ENVIRONMENTAL ASSESSMENT FOR THE CONSTRUCTION AND OPERATION OF THE CONSTELLATION PROGRAM A-3 TEST STAND

JOHN C. STENNIS SPACE CENTER
HANCOCK COUNTY, MISSISSIPPI

Lead Agency: National Aeronautics and Space Administration, John C. Stennis Space Center

Proposed Action: Stennis Space Center proposes to construct and operate a new test stand for simulated altitude testing of a liquid hydrogen/liquid oxygen rocket engine.

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Abstract: This document is an environmental assessment that examines the environmental impacts of a proposed plan to clear land and to construct a test stand for use in testing the J-2X rocket engine at simulated altitude conditions in support of NASA's Constellation Program.

Executive Summary

The National Aeronautics and Space Administration (NASA) is proposing to construct and operate a new test stand at John C. Stennis Space Center (SSC) for testing J-2X engines under vacuum conditions simulating high altitude operation. NASA's Constellation Program would require these tests to develop and certify the J-2X engines.

NASA considered and evaluated the suitability of existing test stand structures to accomplish these tests -- the Arnold Engineering Development Center (AEDC) J-4 facility in Tullahoma, Tennessee and the NASA Plum Brook Station (PBS) B-2 facility in Sandusky, Ohio. The costs to rebuild either J-4 or B-2 to support J-2X Engine testing is comparable to the cost of building A-3. However, neither J-4 nor B-2 are considered as viable long-term test facilities and would only be used for 1 to 2 years during engine design, development, testing & evaluation. By contrast, A-3 would be used for flight acceptance testing over the life of the Program. A-3 can also be operated as a sea-level test facility whereas J-4 and B-2 cannot. In addition, A-3 will be co-located with the J-2X assembly facility and the A-1 and A-2 sea-level test facilities allowing significant leveraging of infrastructure and human resources. A-3 will also benefit from the test site policies and procedures that are already existing and active at SSC. Finally, B-2 has unacceptable technical risks associated with meeting J-2X test requirements and the schedule for activating B-2 does not meet the required first test start date.

The decision to locate the J-2X engine testing and certification work at SSC is heavily influenced by the existence of the SSC Buffer Zone, SSC expertise in rocket engine testing and the ability to use existing human resources and infrastructure for test operations and delivery of propellants, deluge water, inert gases, and electrical power to the new test stand.

The proposed test stand would be constructed on a site 0.40 kilometers (0.25 miles) south of the A-1 Test Stand in an area designated in the SSC Master Plan for Medium Propulsion System Testing. The construction site would be approximately 10 hectares (25 acres) located next to the SSC Access Canal. The test stand would include the following components:

- Test Cell Vacuum Chamber
- Exhaust diffuser system
- Chemical steam generators (nine, three-unit modules)
- Thermal waste water retention pond
- Liquid Hydrogen (LH) run tank
- Liquid Oxygen (LOX) run tank
- Three LOX storage tanks
- Two isopropyl alcohol storage tanks
- Nine potable water storage tanks
- Pressurized tank field for gaseous hydrogen, gaseous nitrogen and helium vessels
- Hydrogen flare stacks
- LOX dump pond

- Mooring and docks for propellant barges and engine stage installation in the SSC canal
- Office/storage building
- Test Control Center

The proposed test stand would be used to test rocket engines capable of 1.3 million newtons (300,000 pounds) thrust with a simulated altitude of approximately 30,480 meters (100,000 feet). To achieve the simulated altitude environment, chemical steam generators using isopropyl alcohol, LOX, and water would run for the duration of the test and would generate approximately 2,096 kilograms (4,620 pounds) per second of steam to reduce the pressure in the test cell and downstream of the engine. The propellants used to test the engines would be LOX and LH. The test stand would include all systems required to run an engine test including LOX and LH run tanks and LOX and LH replenishment barges. The engine would be located in a vacuum test cell at the top of the exhaust duct and would feed into a diffuser which would direct the engine exhaust away from the test stand. Gaseous nitrogen, helium and hydrogen would be supplied to the test stand from existing onsite supply systems. The exhaust duct would be cooled by water supplied by the onsite High Pressure Industrial Water distribution system. All process water would be captured in a new site retention pond. A personnel support building and a test control center would be located near the test stand.

This environmental assessment addresses the environmental impacts for the construction and operation of a new test stand and the “No Action Alternative” which addresses environmental impacts if NASA would not construct and operate a new test stand.” Inclusion of the "No Action Alternative" is prescribed by the Council on Environmental Quality guidelines implementing the National Environmental Policy Act. The "No Action Alternative" provides the benchmark against which the proposed actions are evaluated.

The most notable environmental impacts from the construction and operation of the proposed test stand would be air emissions from isopropyl alcohol and LOX chemical steam generators, wetlands disturbance, noise from engine testing, cooling water usage, storm water runoff and ground water usage.

This project would require a U.S. Army Corps of Engineers wetlands disturbance authorization, a Mississippi Department of Environmental Quality (MDEQ) Large Construction Storm Water Permit, a modification to the MDEQ National Pollutant Discharge Elimination System Permit, an MDEQ Prevention of Significant Deterioration air permit and subsequent modification to SSC’s Title V Air Permit to Operate Air Emissions Equipment, and certification by the Mississippi Department of Marine Resources for the construction of mooring dolphins or any other work that would be necessary within the SSC Access Canal.

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Acronyms/Abbreviations

AEDC	Arnold Engineering Development Center
CFR	Code of Federal Regulations
CO	Carbon Monoxide
COE	U.S. Army Corps of Engineers
dB	decibel
dBA	decibel A-weighted scale
DMR	Department of Marine Resources
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ft	feet
gal	gallon
ISS	International Space Station
kg	kilogram
km	kilometers
L	liters
lb	pound
LH	Liquid Hydrogen
LOX	Liquid Oxygen
m	meters
MDEQ	Mississippi Department of Environmental Quality
mi	miles
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OASPL	Overall Sound Pressure Level
PBS	Plum Brook Station
ppm	parts per million
PSD	Prevention of Significant Deterioration
SPL	Sound Pressure Level
SSC	Stennis Space Center

1.0 Purpose of and Need for Action

This Environmental Assessment (EA) has been prepared in compliance with the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. §§ 4321-4370d) and according to the Procedures of Implementation of NEPA for National Aeronautics and Space Administration (NASA) [Title 14, Code of Federal Regulations, part 1216 subparts 1216.1 and 1216.3]. The EA describes the purpose and need for the construction and operation of a new test stand to support the Constellation Program at John C. Stennis Space Center (SSC) in Hancock County, Mississippi. Two alternatives are considered: 1) no action; or 2) construct and operate a test stand that would simulate altitude conditions for rocket testing as part of the NASA Constellation Program. This document describes existing environmental conditions that would be affected by the alternatives and the potential environmental consequences for each alternative.

The NASA Authorization Act of 2005 requires NASA to establish a program to develop a sustained human presence on the Moon, including a robust precursor program, to promote exploration, science, commerce, and United States preeminence in space, and as a stepping-stone to future exploration of Mars and other destinations. In pursuing this new policy, NASA has been tasked with developing the spacecraft, launch vehicles and related technologies necessary to travel and explore the Solar System. NASA's Constellation Program, a family of new spacecraft, launchers, and associated hardware, will facilitate a variety of human-rated missions, from International Space Station re-supply to lunar and planetary landings. Much of the Constellation hardware is based on systems originally developed for the Space Shuttle, although a key component, the Orion Spacecraft, is heavily influenced by the earlier Apollo spacecraft design, consisting of a two-part crew and service module system (NASA, 2007a).

The proposed rockets to be used for launching the different components are the Ares I for the Orion spacecraft and the Ares V for the Lunar mission components. During launch of the Ares I, the first-stage booster powers the vehicle toward low Earth orbit. In mid-flight, the reusable booster separates and the Upper Stage J-2X engine ignites. Ares V, a heavy lift launch vehicle, would use five RS-68 Liquid Oxygen (LOX)/Liquid Hydrogen (LH) engines mounted below a larger version of the Space Shuttle's external tank, and two five-segment solid propellant rocket boosters for the first stage. A single J-2X engine would power the Upper Stage. The Ares V can lift more than 129,730 kilograms (kg) (286,000 pounds (lbs)) to low Earth orbit and stands approximately 110 meters (m) (360 feet (ft)) tall. This versatile system would be used to carry cargo and the components into orbit needed to go to the Moon and later to Mars (NASA, 2007c).

The J-2X is an evolved variation of two historic predecessors: the J-2 engine that propelled the Apollo-era Saturn IB and Saturn V rockets, and the J-2S, a simplified version of the J-2 developed and tested in the early 1970s but never flown (NASA, 2007c).

In order to test J-2X engines under vacuum conditions, simulating high altitude operation, NASA is considering building a new test stand at SSC. The proposed test stand, hereafter called the A-3 Test Stand, would be used to test rocket engines capable of 1.3 million newtons (300,000 lbs) thrust with a simulated altitude of approximately 30,480 m (100,000 ft). To achieve the simulated altitude environment, chemical steam generators using isopropyl alcohol, LOX, and water would run for the duration of the test and would generate approximately 2,096 kg (4,620 lbs) per second of steam to reduce the pressure in the test cell and downstream of the engine. The propellants used to test the engines would be LOX and LH. The test stand would include all systems required to run an engine test including LOX and LH run tanks and LOX and LH replenishment barges. The engine would be located in a vacuum test cell at the top of the exhaust duct and would feed into a diffuser that would direct the engine exhaust away from the test stand. Gaseous nitrogen, helium and hydrogen would be supplied to the test stand from existing onsite supply systems. The exhaust duct would be cooled by water supplied by the onsite High Pressure Industrial Water distribution system. All process water would be captured in a new site retention pond. A personnel support building and a test control center would be located near the test stand.

The Constellation Program is scheduled to be completed in phases over several decades, and a Constellation Programmatic Environmental Impact Statement (EIS) Notice of Intent was published in the Federal Register (71 FR 56183) in September 2006. The anticipated completion date of the EIS is no later than June 2008. However, in order to meet the aggressive schedule necessary to develop the Constellation Program in time to succeed the Space Shuttle Program, some facility construction at SSC must begin before EIS completion. Specifically, NASA proposes to conduct altitude testing of the J-2X engine in December 2010. In order to support this schedule, NASA must begin facility construction in 2007. If facility construction is not begun early, NASA would have to delay the rocket engine development tests and the overall schedule of the Constellation Program would be affected.

This EA addresses the environmental impacts for construction of the test stand and the associated rocket test operations that are required for early start to support the altitude testing of the J-2X.

2.0 Proposed Action and Alternatives

The National Aeronautics and Space Administration (NASA) is proposing to construct and operate a new test stand at John C. Stennis Space Center (SSC) for testing J-2X engines under vacuum conditions simulating high altitude operation. NASA's Constellation Program would require these tests to develop and certify the J-2X engines.

NASA considered and evaluated the suitability of existing test stand structures to accomplish these tests -- the Arnold Engineering Development Center (AEDC) J-4 facility in Tullahoma, Tennessee and the NASA Plum Brook Station (PBS) B-2 facility in Sandusky, Ohio. The costs to rebuild either J-4 or B-2 to support J-2X Engine testing is comparable to the cost of building A-3. However, neither J-4 nor B-2 are considered as viable long-term test facilities and would only be used for 1 to 2 years during engine design, development, testing & evaluation. By contrast, A-3 would be used for flight acceptance testing over the life of the Program. A-3 can also be operated as a sea-level test facility whereas J-4 and B-2 cannot. In addition, A-3 will be co-located with the J-2X assembly facility and the A-1 and A-2 sea-level test facilities allowing significant leveraging of infrastructure and human resources. A-3 will also benefit from the test site policies and procedures that are already existing and active at SSC. Finally, B-2 has unacceptable technical risks associated with meeting J-2X test requirements and the schedule for activating B-2 does not meet the required first test start date.

The decision to locate the J-2X engine testing and certification work at SSC is heavily influenced by the existence of the SSC Buffer Zone, SSC expertise in rocket engine testing and the ability to use existing human resources and infrastructure for test operations and delivery of propellants, deluge water, inert gases, and electrical power to the new test stand.

The proposed A-3 Test Stand would be constructed on a site 0.40 kilometers (km) (0.25 miles (mi)) south of the A-1 Test Stand in an area designated in the SSC Master Plan for Medium Propulsion System Testing. The construction site would be approximately 10 hectares (25 acres) located next to the SSC Access Canal. A general vicinity map is provided as Figure 1. A local area map is provided as Figure 2. The test stand would include the following components:

- Test Cell Vacuum Chamber
- Exhaust diffuser system
- Chemical steam generators (nine, three-unit modules)
- Thermal waste water retention pond
- Liquid Hydrogen (LH) run tank, 492,000 liters (L) (130,000 gallons (gal))
- Liquid Oxygen (LOX) run tank, 227,100 L (60,000 gal)
- Three LOX storage tanks of 132,475 L (35,000 gal) each
- Two Isopropyl Alcohol storage tanks of 132,475 L (35,000 gal) each
- Nine potable water storage tanks of 132,475 L (35,000 gal) each
- Pressurized tank field for gaseous hydrogen, gaseous nitrogen and helium vessels
- Hydrogen flare stacks

- LOX dump pond
- Mooring and docks for propellant barges and engine stage installation in the SSC Canal
- Office/storage building, 372 square meters (4,000 square feet)
- Test Control Center 557 square meters (6,000 square feet)

Two site plans have been developed. One proposed site plan is the configuration that would have new LH barge docks and mooring dolphins for the A-3 Test Stand (Figure 3). The other site plan configuration would be used if the A-3 Test Stand would use LH from the A-1 Test Stand barges (Figure 4). This second configuration is essentially the same as the first but relocates the test cell point 44.8 m (147 ft) east and 78.3 m (257 ft) north. The environmental impacts described in Section 3.0 of this document apply to both sites equally.

This project would require a U.S. Army Corps of Engineers (COE) wetlands disturbance authorization, a Mississippi Department of Environmental Quality (MDEQ) Large Construction Storm Water Permit, a modification to the MDEQ National Pollutant Discharge Elimination System (NPDES) Permit, an MDEQ Prevention of Significant Deterioration (PSD) air permit and subsequent modification to SSC's Title V Air Permit to Operate Air Emissions Equipment, and certification by the Mississippi Department of Marine Resources for the construction of mooring dolphins or any other work that would be necessary within the SSC Access Canal.

A drawing of the design concept for the proposed new test stand is provided in Figure 5. The test stand would provide maximum flexibility for future test configurations. The test stand vertical height to the engine test cell would be 59 m (192 ft) with the LOX and LH run tanks above the test cell. The diffuser horizontal length would be 67 m (220 ft) with an exit diameter of 7 m (23 ft). No other alternatives are considered in the EA except for the "No Action Alternative."

Inclusion of the "No Action Alternative" is prescribed by the Council on Environmental Quality guidelines implementing the National Environmental Policy Act. The "No Action Alternative" provides the benchmark against which the proposed actions are evaluated.

Figure 1 – General Vicinity

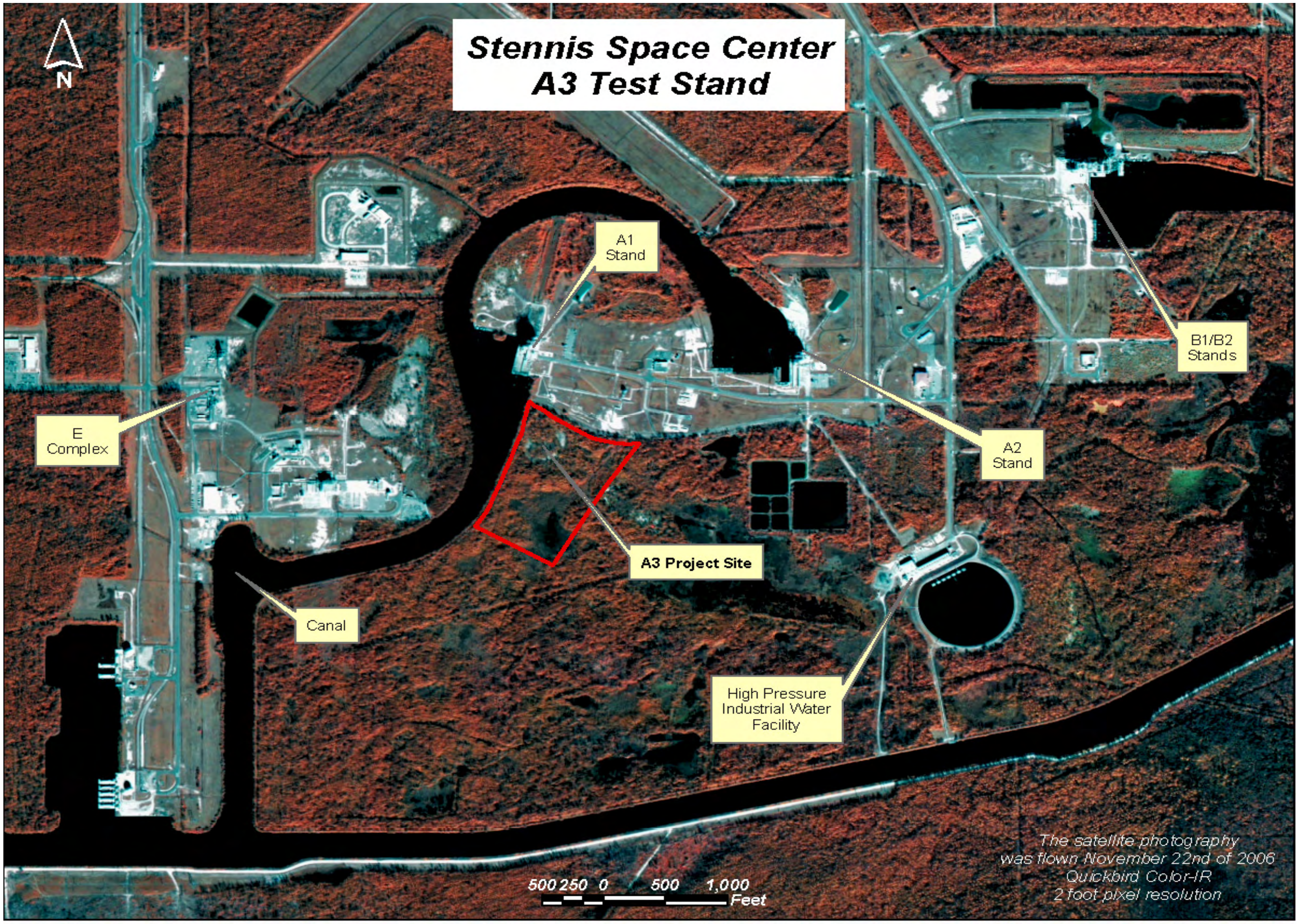

Figure 2 – Local Area Map

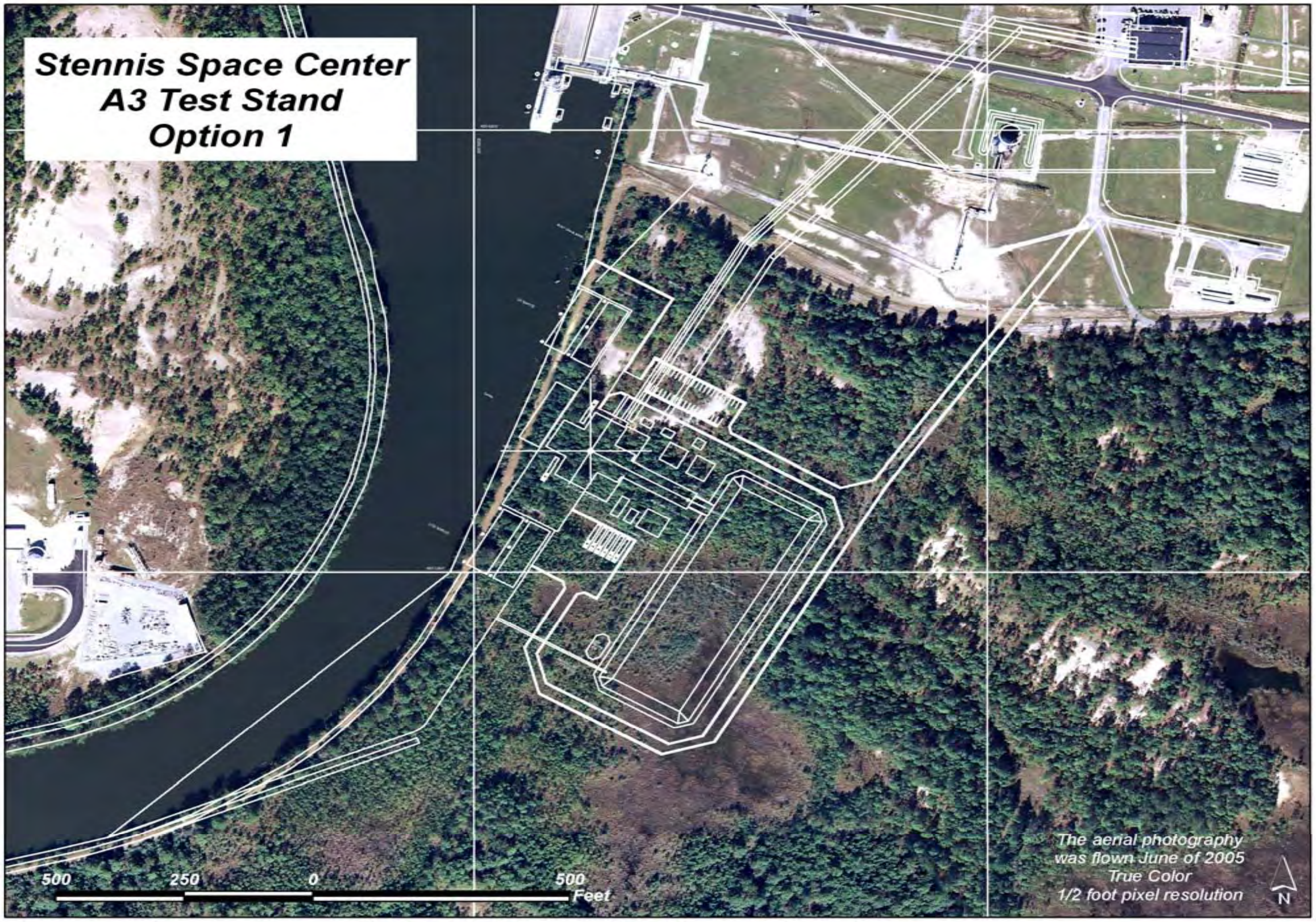

Figure 3 – Proposed Site Plan Configuration 1

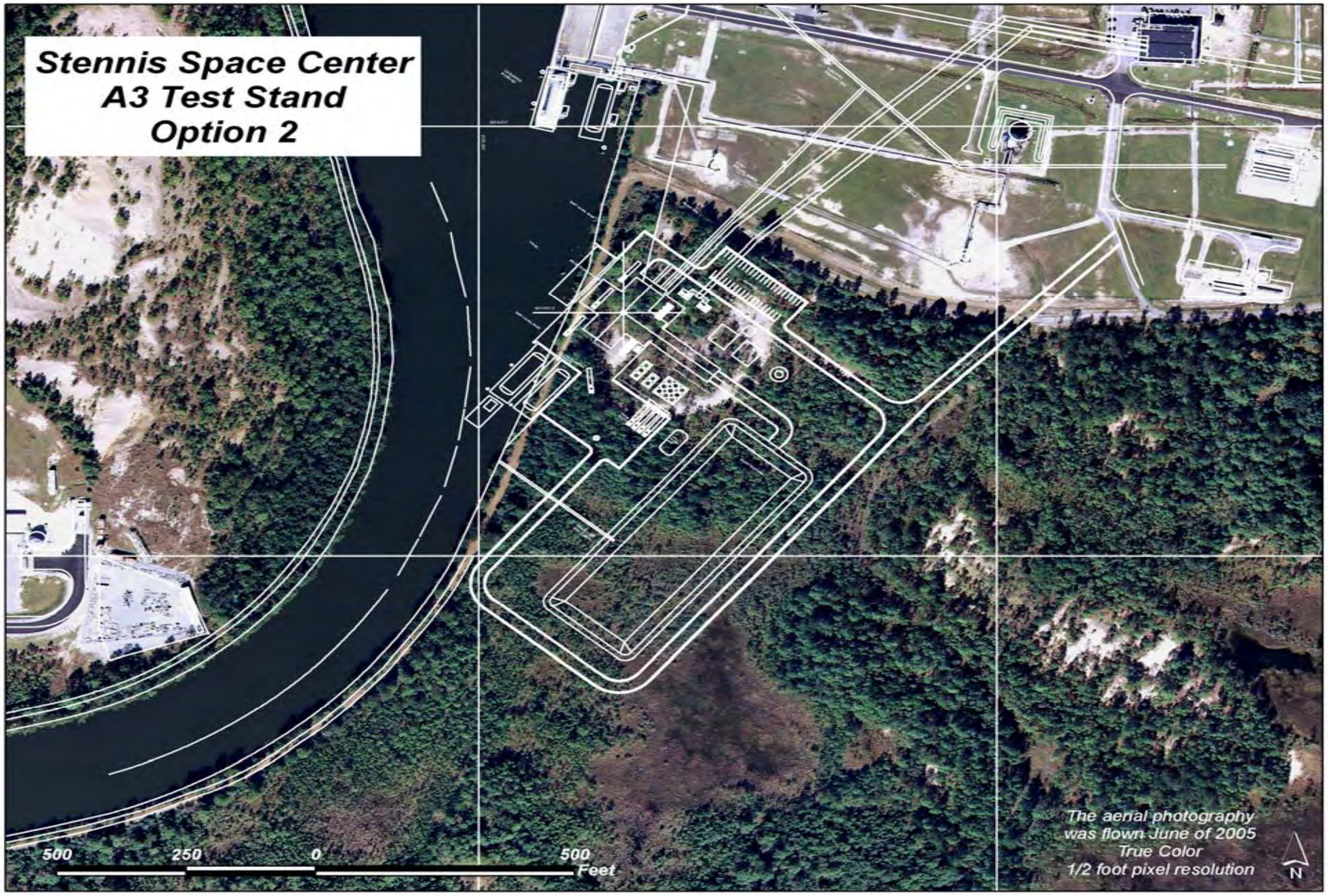

Figure 4 – Proposed Site Plan Configuration 2

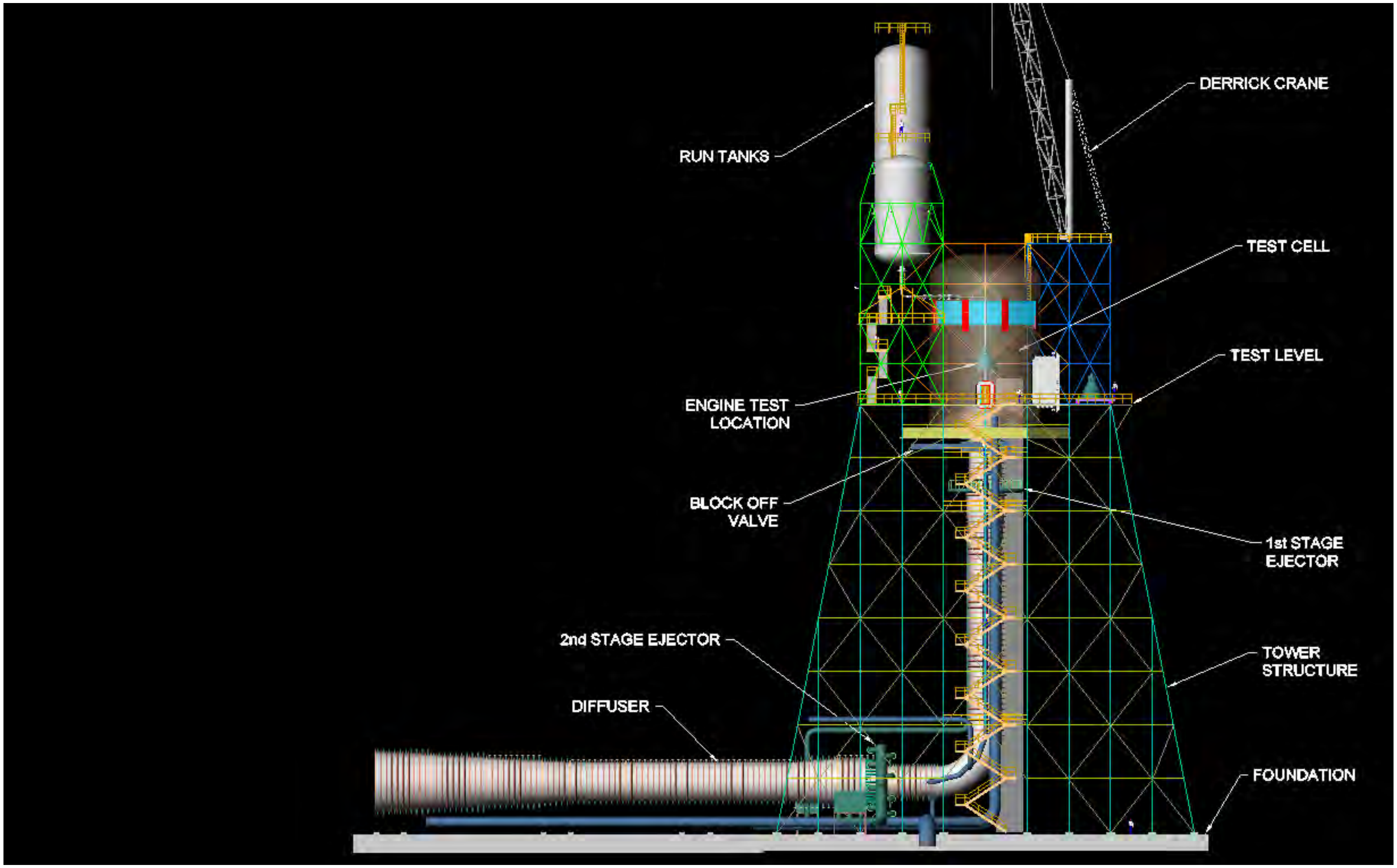

Figure 5 - Test Stand Design Concept

3.0 Existing Environment and Environmental Consequences of Alternatives

SSC is located near the Gulf of Mexico in western Hancock County, Mississippi, approximately 89 km (55 mi) northeast of New Orleans, Louisiana and approximately 48 km (30 mi) west of Biloxi/Gulfport, Mississippi. The facility is situated 30.38 north latitude (30º 22' 48") and 89.60 west longitude (89º 36' 0") at its center point. In May 1962, the Federal government acquired the approximately 5,585 hectares (13,800 acres) that constitute the "Fee Area", or confines within the gates of SSC. Within this area, NASA along with numerous federal and state agencies have constructed administrative, research, remote sensing, and propulsion testing facilities.

Rocket testing operations necessitated development of a "Buffer Zone" for safety and acoustic considerations. A perpetual restrictive easement on 50,588 hectares (125,001 acres) was acquired, which extends 10 km (6 mi) in all directions of the Fee Area. The majority of the Buffer Zone is located in Hancock County, Mississippi, although portions extend into Pearl River County, Mississippi and St. Tammany Parish, Louisiana. The region is bounded on the east and west by the Pearl River and Jourdan River watersheds, respectively. At present, the government owns 2,755 hectares (6,808 acres) of the Buffer Zone with the remainder being held by individuals, corporations, or state government. Provisions of the restrictive easement prohibit maintenance or construction of dwellings and other buildings suitable for human habitation. Predominant land use in the Buffer Zone includes sand and gravel mining, timber production, and recreational pursuits such as hunting and fishing. Several communities are situated just outside the Buffer Zone including Pearlington, Waveland, Bay St. Louis, Kiln, and Picayune, Mississippi as well as Slidell and Pearl River, Louisiana.

There are approximately 11 km (7 mi) of canals inside the fee area available to transport material within SSC. The SSC canal system links to the East Pearl River through a canal lock system. The East Pearl River links SSC to the national waterway transportation system. It is 34 km (21 mi) from the main canal to the Gulf Intracoastal Waterway. The canal system provides a means of transporting large rocket engine stages, propellants and other heavy equipment and materials to the facility.

The proposed construction site would be located within the SSC Rocket Propulsion Test Complex that includes the A-1 Test Stand, A-2 Test Stand and B-1/B-2 Complex Test Stand. The A-1 Test Stand is currently being prepared for testing the J-2X engine at sea level conditions. The A-2 Test Stand is currently being used for testing the Space Shuttle Main Engine and may be used for testing the J-2X engine at sea level conditions in the future. The B-1 Test Position is dedicated to testing Pratt Whitney/Rocketdyne's RS-68 engine used on Delta IV launch vehicles. The B-2 Test Position will be prepared for testing the NASA Ares I and Ares V launch vehicles. Additionally, SSC maintains a number of facilities and provides specialized services required for the direct support and operation of test facilities such as a cryogenics propellant receiving area, a High Pressure Gas Facility and a High Pressure Industrial Water facility.

The following sections describe possible impacts that may occur during construction and operation of the A-3 Test Stand. The most notable impacts would be air emissions from isopropyl alcohol and LOX chemical steam generators, wetlands disturbance, noise from engine testing, cooling water usage, storm water runoff and ground water usage.

3.1 Air Quality

SSC is considered to be in a rural area for air quality. It will probably remain rural due to NASA's restrictive easement Buffer Zone. The ambient air quality of the three southern Mississippi counties (Hancock, Harrison and Jackson) is considered to be in attainment for particulate matter, ozone, carbon monoxide (CO), sulfur dioxide, nitrogen oxides, and lead.

SSC currently holds a Title V Permit to Operate Air Emissions Equipment (Permit #1000-00005) issued by the Mississippi Department Of Environmental Quality. This permit includes all of the air emission points at SSC including rocket engine and component test stands, diesel fueled generators and pumps, fuel storage tanks, and flare stacks.

Rocket engine tests on the proposed test stand would be to develop and certify J-2X engines that can achieve 1.3 million newtons (300,000 lbs) of thrust. The engines are similar in function to the Space Shuttle Main Engine that has been tested at SSC since 1975. To achieve the simulated altitude environment, chemical steam generators using isopropyl alcohol, LOX, and water would run for the duration of the test and would generate approximately 2,096 kg (4,620 lbs) per second of steam to reduce the pressure in the test cell and downstream of the engine. The propellants used to test the engines would be LOX and LH.

Preliminary estimates for potential air emissions are based on thermochemical equilibrium modeling for rocket and steam ejector exhausts, total mass flow, duration of rocket test, and number of tests per year. CO is predicted to be generated at a rate of 0.0205 kg CO per kilogram (0.0205 lbs CO per lb) of mass flow (Table 1). The chemical steam ejector and rocket engine mass flow would be 2,391 kg (5,270 lbs) per second. For an operation time of 650 seconds per test, the total amount of CO predicted to be released would be 31,853 kg (35.1 tons). NASA proposes to perform two rocket tests on the A-3 Test Stand each month. This would be an annual release of approximately 763,850 kg (842 tons) of CO. Other emissions listed in Table 1 are not regulated under ambient air quality standards.

Table 1 – Mass Flow Calculations for Total Emission Output

Emission	Mass Fraction
Nitrogen	0.0098
Oxygen	0.0611
Carbon Dioxide	0.1442
Carbon Monoxide	0.0205
Water	0.7566
Hydrogen	0.0011

NASA operations at SSC are considered to be a "major source" of air emissions because the potential emissions from the test facility exceed the "250 tons per year" criteria for air permitting. Modifications to major sources are considered major modifications if they will increase the potential to emit by more than the PSD annual significant emission threshold or by any amount if the source is located within 100 km (62 mi) of a Class I area and the impact would be greater than "one microgram per cubic meter (24-hour average)" in the Class I area. The net changes in emissions from the proposed project would exceed the PSD annual significant emission threshold of "100 tons per year" for CO. The nearest PSD Class I area is the Breton National Wildlife Refuge in Louisiana which is located approximately 80 km (50 mi) from the test stand areas.

Since the proposed emissions would exceed the "100 tons per year" threshold, SSC would perform a PSD review of the project. SSC has prepared a PSD permit application for submittal to the MDEQ and has requested consultation with the Federal Land Manager of Breton National Wildlife Refuge. PSD permit review includes a 30-day comment period during which the public, the Environmental Protection Agency, and any other interested party may provide remarks to the MDEQ. The proposed changes would also be reflected in the Title V Operating Permit renewal application due to the MDEQ no later than April 30, 2008. PSD permits are pre-construction permits therefore NASA would not proceed to construct any permanent structures until the permitting process is complete. According to the MDEQ, clearing and grubbing activities may occur at the proposed site prior to permit issuance.

Additionally, the new facility would require two flare stacks for burning excess hydrogen. The flare stacks would use natural gas or propane for ignition. These emission sources are considered an operational flexibility change to SSC's Title V Operating Permit and would require notification to the MDEQ.

Air emissions from the construction of the A-3 Test Stand would include short-term fugitive air emissions from construction activities. Dust from the site would be controlled using best management practices.

The "No Action Alternative" would have no additional air emissions.

3.2 Noise

SSC is surrounded by a large buffer zone consisting mostly of forests, fields and wetlands. Development and testing of space propulsion systems has been the primary mission of SSC since its establishment in the mid-1960's. The A-3 Test Stand would be the location for testing the J-2X engine at simulated altitude of approximately 30,480 m (100,000 ft).

Noise that would be produced from testing the J-2X engine and the two stages of steam ejectors on the A-3 Test Stand would be similar to the noise generated by Space Shuttle Main Engine tests that frequently occur at SSC. Predictions of the noise levels have been made using a first order analysis of the sound pressure level for the decibel A-weighted (dBA) scale and for the decibel (dB) Overall Sound Pressure Level (OASPL). The A-weighted scale is used to account for the hearing range of the human ear. This adjusted sound pressure accounts for the insensitivity of the human ear to low frequencies. The A-weighted sound pressure level (SPL) at the edge of the Buffer Zone, 10.6 km (6.6 mi) from the proposed test stand site, that the public may encounter is predicted to be approximately 77 dBA (Figure 6). Sound levels of common noises are provided in Table 2.

Table 2 – Common Noise Levels

dBA Level	Source
70	Normal street traffic
90	Lawn mower
100	Loud music
140	Thunder

Maximum potential test firings are projected to include two full duration tests per month. Each test operation would be 650 seconds, for a collective total test firing schedule of 15,600 seconds per year. The OASPL contours in Figure 8 show the extent of low frequency noise or rumble that can cause vibration in buildings. The sound would be directed toward the southeast of the test stand through a 7 meter (23 foot) diameter diffuser. Computer modeling of estimated sound generation predicts that the OASPL at the edge of the Buffer Zone would be approximately 96 dB (Figure 7). At this level the chance of structural damage outside of the SSC Buffer Zone would be negligible. NASA has determined by experience that structural damage claims do not normally occur at less than 110 dB (NASA, 1997).

The "No Action Alternative" would result in no additional noise.

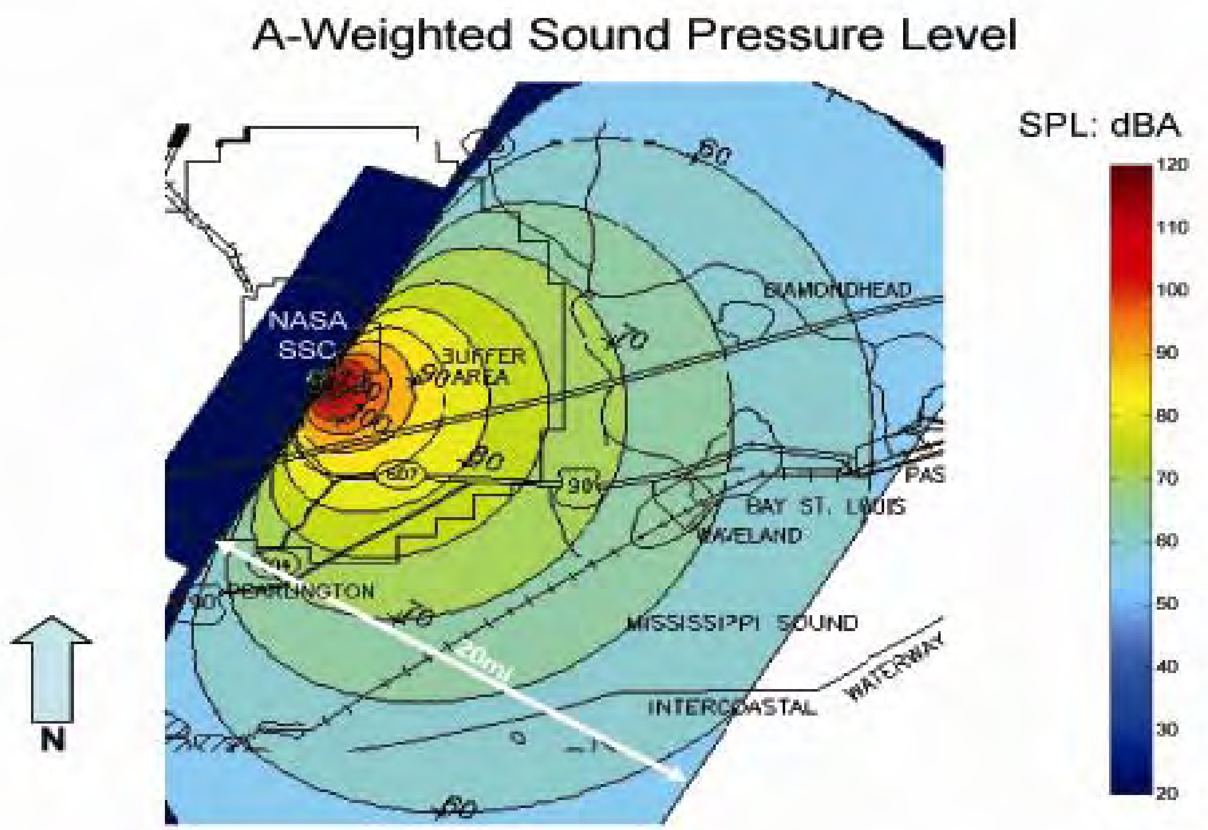

Figure 6 A-Weighted Sound Pressure Level Prediction

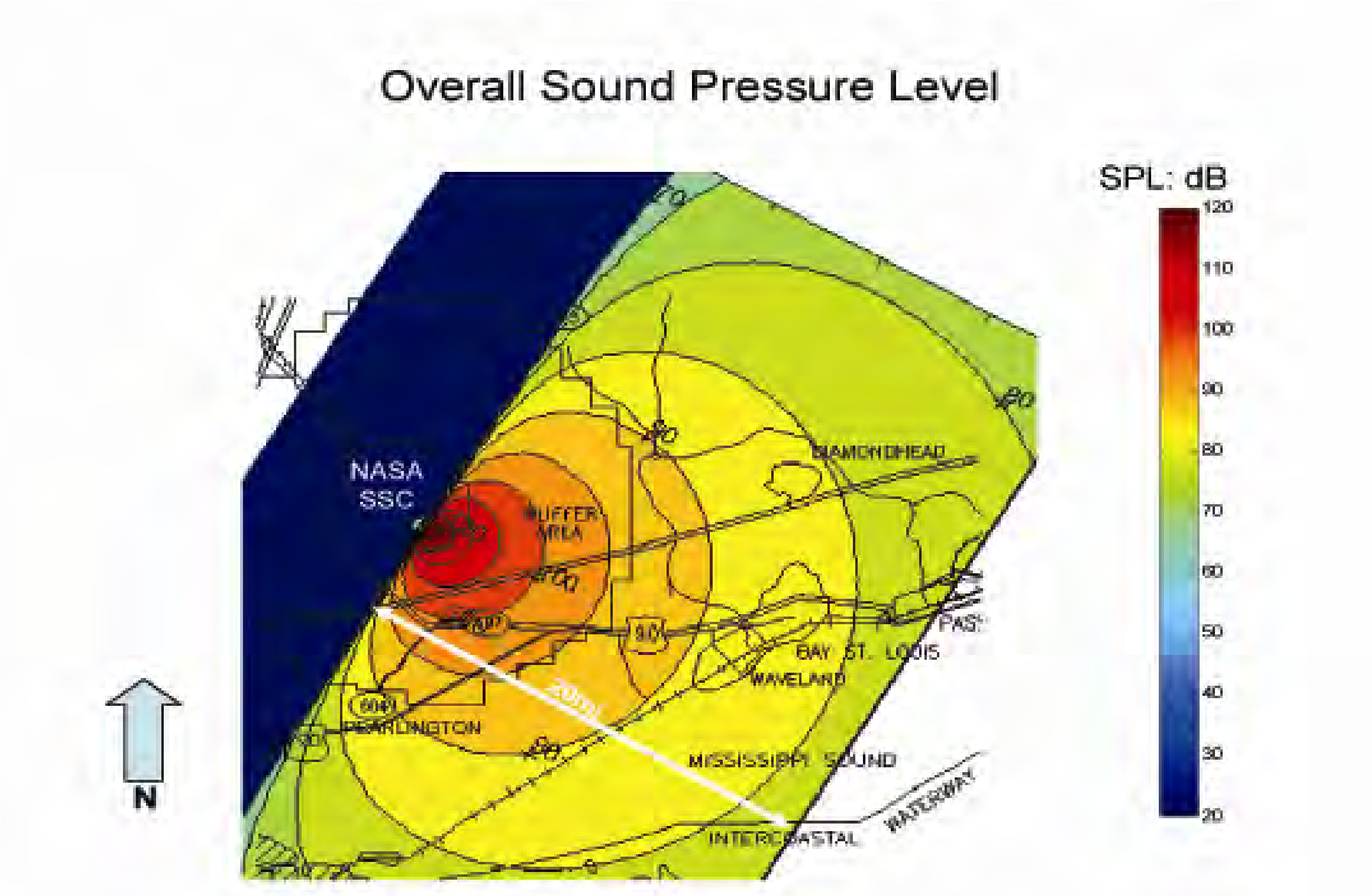

Figure 7 Overall Sound Pressure Level Prediction

3.3 Surface Water Quality

The SSC facility is located in the southwestern part of Hancock County, Mississippi. The Buffer Zone around the Fee Area is located in Hancock and Pearl River counties in Mississippi and St. Tammany Parish, Louisiana. The East Pearl River flows along the southwest boundary of the Fee Area and the Jourdan River flows in a southeasterly direction through the eastern portion of the Buffer Zone. Tributaries that drain the Fee Area and are hydraulically connected to these two rivers are Mikes River and Turtleskin Creek in the East Pearl River Basin, and the Lion and Wolf branches of Catahoula Creek in the Jourdan River Basin. Approximately 11 km (7 mi) of constructed canals in the Fee Area are also connected through locks to the East Pearl River (NASA, 2006). The proposed test stand site would be located adjacent to the SSC Access Canal which discharges to the East Pearl River.

SSC holds a permit (MS-SW-02432) to divert or withdraw water, for beneficial use, from the public waters of the State of Mississippi. Permit MS-SW-02432 (9/12/2000-9/12/2010) covers an inlet and pumps that withdraw water from the East Pearl River into the elevated portion of the facility's Access Canal. The Access Canal provides a source of water for emergency fire suppression and rocket test stand deflector cooling via industrial pumps at the SSC High Pressure Industrial Water Facility. During operations at the A-3 Test Stand, this water would be used for cooling the steam and rocket exhaust diffuser. Each water cooled section of the diffuser would be provided cooling water from a common supply header. Diffuser water would be discharged from the horizontal section of the diffuser from each subsection directly to a trench that would be constructed under the diffuser. Water from the vertical section of the diffuser would be discharged through a fifty inch discharge pipe downstream of the horizontal section of the diffuser. The water would be directed from the trench to a large retention pond. Additionally, potable water from the chemical steam generator system would be directed to the retention pond. The water entering the retention pond is expected to be approximately 46º Centigrade (114º Fahrenheit).

The retention pond would have a clay liner or other barrier and would be constructed in a manner similar to the retention pond for the B-1/B-2 Test Stands. It would be constructed to hold approximately 15 million L (4 million gal) of water that would be discharged from the test stand during each rocket engine test. The pond would be constructed in accordance with state and federal regulations.

SSC holds an NPDES permit (# MS0021610) for five waste water outfalls. Outfalls #001 and #002 are for discharge of water from biological treatment lagoons. Outfalls #008 and #010 are for discharge of water from rock-reed filter systems at the SSC north and south guard gates. The only other outfall, #011, is for the discharge of deluge water from the SSC test stands into the SSC Access Canal. The current permit expires April 30, 2009. During the renewal process SSC would revise the flow diagram for all waste water for Outfall #011 to include the deluge water for the A-3 Test Stand. The retention pond would be constructed to contain the deluge water until it reaches ambient temperature for release. The outfall is currently monitored for flow, pH, oil and grease, and total suspended solids. Water temperature monitoring or other management controls may be required for the outfall upon renewal of the NPDES permit.

Construction activities would impact storm water runoff from an area that would include the test stand, roads and parking lots. An MDEQ Large Construction Storm Water Permit would need to be secured by the construction contractor prior to clearing and grubbing the site. A storm water detention pond would be established to collect storm water during construction. A storm water pollution prevention plan would be developed as part of the permitting process. Weekly inspections of the site would be required to ensure compliance with the permit and plan.

The "No Action Alternative" results in no new waste water source.

3.4 Groundwater Resources

Several aquifers can be traced through Hancock County. The area is underlain by fresh water-bearing, southward-tipping sands of the Miocene and Pliocene ages. Within these fresh water-bearing sands, one unconfined aquifer is found near the surface with ten or more confined aquifers at depth. The fresh water-bearing zone is 600 to 900 m (2,000 to 3,000 ft) thick in the area. Individual aquifers range from 30 to 140 m (100 to 450 ft) in thickness, with most measurements closer to 30 m (100 ft). The sequence of alternating sands and discontinuous clay layers, creating the confining nature of the deeper aquifers, is part of the Coastal Lowlands Aquifer System or the Southeastern Coastal Plain System. Groundwater at SSC is soft, containing sodium bicarbonate and exhibiting a high pH (above 8). Concentrations of chlorides range from 13 to 16 parts per million (ppm) and iron content is less than 0.3 ppm. Solids content does not exceed 315 ppm. The aquifers have plentiful, almost untapped supplies of fresh water.

Potable water for use at SSC is supplied through two large capacity wells onsite. A third well is currently not used and held in standby condition. The well depths range from 437 m to 466 m (1,434 ft to 1,530 ft). All wells are permitted for withdraw of water by the MDEQ Office of Land and Water Resources. Potable water usage in 2005 was 278.6 million L (73.6 million gal) for well #MS-GW-01910 and 169.6 million L (44.8 million gal) for well # MS-GW-01911. The permitted maximum flow rates for the wells are provided in Table 3.

Table 3 – Permitted Maximum Flow Rates for Potable Water Wells

Permit Number	L Per Day (Gal Per Day)	L Per Minute (Gal Per Minute)
#MS-GW-01910	908,400 (240,000)	2,271 (600)
#MS-GW-01911	643,450 (170,000)	1,609 (425)

The two wells and associated pumps, chlorinators, elevated storage tanks, automatic controls, and a distribution system supply the support and test areas with water for drinking, sanitation, and fire protection.

The elevated tanks supply water to the system and maintain system pressure at 4.6 to 4.9 kg-force per square centimeter (65 to 70 lbs/square inch gauge [psig]). Chlorination operates in conjunction with booster pumps, adding chlorine to the water while the pumps are operating. The water supply is sampled monthly and analyzed in accordance with the federal and state requirements.

The operation of the proposed test stand would require 1,124,145 L (297,000 gal) of potable water for steam generation per rocket engine test. There would be approximately two tests per month for an annual usage of 27.3 million L (7.2 million gal). The water would be pulled from the wells and kept in nine 32,489 liter (35,000 gallon) storage tanks in preparation for testing operations. Filling of the storage tanks would be coordinated with the Facility Operating Contract Services plumbing shop to prevent facility shortages and to ensure compliance with current permit limits. If necessary, the third potable water well currently held in standby mode would be reactivated.

The "No Action Alternative" would have no change to groundwater usage.

3.5 Coastal Zone Management

The SSC Access Canal is considered to be "Waters of the State" according to the Mississippi Department of Marine Resources (DMR). As such, the DMR reviews all activities that would occur within the canal according to the Mississippi Regional Permit Program. The DMR determines compliance with the Mississippi Coastal Wetlands Protection Law and the COE, Mobile District General Permit MSG0295-MSG2795 upon receipt of a permit application. They would then issue a DMR permit authorizing work that would be done within the canal.

The development of the A-3 Test Stand would require the construction of docks and mooring dolphins within the SSC Access Canal for LOX and/or LH barges and a docking slip for engine stage handling by the test stand crane. The barges are required to supply the propellants to the run tanks on the test stand. The canal bulkhead would be constructed of sheet piling. SSC would submit a permit application to the DMR upon definition of the construction work.

The "No Action Alternative" would have no change to the SSC Access Canal.

3.6 Wetlands and Flood Plains

SSC lies within the watersheds of two rivers: the East Pearl River on the western Fee Area boundary and the Jourdan River on the eastern Fee Area boundary. Some tributaries at the facility flow west to Mike's River and eventually drain into the East Pearl River. The Pearl River empties into Lake Borgne, while the Jourdan River drains into the Bay of St. Louis. Both Lake Borgne and the Bay of St. Louis discharge into the Mississippi Sound.

As a result of the wetlands hydrology found at and around SSC and the presence of hydric soils and hydrophytic vegetation, a large portion of both the Fee Area and Buffer Zone are considered jurisdictional wetlands by the COE.

A 1967 photograph of the Rocket Propulsion Test Complex, during the construction phase, shows the proposed project site as severely disturbed by early construction activities (Figure 9). The soil at the site is mostly sandy spoils from construction of the SSC Access Canal through the area. Since the early 1970's small stunted pine trees have grown on the site and some areas within the proposed construction site appear to be reverted from disturbed areas to present day wetlands.

The disturbance of wetlands on NASA owned land in Hancock County is covered under an existing General Permit #CELMK-OD-FE 14-GPD (Vicksburg District)-53 issued by the COE. As required by the permit, a Final Mitigation Plan was developed by NASA and the COE. NASA mitigates the unavoidable impacts to wetland functions associated with construction projects through creation, restoration, or enhancement and continued management of wetlands on property owned by NASA in the SSC Fee Area and Buffer Zone. Management of wetlands and mitigation areas is conducted in accordance with 14 CFR 1216.205, Procedures for evaluating NASA actions impacting floodplains and wetlands.

The clearing, grubbing and filling of 9 hectares (22 acres) of the 10 hectare (25 acre) construction site would impact an area that includes non-wetlands, low quality wetlands and high quality wetlands. The areas are designated in Figure 10. The proposed site has been inspected and compensatory mitigation credit factors have been calculated. The wetlands delineation and mitigation calculations are provided in Appendix A. The total area of low quality and high quality wetlands is 8 hectares (19.7 acres). Calculations for credit factors are based on the "Charleston Method" developed by the COE of the Charleston District. This method incorporates information about the project such as construction plans, parking areas, and fill material. Of the 1,600.71 credits that SSC currently has available, 118.54 credits would be charged against the "Mitigation Bank" for the A-3 Test Stand. This information, an application form for authorization to disturb wetlands, associated maps, and other data were submitted to the COE on March 27, 2007. SSC is required by the COE to examine several optional locations to minimize wetland loss as part of the authorization process. The options were not considered to be acceptable as test stand sites due to operational constraints and greater wetland impact.

According to the Flood Insurance Rate Map for Hancock County, Mississippi (September 18, 1987), there is a 100-year floodplain along the East Pearl River at the western edge of the Fee Area, and a 100-year floodplain along the Wolf Branch and along the Lion Branch of Catahoula Creek in the northeast portion of the Fee Area. The line for the 500-year floodplain extends a little further into the site along the same boundaries. The proposed location for the A-3 Test Stand is classified as Zone "C" meaning an area of minimal flooding. The test stand would not be located in the 100-year or 500-year floodplain.

The "No Action alternative" would have no impact to wetlands.

Figure 8 – 1967 Photograph of the A-1 Test Stand Under Construction with the Proposed A-3 Site Highlighted

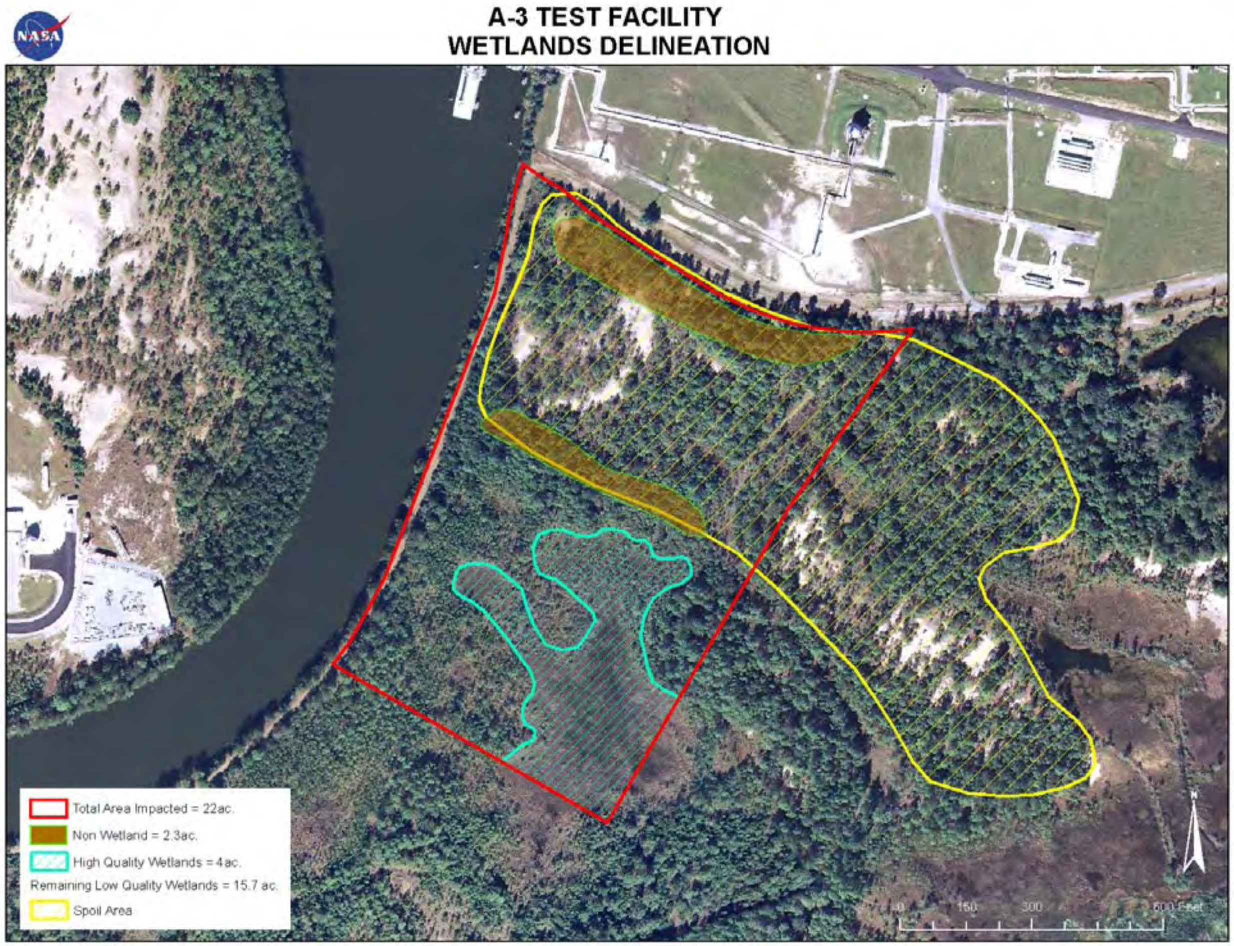

Figure 9 – Wetlands Delineation

3.7 Biotic Resources

Four major plant community types have been identified within the SSC area. These community types, generally identified by the predominant type of vegetation, are:

- Pine Flatwoods
- Bottomland hardwood
- Pitcher plant bogs and swamps
- Grasslands and marshes

Pine Flatwoods account for the majority of the vegetation in the undeveloped portions of SSC and in the surrounding Buffer Zone. The dominant species in these communities is slash pine interspersed with some cypress, loblolly pine, swamp tupelo, red maple, and sweet gum. Oak species occur in locations that are more elevated with better drainage. The understory in these communities includes holly species, sweet bay gallberry, yaupon, wax myrtle, grasses, and cane.

Bottomland hardwood communities occur in low, poorly-drained soils, which may have standing or slowly moving water. The dominant species in these communities are black gum, swamp tupelo, and pond cypress. The understory includes ash species, black willow, red maple, poison ivy, and honeysuckle. Very few grass or forb (herbs other than grass) species occur in these communities.

Pitcher plant bogs are unique to the coastal plain of the southeastern United States and occur in low-lying, poorly-drained areas with acidic soil. The few mature trees, if any are present, are generally cypress or longleaf pine species. These communities occur where the area is burned regularly, which prevents transition to forest or bottomland hardwood-type communities. Prominent herbaceous species in pitcher plant bogs include orchids, sundews, pitcher plants, pipeworts, and yellow-eyed grass.

Grasslands often occur in disturbed areas where the land has been cleared for construction or burned. The most common grass species in the SSC area include broomsedges and panic grasses. Other plants occurring in grassland communities include cane and rushes. In low, wet areas, pipeworts, milkworts, and sedges may occur, while in drier grasslands, throughworts, rabbit tobacco, and goldenrod may be found.

The location for the A-3 Test Stand would be in an area previously disturbed by construction of the SSC Access Canal in the 1960's. The soil is mostly sandy and there is no marketable timber. The flora that is present consists mostly of stunted loblolly and slash pine with a small area in fresh water marsh dominated by panic grasses. The proposed construction site is located adjacent to an area of developed land that is covered by pavement or mowed grass and is currently being used for testing the Space Shuttle Main Engine and the RS-68 Engine on SSC test stands.

The topography at SSC is generally low and flat with low gradient streams. Aquatic habitats present at the facility include the Pearl River, man-made access canals, lakes, ponds, borrow pits, drainage ditches, shallow swamps, marshes, and small creeks. Aquatic fauna include fish, as well as some amphibians and reptiles. Several species of sport fish have been identified at SSC, including mullet, yellow bass, blue catfish, bluegill, and largemouth bass in the East Pearl and spotted gar, threadfin shad, and longear sunfish in Mikes River. Most of the species identified in surveys are known to be present in the SSC Access Canal.

Because of the various types of terrestrial habitats at SSC, including grasslands, forests, and wetland areas, a diversity of terrestrial animal species are found. Ecological surveys conducted at SSC have documented many species of amphibians, reptiles, mammals, and birds (Keiser and Lago, 1991, Keiser, 1994, Jones 2002). Twenty species of frogs, fourteen species of snakes and the alligator were found at SSC during surveys. Over one hundred bird species have been documented at SSC. The most common species of birds occurring on most habitats of SSC were Northern Cardinals, American Crows, Tufted Titmice, Yellow-breasted Chats, White-eyed Vireos, and Red-bellied Woodpeckers. Twenty-six species of mammals have been identified. These include Virginia opossum, armadillo, shrews, rabbits, squirrels, mice, Nutria, Red fox, raccoon and White Tail deer.

Wildlife habitat in the immediate area of the proposed test stand is considered marginal because of the present use of this facility complex. The proposed site may be a suitable foraging area for various species such as deer, mice, song birds and raptors, however, activity associated with current engine tests limits its suitability as a nesting or roosting habitat. There would be no significant impact to wildlife.

The "No Action Alternative" would result in no additional impact.

3.8 Threatened and Endangered Species

Threatened and endangered species that are suspected to have ranges or suitable habitats that include SSC and the Buffer Zone are the Gulf sturgeon, eastern indigo snake, Florida panther, gopher tortoise, bald eagle, red-cockaded woodpecker, American peregrine falcon and Louisiana quillwort. The SSC Fee Area has been surveyed for the presence of these species on several occasions. The most recent faunal study was completed in 1998 by Dr. E.D. Keiser and Dr. P.K. Lago entitled “Survey for Five Endangered Animal Species at the Stennis Space Center, Hancock County, Mississippi,” (Keiser and Lago, 1998). The study found no indications of the occurrence of indigo snakes, red-cockaded woodpeckers, or peregrine falcons. One abandoned burrow was found that may have been dug by a gopher tortoise, but no individuals were sighted. Dr Jean Wooten has completed several vegetation surveys within the SSC Fee Area and has not found any species of quillwort present (Wooton, 1990 & 1998) .

The U.S. Fish and Wildlife Service concurs with the opinions of Keiser, Lago and Wooten in a letter to NASA, February 1999, although they request a visual survey for federally listed species be conducted prior to any earth or vegetation disturbance (James, 1999). A visual inspection of the proposed site for the A-3 Test Stand was conducted on March 16, 2007 by a Mississippi State University research group. No known federally listed species or species habitats were sighted. A letter on the results of the inspection is provided in Appendix A.

Based on the Keiser and Lago report, the Wooten opinion, the concurrence by the U.S. Fish and Wildlife Service and a visual inspection of the proposed construction site for the A-3 Test Stand, this proposed project would not affect any threatened or endangered species that may exist in the SSC vicinity.

The "No Action Alternative" would result in no impact to threatened or endangered species.

3.9 Archaeological, Cultural and Historic Resources

Historically, the land at SSC has been severely disturbed by timber harvesting and the associated naval stores industry during the late nineteenth and early twentieth centuries. More recently, the land was disturbed by the construction of the SSC facility during the 1960s, making it unlikely that undisturbed archaeological sites would be found. In the Fee Area, only the townsite of Gainesville may require future archaeological considerations. This project would be located approximately 5 km (3 mi) to the north east of the Gainesville townsite and is on previously disturbed land.

There are no anticipated archaeological or cultural impacts resulting from this project. NASA would confirm this by contract with experts for an archeological assessment of the proposed test stand site prior to any clearing or grubbing activities. If items of potential archaeological or cultural interest are uncovered during construction, further construction in the immediate area would cease until the requirements of Section 106 of the National Historic Preservation Act have been satisfied (NASA, 2003).

The A-1, A-2 and B-1/B-2 Test Stands at SSC have been designated as National Historic Landmarks and appear on the National Register of Historic Places. These test stands and associated control centers have been so designated because of their importance in the testing of Saturn rockets and the importance of the Saturn rocket in landing men on the Moon. The proposed construction would not alter the historical attributes of the test stands or affect their status as National Historic Landmarks.

The “No Action Alternative” would have no impact to archaeological resources.

3.10 Transportation

Interstates 10 and 59, US Highway 90 and Mississippi Highway 607 serve the SSC area. Interstate 10 is the primary corridor linking Biloxi, Gulfport, Bay St. Louis, and other coastal cities with New Orleans. It is located approximately 5 km (3 mi) south of the SSC Fee Area. Interstate 59 joins Interstate 10 near Slidell, Louisiana and extends northeastward to Hattiesburg, Mississippi and on into Alabama, passing about 8 km (5 mi) from the northwestern corner of

SSC. Direct access to and through SSC from I-10 and I-59 is provided by Mississippi Highway 607. The highway is closed to the general public within the Fee Area and security guard checkpoints exist at both entrances to SSC. Highway 607 connects with US 90 approximately 14 km (9 mi) southeast of SSC.

Operation of the A-3 Test Stand would require delivery of LOX, LH and isopropyl alcohol to SSC. Delivery and storage of LH and LOX is currently part of normal operations to supply propellants for testing the Space Shuttle Main Engine and the RS-68 engine. The proposed isopropyl alcohol delivery would require nine truckloads for each J-2X engine test. This would not impact transportation corridors.

The SSC Fire Department is available 24 hours a day for response to spills of hazardous materials onsite. The SSC *Environmental Integrated Contingency Plan* (NASA, 2005) documents procedures and operational controls for spills.

The “No Action Alternative” would have no impact to transportation corridors.

3.11 Waste Generation

SSC generates solid and hazardous waste from its research, development operations, laboratories, instrument repair, and operations and maintenance functions. Solid waste consisting of household-type wastes and non-hazardous industrial waste are disposed of onsite in an MDEQ permitted solid waste landfill (Permit # SW02401B0376). Hazardous waste, maintained in satellite accumulation areas and a 90-day Accumulation Point, is transported off-site for treatment, storage, and disposal. NASA maintains large quantity generator status under the Resource Conservation and Recovery Act subtitle C for generating hazardous waste. The following processes or activities generate hazardous wastes at SSC:

- Research/development and analytical testing generate wastes such as spent solvents, reaction products, unused or expired reagents, acids, bases, and test sample wastes.
- Facility maintenance generates a variety of materials including paints, solvents, and spent abrasive blast material that may contain heavy metals.
- Construction generates a variety of wastes including spent solvents, acids and bases, paint waste with heavy metals, ignitable wastes and vehicle maintenance wastes.
- Aerospace testing, cleaning, and maintenance generate spent cleaning solutions, dyes, and photographic wastes.
- Equipment cleaning/degreasing generates alkaline cleaners and nitric acid.

Construction and operation of the A-3 Test Stand would not generate wastes inconsistent with current construction and operational activities.

The "No Action Alternative" would produce no additional hazardous or solid waste.

3.12 Socioeconomics

Economic impact data compiled by Mississippi State University economics professor Dr. Charles Campbell shows SSC is a significant source for employment and income in the area of South Mississippi and Southeast Louisiana. In 2006, the direct economic impact within the core 50-mile radius resulted in $488 million. While post-Hurricane Katrina recovery efforts continue, the study noted SSC maintained a stable direct impact on the global economy for two consecutive years, totaling $691 million. Without SSC operations in 2006, considering both direct and indirect effects, a conservative estimate of reduction in employment for the area would have been 19,500 jobs. A similar conservative estimate indicated personal income would have been reduced by more than $811.4 million, and retail sales would have been reduced by $324.6 million. It is estimated that SSC has a positive contribution on local tax revenues of $87.6 million (NASA Press Release, 2007b).

NASA and its contractors employ 1,973 people. The largest agency onsite is the Department of Defense with 1,885 employees, including the U.S. Navy, U.S. Army and contractors. Other resident agencies employ an additional 693, bringing the total SSC workforce to 4,551.

Construction would require temporary employment of approximately 100 employees through construction contractors. The A-3 Test Stand operations would require approximately 45 employees responsible for day to day operations. Most of these employees would be drawn from the current pool of employees working on Space Shuttle Main Engine rocket tests.

The “No Action Alternative” would result in no temporary construction employment and fewer jobs for rocket engine testing specialists as the Space Shuttle Main Engine Program is ended.

3.13 Pollution Prevention and Environmental Justice

Executive Order (EO) 13423, “Strengthening Federal Environmental, Energy, and Transportation Management,” requires Federal agencies to conduct environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner. SSC has an Environmental Management System in place to identify all environmental aspects of operations and to select objectives and targets to minimize impact to the environment.

SSC prevents pollution by recycling and reusing materials whenever possible, purchasing environmentally preferable products, minimizing the use of hazardous materials, and conserving water as well as other strategies delineated in the SSC *Pollution Prevention Plan* (NASA, 2002).

In accordance with EO 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” NASA considers environmental justice issues during program and project planning consistent with the SSC *Environmental Justice Strategy* (NASA, 1995). Any disproportionately high and adverse effects of proposed programs at SSC on minority or low-income populations would be identified and action would be taken to resolve public concern. Because of the size of the SSC Buffer Zone surrounding the Fee Area, there are no environmental justice concerns associated with this project.

The "No Action Alternative" would not change current pollution prevention activities.

3.14 Cumulative Impact

Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The A-1 Test Stand is currently being prepared for testing the J-2X engine at sea level conditions. The A-2 Test Stand is being used for testing the Space Shuttle Main Engine. The B-1 Test Position is dedicated to testing Pratt Whitney/Rocketdyne's RS-68 engine used on Delta IV launch vehicles. The B-2 Test Position will be prepared for testing the NASA Ares I and Ares V launch vehicles. The cumulative effect of these testing activities is not expected to have long term impact.

Cumulative impacts potentially resulting from the entirety of the Constellation Program will be addressed in the Constellation Programmatic Environmental Impact Statement scheduled to be completed no later than June 2008 (NASA, 2007a).

The "No Action Alternative" would not add to the cumulative environmental impact of NASA rocket test stand activities.

4.0 Agencies and Individuals Consulted

NASA Environmental Management staff and the SSC Facilities Operating Services Contract air quality specialist met with the MDEQ in Jackson, Mississippi on March 13, 2007 to discuss the requirements for permitting air emissions and waste water from the A-3 Test Stand. The results of this discussion are incorporated into this EA. A PSD permit application was submitted to the MDEQ on April 3, 2007.

A letter was sent to the Federal Land Manager, U.S. Fish and Wildlife Service, on March 21, 2007 for consultation on the project impacts to the Class I Breton National Wildlife Refuge.

The COE has been contacted on the completeness of the wetlands authorization package that was submitted March 27, 2007. The COE requested separate delineations for the four different types of soils/vegetation within the proposed construction site. These separate delineations were provided to the COE and can be viewed in Appendix A.

5.0 List of Contributors and Preparers

Name	**Position**	**Expertise**
Michael J. Blotzer	NASA, SSC Environmental Officer	Environmental Management
Hugh V. Carr	NASA, SSC Environmental Specialist	Natural Resources Wetlands
Robert Geierman	Jacobs Technology, Aero/Mechanical Engineer	Air Emission Predictions
Dave H. Golden	Applied Geo Technologies, Scientist	Wetlands Wildlife
Jenette B. Gordon	NASA, SSC Environmental Specialist	Water Quality Solid Waste Pollution Prevention
Carolyn D. Kennedy	NASA, SSC Environmental Specialist	NEPA Management Air Quality
Bridget D. Moody	Mississippi Space Services, Environmental Engineer	Air Quality
Grady P. Saunders, P.E.	Jacobs Technology, Fluid Dynamics Laboratory Manager	Air Emission Predictions
Dale L. Sewell	NASA, SSC Project Manager	Project Management
Joseph Yen, Ph.D.	Jacobs Technology, Senior Aerodynamic Engineer	Noise Modeling Predictions

6.0 References

Federal Emergency Management Agency, Flood Insurance Rate Map, Hancock County, Revised Map, September, 1987.

James, Curtis B. U.S. Fish and Wildlife letter dated February 23, 1999 regarding the presence of federally listed species within the Fee Area of the Stennis Space Center, Hancock County, Mississippi.

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NASA. 2007a. Environmental Assessment for the Construction, Modification, and Operation of Three Facilities in Support of the Constellation Program, John F. Kennedy Space Center, Florida.

NASA. 2007b. Press Release – NASA Stennis Space Center Presents Economic Impact at Mississippi Capitol, February 28, 2007.

NASA. 2007c. Constellation Program Web Site. http://www.nasa.gov/mission_pages/constellation/main/index.html

Wooten, J.W. 1990. A Fall Botanical Survey of a portion of the National Aeronautics and Space Administration Installation Stennis Space Center Mississippi, John C. Stennis Space Center.

Wooten, J.W. 1998. University of Southern Mississippi letter dated April 21, 1998 regarding the presence of species of *Isoetes* within the SSC Fee Area.

7.0 Distribution List

Maury Oceanographic Library, Building 1003, Stennis Space Center, MS 39529

Bay St. Louis - Hancock County Library, 312 Highway 90, Bay St. Louis, MS 39520

Kiln Public Library, 17065 Highway 603, Kiln, MS 39556

Margaret Reed Crosby Memorial Library, 900 Goodyear Blvd., Picayune, MS 39466

St. Tammany Parish Library, 555 Robert Blvd., Slidell, LA 70458

U.S. Army Corps of Engineers, 4155 Clay Street, Vicksburg, MS 39183

U.S. Fish and Wildlife Service, 2524 South Frontage Road, Suite C, Vicksburg, MS 39180

Mississippi Department of Environmental Quality, P.O. Box 10385, Jackson, MS 39289

Mississippi Department of Archives and History, P.O. Box 571, Jackson, MS 39205

Mississippi Department of Marine Resources, 1141 Bayview Avenue, Biloxi, MS 39530

National Aeronautics and Space Administration, Headquarters, Library, 300 E Street SW, Washington, DC

APPENDIX A

ENVIRONMENTAL REVIEWS AND CONSULTATIONS

NOTE

This appendix includes:

1. Letter on Inspection for Threatened and Endangered Species
2. Wetland Delineation and Mitigation Calculations

The information in this appendix refers to a proposed A-X Test Stand. This is a term that was used for the proposed test stand prior to renaming to A-3 Test Stand.

March 16, 2007

Carolyn Kennedy
NASA Environmental Office
Building 1100
Stennis Space Center, MS 39529

Re: Threatened & Endangered species at the proposed A-X Test Facility, SSC

Dear Ms. Kennedy:

Concurrent with the wetland delineation made on the proposed A-X Test Facility site, a survey was made for threatened and endangered species (T&E) by Dr. Jarrod Fogarty’s research team from Mississippi State University. There was no evidence of past, present, or the likelihood of future nesting sites or activity of any recognized T&E on the proposed site, specifically, the Louisiana black bear, gopher tortoise, indigo snake, peregrine falcon, red-cockaded woodpecker, and the Louisiana quillwort.

Sincerely,

Dave Golden,
Wetlands Mitigation Manager

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	A-X Test Facility - Low Quality Wetlands - 1 of 4 Stennis Space Center	Date:	03/14/07
Applicant/Owner:	NASA	County:	Hancock
Investigator:	Dave Golden	State:	MS
Do Normal Circumstances exist on the site?	☐Yes ☒No	Community ID:	
Is the site significantly disturbed (Atypical Situation)?	☒Yes ☐No	Transect ID:	
Is the area a potential Problem Area? (If needed, explain on reverse.)	☐Yes ☒No	Plot ID:	

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Pinus elliotti		FAC	9. xyris baldwiniana		OBL
2. Ilex glabra		FACW	10. Viola pratincola		OBL
3. Rubus trivialis		FAC	11. Rhynchospora microcarpa		OBL
4. Schizachyrium scoparium		FAC	12. Smilax laurifolia		FACW+
5. Andropogon virginicus		FAC-	13. Erianthus giganteus		FACW
6. Smilax bona-nox		FAC	14. Burmannia capitata		OBL
7. Eleocharis obtusa		OBL	15. Centella asiatica		FACW
8. Eleocharisalbida		OBL	16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 93

Remarks:

HYDROLOGY

☐ Recorded Data (Describe in Remarks):

- ☐ Stream, Lake, or Tide Gauge
- ☒ Aerial Photographs
- ☐ Other

☐ No Recorded Data Available

Wetland Hydrology Indicators:

Primary Indicators:

- ☐ Inundated
- ☒ Saturated in Upper 12 Inches
- ☒ Water Marks
- ☒ Drift Lines

Field Observations: Depth of Surface Water: 1-2 (in.) Depth to Free Water in Pit: 1-2 (in.) Depth to Saturated Soil: 1 (in.)	☐ Sediment Deposits ☒ Drainage Patterns in Wetlands Secondary Indicators (2 or more required): ☐ Oxidized Root Channels in Upper 12 Inches ☒ Water-Stained Leaves ☒ Local Soil Survey Data ☐ FAC-Neutral Test ☐ Other (Explain in Remarks)

Remarks: Much of the area holds water either at or immediately below the surface.

SOILS

Map Unit Name
(Series and Phase): Soil Survey of Hancock County, MS USDA, 1978

Drainage Class:

Field Observations

Taxonomy (Subgroup): Atmore

Confirm Mapped Type? ☒ Yes ☐ No

Profile Descriptions:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc,
1-4		GLEY1 3/3	none	none	High organic content
4-8		10YR 4/2	7.5 YR 5/3	few	Sandy clay
8-14		10YR 5/2	7.5 YR 5/3	moderaste	Sandy clay

Hydric Soil Indicators:

☐ Histosol	☐ Concretions
☐ Histic Epipedon	☒ High Organic Content in Surface Layer in Sandy Soils
☐ Sulfidic Odor	☐ Organic Streaking in Sandy Soils
☐ Aquic Moisture Regime	☒ Listed on Local Hydric Soils List
☐ Reducing Conditions	☒ Listed on National Hydric Soils List
☒ Gleyed or Low-Chroma Colors	☐ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? ☒Yes ☐No (Check) Wetland Hydrology Present? ☒Yes ☐No Hydric Soils Present? ☒Yes ☐No	(Check) Is this Sampling Point Within a Wetland? ☒Yes ☐No
Remarks Site is not entirely wetland.This is section 1 of 4 and constitutes the majority of the site. See map.	

Approved by HQUSACE 3/92

Forms version 1/02

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	A-X Test Facility - High Quality Wetlands Stennis Space Center	Date:	03/14/07
Applicant/Owner:	NASA	County:	Hancock
Investigator:	Dave Golden	State:	MS
Do Normal Circumstances exist on the site?	☐Yes ☒No	Community ID:	
Is the site significantly disturbed (Atypical Situation)?	☒Yes ☐No	Transect ID:	
Is the area a potential Problem Area? (If needed, explain on reverse.)	☐Yes ☒No	Plot ID:	

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Pinus elliotti		FAC	9. xyris baldwiniana		OBL
2. Centella asiatica		FACW	10. xyris sp.		OBL
3. Erianthus giganteus		FACW	11. Rhynchospora microcarpa		OBL
4. Schizachyrium scoparium		FAC	12. Dicanthelium sp.		OBL
5. Andropogon virginicus		FAC-	13.		
6. Eleocharis sp.		OBL	14.		92
7. Eleocharis obtusa		OBL	15.		
8. Eleocharis albida		OBL	16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 91

Remarks: Dicanthelium and Eleocharius predominate in flooded areas..

HYDROLOGY

☐ Recorded Data (Describe in Remarks):	Wetland Hydrology Indicators:
☐ Stream, Lake, or Tide Gauge	Primary Indicators:
☒ Aerial Photographs	☐ Inundated
☐ Other	☒ Saturated in Upper 12 Inches
☐ No Recorded Data Available	☐ Water Marks

	☐ Drift Lines ☐ Sediment Deposits ☐ Drainage Patterns in Wetlands
Field Observations: Depth of Surface Water: 1-3 (in.) Depth to Free Water in Pit: 1-3 (in.) Depth to Saturated Soil: 1 (in.)	Secondary Indicators (2 or more required): ☐ Oxidized Root Channels in Upper 12 Inches ☐ Water-Stained Leaves ☒ Local Soil Survey Data ☐ FAC-Neutral Test ☐ Other (Explain in Remarks)

Remarks: Much of the area holds water either at or immediately below the surface

SOILS

Map Unit Name
(Series and Phase): Soil Survey of Hancock County, MS USDA, 1978

Drainage Class:

Field Observations

Taxonomy (Subgroup): Atmore

Confirm Mapped Type? ☒ Yes ☐ No

Profile Descriptions:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc,
1-4		GLEY1 3/3	none	none	High organic content
4-8		10YR 4/2	7.5 YR 5/3	few	Sandy clay

Hydric Soil Indicators:

☐ Histosol
☐ Histic Epipedon
☐ Sulfidic Odor
☒ Aquic Moisture Regime
☐ Reducing Conditions
☒ Gleyed or Low-Chroma Colors

☐ Concretions
☒ High Organic Content in Surface Layer in Sandy Soils
☐ Organic Streaking in Sandy Soils
☒ Listed on Local Hydric Soils List
☒ Listed on National Hydric Soils List
☐ Other (Explain in Remarks)

Remarks: Area covered with water most of the year.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	☒Yes ☐No (Check)	(Check)
Wetland Hydrology Present?	☒Yes ☐No	
Hydric Soils Present?	☒Yes ☐No	Is this Sampling Point Within a Wetland? ☒Yes ☐No

Remarks Site is not entirely wetland. This is section 2 of 4 and occupies a small portion in the southeast corner of the tract.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	A-X Test Facility - Spoil Filled Area - 3 of 4 Stennis Space Center	Date:	03/14/07
Applicant/Owner:	NASA	County:	Hancock
Investigator:	Dave Golden	State:	MS

Do Normal Circumstances exist on the site?	☐ Yes	☒ No	Community ID:	
Is the site significantly disturbed (Atypical Situation)?	☒ Yes	☐ No	Transect ID:	
Is the area a potential Problem Area? (If needed, explain on reverse.)	☐ Yes	☒ No	Plot ID:	

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Pinus elliotti		FAC	9. Erianthus giganteus		FACW
2. Ilex glabra		FACW	10. Viola pratincola		OBL
3. Rubus trivialis		FAC	11. Smilax laurifolia		FACW+
4. Schizachyrium scoparium		FAC	12. Pinus taeda		FAC-
5. Andropogon virginicus		FAC-	13.		
6. Smilax bona-nox		FAC	14.		
7. Burmannia capitata		OBL	15.		
8. Rhynchospora microcarpa			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 83

Remarks: This is part of a lager area of spoil deposited during the construction of the navigation canal system within the southern portion of the John C. Stennis Space Center in the 1960's. Pines are 30-40 years old, but stunted.

HYDROLOGY

☐ Recorded Data (Describe in Remarks):	Wetland Hydrology Indicators:
☐ Stream, Lake, or Tide Gauge	Primary Indicators:
☒ Aerial Photographs	☐ Inundated
☐ Other	☒ Saturated in Upper 12 Inches

☐ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0-1/2 (in.)

Depth to Free Water in Pit: 6 (in.)

Depth to Saturated Soil: 1-6 (in.)

☒ Water Marks
☒ Drift Lines
☐ Sediment Deposits
☒ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):

☐ Oxidized Root Channels in Upper 12 Inches
☒ Water-Stained Leaves
☒ Local Soil Survey Data
☐ FAC-Neutral Test
☐ Other (Explain in Remarks)

Remarks: This area holds water close to the surface for most of the growing season. Flow patterns are common. Animal tracks are "wet" most of the growing season.

SOILS

Map Unit Name (Series and Phase): Soil Survey of Hancock County, MS USDA, 1978

Drainage Class:

Field Observations

Taxonomy (Subgroup): Atmore

Confirm Mapped Type? ☒ Yes ☐ No

Profile Descriptions:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc,
to 13"		2.5YR 8/2	none	none	Sand with light organic
13-20		2.5YR 8/3	7.5 YR 5/3	few	Sandy with some clay
		10YR 5/2			

Hydric Soil Indicators:

☐ Histosol
☐ Histic Epipedon
☐ Sulfidic Odor
☐ Aquic Moisture Regime
☐ Concretions
☐ High Organic Content in Surface Layer in Sandy Soils
☐ Organic Streaking in Sandy Soils
☒ Listed on Local Hydric Soils List

- [ ] Reducing Conditions
- [ ] Gleyed or Low-Chroma Colors
- [x] Listed on National Hydric Soils List
- [ ] Other (Explain in Remarks)

Remarks: Spoil area is sand with little organic component to a depth greater than 20".

WETLAND DETERMINATION

Hydrophytic Vegetation Present? ☒Yes ☐No (Check)		(Check)
Wetland Hydrology Present? ☒Yes ☐No		
Hydric Soils Present? ☒Yes ☐No	Is this Sampling Point Within a Wetland?	☒Yes ☐No

Remarks Site is not entirely wetland. This is a poor quality wetland, section 3 of 4 distinct communities. Although heavily filled, the area retains wetland characteristics. A smaller portion of the spoil area, section 4 o 4 of the A-X tract has sufficient elevation and drainage to have lost its wetland character.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	A-X Test Facility - Non-Wetland Area - 4 of 4 Stennis Space Center	Date:	03/14/07
Applicant/Owner:	NASA	County:	Hancock
Investigator:	Dave Golden	State:	MS
Do Normal Circumstances exist on the site?	☐ Yes ☒ No	Community ID:	
Is the site significantly disturbed (Atypical Situation)?	☒ Yes ☐ No	Transect ID:	
Is the area a potential Problem Area? (If needed, explain on reverse.)	☐ Yes ☒ No	Plot ID:	

VEGETATION

	Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
1.	Pinus elliotti		FAC	9.	Pinus taeda		FAC-
2.	Myrica cerifera		FAC+	10.			
3.	Rubus trivialis		FAC	11.			
4.	Schizachyrium scoparium		FAC	12.			
5.	Andropogon virginicus		FAC-	13.			
6.	Smilax bona-nox		FAC	14.			
7.	Magnolia grandiflora		FAC+	15.			
8.	Smilax rotundifolia		FAC	16.			

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 56

Remarks: There is a small (25 meter wide) sliver that shows a clean upland floor under a heavy pine canopy, Pines in this section are more rubust than the stunted pines found in sections 1-3. See attached photo and map.

HYDROLOGY

☐ Recorded Data (Describe in Remarks):	Wetland Hydrology Indicators:
☐ Stream, Lake, or Tide Gauge	Primary Indicators:
☒ Aerial Photographs	☐ Inundated
☐ Other	☐ Saturated in Upper 12 Inches

- [ ] No Recorded Data Available

Field Observations:

Depth of Surface Water: 0 (in.)

Depth to Free Water in Pit: N/A (in.)

Depth to Saturated Soil: > 16 (in.)

- [ ] Water Marks
- [ ] Drift Lines
- [ ] Sediment Deposits
- [ ] Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):

- [ ] Oxidized Root Channels in Upper 12 Inches
- [ ] Water-Stained Leaves
- [x] Local Soil Survey Data
- [ ] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

Remarks: This is the smallest area of the tract and is in two parts. The largest is at the northern most portion of the tract, lying within the spoil-filled area. The second is a sliver of land at the southern boundary of the spoil-filled area. There is no evidence of any regular hydrology.

SOILS

Map Unit Name (Series and Phase): Soil Survey of Hancock County, MS USDA, 1978

Drainage Class:

Field Observations

Taxonomy (Subgroup): Atmore

Confirm Mapped Type? [x] Yes [ ] No

Profile Descriptions:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc,
1-2		2.5YR 8/2	none	none	see comment below
1-13		2.5YR 8/2	7.5 YR 5/3	none	Sandy with light clay
13-20		2.5YR 8/3	7.5 YR 5/3	few	Sandy with light clay

Hydric Soil Indicators:

- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Concretions
- [ ] High Organic Content in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils

☐ Aquic Moisture Regime	☐ Listed on Local Hydric Soils List
☐ Reducing Conditions	☒ Listed on National Hydric Soils List
☐ Gleyed or Low-Chroma Colors	☐ Other (Explain in Remarks)

Remarks: Spoil area is sand with little organic component to a depth greater than 20" except for a shallow layer of organic material in the sliver of land with the heavy pine canopy. There are large piece of "rip-rap" mixed with surface sand in the northern area. The elevation here is slightly higher than the remainder of the spoil bank and has, asscordingly, lost its wetland character.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	☒Yes ☐No (Check)		(Check)
Wetland Hydrology Present?	☐Yes ☒No		
Hydric Soils Present?	☒Yes ☐No	Is this Sampling Point Within a Wetland?	☐Yes ☒No

Remarks Site is not entirely wetland. This is section 4 of 4 distinct communities present. A portion of the proposed site was filled prior to 1973 during contruction of the Stennis Space Center navigation canal system. The northernmost portion of this spoil deposit is non-wet. Hydric soils are present, but lie buried under many inches of sand and rock. These two small sections of an otherwise textbook wetland no longer "act as a wetland" due to loss of character from missing hydrology and hydric soils being buried under heavy spoil. Hydrophilic vegetation is marginal at 56 percent. This non-wet area constitutes 2.3 acres out of 22 acres total for the A-X tract.

Stennis Space Center

NASA Environmental Office

Compensatory Mitigation Adverse Impact Credit Factors and Worksheet

Charleston Method

Project Name: A-X Test Facility

Factors	Options						
Magnitude		0.05 X Σ AA_i (rounded to the nearest tenth decimal place)					
Dominant Effect	Fill 2.0	Impound 1.8	Dredge 1.6	Drain 1.4	Flood 1.2	Clear 1.0	Shade 0.5
Duration of Effects		7 + years 2.0	5-7 years 1.5	3-5 years 1.0	1-3 years 0.5	0-1 years 0.1	Seasonal 0.1
Existing Conditions		Class 1 2.0	Class 2 1.5	Class 3 1.0	Class 4 0.5	Class 5 0.3	Class 6 0.1
Rarity Ranking			Imperiled *	Vulnerabl e *	Rare 2.0	Uncommon 0.5	Common 0.1
Lost Kind			Kind A 2.0	Kind B 1.5	Kind C 1.0	Kind D 0.5	Kind E 0.1
Preventability				High 2.0	Moderate 1.0	Low 0.5	None 0

***** These factors are determined on a case-by-case basis.

Required Mitigation Credits Worksheet

Factor	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Magnitude	0.555	0.175	0.255	0	0	0
Dominant Effect	1	1	2			
Duration	2	2	2			
Exisiting Condition	0.5	1	0.5			
Rarity Ranking	0.1	0.5	0.1			
Lost Kind	1	1.5	1			
Preventability	0.5	0.5	0.5			
Sum of Factors (R_1 -R_6)	5.66	6.68	6.36	0.00	0.00	0.00
Impacted Area (Σ AA_{1-6}) (Enter Acreage)	11.10	3.50	5.10			
R x AA	62.77	23.36	32.41	0.00	0.00	0.00

Total acres = 19.7 **Total Required Credits = Σ (R x AA) =** **118.54**

Computed by: Dave Golden, Wetlands Manager Date: 3/22/2007

SSC Natural Resources Management Team