Five-Year Review Report
(Second Five-Year Review Report)

for the

Maxey Flats Disposal Site
Fleming County, Kentucky

United States Environmental Protection Agency – Region 4

Atlanta, Georgia

September 2007

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9/28/07

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List of Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
BORP	Balance of Remedial Phase
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Commonwealth	The Commonwealth of Kentucky
DAW	Dry Active Waste
EDB	East detention basin
EMDC	East main drainage channel
EPA	U.S. Environmental Protection Agency
FCP	Final Closure Period
HASP	Health and Safety Plan
IMP	Interim Maintenance Period
IRP	Initial Remedial Phase
LLRW	Low Level Radioactive Waste
LMB	Lower Marker Bed
LNM	Lower Nancy Member
LR/D	Leachate Removal and Disposal
LSF	Leachate Storage Facility
MFDS	Maxey Flats Disposal Site
NCP	National Contingency Plan
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NECO	Nuclear Engineering Company
NRC	U.S. Nuclear Regulatory Commission
O&M	Operations and Maintenance
OSWER	Office of Solid Waste and Emergency Response
PCP	Process Control Program
PSVP	Performance Standards and Verification Plan
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control

RA	Remedial Action
RCA	Radiologically Controlled Area
RCN	Runoff Curve Number
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
RW	Remaining Work
SARA	Superfund Amendments and Reauthorization Act
SOW	Statement of Work
SPP	Settling Private Parties

Executive Summary

The Maxey Flats Disposal Site (MFDS), located in Fleming County, Kentucky, is an inactive low-level radioactive waste site owned by the Commonwealth of Kentucky in Fleming County, Kentucky, approximately ten (10) miles northwest of Morehead, Kentucky. The remedy selected at the MFDS is natural stabilization, which will allow the materials in the trenches to subside naturally to a stable condition prior to installation of a final engineered cap. Installation of an interim cap was completed in 2003. Natural stabilization was predicted to take 35 to 100 years. Construction completion at the site will not be achieved until the final cap is in place.

This is the second five-year review of the ongoing remedy. The selected remedy at the MFDS is expected to be protective of human health and the environment at the conclusion of the remedial action (RA), and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (*from WasteLan*): Maxey Flats Disposal Site		
EPA ID (*from WasteLan*): KYD980729107		
Region: 4	**State:** Kentucky	**City/County:** Fleming

SITE STATUS	
NPL status: Final Deleted Other (specify): _____	
Remediation status (choose all that apply): Under construction Operating Complete	
Multiple OUs?* YES NO	**Construction completion date:** October 3, 2003 - Initial Phase Final Phase - Pending
Has site been put into reuse? YES NO	

REVIEW STATUS	
Lead agency: EPA State Tribe Other Federal Agency _____	
Author name: Pam Scully	
Author title: Remedial Project Manager	**Author affiliation:** U.S. EPA, Region 4
Review period:** 12/2006 to 9/2007	
Date(s) of site inspection: 25 April 2007	
Type of review: Post-SARA Pre-SARA NPL-Removal only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion	
Review number: 1 (first) 2 (second) 3 (third) Other (specify) _____	
Triggering action: Actual RA Onsite Construction at OU #NA Construction Completion Other (specify)	Actual RA Start at OU #_____ Previous Five-Year Review Report
Triggering action date (*from WasteLAN*): September 2002	
Due date (*five years after triggering action date*): September 2007	

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd

Issues:

No deficiencies that affect the protectiveness of the remedy were noted during the second five-year review.

Recommendations and Follow-up Actions:

No recommendations or required actions are needed to correct deficiencies affecting protectiveness based on this five-year review.

Protectiveness Statement(s):

The selected remedy at the MFDS is expected to be protective of human health and the environment at the conclusion of the RA, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Other Comments:

There are a number of decisions made during the Initial Remedial Phase (IRP) that have changed the requirements described in the ROD and need to be documented in an Explanation of Significant Differences (ESD). The ROD required the installation of an infiltration monitoring system to continuously verify remedy performance and detect the accumulation of leachate in disposal trenches. Continuous water level monitors were installed in eighty-three sumps during the IRP. Due to extensive malfunctions and accuracy concerns, the electronic water level monitors were discontinued from use and only manual measurements are now being used. The Commonwealth documented this change in a Technical Change submitted to and approved by EPA, and it should also be documented in an ESD.

The ROD identified ground water indicator contaminants of concern as listed on Table III-2. Based on the historical site data and data collected by the Commonwealth during the IRP, the configuration of the site, the mobility of tritium, and the use of realistic exposure pathways, it was determined that compliance testing and monitoring related to source control should focus on water borne pathways for tritium. Analysis for other contaminants will not occur unless any annual average concentration of tritium exceeds 50% of the screening assessment (20pCi/ml or

100 pCi/ml as applicable) during the previous five years. This determination should be documented in an ESD.

The ROD also required the installation of a ground water flow barrier, if necessary. Hydrogeologic evaluations of Maxey Flats indicate that ground water movement through the rock strata into the disposal trenches may be negligible. Regardless, the potential pathway for ground water flow into the trenches through the narrow neck at the north side of Maxey Flats where the trench area is connected to the main portion of the Maxey Plateau was eliminated during IRP Construction through construction of the North Channel. A review of the monitoring data reveals little change in leachate levels in the sumps and a site wide change from the exterior to the interior is not present, confirming that no Horizontal Flow Barrier other than the North Channel will be required. This determination should be documented in an ESD.

The end of the Interim Maintenance Period (IMP) and the beginning of the Final Closure Period (FCP) is defined as the time when subsidence of the trenches has nearly ceased and final cap installation can begin. EPA and the Commonwealth of Kentucky agree that subsidence in the trenches has been significantly lower than originally anticipated. EPA will confer with the Commonwealth of Kentucky to determine when the Final Closure Period should begin.

I. Introduction

The MFDS (MFDS or Site), located in Fleming County, Kentucky, is an inactive low-level radioactive waste site owned by the Commonwealth of Kentucky in Fleming County, Kentucky, approximately 10 miles northwest of Morehead, Kentucky.

The purpose of the five-year review is to determine whether the remedy at the MFDS is protective of human health and the environment. The methods, findings, and conclusions of the review are documented in the Five-Year Review report. In addition, the Five-Year Review report identifies issues found during the review, if any, and includes recommendations to address them.

The United States Environmental Protection Agency (EPA or Agency) is preparing this Five-Year Review report pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the president selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review, it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP. 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

EPA Region 4 conducted the five-year review of the remedy implemented at the MFDS in Fleming County, Kentucky. The review was conducted between December 2006 and August 2007. This report documents the results of that review. *de maximis, inc.*, a contractor for the Settling Private Parties (SPPs) conducted analyses and provided information in support of the five-year review. EPA conducted the site inspection.

This is the second five-year review for the MFDS. The first five-year review was completed in 2002, five years after mobilization for the remedial action, which is the triggering action for this statutory review. The five-year review is required because hazardous substances pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestrictive exposure. The next five-year review will be required in September 2012.

II. Site Chronology

The following is a list of the chronology of events that occurred at the MFDS.

Month/Year	Activity
May 1963 – Dec 1977	NECO managed and operated the disposal of approximately 4,750,000 cu. ft. of Low Level Radioactive Waste (LLRW).
1973 – Apr 1986	Evaporator operations processed more than 6,000,000 gallons of liquid.
1981	PVC cover was placed over the disposal trenches
1986	EPA lists Maxey Flats Disposal Site on National Priorities List
1987	PRPs sign Administrative Order by Consent (EPA Docket No. 87-08-C) for the Remedial Investigation and Feasibility Study (RI/FS). PRPs formed the Maxey Flats Steering Committee
Dec 1988 – Nov 1991	EPA performed Emergency Action
Jul 1989	EPA approves the SPPs' RI Report
May 1991	EPA submits the FS and the Administrative Record to the public.
Sep 1991	EPA issues the Record of Decision for the MFDS, Fleming County, Kentucky.
1992	EPA issues Special Notice to the Potentially Responsible Parties.
1992-1995	Settling Defendants Consent Decree and Statement of Work, *de minimis* Consent Decree, Settlement Agreement between the Federal Agencies and the Settling Private Parties (SPPs), Steering Committee Participation and Cost Sharing Agreement, and the Operating Agreement of the Maxey Flats Site IRP, L.L.C. negotiated among Settling Private Parties, Commonwealth of Kentucky, Settling Federal Agencies and EPA.
Jul 1995	Consent Decree, U.S. District Court for the Eastern District of KentuckyNo. 95-58, for the Maxey Flats Disposal Site is lodged. Settling Private Parties (SPPs) initiate installation of Construction cover.
Oct 1995	SPPs complete installation of Construction cover.

Month/Year	Activity
Apr 1996	Consent Decree is entered by the Court. Initial Remedial Phase (IRP) Remedial Design activities begun by SPPs; IRP Monitoring and Maintenance activities begun by the Commonwealth
Jun 1997	SPPs mobilize to site, initiate Leachate Removal / Disposal (LR/D) Design Construction.
Jan 1998	EPA approves SPP's Final LR/D Design Report
Aug 1998	EPA holds Public Open House at MFDS
Sep 1998	SPPs complete LR/D Construction and initiate LR/D operations
Feb 1999	EPA holds Public Meeting, Fleming County Courthouse to discuss LR/D Operations and winter shutdown.
Jun 1999	SPPs initiate Remaining Work with Southeast Cap construction.
Oct 1999	EPA holds Public Open House at MFDS to review ongoing IRP LR/D activities.
Aug 2000	EPA finds Leachate Removal Performance Standards met, Leachate removal operations cease and shutdown/ decommissioning is initiated.
Sep 2000	EPA holds Public Open House at MFDS to discuss LR/D decommissioning and RW construction.
Oct 2000	SPPs initiate balance of RW construction.
Jun 2002	EPA conducts Five-Year Review. SPPs continue RW Construction.
Jan 2003	Commonwealth begins Interim Maintenance Period (IMP) Monitoring
May 2003	SPPs complete the IRP work.
Jun 2003	SPPs submit IRP Remedial Action (RA) Construction Report to EPA. EPA approves Commonwealth IMP Work Plan.
Oct 2003	EPA issues the IRP Certification of Completion.
Apr 2006	Commonwealth holds Public Open House at MFDS.
Dec 2006 – Present	EPA performs second Five-Year review.

III. Background

Physical Characteristics

The MFDS includes an inactive low-level radioactive waste landfill and a 464-acre buffer zone. The whole site encompasses 770 acres. The Site is owned by the Commonwealth of Kentucky. The landfill is capped to reduce groundwater infiltration.

The MFDS is located in the Appalachian Plateau, in the Knobs physiographic region of northeast Kentucky, an area characterized by relatively flat-topped ridges (flats) and hills (knobs). The MFDS is located on a spur of Maxey Flats, one of the larger flat-topped ridges in the region. The MFDS is bounded by steep slopes to the west, east, and south and is approximately 350 feet above the adjacent valley bottoms.

Numerous studies have reported on the geology of the MFDS. The following text is a summary of the geology, hydrology, and hydrogeology from the RI report and the ROD.

The Maxey Flats Disposal Site lies in a tectonically stable region of North America with few exposed faults and relatively infrequent earthquakes. The rock units exposed in the area surrounding the MFDS consist of shale, siltstone, and sandstone ranging in age from the Silurian to Mississippian (320 to 430 million years old). In the MFDS area, the rock units dip 25 feet per mile (0.3 degrees); regionally they dip to the east at 30 to 50 feet per mile.

The Nancy Member of the Borden Formation is exposed on the hilltop at Maxey Flats and is 27 to 60 feet thick. The unit is mostly shale with two laterally extensive siltstone beds, the Lower Marker Bed (LMB) and Upper Marker Bed (UMB). These beds were up to 2.8 feet thick at locations encountered during drilling operations at Maxey Flats

Underlying the Nancy Member, the Farmers member of the Borden Formation is characterized as an interbedded siltstone and shale, approximately 29 to 42 feet thick. Underlying the Farmers Member is the 4 to 7 feet thick shale of the Henley Bed, 17 to 18 feet thick Sunbury Shale, and 21 feet thick Bedford Shale.

Fractures are present in all rock units at the MFDS with fracture sets oriented in descending order, northeast-southwest, northwest-southeast, and north-south. The fracture sets are generally within 20 degrees of vertical. The weathered shale of the Nancy Member is the most highly fractured.

The distinguishing feature of the Nancy Member, and perhaps that of the MFDS geology, is the LMB of the Nancy Member. The LMB is a thin siltstone layer that is generally flat-lying (some local undulations of the bed are present), fractured and weathered, and lies approximately 15 to 25 feet below ground surface. The LMB has been identified as the principal leachate flow pathway at the MFDS and underlies or intersects the majority of disposal trenches. Consequently, the LMB is a highly contaminated geologic unit at the MFDS. Another distinguishing characteristic of the LMB is that underlying units are hydraulically connected to the LMB.

Groundwater resources in a three county area, including the Maxey Flats area, are very limited, with adequate residential supplies (up to 500 gallons per day (gpd)) generally available only in broad valley bottoms like the Licking River valley. The small valleys adjacent to MFDS would not produce enough water for a dependable domestic water supply. On hills the Borden Formation yields little water (less than 100 gpm), and almost no water from wells drilled in shale. Groundwater is sometimes present in the fractures of rock units. Wells drilled in the Ohio Shale can provide up to 500 gpd but locally can be of poor quality.

The residents of Maxey Flats have been on a public water supply since about 1985. Before then, water was typically obtained from shallow wells dug in the soil or weathered shale of the Nancy Member, which supplied approximately 25 to 50 gpd. Most investigators have considered the water to be from a perched water table. The source of this water was apparently from secondary porosity in the soil or weathered rock, and also from roof downspouts routed into the wells. These shallow wells were unreliable sources of water and may have acted more as storage cisterns than as wells.

Vertical migration of groundwater between geological strata is limited by low permeability shale layers, which act as aquitards. Because the MFDS is bounded on the

three sides by steep slopes, the contaminated leachate migrating horizontally through the fractured siltstone layers generally moves into the bottom of the soil layer on these hillslopes. However, as evidenced by the occurrence of seeps on the east hillside, not all leachate migrates to the bottom of the soil layer. A cross-section of the geologic units at the MFDS is included as Figure III-1.

Hydrogeologic evaluations of the MFDS indicate that ground water movement through the rock strata into the disposal trenches may be negligible. Regardless, the potential pathway for ground water flow into the trenches through the narrow neck at the north side of Maxey Flats where the trench area is connected to the main portion of the Maxey Plateau was eliminated during IRP Construction by construction of the North Channel.

Drip Springs Creek, located on the west side of the MFDS, and No Name Creek, located on the east side of the MFDS, both flow into Rock Lick Creek to the southwest of the MFDS. Rock Lick Creek flows into Fox Creek approximately 2 miles southwest of Maxey Flats. Fox Creek flows into the Licking River, approximately 6.5 miles west of MFDS, which empties into the Ohio River near Cincinnati, Ohio, approximately 100 miles from Maxey Flats.

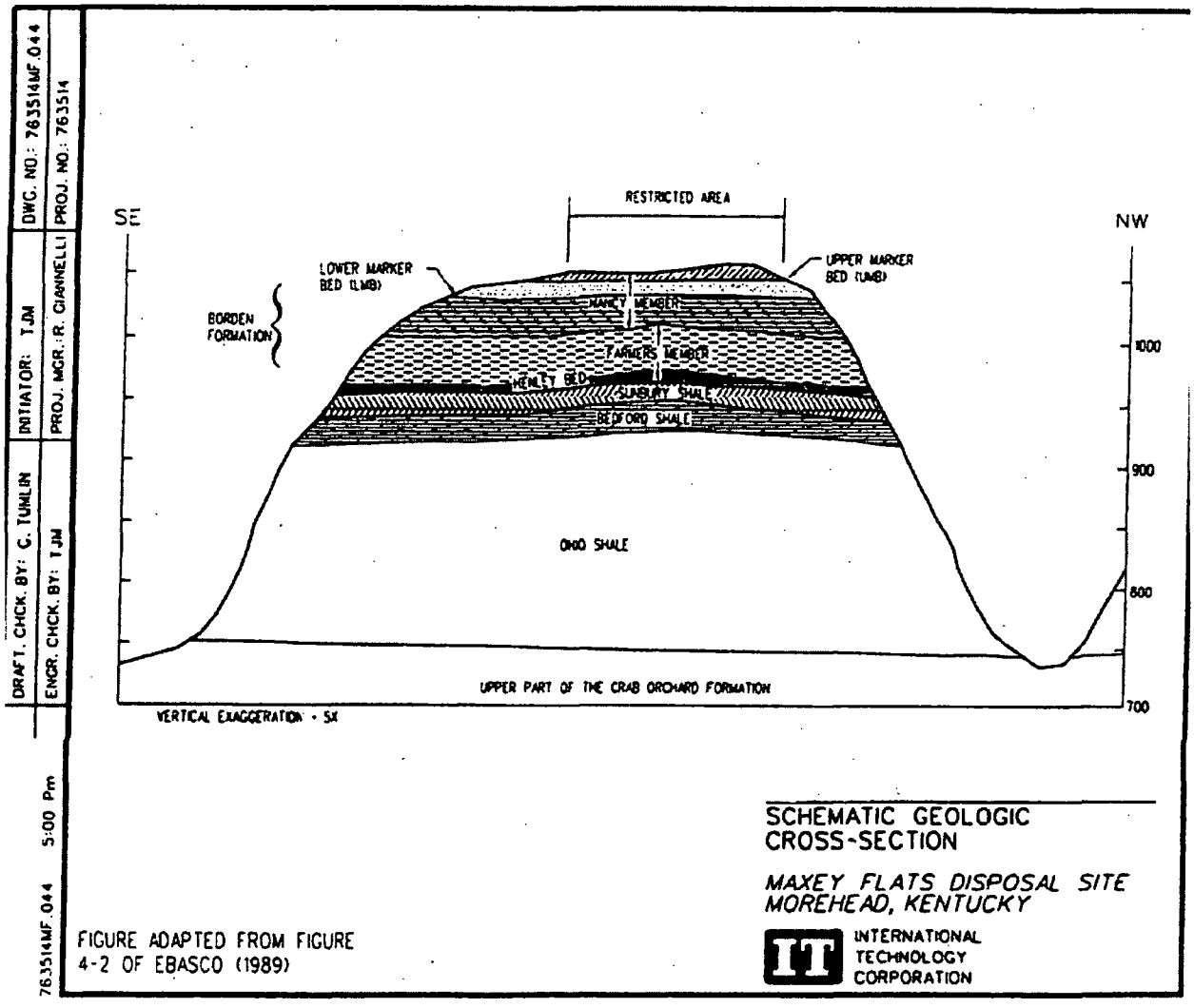

Table III-1: Geologic Cross Section of Maxey Flats; IT Corporation's Remedial Design Report (Figure comes from Ebasco's FS report)

Land & Resource Use

The land surrounding the MFDS is primarily mixed woodlands and open farmland. A number of residences, farms and some small commercial establishment are located on roadways near the site. The region around the site is best characterized as a rural, undeveloped area distinguished by low-density housing and rugged topography. The Maxey Flats region has a public water supply system that is operated by the Fleming County Water Association. The limited employment base of the area, along with the limited roadway and utilities access, makes large-scale economic expansion in this region

unlikely. Future land use can be expected to follow the same historical patterns for the area: small family farms, crop raising, logging activities and moderate growth in population.

During the IRP, the Settling Defendants purchased additional land consisting of 197 acres surrounding the site, to be added to the Buffer Zone, pursuant to the Consent Decree. This Buffer Zone area surrounding the original site boundary of 306.5 acres is an additional 464 acres, including the IRP purchase. Access to the Buffer Zone is restricted and monitored and maintained by the Commonwealth.

The perennial streams at the base of the plateau, outside of the MFDS Buffer Zone, are used as freshwater supplies for livestock raised in the valleys. Fox Creek is also used for light recreational fishing. The Licking River is used both for recreational purposes and as a source of public drinking water through municipal water systems upstream and downstream of Maxey Flats. The nearest municipal water intake downstream of the MFDS on the Licking River is located approximately 54 miles from the site.

History of Contamination

In January 1963, the Commonwealth of Kentucky issued a license to Nuclear Engineering Company, Inc. (NECO) for the disposal of solid by-product, source and special nuclear material on a 252-acre tract now known as MFDS. From May 1963 through December 1977, NECO managed and operated the disposal of an estimated 4,750,000 cubic feet of low-level radioactive waste (LLRW) at the Site. Environmental monitoring in 1972 by the Commonwealth revealed possible migration of radionuclides from the Restricted Area. A special study was performed by the Commonwealth in 1974 that confirmed that tritium and other radioactive contaminants were migrating out of the trenches and that some radioactive material had migrated into unrestricted areas. In 1977, it was determined that leachate was migrating through the subsurface geology and NECO was ordered to cease the receipt and burial of radioactive waste. NECO's license was transferred back to the Commonwealth Department of Natural Resources and Environmental Protection in 1979, when the Commonwealth hired independent contractors to assist in stabilization and maintenance activities for the 27-acre trench

disposal area.

From 1973 through April 1986, an evaporator was operated at the Site as a means of managing the large volume of water infiltrating the disposal trenches as well as waste water generated by on-site activities. The evaporator processed over 6,000,000 gallons of liquids during its operation and the evaporator concentrates were disposed of on-site.

Initial Response

From 1983 to 1986, MFDS was in the process of being listed on EPA's National Priorities List (NPL) at the request of the Commonwealth. In 1986, the listing was finalized and EPA issued general notice letters to 832 Potentially Responsible Parties (PRPs) informing them of their potential liability with respect to site contamination. In March 1987, 82 PRPs signed an Administrative Order by Consent to perform the Remedial Investigation and Feasibility Study (RI/FS).

In December 1989, EPA initiated an Emergency Response Action at Maxey Flats due to an imminent threat to public health, welfare, and the environment posed by the potential release of liquids stored in on-site storage tanks. EPA installed heaters in the tank farm building to prevent freezing and possible rupturing and installed additional storage capacity on-site. EPA also solidified 286,000 gallons of radioactive liquids stored in the tanks and on the floor of the tank building. These 216 solidified blocks were buried in newly constructed trenches within the Restricted Area.

Basis for Action

The MFDS has approximately 4.8 million cubic feet of low level radioactive waste buried onsite. Radionuclides and non-radionuclides have been found in ground water, soil and surface water at the Site. Tritium is the most abundant and most mobile of the indicator contaminants and has therefore been identified as the primary contaminant of concern. Indicator contaminants identified in the ROD are listed in Table III-2. No groundwater goals have been established for these indicator contaminants.

TABLE III -2
INDICATOR CONTAMINANTS

Radionuclides	Non-Radionuclides
Hydrogen-3 (Tritium)	Arsenic
Carbon-14	Benzene
Cobalt-60	Bis (2-Ethylhexyl) Phthalate
Strontium-90	Chlorobenzene
Technetium-99	Chloroform
Iodine-129	1, 2-Dichloroethane
Cesium-137	Lead
Radium-226	Nickel
Thorium-232	Toluene
Plutonium-238	Trichloroethylene
Plutonium-239	Vinyl Chloride
Americium-241	

An assessment of site risks was performed using existing site data and information gathered during the remedial investigation. The risk assessment evaluated the contaminant sources and exposure pathways posing the greatest potential threat to human health and the environment. The ground water pathway was determined to be the pathway with the highest potential risk. It was also demonstrated that if left uncontrolled, individuals might unintentionally become exposed to radionuclide and non-radionuclide contaminants at unacceptable levels.

IV. Remedial Actions

Remedy Selection

The remedy selected at the MFDS is natural stabilization, which will allow the materials in the trenches to subside naturally to a stable condition prior to installation of a final engineered cap. The major components of the selected remedy include:

- Excavation of additional on-site disposal trenches for disposal of site debris and solidified leachate;
- Demolition and on-site disposal of site structures;
- Extraction, solidification, and on-site disposal of approximately three million gallons of trench leachate;
- Installation of an initial cap consisting of clay and a synthetic liner;
- Re-contouring of capped disposal area to enhance management of surface water runon and runoff;
- Installation of a ground water flow barrier, if necessary;
- Installation of an infiltration monitoring system to continuously verify remedy performance and detect the accumulation of leachate in disposal trenches;
- Monitoring of ground water, surface water, air, selected environmental indicators, and rates of subsidence;
- Procurement of a buffer zone adjacent to the existing site property boundary, estimated to range from 200 to 400 acres, for the purposes of preventing deforestation of the hillslopes or other activities which would accelerate hillslope erosion and affect the integrity of the selected remedy, and providing frequent and unrestricted access to areas adjacent to the site to allow monitoring;
- Installation of a multi-layer engineered soil cap with synthetic liner after natural subsidence process is complete;
- Five-year reviews to evaluate the protectiveness of the remedy and to ensure the selected remedy is achieving the necessary remedial action objectives; and
- Institutional controls to restrict the use of the MFDS and to ensure monitoring and maintenance in perpetuity.

The remedy was divided into four phases: the Initial Closure Period, the Interim Maintenance Period, the Final Closure Period, and the Custodial Maintenance Period. This remedy selection in the ROD led to the division of the remedy, as defined in the Consent Decree/Statement of Work, into the Initial Remedial Phase (IRP), which incorporates the activities described as the Initial Closure, and the Balance of the Remedial Phase (BoRP), which incorporates the activities described as the Interim Maintenance Period, the Final Closure Period, and the Custodial Maintenance Period.

Section II of the Statement of Work (SOW) to the Consent Decree defines the objectives of the remedy for the Site as follows:

- Prevent or mitigate the continued release of hazardous substances, pollutants and contaminants from the Site to underlying bedrock formations and ground water aquifers;

- Prevent or mitigate the continued release of hazardous substances, pollutants and contaminants from the Site to surface water bodies and sediments;

- Reduce the risks to human health associated with direct contact with hazardous substances, pollutants or contaminants within the Site;

- Eliminate or reduce the risks to human health from inhalation of hazardous substances, pollutants or contaminants from the Site;

- Eliminate or minimize the threat posed to human health and the environment from current and potential migration of hazardous substances from the Site in the surface water, ground water, and subsurface and surface soil and rock;

- Minimize the infiltration of rainwater and ground water into the trench areas and migration from the trenches;

- Allow natural stabilization of the Site to provide a foundation for a final cap over the trench disposal area that will require minimal care and maintenance over the long term;

- Minimize the mobility of trench contaminants by extracting trench leachate to the extent practicable and by solidifying the leachate in earth

mounded concrete (EMC) bunkers;

- Control Site drainage and minimize the potential for erosion to protect against natural degradation;
- Implement institutional controls to permanently prevent unrestricted use of the Site; and
- Implement a Site performance and environmental monitoring program.

These objectives satisfy the remedial action objectives defined in the ROD.

Remedy Implementation

Initial Remedial Phase Remedial Action

The objectives of the IRP RA were met through two construction phases: Leachate/Removal Disposal (LR/D) and Remaining Work (RW). These activities were completed by the SPPs in 2003. The Commonwealth performed the environmental monitoring and maintenance throughout the IRP. The LR/D RA phase included the following activities:

- Removing leachate from the trenches by pumping from specified sumps;
- Conveying removed leachate to field collection tanks (FCTs);
- Transferring the leachate from the FCTs to leachate storage tanks where the leachate was confirmed to be Class A (NRC 10 CDR 61 Class A, B, C) waste and sample process control tests were performed to confirm the proper leachate-to-cement ratio;
- Metering leachate from the storage tanks and cement from a storage silo into a transit mix truck for mixing; and
- Transferring leachate-cement mixture (grout) to the earth mounded concrete (EMC) bunkers where the mixture solidified.

A few RW RA activities (building demolition, southeast cap construction, and east detention basin) were performed during LR/D to expedite IRP completion. The RW RA

phase included the following activities:

- Demolition of buildings and on-site disposal of debris;
- Construction of a geomembrane cap which directs storm water away from disposal trenches to the East Detention Basin (EDB) and minimizes storm water infiltration into the trenches;
- Enlarging the EDB to accommodate a range of storm events including the 100-year, 24-hour storm event. The EDB contains storm water from the cap area (geomembrane lined area) and directs the water in a controlled manner to the East Main Drainage Channel. Storm water is released from the EDB at rates below the pre-development condition at the site;
- Construction of a geomembrane and soil cover cap in the southeastern corner of the site immediately outside of the restricted area to prevent infiltration of rainwater into the subsurface near several disposal trenches;
- Modifying/constructing the perimeter drainage channels to direct storm water to the EDB; and
- Construction of erosion monuments along the East Main Drainage Channel (EMDC).

Commonwealth IRP Activities

During the IRP, the Commonwealth performed the following activities:

- Acquisition of the additional Buffer Zone property;
- Buffer zone building demolition;
- Acquiring Deed Restrictions for the entire Maxey Flats Site;
- Environmental monitoring; and
- Continued Site maintenance.

Balance of the Remedial Phase (BoRP) Remedial Action

The BoRP is divided into the Interim Maintenance Period (IMP), currently on-going since

2003, and the Final Closure Period (FCP). The Commonwealth is responsible for implementation of the BoRP. The primary objective of the IMP is to allow the trenches to stabilize by natural subsidence. During this period, the following activities are also required:

- IRP Cap maintenance and replacement as necessary;
- Trench leachate management and monitoring;
- Subsidence monitoring, periodic surveys, and repairs as necessary;
- Erosion evaluation in channels along the hillslopes;
- General Site maintenance;
- Stream monitoring;
- Alluvial well monitoring;
- Data collection, analysis and reporting to EPA;
- Maintenance of site drainage and erosion control features; and
- Waste burial.

The activities required during the IMP are ongoing. The costs associated with these activities are provided in Table IV-1, IMP Costs. These costs are expected to increase with geomembrane liner deterioration over time and will be significantly increased in years where the replacement of the exposed geomembrane is required. A decrease in the required monitoring (locations and frequency) may help decrease overall costs. The end of the IMP and the beginning of the Final Closure Period (FCP) is defined as the time when subsidence of the trenches has nearly ceased and final cap installation can begin. Once the final cap is completed and EPA issues Certification of Completion, the remedy will be complete and Long-Term O&M will commence under the Institutional Control Period (ICP).

TABLE IV – 1

Annual IMP Costs

	2003	2004	2005	2006	2007
Payroll/Personnel Expenses	322,600	337,900	355,000	322,495	363,100
Operating Expenses	90,400	71,455	77,400	73,100	72,200
USGS	53,000	51,748	52,632	54,696	57,796
Machinery/Equip/Bldgs	-	6,074	5,250	35,936	38,658
Site Maintenance	-		11,245	67,400	55,834
	466,000	467,177	501,527	553,627	587,588

Operations and Maintenance /Institutional Control Period

Following completion of the BoRP when the Remedial Action has been fully performed and the Performance Standards have been achieved, the Commonwealth will then be responsible for the Custodial Maintenance Period, or Institutional Control Period (ICP). The ICP shall be conducted for 100 years following EPA issuance of the Certification of Completion of the Remedial Action. The Post-Institutional Control Period will follow the ICP with the necessary operations and maintenance activities to be performed in perpetuity.

V. Progress Since the Last Five-Year Review

Protectiveness Statement from 2002 Five-Year Review

The first Five-Year Review was performed five years following IRP construction mobilization while IRP construction was still ongoing. This Five-Year Review is being performed four years into the Interim Maintenance Period prior to Final Closure and commencement of long term O&M.

The following statements are from the 2002 Five-Year Review for the MFDS:

The selected remedy at the Maxey Flats is expected to be protective of human health and the environment at the completion of the RA. The following conclusions support this determination:

- There are no current or planned changes in land use. Deed restrictions are in place and the property is under the ownership and direct control of the Commonwealth.
- Environmental monitoring demonstrates no unacceptable exposure potential under current conditions.
- HASP and contingency plans are in place and are being properly implemented to control risks during IRP construction activities.
- IRP maintenance and monitoring performed by the Commonwealth of Kentucky is consistent with their IRP Monitoring and Maintenance Plan.
- There are no issues with the initial remedial phase currently under construction.

The selected remedy at the MFDS is expected to be protective of human health and the environment at the conclusion of the RA, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Deficiencies

No deficiencies were noted during the initial statutory five-year review.

Recommendations and Required Actions

No recommendations or required actions were needed based on the initial five-year review. IRP RA construction should proceed to completion followed by implementation of IMP requirements.

VI. Second Five-Year Review Process

Administrative Components

The Commonwealth of Kentucky, the Settling Federal Agencies and the Settling Private Parties were notified of the initiation of the second five-year review in fall 2006. The MFDS Five-Year Review team was led by Pam Scully of EPA, Remedial Project Manager (RPM) for the MFDS and included members of the Regional Technical Services staff with expertise in hydrology and radiation risk assessment. The Commonwealth of Kentucky participated in the review.

From January through May 2007, the review team established the review schedule whose components included:

- Community involvement;
- Document review;
- Data review;
- Site inspection;
- Local interviews; and
- Five-year review report development and review.

The Five-Year Review Report completion was scheduled for September 2007.

Community Involvement

Activities to involve the community and the PRPs in the five-year review were initiated with notification of the upcoming five-year review during the Maxey Flats Open House on site in April 2006. In March 2007, a notice was sent to six local area newspapers (see Attachments 1 and 2) that a five-year review was to be performed. Although the Maxey Flats Concerned Citizens Group disbanded during the IRP, EPA RPM Pam Scully contacted former secretary, Nancy Powell, to personally notify her of the review. The former President of the Maxey Flats Concerned Citizens Group, Ed Story, has moved out of the area and could not be reached. Contacts were also made by the RPM to local

emergency management, security, and health officials. None of the individuals expressed any concerns over the protectiveness of the remedy, although several individuals indicated that monitoring data should be more readily available. The Commonwealth employee charged with operations at the facility indicated that the Commonwealth was interested in moving the site to final closure due to high maintenance costs for the interim cap and little evidence of subsidence occurring. He also indicated substantial data, in addition to the data collected for EPA, is collected at the NRC license maintained by the facility. He felt that all the data collected should be reported to EPA.

After the Five-Year Review is signed by the Superfund Division Director, a notice will be sent to the same area newspapers that announced that the Five-Year Review report for the MFDS is complete and that the results of the review and the report are available to the public at the Fleming County Public Library and EPA Region 4 office.

Document Review

This five-year review consisted of a review of relevant documents, including the O&M records and monitoring data at the MFDS. Specifically, the following documents were reviewed during this five-year review:

Maxey Flats Record of Decision
Maxey Flats Consent Decree and Statement of Work, Civil Action 95-58
Commonwealth of Kentucky Interim Maintenance Work Plan and appendices
  Appendix A, Health and Safety Plan
  Appendix B, Operations and Maintenance Requirements Summary
  Appendix C, Performance Standards Verification Plan
Commonwealth of Kentucky Annual Report 2003
Commonwealth of Kentucky Semi-Annual Report 2004
Commonwealth of Kentucky Annual Report 2004
Commonwealth of Kentucky Semi-Annual Report 2005
Commonwealth of Kentucky Annual Report 2005
Commonwealth of Kentucky Semi-Annual Report 2006
Commonwealth of Kentucky Annual Report 2006
IRP Remedial Action Construction Report

First Five-Year Review Report for MFDS, September 2002
Remedial Investigation Report
Feasibility Study Report
Maxey Flats Nuclear Disposal Site Summary Report 2006, (Commonwealth Cabinet for Health Services, April 2007)
Institutional Control Documents

Data Review

The data review included the data collected and reported by the Commonwealth of Kentucky Division of Waste Management pursuant to the IMP Work Plan. The findings from this data review have been divided into two sections: (A) Physical Conditions and (B) Contaminant Monitoring. The Physical Conditions include (1) Erosion Monitoring of the Drainage Channels; (2) Subsidence Area Monitoring; (3) Leachate Level Monitoring; and (4) EDB Discharge Flow Monitoring, all pursuant to the IMP Work Plan. The Contaminant Monitoring includes (1) Surface Water Sampling; (2) Alluvial Well Sampling; and (3) Drainage Channel Sampling. In addition to the documents reviewed as listed above, additional tables and figures have been prepared as part of this review and are included in attachments to this report as referenced herein. Other IMP activities are addressed in Section C.

A. Physical Conditions

1. Erosion Monitoring

The erosion monitoring program monitors the East Main Drainage Channel (EMDC), the South Drainage Channel and the West Drainage Channel.

The EMDC extends from the outlet of the East Detention Basin (EDB) to its confluence with No-Name Creek. As part of the IRP design, all storm water from the cap area was routed to the EDB. As a result, no storm water runoff from the cap flows down the South or West Drain age channels. During the IRP, twenty-two fixed monuments (eleven cross sections) were installed in the EMDC and surveyed to establish baseline conditions.

Pursuant to the IMP Work Plan, the Commonwealth performed erosion monitoring in the EMDC semi-annually collecting cross-sectional measurements for screening purposes using standard USGS methodology. These data are presented in Table A.1.1.

As part of the five-year review, a statistical analysis of changes in the cross sectional areas was performed using the Student's t Statistical evaluation. These results required a review of the cross sectional area and a visual inspection of the channel. No unsatisfactory conditions were observed during the semi-annual visual channel inspections. The cross sectional areas are plotted on the graph in Figure A.1.2. This graph shows minimal erosion and deposition for each cross section over time. The longitudinal cross sections were also reviewed and are provided in Table A.1.3. This centerline profile of the EMDC varies little over the review period.

The student's t evaluation for the EMDC is provided as Table A.1.4. This statistical evaluation did not show any cross sectional change to be greater than 25% from baseline. The 25% change from baseline is an event marker to be used as an action level where one might expect to see major erosive conditions that would require further engineering evaluation. The greatest change from baseline was only 6.4%, which occurred in only one cross section. This review concludes there are no unacceptable erosive conditions for the EMDC.

In addition, the South Drainage Channel, which no longer receives run-off from the cap, was inspected semi-annually. Monitoring involved specified cross sectional areas using the USGS manual leveling methodology for screenings. Measurements and observations were to be collected a minimum of every five years. The requirements for the South Drainage Channel also apply to the West Drainage Channel, which also does not receive any runoff from the IRP cap. The 2007 erosion monitoring data for the west and south drains, when evaluated with previous data, indicate erosion is static. No erosion cross section from either drain indicated a greater than two percent change from their 1998 baselines.

2. Subsidence Area Monitoring

During the IMP, the Commonwealth annually surveyed the subsidence monuments and monitoring locations installed during the IRP. The Commonwealth also performed monthly subsidence inspections on the IRP cap. Over the past five years, only one area (see Figures A.2.1 and A.2.2) met the IMP Work Plan requirements for repair. This area had previously been repaired during IRP construction. As shown in Table A.2.3, repairs were relatively minor in nature. Figure A.2.1 tracks the subsidence by year with contours as labeled and also shows the outline of the disposal trenches. This figure also shows the subsidence monitoring points, their change from 2004 to 2006, and the one subsidence repair performed since the last five-year review. Figure A.2.2 shows the same data overlaid on a map of the liner panels instead of the trenches.

The average subsidence site wide since placement of the IRP cap until now is 0.08 ft. The minimal variation in elevations shows that the disposal trenches are relatively stable. This conclusion is also supported by the leachate level stability as explained in the next section. During IRP construction, the trenches underwent passive compaction by use of heavy construction equipment and placement of approximately 250,000 cubic yards of fill. No notable subsidence was observed, nor were any significant changes in leachate levels observed as a result of subsidence, further indicating site stabilization. From 1995 to date, site subsidence observed, both before and after IRP construction, was relatively minor and localized.

Appendix C of the IMP Work Plan, requires collection of the data displayed in Figure A.2 for evaluation of achievement of Trench Stabilization Criteria, which are to be reviewed and revised as necessary at the five-year review. The following factors have been considered: (1) the number of past subsidence repairs; (2) at least 30 years post waste disposal (landfill open for disposal from 1963-1977); (3) increased exposure risk with exposed geomembrane; and (4) subsidence repairs over the last twelve years have been minor and localized. Based on those factors, the trenches have in all likelihood stabilized.

3. Leachate Level Monitoring

Sump leachate levels are collected for two primary purposes: (1) detect recharge conditions that may require leachate management, and (2) provide data for future evaluation of possible horizontal flow barrier in addition to the North Channel installed during the IRP. Leachate levels may also be used in evaluating subsidence as subsidence may affect localized water levels.

Pursuant to the ROD, continuous water level monitors were installed in the eighty-three remaining sumps during the IRP. Sump leachate levels have been collected by the Commonwealth. From 2003 through the third quarter of 2005, the Commonwealth used the continuous water level monitoring devices for 77 of the 83 remaining sumps (with six being dry or having insufficient liquid for the electronic devices to measure). The data loggers recorded one liquid level daily. For reporting purposes, the Commonwealth used the reading on the first day of the month for reporting. The other six sumps were measured manually at least once per year. In October 2004, a manual measurement of all sumps leachate was performed to verify readings obtained from the electronic water level monitoring devices. Adjustments were made to the data loggers to correlate to the manual measurements. Due to extensive malfunctions and accuracy concerns, the electronic water level monitors were discontinued from use and only manual measurements have been used since fourth quarter 2005. The Commonwealth documented this change in a Technical Change submitted to and approved by EPA.

Table A.3.1 compares baseline and annual measurements as well as the percent freeboard used in the sump. Freeboard is defined as the available column above the baseline water level to the top of sump. No leachate pumping has been required based on increasing water levels and loss of freeboard for the entire IMP to date. Only two out of eighty-three sumps have shown any significant increase in leachate levels or have a greater than 10% use of freeboard: sump 7-4 increased 5 feet and sump 46-1 increased approximately 3 feet. Figure 3.4 shows these sumps with the liner maintenance repairs and the site topography.

Since IRP completion, the overall leachate level average change is about 0.37 feet, showing that leachate levels are relatively stable across the site. As part of this review, the pre-pumping leachate levels were compared with recent leachate levels, as shown in Attachment 3.5, Pre-pumping Leachate Level Comparison. This analysis showed that relative to pre-pumping conditions, the leachate levels remain low, with the vast majority of sumps remaining at or below pre-pumping conditions. Slow sump water level recovers is expected from formation water. Sump recharge to greater than 50% of pre-pumping conditions is expected based upon RI leachate volume estimate of 3 million gallons and actual extraction to EPA approved stop pumping conditions of just under 1 million gallons. The time frame for site equilibration is unknown. No sump leachate level exceeded any action level for the site this review period. These leachate level conditions demonstrate that the IRP, or interim, cap and its maintenance is effective.

These leachate data were also used to produce potentiometric surface maps and potentiometric surface change maps to evaluate trends and recharge across the IRP cap area (see Figures A.3.2 and A.3.3.). Figure A.3.2.1 shows the potentiometric comparison from 2003 to 2006 for the sumps completed in the Lower Marker Bed. These potentiometric contours are overlayed on the trench outlines; the percent freeboard by sump is also shown.

Figure A.3.2.2 compares the leachate levels from 2003-2006 for the sumps completed in the Lower Nancy formation. These potentiometric contours are overlayed on the trench outlines; the percent freeboard is also shown.

Figures A.3.2.3 and A.3.2.4 present the same potentiometric information as Figures A.3.2.1 and A.3.2.2 but overlaid on the IRP cap with geomembrane panel numbers and liner defects by year.

A review of these figures reveals little change in leachate levels in the sumps. This confirms EPA's previous evaluation that a horizontal flow barrier other than the North Channel will not be required.

The potentiometric maps in the Section A.3.2 series use the same data as those in the

A.3.3 series with two differences: (1) they do not include the USGS well data that surround the perimeter of the Restricted Area and (2) the potentiometric levels are analyzed in two separate confining layers, the Lower Marker Bed and the Lower Nancy.

Figures A.3.3 are potentiometric maps by year and with a 2003-2006 comparison. These maps also include liquid levels from the wells surrounding the Restricted Area to analyze any recharge conditions. Recharge from the exterior to the interior of the site has not been observed.

4. EDB Discharge Flow Monitoring

Pursuant to the ROD and IRP Design, discharge from the East Detention Basin should be released to the East Main Drainage Channel at a rate not to exceed predevelopment flow conditions. Following storm events exceeding 2.8 inches rainfall in 24 hours (2-year storm event or greater), the Commonwealth is required to collect recordings and report findings. These results are then evaluated by comparing the actual EDB outflow rates and rainfall to the predicted flow rate/rainfall curve used in the outfall design (included in Appendix E of Appendix C of the IMP Work Plan). If this screening comparison shows flowrates above predevelopment levels, then the design model (SEDCAD version 4.0) must be run to evaluate actual hydrographic conditions.

The following table presents the design flows for defined storm events.

24-hour Storm Event (years)	Rainfall in a 24-hour period (inches) (1)	Pre-IRP EDB discharge Flow (CFS) (2)	Post IRP EDB Design Discharge Flow (CFS) (2)
2	2.87	48	11
10	4.2	86	24
25	4.9	118	32
100	5.8	146	44

Notes:

(1) – Design Analysis Report, IT Corporation, April 2001, Sheet 8 of 15.

(2) – PSVP, Interim Maintenance Period Work Plan, Appendix C, Commonwealth of Kentucky, March 2003.

Three storms during the period JAN03 – DEC 06 approached or exceeded the evaluation trigger criterion. These events were:

Date of Storm Event	24-hour Maximum Rainfall Interval	Accumulated Rainfall for the Rain Interval	Peak Flow During Storm Events (CFS)
August 2004	August 20, 2004 begin 2144 hours, End August 21, 2004 2144 hours	2.68 Inches	12.26 @ ~ 0200 hours through 0215 hours August 21, 2004
September 2004	September 17, 2004 begin 0000 hours, End August 18, 2004 0000 hours	2.73 Inches	10.95 @ ~ 1145 hours through 1200 hours August 17, 2004
September 2006	September 22, 2006 begin 0800 hours, End September 23, 2004 0800 hours	3.52 Inches	13.65 @ ~ 0200 hours August 23, 2004

The two storm events in August and September 2004 barely missed the trigger of 2.8-inches of rainfall within a 24-hour period. The maximum discharge flow from the EDB for these two events was within approximately 10 percent of the predicted flow for a 2-year storm event. Based on these flowrates and the associated hydrographs, the Commonwealth decided that the discharge flows were substantially compliant and therefore, did not confirm this conclusion by running the SEDCAD model with the storm event hydrograph.

The August 2006 storm event of 3.52 inches was near the average of a 2 year and 10 year storm event of 3.55 inches. Assuming an average maximum expected flow from a 2-year event of 11 CFS and a 10-year event of 24 CFS, that average would be 17.7 CFS. The maximum discharge flow from the EDB observed during the August 2006 event was 13.65 from the 3.52 inch rain. The observed flow was significantly less than this predicted average flow. The Commonwealth determined that discharge flow was again acceptable and did not run the SEDCAD model.

B. Contaminant Monitoring

1. Surface Water Sampling Subject to Drinking Water Standard (4 mrem/yr)

Surface water samples were collected in drainage channels and streams both inside and outside the site boundary, at locations 106, 122C, 103E, 102D (REI) and background location 122A.

Based on the Commonwealth's collection of historical data and data obtained during the IRP, the configuration of the site, the mobility of tritium, and the use of realistic exposure pathways, compliance testing and monitoring related to source control focuses on water borne pathways for tritium. Tritium is the most mobile and easily detectable contaminant at the site. Other radiological and chemical contaminants have not been historically detected in soils, ground water, and surface water unless tritium activities approach action levels. Data relating to the activities of radiological contaminants in different media can be found in Radiation Health and Toxic Agents Branch historical annual reports and the Remedial Investigation Report (Ebasco, 1989). The IMP Work Plan specifies that sampling and analysis for other contaminants will not occur unless any annual average concentration exceeds 50% of the screening assessment (20 pCi/ml) during the previous five years.

Locations 106, 122C, and 103E are within the perennial streams in the buffer zone area. Location 103 E is in Drip Springs Creek, 106 in No Name Creek, and 122C in Rock Lick Creek (See Figure B.1.1). Access to these streams within the buffer zone will be limited in perpetuity. This action precludes members of the public from being continuously exposed to radionuclides within the buffer zone.

Location 102D is outside of the buffer zone and after confluence of the three creeks surrounding the site. This location serves as the point of compliance since it monitors exposure to the reasonably exposed individual (REI).

Location 122A is upstream of the confluence of No Name Creek with Rock Lick Creek and provides a background measurement.

Figures B.1.1 and B.1.2 show the annual average tritium concentrations from baseline (2001) through 2006. Graphs for each sampling location and compare measured results to the 20 pCi/mL dose-derived annual average concentration for tritium (4 mrem/yr). The dose limit for the Drinking Water Standard (4 mrem/yr annual average) is derived from an annual average tritium concentration of 20 pCi/mL, which is used as a screening level. As shown in Figure B.1.1 and B.1.2, the annual average concentrations from baseline measurements through 2006 data were far below the 20 pCi/ml screening level.

Pursuant to the IMP Work Plan and based upon the tritium concentrations over the past five years, location 106 can be dropped from the monitoring program. Surface water sampling can be decreased to quarterly at four locations: 102D, 122A, 122C, and 103E.

2. Alluvial Wells

The alluvial ground water within the Site boundary is treated as a potential source of drinking water under CERCLA. Fourteen alluvial wells were installed during the IRP to allow radionuclide monitoring. Access to the alluvium within the buffer zone is controlled by the Commonwealth; therefore, these wells cannot be used as a drinking water source and do not represent a potential radiological dose. In the PSVP, the four locations listed below were chosen to be monitored quarterly for two years following the IRP and annually thereafter. These locations were selected due to their representation of the surrounding creeks, monitoring the area between the site and the surface water monitoring locations.

- AW-6 is representative of ground water leaving the buffer zone via Drip Springs Creek alluvium;

- AW-7 is representative of ground water in the alluvium in No Name creek, downgradient from the East Main Drainage Channel;

- AW-10 is representative of ground water in Rock Lick Creek alluvium, downgradient from the South Drainage Channel; and

- AW-12 is representative of ground water leaving the buffer zone in Rock Lick Creek alluvium.

The remaining ten alluvial wells were to be sampled annually for two years then sampling may have been discontinued. The Commonwealth sampled the four key locations quarterly for two years and then decreased the sampling frequency of AW-6, AW10 and AW-12 to annually thereafter. The Commonwealth continued to sample Location AW-7 quarterly through 2006. The remaining ten wells were sampled annually each year following IRP completion with the exception of AW-1, which was sampled quarterly based on levels reaching 50% of the ARAR screening level.

The sampling results are provided in Figures B.2.1 and B.2.2. There were no exceedances of the ARAR screening level of 20 pCi/ml during the entire monitoring period. Both AW-7, which showed levels above 20 pCi/ml when first installed in 2003, and AW-1, which exceeded 50% of the screening level in 2003, have shown a decreasing trend in tritium concentrations. Average concentrations in 2006 were 2.79 pCi/ml for AW-1 and 6.96 pCi/ml for AW-7.

Based upon these measurements and pursuant to the IMP Work Plan, the Commonwealth may conduct annual sampling at three of the four key locations, AW-6, AW-10 and AW-12. Sampling at locations AW-7 and AW-1 should continue on a quarterly basis for the next 2 years depending on the concentrations and data trends. Sampling of the remaining wells may be discontinued.

3. Surface Water Sampling at Locations Subject to 25mrem/yr Standard

Compliance with the 25-mrem standard (Section 18 of 902 KAR 100:022) is to be based on combined doses from air, water, drinking water and soil pathways. At the completion of the IRP, the only viable exposure pathway was through surface water runoff. The points of compliance with the 25 mrem standard are at the drainage channels at the former licensed site boundary, measured at locations 107C, 143 and 144. These locations were chosen to be conservative and to ensure early detection of releases from within the

Site boundary. A concentration of 125 pCi/ml is the dose-derived concentration for continuous tritium exposure equivalent to 25 mrem/yr total effective dose equivalent.

Figures B.3.1 and B.3.2, show measured tritium levels below 50% of the 100 pCi/ml screening level. Pursuant to the IMP Work Plan, sampling at these locations may be suspended.

C. IMP Activities

Pursuant to the IMP Work Plan, Appendix D, Operations and Maintenance Requirements Summary, an independent liner inspection was performed as part of this five-year review. This report is included in Attachment C.1. This review concluded the exposed geomembrane is in good to excellent condition.

The maintenance of the exposed geomembrane liner has increased over time, as expected. The associated liner defects are shown in Figure C.2.

Site Inspection

The USEPA RPM performed a Site Inspection on April 25, 2007, accompanied by representatives of the Commonwealth of Kentucky, the Settling Private Parties and Department of Energy. (See Attachment 4). The purpose of the inspection was to assess the protectiveness of the remedy, including all barriers to restrict access and the integrity of the interim cap. Institutional controls were evaluated by visiting the Fleming County Clerk's office to review the property deed. EPA and the Commonwealth confirmed that appropriate restrictions to the deed had been filed.

No significant issues have been identified at any time regarding the interim cap or surface water drainage structures. Wooded areas adjacent to the interim cap have been cleared to reduce the likelihood that a fire could encroach upon the cap, in response to community concerns. Additional security measures have been implemented at the property to reduce homeland security concerns expressed by local officials.

The institutional controls that are in place include prohibitions on the use of ground water, excavation activities, disturbance of the interim cap, and any other activities or actions that might interfere with the implemented remedy. No activities were observed that would have violated the institutional controls. Mr. Wilmer Conn, a resident outside the restricted area, has petitioned the local water and sewer authority to extend a water line to his residence. The water line will pass through the buffer zone around the restricted area. EPA does not believe that a potable water line under pressure passing through the buffer zone is a violation of any of the restrictions contemplated by the remedy.

Interviews

The EPA RPM personally performed interviews with various parties regarding the site. Nancy Powell, former secretary for the now disbanded Maxey Flats Concerned Citizens Group was interviewed on April 17, 2007. Ms. Powell indicated that she did not have any specific concerns about the site but that she would be interested in reading the Five-Year Review when it was complete. Mr. Herbert Jolley, a nearby resident, was contacted April 17, 2007, but was unable to participate in site interviews during the spring planting season. EPA contacted Willa Granis, the daughter of a nearby resident, on June 7, 2007. Ms. Granis expressed concern that the site had impacted her parent's ability to sell their property. Contacts were also made to local emergency management, fire, enforcement, and health officials. None of the individuals expressed any concerns over the protectiveness of the remedy, although several individuals indicated that monitoring data should be more readily available.

Mr. Scott Wilburn, the Commonwealth employee charged with operations at the facility indicated that the Commonwealth was interested in moving the site to final closure due to high maintenance costs for the interim cap and little evidence of subsidence occurring. He also indicated substantial data, in addition to the data collected for EPA, are collected for the NRC license maintained by the facility. He believes that all the data collected should be reported to EPA.

VII. Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the remedy is functioning as intended by the ROD. Leachate removal and disposal, building demolition, interim cap construction, and storm water controls are complete. Environmental monitoring and maintenance of the interim cap are ongoing. Institutional controls to protect the containment areas have been implemented.

The primary objective of the interim cap is to allow the trenches to stabilize by natural subsidence prior to construction of the final cap. The monitoring data demonstrates that very little erosion or subsidence has occurred since the interim cap was constructed. Based upon the age of the waste (more than 30 years), the passive action of compacting the trenches during cap construction (e.g. use of heavy equipment and the weight of approximately 250,000 cubic yards of soil fill), and the results of subsidence monitoring, EPA does not anticipate substantial trench subsidence in the future.

The interim cap has been effective at preventing recharge of the trenches. Following trench leachate pumping (1998-2000), recharge of the sumps was expected due the formation water. The extent of recharge and the timeframe was not reasonably predictable, other than complete recharge to pre-pumping conditions was not expected. Only two sumps at the site have shown any significant recharge, and both sumps (7-4 and 46-1) remain well below pre-pumping levels (Attachment 3, Table A.3.1 and Table A.3.5). The selected remedy is one of natural stabilization. The remedy requires time to work (half life of tritium is 12.08 years). From visual data presentations (see Figures B.1.1 and B.3.1), tritium concentrations site wide are stable or declining. Even though short-term spikes may occur, this overall trend is expected to continue, driven by the physics of tritium decay.

Operation and maintenance of the interim cap and storm water controls by the Commonwealth have been effective. The Commonwealth monitors erosion of existing drainage channels, subsidence of the interim cap, leachate levels in the trenches, surface water discharge rates, tritium concentrations in surface water, and tritium concentrations in ground water. The Commonwealth maintains a significant level of staff at the facility to perform the required operation and maintenance activities

Monitoring frequencies and locations could be optimized based on the data review.

Institutional controls have been verified. No activities have been observed or documented that violate the institutional controls.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considered

A list of ARARs is included in Attachment 5. There have been no changes in these ARARs and no new standards or TBCs affecting the protectiveness of the remedy.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the Risk Assessment included exposures to older child trespassers, adult trespassers, and offsite individuals under a number of different conditions. There have been no changes in the toxicity factors for contaminants of concern. There is no change to the standardized risk assessment methodology that could affect the protectiveness of the remedy.

Expected Progress Towards Meeting RAOs

Remedial action objectives for the Site are being met. The continued release of contaminants to bedrock, groundwater, sediment, and surface water has been mitigated. Exposures to contaminants are limited and under control. Natural stabilization has been allowed, drainage has been controlled, and a monitoring program has been implemented.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No ecological targets were identified during the baseline ecological risk assessment and none were identified during the five-year review. Therefore, monitoring of ecological targets is not necessary. Surface water meets health based standards at the point of compliance. No weather related events have affected the protectiveness of the remedy. There is no information that calls into question the protectiveness of the remedy.

Technical Assessment Summary

According to the data reviewed, the site inspection, and the interviews, the remedy is functioning as intended by the ROD. There have been no changes to the physical conditions of the site that would affect the protectiveness of the remedy. All ARARs pertinent to the IRP and the IMP to date have been met. Most ARARs for treating and containing waste, i.e. the overall remedy, at the site have been met. There have been no changes in the toxicity factors for contaminants of concern or the standardized risk assessment methodology. There is no other information that calls into question the protectiveness of the remedy.

VIII. Issues

No deficiencies were noted during the second five-year review.

IX. Recommendations

No recommendations or required actions are needed to correct deficiencies based on this five-year review.

Other comments

Information obtained and decisions made during the IRP and the IMP to date indicate that clarifications to the ROD may be required. The EPA believes that these items discussed below should be documented and clarified in an Explanation of Significant Differences (ESD). The ROD required the installation of an infiltration monitoring system to continuously verify remedy performance and detect the accumulation of leachate in disposal trenches. Continuous water level monitors were installed in eighty-three sumps during the IRP. Due to extensive malfunctions and accuracy concerns, the electronic water level monitors were discontinued from use and only manual measurements are being used. The Commonwealth documented this change in a Technical Change submitted to and approved by EPA, and should also be documented in an ESD.

The ROD identified indicator contaminants of concern as listed on Table III-2. Based on the Commonwealth's collection of historical data and data obtained during the IRP, the configuration of the site, the mobility of tritium and the use of realistic exposure pathways, it was determined that compliance testing and monitoring related to source control should focus on water borne pathways for tritium. It was agreed that analysis for other contaminants will not occur unless any annual average concentration of tritium exceeds 50% of the screening assessment (20pCi/ml or 100 pCi/ml, as applicable) during the previous five years. This determination should be documented in an ESD.

The ROD also required the installation of a ground water flow barrier, if necessary. Hydrogeologic evaluations of Maxey Flats indicate that ground water movement through the rock strata into the disposal trenches may be negligible. Regardless, the potential pathway for ground water flow into the trenches through the narrow neck at the north side of Maxey Flats where the trench area is connected to the main portion of the Maxey Plateau was eliminated during IRP Construction through construction of the North Channel. A review of the monitoring data revealed little change in leachate levels in the sumps and a site wide change from the exterior to the interior is not present,

confirming that no Horizontal Flow Barrier other than the North Channel will be required. This determination should be documented in an ESD.

The end of the Interim Maintenance Period (IMP) and the beginning of the Final Closure Period (FCP) is defined as the time when subsidence of the trenches has nearly ceased and final cap installation can begin. EPA and the Commonwealth of Kentucky agree that subsidence in the trenches has been significantly lower than originally anticipated. EPA will confer with the Commonwealth of Kentucky to determine when the Final Closure Period should begin.

X. Protectiveness Statement

The selected remedy at the MFDS is expected to be protective of human health and the environment at the conclusion of the RA, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

XI. Next Review

The next five-year review for the review for the MFDS is required by September 2012, five years from the date of this review.

Attachment 1

Figure 1

Site Overview Map

Maxey Flats
Fleming County, Kentucky

Description:
Map adapted from FSA NAIP Digital Ortho Photo 2004.

Map Legend:

Waterway

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: SiteOverview_fig1.mxd
Project No.: 3088
Plot Date: 11 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

de maximis, inc.
450 Montbrook Lane
Knoxville, TN 37919
Main Phone: (865) 691-5052
www.demaximis.com

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1217 Bandana Boulevard North
Saint Paul, Minnesota 55108
Main Phone: (651) 842-4224
www.ddmsinc.com

R:\Projects\DEF\de maximis\Data\Maxey Flats\Data\mxds\3088-MaxeyFlatsSiteOverview_fig1.mxd

Attachment 2

TABLE 2 A

LEGAL NOTICE

The U.S. Environmental Protection Agency (EPA) Region 4 announces the commencement of a Five-Year Review for the Maxey Flats Disposal Site in Hillsboro, Fleming County, Kentucky. Five Year Reviews are intended to evaluate the protectiveness of cleanup actions taken at Superfund sites.

This site was placed on the National Priorities List in 1986. The Site Remedy is outlined in EPA's 1991 Final Record of Decision. The source of the contamination was placed under an Initial Remedial Phase cap in 2003, followed by an Interim Monitoring Period for cap and groundwater monitoring. The first Five-Year Review of the site was completed in September 2002 during the initial cap construction and prior to the Interim Maintenance Period and monitoring of the Initial Remedial Phase.

EPA anticipates that this Five-Year Review will be completed by September 2007. Public comments and questions about the Site and the Five-Year Review process are welcomed. The report will be available for public review or copying at the Fleming County Public Library in Flemingsburg, Kentucky

For further information please contact:

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TABLE 2B

2007 Five-Year Media Review Correspondence Log

Media Name	Contact	Publication Schedule/Circulation	Comments
Ashland Daily Independent 224 17th Street Ashland, KY 41101 (606) 326-2600	Alison Barlow Abarlow@dailyindependent.com	Daily 19,500 Sunday Largest circulation	• E-mail and letter sent 3/13/07 • Ran Sunday, 3/18/07 • Ran Sunday 4/15/07
Lexington Herald Leader 100 Midland Avenue Lexington, KY 40508 (859) 231-1361 Legal Clerk	Sharon Walsh Swalsh@harold-leader.com Legal Clerk tmcconnell@harold-leader.com	Daily 500,060 circulation Sunday largest circulation day Must be in by Wed AM	• E-mail and letter sent 3/13/07 • Ran Sunday, 3/18/07 • Ran Sunday 4/15/07
Maysville Ledger/Independent 41-43 West Second Street P.O. Box 518 Maysville, KY 41506 (606) 564-9091	Patty Moore Patty.moore@lee.net Contact is Becky Striplin Becky.striplin@lee.net	Monday – Saturday 8500 Circulation Saturday largest circulation	• E-mail and letter sent 3/13/07 • Ran Saturday, 3/17/07 • Ran Saturday 4/14/07
Morehead News 722 West First Street Morehead, KY 40351 (606) 784-4116 (606) 784-7337 Fax	Stephanie Oskerman Dan Duncan Contact Dduncan@cnhi.com	Tuesday and Friday Deadline Friday for Tuesday Wednesday for Friday 5800 circulation Friday is largest circulation	• E-mail and letter sent 3/13/07 • Ran Friday 3/23/07 • Ran Friday 4/13/07
Fleming Shopper 222 Mt Carmel Avenue Flemingsburg, KY 41041 (606) 845-0771	Bonnie Fleming Flemingshopper@KYWLS.com	Tuesdays only Must have by Friday 7200 circulation	• E-mail and letter sent 3/13/07 • Ran Tuesday, 3/20/07 • Ran Tuesday, 4/17/07
Flemingsburg Gazette P.O. Box 32 Flemingsburg, KY 41041 (606) 845-9211	Gary Barker Gbarker@flemingsberg.com	Wednesdays only Must have by 1200 Tuesday 2400 paid circulation	• E-mail and letter sent 3/13/07 • Ran Wednesday, 3/21/07 • Ran Wednesday 4/18/07

Attachment 3-A

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 3.5

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	October 2006
0	747.08	746.66	746.66	746.66	747.04	746.67	746.68	746.65	746.82
2	747.08	746.66	746.66	746.66	747.04	746.67	746.68	746.65	746.82
4	746.58	746.50	746.59	746.58	746.50	746.61	746.46	746.59	746.50
6	746.08	746.03	745.98	745.98	745.98	746.00	745.98	746.07	746.16
8	745.96	745.97	745.87	745.75	745.89	745.87	745.80	745.94	746.01
10	746.44	745.96	745.92	745.89	745.98	745.98	746.02	745.94	746.07
12	746.27	746.19	746.13	745.88	746.32	746.27	746.19	746.20	746.32
14	746.22	746.18	746.08	746.04	746.13	746.13	746.08	746.08	746.26
16	746.76	746.69	746.67	746.62	746.70	746.67	746.61	746.59	746.95
18	747.23	747.18	747.16	747.11	746.80	746.88	746.77	747.02	746.97
20	747.26	747.23	747.21	747.16	747.11	747.18	747.18	747.19	747.30
22	747.08	747.03	747.01	746.95	747.06	747.08	747.04	747.12	747.15
24	747.00	747.06	746.96	746.94	747.00	746.99	746.96	746.97	747.03
26	747.21	747.19	747.17	747.15	747.26	747.21	747.18	747.20	747.24
28	747.10	747.06	746.99	746.99	747.10	747.04	747.04	747.02	747.09
30	747.47	747.51	747.36	747.37	747.44	747.46	747.46	747.47	747.45
30.5	747.47	747.51	747.36	747.37	747.44	747.46	747.46	747.47	747.45

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 5.0

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	October 2006
0	767.49	767.51	767.51	767.49	767.45	767.45	767.47	767.44	767.41
2	767.49	767.51	767.51	767.49	767.45	767.45	767.47	767.44	767.41
4	768.17	767.37	768.09	768.07	767.92	767.91	767.94	767.89	767.79
7	764.89	764.93	764.92	764.97	764.89	764.83	764.10	764.75	765.08
7.5	764.60	764.61	764.57	764.53	764.52	764.46	764.80	764.42	764.66
8	764.10	764.18	764.28	764.52	764.37	764.30	764.43	764.31	764.27
10	763.48	764.43	763.53	763.48	763.42	763.40	764.55	763.37	763.27
12	763.12	763.11	763.23	763.34	763.06	763.09	763.30	762.94	762.97
14	763.01	762.97	763.14	763.03	762.96	762.99	763.19	762.86	762.82
16	763.21	762.93	763.12	763.12	762.76	762.76	763.04	763.10	763.06
18	765.02	764.93	765.04	765.00	764.91	764.87	765.03	764.84	764.88
20	765.63	765.31	765.33	765.38	765.35	765.27	765.41	765.40	765.29
22	765.47	765.43	765.52	765.54	765.50	765.47	765.60	765.47	765.49
24	765.70	765.61	765.78	765.78	765.73	765.70	765.77	765.77	765.68
26	766.75	766.71	766.72	766.73	766.67	766.65	766.72	766.72	766.67
28	768.11	768.03	767.92	768.07	768.06	768.06	768.09	768.05	768.08
29.5	768.11	768.03	767.92	768.07	768.06	768.06	768.09	768.05	768.08

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 5.5

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	October 2006
0	769.31	769.27	769.25	769.26	769.10	769.31	769.14	769.27	769.09
2	769.31	769.27	769.25	769.26	769.10	769.31	769.14	769.27	769.09
4	767.45	767.23	767.36	767.53	767.29	767.31	767.58	767.51	767.32
6	766.19	766.53	766.20	766.27	766.25	766.23	766.62	766.40	766.25
8	765.18	764.86	765.01	765.03	765.10	765.07	765.14	765.18	765.37
10	764.99	764.85	764.96	764.89	764.85	765.02	765.11	764.93	765.48
12	765.19	765.09	765.13	765.08	764.98	765.08	765.13	765.10	765.55
14	765.29	765.25	765.18	765.29	765.45	765.43	765.40	765.36	765.08
16	765.17	765.14	765.18	765.19	765.04	765.07	765.00	765.05	764.75
18	767.89	767.91	767.20	767.31	767.30	767.32	767.42	767.35	767.39
20	769.27	769.09	769.09	769.11	769.09	769.12	769.12	769.12	769.11
21	769.46	769.35	769.33	769.31	769.36	769.44	769.51	769.53	769.46
22.5	769.46	769.35	769.33	769.31	769.36	769.44	769.51	769.53	769.49

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 6.0

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	October 2006
0	780.54	780.66	780.70	780.67	780.62	780.64	780.61	780.66	780.63
1	780.54	780.66	780.70	780.67	780.62	780.64	780.61	780.66	780.63
2	780.23	780.26	780.37	780.17	780.21	780.28	780.24	780.30	780.28
3	779.55	779.58	779.68	779.74	779.74	779.78	779.79	779.77	779.81
4	777.52	777.78	778.74	778.12	778.01	777.67	778.09	778.08	777.53
5	774.44	777.11	775.51	776.87	776.90	775.31	775.55	775.29	775.38
6	774.09	774.94	773.83	774.39	773.76	773.21	774.21	774.03	773.83
8	772.92	773.24	773.07	772.93	772.85	772.90	772.96	773.06	773.19
10	773.01	772.99	773.02	772.87	772.67	772.81	772.83	772.96	772.79
12	773.38	773.26	773.22	773.22	773.23	773.24	773.24	773.35	773.25
14	773.74	773.62	773.72	773.66	773.61	773.68	774.29	774.38	773.65
16	777.27	776.98	776.78	776.72	777.21	777.31	777.24	777.24	777.22
21	782.45	782.49	782.49	782.49	782.49	782.48	782.49	782.49	782.50

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 6.5

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	October 2006
0	781.14	781.15	781.14	780.91	781.01	781.07	781.08	781.08	781.05
2	781.14	781.15	781.14	780.91	781.01	781.07	781.08	781.08	781.05
4	780.71	780.60	780.64	780.53	780.52	780.58	780.46	780.23	780.40
6	779.50	779.55	779.49	778.51	779.27	779.66	779.48	779.57	779.37
8	778.75	779.03	778.73	778.56	778.72	778.67	778.72	778.68	778.62
10	778.86	779.00	778.78	778.82	778.83	778.73	778.99	778.70	778.93
12	778.12	778.18	778.07	778.16	778.05	778.22	778.40	778.04	777.77
14	779.59	779.73	779.43	779.41	779.40	779.39	779.41	779.43	779.48
16	779.57	779.68	779.69	779.90	779.82	780.08	779.83	779.82	779.81
18	781.52	781.58	781.53	781.80	781.61	781.57	781.81	781.94	781.93
18.5	782.96	782.97	782.97	782.95	782.96	782.96	782.95	782.94	782.93

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 6.75

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	October 2006
0	793.43	793.43	793.43	793.40	793.43	793.40	793.39	793.35	793.37
1	791.42	791.23	791.57	791.39	791.26	791.47	791.40	791.48	791.28
2	790.71	790.38	790.42	790.65	790.45	790.92	789.63	789.52	789.50
4	788.83	788.81	788.88	788.84	788.80	788.73	788.79	788.74	788.70
6	791.31	791.18	791.08	791.14	791.15	791.04	788.97	790.95	791.00
8	789.57	790.23	790.23	790.25	790.24	790.15	789.97	790.35	789.90
10	790.02	790.00	789.98	790.19	790.36	790.29	790.35	790.08	790.08
12	789.85	790.09	790.07	790.21	790.33	790.23	790.23	790.05	790.23
14	790.19	790.29	790.32	790.49	790.38	790.63	790.62	790.52	790.59
16	790.42	790.53	790.44	790.85	791.64	791.44	791.37	791.35	791.53
17	792.23	791.98	791.87	792.29	792.25	792.22	792.38	792.33	792.33
18	793.41	793.41	793.40	793.37	793.37	793.33	793.31	793.29	793.31

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 8.0

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	January 2007
0	925.38	925.69	925.17	925.61	925.64	925.19	925.22	927.40	925.58
2	925.38	925.69	925.17	925.61	925.64	925.19	925.22	927.40	925.58
4	925.73	925.79	925.83	925.84	925.69	925.71	925.68	925.20	925.63
6	922.72	922.55	922.08	922.31	922.61	922.60	922.70	922.36	922.30
8	922.65	923.31	922.84	922.71	923.03	922.82	922.68	922.95	922.85
10	922.18	922.71	922.20	922.19	922.41	922.28	922.00	922.30	922.37
12	923.33	923.61	923.66	923.68	923.67	923.73	923.80	923.45	923.54
14	922.93	923.49	923.39	923.26	922.86	923.17	923.33	922.87	923.35
16	924.28	924.09	924.13	923.81	923.61	924.13	923.86	924.20	923.58
18	925.76	925.87	925.74	925.18	925.38	925.67	925.54	925.51	926.19
20	926.34	926.57	926.45	926.43	926.44	926.40	926.30	926.39	926.47
22	925.62	925.77	925.68	925.73	925.70	925.64	925.54	925.64	925.79
24	926.50	926.43	926.34	926.36	926.49	926.28	926.38	926.27	926.43
26	926.20	926.13	926.20	926.13	926.19	926.18	926.15	926.18	926.24
28	926.22	926.29	926.09	925.81	926.17	926.15	926.11	926.30	926.25
28.7	926.22	926.29	926.09	925.81	926.17	926.15	926.11	926.30	926.25

October 2006 measurements rescheduled to January 2007 due to hazardous conditions

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTION # 12.0

ELEVATION IN FEET

Station	April 2003	June 2003	November 2003	April 2004	October 2004	April 2005	October 2005	April 2006	October 2006
0	984.97	984.95	985.05	985.06	984.94	984.89	984.96	984.91	985.04
6	984.97	984.95	985.05	985.06	984.94	984.89	984.96	984.91	985.04
8	985.07	985.08	984.26	985.09	984.96	985.01	985.09	985.05	985.16
10	984.93	984.93	985.06	985.01	984.88	984.83	984.92	984.88	984.99
12	984.60	984.64	984.77	984.65	984.66	984.60	984.66	984.49	984.75
14	984.07	984.20	984.37	984.20	984.16	984.05	984.20	984.09	984.34
16	983.73	983.68	983.84	984.00	984.70	983.76	983.89	983.74	984.06
18	983.35	983.60	983.66	982.17	982.01	982.08	982.08	982.02	982.16
20	981.97	982.08	982.20	982.11	981.96	982.00	982.02	981.96	982.14
22	983.98	984.12	984.19	984.10	983.97	983.97	984.01	983.89	984.11
24	984.35	984.48	984.54	984.48	984.32	984.34	984.36	984.28	984.47
26	983.64	983.78	983.84	983.77	983.62	983.67	983.69	983.63	983.82
28	983.97	984.10	984.13	984.10	983.96	983.95	983.95	983.91	984.13
30	983.21	983.40	983.43	983.32	983.18	983.22	983.25	983.18	983.38
32	984.55	984.66	984.70	984.66	984.54	984.56	984.56	984.48	984.76
34	984.84	984.98	985.03	984.96	984.87	984.88	984.89	984.76	984.97
36	985.17	985.26	985.33	985.29	985.19	985.17	985.17	985.14	985.27
38	984.63	984.76	984.76	984.85	984.64	984.64	984.64	984.58	984.70
40	984.84	984.81	984.85	984.80	984.70	984.90	984.77	984.69	984.85
42	985.41	985.52	985.44	985.49	985.90	985.43	985.40	985.39	985.45
44	985.85	985.88	985.90	985.86	985.81	985.85	985.87	985.86	985.45
45.7	985.85	985.88	985.90	985.86	985.81	985.85	985.87	985.86	985.86

TABLE A.1.1
EAST MAIN DRAINAGE CHANNEL CROSS SECTION ELEVATIONS

MAXEY FLATS, EAST DRAIN CROSS SECTIONAL AREAS

Area in Square Feet

Cross Section	April 2003	June 2003	Nov 2003	April 2004	Oct 2004	April 2005	Oct 2005	April 2006	Oct 2006
3.5	34.79	37.47	39.06	40.45	37.62	38.55	39.71	38.54	35.21
5.0	103.9	103.71	104.5	103.84	106.48	107.03	103.93	107.05	107.35
5.5	114.52	117.09	117.74	116.98	121.26	116.68	115.75	116.04	116.22
6.0	123.07	119.88	122.97	122.48	122.28	124.01	120.97	120.51	123.12
6.5	58.68	57.42	59.4	61.26	59.73	58.37	57.94	59.42	59.52
6.75	53.26	52.53	52.29	49.46	49.25	47.93	53.81	49.95	50.63
8.0	134.02	130.63	134.26	136.1	133.92	133.94	135.23	130.28	132.65
12.0	166.96	163.5	162.09	164.82	167.47	170.02	168.51	171.20	164.38

* measurement taken January 2007

* - Cross-section measurements 8.0 for October 2006 had to be rescheduled for January 2007

TABLE A.1.2

East Main Drainage Channel Cross-Section Areas

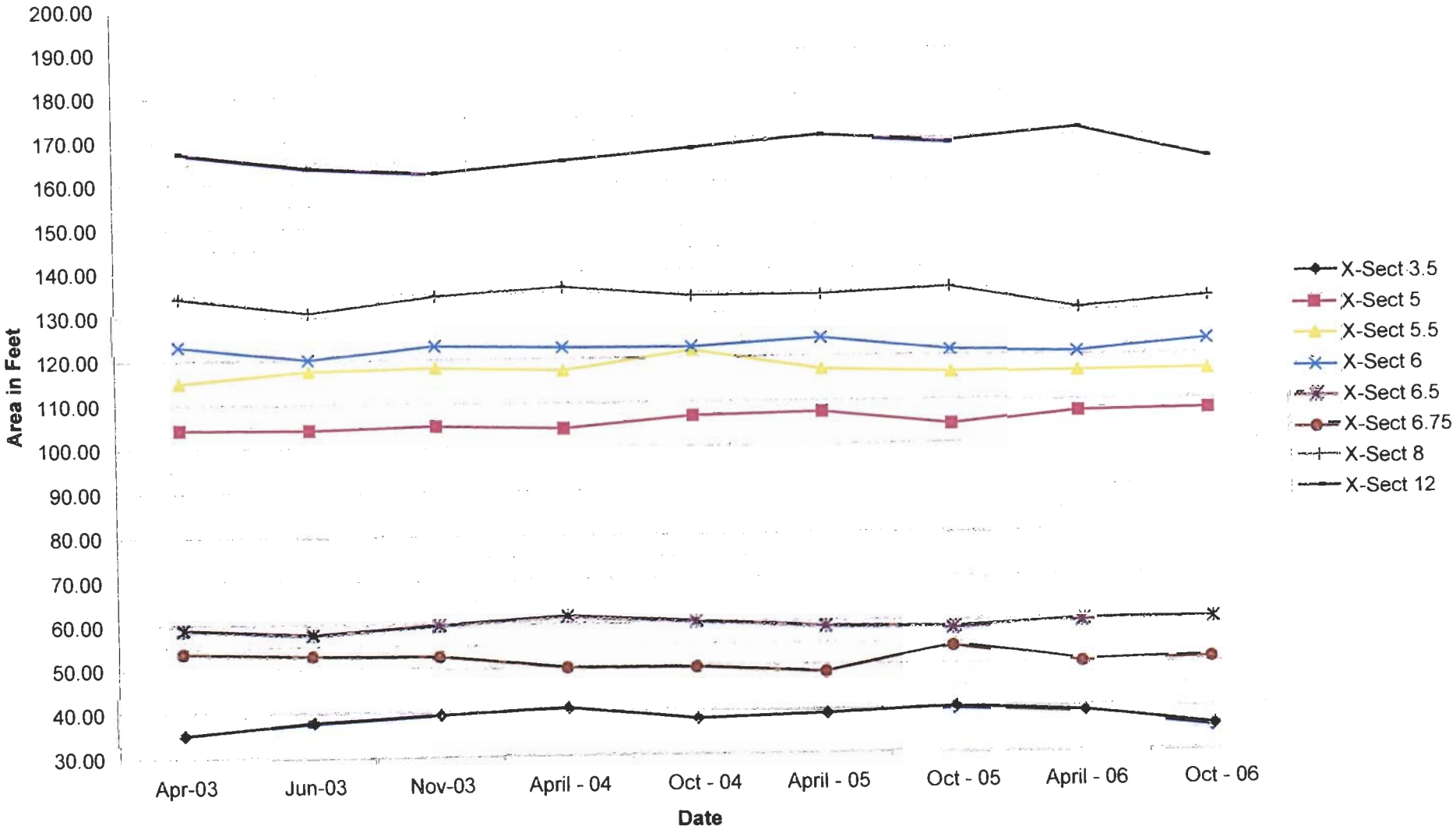

TABLE A.1.3

East Main Drainage Channel
Longetudinal Cross Section Overlay
2003 - 2006

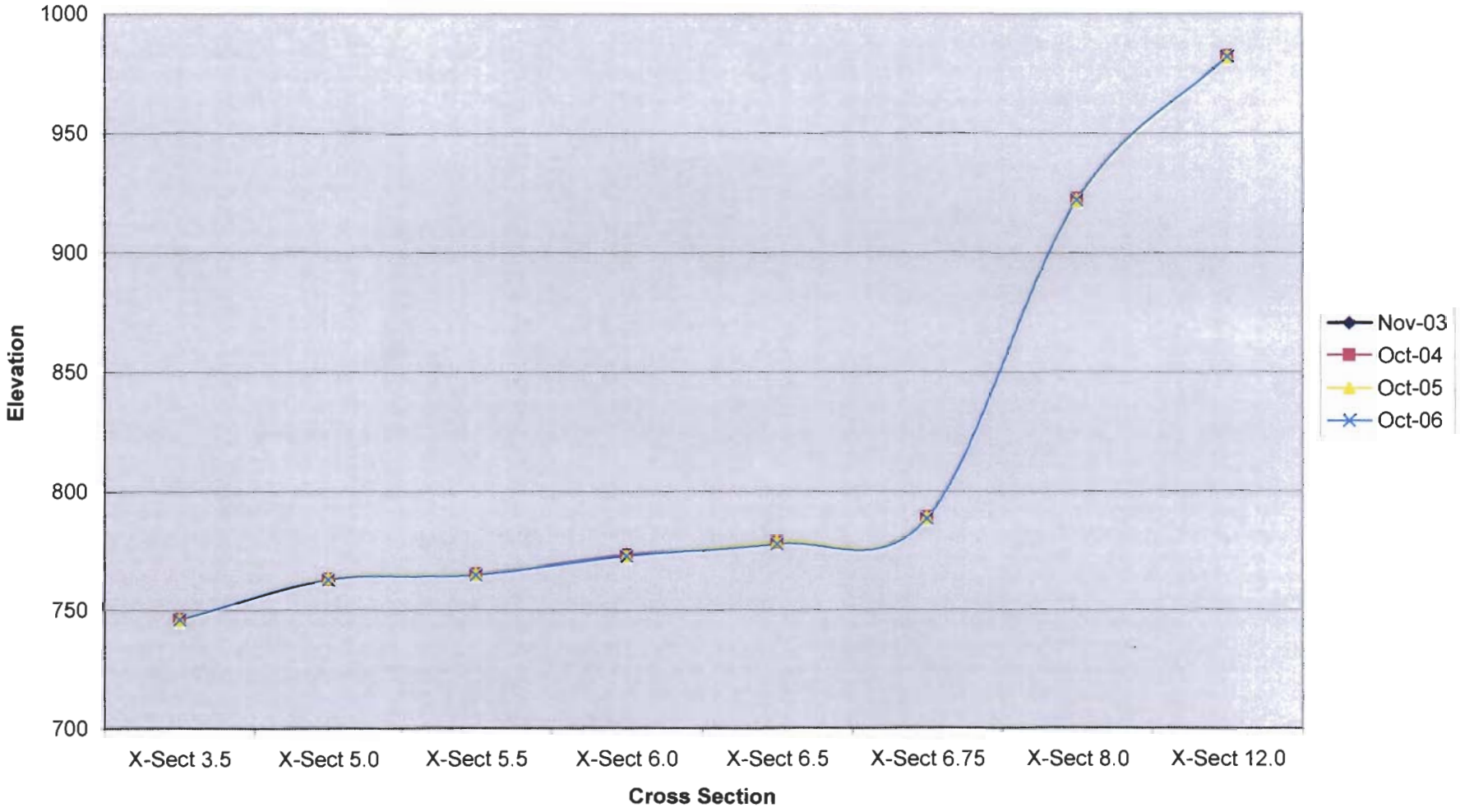

TABLE A.1.4

Statistical Evaluation of Cross Section Areas for East Main Drainage Channel

	Cross Section Data Area in Square Feet										Statistical Analysis Student's t Test Method						
	Baseline																
Cross Section	Apr-03	Jun-03	Nov-03	April - 04	Oct - 04	April - 05	Oct - 05	April - 06	Oct - 06		Sample Mean	Standard Deviation, σ	Calculated t value	Table t value	Is change significant?	% Change from Baseline	> 25% Change from Baseline?
X-Sect 3.5	34.79	37.47	39.06	40.45	37.62	38.55	39.71	38.54	35.21		38.33	1.500	6.668	1.415	Yes	6.42	No
X-Sect 5	103.90	103.71	104.50	103.84	106.48	107.03	103.93	107.05	107.35		105.49	1.523	2.946	1.415	Yes	-3.39	No
X-Sect 5.5	114.52	117.09	117.74	116.98	121.26	116.68	115.75	116.04	116.22		117.22	1.640	4.657	1.415	Yes	0.75	No
X-Sect 6	123.07	119.88	122.97	122.48	122.28	124.01	120.97	120.51	123.12		122.03	1.338	-2.204	1.415	Yes	-2.63	No
X-Sect 6.5	58.68	57.42	59.40	61.26	59.73	58.37	57.94	59.42	59.52		59.13	1.125	1.138	1.415	No	-3.53	No
X-Sect 6.75	53.26	52.53	52.29	49.46	49.25	47.93	53.81	49.95	50.63		50.73	1.851	-3.863	1.415	Yes	3.75	No
X-Sect 8	134.02	130.63	134.26	136.10	133.92	133.94	135.23	130.28	132.65	*	133.38	1.933	-0.942	1.415	No	-1.52	No
X-Sect 12	166.96	163.50	162.09	164.82	167.47	170.02	168.51	171.20	164.38		166.50	3.066	-0.425	1.415	No	-0.54	No

Student's t Test Formula:

$$t = \frac{X_{s,\,aver} - X_{base}}{\sigma / \sqrt{n}}$$

where **$X_{s,\,aver}$** is the sample mean of the cross sectional area
X_{base} is the baseline cross sectional area
σ is the standard deviation of the the sample
n is the sample number

*Measurement for cross section 8 was taken in Jan 07 because of harzardous conditions in Oct 06

Figure A.2.1

Yearly Subsidence Comparison 2004-2006 over Trenches

Maxey Flats
Fleming County, Kentucky

Description:

Map adapted from FSA NAIP Digital Ortho Photo 2004.

Subsidence Elevation Data Source: "Subsidence yearly comparisons.xls"
Spline methodology was used to generate contours.

Map Legend:
- Subsidence Monitoring Pt
- Trench
- Subsidence Repair
- 1 ft contour 2004
- 1 ft contour 2005
- 1 ft contour 2006
- -0.51 2004-2006 Subsidence (ft)

Average 2004-2006 Subsidence is 0.08 feet

Spatial Projection:

Coordinate System: Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigA.2.1_Subsidence.mxd
Project No.: 3088
Plot Date: 11 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

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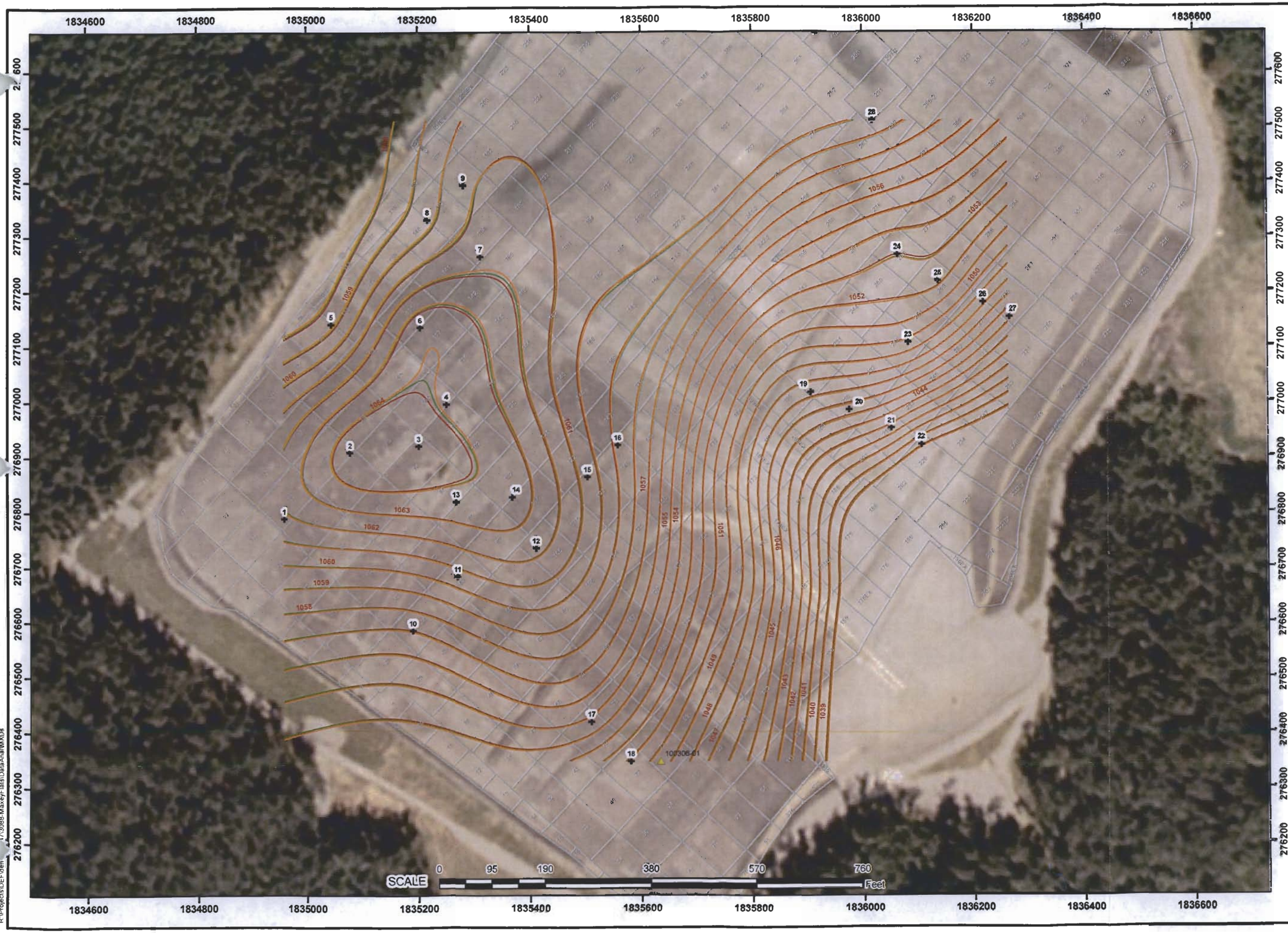

Figure A.2.2

Yearly Subsidence Comparison 2004-2006 over Liner

Maxey Flats
Fleming County, Kentucky

Description:

Map adapted from FSA NAIP Digital Ortho Photo 2004.

Subsidence Elevation Data Source: "Subsidence yearly comparisons.xls"
Spline methodology was used to generate contours.

Map Legend:

- Subsidence Monitoring Pt
- Subsidence Repair
- 1 ft contour 2004
- 1 ft contour 2005
- 1 ft contour 2006
- Panel

Average 2004-2006 Subsidence is 0.08 feet

Spatial Projection:

Coordinate System: Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigA.2.2_Subsidence.mxd
Project No.: 3088
Plot Date: 11 Sept., 2007
Arc Operator: HRVG
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TABLE A.2.3

Subsidence Tracking Form

Subsidence Discovery		Subsidence Repair					
Date	Location	Date	Topographic Location	Area (sq ft)	Depth	Fill Type	Fill Quantity
9/25/2006	Sump 46-2: 24' S Sump 38-4: 65' E	10/3/2006	N 38° 15.413' W 83° 34.220' 1068 Ft Elev.	63.6	12 inches	Sand	0.50 ton

TABLE A.3.1

LEACHATE LEVEL COMPARISON

Sump ID	Top of Sump Elevation	Baseline Water Level Elevation	2004 Water Level Elevation	2005 Water Level Elevation	2006 Water Level Elevation	Change in level (2006) from Baseline	2004 % of freeboard used	2005 % of freeboard used	2006 % freeboard used
1-2	1056.17	1035.37	1036.87	1036.77	1036.67	1.30	7.53%	7.02%	6.52%
2-6	1057.51	1036.06	1036.91	1037.11	1037.19	1.13	4.35%	5.38%	5.79%
3-2	1059.45	1036.45	1036.65	1036.45	1036.41	-0.04	0.94%	0.00%	-0.19%
3-4	1054.33	1038.70	1038.53	1038.43	1038.40	-0.30	-1.19%	-1.89%	-2.10%
7-4	1052.42	1037.14	1039.52	1041.02	1042.37	5.23	17.17%	27.99%	37.73%
7-5	1057.95	1039.52	1039.25	1038.75	1038.50	-1.02	-1.67%	-4.76%	-6.31%
7-7	1059.01	1039.68	1039.21	1038.91	1038.62	-1.06	-2.58%	-4.22%	-5.81%
10-7	1060.34	1032.51	1032.74	1032.74	1032.77	0.26	0.88%	0.88%	1.00%
10-8	1058.78	1031.27	1031.18	1031.08	1031.06	-0.21	-0.35%	-0.73%	-0.81%
10-9	1054.92	1028.86	1029.52	1029.62	1029.84	0.98	2.77%	3.19%	4.11%
11-5	1057.08	1036.16	1036.18	1036.18	1036.12	-0.04	0.10%	0.10%	-0.21%
11-6	1063.22	1039.19	1039.12	1038.92	1038.80	-0.39	-0.31%	-1.19%	-1.72%
15-4	1062.04	1035.36	1035.44	1035.34	1035.37	0.01	0.32%	-0.08%	0.04%
15-5	1061.21	1037.07	1036.21	1036.11	1036.09	-0.98	-3.79%	-4.23%	-4.32%
15-6	1059.46	1030.58	1030.86	1030.96	1031.06	0.48	1.04%	1.40%	1.77%
15-8	1055.85	1033.64	1033.45	1033.35	1033.43	-0.21	-0.95%	-1.45%	-1.05%
18-6	1065.42	1035.01	1035.02	1035.12	1035.10	0.09	0.03%	0.38%	0.31%
18-9	1059.54	1037.66	1037.54	1037.54	1037.54	-0.12	-0.58%	-0.58%	-0.58%
19-5	1063.23	1034.38	1034.43	1032.73	1034.34	-0.04	0.18%	-6.02%	-0.15%
19-6	1058.71	1035.21	1035.51	1035.41	1035.47	0.26	1.42%	0.94%	1.23%
19-7	1064.26	1033.46	1034.16	1034.16	1034.23	0.77	2.41%	2.41%	2.66%
20W	1065.49	1038.99	1037.59	1037.39	1037.34	-1.65	-5.67%	0.49%	0.36%
20-7	1063.29	1033.44	1033.49	1033.39	1033.35	-0.09	0.18%	-0.18%	-0.32%
20-9	1065.36	1035.30	1035.26	1034.66	1035.30	0.00	-0.14%	-2.29%	0.00%
20-11	1059.06	1034.85	1034.86	1034.96	1034.93	0.08	0.04%	-6.48%	-6.68%
23-5	1063.61	1032.41	1032.51	1032.61	1032.69	0.28	0.34%	0.69%	0.96%
23-6	1064.28	1033.11	1033.48	1033.48	1033.53	0.42	1.27%	1.27%	1.44%
23-9	1059.08	1034.53	1034.98	1034.78	1034.78	0.25	2.04%	1.13%	1.13%
24-5	1058.86	1035.49	1035.56	1035.56	1035.50	0.01	0.33%	0.33%	0.05%
24-6	1062.47	1036.02	1036.07	1035.97	1036.03	0.01	0.21%	-0.21%	0.04%
25-5	1059.82	1036.91	1036.62	1036.52	1036.47	-0.44	-1.37%	-1.84%	-2.08%
25-7	1060.71	1035.66	1035.71	1035.81	1035.83	0.17	0.21%	0.64%	0.72%
25-9	1057.05	1034.46	1034.45	1034.55	1034.57	0.11	-0.05%	0.44%	0.54%
26-2	1059.31	1031.20	1031.41	1031.61	1031.74	0.54	0.80%	1.57%	2.06%
26-3	1058.38	1031.48	1031.68	1031.78	1031.80	0.32	0.83%	1.25%	1.33%
26-4	1056.44	1034.74	1034.54	1034.44	1034.36	-0.38	-1.02%	-1.53%	-1.93%
27-9	1062.84	1034.76	1035.64	1035.94	1036.15	1.39	3.39%	0.43%	0.21%
27-11	1064.78	1038.98	1039.28	1039.08	1039.03	0.05	1.28%	4.54%	5.35%
28W	1064.15	1038.15	1038.15	1038.05	1038.11	-0.04	0.00%	-0.40%	-0.40%
28-6	1064.58	1037.08	1037.38	1037.18	1037.14	0.06	1.20%	0.00%	0.08%
28-11	1063.79	1036.79	1036.99	1036.79	1036.81	0.02	0.79%	-0.43%	-0.17%
28-12	1065.48	1039.18	1039.08	1039.08	1039.08	-0.10	-0.40%	0.40%	0.24%
29W	1063.52	1038.57	1038.52	1038.72	1038.10	-0.47	1.77%	0.65%	-2.04%
29-5	1066.43	1038.48	1038.93	1038.73	1038.76	0.28	-1.16%	0.98%	1.10%
29-6	1064.24	1038.91	1038.64	1038.44	1038.67	-0.24	-0.22%	-2.02%	-1.03%
30-4	1062.29	1039.04	1039.19	1039.89	1038.99	-0.05	-0.51%	4.06%	-0.24%
30-8	1067.21	1038.11	1037.51	1037.41	1037.23	-0.88	0.72%	-2.49%	-3.13%
30-10	1066.15	1037.09	1036.95	1036.95	1037.00	-0.09	-2.13%	-0.51%	-0.33%
31-2	1065.86	1040.81	1040.76	1040.66	1040.68	-0.13	-0.21%	-0.63%	-0.55%
31-5	1062.13	1038.90	1039.23	1038.83	1039.08	0.18	1.59%	-0.34%	0.87%
31-7	1065.30	1040.52	1040.60	1040.50	1040.59	0.07	0.34%	-0.09%	0.30%
31-9	1066.46	1041.51	1041.26	1040.96	1040.86	-0.65	-1.11%	-2.44%	-2.88%
32E	1064.75	1035.62	1035.75	1035.75	1034.78	-0.84	-0.04%	0.47%	-3.02%
32-9	1065.27	1036.38	1036.37	1036.37	1036.32	-0.06	0.47%	-0.04%	-0.22%
35-2	1064.08	1037.04	1036.48	1036.18	1036.08	-0.96	-2.34%	-3.59%	-4.01%
35-6	1063.00	1035.35	1035.60	1035.60	1035.62	0.27	0.98%	0.98%	1.06%
36-3	1062.52	1041.79	1041.72	1041.72	1041.76	-0.03	-0.36%	-0.36%	-0.16%
36-6	1066.55	1042.55	1042.65	1042.55	1042.55	0.00	0.49%	0.00%	0.00%
36-7	1064.64	1041.94	1042.14	1042.24	1042.32	0.38	0.99%	1.48%	1.88%
37-3	1055.27	1032.30	1032.37	1032.47	1032.51	0.21	0.33%	0.80%	0.99%
37-4	1055.86	1032.49	1032.36	1032.36	1032.36	-0.13	-0.62%	-0.62%	-0.62%
38-4	1055.75	1033.95	1034.05	1034.15	1034.25	0.30	0.52%	1.04%	1.57%
38-5	1055.53	1034.08	1034.23	1034.33	1034.35	0.27	0.78%	1.30%	1.40%
39-1	1056.84	1036.24			1056.84	20.60	0.00%	0.00%	0.00%
39-4	1056.93	1037.91	1037.73	1037.73	1037.81	-0.10	-1.09%	-1.09%	-0.61%
40-15	1047.28	1025.88	1025.98	1025.88	1025.87	-0.01	0.50%	0.00%	-0.05%
40-17	1052.66	1023.91	1024.16	1023.96	1024.08	0.17	0.92%	0.18%	0.63%
40-19	1054.59	1024.29	1024.89	1024.79	1024.83	0.54	2.08%	1.73%	1.87%
40-22	1056.95	1024.42	1024.85	1024.85	1024.97	0.55	1.41%	1.41%	1.81%
42-11	1049.49	1020.89	1021.29	1021.09	1021.04	0.15	1.47%	0.74%	0.55%
42-19	1046.99	1019.29	1019.29	1019.19	1019.11	-0.18	0.00%	-0.41%	-0.73%
42-20	1052.04	1016.69	1016.74	1016.94	1016.94	0.25	0.15%	0.75%	0.75%
43-7	1047.17	1011.22	1011.17	1011.07	1010.97	-0.25	-0.14%	-0.76%	-0.86%
43-9	1045.19	1011.04	1011.09	1010.79	1010.76	-0.28	0.15%	-0.84%	-0.84%
43-13	1041.02	1010.67	1010.52	1010.42	1010.42	-0.25	-0.51%	-0.43%	-0.72%
44-14	1048.42	1014.12	1014.32	1014.12	1014.14	0.02	0.62%	0.00%	0.06%
44-20	1052.25	1013.75	1013.85	1013.85	1013.85	0.10	0.28%	0.28%	0.28%
44-22	1055.02	1015.12	1015.32	1015.02	1014.97	-0.15	0.53%	-0.26%	-0.40%
44-5	1057.33	1015.88	1015.83	1015.83	1016.03	0.15	-0.13%	-0.13%	0.38%
45-1	1054.78	1025.28	1025.28	1025.38	1025.38	0.10	0.00%	0.37%	0.37%
46-1	1054.17	1028.27	1028.87	1029.97	1031.26	2.99	2.58%	7.31%	12.85%
46-2	1052.89	1030.74	1031.69	1031.99	1032.11	1.37	4.84%	6.37%	6.98%
46-3	1052.27	1033.77	1034.07	1034.07	1033.81	0.04	2.09%	2.09%	0.28%

Average change 0.37

Figure A.3.2.1

Potentiometric Map
Lower Marker Bed Sump
Comparisons 2003-2006

Maxey Flats
Fleming County, Kentucky

Description:

Map adapted from
FSA NAIP Digital Ortho
Photo 2004.

Sump Water Level Elevation
Data calculated from
Source: "Sump Liquid Level
Monitoring.xls"
Spline methodology was used
to generate contours.

Map Legend:

- Lower Marker Bed Sumps
- Trench
- **% Freeboard**
  - 0 - 10%
  - 10 - 20%
  - 20 - 30%
  - 30 - 40%
- 5ft contour 2003
- 5ft contour 2004
- 5ft contour 2005
- 5ft contour 2006

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigA.3.2.1_SumpsLMB.mxd
Project No.: 3088
Plot Date: 12 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

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Figure A.3.2.3

Potentiometric Map and Liner Maintenance Lower Marker Bed Sump Comparisons 2003-2006

Maxey Flats
Fleming County, Kentucky

Description:

Map adapted from FSA NAIP Digital Ortho Photo 2004.

Sump Water Level Elevation Data calculated from Source: "Sump Liquid Level Monitoring.xls"
Spline methodology was used to generate contours.

Map Legend:
- Lower Marker Bed Sumps
- Panel

% Freeboard
- 0 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 5ft contour 2003
- 5ft contour 2004
- 5ft contour 2005
- 5ft contour 2006

Liner Defects

Year
- 2003
- 2004
- 2005
- 2006

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigA.3.2.3_SumpsLMB.mxd
Project No.: 3088
Plot Date: 12 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

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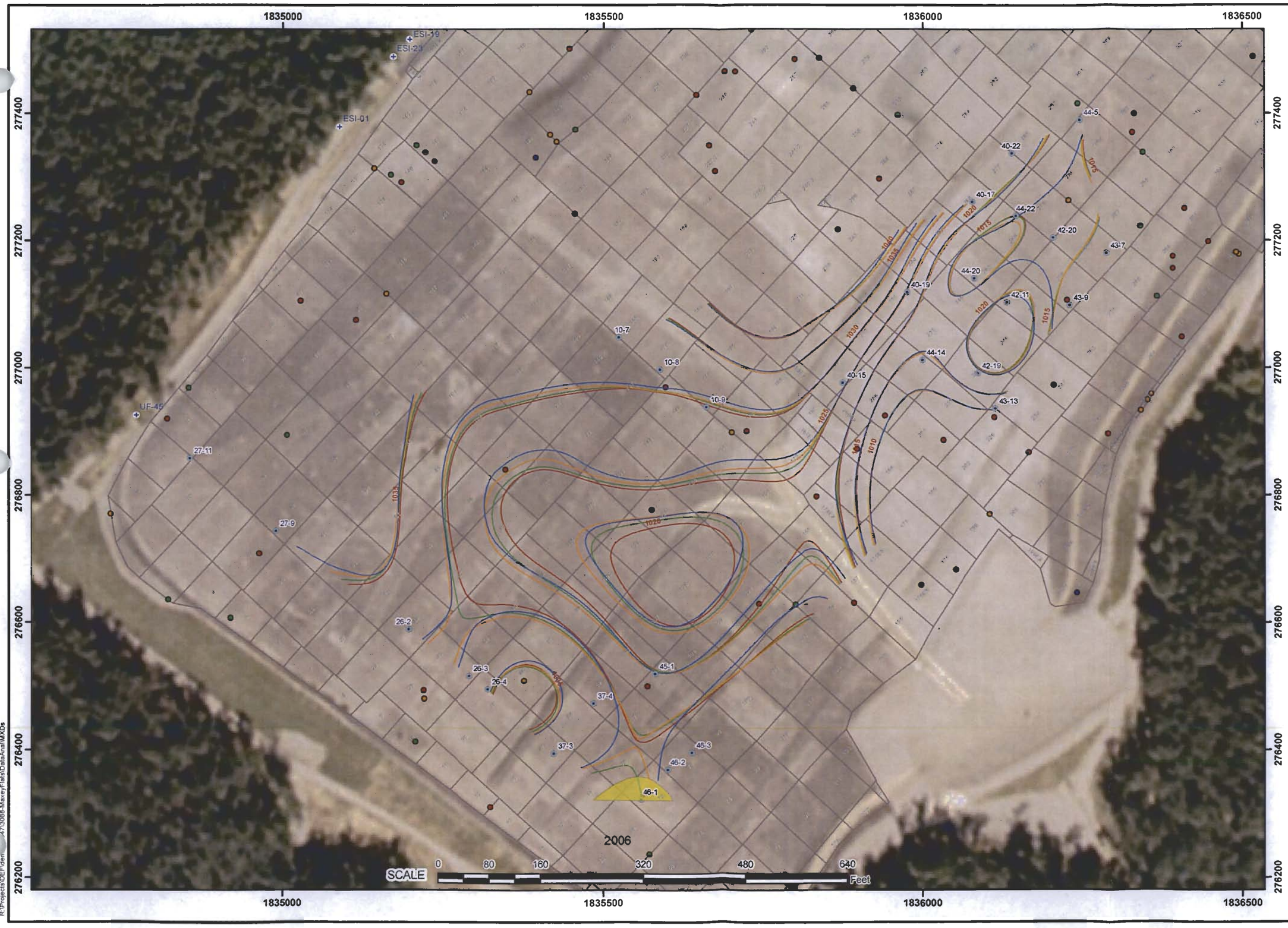

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Figure A.3.2.4

Potentiometric Map and Liner Maintenance Lower Nancy Sump Comparisons 2003-2006

Maxey Flats
Fleming County, Kentucky

Description:

Map adapted from FSA NAIP Digital Ortho Photo 2004.

Sump Water Level Elevation Data calculated from Source: "Sump Liquid Level Monitoring.xls" and Sump Meas Levels2003.xls"
Spline methodology was used to generate contours.

Map Legend:

- Lower Nancy Sumps
- Panel

% Freeboard

- 0 - 10%
- 10 - 20%
- 20 - 30%
- 5ft contour 2003
- 5ft contour 2004
- 5ft contour 2005
- 5ft contour 2006

Liner Defects

Year

- 2003
- 2004
- 2005
- 2006

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigA.3.2.4_SumpsLN.mxd
Project No.: 3088
Plot Date: 12 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

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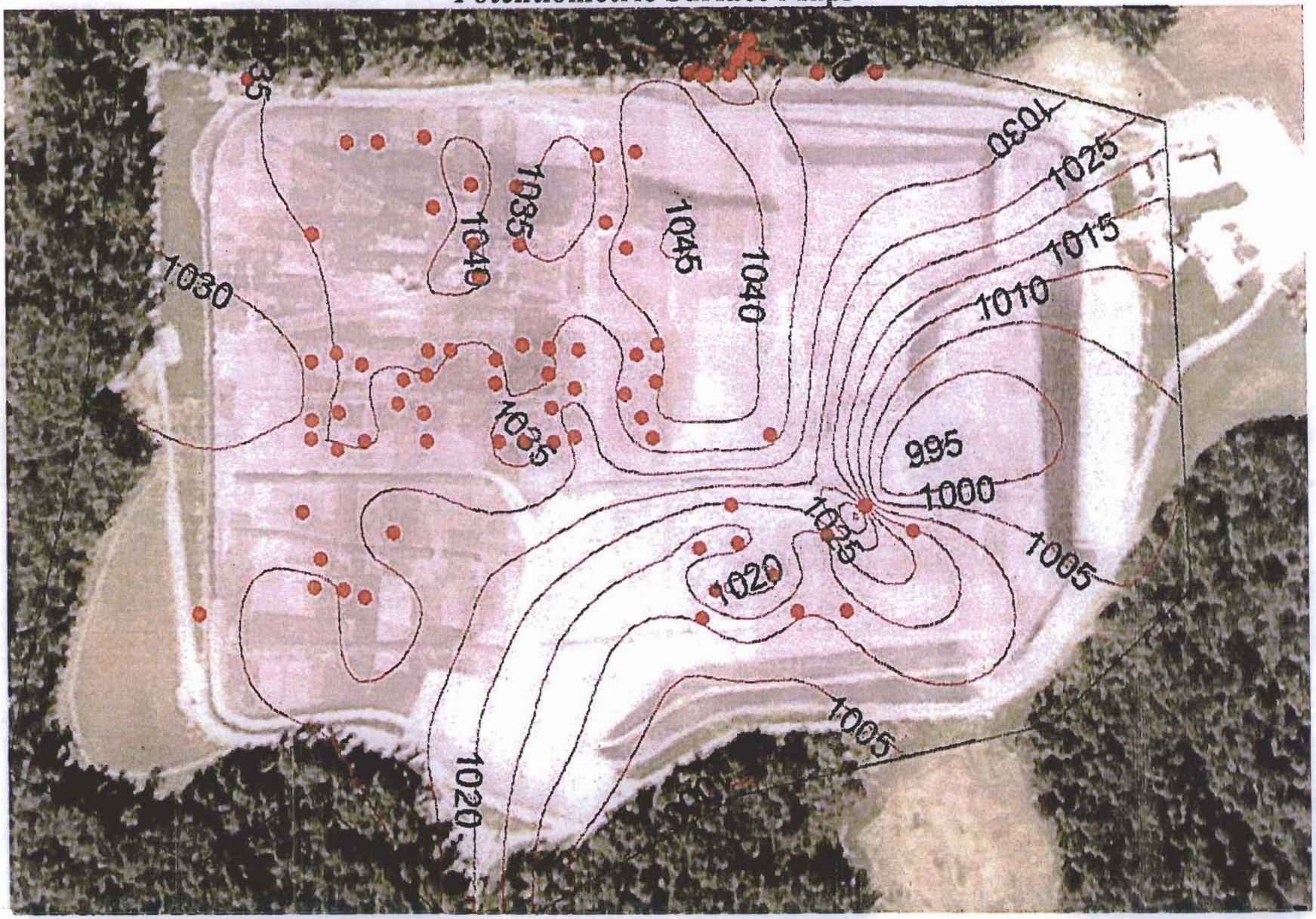
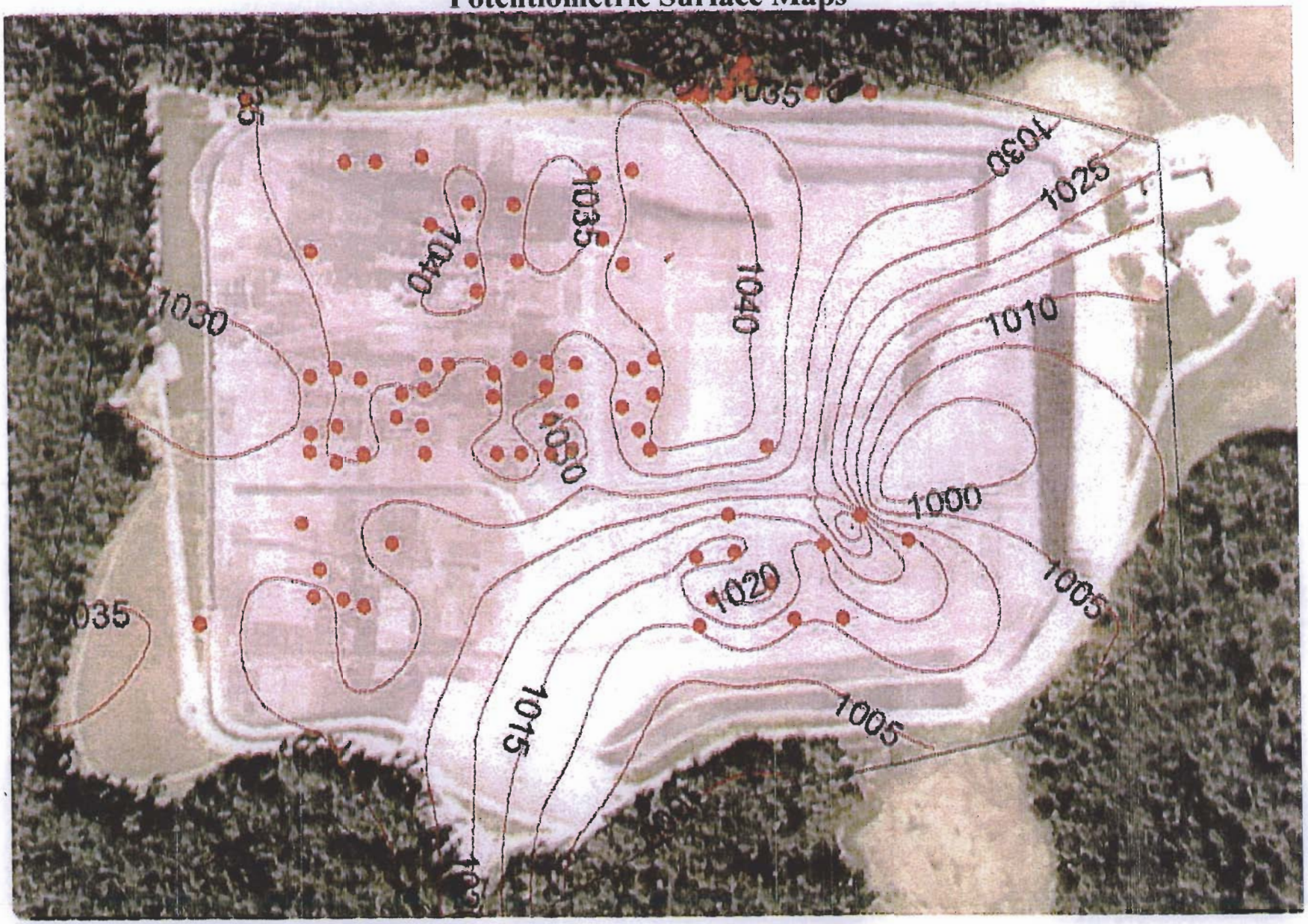
Figures A.3.3
Potentiometric Surface Maps



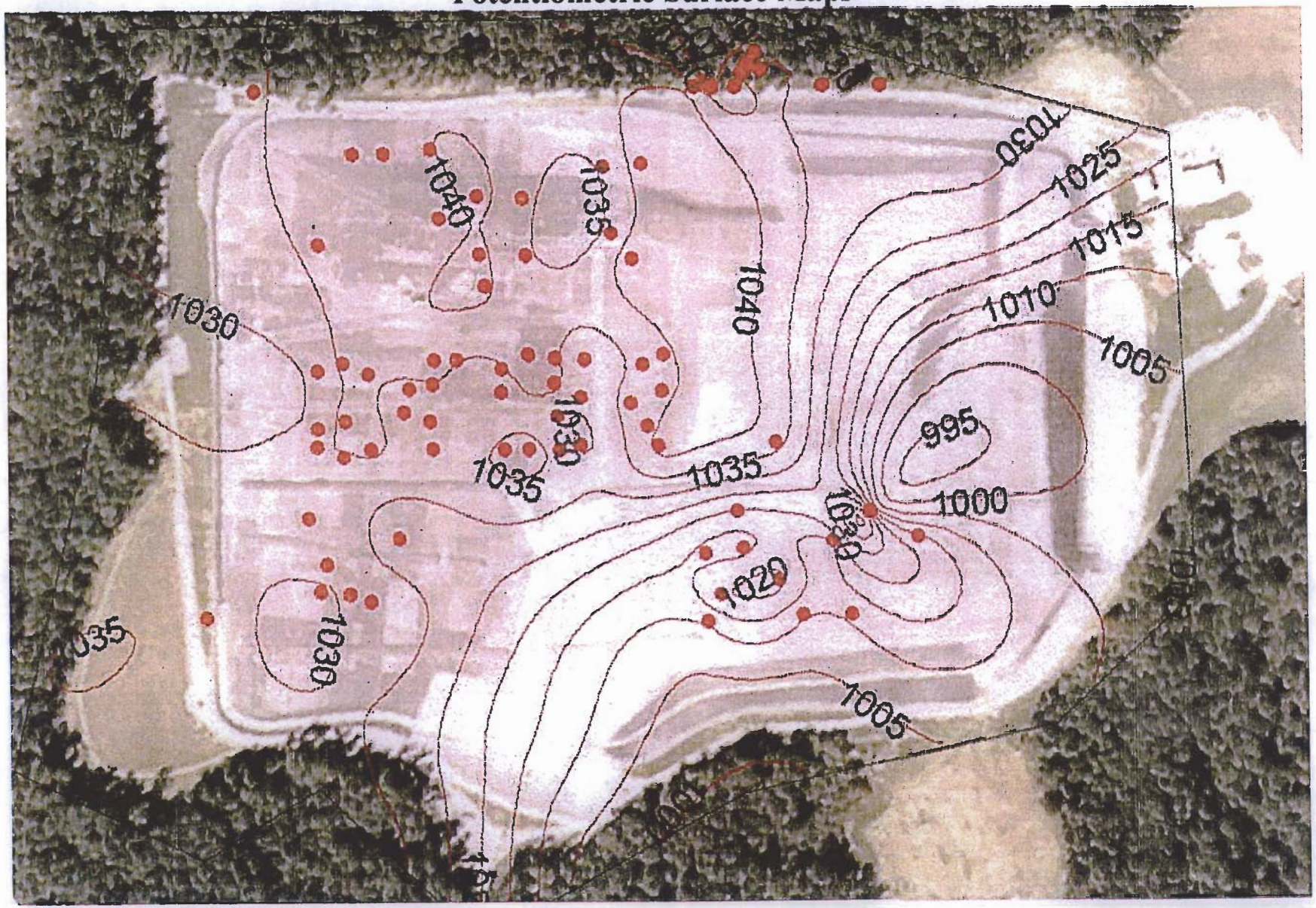
October 2003 – Potentiometric Map

Figures A.3.3
Potentiometric Surface Maps



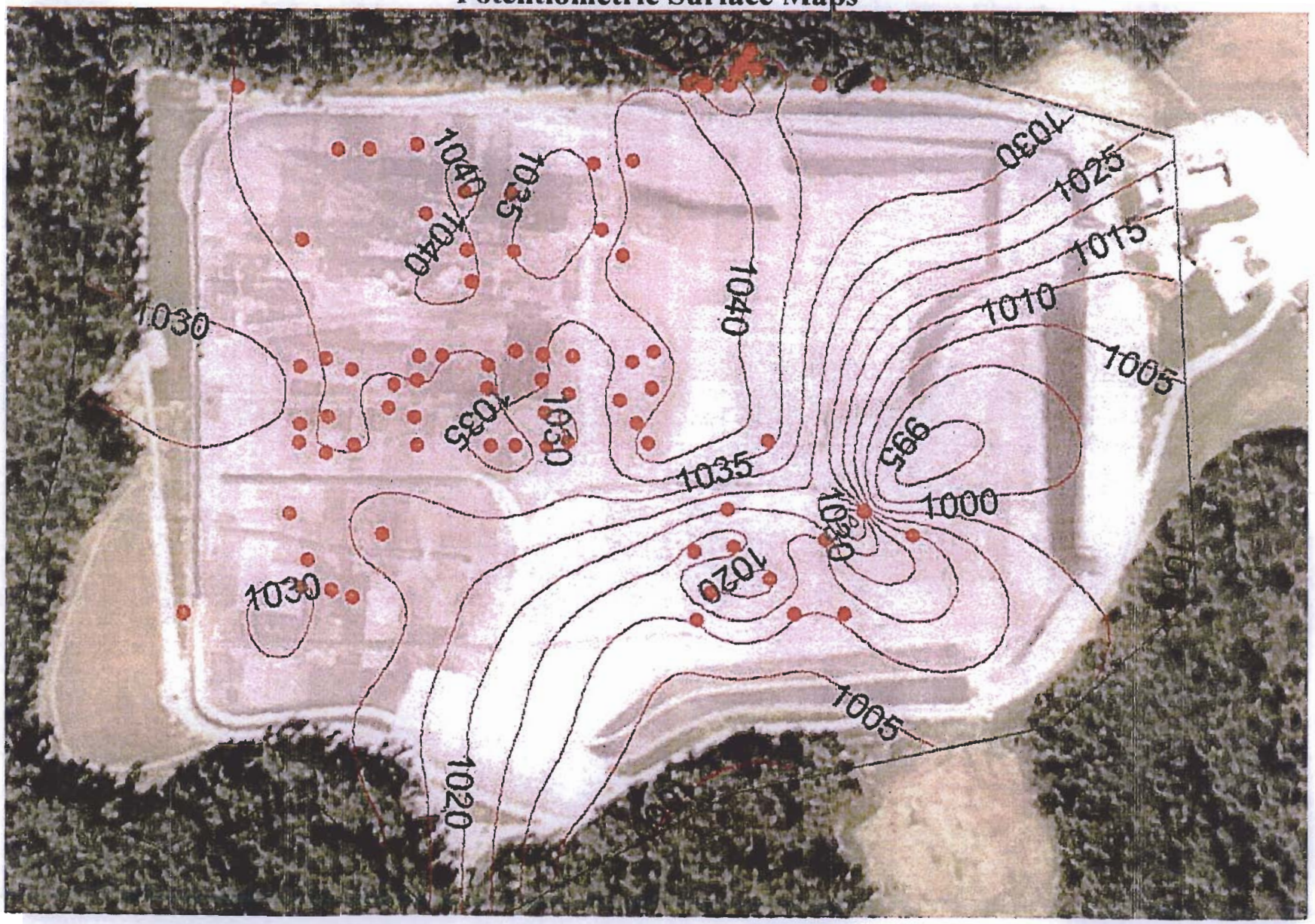
October 2004 – Potentiometric Map

Figures A.3.3
Potentiometric Surface Maps



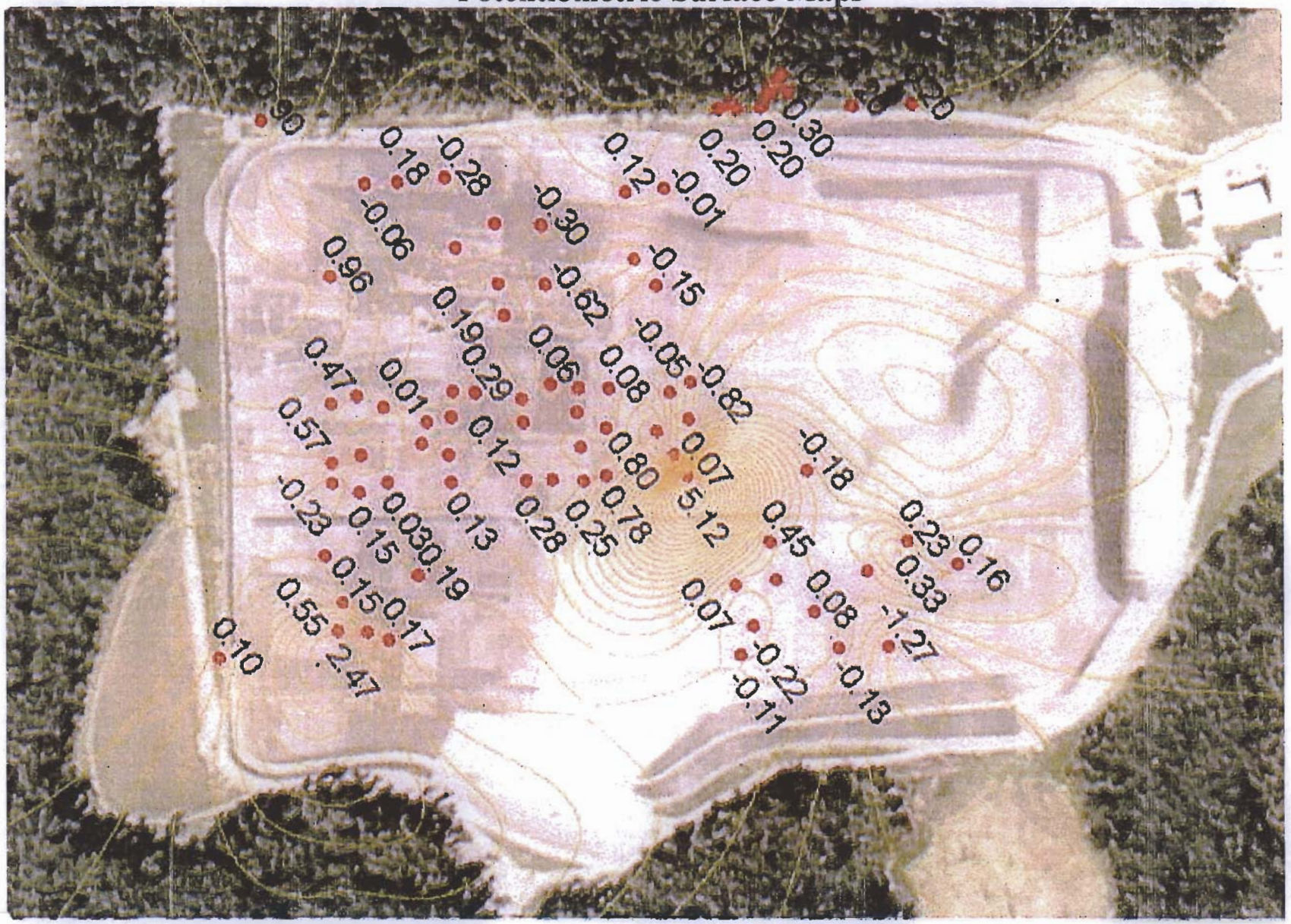
October 2005 – Potentiometric Map

Figures A.3.3
Potentiometric Surface Maps



October 2006 – Potentiometric Map

Figures A.3.3
Potentiometric Surface Maps



Water Level Difference Map October 2003 to October 2006

Figure A.3.4

Liner Maintenance and Sumps with Freeboard Loss 2003-2006

Maxey Flats
Fleming County, Kentucky

Description:

Map adapted from FSA NAIP Digital Ortho Photo 2004.

Sump Water Level Elevation Data calculated from Source: "Sump Liquid Level Monitoring.xls" & "Sump Meas Levels2003.xls"

Map Legend:

- Sumps
- Panel

Site Topography

- 5 ft contour
- 20 ft contour
- 100 ft contour

% Freeboard

- 0 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%

Liner Defects

Year

- 2003
- 2004
- 2005
- 2006

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigA.3.4_Sumps_wTopo.mxd
Project No.: 3088
Plot Date: 11 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

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TABLE 3.5
Prepumping Leachate Level Comparison

Sump ID	Leachate Elevation ft msl NOV02*	Leachate Elevation ft msl April 1998**	Leachate Elevation ft msl October 2006***	Change from Baseline *to October 2006* ft	Change from Pre-Pumping *to October 2006* ft	Remarks
1-2	1035.17	1037.80	1036.67	1.50	-1.13	Depth to leachate measured 18JUN02
2-6	1036.06	1040.50	1037.23	1.17	-3.27	
3-2	1036.45	1037.90	1036.46	0.01	-1.44	Depth to leachate measured by KY DEC02 - JAN03
3-4	1038.70	1039.60	1038.48	-0.22	-1.12	
7-4	1037.14	1047.20	1042.36	5.22	-4.84	
7-5	1039.52	1041.00	1038.53	-0.99	-2.47	
7-7	1039.68	1041.00	1038.73	-0.95	-2.27	
10-7	1032.51	1033.90	1032.73	0.22	-1.17	
10-8	1031.27	1032.40	1030.98	-0.29	-1.42	
10-9	1028.86	1032.50	1029.82	0.96	-2.68	
11-5	1036.16	1036.50	1036.14	-0.02	-0.36	
11-6	1039.19	1039.60	1038.78	-0.41	-0.82	**April 1997 measurement**
15-4	1035.36	1036.00	1035.33	-0.03	-0.67	
15-5	1037.07	1037.00	1036.08	-0.99	-0.92	April 1997 measurement
15-6	1030.58	1032.60	1031.10	0.52	-1.50	
15-8	1033.64	1034.00	1033.38	-0.26	-0.62	
18-6	1035.01	1035.50	1035.18	0.17	-0.32	
18-9	dry	dry	dry	N/A	N/A	Sump depth (from TOC) = 21.88 ft, sump bottom elevation = 1037.66 ft msl
19-5	1034.38	1036.10	1034.41	0.03	-1.69	
19-6	1035.21	1036.50	1035.50	0.29	-1.00	
19-7	1033.46	1036.30	1034.27	0.81	-2.03	
20-W	1038.99	1037.60	1037.45	-1.54	-0.15	Depth to leachate measured 18JUN02
20-7	1033.44	1033.60	1033.36	-0.08	-0.24	
20-9	1035.30	1035.80	1035.34	0.04	-0.46	
20-11	1034.85	1035.40	1034.95	0.10	-0.45	
23-5	1032.41	1033.90	1032.78	0.37	-1.12	
23-6	1033.11	1034.30	1033.55	0.44	-0.75	
23-9	1034.53	1034.53	1034.53	0.00	0.00	**sump bottom elev.=1034.53 - dry**
24-5	1035.49	1035.40	1035.54	0.05	0.14	
24-6	1036.02	1036.30	1035.96	-0.06	-0.34	**April 1997 measurement**
25-5	1036.91	1037.50	1036.45	-0.46	-1.05	
25-7	1035.66	1036.30	1035.82	0.16	-0.48	
25-9	1034.46	1035.10	1034.52	0.06	-0.58	April 1997 measurement
26-2	1031.20	1032.20	1031.73	0.53	-0.47	
26-3	1031.48	1031.90	1031.90	0.42	0.00	
26-4	1034.74	1034.40	1034.32	-0.42	-0.08	
27-9	1034.77	1037.50	1036.21	1.44	-1.29	
27-11	1039.08	1039.30	1039.08	0.00	-0.22	Sump depth (from TOC) = 25.70 ft, sump bottom elevation = 1039.08 ft msl
28-W	1038.15	1038.70	1038.16	0.01	-0.54	
28-6	1037.08	1037.20	1036.98	-0.10	-0.22	**ToC to bottom 27.6 ft - dry**
28-11	1036.79	1037.40	1036.59	-0.20	-0.81	**ToC to bottom 27.2 ft - dry**
28-12	1039.18	dry	dry	N/A	N/A	Sump depth (from TOC) = 26.30 ft, sump bottom elevation = 1039.18 ft msl
29-W	1038.57	1038.70	1038.08	-0.49	-0.62	
29-5	1038.48	dry	dry	N/A	N/A	Sump depth (from TOC) = 27.95 ft, sump bottom elevation = 1038.48 ft msl
29-6	1038.91	1038.90	1038.44	-0.47	-0.46	**ToC to bottom 25.8 ft - dry**
30-4	1039.04	1039.20	1039.00	-0.04	-0.20	Sump depth (from TOC) = 23.25 ft, sump bottom elevation = 1039.04 ft msl
30-8	1038.11	1038.30	1037.43	-0.68	-0.87	
30-10	1037.09	1037.20	1037.09	0.00	-0.11	Sump depth (from TOC) = 29.06 ft, sump bottom elevation = 1037.09 ft msl
31-2	1040.81	1041.40	1040.72	-0.09	-0.68	
31-5	1038.90	1039.30	1038.83	-0.07	-0.47	**ToC to bottom 23.3 ft - dry**
31-7	1040.52	1041.00	1040.59	0.07	-0.41	

TABLE 3.5
Prepumping Leachate Level Comparison

31-9	1041.51	1042.70	1040.80	-0.71	-1.90	
32-E	1035.62	1036.10	1034.83	-0.79	-1.27	
32-9	1035.38	1036.50	1036.35	0.97	-0.15	
35-2	1037.04	1036.30	1036.08	-0.96	-0.22	
35-6	1035.35	1035.90	1035.66	0.31	-0.24	
36-3	1041.79	1043.20	1042.14	0.35	-1.06	
36-6	1042.55	1043.10	1042.60	0.05	-0.50	
36-7	1041.94	1043.20	1041.84	-0.10	-1.36	**ToC to bottom 22.8 ft - dry**
37-3	1032.30	1032.80	1032.54	0.24	-0.26	
37-4	1032.49	1032.80	1032.36	-0.13	-0.44	**ToC to bottom 23.5 ft - dry**
38-4	1033.95	1039.10	1036.58	2.63	-2.52	
38-5	1034.08	1038.70	1034.42	0.34	-4.28	
39-1	1036.24	1039.10		N/A	N/A	No measurement by Commonwealth since baseline
39-4	1037.91	1038.00	1037.73	-0.18	-0.27	**ToC to bottom 19.2 ft - dry**
40-15	1025.88	1025.80	1025.88	0.00	0.08	Sump depth (from TOC) = 21.40 ft, sump bottom elevation = 1025.88 ft msl (apr97)
40-17	1023.91	1026.80	1022.82	-1.09	-3.98	
40-19	1024.29	1023.80	1019.64	-4.65	-4.16	April 1997 measurement
40-22	1024.42	1026.90	1025.00	0.58	-1.90	
42-11	1020.89	1022.00	1021.07	0.18	-0.93	April 1997 measurement
42-19	1019.29	1019.60	1019.37	0.08	-0.23	
42-20	1016.69	1017.30	1016.54	-0.15	-0.76	**ToC to bottom 35.5 ft - dry**
43-7	1011.22	1010.80	1011.04	-0.18	0.24	
43-9	1011.04	1011.00	1010.77	-0.27	-0.23	
43-13	1010.67	1010.10	1010.79	0.12	0.69	
44-5	1015.88	1015.00	1016.05	0.17	1.05	
44-14	1014.12	1014.20	1014.17	0.05	-0.03	
44-20	1013.75	1013.80	1013.88	0.13	0.08	
44-22	1015.12	1015.00	1015.04	-0.08	0.04	Depth to leachate measured by KY DEC02 - JAN03
45-1	1025.28	1028.00	1025.91	0.63	-2.09	
46-1	1028.27	1039.00	1029.19	0.92	-9.81	
46-2	1030.74	1039.40	1032.29	1.55	-7.11	
46-3	1033.77	1038.90	1034.46	0.69	-4.44	

* Baseline water levels at about the time of IRP RA Construction Completion
**Water levels prior to pumping, IRP LR/D; APR98 with some measurements from Apr1997
***Water levels by Commonwealth October 2006 (current)

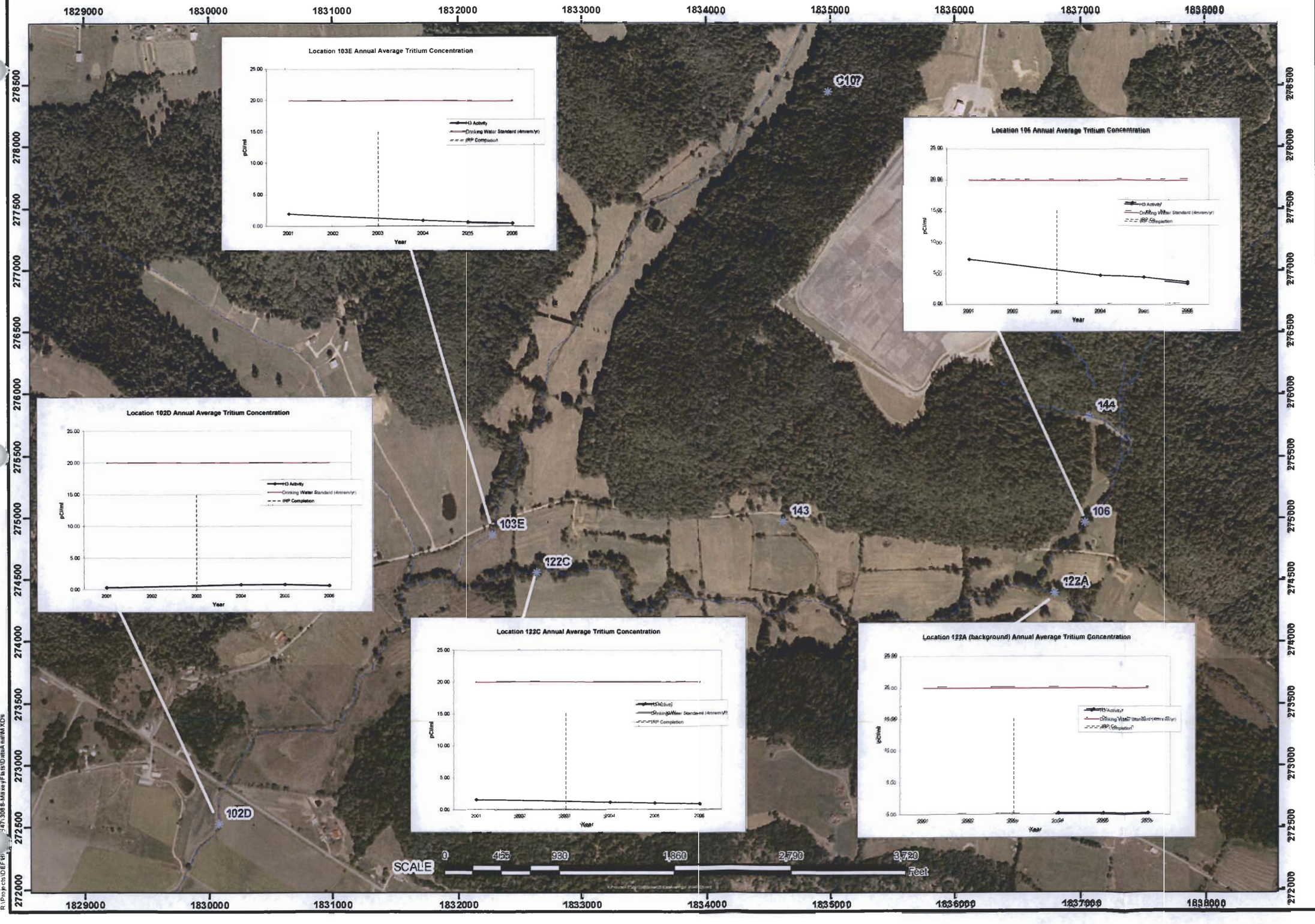

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Figure B.1.1

Contaminant Monitoring of Surface Water Sampling Locations subject to 4 mrem/yr Standard

Maxey Flats
Fleming County, Kentucky

Description:
Map adapted from FSA NAIP Digital Ortho Photo 2004.

Annual average calculated from each years sampling records. Sources: DEP 2001 Data for Baseline with trends.xls, DEP 2001 Data for Baseline 122A&C with trends.xls, 2004 Data.xls, 2005 Report Data.xls and 2006 Report Data.xls

Map Legend:
- Surface Water Sampling Pt
- Waterway

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigB.1.1_SW_4mrem.mxd
Project No.: 3088
Plot Date: 11 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

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TABLE B.1.2

Location 106 Annual Average Tritium Concentration

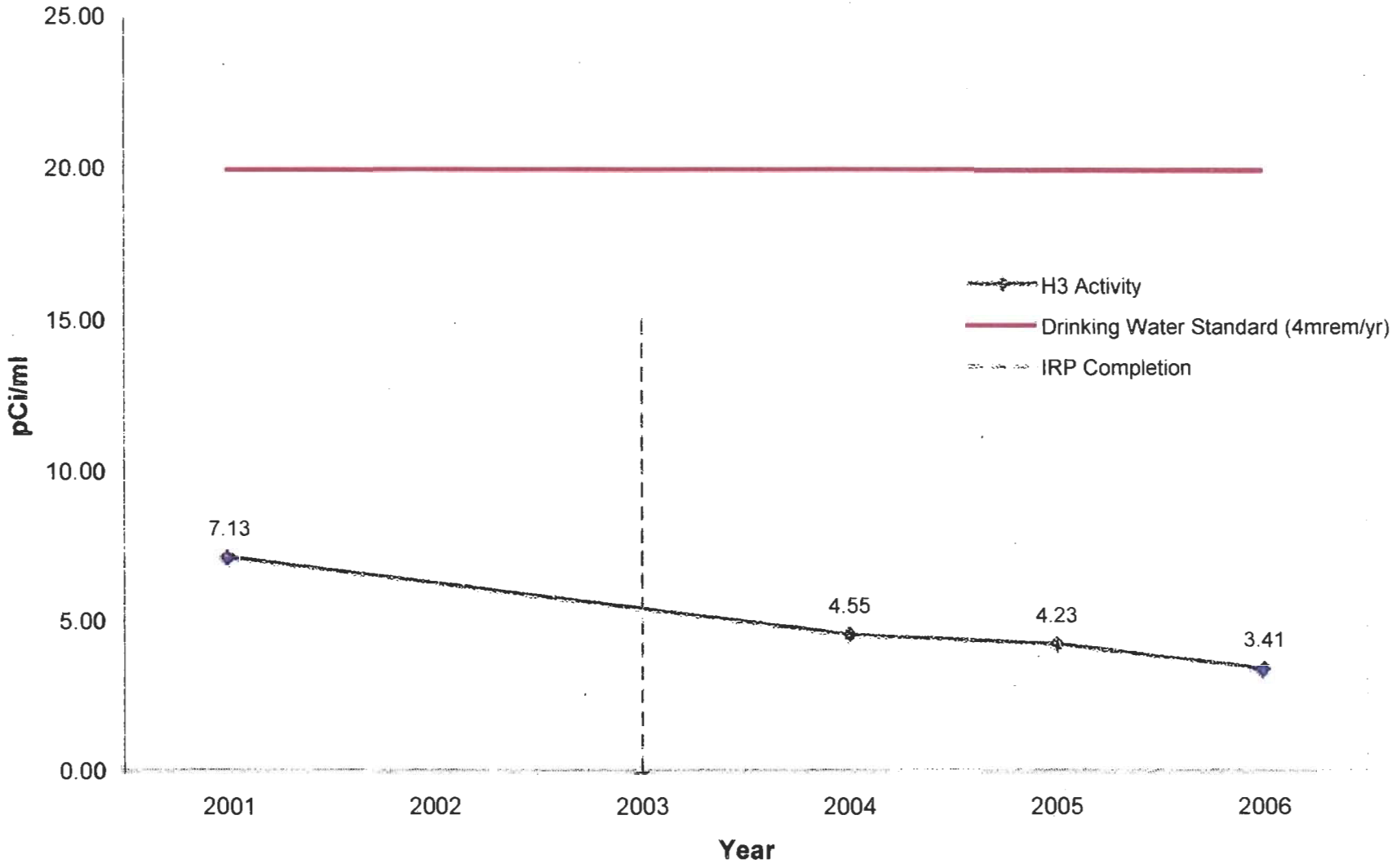


TABLE B.1.2

Location 122C Annual Average Tritium Concentration

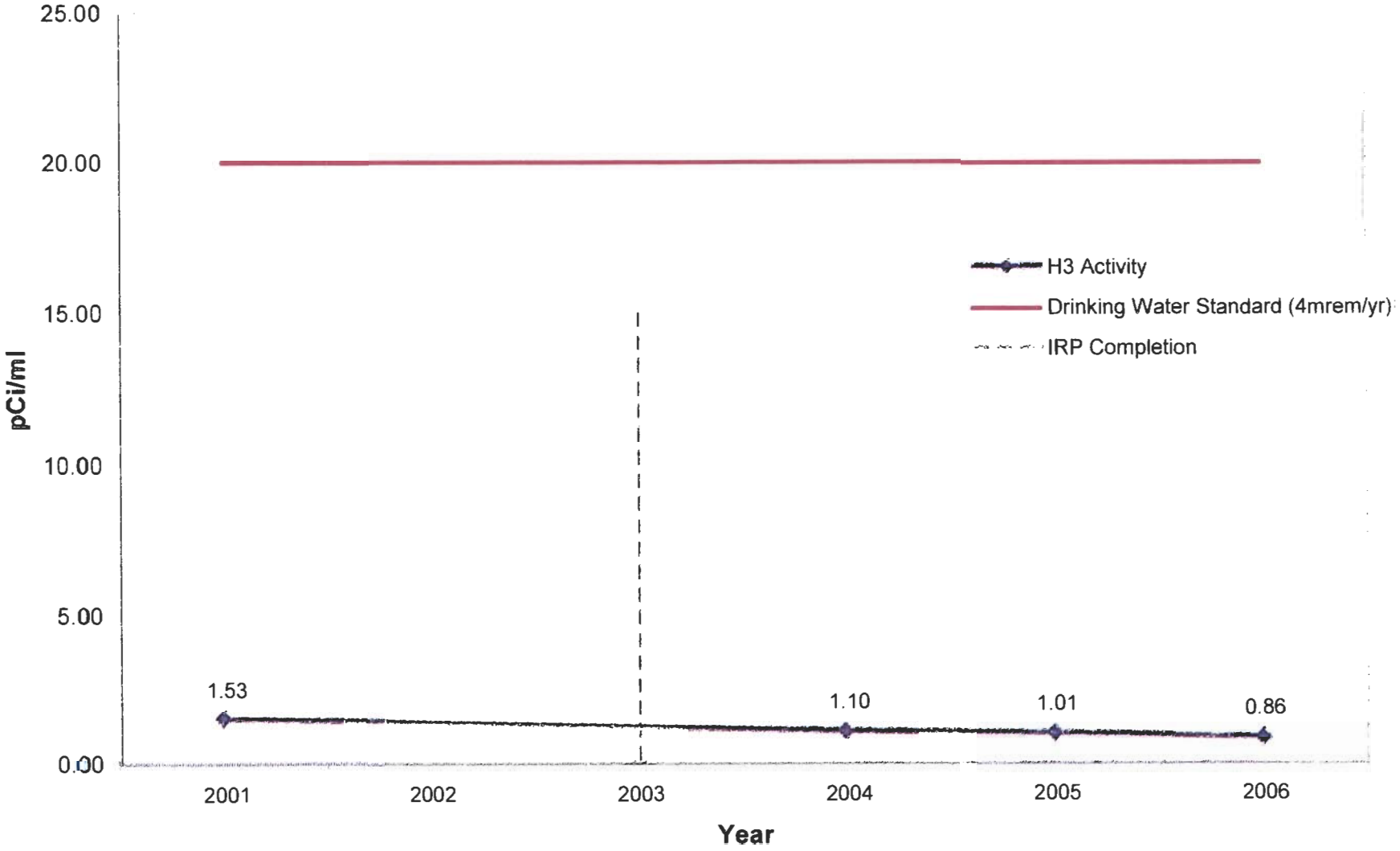


TABLE B.1.2

Location 103E Annual Average Tritium Concentration

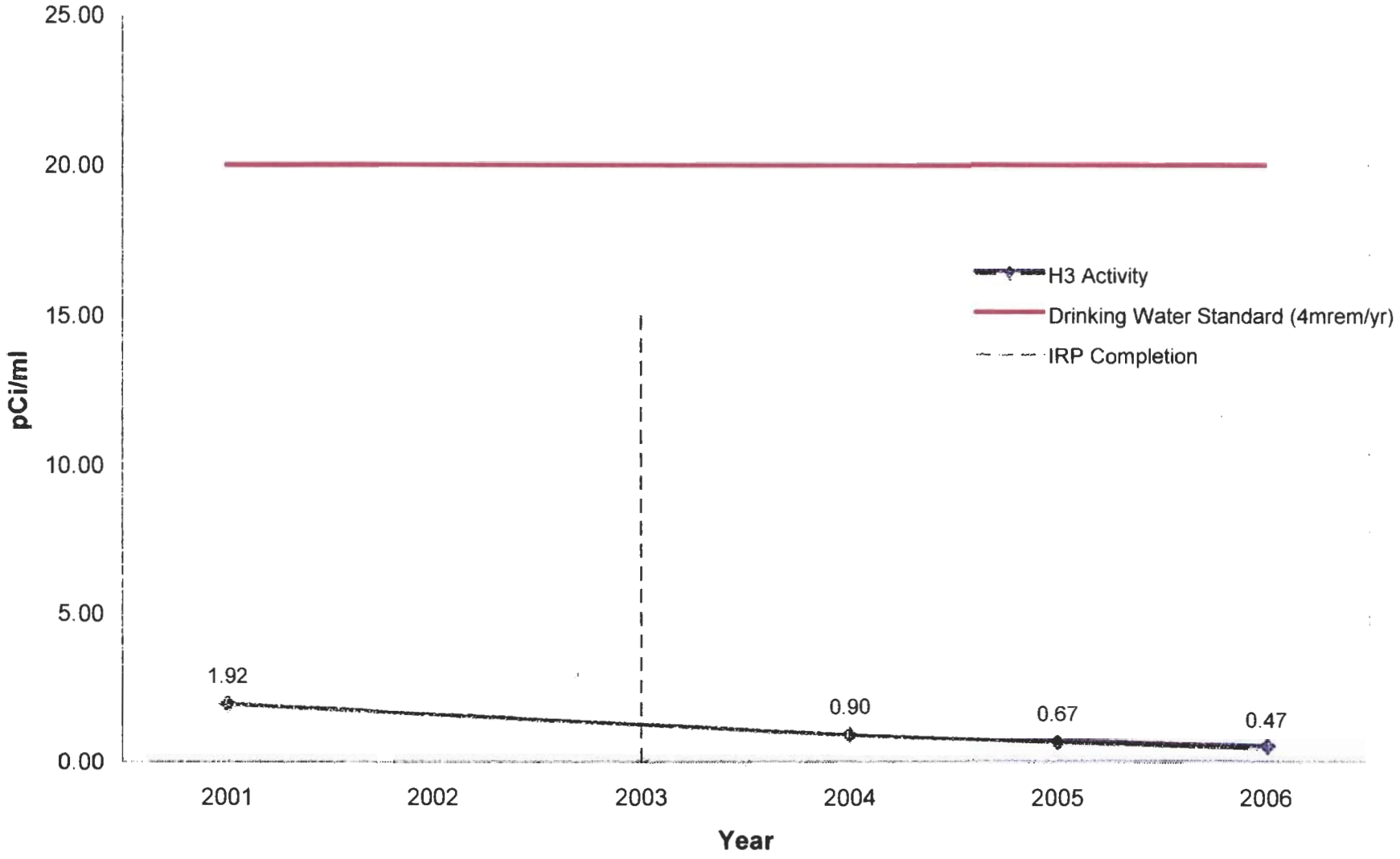


TABLE B.1.2

Location 102D Annual Average Tritium Concentration

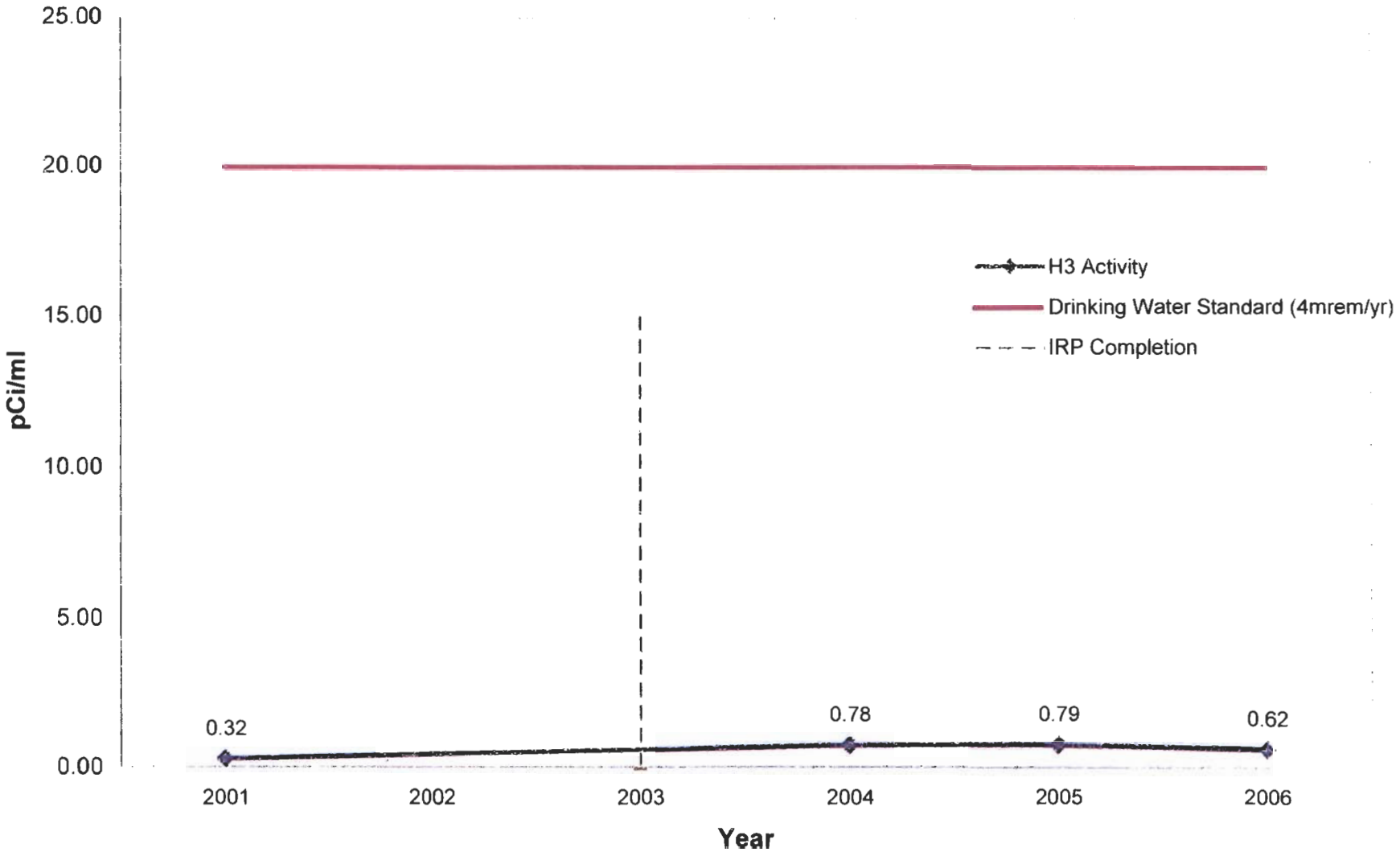
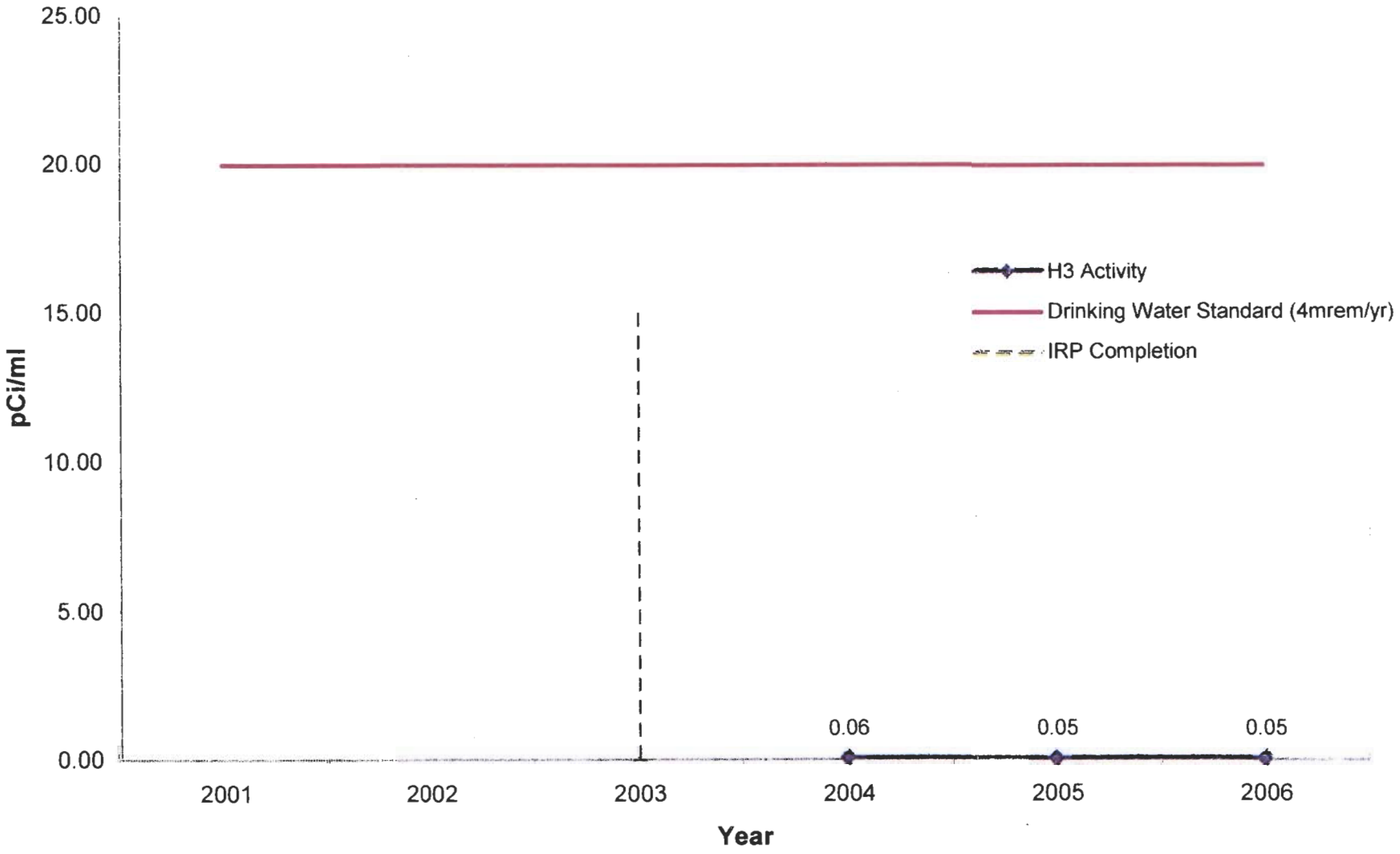


TABLE B.1.2

Location 122A (background) Annual Average Tritium Concentration



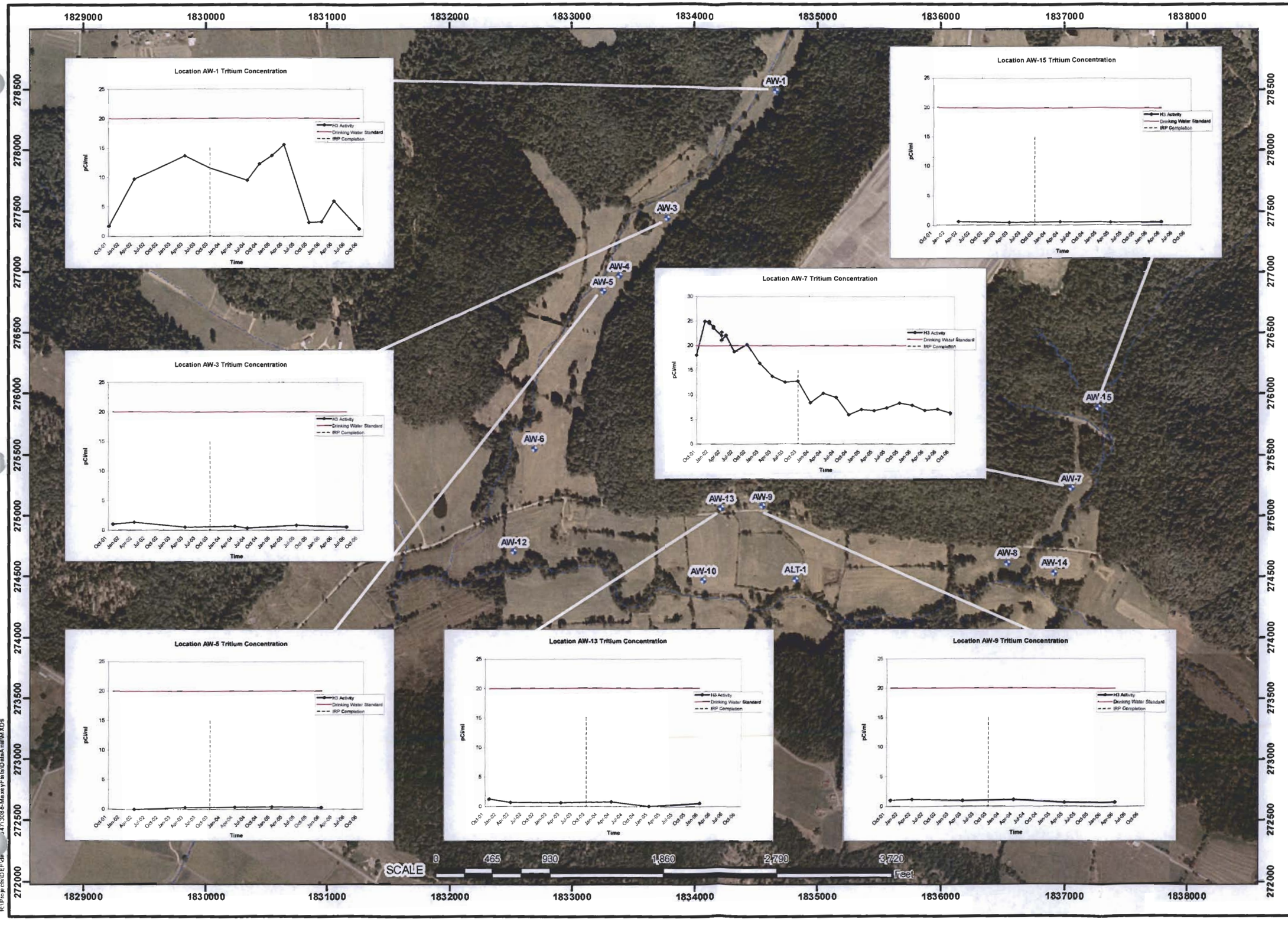


Figure B.2.1

Contaminant Monitoring of Alluvial Well Locations (odd numbered) subject to 4mrem/yr Standard

Maxey Flats
Fleming County, Kentucky

Description:
Map adapted from FSA NAIP Digital Ortho Photo 2004.

Annual average calculated from each years sampling records. Sources: MFP_Alluvial Wells_2003-2006.xls, Table P-1 Alluvial Wells 01-02.xls, Table P-3 Alluvial Wells 2003.xls.

Map Legend:
- Alluvial Well
- Waterway

Spatial Projection:
Coordinate System: Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:
File: FigB.2.1_AlluvialWells.mxd
Project No.: 3088
Plot Date: 11 Sept, 2007
Arc Operator: HRVG
Reviewed by: NB

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TABLE B.2.3

Location AW-1 Tritium Concentration

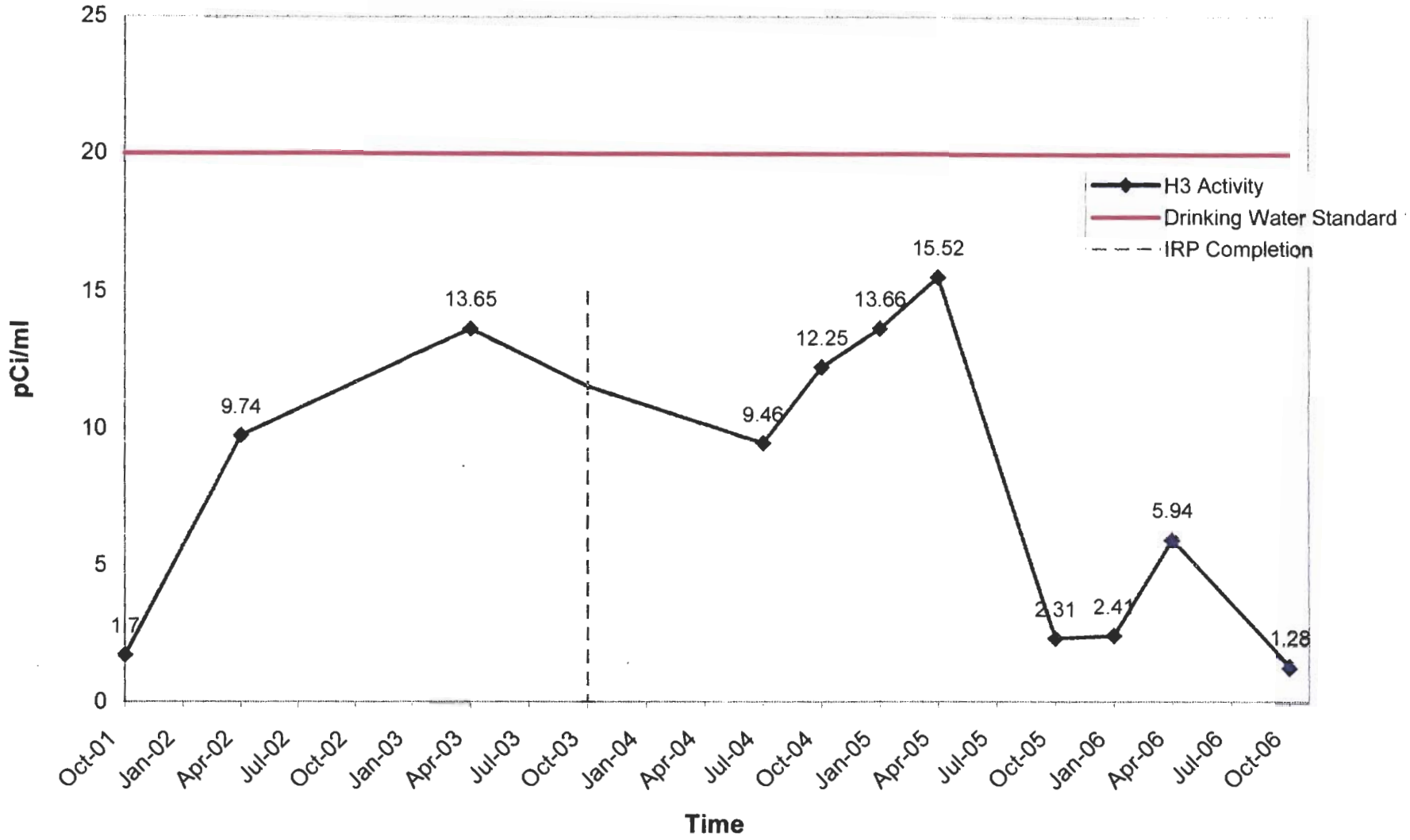


TABLE B.2.3

Location AW-3 Tritium Concentration

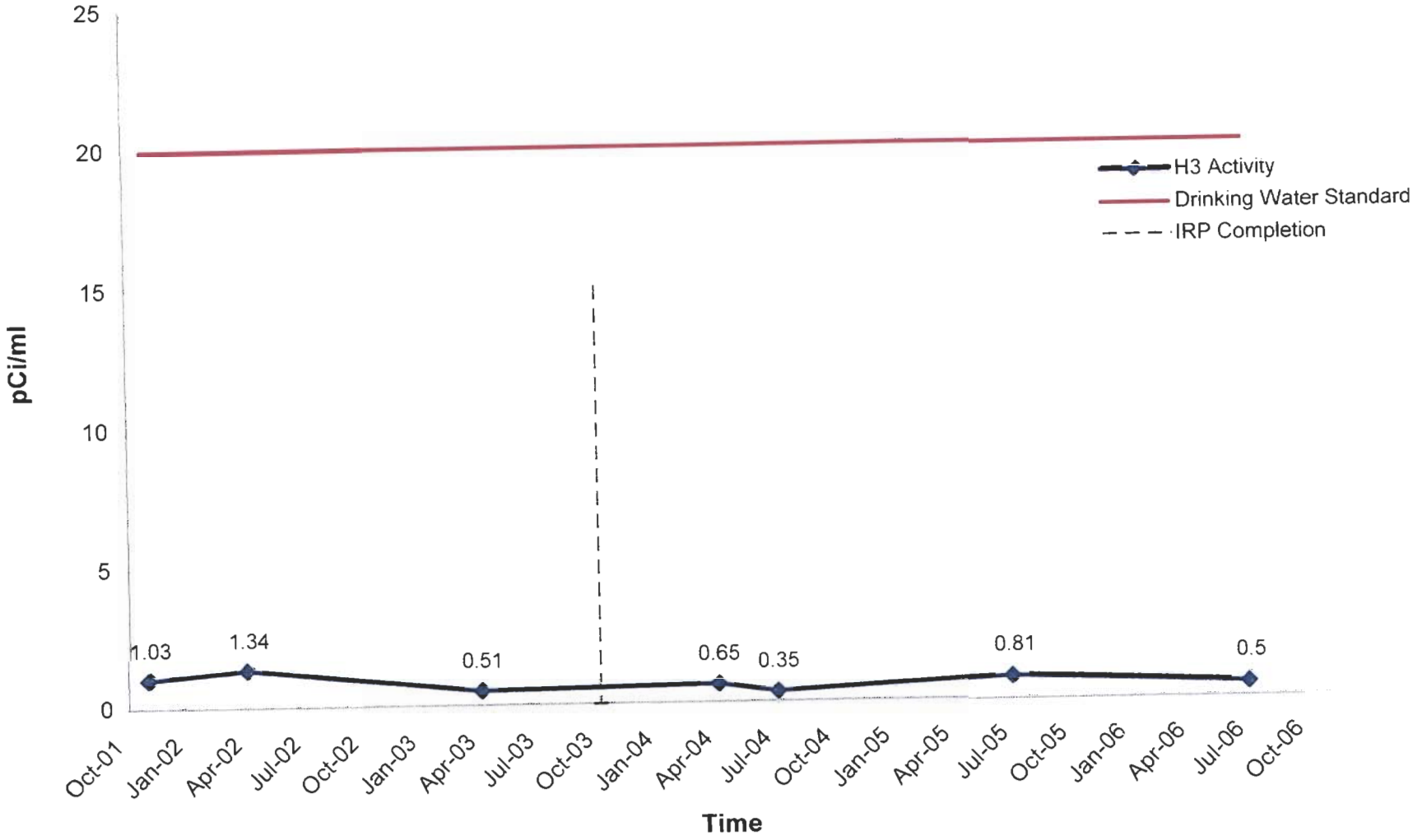


TABLE B.2.3

Location AW-4 Tritium Concentration

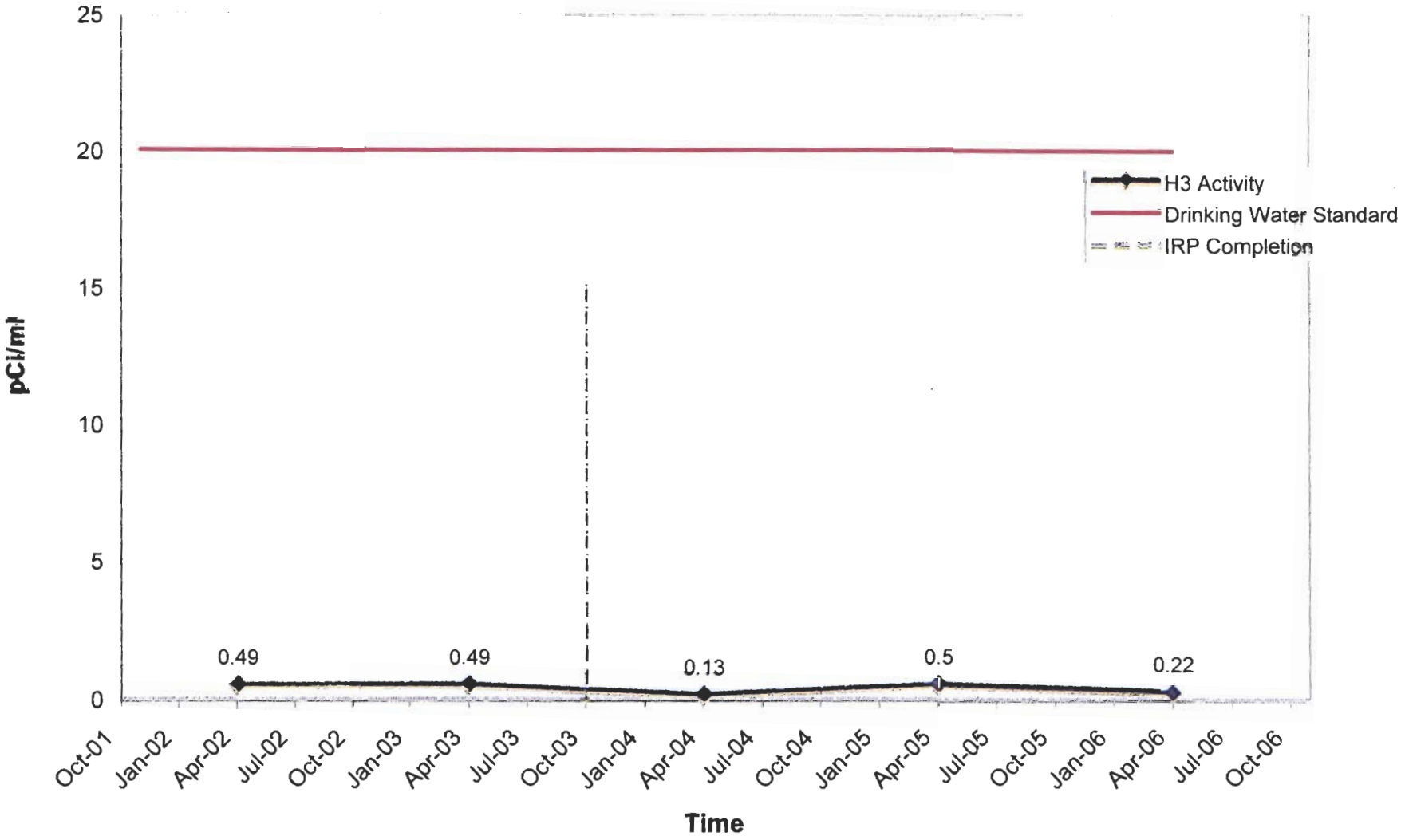


TABLE B.2.3

Location AW-5 Tritium Concentration

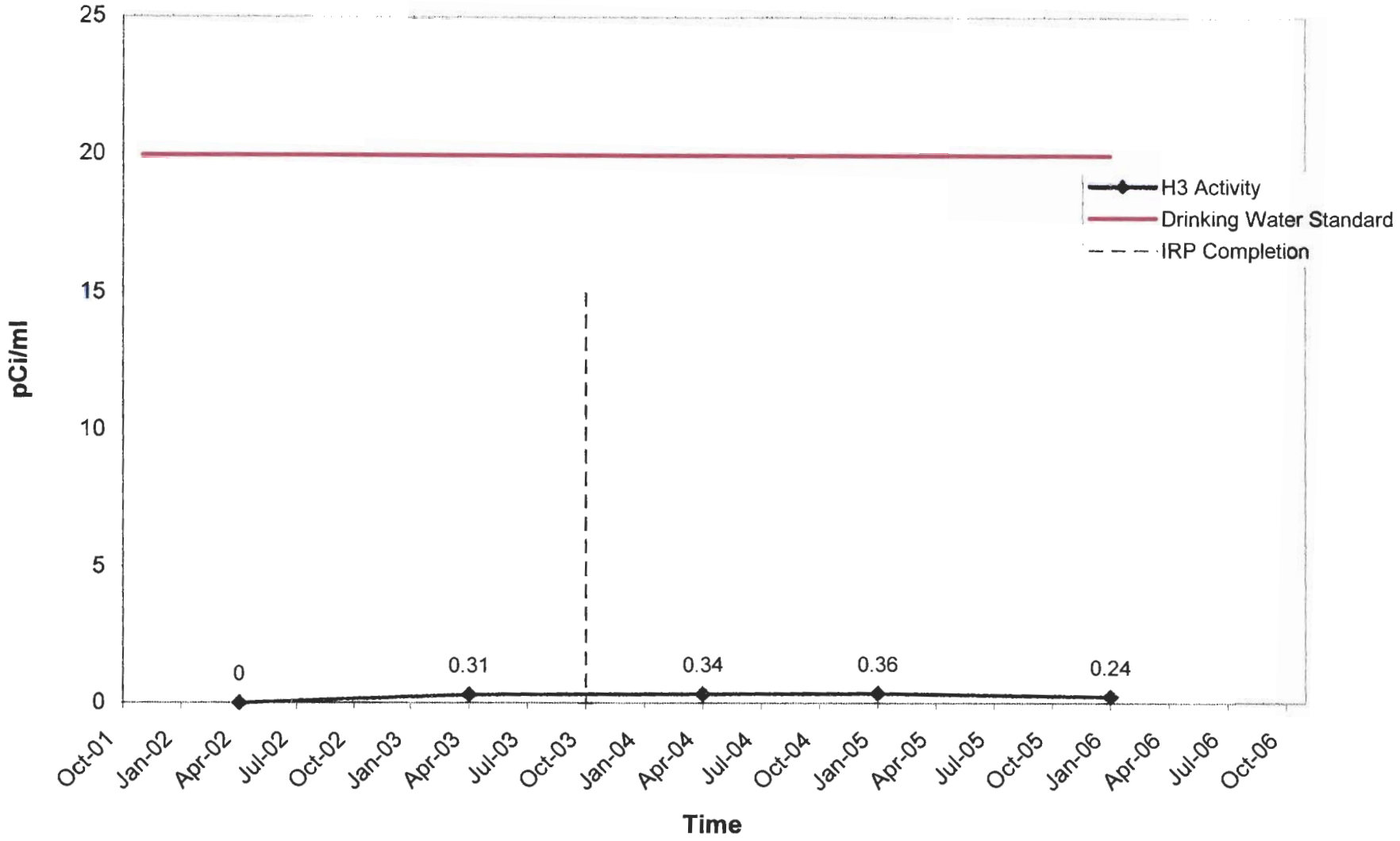


TABLE B.2.3

Location AW-6 Tritium Concentration

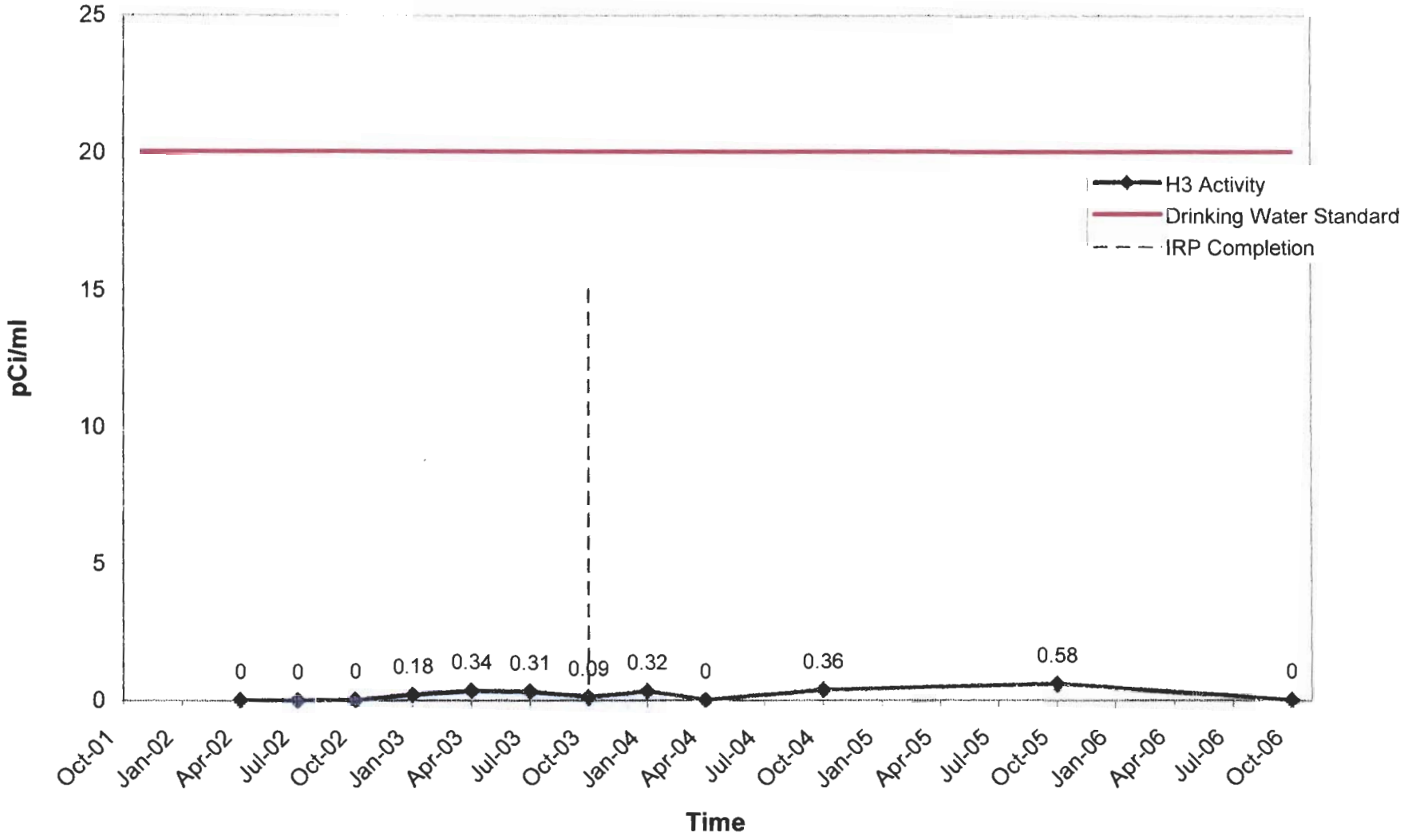


TABLE B.2.3

Location AW-7 Tritium Concentration

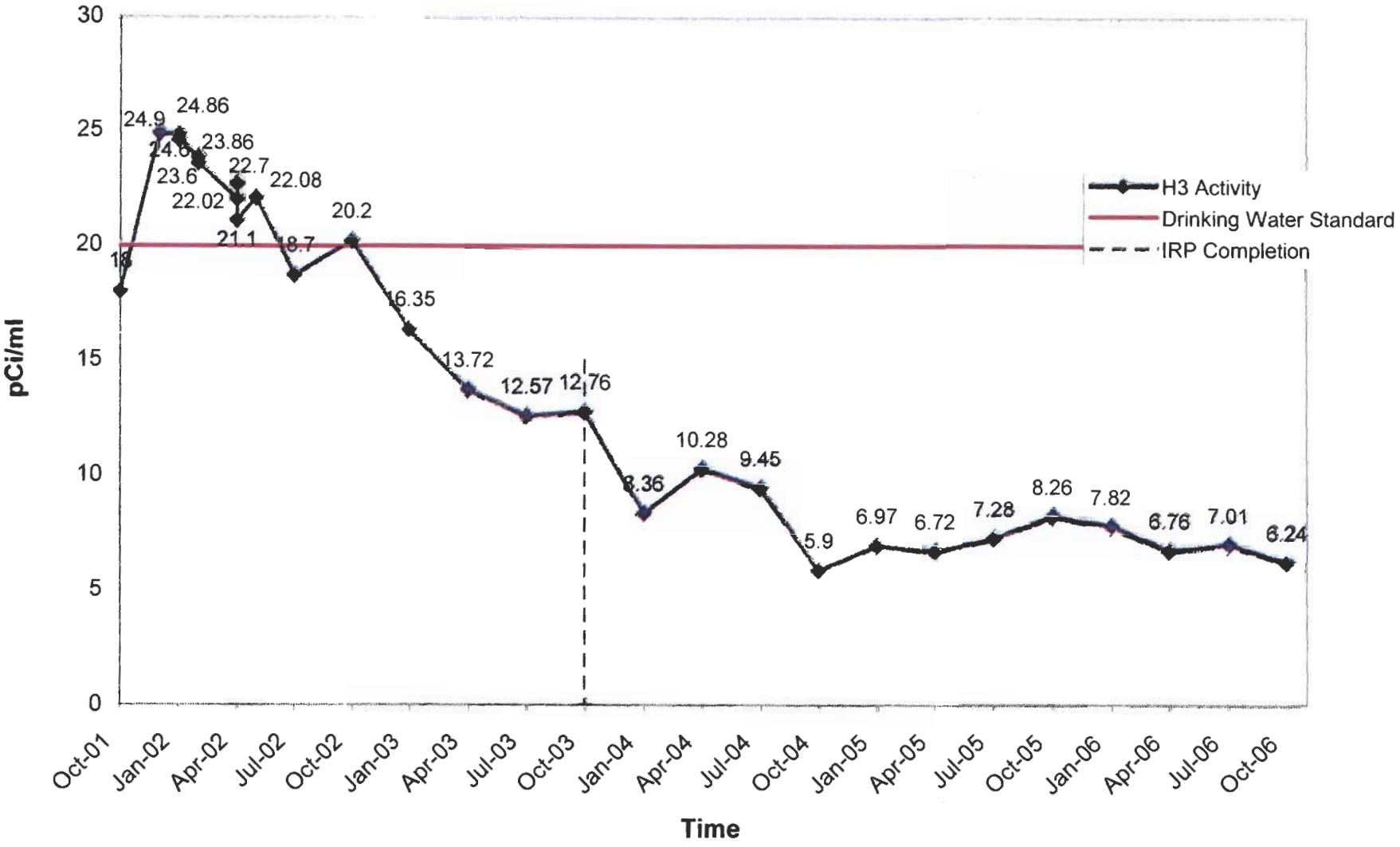


TABLE B.2.3

Location AW-8 Tritium Concentration

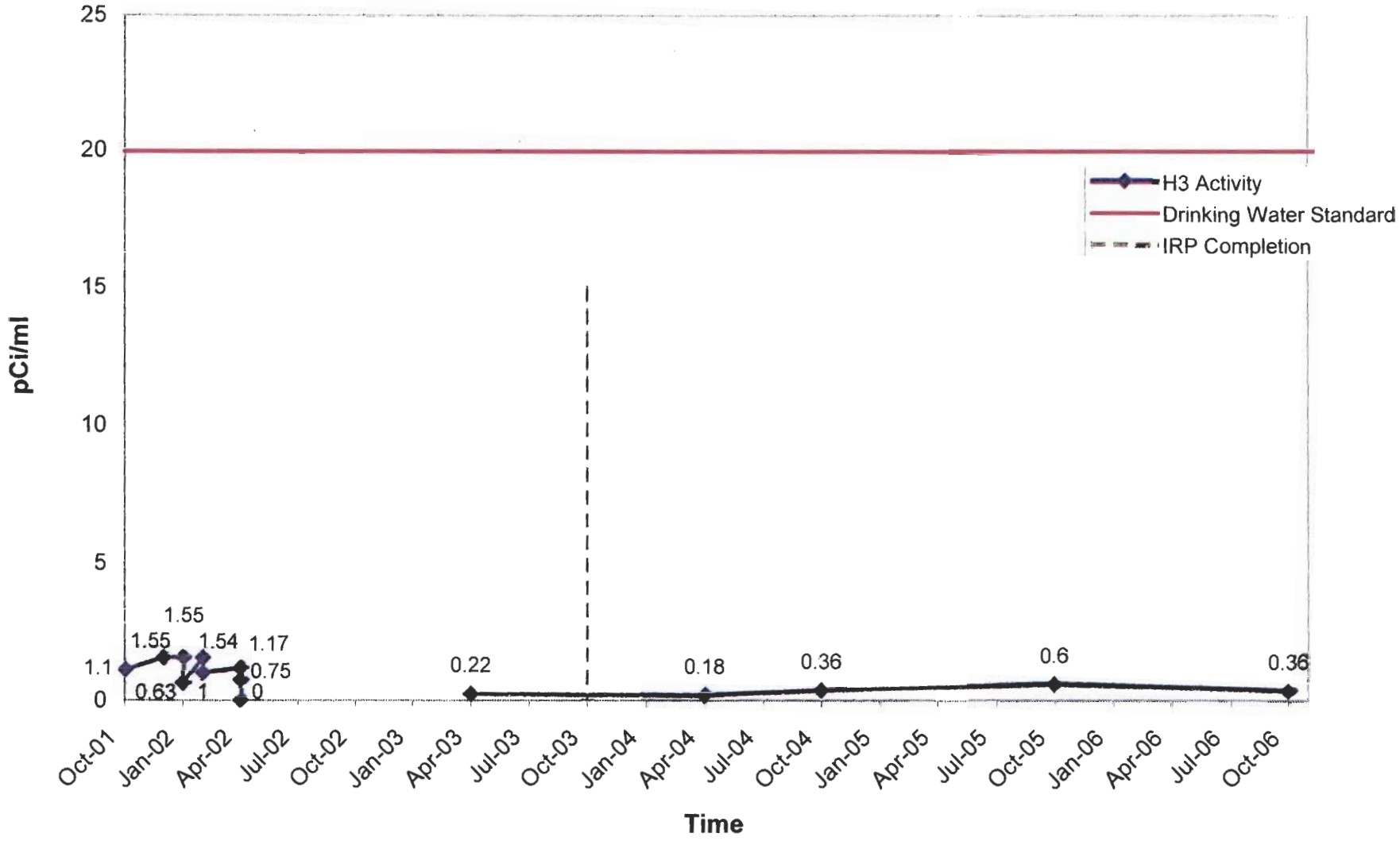


TABLE B.2.3

Location AW-9 Tritium Concentration

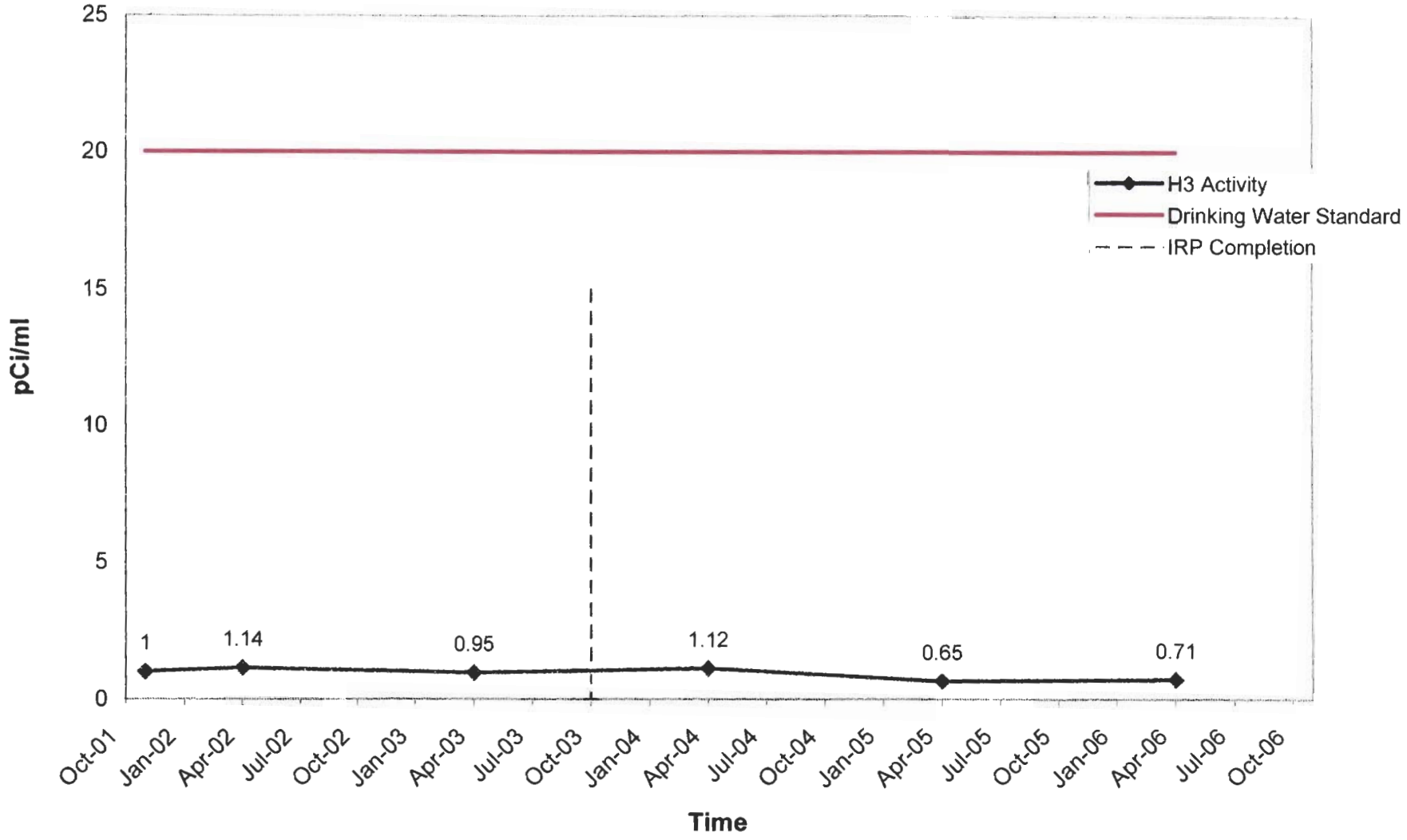


TABLE B.2.3

Location AW-10 Tritium Concentration

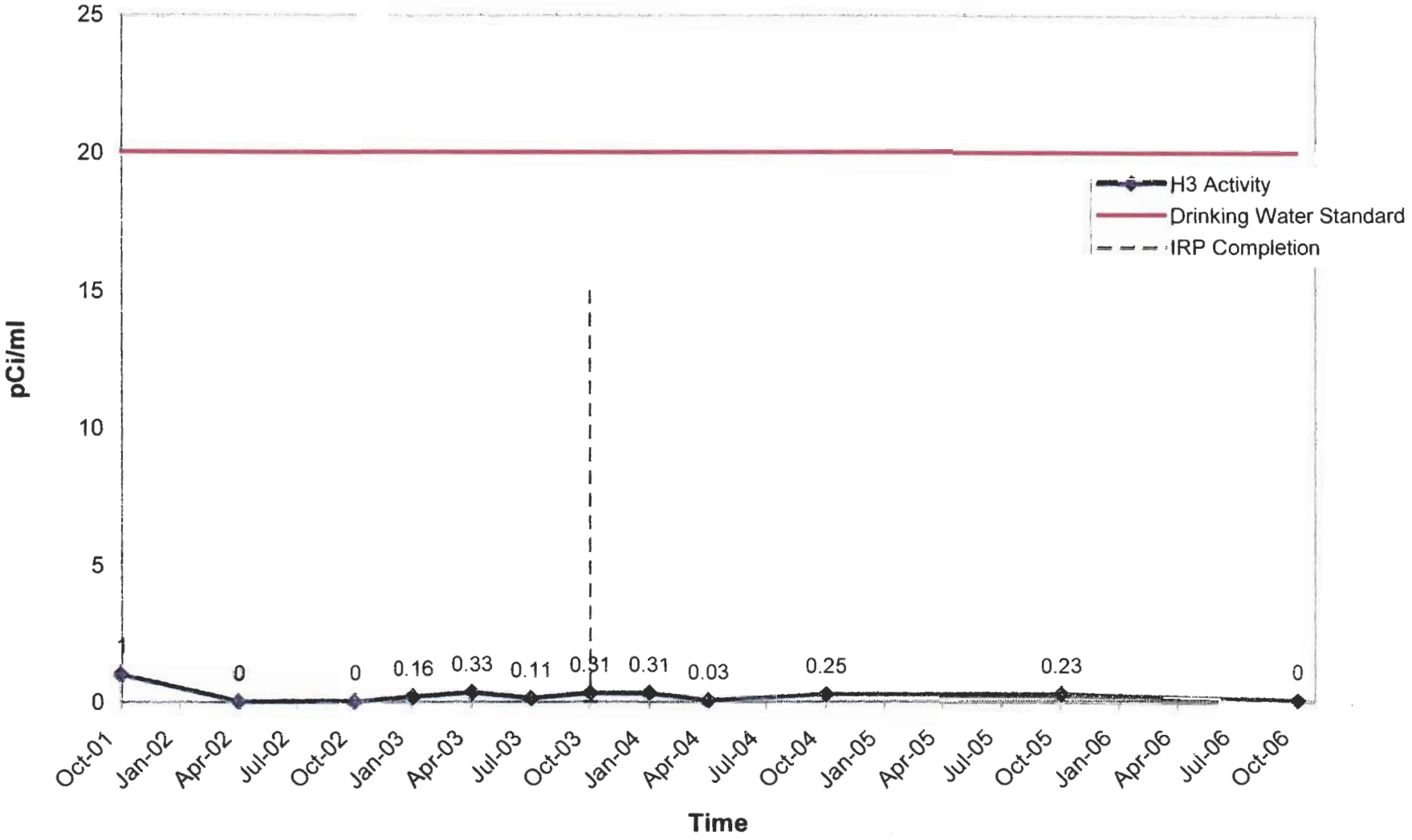


TABLE B.2.3

Location AW-12 Tritium Concentration

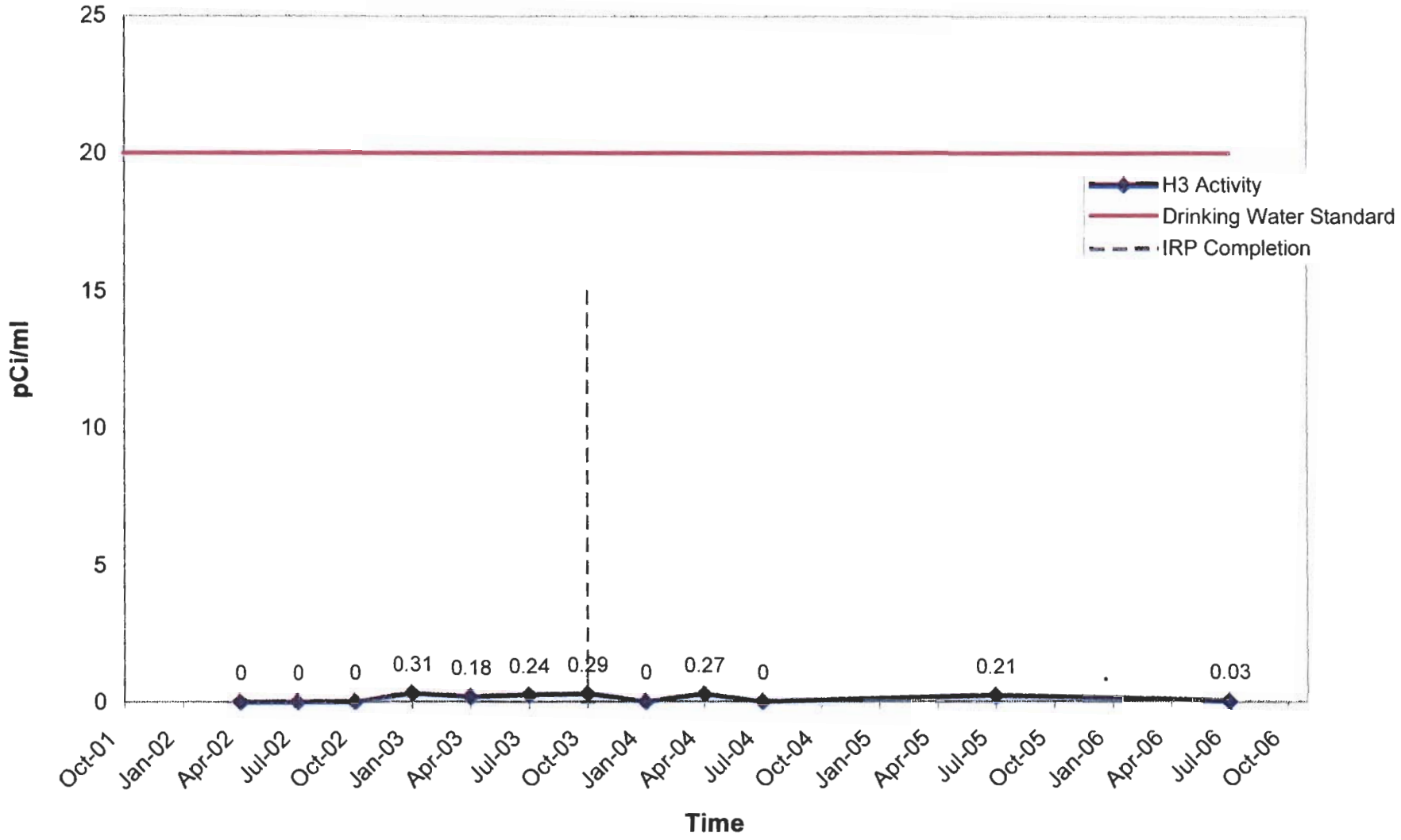


TABLE B.2.3

Location AW-13 Tritium Concentration

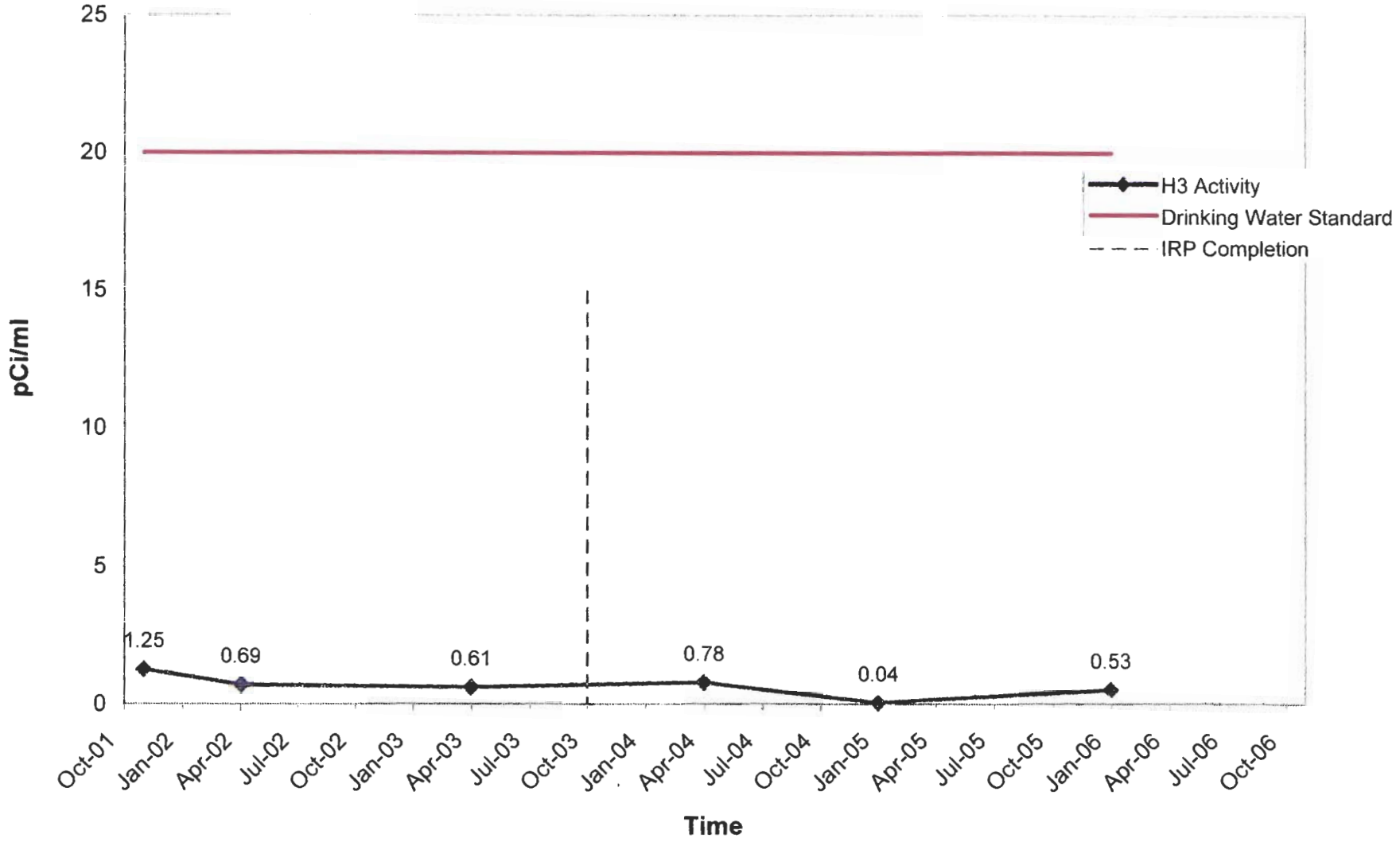


TABLE B.2.3

Location AW-14 Tritium Concentration

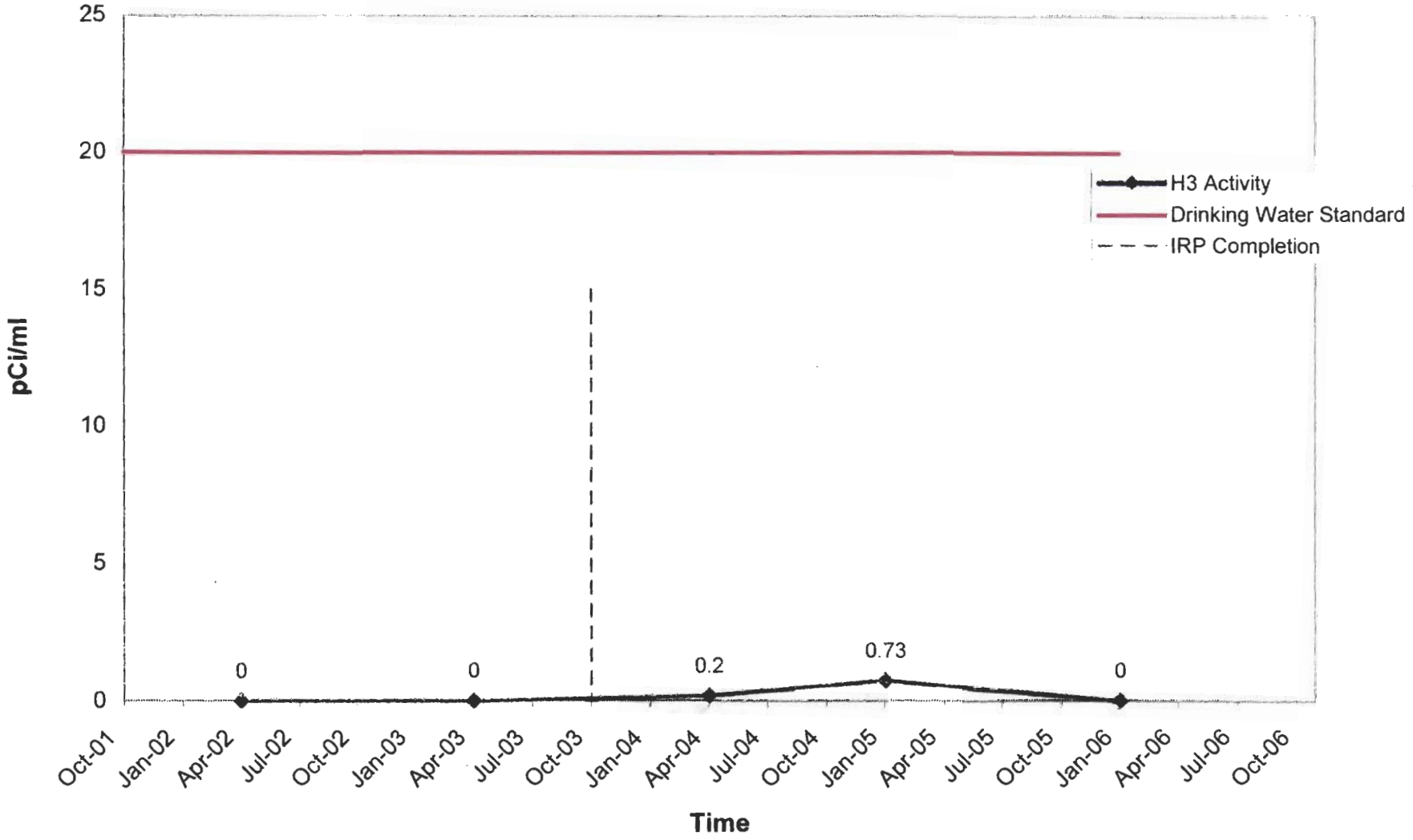


TABLE B.2.3

Location AW-15 Tritium Concentration

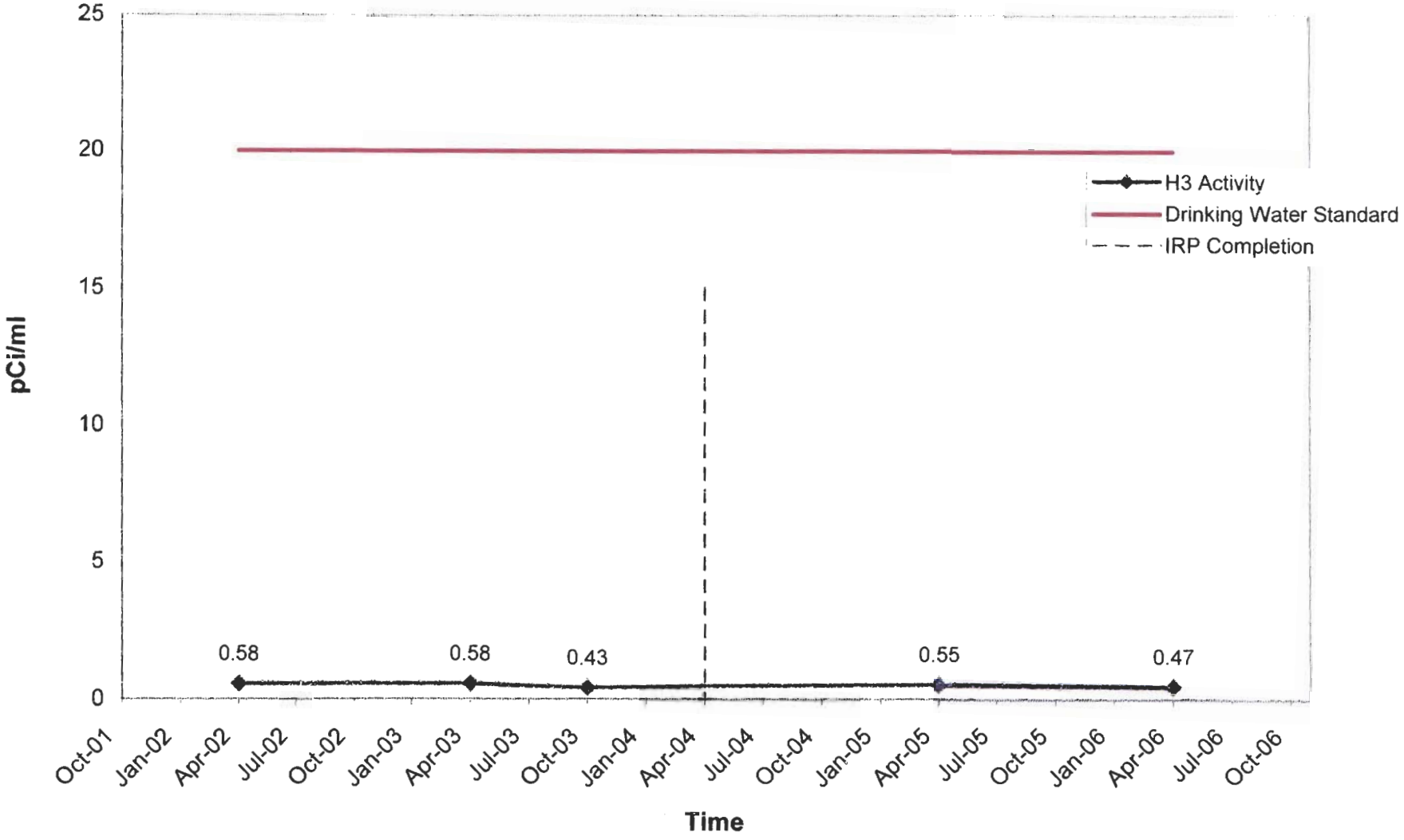
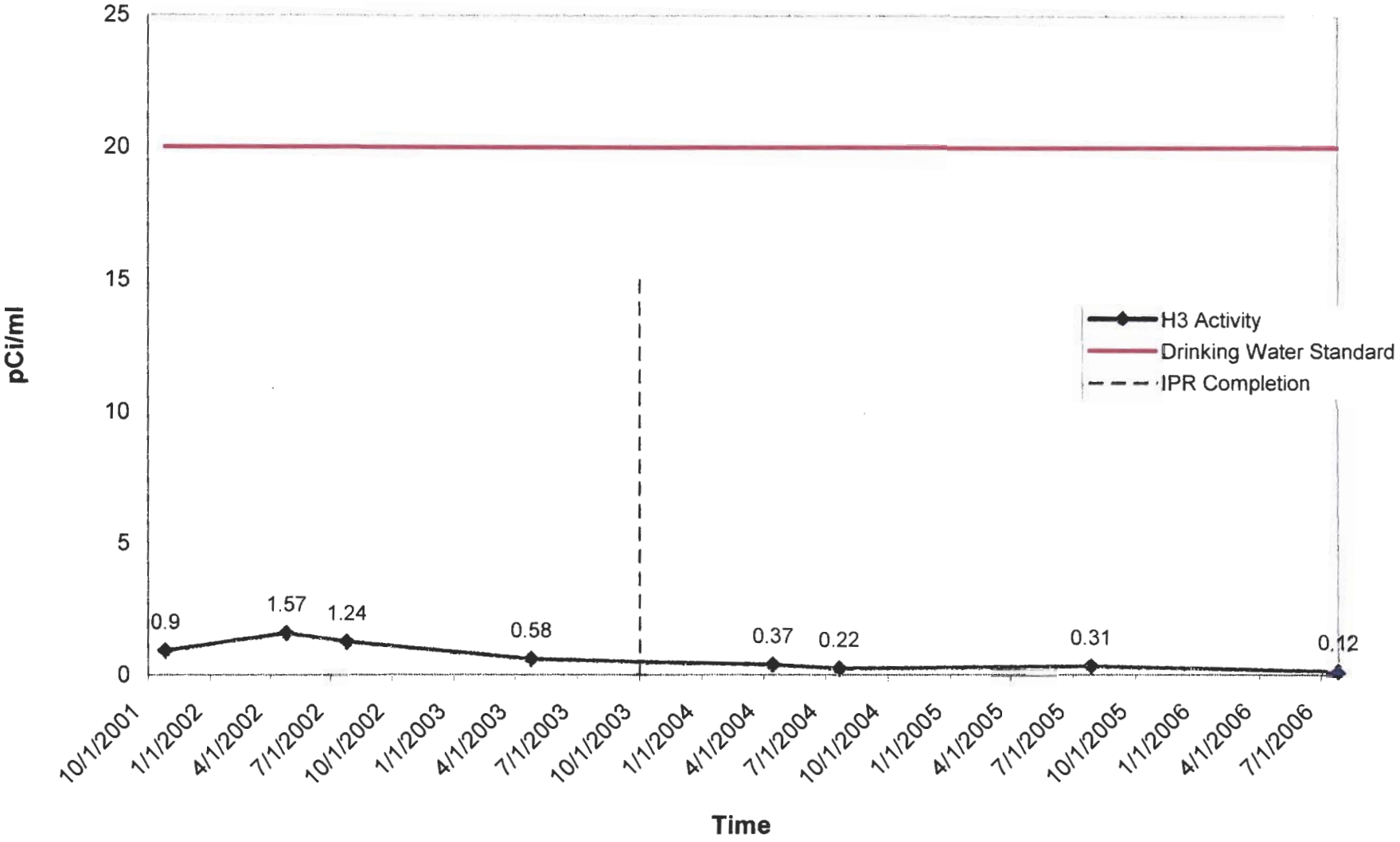


TABLE B.2.3

Location ALT-1 Tritium Concentration



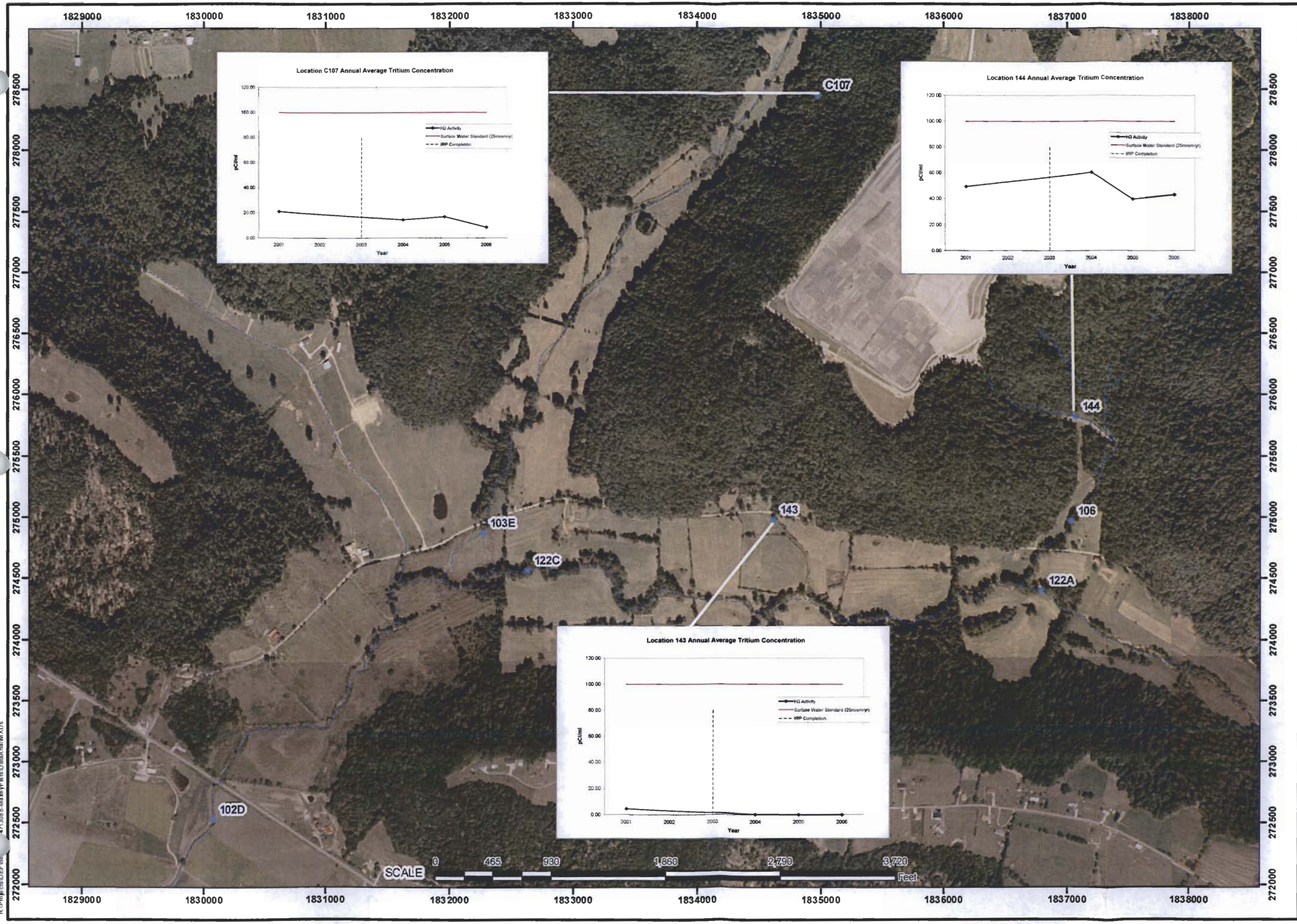


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Figure B.3.1

Contaminant Monitoring of Surface Water Sampling Locations subject to 25 mrem/yr Standard

Maxey Flats
Fleming County, Kentucky

Description:
Map adapted from FSA NAIP Digital Ortho Photo 2004.

Annual average calculated from each years sampling records. Sources: DEP 2001 Data for Baseline with trends.xls, DEP 2001 Data for Baseline 122A&C with trends.xls, 2004 Data.xls, 2005 Report Data.xls and 2006 Report Data.xls

Map Legend:
- Surface Water Sampling Pt
- Waterway

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigB.3.1_SW_25mrem.mxd
Project No.: 3088
Plot Date: 11 Sept., 2007
Arc Operator: HRVG
Reviewed by: NB

de maximis, inc.
450 Montt rook Lane
Knoxville, TN 37919
Main Phone: (865) 691-5052
www.demaximis.com

de maximisData ddms
Management Solutions Inc.
1217 Bandana Boulevard North
Saint Paul, Minnesota 55108
Main Phone: (651) 842-4224
www.ddmsinc.com

TABLE 3.2

Location C107 Annual Average Tritium Concentration

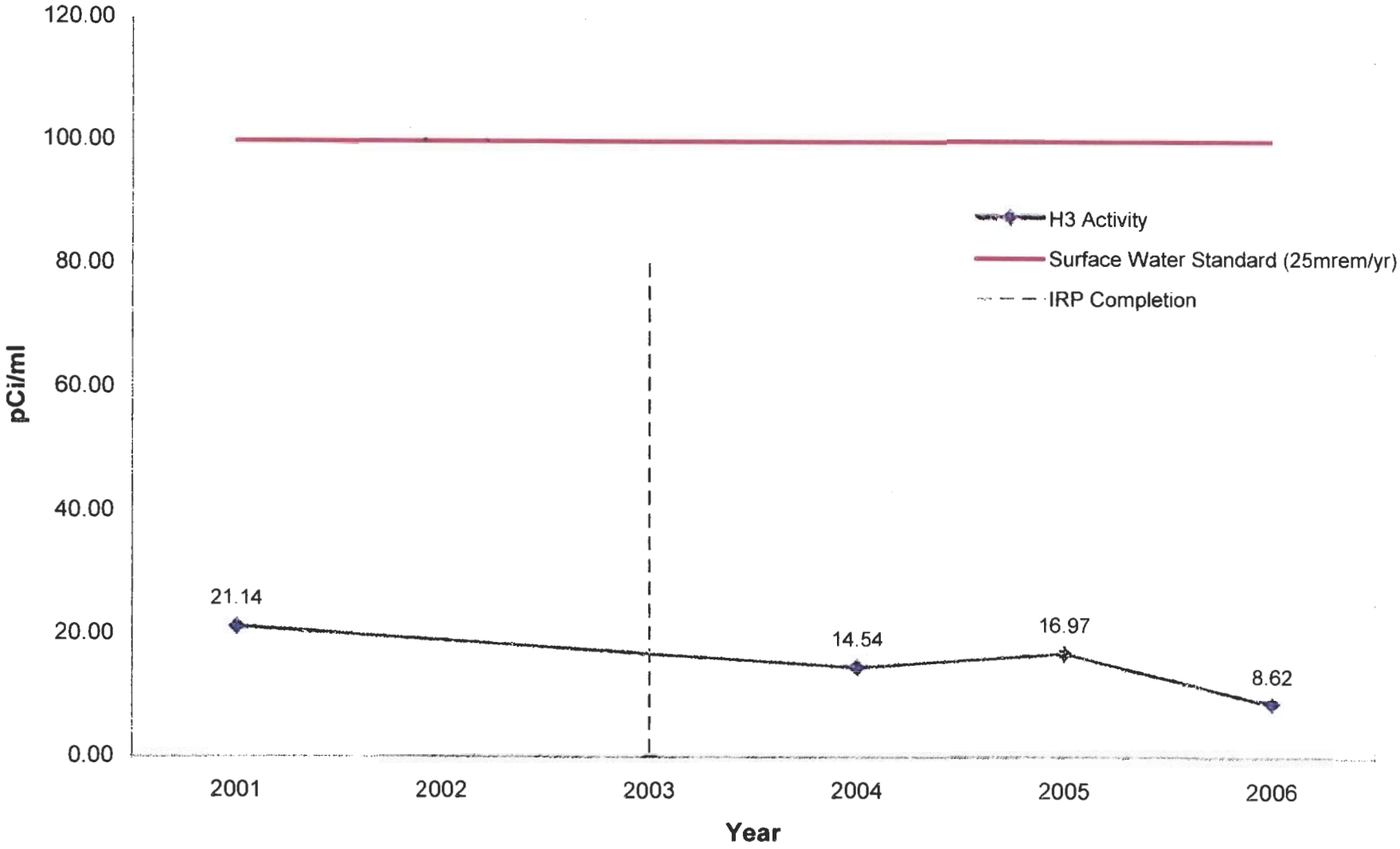


TABLE B.3.2

Location 143 Annual Average Tritium Concentration

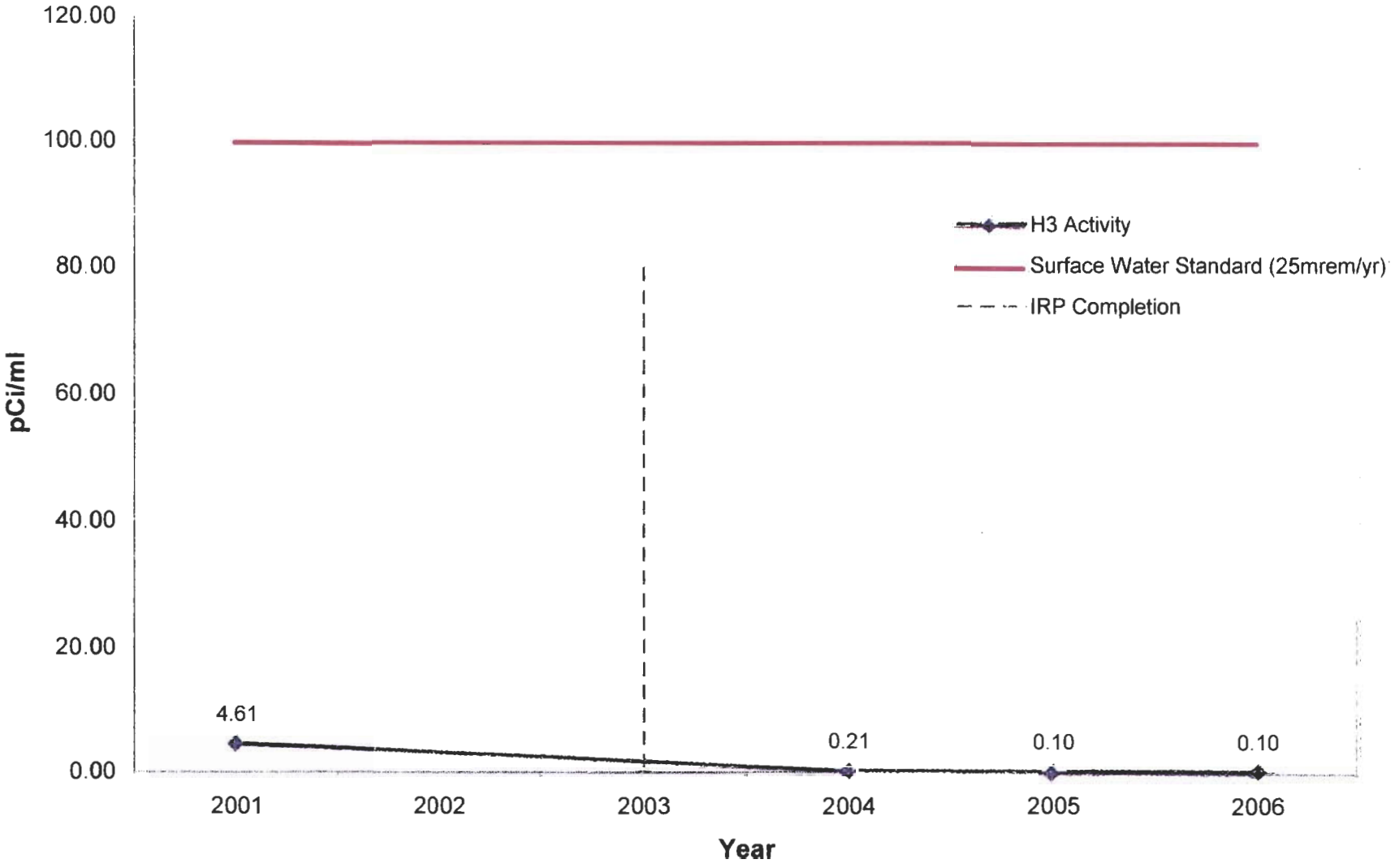
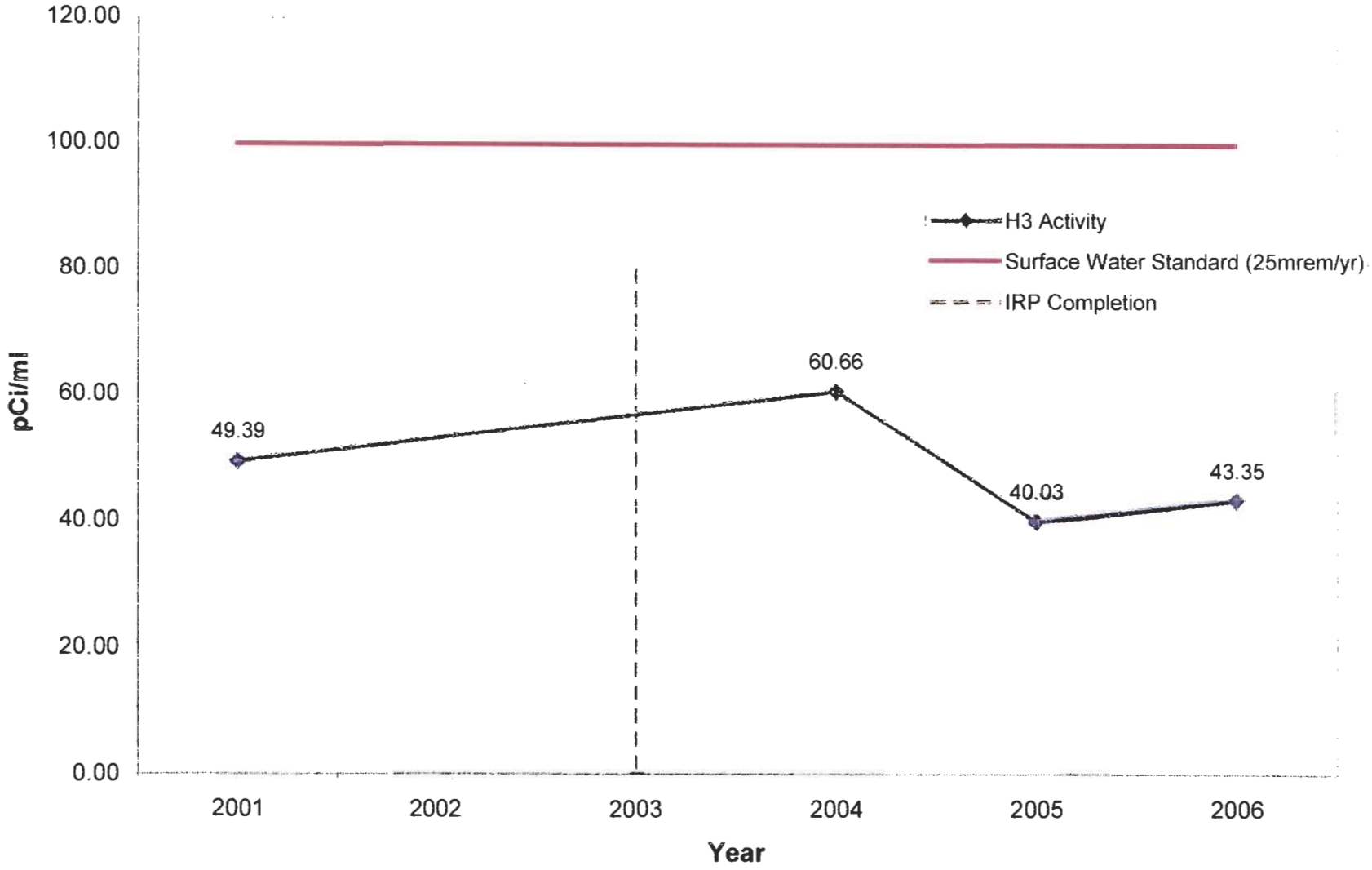


TABLE B.3.2

Location 144 Annual Average Tritium Concentration



2007 Flexible Membrane Liner Evaluation

Maxey Flats Project
Hillsboro, Kentucky

Prepared for:
Division of Waste Management
Hillsboro, Kentucky

June 6, 2007

2007 Flexible Membrane Liner Evaluation
Maxey Flats Project
Hillsboro, Kentucky

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Appendix

Appendix A Historical Information
Appendix B Photos
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2007 Flexible Membrane Liner Evaluation

Maxey Flats Project
Hillsboro, Kentucky

1. Introduction

The Maxey Flats Nuclear Disposal Site is an inactive low-level radioactive waste site, located in Fleming County, Kentucky, approximately ten miles northwest of the city of Morehead, Kentucky. Construction of the facility 55-acre exposed geomembrane cap was reportedly completed in 2002. The liner reportedly consists of 45-mil thick reinforced polypropylene.

2. Scope of Work

The objective of this liner evaluation is to provide professional engineer opinion regarding the condition of the liner material as it relates to anticipated performance of the material as a barrier to surface water infiltration five years following construction. It is understood subsequent evaluations will continue to be performed on five year increments. The general required scope elements as defined by Maxey Flats-Division of Waste Management personnel includes both a field walkover to facilitate observation of liner conditions and review of specific operational/maintenance records maintained by the facility personnel. FMSM elected to include laboratory testing of prefabrication seams, field seams and parent liner material to provide background data for future reference.

Based upon our understanding of the objective, FMSM has structured the scope of work into the following three primary tasks:

- Historical Documentation Review
- Walk Over and Seam Test Observation
- Engineering Evaluation and Reporting

Specific task scope elements are outlined below.

2.1. Historical Documentation Review

Historical documentation relates to review of ongoing operations and maintenance activities performed by Maxey Flats personnel. The following information was provided for reference and is included in Appendix A:

- Defect Logs (2004, 2005, 2006 and 2007)
- Defect Maps (2004 through 2007)
- Potentiometric Surface Maps (2003 through 2006)
- Sump Liquid Levels Data Tabulation

2.2. Site Observations and Liner Sampling

The liner walk over was performed by representatives of FMSM and DEP Maxey Flats on April 27, 2007. The ambient temperature was roughly 62°F at the time of the field visit. Site observations followed the February, 2007 annual facility liner comprehensive visual inspection and airlance testing activities by DEP-Maxey Flats personnel. It should be noted that defects identified in the 2007 annual inspection were marked in the field but not repaired at the time of the site walkover. The FMSM reconnaissance activities included standard facility safety orientation, visual observation of the liner and random sampling of the liner material for laboratory testing. It should be understood that FMSM observation efforts did not include full reconnaissance of all areas of the liner. Observations were performed on roughly four randomly selected diagonal transects across the facility.

A total of four liner material samples, designated LE-1 through LE-4 were obtained for testing. LE-1 through LE-3 were obtained from field seams and LE-4 was obtained from a prefabrication seam area. Repairs of the destructive sampling locations were reportedly to be performed by Maxey Flats facility personnel. The samples were transported to FMSM's Lexington, Kentucky office by Maxey Flats personnel. FMSM then shipped the samples to Precision Geosynthetic Laboratories for testing. The approximate sample locations are shown in Figure 1.

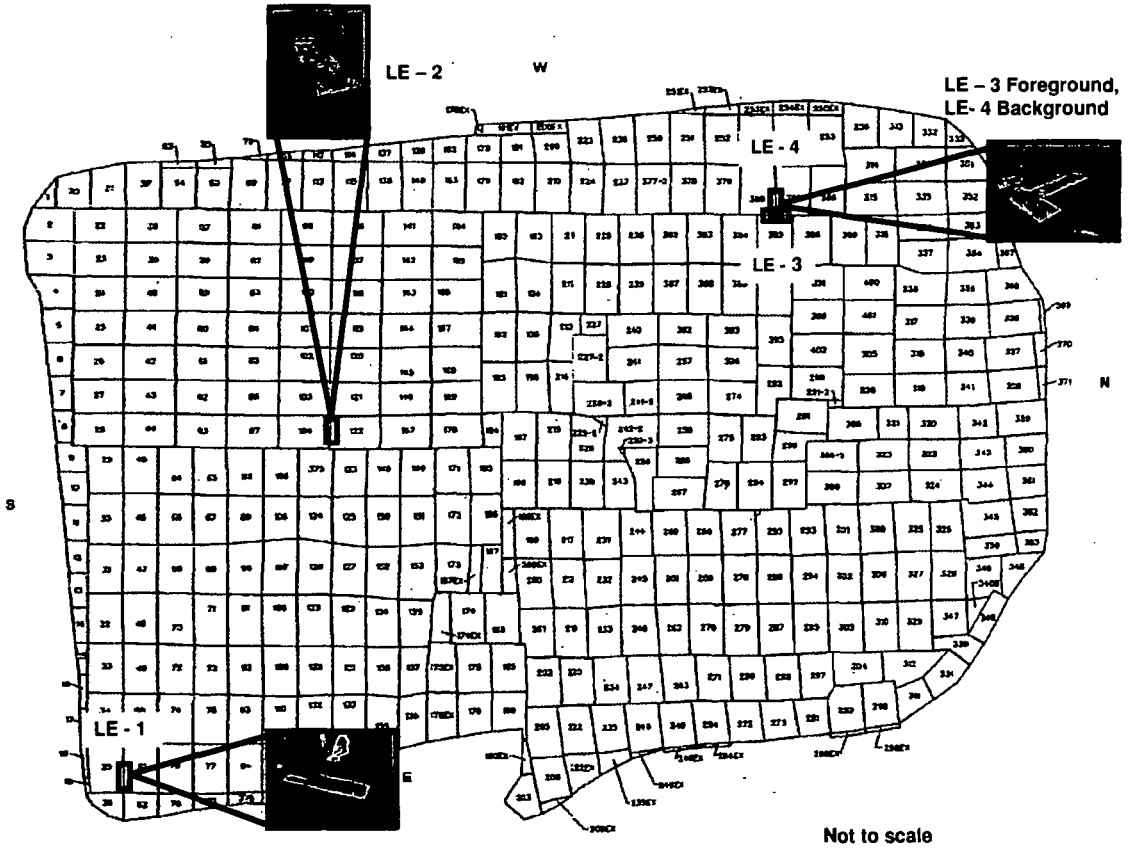


Figure 1. Approximate Sample Location

2.3. Engineering Evaluation and Reporting

An overall liner condition evaluation was performed considering the available information, site observations and material test data. As referenced previously, this study is limited to an evaluation of the liner material and does not include an assessment of the facility design as it relates to liner performance. Evaluation activity results and conclusions are presented below.

3. Results

3.1. Historical Documentation Review

Review of the available defect information indicates that the number of defects increased during the initial three years with a decrease in 2007. The defects as documented by site personnel include visual elements and leaks identified through air lance testing and "unique locations of water occurrence". The "unique locations" are defined as areas where water was noted to be trapped between the liner and the soil subgrade. Although the source of water at these locations is likely to be from a liner defect, the source of water has not been definitively established. Figure 2 shows the visual and air lance defects identified from 2004 to 2007. It should be noted that the 2007 data is based solely on the 2007 annual liner inspection while the remaining data includes all similar defects noted annually. Based on the information provided by the Maxey flats personnel, it is understood that the vast majority of defects identified for any year are observed during the annual liner inspection.

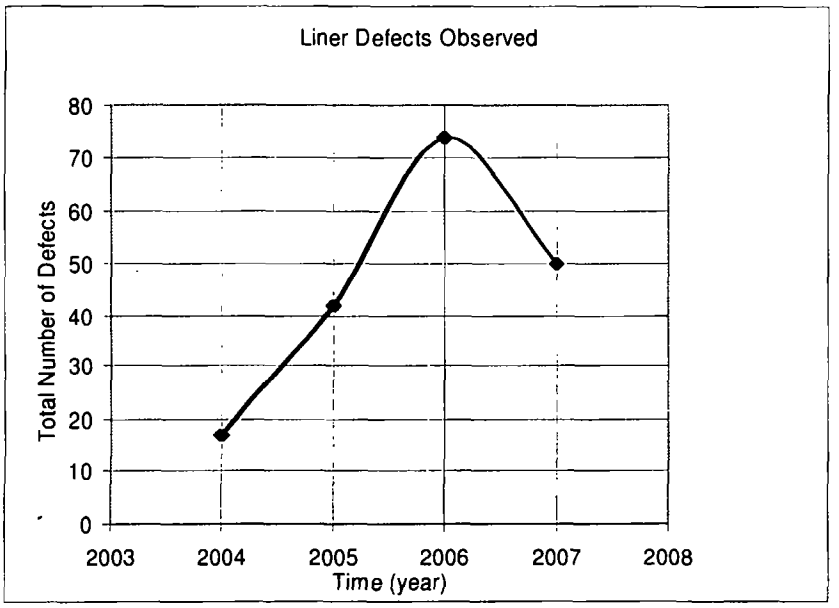


Figure 2. Observed Defect Trends

Current 2007 defect maps indicate that trapped water is located along the western limits in the areas between panel numbers 21 and 56, 223, and 256/313, north central at panel 223. Additional perimeter trapped water areas include panel 363 along the north and 78 on the east. Panel 45 along the south central portion was also noted with trapped water.

Sump water levels are recorded quarterly. The purpose of the sump readings is to evaluate the necessity of pumping to prevent overflow of the contaminated liquids. Reportedly, seasonal sump level fluxtuations have not been observed since placement of the liner therefore only annual levels were provided for use in this evaluation. Potentiometric mapping has been developed from the annual data.

Review of the available potentiometric information indicates two areas showing a significant increase in the sump level readings. The area of sump 46-1 indicates a roughly two foot rise while the area of sump 7-4 indicates a roughly five foot increase. It should be noted that the boundary conditions used to generate the referenced potentiometric mapping are largely unknown. An evaluation of the potentiometric mapping accuracy was not included within the scope of work. It should be noted that perimeter monitoring well data appears to be used as a part of the mapping boundary conditions.

3.2. Site Observations and Liner Sampling

General visual observations of the site revealed no clear indication that the liner parent material has experienced significant degradation from ultraviolet exposure at this time, such as delamination of the respective polypropylene sheets or reinforcing scrim.

There were several locations at pipe penetrations where the material appears to be "creeping" apparently as a result of thermal expansion and contraction. An example of the visually observed strain near pipe boots is shown in photograph No. 3 presented in Appendix B.

Observations indicate that the cap does not maintain positive drainage within several areas due to a lack of slope which results in shallow ponding over the liner surface.

It appears that the liner was placed with little slack in the deployed material. This results in large areas along the lower portion of bunker slopes exhibiting tension "trampoline" effects. This condition results in the liner not resting on the subgrade but being held suspended in tension for some distance. Perpetual tensile stress is likely to increase the probability of seam and/or parent materials failure.

3.3. Laboratory Testing Results

The results of the laboratory testing performed on the samples LE-1 through LE-4 indicate that these samples meet the required minimum seam peel and shear strengths for the project. In addition, tensile strength coupons obtained from outside the LE-4 sample seamed area meet project specifications for break strength. Tables 3.1 and 3.2 provide the results of the laboratory tests. The full laboratory test report is provided in Appendix C.

Table 1. *Testing for LE1 through LE4*

Property	Test Method	Project Specified Minimum (lb/in width)	Test Value (lb/in width)			
			LE - 1	LE - 2	LE - 3	LE - 4
Seam Shear Strength	ASTM D-751	200	309	345	370	262
Seam Peel Adhesion	ASTM D -413	20	45	61	39	45

Table 2. **Testing for LE4 (Parent Material)**

Property	Test Method	Project Specified Minimum	Direction	
			MD	TD
Grab Tensile	ASTM D-751			
Tensile Strength, lbs		220	283	340
Elongation at Break, %		N/A	103	69
Tear Strength lbs, minimum	ASTM D -751	70	86	68

4. Conclusions and Recommendations

4.1. The supplied information does not include any quantitative design performance criteria related to maximum acceptable infiltration rates for the facility liner. This indicates that the liner design process was not established based on specific infiltration criteria in relation to the statement that the intent of the liner is to "minimize" infiltration. As such, this evaluation will assume the liner met the design intent upon installation and rely primarily on available site specific information and established industry defect frequency rates correlated to quality of liner.

4.2. Industry standards indicate liners may be classified as poor, good or excellent based on the number of defects (holes) per unit area. Published information provided by Koerner[1] shows the correlation of the liner as Excellent for one small hole (0.1 cm^2 area) per acre with a permeability of 1E-8 cm/sec; Good for one small hole (1 cm^2 area) per acre with a permeability of 1E-7 cm/sec; and Poor for 30 holes (0.1 cm^2 area) or more per acre. Based on these criteria, the geomembrane at the site is currently estimated to be between good and excellent quality with approximately 0.9 holes per acre. It should be noted that the approximate area of the defect (hole) is not recorded in the project records.

4.3. It is generally recognized that geomembrane mechanical tensile stress causes failure in liner systems. A zero stress installation is difficult to achieve and wrinkles are unavoidable. In FMSM's professional opinion it should be anticipated that the level of effort required to repair observed defects resulting from excessive tensile stress will increase significantly over the liner design life. The presence of tensile stress over large areas of the material is likely to result in large-scale seam and/or liner failures with time.

4.4. Seam and liner parent material test data indicates the sampled material meets physical strength parameters at this five-year service interval.

4.5. It is FMSM's professional opinion that all areas displaying surface water ponding effects should be corrected to reduce potential infiltration from these areas. In addition, further evaluation of the tension "trampoline" conditions along slopes should be performed to evaluate the cost/benefits of repairing this condition. Prevailing liner temperatures are likely to have a significant impact on these conditions due to thermal expansion and contraction effects.

4.6. Available information does not indicate that there is a direct correlation between observed defects and areas where the water is trapped between the liner and the subgrade.

4.7. FMSM recommends that further evaluation of sumps 46-1 and 7-4 be performed as necessary to delineate the source of the collected waters.

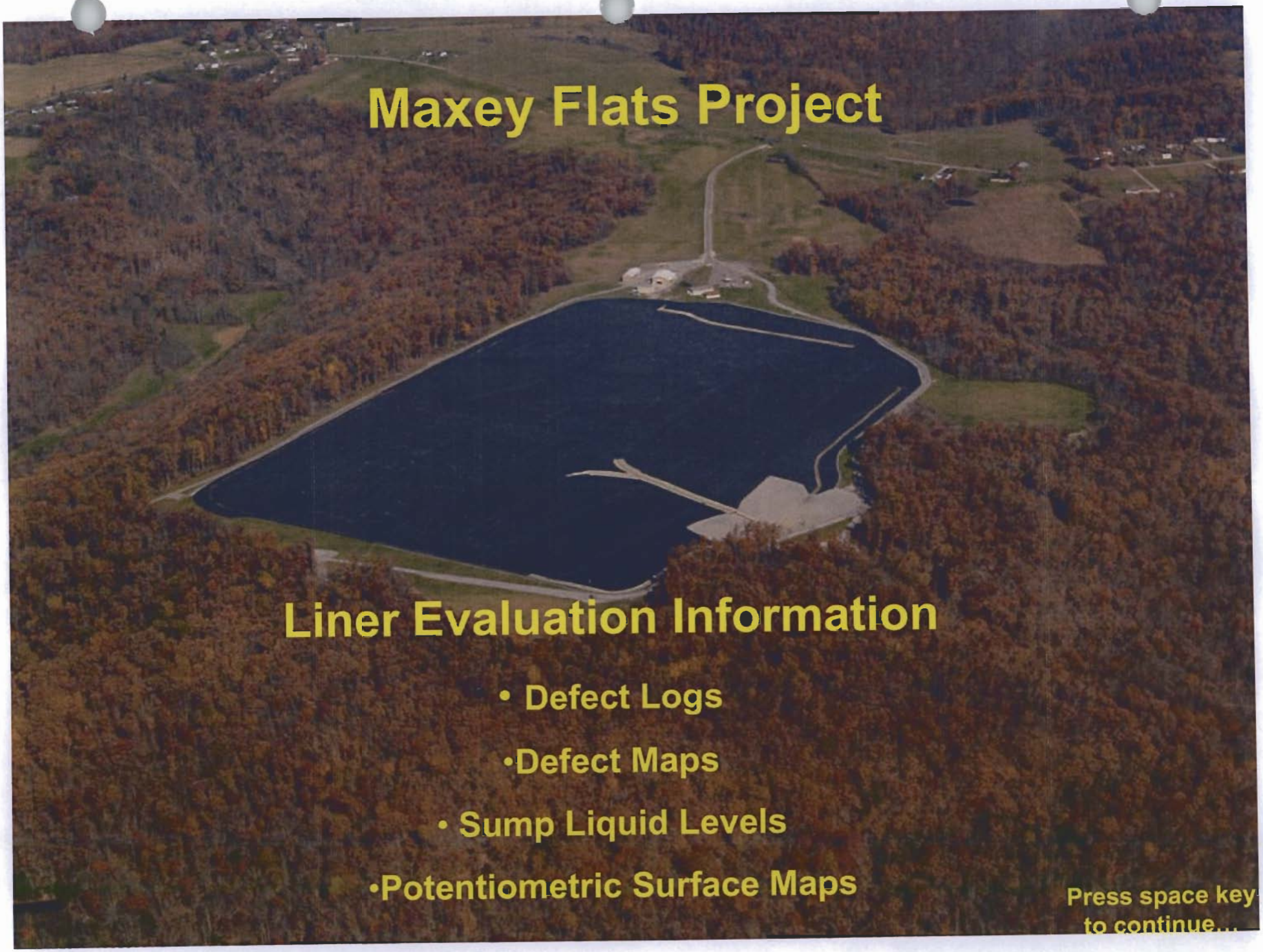
4.8. These conclusions and recommendations are based on data and observed conditions associated with this liner evaluation using that degree of care and skill normally exercised under similar conditions by competent members of the engineering profession. No warranties can be made regarding the suitability of the liner or continuity of conditions between observed areas.

5. References

[1] Xuede Qian, Robert M. Koerner and Donald H. Gray., (2002) "Geotechnical Aspects of Landfill Design and Permitting"

Appendix A

Historical Information



Maxey Flats Project

Liner Evaluation Information

- Defect Logs
- Defect Maps
- Sump Liquid Levels
- Potentiometric Surface Maps

Press space key to continue...

Defect Log

Year	2004	2005	2006	2007
Visual	3	23	51	28
Air Lance	14	19	23	22
*Unique locations of water occurrence	5	1	14	12*
Total Defects	**17**	**42**	**74**	**50****

* Indicates water trapped between the liner and the subgrade. These occurrences do not reflect an additional defect although their occurrence and disappearance cannot always be associated with a known defect/repair.

**2007 data is based solely from the 2007 Annual Liner Inspection. There is no need to prorate the 2007 data due to the fact that the vast majority of defects for any year are discovered during the Annual Liner Inspection.

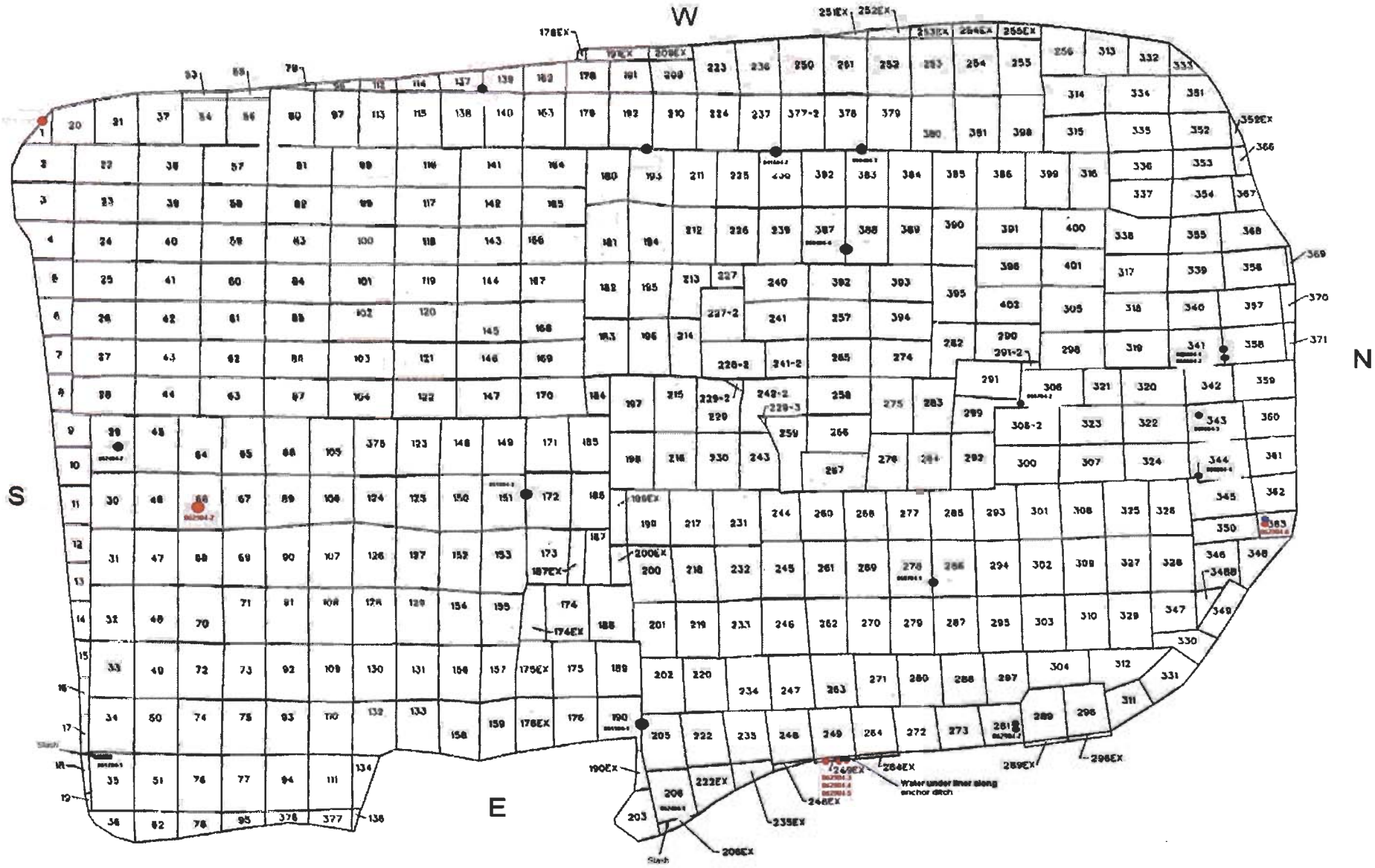
Defect Maps

The defect maps are necessary to trend any areas of the liner cap that may be more susceptible to failures and to evaluate the liners' year to year effectiveness.

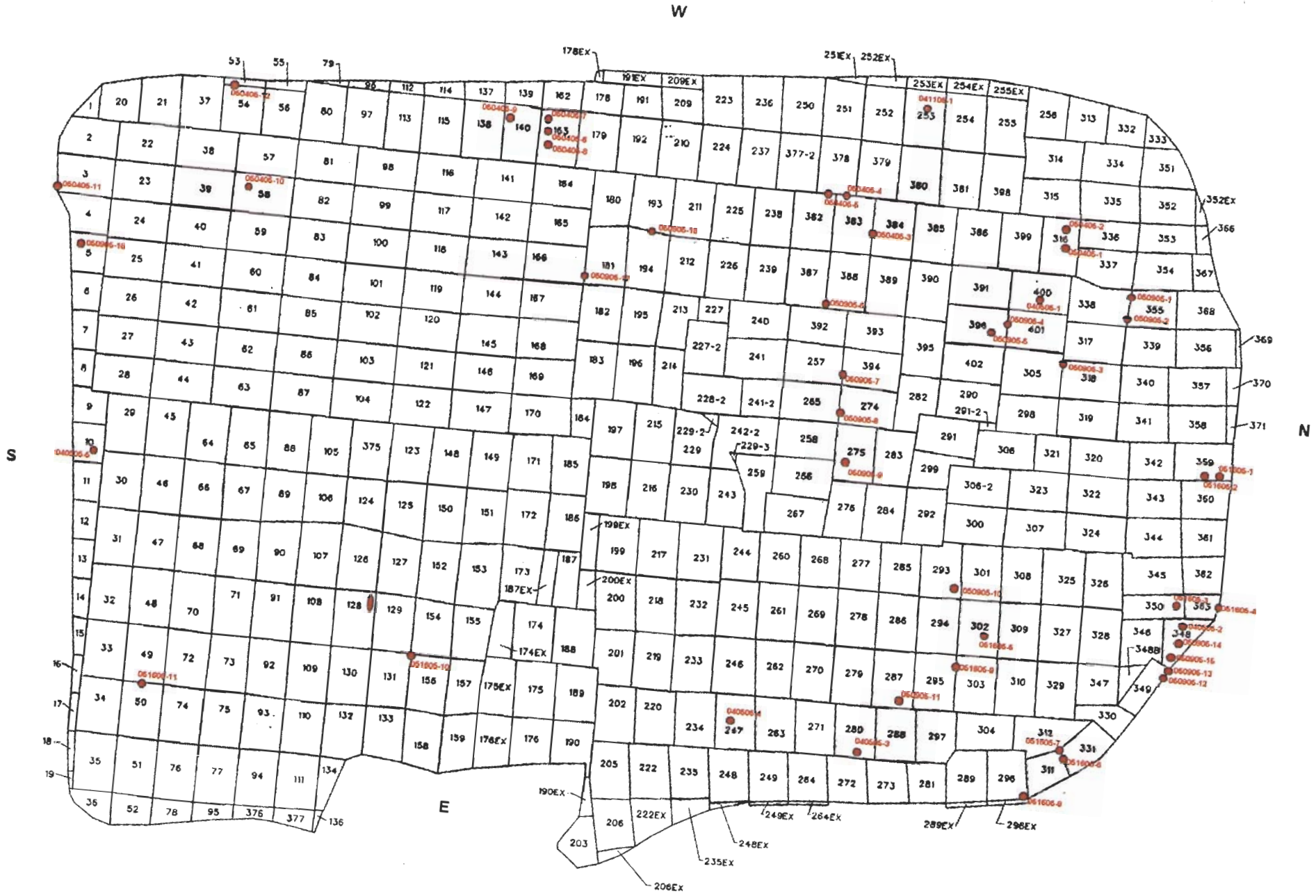
The defect maps that follow denote holes, tears and seam failures with red dots. Blue dots or lines indicates areas where water has been observed pooled under the liner.

The maps are also available by clicking the corresponding links at the end of this presentation.

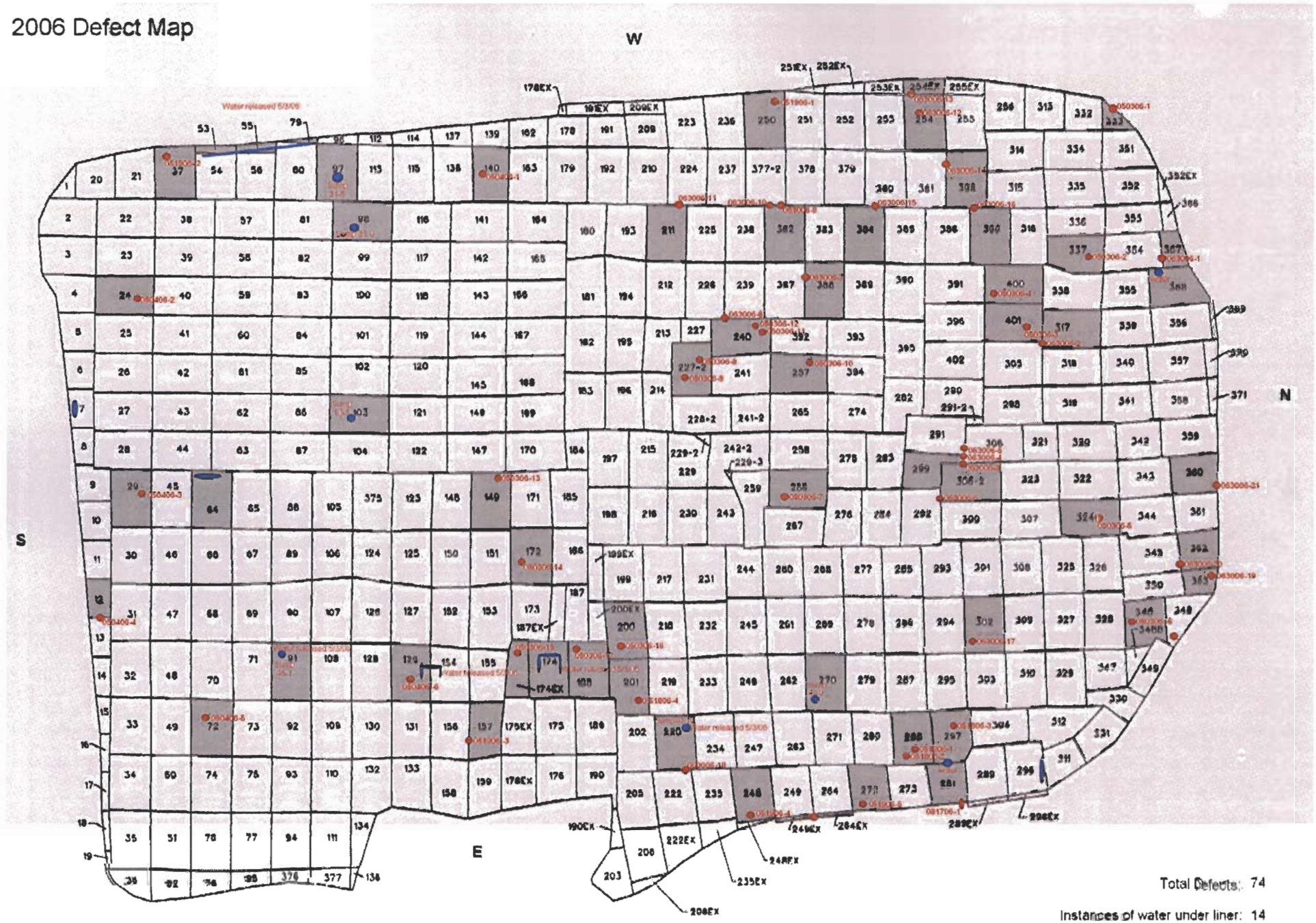
2004 Defect Map



2005 Defect Map



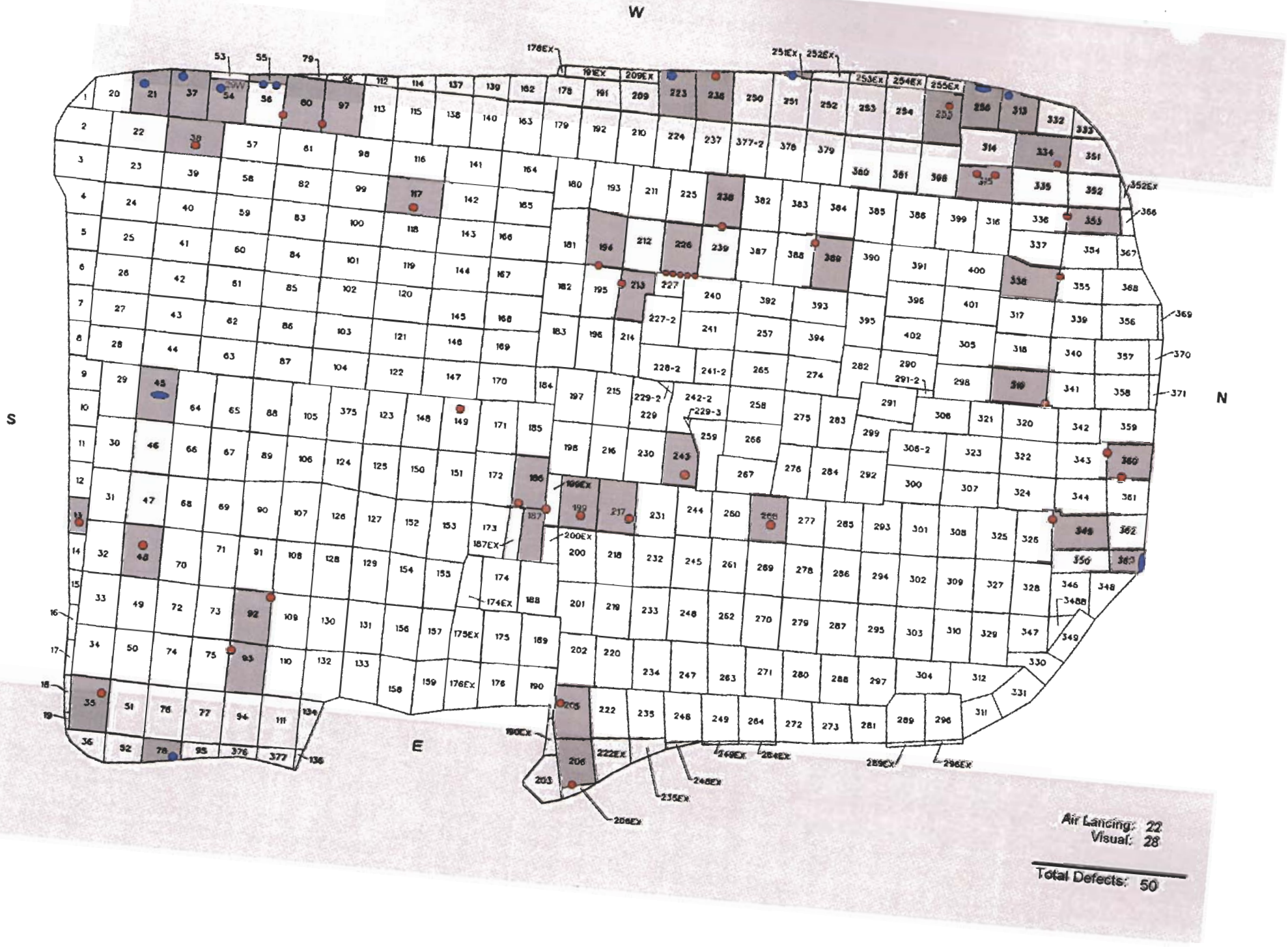
2006 Defect Map



Total Defects: 74

Instances of water under liner: 14

2007 Defect Map



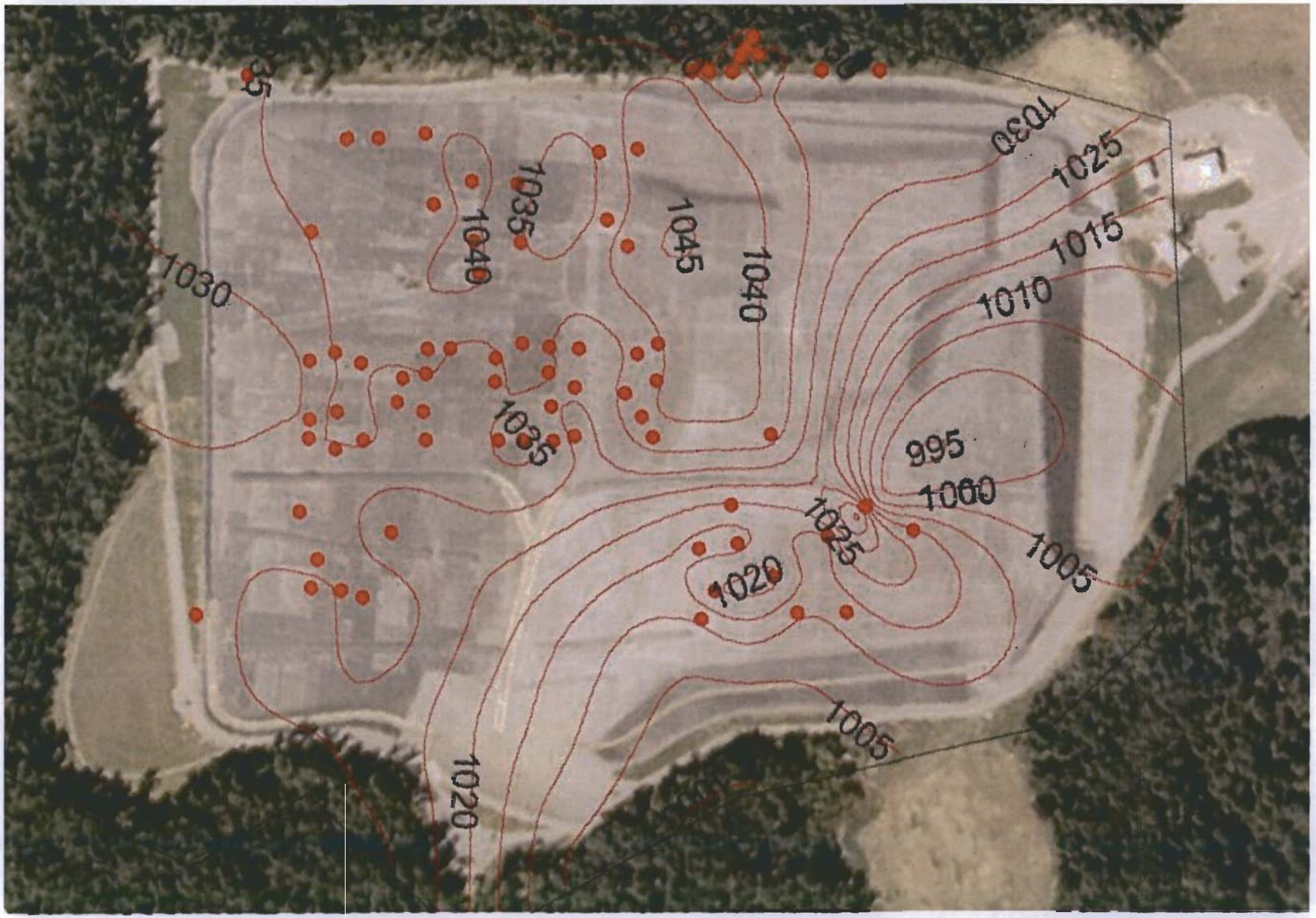
Potentiometric Surface Maps

The Potentiometric Surface Maps and the 2003-2006 change map should be used as a tool to aid in determining if the liner is effective in preventing the infiltration of water into the trenches.

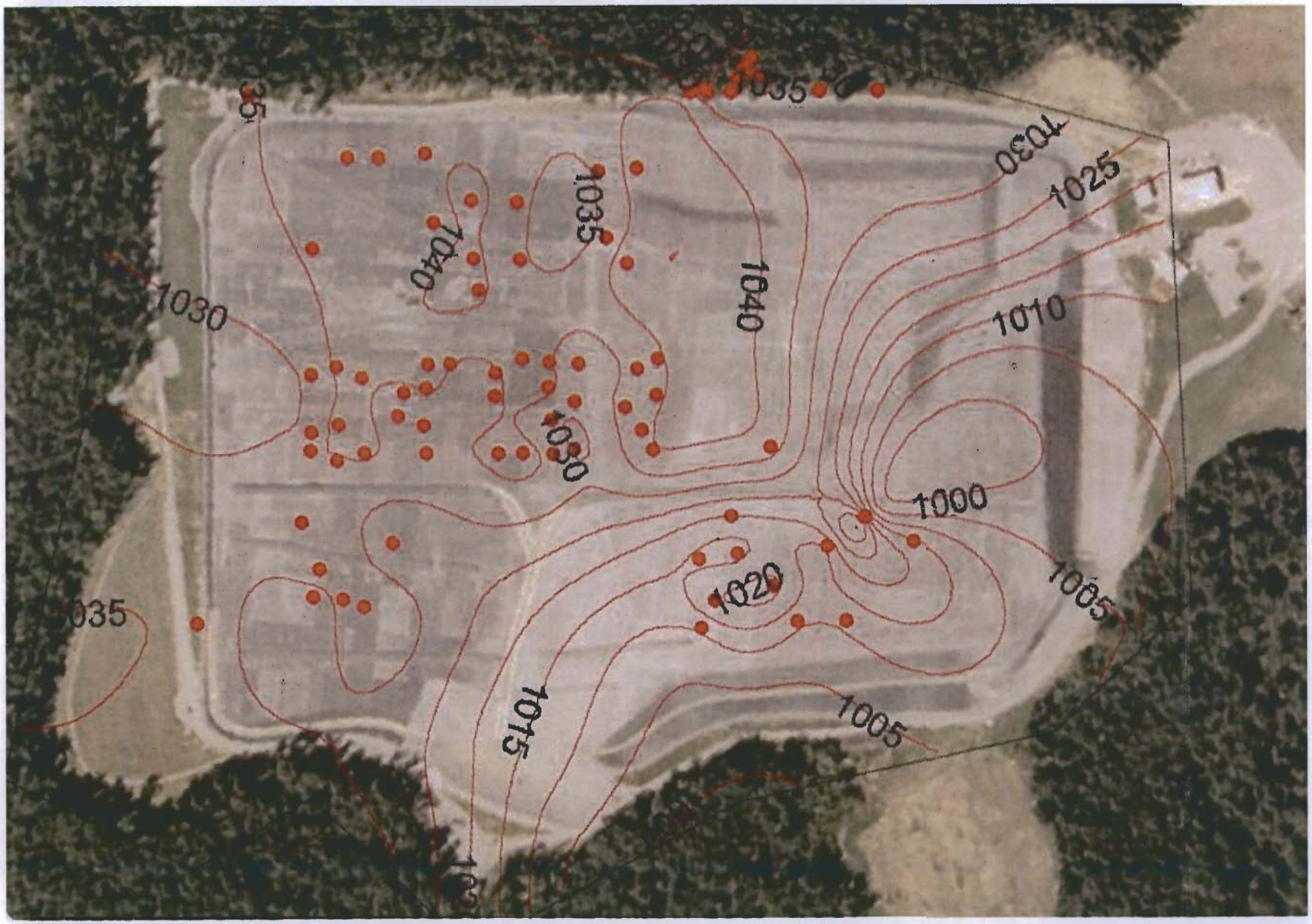
Based on the sump liquid level measurements, close attention should be paid to the area around Sump 7-4.

These Potentiometric Surface Maps are are also available by clicking the corresponding links at the end of this presentation.

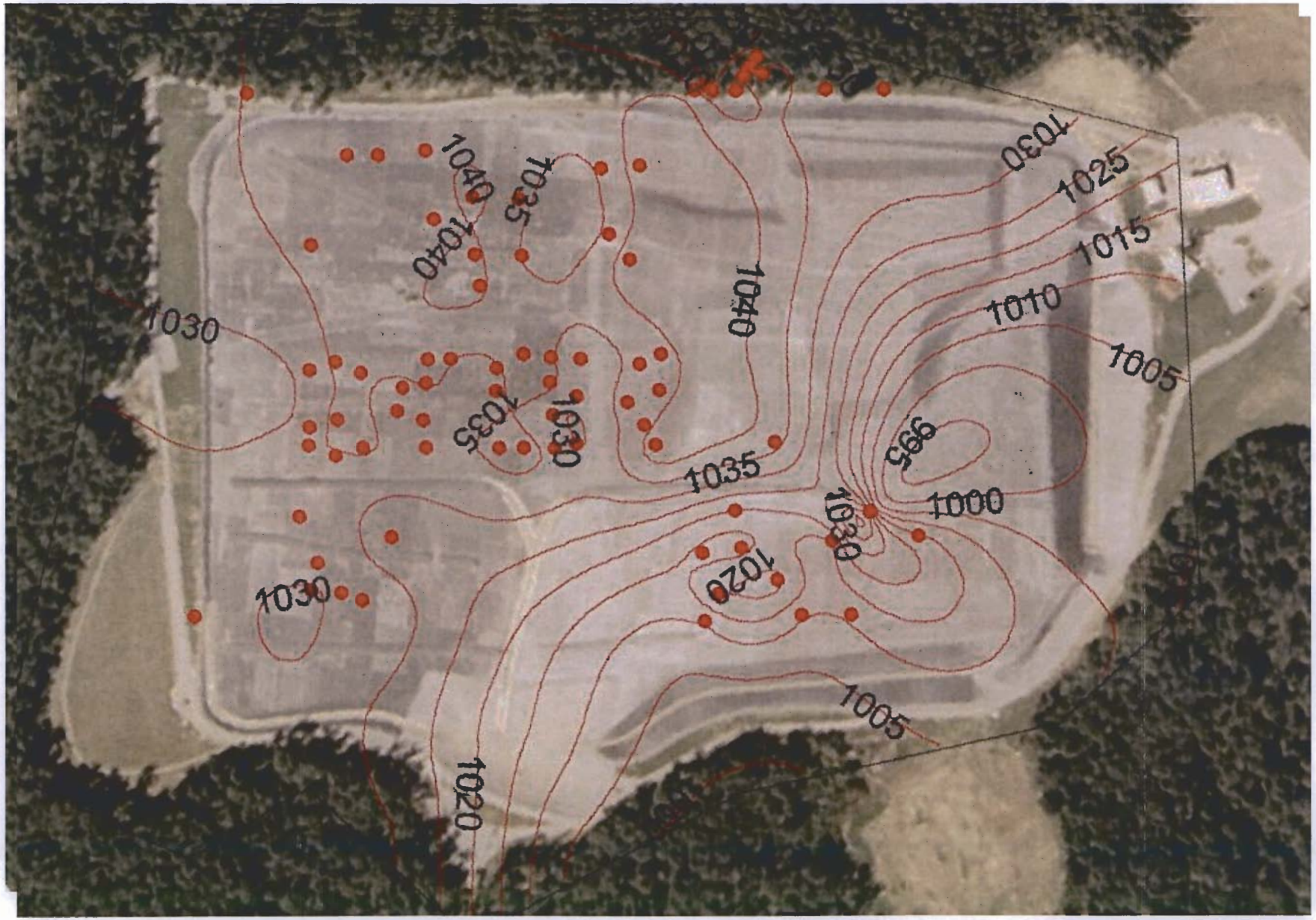
October 2003 – Potentiometric Map



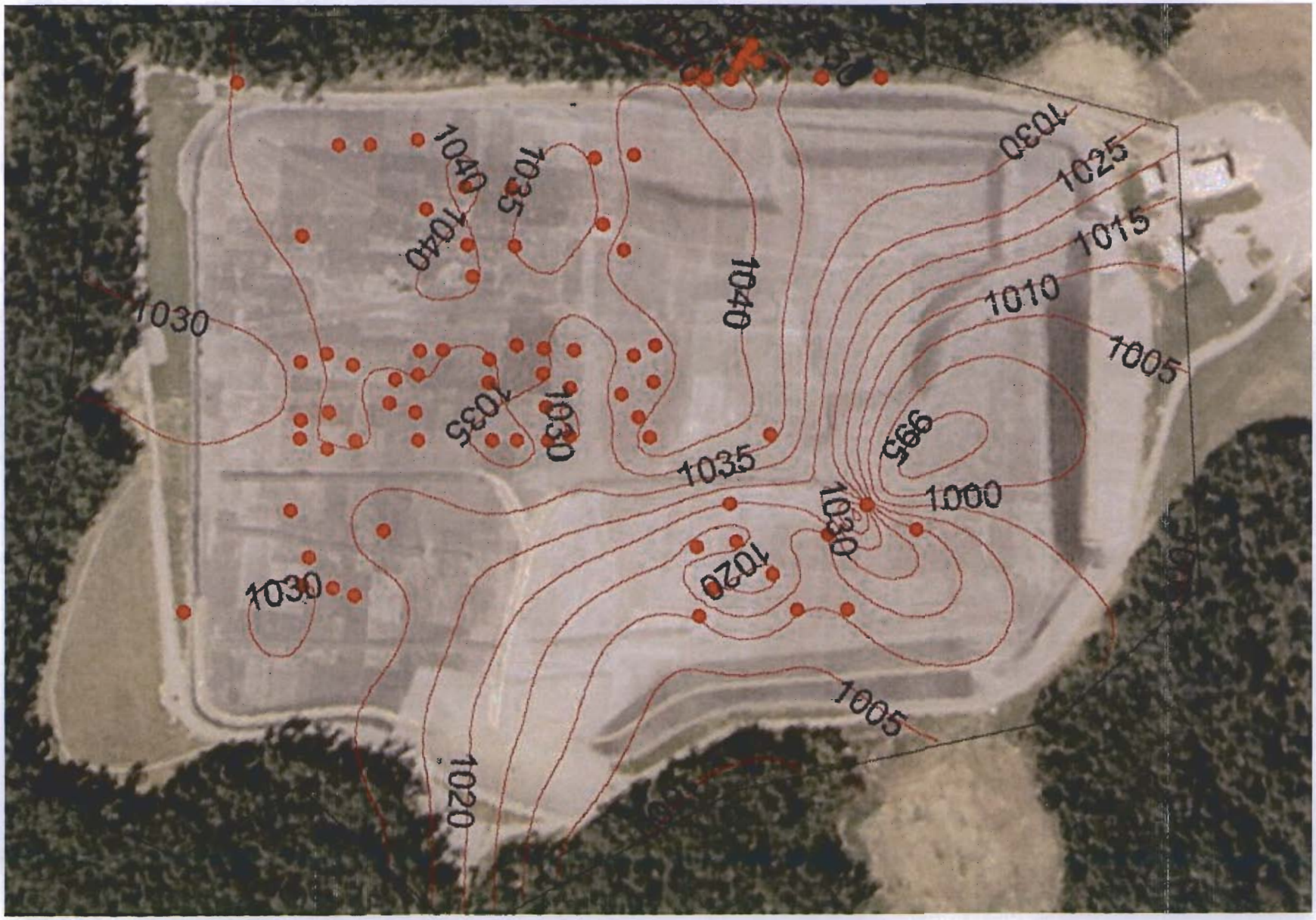
October 2004 – Potentiometric Map



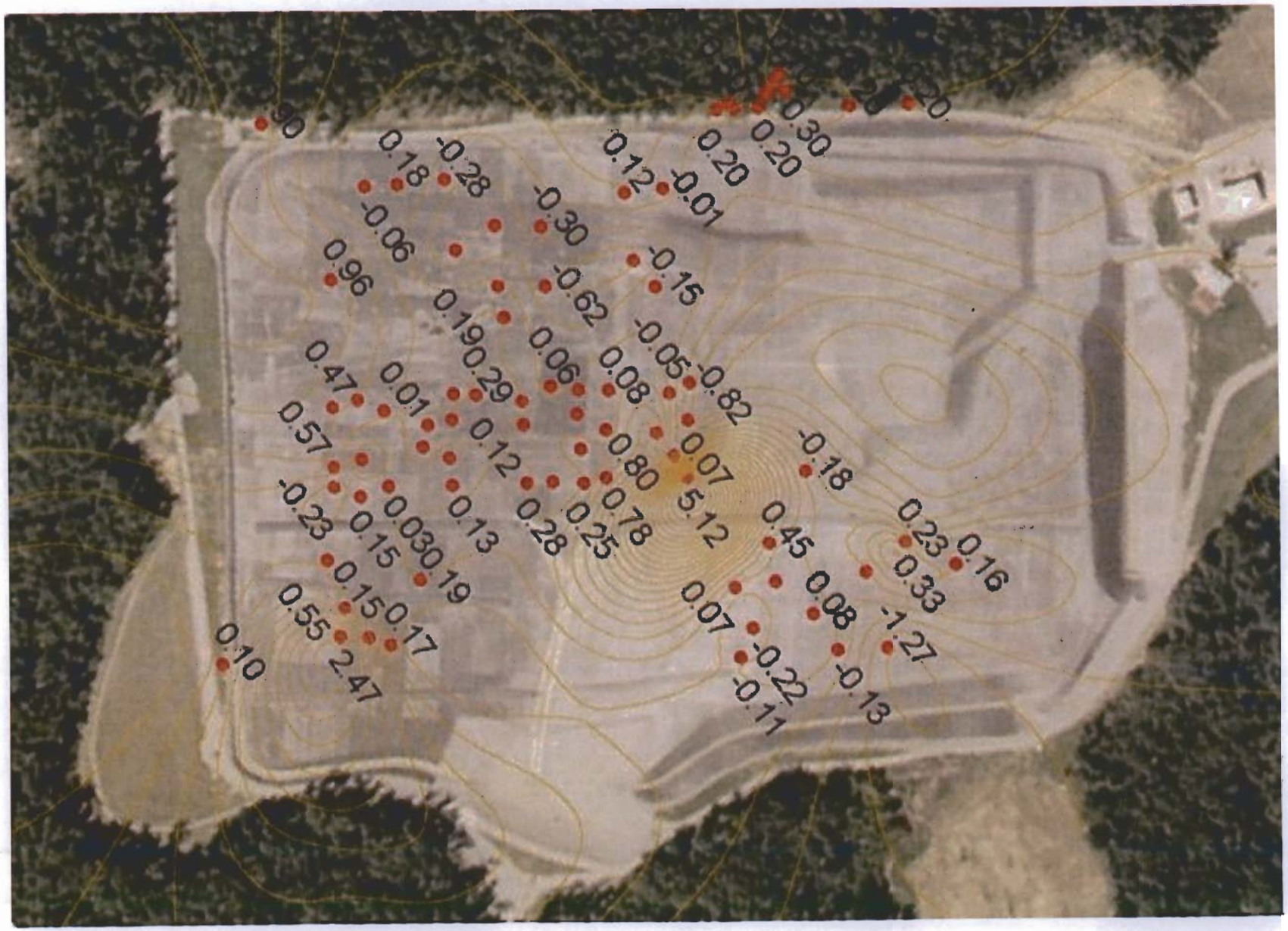
October 2005 – Potentiometric Map



October 2006 – Potentiometric Map



Water Level Difference Map October 2003 to October 2006



Sump Liquid Levels

Liquid levels of the sumps are collected quarterly to evaluate the necessity of pumping to prevent overflow of the contaminated liquids to the surface. Because no seasonal fluctuations have been observed within the sumps, since placement of the liner only annual liquid levels are provided. These levels will be used to evaluate the effectiveness of the liner to prevent infiltration of rain waters. Only Sump 7-4 has indicated substantial recharge since discontinuation of pumping October 2002.

All liquid level measurements are from October except for year 2007 which were collected in February.

Liquid level measurements are also available by clicking the corresponding link at the end of this presentation.

Sump ID	Baseline ToC to ToL	04 ToC to ToL	05 ToC -ToL	06 ToC - ToL	07 ToC - ToL
1-2	20.8	19.30	19.40	19.50	19.48
2-6	21.45	20.60	20.40	20.32	20.28
3-2	23.00	22.80	23.00	23.04	22.78
3-4	15.63	15.80	15.90	15.93	15.96
7-4	15.28	12.90	11.40	10.05	9.64
7-5	18.43	18.70	19.20	19.45	19.52
7-7	19.33	19.80	20.10	20.39	20.45
10-7	27.83	27.60	27.60	27.57	27.49
10-8	27.51	27.60	27.70	27.72	27.68
10-9	26.06	25.40	25.30	25.08	24.94
11-5	20.92	20.90	20.90	20.96	21
11-6	24.03	24.10	24.30	24.42	24.42
15-4	26.68	26.60	26.70	26.67	26.64
15-5	24.14	25.00	25.10	25.12	25.05
15-6	28.88	28.60	28.50	28.40	28.35
15-8	22.21	22.40	22.50	22.42	22.29
18-6	30.41	30.40	30.30	30.32	30.27
18-9	21.88	22.00	22.00	22.00	22.01
19-5	28.85	28.80	30.50	28.89	28.89
19-6	23.50	23.20	23.30	23.24	23.19
19-7	30.80	30.10	30.10	30.03	29.94
20W	26.50	27.90	28.10	28.15	28.15
20-7	29.85	29.80	29.90	29.94	29.93
20-9	30.06	30.10	30.70	30.06	30.05

Sump ID	Baseline ToC to ToL	04 ToC to ToL	05 ToC -ToL	06 ToC - ToL	07 ToC - ToL
20-11	24.21	24.20	24.10	24.13	24.11
23-5	31.20	31.10	31.00	30.92	30.88
23-6	31.17	30.80	30.80	30.75	30.7
23-9	24.55	24.10	24.30	24.30	24.3
24-5	23.37	23.30	23.30	23.36	23.31
24-6	26.45	26.40	26.50	26.44	26.44
25-5	22.91	23.20	23.30	23.35	23.35
25-7	25.05	25.00	24.90	24.88	24.84
25-9	22.59	22.60	22.50	22.48	22.41
26-2	28.11	27.90	27.70	27.57	27.52
26-3	26.90	26.70	26.60	26.58	26.52
26-4	21.70	21.90	22.00	22.08	22.09
27-9	28.08	27.20	26.90	26.69	26.59
27-11	25.80	25.50	25.70	25.75	25.75
28W	26.00	26.00	26.10	26.04	26.04
28-6	27.50	27.20	27.40	27.44	27.44
28-11	27.00	26.80	27.00	26.98	26.98
28-12	26.30	26.40	26.40	26.40	26.4
29W	24.95	25.00	24.80	25.42	25.45
29-5	27.95	27.50	27.70	27.67	27.67
29-6	25.33	25.60	25.80	25.57	25.6
30-4	23.25	23.10	22.40	23.30	23.32
30-8	29.10	29.70	29.80	29.98	29.92
30-10	29.06	29.20	29.20	29.15	29.2

Sump ID	Baseline ToC to ToL	04 ToC to ToL	05 ToC -ToL	06 ToC - ToL	07 ToC - ToL
31-2	25.05	25.10	25.20	25.18	25.18
31-5	23.23	22.90	23.30	23.05	23.05
31-7	24.78	24.70	24.80	24.71	24.68
31-9	24.95	25.20	25.50	25.60	25.58
32E	29.13	29.00	29.00	29.97	28.97
32-9	28.89	28.90	28.90	28.95	28.94
35-2	27.04	27.60	27.90	28.00	28.06
35-6	27.65	27.40	27.40	27.38	27.34
36-3	20.73	20.80	20.80	20.76	20.76
36-6	24.00	23.90	24.00	24.00	23.98
36-7	22.70	22.50	22.40	22.32	22.31
37-3	22.97	22.90	22.80	22.76	22.71
37-4	23.37	23.50	23.50	23.50	23.51
38-4	21.80	21.70	21.60	21.50	21.47
38-5	21.45	21.30	21.20	21.18	21.13
39-1	20.60				
39-4	19.02	19.20	19.20	19.12	19.2
40-15	21.40	21.30	21.40	21.41	21.36
40-17	28.75	28.50	28.70	28.58	28.52
40-19	30.30	29.70	29.80	29.76	29.68
40-22	32.53	32.10	32.10	31.98	31.93
42-11	28.60	28.20	28.40	28.45	28.43

Sump ID	Baseline ToC to ToL	04 ToC to ToL	05 ToC -ToL	06 ToC - ToL	07 ToC - ToL
42-19	27.70	27.70	27.80	27.88	27.83
42-20	35.35	35.30	35.10	35.10	35.02
43-7	35.95	36.00	36.10	36.20	36.21
43-9	34.15	34.10	34.40	34.43	34.44
43-13	30.35	30.50	30.60	30.60	30.58
44-14	34.30	34.10	34.30	34.28	34.26
44-20	38.50	38.40	38.40	38.40	38.38
44-22	39.90	39.70	40.00	40.05	40.08
44-5	41.45	41.50	41.50	41.30	41.3
45-1	29.50	29.50	29.40	29.40	29.33
46-1	25.90	25.30	24.20	22.91	22.64
46-2	22.15	21.20	20.90	20.78	20.83
46-3	18.50	18.20	18.20	18.46	18.88

Highlighted cells indicate sumps that are typically dry.

If you have any questions or require any additional information please contract Scott Wilburn by phone at 606/784-6612 or email at: scott.wilburn@ky.gov .

Thanks

- Liner Defect Log
- 2003 Defect Map
- 2004 Defect Map
- 2005 Defect Map
- 2006 Defect Map
- 2007 Defect Map

- Trench Sump Liquid Level Measurements

- Potentiometric Maps 2003-2006
- Potentiometric Surface Maps Raw Data 2003-2006.xls

Appendix B

Photos

Photo1: North West Quadrant Liner Overview – Looking North

Photo2: North West Quadrant Looking South – Typical Bunker Slopes

Photo 3: Typical Sump with Liner Boot

Photo 4: South West Quadrant Overview Looking West

Photo 5: Ponded Water in South Central Area

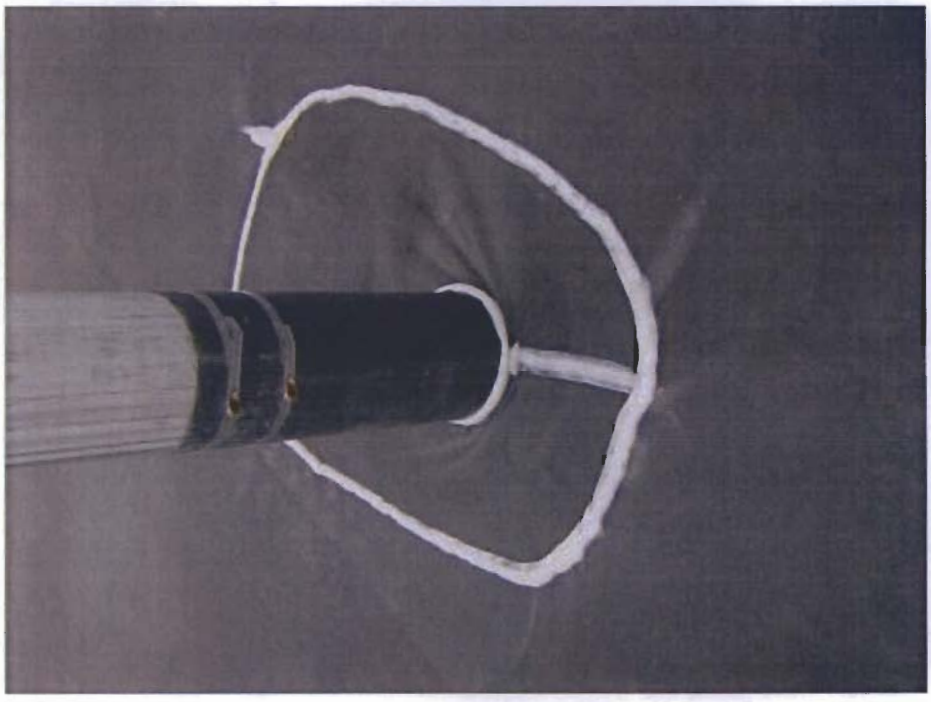


Photo 6: North East Quadrant - Liner Pipe Boot Strain (Apparent Creep Impacts)

Photo 7: Liner Overview from Northern Area Looking South

Photo 8: 2007 Seam Defect – Panel 186

Photo 9: Y-Channel Revetment

Photo 10: Liner Overview from South East Quadrant Looking North West

Photo 11: Liner Evaluation (LE) Sample LE-1

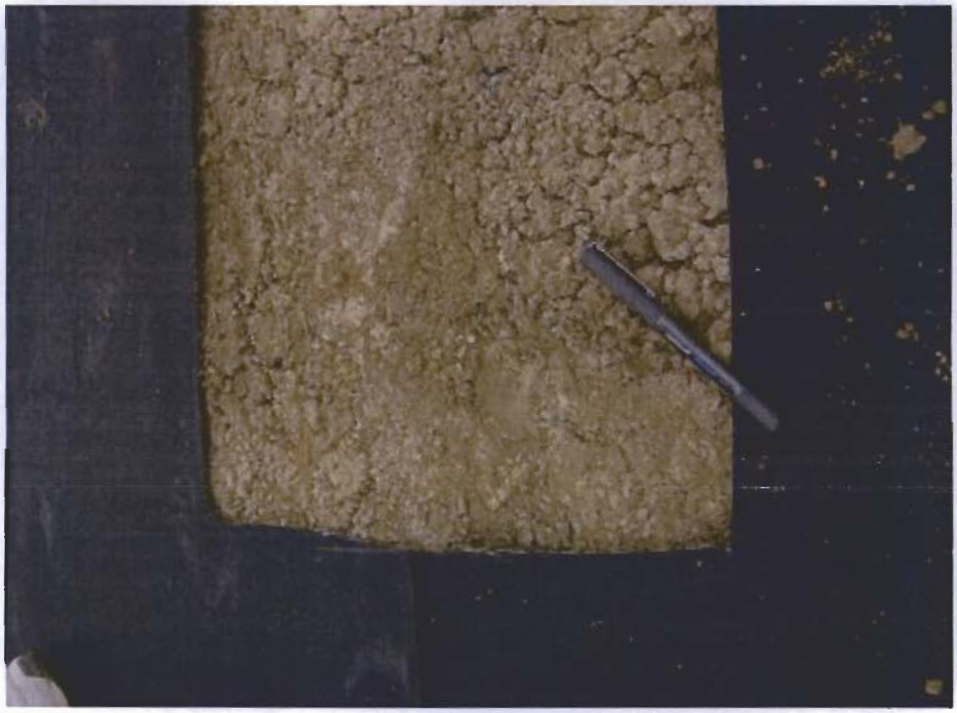


Photo 12: Desiccated Soil Subgrade at LE-1

Photo 13: LE-3

Photo 14: LE-2

Photo 15: LE-4 (Foreground)

Photo 16: LE3-Foreground LE4-Background

Appendix C

Laboratory Test Report

Precision Geosynthetic Laboratories

CLIENT: FULLER, MOSSBARGER, SCOTT & MAY
PROJECT NAME: *Conformance / Seam Testing*

VERIFICATION OF MATERIAL PROPERTIES
(PGL Job No. G070462)

MATERIAL DESCRIPTION: RPP Seams

SAMPLES SENT BY: R. Nanduri, Fuller, Mossbarger, Scott & May

DATE RECEIVED: May 4, 2007 **DATE REPORTED:** May 4, 2007

SAMPLE IDENTIFICATIONS:

SAMPLE ID	PRECISION CONTROL NUMBER
LE- 1	32853
LE- 2	32854
LE- 3	32855
LE- 4	32856

TESTS REQUIRED:

TEST METHOD	DESCRIPTION
Seam	
ASTM D751	Shear Bonded Strength
ASTM D413	Peel Adhesion
Conformance	
ASTM D751	Tongue Tear, NSF Modified
ASTM D751	Grab Strength Procedure A

TEST CONDITIONS: The samples were conditioned for a minimum one hour in the laboratory at 22 ± 2°C (71.6 ± 3.6°F) and at 60 ± 10% relative humidity prior to test.

TEST RESULTS:

The test results are summarized in Tables 1 & 2. The units in which the data are reported are included on these tables.

PRECISION GEOSYNTHETIC LABORATORIES

Lyvia Toledo
Quality Assurance

Cora B. Queja
Vice President

1160 North Gilbert Street, Anaheim, CA. 92801, Tel# 714-520-9631, Fax# 714-520-9637

TABLE 1.

SEAM PEEL AND SHEAR TEST RESULTS

CLIENT: **FULLER, MOSSBARGER, SCOTT & MAY** MATERIAL: **RPP Seam** QC'd By: L. Toledo

PROJECT: **Conformance / Seam Testing** SEAM TYPE: **Fusion Weld** TEST METHOD: **ASTM D751 NSF MOD/D413 NSF MOD**

DATE REC'D: **4-May-07** PGL JOB #: **G070462** DATE REPORT: **4-May-07**

ASTM D751 NSF MOD USING 4" WIDE SPECIMENS						ASTM D413 NSF MOD USING 1" WIDE SPECIMEN				
		SHEAR EVALUATION				PEEL EVALUATION				
SAMPLE ID	PGL CONTROL #	MAXIMUM STRENGTH (lbs)	LOCUS of BREAK	CLASSIFICATION	PROJECT SPEC. (lbs)	SPECIMEN NUMBER	MAXIMUM STRENGTH (lb/in width)	LOCUS of BREAK	CLASSIFICATION	PROJECT SPEC. (lb/in width)
LE- 1	**32853**	329	BRK	FTB		1 Outside	***43***	***AD***	***FTB***	
		301	BRK	FTB		2 Outside	***53***	***AD***	***FTB***	
		311	BRK	FTB		3 Outside	51	DEL	NON-FTB	
		303	BRK	FTB		4 Outside	***44***	***AD***	***FTB***	
		302	BRK	FTB		5 Outside	***36***	***AD***	***FTB***	
	AVG.	**309**			200	***AVG:***	**45**			20
	STD. DEV.	**12**				*STD. DEV.*	**7**			
LE- 2	**32854**	351	BRK	FTB		1 Outside	61	DEL	NON-FTB	
		340	BRK	FTB		2 Outside	63	DEL	NON-FTB	
		330	BRK	FTB		3 Outside	56	DEL	NON-FTB	
		357	BRK	FTB		4 Outside	65	DEL	NON-FTB	
		347	BRK	FTB		5 Outside	61	DEL	NON-FTB	
	AVG:	**345**			200	***AVG:***	**61**			20
	STD. DEV.	**11**				*STD. DEV.*	**3**			

LOCUS OF BREAK AND CLASSIFICATION BASED ON FABRIC- REINFORCED SEAMS (NSF 54, 1993):

LOCUS OF BREAK

AD	ADHESION FAILURE RESULTING IN THE DELAMINATION IN THE PLANE OF THE BOND.
DEL	DELAMINATION IN THE PLANE OF THE SCRIM.
AD-DEL	DELAMINATION IN THE PLANE OF THE SCRIM AFTER SOME DELAMINATION IN THE PLANE OF THE BOND
BRK	BREAK IN THE SHEET THROUGH BOTH THE FABRIC AND THE PLIES OF THE POLYMER.
FP	FABRIC PULLOUT. (NO TEST).

CLASSIFICATION

FTB	FILM TEAR BOND
NON-FTB	ADHESION FAILURE

T_E 2.

SEAM PEEL AND SHEAR TEST RESULTS

CLIENT: **FULLER, MOSSBARGER, SCOTT & MAY** MATERIAL: **RPP Seam** QC'd By: L Toledo

PROJECT: **Conformance / Seam Testing** SEAM TYPE: **Fusion Weld** TEST METHOD: **ASTM D751 NSF MOD/D413 NSF MOD**

DATE REC'D: **4-May-07** PGL JOB #: **G070462** DATE REPORT: **4-May-07**

ASTM D751 NSF MOD USING 4" WIDE SPECIMENS						ASTM D413 NSF MOD USING 1" WIDE SPECIMEN				
		SHEAR EVALUATION				PEEL EVALUATION				
SAMPLE ID	PGL CONTROL #	MAXIMUM STRENGTH (lbs)	LOCUS of BREAK	CLASSIFICATION	PROJECT SPEC. (lbs)	SPECIMEN NUMBER	MAXIMUM STRENGTH (lb/in width)	LOCUS of BREAK	CLASSIFICATION	PROJECT SPEC. (lb/in width)
LE- 3	**32855**	376	BRK	FTB		1 Outside	***44***	***AD***	***FTB***	
		351	BRK	FTB		2 Outside	***36***	***AD***	***FTB***	
		377	BRK	FTB		3 Outside	***41***	***AD***	***FTB***	
		383	BRK	FTB		4 Outside	***44***	***AD***	***FTB***	
		362	BRK	FTB		5 Outside	***32***	***AD***	***FTB***	
	AVG.	**370**			200	***AVG:***	**39**			20
	STD. DEV.	**13**				*STD. DEV.*	**5**			
LE- 4	**32856**	258	BRK	FTB		1 Outside	46	DEL	NON-FTB	
		271	BRK	FTB		2 Outside	45	DEL	NON-FTB	
		261	BRK	FTB		3 Outside	49	DEL	NON-FTB	
		264	BRK	FTB		4 Outside	41	DEL	NON-FTB	
		258	BRK	FTB		5 Outside	46	DEL	NON-FTB	
	AVG:	**262**			200	***AVG:***	**45**			20
	STD. DEV.	**5**				*STD. DEV.*	**3**			

LOCUS OF BREAK AND CLASSIFICATION BASED ON FABRIC- REINFORCED SEAMS (NSF 54, 1993):

LOCUS OF BREAK

AD	ADHESION FAILURE RESULTING IN THE DELAMINATION IN THE PLANE OF THE BOND.
DEL	DELAMINATION IN THE PLANE OF THE SCRIM.
AD-DEL	DELAMINATION IN THE PLANE OF THE SCRIM AFTER SOME DELAMINATION IN THE PLANE OF THE BOND
BRK	BREAK IN THE SHEET THROUGH BOTH THE FABRIC AND THE PLIES OF THE POLYMER.
FP	FABRIC PULLOUT. (NO TEST).

CLASSIFICATION

FTB	FILM TEAR BOND
NON-FTB	ADHESION FAILURE

TABLE 2A.

MATERIAL PROPERTIES

CLIENT: FULLER, MOSSBARGER, SCOTT &MAY

PROJECT: Conformance / Seam Testing

Date Received: **5/4/2007**
Date Reported: **5/4/2007**
Client Sample ID: **LE- 4**
Material Description: **RPP Seam (Parent Material)**

QC'd By: A Toledo
PGL Job No.: **G070462**
PGL Control No.: **32856**

		SPECIMENS														Proj.
		1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Min	Max	Specs.
METHOD	**DESCRIPTION**															
ASTM D751	Tongue Tear Resistance (lbs)															
NSF Modified	*MD*	**74**	**88**	**94**	**94**	**82**						**86**	**8**	74	94	**70 min**
	TD	**74**	**67**	**68**	**64**	**66**						**68**	**3**	64	74	
ASTM D751	Grab Tensile															
Procedure A	Tensile Strength (lbs)															
	MD	**288**	**285**	**276**								**283**	**6**	276	288	**220 min**
	TD	**345**	**335**	**341**								**340**	**5**	335	345	
	Elongation at Break (percent)															
	MD	**86**	**110**	**114**								**103**	**15**	86	114	
	TD	**35**	**111**	**59**								**69**	**39**	35	111	

MD - MACHINE DIRECTION
TD - TRANSVERSE DIRECTION
DC#1991 Record#272

Figure C.2

Liner Maintenance
2003-2007

Maxey Flats
Fleming County, Kentucky

Description:

Map adapted from FSA NAIP Digital Ortho Photo 2004.

Liner Repair data adapted from figures: 2006 Defect Map, 2005 Defect Map, 2004 Defect Map and 2003 Defect Map.

Map Legend:

Liner Defects

Year

- 2003
- 2004
- 2005
- 2006
- 2007 (partial)

Liner Defects (areas)

Year

- 2003
- 2004
- 2005
- 2006
- 2007 (partial)
- PanelAnno_fullgrid
- Panel
- Trench

Spatial Projection:

Coordinate System:
Kentucky State Plane North
FIPS Zone: 1601
Units: Feet
Datum: NAD83

Plot Info:

File: FigC.2_Liner_maint.mxd
Project No: 3088
Plot Date: 12 Sept. 2007
Arc Operator: HRVG
Reviewed by: NB

Year	Total Defects
2003	7
2004	26
2005	47
2006	74
2007*	61

** partial year of data thru 050907*

SCALE 0 135 270 540 810 1,080 Feet

de maximis, inc.
Knoxville, TN 37919
Main Phone: (865) 691-5052
www.demaximis.com

de maximis Data Management Solutions, Inc.
Saint Paul, Minnesota 55108
Main Phone: (651) 842-2224
www.ddms.com

R:\Projects\DEF\fle...\3088-MaxeyFlats\Data Anal\MXDs

Attachment 4-A

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Site name: Maxey Flats Disposal Site	**Date of inspection:** 25APR07
Location and Region: Region IV	**EPA ID:** KYD980729107
Agency, Office, or company leading the five-year review: USEPA	**Weather/temperature:** windy, sunny, 78 degrees 35 mph winds

Remedy Includes:

Natural Stabilization

Attachments: Inspection team roster attached Site map attached

II. INTERVIEWS (Check all that apply)

1. O&M site manager: Scott Wilson (Name) Site Manager (Title) 25APR07 (Date)

Interviewed at site **by phone** **Phone no.**

Problems, suggestions; **Report attached** _____

Interested in moving site to final closure due to high maintenance costs and little evidence of subsidence. Mr. Wilson noted that the Commonwealth collects additional data pursuant to their NRC license and believes all data collected should be reported to EPA.

2. O&M staff: None (Name) _____ (Title) _____ (Date)

Interviewed **at site** **by phone** **Phone no.** _____

Problems, suggestions; **Report attached** _____

_____

3. **Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc) Fill in all that apply.**

Agency: Hillsboro Fire Department

Contact: Billy Thompson (**Name**) Fire Cheif (**Title**) 2APR07 (**Date**) 1-606-876-4331 (**Phone no.**)

Problems, suggestions; **Report attached** Contacted through e-mails, no response

---

Agency: Fleming County Emergency Management

Contact: Dwayne Price (**Name**) EM Director (**Title**) 2APR07 (**Date**) _____ (**Phone no.**)

Problems, suggestions; **Report attached** _____
Wanted to see more data and have it readily available.

Agency: Commonwealth of Kentucky

Contact: Larry Dixon (**Name**) State DES (**Title**) 2APR07 (**Date**) _____ (**Phone no.**)

Problems, suggestions; **Report attached** _____
Contacted via e-mail, no response.

Agency: Local Official

Contact: Larry Foxworthy (**Name**) County Judge (**Title**) 2APR07 (**Date**) _____ (**Phone no.**)

Problems, suggestions; **Report attached** _____
Contacted via e-mail, no response.

Agency: State Legislature

Contact: Mike Denham (**Name**) Ky State Representative (**Title**) 2APR07 (**Date**) _____ (**Phone no.**)

Problems, suggestions; **Report attached** _____
Contacted via e-mail, no response.

Agency: MFCCG

Contact: Ed Story (**Name**) Former President (**Title**) 18APR07 (**Date**) _____ (**Phone no.**)

Problems, suggestions; **Report attached** _____
Contacted via e-mail, no response.

Agency: MFCCG

Contact: Nancy Powell	Former Secretary	17APR07	1-606-849-9041
Name	**Title**	**Date**	**Phone no.**

Problems, suggestions; Report attached _____

I asked Nancy if she had seen any of the advertisements placed in local newspapers to inform the community about the Five-Year Review. She indicated that she had not seen or heard about the Five-Year Review before my call to her. I inquired as to other ways she would recommend for notifying people. She didn't have any suggestions above what we had already done. Nancy indicated that many people find out these types of things by word of mouth. She was pleased to know that EPA was conducting the review. She indicated that she was happy with the work that had been done at the site and felt safe knowing that the site was well monitored and maintained. She had no comments to make but would like to know when the report is available to read.

4. Other Interviews:

William Conn, Neighbor to site, 4APR07: wanted a water line extension
Herbert Jolley, Neighbor to site, 17APR07: unable to participate in interview due to spring planting season
Willa Granis, Neighbor's daughter, 7JUN07: concerned about parent's ability to sell their property
Dr. John Volpe, Consultant to Kentucky Cabinet for Health Services, 2APR07: said CHS was reviewing the data collected pursuant to their license and would send EPA a copy of their 2006 Report.
Stephanie Broch, Kentucky Rad Branch Manager, 2APR07: no response

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. O&M Documents

IMP Work Plan documents	Readily available	Up to date	N/A
O&M manual	Readily available	Up to date	N/A
As Built drawings	Readily available	Up to date	N/A
Maintenance logs	Readily available	Up to date	N/A

Remarks: _____

2. O&M and OSHA Training Records Readily available Up to date N/A

Remarks: _____

3. Settlement Monument Records Readily available Up to date N/A

Remarks: _____

4. Leachate Extraction Records Readily available Up to date N/A

Remarks: Currently not applicable. IRP extraction data provided in RA Construction Report (2003); Pumping operations completed August 2000 .

5. **Daily Access/Security Logs** Readily available Up to date N/A

Remarks:_____

_____

IV. O&M COSTS

1. **O&M Organization**

State in-house

2. **O&M Cost Records**

Readily available Up to date
Funding mechanism/agreement in place
Original O&M cost estimate _____ Breakdown attached

Total annual cost by year for review period if available

From _____ **To** _____ Breakdown attached
Date Date

From _____ **To** _____ Breakdown attached
Date Date

From _____ **To** _____ Breakdown attached
Date Date

From _____ **To** _____ Breakdown attached
Date Date

From _____ **To** _____ Breakdown attached
Date Date

Commonwealth provided costs through 2006, would provide through 2007 for the report. Costs were summarized into a table for the report.

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: _____

_____

_____

V. ACCESS AND INSTITUTIONAL CONTROLS Applicable N/A

A. Fencing

1. Fencing damage Location shown on site map Gates secured N/A
Remarks _____

B. Other Access Restrictions

1. Signs and other security measures Location shown on site map Gates secured N/A
Remarks _____

See photographic documentation

C. Institutional Controls (ICs)

1. Deed Restriction:
Remarks confirmed deed restrictions were on file at the Fleming County Courthouse

D. General

1. Vandalism/trespassing Location shown on site map No vandalism evident
Remarks _____

2. Land use changes on site N/A
Remarks _____

3. Land use changes off site N/A
Remarks _____

VI GENERAL SITE CONDITIONS

A. Roads Applicable N/A

1. Roads damaged **Location shown on site map** **Roads adequate** N/A

Remarks _____

B. Other Site Conditions

Remarks Access/Building

VII. LANDFILL COVERS Applicable N/A

A. Landfill Surface:

1. **Settlement** (Low spots) Location shown on site map Settlement not evident
   Areal extent _____ Depth _____
   Remarks: LP119
   LP 101 sump 31-7, LP 101 Sump 29-2
   LP 68, sump 37-3 water around
   LP 72, subsidence repair S of 46-2
   North of Y channel-erosion in subgrade, channeling of watr into EDB, increased silt in EDB
   LP 172/186, extrusion weld W of Diversion Berm, 2 W of EDB (Top of Y channel)

2. **Holes /Geomembrane damage** Location shown on site map Holes/Damage not evident
Areal extent_____ Depth_____
Remarks:
Soft spots under liner LP 240
Soft spots and water/depression under LP 227-2 (bottom of hill)

3. **SE Cap**
Vegetative Cover Grass Cover properly established/maintained No sign of Stress
Trees/shrubs (indicate size and locations on a diagram)
Remarks_____

B. Benches Applicable N/A

1. **Interior Y-Channel** Location shown on site map N/A or okay
Remarks_____

2. **Interior Anchor Trenches** Location shown on site map N/A or okay
Remarks_____

C. Letdown Channels Applicable N/A
SE Perimeter Channel
West Perimeter Channel
North Channel
NE Corner Piping
East Perimeter Channel

1. **Settlement** Location shown on site map Settlement not evident
Areal extent_____ Depth_____
Remarks:

2. **Excessive Vegetative Growth** Type_____
No evidence of excessive growth
Vegetation in channelss does not obstruct flow
Location shown on site map Areal extent_____
Remarks_____

3. **Material Degradation** Location shown on site map No evidence of degredation
Material Type _____ Areal extent_____
Remarks_____

D. Cover Penetrations Applicable N/A

1. **Sumps**
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs maintenance N/A
Remarks_____

2. **Settlement Monuments** Located Routinely Surveyed N/A
Remarks _____

3. **Leachate Storage Facility** Located Cathodic Protection Maintained
Properly secured/locked Functioning Good condition
Evidence of leakage at penetration Needs maintenance N/A
Remarks _____

E. Gas Collection and Treatment Applicable N/A

F. Cover Drainage Layer Applicable N/A

G. Detention/Sedimentation Ponds – East Detention Basin-see Landfill cover comments

1. **Siltation** Areal extent _____ Depth _____ N/A
Siltation no evident

Remarks _____

2. **Erosion** Areal extent _____ Depth _____ N/A
Erosion not evident

Remarks _____

3. **Outlet Works** Functioning N/A

Remarks _____

4. **Dam** Functioning N/A

Remarks _____

H. Retaining Walls Applicable N/A

I. Perimeter Ditches/Off Site Discharge Applicable N/A

VIII. VERTICAL BARRIER WALLS

Applicable N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES

Applicable N/A

X. OTHER REMEDIES

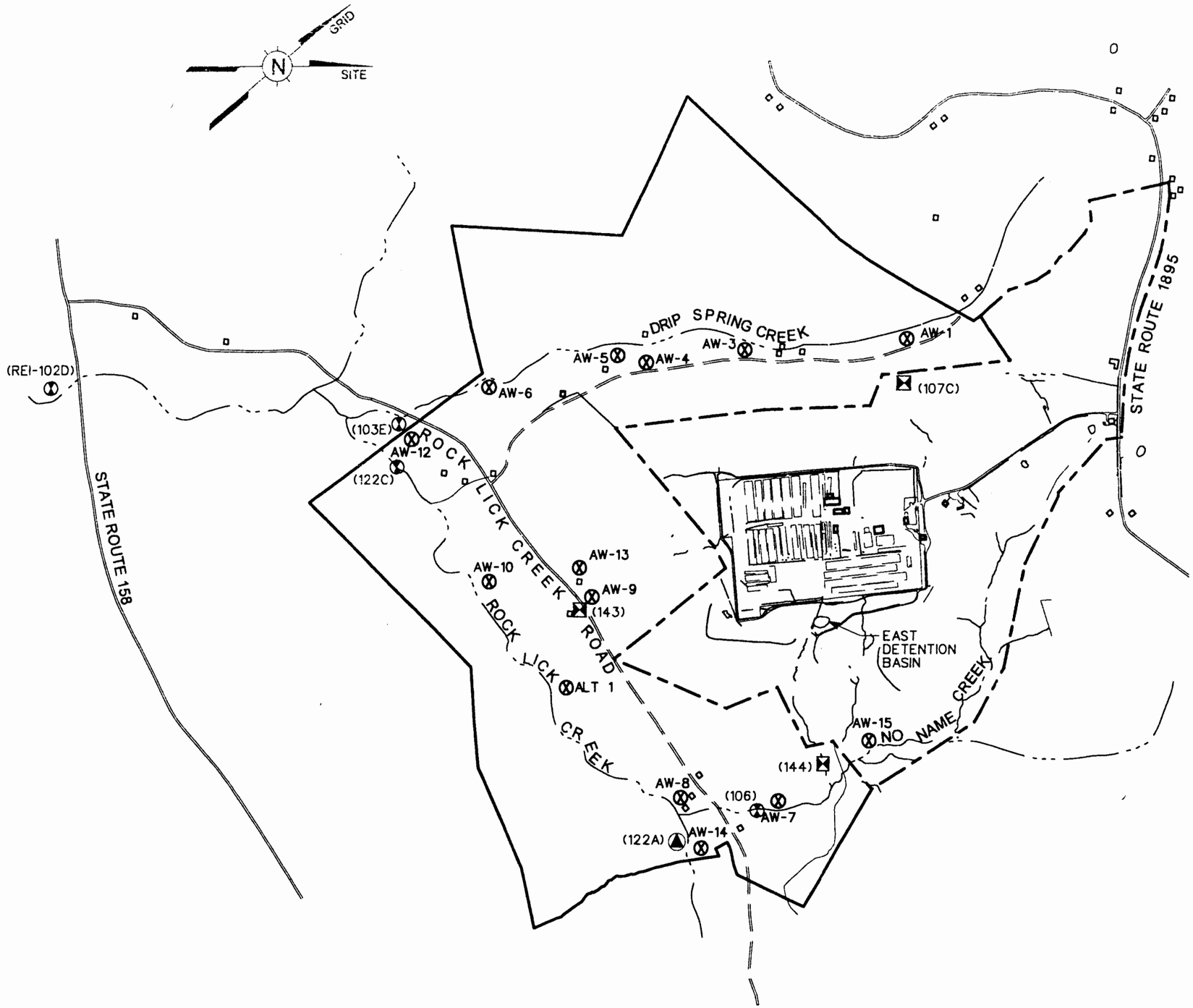
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

No Issues observed.



LEGEND

- BUILDING
- ROADS
- CURRENT SITE PROPERTY BUFFER ZONE
- PRE-CONSENT DECREE SITE BOUNDARY
- CREEK

4 MREM /YEAR - 20 pci/ml SAMPLING LOCATIONS:

- SURFACE WATER SAMPLE LOCATIONS
- ALLUVIAL WELL LOCATIONS

25 MREM /YEAR SAMPLING LOCATIONS:

- SURFACE WATER SAMPLE LOCATION

BACKGROUND:

- SURFACE WATER SAMPLE LOCATION

FIGURE 3-3
CONTAMINANT MONITORING LOCATIONS

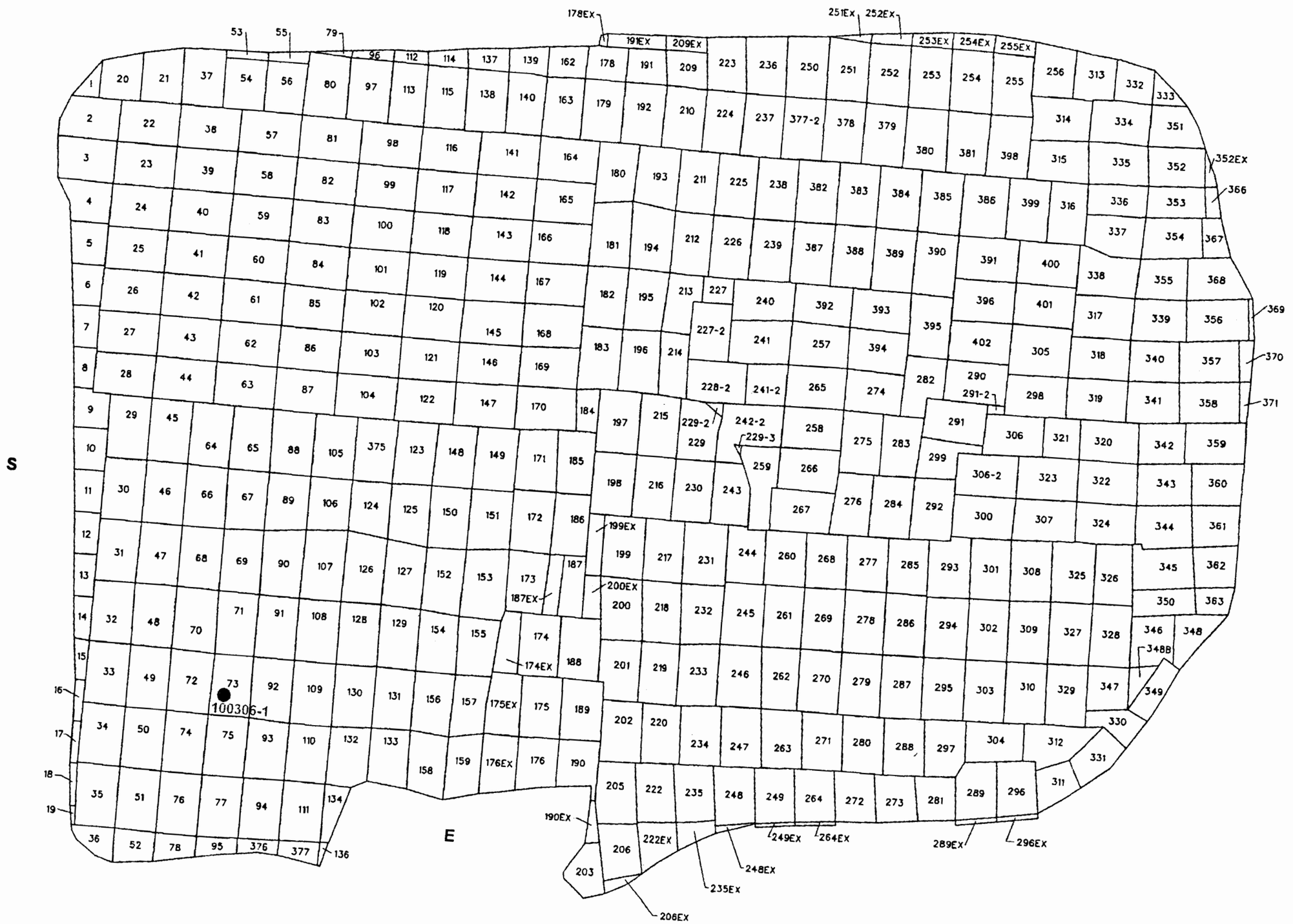
MAXEY FLATS DISPOSAL SITE
MOREHEAD, KENTUCKY

Shaw
Shaw Environmental, Inc.

DRAFT. CHCK. BY: C.E.TUMLIN	INITIATOR: J. SERAFIN	DWG. NO. 838409-ro	-3.dgn
ENGR. CHCK. BY:	PROJ. MGR.: M. CAPPS	PROJ. NO. 838409	
STARTING DATE: 06/20/01	DATE LAST REV.: 2/03		
DRAWN BY: J. WATERS	DRAWN BY: J. WATERS		

jwaters 04:00:20 PM
C:\CADD\Design\838409-rofig 3-3.dgn 09/04/03

2006 Subsidence Repair Map



B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures.
In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

No Issues

Attachment 4 B & C


NO


FARM for SALE
CHUCK
MARSHALL

U.S. EPA REGION IV

SDMS

Unscannable Material Target Sheet

DocID: 10520122 Site ID:

Site Name: MAXEY FLATS DISPOSAL SITE

Nature of Material:

Map:		Computer Disks:	
Photos:		CD-ROM:	x
Blueprints:		Oversized Report:	
Slides:		Log Book:	

Other (describe): ATTACHMENT 4C - FIVE YEAR LINER INSPECTION VIDEO

Amount of material: ONE

* Please contact the appropriate Records Center to view the material *

Attachment 5

ATTACHMENT 5 - ARAR Table

MEDIUM/ AUTHORITY	Contaminant-Specific ARAR Contaminant-specific ARARs listed in the ROD include some requirements that are also listed as Action Specific ARARs.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
All Pathways (TEDE) AEA (Atomic Energy Act)	902 KAR 100:020 Section 7 and 8 and Table II of 100:025 Kentucky Standards for Protection Against Radiation Allowable Doses in Unrestricted Areas	Applicable	This ARAR limits the total effective dose equivalent to individual members of the public from licensed operations to less than 100 mrem/yr.	Compliance was demonstrated at the peak of IRP operations using liquid discharge, air emissions and direct dose monitoring. During IMP, Commonwealth monitors liquid discharge (remaining viable pathway) as indicator with TEDE at less than 25 mrem/yr at the current licensed site boundary.
All Pathways (TEDE) AEA	10 CFR 20 Federal Standards for Protection Against Radiation (Allowable Doses in Unrestricted Areas), 10 CFR 20.105, 20.106 and Appendix B, Table II	Relevant and Appropriate	This ARAR limits the total effective dose equivalent to individual members of the public from licensed operations to less than 100 mrem/yr.	Compliance was demonstrated at the peak of IRP operations using liquid discharge, air emissions and direct dose monitoring. During IMP, Commonwealth monitors liquid discharge (remaining viable pathway) as indicator with TEDE at less than 25 mrem/yr at the current licensed site boundary.
Surface Water CWA	401 KAR 5:026 – 035, Kentucky Surface Water Quality Standards	Applicable	This ARAR limits contaminant loading to waters of the Commonwealth. EPA determined that monitoring for tritium will be used to show compliance, using the dose derived standard of 20 pCi/ml (equiv. to 4 mrem/yr drinking water).	Compliance is demonstrated currently with data collected by the Commonwealth at multiple monitoring locations prescribed by the PSVP (102D, 103, 106, 122C and 122A). During the IMP (with continued maintenance), after the Final Closure Period and considering radioactive decay, water quality is expected to remain within the surface water quality standards.
Surface Water CWA	Section 304(a)(1) of the Clean Water Act – Ambient Water Quality Criteria, EPA criteria for protection of aquatic life from acute or chronic toxic effects or the human health criteria for consumption of fish	Relevant and Appropriate	This ARAR limits contaminant loading to waters of the Commonwealth. EPA determined that monitoring for tritium will be used to show compliance, using the dose	Compliance is demonstrated currently with data collected by the Commonwealth at multiple monitoring locations prescribed by the PSVP (102D, 103, 106, 122C and 122A). During the IMP (with continued maintenance), after the Final

MEDIUM/ AUTHORITY	Contaminant-Specific ARAR Contaminant-specific ARARs listed in the ROD include some requirements that are also listed as Action Specific ARARs.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
			derived standard of 20 pCi/ml (equiv. to 4 mrem/yr drinking water).	Closure Period and considering radioactive decay, water quality is expected to remain within the surface water quality standards.
Ground Water/SDWA Surface Water/CWA	401 KAR 6:015, Kentucky Drinking Water Standards	Relevant and Appropriate	Compliance with the 4 mrem/yr drinking water standard for tritium is judged beginning at the contact of the alluvium with the hillside and ending at the streams. Monitoring for tritium is used to show compliance.	Commonwealth compiles data from 14 monitor wells located in the alluvium (within the buffer zone), and at a stream location outside the buffer zone (102D) where adequate water is available to be used as a possible drinking water source. Current data show all sampled wells below the dose derived standard. Given the relatively short decay rate of tritium, drinking water limits are expected to continue to show compliance after the final cap is constructed.
Ground Water/SDWA Surface Water/CWA	40 CFR 141, 142, and 143, Federal Drinking Water Regulations *same as State Standards* Section 304(a)(1) Ambient Water Quality Criteria *same as State Standards*	Relevant and Appropriate	Compliance with the 4 mrem/yr drinking water standard for tritium is judged beginning at the contact of the alluvium with the hillside and ending at the streams. Monitoring for tritium is used to show compliance.	Commonwealth compiles data from 14 monitor wells located in the alluvium (within the buffer zone), and at a stream location outside the buffer zone (102D) where adequate water is available to be used as a possible drinking water source. Current data show all sampled wells below the dose derived standard. Given the relatively short decay rate of tritium, drinking water limits are expected to continue to show compliance after the final cap is constructed.
Ground Water/RCRA	401 KAR 34:060 (section 5) – Ground Water Protection… maximum ground water concentration limits for certain metals and organic compounds.	Applicable	EPA determined and the Commonwealth agreed that compliance testing/monitoring will focus on water borne pathways for tritium, and that unless tritium levels	Based on current data, information provided by the Commonwealth and data collected during the RI/FS, constituents regulated pursuant to the hazardous waste management groundwater regulations are in compliance at the compliance locations

MEDIUM/ AUTHORITY	Contaminant-Specific ARAR Contaminant-specific ARARs listed in the ROD include some requirements that are also listed as Action Specific ARARs.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
			substantially exceed the criteria, organic and metal analyses will not be required. If tritium levels increase substantially, indicating changed site conditions, expanding the analyte list will be in accordance with the EPA approved PSVP.	and that exceedances of standards in the future are not expected.
Air/CAA	40 CFR Part 61.92, subpart H, National Emission Standards for Hazardous Air Pollutants (NESHAPS)	Relevant and Appropriate	This ARAR limits dose to the public via the air pathway to 10 mrem/yr. Monitoring during IRP RA demonstrated levels less than 10 percent of limit. Monitoring discontinued during IMP unless/until Commonwealth initiates solidification activities, then monitoring resumed.	Air releases during IMP are negligible. Should the Commonwealth perform solidification during the IMP, the affect of air dose will need to be considered. Air dose after final cap construction is expected to be negligible.
All Pathways/AEA	902 KAR 100:022, Kentucky Licensing Requirements for Land Disposal of Radioactive Waste	Relevant and Appropriate	Combined doses from air, water, drinking water and soil pathways should not exceed 25 mrem/yr effective dose equivalent at the current licensed site boundary. Water runoff is the only viable pathway and tritium is selected for monitoring compliance (PSVP).	Monitoring locations (107C, 143 and 144) were in compliance at the end of IRP RA, and continue to show compliance. The Commonwealth will control access to these locations in perpetuity. Therefore, the potential dose to members of the public now and in the future is negligible.
All Pathways/AEA	10 CFR 61.41, Federal Licensing Requirements for Land Disposal of Radioactive Waste *same as State Requirements*	Relevant and Appropriate	Combined doses from air, water, drinking water and soil pathways should not exceed 25 mrem/yr effective dose equivalent at the current licensed site boundary. Water runoff is the only viable pathway and tritium is selected for monitoring compliance (PSVP).	Monitoring locations (107C, 143 and 144) were in compliance at the end of IRP RA, and continue to show compliance. The Commonwealth will control access to these locations in perpetuity. Therefore, the potential dose to members of the public now and in the future is negligible.

MEDIUM/ AUTHORITY	Contaminant-Specific ARAR Contaminant-specific ARARs listed in the ROD include some requirements that are also listed as Action Specific ARARs.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
Soil/AEA	40 CFR Part 192, Federal Standards for Uranium and Thorium Mill Tailings	Relevant and Appropriate	Standard for uranium and thorium mill tailings requires radium-226 concentrations in the top 15 cm of soil to be less than 5 pCi/g.	The pre-existing soil cover, placement of the IRP Cap with fill of 1 to 3 feet, along with the 45 mil reinforced polypropylene liner, satisfy this requirement. In addition, placement of the final cap by the Commonwealth to complete the RA will ensure this ARAR will continue to be met in the future.

ATTACHMENT 5 – ARAR Table

MEDIUM/ AUTHORITY	Action-Specific ARAR ARARs Action Specific ARARs listed in the ROD include some requirements that are also listed as Contaminant-specific.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
All Pathways, Safety/OSHA	Occupational Safety and Health Standards (OSHA) 29 CFR 1910.120, 1910.1000 – 1910.1500	Applicable	Acceptable employee exposure levels including without limitation training, have been promulgated to control exposures and safety in workplace environments.	Compliance with OSHA standards is achieved through implementation of the EPA approved Health and Safety Plan (HASP) for the IMP. Continued implementation of the HASP is expected to achieve compliance in the future.
All Pathways, Safety/OSHA	Occupational Safety and Health Standards (OSHA) 29 CFR 1926.53, 1926.650 – 1926.653	Relevant and Appropriate	Acceptable general duty safety requirements have been promulgated to control personnel safety in workplace environments.	Compliance with OSHA standards is achieved through implementation of the EPA approved Health and Safety Plan (HASP) for the IMP. Continued implementation of the HASP is expected to achieve compliance in the future.
Air/CAA	National Emission Standards for Hazardous Air Pollutants (NESHAPS) 40 CFR Part 61, Subpart I	Applicable	This ARAR limits dose to the public via the air pathway to 10 mrem/yr. Monitoring during IRP RA demonstrated levels less than 10 percent of limit. Monitoring discontinued during IMP unless/until Commonwealth initiates solidification activities, then monitoring resumed.	Air releases during IMP are negligible. Should the Commonwealth perform solidification during the IMP, the affect of air dose will need to be considered. Air dose after final cap construction is expected to be negligible.
All Pathways/AEA	Kentucky Standards for Protection Against Radiation 902 KAR 100:020 Because Kentucky is an Agreement State, its radiation protection standards (902KAR 100:020) are the applicable standards.	Applicable	This ARAR establishes radiation protection standards for workers within a restricted area.	Compliance is achieved through implementation of the Radiation Protection Program as part of the site specific, EPA approved HASP. Continued implementation is expected to achieve compliance in the future.
All Pathways/AEA	10 CFR 20 Federal Standards for Protection Against Radiation (Allowable Doses in Restricted Areas).	Relevent and Appropriate	This ARAR establishes radiation protection standards for workers within a restricted area.	Compliance is achieved through implementation of the Radiation Protection Program as part of the site specific, EPA approved HASP. Continued implementation is expected to achieve compliance in the future.
All Pathways/AEA	General Kentucky Requirements Concerning Radiological Sources (ALARA) 902 KAR		This ARAR establishes the requirement	Compliance is achieved through

MEDIUM/ AUTHORITY	Action-Specific ARAR ARARs Action Specific ARARs listed in the ROD include some requirements that are also listed as Contaminant-specific.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
	100:015	Applicable	for a program to achieve radiation protection standards "as low as reasonably achievable" (ALARA).	implementation of the Radiation Protection Program as part of the site specific, EPA approved HASP. Continued implementation is expected to achieve compliance in the future.
Air/CAA	Kentucky Fugitive Air Emissions Standards 401 KAR 63:010	Applicable	This ARAR establishes air standards for fugitive emissions related to site activities.	The waste area is covered by a 45 mil reinforced polypropylene geomembrane, Commonwealth has paved the access road and the perimeter road has infrequent use. Monitoring of fugitive emissions will not be required until/unless there is major repair to IRP Cap, replacement of the geomembrane or construction of the final cap. The Commonwealth will comply if and when required.
Waste/AEA	Kentucky Standards for the Disposal of Radioactive Material 902 KAR 100:021, sections 7 and 8	Applicable	This ARAR establishes requirements for analysis and classification of waste for disposal.	The Commonwealth evaluates, analyzes and classifies all waste disposed on site. Records are maintained in accordance with the approved IMP work plan. Initiation of solidification will require a process control program, including sampling and testing of grout.
Waste/AEA	Kentucky Licensing Requirements for Land Disposal of Radioactive Waste 902 KAR 100:022 sections 14, 19, 21, 23, 24 (1) – (11), 25(3) and 27(2)	Relevant and Appropriate	This ARAR establishes standards for facility construction relative to land disposal of radioactive waste. Compliance was previously demonstrated. During the BoRP, the Commonwealth will perform post-closure surveillance of the site, which includes a monitoring system that provides early warning of the release of radionuclides before they reach the site boundary.	Compliance during the BoRP will be achieved through implementaion of the EPA approved IMP work plan. During the FCP and the ICP, the Commonwealth will be required to comply.

MEDIUM/ AUTHORITY	Action-Specific ARAR ARARs Action Specific ARARs listed in the ROD include some requirements that are also listed as Contaminant-specific.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
Waste/AEA	Federal Licensing Requirements for Land Disposal of Radioactive Waste 10 CFR 61.29, 61.42, 61.44, 61.51(a), 61.52(a)(1) – (11), 61.53 (d), 61.55, 61.56	Relevant and Appropriate	This ARAR establishes standards for facility construction relative to land disposal of radioactive waste. Compliance was previously demonstrated. During the BoRP, the Commonwealth will perform post-closure surveillance of the site, which includes a monitoring system that provides early warning of the release of radionuclides before they reach the site boundary.	Compliance during the BoRP will be achieved through implementaion of the EPA approved IMP work plan. During the FCP and the ICP, the Commonwealth will be required to comply.
Soil and Water/Kentucky Law	KRS 262, Kentucky Soil and Water Conservation Requirements	Relevant and Appropriate	Standards have been adopted to provide for conservation of Commonwealth of Kentucky soil and water. In general, implementation of a surface water and erosion control plan will achieve compliance.	The Commonwealth will be required to implement a surface water and erosion control plan if and when there is major repair to IRP Cap, replacement of the geomembrane or construction of the final cap.

MEDIUM/ AUTHORITY	Action-Specific ARAR ARARs Action Specific ARARs listed in the ROD include some requirements that are also listed as Contaminant-specific.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
Waste/RCRA	Kentucky Hazardous Waste Management Regulations 401 KAR Chapter 34 The following Kentucky Hazardous Waste Management Regulations are ARARs that must be met by the selected remedy:	Applicable	This ARAR establishes standards for ground water protection, including monitoring, detection and concentration limits.	A groundwater monitoring detection program, including data validation, data evaluation and corrective action requirements, was established in the EPA approved IMP PSVP. Based on current data, information provided by the Commonwealth and data collected during the RI/FS, constituents regulated pursuant to the hazardous waste management groundwater regulations are in compliance at the compliance locations and that exceedances of standards in the future are not expected.
	• **401 KAR 34:060 – Ground Water Protection,** - Sections 8 and 9, Monitoring and Detection - Sections 10 and 11, Standards for Compliance			
	• **401 KAR 34.070 (Sections 2, 5, 7, 8, and 10) – Closure and Post-Closure** - Section 2, Closure performance standards - Section 5, Disposal or decontamination of equipment, structures, and soils - Section 7, Plat survey to local zoning authority and the Commonwealth - Section 8, Post-closure care and use - Section 10, Notation of the deed to the property noting the previous management of hazardous wastes and the resulting land use restrictions.		This ARAR sets requirements for closure and post-closure care of facilities.	Interim closure requirements for the IRP RA were achieved pursuant to the EPA approved IRP RA Construction Report. IRP post-closure care is the responsibility of the Commonwealth in accordance with the EPA approved IMP work plan.
	• **401 KAR 34.190 – Tanks used for treatment and storage of hazardous waste**		ARAR establishes requirements for tanks, including secondary containment and off-gas controls.	Tanks used for the IRP RA met these requirements, including the LSF underground tank left for Commonwealth use during the BoRP. Tanks used by the Commonwealth during the BoRP will be subject to this ARAR, including the above ground storage facility and any tanks associated with future leachate pumping or the FCP/ICP.
	• **401 KAR 34.230 – Landfill Closure Standards** -Section 6, Closure and Postclosure Care. This ARAR applies to the Final Cap to be constructed by the Commonwealth		This ARAR establishes final closure and post-closure care requirements for caps, specifically applicable to the FCP and ICP	The Commonwealth will be required to comply with requirements during the FCP and ICP.

MEDIUM/ AUTHORITY	Action-Specific ARAR ARARs Action Specific ARARs listed in the ROD include some requirements that are also listed as Contaminant-specific.	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
Waste/RCRA	Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Standards 40 CFR Part 264, In Part.	Relevant and Appropriate	Same as 401 KAR Chapter 34 above.	Same as 401 KAR Chapter 34 above.
Waste/RCRA	Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Standards 40 CFR Chapter 268. The land disposal restrictions for leachate were waived for remedial action at the MFDS (ROD, Section 8.3).	Applicable	RCRA Hazardous Wastes not subject to the ARAR waiver and other wastes that cannot be disposed on-site (e.g. liquids such as oil, ethylene glycol) must be disposed off-site pursuant to 40 CFR 300.440.	The Commonwealth will comply with requirements through implementation of the approved IMP work plan.

NOTES:
1. Compliance with ARARs during the Balance of the Remedial Phase (BoRP) is the responsibility of the Commonwealth of Kentucky.
2. At Maxey Flats, the chosen remedy requires time to work. The remedial action construction will not be complete for up to 100 years, when the Commonwealth of Kentucky constructs the final closure cap. Therefore, the EPA has recognized in the PSVP that ARARs that are used to determine final remediation levels only apply at the completion of the action. See 55 CFR 8755. As a result, this Five Year Review Report will show compliance with contaminant specific ARARs either now or in the future.