STATEMENT OF BASIS

FORMER DRUM STORAGE AREA (SWMU 037)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
KENNEDY SPACE CENTER
BREVARD COUNTY, FLORIDA

PURPOSE OF STATEMENT OF BASIS

This Statement of Basis (SB) has been developed to inform and give the public an opportunity to comment on a proposed remedy to address contamination at the Former Drum Storage Area (FDSA)[1]. The Kennedy Space Center (KSC) Remediation Team consisting of National Aeronautics and Space Administration (NASA) and Florida Department of Environmental Protection (FDEP) has determined that the proposed remedy is cost-effective and protective of human health and the environment. However, prior to implementation of the proposed remedy, the KSC Remediation Team would like to give an opportunity for the public to comment on the proposed remedy. At any time during the public comment period, the public may comment as explained in the "How Do You Participate" section of this SB. After the end of the public comment period, the KSC Remediation Team will review all comments and issues raised in the comments and determine if there is a need to modify the proposed remedy prior to implementation.

WHY IS A REMEDY NEEDED?

The results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) indicated that several chlorinated volatile organic compounds (VOCs) listed in Table 1 are present in groundwater, which could be potentially harmful to human health if this water was used for human consumption now or in the future. In addition, the remedy includes prevention of potential discharge of contaminated groundwater to adjacent Outstanding Florida Waters (OFW).

HOW DO YOU PARTICIPATE?

The KSC Remediation Team solicits public review and comment on this SB before implementing the proposed remedy. The remedy for the FDSA will eventually be incorporated into the Hazardous and Solid Waste Amendments (HSWA) Permit for Kennedy Space Center (KSC).

The Cleanup Remedy

The proposed cleanup remedy for FDSA groundwater includes the following components:

- Placement of a biotreatment barrier to prevent impacts to OFW.
- In-situ bioremediation of groundwater in the Hot Spot and plumes.
- Implementation of institutional controls to prohibit human exposure to groundwater and discharge to OFW until cleanup goals are attained.
- Groundwater monitoring to assess trends, treatment progress, and evaluate potential contaminant migration until cleanup goals are attained.

The public comment period for this SB and proposed remedy will begin on the date of publication for notice of availability of the SB in major local newspapers of general circulation and end 45 days thereafter. If

[1] *In accordance with RCRA §7004(b), this Statement of Basis summarizes the proposed corrective action for the NASA FDSA. For detailed information on the site, consult the FDSA RFI Report, which is available for review by contacting the KSC Environmental Assurance Branch at telephone (321) 867-8402.*

requested during the comment period, the KSC Remediation Team will hold a public meeting to respond to any oral comments or questions regarding the proposed remedy. To request a hearing or provide comments, contact the following person in writing within the 45-day comment period:

Mr. John R. Armstrong, P.G.
FDEP - Bureau of Waste Cleanup
Federal Facilities Section
Bob Martinez Center
2600 Blair Stone Road, MS 4535
Tallahassee, FL 32399-2400
Telephone: (850) 245-8981

The HSWA Permit, SB, and associated administrative file, including the RFI Report and Corrective Measures Study (CMS), can be requested by contacting one of the following people:

Ms. Rosaly Santos-Ebaugh
Remediation Program Manager
Environmental Assurance Branch
Mail Code: TA-B1B
Building M6-399, Room 1641A
Kennedy Space Center, FL 32899
E-mail: Rosaly.J.SantosEbaugh@nasa.gov
Telephone: (321) 867-8402

Mr. John R. Armstrong, P.G.
FDEP - Bureau of Waste Cleanup
Federal Facilities Section
Bob Martinez Center
2600 Blair Stone Road, MS 4535
Tallahassee, FL 32399-2400
E-mail: John.Armstrong@dep.state.fl.us
Telephone: (850) 245-8981
Fax: (850) 245-8976.

FACILITY DESCRIPTION

NASA established the KSC as the primary launch site for the space program. These operations have involved the use of toxic and hazardous materials. Under the RCRA and applicable HSWA permit (Permit No. 0026028-HO-003) issued by the FDEP and/or the Environmental Protection Agency (EPA), KSC was required to perform an investigation to determine the nature and extent of contamination from Solid Waste Management Unit (SWMU) 037, the FDSA.

SITE DESCRIPTION AND HISTORY

FDSA includes approximately 6 acres located on the northeastern portion of the turnaround loop of Fluid Servicing Road and consists of the Building J7-2112A area (Figures 1 and 2). From 1988 through 1994, approximately 100 drums were stored at FDSA, and three tankers with unknown contents were parked in the southern retention area. The drums were stored primarily on a concrete pad in the northern portion of the site but also at multiple locations across the site. The contents of the drums were reported as asbestos materials, solidified paint and debris, adhesives, petroleum-contaminated soils and absorbents, aerosol cans, photo developer solutions, wastewater, latex paints, hydrazine-contaminated materials (hoses) contained in dilute citric acid solutions, nitrogen tetroxide-contaminated materials contained in dilute ammonium hydroxide solution, glycol-based coolants, polyol resin foam components, polymeric isocyanates foam components, polychlorinated biphenyl (PCB) and non-PCB lighting ballasts, and fluorinated oils.

Previous investigations at FDSA include the following:

- 2004: SWMU Assessment (SA) activities were conducted to identify potential locations and contaminants of concern. Four LOCs were identified, and confirmatory sampling was recommended at each LOC.

- 2005: RCRA confirmation sampling was conducted to evaluate impacts to soil and groundwater. Soil and groundwater samples were collected at the four LOCs, and VOCs were identified in groundwater in excess of regulatory criteria. An ecological risk assessment did not identify any ecological contaminants of potential concern (COPCs); therefore, SWMU 037 ecological risks were not further evaluated. Based on confirmation sampling results, the Confirmatory Sampling Report (CSR) recommended No Further Action (NFA) for soil at LOCs 1 through 4, NFA for groundwater at LOCs 2, 3, and 4, and an RFI for groundwater at LOC 1 referred to as FDSA.

- 2006: A RCRA Facility Investigation (RFI) was conducted in three phases to delineate the nature and extent of FDSA groundwater contamination. Permanent and temporary well groundwater samples were collected and analyzed. Results of these analyses were used to update the Preliminary Risk Evaluation (PRE) performed as part of the CSR to evaluate potential risks to human health. Updated PRE results indicated that groundwater containing VOCs would result in unacceptable human health risks if the groundwater was used as a source of drinking water.

- 2007/2008: Post-RFI activities included soil sampling for lithologic information, slug testing for hydraulic characterization, surface water sampling to verify the lack of impacts to OFW, and additional delineation of groundwater contamination.

Based on the results of the above-described site investigations, three co-mingled chlorinated VOC plumes have been delineated at FDSA, two if which have “hot spots”. These two hot spots are defined as areas of the contaminant plumes where concentrations of one or more COCs exceed FDEP Natural Attenuation Default Concentrations (NADCs).

SUMMARY OF SITE RISK

As part of the RFI activities, a Preliminary Risk Evaluation (PRE) was completed in accordance with KSC's Remediation Team Risk Assessment Decision Process Document (DPD).

Chemicals of Concern (COCs) identified for human health during the RFI included chlorinated VOCs in groundwater. For a complete list of COCs in groundwater, see Table 1. No cancer risks or non-cancer hazards were estimated for current receptors to groundwater because of the lack of exposure pathways for any current use at the site. The PRE showed that assuming future use of groundwater for drinking water, cancer and non-cancer risks would be unacceptable. The estimated excess lifetime cancer risk for the hypothetical future resident was determined to be 6×10^{-5}, which exceeds FDEP’s acceptable risk goal of 6×10^{-6}. The main contaminant contributing to this cancer risk was vinyl chloride. The non-cancer hazard index (HI) for the future hypothetical resident was estimated to be 521, which is greater than FDEP’s acceptable threshold of 1.0. The main contaminant contributing to the HI was cis-1,2-dichloroethene (279).

Based on the ecological risk assessment conducted as part of the CSR, no ecological COPCs were identified for LOCs 1, 2, 3, or 4 and therefore no ecological risks are associated with soil and groundwater at SWMU 037.

WHAT ARE THE REMEDY OBJECTIVES AND LEVELS?

The corrective action objectives (CAOs) for FDSA groundwater are as follows:

- To prevent human exposure to groundwater with concentrations of COCs greater than FDEP GCTLs;
- To prevent discharge of FDSA groundwater to neighboring surface water bodies that have been designated OFW (i.e., Cochran Cove and Banana Creek); and
- To restore FDSA groundwater quality by reducing COC concentrations to GCTLs.

Table 1 lists the COCs present in groundwater at FDSA. The first column lists the chemical name, the second column lists the range of concentrations in groundwater detected at FDSA during the RFI, and the last column presents the FDEP cleanup target level to be achieved at the site.

Table 1

Site-Related Chemical of Concern (COCs)	Range of Detections[1] (mg/L)	Site-Specific Cleanup Level[2] (mg/L)
1,1-Dichloroethene	44.5	7
cis-1,2-Dichloroethene	0.52 – 19,500	70
trans-1,2-Dichloroethene	0.57 – 805	100
Methylene chloride	13.7 - 185	5
Tetrachloroethene	306	3
Trichloroethene	8.1 – 3,940	3
Vinyl chloride	0.58 – 2,900	1

[1] Detections in permanent monitoring wells during the RFI
[2] Cleanup levels are GCTLs from Florida Administrative Code 62-777

REMEDIAL ALTERNATIVES FOR FDSA

Remedial alternatives are different combinations of plans or technologies to restrict access to and/or to contain and/or treat contamination to protect human health and the environment. Several potentially applicable corrective measures for FDSA groundwater were identified and screened in the CMS. Detailed information was presented in the CMS concerning each of the following potentially applicable corrective measures for contaminated groundwater at FDSA:

- **Alternative 1**: Air Sparging Wall, Natural Attenuation, Institutional Controls, and Monitoring;
- **Alternative 2**: Groundwater Extraction, On-Site Treatment (air stripping), Discharge to an Infiltration Gallery, Natural Attenuation, Institutional Controls, and Monitoring;
- **Alternative 3A**: Air Sparging Wall, Hot Spot In-Situ Enhanced Bioremediation, Natural Attenuation, Institutional Controls, and Monitoring;
- **Alternative 3B**: Air Sparging Wall, Hot Spot In-Situ Chemical Oxidation, Natural Attenuation, Institutional Controls, and Monitoring;
- **Alternative 3C**: Air Sparging Wall, Hot Spot In-Situ Chemical Reduction and Stabilization (Zero-Valent Iron [ZVI]-clay), Natural Attenuation, Institutional Controls, and Monitoring;
- **Alternative 4**: Groundwater Extraction, On-Site Treatment (air stripping), In-Situ Enhanced Bioremediation, Reinjection, Natural Attenuation, Institutional Controls, and Monitoring;
- **Alternative 5A**: Air Sparging Wall, Hot Spot and Plume In-Situ Enhanced Bioremediation, Institutional Controls, and Monitoring;

- **Alternative 5B**: Air Sparging Wall, Hot Spot In-Situ Chemical Oxidation, Plume In-Situ Enhanced Bioremediation, Institutional Controls, and Monitoring;
- **Alternative 5C**: Air Sparging Wall, Hot Spot In-Situ Chemical Reduction and Stabilization (ZVI-clay), Plume In-Situ Enhanced Bioremediation, Institutional Controls, and Monitoring; and
- **Alternative 5D**: Biotreatment Barrier, Hot Spot and Plume In-Situ Enhanced Bioremediation, Institutional Controls, and Monitoring.

EVALUATION OF REMEDIES

The remedial alternatives were evaluated during the CMS to determine if they comply with EPA's four threshold criteria and five balancing criteria for corrective measures.

The four threshold criteria for the corrective measures are:

- Overall protection of human health and the environment;
- Attainment of media cleanup standards;
- Control of the sources of releases; and
- Compliance with standards for management of wastes.

The following are the five balancing criteria considered for the corrective measures:

- Long-term reliability and effectiveness;
- Short-term effectiveness;
- Reduction in the toxicity, mobility, and volume of wastes;
- Implementability; and
- Cost.

Based on the detailed evaluation in the CMS Report, Alternative 5D, Biotreatment Barrier, Hot Spot and Plume In-Situ Enhanced Bioremediation, Institutional Controls, and Monitoring, meets each of the threshold criteria and was determined by the KSC Remediation Team to be the best overall approach for FDSA groundwater considering the balancing criteria.

FINAL CORRECTIVE MEASURE

The final corrective measure for FDSA groundwater includes a biotreatment barrier to prevent migration of groundwater contamination to adjacent surface water bodies classified as OFW, enhanced bioremediation to treat the three plumes and two hot spots, institutional controls to prevent groundwater use until cleanup goals are attained, and monitoring to evaluate treatment progress and verify that contaminant migration is not occurring. Figure 3 shows the approximate locations of the biotreatment barrier and enhanced bioremediation areas.

The major components of the corrective measure are summarized below.

A **biotreatment barrier** will involve injection of amendments (electron donor compound and specialized bacterial culture) to enhance naturally occurring biological breakdown of COCs to create a strategically located and particularly dense in-situ bioremediation zone to prevent impact from FDSA groundwater contamination to nearby OFW. Injection locations, quantities, and frequency will be determined based on the results of a pilot study.

In-situ enhanced bioremediation will also involve injection of amendments, similar to the biobarrier, to enhance naturally occurring biological breakdown of COCs in the hot

spots and plumes. Injection locations, quantities, and frequency will be determined based on the results of a pilot study.

Groundwater monitoring will consist of regularly collecting and analyzing samples from select wells at an agreed upon frequency. Monitoring will continue until decreases in contaminant concentrations have been documented and MCSs have been attained. Monitoring will confirm that the biotreatment barrier is preventing discharge of contaminated water to OFW, evaluate the effectiveness of enhanced bioremediation treatment, and verify that no contaminant concentrations greater than GCTLs are migrating beyond the boundaries of the LOC.

Institutional controls will consist of administrative controls that will restrict access to and use of groundwater until MCSs have been attained. Institutional controls will prohibit use of groundwater as a drinking water source and will prevent exposure of hypothetical future residents to contaminated groundwater. NASA, EPA and FDEP have entered into a Memorandum of Agreement (MOA), which outlines how institutional controls will be managed at NASA[2]. The MOA requires periodic inspections, condition certification, and agency notification. The area of the site that will be under institutional control is shown on Figure 4.

WHY DOES THE KSC REMEDIATION TEAM RECOMMEND THIS REMEDY?

The KSC Remediation Team recommends the proposed remedy because it is a cost-effective means to remediate/control the contaminated groundwater in a reasonable amount of time.

The institutional controls will prevent exposure to contaminants prior to the cleanup levels being achieved. The proposed remedy meets the four threshold criteria for corrective measures, and after considering the five balancing criteria, were determined to be the best overall approaches to remediate the groundwater at FDSA.

NEXT STEPS

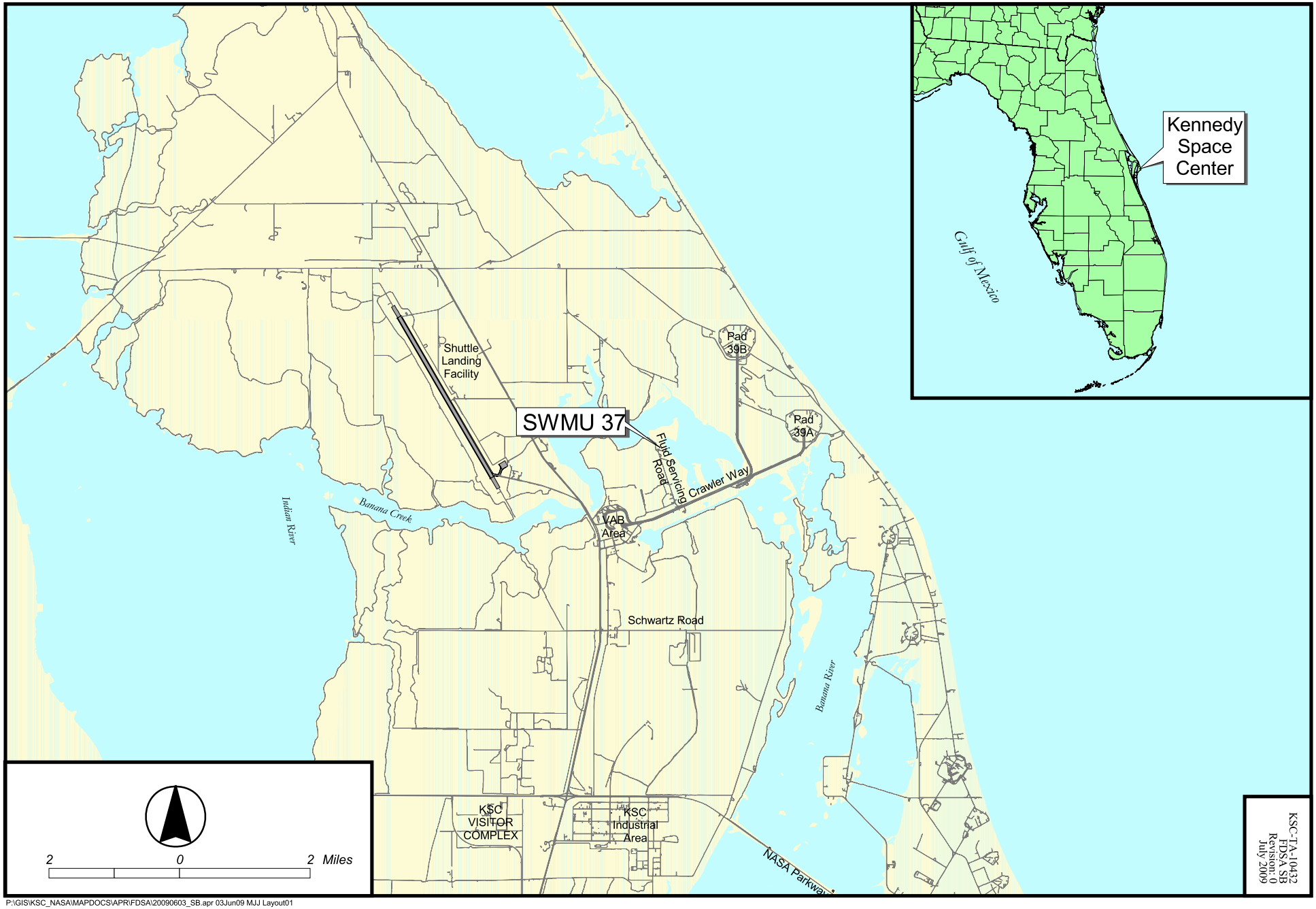
The KSC Remediation Team will review all comments on this SB to determine if the selected corrective measure needs modification prior to implementation and prior to incorporating the corrective measure into KSC's HSWA permit. If the corrective measure is determined to be appropriate for implementation, then the biotreatment barrier and enhanced bioremediation components will be implemented, a monitoring program will be initiated, and a Land Use Control Implementation Plan will be developed to incorporate the institutional controls at this site.

[2] *By separate MOA effective February 23, 2001, with the EPA and FDEP, KSC, on behalf of NASA, agreed to implement Center-wide, certain periodic site inspections, condition certification, and agency notification procedures designed to ensure the maintenance by Center personnel of any site-specific LUCs deemed necessary for future protection of human health and the environment. A fundamental premise underlying execution of that agreement was that through the Center's substantial good faith compliance with the procedures called for herein, reasonable assurances would be provided to EPA and FDEP as to the permanency of those remedies which included the use of specific LUCs.*

Although the terms and conditions of the MOA are not specifically incorporated or made enforceable herein by reference, it is understood and agreed by NASA KSC, EPA and FDEP that the contemplated permanence of the remedy reflected herein shall be dependent upon the Center's substantial good faith compliance with the specific LUC maintenance commitments reflected herein. Should such compliance not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy concurred in may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

FIGURE 1 LOCATION OF KENNEDY SPACE CENTER AND SWMU 37

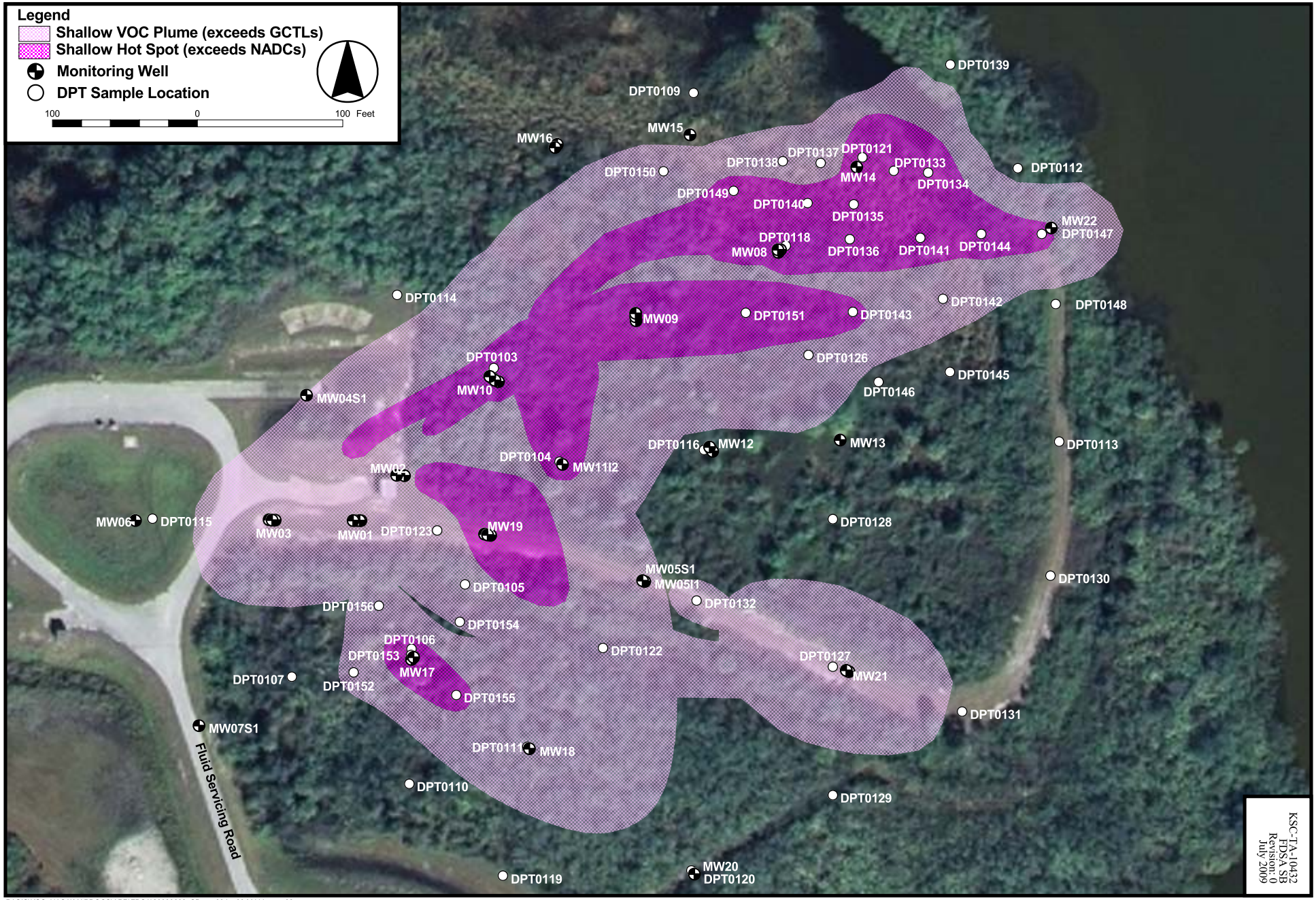
SWMU 37 - FORMER DRUM STORAGE AREA, KENNEDY SPACE CENTER, FLORIDA



P:\GIS\KSC_NASA\MAPDOCS\APR\FDSA\20090603_SB.apr 03Jun09 MJJ Layout01

FIGURE 2 RFI AND POST-RFI GROUNDWATER SAMPLING LOCATIONS

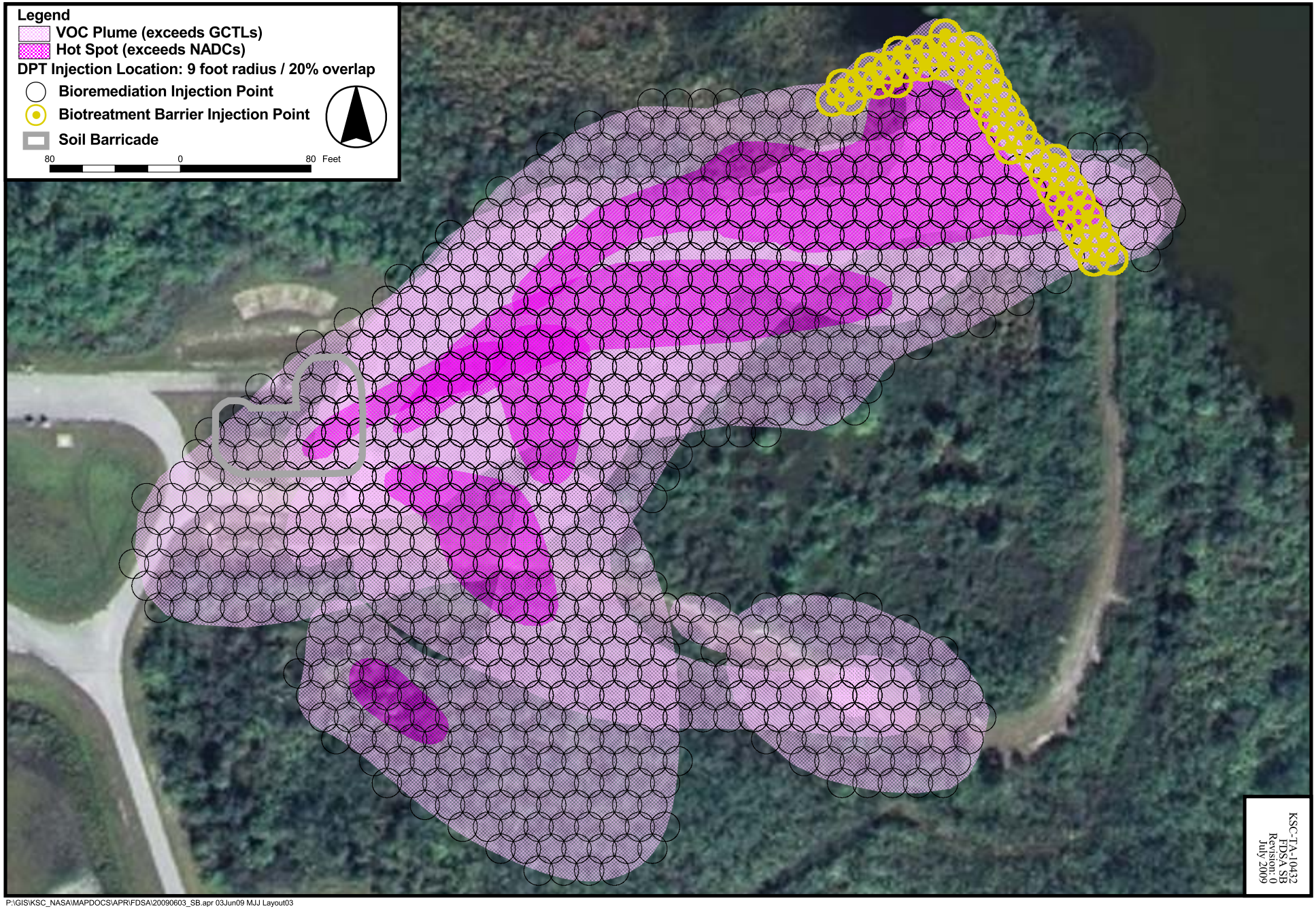
SWMU 37, KENNEDY SPACE CENTER, FLORIDA



KSC-TA-10432
FDSA SB
Revision: 0
July 2009

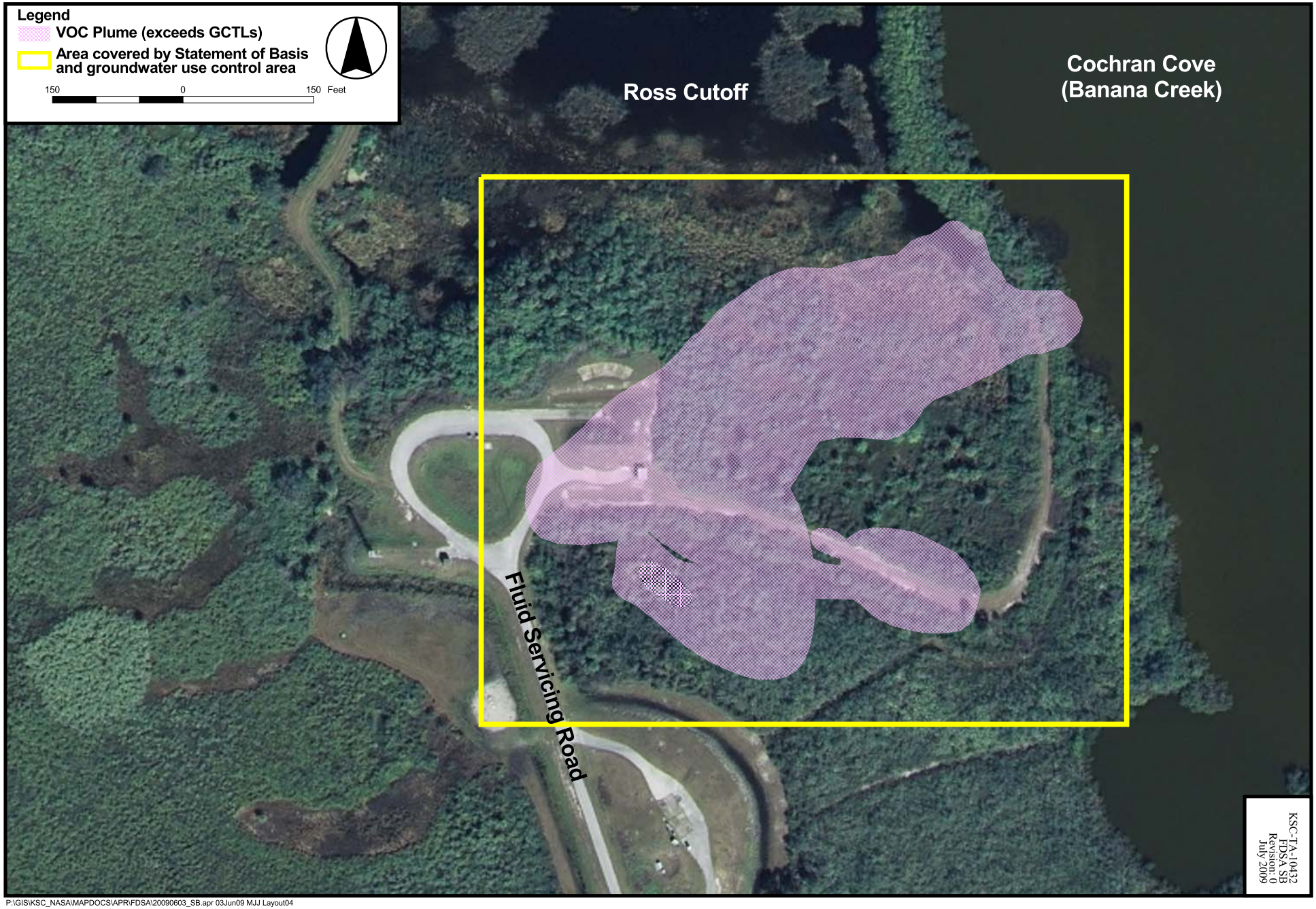
P:\GIS\KSC_NASA\MAPDOCS\APR\FDSA\20090603_SB.apr 03Jun09 MJJ Layout02

FIGURE 3 ALTERNATIVE 5D, ENHANCED BIOREMEDIATION CONCEPTUAL DESIGN
SWMU 37 - FORMER DRUM STORAGE AREA, KENNEDY SPACE CENTER, FLORIDA



P:\GIS\KSC_NASA\MAPDOCS\APR\FDSA\20090603_SB.apr 03Jun09 MJJ Layout03

FIGURE 4 AREA IMPACTED BY GROUNDWAER CONTAMINATION
SWMU 37 - FORMER DRUM STORAGE AREA, KENNEDY SPACE CENTER, FLORIDA



P:\GIS\KSC_NASA\MAPDOCS\APR\FDSA\20090603_SB.apr 03Jun09 MJJ Layout04