks, black clay pipe, a piece of a 100-pound concrete practice bomb, ceramic pieces, cement blocks, metal u-rings, pieces of a 55-gallon metal drum, gravel, asphalt, an empty shotgun shell, burned wood, burned newspaper, burned roots, and tin foil. Groundwater was not encountered during trenching operations conducted at the Fill Area North of Landfill No. 2. All the trenches contained varying amounts of steel/metal material, which correspond to the varying concentrations of "buried metal" anomalies shown in the geophysics interpretation (Figure 7-2). Metals results exceeding SSSLs were identified in subsurface soil, groundwater, surface water, and seep samples. Seeps have been reported at the base of the slope on the eastern side of the fill area and were sampled in the fill area investigation.

7.2 STREAMLINED HUMAN HEALTH RISK ASSESSMENT

The SRA for Fill Area North of Landfill No. 2, Parcel 230(7), evaluated surface soil, surface water, sediment, and groundwater. The recreational site-user and resident were the only receptor scenarios appropriate for the current and future land uses proposed. Subsurface soil was not evaluated for this SRA because neither the recreational site-user nor the resident are anticipated to contact subsurface soil (Figure C-5). SRA tables, figures, and attachments are included in Appendix C.

7.2.1 Surface Soil

Fourteen surface soil samples were collected at the site in 1999; data from these samples were evaluated in the SRA (Table C5-1). Six of these samples were analyzed for chlorinated herbicides and pesticides, organophosphorous pesticides, PCBs, SVOCs, VOCs, explosives, and metals. Four sample locations had four samples that were only analyzed for organophosphorous pesticides, while the remaining four samples at those same locations were analyzed for all of the remaining analyses. Each sample location had the same analyses conducted; however, each individual sample did not. Eighteen metals, two chlorinated pesticides, six SVOCs (all PAHs), and ten VOCs were detected, as presented in Table C5-2. After the metals were screened against background and the essential nutrients were removed, only the organics, lead, and mercury were determined to be site-related chemicals (Table C5-2).

The chemicals determined to be site-related were compared to residential and recreational site user soil SSSLs. No COPCs were selected from this screening process; all site-related chemicals had MDCs less than their respective cancer and noncancer SSSLs (Table C5-3).

7.2.2 Surface Water

Six surface water samples were collected at the site in January and February 1999. Three of these samples were collected from seeps, while the three remaining surface water samples were collected from a creek at the site. All of these samples are from locations where surface water is exposed and thus could be accessed by the recreational site-user and the resident. All of the samples were analyzed for chlorinated herbicides and pesticides, metals, SVOCs, VOCs, PCBs, explosives, and organophosphorous pesticides. Table C5-4 presents the surface water samples used in the SRA.

Eight metals and one SVOC were detected in surface water (Table C5-5). After background screening and removal of essential nutrients, all eight metals were determined to not be site related; thus, only bis(2-ethylhexyl)phthalate was selected as a site-related chemical.

The MDC for bis(2-ethylhexyl)phthalate in surface water (1.3E-3 mg/L) was less than both the cancer (5.2E-2 mg/L) and the noncancer (2.1E-1 mg/L) surface water SSSLs for the recreational site-user and resident (Table C5-6). Therefore, the compound was not selected as a COPC for surface water.

7.2.3 Sediment

The three sediment samples utilized in the SRA were collected in January 1999 (Table C5-7). All of the sediment samples for Fill Area North of Landfill No. 2, Parcel 230(7), were analyzed for chlorinated herbicides and pesticides, metals, SVOCs, VOCs, organophosphorous pesticides, explosives, and PCBs.

Sixteen metals, two chlorinated pesticides, and two VOCs were detected in the three sediment samples. Only mercury and the organics were selected as site-related after the background and nutrient screening (Table C5-8). However, none of these chemicals had MDCs greater than their respective SSSLs. Therefore, no sediment COPC were selected (Table C5-9). 8.2.4 Groundwater The three groundwater samples utilized in the SRA were collected in April 1999 (Table C5-10). All of the groundwater samples for Fill Area North of Landfill No. 2, Parcel 230(7), were analyzed for chlorinated herbicides and pesticides, metals, SVOCs, VOCs, organophosphorous pesticides, explosives, and PCBs.

Twelve metals, one SVOC (4-methylphenol), and three VOCs were detected in groundwater. Only the organics were selected as site-related chemicals after the metals background and nutrient screening (Table C5-11). However, none of the site-related chemicals had MDCs greater than their respective SSSLs. Therefore, no groundwater COPC were selected (Table C5-12).

7.2.4 Uncertainty Analysis

If land use or receptor scenarios change in the future, it may be necessary to re-evaluate the site media or add subsurface soil to the media evaluated.

7.2.5 SRA Conclusions

Based upon the samples utilized in the SRA, none of the media evaluated at the Fill Area North of Landfill No. 2, Parcel 230(7) (surface soil, surface water, sediment, or groundwater) pose an unacceptable cancer risk or noncancer hazard to either the recreational site-user or the resident.

7.3 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

This section presents the SLERA for the Fill Area North of Landfill No. 2, Parcel 230(7).

7.3.1 Environmental Setting

The ecological setting at the Fill Area North of Landfill No. 2, Parcel 230(7), is largely defined by the topography of the site, which is a result of filling activities that have historically occurred at the site. The original ecological setting has been altered through significant anthropogenic activities. As such, the topography and resultant habitat types may not be characteristic of areas that have not been altered by man.

The Fill Area North of Landfill No. 2, Parcel 230(7), is located in the north-central portion of the Main Post and encompasses a total area of approximately 2 acres. The site is located adjacent to a north-south trending dirt road. The portion of the site directly adjacent to the road is relatively flat. This flat area represents historical fill material. On the eastern edge of this fill material is a steep slope that adjoins the floodplain of Cave Creek, which flows in a southerly direction along the eastern edge of the site. Refuse and other evidence of past disposal practices are prevalent along the dirt road that forms the western boundary of the Fill Area North of Landfill No. 2, Parcel 230(7), and the adjacent flat area. Refuse is also visible along the steep embankment that is adjacent to the creek floodplain. In some areas the refuse slope is directly adjacent to Cave Creek. The Fill Area North of Landfill No. 2 is bounded on the north by mixed deciduous forest, on the east by Cave Creek, on the south by an asphalt road, and on the west by a dirt road.

Terrestrial habitat at the Fill Area North of Landfill No. 2, Parcel 230(7), is made up of two general types: upland mixed deciduous forest and lowland mixed deciduous forest. The historical fill area and the steep embankment are best characterized as mixed deciduous forest with many of the vegetative species characteristic of disturbed land. Some of the tree species commonly found in this area include mimosa (Albizia julibrissin), mockernut hickory (Carya tomentosa), white oak (Quercus alba), scarlet oak (Quercus coccinea), chestnut oak (Quercus prinus) red maple (Acer rubrum), flowering dogwood (Cornus jlorida), sweetgum (Liquidambar styracijlua), and sourwood (Oxydendrum arboreum). The shrub layer is dominated by southern low blueberry (Vaccinium pallidum), southern wild raisin (Viburnum nudum), and yellowroot (Xanthorhiza simplicissima). Numerous muscadine grape (Vitis rotundifolia) vines, greenbriar (Smilax rotundifolia) and poison ivy (Toxicodendron radicans) are also present in this area.

The lowland mixed deciduous forest is characteristic of a ravine or stream floodplain. This area may be inundated during periods of significant rainfall and contains vegetative species indicative of wetlands. Some of the plant species most commonly found in this lowland mixed deciduous forest include American beech (Fagus grandifolia), tulip tree (Liriodendron tulipifera), white ash (Fraxinus americana), red maple (Acer rubrum), white oak (Quercus alba), American holly (Ilex opaca), pignut hickory (Carya glabra), sweetgum (Liquidambar styracijlua), common persimmon (Diospyros virginiana), and redbud (Cercis canadensis).

Although there are no aquatic features within the Fill Area North of Landfill No. 2, Parcel 230(7), Cave Creek and its associated wetlands and floodplain are directly adjacent to the eastern boundary of the site. Cave Creek in the vicinity of the site flows in a southwesterly direction. The substrate of Cave Creek in this area is mostly gravel and cobbles with small areas of sand and leaf litter. The stream banks are approximately 4 feet high and the width of Cave Creek in this area is approximately 8 feet. The majority of the creek is shallow (less than one foot deep); however, several deeper pool areas are also present in this area. The canopy above Cave Creek in this area is relatively high. In general, the terrain at FTMC supports large numbers of amphibians and reptiles. Jacksonville State University has prepared a report titled Amphibians and Reptiles of Fort McClellan, Calhoun County, Alabama (Cline and Adams, 1997). The report indicated that surveys in 1997 found 16 species of toads and frogs, 12 species of salamanders, 5 species of lizards, 7 species of turtles, and 17 species of snakes. Typical inhabitants of the area surrounding the Fill Area North of Landfill No. 2, Parcel 230(7), are copperhead (Agkistrodon contortix), king snake (Lampropeltis getulus), black racer (Coluber constrictor), fence lizard (Sceloporour undulatus), and six-lined racerunner (Cnemidophorous sexlineatus).

Terrestrial species that may inhabit the Fill Area North of Landfill No. 2, Parcel 230(7), include opossum, short-tailed shrew, raccoon, white-tail deer, red fox, coyote, gray squirrel, striped skunk, a number of species of mice and rats (e.g., white-footed mouse, eastern harvest mouse, cotton mouse, eastern woodrat, and hispid cotton rat), and eastern cottontail. Approximately 200 avian species reside at FTMC at least part of the year (ACOE, 1997). Common species expected to occur in the vicinity of the Fill Area North of Landfill No. 2 include northern cardinal (Cardinalis cardinalis), northern mockingbird (Mimuspolyglottus), warblers (Dendroica spp.), indigo bunting (Passerina cyanea), red-eyed vireo (Vireo olivaceus), American crow (Corvus brachyrhynchos), bluejay (Cyanocitta cristata), several species of woodpeckers (Melanerpes spp., Picoices spp.), and Carolina chickadee (Parus carolinensis). Game birds present in the vicinity of the Fill Area North of Landfill No. 2 may include northern bobwhite (Colinus virginianus), mourning dove (Zenaida macroura), and eastern wild turkey (Meleagris gallopavo). Woodland hawks (e.g., sharp-shinned hawk) were observed in this area during the ecological

investigation (September, 2000) and are expected to use this area for a hunting ground. A variety of other raptors (e.g., red-tailed hawk, barred owl, and great horned owl) could also use portions of this area for a hunting ground, particularly the fringe area where the forested areas abut roads and cleared areas. Because of the presence of Cave Creek, piscivorous bird species may also be present in the vicinity of the Fill Area North of Landfill No. 2. These piscivorous birds may include great blue heron (Ardea herodias), green-backed heron (Butorides striatus), and belted kingfisher (Ceryle alcyon).

Although shallow (less than one foot deep) over most of its length in this area, Cave Creek has the potential to support a variety of amphibious species and some small fish species. The bullfrog (Rana catesbeiana) and leopard frog (Rana sphenocephala) are examples of amphibians that may be found in Cave Creek in the vicinity of the Fill Area North of Landfill No. 2, Parcel 230(7). Fish species that may be found in Cave Creek in the vicinity of the site include blacknose dace (Rhinichthys atratulus), creek chub (Semotilus atromaculatus), stoneroller(Campostoma anomalum), striped shiner (Luxilus chrysocephalus), and various darters (Etheostoma spp.).

Cave Creek, in the vicinity of the Fill Area North of Landfill No. 2, Parcel 230(7), provides low quality gray bat foraging habitat. Two major requirements for gray bat foraging habitat are contiguous forest cover and habitat for aquatic insects (one of the gray bat's preferred dietary items). These two requirements are met by Cave Creek in this area; therefore, gray bats could be expected to utilize this area for foraging.

7.3.2 Chemicals Detected

Chemicals detected in soil, sediment, and surface water at the Fill Area North of Landfill No. 2, Parcel 230(7), are summarized in Appendix A.

7.3.3 Chemicals of Potential Ecological Concern

COPECs are those constituents whose MDCs exceed their respective ESVs. The COPECs that have been identified at the Fill Area North of Landfill No.2, Parcel 230(7), are the following:

- Surface Soil - lead, mercury, selenium, zinc, 4,4'-DDE, 4,4'-DDT, and m,p-xylenes
- Surface Water - manganese and bis(2-ethylhexyl)phthalate
- Sediment – mercury

Aluminum, chromium, iron, manganese, and vanadium did exceed surface soil ESVs; however the concentrations of these constituents did not exceed BSCs. BSCs were established to assess the ambient

concentration of metals. In these instances above, the ESV happens to be less than the BSC. Because the concentrations did not exceed both the BSC and the ESV, no increased risk is found.

7.3.4 SLERA Uncertainty Analysis

The following site-related constituents exceeded their respective ESVs in surface soil at the Fill Area North of Landfill No. 2, Parcel 230(7) (Appendix D, Table D-12): lead, mercury, selenium, zinc, m,p-xylene, 4,4'-DDE, and 4,4'-DDT. Manganese and bis (2 ethylhexyl)phthalate exceeded their ESVs in surface water (Table D- 13) and mercury exceeded its ESV in sediment (Table D-14).

As described in Section 8.3.1, the historical fill area forms a steep embankment and exhibits vegetation characteristic of disturbed land. Because of the relatively low quality of the terrestrial habitat provided by the historical fill area and the relatively small exceedance of the ESVs (mean HQ values range from 0.33 to 1.97), constituents in soil most likely do not pose significant ecological risks to the terrestrial habitats at FTMC.

Cave Creek flows along the eastern boundary of the site and potentially provides low-quality foraging habitat for the gray bat. Manganese and bis(2-ethylhexyl)phthalate exceeded their ESVs in surface water (manganese HQ = 10.56, bis[2-ethylhexyl]phthalate HQ = 4.33) and one constituent marginally exceeded its ESV in sediment (mercury HQ = 1.77). Because bis (2-ethylhexyl) phthalate was detected in only a single sample and the resultant hazard quotient was less than ten, this constituent most likely does not pose significant ecological risk. Although manganese was frequently detected in surface water, the arithmetic mean concentration of samples from Cave Creek near the Fill Area North of Landfill No. 2 is less than the naturally occurring background concentration of manganese. Therefore, manganese is most likely not site-related. Mercury was only detected in a single sediment sample at a concentration that exceeded its ESV. The arithmetic mean concentration of mercury in sediment is less than the naturally-occurring background concentration of mercury in sediment. Therefore, it is most likely not site related. Using these additional lines-of-evidence, it could be concluded that there are no COPECs in surface water or sediment associated with the Fill Area North of Landfill No. 2. The various lines-of-evidence used to draw these conclusions are presented in Table D-29.

7.3.5 SLERA Conclusions

The Fill Area North of Landfill No. 2, Parcel 230(7), is located adjacent to a north-south trending dirt road. The portion of the site directly adjacent to the road is relatively flat. This flat area represents historical fill material. On the eastern edge of this fill material is a steep slope that adjoins the floodplain

of Cave Creek, which flows in a southerly direction along the eastern edge of the Fill Area North of Landfill No. 2. The historical fill area and the steep embankment are best characterized as mixed deciduous forest with many of the vegetative species characteristic of disturbed land. Cave Creek and its associated wetlands and floodplain are directly adjacent to the eastern boundary of the Fill Area North of Landfill No. 2. Cave Creek, in the vicinity of the Fill Area North of Landfill No. 2, provides low-quality gray bat foraging habitat.

The following site-related constituents exceeded their respective ESVs in surface soil (Table D-12): lead, mercury, selenium, zinc, m,p-xylene, 4,4'-DDE, and 4,4'-DDT. Manganese and bis(2-ethylhexyl)phthalate exceeded their ESVs in surface water (Table D- 13) and mercury exceeded its ESV in sediment (Table D-14).

Although the MDCs of a number of constituents exceed their respective ESVs in site media, additional lines-of-evidence suggest that these COPECs may not pose significant risks to the terrestrial or aquatic ecosystems at McClellan. These COPECs (Table D-28) have been identified through a very conservative screening process that utilizes ESVs based largely on NOAELs from the scientific literature and maximum detected constituent concentrations.

7.4 RECOMMENDATIONS

Based on the results of the field investigations, the current and proposed future land use, and the results of the risk assessments completed for Fill Area North of Landfill No. 2, Parcel 230(7), no remediation is recommended. Protection of human health and the environment will be maintained through the implementation of LUCs.

The specific LUCs include placing a deed notice that will prevent excavation within the landfill, and installing signs and monuments to mark the boundaries of the fill. These LUCs are selected to fulfill the requirements of Section IV B of the CA and will be implemented by the JPA.

As post closure activities in accordance with the requirement in Part VI of the CA, the JPA proposes to repair the existing soil cover in areas where the integrity of the existing cover has been compromised. In addition, the JPA will provide regular cover inspections and repair as necessary to ensure that a satisfactory cover remains in place, no debris is exposed and the integrity of the cover is maintained for the period of required post closure monitoring. In addition, rip-rap will be placed on slopes for erosion control. Removal of surface debris will also be performed. Subsurface utilities may also be present on

site. Access to subsurface utilities will be restricted so that intrusive work shall be conducted under a site-specific health and safety plan to ensure worker safety. According to the CA, as modified on October 13, 2005, funding for this site is not appropriated and is not currently available for disbursement; therefore the JPA obligation is pending availability to funds.

A CMIP will be prepared in accordance with the requirements of the CA which will provided the details of the LUC implementation and the post closure maintenance and monitoring activities.

8.0 SUMMARY AND RECOMMENDATIONS

Summary

This EE/CA provides data to support the environmental remediation decisions at five landfills/fill areas located at McClellan. The initial Army EE/CA (IT, 2002) was performed in accordance with current EPA guidance documents for a non-time-critical removal action under CERCLA and summarizes site characterization information and provides human health and ecological risk assessment for all landfills and fill areas in accordance with CERCLA criteria. This EE/CA prepared by the JPA provides an update of information and represents conclusions for five of the sites included in the original Army EE/CA. In addition, for Landfills No. 2 this EE/CA identifies remedial action objectives, potential remedial action alternatives, analysis of these alternatives, and recommends a remedial action alternative. Table 8-1 summarizes the site characteristics of the landfills and fill areas. A summary of the risk assessments performed for the landfills and fill areas is found in Table 8-2.

Recommendations

Based on data presented in this EE/CA, the Army EE/CA, human health and ecological risk assessment results, and evaluation of the alternatives, the JPA recommends the following actions:

- **Landfill No. 1, Parcel 78(6)**: Based on the results of the field investigations performed by the Army and the JPA, the current and proposed future land use, and the results of the risk assessments completed by the Army and supplemented by the JPA for Landfill No. 1, Parcel 78(6), the no remediation is required. Protection of human health and the environment will be maintained through the implementation of LUCs.

  The specific LUCs at Landfill 1 shall be in the form of monuments and signs designating the landfill boundaries and an appropriate notice to deed prohibiting excavation on Landfill 1. As part of the post closure activities required under Part VI of the CA, the JPA proposes to repair the existing soil cover in areas where the integrity of the existing cover has been compromised. In addition, the JPA will provide regular cover inspections and repair as necessary to ensure that a satisfactory cover remains in place, that no debris is exposed, and the integrity of the cover is maintained for the period of required post closure monitoring. Subsurface utilities may also be present on site. Access to subsurface utilities will be restricted so that intrusive work shall be conducted under a site-specific health and safety plan to ensure worker safety. A CMIP will be prepared in accordance with the requirements of the CA which will provided the details of the LUC implementation and the post closure maintenance and monitoring activities.
- **Landfill No. 2, Parcel 79(6)**: At Landfill No. 2, Parcel 79(6) the streamlined risk assessment indicates human health risks associated with chemical constituents exists in surface soils under a residential reuse scenario, although the human health risk for the planned reuse scenario is acceptable. The ecological risk assessment indicated potential ecological risk associated with Landfill No. 2; however, the uncertainty analysis for the ecological risk assessment identified

several factors that could mitigate the potential ecological risks. The residential reuse scenario has been eliminated by deed restriction, therefore there is no justification for remediation. Based on the results of the field investigations, the current and proposed future land use, and the results of the risk assessments completed for Landfill No. 2, Parcel 79(6), the recommended remedy is LUCs.

The specific LUCs include placing a deed notice that will prevent residential reuse of the property and excavation within the landfill, and installing signs and monuments to mark the boundaries of the fill. These LUCs are selected to fulfill the requirements of Section IV B of the CA. The residential use deed restriction LUC has been completed as part of the September 30, 2003 property transfer from the Army to the JPA. The remaining LUCs will be completed by the JPA.

- **Landfill No. 4, Parcel 81(5) and the Industrial Landfill, Parcel 175(5)**: Landfill No. 4 and the Industrial Landfill present no unacceptable human health or ecological risks. The JPA proposes no further action with regard to this EE/CA. Landfill No. 4 has been closed and will continue to be monitored in accordance with Alabama solid waste regulations. The Industrial Landfill permit has transferred to the JPA. Following completion of demolition activities associated with redevelopment of McClellan, the JPA will close the Industrial Landfill in accordance with permit requirements and Alabama solid waste regulations.

- **Fill Area North of Landfill No. 2, Parcel 230(7)**: Based on the results of the field investigations, the current and proposed future land use, and the results of the risk assessments completed for Fill Area North of Landfill No. 2, Parcel 230(7), no remediation is recommended. Protection of human health and the environment will be maintained through the implementation of LUCs.

  The specific LUCs include placing a deed notice that will prevent excavation within the landfill, and installing signs and monuments to mark the boundaries of the fill. Subsurface utilities may also be present on site. Access to subsurface utilities will be restricted so that intrusive work shall be conducted under a site-specific health and safety plan to ensure worker safety. These LUCs are selected to fulfill the requirements of Section IV B of the CA and will be implemented by the JPA.

These actions are compatible with land reuse plans, and are protective of human health and the environment. The JPA also proposes several additional actions at certain fill areas aimed at eliminating the potential for contact with debris and maintaining satisfactory conditions at the landfills into the future.

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Table 4-1
Identification of COCs
Landfill No. 1, Parcel 78(6)
McClellan, Alabama

Medium Sampled	Metals	VOCs	SVOCs	Pesticides I	Explosives I	Herbicides I	PCBs
Surface and Depositional Soil	Al, Fe > BKG and SSSLs	ND	< SSSL	< SSSL	ND	ND	NS
Subsurface Soil	Al, Fe, Sb > BKG and SSSLs	ND	ND	< SSSL	ND	ND	ND
Sediments	< BKG and SSSLs	ND	< SSSL	< SSSL	ND	ND	ND
Fill Material	Al, As > BKG and SSSLs	< SSSL	< SSSL	< SSSL	ND	ND	ND
Groundwater	Al, Ba, Mn > BKG and SSSLs	< SSSL	< SSSL	< SSSL	ND	ND	ND
Surface Water	As > BKG and SSSLs	< SSSL	ND	ND	< SSSL	ND	ND

Al - aluminum
As - arsenic
Ba - barium
BKG - background Fe - iron
Mn - manganese
NA - not analyzed
ND - not detected
NS - not sampled
PCB - polychlorinated biphenyl Sb - antimony
SSSL - site-specific screening level
SVOC - semivolatile organic compound
VOC - volatile organic compound

Table 4-2: Summary of Detections in Surface Water at Landfill 1 Compared to Site-Specific Screening Levels
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Recreational SSSL	LF1-001-SW 4/8/04	LF1-001-SW (FD) 4/8/04	LF1-002-SW 4/8/04	LF1-003-SW 4/8/04	LF1-004-SW 4/8/04
Metals (Total)									
ALUMINUM	mg/L	5.26	17	15.3	0.442	0.111 J	0.21	< 0.2	< 0.2
BARIUM	mg/L	0.0754	0.113	1.1	0.0333	0.0435	0.0442	0.0383	0.101
CALCIUM	mg/L	25.2	64.1	--	6.05	12.4	12.5	23.8	52.4
IRON	mg/L	19.6	41.2	4.7	0.906 J	0.282 J	0.381 J	0.214 J	0.883 J
MAGNESIUM	mg/L	11	24.4	--	3.52	6.33	6.38	8.6	**38.3**
MANGANESE	mg/L	0.565	1.83	0.64	0.0604	0.0109	0.0132	0.00837 J	1.1
POTASSIUM	mg/L	2.56	4.25	--	1.01 J	< 5	< 5	2.57 J	< 5
SODIUM	mg/L	3.44	15.2	--	2.53	4.98	5	3.23	**37.6**

Notes:
-- = Not applicable
< = The result is considered a non-detection at the reporting limit shown.
Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.
FD = Field duplicate
UTL = Upper tolerance level
SSSL = Site-Specific Screening Level
mg/L = milligrams per liter
Bold font indicates that the concentration exceeds the UTL.
Indicates that the value exceeds the SSSL shown as well as background if applicable.
A metal is considered a Constituent of Concern if the Background, 95% UTL, nutrient screening level, and SSSL is exceeded.

Lab Flags:
J = Estimated detection. Concentration is between the method detection limit and reporting limit.

Table 4-3: Summary of Detections in Sediment at Landfill 1 Compared to Site-Specific Screening Levels
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Recreational SSSL	LF1-001-SD 4/8/04	LF1-002-SD 4/8/04	LF1-002-SD (FD) 4/8/04	LF1-003-SD 4/8/04	LF1-004-SD 4/8/04
Metals (Total)									
ALUMINUM	mg/kg	8590	14300	1150000	5520 (JM)	6860	6720	**15100**	8660
ANTIMONY	mg/kg	0.73	--	422	< 14 (UJM)	3.71 J	3.23 J	4.85 J	< 18
ARSENIC	mg/kg	11.3	20.1	55.8	5.92	13.5	12.9	4.84	2.79
BARIUM	mg/kg	98.9	191	83600	69.4 (JM)	27.5	35.3	67.3	53.5
BERYLLIUM	mg/kg	0.97	1.24	150	0.652 J	1.18 J	0.982 J	0.943 J	0.507 J
CALCIUM	mg/kg	1110	2810	--	459	405	556	7030	3630
CHROMIUM	mg/kg	31.2	63.3	1400000	17.7	45.3	42.5	16.6	8.68
COBALT	mg/kg	11	21.9	67200	12.4	9.9	8.58	8.68	9.07
COPPER	mg/kg	17.1	36.8	47900	9	10.2	10.8	**89.1**	33
IRON	mg/kg	35300	51900	359000	23000	57200	42400	28500	12600
LEAD	mg/kg	37.8	76.4	400	15.9	14.8	18.3	20	39.6
MAGNESIUM	mg/kg	906	2200	--	775	657	855	5880	2070
MANGANESE	mg/kg	712	2050	43800	426 (JM)	220	211	440	226
NICKEL	mg/kg	13	31.6	17600	9.96	16.9	12.5	20.6	14.3
POTASSIUM	mg/kg	1010	2790	--	455 J	182 J	523 J	1540	904
SILVER	mg/kg	0.32	--	6070	1.23 J	0.894 J	1.35 J	0.876 J	< 4.5
SODIUM	mg/kg	692	--	--	77.7 J	< 119	< 134	< 132	179 J
VANADIUM	mg/kg	40.9	66.7	4830	25.8	54	39.2	24.9	15
ZINC	mg/kg	52.7	111	344000	33	60.4	55.5	**113**	39
Organochlorine Pesticides									
4,4'-DDD	ug/kg	--	--	235000	7.9	< 4.8	< 5.3	< 26	< 7.2
ALPHA-BHC	ug/kg	--	--	11700	< 2.8	0.54 J	1.5 J	< 13	< 3.6
ALPHA-CHLORDANE	ug/kg	--	--	135000	< 2.8	< 2.4	< 2.7	15	< 3.6
BETA-BHC	ug/kg	--	--	40500	2.4 J	< 2.4	< 2.7	< 13	< 3.6
DELTA-BHC	ug/kg	--	--	313000	2 J	< 2.4	< 2.7	< 13	< 3.6
DIELDRIN	ug/kg	--	--	4070	< 5.6	< 4.8	< 5.3	5.4 J	< 7.2
GAMMA-CHLORDANE	ug/kg	--	--	135000	< 2.8	< 2.4	< 2.7	8.4 J	< 3.6
Semivolatile Organic Compounds									
BENZO(B)FLUORANTHENE	ug/kg	--	--	89300	< 460	< 390	< 440	480 J	< 590
BIS(2-ETHYLHEXYL)PHTHALATE	ug/kg	--	--	5410000	< 460	< 390	< 440	910	< 590

Notes:

-- = Not applicable

Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.

Table 4-3: Summary of Detections in Sediment at Landfill 1 Compared to Site-Specific Screening Levels
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Recreational SSSL	LF1-001-SD 4/8/04	LF1-002-SD 4/8/04	LF1-002-SD (FD) 4/8/04	LF1-003-SD 4/8/04	LF1-004-SD 4/8/04

< = The result is considered a non-detection at the reporting limit shown.
FD = Field duplicate
UTL = Upper tolerance level
SSSL = Site-Specific Screening Level
mg/kg = milligrams per kilograms
ug/kg = micrograms per kilograms
Bold font indicates that the concentration exceeds the UTL.
Indicates that the value exceeds the SSSL shown as well as background if applicable.
A metal is considered a Constituent of Concern if the Background, 95% UTL, nutrient screening level, and SSSL is exceeded.

Lab Flags:
J = Estimated detection. Concentration is between the method detection limit and reporting limit.

Validation Qualifiers:
J = Estimated detection
UJ = Reporting limit is estimated.

Validation Sub-qualifiers:
M = MS and MSD recoveries were outside laboratory historical control limits.

Table 4-4: Summary of Detections in Surface Water at Landfill 1 Compared to Ecological Screening Values
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Nutrient Screen	ESV	LF1-001-SW 4/8/04	LF1-001-SW (FD) 4/8/04	LF1-002-SW 4/8/04	LF1-003-SW 4/8/04	LF1-004-SW 4/8/04
Metals (Total)										
ALUMINUM	mg/L	5.26	17	--	0.087	0.442	0.111 J	0.21	< 0.2	< 0.2
BARIUM	mg/L	0.0754	0.113	--	0.0039	0.0333	0.0435	0.0442	0.0383	0.101
CALCIUM	mg/L	25.2	64.1	252	116	6.05	12.4	12.5	23.8	52.4
IRON	mg/L	19.6	41.2	196	1	0.906 J	0.282 J	0.381 J	0.214 J	0.883 J
MAGNESIUM	mg/L	11	24.4	110	82	3.52	6.33	6.38	8.6	38.3
MANGANESE	mg/L	0.565	1.83	--	0.08	0.0604	0.0109	0.0132	0.00837 J	1.1
POTASSIUM	mg/L	2.56	4.25	25.6	53	1.01 J	< 5	< 5	2.57 J	< 5
SODIUM	mg/L	3.44	15.2	34.4	680	2.53	4.98	5	3.23	**37.6**

Notes:
< = The result is considered a non-detection at the reporting limit shown.
Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.
FD = Field duplicate
UTL = Upper tolerance level
ESV = Ecological Screening Level
mg/L = milligrams per liter
Bold font indicates that the concentration exceeds the UTL or Nutrient Screen if appropriate.
Indicates that the value exceeds the ESV shown as well as background if applicable.
A metal is considered a Constituent of Concern if the Background, 95% UTL, nutrient screening level, and ESV is exceeded.

Lab Flags:
J = Estimated detection. Concentration is between the method detection limit and reporting limit.

Table 4-5: Summary of Detections in Sediment at Landfill 1 Compared to Ecological Screening Values
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Nutrient Screen	ESV	LF1-001-SD 4/8/04	LF1-002-SD 4/8/04	LF1-002-SD (FD) 4/8/04	LF1-003-SD 4/8/04	LF1-004-SD 4/8/04
Metals (Total)										
ALUMINUM	mg/kg	8590	14300	--	--	5520 (JM)	6860	6720	**15100**	8660
ANTIMONY	mg/kg	0.73	--	--	12	< 14 (UJM)	3.71 J	3.23 J	4.85 J	< 18
ARSENIC	mg/kg	11.3	20.1	--	7.24	5.92	13.5	12.9	4.84	2.79
BARIUM	mg/kg	98.9	191	--	--	69.4 (JM)	27.5	35.3	67.3	53.5
BERYLLIUM	mg/kg	0.97	1.24	--	--	0.652 J	1.18 J	0.982 J	0.943 J	0.507 J
CALCIUM	mg/kg	1110	2810	11100	--	459	405	556	7030	3630
CHROMIUM	mg/kg	31.2	63.3	--	52.3	17.7	45.3	42.5	16.6	8.68
COBALT	mg/kg	11	21.9	--	50	12.4	9.9	8.58	8.68	9.07
COPPER	mg/kg	17.1	36.8	--	18.7	9	10.2	10.8	**89.1**	33
IRON	mg/kg	35300	51900	353000	--	23000	57200	42400	28500	12600
LEAD	mg/kg	37.8	76.4	--	30.2	15.9	14.8	18.3	20	39.6
MAGNESIUM	mg/kg	906	2200	9060	--	775	657	855	5880	2070
MANGANESE	mg/kg	712	2050	--	--	426 (JM)	220	211	440	226
NICKEL	mg/kg	13	31.6	--	15.9	9.96	16.9	12.5	20.6	14.3
POTASSIUM	mg/kg	1010	2790	10100	--	455 J	182 J	523 J	1540	904
SILVER	mg/kg	0.32	--	--	2	1.23 J	0.894 J	1.35 J	0.876 J	< 4.5
SODIUM	mg/kg	692	--	6920	--	77.7 J	< 119	< 134	< 132	179 J
VANADIUM	mg/kg	40.9	66.7	--	--	25.8	54	39.2	24.9	15
ZINC	mg/kg	52.7	111	--	124	33	60.4	55.5	**113**	39
Organochlorine Pesticides										
4,4'-DDD	ug/kg	--	--	--	3.3	7.9	< 4.8	< 5.3	< 26	< 7.2
ALPHA-BHC	ug/kg	--	--	--	6	< 2.8	0.54 J	1.5 J	< 13	< 3.6
ALPHA-CHLORDANE	ug/kg	--	--	--	1.7	< 2.8	< 2.4	< 2.7	15	< 3.6
BETA-BHC	ug/kg	--	--	--	5	2.4 J	< 2.4	< 2.7	< 13	< 3.6
DELTA-BHC	ug/kg	--	--	--	71500	2 J	< 2.4	< 2.7	< 13	< 3.6
DIELDRIN	ug/kg	--	--	--	3.3	< 5.6	< 4.8	< 5.3	5.4 J	< 7.2
GAMMA-CHLORDANE	ug/kg	--	--	--	1.7	< 2.8	< 2.4	< 2.7	8.4 J	< 3.6
Semivolatile Organic Compounds										
BENZO(B)FLUORANTHENE	ug/kg	--	--	--	655	< 460	< 390	< 440	480 J	< 590
BIS(2-ETHYLHEXYL)PHTHALATE	ug/kg	--	--	--	182	< 460	< 390	< 440	910	< 590

Notes:

-- = Not applicable

Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.

< = The result is considered a non-detection at the reporting limit shown.

Table 4-5: Summary of Detections in Sediment at Landfill 1 Compared to Ecological Screening Values
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Nutrient Screen	ESV	LF1-001-SD 4/8/04	LF1-002-SD 4/8/04	LF1-002-SD (FD) 4/8/04	LF1-003-SD 4/8/04	LF1-004-SD 4/8/04

FD = Field duplicate
UTL = Upper tolerance level
ESV = Ecological Screening Level
mg/kg = milligram per kilogram
ug/kg = microgram per kilogram
Bold font indicates that the concentration exceeds the UTL or Nutrient Screen if appropriate.
Indicates that the value exceeds the ESV shown as well as background if applicable.
A metal is considered a Constituent of Concern if the Background, 95% UTL, nutrient screening level, and ESV is exceeded.

Lab Flags:
J = Estimated detection. Concentration is between the method detection limit and reporting limit.

Validation Qualifiers:
J = Estimated detection
UJ = Reporting limit is estimated

Validation Sub-qualifiers:
M = MS and MSD recoveries were outside laboratory historical control limits.

Table 5-1
Summary of COCs
Landfill No. 2, Parcel 79(6)
McClellan, Alabama

Medium Sampled	Metals	VOCs	SVOCs	Pesticides	Explosives	Herbicides	PCBs
Surface and Depositional Soil	Al, Sb, As, Ba, Cr, Cu, Fe, Pb, Mn, Zn > BKG and SSSLs	< SSSLs	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene > SSSLs and BKG	NS	NS	NS	NS
Sediments	< BKG and SSSLs	ND	< SSSLs	ND	ND	ND	ND
Fill Material & Subsurface	As, Ba, Cr, Fe, Pb, Sb, Zn > BKG and SSSLs	< SSSLs	< SSSLs	< SSSLs	ND	ND	ND
Groundwater	Al, Be, Fe, Mn, Pb, Tl > BKG and SSSLs	< SSSLs	< SSSLs	Aldrin > SSSL	< SSSLs	ND	ND
Surface Water	< BKG and SSSLs	ND	ND	ND	ND	ND	ND

Al - aluminum
As - arsenic
Ba - barium
Be - beryillium
BKG - background
Cr - chromium
Cu - copper
Fe – iron
Pb – lead
Mn – manganese
ND - not detected
NS - not sampled
Sb – Antimony
SSSL - site-specific screening level
SVOC - semivolatile organic compound
Tl - thallium
VOC - volatile organic compound
Zn - Zinc

Table 5-2: Summary of Detections in Surface Water at Landfill 2 Compared to Site-Specific Screening Levels
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Recreational SSSL	Fish Consumption SSSL	LF2-001-SW 4/6/04	LF2-001-SW 7/15/04	LF2-002-SW 4/6/04	LF2-002-SW 7/15/04
Dioxins/Furans							
1,2,3,4,6,7,8,9-OCDD	pg/L	548	156	11.3 JB (UBD)	16.6 J	3.8 JB (UBD)	12.1 J
1,2,3,4,7,8,9-HpCDF	pg/L	54.8	3.67	7.6 JF (JFD)	< 47.6	< 50	< 47.2
1,2,3,6,7,8-HxCDD	pg/L	5.48	0.228	6.9 JF (JFD)	< 47.6	< 50	< 47.2
1,2,3,7,8,9-HxCDD	pg/L	5.48	0.228	5 JF (JFD)	< 47.6	< 50	< 47.2
Total HxCDD	pg/L	--	--	20 F (UBFD)	< 143	< 150	3.6 F (JF)

Notes:
< = The result is considered a non-detection at the reporting limit shown.
Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.
SSSL = Site-Specific Screening Level
pg/L = picogram per liter
Indicates that the value exceeds at least one SSSL shown.

Lab Flags:
F = Estimated maximum possible concentration for 8290.
J = Estimated detection. Concentration is between the method detection limit and reporting limit.
B = Analyte was detected in the sample and the associated method blank.

Validation Qualifiers:
J = Estimated detection
UJ = Reporting limit was estimated.
U = Result was qualified as not detected.

Validation Sub-qualifiers:
D = Result not preferred.
F = Ion ratio did not meet specified criteria.
B = Result was qualified based on blank contamination.

Table 5-3: Summary of Detections in Sediment at Landfill 2 Compared to Site-Specific Screening Levels
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Recreational SSSL	LF2-001-SD 4/6/04	LF2-002-SD 4/6/04	LF2-002-SD (FD) 4/6/04
Dioxins/Furans					
1,2,3,4,6,7,8,9-OCDD	pg/g	485000	30.2	25.4 B	9.2 JB
1,2,3,4,6,7,8-HpCDF	pg/g	48500	0.1 J	< 5 (UJAS)	< 5
2,3,7,8-TCDF	pg/g	4850	0.09 J	< 1 (UJA)	0.25 FJ (JF)
Total HpCDD	pg/g	--	2.6	2.8	0.76 F (UBF)
Total HpCDF	pg/g	--	0.16 F (JF)	< 10	< 9.9
Total TCDD	pg/g	--	0.51	< 1	< 1
Total TCDF	pg/g	--	0.21 FX (JF)	< 1	0.97 F (JF)

Notes:
< = The result is considered a non-detection at the reporting limit shown.
Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.
SSSL = Site-Specific Screening Level
FD = Field duplicate
pg/g = picograms per gram
Indicates that the value exceeds the SSSL shown.

Lab Flags:
F = Estimated maximum possible concentration for 8290.
J = Estimated detection. Concentration is between the method detection limit and reporting limit.
X = Result exceeded calibration range.
B = Analyte was detected in the sample and the associated blank.

Validation Qualifiers:
J = Estimated detection
UJ = Reporting limit is estimated.
U = Result was qualified as not detected.

Validation Sub-qualifiers:
A = The internal standard area was outside method control limits.
S = Surrogate recovery was outside laboratory historical control limits.
F = Ion ratio did not meet specified criteria.
B = Result was qualified based on blank contamination.

Table 5-4: Summary of Detections in Groundwater at Landfill 2 Compared to Site-Specific Screening Levels
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Residential SSSL	Groundskeeper SSSL	LF2-G01 4/2/04	LF2-G02 4/1/04	LF2-G03 4/1/04	LF2-G03 (FD) 4/1/04
Metals (Dissolved)									
ALUMINUM	mg/L	2.34	9.6	1.56	10.1	< 0.2	< 0.2	< 0.2	< 0.2
BARIUM	mg/L	0.127	0.472	0.11	0.712	0.0158	0.0159	0.0283	0.0287
CALCIUM	mg/L	56.5	452	--	--	13.2	114	151	144
COBALT	mg/L	0.0234	--	0.0939	0.608	< 0.02	< 0.02 (UJ-)	< 0.02 (UJ-)	< 0.02 (UJ-)
IRON	mg/L	7.04	25.8	0.469	3.05	< 1	< 1	0.0496 J	0.215 J
MAGNESIUM	mg/L	21.3	149	--	--	12.6	123	72.3	69.7
MANGANESE	mg/L	0.581	4.13	0.0735	0.444	0.00455 J	0.0477	0.26	0.343
SODIUM	mg/L	14.8	49	--	--	22.6	**178**	38.3	36.9
ZINC	mg/L	0.22	1.52	0.469	3.04	0.0215 J	0.00736 J	0.00585 J	0.0143 J
Metals (Total)									
ALUMINUM	mg/L	2.34	9.6	1.56	10.1	0.429	< 0.2	< 0.2	< 0.2
BARIUM	mg/L	0.127	0.472	0.11	0.712	0.0184	0.0166	0.026	0.0319
CALCIUM	mg/L	56.5	452	--	--	11.7	119 (JM)	136	155
COBALT	mg/L	0.0234	--	0.0939	0.608	0.0057 J	< 0.02 (UJ-)	< 0.02 (UJ-)	< 0.02 (UJ-)
IRON	mg/L	7.04	25.8	0.469	3.05	0.679 J	< 1	0.257 J	0.257 J
MAGNESIUM	mg/L	21.3	149	--	--	11.8	128 (JM)	59.8	75.8
MANGANESE	mg/L	0.581	4.13	0.0735	0.444	0.0153	0.0566	0.182	0.457
SODIUM	mg/L	14.8	49	--	--	23.5	**188 (JM)**	30.8	40.4
ZINC	mg/L	0.22	1.52	0.469	3.04	0.0238 J	0.00553 J	0.00548 J	0.00549 J
Semivolatile Organic Compounds									
BIS(2-ETHYLHEXYL)PHTHALATE	µg/L	--	--	4.31	16.1	< 19	37	< 19	< 19

Notes:
< = The result is considered a non-detection at the reporting limit shown.
Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.
SSSL = Site-Specific Screening Level
mg/L = milligram per liter
µg/L = microgram per liter
UTL =Upper tolerance limit
Bold font indicates that the concentration exceeds the UTL.
Indicates that the value exceeds at least one SSSL shown.
A metal is considered a Constituent of Concern if the Background, 95% UTL, nutrient screening level, and SSSL is exceeded.

Lab Flags:
J = Estimated detection. Concentration is between the method detection limit and reporting limit.

Validation Qualifiers:
J = Estimated detection
UJ = Reporting limit is estimated.

Validation Sub-qualifieres:
M = MS and MSD recoveries were outside laboratory historical control limits.
-= Analyte was reported as a negative concentration in the method or continuing calibration blank. Detected results are considered to be biased low; non-detec
results are considered to be potential false negatives.

Table 5-5: Summary of Detections in Surface Water at Landfill 2 Compared to Ecological Screening Values
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	ESV	LF2-001-SW 4/6/04	LF2-001-SW 7/15/04	LF2-002-SW 4/6/04	LF2-002-SW 7/15/04
Dioxins/Furans						
1,2,3,4,6,7,8,9-OCDD	pg/L	100000	11.3 JB (UBD)	16.6 J	3.8 JB (UBD)	12.1 J
1,2,3,4,7,8,9-HpCDF	pg/L	1000	7.6 JF (JFD)	< 47.6	< 50	< 47.2
1,2,3,6,7,8-HxCDD	pg/L	100	6.9 JF (JFD)	< 47.6	< 50	< 47.2
1,2,3,7,8,9-HxCDD	pg/L	100	5 JF (JFD)	< 47.6	< 50	< 47.2
Total HxCDD	pg/L	20	20 F (UBFD)	< 143	< 150	3.6 F (JF)

Notes:
< = The result is considered a non-detection at the reporting limit shown.
Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.
ESV = Ecological screening value
pg/L = picogram per liter
Indicates that the value exceeds the ESV shown.

Lab Flags:
F = Estimated maximum possible concentration for 8290.
J = Estimated detection. Concentration is between the method detection limit and reporting limit.
B = Analyte was detected in the sample and the associated method blank.

Validation Qualifiers:
J = Estimated detection
UJ = Reporting limit was estimated.
U = Result was qualified as not detected.

Validation Sub-qualifiers:
D = Result not preferred.
F = Ion ratio did not meet specified criteria.
B = Result was qualified based on blank contamination.

Table 5-6: Summary of Detections in Sediment at Landfill 2 Compared to Ecological Screening Values
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	ESV	LF2-001-SD 4/6/04	LF2-002-SD 4/6/04	LF2-002-SD (FD) 4/6/04
Dioxins/Furans					
1,2,3,4,6,7,8,9-OCDD	pg/g	25000	30.2	25.4 B	9.2 JB
1,2,3,4,6,7,8-HpCDF	pg/g	250	0.1 J	< 5 (UJAS)	< 5
2,3,7,8-TCDF	pg/g	2.5	0.09 J	< 1 (UJA)	0.25 FJ (JF)
Total HpCDD	pg/g	250	2.6	2.8	0.76 F (UBF)
Total HpCDF	pg/g	250	0.16 F (JF)	< 10	< 9.9
Total TCDD	pg/g	2.5	0.51	< 1	< 1
Total TCDF	pg/g	2.5	0.21 FX (JF)	< 1	0.97 F (JF)

Notes:
< = The result is considered a non-detection at the reporting limit shown.
Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.
ESV = Ecological screening value
FD = Field duplicate
pg/g = picograms per gram
Indicates that the value exceeds the ESV shown.

Lab Flags:
F = Estimated maximum possible concentration for 8290.
J = Estimated detection. Concentration is between the method detection limit and reporting limit.
X = Result exceeded calibration range.
B = Analyte was detected in the sample and the associated blank.

Validation Qualifiers:
J = Estimated detection
UJ = Reporting limit is estimated.
U = Result was qualified as not detected.

Validation Sub-qualifiers:
A = The internal standard area was outside method control limits.
S = Surrogate recovery was outside laboratory historical control limits.
F = Ion ratio did not meet specified criteria.
B = Result was qualified based on blank contamination.

Table 5-7

Potential Action-Specific Federal and State ARARs
Landfill No. 2, Parcel 79(6)
McClellan, Anniston Alabama

Action	Law/Regulation	Requirement of Law/Regulation	A	R&A	TBC	Comment
Open dumping	State: ADEM Administrative Code Chapter 420-3-5.09	Unauthorized open dumps or any activity causing the creation or maintenance of such dumps constitutes a nuisance menacing public health and is subject to abatement by the Environmental Department.	1,2,3,4			Basis for DOD action at former disposal sites to address potential nuisance to public health.
Closing or upgrading open dumps	Federal: 40 CFR 256.23	The State shall provide for classification of existing solid waste disposal facilities. For open dumps, the State shall take steps to close or upgrade the facility. Evidence of that action shall be made publicly available. In providing for closure of open dumps, the State shall take steps necessary to eliminate health hazards and minimize potential health hazards. These steps shall include requirements for long-term monitoring or contingency plans where necessary.		1,2,3		Basis for DOD action at former disposal sites to minimize potential health hazards. No Action does not meet these criteria if there are potential health hazards.
OSWER Directive 9355.0-67FS	Guidance: Application of the CERCLA Municipal Landfill Presumptive Remedy for Military Landfills	The volume of landfill contents, types of wastes, hydrogeology and safety must be considered when assessing the practicality of excavation and consolidation or treatment of wastes. Although no set volume limits exists, landfills with a content of more than 100,000 cubic yards would normally not be considered for excavation. If military wastes are present, safety considerations may be important in determining the practicality of excavation.			1,2,3,4	The presumptive remedy would exclude excavation.
On-Site Waste Generation	State: ADEM Admin Code 335-14-3-.01(2)	Person who generates waste shall determine if that waste is a hazardous waste. Including whether waste is excluded from regulation under ADEM Admin Code 335-14-2.01(4) or whether waste is listed under 335-14-2-.04.	4			Hazardous waste is not generated unless the waste is excavated.
Sampling and Analysis	State: ADEM Administrative Code Chapter 335-14-2 Appendix I, II, and III implementing 40 CFR 136, Appendix A (SW-846 sampling methods)	Specific requirements for identifying hazardous wastes. Establishes sampling and analytical requirements for collecting, testing and evaluating wastes.	4	2,3		Potentially applicable for identifying suspicious (potentially hazardous) waste encountered during implementation of Alternatives 2, 3 and 4.

Table 5-7

Potential Action-Specific Federal and State ARARs
Landfill No. 2, Parcel 79(6)
McClellan, Anniston, Alabama

Action	Law/Regulation	Requirement of Law/Regulation	A	R&A	TBC	Comment
Management and Disposal of Medical and Petroleum Contaminated Waste	State: ADEM 335-13-4.26	Generators of a special waste may be required to provide an analysis and certification that the waste is nonhazardous waste or treated medical waste. Waste types for which specific rules and regulations have not been developed shall be managed and disposed of in a manner determined by the Department to be consistent with the intent of this Division. Small quantities of petroleum contaminated waste maybe disposed of without testing if it contains < 25 gallons of petroleum, and the total material is <5 cubic yards per occurrence.		2,3,4		Applicable to Municipal Solid Waste Disposal Facilities. Relevant and appropriate due to a similar action at the DOD Landfill site.
Landfill Design to Assure Groundwater Resources Protection	State: ADEM ADMIN. Code 335-13-4-14	Groundwater resources in the vicinity of the landfill unit shall be determined as a basis for facility design, groundwater protection and groundwater monitoring required under 335-13-4.27. Groundwater in the first saturated zone below the landfill unit shall be evaluated with a minimum of one hydraulically upgradient monitoring well for background data and two hydraulically downgradient monitoring well. Monitoring wells should be installed prior to facility opening to provide undisputed background water quality sample.		3,4		These standards are only applicable for establishing a landfill unit. For an existing landfill unit they are potentially relevant and appropriate. Contamination of groundwater associated with the Landfill has not been clearly established. Groundwater remediation is not within the scope of this analysis and it will be addressed as a separate action.
Drainage	State: ADEM Admin Code 335-13-4.17	Owners and operators of all facilities must design, construct and maintain a run-on control system to prevent flow onto the active and or closed portions of the'landfill during the peak discharge from a 25-year storm; and a run-off control system to collect and control water volume resulting from 24-hour 25-year storm. The site must also have drainage structures to carry away rain from the disposal site and minimize generation of leachate, erosion and sedimentation.	4	2,3		Applicable for modification of Landfill 4 design after consolidation; relevant and appropriate for design of drainage systems after cover modification at Landfill.
Runoff Management	State: ADEM Admin. Code 335-13-4.01(2) (a)&(b)	Runoff management must protect wetlands and surface water quality consistent with NPDES and any applicable Alabama Water Quality Management Plan.	2,3,4			Compliance with substantive requirements of NPDES Stormwater Discharge General Permit requirements is necessary for any construction excavation.

Table 5-7

Potential Action-Specific Federal and State ARARs
Landfill No. 2, Parcel 79(6)
McClellan, Anniston Alabama

Action	Law/Regulation	Requirement of Law/Regulation	A	R&A	TBC	Comment
Landfill Cover Design	State: ADEM Admin. Code 335-13-4.20(2)(b)	Final cover system must be comprised of an infiltration layer of at least 18 inches of earthen material and/or a synthetic layer with permeability < or = to permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10[5] cm/sec, whichever is less. The infiltration layer for a construction/demolition landfill must be a minimum of 18 inches of compacted earthen materials excluding sands. The erosion layer must be a minimum of 6 inches of earthen material capable of sustaining native plant growth. Alternative designs must achieve an equivalent level of protection.	4	3		Relevant and appropriate standard to guide design of Landfill cover. Applicable to final cover at consolidation landfill.
Final Soil Cover Construction	State: ADEM Admin. Code 335-13-4.20 (2)(c)	Cover shall be graded to prevent ponding, and not exceed 25%. Slopes longer than 25 feet shall require horizontal terraces for every 20 foot rise or utilize other erosion control measures. The minimum final grade shall not be <5%. Deep rooted vegetation penetrating >6 feet below cover is prohibited.	4	3		Relevant and appropriate standard to guide design of Landfill cover. Applicable to final cover at consolidation landfill.
Postclosure	State: ADEM Administrative Code Chapter 335-13-4-.30	Requires 30 years post-closure care for permitted facilities, or a minimum of 5 years if closed prior to 10/9/1993. Specific requirements for landfill post-closure including: 1) maintaining the cover on eroded areas; 2) filling and grading areas where ponding may occur; 3) correcting any surface cracks in the landfill soil cover; 4) maintaining an appropriate cover at all times; 5) establishing and maintaining access control structures and signs; 6) removing any waste disposed following closure; 7) maintaining monitoring devices and pollution control equipment.	4	1,2,3		Relevant and appropriate to all alternatives because the regulations address locations where wastes have been deposited and are to remain in place. The regulation protects potential human and ecological receptors from adverse impacts resulting from exposure to materials in the landfill. Applicable to final closure of consolidation landfill.
Deed Restrictions	State: ADEM 335-13-4.20(i)	Upon final closure, facility owner shall record a notation onto the land deed for the property used for disposal (or other instrument normally accessed by title search) that will in perpetuity, notify any potential purchaser of the land that it has been used as a solid waste landfill and must include a survey plat, is subject to post closure monitoring and maintenance, and a certification of closure with a detailed design drawing showing final contour and drainage plan.	4	2,3		Not applicable to closure of a non-permitted facility. Relevant and appropriate for a capped unit being closed. Closure will be certified as part of the final remedy for the entire site.

Table 5-7

Potential Action-Specific Federal and State ARARs
Landfill No. 2, Parcel 79(6)
McClellan, Anniston Alabama

Action	Law/Regulation	Requirement of Law/Regulation	A	R&A	TBC	Comment
Stormwater Runoff to Surface Water from Construction Excavation Activities	Federal: 40 CFR 122.26 implemented by ADEM Administrative Code Chapter 335-6-6-.03 and .23	Requirements for a storm water discharge permit. Requirements ensure that storm water discharges from construction activities (clearing, grading, and excavating) do not violate surface water quality standards	2,3,4			Substantive requirements are applicable. For construction activities, a Stormwater Pollution Prevention Plan identifying Best Management Practices to be used to control storm water runon and contamination of stormwater runoff must be identified.
Construction Stormwater Discharge Permit Conditions	State: ADEM NPDES General Permit No. ALG610000	Authorizes the discharge of storm water from construction sites and other activities involving land disturbances (i.e., construction, excavation, land clearing). Requires Best Management Practices as provided in the Alabama Nonpoint Source Management Program Document and EPA Storm Water Pollution Prevention for Construction Activities. All materials used as fill for construction purposes must be non toxic, non-acid forming and free of solid waste or other debris unless approved by the Department. Include a diagram of the facility showing locations where storm water exits the facility, location or structures or other measures to prevent pollution of stormwater or remove pollutants from storm water and locations of collection and handling systems. A copy of the BMP shall be maintained at the facility, along with a log of inspections required by Part IVB of the Permit. Documentation of training must also be kept on site. Training must be performed prior to implementation of the permit.			2,3,4	Substantive requirements are applicable. For construction activities, a Stormwater Pollution Prevention Plan identifying Best Management Practices to be used to control storm water runon and contamination of stormwater runoff must be identified.
Off-Site Disposal of Hazardous Waste	State: Subparts A through E ADEM Administrative Code Chapter 335-14-9	Identifies hazardous wastes that are restricted from land disposal and defines treatment standards for waste, soil and debris. Excavated wastes must be treated to Land Disposal Restriction (LDR) treatment standards prior to disposal, and the disposal facility must be permitted under RCRA to accept hazardous wastes.			4	Excavated waste that is hazardous not be disposed of on site. The Off-site disposal facility will have to be RCRA permitted and waste characterized as Land Disposal Restricted.

Table 5-7

Potential Action-Specific Federal and State ARARs
Landfill No. 2, Parcel 79(6)
McClellan, Anniston Alabama

Action	Law/Regulation	Requirement of Law/Regulation	A	R&A	TBC	Comment
Packaging, Labeling, and Storage	Federal: USDOT Hazardous Materials Transportation Regulations: 49 CFR 171 to 173 and 177 to 180	Establishes classification, packaging, and labeling requirements for shipments of hazardous materials on publicly accessible roads.	4			Potentially applicable if hazardous waste is encountered during relocation of the waste fill under Alternative 4.
Transportation of Hazardous Waste	State: ADEM Administrative Code Chapter 335-14-4	Requires RCRA manifesting of hazardous waste shipments, waste characterization, labeling, and packaging; reporting of LDR status; transporter placarding compliance; reporting requirements for transporter, disposal facility and generator, record keeping, and training requirements for off-site transport of and hazardous waste.	4,3			Potentially applicable if hazardous waste is encountered during relocation of the waste fill under Alternative 4.
Medical Waste	State: ADEM Administrative Code Chapter 335-13-7	Defines medical waste, including "sharps," such as hypodermic needles, IV tubing with needles attached, scalpels, syringes, glassware, blood vials, pipettes and similar items. Establishes guidelines for storage, treatment, and disposal of untreated medical waste.	4			Potentially applicable if medical waste is encountered during relocation of the waste fill under Alternative 4.

A – applicable
ADEM -Alabama Department of Environmental Management ARAR - applicable or relevant and appropriate requirement
CERCLA -comprehensive Environmental Response, Compensation and Liability Act CFR - Code of Federal Regulations
NPDES - National Pollutant Discharge Elimination System
R&A - relevant and appropriate
RCRA - Resource Conservation and Recovery Act
TBC - to be considered
USC - United States Code
UXO - unexploded ordnance
1, 2, 3, and 4 represent the alternatives for this site

Table 5-8

Potential Location-Specific Federal and State ARARs, Landfill No. 2, Parcel 79(6)
McClellan, Anniston, Alabama

Location	Law/Regulation	Requirement of Law/Regulation	A	R&A	TBC	ARAR/TBC Status
Floodplain	State: ADEM Administrative Code Chapter 335-13-4-.01	Establishes Permit Requirements and location standards for new disposal facilities in floodplains. A facility located in a floodplain shall not restrict the flow of the 100-year flood, reduce temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment. A facility shall not result in the destruction of adverse modifications of critical habitats protected under the Federal Endangered Species Act of 1973, or of threatened or endangered species.		1,2,3,4		Not applicable to existing facilities. Substantive requirements are potentially relevant and appropriate because the standards are intended to identify conditions that could either result in an increased potential for a release from a landfill or would be particularly sensitive if a release occurred. Regulation is appropriate since releases from this landfill would be similar to the types of releases that could occur at a permitted municipal solid waste landfill.
Location Protective of Water Quality	State: ADEM Administrative Code Chapter 335-13-4-.02	Requires that a facility will not be located so as to adversely impact water quality by causing a discharge of pollutants into or degradation of waters of the State. A facility shall not cause non-point pollution of waters of the State that violates any requirement of a water quality management plan that has been approved under the Alabama Water Pollution Control Act.		1,2,3,4		Potentially relevant and appropriate because the standards are intended to identify conditions that could either result in an increased potential for a release from a landfill or would be particularly sensitive if a release occurred. Regulation is appropriate since releases from this landfill would be similar to the types of releases that could occur at a permitted municipal solid waste landfill.
Surface Water	40 CFR 122.41(d) and 122.44(d)	Specifies that reasonable steps must be taken to minimize or prevent discharges that have a reasonable likelihood of causing adverse impacts on surface-water quality (40 CFR 122.41 [d]).	2,3,4			Adverse impacts on surface water quality should be minimized through use of drainage controls.
Surface Water	ADEM 335-6-10.04 Antidegradation Policy ADEM 335-6-10.07 Toxic Pollutant Criteria Applicable to State Waters	Specifies that discharges into surface water must achieve Federal and State water-quality standards (40 CFR 122.44[d]).		2,3,4		Relevant and Appropriate for ponded surface water if present.

Table 5-8

Potential Location-Specific Federal and State ARARs, Landfill No. 2, Parcel 79(6)
McClellan, Anniston Alabama

A - applicable
ADEM -Alabama Department of Environmental Management
ARAR - applicable or relevant and appropriate requirement
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act CFR - Code of Federal Regulations
CoA - Code of Alabama
NPDES - National Pollutant Discharge Elimination System OSHA - Occupational Safety and Health Act
R & A - relevant and appropriate
RCRA - Resource Conservation and Recovery Act
TBC - to be considered
USC - United States Code
UXO - unexploded ordnance
1, 2, 3, and 4 refer to the respective alternatives at each site

Table 5-9

Summary of Detailed Alternative Analysis
Landfill No. 2, Parcel 79(6)
McClellan, Anniston Alabama

Criteria	Alternative 1 No Action	Alternative 2 Land Use Controls	Alternative 3 Soil Cover with Land Use Controls	Alternative 4 On-site Disposal in Secure Landfill
Overall Protection of Human Health and the Environment	Although no chemical human health or ecological risk was identified at this site, this alternative does not provide protection from physical hazards (waste debris).	This alternative provides adequate human health and environmental protection through the use of land use controls.	This alternative provides adequate human health and environmental protection through the use of land use controls and physical barriers to waste.	This alternative provides more than adequate human health and environmental protection through removal of the waste. Disposal in a contained waste cell at Landfill No. 4 would be protective of human health and the environment.
Compliance with Applicable or Relevant and Appropriate Requirements (ARAR)	Meets the requirements of the ARARs.	Meets the requirements of the ARARs.	Meets the requirements of the ARARs.	Meets the requirements of the ARARs.
Long-Term Effectiveness and Permanence	Provides no long-term permanent controls to physical hazards.	This alternative maintains physical access controls and provides for long-term site management but does not create a physical barrier to exposed waste.	This alternative maintains potential exposure controls and provides for long-term site management.	This alternative provides for long-term effectiveness and permanence by clean closing source waste area.
Reduction of Toxicity, Mobility, or Volume Through Treatment	No Chemicals of Potential Concern (COPC) have been identified at this site. Thus, toxicity, mobility, and volume will not be affected by this alternative.	No COPCs have been identified at this site. Thus, toxicity, mobility, and volume will not be affected by this alternative.	No COPCs have been identified at this site. Thus, toxicity, mobility, and volume will not be affected by this alternative.	The lined waste containment cell (at Landfill No. 4) could potentially immobilize any hazardous constituents that may exist in the waste fill.

Table 5-9

Summary of Detailed Alternative Analysis
Landfill No. 2, Parcel 79(6)
McClellan, Anniston Alabama

Criteria	Alternative I No Action	Alternative 2 Land Use Controls	Alternative 3 Soil Cover with Land Use Controls	Alternative 4 On-site Disposal in Secure Landfill
Short-Term Effectiveness	No short-term risks will be posed during implementation of this alternative.	Minimal short-term risks will be posed during implementation of this alternative; these risks can be easily mitigated. No risks will be posed to the community.	Potential short-term risks will be posed during grading; can be reduced/mitigated with proper procedures. Minimal risks will be posed to the community through increased traffic.	Some short-term risks will be posed during implementation of this alternative; exposure to contaminated soil and transportation traffic; can be reduced/mitigated with proper procedures. Additional risks will be posed to the community through increased traffic and dust.
Implementability	No implementing difficulty.	Little implementing difficulty.	Little implementing difficulty.	Some degree of implementing difficulty in removing slopes.
Community Acceptance	The community may accept this alternative because there is no chemical risk. Physical and attractive nuisance hazards may limit public acceptance.	The community may accept this alternative because it would still pose an attractive nuisance.	This alternative is more likely to be acceptable to community.	The community is likely to accept this alternative but may not like increase in Landfill No. 4.
State Acceptance	This alternative may be acceptable to the State because there is no chemical risk at the site.	The State would likely accept this alternative because there is no chemical risk at the site, but the alternative provides a barrier to physical waste and deed restrictions.	The State is likely to accept this alternative. This alternative is defined as a presumptive remedy for military landfills.	The State will accept this alternative. This alternative provides for clean closure of the site. The placement of the waste at Landfill No. 4 may require regulatory review, but would likely be accepted.
Cost (Net Present Worth)	$0	$857,000	$1,018,000	$1,915,000

Table 6-1
Summary of COCs
Landfill No. 4 and the Industrial Landfill, Parcels 81(5) and 175(5)
McClellan, Alabama

Medium Sampled	Metals	VOCs	SVOCs	Pesticides	Explosives	Herbicides	PCBs
Surface and Depositional Soil	NS	NS	NS	NS	NS	NS	NS
Subsurface Soil	NS	NS	NS	NS	NS	NS	NS
Sediments	NS	NS	NS	NS	NS	NS	NS
Fill Material	NS	NS	NS	NS	NS	NS	NS
Groundwater	As, Ba, Cd, Fe, Mn, Pb, Sb > BKG and SSSLs	Trichloroethene > SSSL	ND	ND	ND	ND	ND
Surface Water	NS	NS	NS	NS	NS	NS	NS

As - arsenic
Ba - barium
BKG - Background Cd - cadmium Fe - iron
Pb - lead
Mn - manganese
ND - not detected
NS - not sampled
Sb - Antimony
SSSL - site-specific screening level SVOC - semivolatile organic compound
VOC - volatile organic compound

Table 6-2: Summary of Detections in Groundwater at Landfill 4 and Industrial Landfill
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Residential SSSL	Groundskeeper SSSL	LF4-MW1 3/31/04	LF4-MW2 3/31/04	LF4-MW3 3/31/04	LF4-MW4 3/31/04	LF4-MW5 3/31/04
Metals (Dissolved)										
ALUMINUM	mg/L	2.34	9.6	1.56	10.1	< 0.2	< 0.2	< 0.2	< 0.2	0.199 J
BARIUM	mg/L	0.127	0.472	0.11	0.712	0.0321	0.085	0.0476	0.197	0.011
CALCIUM	mg/L	56.5	452	--	--	2.86	18.4	2.97	87.9	0.458 J
COBALT	mg/L	0.0234	--	0.0939	0.608	0.0119 J (J-)	0.0126 J (J-)	0.0052 J (J-)	0.0103 J (J-)	0.00773 J (J-)
COPPER	mg/L	0.0255	--	0.0626	0.406	< 0.02	< 0.02	0.0054 J	< 0.02	0.0159 J
IRON	mg/L	7.04	25.8	0.469	3.05	0.179 J	0.209 J	0.1 J	2.23	0.528 J
LEAD	mg/L	0.008	0.026	0.015	0.015	< 0.01 (UJ-)	< 0.01 (UJ-)	< 0.01 (UJ-)	< 0.01 (UJ-)	< 0.01 (UJ-)
MAGNESIUM	mg/L	21.3	149	--	--	1.05	6.58	1.59	51.9	0.597 J
MANGANESE	mg/L	0.581	4.13	0.0735	0.444	0.916	0.739	0.0663	1.94	0.0941
POTASSIUM	mg/L	7.2	68.5	--	--	1.33 J (J-)	< 5 (UJ-)	< 5 (UJ-)	1.73 J (J-)	< 5 (UJ-)
SODIUM	mg/L	14.8	49	--	--	15.4	7.85	11.9	**129**	1.78
ZINC	mg/L	0.22	1.52	0.469	3.04	0.021 J	0.0493 J	0.023 J	0.0178 J	0.0554 J
Metals (Total)										
ALUMINUM	mg/L	2.34	9.6	1.56	10.1	1.14	0.873	0.344	< 0.2	0.702
BARIUM	mg/L	0.127	0.472	0.11	0.712	0.0408	0.0872	0.0537	0.197	0.0144
CALCIUM	mg/L	56.5	452	--	--	3.18	17.4	3.15	89.2	0.411 J
COBALT	mg/L	0.0234	--	0.0939	0.608	0.00881 J (J-)	0.00727 J (J-)	< 0.02 (UJ-)	0.00645 J (J-)	< 0.02 (UJ-)
COPPER	mg/L	0.0255	--	0.0626	0.406	< 0.02	< 0.02	0.0274	< 0.02	0.0292
IRON	mg/L	7.04	25.8	0.469	3.05	3.35	3.25	0.546 J	3.09	1.84
LEAD	mg/L	0.008	0.026	0.015	0.015	0.0021 J (J-)	0.00427 J (J-)	0.00534 J (J-)	< 0.01 (UJ-)	0.00498 J (J-)
MAGNESIUM	mg/L	21.3	149	--	--	1.38	6.28	1.71	51.8	0.705 J
MANGANESE	mg/L	0.581	4.13	0.0735	0.444	1.03	0.701	0.0676	1.94	0.101
POTASSIUM	mg/L	7.2	68.5	--	--	1.09 J (J-)	< 5 (UJ-)	< 5 (UJ-)	< 5 (UJ-)	< 5 (UJ-)
SODIUM	mg/L	14.8	49	--	--	16.5	6.99	12.1	**128**	1.79
ZINC	mg/L	0.22	1.52	0.469	3.04	0.0216 J	0.0504 J	0.0694 J	0.0175 J	0.0675 J
Volatile Organic Compounds										
CHLOROBENZENE	µg/L	--	--	16.2	175	< 1	< 1	< 1	3.7	< 1

Notes:

< = The result is considered a non-detection at the reporting limit shown.

Validation codes consist of a validation qualifier and a sub-qualfier(s) and are delineated with parenthesis.

UTL = Upper tolerance level

SSSL = Site-Specific Screening Level

mg/L = milligram per liter

µg/L = microgram per liter

Table 6-2: Summary of Detections in Groundwater at Landfill 4 and Industrial Landfill
Landfill EE/CA, McClellan, Anniston, Alabama

Parameter Name	Units	Background	95% UTL	Residential SSSL	Groundskeeper SSSL	LF4-MW1 3/31/04	LF4-MW2 3/31/04	LF4-MW3 3/31/04	LF4-MW4 3/31/04	LF4-MW5 3/31/04

The "Background" column presents two times the background value.

Bold font indicates that the concentration exceeds the UTL.

Indicates that the value exceeds at least one SSSL shown as well as background if applicable.

A metal is considered a Constituent of Concern if the Background, 95% UTL, nutrient screening level, and SSSL is exceeded.

Lab Flags:

J = Estimated detection. Concentration is between the method detection limit and reporting limit.

Validation Qualifiers:

J = Estimated detection

UJ = Reporting limit is estimated.

Validation Sub-qualifiers:

-= Analyte was reported as a negative concentration in the method or continuing calibration blank. Detected results are considered to be biased low; non-detect results are considered to be potential false negatives.

Table 7-1

Summary of COCs
Fill Area North of Landfill No. 2, Parcel 230(7)
McClellan, Alabama

Medium Sampled	Metals	VOCs	SVOCs	Pesticides	Explosives	Herbicides	PCBs
Surface and Depositional Soil	< BKG and SSSLs	< SSSLS	< SSSLS	< SSSLS	ND	ND	ND
Subsurface Soil	As, Ba, Cr, Fe, Pb > BKG and SSSLs	< SSSLS	Benzo(a)pyrene > SSSL	< SSSLS	ND	ND	ND
Sediments	< BKG and SSSLs	< SSSLS	Di-n-butyl phthalate > SSSL	< SSSLS	ND	ND	ND
Fill Material	< BKG and SSSLs	< SSSLS	Benzo(a)pyrene >SSSL	4,4'-DDD, Aldrin, Dieldrin > SSSL	ND	ND	ND
Groundwater	Al, Ba, Fe, Mn > BKG and SSSLs	< SSSLS	< SSSLS	ND	ND	ND	ND
Surface Water	Tl > BKG and SSSLs	ND	< SSSLS	ND	ND	ND	ND
Seep Samples	Mn > BKG and SSSLs	< SSSLS	ND	ND	ND	ND	ND

Al - aluminum
As - arsenic
Ba - barium
BKG - Background
Cr - chromium
Fe - iron
Mn - manganese
ND - not detected
NS - not sampled
Pb - lead
PCB - polychlorinated biphenyl
SSSL - site-specific screening level
SVOC - semivolatile organic compound
Tl - thallium
VOC - volatile organic compound

Table 8-1
Summary of Landfill and Fill Area Site Characteristics
Fort McClellan, Calhoun County, Alabama

Site Name	Parcel No.	Area		Average Depth of Fill (feet bgs)	Fill Area Factor a	Estimated Fill Volume (yd3)	UXO Site	Medical Debris Found b	Wetlands or Gray Bat Habitat Area
		Acres I	ft2						
Landfill No.1	78(6)	6.3	274,428	11.5	0.70	81,800	no	yes	no
Landfill No. 2	79(6)	5.6	243,936	8	0.75	54,200	no	no	Yes (L)
Landfill No. 4 and Industrial Landfill	81(5)	43.3	1,886,148	25	0.85	1,484,000	no	no	no
	175(5)	15.9	692,604	12	0.10	30,800	no	no	no
Fill Area North of Landfill No. 2	230(7)	2.4	104,544	15	0.50	29,000	yes	no	Yes (L)

[a] Engineer's estimate of ratio of fill material to total fill area volume based on method of waste placement. b Medical debris: glass ware, vials, syringes, and intravenous tubing. bgs - Below ground surface.
ft2 - square feet
yd^3 - Cubic yard.
L - Low-quality habitat.
M - Moderate-quality habitat. UXO - Unexploded ordnance.
Formula for estimation of Fill Volume:
Area (acre) x 43560 (ft2/acre) x Depth (ft) / 27(ft3/yd3) x Factor = Volume (yd3).

Table 8-2
Summary of Landfill and Fill Area Risk Assessments
Fort McClellan, Calhoun County, Alabama

Site, Parcel	Baseline	Proposed	Reuse Scenario		Ecological		Risk Assessment
	Human Health Risk Assessment - Residential	Human Health Risk Assessment Recreational	Human Health Risk Assessment - Industrial		Soil	Surface Water	Sediment
			Grounds-keeper	Highway Worker			
Landfill No. 1, Parcel 78(6)	Acceptable	Acceptable	NA	NA	NR	NR	NR
Landfill No. 2, Parcel 79(6)	Unacceptable (SS)	Acceptable	NA	NA	PR	NR	NR
Landfill No. 4, Parcel 81(5), and Industrial Landfill, Parcel 175(5) (Permitted landfill)	Acceptable (Q) (GW metals only)*	NA	NA	NA	NR	NR	NR
Fill Area North of Landfill No. 2, Parcel 230(7)	Acceptable	Acceptable	NA	NA	PR	PR	PR

* Metals exceedance a result of high turbidity in groundwater samples.

GW Groundwater.
NA Not applicable.
NR No significant risk.
PR Potential risk.
Q Qualified in the streamlined risk assessment.
SS Surface soil.

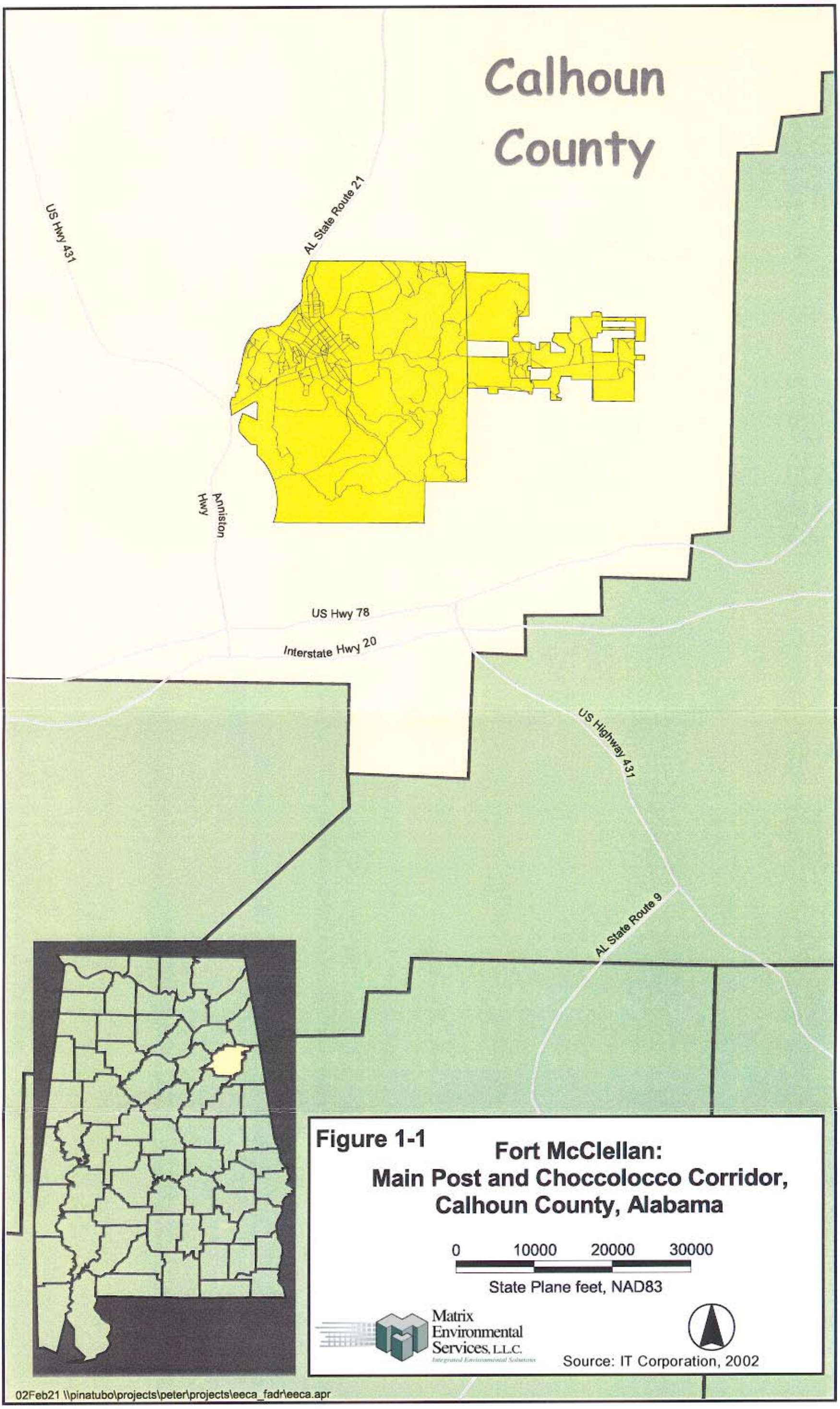


Figure 1-1

Fort McClellan: Main Post and Choccolocco Corridor, Calhoun County, Alabama

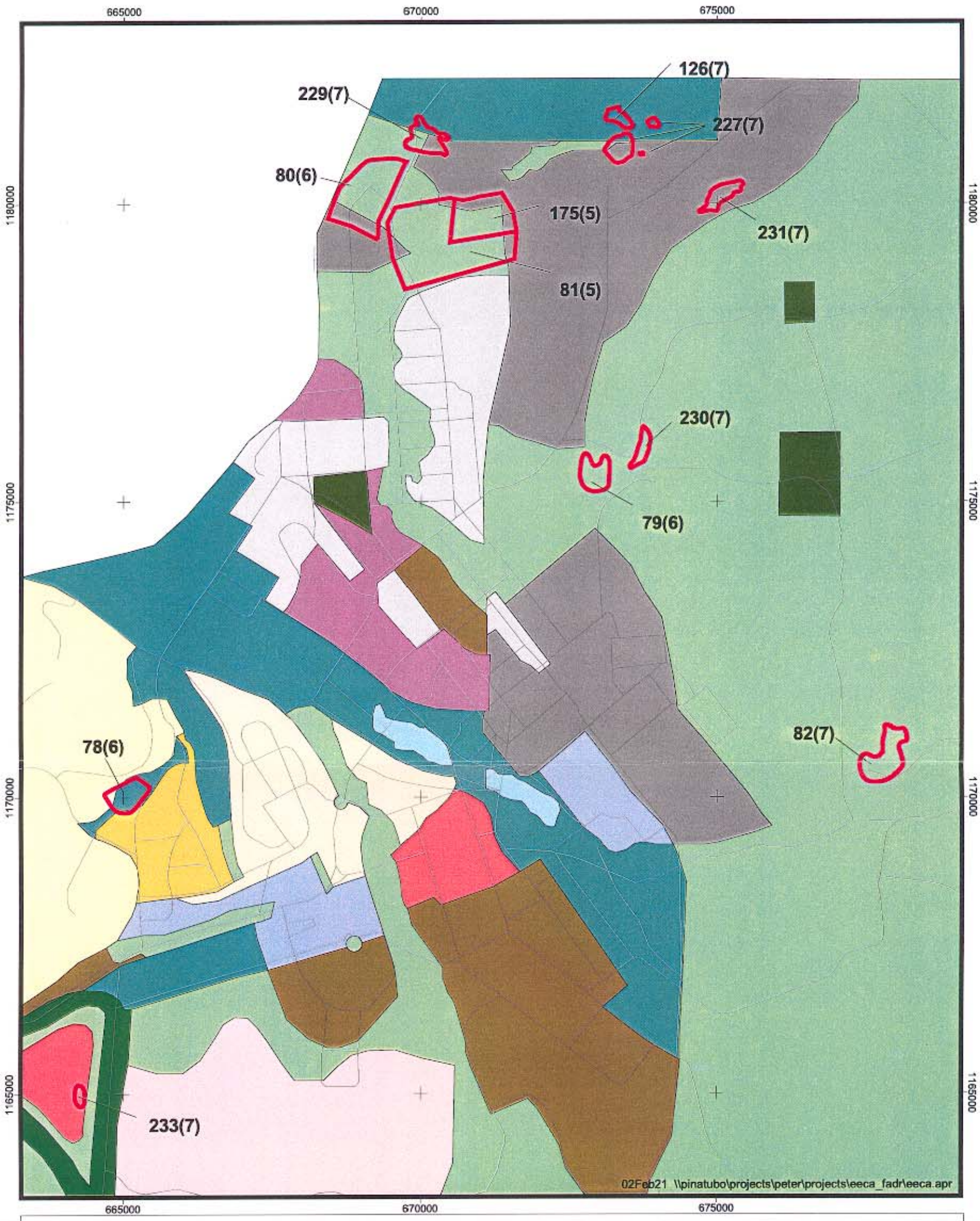
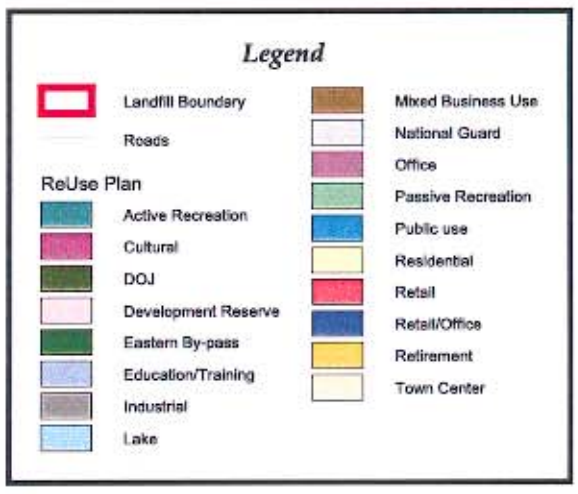
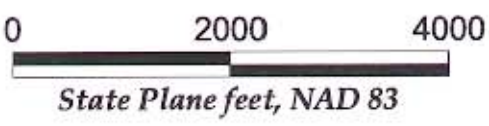


Figure 1-2 Base Reuse Map





Source:
IT Corporation, 2002

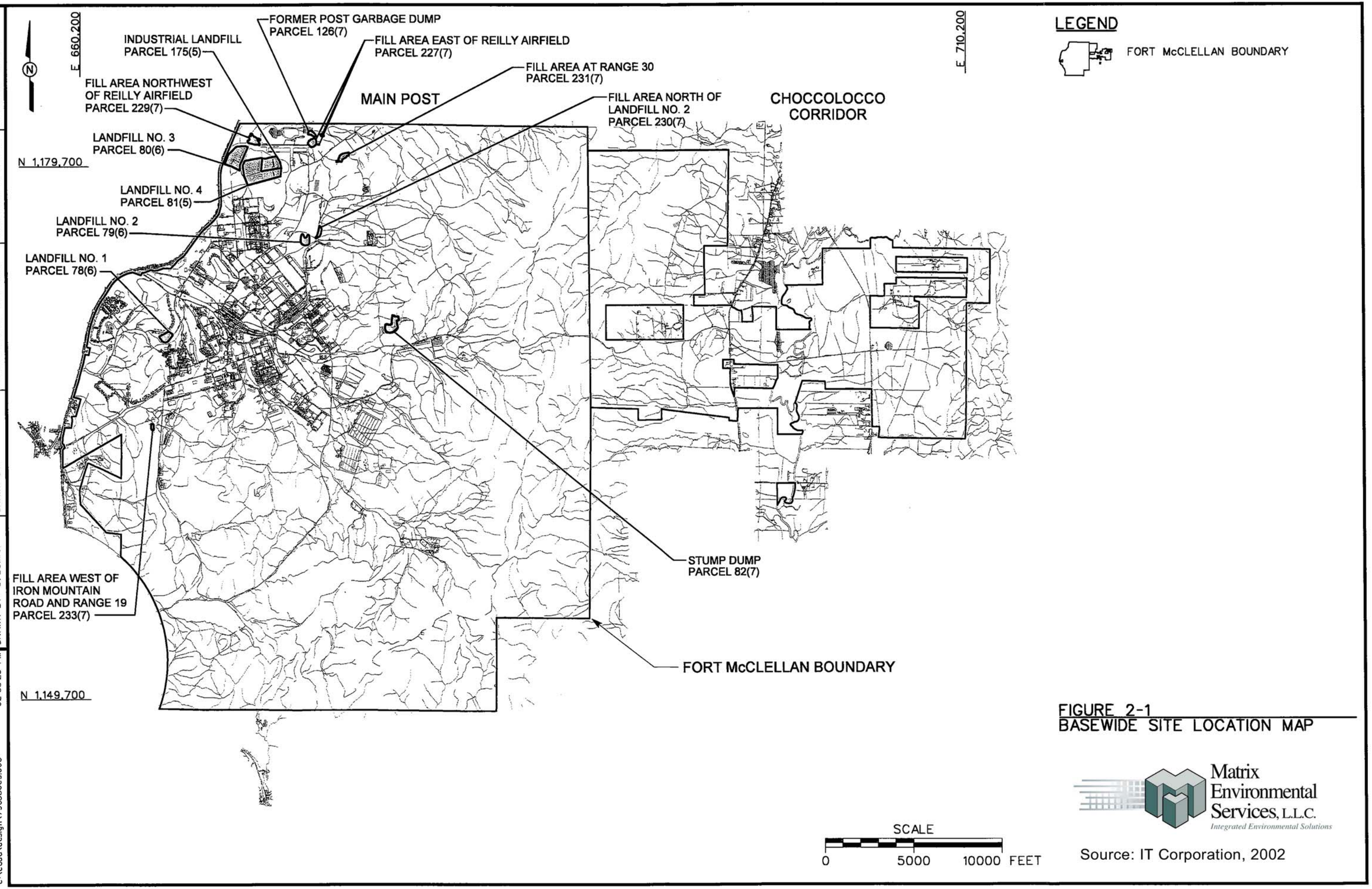


FIGURE 2-1
BASEWIDE SITE LOCATION MAP

Source: IT Corporation, 2002

DWG. NO.: ...\796886es.065
PROJ. NO.: 796886
INITIATOR: J. RAGSDALE
PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY:
ENGR. CHCK. BY: J. JENKINS
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 01/15/01
DRAWN BY: D. BOMAR
02/25/02
02:58:23 PM
DBILLING
c:\cadd\design\796886es.065

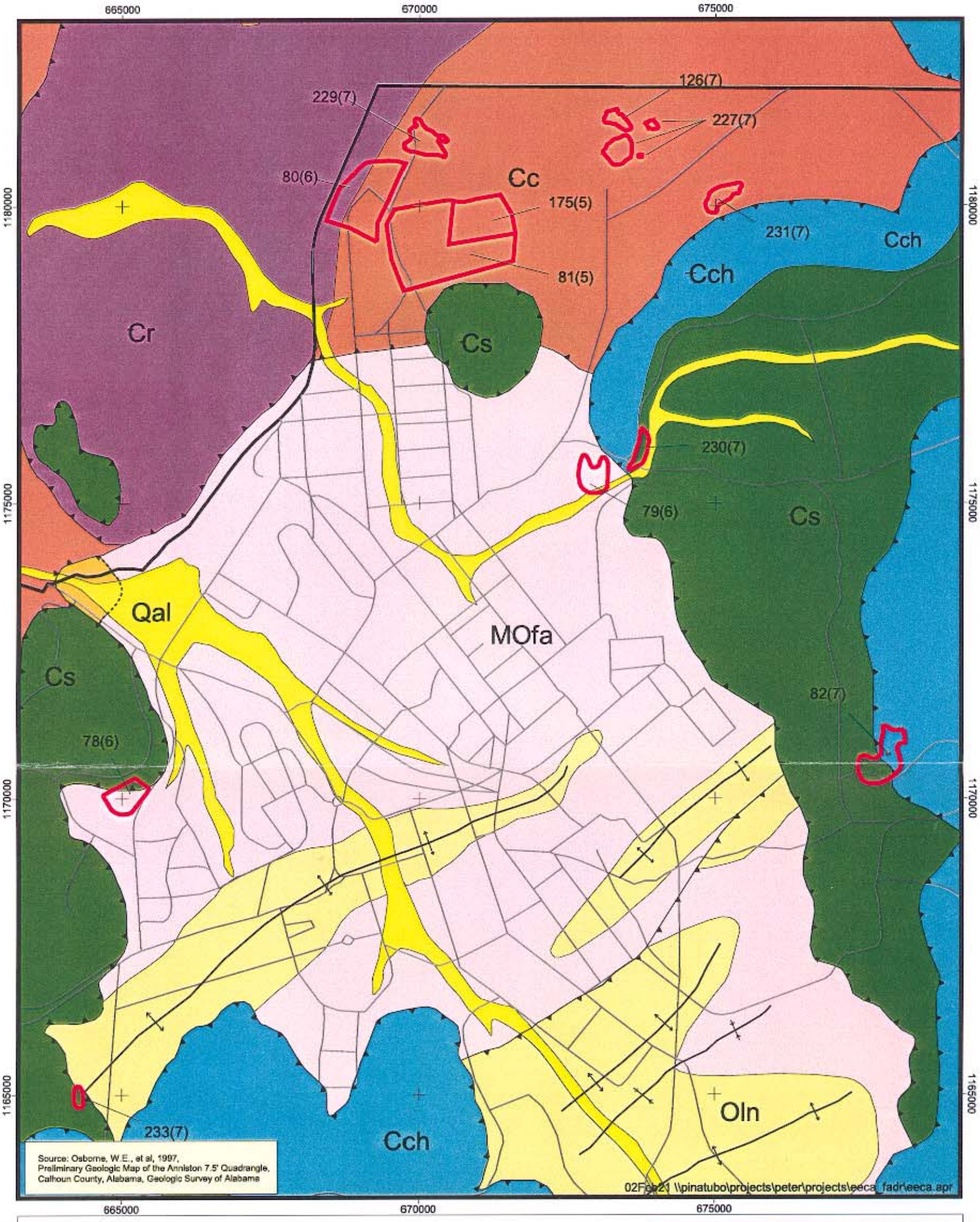


Figure 2-2 Geologic Map

N

0 2000 4000

State Plane feet, NAD 83

Source: IT Corporation, 2002

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

Legend

Syncline
Anticline
Fault
Roads
Main Post Boundary
Landfill Boundary

Geology

l	Limestone - age unknown
ts	Terrace Deposit - age unknown
col	Colluvium - age unknown
Qal	Quaternary - alluvium
OCk	Ordovician - Little Oak and Newala Limestones
MOfa	Cambrian/Ordovician - Knox Group, Undifferentiated
Oln	Mississippian/Ordovician - Floyd & Athens Shale, Undifferentiated
Cs	Cambrian - Shady Dolomite
Cr	Cambrian - Rome Formation
Cch	Cambrian - Chilhowee Group
Cc	Cambrian - Conasauga Formation

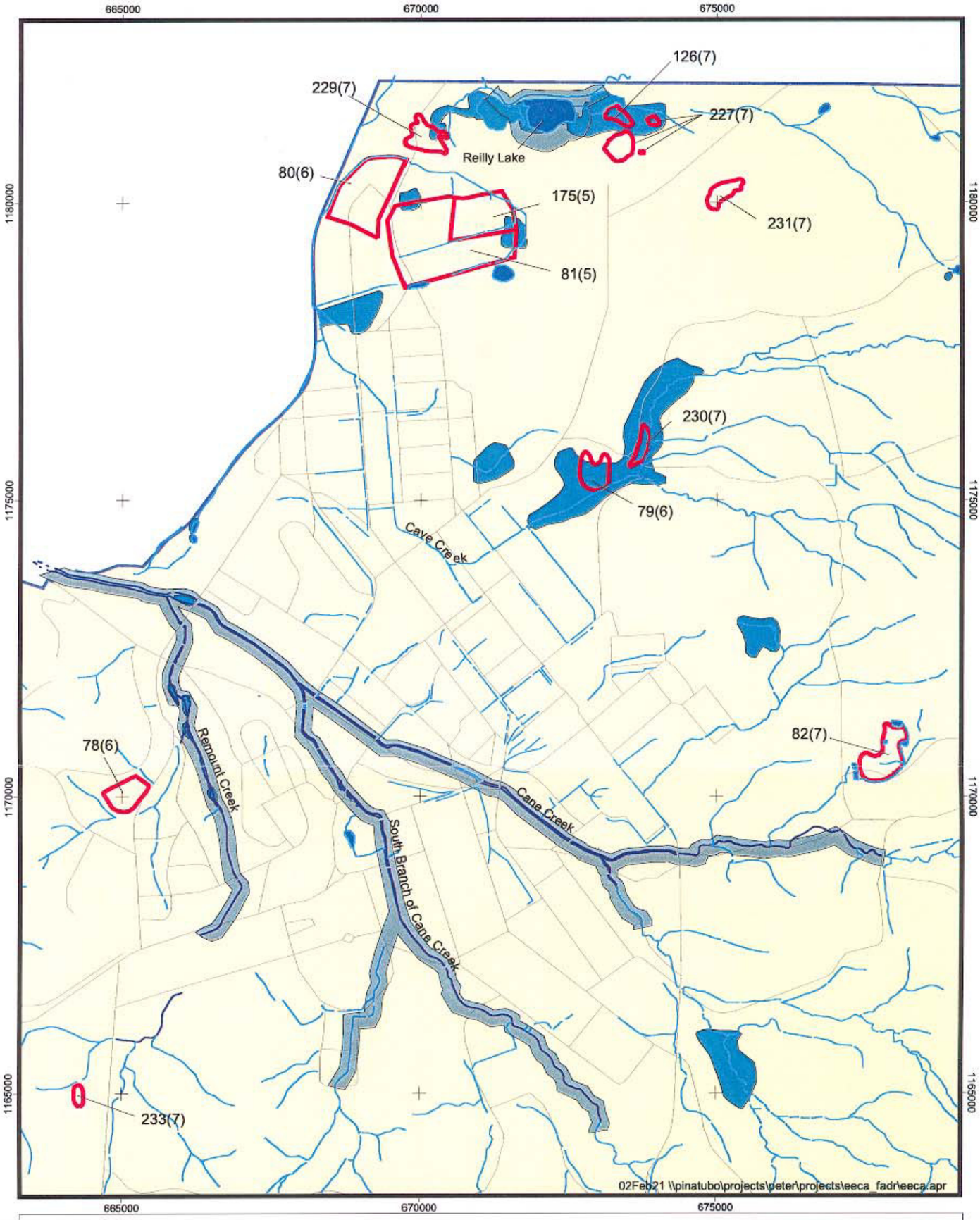


Figure 2- 3 **Base Wetlands/Sensitive Gray Bat Habitat Map**

N

0 2000 4000

State Plane feet, NAD 83

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

Source: IT Corporation, 2002

Legend

- Creeks - Intermittent
- Creeks
- Roads
- Lakes
- Wetlands
- Moderate Gray Bat Habitat
- Main Post
- Landfill Boundary

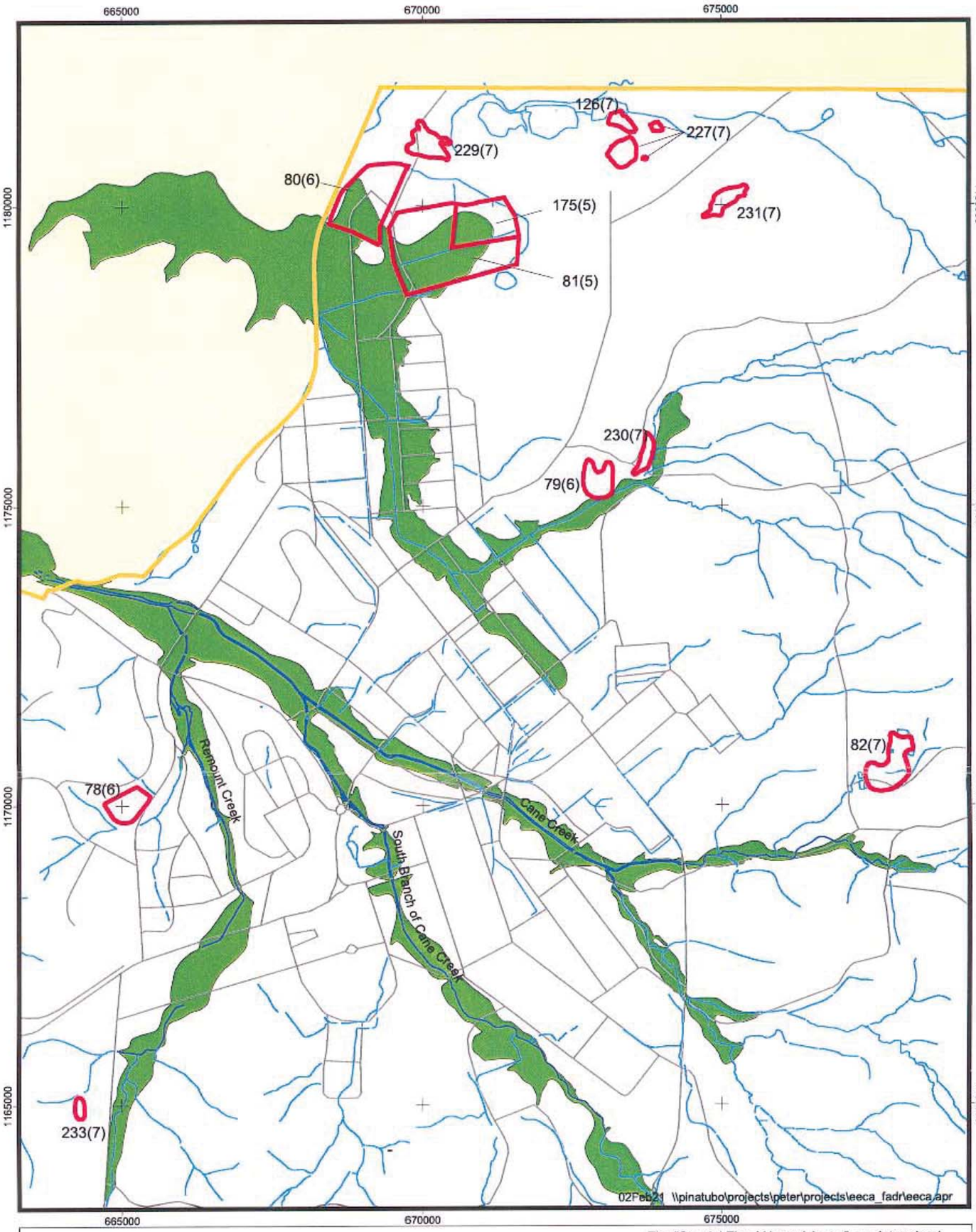


Figure 2-4 Floodplain Map

The "Special Flood Hazard Areas", as determined by FEMA, is an area inundated by 1% annual chance flooding for which Base Flood Elevations or velocity may have been determined. These areas were created at a scale of 1:24,000 and therefore are not as spatially accurate as the planimetric data. Use with caution.

Legend

- Creeks - Intermittent
- Creeks
- Roads
- EE/CA Area
- Special Flood Hazard Area
- Main Post Boundary

0 1500 3000

State Plane feet, NAD 83

N

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

Source: IT Corporation, 2002

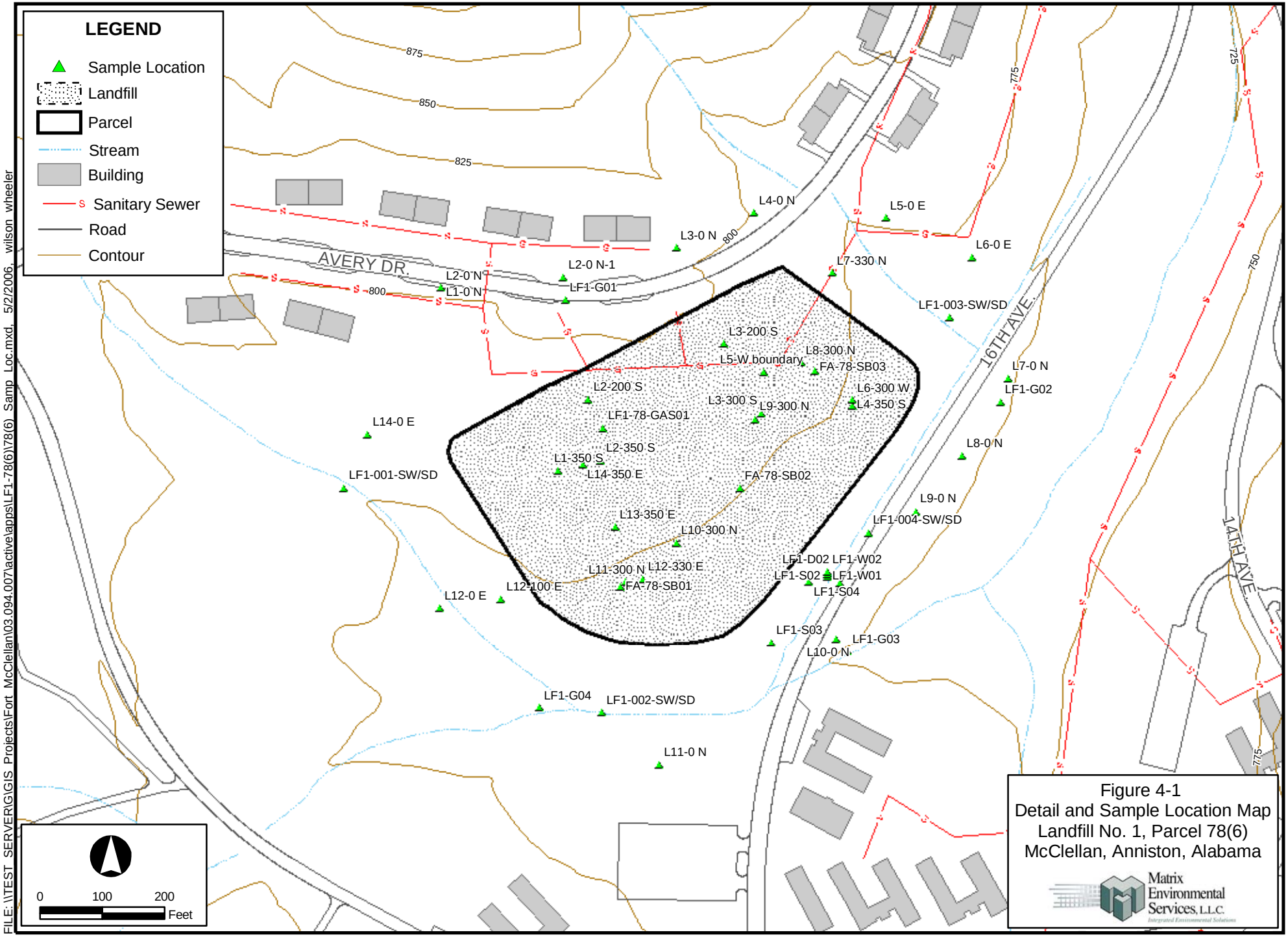
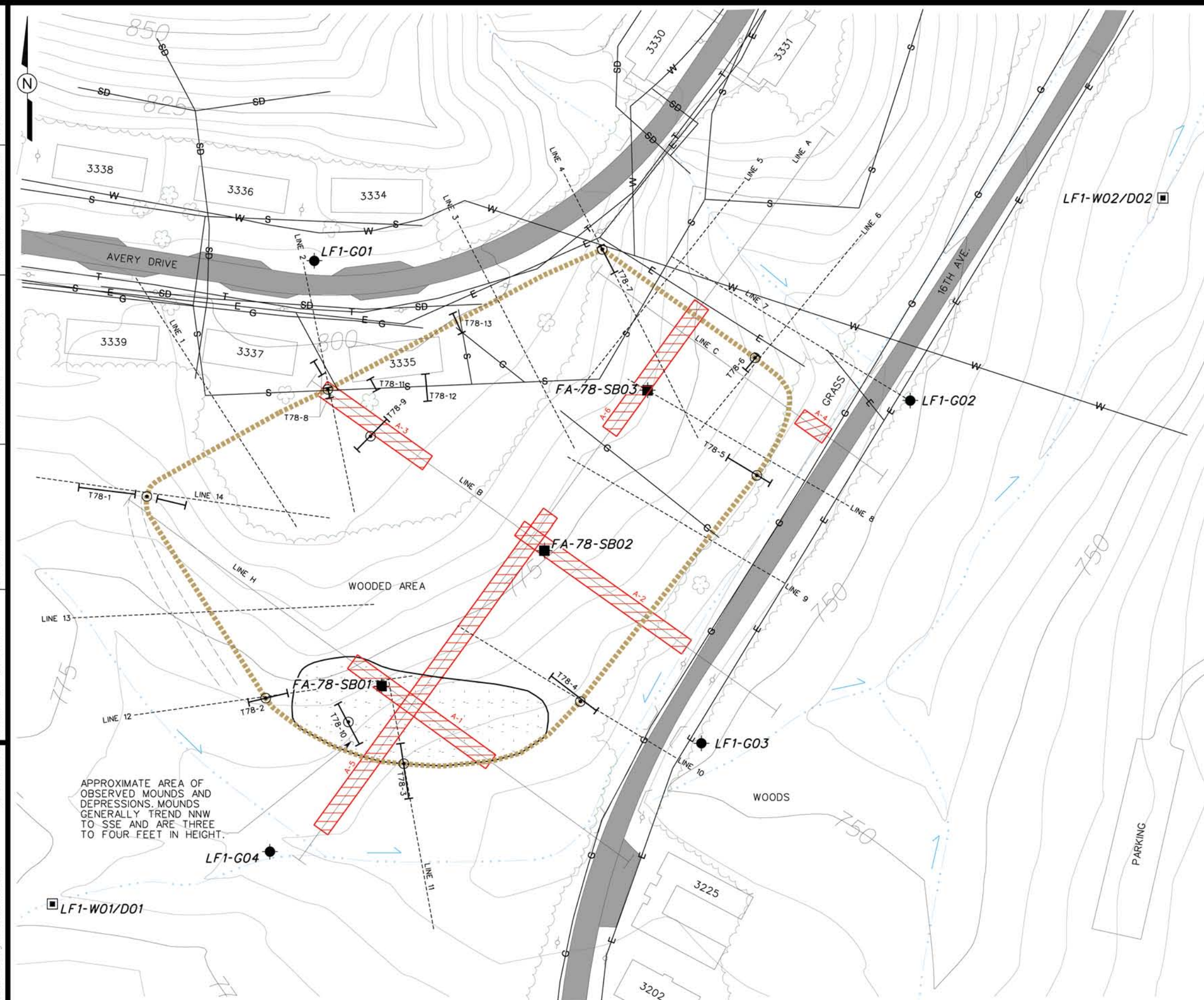


Figure 4-1
Detail and Sample Location Map
Landfill No. 1, Parcel 78(6)
McClellan, Anniston, Alabama

Matrix Environmental Services, L.L.C.

FILE: \\TEST_SERVER\G\GIS_Projects\Fort_McClellan\03.094.007\active\apps\LF1-78(6)\78(6)_Samp_Loc.mxd, 5/2/2006, wilson_wheeler



LEGEND

- LANDFILL BOUNDARY INFERRED BY SURFACE GEOPHYSICS AND TRENCHES
- SAIC GEOPHYSICAL SURVEY LINE
- A-1 SAIC GEOPHYSICAL ANOMALY
- GEOPHYSICAL TRANSECTS
- TRENCH EXCAVATION
- FILL BOUNDARY OBSERVED WITHIN TRENCH EXCAVATION
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 5 FOOT)
- SURFACE DRAINAGE / CREEK W/FLOW DIRECTION
- TREES / TREELINE
- UTILITY POLE
- SD STORM DRAIN UTILITY
- T TELEPHONE UTILITY
- W WATER UTILITY
- S SEWER UTILITY
- G GAS UTILITY
- E ELECTRIC UTILITY
- BEDROCK MONITORING WELL LOCATION
- SUBSURFACE SOIL SAMPLE LOCATION
- SURFACE WATER/SEDIMENT SAMPLE LOCATION

NOTES:

1. WELL LF1-G04 LOCATION IS ESTIMATED BECAUSE COORDINATES ON BORING LOG DO NOT MATCH FIGURE IN SAIC RI REPORT, 1995.

SCALE

0 120 240 FEET

FIGURE 4-2
GEOPHYSICAL INTERPRETATION MAP
LANDFILL NO. 1
PARCEL 78(6)

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

Source: IT Corporation, 2002

DRAFT. CHCK. BY: | ENGR. CHCK. BY: J. JENKINS | DATE LAST REV.: | DRAWN BY:
INITIATOR: J. RAGSDALE | PROJ. MGR.: J. YACOUB | DWG. NO.: ...\796886es.020 | PROJ. NO.: 793886
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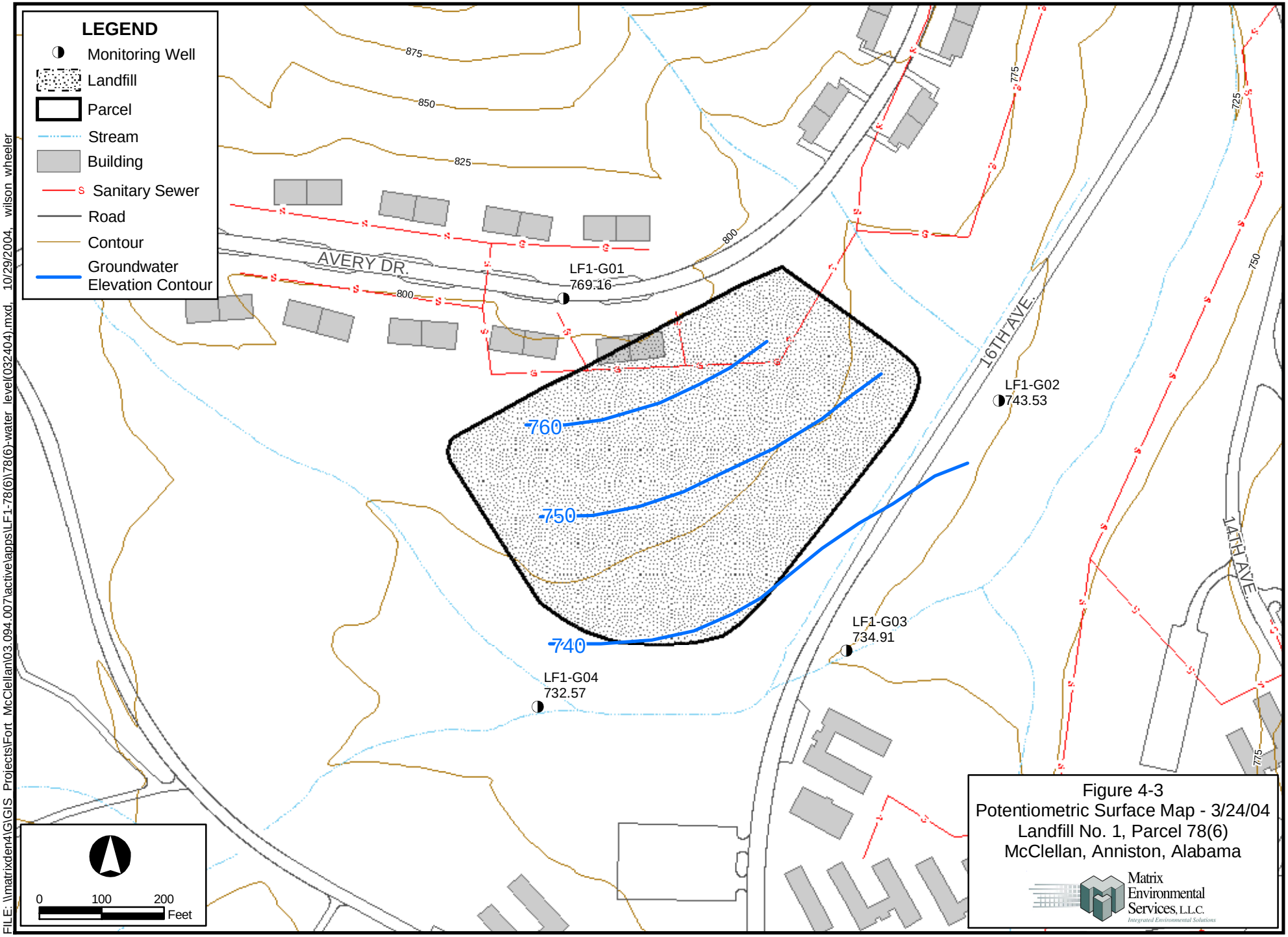


Figure 4-3
Potentiometric Surface Map - 3/24/04
Landfill No. 1, Parcel 78(6)
McClellan, Anniston, Alabama

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

FILE: \\matrixden4\G\GIS Projects\Fort McClellan\03.094.007\active\apps\LF1-78(6)\78(6)-water level(032404).mxd, 10/29/2004, wilson wheeler

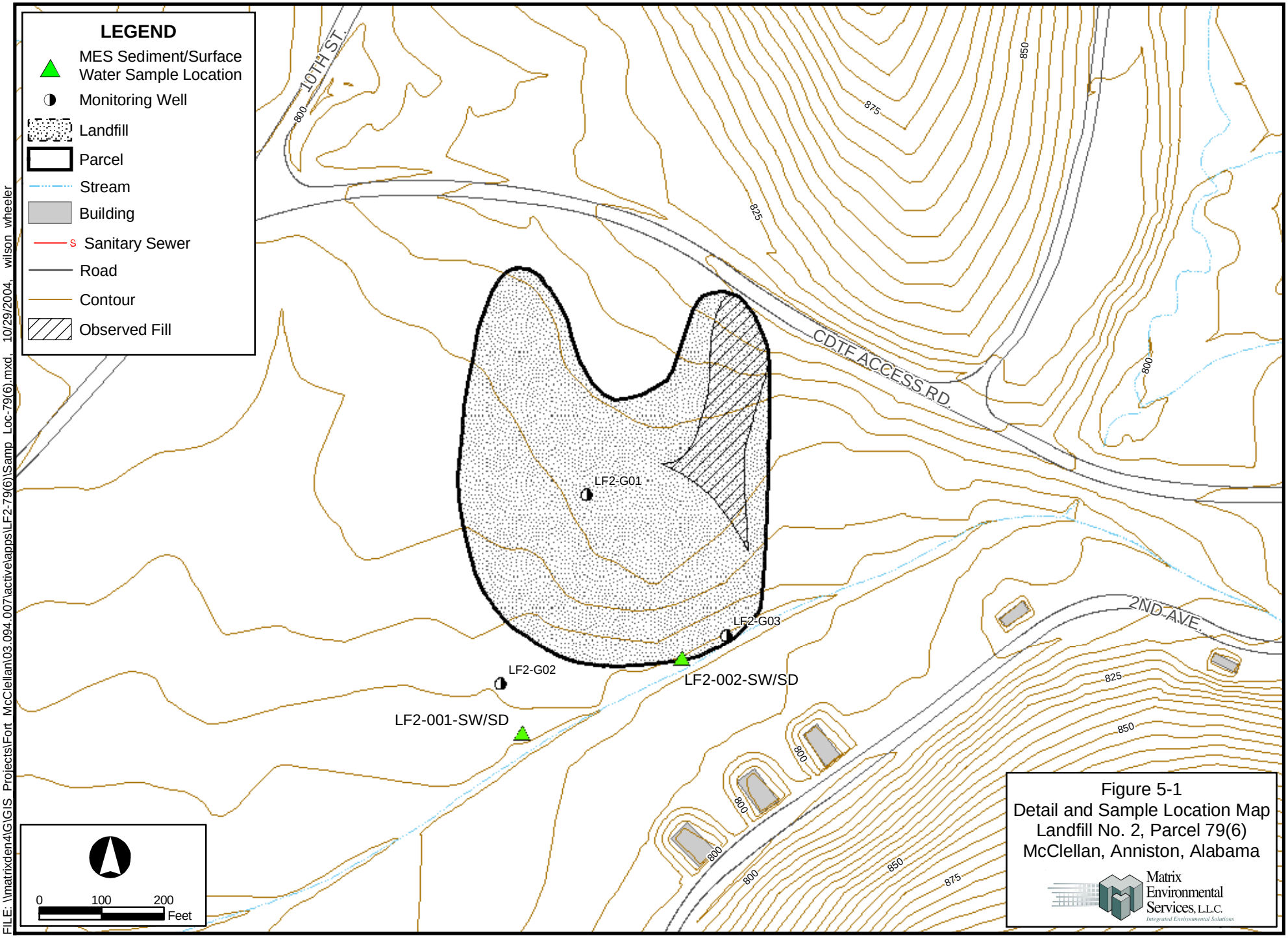
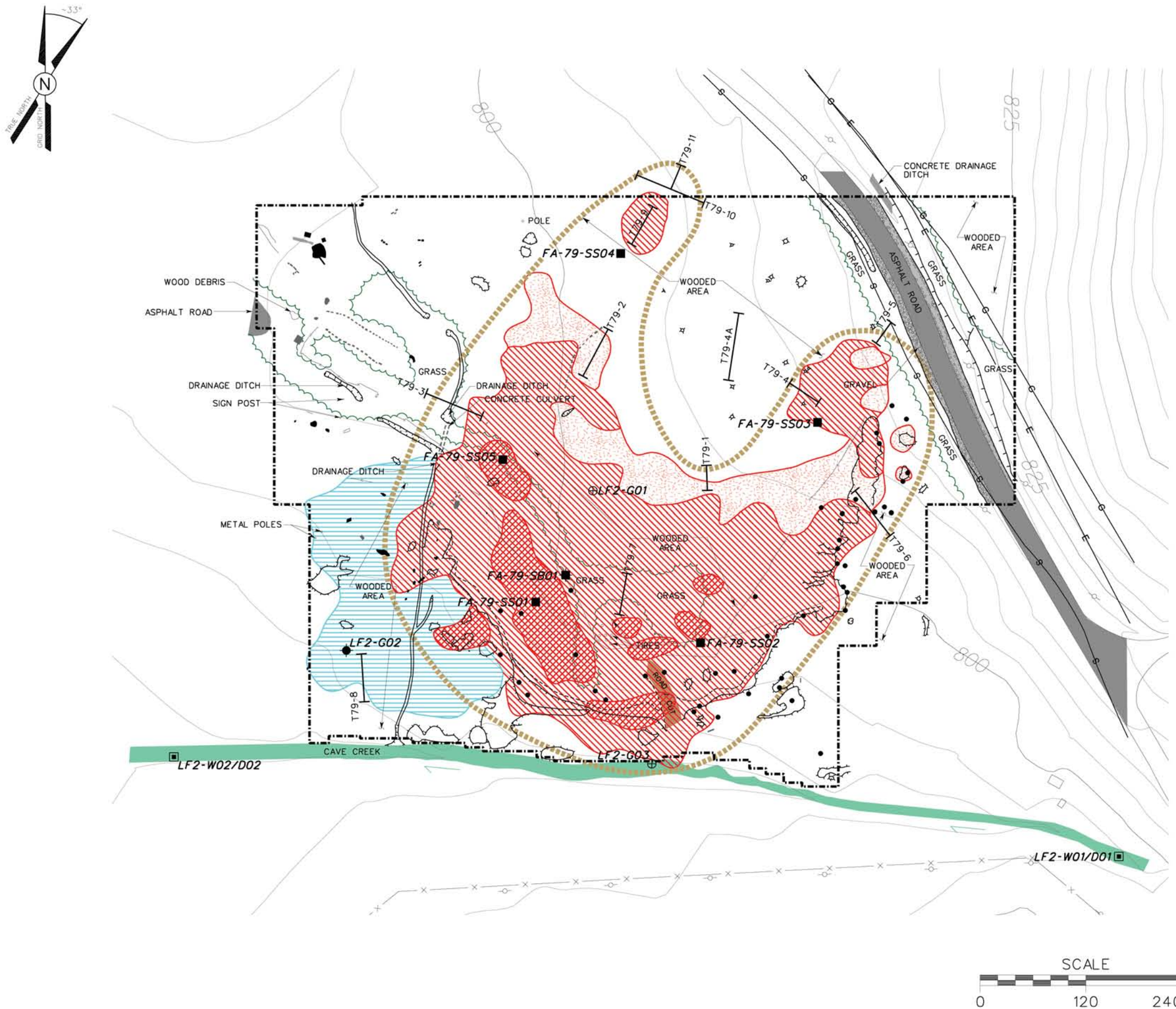


Figure 5-1
Detail and Sample Location Map
Landfill No. 2, Parcel 79(6)
McClellan, Anniston, Alabama

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

FILE: \\matrixden4\G\GIS_Projects\Fort_McClellan\03.094.007\activeapps\LF2-79(6)\Samp_Loc-79(6).mxd, 10/29/2004, wilson_wheeler



LEGEND

- GEOPHYSICAL SURVEY BOUNDARY
- LANDFILL BOUNDARY INFERRED BY SURFACE GEOPHYSICS AND TRENCHES
- LOW CONCENTRATION OF BURIED METAL
- MODERATE CONCENTRATION OF BURIED METAL
- HIGH CONCENTRATION OF BURIED METAL
- HIGH CONDUCTIVITY ANOMALY
- CONCRETE/REINFORCED CONCRETE
- SURFACE METAL OBJECT
- TRENCH EXCAVATION
- MOUND
- DEPRESSION
- CREST OF SLOPE
- TOE OF SLOPE
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 5 FOOT)
- SURFACE WATER FLOW
- FENCE
- TREE/ TREELINE
- SEWER UTILITY
- GAS UTILITY
- ELECTRIC UTILITY
- UTILITY POLE
- RESIDUUM MONITORING WELL LOCATION
- BEDROCK MONITORING WELL LOCATION
- SUBSURFACE SOIL SAMPLE LOCATION
- SURFACE SOIL SAMPLE LOCATION
- SURFACE WATER/SEDIMENT SAMPLE LOCATION

FIGURE 5-2
GEOPHYSICAL INTERPRETATION MAP
LANDFILL NO.2
PARCEL 79(6)

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

SCALE
0 120 240 FEET

Source: IT Corporation, 2002

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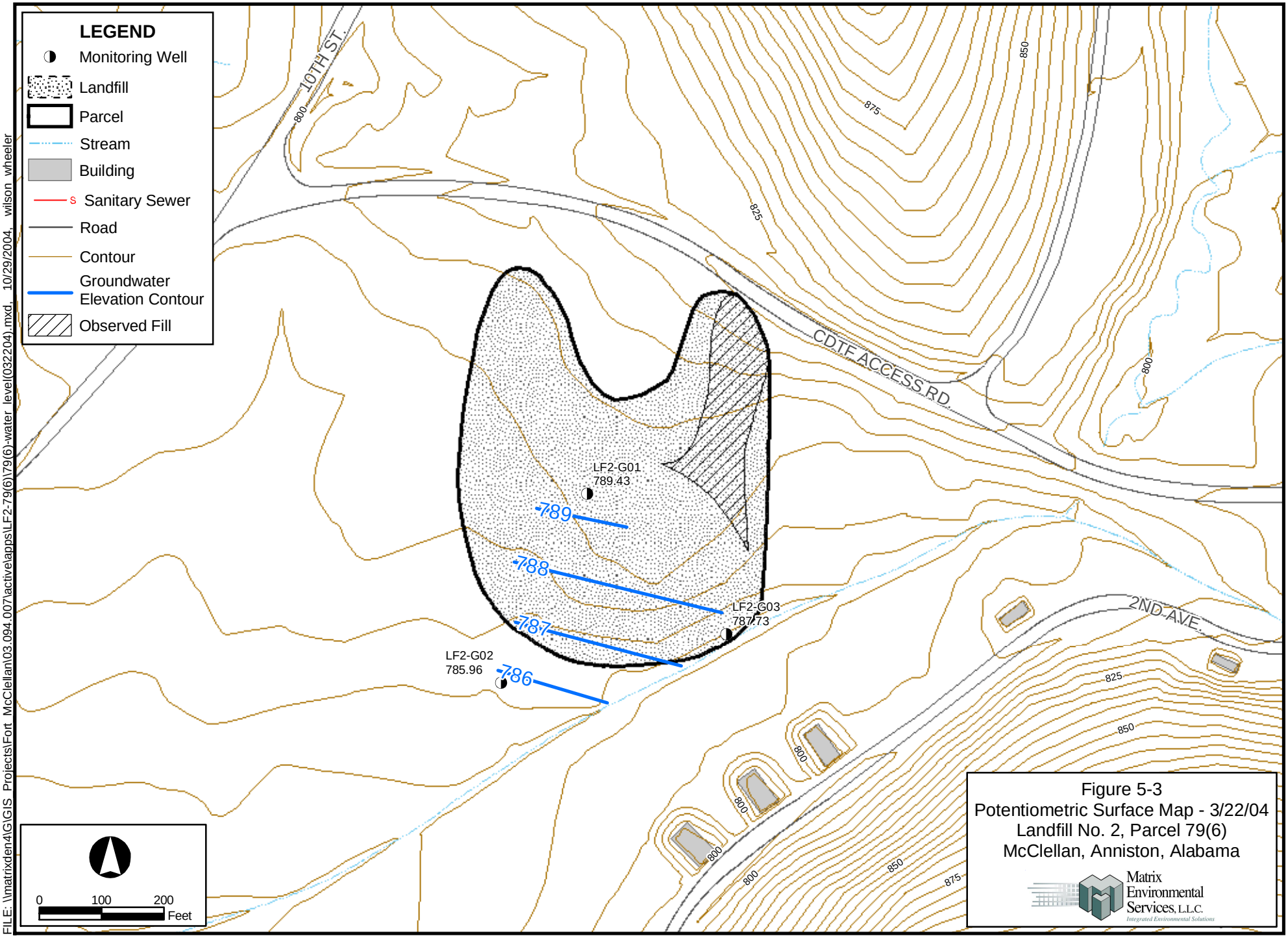

Figure 5-3
Potentiometric Surface Map - 3/22/04
Landfill No. 2, Parcel 79(6)
McClellan, Anniston, Alabama

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

FILE: \\matrixden4\G\GIS_Projects\Fort_McClellan\03.094.007\activeapps\LF2-79(6)\79(6)-water_level(032204).mxd, 10/29/2004, wilson_wheeler

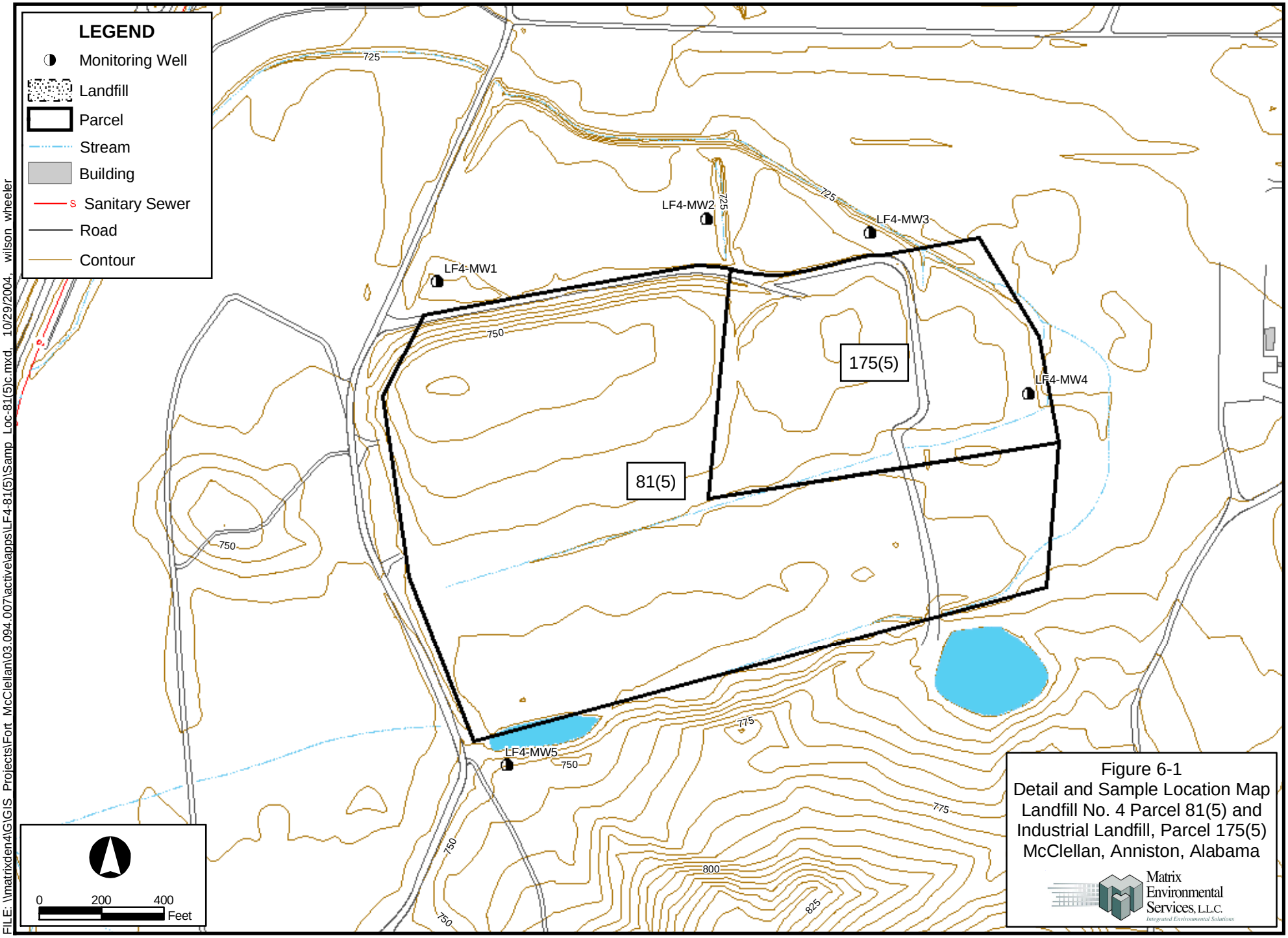

Figure 6-1
Detail and Sample Location Map
Landfill No. 4 Parcel 81(5) and
Industrial Landfill, Parcel 175(5)
McClellan, Anniston, Alabama

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

FILE: \\matrixden4\G\GIS Projects\Fort McClellan\03.094.007\activeapps\LF4-81(5)\Samp Loc-81(5)c.mxd, 10/29/2004, wilson wheeler

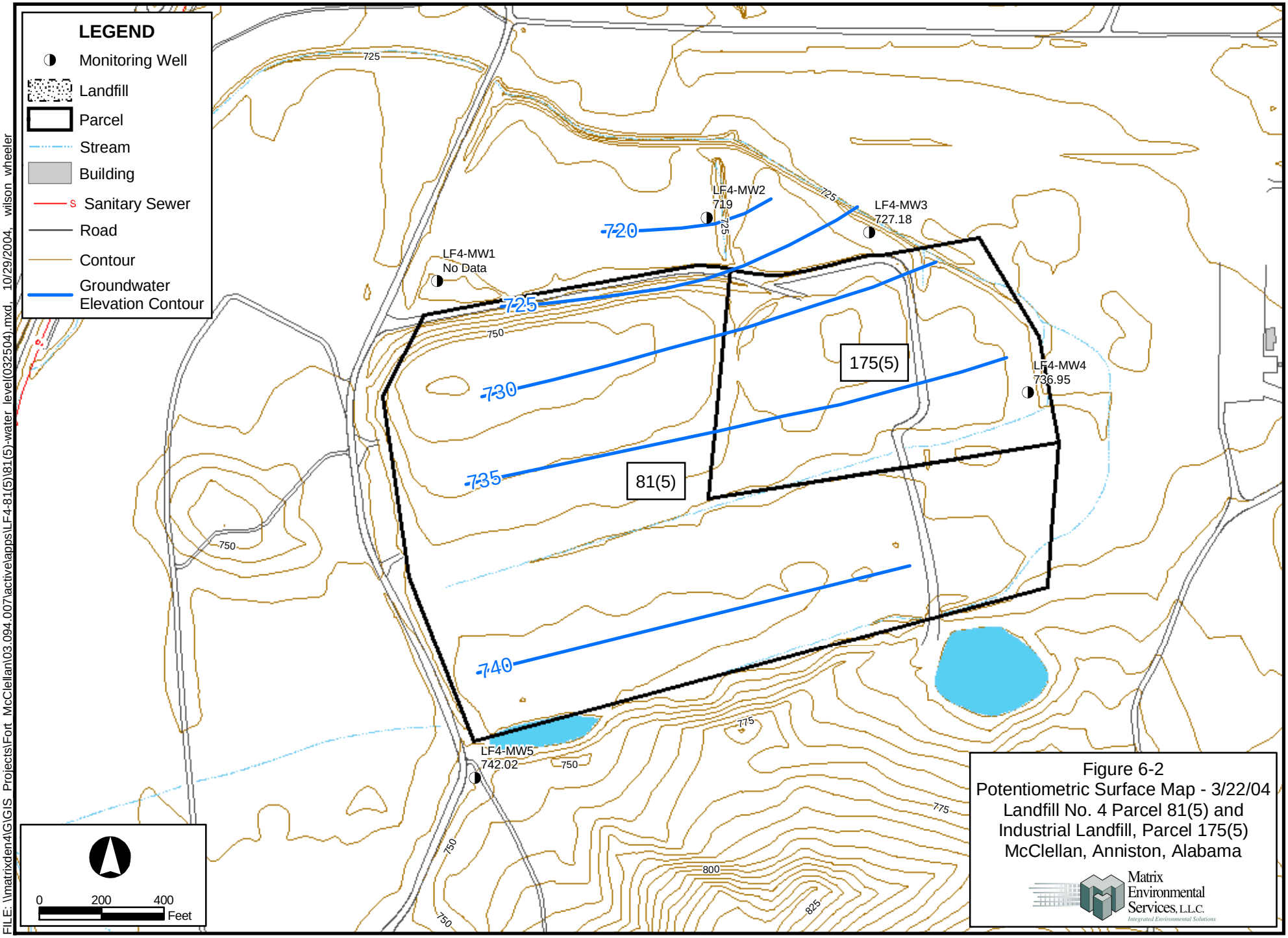

Figure 6-2
Potentiometric Surface Map - 3/22/04
Landfill No. 4 Parcel 81(5) and
Industrial Landfill, Parcel 175(5)
McClellan, Anniston, Alabama

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

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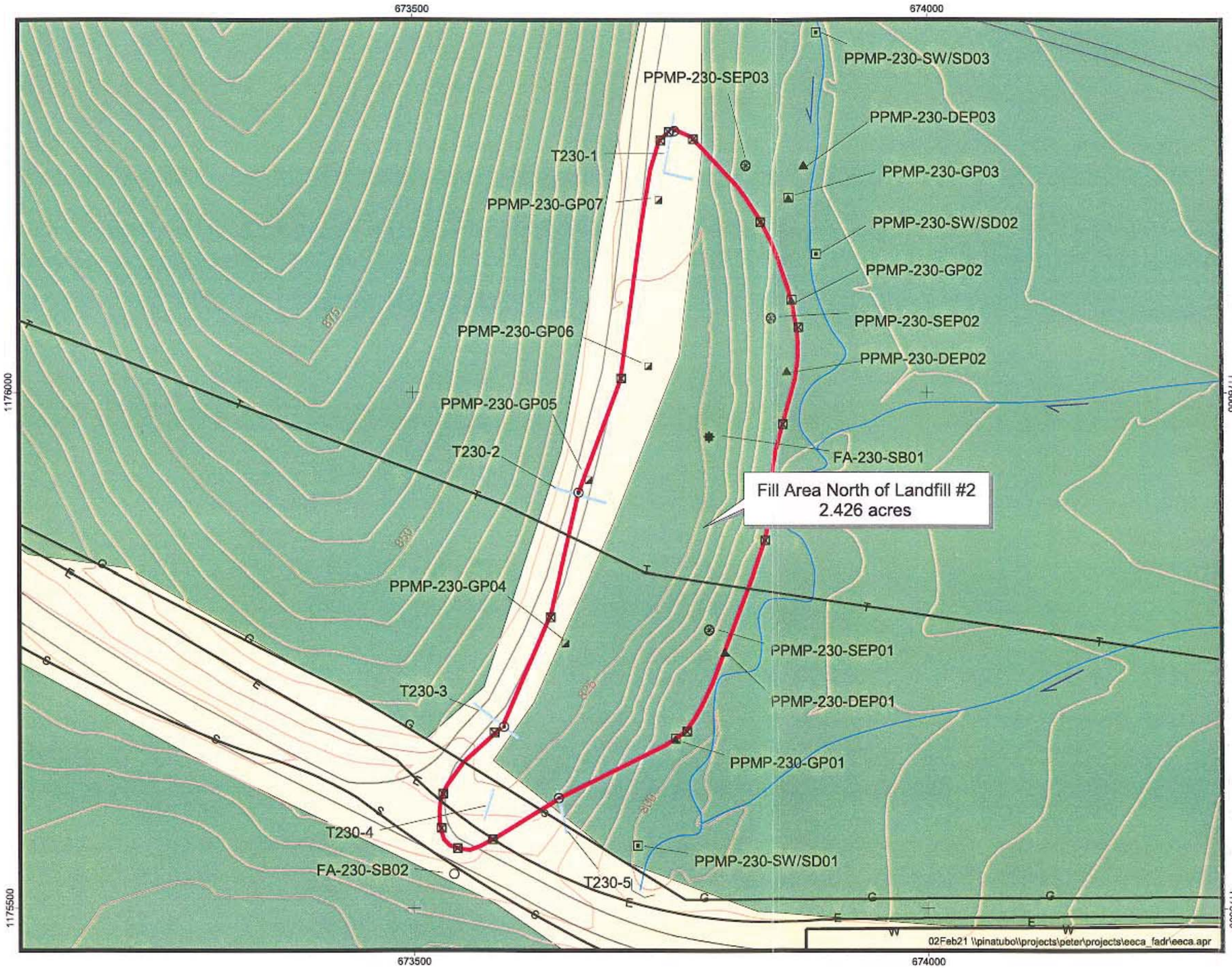


Figure 7-1
Detail Map
Fill Area
North of Landfill No. 2
Parcel 230(7)

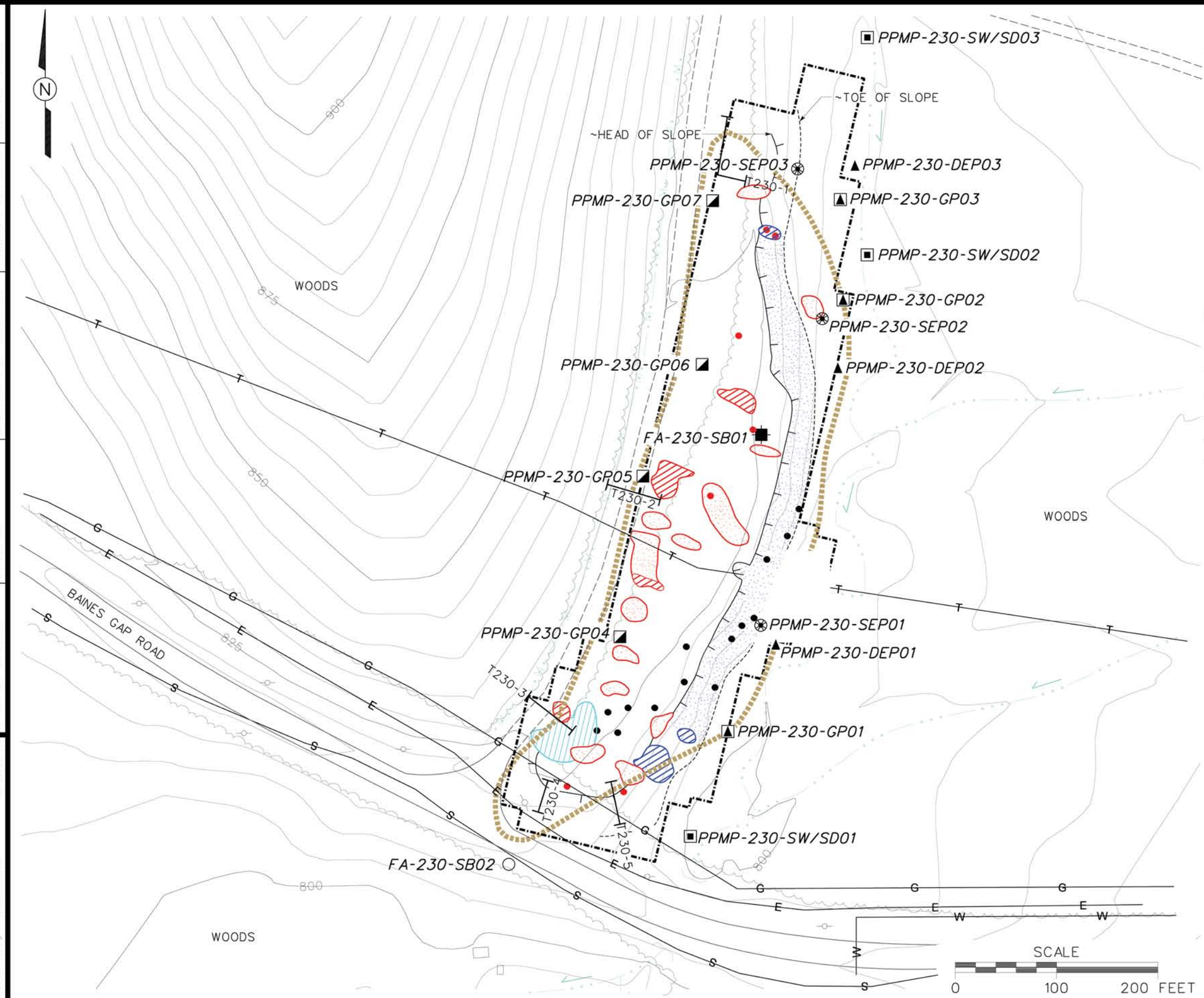
- Proposed Concrete Monument
- Fill Boundary Observed within Trench Excavations
- Depositional Soil Sample Location
- Subsurface Soil Sample Location
- Groundwater, Surface, and Subsurface Soil Sample Location (well)
- Seep Water Sample Location
- Surface Water/Sediment Sample Location
- Surface and Subsurface Soil Sample Location
- Posthole Excavation Location
- Water Utility
- Telephone Utility
- Gas Utility
- Sewer Utility
- Electric Utility
- Surface Drainage/Creek w/ Flow Direction
- Exploratory Trench
- Improved Roads
- 5' Topographic Contours
- Fill Area Boundary Inferred by Surface Geophysics and Trenches
- Wooded
- Lawn/Cleared Area

0 100 200
State Plane feet, NAD83

N

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

Source: IT Corporation, 2002



LEGEND

- GEOPHYSICAL SURVEY BOUNDARY
- FILL AREA BOUNDARY INFERRED BY SURFACE GEOPHYSICS AND TRENCHES
- LOW CONCENTRATION OF BURIED METAL
- MODERATE CONCENTRATION OF BURIED METAL
- BURIED METAL OBJECT
- HIGH CONDUCTIVITY ANOMALY
- LOW CONCENTRATION OF SURFACE AND/ OR PARTIALLY BURIED METAL DEBRIS
- MODERATE CONCENTRATION OF SURFACE AND/OR PARTIALLY BURIED METAL DEBRIS
- SURFACE METAL OBJECT
- TRENCH EXCAVATION
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 5 FOOT)
- TELEPHONE UTILITY
- WATER UTILITY
- SEWER UTILITY
- GAS UTILITY
- ELECTRIC UTILITY
- UTILITY POLE
- TREES / TREELINE
- SURFACE DRAINAGE / CREEK W/FLOW DIRECTION
- SURFACE WATER/SEDIMENT SAMPLE LOCATION
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION
- SUBSURFACE SOIL SAMPLE LOCATION
- GROUNDWATER, SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (WELL)
- DEPOSITIONAL SOIL SAMPLE LOCATION
- SEEP WATER SAMPLE LOCATION
- POSTHOLE EXCAVATION LOCATION

FIGURE 7-2
GEOPHYSICAL INTERPRETATION MAP
FILL AREA NORTH OF
LANDFILL NO. 2
PARCEL 230(7)

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

Source: IT Corporation, 2002

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ATTACHMENT 1

LIST OF ABBREVIATIONS AND ACRONYMS

List of Abbreviations and Acronyms

2,4-D	2,4-dichlorophenoxyacetic acid
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4,5-TP	silvex
3D	3D International Environmental Group
AB	ambient blank
AbB3	Anniston gravelly clay loam, 2 to 6 percent slopes, severely eroded
AbC3	Anniston gravelly clay loam, 6 to 10 percent slopes, severely eroded
AbD3	Anniston and Allen gravelly clay loams, 10 to 15 percent slopes, eroded
Abs	skin absorption
ABS	dermal absorption factor
AC	hydrogen cyanide
ACAD	AutoCadd
AcB2	Anniston and Allen gravelly loams, 2 to 6 percent slopes, eroded
AcC2	Anniston and Allen gravelly loams, 6 to 10 percent slopes, eroded
AcD2	Anniston and Allen gravelly loams, 10 to 15 percent slopes, eroded
AcE2	Anniston and Allen gravelly loams, 15 to 25 percent slopes, eroded
ACGIH	American Conference of Governmental Industrial Hygienists
AdE	Anniston and Allen stony loam, 10 to 25 percent slope
ADEM	Alabama Department of Environmental Management
ADPH	Alabama Department of Public Health
AEC	U.S. Army Environmental Center
AEL	airborne exposure limit
AET	adverse effect threshold
AF	soil-to-skin adherence factor
AHA	ammunition holding area
AL	Alabama
ALARNG	Alabama Army National Guard
ALAD	d-aminolevulinic acid dehydratase
ALDOT	Alabama Department of Transportation
amb.	amber
amsl	above mean sea level
ANAD	Anniston Army Depot
AOC	area of concern
APEC	areas of potential ecological concern
APT	armor-piercing tracer
AR	analysis request
ARAR	applicable or relevant and appropriate requirement
AREE	area requiring environmental evaluation
AS/SVE	air sparging/soil vapor extraction
ASP	Ammunition Supply Point
ASR	Archives Search Report
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	all-terrain vehicle
AUF	area use factor
AWARE	Associated Water and Air Resources Engineers, Inc.
AWQC	ambient water quality criteria
AWWSB	Anniston Water Works and Sewer Board
'B'	Analyte detected in laboratory or field blank at concentration greater than the reporting limit (and greater than zero)
BCF	blank correction factor; bioconcentration factor
BCT	BRAC Cleanup Team
BERA	baseline ecological risk assessment
BEHP	bis(2-ethylhexyl)phthalate
BFB	bromofluorobenzene
BFE	base flood elevation
BG	Bacillus globigii
BGR	Bains Gap Road
bgs	below ground surface
BHC	betahexachlorocyclohexane
BHHRA	baseline human health risk assessment
BIRTC	Branch Immaterial Replacement Training Center
bkg	background
bls	below land surface
BOD	biological oxygen demand
Bp	soil-to-plant biotransfer factors
BRAC	Base Realignment and Closure
Braun	Braun Intertec Corporation
BSAF	biota-to-sediment accumulation factors
BSC	background screening criterion
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, ethyl benzene, and xylenes
BTOC	below top of casing
BTV	background threshold value
BW	biological warfare; body weight
BZ	breathing zone; 3-quinuclidinyl benzilate
C	ceiling limit value
Ca	carcinogen
$CaCO_3$	calcium carbonate
CAA	Clean Air Act
CAB	chemical warfare agent breakdown products
CAMU	corrective action management unit
CBR	chemical, biological, and radiological
CCAL	continuing calibration
CCB	continuing calibration blank
CCV	continuing calibration verification
CD	compact disc
CDTF	Chemical Defense Training Facility
CEHNC	U.S. Army Engineering and Support Center, Huntsville
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act
CESAS	Corps of Engineers South Atlantic Savannah
CF	conversion factor
CFC	chlorofluorocarbon
CFDP	Center for Domestic Preparedness
CFR	Code of Federal Regulations
CG	carbonyl chloride (phosgene)
CGI	combustible gas indicator
ch	inorganic clays of high plasticity
CHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
CK	cyanogen chloride
cl	inorganic clays of low to medium plasticity
Cl	chlorinated
CLP	Contract Laboratory Program
cm	centimeter
CN	chloroacetophenone
CNB	chloroacetophenone, benzene, and carbon tetrachloride
CNS	chloroacetophenone, chloropicrin, and chloroform
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
CoA	Code of Alabama
COC	chain of custody; chemical of concern
COE	Corps of Engineers
Con	skin or eye contact
COPC	chemical(s) of potential concern
COPEC	chemical(s)/constituent(s) of potential ecological concern
CPSS	chemicals present in site samples
CQCSM	Contract Quality Control System Manager
CRDL	contract-required detection limit
CRL	certified reporting limit
CRQL	contract-required quantitation limit
CRZ	contamination reduction zone
Cs-137	cesium-137
CS	ortho-chlorobenzylidene-malononitrile
CSEM	conceptual site exposure model
CSM	conceptual site model
CT	central tendency
ctr.	container
CWA	chemical warfare agent; Clean Water Act
CWM	chemical warfare material; clear, wide mouth
CX	dichloroformoxime
'D'	duplicate; dilution
D&I	detection and identification
DAAMS	depot area air monitoring system
DAF	dilution-attenuation factor
DANC	decontamination agent, non-corrosive
ºC	degrees Celsius
ºF	degrees Fahrenheit
DCA	dichloroethane
DCE	dichloroethene
DDD	dichlorodiphenyldichloroethane

DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DEH	Directorate of Engineering and Housing
DEP	depositional soil
DFTPP	decafluorotriphenylphosphine
DI	deionized
DID	data item description
DIMP	di-isopropylmethylphosphonate
DM	dry matter; adamsite
DMBA	dimethylbenz(a)anthracene
DMMP	dimethylmethylphosphonate
DOD	U.S. Department of Defense
DOJ	U.S. Department of Justice
DOT	U.S. Department of Transportation
DP	direct-push
DPDO	Defense Property Disposal Office
DPT	direct-push technology
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
DRO	diesel range organics
DS	deep (subsurface) soil
DS2	Decontamination Solution Number 2
DSERTS	Defense Site Environmental Restoration Tracking System
DWEL	drinking water equivalent level
E&E	Ecology and Environment, Inc.
EB	equipment blank
EBS	environmental baseline survey
EC_{50}	effects concentration for 50 percent of a population
ECBC	Edgewood Chemical/Biological Command
ED	exposure duration
EDD	electronic data deliverable
EF	exposure frequency
EDQL	ecological data quality level
EE/CA	engineering evaluation and cost analysis
Elev.	elevation
EM	electromagnetic
EMI	Environmental Management Inc.
EM31	Geonics Limited EM31 Terrain Conductivity Meter
EM61	Geonics Limited EM61 High-Resolution Metal Detector
EOD	explosive ordnance disposal
EODT	explosive ordnance disposal team
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EPIC	Environmental Photographic Interpretation Center
EPRI	Electrical Power Research Institute
ER	equipment rinsate
ERA	ecological risk assessment
ER-L	effects range-low
ER-M	effects range-medium
ESE	Environmental Science and Engineering, Inc.
ESMP	Endangered Species Management Plan
ESN	Environmental Services Network, Inc.
ESV	ecological screening value
ET	exposure time
EU	exposure unit
Exp.	explosives
E-W	east to west
EZ	exclusion zone
FAR	Federal Acquisition Regulations
FB	field blank
FD	field duplicate
FDA	U.S. Food and Drug Administration
Fe^{+3}	ferric iron
Fe^{+2}	ferrous iron
FedEx	Federal Express, Inc.
FEMA	Federal Emergency Management Agency
FFCA	Federal Facilities Compliance Act
FFE	field flame expedient
FFS	focused feasibility study
FI	fraction of exposure
Fil	filtered
Flt	filtered
FMDC	Fort McClellan Development Commission
FML	flexible membrane liner
FMP 1300	Former Motor Pool 1300
f_{oc}	fraction organic carbon
FOMRA	Former Ordnance Motor Repair Area
FOST	Finding of Suitability to Transfer
Foster Wheeler	Foster Wheeler Environmental Corporation
FR	Federal Register
Frtn	fraction
FS	field split; feasibility study
FSP	field sampling plan
ft	feet
ft/day	feet per day
ft/ft	feet per foot
ft/yr	feet per year
FTA	Fire Training Area
FTMC	Fort McClellan
FTRRA	FTMC Reuse & Redevelopment Authority
g	gram
g/m^3	gram per cubic meter
G-856	Geometrics, Inc. G-856 magnetometer
G-858G	Geometrics, Inc. G-858G magnetic gradiometer
GAF	gastrointestinal absorption factor
gal	gallon
gal/min	gallons per minute
GB	sarin
gc	clay gravels; gravel-sand-clay mixtures
GC	gas chromatograph
GCL	geosynthetic clay liner
GC/MS	gas chromatograph/mass spectrometer
GCR	geosynthetic clay liner
GFAA	graphite furnace atomic absorption
GIS	Geographic Information System
gm	silty gravels; gravel-sand-silt mixtures
gp	poorly graded gravels; gravel-sand mixtures
gpm	gallons per minute
GPR	ground-penetrating radar
GPS	global positioning system
GRA	general response action
GS	ground scar
GSA	General Services Administration; Geologic Survey of Alabama
GSBP	Ground Scar Boiler Plant
GSSI	Geophysical Survey Systems, Inc.
GST	ground stain
GW	groundwater
gw	well-graded gravels; gravel-sand mixtures
H&S	health and safety
HA	hand auger
HCl	hydrochloric acid
HD	distilled mustard
HDPE	high-density polyethylene
HEAST	Health Effects Assessment Summary Tables
Herb.	herbicides
HHRA	human health risk assessment
HI	hazard index
H_2O_2	hydrogen peroxide
HPLC	high performance liquid chromatography
HNO_3	nitric acid
HQ	hazard quotient
HQ_{screen}	screening-level hazard quotient
hr	hour
HRC	hydrogen releasing compound
HSA	hollow-stem auger
HTRW	hazardous, toxic, and radioactive waste
'I'	out of control, data rejected due to low recovery
IATA	International Air Transport Authority
ICAL	initial calibration
ICB	initial calibration blank
ICP	inductively-coupled plasma
ICRP	International Commission on Radiological Protection
ICS	interference check sample
ID	inside diameter

IDL	instrument detection limit
IDLH	immediately dangerous to life or health
IDM	investigative-derived media
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
IF	ingestion factor; inhalation factor
ILCR	incremental lifetime cancer risk
IMPA	isopropylmethyl phosphonic acid
IMR	Iron Mountain Road
in.	inch
Ing	ingestion
Inh	inhalation
IP	ionization potential
IPS	International Pipe Standard
IR	ingestion rate
IRDMIS	Installation Restoration Data Management Information System
IRIS	Integrated Risk Information Service
IRP	Installation Restoration Program
IS	internal standard
ISCP	Installation Spill Contingency Plan
IT	IT Corporation
ITEMS	IT Environmental Management System™
'J'	estimated concentration
JeB2	Jefferson gravelly fine sandy loam, 2 to 6 percent slopes, eroded
JeC2	Jefferson gravelly fine sandy loam, 6 to 10 percent slopes, eroded
JfB	Jefferson stony fine sandy loam, 0 to 10 percent slopes have strong slopes
JPA	Joint Powers Authority
K	conductivity
K_d	soil-water distribution coefficient
kg	kilogram
KeV	kilo electron volt
K_{oc}	organic carbon partioning coefficient
K_{ow}	octonal-water partition coefficient
$KMnO_4$	potassium permanganate
L	lewisite; liter
L/kg/day	liters per kilogram per day
l	liter
lb	pound
LBP	lead-based paint
LC	liquid chromatography
LCS	laboratory control sample
LC_{50}	lethal concentration for 50 percent population tested
LD_{50}	lethal dose for 50 percent population tested
LEL	lower explosive limit
LOAEL	lowest-observed-advserse-effects-level
LRA	land redevelopment authority
LT	less than the certified reporting limit
LUC	land-use control
LUCAP	land-use control assurance plan
LUCIP	land-use control implementation plan
max	maximum
MB	method blank
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MCPA	4-chloro-2-methylphenoxyacetic acid
MCPP	2-(2-methyl-4-chlorophenoxy)propionic acid
MCS	media cleanup standard
MD	matrix duplicate
MDC	maximum detected concentration
MDCC	maximum detected constituent concentration
MDL	method detection limit
mg	milligrams
mg/kg	milligrams per kilogram
mg/kg/day	milligram per kilogram per day
mg/kgbw/day	milligrams per kilogram of body weight per day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
mh	inorganic silts, micaceous or diatomaceous fine, sandy or silt soils
MHz	megahertz
µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
MeV	mega electron volt
min	minimum
MINICAMS	miniature continuous air monitoring system
ml	inorganic silts and very fine sands
mL	milliliter
mm	millimeter
MM	mounded material
MMBtu/hr	million Btu per hour
MNA	monitored natural attenuation
MnO_4-	permanganate ion
MOA	Memorandum of Agreement
MOGAS	motor vehicle gasoline
MOUT	Military Operations in Urban Terrain
MP	Military Police
MPA	methyl phosphonic acid
MPM	most probable munition
MQL	method quantitation limit
MR	molasses residue
MRL	method reporting limit
MS	matrix spike
mS/cm	millisiemens per centimeter
mS/m	millisiemens per meter
MSD	matrix spike duplicate
MTBE	methyl tertiary butyl ether
msl	mean sea level
MtD3	Montevallo shaly, silty clay loam, 10 to 40 percent slopes , severely eroded
mV	millivolts
MW	monitoring well
MWI&P	Monitoring Well Installation and Management Plan
Na	sodium
NA	not applicable; not available
NAD	North American Datum
NAD83	North American Datum of 1983
$NaMnO_4$	sodium permanganate
NAVD88	North American Vertical Datum of 1988
NAS	National Academy of Sciences
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NCRP	National Council on Radiation Protection and Measurements
ND	not detected
NE	no evidence; northeast
ne	not evaluated
NEW	net explosive weight
NFA	No Further Action
NG	National Guard
NGP	National Guardsperson
ng/L	nanograms per liter
NGVD	National Geodetic Vertical Datum
Ni	nickel
NIC	notice of intended change
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NLM	National Library of Medicine
NO_3^-	nitrate
NPDES	National Pollutant Discharge Elimination System
NPW	net present worth
No.	number
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no-observed-adverse-effects-level
NR	not requested; not recorded; no risk
NRC	National Research Council
NRCC	National Research Council of Canada
NRHP	National Register of Historic Places
ns	nanosecond
N-S	north to south
NS	not surveyed
NSA	New South Associates, Inc.
nT	nanotesla
nT/m	nanoteslas per meter
NTU	nephelometric turbidity unit
nv	not validated

O_2	oxygen
O_3	ozone
O&G	oil and grease
O&M	operation and maintenance
OB/OD	open burning/open detonation
OD	outside diameter
OE	ordnance and explosives
oh	organic clays of medium to high plasticity
OH•	hydroxyl radical
ol	organic silts and organic silty clays of low plasticity
OP	organophosphorus
ORC	Oxygen Releasing Compound
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OVM-PID/FID	organic vapor meter-photoionization detector/flame ionization detector
OWS	oil/water separator
oz	ounce
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
Parsons	Parsons Engineering Science, Inc.
Pb	lead
PBMS	performance-based measurement system
PC	permeability coefficient
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
PCE	perchloroethene
PCP	pentachlorophenol
PDS	Personnel Decontamination Station
PEF	particulate emission factor
PEL	permissible exposure limit
PERA	preliminary ecological risk assessment
PES	potential explosive site
Pest.	pesticides
PETN	pentarey thritol tetranitrate
PFT	portable flamethrower
PG	professional geologist
PID	photoionization detector
PkA	Philo and Stendal soils local alluvium, 0 to 2 percent slopes
PM	project manager
POC	point of contact
POL	petroleum, oils, and lubricants
POTW	publicly owned treatment works
POW	prisoner of war
PP	peristaltic pump; Proposed Plan
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PPMP	Print Plant Motor Pool
ppt	parts per thousand
PR	potential risk
PRA	preliminary risk assessment
PRG	preliminary remediation goal
PS	chloropicrin
PSSC	potential site-specific chemical
pt	peat or other highly organic silts
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QAM	quality assurance manual
QAO	quality assurance officer
QAP	installation-wide quality assurance plan
QC	quality control
QST	QST Environmental, Inc.
qty	quantity
Qual	qualifier
R	rejected data; resample; retardation factor
R&A	relevant and appropriate
RA	remedial action
RAO	remedial action objective
RBC	risk-based concentration; red blood cell
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RDX	cyclonite
ReB3	Rarden silty clay loams
REG	regular field sample
REL	recommended exposure limit
RFA	request for analysis
RfC	reference concentration
RfD	reference dose
RGO	remedial goal option
RI	remedial investigation
RL	reporting limit
RME	reasonable maximum exposure
ROD	Record of Decision
RPD	relative percent difference
RRF	relative response factor
RSD	relative standard deviation
RTC	Recruiting Training Center
RTECS	Registry of Toxic Effects of Chemical Substances
RTK	real-time kinematic
SA	exposed skin surface area
SAD	South Atlantic Division
SAE	Society of Automotive Engineers
SAIC	Science Applications International Corporation
SAP	installation-wide sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
sc	clayey sands; sand-clay mixtures
Sch.	Schedule
SCM	site conceptual model
SD	sediment
SDG	sample delivery group
SDWA	Safe Drinking Water Act
SDZ	safe distance zone; surface danger zone
SEMS	Southern Environmental Management & Specialties, Inc.
SF	cancer slope factor
SFSP	site-specific field sampling plan
SGF	standard grade fuels
SHP	installation-wide safety and health plan
SI	site investigation
SINA	Special Interest Natural Area
SL	standing liquid
SLERA	screening-level ecological risk assessment
sm	silty sands; sand-silt mixtures
SM	Serratia marcescens
SMDP	Scientific Management Decision Point
s/n	signal-to-noise ratio
SO_4^{-2}	sulfate
SOD	soil oxidant demand
SOP	standard operating procedure
SOPQAM	U.S. EPA's *Standard Operating Procedure/Quality Assurance Manual*
sp	poorly graded sands; gravelly sands
SP	submersible pump
SPCC	system performance calibration compound
SPCS	State Plane Coordinate System
SPM	sample planning module
SQRT	screening quick reference tables
Sr-90	strontium-90
SRA	streamlined human health risk assessment
SRM	standard reference material
Ss	stony rough land, sandstone series
SS	surface soil
SSC	site-specific chemical
SSHO	site safety and health officer
SSHP	site-specific safety and health plan
SSL	soil screening level
SSSL	site-specific screening level
SSSSL	site-specific soil screening level
STB	supertropical bleach
STC	source-term concentration
STD	standard deviation

STEL	short-term exposure limit
STL	Severn-Trent Laboratories
STOLS	Surface Towed Ordnance Locator System®
Std. units	standard units
SU	standard unit
SUXOS	senior UXO supervisor
SVOC	semivolatile organic compound
SW	surface water
SW-846	U.S. EPA's *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*
SWMU	solid waste management unit
SWPP	storm water pollution prevention plan
SZ	support zone
TAL	target analyte list
TAT	turn around time
TB	trip blank
TBC	to be considered
TCA	trichloroethane
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofurans
TCE	trichloroethene
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environment and Conservation
TDGCL	thiodiglycol
TDGCLA	thiodiglycol chloroacetic acid
TERC	Total Environmental Restoration Contract
THI	target hazard index
TIC	tentatively identified compound
TLV	threshold limit value
TN	Tennessee
TNT	trinitrotoluene
TOC	top of casing; total organic carbon
TPH	total petroleum hydrocarbons
TR	target cancer risk
TRADOC	U.S. Army Training and Doctrine Command
TRPH	total recoverable petroleum hydrocarbons
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
TWA	time-weighted average
UBR	upper background range
UCL	upper confidence limit
UCR	upper certified range
'U'	not detected above reporting limit
UIC	underground injection control
UF	uncertainty factor
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USACMLS	U.S. Army Chemical School
USAMPS	U.S. Army Military Police School
USATCES	U.S. Army Technical Center for Explosive Safety
USATEU	U.S. Army Technical Escort Unit
USATHAMA	U.S. Army Toxic and Hazardous Material Agency
USC	United States Code
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTL	upper tolerance level; upper tolerance limit
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Supervisor
UXOSO	UXO safety officer
V	vanadium
VC	vinyl chloride
VOA	volatile organic analyte
VOC	volatile organic compound
VOH	volatile organic hydrocarbon
VQlfr	validation qualifier
VQual	validation qualifier
VX	nerve agent (O-ethyl-S-[diisopropylaminoethyl]-methylphosphonothiolate)
WAC	Women's Army Corps
Weston	Roy F. Weston, Inc.
WP	installation-wide work plan
WRS	Wilcoxon rank sum
WS	watershed
WSA	Watershed Screening Assessment
WWI	World War I
WWII	World War II
XRF	x-ray fluorescence
yd^3	cubic yards