US Army Corps

of Engineers

BALTIMORE DISTRICT

Engineering Evaluation / Cost Analysis

For Non-time Critical Removal Action

Control of Exposure to Near-Surface Waste at Ball Field Landfill

FTGL-02

Forest Glen Annex

U.S. Army Ft. Detrick

Silver Spring, Maryland

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Executive Summary

The Baltimore District of the U.S. Army Corps of Engineers (USACE) contracted AECOM under Contract No. W912DR-09-D-0019, Delivery Order 0001 to conduct a Remedial Investigation (RI) at Fort Detrick's Forest Glen Annex (FGA) in Silver Spring, Maryland. The RI was conducted for the following four sites:

- FTGL-02: Ball Field / Helipad / Rubble Dump Site;
- FTGL-03: Commissary Landfill
- FTGL-04: Building 511 Landfill; and
- FTGL-05: Building 607 Washdown Rack (Stream E)

FGA sites FTGL-02, -03, -04, and -05 are part of the Army's Installation Restoration Program (IRP) and the RI was performed within the statutory framework of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). None of the FGA sites are on the National Priorities List. The Maryland Department of the Environment (MDE) Waste Management Administration's Federal Facilities Division is acting as the lead regulator while the Army is conducting remedial activities as the lead agent in accordance with E.O. 12580.

During the course of the RI it was determined that for site FTGL-02 buried waste, including medical waste, extended beyond the current Forest Glen installation security fence, which is set well inside the actual Government property line in this area. Exposed waste was also discovered on the steep landfill slopes. The RI has confirmed file and anecdotal evidence that these landfilled wastes are likely to be made up of medical-derived materials. Because this buried and exposed waste is outside the installation security fence, it is within easy public access from the adjacent Rock Creek Regional Park trails and the Ireland Trail, a publicly accessible historic foot path heavily used for dog walking, physical exercise, and general nature viewing. These foot paths have been used by the public for many years. Ireland Trail is situated on Army property, though public access has never been denied to the trail and there is no barrier between Ireland Trail and the slopes of the landfill (AECOM, 2013).

The RI also determined that contaminants from the waste disposal areas and potentially from an off-site source are migrating into the Ireland Creek, which flows through the installation along part of the Ireland Trail, and hence is accessible to the public and pets that use the trail.

It was determined that a CERCLA Non Time-Critical Removal Action (NTCRA) was appropriate at FTGL-02 to prevent public accessibility and possible exposure to landfill wastes and other contamination on the installation property. Non Time-Critical removal actions are actions that may take at least 6 months to plan and begin field execution. Removal actions are not meant to take the place of a complete site remedial response, including a Remedial Investigation/Feasibility Study that takes a complete look at a site and arrives at a final Remedial Action that protects human health and the environment.

The NTCRA process requires the preparation of a document called an Engineering Evaluation/ Cost Analysis (EE/CA). The EE/CA document is prepared to evaluate the various removal alternatives being considered for a NTCRA and select a preferred remedy.

The Baltimore District of the U.S. Army Corps of Engineers (USACE) was charged with preparing an EE/CA for protecting the public from the waste disposed of in the FTGL-02: Ball Field / Helipad / Rubble Dump Site located outside the current installation security fence, and from Ireland Creek contamination.

The objective of taking this removal action is to protect the general public from the physical and possible pathogenic hazards associated with waste disposed of in landfill FTGL-02 and other contamination located outside the installation fence, while the Remedial Investigation and Feasibility Study for FTGL-02 proceeds to determine if a more permanent remedial action is needed. In addition, the continued access to the Ireland Trail by the general public, while still remaining protective of human health and the environment, was also included as a consideration factor.

To that end nine removal alternatives had been proposed for EE/CA evaluation. However, the ninth alternative, that involved installation of a fence on the surveyed FGA installation boundary from just south of Ament Street to south of Ireland Creek, was not advanced since it precluded public use of nearly all of the Ireland Trail. The eight alternatives are:

Alternative 1: **No Action**

This alternative is required by statute to be considered as a benchmark for comparison, though it would not address the NTCRA objectives. Under this alternative no action is taken to keep human or ecological receptors from having interaction with landfill FTGL-02 waste. Cost: None

Alternative 2: Access Notifications – FGA property Boundary

This alternative places US Government signs along the entire landfill boundary and clearly visible from Ireland Trail. The signs will make users of the area aware of Army ownership and the hazards of digging or otherwise interfacing with buried/exposed waste and other accessible contamination in Ireland Creek. 20 Yr. Cost: $11,000

Alternative 3: Access Controls – Ball Field Landfill and Ireland Creek Valley

This alternative involves fencing off the entire FTGL-02 landfill, with the fence set on the east side of the Ireland Trail and crossing Ireland Creek so as to fence off the Army's section of Ireland Creek valley from Stephen Sitter Avenue down to the point where the Ireland Trail turns north to leave the Ireland Creek valley. The fence would prevent open access to all of the FTGL-02 landfill and nearly all of the Army-owned portion of Ireland Creek, including all of the portion where surface water contamination was found. The fence would take the shortest route to join with the existing installation security fence behind the parking lot for the WRAIR building. The fence would have to be engineered to preclude trespassers from slipping under at the Ireland Creek crossing. This alternative requires the installation of approximately 2,200 feet of fence. 20 Yr. Cost: $281,000

Alternative 4: Access Controls – Ball Field Landfill Area and a Portion of Ireland Creek Valley

This alternative involves fencing off the entire FTGL-02 landfill..with the fence set on the east side of the Ireland Trail and crossing the Ireland Creek valley at approximately one-third of the distance up the valley from Rock Creek. The new fence would connect with the FGA security fence behind the parking lot for the WRAIR building. It removes the current unrestricted access to the FTGL-02 landfill and approximately 1000 feet of Ireland Creek valley on FGA property where site-related contamination was detected in the surface water. The fence would have to be engineered to preclude trespassers from slipping under at the Ireland Creek crossing,. . This alternative will require the installation of approximately 2,450 feet of fence and involve difficult installation and more maintenance than other fencing alternatives. 20 Yr. Cost $395,000

Alternative 5: Access Controls – Ball Field Landfill Area

This alternative involves the fencing off of the entire FTGL-02 landfill, with the fence set on the edge of the Ireland Trail nearest the BFLF but allows open access to the entire current Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue. The fence would have to be engineered to preclude trespassers from slipping under at several Ireland Creek crossings. This alternative does not restrict access to any portion of the contaminated portion of Ireland Creek. This alternative would require the installation of approximately 3,200 feet of fence. 20 Yr. Cost $517,000

Alternative 6: Access Controls – Newly Defined Landfill Waste Boundary

This alternative involves placing fencing at the newly defined waste boundary of the FTGL-02 landfill. The fence would be installed in most cases part way up the hillside. This routing presents a greater construction challenge than the other Access Control alternatives as the fence would be installed on steep, difficult to access slopes and both sides of the fence would have to have brush and saplings cleared to allow for construction and maintenance. The fence would not have to cross Ireland Creek. As with Alternative 5, this Alternative allows open access to the entire Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue while blocking access to areas of the landfill slope known to contain waste. 20 yr. Cost $487,000

Alternative 7: Soil Cover

This alternative does not change the existing fence lines of FGA, but reduces the chances of public contact with waste materials by covering the disposal area outside the installation fence with two feet of clean soil over a 5.5 acre area. It preserves the open access to the Ireland Trail. This alternative will require the removal of all vegetation on the slopes of the landfill area for the placement of two feet of soil. The new soil cover will have to be vegetated with a selection of native species to protect against erosion, changing the appearance of the area as seen from the Ireland Trail. This alternative will require the placement of approximately 17,600 cubic yards of fill material. 20 yr. Cost $1,508,000

Alternative 8: Waste Removal

This alternative does not change the existing fence lines of FGA, but removes the risk of public open access contact with waste materials by removing the most accessible of them. Over a period of 6-12 months the landfilled materials outside the current fence lines would be carefully investigated. Those materials found closer than 2 feet to the surface will be excavated to a depth of two feet, characterized, and transported off site for disposal. Access to the surrounding area will be restricted during this period due to the unknown, but presumed medical nature of the waste. Excavations will be filled with top soil and revegetated. The actual extent of waste to be excavated is unknown, but has been estimated as a range dependent on excavating 2.5 to 5.5 acres of the approximately 5.5 acres of fill. Most vegetation will be removed at excavation sites. 20 Yr. Cost – 2.5 acre: $1,401,000. 20 yr Cost –5.5 acres: $3,081,000

Selected Alternative

Analysis of the eight alternatives resulted in the selection of Alternative 4. The selection of this alternative is a balance between protecting the public from landfilled wastes and contaminated surface water in the upstream reaches of Ireland Creek, maintaining public access to portions of the Ireland Trail and not impacting the bridges. The fence will only be required to cross Ireland Creek at one place while keeping Ireland Trail users out of the upper reaches of Ireland Creek valley where contaminated surface water has been detected. The Army believes that this alternative provides the best balance of all options considering the overarching mandate to protect human health and the environment, and achieve the best combination of effectiveness, implementability, and cost effectiveness, as well as continue public access to the Ireland Trail as much as possible.

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List of Acronyms and Abbreviations

ARAR	Applicable or relevant and appropriate requirement
BERA	Baseline Ecological Risk Assessment
BFLF	Ball Field Landfill, also FTGL-02
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
BRAC	Base Re-alignment and Closure
BTAG	Biological Technical Assistance Group
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
COMAR	Code of Maryland Regulations
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
CSX	Chessie Seaboard Multiplier
CWA	Clean Water Act
DCB	Dichlorobenzene
DCE	Dichloroethene (dichloroethylene)
DEHP	Bis (2-ethylhexyl) phthalate
DERP	Defense Environmental Restoration Program
DEP	Department of Environmental Protection
DORF	Diamond Ordnance Research Facility
DOT	Department of Transportation
DRO	Diesel Range Organics
ECORAGS	Ecological Risk Assessment Guidance for Superfund
EE/CA	Engineering Evaluation/Cost Analysis
USEPA	US Environmental Protection Agency
ERA	Ecological Risk Assessment
FSP	Field Sampling Plan
FTGL-02	Forest Glen Annex Environmental Restoration Site 2, also referred to herein as the Ball Field Fill Area, or the Ball Field Landfill
g	gram
GIS	Geographic Information Systems
HHRA	Human Health Risk Assessment
HOD	Historic Open Dump
HSA	Hollow Stem Auger
IRP	Installation Restoration Program
kg	kilogram

l, L	liter
LMA	Land Management Administration
m	meter
MASW	Multi-Channel Analysis of Shear Waves
MCL	Maximum Contaminant Level
MCPP	Methylchlorophenoxypropionic acid
MDC	Maximum Detected Concentration
MDE	Maryland Department of the Environment
mg	milligram
ml	milliliter
M-NCPPC	Maryland – National Capital Parks and Planning Commission
msl	mean sea level
NARA	National Archives and Records Administration
NCDC	National Climatic Data Center
NCP	National Contingency Plan
NMRC	Naval Medical Research Center
NPS	National Park Seminary
NPSV	National Park Seminary Venture
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRWQC	National Recommended Water Quality Criteria
NTCRA	Non Time-Critical Removal Action
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Poly-cyclic Aromatic Hydrocarbons
PCB	Poly-Chlorinated Biphenyl
PCE	Tetrachloroethene (tetrachloroethylene)
pCi	picocuries
pg	picogram
PID	Photo-Ionization Detector
PPE	Personal Protective Equipment
ppb	parts per billion
PPL	Priority Pollutant List
ppm	parts per million
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SERA	Screening Ecological Risk Assessment

SI	Site Inspection
Stream D	Used herein interchangeably with the names Ireland Creek, and South Ireland Creek
SSHP	Site Safety and Health Plan
SVOC	Semi-Volatile Organic Compound
SW-846	Test Methods for Evaluating Solid Waste Physical/Chemical Methods
TCA	Trichloroethane
TCDD	Tetrachlorodibenzo-p-dioxin
TCE	Trichloroethene (trichloroethylene)
TCLP	Toxicity Characteristic Leachate Procedure
TEF	Toxic Equivalency Factors
TPH	Total Petroleum Hydrocarbons
TEQ	Toxic Equivalent Concentration
TPP	Technical Project Planning
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAPHC	U.S. Army Public Health Command
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
WRAIR	Walter Reed Army Institute of Research
WRAMC	Walter Reed Army Medical Center
μg	microgram

1 Introduction

The Baltimore District of the U.S. Army Corps of Engineers (USACE) has conducted an Engineering Evaluation/Cost Analysis (EE/CA) for the waste disposed in the FTGL-02: Ball Field / Helipad / Rubble Dump Site for the Forest Glen Annex/Ft. Detrick, MD installation. This is one of four sites covered in the Remedial Investigation (RI) at Fort Detrick's Forest Glen Annex (FGA) in Silver Spring, Maryland (AECOM 2013). That RI Report is being prepared by AECOM and is documented in an internal draft report dated October 2012.

The primary objectives of the RI were as follows:

- Characterize the site conditions;
- Determine the nature and extent of contamination;
- Evaluate potential migration pathways of contaminants;
- Assess potential risks posed by the sites to human and ecological receptors; and
- Develop information to evaluate potential environmental response actions

This EE/CA was prepared by USACE, Baltimore District for FTGL-02 using information developed in the RI. CERCLA and the National Contingency Plan (NCP) require removal actions to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action with respect to the release or threatened release concerned. FGA site FTGL-02, is part of the Army's Installation Restoration Program (IRP) as part of DERP, and the
RI was performed within the statutory framework of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and to the extent practicable, the NCP. None of the FGA sites are on the National Priorities List. The Maryland Department of the Environment (MDE) Waste Management Administration's Federal Facilities Division is acting as the lead regulator.

The purpose of this EE/CA is to evaluate non time-critical interim response measures, i.e. NTCRAs, at FTGL-02 proposed in accordance with all the factors in 40 CFR 300.415 (b)(2). The following factors were determined be the most relevant and likely have the greatest impact at the site, these include: (i), to prevent actual or potential exposure to nearby human populations, animals or food chain from hazardous substances or pollutants or contaminants, and (ii) to prevent actual or potential exposure to contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release until a final remedy is chosen and implemented. The alternatives were analyzed against the three mandatory criteria of effectiveness, implementability and cost effectiveness.

In addition, based on information obtained from the Restoration Advisory Board (RAB) meetings, the Forest Glen Annex/Ft. Detrick, MD command decided to include the continued access to the Ireland Trail by the general public in the assessment and evaluation. Though not a mandatory criterion, continued use of the trail to the extent practical would be an important consideration factor.

Evaluated interim measures range from fencing to inhibit public entry into the areas newly identified in the RI as part of FTGL-02 landfill, to removing landfill materials found outside the pre-RI landfill boundary. Removal alternatives are identified and evaluated in Section 6, and evaluated against each other in Section 7.

2 Site Description and Background

2.1 Site Description

The FGA is located in the Forest Glen area of Silver Spring, Maryland in Montgomery County. The installation is bounded to the north by the National Park Seminary (NPS) historic district, a residential area that was previously a part of the FGA, and beyond by Interstate 495, the Capital Beltway. It is bounded to the south by Garfield Avenue and beyond by a commercial and industrial area. It is bounded to the west by Rock Creek Regional Park, a park along the Montgomery County valley of Rock Creek, a tributary of the Potomac River. It is bounded to the southeast by Brookville Road and beyond by commercial, industrial, and residential properties, and to the northeast by the Chessie Seaboard Multiplier (CSX) railroad and by commercial and residential properties beyond. **Figure 1-1** is a map indicating the location and boundaries of the FGA and its immediate environs. The current facility includes approximately 132 acres.

The area addressed by this EE/CA lies on the west side of FGA along its boundary with Rock Creek Regional Park. It is notable that in this area, due to the rugged and wooded topography, the current security fenceline for the FGA does not lie along the FGA property boundary, but rather has been routed well inside the property boundary in order to follow more level terrain. The security fence surrounds the ball park/helicopter landing pad that sits atop FTGL-02 as an engineering control to prevent the public that are currently using the ball fields from being able to access the areas of concern where there is exposed waste from landfill FTGL-02. The result is that significant FGA acreage lies outside the installation fence and is accessible to the public. Most of this acreage is wooded and has no property signs. Because it lies adjacent to the Rock Creek Park, this property appears as part of the Park and there are no engineering controls to prevent the public using Ireland Trail from potentially coming into contact with the exposed wastes from the former landfill if they leave the designated path.

There are several clear, active visible trails/paths through the woods on the installation property, and branching off of the Ireland Trail where unauthorized individuals have and continue to traverse over suspected landfill areas. This included destruction of the temporary security fence (orange snow fence) utilized to prevent access to the initial discovered landfill material. There have been observed and documented incidents where suspected landfill material (pottery, suspected laboratory glassware, etc.) has been removed from the landfill. In addition, there have been reports of domestic pets (dogs) utilizing portions the stream on the installation property.

The concern addressed by this EE/CA is to protect the public who are using areas off of the Ireland Trail. Current tenants at the FGA include the Walter Reed Army Institute of Research (WRAIR), and the Naval Medical Research Center (NMRC). Additional minor tenants include various research and health care facilities. There is a motor pool, a vaccine preparation facility, warehouses, medical training facilities, recreation fields and picnic areas, a fitness center, a commissary, child care facility, and a gas station.

2.2 Site History

The property currently occupied by FGA was part of the Edgewood plantation, historically a tobacco plantation, until the late 19th century. In 1887, the Forest Glen Improvement Company purchased a portion of the plantation now occupied by the National Park Seminary (NPS) Historic District north and west of the current FGA installation, and established a resort hotel called Ye Forest Inne and later, a casino, near the wooded glen. Following closure of the resort, John and Vesta Cassedy purchased the property and a girls' finishing school was established on the resort grounds. The current NPS Historic District to the north of the property was the main campus of the school and many of the current buildings originated with the resort or the school. The NPS was purchased in 1916 by Dr. James Ament, who expanded the campus. Dr. Ament also acquired additional portions of the former Edgewood plantation, including the property now comprising the FGA and renamed the combined property Amentdale Estates. Dr. Ament operated a dairy farm (Building 156 at the FGA dates to this period) on the property in addition to the school and made it available to students for recreation. The Edgewood plantation house was located at the current location of the Commissary and was razed in 1960 prior to construction of the Commissary. The NPS was purchased by Dr. Roy Tasco Davis in 1937, who introduced a business curriculum, and renamed the school the National Park College. During the school's tenure, the campus buildings were primarily located north of Linden Lane on the grounds of the NPS Historic District. Some of the grounds south of Linden Lane were utilized for small buildings, athletic fields, and recreation (RGH, 1990; http://www.operant.com/seminary/, 2012).

The National Park College operated until the Army acquired the property in 1942. This original property acquired by the Army consisted of 174 acres. The Army utilized the property, an annex to the Walter Reed Army Medical Center (WRAMC), as a convalescent residence for returning soldiers. NPS buildings were renovated and patients were received beginning in January 1943 (USACHPPM, 2000). Following the war, the facility was converted to use for medical research. Although the NPS buildings remained on the former campus, further development of the FGA was concentrated on the former plantation as more area was filled and leveled. Within the current FGA, Buildings 136, 154, and 155, formerly associated with the Edgewood Plantation, pre-date Army acquisition. Further development on the facility started with establishment of the WRAIR in the early 1950s with construction of Buildings 500, 501, 506, 508, and 512. These were primarily research laboratories and hazardous storage facilities. Building 179 (Salt Dome) was built in 1961, Buildings 516 and 518 (DORF) were built in 1963, and Building 178 (a logistics warehouse) was built in 1965. During the early 1970s, community facilities and additional research facilities, were added, including Buildings 161 (PX), 162 (Commissary), 163 (Commissary), 173 (Fisher House), 605 (Motor Pool), 606 (Laundry), 602, 603, 601, and 511 (former incinerator building). Building 164 (AAFES Station) was built in 1977. Building 172 was built in 1995. Building 503, the main WRAIR building, was built in 1997, along with Buildings 509 and 510. Building 609 (Fire Station) was built in 2001 (2007 Master Plan).

In September 1972, many of the structures associated with the NPS were listed on the National Register of Historic Places as a National Historic District. This Historic District is bounded by Smith Drive to the east, the Capital Beltway to the north, and Linden Lane to the south and west, with the inclusion of an area opposite Linden Lane at the intersection with Woodstock Court and Woodstock Avenue. Three additional structures (Buildings 135, 136, and 139) were identified as contributors to the character of the NPS (CH2M Hill, 1996), but were not incorporated into the Historic District. In 2002, two portions of the FGA were declared excess. One portion on the northwest portion of the FGA, approximately 20 acres in size, was conveyed to the Maryland-National Capital Park and Planning Commission (M-NCPPC) and incorporated into the Rock Creek Regional Park. The other, a 26-acre property consisting primarily of the aforementioned NPS Historic District, was transferred to the National Park Seminary Venture (NPSV), who initiated redevelopment of the buildings for residential use. An additional five acres on either side of Linden Lane were subsequently transferred for residential development. On 1 October 2008, as a direct result of the Defense Base Realignment and Closure (BRAC) Commission recommendation, the command of FGA was passed from WRAMC to Fort Detrick.

The area of FGA addressed by this EE/CA is not part of the National Park Seminary Historic District; however it contains a historical feature from the former seminary which figures into the need for this

EE/CA and for the follow on removal action. This feature is the so-called Ireland Trail, a paved path that originates in the Historic District, and enters the northwest part of FGA. The Ireland trail route then remains on FGA property as it first parallels the FGA west property line, then turns east to follow the Ireland Creek valley, and terminates at the installation security fence at Stephen Sitter Avenue. The installation security fence is approximately 1500 feet east of the actual FGA property boundary at this point. If viewed on a map, this termination point is very near the center of the installation. Figure 6-3 illustrates Ireland Trail and surrounding landmarks. It should be noted that in the past erosion has been an issue at FTGL-02 resulting in actions that created terracing and a storm water pond at the south side of the landfill.

The Ireland Trail reportedly was used by the former seminary and has remained open to the public until the present. It is maintained by FGA including upkeep and repair of the several bridges on the trail and removal of downed trees. The trail is used frequently by the public for walking and pet exercise. Public use of the trail provides unobserved public access to parts of the FTGL-02 landfill and the Ireland Creek valley up to the FGA security fence at Stephen Sitter Avenue.

2.3 FGA Waste Disposal Practices

The Army has historically used portions of the FGA property for disposal of solid waste from the Walter Reed Army Medical Center and the Forest Glen Annex. Undocumented landfilling of waste materials allegedly occurred in three separate areas from the 1940s until the 1960s. This dumping largely occurred in low-lying ravine areas. Wastes buried in the landfills reportedly included construction debris, medical waste, incinerator ash, household waste, and office waste (USACHPPM, 2002). There have been multiple instances when landfill waste materials have been encountered at FGA construction sites (i.e., 1972 construction of the Commissary; 1989 WRAIR Building 503 investigation; and 2009 National Museum of Health and Medicine investigation).

Prior to the start of RI field activities, medical waste had been positively confirmed in one (FTGL-04) of the three landfill areas. Medical wastes were reportedly uncovered in 1989 during the WRAIR Building preconstruction investigation (ANL, 1990). Landfill use may predate the medical laboratories onsite; waste was reportedly transported from the Walter Reed Main Section and disposed of at FGA from 1942 until 1966 (ESE, 1984). Radiological materials have been used for research activities at WRAMC and FGA. Isotopes were received and stored at Forest Glen. At one time the Diamond Ordnance Research Facility (DORF) operated a nuclear reactor on the property. In 1977 the DORF was decommissioned under then applicable Nuclear Regulatory Commission (NRC) requirements; however, requirements have since changed. The reactor is currently being decommissioned again under the new NRC requirements so that it can be removed from the NRC list. The USACE performed sampling at the DORF and is now in the process of analyzing alternatives for the disposition of the remaining structure. No spills or accidents resulting in contamination by radioactive materials have been reported at FGA as a result of isotope use or reactor operation (ESE, 1984).

2.4 Physical Characteristics

2.4.1 Topography and Surface Features

The majority of the FGA consists of flat, developed areas on which facility buildings, roads, and parking lots are built. There are steep, incised stream valleys along and surrounding the Rock Creek tributaries in the western portion of the facility beyond the limit of historical disturbance. This topography is depicted on **Figure 3-1**, which also depicts each of the unnamed tributaries, which generally flow from east to west towards Rock Creek. Topographic elevations within the FGA range from 188 feet above mean sea level (msl) in the western valleys to 347 feet above msl along the northern perimeter near Linden Lane.

As noted in Section 2.3, historical landfilling at the facility is an explanation for the filling of the valleys whose historical headwaters were moved west or buried by fill placement. A preliminary assessment of the alteration of topography at the FGA based on these landfilling activities was completed through a comparison of the 1944 U.S. Geological Survey (USGS) topographic map to current topographic data available from Fort Detrick. This comparison, with roughly estimated fill depths, is depicted on **Figure 2-3**. This map approximates the location of the former headwaters of Stream D that was buried by fill placement by 1961.

Most of the eastern and central portions of FGA is developed and dominated by impermeable surfaces. Buildings and parking lots comprise the majority of this area. The western periphery along the Rock Creek Regional Park boundary is undeveloped. The northwestern portion is dominated by permeable surfaces including recreational areas.

2.4.2 Geology

The FGA lies within the eastern Piedmont Plateau Physiographic Province, which spreads southeastward from the Appalachian chains. The boundary of this Province with the Coastal Plain, known as the Fall Line, is southeast of the FGA. The nearest exposure of the Potomac Group of the Coastal Plain is located approximately 2.5 miles east-southeast of the FGA’s eastern boundary. According to published geologic maps, the FGA underlying bedrock is the Kensington Tonalite (symbol Ok, formerly known as the Kensington Quartz Diorite) (Cleaves, Edwards, & Glaser, 1968; Drake, 1998).

The Kensington Tonalite is a Middle Ordovician formation that formed as an intrusion into the surrounding Sykesville Formation, a metasedimentary unit of the Lower Cambrian. The north trending Rock Creek Shear Zone separates the Kensington Tonalite from the Laurel Formation (Clo), at its nearest point, approximately 0.1 mile east of the easternmost point of the FGA. Slightly to the north of this point, the Shear Zone cuts off the northeast trending Burnt Mills thrust fault. To the north of the Burnt Mills, the Shear Zone forms the boundary between the Kensington Tonalite and the lower Cambrian Northwest Branch Formation (CZn). Varying degrees of metamorphism are observed in the Kensington Tonalite.

Strike and dip measurements vary widely across the site. Bedrock occurs at or near the ground surface in certain areas at the FGA, including the bed and banks of South Ireland Creek and the hillside in front of Building 503 to the northwest.

Soil borings conducted throughout the installation during implementation of the RI encountered thick units of saprolite or weathered micaceous, dense, often quartz-rich, schistose soils with subtle to intense residual foliation and irregular lenses or veins of quartz sand or gravel (see **Appendix F**). This saprolite is often present at or very near the ground surface presumably at areas previously cut during development activities. The saprolite occurs deeper in areas of greater disturbance where fill activities are known or suspected to have occurred.

2.4.3 Soils

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) *Soil Survey of Montgomery County* indicates several undisturbed soil types, in addition to Urban Land, within the facility. Soils on Urban Land, comprising the majority of the eastern and southern portions of the facility, do not exhibit characteristic structure as a result of disturbance during construction and development. Mapped soil units include the Gaila silt loam, 8-15% slopes (1C), the Glenelg silt loam, 3-8% slopes (2B), the Brinklow-Blocktown channery silt loam, 15-25% slopes (16D), the Wheaton silt loam, 0-8% slopes (65B), and the Occaquan loam, 8-15% slopes (17C), and the Blocktown channery silt loam, 25-45% slopes (116E). All of the aforementioned soil types, with the exception of the Wheaton silt loam, are on the NRCS National Hydric Soils List (USDA NRCS, 2012). Several other mapped soil units are present on the facility's periphery. The majority of the mapped soil units are moderately well-drained or well-drained (USDA NRCS, 1995).

Soil borings conducted throughout the installation during implementation of the RI encountered in undisturbed soil primarily elastic silt and fine sand (ML and SP), often micaceous, and often exhibiting residual foliation derived from the parent bedrock and indicative of the gradual transitions from soil to underlying saprolite and bedrock. Colors vary and range within yellow and redyellow hues (2.5Y, 5Y, 7.5YR, and 10YR) and include varieties of brown, yellow, olive, red, and gray. Soils of a Gley hue are present, but infrequent. Sands are generally poorly sorted. Some areas of angular quartz gravel occur in soils, often with coarser-grained sands. Clay is generally present within a lean textured soil (CL). Fat clay is very infrequent.

Areas of fill include a variety of textures, including both engineered fill, local and potentially imported fill. In some locations, waste was encountered from trace to massive quantities. Borings were terminated when waste suspected of being part of the landfill operations were identified. Fill material is relatively infrequent in soil borings relative to native soil, but occurs at greater depths at locations where fill activities are known or suspected to have occurred.

FTGL-02 is a landfill covered with fill from various locations at various times. At this time the landfill banks, though steep in places, are not highly eroded due to the extensive tree and brush cover on the banks. Several of the alternatives being considered in this EE/CA may change the nature of the landfill cover creating the potential for severe erosion. This will have to be considered in planning any measures that will disturb the existing landfill cover.

2.4.4 Hydrogeology

<u>Shallow Hydrogeology</u>

The depth to encountering shallow groundwater at the FGA varies depending on the topography of the site location. Shallow groundwater is encountered within soils closer to ground surface in the lower elevation areas (valleys) of the surface drainage features, and conversely is encountered deeper within the saprolite at higher topographic (upland areas) elevations of the site. Groundwater is also present in previously filled areas. Based on groundwater elevation data collected during implementation of the RI between July 2011 and January 2012, the depths to groundwater ranged from approximately five feet bgs along the western periphery near South Ireland Creek to approximately 64 feet below ground surface (ft bgs) north of FTGL-02. Groundwater elevations obtained from measurements collected during the RI range from approximately 180 feet above mean sea level (ft amsl) along the western periphery to approximately 315 ft amsl along the eastern periphery near the CSX railroad line. Groundwater contours are plotted in Figure 2-7.

Groundwater at the FGA, predominantly flows from the northeast to southwest, mimicking the topographic surface profile and eventually discharging into the surrounding surface water features of Rock Creek and its tributaries in the western portion of the facility, but will be greatly influenced by the presence of high permeability structural features (e.g. fracture zones, faults and foliation) present within the aquifer matrix.

Bedrock Hydrogeology

Groundwater also occurs within fractured zones within the underlying crystalline bedrock. There are no potable water supply wells at the FGA. Public water supply is provided by the Washington Suburban Sanitary Commission which obtains water from the Potomac River. A review of regulatory databases performed for the RI did not indicate any potable water supply wells within one mile of the facility.

Step-drawdown testing performed at each of four deep monitoring wells installed as part of the RI, indicate that well yields at two of the four wells installed (FG401 and FG402) would be adequate for groundwater supply based on anticipated yields exceeding 100 gallons per day.

Surface Hydrology

The FGA is located in the Potomac Sub region (0207) of the mid-Atlantic water resources region. Runoff is greatest between March and May, due to melting snow, elevated rainfall, reduced evapotranspiration, and soil saturation. The region is drained by the Potomac River and its tributaries. The local drainage features at FGA consist mainly of Rock Creek and its tributaries which drain to the Potomac River. The surrounding area is urbanized and drained by numerous storm water facilities in addition to surface runoff. Locally, these tributaries include South Ireland Creek (see **Figure 2-8)**. All streams flow roughly east to west eventually draining into Rock Creek. Stream width ranges from approximately three to 20 feet.

Portions of streams through FGA have been altered by stormwater features associated with landfill operations or more recent construction and development. Accumulated precipitation drains into these stream beds or by overland flow into Rock Creek. Streams through FGA all receive some drainage from stormwater structures. Some streams, like Ireland Creek, are perennial, while others through FGA are intermittent.

The primary drainage feature in the EE/CA area is Ireland Creek, which begins as flow from three culverts exiting the large filled area of FGA that covers the former upper valley of Ireland Creek. According to the storm sewer map of FGA, the culverts transmit storm runoff from the Commissary Area and the WRAIR area, as well as some runoff from a small area east of the installation.

A stormwater retention pond is present outside the southwestern corner of FTGL-02 near South Ireland Creek (see **Figure 2-8**). The pond is located alongside the Ireland Trail as the trail makes a sharp left turn from paralleling the west FGA boundary to entering the Ireland Creek valley. The pond contains an outlet structure that drains to South Ireland Creek. The pond was observed to be generally dry throughout the implementation of the RI in 2010 through 2012, indicating that surface water drainage is not typically directed to the pond at a volume approaching its capacity.

Three small wetlands are reported in a 2009 USACE Wetland Delineation Report for FGA (see Figure 2-8). Wetland nos. 1 and 3 are located outside the area addressed by this EE/CA. Wetland no. 2 corresponds to the stormwater retention pond present outside the southwestern corner of FTGL-02. A

100-year floodplain is located west of the site associated with Rock Creek and crosses onto site property along the downstream portion of Ireland Creek.

The nearest continuous gauging station to the FGA (USGS gage no. 01648000) is located on Rock Creek near Sherrill Drive in Washington, DC, approximately 3.4 miles downstream of the FGA. This point encompasses a drainage basin area of approximately 62.2 square miles. The average discharge over 50 years is 62.3 cubic feet per second (cfs), with extremes of 0.5 cfs in October 1930 and 12,500 cfs in June 1972 (Carpenter, 1972).

Regarding the area addressed by the EE/CA, the only wetland area that is likely to be impacted is Wetland no.2, located at the southwest corner of FTGL-02, right next to Ireland Trail. This area is also within the 100-year flood zone. All proposed fencing alternatives will pass through this area and two of them will cross Ireland Creek and Ireland Trail at some point along its path. Impacts are expected to be minor.

2.4.5 Meteorology and Climate

The climate in the area of the FGA lies in the transition between a humid subtropical zone (Köppen *Cfa*), with hot, humid summers and cool winters, with significant amounts of precipitation during all seasons. The National Climatic Data Center (NCDC) monthly Normals for 1981 to 2010 for nearby Rockville, Maryland indicate an average annual precipitation in the area of the FGA of 40.26 inches, ranging from 2.71 inches in February to 4.13 inches in May. The mean annual temperature is 55.7°F, ranging from 33.7°F in January to 76.9°F in July (NCDC, 2010).

2.4.6 Demography and Land Use

The FGA is located in Montgomery County, Maryland. Montgomery County is the most populous county in Maryland and population density is concentrated in the southern portion of the County, which includes the FGA and borders the District of Columbia. The District line is located approximately 0.80 miles southeast of the FGA’s Brookville Road boundary. Figure 2-1 depicts the location and boundary of FGA.

The FGA is primarily a medical research and development facility. Research and development facilities comprise approximately 28% of the land area, while ancillary uses comprise the balance of land use. These ancillary uses include open space and buffer areas (25%), recreation (16%), community facilities (16%), supply and storage (8%), maintenance (5%), administration (1%), and utilities (1%) (USACE with Tetra Tech, 2008). Research and development facilities are concentrated in the southern portion of the FGA, dominated by the Daniel K. Inouye Building, while community facilities dominate the northern portion between Forney Road and Linden Lane and recreation areas and open space dominates the northwestern portion. The FTGL-02 area is currently used as a recreation area and helicopter landing pad. Future development of the area is being considered.

Land use surrounding the FGA is a mix of residential, commercial, industrial, and conserved recreational areas. Major transportation arteries, including Interstate 495 (Capital Beltway) and the CSX railroad line pass within its immediate vicinity.

The NPS Historic District is located north of the facility opposite Linden Lane. This area, formerly part of the FGA, has been redeveloped (or redevelopment is underway) into residential properties, including apartments, townhouses, and single-family homes. The Linden Historic District, consisting of historic residential properties, is located east of the facility beyond the CSX railroad tracks.

The area west of the facility is comprised of Rock Creek Regional Park, which is owned by the M-NCPPC. This area is forested and contains various cycling and a walking trails, which are connected to a trail (Ireland Drive) within the FGA's western boundary that roughly follows a historic concrete carriage road associated with the NPS. The area to the south of and east of the FGA are light industrial or mixed use areas.

2.4.7 Ecology

The undeveloped western portion of the FGA is adjacent to a natural forested corridor extending from Rock Creek National Park through the Rock Creek Regional Park in Maryland. Deciduous woods cover most of the corridor's total acreage. While there are six forest communities in the National Park, over half of the Rock Creek Park is an American beech (*Fagus grandifolia*)/white oak (*Quercus alba*) forest (National Park Service, 2009). Several species of oak, including black oak (*Quercus velutina*), chestnut oak (*Q. prinus*), scarlet oak (*Q.coccinea*), and hickory (*Carya* spp.), occur less commonly. Tulip poplar (*Liriodendron tulipifera*) and American beech predominate the slopes and ridges. Elm (*Ulmus* spp.), sycamore (*Platanus occidentalis*), ash (*Fraxinus* spp.), box elder (*Acer negundo*), and tulip poplar are common in the occasional floodplain areas along stream channels.

The forest habitat on FGA is similar to the Rock Creek parks, but smaller and somewhat more disturbed. Remnant coniferous trees such as Virginia pine (*Pinus virginiana*) and pitch pine (*P.rigida*) are spread throughout the forest as single trees or small groves. Native understory species include spicebush (*Linera benzoin*), mapleleaf viburnum (*Viburnum acerfolia*), black snakeroot (*Sanicula canadensis*) and hairy sweet cicely (Osmorhiza daytoni). Typical of urbanized environments, a number of non-native species have displaced native species and occur as dominants in the understory. These species include amur honeysuckle Lonicera maakii), English ivy (*Hedera helix*), Japanese honesuckle (*L. japonica*), climbing euonymous (*Euonymous fortunei*), and oriental bittersweet (*Celastrus orbiculatus*) (USACE with Tetra Tech, 2008). An inventory of the Park's vegetation has documented approximately 700 species of vascular plants. Thirty-one rare or uncommon plants listed by Maryland and Virginia are found in the park (National Park Service, 2005).

Wildlife studies conducted throughout the adjacent National Park have identified 36 species of mammals, 181 species of birds, and 19 species of reptiles and amphibians that are present or probably present in the park (NPS unpublished data-NPSpecies 2008). Species in the park include white-tailed deer, red (*Vulpes vulpes*) and gray (*Urocyon cinereoargenteus*) fox, raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), beaver (*Castor canadensis*), chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), coyote (*Canis latrans*), great horned owl (*Bubo virginianus*), barred owl (*Strix varia*), red shouldered hawk (*Buteo lineatus*), eastern box turtle (*Terrepene carolina*), spotted salamander (*Ambystoma maculatum*),and black rat snake (*Elaphe obsoleta*) (National Park Service, 2005). This flora and fauna would be expected to use the forested area of FGA as a path of migration in moving between the National Park and less developed forest habitat north of the facility in Maryland.

Three state rare plant species have been documented within the FGA boundaries: a ten-foot patch of passionflower vine (*Passiflora incarnate*), sapling of umbrella tree (*Magnolia tripetala*), and an American chestnut tree (*Castanea dentate*). Recent investigations have been unable to locate any American Chestnut trees, and no passionflower vine has been located. The Umbrella Magnolia tree will be carefully avoided and depending on the alternative chosen, protected. All individuals were reportedly located within 100 feet of Ireland Creek (USACE with Tetra Tech, 2008).

The entire area of the FTGL-02 landfill was disturbed by clearing and fill activities from the 1940s through the 1960s. This area extends west and south up to the Ireland Trail. Forest in this area has regenerated since that time period.

3 Previous Site Investigations

This subsection chronologically summarizes relevant historical investigations conducted prior to the 2012 RI characterization of FTGL-02. Additional details regarding these investigations may be found in the referenced reports.

3.1 Previous Investigations at FTGL-02

3.1.1 2000 USACHPPM Preliminary Assessment

A site-wide Preliminary Assessment (PA) was completed at FGA in 2000 by the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), now the U.S. Army Public Health Command (USAPHC). The purpose of the PA was to conduct site reconnaissance to identify potential threats to human health and the environment and to identify any waste sites that warrant further investigation or response action. A total of two former landfills (subsequently identified as FTGL-02 and FTGL-03) were identified in the central portion of the installation and one was identified in the area of Building 511 (subsequently identified as FTGL-04). The PA indicated that the landfills operated from 1942 until 1966 and two ball fields and several buildings are currently located on the former landfill sites. Wastes buried in the landfills were identified as construction debris, medical waste, incinerator ash, household waste, and office waste. The PA also identified that two incinerators were constructed north of Building 511. Papers, contaminated wastes, animal bodies, bedding, and garbage were incinerated; and ash from the incinerators was buried in the landfills. Lastly, the PA identified some exposed waste and construction debris in the wooded area north of the ball fields. Recommendations made in the PA concerning the landfills included sampling of the groundwater down gradient of the former landfills to determine if there is contaminant leaching and the removal of surficial waste and construction debris near the ball fields.

3.1.2 2002 USACHPPM Phase I Site Inspection

The Phase I Site Inspection (SI) (USACHPPM, 2002) was conducted to determine the presence or absence of any contamination that may be harmful to human health and the environment as a result of past activities at FGA. The investigation incorporated sampling of soil, groundwater, surface water, and sediment. Monitoring wells and sampling points were placed to detect potential contaminants released from the former landfills at FGA. During the SI Phase I, groundwater monitoring wells were installed to intercept groundwater after it passed under the landfills. Four monitoring wells (FG207, FG208, FG209, and FG210) were installed downgradient of FTGL-02 Groundwater samples were analyzed for total metals, nonmetal inorganics, total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and gross alpha and beta radionuclides. Analytical results indicated concentrations of barium, beryllium, cadmium, chromium, lead, and nickel above primary drinking water Maximum Contaminant Levels (MCLs) in one or more of the downgradient wells. Gross alpha was also above its MCL and its level attributed to suspended particles in the unfiltered samples.

Five co-located surface water and sediment samples (FGS3/FGSED3 through FGS7/FGSED7) were obtained from South Ireland Creek (Stream D) that runs along the south side of FTGL-02 (see **Figure 2-8**). Sediment samples were analyzed for total metals, TPH diesel range organics (DRO), pesticides, PCBs, and SVOCs. Surface water samples were analyzed for the same chemicals with the exceptions of pesticides and PCBs. Analytical results indicated no analytes in sediment or surface water above screening levels.

3.1.3 2003 USACHPPM Phase II Site Inspection

During the Phase II SI (USACHPPM, 2003), contaminants detected above levels of concern during the Phase I were re-sampled, and additional sampling points were added. Two new monitoring wells (FG211 and FG212) were installed down gradient of FTGL-02. Both the Phase I and Phase II wells were sampled for a full suite of metals, ammonia, chloride, nitrate and nitrite as nitrogen, TPH-DRO, VOCs, pesticides, PCBs, and gross alpha and beta radionuclides. Results indicated that only lead in monitoring well FG212 exceeded the primary drinking water MCL. VOCs, including carbon disulfide and acetone, were detected in well FG211 located north of the ball fields. The Phase II SI recommended FG211 be re-sampled to determine whether contaminants are increasing or decreasing over time.

3.1.4 2005 Risk Assessment Data Collection Report for the Proposed RCI Parcel

Soil and groundwater samples were collected immediately northeast of FTGL-02 during this investigation and analyzed for VOCs, SVOCs, pesticides, metals, and TPH-DRO. A total of 10 soil borings were conducted and 10 groundwater grab samples were collected (DPS-5 through -14) using Direct-Push Technology (DPT) Soil sampling results indicated multiple detections of arsenic and one of benzo(a)pyrene above USEPA industrial risk-based concentrations (RBCs). The highest level of contaminants was found in the parking lot located west of Building 156. Based on correlations to the soil boring logs, the elevated contaminant concentrations correspond with visible waste material and was not detected in soils located north and south of the parking lot which appeared to be reworked native material with only trace amounts of debris. Perched water was sampled in one boring and all analytes were detected at concentrations below groundwater screening levels. Based on this investigation and prior borings (B1 - B4) and test pits (11 - 13), fill material was found in most of the investigation area ranging in thickness from two to 10 feet at the northern end of the parcel to 22 feet at the location of the southern extent of the investigation in boring B4.

3.1.5 2006 USACHPPM Soil Gas Sampling

In July 2006, soil gas sampling was conducted at the Historic Open Dump (HOD) located along the northern boundary of FTGL-02 to evaluate levels of methane inside and along the HOD perimeter. The investigation was conducted in response to the directive of the MDE Land Management Administration’s (LMA’s) Solid Waste Program to render the area safe prior to the planned surface debris removal at the HOD. The analytical results indicated no explosive gas present inside or along the HOD perimeter.

3.1.6 2008 USACHPPM Groundwater Monitoring

Sampling and analysis of 19 existing groundwater monitoring wells throughout the FGA was conducted in

June 2008. The samples were analyzed for metals, TPH-DRO, pesticides, PCBs, radiological parameters, and VOCs. Five monitoring wells (FG207, FG208, FG210, FG211 and FG212) located down gradient of FTGL-02 were part of this investigation. The reported results of this investigation indicated no exceedances of primary drinking water MCLs for dissolved samples.

3.1.7 2009 Historic Open Dump Characterization Summary

The HOD investigation included soil and groundwater sampling, a gamma radiation survey, geophysical survey, and surface debris removal. A total of 10 surface soil samples (HODSS01 - HODSS10) were collected and three monitoring wells (HODMW01 - HODMW03) were installed and sampled. The report concluded that:

- Surface soil results indicated the presence of pesticides above industrial RBCs.
- Groundwater results indicated the presence of one SVOC [bis(2-ethylhexyl)phthalate (DEHP)] and one herbicide (dinoseb) above primary drinking water MCLs.
- Gamma walkover survey results did not indicate the presence of radioactive materials in the HOD.
- The geophysical survey results indicated that the size of the disposal area may be larger than anticipated and extends to the west beyond the investigation limit.

The investigation also included the removal of surface waste and the installation of fencing around the area to prevent human access and exposure to the waste. Based on the investigation results, the HOD was determined to be an extension of the FTGL-02 landfill.

3.1.8 2010 Analysis of Historic Aerial Photography

An installation-wide historic photographic analysis was conducted prior to the RI to better evaluate the footprint of the FGA IRP sites as well as identify any additional areas of potential environmental concern. AECOM subcontracted TLI Solutions, Inc. (TLI) to evaluate all available historic aerial photography for the FGA to identify areas or features of environmental concern within the current and historic installation boundaries and adjacent properties. The aerial photographs obtained and evaluated ranged from 1937 to 2008. As part of the aerial photograph evaluation, historical records, such as maps and drawings that would assist in the interpretation of aerial photographs, were reviewed at the National Archives and Records Administration (NARA) and USACE Baltimore District.

Based on this photographic analysis, ground disturbance and potential waste disposal activities by the Army appear to have been conducted at FTGL-02 beginning in the 1940’s and ending in the 1970’s when aerial photographs show ground leveling and construction of the ball fields. Also, based on this analysis, additional disturbed area beyond the IRP-identified landfill boundary in all directions was identified. Due to the lack of detail in many of the historical aerials, it is difficult to determine if these additional areas were actually used for waste disposal or were simply a result of ground scarring due to clean earthwork/grading and equipment movement over these areas. The approximate limits of this historical area of disturbance are shown on Figure 2-2 and subsequent figures.

4 Remedial Investigation, 2012

This section addresses the objectives and results of the on-going RI at FGA, including Site FTGL-02. The objective of the RI was to determine the nature and extent of contamination due to past facility operations associated with the FTGL-02 and other landfills at FGA. In the course of this RI it was determined that medical waste is located outside the established boundaries of FTGL-02 and was accessible to the public using an adjacent hiking trail. An immediate time critical removal action was performed. The action consisted of the erection of a fence around the exposed waste to limit public access to the materials that were discovered. It was decided that additional non-time-critical removal/interim actions were necessary to limit public access and potential exposure to wastes that might similarly be exposed during the time necessary to choose and execute remedial actions that are designed to more permanently address the problems identified during the RI.

4.1 RI Objectives and Data Needs

The overall objective of the RI, as previously noted, is to determine the nature and extent of contamination due to past facility operations associated with the subject IRP sites. The results of the RI will be used to develop and evaluate response action alternatives associated with unacceptable risk from associated contaminants.

Project objectives identified for the three landfill sites (FTGL-02, 03, -04) are the following:

- Delineate landfill waste extent (lateral and vertical) and location relative to groundwater;
- Characterize the potential release to perimeter/downgradient environmental media from landfill;
- Characterize landfill surface soils;
- Evaluate the potential vapor intrusion exposure pathway; and
- Evaluate human health and ecological risk.

A presumptive remedy of containment/capping of the three landfill sites w taken into account in the Technical Project Planning (TPP) process. The achievement of these objectives was pursued under the constraint that no intrusive investigation into subsurface landfill material would occur during this RI. The closure of these landfills under MDE oversight and State of Maryland regulations was also a condition for consideration.

Specific data needs and collection options were identified in order to achieve the aforementioned project objectives. Following are the data needs and collection options identified at the three landfills-02:

Data Needs	
Delineate extent of landfill waste	Geophysical survey surface of landfill; perimeter test pits and soil borings with confirmatory soil sampling; and perimeter soil gas sampling.
Characterize soil contaminants	Landfill surface soil sampling; and surface and subsurface soil sampling around perimeter/downgradient of landfill areas.
Characterize saprolite and bedrock groundwater contaminants, lateral and vertical flow, and bedrock yield	Groundwater sampling of new and existing wells. New wells to be installed around perimeter of landfill areas into saprolite and fractured bedrock. Step-drawdown test on bedrock wells.
Characterize surface water/sediment contaminants	Surface water and sediment sampling of downgradient streams.

Evaluate VOC vapor intrusion	Conduct vapor intrusion investigation of active buildings that are within 100 feet of a chlorinated solvent groundwater plume or within the landfill boundaries.

4.2 RI Field Investigation Activities

RI field investigation activities were conducted in accordance with the approved final RI Work Plan except where noted. The following text represents a summary of the completed RI field characterization and table top activities. Additional detailed information concerning these activities can be found in the RI Work Plan. The results of the RI activities are presented in Section 4.

4.2.1 FTGL-02 Landfill Delineation (geophysics, test pits, soil borings, soil gas)

Delineation of the landfill at FTGL-02 consisted of three primary investigation methods: initial geophysical survey followed by test pit excavation and soil gas sampling. Based on project team discussions following the geophysical investigation, soil borings were also added to the investigation activities at FTGL-02 to assist in landfill delineation since the depth of investigation using test pits was limited in comparison to soil borings in areas anticipated to have significant fill.

Geophysical Survey

AECOM subcontracted ARM Geophysics, Inc. (ARM) to complete a geophysical survey of FTGL-02 Landfill to approximate the lateral and vertical limits of subsurface landfill material. ARM completed the geophysical surveys at the three landfill sites between 15 November 2010 and 3 January 2011 and completed subsequent data processing in February 2011. The geophysical data collection at FTGL-02 consisted of electromagnetic terrain conductivity using a Geonics® EM31-MK2 ground conductivity meter over the landfill, high sensitivity metal detection using a Geonics® EM61-MK2 metal detector over the landfill, and multi-channel analysis of shear waves (MASW) along several traverses across the landfill. The EM31 terrain conductivity surveying is a reconnaissance method of determining the electric and magnetic properties of subsurface materials and is used to gauge the relative amounts of soil, rock and man-made materials within a survey area. The EM61 collects and records the Earth's electromagnetic field and the resulting response after the EM61 introduces a secondary electromagnetic field. The EM61 differs from the EM31 in that the EM61 is capable of detecting both ferrous and non-ferrous metallic items. The MASW survey is a seismic survey able to discriminate between and among materials with relatively different physical properties (i.e., density) based on the velocity of the seismic wave as it travels through discrete layers. At FTGL-02, EM31 and EM61 data were collected over open areas. Additionally, individual traverses of EM31 data were extended into the wooded areas surrounding the landfill. Seven MASW traverses were collected across the landfill. The geophysical investigation was limited in extent at the southern, eastern, and northern perimeter due to a combination of obstacles, including the perimeter fence, steep slopes, foliage and wintry conditions.

A new interpreted lateral extent of the landfill material was identified for FTGL-02 based on the geophysical survey results. The following bullets summarize the revision of the former landfill boundary based on the interpreted geophysical results:

- Along the north and northeast sections of FTGL-02, the interpreted landfill perimeter was extended up to 200 feet to the northeast near the parking area in order to include areas of elevated EM61 data and subsurface anomalies detected by the MASW surveys.

- The eastern boundary of FTGL-02 was extended approximately 75 feet to include elevated EM anomalies that may represent possible subsurface debris.
- The south and southwest boundaries were extended up to 75 feet in order to include EM anomalies detected in the woods.
- Along the west and northwest sections of FTGL-02, the landfill perimeter was revised as far as 100 feet out in order to include EM anomalies detected in the woods area.

These new interpreted lateral limits were identified in the final Geophysical Report **(see figure 4-1).**

Additionally, based on MASW results, ARM estimated the depth of landfill material to extend to approximately 57 to 60 feet below ground surface (bgs) in the western and northern portions of the landfill. However, excessive subsurface moisture content along several traverses at FTGL-02 caused a reduction in the quality of the vertical data in the eastern and southern portions of the landfill. Depth estimates for landfill material in these areas were identified as extending greater than 40 feet bgs with no maximum estimate identified. Due to the uncertainty associated with geophysical-based depth estimates, other lines of evidence were considered in the estimation of landfill depth including nearby soil borings, and historical site topography. The resultant landfill depth estimate was approximately 45 feet bgs.

Test Pits and Soil Borings

Ten test pits were planned for excavation outside of the landfill perimeter to a depth of approximately 15 feet bgs with a compact excavator to confirm the revised boundary without intrusive excavation into known waste materials. Since wastes were encountered at some of those test pits, more locations were added to bring the total to 21 test pits excavated at FTGL-02 to confirm the revised perimeter. These include 9 additional offset locations (see Figure 4-2). Test pits 02-TP-01 through 02-TP-10 were part of the originally proposed sample set intended to confirm the perimeter outside the defined extent of the landfill. Waste was encountered at TP-03 and therefore resulted in an additional TP-03A, where waste was also encountered. Test pits 02-TP-19 and 02-TP-20 were then offset outward from test pits 02-TP-03 and 03A, and they showed no waste materials.

Test pits 02-TP-11 through 02-TP-18 were excavated in the northeastern and eastern portion of the landfill to evaluate multiple discrete EM-61 anomalies identified during the geophysical investigation. A subsurface soil sample was collected from the bottom of each test pit where landfill waste was not encountered.

Soil borings were added to the FTGL-02 investigation program following the geophysical survey to aid in confirmation of the landfill boundary in areas anticipated to have deep fill. One soil boring (02-SB01) was advanced using Hollow Stem Auger (HSA) within the parking lot of Building 156, thus avoiding a test pit to prevent disturbance to the pavement, and five soil borings (02-SB02 through 02-SB05), included one location offset due to shallow auger refusal (02-SB02A), were advanced where the anticipated potential depth of fill material exceeded the range of test pit excavation (see Figure 4-2).

Following the geophysical investigation, test pits and soil borings were completed around the outside perimeter of the landfill to visually confirm the presence of native/clean soils and the absence of landfill waste. As detailed above, a total of 21 test pits and 6 soil borings were completed (see Figure 4-2). Analytical results for samples collected from the test pits and borings are discussed below.

Most of the test pit and soil boring results confirmed the limits of the landfill waste. However, waste material associated with the landfill was encountered in test pit TP03 and its initial offset location, TP03A.

Wastes observed were consistent with materials typically associated with laboratory or medical waste, such as glass bottles, tubes, and vials. Consistent with the RI work plan procedure, excavation of test pits TP03 and TP03A was terminated immediately upon encountering the waste material and the pits were filled back in Test pits TP19 and TP20, offsets from test pits TP03 and TP03A, were subsequently excavated and found to contain no landfill waste materials.

Small to moderate quantities of construction and demolition debris (C&DD), including concrete and asphalt fragments, a segment of steel pipe and fragments of terra cotta pipe, were observed in test pits TP10, TP12, TP13, TP16, TP17, TP18, and SB02 located east and northeast of the ball fields. This debris was interpreted as being construction debris within fill material, but not associated with the FTGL-02 landfill waste.

Soil Gas Sampling

Passive soil gas samples were collected at FTGL-02 as a screening tool to aid in delineating the landfill perimeter. Samples were collected into vacuum sealed, six-liter stainless steel SUMMA® canisters from a depth of approximately three to four feet bgs and analyzed by the analytical laboratory for VOCs via Method TO-15. The probes were advanced using a hammer drill and the canister flow controllers were calibrated for a one-hour collection period. A total of 10 soil gas samples (02-AIR-01 through 02-AIR-10) were collected at FTGL-02 (see Figure 4-2).

As indicated above, soil gas sampling was conducted as a screening tool to help identify the perimeter of the landfill. There are no direct chemical-specific screening levels for soil gas results. However, background ambient air samples were collected at the ground surface of the landfill sites for general comparison purposes. Ambient air results for these sites yielded VOC detections for 13 of the 14 detected VOCs at FTGL-02. The highest detected soil gas VOC concentrations at FTGL-02 were mostly detected in sample 02-AIR-05. As shown on Figure 4-2, this sample location is adjacent to test pit TP03 where waste was encountered.

Landfill Delineation Results Summary

In summary, based on the cumulative investigation results from the geophysical survey, and subsequent test pit excavations, soil borings, and soil gas sampling efforts at FTGL-02, a revised landfill boundary was delineated for the site (see Figure 4-2). In comparison to the geophysical interpreted landfill boundary, the southern boundary was modified inward based on the absence of waste material in test pits TP06 and TP07 and the northwest boundary was modified outward based on the presence of waste in test pits TP03 and TP03A. In addition to the test pit and boring data results, the boundary was modified based on site observations and topography along the western and southern boundaries. Lastly, landfill material depth estimates were made based on the collected geophysics, perimeter boring data, and historical topography. These depths are approximations and confirmation via a boring program is recommended in the draft RI Report.

4.2.2 Landfill Surface Soil Characterization

Surface soil samples were collected at a total of 19 locations within the ball fields, helipad and recreational areas of FTGL-02 (see Figure 4-3) to characterize landfill surface soils and assess human health and ecological risk. Samples were collected using dedicated plastic scoops from a depth interval of approximately zero to six inches bgs. Each sample was analyzed for VOCs, SVOCs, metals (including hexavalent chromium), pesticides, herbicides, and PCBs.

The significance of the results was judged by comparing them to Regional Screening Levels (RSLs) for residential and industrial use, which is published by the USEPA every six months (USEPA, 2012); the most recent (Nov 2012) values were used in the draft RI. Such values are published for exposure to soil, to groundwater, and to air. For radiological results, the comparison criteria were USEPA's most recent Preliminary Remediation Goals (PRGs) (USEPA, 2010). Besides these health-based screening levels, estimates of naturally occurring concentrations were also used for comparison with RI results; this was done for metals and radionuclides, which are known to occur naturally. These background estimates in soil and groundwater came from sampling results from four locations on FGA that were chosen based on their having had minimal Army activity in the past. Another set of background values used in the draft RI for metals in soil were from the Maryland Department of the Environment's Voluntary Cleanup Program guidance (MDE, 2008). MDE provides these Anticipated Typical Concentrations (ATCs) grouped into three categories for Western, Central, and Eastern Maryland.

Preliminary data for PCB Aroclors were screened in accordance with a PCB Analysis Decision Tree developed for the RI. Aroclor results were compared to the action limits provided in the Project QAPP Worksheet #15-5 and additional analysis for PCB congeners was performed on samples with an Aroclor concentration that exceeded the respective action limit. Selected samples were also analyzed for dioxins/furans and radionuclides. The sample aliquot analyzed for VOCs was collected directly from the earth at the bottom of the sample depth interval using TerraCore® samplers and preserved in methanol. A summary of the results follows.

<u>VOCs</u>

Eleven VOCs were detected in one or more of the 20 landfill surface soil samples (1 duplicate was taken) at FTGL-02. However, none of the VOCs were detected at concentrations exceeding residential or industrial RSLs.

<u>SVOCs</u>

As summarized in the Draft RI Report, 23 SVOCs were detected in one or more landfill surface soil samples at FTGL-02. Four SVOCs, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and dibenz(a,h)anthracene, were detected at concentrations exceeding the residential RSLs:

- Benzo(a)anthracene was detected in 2 of 20 samples exceeding the residential RSL at a maximum concentration of 280 µg/kg at 02-SS15. None of these detections exceeded the industrial RSL.
- Benzo(a)pyrene was the most frequently detected PAH exceeding the residential RSL in 17 of the 20 samples. It was only detected in one sample (02-SS15) slightly exceeding the industrial RSL (210 µg/kg) at a concentration of 230 µg/kg.
- Benzo(b)fluoranthene was detected in 5 of 20 samples exceeding the residential RSL at a maximum concentration of 310 J µg/kg at 02-SS15. None of these detections exceeded the industrial RSL.
- Dibenz(a,h)anthracene was detected in 3 of 20 samples exceeding the residential RSLat a maximum concentration of 34 µg/kg at 02-SS15. None of these detections exceeded the industrial RSL.

Figure 4-4 illustrates the locations of the SVOC exceedances in landfill surface soils for FTGL-02.

Pesticides/Herbicides

As summarized in the draft RI Report, five pesticides and herbicides were detected in one or more landfill surface soil samples at FTGL-02. However, none of the pesticides or herbicides was detected at concentrations exceeding residential or industrial RSLs.

PCBs

As summarized in the draft RI Report, one PCB, Aroclor 1260, was detected in four landfill surface soil samples at FTGL-02. However, this PCB was not detected at a concentration exceeding the residential or industrial RSLs.

Dioxins/Furans

Six (6) of the 20 surface soil samples collected from the landfill surface soil were analyzed for dioxins and furans. Fifteen dioxins and furans were detected in surface soil from one or more of these samples. RSLs have only been published for 2,3,7,8-TCDD. TCDD was not detected in soil at FTGL-02. For the other dioxin/furan compounds, Toxic Equivalency Factors (TEFs) were used to calculate an equivalent concentration (TEQ) of TCDD for screening purposes. The calculated 2,3,7,8-TCDD TEQ concentrations did not exceed the residential or industrial RSLs.

Metals

Twenty-five metals were detected in one or more landfill surface soil samples at FTGL-02. Three of these 25 metals exceeded the residential and/or industrial RSLs including arsenic, hexavalent chromium and cobalt. However, the source of these metals is considered to be representative of naturally occurring background conditions, and is not considered to be site related:

- Arsenic concentrations exceed the residential RSL in all 20 samples and industrial RSL in 16 samples, with a maximum concentration of 3.9 mg/kg in 02-SS41. However, the detected concentrations of arsenic did not exceed the background cutoff level of 5.9 mg/kg or the 4.9 mg/kg ATC for soil.
- Hexavalent chromium concentrations exceed the residential RSL in 14 samples, with a maximum concentration of 1.8 mg/kg in 02-SS26. However, the detected concentration of hexavalent chromium did not exceed the background cutoff level of 1.9 mg/kg.
- Cobalt was detected in one sample at a concentration of 28 mg/kg (02-SS26) above the residential RSL (23 mg/kg) and above the background cutoff level (16 mg/kg). However, this cobalt concentration did not exceed the ATC of 33 mg/kg for soil.

Radionuclides

Three of the 20 surface soil samples (including 1 duplicate) collected from the landfill surface soil were analyzed for radionuclides. Six radionuclides were detected in all of these samples, and cesium-137, radium-226, radium-228, and uranium-238 concentrations exceeded residential PRGs. The occurrences of radionuclides in the soil and bedrock within the Piedmont are considered to be naturally occurring conditions, while the cesium-137 is a background man-made condition from global nuclear weapons testing fallout:

- The detected concentrations of radium-226 and radium-228 did not exceed the background cutoff levels of 1.69 and 1.36 pCi/g, respectively.
- The detected concentration of uranium-238 in one sample slightly exceeded the background cutoff level (1.17 pCi/g) at a concentration of 1.26 pCi/g. This uranium-238 concentration was detected at sample 02-SS18 located on the western slope of the FTGL-02 landfill.

- Even though a background cutoff level was not determined for cesium-137, the detected concentrations of cesium-137 in three samples (ranging from 0.139 J to 0.37 pCi/g) are considered to be within background based on the concentrations not exceeding the maximum detected background surface soil concentration of 0.68 pCi/g.

4.2.3 Landfill Perimeter Investigation (Surface & Subsurface Soil, Groundwater Sampling, Surface Water & Sediment Sampling)

Media in the mostly wooded area outside and downgradient of the fence line surrounding the ball fields, helipad and recreational areas were sampled to characterize any potential release from the landfill and assess human health and ecological risk. This evaluation included sampling of surface and subsurface soil, groundwater, surface water, and sediment.

Surface and Subsurface Soil Samples

Surface soil samples were collected at a total of 23 locations outside of the landfill perimeter (see Figure 4-3). Sampling and analysis was conducted in the same manner as described above for landfill surface soil characterization.

Surface Soil Investigation

A total of 26 surface soil samples (including 3 duplicates) were collected from a total of 23 locations on the perimeter of the landfill. Analytical results for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins/furans, and metals were screened against the USEPA Region 3 residential and industrial RSLs. Results for radionuclides were screened against USEPA residential soil PRGs. The following sections summarize the screening results of detected compounds. Figure 4-4 illustrates the locations of the contamination exceedances in landfill perimeter surface soils for FTGL-02.

<u>VOCs</u>

Fourteen VOCs were detected in one or more landfill perimeter surface soil samples at FTGL-02. However, none of the VOCs were detected at concentrations exceeding residential or industrial RSLs.

<u>SVOCs</u>

Twenty-two SVOCs were detected in one or more landfill perimeter surface soil samples at FTGL-02. SVOC’s also known as Polyaromatic hydrocarbons are a byproduct of incomplete combustion of the burning of organic (carbon containing) compounds. These are a by-product of many industrial processes and are found in cigarettes, auto exhaust, incinerators and asphalt. Two SVOCs, benzo(a)pyrene and benzo(b)fluoranthene, were detected at concentrations exceeding the residential RSLs:

- Benzo(a)pyrene was the most frequently detected PAH exceeding the residential RSL in 17 of the 26 samples with the two samples (02-SS22 and 02-SS35) exceeding this 15 µg/kg screening by approximately one order of magnitude. The maximum detected concentration of 180 µg/kg at 02-SS-35 is located on the slope of the southeastern perimeter of the landfill. None of the detections exceeded the industrial RSL (210 µg/kg).
- Benzo(b)fluoranthene was detected in 1 of 26 samples exceeding the residential RSL at a concentration of 250 µg/kg at 02-SS35. This concentration is significantly below the industrial RSL (1,500 µg/kg).

<u>Pesticides/Herbicides</u>

Eight pesticides and herbicides were detected in one or more landfill perimeter surface soil samples at FTGL-02. However, no pesticides or herbicides were detected at concentrations exceeding residential or industrial RSLs.

<u>PCBs</u>

One PCB, Aroclor 1260, was detected in three landfill perimeter surface soil samples at FTGL-02. However, this PCB was not detected at a concentration exceeding the residential or industrial RSLs.

<u>Dioxins/Furans</u>

Twelve (12) of the 26 surface soil samples collected from the landfill perimeter were analyzed for dioxins and furans. Seventeen dioxins and furans were detected in surface soil from one or more of these samples. RSLs have only been published for 2,3,7,8-TCDD. TCDD was detected in 2 samples; however, at concentrations below RSLs. For the other dioxin/furan compounds, TEFs were used to calculate an equivalent concentration (TEQ) of TCDD for screening purposes. The calculated 2,3,7,8-TCDD TEQ concentrations for four samples exceeded residential RSLs: 02-SS07 (7.3 µg/kg), 02-SS10 (5.25 µg/kg) 02-SS13 (5.19 µg/kg), and 02-SS37 (6.24 µg/kg). Samples 02-SS07, -SS10, and –SS13 were all collected from the north side of the landfill perimeter and sample 02-SS37 was collected from the south side of the landfill perimeter (see Figure 4-4).

<u>Metals</u>

Twenty five metals were detected in one or more landfill surface soil samples at FTGL-02. Three of these 25 metals exceeded the residential and/or industrial RSLs including arsenic, hexavalent chromium and cobalt. However, the source of these metals is considered to be representative of naturally occurring background conditions, therefore they are not considered to be site related:

- Arsenic concentrations exceeded the residential RSL in all 26 samples and industrial RSL in 23 samples, with a maximum concentration of 3.8 mg/kg in sample 02-SS34. However, the detected concentrations of arsenic did not exceed the background cutoff level of 5.9 mg/kg or the 4.9 mg/kg ATC for soil.
- Hexavalent chromium concentrations exceed the residential RSL in 14 samples, with a maximum concentration of 1.5 mg/kg in sample 02-SS06. However, the detected concentration of hexavalent chromium did not exceed the background cutoff level of 1.9 mg/kg.
- Cobalt was detected in one sample at a concentration of 24 mg/kg (02-SS09) above the residential RSL (23 mg/kg) and above the background cutoff level (16 mg/kg). However, this cobalt concentration did not exceed the ATC of 33 mg/kg for soil.

Radionuclides

Three of the 20 surface soil samples collected from the landfill perimeter were analyzed for radionuclides. Six radionuclides were detected in surface soil in one or more of these samples, and cesium-137, radium-226, radium-228, and uranium-238 concentrations exceeded residential PRGs. The occurrences of radionuclides in the soil and bedrock within the Piedmont are considered to be naturally occurring conditions, while the cesium-137 is a background man-made condition from global nuclear weapons testing fallout:

- The detected concentrations of radium-226, radium-228, and uranium-238 exceeded residential PRGs but did not exceed the background cutoff levels of 1.69, 1.36, and 1.17 pCi/g, respectively.
- Even though a background cutoff level was not determined for cesium-137, the detected concentrations of cesium-137 in two samples (ranging from 0.127 J to 0.53 pCi/g) is considered to be within background based on the concentrations not exceeding the maximum detected background surface soil concentration of 0.68 pCi/g.

Subsurface Soil Investigation

Subsurface soil samples were collected at a total of 26 locations outside of the landfill perimeter including 19 of the 21 test pits, six soil borings, and one monitoring well soil boring (FG302) (see Figure 4-5). A soil sample was planned but not collected from the monitoring well FG301 borehole due to the degree of consolidation in the weathered rock and limited recovery at this location. Two soil samples were collected from each soil boring. One soil boring (02-SB02) was offset and re-drilled (02-SB02A) due to shallow refusal (drill refuses to advance). Sampling of 02-SB03A started at the depth of refusal of 02-SB03. Each sample was analyzed for VOCs, SVOCs, metals (including hexavalent chromium), pesticides, herbicides, and PCBs. Per the PCB Analysis Decision Tree, additional analysis for PCB congeners was performed if initial PCB analysis indicated an Aroclor concentration exceeding action limits. Six subsurface soil samples were also analyzed for dioxins/furans and four were analyzed for radionuclides A total of 33 subsurface soil samples (including 3 duplicates) were collected from 19 test pits and 7 borings on the perimeter of the landfill. Analytical results for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins/furans, and metals were screened against the USEPA residential and industrial RSLs. Results for radionuclides were screened against USEPA residential soil PRGs. The following sections summarize the screening results of detected compounds. Figure 4-6 illustrates the locations of the criteria exceedances in subsurface soils for FTGL-02.

VOCs

Fourteen VOCs were detected in one or more landfill perimeter subsurface soil samples at FTGL-02. However, none of the VOCs were detected at concentrations exceeding residential or industrial RSLs.

SVOCs

Twenty-five SVOCs were detected in one or more of the 33 landfill perimeter subsurface soil samples at FTGL-02. Four SVOCs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and Dibenzo(a,h)anthracene, were detected at concentrations exceeding the residential RSLs:

- Benzo(a)anthracene was detected in 2 of 33 samples (02-TP12-12.5 and 02-TP13-14) exceeding the residential RSL at a maximum concentration of 250 J µg/kg in 02-TP12 at a depth of 12.5 ft bgs. None of the detections exceeded the industrial RSL. These two test pits are located north of the landfill near the headwaters of Stream C. The materials in the test pit logs for TP12 and TP13 indicate that asphalt and wood fragments were observed in the subsurface. This presence of demolition debris, may be the source of the elevated PAHs detected at depth in 02-TP12.

- Benzo(a)pyrene was the most frequently detected PAH exceeding the residential RSL in 6 of the 33 samples. Only sample 02-TP12-12.5 slightly exceeded the industrial RSL (210 µg/kg) at aconcentration of 250 J µg/kg.
- Benzo(b)fluoranthene was detected in 2 of 33 samples exceeding the residential RSL at a maximum concentration of 350 J µg/kg at 02-TP12. None of the detections exceeded the industrial RSL.
- Dibenz(a,h)anthracene was detected in 2 of 33 samples exceeding the residential RSL at a maximum concentration of 58 µg/kg at 02-TP12. None of the detections exceeded the industrial RSL.

Pesticides/Herbicides

Eleven pesticides and herbicides were detected in one or more landfill perimeter subsurface soil samples at FTGL-02. Only one compound, the herbicide MCPP, was detected at a concentration that exceeds the residential RSL (61,000 µg/kg), but was significantly less than the industrial RSL (620,000 µg/kg). This MCPP concentration of 89,000 µg/kg was detected at sample 02-SB04 located on the eastern perimeter of the FTGL-02 landfill (see Figure 4-6). This sample result appears to be an isolated occurrence located at a depth of 4 ft bgs.

PCBs

Three PCBs were detected in one or more of 33 landfill perimeter subsurface soil samples at FTGL-02. PCB Aroclor-1260 was detected in 2 of 33 samples at concentrations exceeding the residential and/or industrial RSL:

- Aroclor-1260 was detected at a concentration of 420 µg/kg in test pit sample 02-TP10 at 15 ft bgs, which exceeded the residential RSL, and at a concentration of 2400 J µg/kg in soil boring sample 02-SB04 at 10 ft bgs, which exceeded both the residential and industrial RSLs. Both sample 02-TP10 and 02-SB04 were located on the eastern perimeter of the FTGL-02 landfill (see Figure 4-6).

PCB Aroclor results were compared with project action limits in accordance with the approved PCB Decision Tree. Aroclor-1260 exceeded the action limit of 220 µg/kg in samples 02-TP10 (420 µg/kg) and 02-SB04-10 (2400 J µg/kg). Therefore, these two samples were analyzed for 12 human health PCB congeners. Two of the 12 detected congeners exceeded the residential RSLs:

- PCB-118 exceeded the residential RSL at a maximum concentration of 120,000 pg/g (pico grams per gram [parts per trillion]) at sample 02-SB04 at 10 ft bgs.
- PCB-126 exceeded both the residential and industrial RSLs at a maximum concentration of 880 pg/g at sample 02-SB04 at 10 ft bgs.

Dioxins/Furans

Fifteen (15) of the 33 subsurface soil samples collected from the landfill perimeter were analyzed for dioxins and furans. Fourteen dioxins and furans were detected in subsurface soil from one or more of these samples. RSLs have only been published for 2,3,7,8-TCDD. TCDD was detected in only one sample at a concentration below the RSL. For the other dioxin/furan compounds, TEFs were used to calculate an equivalent concentration (TEQ) of TCDD for screening purposes. The calculated 2,3,7,8-TCDD TEQ concentrations for one sample, 02-SB04-10, exceeded the residential RSL at a concentration of 5.87 µg/kg. Sample 02-SB04-10 was collected on the eastern side of the landfill perimeter (see Figure 4-5).

Metals

Twenty-five metals were detected in one or more of the 33 landfill perimeter subsurface soil samples at FTGL-02. Four of these 25 metals exceeded the residential and/or industrial RSLs including arsenic, hexavalent chromium, cobalt and thallium. However, the source of these metals is considered to be representative of naturally occurring background conditions, and is therefore not considered to be site related:

- Arsenic concentrations exceed the residential RSL in all 33 samples and industrial RSL in 22 samples, with a maximum concentration of 3.9 mg/kg in sample 02-SB02-14. However, the detected concentrations of arsenic did not exceed the background cutoff level of 5.9 mg/kg or the 4.9 mg/kg ATC for soil.
- Hexavalent chromium concentrations exceed the residential RSL in 7 samples, with a maximum concentration of 1.2 mg/kg in 02-TP08. However, the detected concentrations of hexavalent chromium did not exceed the background cutoff level of 1.9 mg/kg.
- Cobalt was detected in 3 samples at concentrations above the residential RSL (23 mg/kg) and above the background cutoff level (16 mg/kg). However, these cobalt concentrations did not exceed the ATC of 33 mg/kg for soil.
- Thallium was detected in one sample, 02-TP08, slightly above the residential RSL (0.78 µg/kg) and the background cutoff value (0.81 µg/kg) at a concentration of 0.88 J µg/kg. However, this thallium concentration did not exceed the ATC of 1.9 mg/kg for soil.

Radionuclides

Four (4) of the 33 subsurface soil samples collected from the landfill perimeter were analyzed for radionuclides. Five radionuclides were detected in subsurface soil in all of these samples and radium-226, radium-228, and uranium-238 concentrations exceeded residential PRGs. The occurrences of radionuclides in the soil are considered to be generally consistent with naturally occurring conditions within the Piedmont area, as discussed in the draft RI Report:

- One radium-226 detection at 02-TP04 (2.39 pCi/g) was above the subsurface soil background cutoff value of 1.87 pCi/g. Sample 02-TP04-13 was located on the western perimeter of the FTGL-02 landfill at a depth of 13 ft bgs (see Figure 4-5).
- Even though a background cutoff level was not determined for radium-228 in subsurface soil, the detected concentrations in the four samples (ranging from 0.61 J to 0.98 J pCi/g) are considered to be within background based on the concentrations not exceeding the maximum detected background subsurface soil concentration of 1.46 pCi/g.
- Similarly, the detected concentrations of uranium-238 in the four samples (ranging from 0.86 J to 1.99 pCi/g) are considered to be within background based on the concentrations not exceeding the maximum detected background subsurface soil concentration of 3.09 pCi/g.

4.2.4 Groundwater Sampling

Shallow Groundwater Investigation

Two shallow groundwater monitoring wells (FG301 and FG302) were constructed at FTGL-02 downgradient of the landfill near Stream D (South Ireland Creek) (see Figure 4-7). Due to the relatively low permeability observed in the saprolite, water was not observed during drilling. At locations where the depth to groundwater could not be identified during drilling, the boreholes were left open up to 24 hours to determine the depth to water prior to well construction. Well screens were installed below the water table wherever adequate depth was available.

Two rounds of groundwater sampling were conducted, from 19 July to 22 August 2011, and from 5 December 2011 to 13 January 2012. This sampling effort included the two new wells (FG301 and FG302) and eight existing wells at FTGL-02 (FG207, FG208, FG209, FG210, FG211, FG212, HODMW01, and HODMW02). Monitoring well HODMW03 was not sampled as proposed due to a partial obstruction or deviation of the well that prevented passage of some sampling equipment. This partial obstruction or deviation was observed by the passage of small diameter (i.e., less than one-inch diameter) instruments, but not larger diameter instruments and pumps beyond a depth of approximately 32 feet bgs.

In accordance with the FSP, a minimum of three well volumes were purged from each well prior to sampling. Prior to purging, the volume of the well was calculated including an assumed 30% filter pack porosity. In cases where the wells were purged dry prior to the removal of one calculated well volume, the well volume was revised to be the volume removed. During sampling, if wells were not found to sustain a minimum 100 ml/min flow rate, then grab samples were collected. At FTGL-02, monitoring wells FG207, FG208, FG209, FG210, FG211, and FG302 did not sustain a 100 ml/min flow rate without drawdown. Monitoring well FG212 sustained the minimum flow rate in the initial round of groundwater sampling, but did not in the second round. Grab samples were collected from these wells using a bladder pump or dedicated bailers in accordance with requirements of the FSP. Groundwater stabilization parameters were measured using an YSI 6920 or 6820 Multi-parameter Meter. Results are summarized below. Figure 4-8 illustrates the locations of the criteria exceedances in shallow groundwater for FTGL-02.

<u>VOCs</u>

Twelve VOCs were detected in one or more shallow groundwater samples at FTGL-02. Six VOCs, 1,1,2-TCA, 1,4-DCB, benzene, chloroform, naphthalene and PCE, were detected in shallow groundwater at concentrations exceeding the tap water RSLs. However each VOC was detected at concentrations below their respective MCL, except for PCE:

- 1,1,2-TCA exceeded the tap water RSL in one shallow monitoring well, FG301, located along the south perimeter of the landfill. The exceedance only occurred during the second round of sampling.

- 1,4-DCB, benzene, and naphthalene exceeded the tap water RSLs in one shallow monitoring well, FG302, located along the south perimeter of the landfill. These compounds were consistently detected at similar concentrations during each sampling round. These detections may represent isolated low level occurrences to groundwater at this location.
- Chloroform was the most frequently detected VOC above the tap water RSL in seven samples collected from four monitoring wells including FG211, FG212, FG301, and HODMW01. The highest concentration of chloroform (5.3 μg/l) was detected in monitoring well HODMW01 located within the revised boundary of the landfill. Chloroform was only consistently detected above the RSL in monitoring well HODMW01 during each sampling round. Chloroform has been detected at relatively low to similar concentrations in the groundwater and surface water on a site-wide basis. No MCL has been developed for chloroform. However, the maximum contaminant level goal (MCLG) is 70 μg/l for chloroform. These chloroform detections are significantly below this value.
- PCE exceeded the tap water RSL in one shallow monitoring well, FG208, located within the revised boundary of the landfill. The PCE detected concentration of 12 μg/l is slightly more than twice the MCL (5 μg/l). Previous SI sampling of monitoring well FG208 found no detections of PCE above MCLs.

SVOCs

Sixteen SVOCs were detected in one or more shallow groundwater samples at FTGL-02. Four SVOCs, 1,4-DCB, DEHP, hexachlorobenzene, and naphthalene, were detected at concentrations exceeding the tap water RSLs while none of these exceed the MCLs:

- 1,4-DCB and naphthalene – see VOC discussion above.
- DEHP was the most frequently detected SVOC above the tap water RSL in three samples collected from three monitoring wells including FG207, FG211, and HODMW01. These exceedances only occurred in the first or second round of sampling at these wells, but not both rounds. The source of phthalate detections are sometimes due to sampling equipment (tubing) containing plastic.
- Hexachlorobenzene exceeded the tap water RSL in one shallow monitoring well, HODMW01, located within the revised boundary of the landfill. The exceedance only occurred during the second round of sampling.

Pesticides/Herbicides

Seven pesticides and herbicides were detected in one or more of the 23 shallow groundwater samples at FTGL-02. Two pesticides, Alpha BHC and Delta BHC, were detected at concentrations exceeding the tap water RSLs:

- Alpha BHC and delta BHC exceeded the tap water RSLs in one shallow monitoring well, FG207, located along the south perimeter of the landfill. These exceedances in this well only occurred during the first round of sampling.

PCBs

No PCB Aroclors were detected in the 23 groundwater samples collected from shallow groundwater at FTGL-02.

Metals

Twenty-four metals were detected in one or more of 23 shallow groundwater samples collected at FTGL-02. Six metals, including aluminum, arsenic, cobalt, iron, manganese, and thallium, exceeded the USEPA tap water RSLs.

- These elevated metals detections may be the direct result of suspended sediment (particles) present in the unfiltered grab (bailer-collected) samples. During laboratory testing, the acidic digestion process will dissolve all suspended metallic particles within the sample matrix. This process will bias the testing results towards higher total metals concentrations when compared to lower concentrations typical of dissolved metals concentrations when samples are field-filtered.
- Each of these metals also may be representative of groundwater chemistry that evolves from the naturally occurring background metals present in the soil and bedrock matrix.
- Additionally, presence of elevated metals in groundwater may be indirectly related to the modified geochemical conditions caused by surface/subsurface disturbances (soil cut and fill activities) and the result of non-native fill/waste disposal. The presence of these fill materials and/or wastes will act to consume the available dissolved oxygen in groundwater, provide very little pH buffering capacity for infiltrating acidic rainwater, and will act to enhance reducing conditions in groundwater, that will raise the solubility and mobility of some metallic compounds and related species.

Specific metals results are as follows:

- Aluminum and iron exceeded tap water RSLs in one shallow monitoring well, FG208, located within the revised boundary of the landfill. These exceedances only occurred during the first round of sampling. No MCLs are established for these metals.
- Arsenic exceeded the tap water RSL but did not exceed the 10 µg/L MCL in all 23 groundwater samples collected from all ten monitoring wells during two sampling rounds.
- Cobalt exceeded the tap water RSL in two monitoring wells, FG207 and FG208. Monitoring well FG207 is located along the south perimeter of the landfill and the exceedance only occurred during the first round of sampling. No MCL is established for this metal.
- Manganese exceeded the tap water RSL in eight samples collected from five monitoring wells including FG207, FG208, FG209, FG301 and FG302. No MCL is established for this metal. The highest detected concentration (8,100 mg/L) was in FG208 which is located within the revised boundary of the landfill. The remaining four wells are located along the south perimeter of the landfill. Three of the five monitoring wells with the highest detected levels of manganese (FG208, FG209, and FG302) consistently exhibited the manganese exceedances during each sampling round.
- Thallium exceeded the RSL in two monitoring wells, FG301 and FG302, but did not exceed the 2 µg/l MCL. These exceedances only occurred during the first round of sampling at each well.

Radionuclides

Nineteen (19) of the 23 shallow groundwater samples were analyzed for radionuclides. Six radionuclides were detected in groundwater in one or more of these samples and radium-226, radium-228, and uranium-238 concentrations exceeded tap water PRGs. These detections in groundwater suggest that the source may be the naturally occurring conditions that are prevalent throughout the Piedmont in the soil and bedrock. Background conditions have not been established for radionuclides in groundwater. All samples were collected as unfiltered samples. Specific results are as follows:

- Radium-226 was detected at concentrations exceeding the PRG in 17 of the 19 samples with a maximum concentration of 1.63 pCi/L at monitoring well FG209.
- Radium-228 was detected at concentration exceeding the PRG in 3 of the 19 samples with a maximum concentration of 1.14 pCi/L at monitoring well HODMW01.
- Uranium-238 was detected at concentration exceeding the PRG in 2 of the 19 samples with a maximum concentration of 0.85 pCi/L at monitoring well FG208.

Bedrock Groundwater Investigation

One bedrock monitoring well (FG401) was constructed at FTGL-02 at its the southwest corner (see Figure 4.8. Bedrock groundwater was sampled from this monitoring well during each of two rounds of groundwater sampling (August 2011 and December 2011/January 2012). Analytical results for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins/furans, and metals were screened against the USEPA tap water RSLs and federal MCLs. Results for radionuclides were screened against USEPA tap water PRGs. The following sections summarize the screening results of detected compounds in both rounds of sampling. Figure 4-8 illustrates the locations of the criteria exceedances in bedrock groundwater for FTGL-02.

<u>VOCs</u>

Three VOCs were detected in one or both of the deep groundwater samples at FTGL-02. Two VOCs, 1,1,2-TCA and chloroform, were detected at concentrations exceeding the tap water RSLs.

- 1,1,2-TCA concentration exceeded the RSL (0.24 µg/L) in both samples collected (0.056-0.059 µg/L) during the two sampling rounds at monitoring well FG401, but is below the MCL of 5 µg/L.
- Chloroform exceeded the RSL in one sample collected during the first round of sampling of monitoring well FG401. The concentration detected (0.86 µg/L) is far below the MCLG of 70 µg/L.

<u>SVOCs</u>

No SVOCs were detected in the two groundwater samples collected from bedrock monitoring well FG401 at FTGL-02.

<u>Pesticides/Herbicides</u>

Four pesticides and herbicides were detected in one or both of the deep groundwater samples collected from monitoring well FG401 at FTGL-02. One pesticide, beta-BHC was detected at a concentration exceeding the tap water RSL:

- Beta BHC exceeded the tap water RSL in one sample collected during the first round of sampling of monitoring well FG401.

<u>PCBs</u>

No PCB Aroclors were detected in the two groundwater samples collected from bedrock monitoring well

FG401 at FTGL-02.

Metals

Fourteen metals were detected in one or both of the bedrock groundwater samples collected at FTGL-02. Only arsenic was detected at concentrations exceeding the tap water RSL, but is present below the MCL:

- Arsenic exceeded the RSL in both samples collected during the two sampling rounds at monitoring well FG401. As previously discussed, the presence of arsenic in shallow and deep groundwater may not be related to site contamination.

Radionuclides

Both bedrock groundwater samples collected from monitoring well FG401 were analyzed for radionuclides. Five radionuclides were detected in groundwater in one or both of these samples and radium-226, uranium-238, and radium-228 concentrations exceeded tap water PRGs. These detections in groundwater suggest that the source may be the naturally occurring conditions that are prevalent throughout the Piedmont in the soil and bedrock. Background conditions have not been established for radionuclides in groundwater. All samples were collected as unfiltered samples.

- Radium-226 and radium-228 were routinely detected in a majority of the sampled shallow monitoring wells across the FTGL-02 site. The concentrations of these radionuclides detected in bedrock monitoring well FG401 were very similar to the shallow well concentrations.
- Uranium-238 exceeded the PRG in both samples collected during the two sampling rounds at monitoring well FG401. There is the potential that the detected levels may be the result of naturally occurring geological conditions. However, unlike radium-226 and radium-228 which were detected at similar concentrations in shallow and bedrock groundwater, uranium-238 concentrations in bedrock groundwater were an order of magnitude larger than concentrations detected in shallow groundwater. The presence of higher concentrations in the deeper groundwater is likely due to the geochemistry of the aquifer favoring one dissolved radionuclide compound over another. Further studies would have to be performed to fully understand the nature of this relationship.

4.2.5 Surface Water and Sediment Sampling

Co-located surface water and sediment samples were collected in Stream D (South Ireland Creek), Stream C, and the retention pond down gradient from FTGL-02 on 27 and 28 June 2011 (see Figure 4-3). At locations without adequate surface water flow (i.e., 02-SE01 and 02-SE02 in the retention pond, and 02-SE10 in Stream C), only sediment samples were collected. These locations were also observed during subsequent storm events to ascertain if surface water sampling would be feasible and found to contain negligible surface water flow. Water quality measurements were taken at the time of sampling using a Horiba U-52 Multi-parameter Meter.

Surface Water Sampling

At three of the surface water sample locations (02-SW03, 02-SW04, and 02-SW06) in Stream D, additional sample volume was collected to evaluate surface water quality in accordance with COMAR Use I-P Waters. Each water body in Maryland is assigned a use that serves as the goal for water quality. COMAR Use I-P is defined for water contact recreation, protection of aquatic life, and public water safety.

Under COMAR 26.08.02.08O, Stream D is a Rock Creek tributary designated as Use I-P. Waters designated as Use I-P must meet various water quality criteria for bacteriological indicators, geochemical and aesthetic parameters, and toxic substances in accordance with COMAR 26.08.02.03-2 (*Numerical Criteria for Toxic Substances in Surface Waters*) and 26.08.02.03-3 (*Water Quality Criteria Specific to Designated Uses*). In accordance with these requirements, the three surface water samples (plus one field duplicate sample) were collected and the following analysis conducted:

Bacteriological

- *Enterococcus* (ASTM D6503-99); and
- Escherichia coli (SM 9223B).

Due to the short hold times, bacteriological samples were transported immediately to a local laboratory (Trace Laboratories) after collection.

Geochemical

- Color (SM 2120C) analyzed by Trace Laboratories; and
- Field measurements of pH, temperature, dissolved oxygen, and turbidity.

Toxic Substances

- Ammonia (SM 4500 NH3 E);
- Asbestos (EPA 110.1) analyzed by ALS Cincinnati;
- Chlorine (SM 4500 Cl G);
- Chromium VI (7196A) analyzed by Trace Laboratories;
- Chromium III (a calculation by lab from chromium VI and total chromium);
- Cyanide (SW9012A);
- Methylmercury (EPA 1630);
- Methyl bromide (SW8260);
- Acrolein (SW8260);
- Acrylonitrile (SW8260);
- Hexachlorocyclopenta-diene (SW 8270);
- Pentachlorophenol (SW 8270); and
- Tributyltin (OR560).

The sampling locations were biased to downstream locations prior to the stream leaving the FGA site. No biota survey was performed as part of this effort. This data was compared to applicable COMAR criteria.

A total of eight surface water samples, including one duplicate, co-located with sediment samples were collected from Stream D at FTGL-02 (see Figure 4-9). As discussed in Section 4.2.5, surface water flow was insufficient at three planned sampling locations (SW01, SW02, and SW10) therefore samples were not collected. Surface water sample results for VOCs, SVOCs, pesticides, herbicides, PCBs, and metals were screened in the draft RI Report against USEPA National Recommended Water Quality Criteria (NRWQC) for freshwater chronic toxicity, and human health and aquatic life. The following sections summarize the screening results of detected compounds. Figure 4-9 illustrates the locations of the exceedances in surface water for FTGL-02.

VOCs

Five VOCs were detected in one or more surface water samples at FTGL-02. One VOC, PCE, was detected at concentrations exceeding the NRWQC human health 'water & organism' screening value:

- PCE exceeded the NRWQC for human health 'water and organism' (0.69 ug/L) in the two most upgradient Stream D samples, 02-SW08 (1.1 ug/L) and 02-SW09 (3.4 ug/L). Similar to the sediment samples in Stream D, detections of VOCs, including PCE and its degradation daughter products TCE and cis-1,2-DCE, are highest in sample 02-SW09 and generally decrease downstream of this location. The source of these contaminants is likely related to groundwater/surface water emanating from site FTGL-03 (Commissary Landfill), where much higher concentrations of PCE were detected in groundwater, and which drains to Stream D through the storm sewer system.

<u>SVOCs</u>

One SVOC, bis (2-ethylhexyl) phthalate, also known as DEHP, was detected in surface water samples at FTGL-02.

DEHP was detected at concentrations exceeding the NRWQC for human health and aquatic organisms:

- DEHP exceeded the NRWQC for human health and organisms (1.5 ug/L) in one Stream D sample, 02-SW05 (1.2 ug/L).

<u>Pesticides/Herbicides</u>

Three pesticides and herbicides were detected in surface water samples at FTGL-02. One pesticide, Beta-BHC, was detected at concentrations exceeding the NRWQC for human health and organisms:

- Beta-BHC exceeded the NRWQC for human health and organisms (0.0091 µg/L) in two Stream D samples, 02- SW03 and 02-SW05 (0.063J µg/L and 0.015J µg/L respectively).

<u>PCBs</u>

No PCBs were detected in the surface water samples collected from Stream D at FTGL-02.

<u>Metals</u>

Nineteen metals were detected in one or more of the 8 surface water samples at FTGL-02. Four metals, aluminum, arsenic, iron, and manganese, were detected at concentrations exceeding NRWQC for aquatic life and human health and organisms in one or more samples:

- Aluminum exceeded the NRWQC (87 µg/L) for aquatic life in one Stream D sample location, 02-SW05 (160 µg/L).
- Arsenic exceeded the NRWQC (0.018 µg/L) for human health and organisms in all eight Stream D samples, (0.069 J µg/L -.081J µg/L).
- Iron exceeded the NRWQC (300 µg/L) for aquatic life and/or human health and organisms in three Stream D samples, 02-SW07, 02-SW08, and 02-SW09 (160 µg/L -1900 µg/L).
- Manganese exceeded the NRWQC (50 µg/L) for human health and organisms in five Stream D samples (23 µg/L -1800 µg/L). The highest iron and manganese concentrations were detected in the most up gradient samples 02-SW08 and 02-SW09 and decrease downstream. These results

are consistent with observations of iron staining and deposition at the outfall discharge pipes and stream headwaters.

Radionuclides

Four out of the eight surface water samples were analyzed for radionuclides. Four radionuclides were detected in one or more of the surface water samples.

The highest radium-226 detected concentration (0.53J (pCi/L) was in sample 02-SW09 and the highest radium-228 detected concentration (0.52J (pCI/L) was in sample 02-SW03.

It is anticipated that these radiological concentrations are indicative of background levels. However, further offsite surface water studies will be required to establish the onsite background conditions.

Sediment Investigation

A total of 11 sediment samples (including 1 duplicate) were collected from a total of 10 locations in Stream C, Stream D (South Ireland Creek), and the stormwater retention pond at the southwest corner of the Ball Field Landfill. Samples 02-SE01 and 02-SE02 were collected from the retention pond, samples 02-SE03 through 02-SE09 were collected from Stream D, and sample 02-SE10 was collected from Stream C (see Figure 4-10). Analytical results for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins/furans, and metals were screened in the draft RI against the USEPA Biological Technical Assistance Group (BTAG) freshwater sediment screening benchmarks (USEPA, 2006) and USEPA residential and industrial soil RSLs (USEPA, 2012). Results for radionuclides were screened against USEPA residential soil PRGs (USEPA, 2010). The following sections summarize the screening results of detected compounds. Figure 4-10 illustrates the locations of the various exceedances in sediment for FTGL-02.

VOCs

Five VOCs were detected in one or more of 11 sediment samples at FTGL-02. Four VOCs, carbon disulfide, chloroform, PCE and TCE, were detected at concentrations exceeding the BTAG screening benchmarks and/or RSLs:

- Carbon disulfide exceeded the BTAG benchmark (0.000851 µg/kg) in three upgradient Stream D samples including SE07 and SE08 and its duplicate, but did not exceed the residential soil RSL (820 µg/kg).
- Chloroform exceeded the residential (0.29 µg/kg) and industrial (1.5 µg/kg) soil RSL in one Stream D sample, SE06 (3J µg/kg).
- PCE exceeded the BTAG benchmark (0.468 µg/kg) in five samples including four upgradient Stream D samples (i.e., SE07, SE08 and its duplicate, and SE09), and in sample SE03 located furthest downgradient in Stream D. The highest concentrations were detected in the most upgradient sample, SE09 (6.5 µg/kg), and the concentrations decrease downstream. None of these samples exceed the residential soil RSL (22 µg/kg).
- TCE exceeded the BTAG benchmark (0.0969 µg/kg) and residential soil RSL (0.91 µg/kg) in one Stream D sample, SE09 (1J µg/kg), the most upgradient sample. None of these samples exceed the industrial soil RSL (6.4 µg/kg).

SVOCs

Twenty SVOCs were detected in one or more sediment samples at FTGL-02. All of the detected SVOCs exceed the BTAG benchmarks and/or RSLs:

- Multiple PAHs exceeded BTAG benchmarks in all samples. Seven of these PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene also exceeded residential and industrial soil RSLs with the greatest detections present at sample 02-SE02 located within the bottom of a sediment retention pond, that receives run-off laden with sediment from upslope areas of the Ballfield Landfill.
- DEHP exceeded BTAG benchmarks (0.18 µg/kg), and residential (35 µg/kg) and industrial (120 µg/kg) soil RSLs in multiple samples. Plasticizers like DEHP are fairly ubiquitous in commercial and household plastic products, and are very persistent in the environment. The DEHP found may have originated in the equipment that was used to collect the sediment samples (e.g., disposable scoops).

Pesticides/Herbicides

Three pesticides and herbicides were detected in one or more sediment samples at FTGL-02. Two pesticides, chlordane and p,p'-DDE, were detected at concentrations exceeding the BTAG benchmarks and RSLs:

- Chlordane exceeded the BTAG benchmark (00324 µg/kg) and residential (1.6 µg/kg) and industrial (6.5 µg/kg) RSLs in one retention pond sample, 02-SE02 (27K µg/kg).
- p,p'-DDE exceeded the BTAG benchmark (0.00316 µg/kg) and residential RSL (1.4 µg/kg) in one retention pond sample, 02-SE02 (3.9J µg/kg).

PCBs

PCB Aroclor results were compared with project action limits in accordance with the approved PCB Decision Tree. As indicated above, six sediment samples had PCB Aroclor concentrations above project action limits. Therefore, these six samples were analyzed for the 18 NOAA PCB congeners. Two of the 18 congeners, PCB-105 and PCB-118 were detected at concentrations exceeding both the residential and industrial soil RSLs in all six samples. The highest concentrations of these congeners were detected in sample SE02 located in the retention pond.

Metals

Twenty-five metals were detected in one or more sediment samples at FTGL-02. Eight metals including arsenic, hexavalent chromium, total chromium, copper, iron, lead, manganese, and zinc, were detected at concentrations exceeding BTAG benchmarks and/or soil RSLs. No background sediment values have been established by the MDE or were located from other sites in close proximity to the FGA site during a literature search. For comparative purposes, sediment data results from the Gwynns Falls watershed in Baltimore, Maryland, and the background soil MDE ATCs were used.

- Arsenic exceeded the residential soil RSL (0.39 mg/kg) in 11 samples and industrial soil RSL(1.6 mg/kg) in seven samples with a maximum concentration of 4.7 mg/kg in retention pond sample 02-SE02. The ATC for arsenic in soil is 4.9 mg/kg which may correlate with the sediment sample. For comparison the Gwynns Falls sediment value was 1.6 mg/kg for arsenic.

- Hexavalent chromium exceeded the residential soil RSL (0.29 mg/kg) in four samples with a maximum concentration of 1.2 mg/kg in Stream D sample 02-SE05. The background cut-off level for hexavalent chromium in soil was 1.9 mg/kg. No Gwynns Falls value was established for this metal.
- Total chromium concentrations exceeded the BTAG benchmark (43.4 mg/kg) in retention pond sample 02-SE02 (55 mg/kg) and in Stream D sample 02-SE09 (74 mg/kg), the most upgradient sample. The ATC for total chromium in soil is 30 mg/kg and the Gwynns Falls value for sediment is 31 mg/kg.
- Copper exceeded the BTAG benchmark (31.6 mg/kg) in four samples, including retention pond sample 02-SE02 and three Stream D samples. The maximum concentration detected at 02-SE02 was 55 mg/kg. The ATC for copper in soil is 42 mg/kg and the Gwynns Falls value for sediment is 30 mg/kg.
- Iron exceeded the BTAG benchmark (20,000 mg/kg) in five samples, including two in retention pond samples 02-SE01 and 02-SE02, two Stream D samples, and the single Stream C sample. The maximum concentration detected in Stream C at 02-SE10 was 32,000 mg/kg. The ATC for iron in soil is 26,000 mg/kg and the Gwynns Falls value for sediment is 20,000 mg/kg.
- Lead exceeded the BTAG benchmark (35.8 mg/kg) in retention pond sample 02-SE02 with a concentration of 59 mg/kg. The ATC for lead in soil is 61 mg/kg and the Gwynns Falls value for sediment is 76 mg/kg.
- Manganese exceeded the BTAG benchmark (460 mg/kg) in nine samples and residential soil RSL (1,800 mg/kg) but not the industrial soil RSL (23,000 mg/kg) in one sample with a maximum concentration of 2,100 mg/kg in Stream D sample 02-SE06. The ATC for manganese in soil is 1,400 mg/kg and the Gwynns Falls value for sediment is 440 mg/kg.
- Nickel exceeded the BTAG benchmark (22.7 mg/kg) in nine samples with a maximum concentration of 180 mg/kg in Stream D sample 02-SE08D. The ATC for nickel in soil is 22 mg/kg and the Gwynns Falls value for sediment is 40 mg/kg.
- Zinc concentrations exceeded the BTAG benchmark (121 mg/kg) in the two retention pond samples 02-SE01 (220 mg/kg) and 02-SE02 (170 mg/kg). The ATC for zinc in soil is 73 mg/kg and the Gwynns Falls value for sediment is 120 mg/kg.

<u>Radionuclides</u>

A total of four of the 11 sediment samples were analyzed for radionuclides. Five radionuclides were detected in all of the sediment samples. Two radionuclides, radium-226 and radium-228, were detected at concentrations exceeding residential soil PRGs:

- Radium-226 and radium-228 exceeded residential soil PRGs (0.0121 pCi/g) in all four samples in Stream D. These detections in sediment suggest as a source the naturally occurring conditions that are prevalent throughout the Piedmont.

4.2.6 Additional RI Investigation Activities

4.2.6.1 Background Sampling Program

Background surface soil, subsurface soil, and groundwater samples were collected at the FGA for comparison to results from FTGL-02 through -05. Background sample locations are shown in Figure 4-11. The proposed activity included the:

- Construction and sampling of three shallow groundwater monitoring wells;
- Collection of 12 surface soil samples at four cluster locations; and
- Advancement of 12 soil borings at four cluster locations for subsurface soil sampling.

Sample locations were selected at locations that appeared to be least impacted by historical activities at the FGA and sample locations were observed for evidence of prior disturbance. Subsurface soil samples were collected at or near three feet, eight feet, and thirteen feet bgs unless refusal was encountered prior to those depths in soil borings. Background sample collection was performed in accordance with the requirements of the FSP, with the following exceptions. Only one (FG306) of the three planned monitoring wells was successfully installed.

Monitoring wells were not constructed at locations FG312 and FG313 (see Figure 4-11) due to auger refusal in the saprolite prior to encountering groundwater during drilling. In replacement of one of these background wells, monitoring well FG307, installed as part of the FTGL-04 investigation, will be treated as a background well based on groundwater flow contours in the vicinity of this well. Lastly, three of the 12 soil borings (BKGSB07, SB08, and SB09 on Figure 4-11) were advanced using a manual hand auger due to inaccessibility to the soil boring locations for the HSA drill rig.

In addition to the above, at each landfill site, FTGL-02 through FTGL-04, one ambient air sample was collected and analyzed for VOCs. These were collected to account for background VOC concentrations in relation to the soil gas samples.

5 Removal Action Objectives

5.1 Removal Action Objectives

The objective of taking a removal action (also referred to as an ”interim measure”) at FTGL-02 is to protect the general public from the physical hazards associated with waste disposed of in landfill FTGL-02 and landfill leachate contaminating portions of the stream while the preparation of the Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document for FTGL-02 proceed. The ongoing draft RI showed that landfill FTGL-02 waste extends beyond the security fence of FGA onto unfenced and publicly accessible FGA property. Waste has been found exposed on the west side of the landfill in a steeply sloped and wooded area within sight of Ireland Trail, an historic foot path used by the public for dog walking, physical exercise, and general nature viewing. This foot path has been used by the public for many years. Ireland Trail is situated on Army property, though public access has never been denied to the trail and there is no barrier between Ireland Trail and the slopes of the landfill containing waste materials.

The objective of this removal action is, in accordance with 40 CFR 300.415(b)(2)(i), (iii), and (viii) is intended to:

- minimize the potential for waste on and within the slopes of landfill FTGL-02 to pose unacceptable risks to human receptors who traverse across the landfill or might attempt to leave Ireland Trail to investigate such exposed or buried wastes, and
- reduce risk of exposure to contaminants around FTGL-02 and in and along Ireland Creek and
- contribute to the efficient performance of any anticipated long-term remedial action at landfill FTGL-02.

In addition, use of the trail by the general public, while remaining protective of human health and the environment, was an important consideration factor.

A removal action is intended to expeditiously mitigate risks to human health and the environmental, but is not required, or necessarily intended, to be the final action. The action implemented as a result of this EE/CA will be evaluated in the ongoing RI, and the future Feasibility Study, to determine if additional, or different, actions are needed to permanently mitigate the risks identified.

5.2 Removal Action Schedule

The time required to implement the NTCRA alternatives discussed in this EE/CA varies depending on the complexity and is discussed in the following sections.

5.3 Statutory Limits on Removal Actions

The statutory limits for cost and schedule for fund-financed removal actions are contained in Section 104(C)(1) of CERCLA. These limits are not applicable because the actions at the FTGL-02 are financed by the Department of Defense, not the Federal Superfund.

6 Identification and Evaluation of Non Time-Critical Removal Actions

Initially, nine (9) Alternatives were considered for analysis and evaluation. However, the Alternative that involved installation of a fence inside the installation boundary just south of Ament Street was not advanced since it precluded public use of all of the Ireland Trail on Army property. This was eliminated from consideration because the Army wanted to allow the continued access, to the extent practicable and in accordance with the EE/CA objectives, to the Ireland Trail by the general public.

It should be noted that this EE/CA is not a detailed design document. The exact locations and site specific details of the selected Alternative will be determined and finalized in the subsequent design and construction documents.

The following eight (8) Removal Action Alternatives have been identified to achieve the above objectives.

6.1 Alternative 1: No Action

This alternative is required by DERP and the NCP to be considered as a benchmark for comparison, though it would not address the NTCRA objectives. Under this alternative no action is taken to keep human or ecological receptors from having interaction with landfill FTGL-02 waste or other contaminated media.

6.2 Alternative 2: Access Notifications –FGA property Boundary

This alternative places US Government/Department of Defense signs along the entire landfill boundary and clearly visible from Ireland Trail. The signs will make users of the area aware of Army ownership and the hazards of digging or otherwise interfacing with exposed or buried waste, and contaminated sediment and water. The signs will be posted on durable steel posts. This alternative may be implemented immediately.

6.3 Alternative 3: Access Controls – Ball Field Landfill and Ireland Creek Valley

This alternative involves the fencing off of the entire Ball Field Landfill (BFLF) up to the east side of the Ireland Trail and fencing off the section of Ireland Creek valley between the stormwater retention pond and Stephen Sitter Avenue (**Figure 6-1**). The fence would prevent unrestricted access to all of the BFLF and provides a buffer area around nearly the entire perimeter of the BFLF. It also prevents unrestricted access to the contaminated portions of Ireland Creek on FGA as well as a small buffer stretch on FGA that while not currently known to be contaminated, helps ensure that contaminants have attenuated prior to the creek reaching an unrestricted area. It maintains unrestricted access to the Ireland Trail from the National Park Seminary Area up to but not including Ireland Creek valley. It removes the current unrestricted access to approximately 1000 feet of Ireland Trail on FGA property, so Ireland Trail users will have to turn around at the dead end where the fence crosses the trail. This alternative requires the installation of approximately 2,200 feet of new fence, which is the shortest distance that accomplishes the NTCRA goals. The fence will cross Ireland Creek at a single location at the retention pond, with special provisions to allow the creek to flow under the fence, but keep potential trespassers from crawling under the fence. An aerial photo showing the proposed fence may be seen in Figure 6-1. This alternative includes posting signs on the fence to identify Government property and the dangers that may lie beyond the fence.

For all Alternatives that include a fence (Alt. 3, 4, 5 and 6) the following description applies.

The fence will be a dark colored (green or black) 8 foot tall chain link type, with barbed wire set on outriggers at the top in accordance with Department of Defense (DoD) security fence regulations. Alternately, an ornamental metal fence similar to the installation perimeter fence on Brookville Road and Linden Lane could be a utilized. See Figure 7-1Fence Design for examples of the fence options. Such regulations also require a minimum "clear zone" of 50 feet (20' outside, 30' inside) for an installation perimeter fence. The fence proposed is not intended to be an FGA perimeter fence and will not be designed in full accordance with DoD perimeter fence clear zone guidelines in order to avoid unnecessary forest disturbance, and to simplify and expedite the installation. It is anticipated that the current FGA security fence will remain. The minimum amount of vegetation will be removed to install the fence. Care will be taken to preserve all larger specimens trees and endangered or state rare plant species (Umbrella Magnolia) that may be encountered along the fence route. . It is recognized that access to the inside (landfill side) of the fence will be required for maintenance purposes, so some clearing and grubbing of vegetation on the inside of the fence can be performed. Additionally, two or more gates will be installed so that controlled site access, tree pruning and brush and vine clearing can take place as part of normal fence maintenance. Appropriate sedimentation and erosion controls will be used to prevent negative impacts to Ireland Creek.

6.4 Alternative 4: Access Controls – Ball Field Landfill and a Portion of Ireland Creek Valley

While similar to Alternative 3, Alternatives 4, 5, and 6, were added to allow additional access to upper reaches of the Ireland Trail while maintaining the same level of protection for the BFLF, but lesser amounts of protection to the contaminants in the stream as compared to Alternative 3.

This alternative is similar to No. 3 in that it also involves fencing off of the entire BFLF up to the east side of the Ireland Trail but differs by routing the new fence up the Ireland Creek valley to approximately halfway between Rock Creek and Stephen Sitter Avenue and crossing the valley. The Alternative 4 fence would connect with the FGA perimeter fence at the northwest corner of the WRAIR parking lot. This prevents open access to all of the BFLF to and including a buffer area around its entire perimeter. It maintains unrestricted access to the Ireland Trail from the Seminary Area up to a point approximately halfway up the Ireland Creek Valley. This alternative blocks access to the upper reaches of Ireland Creek where PCE is detected and metals are found in the water, and removes current unrestricted access to approximately 600 feet of Ireland Trail on FGA. As with Alternative 3, this alternative includes the installation of signage on the fence. This alternative will require the installation of approximately 2,600 feet of fence. The fence route will need to traverse the steep slopes of the east side of the landfill to remain west of Ireland Creek and avoid the need for bridge or multiple creek crossings. . Like Alternative 3, this alternative will create a dead end on Ireland Trail requiring users to turn around downstream of the third stone bridge. As with Alternative 3, special provisions will be provided to allow the creek to flow under the fence, but keep potential trespassers from crawling under the fence. Additionally, placement of the fence at the stream crossing will need to occur so as to not create a debris pile or flooding condition that would impact the bridge, abutments or culvert. An aerial photo showing the proposed fence route may be seen in **Figure 6-2.** Details of the exact location of the Ireland Creek fence crossing will have to be determined during the design phase.

6.5 Alternative 5: Access Controls – Ball Field Landfill

This alternative involves the fencing off of the BFLF, but allows open access to the entire current Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue. Along the Rock Creek side of BFLF it provides some buffer between known waste and the unrestricted access area, but it provides no buffer along Ireland Creek, where the new fence would be immediately adjacent to waste on the steep slope of the fill area. This alternative would require the installation of approximately 3,200 feet of fence. As with Alternative 3, this alternative includes the installation of signage on the fence. This fence route will probably need to cross Ireland Creek in several locations and require special provisions to allow the creek to flow under the fence, but keep potential trespassers from crawling under the fence.. An aerial photo showing the proposed fence route may be seen in **Figure 6-3**.

Because the fence will be installed on much of the length of steep hillside on the north side of the Ireland Creek valley, more significant vegetation and ground disturbance may be unavoidable in order to access the fence route with machinery and materials. Erosion and sedimentation control measures will be used to minimize significant negative impact to Ireland Creek. This alternative will allow full access to the waters of Ireland Creek and will not prevent potential exposure to contaminated water.

6.6 Alternative 6: Access Controls – Newly Defined Landfill Waste Boundary

This alternative involves the fencing off of the BFLF, but allows open access to the entire current Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue. Along the Rock Creek side of BFLF it provides some buffer between known waste and the unrestricted access area, but it provides no buffer along Ireland Creek, where the new fence would be immediately adjacent to waste on the steep slope of the fill area. This alternative would require the installation of approximately 2,230 feet of fence. This is only slightly more fence than Alternative 3 because the route does not follow Ireland Trail. This fence route will not need to cross Ireland Creek as it will be above the creek on the landfill's steep slopes. As with Alternative 3, this alternative includes the installation of signage on the fence. An aerial photo showing the proposed fence route may be seen in **Figure 6-4.**

Since this Alternate is installed in more wooded portions of the site it is anticipated that normal fence maintenance will require more grubbing, tree removal, and trimming than the other three Access Control alternatives.

This alternative will allow full access to the waters of Ireland Creek and will not prevent potential exposure to contaminated water. Signage as proposed in Alternative 2 will be posted on the fence, it is anticipated that the fence will be nearly invisible from Ireland trail at places.

6.7 Alternative 7: Soil Cover

This alternative does not change the existing fence lines of FGA, but reduces the chances of public contact with waste materials by covering the disposal area with two feet of clean soil. It preserves the open access to the Ireland Trail. An aerial photo showing the proposed soil cover area may be seen in **Figure 6-5.** This alternative will require the removal of all vegetation on the slopes of the landfill area for the placement of two feet of soil. The new soil cover will have to be vegetated with a selection of native species to protect against erosion and invasive species, changing the appearance of the area as seen from the Ireland Trail. This alternative will require the placement of approximately 17,600 cubic yards of fill material if the entire 5.5 acre area shown in Figure 6-5 is covered with 2 feet of soil. Due to the steepness of the terrain along Ireland Creek, more clearing and ground disturbance may be needed to allow materials to be staged. Appropriate sedimentation and erosion controls would be used to prevent negative impacts to Ireland Creek. This alternative will allow full access to the waters of Ireland Creek and will not prevent potential exposure to contaminated water.

6.8 Alternative 8: Waste Removal

This alternative does not change the existing fence lines of FGA, but removes the risk of public open access contact with waste materials by removing them. Over a period of 6-12 months the landfilled materials outside the current fence lines will be carefully investigated. Those materials in threat of being exposed due to erosion will be excavated and transported off site for disposal. Access to the surrounding area will be restricted during this period due to the unknown, but presumed medical nature of the waste materials. An aerial photo showing the proposed area where the removal action is likely to take place may be seen in **Figure 6-5.**

The amount of waste that will require removal is unknown, but the area shown in Figure 6-5 is the same, as for Alternative 7. While it is expected that the whole area potentially contains FTGL-02 waste, the whole area may not require excavation. The area would be further explored using test pits and borings in an effort to find all the waste that resides outside the existing FTGL-02 landfill fence and might present a future threat to the public if exposed through erosion, freeze thaw action, or proximity to the ground surface. It is expected that excavations would be performed in level A or B personal protective gear due to the possible presence of infectious medical waste. Waste removed would have to be characterized for proper transportation and disposal at an authorized facility, possibly an incinerator. Clean fill would have to be provided to fill excavations, but confirmatory samples would not be taken to document reaching clean soil, as the object of the EE/CA is to prevent Ireland Trail users from seeing, coming in contact with, or being able to access waste, but not complete removal of all waste. Instead, waste will be removed between ground level and two feet below ground level. Deeper waste will be left in place. Excavation and disposal could amount to 10,000 cubic yards of material but it is estimated that the environmental impact on the landfill slopes and the area adjacent to Ireland trail will be less than Alternative 7, as not all vegetation will be removed from the sides of the landfill, but only where excavation will take place.

7 Comparative Analysis of NTCRA Alternatives

The eight NTCRA alternatives were analyzed and compared for effectiveness, implementability, and cost according to USEPA guidance on preparing EE/CAs (USEPA, 1993).

Effectiveness addresses protectiveness and the ability of the alternative to meet the removal action objectives (i.e., long-term effectiveness). Protectiveness was evaluated based on protectiveness of the alternative for human health and the environment, protectiveness of workers during implementation of the removal action, and compliance with applicable or relevant and appropriate requirements (ARARs).

Implementability is evaluated based on technical and administrative feasibility, including availability of equipment, personnel, services, and disposal facilities needed to implement a particular alternative.

Cost involves estimation of the capital cost of construction and the annual operation and maintenance (O&M) costs. If the cost of an alternative includes O&M costs, then a present worth value is calculated so that alternatives can be compared using a single cost figure. The level of detail employed in developing the cost estimate is considered appropriate for making choices between alternatives, but the estimates are not intended for use in detailed budgetary planning.

7.1 Effectiveness

7.1.1 Applicable or Relevant and Appropriate Requirements

Section 300.415(j) of the NCP provides that removal actions pursuant to CERCLA Sections 104 or 106 attain ARARs under federal and state environmental laws or facility sighting laws, to the extent practicable considering the urgency of the situation and the scope of the removal action, unless a waiver can be justified. USEPA identifies three categories of ARARs: chemical-specific, location-specific, and action specific.

- Chemical-specific ARARs. Chemical-specific requirements include laws or regulations that set concentration limits or ranges for specific hazardous substances in various environmental media. These requirements provide site cleanup levels, or a basis for calculating cleanup levels, for chemicals of concern in the designated media. There are none available for the alternatives presented here as these alternatives are directed at preventing the public from coming into physical contact with landfill waste and are not directed at mitigating specific hazardous substances that may be associated with the landfill. Chemical-specific ARARs developed during the RI/FS will be selected for the final solution chosen for FTGL-02.

- Location-specific ARARs. Location-specific requirements set restrictions on the types of removal activities that can be performed based on the location of the site or other site-specific characteristics. Alternative removal actions may be restricted or precluded based on federal and state citing laws for hazardous waste facilities; proximity to wetlands or floodplains; or proximity to man-made features such as existing landfills, disposal areas, or historic landmarks or buildings. A list of potential location-specific ARARs is presented in Table 7-1.
- Action-specific ARARs. Action-specific requirements set controls or restrictions on the design, implementation, and performance of specific removal activities. Action-specific ARARs also indicate requirements for management of action-generated discharges and wastes, and provide a basis for assessing the feasibility and effectiveness of removal. A list of potential action-specific ARARs is presented in Table 7-2.

The lists of potential ARARs presented in Tables 7-1 through 7-2 were narrowed based on whether the requirement is legally enforceable either at the site or over site conditions, whether it would be reasonable to apply the requirement to site conditions, and lastly whether the site or removal actions are under its jurisdiction (i.e. in Tables 7-1 and 7-2, each ARAR is identified as being applicable, potentially applicable, not applicable, or relevant and appropriate to the FTGL-02 removal action).

7.1.2 Alternative 1: No Action

Alternative 1, No Action, does not include any actions or restrictions that would provide any protection to human health or the environment and it offers inadequate long-term effectiveness due to the continuing potential for human and environmental exposure to the exposed and buried wastes. Implementing Alternative 1 poses no short-term risks because this alternative consists of no actions.

7.1.3 Alternative 2: Access Notifications – FGA property Boundary

This alternative places US Government signs along the entire landfill boundary. It makes users of the area aware of the Army ownership and the hazards of digging or otherwise interfacing with exposed waste. This alternative offers a limited amount of protection by informing the public of the potential risks. The signs rely on compliance by the public, visibility of the signs, and no vandalism to the signs as there is no permanent and durable physical barrier to prevent human exposure to the landfill wastes. This alternative is further compromised by non-English speakers who may not understand the message the signs are attempting to convey. This is judged to be the least effective of all of the alternatives considered, other than alternative 1, as it does nothing to inhibit physical access to the landfill slopes and does nothing to cover, or remove wastes that may appear on the treacherous landfill slopes.

7.1.4 Alternative 3: Access Controls – Ball Field Landfill and Ireland Creek Valley

Alternative 3 effectively protects human health by inhibiting public access to landfill FTGL-02 slopes that are outside the existing FGA security fence through the use of an 8 foot high chain link fence. The type of fence chosen is shown in Figure 7-1, would be eight feet high, green or black chain link with barbed wire on top to discourage trespassers while providing minimal visual impact. The fence would be posted with DoD signs like those proposed for Alternative 2 to enhance its effectiveness.

DoD security guidelines require a minimum "clear zone" of 50 feet (20' outside, 30' inside) for an installation perimeter fence. It has been determined that this requirement is not applicable to the FTGL-02 landfill as this alternative is for a landfill fence, not a perimeter security fence. The proposed fence will not replace the existing perimeter fence at FGA. This allows the Army to minimize environmental disturbance in the course of fence installation by providing a much smaller, variable, buffer area on the inside of the fence. This smaller buffer area allows for the preservation of many larger specimen trees and natural cover while not inhibiting the effectiveness of the fence. The buffer will vary in depth according to conditions encountered. As envisioned, the buffer will always be a balance between fence maintenance requirements and the preservation of environmental conditions as close to existing as possible.

Fence maintenance will involve the trimming of vegetation (trees, vines, and creepers), removal of dead tree branches that may fall onto the fence. Fence maintenance is critical to maintain its effectiveness. Ireland trail will provide a 20’ buffer on the outside of the proposed landfill fence, though it is recognized that in the future it will be necessary for the Army to have access to the wooded landfill side of the fence. To that end it is expected that the fence will require several gates for Army access to the landfill from the Ireland Trail.

Alternative 3 will not only be an effective barrier to discourage the general public that uses Ireland Trail from accessing the steep slopes of FTGL-02, but will also inhibit access to the contaminated waters and most sediments of Ireland Creek. To support discussions herein about the protectiveness of the alternatives with respect to exposure in the Ireland Creek valley, see Figures 7-2, 7-3, 7-4, and 7-5. These show measured concentrations of chlorinated ethenes, metals, and other organic contaminants down the length of Ireland Creek, as well as the locations of the Alternative 3 and Alternative 4 fences where they would cross Ireland Creek.

Samples of Ireland Creek have shown the presence of one organic, PCE, and several metals that exceeded the NRWQC. PCE was detected at low levels at three locations, the first near the stone picnic structure, the second downstream of the picnic structure and just upstream of the last stone bridge (bridge 4) on Ireland trail, and the third between bridges 3 and 4. PCE was not found downstream of the third stone bridge before the picnic structure, probably the result of dilution or other natural attenuation process. With respect to the sediments, the highest Polycyclic Aromatic Hydrocarbons (PAH) concentrations were in the most downgradient sample of the Ireland Creek. DEHP and PCB contamination was widespread within the creek. Similar to the water, organics (PCE, TCE) concentrations were highest in upper reaches of the stream and decreased downgradient. The Army intends that people and pets not enter or drink the waters of Ireland Creek to prevent possible exposure to PCE and metals.

Besides restricting access to Ireland Creek, Alternative 3 would prevent access to a known culvert/seep draining the base of the hillside on the south side of the BFLF. See photo taken April 11, 2012 at right. The seep enters Ireland Creek just upstream of the fourth bridge. Limited chemical analysis results obtained in 2008 showed no constituents posing a health issue, or differing much from Ireland Creek itself. However orange precipitate is clearly visible in the bed of the seep, giving a distasteful appearance, and

implying some level of contamination to viewers who are not in possession of the chemical analysis results. Though no other such drainages or seeps are currently known along the base of the south hillside, the steepness of it and close proximity to the fill contents makes the presence of additional seeps likely. Any seeps draining the fill of the BFLF would be suspect for a range of contaminants, unless ruled out by sampling and chemical analysis.

All of the Access Control alternatives (3, 4, 5, and 6) will require a minimum of construction, though tree removal and brush clearing will be necessary to the extent required to provide whatever buffer is decided on the landfill side of the fence. Installation of the fence itself will only require boring holes and setting fence posts. On that basis it is expected that the actual fence construction will involve minimal environmental impact, though the fence will be passing through wetlands and the 100 year floodplain at the south side of the landfill. It is expected that the erection of a fence will result in minimal wetland impact. Of the access alternatives, Alternative 3 will have the least environmental impact because it features the shortest length of fence, and the least amount tree and brush cutting to establish a buffer on the landfill side of the fence. This alternative will require the fence to cross Ireland Creek at only one location requiring design and installation of a system to prevent trespassers from ducking under the fence where it crosses the Ireland Creek.

Of the four Access Control alternatives, this is the most effective as, it will remove the current unrestricted access to all of the BFLF, and all unrestricted access to the contaminated part of Ireland Creek including a downstream buffer. It places the new fence in the most installable route, avoiding having to thread and maintain the fence along the narrow base of the Ireland Creek valley and the steep slopes of the BFLF there. The number of trees cut and brush removed will be minimized, possibly avoiding any state reforestation requirements. It will require the least amount of fencing, vegetation buffer area, and maintenance, and will provide the highest level of public protection of the access control options. It must be noted that protection provided by all of the access control options could be compromised by damage caused by vandals and the forces of nature (i.e., storms, fallen trees, etc.). Dedication to maintenance will be a key part of the successful implementation of the access control options.

7.1.5 Alternative 4: Access Controls – Ball Field Landfill and Part of Ireland Creek Valley

Alternative 4 protects human health and the environment by inhibiting public access to landfill FTGL-02 slopes that are outside the existing FGA security fence. The type of fence chosen would be green or black 8 foot high chain link with barbed wire top to discourage trespassers and provide minimal visual impact. This alternative will include DoD signs like those proposed for Alternative 2 to enhance its effectiveness. As with Alternative 3, this is not a perimeter fence, so the buffer on the landfill side of the fence could be variable to suit conditions. To the west and south side of the fence will be the Army-owned Ireland Trail which will provide a 20’ buffer on the outside of the fence. It is expected that several gates will have to be installed in the fence to ease access to the landfill side for maintenance purposes.

It is expected that the erection of an Alternative 4 fence will result in minimal wetland impact. As in Alternative 3, the fence will require tree trimming and removal from the slope of the landfill on the landfill side of the fence. Along the east side of the landfill the fence will remain west of Ireland Creek and be placed on the steep landfill slope so that only one Ireland Creek crossing will be required. All attempts will be made to preserve trees on both sides of the landfill fence, but trimming and removal is expected to be necessary to allow installation and maintenance and prevent damage to the new fence from falling limbs and trees. The route chosen will require only one crossing of Ireland Creek, south of the third stone bridge as you walk upstream. As with Alternative 3 there will have to be a system to prevent trespassers from ducking under the fence where it crosses the Ireland Creek. .

Compared to Alternative 3, Alternative 4 is expected to be somewhat less effective at preventing access to the landfill slopes, because more of Ireland Trail at the foot of the landfill will remain accessible to the public and the 250 foot longer fence line that is situated along the steep slopes next to Ireland Creek, will make the fence subject to damage that could allow public access to the landfill slopes. Alternative 4 has been proposed because it leaves a portion of Ireland Creek accessible to Ireland Trail users, but the alternative is protective because the fence will cut off access to Ireland Creek at a point below where PCE and unacceptably high levels of metals were detected.

No PCE, or its environmental degradation products, was detected in the portion of Ireland Creek left accessible to the public by this alternative (see Figure 7-2). PCE does exist in the creek beginning at its source, but the PCE gradually decreases in concentration as one goes downstream, reaching a point of nondetection just upstream from the Alternative 4 fence.

Metals, because they are naturally occurring materials, were detected down the full length of the creek, but the most notable metal is iron because it is responsible for the reddish precipitate or slime that coats the creek bottom in its upper reaches. Iron concentrations in Ireland creek water are plotted in Figure 7-3, along with manganese; both of these metals are elevated in concentration where the creek begins, and then they decrease gradually in the creek as it flows downstream. The only comparison values available for them are secondary MCLs, which are nonenforceable values listed by EPA as guidance to water supply systems to avoid aesthetic effects like objectionable taste and color. The secondary MCLs for iron and manganese are to protect against staining (of porcelain), development of sediment, and metallic taste. The higher iron concentrations at the upstream end of the creek are indicated by the reddish slime, caused as the dissolved iron is oxidized in the aerated stream to a non-soluble form and precipitates out, assisted in this process by a type of common naturally occurring bacteria called “iron bacteria”. This slippery reddish precipitate is abundant down to bridge four, and disappears between bridges 3 and 4. At the Alternative 4 fence crossing of Ireland Creek, iron has already decreased below its MCL. The section of creek below the Alternative 4 fence will then not have iron at greater than its secondary MCL, nor will it have the very visible, slippery, and staining iron precipitate.

Manganese remains above its MCL from the creek source down to bridge one. The portion of creek from bridge one to just above bridge two will then have manganese exceeding its MCL and be accessible to the public, however there is no adverse health effect, and no slipping, safety, and staining issues since manganese precipitates are not apparent in the creek.

The only other metal with a health or environmental issue is aluminum, shown in Figure 7-4. The tan line for Aluminum in that figure shows it starting low at the upstream end of Ireland Creek, increasing as one proceeds downstream, including an upward spike at bridge one, and then decreasing back to the initial levels. Aluminum also has a secondary MCL, in this case for water color, and exceeds it only at bridge one. This stretch will be accessible to the public, but will pose no health concern, and no aesthetic concern since the water does not appear to be significantly discolored.

A last category of constituents sampled for and detected in the stream is organics, consisting of volatiles, semi-volatiles, pesticides, polychlorinated biphenyls (PCBs), and herbicides. Only a small number of these compounds were detected in the creek water. Detected volatiles consisted of PCE and its environmental degradation products, and these were already discussed just above. One semi-volatile, one pesticide, and two herbicides were detected, and no PCBs were detected. The two herbicides were not detected in the stretch of creek below the Alternative 4 fence, and were at very low concentrations, below any comparison criteria, above the fence. The single detected semi-volatile and single detected pesticide are plotted in Figure 7-5. They both were found in the creek stretch below the Alternative 4 fence, and the pesticide, beta BHC, first appeared only in this stretch of creek. Neither compound exceeds available human health-based criteria, including NRWQC (at $1x10^{-5}$ cancer risk), Maryland Ambient Water Quality Criteria, MCLs, or USEPA Regional Screening Levels (at $1x10^{-5}$ cancer risk). The surface water data for Ireland Creek is based on only two sampling episodes, one in 2008, and again in 2011 during the RI. The 2008 event detected more PCE at the source of the creek than was found in 2011. This could be a seasonal variation or part of a general declining trend in PCE over time, but insufficient data is available to know. Surface water concentrations are likely to vary between high water conditions in the spring to low water conditions in the summer and fall. Alternative 4 crosses Ireland Creek only a short distance below where PCE became nondetectable, and restricts no additional length of stream as a buffer in case PCE concentrations, or other contaminant concentrations, would increase in the future and possibly extend into the unrestricted access stretch. For this reason, the stream restriction of Alternative 4 is less effective than that of Alternative 3.

Depending on the number of trees removed, Alternative 4 may trigger state reforestation requirements. As with Alternative 3, protection provided by the access control options could be compromised by damage caused by vandals and the forces of nature. Dedication to maintenance will be a key part of the successful implementation of the access control options.

7.1.6 Alternative 5: Access Controls – Ball Field Landfill

This alternative involves the fencing off of the BFLF, but allows open access to the entire current Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue. The fence would be similar in construction to those proposed in Alternative 3 and 4, with similar issues regarding the buffer on the inside of the fence. The route of the fence would follow Ireland trail for its entire length, blocking access to the steep landfill slopes and any exposed waste as in Alternatives 3 and 4. Alternative 5 would allow full public access to Ireland Creek, as now, and provide no protection from exposure to PCE and metals s in the stream. This alternative will include DoD signs like those proposed for Alternative 2 to enhance its effectiveness.

This alternative is the least effective of the Access Control alternatives due to some 700 to 950 more feet of fencing to be installed and maintained, depending on routing, possibly several more Ireland Creek crossings than in Alternative 3 or 4, and greater environmental impact to the landfill slopes from the additional tree cutting and vegetation clearing required to provide whatever buffer is deemed necessary. This additional cutting my trigger state reforestation requirements.

The longer fence will mean greater exposure to compromise by falling trees or branches, allowing unfettered public access to the landfill slope. Along the Rock Creek side of BFLF it provides some buffer between known waste and the unrestricted access area, but it provides no buffer along Ireland Creek, where the new fence would be immediately adjacent to waste on the steep slope of the fill area.

Also, Alternative 5 is not protective of health for the surface water exposure aspect of the NTCRA, because it provides no access control for Ireland Creek, allowing the public to contact, and pets to contact and drink, waters known to be contaminated with PCE and metals. Of the access control options this is nearly the least effective. As with Alternatives 3 and 4, protection provided by the access control options could be compromised by damage caused by vandals and the forces of nature. Dedication to maintenance will be a key part of the successful implementation of the access control options.

7.1.7 Alternative 6: Access Controls – Newly Defined Landfill Waste Boundary

This alternative involves the fencing off of the BFLF, but places the fence just outside the newly defined waste boundary of the landfill. This allows open access to the entire current Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue. The fence would be similar in construction to those proposed in Alternative 3, 4, and 5, with similar issues regarding the buffer on the inside of the fence, but would add issues with creating a vegetation buffer on the outside of the fence. The route of the fence would not follow Ireland trail and would not block access to the steep landfill slopes, but would deny access to any exposed waste as in Alternatives 3, 4, and 5. Alternative 6 would allow full public access to Ireland Creek, as now, and provide no protection of human health from exposure to PCE and metalsin the stream. This alternative will include DoD signs like those proposed for Alternative 2 to enhance its effectiveness.

This alternative has somewhat less effectiveness than Alternative 5 for the BFLF waste exposure because it restricts only the area that is estimated to be landfill based on remote geophysical measurements and a minimal number of direct borehole observations. It does not restrict a buffer area outside the estimated fill area, which would help account for uncertainties. Its route is more wooded and less accessible than the other Access Control alternatives, but requires a shorter length of fencing than all the Access Control alternatives except Alternative 3. Because brush and trees will have to be cleared from both sides of the new fence it is expected that construction will cause greater environmental impact to the landfill slopes from additional tree cutting and vegetation clearing required to provide whatever buffer is deemed necessary on both sides of the fence. This additional cutting my trigger state reforestation requirements.

Alternative 6 is not effective for the surface water exposure aspect of the NTRCA, because it provides no access control for Ireland Creek, allowing the public and their pets to contact and drink waters known to be contaminated with PCE and metals. Of the access control options this is the least effective. As with Alternatives 3, 4, and 5, protection provided by the access control options could be compromised by damage caused by vandals and the forces of nature. Dedication to maintenance will be a key part of the successful implementation of the access control options.

7.1.8 Alternative 7: Soil Cover

This alternative does not change the existing fence lines of FGA, but reduces the chances of public contact with waste materials by covering the disposal area with two feet of clean soil. This is an effective but costly action that could take a year to complete and possibly leave the steep slopes of the landfill more vulnerable to erosion during the construction phase. ARARS for erosion control would apply. It is assumed that many trees would have to be cleared to make this an implementable alternative. State reforestation requirements would have to be observed. While it preserves the open access to the Ireland Trail, the landscape to the east and north of the trail would be drastically changed in the areas where the additional two feet of soil cover would be installed, as most of the existing vegetation would be removed and the slopes regraded.

Because the RI/FS is incomplete at this time, the remedial action selected for FTGL-02 may not be compatible with the NTCRA. For example, should the remedial action chosen require removal of the waste in FTGL-02, the additional soil brought to the site for the NTCRA would add to the volume of material to be removed and managed at another landfill.

An aerial photo showing the proposed 5.5 acre soil cover area may be seen in **Figure 6-4.** This is judged to be an effective alternative for the BFLF waste because any waste will be covered, preventing direct contact, though not without environmental impact to the landfill slope and significant site engineering and long-term maintenance to ensure the steeply sloped soil cover does not erode.

This alternative is ineffective for the surface water exposure risk because it provides no access control for Ireland Creek, allowing the public to contact and pets to contact and drink waters known to be contaminated with PCE and metals.

7.1.9 Alternative 8: Waste Removal

This alternative does not change the existing fence lines of FGA, but removes the risk of public open access contact with waste materials by removing the top two feet of waste where it is found. This is an effective alternative that would have the effect of covering the waste on the banks of the landfill where ever waste is found with two feet of soil, as in Alternative 7. Over a period of 18-24 months the landfilled materials outside the current fence lines will be surveyed for waste, and where it is found, the top two feet will be carefully excavated and transported off site for disposal. Access to the surrounding area will be restricted during this period due to the unknown, but presumed medical nature, of the waste materials. Large trees and other existing vegetation would be removed from the areas being excavated potentially triggering state reforestation requirements. The erosion/sedimentation ARAR would apply. Regulations regarding characterization and final disposal of wastes removed would apply, however wastes would be removed only to a depth of two feet. No effort would be made to meet Maryland cleanup standards as any waste below two feet in depth would be left in place. Excavations would be covered in clean soil providing an effective barrier to the public. Because waste is removed from the landfill slopes, this is judged to be a very effective alternative providing more protection to the public than any of the other alternatives from landfill wastes.

This alternative is ineffective for the surface water exposure risk because it provides no access control for Ireland Creek, allowing the public to contact and pets to contact and drink waters known to be contaminated with PCE and metals.

7.2 Implementability

7.2.1 Alternative 1: No Action

Alternative 1, No Action, does not include any actions to implement. It would provide no protection of human health or the environment and would not attain removal action objectives.

7.2.2 Alternative 2: Access Notifications – FGA Property Boundary

This alternative places US Government signs along the entire property boundary. It makes users of the area aware of the Army ownership and the hazards of digging or otherwise interfacing with exposed waste. This is judged to be easily implementable.

7.2.3 Alternative 3: Access Controls – Ball Field Landfill and Ireland Creek Valley

Alternative 3 prevents public access to landfill FTGL-02 slopes that are outside the existing FGA security fence, and to most of Ireland Creek, by placing a new fence along the east edge of the Ireland Trail and across the Ireland Creek valley a short distance above the junction with Rock Creek. Fence construction is a minor construction project that is from a technical standpoint easily implementable. From start to finish fence installation should require less than 6 months as this is the shortest fence of the four access control alternatives.

As this alternative will restrict access to approximately 1,400 feet of the existing Ireland Trail, this is the most disruptive of the access control alternatives and it is likely to meet with the most public opposition. Although the area proposed to be restricted has been Government property since the 1940s, it has remained accessible to the public and indistinguishable from the adjacent Rock Creek Regional Park. The area to be restricted is arguably the most scenic of the entire Ireland Trail as it parallels Ireland Creek and features four creek crossings by concrete and stone arch bridges. At the end of the Ireland Trail is a unique stone picnic structure. Loss of access to this portion of Ireland Trail will likely be a disappointment to many local people who use it on a frequent basis, and a subject of public discussion during the comment period for this EE/CA.

Alternative 3 involves the installation of a fence, a minor construction project. It is expected that the erection of the fence will result in minimal, if any wetland impact. There is expected to be no need for an erosion sedimentation plan as excavation will be confined to drilling and setting fence posts, some tree removal and trimming, all activities that will require minimum ground disturbance. Reasonable attempts will be made to preserve trees on the landfill side of the fence, but trimming and some removal is expected to be necessary to allow installation and prevent damage to the new fence and comply with security requirements.

The installation of the fence section south of Ireland Creek will be more difficult since no roadway parallels the fence route. However, the route is mostly flat once the short climb away from Ireland Creek is made, and this area is accessible by small vehicle or cart via Stephen Sitter Avenue and the stormwater retention basin west of the WRAIR parking lot.

Technically this alternative appears to be easily implementable.

7.2.4 Alternative 4: Access Controls – Ball Field Landfill and a Portion of Ireland Creek Valley.

This alternative involves the fencing off of the entire ball field landfill to the east side of the Ireland Trail and fencing off approximately two-thirds of the Ireland Creek valley between Rock Creek and Stephen Sitter Avenue. This prevents open access to all of the BFLF to and including a buffer area around its entire perimeter. It allows unrestricted public access to the FGA-owned Ireland Trail from the Seminary Area up to approximately the second bridge from the lower end of the Ireland Creek Valley. It removes the current unrestricted access to approximately 1000 feet of Ireland Trail on FGA property. As with Alternative 3, Alternative 4 is judged to be fairly easily and quickly implementable from a technical point of view. The fence proposed in Alternative 4 is approximately 250 feet longer than in Alternative 3, and there are no additional Ireland Creek crossings if the fence is set on the slope of the landfill. If the fence is set on the lowest part of the hillside next to Ireland Creek, it will be paralleling a very steep slope. This fence is implementable, as fences are often installed in difficult places, but this fence alignment will be more difficult to install and maintain than the Alternative 3 alignment.

7.2.5 Alternative 5: Access Controls – Ball Field Landfill

This alternative involves the fencing off of the BFLF, but allows open access to the entire Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue. This alternative involves some 700 feet more fencing than Alternative 4 and depending on the alignment chosen, one additional Ireland Creek crossing. Although it is implementable from a technical standpoint, it is less so than Alternative 4 due to the additional length, steepness of the terrain it parallels, and the complexity of achieving integrity at the creek crossings. It is expected that this access control alternative, will meet with less public opposition than Alternatives 3 and 4.

7.2.6 Alternative 6: Access Controls – Newly Defined Landfill Waste Boundary

As with Alternative 5, this alternative involves the fencing off of the BFLF, but allows open access to the entire Ireland Trail, including the Ireland Creek Valley up to Stephen Sitter Avenue. Under this alternative the proposed fence would be erected just outside the boundary of the landfill estimated during the RI. This would bring the fence up the slopes of the hill at most locations and away from Ireland Trail. Along its entire length it provides no buffer between the estimated waste boundary and the unrestricted access area. This is most significant in the Ireland Creek Valley where the new fence would be immediately adjacent to waste on the steep slope of the fill area. Because this alternative does not follow the route of Ireland trail, it cuts the length of fence required to surround the BFLF to 2,230 ft., but because of the steep landfill slopes it makes the fence more difficult to construct. Under this alternative there would be no stream crossing, thereby eliminating the issue of trespasser access under the fence and the maintenance required to keep under-fence water passages clear. This is the least implementable of the Access Control alternatives due to the difficult installation, and maintenance, on steep wooded slopes relatively far from routes of vehicle access.

It is expected that of all the access control alternatives, this will meet with the least public opposition as the fence would be the least visible from the Ireland Trail.

7.2.7 Alternative 7: Soil Cover

This alternative reduces the chances of public contact with waste materials by covering the disposal area with two feet of clean soil. While this is an implementable alternative, it will require much more time to engineer, design, and carryoutn than any of the Access Control alternatives. It is expected that all vegetation on the landfill slopes will have to be removed and steep areas may have to be regraded and stabilized. Erosion and sedimentation control requirements will be an ARAR that must be considered and may cause a maintenance issue for many years.

This alternative will have a higher impact on the landfill slopes than any of the other alternatives and change the view to the east and north of Ireland Trail. Much of the natural beauty of the area will be lost for many years, depending on the engineering controls and maintenance required of the new surface.

7.2.8 Alternative 8: Waste Removal

This alternative removes the risk of public open access contact with waste materials by removing them. This is an implementable alternative, but technically it will be much more complex and risky than the Access Control or Soil Cover alternatives due to the direct contact with probable medical wastes. Regulations covering the disposal of waste will be applicable. Wastes will have to be characterized and taken to an appropriate disposal facility. Excavation performed in level A or B protective gear on the steep slopes of the landfill will be difficult at places as will waste staging and handling. Erosion and sedimentation control ARARs will apply. Many trees and most of the natural vegetation on the landfill slopes will be disturbed or removed to allow access by excavation machinery. Though the waste will be removed to a depth of 2 feet, the landfill slopes will be fairly well devoid of vegetation where excavation has taken place. This will be technically the most difficult of all the alternatives to implement, but because the slopes of the landfill will eventually return to their natural state, it should have as little long-term impact on the area as Alternatives 2 through 6.

7.3 Cost

7.3.1 Alternative 1: No Action

This alternative will cost nothing to implement as nothing will be done.

7.3.2 Alternative 2: Access Notifications –FGA property Boundary

This alternative includes the cost of preparing 50 durable signs, erecting them on posts, and maintaining them for 20 years. For this estimate it is assumed that the signs will be mounted on steel posts and require complete replacement after 10 years.

The 20 year cost of mounting and maintaining signs on steel posts is estimated at $11,000.

7.3.3 Alternative 3: Access Controls – Ball Field Landfill and Ireland Creek Valley

This alternative includes the cost of erecting 2,200 feet of fence. It includes some tree removal and trimming to create a buffer on the landfill side of the fence. It is assumed that this buffer will average 10 feet, though it will be narrower at some locations on the fence line and broader at others. The fence erected will have at least two gates. The basic estimate covers a standard specification 8 foot high barbed wire topped chain link fence in black or green for minimum visual impact. The cost estimate includes 20 years of maintenance (fence and buffer area). Alternative 3 will cost approximately $281,000 over a 20 year period.

It is estimated that a more decorative ornamental security fence that will also meet Army requirements, be visually more appealing, and be similar to other decorative security fences used on the facility along Brookville Road and Linden Lane, will cost approximately four times the cost of the barbed wire topped chain link. This relative cost increase is applicable to Alternatives 3, 4, 5 and 6.

7.3.4 Alternative 4: Access Controls – Ball Field Landfill and a Portion of Ireland Creek Valley

This alternative includes the cost of erecting 2,450 feet of fence similar to Alternative 3 at a 20 year cost of $395,000.

7.3.5 Alternative 5: Access Controls – Ball Field Landfill

This alternative includes the cost of erecting 3200 feet of fence and 20 years of maintenance similar to Alternatives 3 and 4 at a 20 year cost of $517,000.

7.3.6 Alternative 6: Access Controls – Newly Defined Landfill Waste Boundary

This alternate is similar to the other access control alternatives, but instead of following Ireland Trail the fence follows the boundary of the landfill waste defined in the RI. This includes the erection of 2,230 feet of fence and 20 years of maintenance at a cost of $487,000.

7.3.7 Alternative 7: Soil Cover

This alternative includes the cost for importing and placing approximately 17,600 cu yds of clean fill (2 feet deep). It also includes the cost of tree removal and revegetating areas where trees and natural vegetation had to be removed. It includes the cost of ground cover. At this point it is assumed that all of the landfill slopes will be covered with clean fill, i.e. there will be no further effort put into mapping the location of wastes outside of the existing landfill boundary. This estimate assumes that all landfill slopes will be stripped of vegetation and covered with soil and revegetated with low maintenance ground cover at a 20 year cost of $1,508,000.

7.3.8 Alternative 8: Waste Removal

This alternative includes the cost for excavating and removing waste from the steep slopes of the landfill. Because of the unknown nature of the waste in this landfill (infectious waste may be encountered) excavation will have to be done in level A or B to prevent exposure to workers should such materials be released. This alternative also includes the cost for disposal (including incineration of infectious waste) of whatever is unearthed and the restoration of the landfill slopes where excavation has taken place. Because of the presence of the DORF reactor and medical research done on site it is also important that excavated soils be screened for radioactivity, and special handling and disposal implemented for any such soil that is found.

To perform this alternative, as discussed in the RI, additional mapping of suspected waste will be required by either additional test pitting or soil boring. Careful waste excavation of only the areas where waste is found allows preservation of some of the vegetation on the landfill slopes. The excavation would not remove all waste in the area but only the top two feet of waste. Excavations would be covered in top soil and revegetated. The actual extent of waste found beyond the existing landfill fence is unknown, so for this estimate a range of areas from 2.5 acre to 5.5 acres have been provided. The excavated areas would be excavated to a depth of 2 feet. The excavated areas would be expected to revert to their natural state in coming years making for low or no long-term maintenance expense. The total 20 years cost for this alternative ranges from $1,401.000 for 2.5 acres to $3,081,000 for 5.5 acres.

8 NTCRA/Interim Measure Comparison and Recommendations

The recommended removal action alternative for the waste outside the current FTGL-02 boundary should be protective of human health and the environment and attain the removal action objectives, including continued public access to the Ireland Trail to the extent practical.

8.1 Alternative 1: No Action, does not satisfy the above criteria. Alternative 1 is not effective as it does nothing, there is nothing to implement, and it costs nothing.

8.2 Alternative 2: Access Notifications –FGA property Boundary, This alternative uses warning signs posted along Ireland Trail as a means of achieving the removal action objectives, i.e. to protect the general public from the hazards associated with waste disposed of in landfill FTGL-02 and Ireland Creek contamination while the Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document for FTGL-02 proceed. This alternative informs the English-reading general public of hazards associated with the landfill slopes and the creek, but does nothing to keep the public away from potential dangers. This action is more effective than Alternative 1, but less effective than all the other alternatives. Implementation is (except for Alternative 1) the easiest of the alternatives as all that is required is ordering and posting durable signs. Costs are the lowest of all the alternatives.

8.3 Alternative 3: Access Controls – Ball Field Landfill and Ireland Creek Valley. This alternative achieves the removal action objectives: to protect the general public from the hazards associated with waste disposed of in landfill FTGL-02 and Ireland creek contamination while the Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document for FTGL-02 proceed. The advantage of Alterative 3 over Alternatives 1 and 2 is that it places a physical barrier between Ireland Trail users and the slopes of the landfill and Ireland Creek. The other access control alternatives (alternatives 4 ,5 and 6) offer similar barriers, but are of different lengths and routes around the landfill. Alternative 3 minimizes the length of the fence while the safety buffer provided around estimated contaminated areas is maximized. In addition, the new fence only has to cross Ireland Creek at one location rather than several, as may be necessary for the other access control alternatives. This minimizes creek blockage issues and associated maintenance due to barriers under the fence to prohibit access by trespassers and construction challenges due to steep landfill slopes. It keeps people and pets out of the section of Ireland Creek where PCE and metals have been detected and contact, ingestion, and aesthetic water quality issues may be present. Adding signs to the fence, as in Alternative 2, will enhance this alternative by notifying Ireland trail users of the landfill and its potential dangers. The total 20-year cost of this alternative is $281,000, the least of all of the alternatives considered except Alternatives 1 and 2.

8.4 Alternative 4: Access Controls – Ball Field Landfill and Portion of Ireland Creek Valley

This alternative achieves the removal action objectives: to protect the general public from the hazards associated with waste disposed of in landfill FTGL-02 and Ireland creek contamination while the Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document for FTGL-02 proceed. The advantage of Alterative 4 over Alternatives 1 and 2 is that it places a physical barrier between Ireland Trail users, and the slopes of the landfill and portions of Ireland Creek that should not be utilized, due to issues and uncertainties with skin contact, ingestion, distasteful appearance, and slippery precipitate. The advantage of Alternative 4 over Alternative 3 is that it allows 400 more feet of public Ireland Trail access, and in doing so preserves public access to part of the attractive Ireland Creek valley, including 2 of the 4 creek crossings on the historical concrete and stone bridges. One disadvantage of the alternative compared to number 3 is that it allows public access near to known creek contamination, and does not take advantage of the downstream stretch of Army-owned Ireland Creek to place an uncontaminated buffer zone between known contamination and the public. Another is that the fence is longer and will have to traverse the steep hillside along Ireland Creek, causing extra effort to install and maintain it. Overall the alternative is protective, and it balances some additional risk and cost with the desire to give the public continued access to the Ireland Creek valley. The other Access Control alternatives (alternatives 5 and 6) offer similar barriers, but offer longer or less secure and less maintainable fencing, and offer no surface water exposure control.
Adding signs to the Alternative 4 fence, as in Alternative 2, will enhance this alternative by notifying Ireland trail users of the landfill (and the creek water) and its potential dangers. The total estimated 20-year cost of this alternative is $395,000, which is $114.000 more than the next lowest-cost, but protective, alterative.

8.5 Alternatives 5 and 6 are additional access control alternatives that involve longer lengths of fence, requiring more tree and brush removal for the buffer area, and allowing the public access closer to the upper reaches of Ireland Creek. While partially meeting removal action objectives by providing a barrier to the public from the BFLF waste, as in Alternative 3, both are less desirable from a public health viewpoint in that they will require more maintenance due to their length and routing and are more vulnerable to damage that would allow access to the landfill until the fence is repaired. In addition, Alternatives 5 and 6 will allow access to areas of Ireland Creek that have shown PCE and metal contamination from an unknown source. Both alternatives cost more to install and more for annual maintenance due to the longer length of fencing, possible larger number of Ireland Creek crossings, and greater difficulty in maintaining the integrity of the fence in steep terrain**.** All of the access control alternatives are judged somewhat less effective than Alternatives 7 and 8 for preventing waste contact, due to the fact that waste remains in place and is neither covered nor removed. All of the access control alternatives are significantly less costly than Alternatives 7 and 8 and involve much less environmental disruption during implementation. Vandalism or storm damage that compromises the fences could allow public access to exposed waste where alternatives 7 and 8 leave no waste exposed.

8.5 Alternative 7 - Soil Cover meets the most significant, though not all, of the removal action objectives by burying all landfill slope waste under two feet of soil. This alternative will have the largest environmental impact on the landfill slopes. As envisioned all existing trees and vegetation will be removed and two feet of soil placed on all of the banks to bury waste that may be close to the surface and become exposed through erosion or freeze/thaw processes. This would require no additional investigation as every possible place where waste could be found will be covered. The landfill cover would have to be maintained to prevent erosion and surface water contamination. Public access to all of Ireland trail would be retained, however exposure to PCE and metals in Ireland creek is not prevented. The landscape on the landfill side of Ireland Trail would be radically different, and decidedly unnatural. As an interim measure the addition of two feet of soil to the landfill slopes may impact the final remedy to be chosen for the FTGL-02 landfill through the ongoing RI/FS process. This alternative may be more effective at keeping the public from accessing landfill waste than the access control alternatives. It does nothing to prevent pets from playing in Ireland creek and it is the second most expensive of the interim measure alternatives.

8.6 Alternative 8 - Waste Removal also meets the most significant, though not all, of the removal action objectives by removing any shallow waste on the banks of the landfill that may become more easily exposed to the public. The cost of this alternative is very difficult to estimate as no information has been generated that definitely indicates the location and extent of this type of waste on the landfill slopes. It is estimated that between 2.5 and 5.5 acres of the 5.5 acre slope area will have to be excavated to a depth of two feet and whatever waste is removed will be characterized, transported and disposed of in an appropriate waste facility. Because this alternative removes waste where found, it is expected that some, if not the majority, of the landfill slopes will remain undisturbed. In the end, public access to the entire Ireland Trail will be retained, but there will be nothing preventing pets from playing in Ireland Creek in areas where PCE has been detected. This is a high cost alternative, with significant uncertainty as the amount of excavation to be done is unknown. Though it is believed to be more protective to the Ireland Trail using public regarding exposure to landfill waste than the access control alternatives, it provides no protection to the public from exposure to the waters of the upper reaches of Ireland Creek that have shown PCE and metal contamination.

8.7 Summary: The above alternatives are summarized in the following table.

Table 8-1

Alternative	Effectiveness	Implementability	20 Yr. Cost
1 No Action	Not effective	Easily implementable	None
2 Access Notifications: - FGA property Boundary	Very limited effectiveness	Easily implementable	$11,000
3. Access Controls – Ball Field Landfill and Ireland Creek Valley	Effective	Implementable, with Ireland Creek Valley public access disruption	$281,000
4 Access Controls – Ball Field Landfill and a Portion of Ireland Creek Valley	Slightly less effective than Alt 3	Implementable, with partial Ireland Creek Valley public access disruption	$395,000
5 Access Controls – Ball Field Landfill	Less effective than alternatives 3 and 4 for BFLF, very limited for creek	Implementable	$517,000
6 Access Controls – Newly Defined Landfill Waste Boundary	Similar to Alternative 5	Implementable, with least public access disruption	$487,000
7. Soil Cover	Effective for BFLF, very limited for creek	Less Implementable due to time required to plan and execute	$1,508,000
8, Waste Removal	Effective for BFLF, very limited for creek	Least Implementable due to time required to plan and execute	from $1,401,000 for 2.5 acre to $3,081,000 for 5.5 acres

8.8 Preferred Alternative – Alternative 4, By providing access control from Ireland Trail to the FTGL-02 landfill and to the upper reaches of Ireland Creek where stream contamination has been identified as a potential health hazard, Alternative 4 achieves the removal action objectives for this non time-critical removal action. It is judged not as effective as Alternatives 7 and 8 for the BFLF because any exposed waste is left in place on the slopes of the landfill but the alternative is estimated to cost a fraction of Alternative 7 and 8, and in comparison inflict minimal impact on the slopes of the landfill. This alternative will have little or no impact on the final RI/FS remedy. Combined with Alternative 2, access notification, this alternative should keep potential users of Ireland Trail, off of the landfill slopes, and out of the upper reaches of Ireland Creek. This alternative is chosen over Alternative 3 because the Army believes that it achieves objectives similar to Alternative 3 while placing fewer restrictions on public access to much of the scenic portion of Ireland trail. The Army believes that the protection afforded by selecting Alternative 4 is similar to Alternative 3 with less impact on the recreational use of Ireland Trail, and at an acceptably greater cost.

With Alternative 4 public access will continue on the lower stretch of Ireland Creek. Chemical constituents measured surface water in that stretch do not exceed health-based comparison criteria, are not known to be a result of FGA activities, and pose no obvious negative aesthetic effects such as distasteful appearance or odor. It is noted that the public will have access to a portion of the Ireland Creek with some level of contaminants in sediments. It is recommended that FGA perform annual monitoring of Ireland Creek to ensure that constituent levels remain protective and to detect seasonal and long-term trends.

To summarize, Alternative 4 features:

- No public access to all of the known footprint of landfill FTGL-02, plus a safety buffer over most of its perimeter
- No public access to the upper reaches of Ireland Creek where PCE and high levels of metals have been detected, and appearance is adversely affected.
- Likely not incompatible with the final RI/FS solution selected.
- Fast implementation (less than 6 months) compared to Alternatives 6 and 7.
- Allows continued access to much of Ireland Trail, but blocks access to known landfill and surface water hazards. However, it should be noted that lower portions of the stream will be accessible to the general public.

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Tables

Table 7-1: Location-specific ARARs, Forest Glen Annex Ball Field Landfill EE/CA			
Action	**Regulation/Citation**	**Requirement of Law/Regulation**	**ARAR Status**
Access Controls: Construction of Fencing/Soil Cover	Clean Water Act (CWA) Effluent Guidelines-Discharge of aqueous waste 40 CFR 136.1 – 136.4	Provides requirements for point source discharges of pollutants.	ARAR Potentially Applicable On-site excavation activities could involve discharge of wastewaters to surface water bodies. There are nearby streams that could be impacted by the discharge of stormwater that may originate from the site during on-site excavation activities.
Waste Removal/Soil Cover	Maryland Stormwater Management Regulations COMAR 26.17.02.05	Inhibits the deterioration of existing surface waters and waterways by requiring that post development stormwater runoff characteristics, including both water quality and quantity, are maintained, to the extent practicable, equal to or better than the predevelopment runoff characteristics.	ARAR Applicable Potentially applicable for "land development projects" undertaken as part of a removal or remedial action, and would require that such projects develop a stormwater management plan. *(Note: A land development project is a manmade change to the land surface that potentially changes its runoff characteristics.)*
Waste Removal/ Soil Cover	Air Emissions General Emission Standards, Prohibitions, and Restrictions COMAR 26.11.06.03-09	The term "fugitive emissions" refers to unintended emissions. Testing is required and the standard to be met is that visible emissions cannot exceed 20 percent opacity, except for one 6-minute period in any 1 hour of not more than 30 percent opacity. Continuous monitoring systems and other monitoring devices shall be installed, calibrated, maintained, and operated.	ARAR Applicable These regulations are applicable to disturbance of soil during excavation; and transportation of excavated debris and/or soils.

Figures

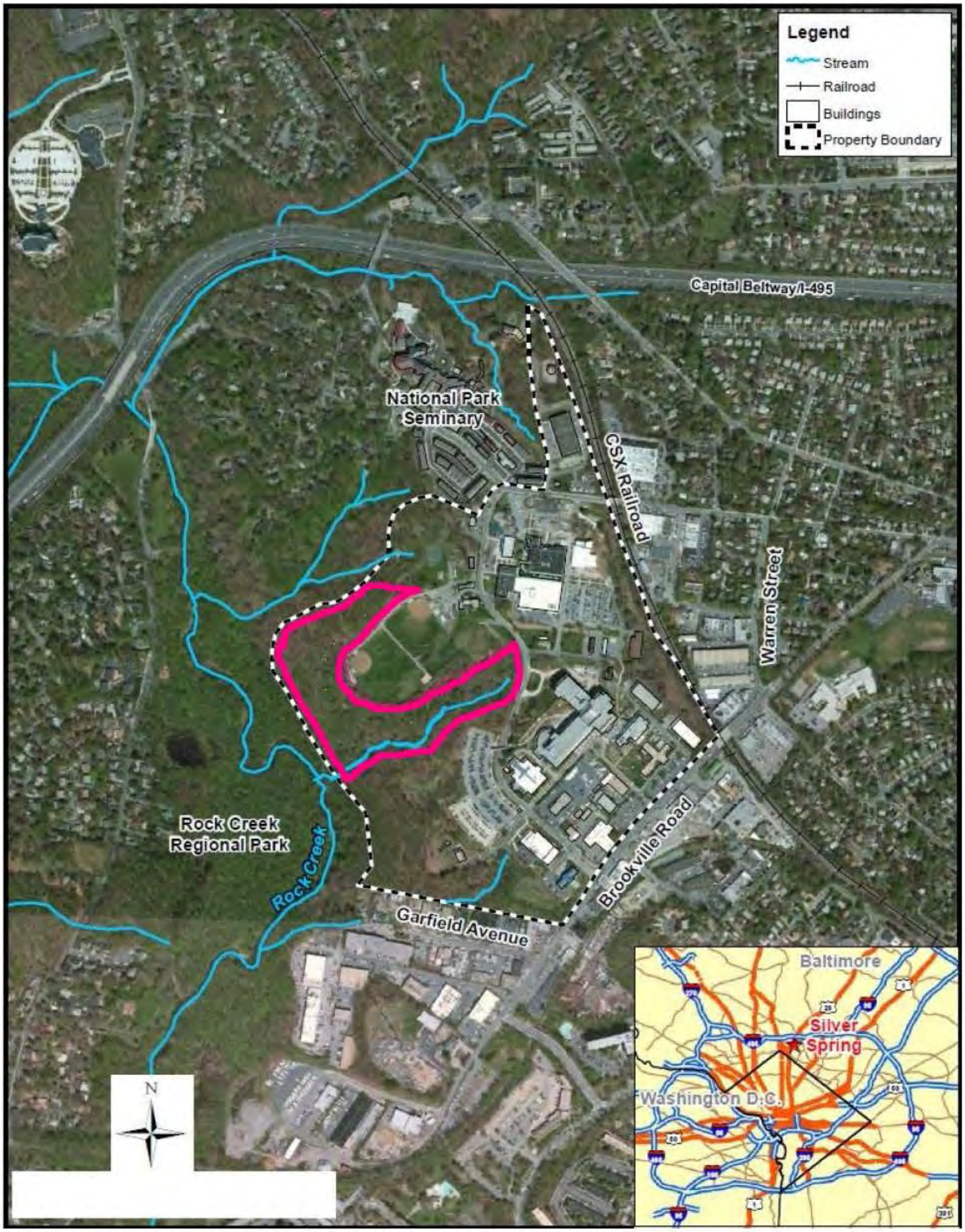

Figure 2-1: General Location and Boundary of Forest Glen Annex. Area addressed by EE/CA is outlined in pink.

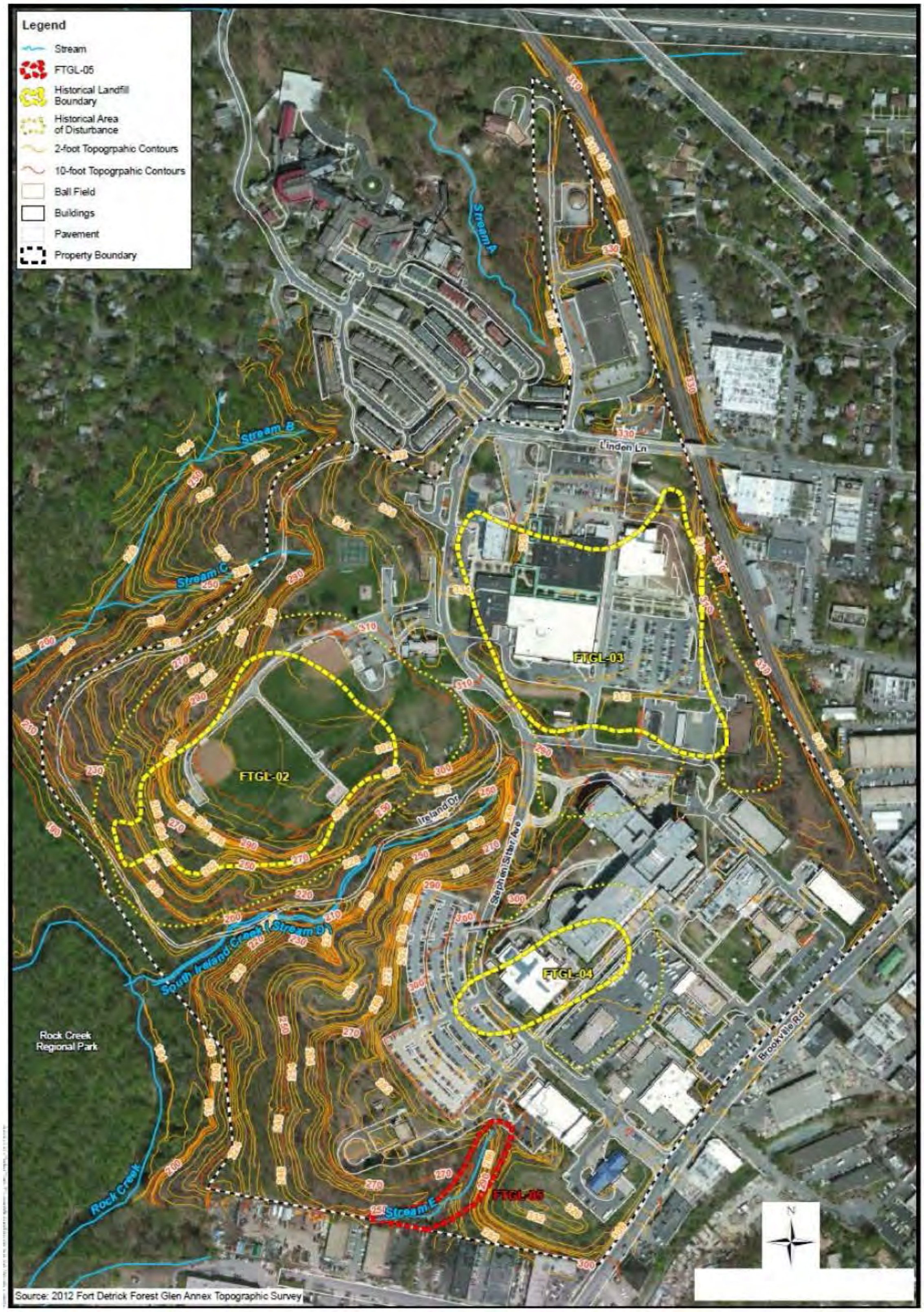

Figure 2-2: Topographic map of FGA, showing terrain around site FTGL-02 on the west side of FGA.

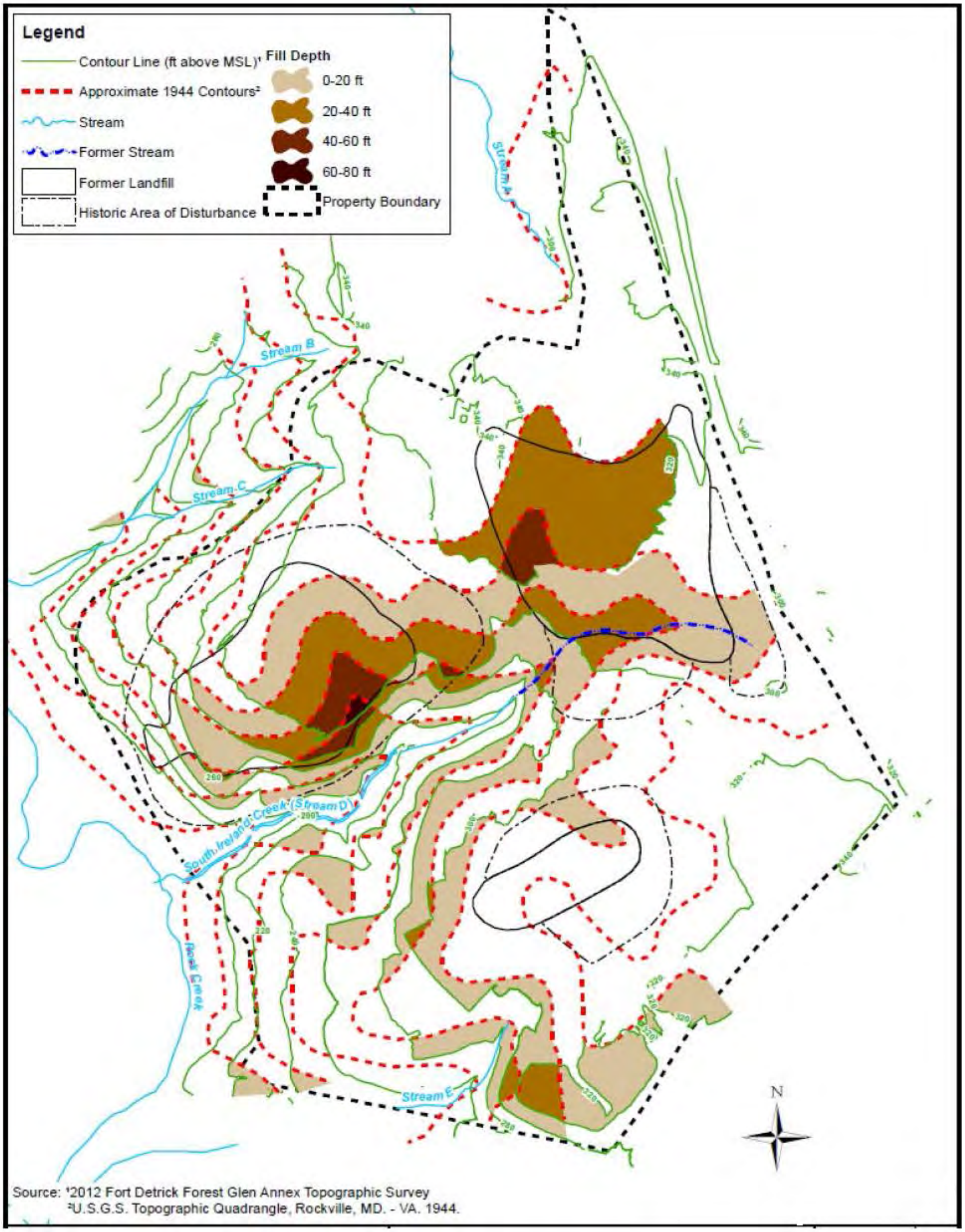

Figure 2-3: Estimated Fill Depths on FGA Based On USGS Topographic Map Comparison

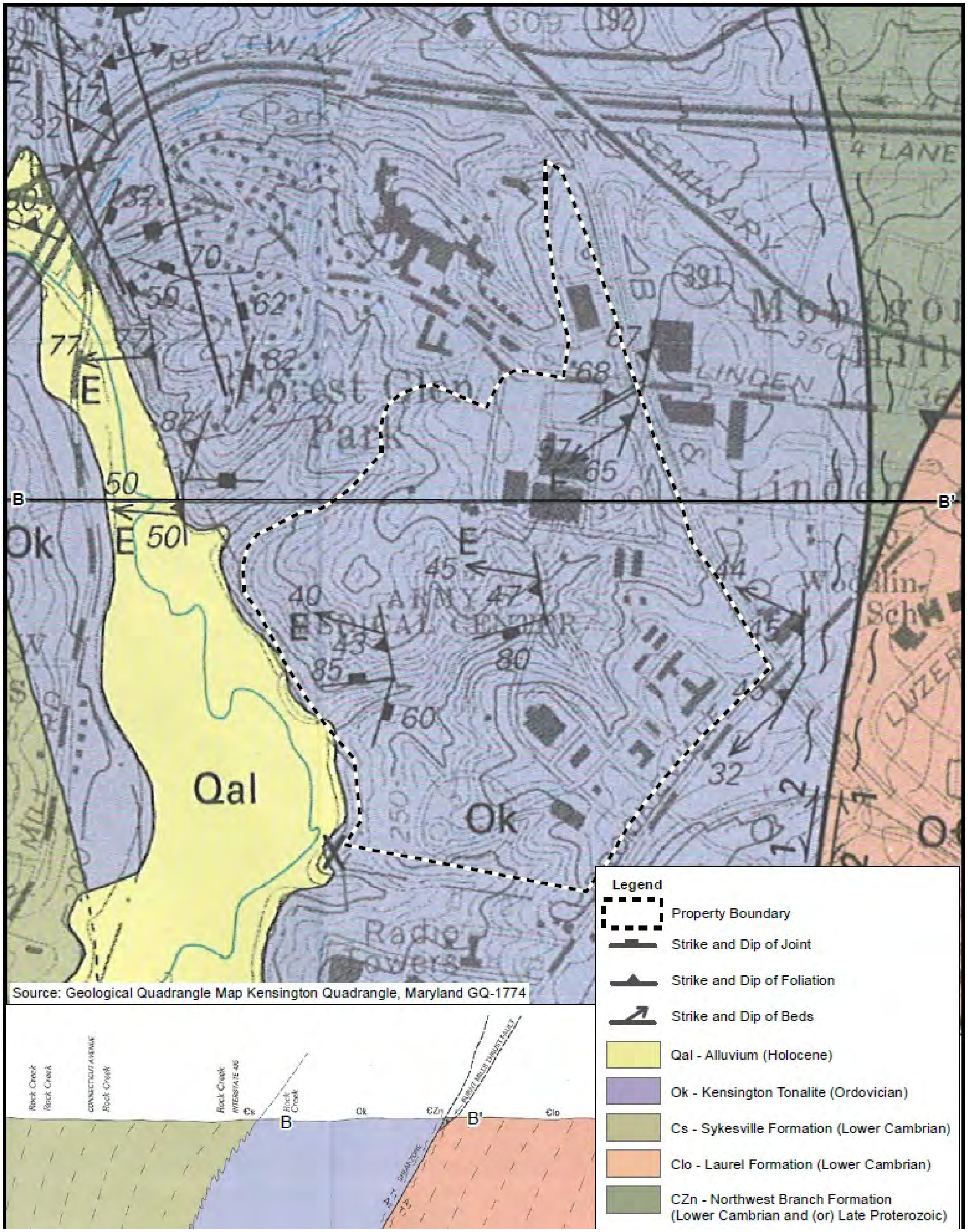

Figure 2-4: Geologic Map of Forest Glen Annex Area

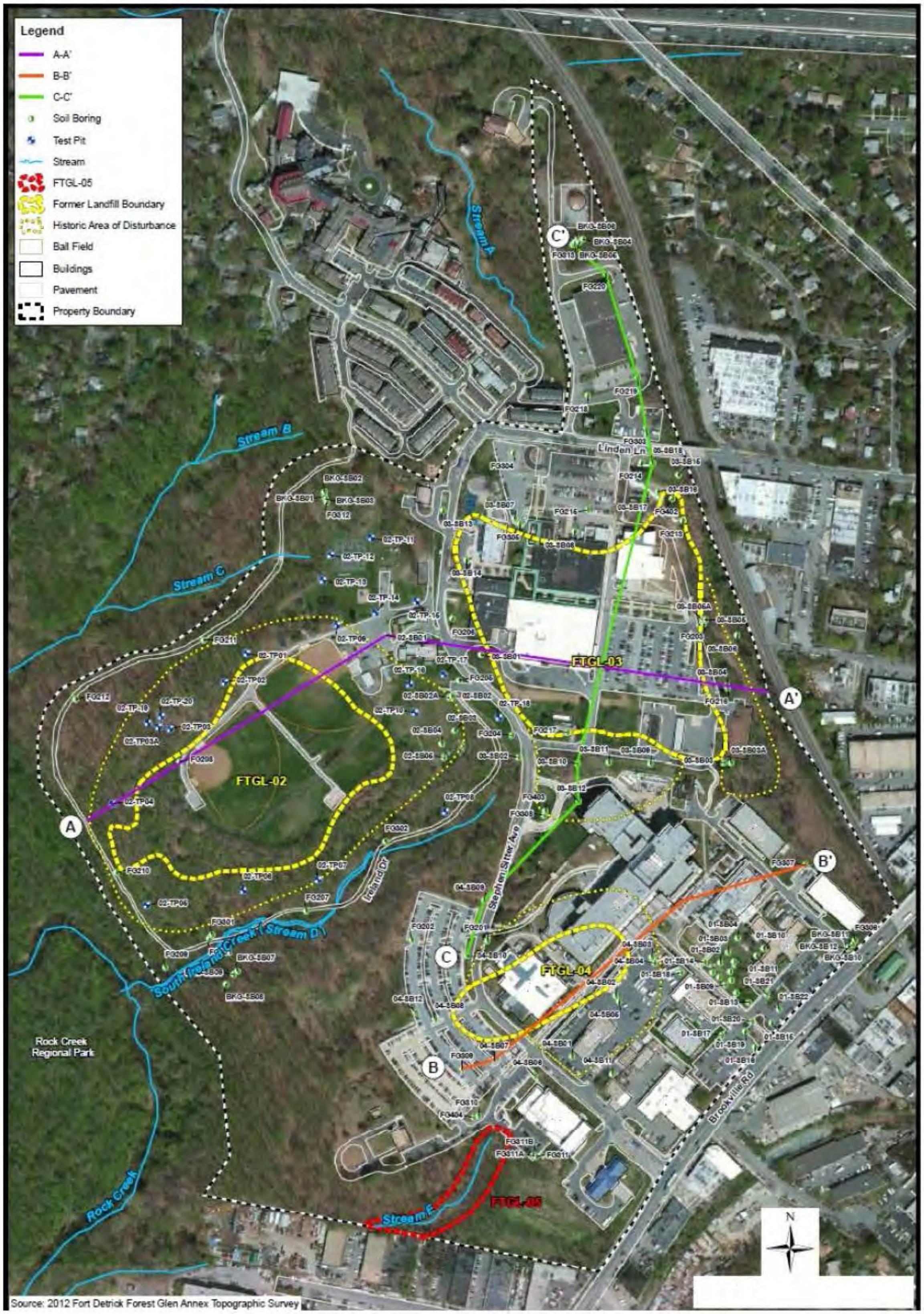

Figure 2-5: Location of Mapped Cross-sections at Forest Glen Annex

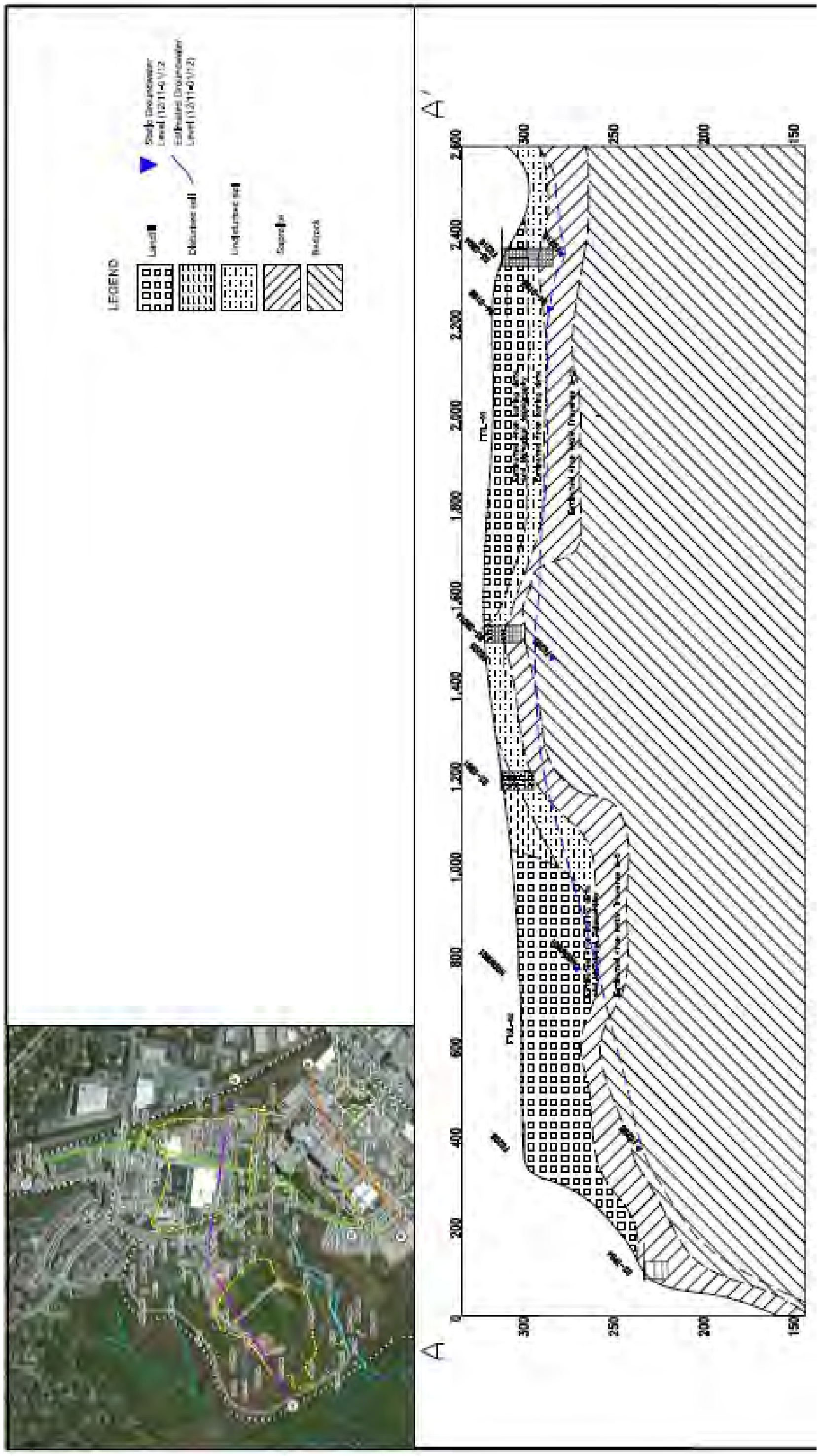

Figure 2-6: Cross Section A-A'

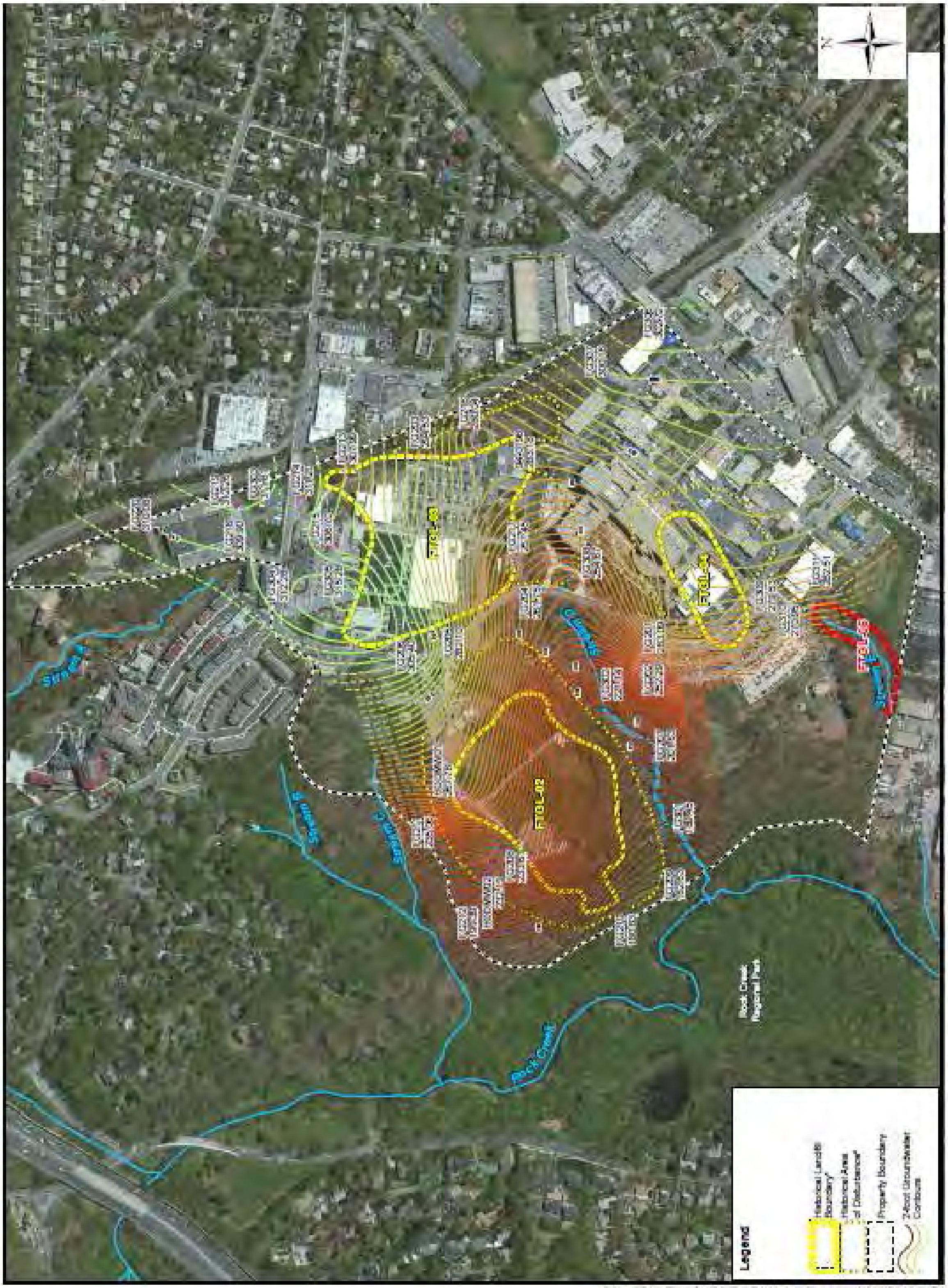

Figure 2-7: Groundwater contours in 2011-2012

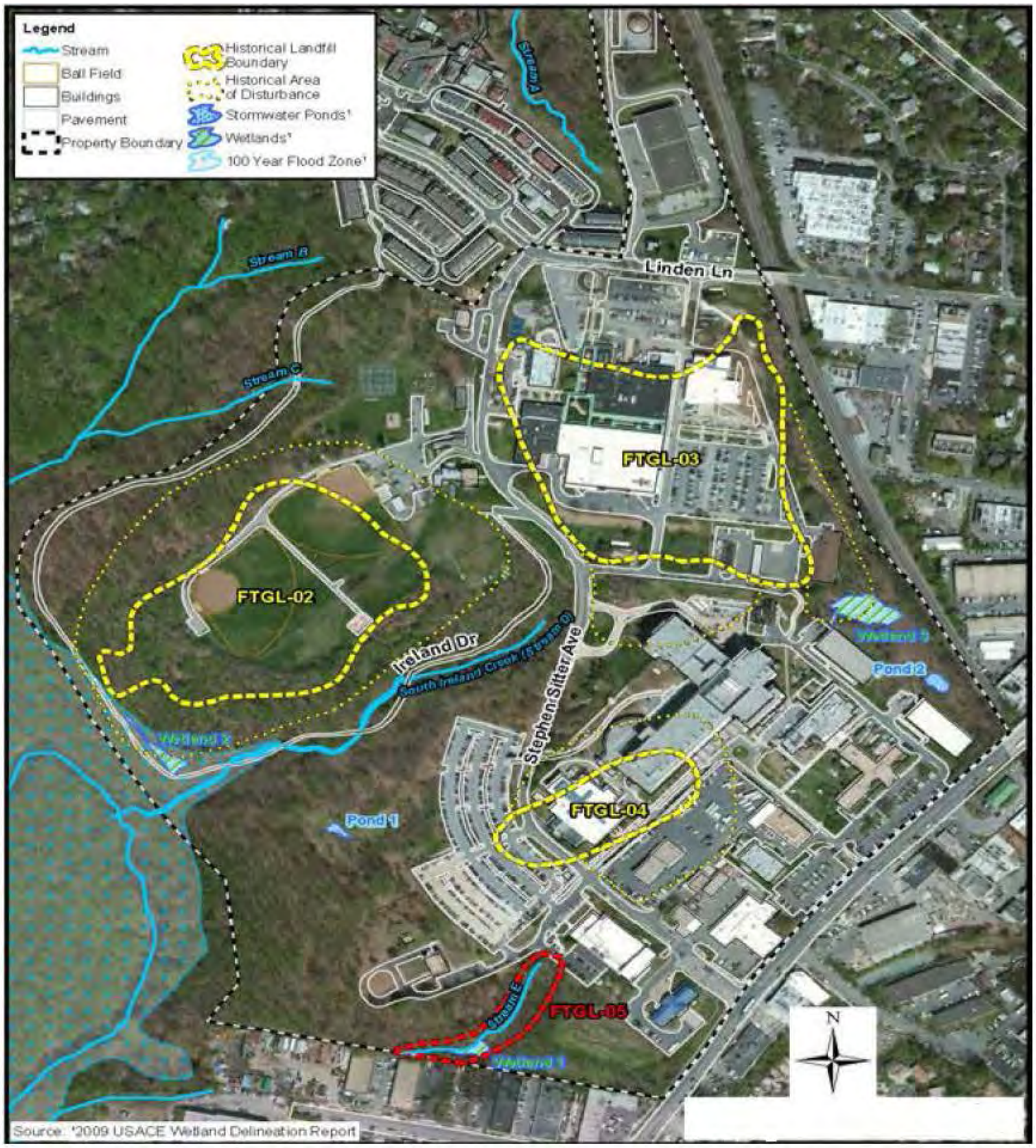

Figure 2-8: Surface water and wetlands

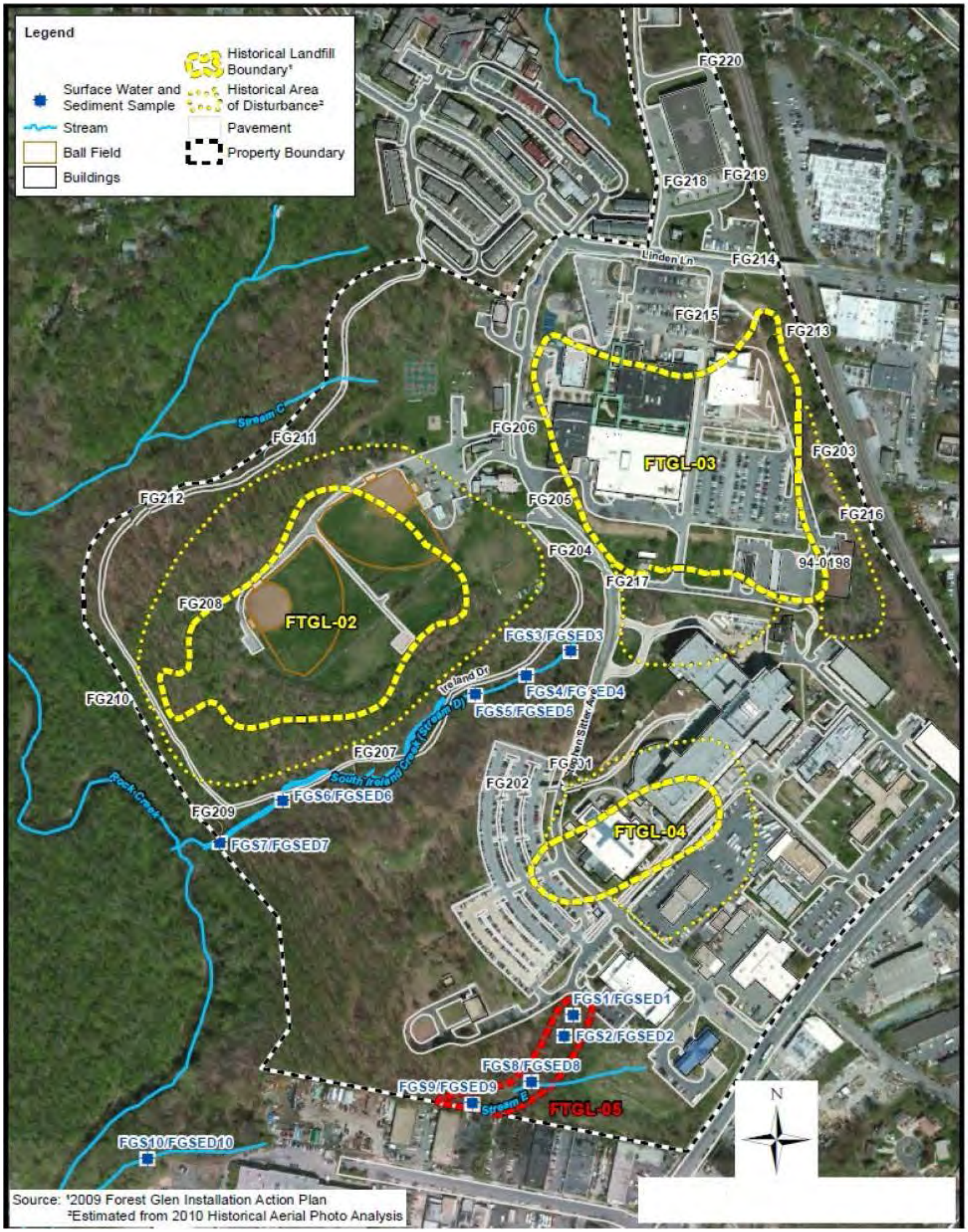

Figure 3-1: Groundwater Monitoring Wells at Site FTGL-02

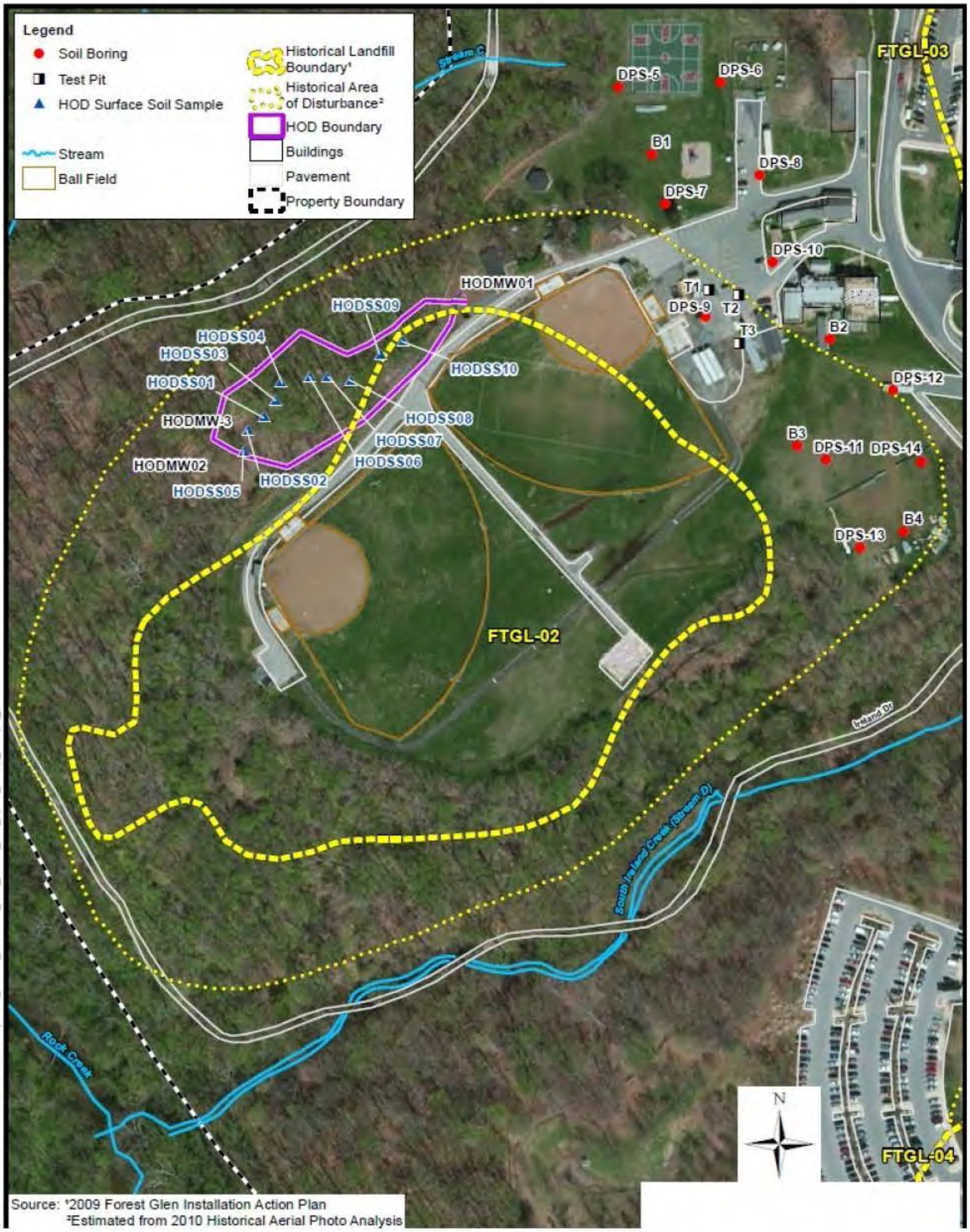

Figure 3-2: Historical Open Dump Gas Sampling Locations (and possible new military housing study sampling locations, outside EE/CA study area)

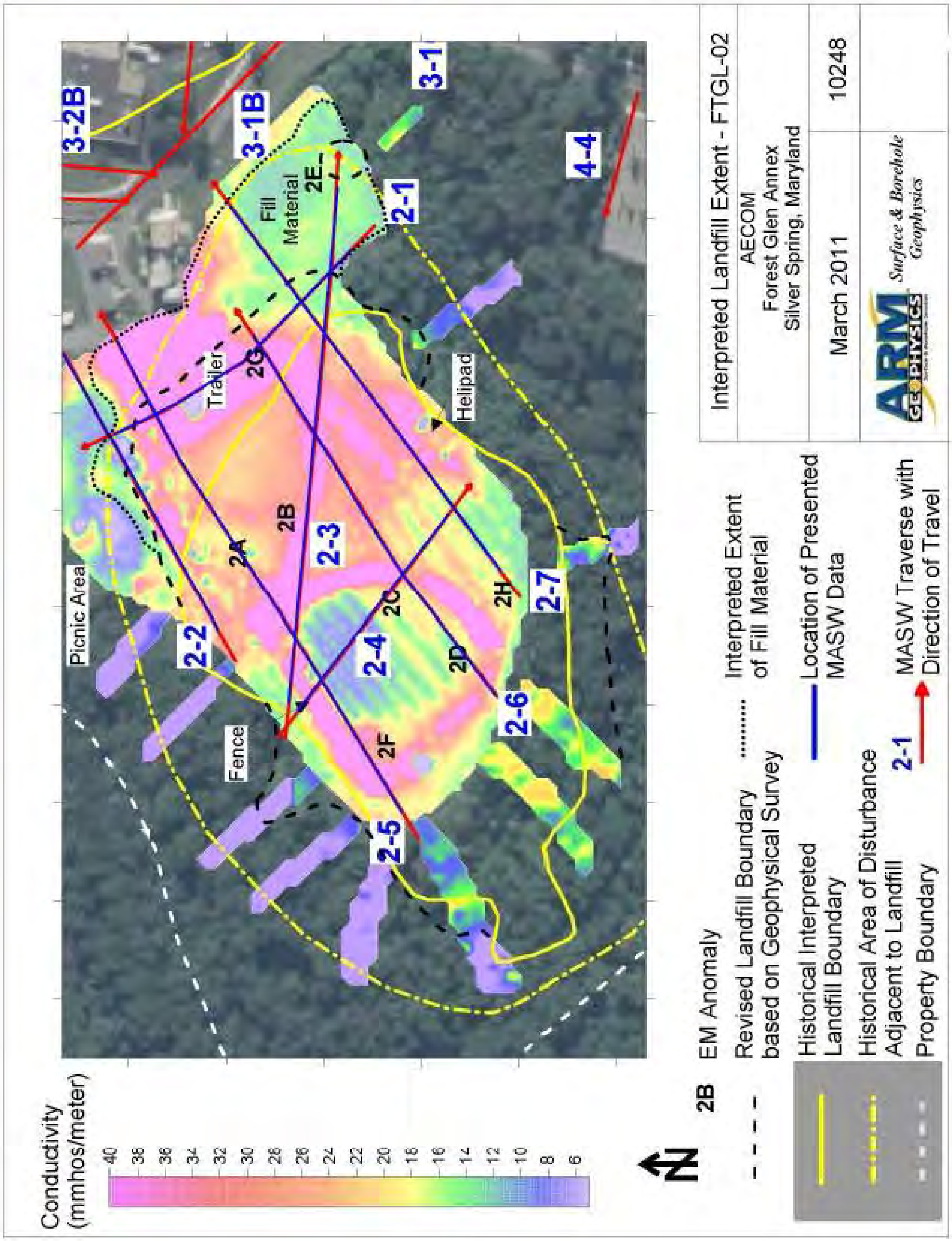

Figure 4-1: Geophysical Survey Results

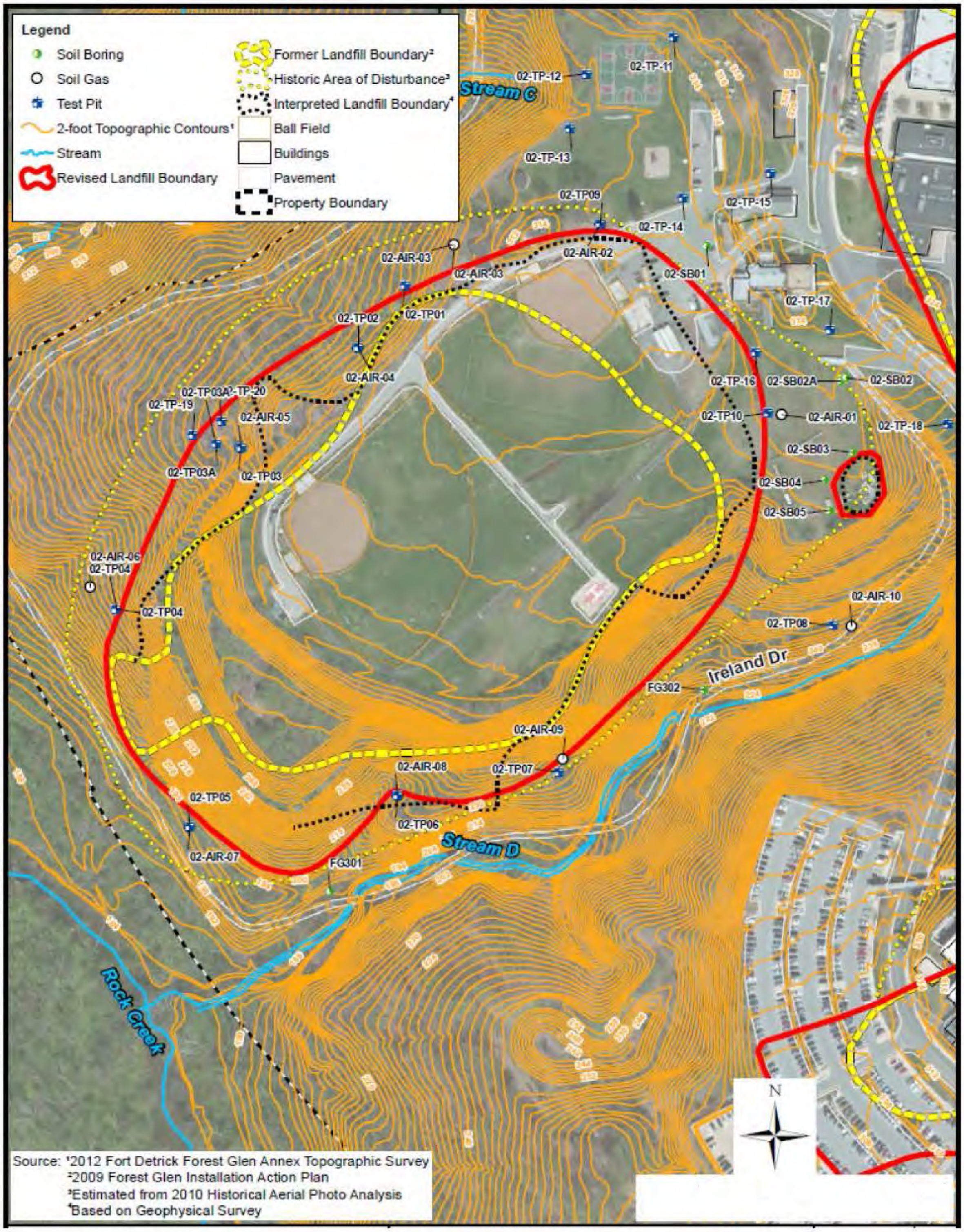

Figure 4-2: Test Pit Locations Around Perimeter of Site FTGL-02

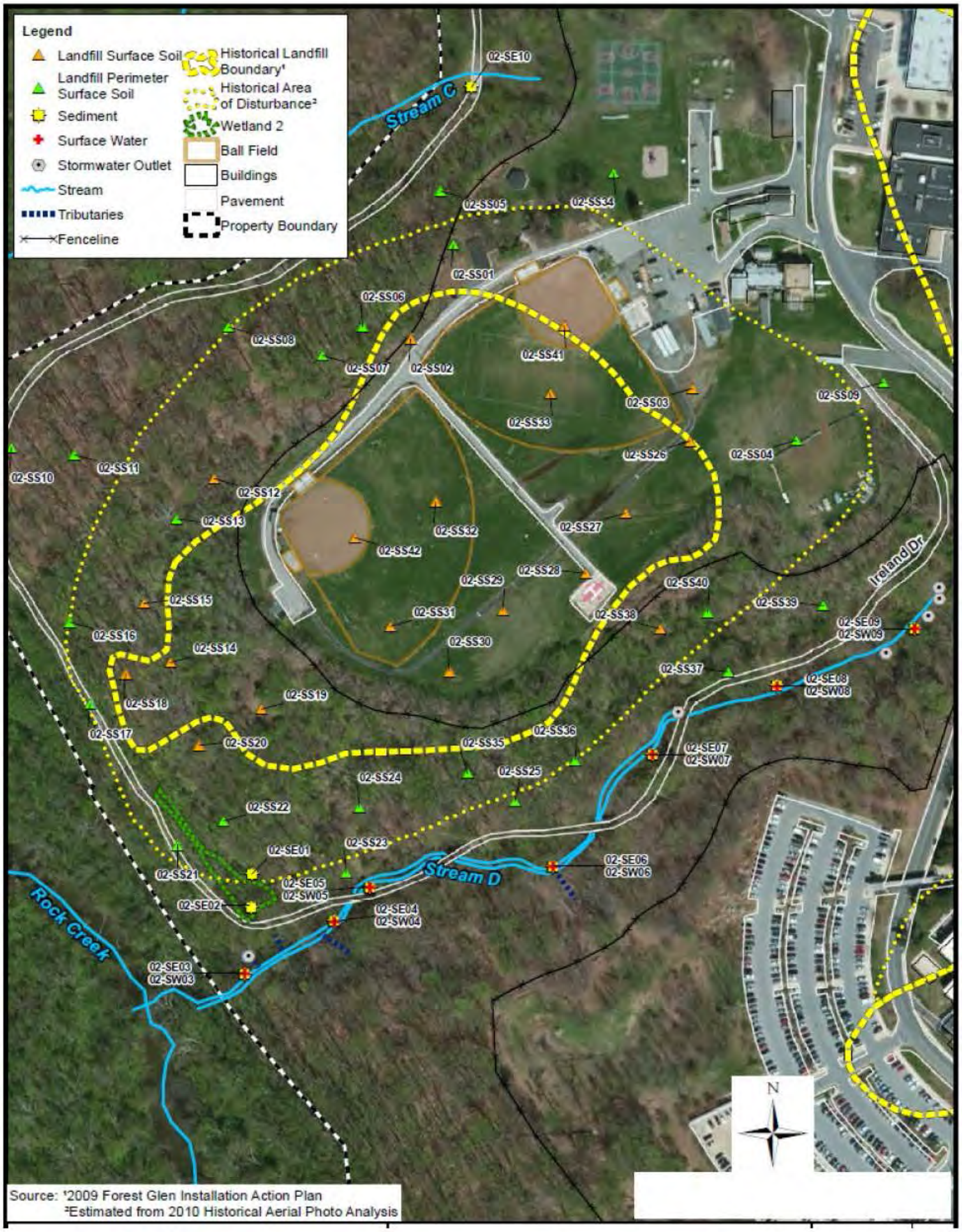

Figure 4-3: Surface soil sampling locations at site FTGL-02

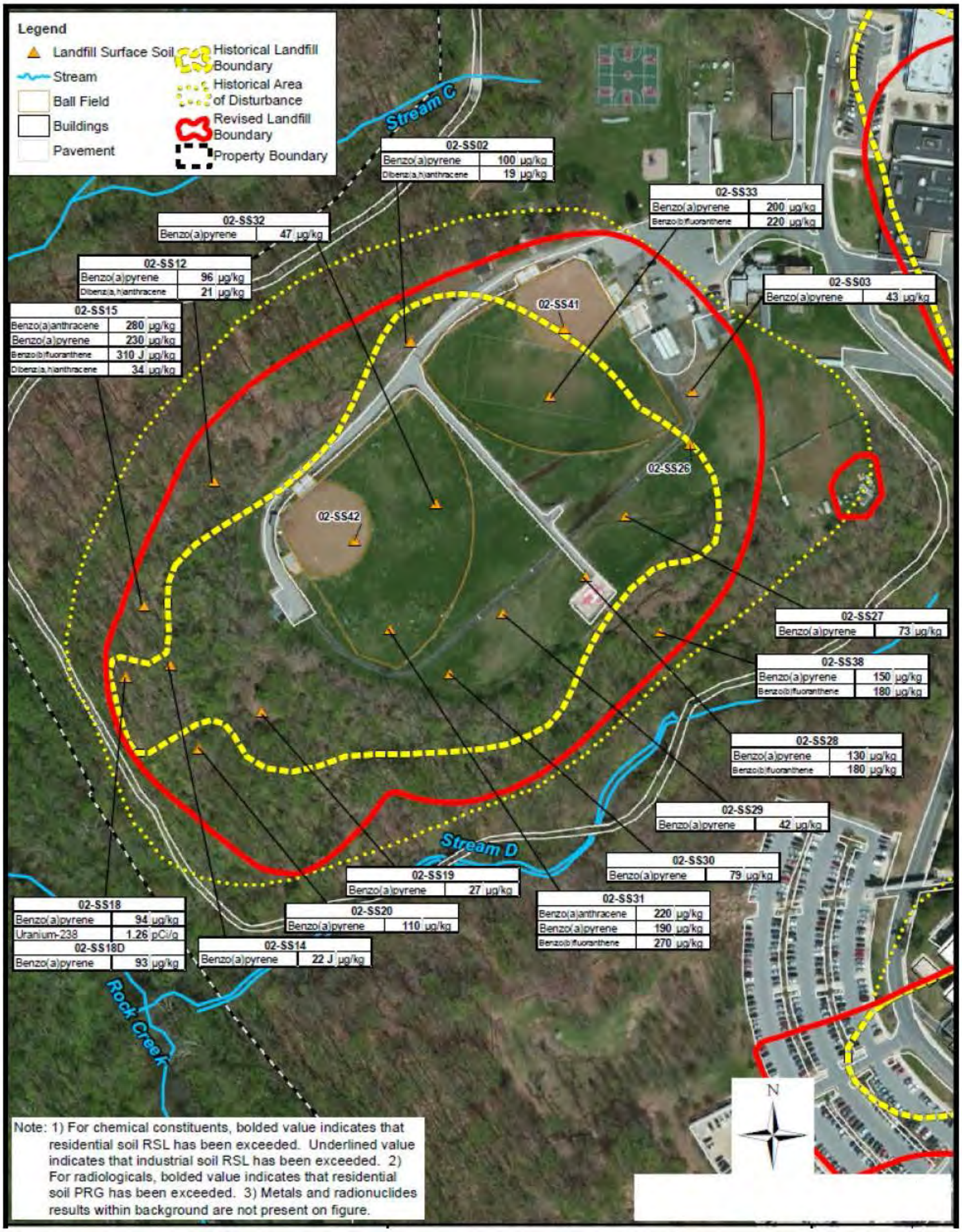

Figure 4-4: Significant sampling results in surface soils

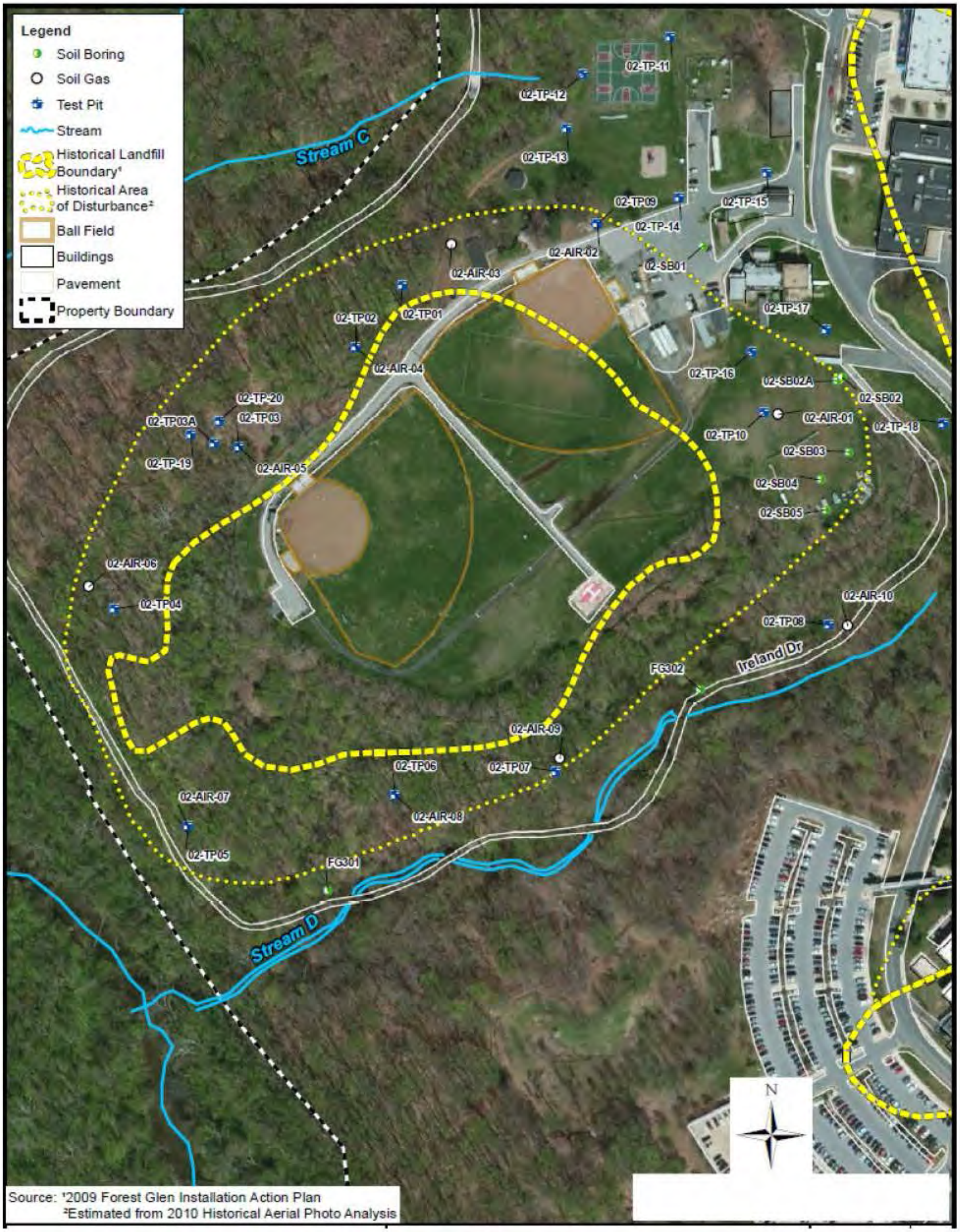

Figure 4-5: Subsurface soil sample locations

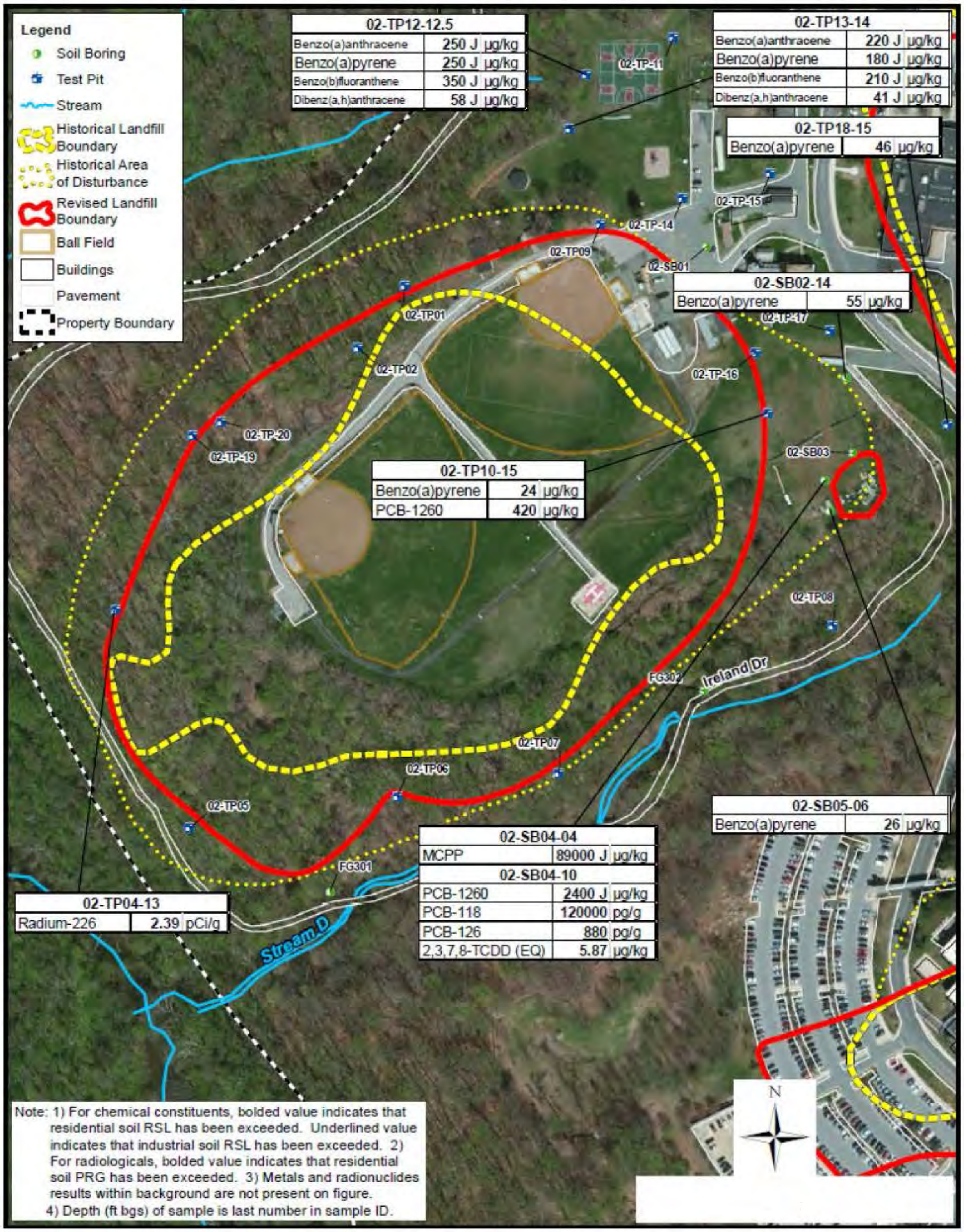

Figure 4-6: Subsurface soil criteria exceedances

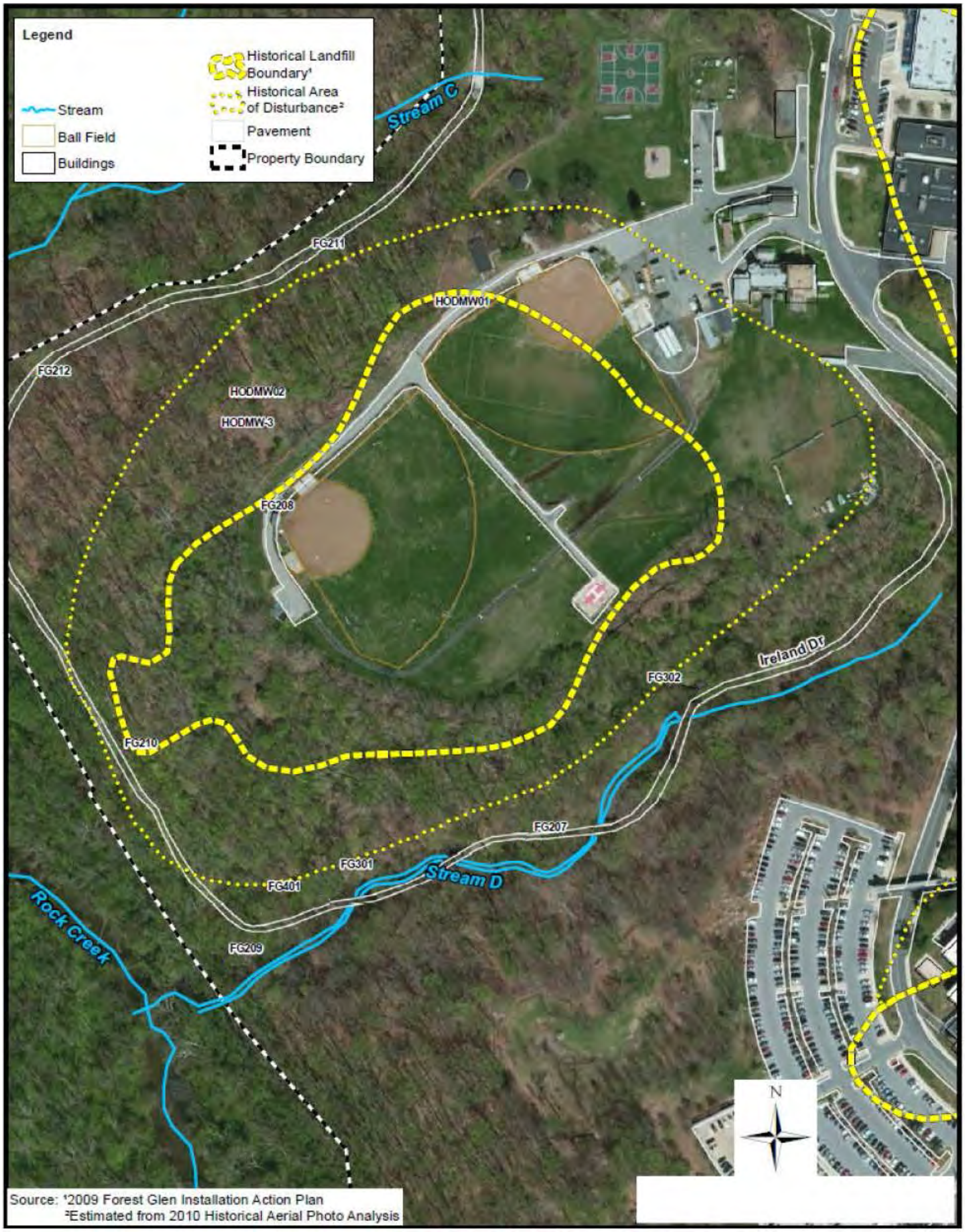

Figure 4-7: Groundwater monitoring well locations

Figure 4-8: Exceedances of screening levels in groundwater

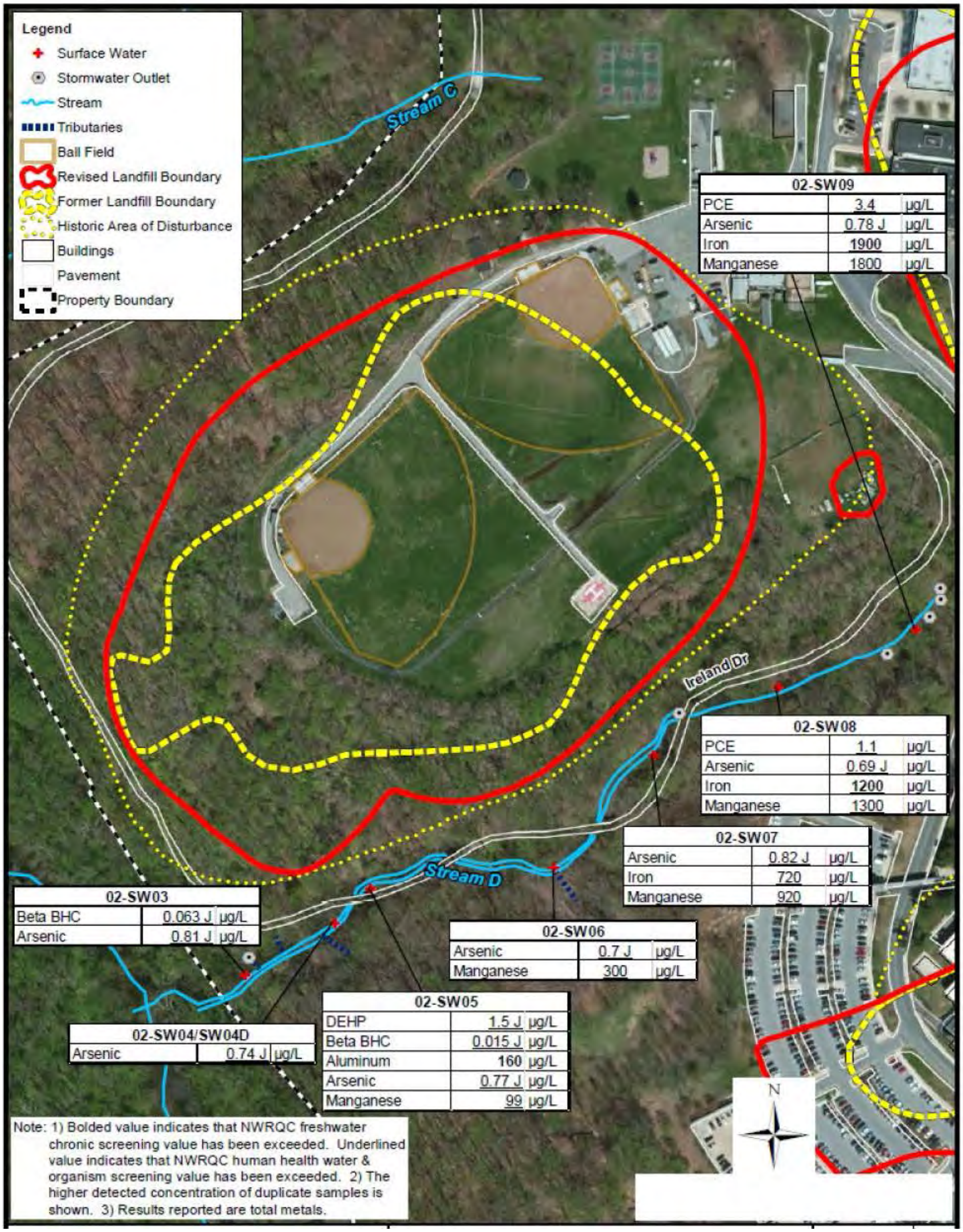

Figure 4-9: Screening level exceedances in surface water

Figure 4-10: Criteria exceedances in sediment.

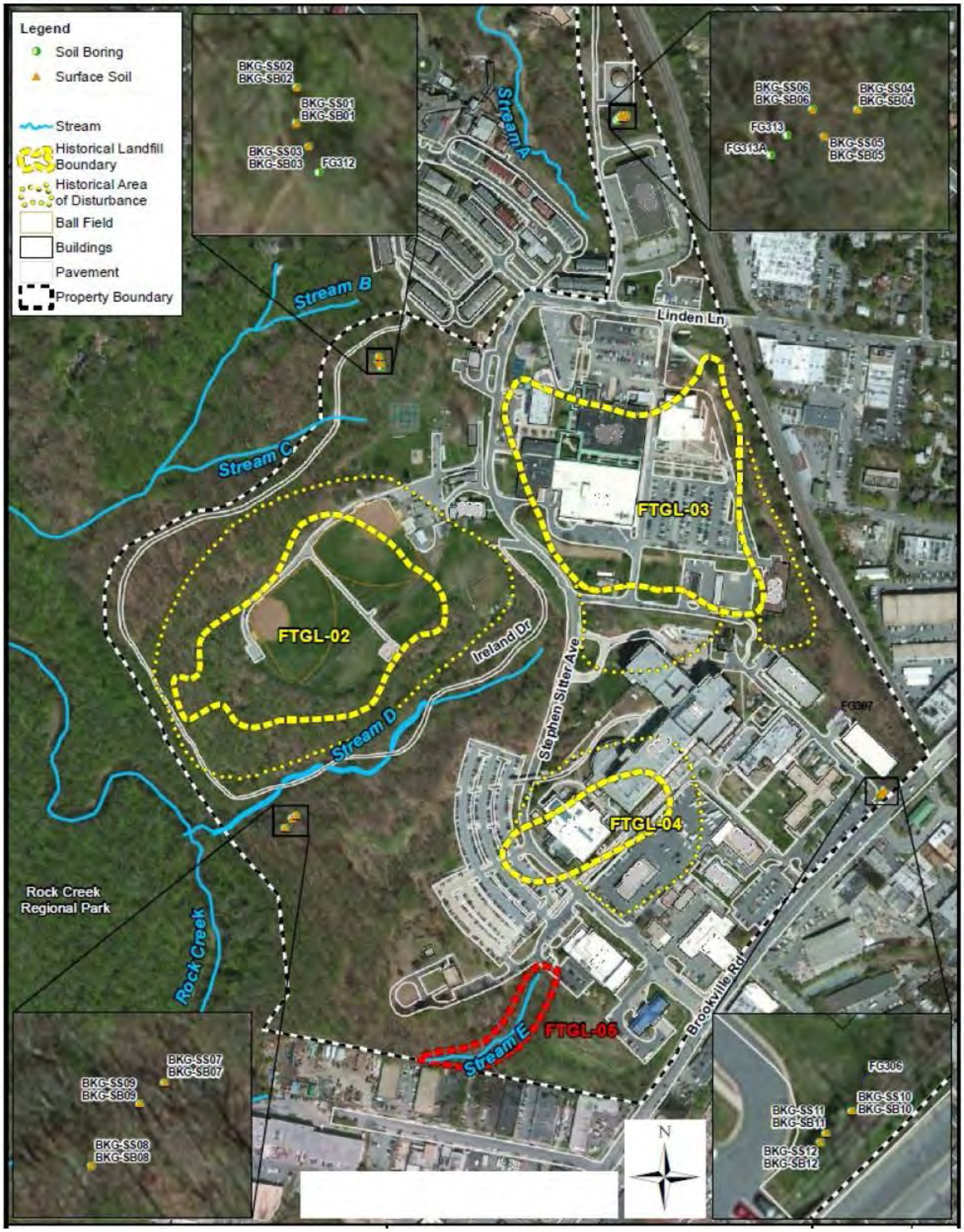

Figure 4-11: Background sampling locations

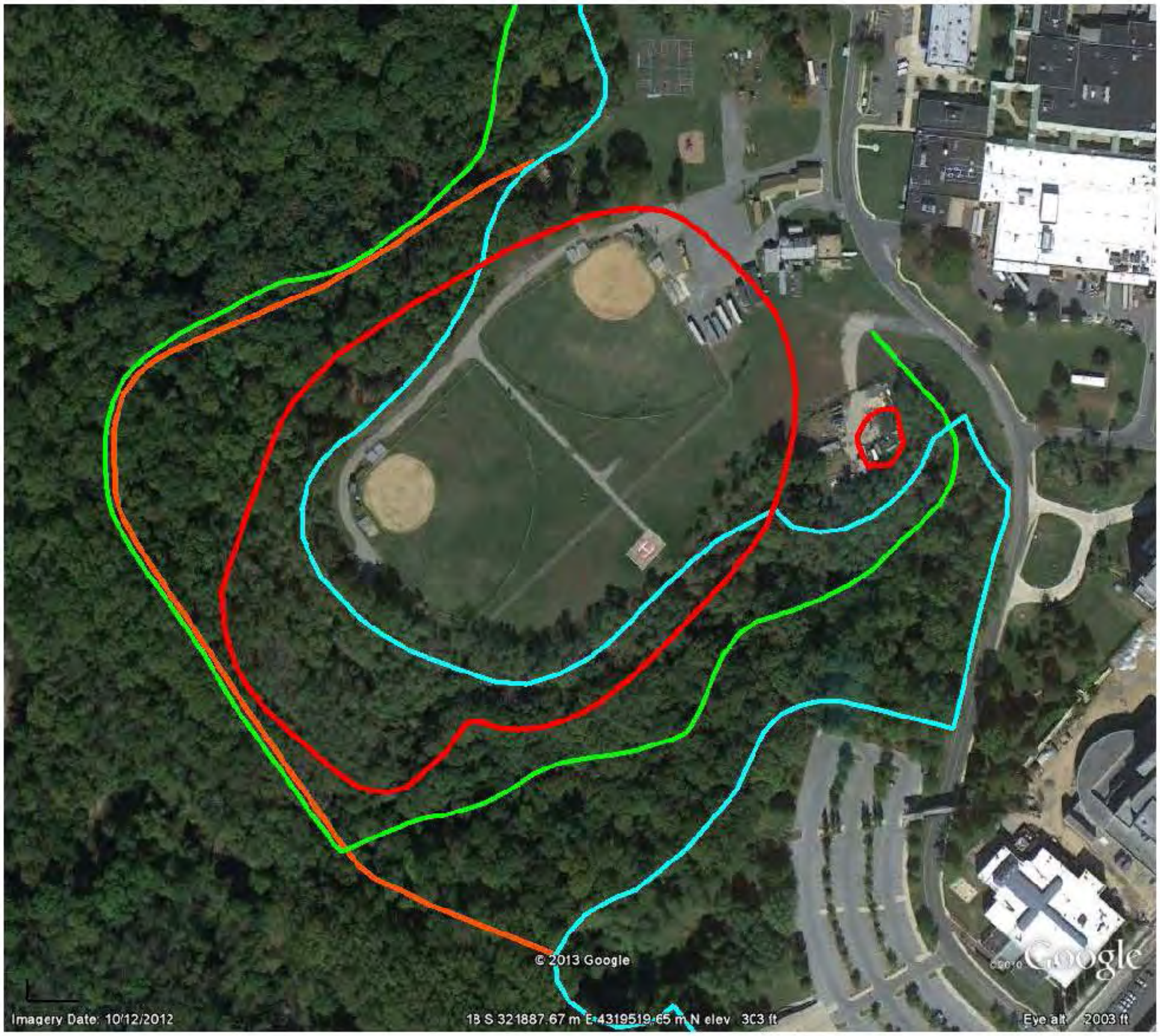

Figure 6-1: Alternative 3 (Green: Ireland Trail; Orange: Proposed fence; Blue: Existing fence; Red: Waste)

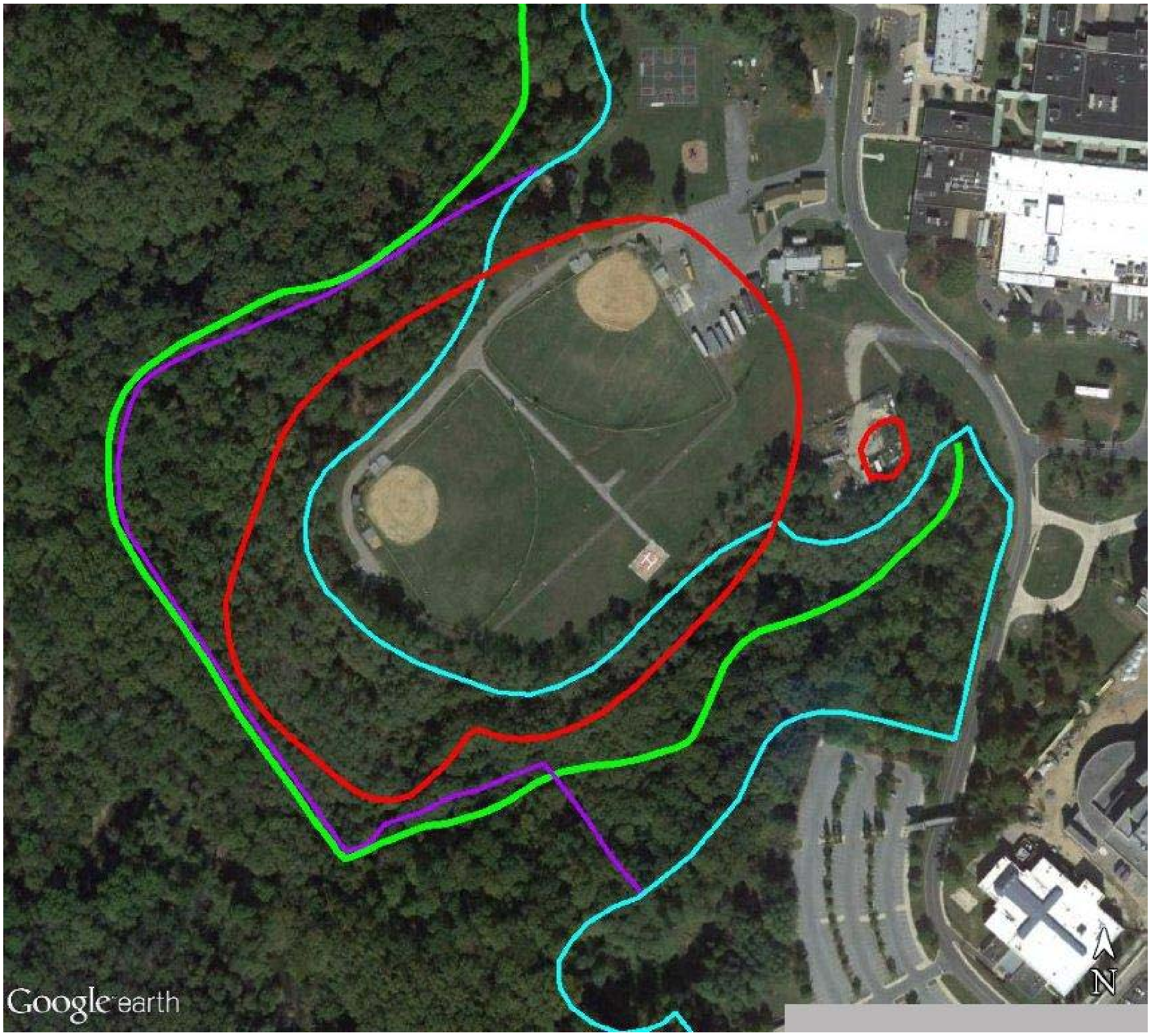

Figure 6-2: Alternative 4 (Green: Ireland Trail; Purple: Proposed fence; Blue: Existing fence; Red: Waste)

Figure 6-3: Alternative 5 (Green: Ireland Trail; Yellow: Proposed fence; Blue: Existing fence; Red: Waste)

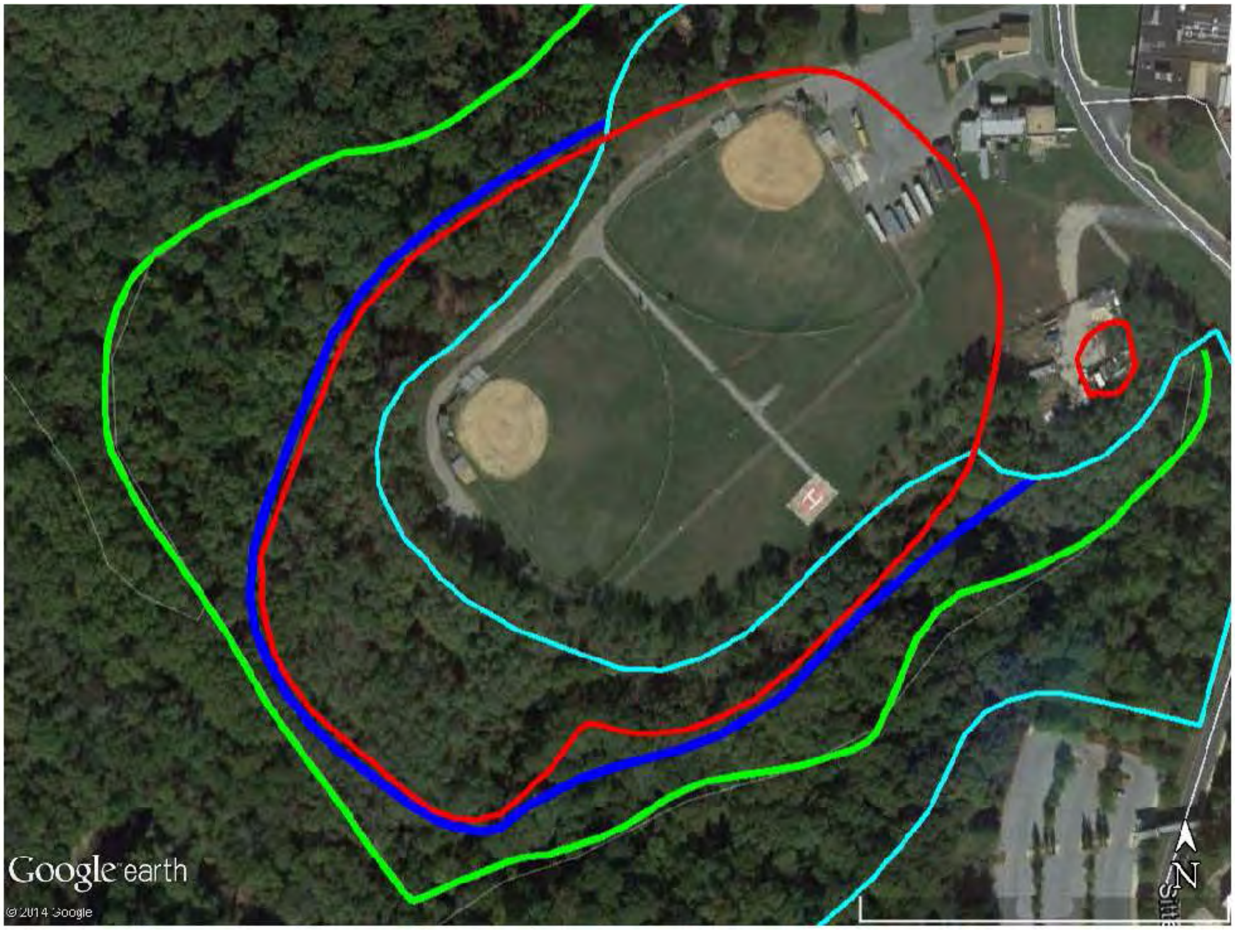

Figure 6-4: Alternative 6 (Green: Ireland Trail; Dark Blue: Proposed fence; Lt Blue: Existing fence; Red: Waste)

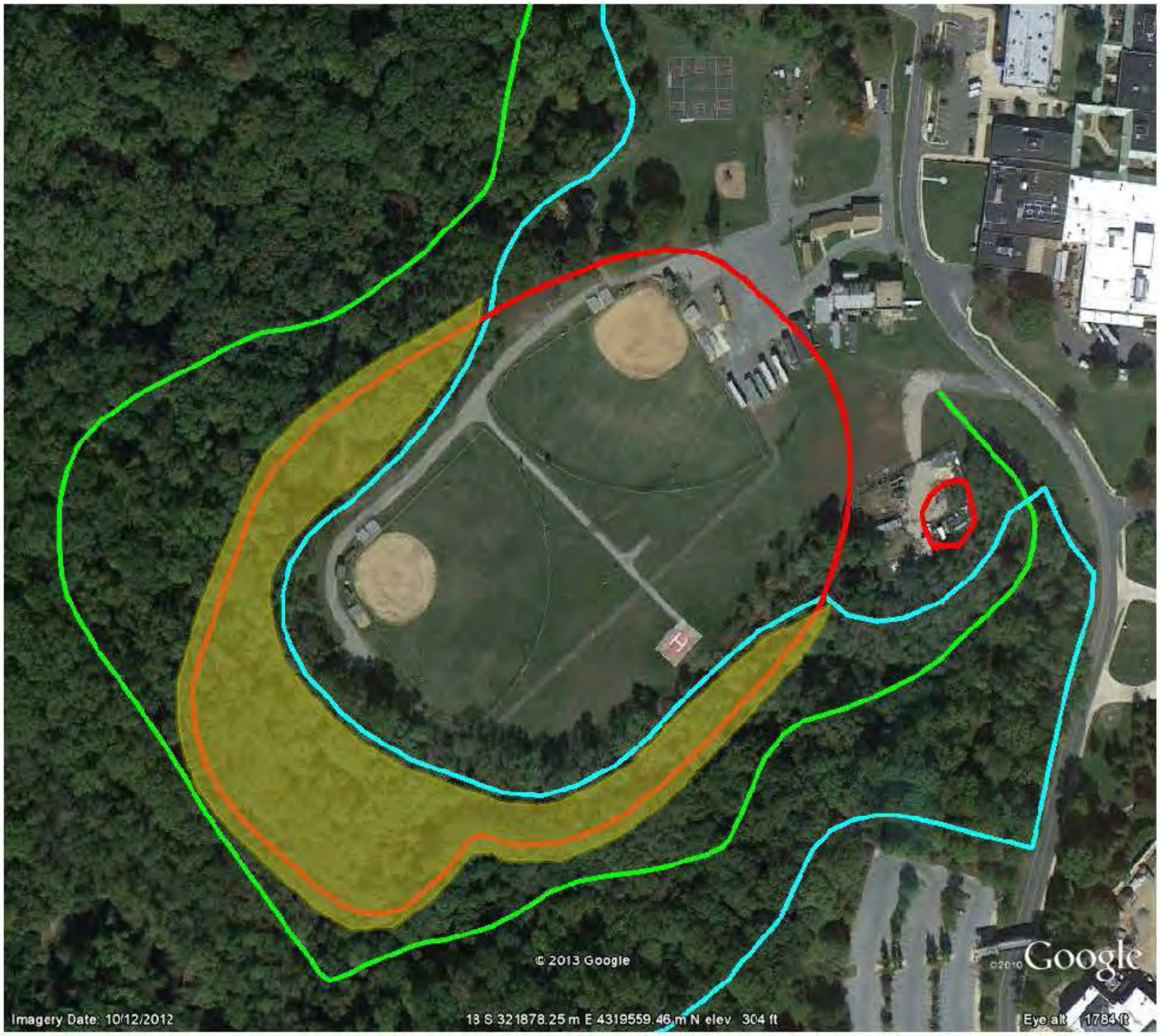

Figure 6-5: Alternatives 7 and 8 (Green: Ireland Trail; Yellow: Proposed cover/excavation; Blue: Existing fence; Red: Waste)

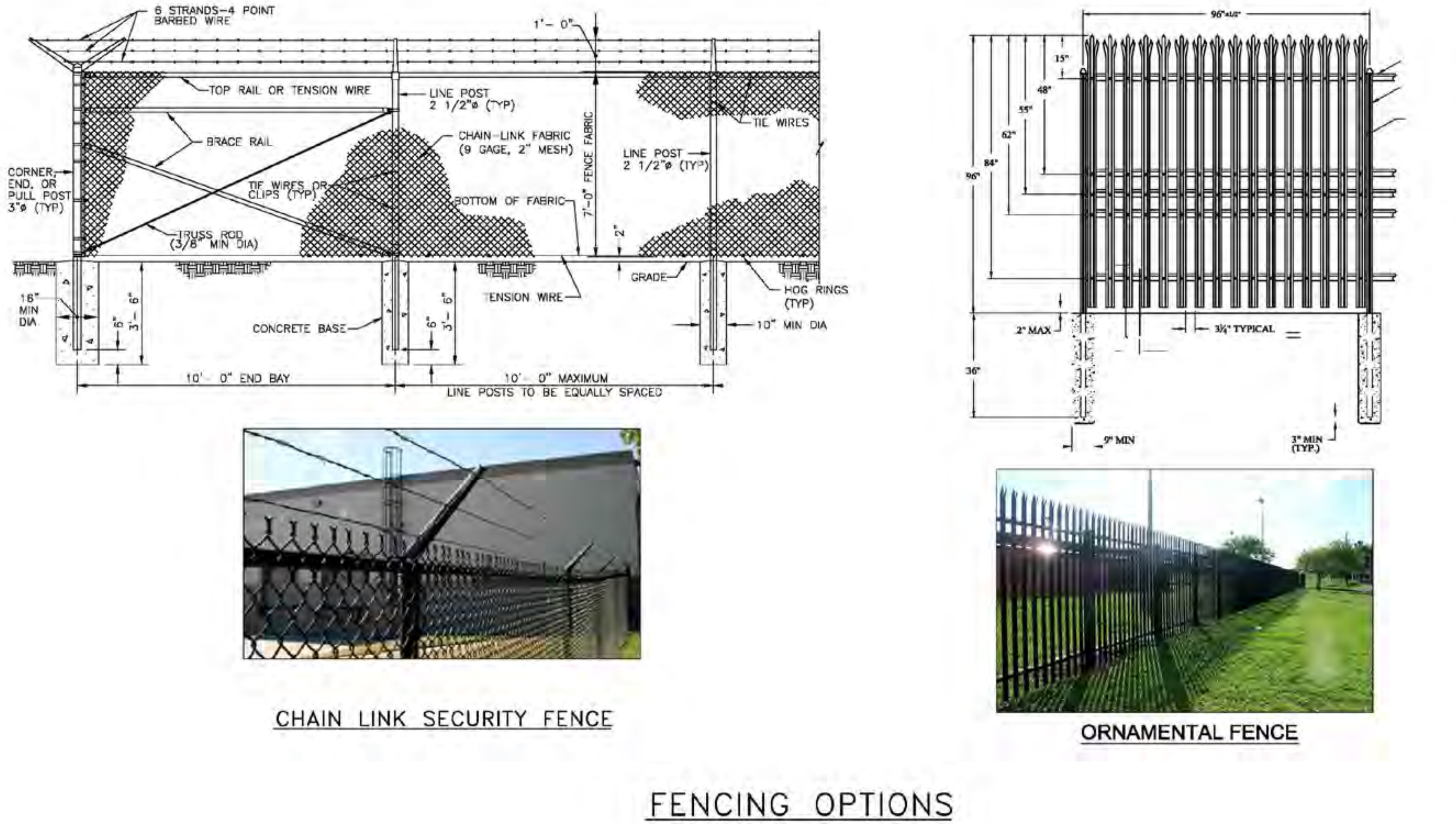

Figure 7-1: Fence Design

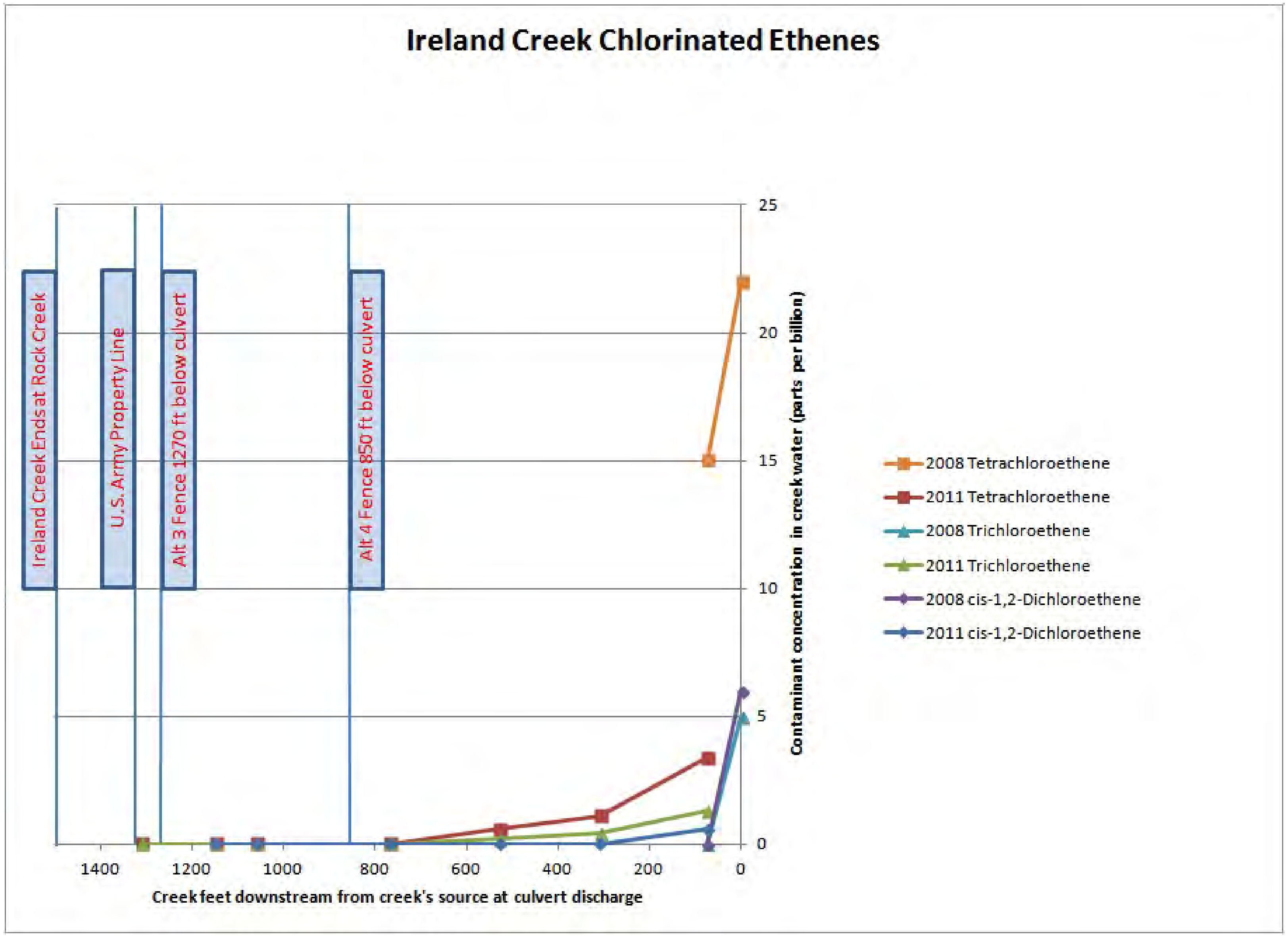

Figure 7-2: Concentrations of chlorinated ethenes in Ireland Creek surface water.

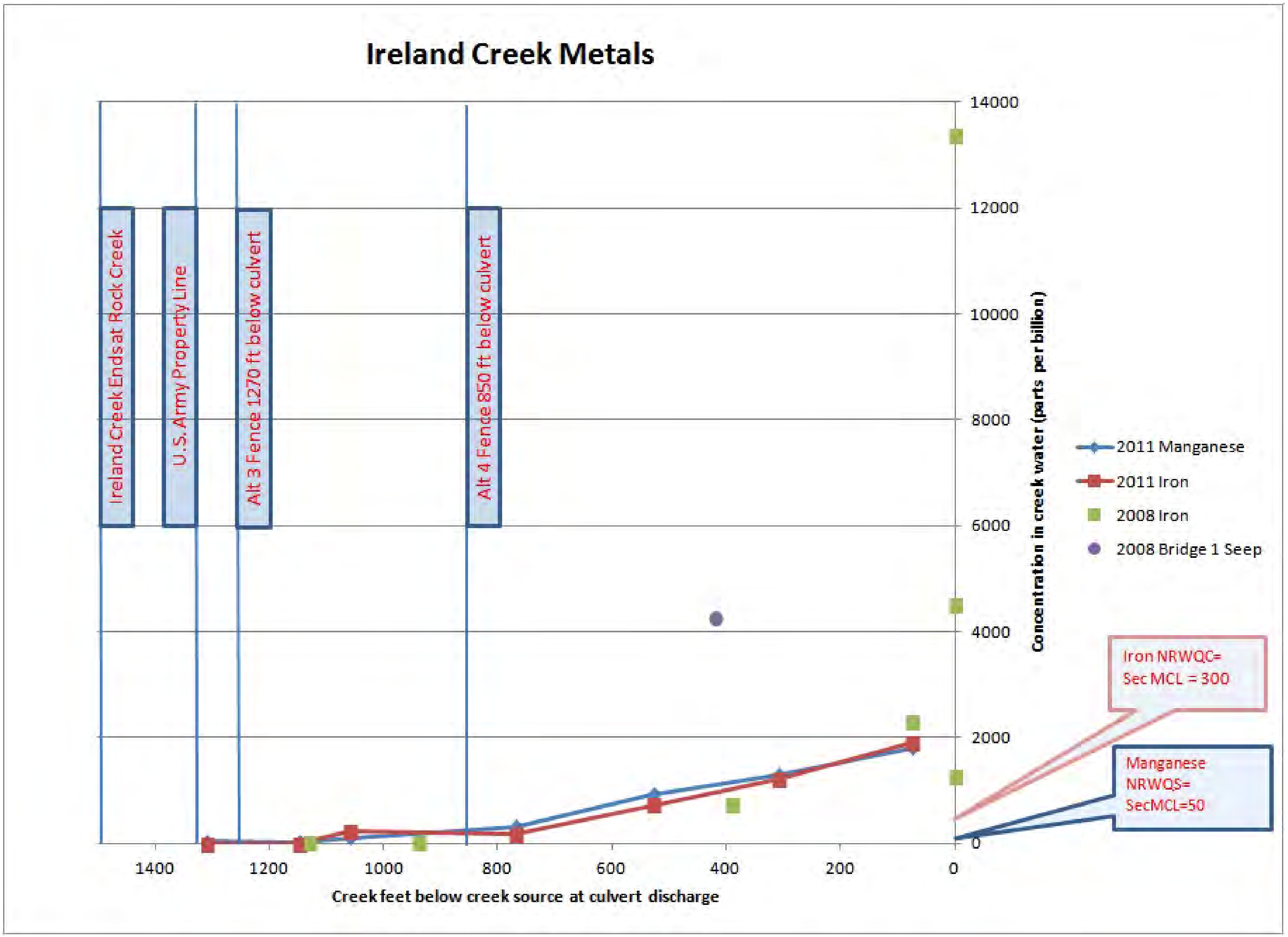

Figure 7-3: Concentrations of metals in Ireland Creek surface water.

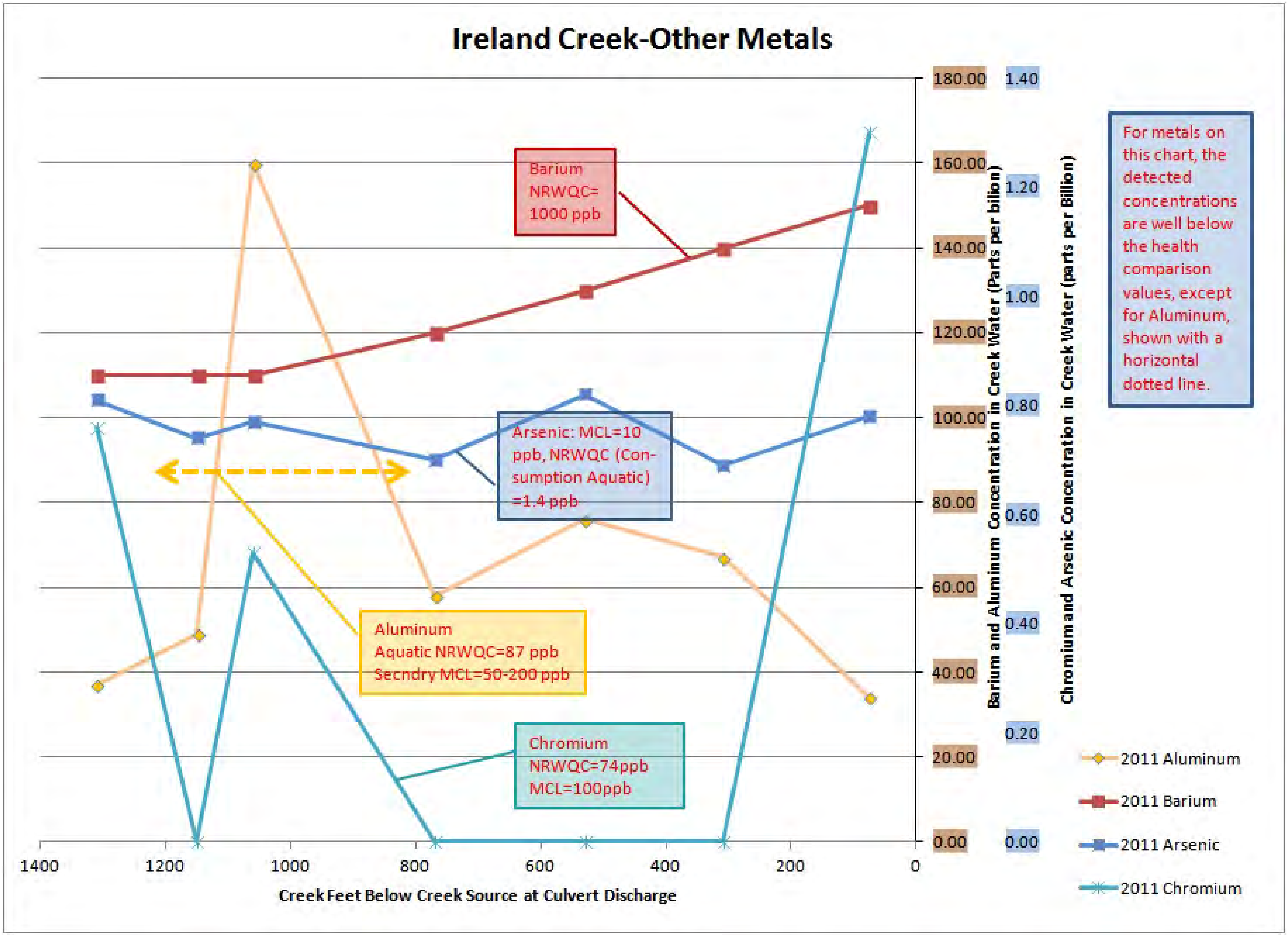

Figure 7-4: Additional Metals in Ireland Creek Surface Water

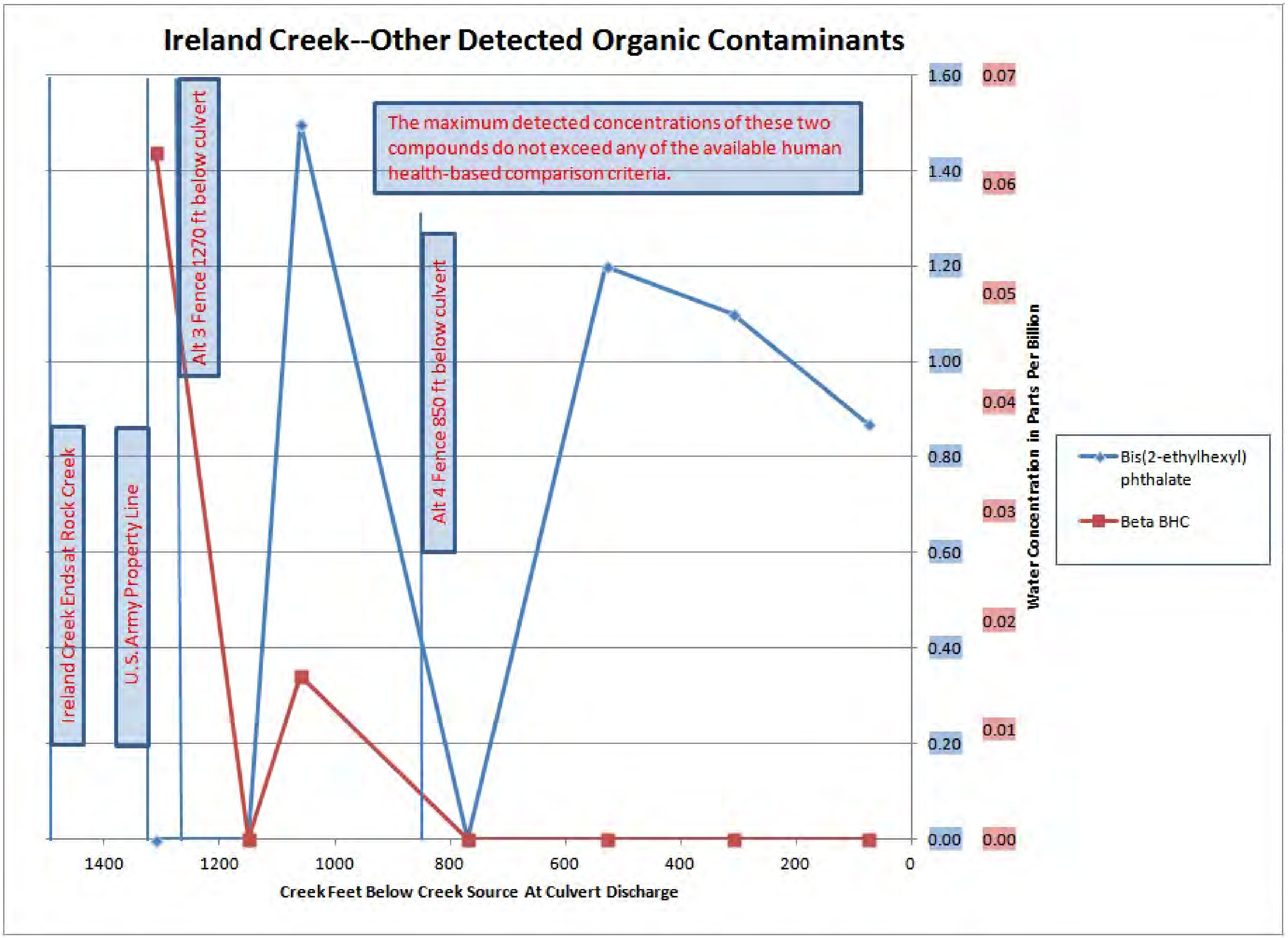

Figure 7-5: Concentrations of other detected organic contaminants in Ireland Creek surface water.

Appendix A: Cost Estimates

Access Notifications – FGA property Boundary

The unit cost of a custom sign will vary according to the specification required. It is assumed that aluminum will be the material selected and that the sign will be approximately 18"x18". Signs such as this are available for approximately $20 each in quantities over 10. Assume 50 signs will be required.

Total Cost of Signs:

50 X $20 = $1,000

Cost to erect signs on chain link fence.

Assume 10 minutes per sign to fasten to chain link fence using wire ties. It will take 8 hours to erect 50 signs. Assume a 2 man crew at a cost of $50 per hour for each man. A two-man crew will be essential in the rougher terrain that it will be necessary to hang signs. Assume $800 labor.

Assume the use of a vehicle and fuel to assist in the effort to hang signs. It is estimated that the vehicle could be a pickup or gator type vehicle. Assume vehicle and fuel would cost $100 for the day.

Signs	$1,000
Labor	$ 800
Logistics	$ 100
TOTAL	$1,900

It is assumed that these signs will require no maintenance for 20 years.

Cost to erect signs on metal posts.

Assume 20 minutes per sign to drive metal posts into soil and erect sign along Ireland Trail. As above signs cost $20 each, posts cost $37 each. Assume the above 2-man crew will require 16 hours to erect 50 signs. Assume $1,600 in labor. Steel fence posts will require maintenance over a 20 year period. Assume complete replacement of the sign posts once in the 20 year period.

Signs	$1,000
Posts	$1,850
Labor	$1,600
Logistics	$ 200
TOTAL	$4,650
Replacement after 10 yrs	$6,249
Total 20 yr cost	$10,899

Alternative 3: Access Controls – Ball Field Landfill and Ireland Creek Valley

This alternative requires the installation of approximately 2,200 feet of 8' high black or green vinyl coated chain link fence paralleling Ireland Trail to the point where Ireland Creek is intersected. The fence will cross Ireland Creek and tie into the existing facility perimeter fence. An aerial photo showing the proposed fence may be seen in Figure 6-1. The cost of installing vinyl coated chain link fencing as illustrated in Figure 7-1, given the rugged terrain at places, is $35 per linear foot. The estimated length of Alternative 3 fence is 2,200 feet. It is assumed that two gates will be installed in the fence and that an average of 10 feet will be cleared on the landfill side of the fence. This is for estimating purposes only as the width of clearance may vary between 2 and 20 feet, depending on the location along the fence and the need for access to the landfill side of the fence at different locations.

Maintenance will be an issue for the life of the fence. It is assumed that tree branches will fall on the fence and vines will have to be cleared as they grow. The fence will need to be inspected at some interval. For estimating purposes, we will assume weekly inspections, by the guard force at no additional cost. Faults will be reported by the guard force and fixed by maintenance people as they are found. For estimating purposes it will be assumed that maintenance will average $10,000 per year including trimming overhanging trees, removing vines and creepers from the fence, fixing/replacing broken down chain link, and keeping the buffer area clear of saplings and brush. This is based on a two-man crew working 4 days a year on the above. The estimate makes some allowance for fence repair/replacement due to vandalism, or storm damage.

Eight foot high black vinyl fencing – 2200 feet – installed	$ 77,000
Clear a 10' wide swath on the landfill side of the fence	$ 1,931
Warning signs on fence, installed	$ 1,900
Two gates	$ 200
TOTAL CAPITAL COST	$ 81,031
MAINTENANCE, 20 Yrs. @ $10,000/ year	$200,000
TOTAL COST OVER 20 YEARS	$281,031

Should more decorative fencing be desired, it is estimated that the cost will be approximately 4 times that of the 8' high barbed wire topped chain link.

Alternative 4: Access Controls – Ball Field Landfill and a Portion of Ireland Creek Valley

As in Alternative 3, this alternative requires the installation of 8' high, barbed wire topped, vinyl coated fence paralleling Ireland Trail. An aerial photo showing the proposed fence may be seen in Figure 6-2. The cost of installing vinyl coated barbed wire fencing as illustrated in Figure 7-1, given the rugged terrain at places, is $35 per linear foot. The estimated length of Alternative 4 fence is 2,600 feet. It is assumed that two gates will be installed in the fence and that an average of 10 feet will be cleared on the landfill side of the fence. This is for estimating purposes only as the width of clearance may vary between 2 and 20 feet, depending on the location along the fence, the need for access to the landfill side of the fence and the presence of wetland restrictions.

Maintenance will be an issue for the life of the fence. It is assumed that tree branches will fall on the fence and vines will have to be cleared as they grow. The fence will need to be inspected at some interval. For estimating purposes, it is assumed weekly inspections, by the guard force at no additional cost. Faults will be reported by the guard force and fixed by maintenance people as they are found. For estimating purposes it will be assumed that maintenance will average $15,000 per year including trimming overhanging trees, removing vines and creepers, fixing/replacing broken down chain link, and keeping the buffer area clear of saplings and brush. This is based on a two-man crew working six days (3 days twice a year) a year on fence maintenance. This estimate makes some allowance for repair/replacement due to vandalism and storm damage.

Eight foot high black vinyl fencing – 2600 feet – installed	$91,000
Clear a 10' wide swath on the landfill side of the fence	$ 2,282
Warning signs installed on fence	$ 1,900
Two gates	$ 200
TOTAL CAPITAL COST	$ 95,382
MAINTENANCE, 20 Yrs. @ $15,000/ year	$300,000
TOTAL COST OVER 20 YEARS	$395,382

Should more decorative fencing be desired, it is estimated that the cost will be approximately 4 times that of the 8' high barbed wire topped chain link.

Alternative 5: Access Controls – Ball Field Landfill

As in Alternative 3, this alternative requires the installation of 8' high, barbed wire topped, vinyl coated fence paralleling Ireland Trail. An aerial photo showing the proposed fence may be seen in Figure 6-3. The cost of installing vinyl coated barbed wire fencing illustrated in Figure 7-1, given the rugged terrain at places, is $35 per linear foot. The estimated length of Alternative 5 fence is 3,200 feet. It is assumed that two gates will be installed in the fence and that an average of 10 feet will be cleared on the landfill side of the fence. This is for estimating purpos1es only as the width of clearance may vary between 2 and 20 feet, depending on the location along the fence and the need for access to the landfill side of the fence.

Maintenance will be an issue for the life of the fence. It is assumed that tree branches will fall on the fence and vines will have to be cleared as they grow. The fence will need to be inspected at some interval. For estimating purposes, we will assume weekly inspections, by the guard force at no additional cost. Faults will be reported by the guard force and fixed by maintenance people as they are found. For estimating purposes it will be assumed that maintenance will average $20,000 per year including trimming overhanging trees, removing vines and creepers, fixing/replacing broken down chain link, and keeping the buffer area clear of saplings and brush. This is based on a two-man crew working 8 days a year on trimming and maintenance and makes some allowance for repairs due to vandalism and storm damage.

Eight foot high black vinyl fencing – 3200 feet – installed	$112,000
Clear a 10' wide swath on the landfill side of the fence	$ 2,806
Warning signs installed on fence	$ 1,900
Two gates	$ 200
TOTAL CAPITAL COST	$116,906
MAINTENANCE, 20 Yrs. @ $20,000/ year	$400,000
TOTAL COST OVER 20YEARS	$516,906

Should more decorative fencing be desired, it is estimated that the cost will be approximately 4 times that of the 8' high barbed wire topped chain link.

Alternative 6: Access Controls – Newly Defined Landfill Waste Boundary

As in Alternative 3, this alternative requires the installation of 8' high, barbed wire topped, vinyl coated fence just outside of the landfill waste boundary. An aerial photo showing the proposed fence may be seen in Figure 6-3. The cost of installing vinyl coated barbed wire fencing illustrated in Figure 7-1, given the rugged terrain at places, is $35 per linear foot. The estimated length of Alternative 6 fence is 2,230 feet. It is assumed that two gates will be installed in the fence and that an average of 10 feet will be cleared on both sides of the fence. This is for estimating purposes only as the width of clearance may vary, depending on the location along the fence and the need for access to the landfill side of the fence.

Maintenance will be an issue for the life of the fence. It is assumed that tree branches will fall on the fence and vines will have to be cleared as they grow. The fence will need to be inspected at some interval. For estimating purposes, we will assume weekly inspections, by the guard force at no additional cost. Faults will be reported by the guard force and fixed by maintenance people as they are found. For estimating purposes it will be assumed that maintenance will average $20,000 per year including trimming overhanging trees, removing vines and creepers, fixing/replacing broken down chain link, and keeping the buffer area clear of saplings and brush. This is based on a two-man crew working 8 days a year on trimming and maintenance and makes some allowance for repairs due to vandalism and storm damage.

Eight foot high black vinyl fencing – 2,230 feet – installed	$78,050
Clear a 10' wide swath on the both sides of the fence	$ 6,672
Warning signs installed on fence	$ 1,900
Two gates	$ 200
TOTAL CAPITAL COST	$ 86,822
MAINTENANCE, 20 Yrs. @ $20,000/ year	$400,000
TOTAL COST OVER 20 YEARS	$486,822

Should more decorative fencing be desired, it is estimated that the cost will be approximately 4 times that of the 8' high barbed wire topped chain link.

Alternative 7: Soil Cover

This alternative includes the cost for importing and placing 17,569 cu yds of clean fill. It also includes the cost of tree removal and revegetating areas where trees and natural vegetation had to be removed. It includes the cost of ground cover. At this point it is assumed that all of the landfill slopes will be covered with clean fill, i.e. there will be no further effort put into mapping the location of wastes outside of the existing landfill boundary. This estimate assumes that all landfill slopes will be stripped of vegetation and covered with soil 2 feet deep. After vegetation is established on the slope it is assumed that the ground cover placed on the slope will require minimal maintenance other than spot repairs. Assume $10,000 a year, one or two days per year of maintenance that would consist of spot erosion repairs where necessary.

Prepare work plans	$ 30,000
Cut and chip trees to 24” diameter - $12,800 per acre	
To do 5.5 acres	$ 70,400
Spread fill to 2 feet deep over 5.5 acre	
Equipment and crew (47.4 days, $2,607/day)	$ 123,572
Material delivery ($2.92/cu yd, 17,569 cu yd)	$ 51,301
Compaction ($7.05/cu yd)	$ 123,861
Fill cost – Top soil (4,392 cu yd @$66/ cu yd)	$ 289,872
Fill cost - Common (13,177 cu yd @46/ cu yd)	$ 606,142
Vegetate landfill bank – Hydroseed 239,613 SF @$53.30/MSF	$ 12,769
TOTAL CAPITAL COST	$1,307,917
MAINTENANCE, 20 Yrs. @ $10,000/ year	$ 200,000
TOTAL COST OVER 20 YEARS	$1,507,917

Alternative 8: Waste Removal

This alternative includes the cost for excavating and removing waste from the steep slopes of the landfill. To do this the waste outside the existing landfill fence must be found. As discussed in the RI, additional mapping of suspected waste will be required by either additional test pitting or soil boring. This estimate assumes 30 shallow test pits or bore holes. Any waste excavated must be staged, characterized, transported, and disposed of at a suitable facility. It is expected that wastes will be either medical or simple household in nature. Hazardous waste is not expected and this estimate does not take into account hazardous waste disposal costs, but does include TCLP test for characterization. It is estimated that a minimum of 2.5 noncontiguous acres of the 5.5 acre site will be excavated to a depth of 2 feet. Waste excavation and staging in containers will be difficult due to the steep slopes in some areas. Given the nature of research medical waste, extra cost has been added to take into account the use of level B personal protective gear for at least some of the excavation at a 22% premium. An additional premium of 50% has been added to take into account the fact that some of the sites may be inaccessible to machinery and may have to be hand excavated. Careful waste excavation should allow preservation of natural vegetation on the landfill slopes at places where no waste is identified. The excavation would not remove all waste in the area, as anything below 2 feet would be left in place. Excavations would be covered in top soil and revegetated through hydroseeding. Maintenance costs would be minimal as the year's progress and the areas excavated and backfilled are allowed to revert to their natural state. Some erosion and sedimentation controls will be necessary in the first several years to minimize erosion.

Prepare Work Plan, including waste sampling plan, and permits	$ 55,000
Test pitting or boring to locate wastes outside of the existing landfill fence	
30 pits or 30 bores (Bores 2'-3'deep, pits approx 1 cu yd ea, heavy soil)	
Means 2013, 02. 32. 19.10 Indicates hand auger @ $175 ea.	
For estimate assume 30 pits.	$ 5,250
Cut and chip trees to 24" diameter in areas to be excavated,	
Assume 2.5 acres or less, (Means 31 11 10 .10 0300)	$ 38,500
Excavate and backfill waste locations and stage waste in roll off	
containers. Assume 2.5 acres dug Two feet deep = 8064 cu yd	
Excavate 8064 cu yd @ $26.50/cu yd (Means 31 23 16.16 6030) add	
22% premium for Level B (Means02 56 13.10 0035) $213,696X1.22 =	$260,709
50% premium for steep slopes and possible hand excavation	$130,354
Backfill by hand and compact 8064 cu yds of topsoil, @$60.50/cu yd	$487,872
Stabilize with geotextile@ $2.36/ SY X 10,847 SY (Means 31 32 19.16 1510)	$ 25,600
Revegetate landfill bank – Hydroseed 108,900 SF @$53.30/MSF	$ 5,804

Characterize excavated waste 81- 40 cu yd dumpsters, one TCLP each @ $800 ea.	$ 64,800
Store Transport and Dispose of excavated waste 81 dumpsters @ $1276/wk for 2 weeks	$ 206,712
TOTAL CAPITAL COST (2.5 acre)	$1,280,601
MAINTENANCE, 20 Yrs. @ $6,000/ year (this may be front loaded with little maintenance later)	$ 120,000
TOTAL COST for 2.5 ACRE OVER 20 YEARS	$ 1,400,601
TOTAL COST FOR 5.5 ACRES OVER 20 YEARS	$ 3,081,322

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