STATEMENT OF BASIS

LAUNCH COMPLEX 39B SWMU 9 (GROUP B)
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 the proposed remedy to address contamination at the Launch Complex 39B (LC39B) Facility[1]. A Kennedy Space Center (KSC) Remediation Team consisting of National Aeronautics and Space Administration (NASA) and Florida Department of Environmental Protection (FDEP) personnel 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 organics (CVOCs) primarily (trichloroethene, cis-1,2-dichloroethene, and vinyl chloride) are present in groundwater downgradient of the liquid oxygen (LOX) tank discharge pipes and the Environmental Control System (ECS) area which could be potentially harmful to human health if this water is used for human consumption now or in the future. Additionally, metals (aluminum, arsenic, barium, lead, mercury, and thallium) are also present in groundwater at the site. Table 1 provides the constituents of concern (COC) present in groundwater. Groundwater underlying LC39B has been characterized as GIII (non-potable) for remediation purposes; however, the primary concern has been the potential for migration of groundwater to adjacent surface-water bodies that are considered to be outstanding Florida waters (OFW). As such, a non-degradation policy is in effect for these surface waters.

An Interim Measure (IM) was performed between 3 December 2003 and 6 January 2004 to remove soil containing polychlorinated biphenyls (PCBs) at concentrations above the industrial soil cleanup target level (SCTL) from the ECS and Deluge Basin Area (DBA). Based on the successful completion of the IM no

[1] *In accordance with RCRA §7004(b), this Statement of Basis summarizes the proposed remedy for the NASA LC39B Facility. For detailed information on the site, consult the LC39B CMS Report, which is available for review at the information repository located at the North Brevard Library, 2121 South Hopkins Avenue, Titusville, FL 32780, telephone: (321) 264-5026.*

unacceptable risks exist for site workers. The IM Report dated February 2004 was approved by the FDEP on 25 May 2004. Since the site is and will remain an active launch pad, evaluation of potential ecological impacts from soils inside the fenceline is not applicable. Soil remaining on site contains concentrations of benzo(a)pyrene, PCBs, arsenic, and nickel at concentrations above the residential SCTLs; therefore, a land use control plan (LUCIP) was recommended for site soil. In addition swale soil contains zinc at concentrations above the residential SCTL as discussed in the Corrective Measures Study (CMS) Report.[1] The site presently has restricted access due to the nature of operations. A LUCIP will be developed to address potential risks associated with the residential land-use scenario.

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 LC39B Facility will eventually be incorporated into the Hazardous and Solid Waste Amendments (HSWA) Permit for KSC. 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 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:

The Cleanup Remedy

The proposed cleanup remedy for the LC39B Facility includes the following components:

- Bioaugmentation of the high TCE concentration plume area with downgradient extraction and Monitored Natural Attenuation (MNA).
- MNA for the low concentration plume (TCE <300 and > 3 µg/L, VC <100 and > 2.4 µg/L) and for metals present in groundwater.
- A combination of best management practices and installation of strategically located sediment traps to control potential offsite discharges from swale/ditch sediments into adjacent wetland areas.
- Monitoring of groundwater to document water quality and contaminant levels.
- Implementation of institutional controls to prohibit residential exposure to site surface and swale soils.

Mr. John R. Armstrong, P.G.
FDEP - Bureau of Waste Cleanup
2600 Blair Stone Road, MS 4535
Tallahassee, FL 32399-2400

The HSWA Permit, SB, and associated administrative file, including the CMS Report, will be available to the public for viewing and copying at:

NASA Document Library
North Brevard Library
2121 South Hopkins Avenue
Titusville, FL 32780
Telephone: (321) 264-5026

To request further information, you may contact one of the following people:

Mr. Harold Williams
Remediation Program Manager
Environmental Program Office
Mail Code: TA-C3
Kennedy Space Center, FL 32899
E-mail: Harold.G.Williams@nasa.gov
Telephone: (321) 867-8411

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

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. FL6800014585) issued by the FDEP, KSC was required to perform an investigation to determine the nature and extent of contamination from Solid Waste Management Unit (SWMU) No. 9, the LC39B Facility.

SITE DESCRIPTION AND HISTORY

LC39B is the northernmost of the two NASA operated space shuttle launch sites. It is situated along the eastern boundary of KSC, encompassing approximately 170 acres (Figure 1). The area where LC39B resides was undeveloped prior to the mid-1960s when construction for the Apollo Space Program commenced. The pad structure was retrofitted to support Space Transportation System (STS) operations in 1975. The facility is registered as a National Historic Site located within Brevard County. Investigations conducted at the site included:

- 1998 - 1999: RFI activities focused on identifying potential contamination in site media. Samples of soil/sediment, surface water, and groundwater were collected and analyzed to evaluate potential risks to human health and ecological receptors. RFI results indicated that (i) metals, PCBs, and polynuclear aromatic hydrocarbons (PAHs) were present in soil; and (ii) CVOCs, pentachlorophenol, and metals were present in groundwater.

- 2000 - 2003: On 7 August 2000, the FDEP Division of Waste Management concurred with the Division of Water Resources that for remediation purposes, the groundwater at LC39B should be considered as Class GIII (non-potable) not GII (potentially potable). Additional RFI activities included sampling and analysis of soil and groundwater to confirm presence or absence of dense non-aqueous phase liquids (DNAPLs), installation of wells downgradient of the site to evaluate potential discharges to nearby surface water bodies, collection of collocated sediment and surface water to evaluate the presence of inorganic constituents outside the pad fenceline, and performing specific capacity tests to evaluate hydraulic properties of zones for use in chlorinated solvent modeling. Additional RFI results indicated that DNAPL is not present, collocated sediment and surface water samples indicated that the areal extent of inorganic constituents exceeding applicable screening criteria outside the pad fenceline is limited. Trichloroethene (TCE) exceeded the Surface Water Cleanup Target Level (SWCTL) of 80.7 micrograms per liter (μg/L) in LOX Tank area and ECS wells. Inorganic constituents exceeded the SWCTLs and/or KSC background values throughout site monitoring wells. These results were documented in the RFI Report Addendum.

- 2003 – 2004: An IM to remove soil impacted with PCBs at concentrations above the industrial SCTL from the ECS and DBA was performed by NASA between 3 December 2003 and 6 January 2004. Additional corrective measure objectives for soil will not be developed; however, a land use control plan was recommended in the RFI to prevent future residential site use.

- 2004: Post RFI/Pre- CMS activities were performed to evaluate: (i) potential sources of CVOCs and DNAPL downgradient of the LOX Tank discharge pipes; (ii) the persistence of pentachlorophenol in groundwater at the Hypergol Fuel Facility (HFF) Area; and (iii) the persistence of metals in groundwater throughout the site. Pentachlorophenol was not detected (all below 1 µg/L) in any of the groundwater samples collected from the HFF Area during the 2004 sampling activities. Groundwater results (direct push technology [DPT] and monitoring wells) indicated that the high concentration plume, consisting of TCE concentrations between 300 µg/L and 4,830 µg/L, is located in the vicinity of the LOX Tank discharge pipes adjacent to the swale that leads to an OFW. In addition, metals (aluminum, arsenic, barium, iron, lead, mercury, and thallium) are present in groundwater at concentrations above SWCTLs in site monitoring wells. Based on these results groundwater at the site must be treated to prevent surface-water impacts due to the migration of contaminated groundwater.

SUMMARY OF SITE RISK

As part of the RFI activities, risk assessments were completed in accordance with KSC's Remediation Team Risk Assessment Decision Process Document (DPD). The Ecological Risk Assessment (ERA) was performed in accordance with the eight-step process described in the EPA's *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, dated 1997.

COCs identified for human health during the RFI included CVOCs and metals in groundwater. Table 1 lists the COCs present in surface water and groundwater at the site. Groundwater underlying LC39B has been characterized as GIII (non-potable) for remediation purposes; however, the primary concern has been the potential for migration of groundwater to adjacent surface-water bodies that are identified as OFW. As such, a non-degradation policy is in effect for these surface waters. The corrective action objective for groundwater is to prevent surface-water impacts due to the migration of contaminated groundwater, either through the demonstration of natural attenuation and/or groundwater treatment.

Based upon the findings of the LC39B RFI Human Health Risk Assessment (HHRA) no further action, other than performing the IM was recommended for site soil to mitigate the risks to site workers. Unacceptable risks to potential residential receptors were identified; therefore, a LUCIP was recommended to prohibit future residential use of the site.

Table 1
Groundwater Cleanup Levels

Site-Related Chemicals of Concern	Maximum Detections Surface Water/ Groundwater [1] (µg/L)	Site-Specific Cleanup Level [2] (µg/L)
TCE	1.9/4,100	80.7/<PQL
tDCE	<2/60.7	11,000/<PQL
cDCE	2.7/1,540	700/<PQL
DCE (total)	2.7/1,600	7,000/<PQL
VC	1.5/4,700	2.4 [3]/<PQL
Aluminum [a]	140/47.8	280 [4]
Arsenic [a]	4.4/6.1	28 [4]
Barium [c]	110/290	410 [4]
Iron [a]	9,700/22,600	10,000 [4]
Lead [d]	19/13	13 [4]
Mercury [a]	0.09/25	ND
Thallium [b]	42/79	2 [4]

[1] Detections in surface water/groundwater monitoring well
[2] The site-specific cleanup goal is to ultimately have contaminant concentrations below their FDEP SWCTLs for wells internal to the plume and below their PQLs in the well closest to the surface water body. Cleanup levels are SWCTLs from Florida Administrative Code 62-777.
[3] FDEP proposed value (July 2004).
[4] Upper range of the KSC Background value.
PQL = Practical Quantitation Limit
ND = Not detected
a = ecologically based SWCTL
b = human health based SWCTL
c = less than two times KSC background
d = ecologically based, calculated using hardness of 400 ppm

The Ecological Risk Assessment performed for swale soil indicated that metals, predominantly zinc, is widely distributed in swales and ditches within the pad fenceline at concentrations that may pose excess risk for the red-winged blackbird and the little blue heron. The corrective action objective for LC39B is to prevent off-site migration of metals into adjacent wetlands and surface water areas. Options for controlling the potential off-site migration of these contaminants are presented in the CMS Report (see Footnote 1). Table 2 lists the COCs identified in swale soil at the site.

WHAT ARE THE REMEDY OBJECTIVES AND LEVELS?

The remedial action objective (RAO) is to: (i) prevent surface-water impacts due to the migration of contaminated groundwater, either through the demonstration of natural attenuation or groundwater treatment; and (ii) to prepare a strategy for preventing the off-site migration of zinc in swale soils. Table 1 lists the COCs present in surface water and groundwater at the LC39B Facility. The first column lists the chemical name, the second column lists the maximum concentration detected in surface water and groundwater at the site, and the last column presents the site specific cleanup level to be achieved at the site. Table 2 lists the COCs present in swale soil at the LC39B Facility.

Table 2
Swale Soil Cleanup Levels

Site-Related Chemicals of Concern	Range of Detections (mg/kg)	Ecological Screening Value (mg/kg)	KSC Background Value (mg/kg)
Zinc	4.1 - 3030	124	14.5

REMEDIAL ALTERNATIVES FOR THE LC39B FACILITY

The RFI performed at the site identified that the contaminated groundwater at LC39B could potentially discharge to adjacent OFW. The portion of the groundwater plume consisting of TCE concentrations above 300 µg/L (the MNA default value) is

located in the vicinity of the LOX Tank discharge pipes adjacent to the swale that leads to an OFW and covers an area of approximately 46,000 square feet. The primary remedial objective for this site is to achieve SWCTLs, with the exception of monitoring wells installed immediately adjacent to the OFW, in which case the objective will be to achieve the practical quantitation limit (PQL) as presented in Table 1. The dissolved CVOC plume present in the vicinity of the ECS consists primarily of VC at concentrations ranging from 1.5 µg/L to 3,710 µg/L and covers an area of approximately 150,000 square feet at depths from 25 to 60 feet below land surface. The primary remedial objective in this area will be to meet the FDEP MNA default values. A number of remedial alternatives were evaluated during the CMS [1]. The alternatives evaluated for CVOC plume and the metals present in groundwater included:

- monitored natural attenuation (MNA);
- soil mixing/steam injection;
- air sparging; groundwater extraction and treatment;
- passive bioaugmentation injection with downgradient extraction;
- bioaugmentation recirculation system;
- enhanced bioremediation;
- excavation;
- emulsified zero valent iron;
- zero valent iron permeable reactive barrier; and
- in-situ chemical oxidation.

In addition to remedial measures, institutional controls will be implemented for site soil and swale soil. The institutional controls will maintain the site use to prevent future residential use of the site. A combination of best management practices and engineering controls will be used to prevent potential off-site migration of contaminants present in swale soil within the pad fenceline. 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 areas of the site that will be under institutional control are shown on Figure 2.

EVALUATION OF REMEDIES

The selected remedies were evaluated to determine if they will comply with EPA's four threshold criteria for corrective measures. The four threshold criteria for corrective measures are:

- overall protection of human health and the environment;
- attain media cleanup standards;
- control the sources of releases; and
- comply with standards for management of wastes.

[2] *By separate MOA effective February 23, 2001, with the EPA and FDEP, KSC, on behalf of NASA, agreed to implement Centerwide, 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.

The five balancing criteria are:

- long term reliability and effectiveness;
- reduction in the toxicity, mobility, or volume of wastes;
- short term effectiveness;
- implementability; and
- cost.

Based upon the detailed evaluation performed for the CMS Report, passive bioaugmentation with downgradient groundwater extraction of the high concentration plume area coupled with MNA of the more dilute plume, meet each of the threshold criteria and was determined by the KSC Remediation Team to be the best overall remedial approach.

FINAL REMEDY

The final corrective measure for groundwater is passive bioaugmentation injection with downgradient extraction and MNA for the LOX Tank Area plume. MNA was also selected as the presumptive remedy for metals in groundwater and areas where TCE concentrations are less than 300 µg/L and VC is less 100 µg/L. Figure 3 shows the approximate location of the proposed active remediation area.

Passive Bioaugmentation with Downgradient Extraction: Passive bioaugmentation with downgradient extraction involves the direct injection of nutrients followed by microbial cultures (such as KB-1™) into a network of injection wells installed throughout the targeted treatment zone. Groundwater will be extracted from the toe of the plume adjacent to the OFW to mitigate the release of CVOCs to the OFW. Extracted groundwater will be pumped directly to injection wells to assist with the movement of the nutrients and microbial cultures in the subsurface (creating a closed loop circulation system). Based upon the low anticipated pumping rate and power requirements necessary to operate the extraction system, a solar array may be used to power the equipment, eliminating the need to obtain dedicated electrical service from LC39B. Passive bioaugmentation with downgradient extraction offers the advantages of (i) providing direct in-situ treatment, (ii) providing source control via downgradient capture, and (iii) requiring minimal electrical power (which may be provided by a solar array) and mechanical equipment.

Monitored Natural Attenuation: MNA which will be used for the dilute plume area entails the use of natural processes (chemical, physical, and biological) to reduce CVOC concentrations. Chemical MNA processes include volatilization, sorption, and hydrolysis. Physical MNA processes include dilution due to infiltration, advection, and dispersion. Biological MNA processes include biological consumption due to electron acceptor reactions (reductive dehalogenation), electron donor reactions, and cometabolism. All of these processes combine to reduce CVOC concentrations over time.

Engineering Controls and Best Management Practices: To control potential migration of metals present in swale soil to the OFW a combination of best management practices and installation of strategically located engineering controls will be performed at the site. Engineering controls are physical measures used to minimize the potential for impacted

sediment transport from the swales to off-site locations (e.g. discharge to OFW outside the LC39B perimeter fence). To reduce swale/ditch sediment discharge to surface waters from the LC39B ditch/swale system an engineering control is required to reduce bed load transport and provides a mechanism for the settling of suspended load. At LC39B, sediment traps are proposed near the outfall of select swale/ditch systems. The purpose of the sediment traps will be to collect sediment transported as bed load in addition to reducing the transport velocity, thereby providing a mechanism for the suspended load to settle.

Institutional Controls: In addition to active remediation, institutional controls will be implemented for site soil and swale soil. The institutional controls coupled with the LUCIP will prohibit residential exposure to site soil and swale soil.

WHAT IMPACTS WOULD THE REMEDY HAVE ON THE LOCAL COMMUNITY?

There would be no impacts to the local community because groundwater is not used for potable water at KSC. The proposed remedy includes administrative actions to prevent the residential exposure to site soils. Long term groundwater monitoring will be used to evaluate and document reduction in contamination concentrations to the cleanup target levels.
The institutional controls will also prevent exposure to contaminants prior to the cleanup levels being achieved. The proposed remedy meets the four threshold standards and five balancing criteria for corrective measures and was determined to be the best overall approach by the KSC Remediation Team.

WHY DOES THE KSC REMEDIATION TEAM RECOMMEND THIS REMEDY?

The team recommends the proposed remedy because treatment takes place in-situ, thus reducing the potential exposure to COCs. Passive bioaugmentation with downgradient extraction is primarily in-situ, thus limiting exposure to contaminants and does not require extensive infrastructure while promoting reduction in CVOC concentrations, thus controlling sources of releases; bioaugmentation will help control the dissolved COC flux and reduce the toxicity of COCs, thus reducing human health risks arising from the potential exposure to COCs. MNA will be used to evaluate and document reduction in contaminant concentrations to the cleanup target levels. The institutional controls will also prevent exposure to contaminants prior to the cleanup levels being achieved. The proposed remedy meets the four threshold criteria and addresses the five balancing criteria for corrective measures and was determined to be the best overall approach.

NEXT STEPS

The KSC Remediation Team will review all comments on this SB to determine if the proposed remedy needs modification prior to implementation and prior to incorporating the proposed remedy into KSC's HSWA permit. If the proposed remedy is determined to be appropriate for implementation, then the Corrective Measure will be initiated, and a Land Use Control Implementation Plan will be developed to incorporate the institutional controls at this site.

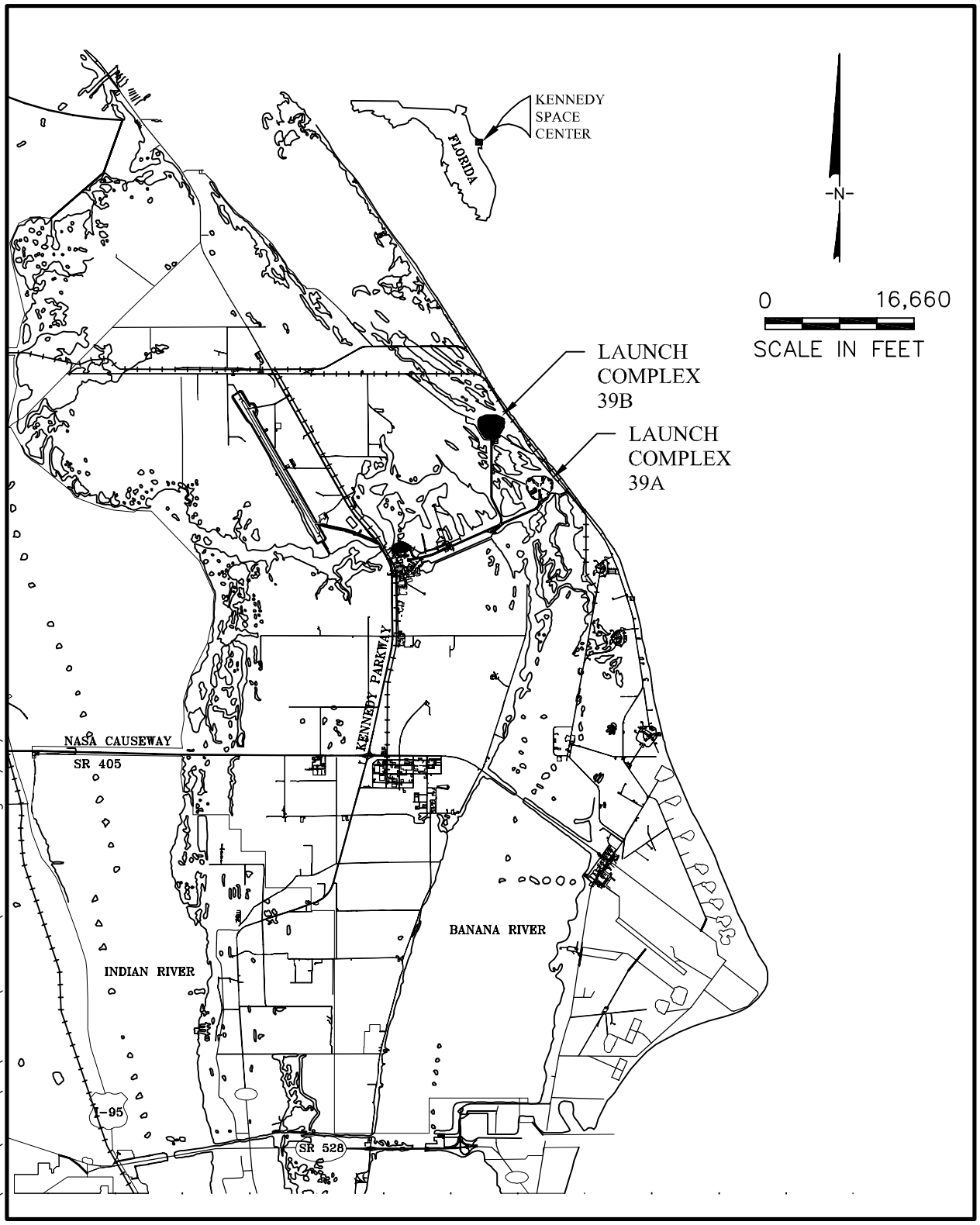
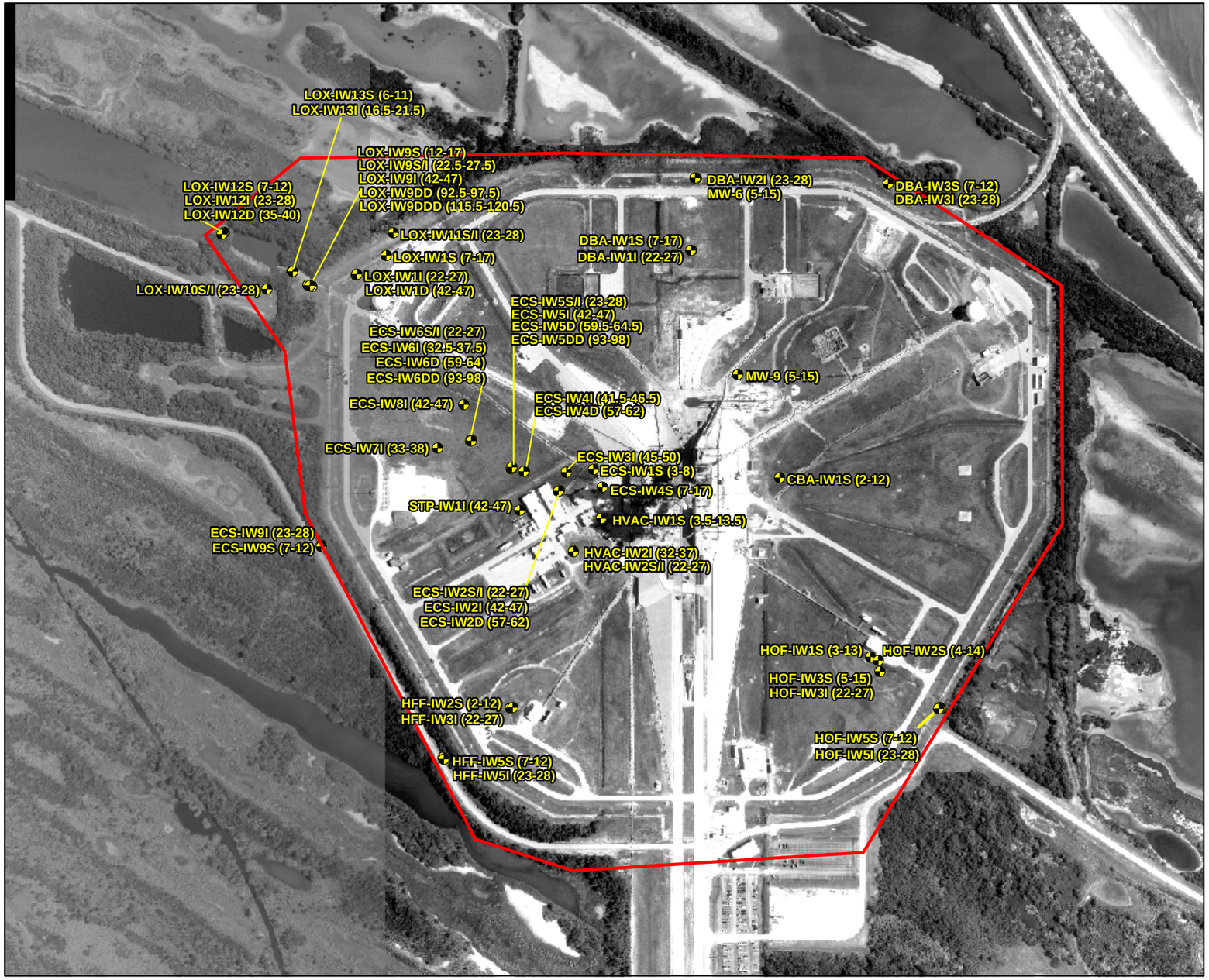
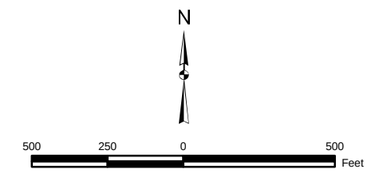


Figure 1
Location of Launch Complex 39B
at Kennedy Space Center





LEGEND

Monitoring well location, showing screened interval (ft BLS)

Area covered by the Statement of Basis and Land Use Control Plan

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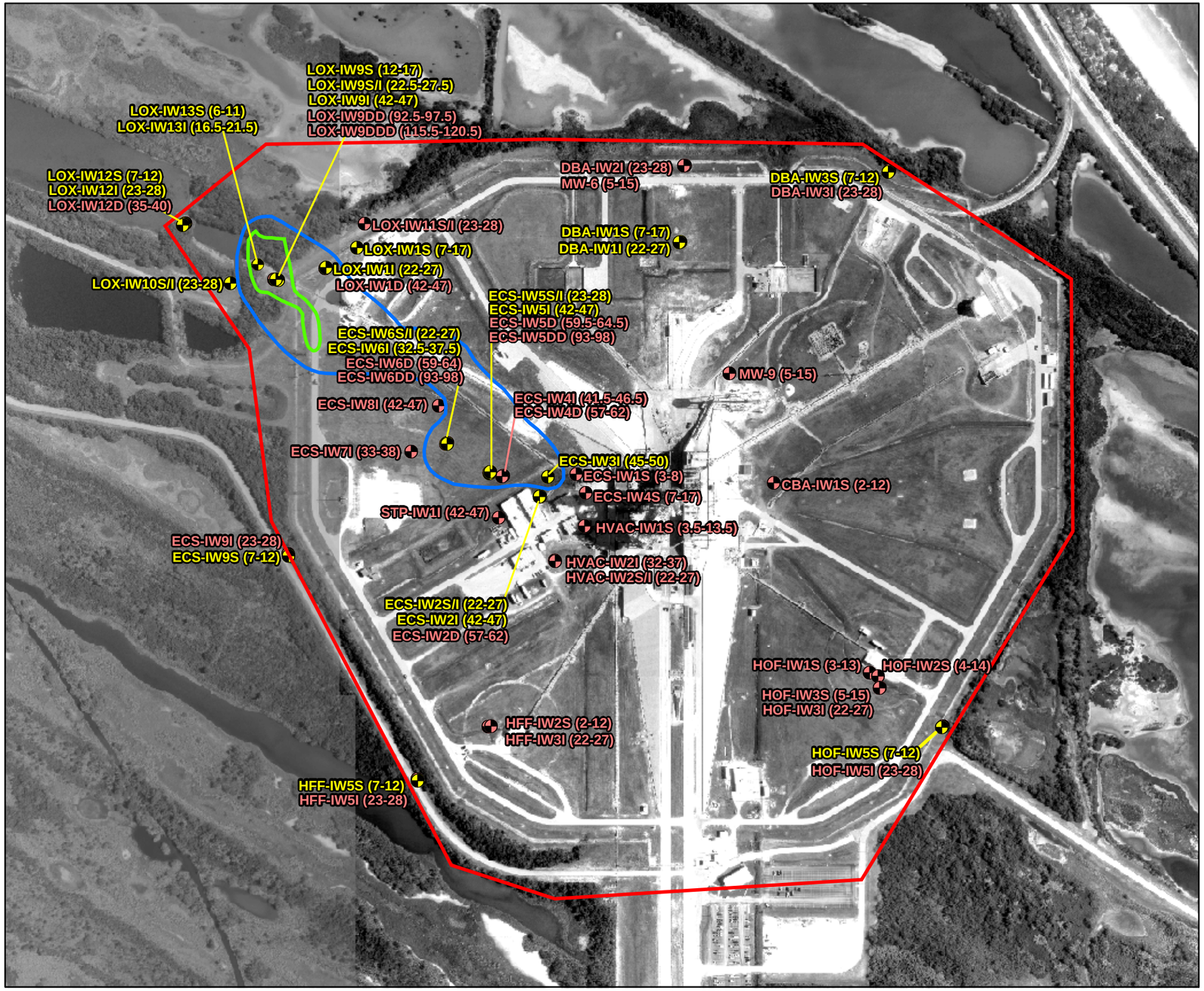
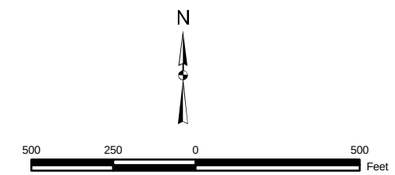
Figure 2
Site Map of LC39B





LEGEND

- **LOX-IW13S (6-11)** Proposed well for continued plume monitoring, showing screen interval (ft BLS)
- **HOF-IW1S (3-13)** Existing Monitoring well locations, showing screen interval (ft BLS), not part of the continued monitoring network.
- Active Remediation Area
- Area where MNA will be evaluated as part of the remedy
- Area covered by the Statement of Basis and Land Use Control Plan

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Figure 3
Active Remediation Area at LC39B