December 1988

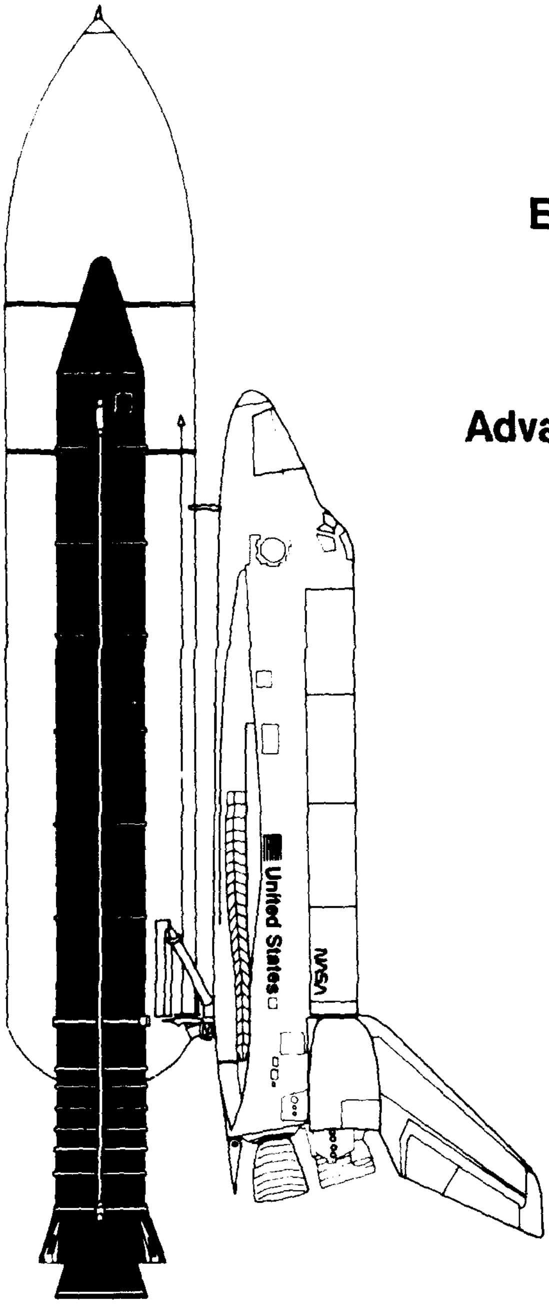
NASA

DRAFT

Environmental Impact Statement

Space Shuttle

Advanced Solid Rocket Motor Program



National Aeronautics and Space Administration
John C. Stennis Space Center
George C. Marshall Space Flight Center

Air Force
Environmental Planning Division
(HQ USAF/CEVP)

Room 5B269
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Washington, DC 20330-1260

16 JUL 93

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Jack Bush, GM-14

Mr. Jack Bush
Special Projects and Plans
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December 1988

NASA

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Environmental Impact Statement

Space Shuttle

Advanced Solid Rocket Motor Program

National Aeronautics and Space Administration
John C. Stennis Space Center
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PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR ADVANCED SOLID ROCKET MOTORS

(X) Draft ( ) Final Environmental Impact Statement

RESPONSIBLE FEDERAL AGENCY:

National Aeronautics and Space Administration
Washington, DC 20546

COOPERATING AGENCIES:

Tennessee Valley Authority
U.S. Air Force
U.S. Army Corps of Engineers

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BRIEF DESCRIPTION OF ACTION:

The proposed action is design, development, testing, and evaluation of Advanced Solid Rocket Motors (ASRM) to replace the motors currently used to launch the Space Shuttle. The proposed action includes design, construction, and operation of new government-owned, contractor-operated facilities for manufacturing and testing the ASRMs. The proposed action also includes transport of propellant-filled rocket motor segments from the manufacturing facility to the testing and launch sites and the return of used and/or refurbished segments to the manufacturing site. Sites being considered for the new facilities include John C. Stennis Space Center, Hancock County, Mississippi; the Yellow Creek site in Tishomingo County, Mississippi, which is currently in the custody and control of the Tennessee Valley Authority; and John F. Kennedy Space Center, Brevard County, Florida. TVA proposes to transfer its site to the custody and control of NASA if it is the selected site. All facilities need not be located at the same site. Existing facilities which may provide support for the program include Michoud Assembly Facility, New Orleans Parish, Louisiana; and Slidell Computer Center, St. Tammany Parish, Louisiana. NASA's preferred production location is the Yellow Creek site, and the preferred test location is the Stennis Space Center.

SUMMARY OF ENVIRONMENTAL EFFECTS:

Facilities and explosive safety clear zones will occupy 1,100 to 2,500 acres, depending on whether manufacturing and testing facilities are located at the same site. Depending on the site, small amounts of wetlands may be filled and wildlife habitat will be removed. Test firing the motors and disposing of waste propellant by burning will release air pollutants, causing a temporary, localized, small degradation in air quality. Surface water, vegetation, and wildlife in the safety clear zone will be minimally affected by these air pollutants. Areas adjacent to the test site will be exposed to moderately high sound levels of predominantly low frequency during the tests, conducted two to four times per year. Employment associated with construction and operation of the facilities will have beneficial effects on employment and payrolls in the vicinity of the site(s).

COMMENT PERIOD:

Comments on the Draft EIS must be submitted by February 6, 1989.

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SUMMARY

The National Aeronautics and Space Administration (NASA) plans to select a site for the production and testing of an Advanced Solid Rocket Motor (ASRM) for the Space Shuttle. The ASRM is needed to enhance safety and reliability, and to provide the additional power required to launch payloads heavier than those launched using the current motors. The ASRM program will include motor production, static test firing, and refurbishing of hardware from previous tests and missions.

NASA has identified three government-owned installations as possible production and testing sites: John C. Stennis Space Center near Bay St. Louis, Mississippi; the Yellow Creek site presently in the custody and control of the Tennessee Valley Authority near Iuka, Mississippi (production only); and John F. Kennedy Space Center (KSC) at Cape Canaveral, Florida.

After groundbreaking in 1989, construction of ASRM facilities, motor development, and initial production of the first pairs of operational ASRMs will extend over about a five-year period. Flight certification of the ASRM will take about a year, and the first Space Shuttle to use the ASRM could be launched as early as 1994. The ASRM program is planned to extend through 2020.

The ASRM production rate will be up to 30 motors per year with 28 to be used for launching the Space Shuttle (14 space flight sets of 2 motors each), and 2 available for static testing. During the latter part of the development period, the ASRM is assumed to be tested on a horizontal test stand an average of four times per year. Thereafter, it would be tested twice a year.

The ASRM motors will be 150 inches in diameter. Each motor will be produced and shipped in segments, which will be joined at the test or launch site. Final design will specify 2-, 3-, or 4-segments per motor. Each ASRM will carry 1.2 million pounds of propellant, with each segment containing from 300,000 to 600,000 pounds of propellant.

The estimate of waste propellant resulting from normal operations or off-specification batches equals approximately 1.0 million pounds per year. Currently, waste propellant is disposed of by open burning. Alternatives to open burning, including incineration, recycling, reuse, and treatment are being investigated.

For purposes of analysis, full-time employment for the routine production of ASRMs is conservatively assumed to be 1,500. An additional 150 employees are assumed to be needed for testing and 200 for ancillary production facilities.

Case segments and raw materials for case refurbishing and propellant production will be shipped to the facility by truck or rail. The fueled motor segments will probably be shipped by barge.

ENVIRONMENTAL IMPACT STATEMENT

This environmental impact statement is intended to compare the relative environmental impacts of continuing the RSRM program (the no action alternative) versus siting ASRM facilities at one or more of the three government-owned

locations. Various design alternatives are presented in terms of their potentially different environmental effects.

NO ACTION ALTERNATIVE

The no action alternative is a continuation of the RSRM program and defines the baseline conditions which would prevail in the absence of the proposed project. Manufacturing and testing of the RSRM could continue under the current contractor in Utah, or a new contractor at another location could be used in addition to or instead of the current contractor. Environmental impacts of the RSRM program under the current contractor are similar to those discussed in previous documents, including the Environmental Analysis of SRM Production at Thiokol/Wasatch (Battelle 1983) and the Final Environmental Statement for SRM DDT&E Program at Thiokol/Wasatch (NASA/MSFC 1977).

DESIGN ALTERNATIVES

Several design alternatives are evaluated in this EIS in terms of their impacts on the motor production process and on the environment. Propellant alternatives include the PBAN formulation used in the RSRMs, various formulations of HTPB similar to the Pershing rocket motor propellant, and others. Configuration alternatives include 2-, 3-, and 4- segment designs. Waste propellant disposal alternatives include open pit burning, incineration, and ammonium perchlorate recovery. Open pit burning is the method used in the past, and the most probable method for waste propellant disposal for the immediate future.

ALTERNATIVE SITES

Three government-owned sites that could be used for production and/or testing of the ASRM are described below.

John C. Stennis Space Center

John C. Stennis Space Center (SSC) is located in southern Mississippi, on the East Pearl River, near the Gulf of Mexico in Hancock County. The SSC reservation consists of 13,480 acres in fee ownership plus 125,327 acres of buffer zone controlled by perpetual easement.

SSC has most recently been used as the site of Space Shuttle main-engine testing and, in the past, for Saturn V rocket testing.

SSC is accessible by Interstate, U.S., and state highways. It is also served by the Southern Railroad. Barge access to the Gulf of Mexico is provided through on-site canals that connect with the East Pearl River.

An area of 2,100 acres has been identified as a potential site for production and/or testing of the ASRM. The majority of the site (1,700 acres) is currently permitted for use by the Mississippi Army Ammunition Plant.

Yellow Creek Site

The Yellow Creek site is located in the extreme northeastern corner of Mississippi, about 12 miles from the town of Iuka, in Tishomingo County. The 1,168 acre site is situated along the shoreline of the Yellow Creek embayment of Pickwick Lake. The Yellow Creek embayment adjoins the Tennessee-Tombigbee Waterway, which connects the Tennessee River System with the Gulf Coast and Intracoastal Waterway.

The Yellow Creek site is the location of TVA's partially built Yellow Creek Nuclear Plant Units 1 and 2. The TVA project was officially cancelled in 1984. The site is about two-thirds cleared of trees, and has a number of facilities including potable water, electric power, rail access, a barge dock, about 700,000 square feet of warehouses and other buildings, and foundations for a cooling tower and other structures.

The site is being considered only for ASRM production, not static testing.

John F. Kennedy Space Center

The John F. Kennedy Space Center (KSC) is located on the east central Florida coast at Cape Canaveral. Of the 139,890-acre KSC reservation, NASA has operational control of 6,507 acres. KSC and Cape Canaveral Air Force Station on the KSC southern border are currently rocket launch sites.

Space Shuttle solid rocket boosters are currently retrieved from the Atlantic Ocean after a launch and disassembled at KSC. It is assumed that the existing disassembly and refurbishing operations will be retained regardless of which site is selected for production of the ASRM.

The KSC site has two potential areas that could be used for some or all of the ASRM production and testing operations.

Area B:

Area B, near the center of KSC, contains about 2,600 acres and is sufficiently large to be considered for both production and testing of ASRMs. Because of its proximity to water, rail, and road transportation routes, Area B has excellent access from the outside and from within KSC.

Area C:

Area C is smaller than Area B. Of its 1,600 acres, as much as 15 percent is only marginally suitable for development due to wet conditions. Because of its limited size, Area C is considered here only as a site for ASRM static testing. Area C lies within the boundaries of Cape Canaveral Air Force Station.

EVALUATION METHODS

The determination of environmental consequences associated with constructing and operating ASRM manufacturing and/or testing facilities was made using a four-step process, which included the identification of a cause-effect network, the definition of criteria by which the significance of impacts could be judged, the quantitative or qualitative evaluation of the size of each impact compared to the baseline condition, and the evaluation of significance by comparing the size of the impact to the significance criteria definitions.

The significance of each impact was determined systematically by assessing four parameters of environmental impact: magnitude (how much), extent (sphere of influence), duration, and likelihood of occurrence. Based on the assessment of the four parameters, each impact at each site was given an overall rating. The use of the terms very significant, moderately significant, and insignificant throughout the EIS are based on the predetermined set of parameter definitions and criteria which define those terms.

ENVIRONMENTAL CONSEQUENCES OF SITING THE ASRM AT STENNIS SPACE CENTER

Air Resources

The primary air quality concerns related to manufacturing ASRMs are solvent emissions and emissions during waste propellant open-burning. Solvent emissions consist of several hydrocarbons, which are precursors to the formation of ozone, a regulated pollutant. Since the area around SSC is considered attainment for ozone standards, the solvent emissions will be subject to controls which demonstrate that Best Available Control Technologies (BACT) are employed and that the ozone standard will not be exceeded.

Open burning emissions, which include the same constituents released during ASRM tests, cannot be controlled. Modeling indicates that open-burning will comply with ambient air quality standards and health guidelines, although short-term concentrations are significant.

ASRM testing will result in significant emissions of particulate matter (primarily aluminum oxide), carbon monoxide, and hydrogen chloride on about four occasions per year during the development phase, and about twice per year in later years. No feasible control technology is available for test emissions. Modeling indicates that testing will comply with ambient air quality standards and health guidelines.

Ancillary emissions associated with the construction and operation of the ASRM facility, such as fugitive dust emissions, construction vehicle and commuter traffic exhaust emissions, and emissions from fuel-burning equipment, are expected to have an insignificant impact on air quality based on modeling results.

Water Resources

Natural hydrological conditions at the site and mitigation measured agreed to by NASA reduce the potential impacts on the groundwater system to insignificant levels. Potential impacts on supply of groundwater are insignificant because 1) the site has abundant supplies that will meet anticipated needs without significant impact to local or regional supplies, and 2) NASA has agreed that critical recharge areas will be avoided and all areas temporarily disturbed by construction will be revegetated, thereby preventing excessive runoff and encouraging infiltration.

Concerns about discharges of process or sanitary water, leaky landfills, open burning on the ground, static testing, and accidental spills of hazardous substances are considered insignificant because of mitigations by NASA.

Most surface water quality impacts would be mitigated through compliance with regulatory criteria and guidelines and through properly designed supply and treatment systems. The runoff zones, flow, and/or channels in Wolf Branch and Lion Branch may be altered, which is considered a moderately significant impact. Discharges to the Jourdan watershed may require regulation. Some minor, temporary pH depression may be observed during static testing in the adjacent water bodies. In case of an accident or spill of hazardous materials, some temporary, reversible degradation of the associated receiving water body could occur. Water supply does not appear to be a concern at this site, due to abundant groundwater sources and potential adjacent surface water body supplies.

Land Resources

The impacts to the geological resources of locating the proposed facility at Stennis Space Center are generally insignificant. Two moderately significant impacts are the deposition of residues from the static testing rocket exhaust and the effects of corrosive soils on subsurface facilities at the site. There is also the possibility of soil erosion in the zone where the rocket blast may impinge, but this effect is not significant due to the use of a deflection ramp.

Wetlands and Floodplains

There is no evidence of areas meeting the U.S. Army Corps of Engineers' criteria for wetlands within the ASRM site.

The 100-year floodplain for Lion Branch may be within the ASRM site, but FEMA and SSC floodplain maps are not in agreement. FEMA and SSC planners should resolve the contradictions between the two maps. If the floodplain is confirmed, there are sufficiently large areas outside the FEMA floodplain within which to place ASRM buildings. In the unlikely event that the floodplain could not be avoided, buildings and construction access will be designed to National Flood Insurance standards, therefore, impacts on the floodplain would be insignificant.

Biotic Resources

Construction of the ASRM production and/or test facilities at SSC would probably eliminate or disturb areas of bottomland hardwood and pitcher plant bogs. Both of these plant communities are unusual and/or diminishing resources and provide habitat for several plant species of concern in Mississippi. Consequently, these impacts would be moderately significant. Because ASRM construction at SSC would permanently eliminate about 25 percent of the habitat on the ASRM site, impacts on wildlife would also be moderately significant.

Static testing at SSC would release a hot exhaust plume and generate high noise levels. However, no significant impacts from static testing are expected on vegetation or wildlife outside the 92-acre area in the immediate vicinity of the test stand and deflection ramp.

Impacts to aquatic resources at SSC are expected to be insignificant because the site has relatively flat terrain, the few affected streams are only intermittent drainageways with no unique species, and NASA will develop and implement a sedimentation and erosion control plan that avoids or minimizes impacts from site runoff or dredging. Static testing is not anticipated to impact aquatic resources because the distance to major water bodies will allow significant dispersion of exhaust cloud components (e.g., HCl and aluminum oxide) before contact with water.

The USFWS has no records of the occurrence of any federally-designated threatened or endangered species within the ASRM site at SSC. However, the bald eagle, an endangered species, and the gopher tortoise and ringed sawbacked turtle, both threatened species, occur in the SSC buffer area. Recently, the ring sawbacked turtle has been observed in the SSC fee area and may occur within the ASRM site. Construction of the static test stand may impact the ring sawbacked turtle and noise from static testing may impact the bald eagles reported to be nesting in the SSC buffer area. Consequently, these impacts would be moderately significant. In order to meet the requirements of the Endangered Species Act, Biological Assessments will be necessary for the bald eagle and the ring sawbacked turtle.

If the ASRM is manufactured at SSC, ASRM segments may require barge transportation to KSC for launch. Part of the transportation system will likely include the inland portion of the Banana River at KSC, which is currently designated as critical habitat for the Florida manatee, an endangered species. Transportation impacts on the manatee are expected to be moderately significant, and a Biological Assessment will be required.

Land Use

ASRM testing and production would be consistent with the master plan at SSC. Some needed land currently under permit to the Army is being transferred back to NASA.

Noise from static testing is predicted to have a moderately significant impact at the Jourdan River, which has potential for designation into the Federal Wild and Scenic Rivers Program, because the noise would be incompatible with the type of experience intended for users of Wild and Scenic Rivers. An increase in barge transportation on the Pearl River, also potentially eligible for designation as Wild and Scenic, would also have a moderately significant impact.

ASRM static testing would potentially create audible disturbances to motorists on Interstate 10 as well as residential, commercial, and recreational uses just outside the buffer zone. Since the tests are for very short intervals and will occur at most only four times a year, the impact is rated moderately significant.

Socioeconomics and Infrastructure

Immigrating employees and their families would moderately impact a portion of the SSC study area, primarily Hancock and Pearl River counties. The remainder would be insignificantly impacted. This population increase would in turn have moderately significant negative impacts on current law enforcement staffing levels in Pearl River County and add to overcrowding in the Hancock and Pearl River County school systems. The physician-to-population ratios in Hancock and Pearl River counties, already below the national average, would decrease even further. The project-induced impacts on public utilities will be insignificant throughout the study area. School enrollments in Hancock and Pearl River counties will increase significantly and may require the addition of teaching staff to maintain current teacher/student ratios. The remaining counties will be insignificantly impacted.

Per capita income levels are expected to increase minimally as the average wage goes up and the unemployment rate goes down. The current depressed housing market should be able to absorb the increased housing demand associated with employees moving to the area.

Transportation

Commuter traffic generated by the ASRM project would cause moderately significant impacts to the existing local road network. Traffic service levels would be decreased on the primary access routes servicing SSC, although in no cases would service decline to level of service (LOS) D, the standard benchmark indicator of the need for capacity improvements.

Transportation of raw materials by rail and/or barge to SSC would not have any significant impact on the capacity of the existing transportation system. Similarly, the shipment of finished ASRM segments from SSC would be feasible by either rail or barge.

Transportation of ASRM materials, primarily finished ASRM segments, would have a moderately significant impact related to potential accidents from shipment of hazardous materials. The probability of a serious transportation accident is extremely low, but the consequences of such an accident could include major property damage and possible loss of human life. Barge transportation of ASRM segments is considered to be safer than rail transportation, although a distinction in level of impact was not made between the two modes.

Historic, Archaeological, and Cultural Resources

Cultural resources surveys of the proposed ASRM production and testing areas have not resulted in discovery of archaeological or historical sites. If buried archaeological sites were discovered during construction, NASA would consult with the Mississippi State Historic Preservation Officer (SHPO) to determine the significance. NASA and the SHPO would plan and execute mitigation measures if the sites were determined significant.

Solid and Hazardous Waste and Toxic Substances and Pesticides

The 21-acre sanitary landfill on-site at SSC has an estimated remaining life-span of 18 years. Surface water runoff is diverted away from the facility to reduce infiltration and leachate generation. Groundwater monitoring is currently in place to monitor for contamination of the subsurface aquifers. Operational and environmental impacts to the current solid waste disposal system are expected to be minimal.

Hazardous wastes generated on-site by existing production and pest management and control programs are shipped off-site to RCRA permitted facilities. No impacts are anticipated. An increase in the volume of wastes handled is likely to result in an increased potential for spills of hazardous substances. Emergency response plans will be revised to accommodate the increase in management and handling activities.

The existing PCB decommissioning program and asbestos disruption/removal program will continue under the current health and safety protocol and will not be affected.

Radioactive Materials and Nonionizing Radiation

Testing of motor assemblies may require a particle accelerator for generating x-rays. The accelerator will be properly shielded to protect workers and the public, and the radiation source will have an insignificant impact on the environment.

Noise

Static testing will produce a moderately significant noise impact on the SSC fee and buffer area. Static test firings will last for 130 seconds and will occur four or five times per year in the initial years of the program and then two to four times a year thereafter. Pressure waves produced from these tests would be capable of damaging light-weight structures within the buffer zone (6 miles from the test stand). However, the restrictive easement on all land within the buffer zone prohibits all inhabitable, lightweight structures. Population centers, such as Picayune and Bay St. Louis will experience noise levels less than 70 dB(A), and drivers along Interstate 10 could be exposed to noise levels in the range of 80 to 85 dB(A) for a distance of about 3 miles. Warning signs could be placed along the highway to inform motorists of the source of this noise. Construction and facility operation noise will be close to background levels at the interior boundary of the SSC buffer zone, and therefore will be indistinguishable to the general public.

Public Health and Safety

Moderately significant public and industrial health and safety impacts from production and testing of the ASRM at SSC include possible exposure of workers to hazardous chemicals, accidental exposure of workers as a result of spills or leaks, potential explosive and/or fire hazards associated with ASRM production, static testing, transport, and waste propellant disposal, and air quality impacts associated with waste propellant disposal.

Most of these hazards would exist to some degree at any of the three proposed ASRM production sites. However, due to the large separation of from the public, health and safety issues may be of less concern at this site relative to the others.

ENVIRONMENTAL CONSEQUENCES OF SITING THE ASRM AT YELLOW CREEK

Air Resources

This site is proposed only for ASRM manufacturing, therefore, as at SSC, the primary air quality concerns are solvent emissions and emissions during waste propellant open burning. The solvent emission controls implemented at Yellow Creek will be the same as those described for SSC.

As at SSC, open burning emissions cannot be controlled. Although short-term concentrations of particulates are significant, open burning will comply with ambient standards and health guidelines.

Although Yellow Creek lies in an area considered to be attainment for all applicable air quality standards, the regional climatology indicates that this site has the highest potential for limited atmospheric dispersion conditions of the three government-owned sites under consideration. However, since the site is far removed from urban sources of air pollution, ancillary emissions associated with the construction and operation of the ASRM facility are expected to have insignificant impacts based on modelling results.

Water Resources

The low to very low hydraulic conductivities of aquifers beneath the site eliminate groundwater as a source of water supply for the site. NASA has agreed to protect the limited supplies in the unconfined aquifer by avoiding critical recharge areas during construction, and revegetating any areas disturbed during construction. Concerns about potential groundwater pollution are considered insignificant because of mitigations by NASA.

Surface water quality impacts will be mitigated through compliance with regulatory criteria and guidelines through properly engineered supply and treatment systems. The two disassembled wastewater treatment systems (sanitary) will be reinstalled. In case of an accident or spill of hazardous substances, some temporary, reversible degradation of the receiving water body could occur. Water supply does not appear as a concern at this site due to the adequacy of existing systems, including on-site industrial supply from Yellow Creek/Pickwick Lake.

Land Resources

The impacts to geological resources of locating the proposed facility at the Yellow Creek site are generally insignificant. Special consideration was given to the possibility of erosion because of susceptible soils and steep slopes originally at the site. However, the impact of soil erosion is considered insignificant because of the various mitigation measures that have been and will be implemented to avoid it, particularly if, as proposed, new construction takes place primarily in areas already terraced during previous construction.

The subsurface conditions at the site are relatively competent and will not require any special design to avoid building settlement (although seismic design requirements are slightly higher here than at other sites). In addition, the soils are not as corrosive as at either of the alternative sites. There is some potential for landsliding; however, with the competent materials on-site, this is not a significant hazard.

Wetlands and Floodplains

Impacts to wetlands at the Yellow Creek site are insignificant. TVA dams on the Tennessee River, reduce the risk of potential floodplain impacts at the Yellow Creek site. All facilities would be located above the 500-year floodplain.

Biotic Resources

ASRM construction impacts to biological resources at Yellow Creek are expected to be insignificant. Over two thirds of the Yellow Creek site has been disturbed by past TVA construction activities, and most of the ASRM development will take place in this area. Most of the vegetation in this area consists of forbs and grasses planted for erosion control and provides habitat for relatively few species.

Impacts to a aquatic resources at Yellow Creek are expected to be insignificant because major site excavations have already occurred at the site. Additional impacts will be avoided by development and implementation of a sedimentation and erosion control, as at SSC.

No threatened or endangered species have been documented on the Yellow Creek site. ASRM construction and operation should not impact bald eagles wintering in the nearby Cooper Creek Natural Area.

ASRM manufacturing at Yellow Creek may require barge transport of ASRM segments from Yellow Creek to KSC. Potential impacts to the Florida manatee at KSC are considered moderately significant, and a Biological Assessment will be required.

Land Use

ASRM production and manufacturing at Yellow Creek would not be consistent with TVA's Pickwick Reservoir Plan. No local land use plan exists. Existing recreation uses of Goat Island will be prohibited, a moderately significant impact. The noise level at nearby residences will be increased sufficiently to be considered a moderately significant impact. Development of nearby lands will probably be accelerated unless controlled by some form of buffer zone.

Socioeconomics and Infrastructure

Impacts on the population base in the Yellow Creek study area are expected to be insignificant everywhere but in Tishomingo County. This predominantly rural county would be moderately impacted. Unemployment level reductions will be very significant, especially in Tishomingo County. The added population would increase the demands on currently understaffed law enforcement agencies, marginally affecting several counties throughout the study area and having a moderately significant impact in Tishomingo County. Furthermore, an increase in school enrollment would have a moderately significant impact on the already overcrowded Tishomingo County schools and marginally impact the rest of the study area, resulting in additional overcrowding. Due to the current physician and nursing shortages, project-induced population increases would have a significantly adverse effect on Tishomingo County, and would make the existing situation marginally worse in Hardin and Alcorn counties. Colbert and Lauderdale counties will be relatively unaffected. Project-induced impacts on most public utilities in the study area would be insignificant. New landfill facilities will be needed in Tishomingo County with or without the project, but the project-induced population increase will only insignificantly add to the existing waste stream.

Per capita income rates should rise with the decrease in unemployment and the increase in the average wage. Additional tax revenues generated because of the project may not be enough to offset the need for additional law enforcement, fire protection, and school system facilities. Current housing availability should be able to meet any project-induced demand. Although the current housing market is depressed, price speculation is already apparent and will probably moderately affect study area housing prices over the life of the project.

Transportation

Commuter traffic generated by the ASRM project would cause moderately significant impacts to the existing local road network. Traffic service levels would be decreased on Mississippi 25 and Red Sulphur Springs Road, which would be used by all vehicles to reach the Yellow Creek site. Service on two segments of Mississippi 25 would be decreased to level of service (LOS) D, indicating a need for system improvements. Pending more detailed evaluation, measures to increase capacity and/or decrease the number of ASRM commuter vehicles may be warranted.

As at SSC, transportation of raw materials to Yellow Creek would not have any significant impacts on the capacity of the existing transportation system. The shipment of finished ASRM segments from Yellow Creek to either SSC or KSC would be feasible by either rail or barge.

As described for SSC, transportation of ASRM raw materials, primarily finished ASRM segments, would have moderately significant impacts related to potential accidents from shipment of hazardous materials.

Historical, Archaeological, and Cultural Resources

Cultural resources surveys for the Yellow Creek Power Plant resulted in discovery of 227 archaeological sites within the proposed ASRM production facility boundaries. Because of quantity and uniqueness of these sites, Tennessee Valley Authority (TVA) nominated the sites, as a district, to the National Register of Historic Places in order to document their eligibility for nomination. TVA completed a program of archaeological data recovery to mitigate the power plant's potential adverse effects on this district. After completing this mitigation program, the TVA determined that the project's effects on the district would not be adverse. The Advisory Council on Historic Preservation nd the Mississippi State Historic Preservation Officer (SHPO) concurred with this determination. Because of the TVA mitigation effort, the proposed ASRM production facility would also not adversely affect the sites. If buried archaeological sites were discovered during the construction process, NASA would consult with the SHPO to determine their significance, and they would plan and execute mitigation measures if the sites were determined significant.

Solid and Hazardous Wastes and Toxic Substances and Pesticides

The sanitary landfill in Tishomingo County, Mississippi has an estimated life of 2 years. Either a new county landfill or a landfill developed by NASA will be utilized for non-hazardous wastes. Based on the small volume of waste, the impact will be insignificant.

Hazardous wastes generated from the ASRM production facility will be shipped-offsite to RCRA permitted facilities. No impacts are anticipated. A spill prevention control and counter-measure plan, and the requisite emergency response plans and reporting requirements must be initiated to comply with CERCLA/SARA.

Radioactive Materials and Nonionizing Radiation

As described for SSC, any radiation source will have an insignificant impact on the environment.

Noise

No static testing will occur at the Yellow Creek site. Activities associated with construction, operations, and vehicular traffic will produce noise levels that decrease to background levels within 0.6 mile away from the source. Impacts will be moderately significant for residents closer than 0.6 mile from the construction area.

Public Health and Safety

Moderately significant public and industrial health and safety impacts from production of the ASRM at Yellow Creek are for the most part the same as those at SSC. These impacts include possible exposure of workers to hazardous chemicals, accidental exposure of workers to spills or leaks, potential explosive and/or fire hazards, and air quality impacts associated with waste propellant burning. Additionally, because there are residences and a church close to the site, an explosion on-site could shatter windows and expose building inhabitants to flying glass off-site.

ENVIRONMENTAL CONSEQUENCES OF SITING THE ASRM AT KENNEDY SPACE CENTER

Air Resources

Two sites at KSC have been identified for either ASRM manufacturing or testing. As at SSC and Yellow Creek, the primary air quality concerns related to manufacturing are solvent emissions and emission during waste propellant open-burning. The solvent emission controls implemented at KSC will be the same as those at SSC and Yellow Creek.

Open burning emission impacts are the same as SSC and Yellow Creek and will comply with ambient air quality standards.

ASRM testing impacts are the same for KSC as they are for SSC, however, impacts at KSC must be evaluated in conjunction with existing launch impacts. The additional emissions associated with testing will add to the existing emissions due to launches of all types at KSC and CCAFS. Modeling indicates tests will comply with ambient air quality standards.

As at SSC and Yellow Creek, ancillary emissions are expected to have insignificant impact based on modeling results.

Water Resources

Most potential impacts to water quality and water supply are similar to those described for SSC, and are insignificant. Some small surface ponds (wetlands) may be altered or relocated due to project construction, which is considered only a moderately significant, rather than very significant, impact because mitigative measures are incorporated to minimize affected areas.

The primary concern related to groundwater at KSC is contamination of the surficial aquifer from saltwater intrusion, which may affect surface water bodies and may occur if critical recharge areas are covered by facilities or the surficial aquifer is overpumped. NASA has agreed to avoid critical recharge areas when constructing the facilities, and to supplement natural recharge, thus, infiltration problems are considered insignificant. The surficial aquifer may provide low-yield, nonpotable process water from shallow wells in some areas, but because pumping even small quantities of water may cause a major salinity increase, the impact is considered moderately significant. Any pumping from the surficial aquifer should be carefully monitored to prevent overpumping. Should saltwater intrusion occur due to overpumping, switching to another water source should eventually reduce the saltwater intrusion.

Land Resources

The impacts to the geological resources of locating the proposed facility at KSC are generally insignificant. The one moderately significant impact, after reasonable provisions of mitigation, is the deposition of residues from the static testing rocket exhaust. Coastal dune erosion from testing would be reduced to an insignificant impact using erosion control measures during construction of the deflection ramp.

Wetlands and Floodplains

Construction of ASRM facilities in Area B would directly impact an estimated 125 acres of wetlands. Mitigation for these wetlands would include creation of new wetlands or enhancement of existing wetlands. Mitigation will be determined through consultation with federal and state resource management agencies. Even with mitigation, filling these estimated 125 acres would produce a cumulative, moderately significant impact to a regionally decreasing resource. There are no construction impacts to wetlands in Area C since all facilities will be located in previously developed upland areas. Emissions from testing at Area B will result in insignificant impacts to wetland habitats due to low concentrations from the dispersion of the plume over a large area. Surface water discharge impacts are also insignificant because all runoff of waste effluents will be treated.

At Area C, all proposed construction is located above the 100 year floodplain. However, it is unlikely that construction and access roads can be located to completely avoid the 100 year floodplain at Area B. For facilities that cannot be located outside of the floodplain, all buildings would be designed to National Flood Insurance Program Standards or would be protected by dikes. Buildings or access roads would not impair the floodway, thereby resulting in insignificant impacts.

Biotic Resources

Construction in Area B at KSC would eliminate about 125 acres of wetlands. In Area C at least 32 acres of coastal dune vegetation and beach would be eliminated by test stand and deflection ramp construction. Both of these communities represent important and diminishing resources. Consequently, ASRM construction impacts in both Areas B and C would be moderately significant. Because ASRM construction would eliminate about 30 percent of the habitat in Area B and/or about 10 percent in Area C, impacts on wildlife would be moderately significant.

Static testing at KSC would release a hot exhaust plume and generate noise levels of 90 to 110 dB over most of Merritt Island. However, no significant impacts from static testing are expected on vegetation or wildlife outside the cleared area in the vicinity of the test stand and deflection ramp in either Area B or C.

Dredging and filling of wetlands during construction would result in the loss or alteration of aquatic habitat at KSC in Area B. This would be a moderately significant impact.

Static testing is not anticipated to impact aquatic resources because the exhaust plume will be directed over the ocean, which has a high buffering capacity and mixing zone, and significant dispersion of exhaust cloud components (e.g., HCl and aluminum oxide) will occur before contact with the water.

Moderately significant impacts would be expected on three threatened or endangered species from ASRM construction in Area B. Biological Assessments would be required for the woodstork, Florida scrub jay, and eastern indigo snake. Area C provides nesting habitat for both the Atlantic green turtle, an endangered species, and loggerhead turtle, a threatened species. Construction of the test stand would significantly impact sea turtles; impacts to the Florida scrub jay and eastern indigo snake would be moderately significant. Biological Assessments would be required for these species.

Noise from static testing in the immediate vicinity of the static test stand and deflection ramp may damage the hearing of any wildlife present. However, it is expected that few if any threatened or endangered species would be present in the area. No impacts from impulse on steady state noise have been demonstrated on wildlife reproductive success or productivity. However, the effects of noise levels over 100 dB for over two minutes are unknown. Consequently, static testing impacts on threatened and endangered species are expected to be moderately significant, and Biological Assessments would be required.

If the ASRM is manufactured at SSC or Yellow Creek, rather than at KSC, ASRM segments may be transported to KSC by barge. Potential impacts to the Florida manatee are considered moderately significant.

Land Use

ASRM testing and production would be consistent with the KSC master plan at Area B. The use of Area C, however, would be in conflict with Air Force planned land uses. This is a moderately significant impact. Extensive cooperation between NASA and the Air Force would be required to ensure operational needs, such as lines of sight, are not impacted. The proposed project appears to be consistent with the Florida Coastal Zone Program.

Socioeconomics and Infrastructure

Due to the size and density of the population base in the KSC study area, impacts on population, employment, and income will be insignificant, as will impacts on law enforcement and fire protection services. School enrollment should increase moderately but will stay below the teacher to student ratio standard. Physician-to-population ratio changes would be insignificant, but any population increase would add to the existing shortage of doctors in the area. Hospitals and registered nurse staffing levels will be insignificantly affected.

Public utilities in Brevard County will be able to handle any project-induced increase in demand with the exception of Titusville, where the water and sewer systems are currently at capacity and will have to be expanded with or without the project.

The building industry in Brevard County will be able to provide the necessary housing for the incoming workers. Revenues generated from property sales and other taxes will be a net benefit to local governments but will probably not be enough to offset the demand for additional services and facilities that may be needed.

Transportation

Commuter traffic generated by the ASRM project would probably not cause significant impacts to the existing local road network. This is due to the planned expansion of North Courtenay Parkway, between Gate 2 and Florida 528, from two lanes to four, which would alleviate an existing congestion problem and prevent a major service decrease with the addition of ASRM commuter traffic. If the planned expansion is not implemented in the next three years, ASRM traffic would create significant impacts in this location. The ASRM project will also increase traffic flow on other key approach routes, primarily Florida 528 and 405, but these roads have available capacity, and acceptable service levels will be maintained.

Transportation of raw materials by rail and/or barge to KSC for the production process would not have any significant impacts on the capacity of the existing transportation system. Development of the KSC site would largely or totally eliminate the need to transport ASRM segments off-site, and therefore avoids significant impacts from potential transportation accidents.

Historical, Archaeological, and Cultural Resources

Archaeological surveys of Areas B and C have not been completed. Previous KSC surveys, however, have led to the discovery of five prehistoric sites, one historic site, and two modern rocket launch facilities of potential historic significance within the proposed ASRM facility boundaries in Area C, and two prehistoric sites of potential significance within Area B. It might be possible for NASA to avoid these sites during construction and operation of the ASRM facility, but if not, NASA would plan a testing program to determine their significance, in consultation with the Florida State Historic Preservation Officer (SHPO). If significant, NASA and SHPO would plan appropriate mitigation measures in compliance with Section 106 of the National Historic Preservation Act and its implementing regulations.

Because KSC is relatively sensitive archaeologically, it is possible that a complete survey of the proposed ASRM facilities sites would lead to the discovery of additional archaeological sites. If additional sites are discovered during the construction process, NASA would consult with the SHPO to determine their significance, and they would plan and execute mitigation measures if the sites were determined significant.

Solid and Hazardous Waste and Toxic Substances and Pesticides

The existing Class III landfill on-site is licensed for disposal of construction debris. The estimated remaining life of the facility is 5 to 10 years. Other solid wastes are shipped off-site to the Brevard County Class I landfill. The impacts to these facilities are not expected to be significant.

Concurrently, there are two hazardous waste storage facilities on-site at KSC. ASRM operations will use these facilities for storage for accumulation prior to off-site shipment to a RCRA-permitted disposal facility, thus impacts are expected to be moderately significant. Emergency response plans will be revised to include ASRM facilities and emergency response planning needs. Reports to local emergency response officials will also be revised.

The pest management program will be expanded to include ASRM facilities. No PCBs or asbestos control programs are known to be needed.

Radioactive Materials and Nonionizing Radiation

As described for SSC and Yellow Creek, any radiation source will have an insignificant impact on the environment.

Noise

Static testing will produce a moderately significant noise impact. Static testing frequency will be the same for KSC as for SSC. Large areas of KSC, CCAFS, and surrounding areas will be subjected to modest levels of predominantly low frequency noise. This would be capable of damaging light-weight structures more than a mile away from the test stand; however, no population centers should be significantly affected. Despite the high noise level generated by testing, it will not be as loud as Space Shuttle launches, which produce noise from two ASRMs plus the main engine. For the two sites proposed for testing, the highest noise levels will occur over engine. For the two sites proposed for testing, the highest noise levels will occur over the water or within the boundaries of KSC.

Public Health and Safety

Public and industrial health and safety impacts associated specifically with production and testing of the ASRM at KSC are similar to SSC, but add to impacts from launch-related activities at KSC.

GLOSSARY OF ABBREVIATIONS

AADT	Average annual daily traffic
ACGIH	American Conference of Governmental Industrial Hygienist
ADT	Average daily traffic
AHA	American Hospital Association
Al	Aluminum
Al_2O_3	Aluminum Oxide
ALS	Advanced Launch System
AN	Ammonium nitrate
AP	Ammonium perchlorate
ASRM	Advanced Solid Rocket Motor
Avg.	Average
BACT	Best available control technology
BLM	Bureau of Land Management
BOD_5	Biological oxygen demand
Btu	British thermal unit
BWT	Black Warrior-Tombigbee Waterway
Ca	Calcium
CAS	Chemical Abstracts Service
CCAFS	Cape Canaveral Air Force Station
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Register
cfs	cubic feet per second
CITIES	Convention of International Trade in Endangered Species
Cl	Chlorine
CNS	Canaveral National Seashore
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical oxygen demand
Cr	Chromium
Cu	Copper
cu. yd.	Cubic yard
CWA	Clean Water Act
CZMA	Coastal Zone Management Act

dB	Decibel
dB(A)	A-weighted decibels
DDD	Dichloro-diphenyl-dichloroethane
DDE	1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene
DDT	Dichloro-diphenyl-trichloroethane
DMR	Discharge monitoring report
DO	Dissolved oxygen
DOD	Department of Defense
DPRD	Design and Performance Requirements Document
EEO	Equal Employment Opportunity
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPDM	Ethylene-propylene-diene-monomer
EP Tox	Extraction Procedure Toxicity Test
ERC	Environmental Regulatory Commission
ET	External tank
EWI	Explosive waste incinerator
FAA	Federal Aviation Administration
FCMP	Florida Coastal Management Program
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDA	Florida Department of Agriculture
FDER	Florida Department of Environmetal Regulation
Fe_2O_3	Ferrous oxide
Fecal Col.	Fecal coliform
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FL	Florida
FNAI	Florida Natural Areas Inventory
FR	Federal Register
ft^2	Square feet
GA	Georgia
gal	Gallon
GFC	Florida Game and Fresh Water Fish Commission
gpd	Gallons per day
gpm	Gallons per minute

H_2	Hydrogen
H_2O	Water
HCN	Cyanide
HCl	Hydrogen chloride
HMX	Cyclotetramethylene tetranitramine
HSWA	Hazardous and Solid Waste Amendments
HTPB	Hydroxyl terminated polybutadiene
IL	Illinois
in	Inch
IPDI	Isophorone diisocyanate
JANNAF	Joint Army Navy NASA Air Force (Propulsion Committee)
JTU	Jackson turbidity units
K	Potassium
kg	Kilogram
km	Kilometer
KSC	Kennedy Space Center
kV	Kilovolt
LA	Louisiana
lbs	Pounds
Leq	Average sound levels
LOS	Level of service
m	Meter
MAAP	Mississippi Army Ammunition Plant
MAF	Michoud Assembly Facility
max.	Maximum
MDNR	Mississippi Department of Natural Resources
MDWC	Mississippi Department of Wildlife Conservation
MeV	Million electron volt
Mg	Magnesium
mg/l	Milligram per liter
mg/m^3	Milligram per cubic meter
MGO	Million gallons per day
mi	Mile
min.	Minimum
MINWR	Merritt Island National Wildlife Refuge
MM	Modified Mercalli
mph	Miles per hour
mR/hr	Millirad per hour

mrem	Millirem
MS	Mississippi
MSAAP	Mississippi Army Ammunition Plant
MSDS	Material Safety Data Sheets
MSFC	Marshall Space Flight Center
msl	Mean sea level
μmho	Micromho
μs/cm	Microsecond per centimeter
$\mu g/m^3$	Microgram per cubic meter
N_2	Nitrogen
Na	Sodium
$NaClO_4$	Sodium perchlorate
NASA	National Aeronautics and Space Administration
NCRP	National Council for Radiation Protection
NDE	Nondestructive evaluation program
NEPA	National Environmental Policy Act
NH_4BrO_3	Ammonium bromide
NH_4Cl	Ammonium chloride
NH_4ClO_4	Ammonium perchlorate
Ni	Nickel
nm	Nautical miles
no.	Number
NO_x	Nitrogen oxide
NPDES	National Pollution Discharge Elimination System
NRC	National Research Council
NSTL	National Space Technology Laboratories (see SSC)
NTU	Nephelometric turbidity unit
NV	Nevada
OASPL	Overall sound pressure level
OBSPL	Octave band sound pressure level (dB)
OFW	Outstanding Florida waters
OSHA	Occupational Safety and Health Administration
P	Phosphorus
PAMS	Permanent Air Monitoring System
Pb	Lead
PBAN	Polybutadiene acrylonitrile
PCAD	Products of combustion and dispersion (air quality model)
PCB	Polychlorinated biphenyl
ppm	Parts per million

ppt	Parts per thousand
PSD	Prevention of Significant Deterioration
psf	Pound per square foot
psig	Pounds per square inch gauge
QD	Quantity distance
RCRA	Resource Conservation and Recovery Act
RQ	Reportable quantity of hazardous material
RSRM	Redesigned Solid Rocket Motor
S.U.	Standard unit
SARA	Superfund Amendments and Reauthorization Act
SD	Standard deviation
sec	Second
Sec.	Section
scfm	Standard cubic feet per minute
SHPO	State Historic Preservation Officer
Si	Silicon
SMPDD	Southern Mississippi Planning and Development District
SO_2	Sulfur dioxide
SPCC	Spill prevention, control, and countermeasure plan
sq. mi	Square mile
sq. yd.	Square yard
SRB	Solid Rocket Booster
SRM	Solid Rocket Motor
SRM DD&T	Solid Rocket Motor Design, Development, Test, and Evaluation
SSC	Stennis Space Center
Sta	Station
STS	Space transport system
SWMU	Solid waste management unit
TCP	Total complexed phosphorus
TCR	Toxic Chemical Release
TDS	Total Dissolved Solids
Temp.	Temperature
TKN	Total Kjeldahl Nitrogen
TLV	Threshold limit value
TN	Tennessee
TOC	Total Organic Carbon
TP	Total Particulates
TSCA	Toxic Substances Control Act
TSP	Total Standard Particulate

TSS	Total Suspended Solids
TTW	Tennessee-Tombigbee Waterway
TVA	Tennessee Valley Authority
ULV	Ultraviolet ray
umho	Micromho
us/cm	Microsecond per centimeter
ug/m^3	Microgram per cubic meter
USACOE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAB	Vertical assembly building (at KSC)
VAFB	Vandenberg Air Force Base
VIC	Visitors Information Center
VMT	Vehicle miles traveled
WI	Wisconsin
YF	Yard freight
yr	Year
Zn	Zinc

1.0 PURPOSE AND NEED

1.1 BACKGROUND OF THE ASRM PROGRAM

Since 1977 the Space Shuttle has consisted of a manned reusable orbiter, an expendable external tank (ET) as containment for liquid hydrogen (fuel) and liquid oxygen (oxidizer), and two recoverable and reusable Solid Rocket Boosters (SRBs). Each SRB is composed of several subsystems, including the Solid Rocket Motor (SRM) with its ignitor and nozzle.

In 1986, NASA contracted for a Redesigned SRM (RSRM). In accordance with the President's Space Policy, NASA prepared the "Space Shuttle Solid Rocket Motor Proposed Acquisition Strategy and Plan" of March 31, 1987, and presented to Congress three options for future action to further improve the SRMs. These options were:

- Recompetition of the RSRM;
- Continued single source procurement of the RSRM; and
- Competitive acquisition of an advanced SRM (ASRM).

NASA recommended the third option, to develop an ASRM, which received congressional approval in October 1987 by passage of the NASA Authorization Act of 1988. In March 1988, NASA published an Acquisition Plan to proceed with implementation of an ASRM Program to be contracted through full and open competition. The ASRM is to incorporate design changes that will improve system reliability, safety, and performance.

In order to achieve the level of process control needed for the improved system safety, reliability, and performance, NASA concluded that modern production processes and, consequently, new facilities are required for the ASRM program. NASA's intent is to use an existing government-owned site where a facility would be designed, built, and operated by the selected contractor. A NASA Site Evaluation Board was formed to evaluate site options for the ASRM facilities. Subsequent to that evaluation process, NASA initiated preparation of this programmatic Environmental Impact Statement (EIS), which will address NASA's decisions to proceed with the ASRM Program in compliance with the National Environmental Policy Act (NEPA) (see Section 1.4).

The proposed project schedule calls for contractor selection, completion of the EIS, site selection, and groundbreaking in early 1989. Construction of facilities, motor development, and initial production of the first pairs of operational ASRMs will extend over about five years, leading to a first flight of the Space Shuttle using the ASRMs as early as 1994. The ASRM program is expected to continue until 2020.

1.2 ASRM GOAL AND OBJECTIVES

The ASRM Program goal is to enhance shuttle system reliability, safety, and performance. The specific objectives stated in the NASA Acquisition Plan (NASA 1988m) are to:

- Improve flight safety design margins;

- Improve system reliability through enhanced quality and reproducibility;
- Achieve full shuttle payload capability;
- Optimize program cost;
- Encourage commercial initiatives; and
- Promote a competitive solid rocket motor industry.

The ASRM Program also seeks to implement the President's goals for reducing federal expenditures and increasing opportunities for privatization of space-related industries by offering an opportunity for private investment in the ASRM production facility.

The ASRM Program's design goal is to produce a 12,000 pound payload increase which will equate to an additional 2.4 equivalent Shuttle missions per year at an annual flight rate of 14 missions (NASA 1988m). This will produce an early payback of the development cost and will achieve program cost reductions by increasing the payload capability of each launch. The ASRM Program will include motor production, static test firing, and refurbishing of hardware from previous missions. The motors produced will be shipped as multiple segments that are joined at the launch site.

1.3 ORGANIZATION AND APPROACH OF THE ASRM PROGRAM STUDIES

The ASRM Program is divided into 3 contract phases:

- Phase A - definition of alternate concepts to support space shuttle requirements;
- Phase B - preliminary design of ASRM concepts and facilities; and
- Phase C/D - ASRM design, development, testing, and evaluation (DDT&E) and design and construction of the ASRM production and test facilities.

Phases A and B have been completed. Results from Phases A and B have led to ASRM Program refinements and decisions by NASA regarding which program options to consider in detail at this time and which options to reject or defer for future consideration. As stated in NASA's Notice of Intent to Prepare an EIS (NASA 1988l), Phase B of the ASRM Program provided information on proposed facility baseline concepts, including waste processing effluents, testing emissions, and recognized environmental concerns.

1.4 SCOPE OF THE PROGRAMMATIC EIS

This EIS addresses programmatic and site considerations relevant to NASA's decision whether to proceed with Phase C/D and select a contractor to perform the ASRM DDT&E effort and to design and construct the ASRM production and testing facilities. The focus is on critical environmental issues that may influence the decision on one design or site versus another. This EIS has been prepared in accordance with the requirements of the NASA Handbook (NHB) 8800.11 "Implementing the Provisions of the National Environmental Policy Act (NEPA)." NASA intends that the EIS be a part of the overall evaluation process in contracting the ASRM Program.

This EIS addresses the environmental impacts associated with several ASRM program design alternatives for production and testing at any of three government-owned sites, including:

- the John C. Stennis Space Center (SSC), Mississippi;
- the Yellow Creek site, near Iuka, Mississippi, currently in the custody and control of the Tennessee Valley Authority (TVA); and
- the John F. Kennedy Space Center (KSC), Florida.

To a large extent, this EIS also covers issues relevant to other agencies' related decisions, such as TVA's transfer of the Yellow Creek site to NASA. Additionally, this EIS presents information relevant to agencies with permitting authority for the project, such as the U.S. Army Corps of Engineers, the Environmental Protection Agency, and respective state agencies. When environmental permits are applied for, the applications will include additional data based on a more refined, rather than preliminary, project design.

The NASA preference for the production facility is the Yellow Creek site and for static testing, the Stennis Space Center. ASRMs produced at the completed facility will be used to launch the Space Shuttle at Kennedy Space Center, Cape Canaveral, Florida. In addition to the production and testing facility sites, NASA will make available up to 123,000 square feet of space for peripheral manufacturing activities and 17,000 square feet of office space at the Michoud Assembly Facility, New Orleans, Louisiana and office and computer space at the Slidell Computer Complex in Slidell, Louisiana. Environmental impacts of the use of these ancillary facilities are included in this EIS.

The EIS is organized to first describe the alternatives, including the manufacturing and testing activities and environmental mitigation measures which constitute the proposed ASRM Program (Sec. 2.1), various design alternatives (Sec. 2.2), the No Action alternative to the ASRM Program (Sec. 2.3), and a comparison of the No Action alternative with the other design and site alternatives (Sec. 2.4). The next three sections cover the existing environment and environmental consequences of locating ASRM manufacturing and/or testing facilities at Stennis Space Center (Sec. 3.0), Yellow Creek (Sec. 4.0), or Kennedy Space Center (Sec. 5.0). Section 6.0 discusses impacts associated with support activities at Michoud Assembly Facility and Slidell Computer Center. Subsequent sections include references (Sec. 7.0), a list of EIS preparers (Sec. 8.0), the EIS distribution list (Sec. 9.0), an index (Sec. 10.0), and appendices.

1.5 ALTERNATIVES NOT CONSIDERED IN DETAIL

Several design and site alternatives are not under consideration by NASA at this time as a result of findings in earlier stages of the program study.

1.5.1 Design Alternatives

Insulation

The RSRM uses asbestos-filled nitrile butadiene rubber and asbestos/silica case insulation. This will be replaced with new materials. According to Requirement 3.2.1.8 of NASA's Design and Performance Requirements Document (DPRD) (J-1 attachment), "the insulation shall be free of any asbestos material" (NASA 1988e).

Configuration

The monolithic rocket motor is no longer under consideration. In the monolithic design, the entire ASRM case is filled with propellant in a single one-piece operation, while the segmented design employs sections that are cast separately and assembled later. The factors which excluded the monolithic design in favor of the segmented motor concept include the following:

- The feasibility of loading propellant into motors with a size and length-to-diameter ratio typical of monolithic motors has not been demonstrated.
- Major new equipment that departs from the experience base would be required to produce monolithic motors, and fewer options are available for handling and transportation of monolithic motors.
- Any process or assembly problems or incidents causing propellant ignition or motor damage would have more severe consequences.

Static Test Position

Vertical static testing of rocket motors will not be considered as an alternative. The accumulated experience with horizontal testing and the existing horizontal test stands provide a substantial advantage for the horizontal testing procedure.

1.5.2 Site Alternatives

Contractor Owned/Contractor Operated (COCO) Sites

Contractor owned sites at Promontory, Utah and Montgomery, Alabama were evaluated by potential ASRM contractors in the course of preparing proposals to be submitted to NASA. However, final proposals received by NASA in October 1988 did not include either site. They are therefore not included in this EIS.

Area A at KSC

ASRM project staff and KSC environmental staff agreed earlier in the site evaluation process to eliminate Area A at KSC from further consideration. Area A is fully described in the Environmental Analysis that preceded this EIS (CH2M Hill 1987). The primary reason for eliminating Area A is that required explosive safety clear zones at the test site would require closure of the intracoastal waterway during tests. Area A is also outside the secure area of KSC and is open to public access as part of the Canaveral National Seashore, thereby creating major land use jurisdiction and security problems. Proximity to the City of Oak Hill is of concern for noise impacts during testing. Finally, use of Area A raises several major ecological concerns, including disturbance of eagles nesting in the area (CH2M Hill 1987).

Vandenberg Air Force Base

The ASRM Environmental Analysis (CH2M Hill 1987) included a review of the suitability of Vandenberg Air Force Base (VAFB) for the ASRM program. Although no prohibitive environmental issues were identified, production or testing at VAFB would necessitate water transport of ASRM segments through the politically sensitive Panama Canal or cross country transport by rail. NASA has concluded that support of the Shuttle Mission could be severely compromised by the exclusive use of VAFB as an ASRM production site, consequently, VAFB is not being considered further (NASA 1988m).

Yellow Creek (Testing)

The Phase C/D Request for Proposal (NASA 1988e, Vol. 2) states that ASRM testing will not be considered at the Yellow Creek site. Results of the Phase B studies indicate that a minimum 2,500-acre site is required to provide an adequate explosive safety clear zone for ASRM production and testing. The Yellow Creek site is only 1,168 acres, which would not be large enough to accommodate the safety zone requirements for both production and testing. Nor is the Yellow Creek site large enough to include an acoustical buffer necessary for ASRM testing in addition to the 2,500 acres. Consequently, the Yellow Creek site is considered herein only as an alternate site for ASRM production, not testing.

1.6 EVALUATION METHODS

The determination of environmental consequences associated with constructing and operating ASRM manufacturing and/or testing facilities followed a four-step process, which included the identification of a cause-effect matrix, the definition of criteria by which the significance of impacts could be judged, the quantitative or qualitative evaluation of the size of each impact compared to the baseline condition, and the evaluation of significance by comparing the size of the impact to the significance criteria definitions.

1.6.1 Identification of Cause-Effect Matrix

Numerous documents were reviewed to ascertain the features of the ASRM program which could potentially cause environmental impacts, and the types of impacts they could cause. Among the most important documents consulted were the ASRM Environmental Analysis (CH2M Hill 1987), NASA's EIS on the Space Shuttle program (NASA 1978), a report on the environmental effects of the first 24 Shuttle launches (Hinkle and Knott 1985), and the environmental analysis of SRM production in Utah (Battelle 1983). These sources were supplemented by professional judgment concerning impacts of typical concern for any large construction project or manufacturing operation. Worksheets were devised which listed each potential impact and the particular aspect of ASRM facility construction, manufacturing, testing, or launching which could cause that impact. The completed worksheets appear in Appendix G.

1.6.2 Definition of Significance Criteria

Given the list of impacts which had been identified as potentially relevant to the project, criteria were defined as a means of measuring the size of the impact and its significance. For example, construction projects generally require some grading and soil disturbance. This disturbance of the soil could be important in and of itself, and it could also affect air quality (by creating fugitive dust), water quality and aquatic species (through erosion of the bare soil and sediment deposition in the surface water), terrestrial resources (through the removal of vegetation and wildlife habitat), and land resources (such as through the removal of prime agricultural soils). A structured framework is required to support conclusions concerning the significance of each of these effects and to systematically integrate individual resource assessments.

The identification of cause-effect relationships by resource provided the basis for assessing the significance of impacts. The significance was determined systematically by assessing four parameters of environmental impact: magnitude (how much), extent (sphere of influence), duration, and likelihood of occurrence. Although the range of possible impacts for each resource is essentially a continuum, each parameter was divided into three discrete levels as follows:

Magnitude
- major
- moderate
- minor

Duration
- long term
- medium term (limited or intermittent)
- short term

Extent
- large
- medium (localized)
- small (limited)

Likelihood
- probable
- possible
- unlikely

For each type of impact identified, definitions of each of the terms were prepared. For example, the magnitude of an erosive soil loss was defined as major if it would cause secondary damage such as siltation in surface waters: moderate if it caused only aesthetic effects; and minor if the soil loss was imperceptible. Duration was defined as long term if it was for the life of the facility, medium term if it would occur recurrently, and short term if it would be associated only with specific brief events. Extent was defined in terms of the square yards of soil affected. Likelihood was defined as probable if it would be expected under routine operating conditions, possible if it would occur under worst case operating conditions, and unlikely if it were expected only as the result of an accident or malfunction. The definitions derived for each impact are provided in Appendix G, Section G-1. In many cases, magnitude was defined in terms of a percentage change from the base. Thus, the clearing of 250 acres of wildlife habitat could be classified as an impact of major magnitude if it were unique to the area, but would be classified as minor if similar habitat were abundant.

1.6.3 Quantitative/Qualitative Assessment of Impacts

The assessment of impacts was based on descriptions of the project provided by NASA (see Section 2.1) and interpretations of impacts at each site. Methods of analysis were as quantitative as possible, given the amount and reliability of the data available and the apparent importance of each issue. In most cases, quantitative estimates were based on the best available preliminary project design information. Estimates of the amount of vegetation removed at each site, for example, are based on preliminary facility layouts. The precise location of buildings and their effect on vegetation clearing will not be known until designs are finalized. Other evaluations are strictly qualitative, such as discussions of hazardous waste handling procedures. In each case, the level of investigation was predefined to be in keeping with the apparent importance of the issue, the availability of data, and the availability of established methodologies for interpreting the data. Methods used to make individual resource evaluations are discussed in the environmental consequences sections of the EIS for impacts at Stennis Space Center (Sec. 3.2), Yellow Creek (Sec. 4.2), and Kennedy Space Center (Sec. 5.2).

1.6.4 Evaluation of Impact Significance

Given the definitions of magnitude, duration, extent, and likelihood for each type of impact, plus the quantitative or qualitative assessment of impacts at each site, the significance of each impact at each site was determined by comparing the magnitude, duration, extent, and likelihood of each impact to the predetermined definitions. The overall significance of each impact was then defined by referring to the guidelines shown in Appendix Table G-1. For example, any impact which conformed to the definitions of major magnitude, medium extent, long-term duration, and probable likelihood was judged a significant impact. The same type of impact meeting the definitions of moderate magnitude, medium extent, long-term duration, and probable likelihood was judged moderately significant. Thus, the use of the terms very significant, moderately significant, and insignificant throughout the EIS are based on a predetermined set of definitions and criteria which define those terms.

Worksheets which summarize the magnitude, duration, extent, likelihood, and overall significance of each impact are included in Appendix G.

2.0 ALTERNATIVES

2.1 GENERIC ASRM FACILITY

The ASRM program will be comprised of production and test facilities as shown in Figure 2-1 (NASA 1988b). As indicated in Figure 2-1, not all of these processes will necessarily be located at the same site.

A core of production facilities, consisting of propellant mixing, casting, nondestructive evaluation (NDE), and waste disposal will be located at a primary site for effective process control. Peripheral manufacturing, static testing, and computer support facilities may be located apart from the selected primary site. Numerous options exist for locating these facilities, as summarized in Table 2-1. The specific process buildings and their arrangement will ultimately depend on the final selection of both the site(s) and contractor.

The ASRM facilities will require an area of from 1,100 acres to 2,500 acres depending on:

- the number of production and testing processes located at the site;
- the maximum amount of storage capacity needed for raw materials and completed ASRMs;
- the site optimization with regard to distances, building arrangements, and facility explosive safety clear zones and acoustic buffer zones; and
- environmental considerations (such as natural buffers and avoidance of wetlands).

Safety dictates that certain production processes must be separated from others on account of their hazards. The quantity of potentially explosive material in a building or area and its TNT equivalency determine the quantity distance (QD) requirements, a measure of the minimum distance facilities must be separated to assure safe operations (NASA 1988b). Concepts such as QD will be used not only to determine the layout of individual facilities at the ASRM production and test facility to protect plant workers, but also to ensure adequate distance between processing buildings, the facility boundary, and the public.

Site requirements include a surrounding buffer area in which there is no human habitation. Adequate and safe transportation, both on site and connecting to the site, is necessary. Utilities such as water, sewage, and electricity are also required. Natural gas is required if gas boilers are used. Program and facility characteristics are summarized in Table 2-2.

A basic generic facility layout consists of the process steps shown in Figure 2-1 organized in a step-wise linear fashion. This generic layout is shown in Figure 2-2. The static test stand is located so that inert materials processing and storage, and administrative and operation functions are away from the area most impacted by static tests. A variation of this layout would divide the propellant manufacturing and casting/curing processes into dual process streams to improve reliability.

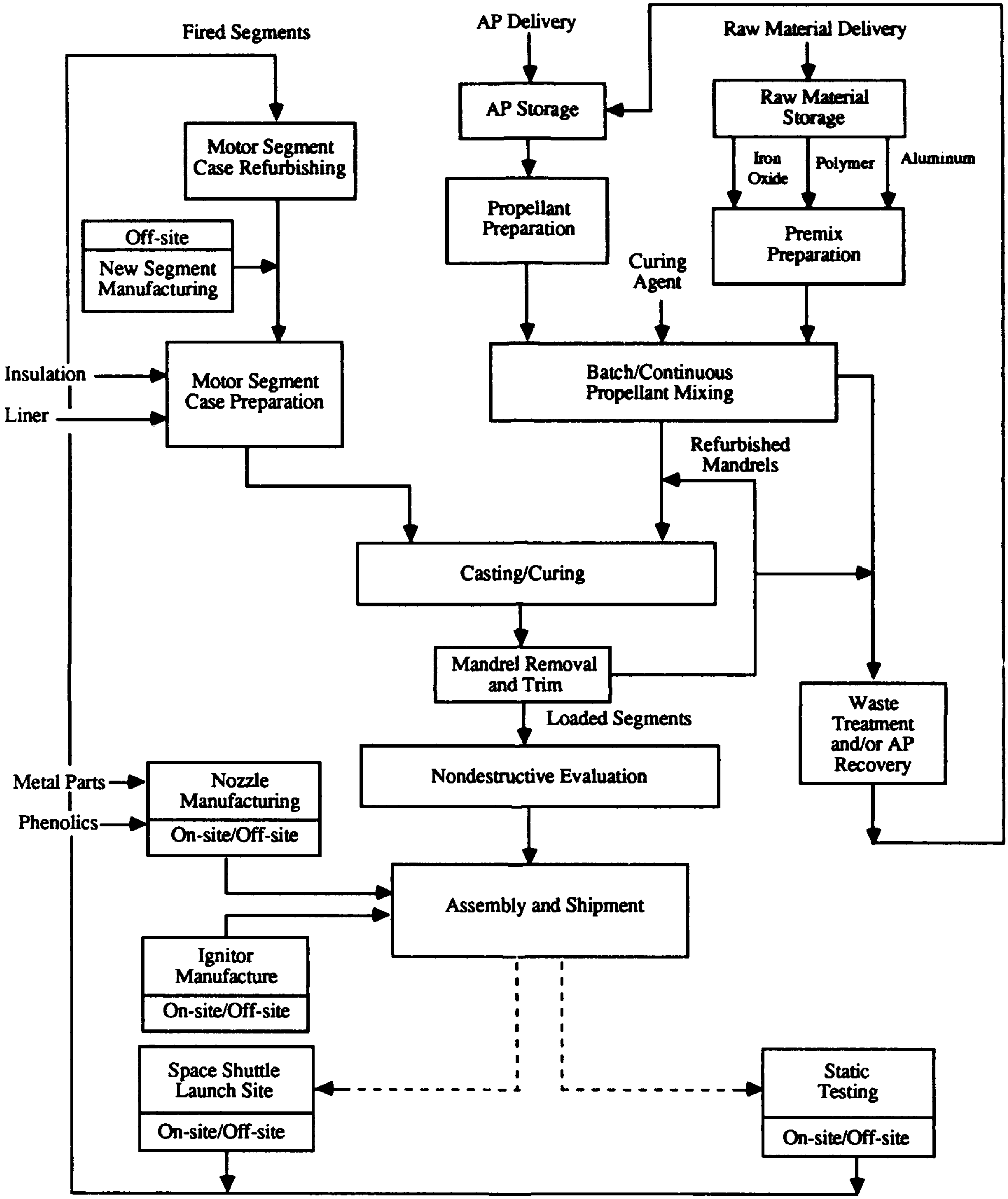


Figure 2-1
FLOW DIAGRAM OF ASRM PRODUCTION AND TESTING

Table 2-1
SUMMARY OF SITING OPTIONS FOR PROPOSED PROJECT FACILITIES

Site	Yellow Creek	Stennis Space Center	Kennedy Space Center	Slidell Computer Center	Michoud Assembly Facility
Case Preparation	●	●	●		
Nozzle Manufacturing	●	●	●		●
Propellant Mixing and Casting	●	●	●		
Motor Finishing and NDE	●	●	●		
Case/Nozzle Refurbishment	●	●	●		●
Static Test		●	●		
Computer/Support	●	●	●	●	
Peripheral Manufacturing					●

TABLE 2-2

ASRM PROGRAM GENERIC MANUFACTURING FACILITY CHARACTERISTICS

ASRM Production Rate	30 motors/year1/
ASRM Size	150-inch-diameter; divided into 2, 3, or 4 segments; 1.2 million lb propellant
Facility Availability	3 shifts/day, 7 days/week, and 85\percent availability
Construction Workforce	1,900 (production facility); 100 (test facility)
Operations Workforce	1,500 (production); 150 (testing)
Area of Facility Buildings	21 acres
Material Storage	70 days
Propellant Mix Bowl Size	600-2,000 gal
Ignitor	May be manufactured on or off site
Main Electrical Distribution	12 kV
Natural Gas (Fuel Oil)	300 therms/hour (or 3.5 gpm)2/
Steam Distribution	150 psig (transported above grade)
Sanitary Sewer	60,000 gal/day
Roads	13-20 miles3/
Railroads	6-10 miles 3/
Potable Water Use and Treatment	200,000 gal/day

1/ Each Space Shuttle flight uses two motors.

2/ Order of magnitude estimates calculated by Ebasco Services Incorporated. Value per boiler, 2 boilers to be installed.

3/ Upper limits are approximates based on larger site acreage of 2,500 acres.

Source: From NASA 1988b, except as noted.

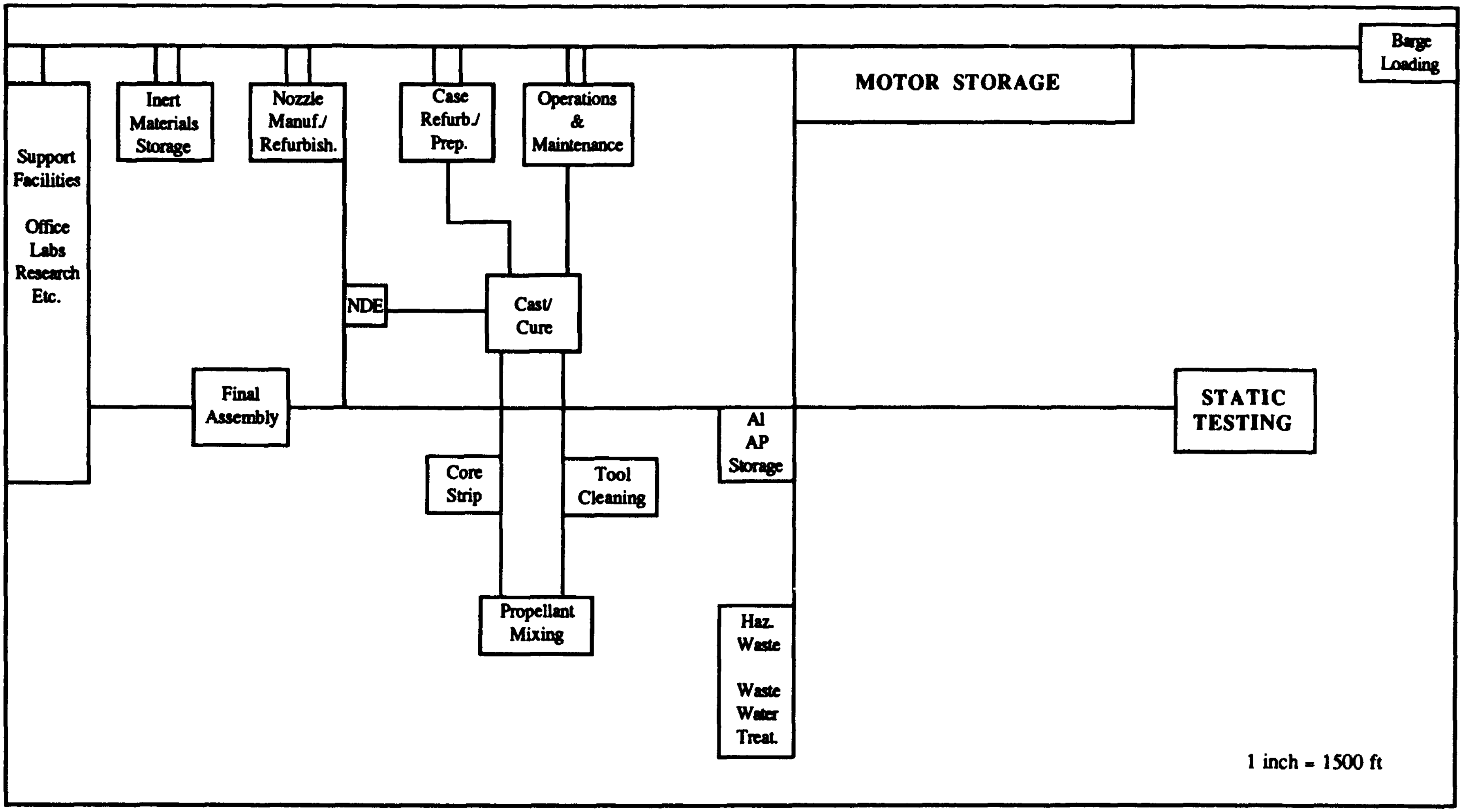


Figure 2-2
Generic Facility Layout for ASRM Production and Testing

Other support facilities for ASRM production and testing include the following, which are not depicted in Figure 2-2:

- Security
- Fire Station/First Aid
- Cafeteria
- Central Warehouse
- Propellant Waste Treatment and/or Reclamation
- Quality Assurance
- Motor Pool
- Safety Shelters
- Communications
- Meteorology
- Motor Shipping/Receiving
- Power Plant
- Boiler Plant/Chillers
- Component Testing

2.1.1 Production Processes and Facilities

ASRM propellant will burn vigorously and cannot be extinguished once ignited. Its ingredients also have the potential to ignite and burn vigorously. Safety is therefore of paramount importance so automation is used wherever possible for transportation, handling, material preparation, mixing, casting and curing, and waste propellant disposal.

Several levels of automation are possible at the proposed manufacturing facility, including (listed by increasing levels of automation):

- The automation of selected operations, such as motor case painting, which are done manually at this time.

- The automation of an entire process. This may include, for example, propellant receiving through the curing of propellant in the motors.

- The next level of automation, and most difficult to achieve, involves the whole manufacturing process, as is typical of automobile and other product assembly lines. It is assumed that the facility will approach this level of automation.

Production of the ASRM will consist of six distinct processing steps:

- Nozzle manufacture;
- Case recovery, refurbishment, and preparation;
- Propellant mixing;
- Propellant casting and curing;
- Cleaning/mandrel preparation; and
- Final assembly and nondestructive evaluation.

Each of these processing steps is discussed below.

<u>Nozzle Manufacturing</u>

Nozzles for the ASRM consist of parts which are bonded and fastened together. Nozzle components, raw materials, and forgings will be received from other sources, while metal parts and flexseals will be recovered from the case refurbishment facility. The manufacturing process will include automated tape wrapping, curing, machining of nozzle parts, grit blasting, solvent cleaning, painting, final assembly of nozzles and exit cone extensions, and nondestructive evaluation. Nozzle operations will occupy approximately 175,000 ft^2 (4 acres) in a single dedicated building, or in two structures if assembly operations are separate (NASA 1988b).

Case Refurbishment/Preparation

The purpose of the case refurbishment/preparation operation is to clean, inspect, and refurbish recovered ASRM cases and prepare these and new cases for propellant casting. ASRM motor cases will be manufactured early in the program and will be refurbished for subsequent missions. Like the motors currently in use, the ASRMs will be used during the first two minutes of Space Shuttle flight, then separate from the external tank at an altitude of approximately 30 miles. After being slowed by parachutes, the spent motors will fall into the ocean where they will be recovered and towed to a dock at KSC. The used motor cases will be transported from the recovery site either to a washdown facility where the ASRMs will be rinsed thoroughly to remove saltwater, broken into segments, greased, and sent on to an off-site refurbishment facility or to an on-site refurbishment facility which will eliminate the need for greasing. The refurbishment facility whether at SSC, Yellow Creek, or KSC will restore the cases to a new condition, to be confirmed by testing.

Case refurbishment includes the following steps:

- Case receipt;
- Nozzle, ignitor, and case disassembly;
- Ignitor and nozzle refurbishment;
- Case rinsing;
- Post-fire inspection;
- Water jet washout of insulation;
- Hydrotesting;
- Solvent washing;
- Blasting with glass beads;
- Inspection of machined surfaces;
- Grit blasting, as required, based on inspection; and
- Final inspection and welding.

Case preparation of new and refurbished cases will include the following steps:

- Case solvent cleaning;
- Exterior painting;
- Coating inspection;
- Interior cleaning;
- Interior primer and adhesive application;
- Adhesive inspection;
- Application of tackifier to aid in application of insulation;
- Installation of insulation;
- Insulation curing;
- Insulation inspection;
- Liner application;
- Liner curing; and
- Shipping to casting area.

These operations may be performed on cases which are in either a vertical or horizontal position. Prepared cases are then ready for filling with propellant. The facilities for case refurbishment and preparation will occupy about 225,000 ft^2 (5 acres)(NASA 1988b).

Propellant Mixing

NASA (1988b) has indicated typical ingredients for the mixing of propellant, as follows:

- Aluminum metal powder (fuel)
- Ammonium perchlorate (oxidizer)
- Iron oxide powder (burn rate catalyst)
- HTPB R-45 (binder)
- IPDI (curative)
- Dioctyl adipate (plasticizer)
- Bonding agent

Ammonium perchlorate (NH_4ClO_4) or AP acts as the oxidizer in the propellant, and the aluminum powder (Al) and binder act as the fuel. Specific propellant formulations are discussed in more detail in Section 2.2.1. AP must be carefully handled and stored because it severely decomposes at 270°F, explodes at 700°F, and becomes impact sensitive if contaminated with organic matter or powdered metals (Sax 1979). AP and Al will both be transported to the site by rail and/or truck in tote bins. The tote bins will be unloaded by conveyor into their respective storage buildings, and will be stored and retrieved by an automatic system. The bins will be transported to processing areas at speeds up to 1.5 mph. Each storage area will occupy approximately half an acre. The AP building will have environmental controls for humidity and temperature.

The following process steps will produce propellant ready for casting:

- Screen AP for proper chunk size and grind the oversized pieces;
- Combine ground AP and small pieces;
- Send ground AP to oxidizer feed hopper;
- Combine the plasticizer (to give plastic flexibility) and bonding agent;
- Combine the above ingredients, polymer, Al, and iron oxide in a premix tank (Mixture A);
- To a portion of Mixture A, add a burn rate additive and curing agent (Mixture B);
- Combine AP, Mixture A, and Mixture B in lots up to approximately 25,000 pounds in batch or continuous mixers; and
- Degas the mixture.

The propellant facility will be capable of producing approximately 18,000 tons per year of propellant. Process or raw water requirements for cooling, cleaning, and air conditioning for the process are as follows (NASA 1988b):

Ingredient preparation	1.2 million gal/yr
Aluminum Premix	7.5 million gal/yr
Mixing	17.2 million gal/yr
TOTAL	25.9 million gal/yr

Each ASRM will be constructed of motor segments with a total of approximately 1,200,000 pounds of propellant. Segments will contain approximately 300,000 to 600,000\lbs of propellant (see Section 2.2.2).

Propellant Casting and Curing

Mixed propellant and the insulated and lined segment cases will be transported to the cast/cure facility where the cases will be filled with rocket propellant. Segment cases will be transported horizontally and positioned vertically in casting pits. The casting mandrel will be put in place, then vacuum lids will be installed to each end of the segment. Propellant and vacuum piping will then be installed. A vacuum will be established in the segment, which will draw the propellant into the case segment. Propellant will be drawn into the case segments continuously or in batches. Environmental impacts estimated in this EIS are based on worse case conditions, which correspond to about 25,000 pound batches. Curing of the propellant will occur while the filled cases are in the casting pits by action of warm, circulating air (NASA 1988b). A facility of approximately 6,000 ft^2 will be necessary for casting and curing ASRM segments (NASA 1988b).

Following propellant curing, the casting mandrel will be removed hydraulically from the segment, lifted by crane, and placed on a transporter. The mandrel will be sent to the cleaning facility. The loaded segment will then be trimmed to remove stray propellant from the case. Following the core stripping/trimming operation, the segments will be transported to the NDE facility (see Section 2.1.2).

The casting and curing process will use water for cooling and cleaning, creating an effluent stream of approximately 4.2 million gallons per year (NASA 1988b) to the wastewater treatment facility.

Mandrel Cleaning and Preparation

This facility is required for cleaning, tooling, and refurbishment of the mandrels, which are hollow core supports around which propellant is cast and cured, and through which air is passed for temperature control. High-pressure wash bays will be used to clean tools and tote bins. The n adrels will be inspected to determine whether additional teflon liner should be applied. Teflon is used to reduce friction and aid in mandrel removal. If additional liner is required, the mandrels will be grit blasted, solvent cleaned, and baked out. Following this, a teflon primer will be applied, cured, and cleaned, and the final teflon coat will be applied and cured. Casting mandrels will then be inspected and shipped to the casting facility.

Final Assembly

Each segment will be weighed and its center of gravity will be determined. Aft segments will have the nozzles installed and will be leak tested. The ignitor will be installed in the forward section and, again, the unit will be leak tested. Insulation, touch-up paint, labels, and markings will be applied; a final inspection will be conducted; and segments will be sealed and transported to storage, ready for shipment to the launch site at Kennedy Space Center or the Static Test stand which may be at a different location than manufacturing.

Effect of Alternative Sites on Production Processes

The preceding description is based on facilities located at a generic site. The topography and existing facilities at a site will influence the proximity of process buildings to one another. For example, a production facility with a high explosive hazard could potentially be located closer to inert processing buildings if the topography forms a protective barrier between them. Optimization of building placement may not be possible if existing structures are used. Other environmental factors, such as the location of wetland areas to be avoided, could also affect the relative placement of buildings.

2.1.2 Testing Procedures and Facilities

Testing of the ASRM components and assembled motors is crucial to the entire program to ensure that safety and performance objectives are met. Production process quality will be assured at every step during manufacturing and assembly. Two categories of testing merit further discussion: nondestructive evaluation and static testing.

Nondestructive Evaluation (NDE) Program

NDE will be conducted throughout the manufacturing process of the loaded segments. The current motor manufacturer uses X-rays produced by a 50 million electron volt (MeV) accelerator to inspect the segments and determine the integrity of the propellant grain and check for discontinuities in the bonds between the propellant and case liner. Other potential NDE methods include use of ultrasound, magnetic particles, and acoustics.

Static Testing

Once motors are approved by NDE methods, some of them will undergo static testing. These tests will provide data on ASRM performance during full-scale, full-duration firing with simulated flight conditions. During the verification program, up to 4 motors per year may be tested for about a two-year period. Subsequently, two motors out of the annual production of 30 motors will be available for static test firing each year.

Static test firings will occur with the motor in a horizontal position. The motor will be braced against a thrust block designed to withstand 10 million to 18 million pounds of thrust, 3 to 5 times the design thrust load of an ASRM (NASA 1988b). The design loading will withstand a downward force of 750,000 pounds (at 3 hertz) on the lateral supports. The foundation and conditioning building will occupy 30,000 to 40,000 ft^2 (1 acre) (NASA 1988b).

During each test, combustion products will be expelled from the nozzle, forming a plume. A deflection ramp will be located immediately behind the motor to direct the plume upward. The ramp will be 200 ft wide and approximately 600 ft long, with a steel reinforced understructure and a concrete surface 1 ft or more thick. As needed, an area approximately 1,000 ft wide and 4,000 ft long (92 acres) will be cleared around the deflection ramp to eliminate the possibility of fires. A noise and safety buffer zone is enforced during test firings.

Cooling water requirements for static tests will be 50,000 to 60,000 gallons per minute (NASA 1988b) and will be used to quench the external surface of the motor following the test. The source of this water will depend on the site selected, but the water will probably be stored in a large holding pond or tanks adjacent to the test stand.

2.1.3 Waste Disposal

Manufacturing of the ASRM will produce several waste streams requiring disposal, including waste propellant, chemical hazardous wastes, and industrial wastewater. Waste propellant is generated from mixing and casting operations, core removal and trimming, and could include the propellant in an entire rejected segment or batch. Estimated quantities of waste propellant and other waste streams presented in Table 2-3 were provided by NASA (1988b). The worst case quantity of waste propellant (1.5 million lb) is based on rejection of the number of segments equivalent to one complete ASRM, plus the average annual waste from cast/mix operations. The total amount of waste propellant and refuse contaminated with propellant is approximately 5 percent of total propellant production.

Waste Propellant Disposal

Open burning of waste propellant has been used in the past. NASA currently considers open burning as an interim method for propellant disposal until other methods can be fully developed and made operational. After new disposal methods are adopted, open burning may be used as a backup. Other possible methods of waste propellant disposal include controlled incineration and propellant reclamation, which recovers Ammonium Perchlorate (AP) in a usable form. (See Section 2.2.3 for additional discussion of propellant disposal methods.)

Disposal of Other Wastes

Although propellant is the most significant waste generated by ASRM production, other effluents from the facility will also require processing and disposal. Chemical hazardous wastes, the quantity of which is estimated in Table 2-3, will be segregated according to similar chemical properties at a hazardous waste processing facility, and then could be either incinerated on-site in a permitted facility, transported off-site to an approved disposal facility or distilled for reuse on site (NASA 1988b).

Industrial wastewater will be pretreated prior to mixing with domestic wastewater or being discharged. Most of the wastewater generated from production activities is from cleanup, such as floor washdown following processing (NASA 1988b). The quantity of wastewater that would require treatment beyond that provided by a conventional sewage treatment plant is expected to be approximately 15,000 gal/day (NASA 1988b). Cooling water will be recycled with the use of cooling towers where possible to conserve water.

2.1.4 Transportation

The transport of components and assembled products from the raw material stage to the launch is a key factor in the success of the overall ASRM program. Materials used in ASRM production may be brought to the primary production site by rail,

TABLE 2-3

ESTIMATED WASTE QUANTITIES GENERATED BY ASRM PRODUCTION

Type/Sources	Quantity
Waste Propellant	
Cast/Mix operations	
Cured propellant	250,000 lb/yr
Uncured propellant	50,000 lb/yr
Rejected Segments	650,000 - 1.2 million lb/occurrence 1/
TOTAL	950,000 - 1.5 million lb
Refuse Contaminated with Propellant	300,000-600,000 lb/yr 2/
Chemical Hazardous Waste	220,000 lb/yr
Solvent Emissions	
1, 1, 1-Trichloroethane	30,000-280,000 lb/yr
Other Solvents	10,000-70,000 lb/yr
TOTAL	40,000-350,000 lb/yr
Wastewater Contaminated with AP 3/	5.5 million gal/yr

1/ 1.2 million lb is the equivalent of 1 motor; 650,000 lb is approximately equivalent to the largest segment of a 2-segment motor or the two largest segments of a 4-segment motor (see Section 2.2.2).

2/ Refuse estimated to be 20 percent of maximum waste propellant and 30 percent of the total propellant and refuse waste.

3/ Also contaminated with Al, oils, and solvents. Represents 10 percent (15,000 gpd) of the minimum total daily usage (150,000 gpd).

Source: NASA 1988b.

barge, or truck. For all three sites under consideration, several raw materials will have to be transported long distances, as illustrated in the examples below (NASA 1988b):

Material	Probable Shipping Method	Supplier Location
Aluminum Powder	Rail	Joliet, IL
Ammonium Perchlorate	Rail	Henderson, NV
Case Forgings	Rail	Cudahy, WI

Other materials, such as binders, catalysts, and solvents, will be transported from a variety of locations, depending on the contractor selected for site development.

Finished ASRM segments will be transported by barge or high-capacity rail flatcar. The ASRM transporter must be capable of handling a filled segment (approximately 150 to 200 tons) or segments and will require appropriate loading and unloading facilities. Barges crossing open water must be a minimum of 200 to 300 ft by 50 ft to ensure stability.

NASA has five World War II vintage yard freight (YF) barges sized at 265 by 48 feet. Two of the barges are covered and are used to transport the Space Shuttle's External Tanks from Michoud Assembly Facility to Kennedy Space Center. The remaining three barges are available to handle Solid Rocket Motor segments. These barges require refurbishment and the installation of a cover to protect the ASRM segments. Each barge can only accommodate four segments, or one motor, without major modification. As a result, two barges will be required to transport a flight set to Kennedy Space Center (NASA 1988b).

A total of 14 trips of two barges each will be made each year to the launch site and two to four single barge trips may be made to the static test site should it be at a facility separate from the production site.

2.1.5 Power Facilities

The power facilities will include a power plant, oil- or gas-fired steam boiler, and air compressor.

The power plant will include diesel generator sets. The diesel generators will be used to supply auxiliary, supplementary, and emergency power. The units will have sufficient fuel to supply 6 days of power.

The boiler plant will include two 600 horsepower steam boilers (equivalent to two 20,000 pounds per hour). These units could be operated with natural gas or fuel oil (three 50,000 gallon tanks with 10-day storage). The boilers will operate 1,550 ton chillers for temperature and humidity control in process buildings. Fuel input to each boiler will be approximately 30 million Btu per hour (3.5 gallons per minute oil or 300 therms per hour of natural gas).

The site will also include 8 air compressors, with one at standby. The units will have a capacity of 5,000 standard cubic feet per minute (scfm) at 175 pounds per square inch (psig).

2.1.6 Launch Procedures and Facilities

Use of the ASRM will not significantly change the launch procedures and facilities of Kennedy Space Center presently employed by NASA for Space Shuttle launches with the RSRMs. Some new minor assembly equipment will be required and the platform may be modified to accommodate the larger diameter ASRM case. The ASRM has a design peak thrust of 3.6 million pounds (NASA 1988b).

2.1.7 Mitigation

The Council on Environmental Quality (40 CFR 1508.20) has defined mitigation to include the following:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action;

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

(e) Compensating for the impact by replacing or providing substitute resources or environments.

NASA has already avoided or minimized many potential impacts by carefully selecting alternatives. However, other impacts may still occur. To rectify, reduce, eliminate, or compensate for these impacts, NASA has committed to certain mitigative measures, some of which pertain to the overall project (Table 2-4), while others are site specific (Table 2-5). NASA will also consider other mitigative measures during the life of the project on a case-by-case basis. These measures are discussed throughout the text as appropriate.

2.2 DESIGN ALTERNATIVES

ASRM design alternatives are evaluated on the basis of their impacts on the motor production process and the environment. The design alternatives which are evaluated in this section are ASRM propellant, motor segment configuration, and waste propellant disposal alternatives. Other alternatives not considered in detail were briefly discussed in Section 1.5.1. These were asbestos insulation, monolithic configuration, and a vertical static testing position.

TABLE 2-4

OVERALL PROJECT MITIGATIVE MEASURES COMMITTED TO BY NASA

Discipline	Mitigative Measure
ALL SITES	
Air Quality	
Mobile Sources	To reduce the impact of automobile emissions (carbon monoxide, hydrocarbons, and nitrogen oxides), the facilities will encourage ride sharing programs or buses from population centers.
Area Sources	Several construction activities at the sites will expose soil and generate fugitive dust. To reduce emissions during construction, contractors will use water during dry periods, if required. Land temporarily disturbed by construction activities will be reseeded.
Point Sources	Point sources (i.e., boiler, steam generator) will be subject to strict permit review by air pollution control agencies. For this reason, during detailed design optional mitigative measures will be identified and evaluated based on the source's energy, environmental, and economic impacts.
Water Resources	
Wastewater	New ponds will be lined (to prevent contamination leaks). Ponds will be unlined only if recharge is desirable (assuming water is of good quality). Sanitary wastewater facilities will be constructed and/or expanded to treat all sanitary discharges. All treated effluents will comply with state and federal regulations. All industrial and process discharges to surface and/or groundwaters will be treated to satisfy effluent guidelines and federal, state, and local receiving water quality standards. Industrial and process wastewater will be pretreated by filtration and solvent recovery to the extent practical. Treatment options may include (but are not limited to) the following: • Sedimentation/settling ponds (flocculant addition) • pH control (acid/lime addition) • Ion exchange resins • Carbon filtration • Solvent stripping/aeration • Biological treatment (primary and secondary) All treated and/or pretreated effluent discharges will be monitored through a state/federal agency-approved compliance monitoring program. All stand alone, customized, or specialized waste stream treatment systems will be required to use EPA-approved technology. Effluents will be subject to water quality-based monitoring, including biomonitoring, at the discretion of EPA or EPA state-designated agency.

Discipline	Mitigative Measure
Water Resources (Cont'd)	
Wastewater (Cont'd)	All discharges to existing sewers/municipal-industrial treatment systems will be subject to pretreatment requirements and compliance monitoring programs such that all state and federal effluent guidelines and receiving water standards are satisfied at ultimate point of discharge. Pretreatment must include EPA-approved technology. Simple dilution is not considered an acceptable technology.
	All critical wastewater treatment system components will have redundant design and/or adequate backup capacity.
	All wastewater treatment sludges will be handled, processed, and disposed of in accordance with federal (RCRA) and state regulations and guidelines where required. There will be no releases of sludges to surface water bodies.
Landfills	To prevent groundwater contamination from landfills, these facilities will be operated such that liquids are not allowed in landfills, landfills will be covered to prevent infiltration, and landfills will be above the water table.
Contaminant Spills/ Accidents	Roofed storage of hazardous substances and redundant transportation containers will be used to prevent accidental contamination of groundwater.
	An emergency response plan will be developed to deal with spills, treatment system failures, and accidents. Equipment/chemicals identified in the plan will be available at strategic locations throughout the facility. Employees will receive emergency response training with periodic updates/refresher courses.
	A spill prevention, control, and countermeasure (SPCC) plan for fuel handling and storage facilities will be prepared and followed.
	All aboveground fuel storage tanks will have secondary containment sufficient to hold the contents of the tanks. All new underground tanks will have double wall or cathodic protection.
Static Tests/ Launches	Firing pads will be designed to prevent infiltration and will be properly drained for runoff control.
Waste Propellant Disposal	A lined pit will be required for any open burning of waste propellant. An attendant leachate collection system will be included. Leachate will be treated to satisfy all federal and state effluent standards and guidelines, including Subpart X, and at a minimum will incorporate a settling/collection pond with pH control.
	Other propellant disposal methods, solvent recovery, solvent chilling, fugitive emissions minimization, and minimization or elimination of solvents such as methyl cellosolve will be explored.
Dredge and Fill	The project will be designed to minimize dredging and filling, both in terms of time (events) and scope (extent).

Discipline	Mitigative Measure
Water Resources (Cont'd)	
Dredge and Fill (Cont'd)	All dredging/filling activities will comply with federal and state laws and regulations and employ best management practices, including selection of appropriate dredging methods to minimize water quality impacts.
	Dredge spoils will be placed in permitted areas.
	A compliance monitoring program will be developed for dredging operations. Dredge spoils will be tested for compliance with applicable federal and state regulations. Spoils will be disposed of only in agency-approved manner and locations.
Miscellaneous	Areas will be replanted to control soil erosion and to retain wildlife habitat and surface water for percolation.
	Facilities will be designed to handle runoff effectively.
	Groundwater monitoring wells will be installed around facilities as needed to detect any contamination in the groundwater and comply with EPA and applicable state and local quality standards.
	With the exception of barge transport and water withdrawal/ discharge facilities, there will be no construction in surface water bodies.
	Significant construction, grading, or vegetation removal will be avoided, where feasible, within 100 feet of significant surface water bodies to provide a buffer zone.
Geology and Soils	
Soil Dynamics	Dynamic analysis and test stand foundations design will be used to minimize soil dynamics effects (ground vibrations). Special modification of nearby structures will be made, if necessary.
	Weak soil areas will be avoided when choosing sites for test stand or heavy structures, or foundations will be specially designed, based on geotechnical subsurface investigations.
Soil Erosion	Best management practices will be used to avoid soil erosion during construction or in areas denuded by test blast effects. Practices will include minimizing exposure area/duration, covering the area or sprinkling with water, runoff controls or sediment (settlement) ponds, prompt revegetation, and an erosion control maintenance program.
	Blast-induced soil erosion will be minimized by construction of an exhaust deflection ramp or berms, and placement of armor rock or similar protective materials in the blast impact area.
	The ASRM contractor will implement erosion control that will include slope stabilization, prevention of soil loss, and protection of water quality. This will be guided by stream course configuration, soil protection, and erosion prevention.

Discipline	Mitigative Measure
Geology and Soils (Cont'd)	
Soil Erosion (Cont'd)	All activities during construction will be performed in ways that will minimize disturbed acreage.
	To the extent possible, erosion and sediment control measures will be implemented during grading operations to minimize the exposure time of bare soils and reduce erosion potential. Erosion and sedimentation control to be implemented will be determined by the needs of specific sites and will accommodate and be based on the maximum runoff that may be produced from the 10-year, 24-hour event where applicable.
	To minimize sedimentation of any stream, the duration of instream activities will be restricted to the minimum time required by safe and good construction practices.
	Workers will be given covers for their cars near the test site.
	Drainage control structures (including culverts, drainage channels, and diversion levees) will be installed as required to meet the principal objective of drainage control--to direct surface runoff away from the project areas or collect and transport such runoff across them with a minimum of erosion. Drainage control structures will be built or installed as needed during construction and repaired and maintained following construction until adequate vegetation cover has been reestablished.
Soil Contamination	A soil sampling program will be developed to obtain baseline conditions and determine impacts of aluminum oxide and hydrochloric acid deposition from the plume.
Miscellaneous	An exhaust deflection ramp will be constructed to avoid potential for subterranean fires. After test firing, the area will be examined to detect hot spots to be covered.
	Consistent with soil conditions, subsurface facilities will be provided with cathodic protection or protective coatings to avoid corrosion problems.
Wetlands and Floodplains	
Floodplains	The 100-year floodplains will be mapped. The facility and construction access will be laid out so that the 100-year floodplain will be completely avoided or buildings will be protected by dikes or floodproofing. Any construction in the 100-year floodplain will not impair the floodway.
Terrestrial Resources	
Vegetation	All areas temporarily disturbed by construction activities will be revegetated.
Wildlife	Care will be used in site selection, and land area disturbance during construction will be minimized. This will be particularly important to sensitive habitats.
	Areas of natural habitat not required for access or facilities will be left intact.

Discipline	Mitigative Measure
Terrestrial Resources (Cont'd)	
Wildlife (Cont'd)	Facilities and construction activities will be designed to avoid riparian and wetland areas, wherever possible.
Aquatic Resources	
	Open burning and static testing will not be performed during periods of precipitation, fog, or forecasted precipitation to prevent acidification of water bodies.
	A biomonitoring and comprehensive water quality monitoring program will be implemented. This program will identify any impacts to aquatic species and assist in developing effective mitigative measures. The program will require baseline sampling prior to initiation of construction and sampling periodically during and after construction.
Other measures relevant to the protection of aquatic species are covered under Water Resources. These include process wastewater treatment, sound construction practices in and near water bodies, and accident/spill control and cleanup.	
Socioeconomics	
Employment and Job Training	The ASRM contractor will be encouraged to hire, to the extent practical, new personnel from the local labor force during the construction and operation phases.
	NASA will encourage and advise establishment of a training program and a professional recruitment program at local community colleges, other colleges, universities, or voc-tech schools to train potential employees of the project and to recruit upper-level technical and professional personnel.
	The ASRM contractor will be required to comply with EEO hiring practices.
Wage Levels	The ASRM contractor will meet or exceed Davis-Bacon wage levels during construction.
Local Business Support	To the extent practical, the ASRM contractor will utilize local businesses and suppliers during the construction and operation phases of the project.
Public Services	
Community Relations	NASA and the ASRM contractor will cooperate with local governments to reach mitigation agreements.
Health Care	Training programs are contemplated for local health care professionals that may be faced with new health and safety situations that may arise from the project.
	Water, sewer, and garbage collection systems will be monitored and/or inspected to ensure there is no project-related hazardous waste contamination of these local services.

TABLE 2-4

OVERALL PROJECT MITIGATIVE MEASURES COMMITTED TO BY NASA

Discipline	Mitigative Measure
Transportation	
Construction Damage	The ASRM contractor will abide by weight limits to avoid damage to roads.
Construction Worker Traffic	Bus or van service from centralized off-site locations will be encouraged.
Permanent Employee Traffic	Work hours will be staggered and/or carpool/vanpool programs will be encouraged. Traffic will be restored to service level D (high density but stable flow) or better at adversely affected intersections. Measures to be considered are the following: • Constructing additional lanes of roadway • Channelizing roadways and/or providing new turning lanes • Installing new or updated traffic signals to improve flow • Providing subscription bus or van service to ASRM facility • Sponsoring carpool/vanpool programs, and providing incentives to employees • Underwriting service expansion by existing public transportation • Staggering working hours/shift timing to reduce commuting peaks
Shipment of Hazardous Materials	Risk of accidents will be minimized by using transportation modes with the most favorable accident rates (presumably water) as much as possible. For any transportation mode that must be used, risk will be minimized by selecting routes that minimize population exposed during transport.
Rail and Waterway Traffic Levels	Transportation modes and/or routes will be selected to avoid areas of congestion or, alternatively, scheduling will be coordinated to avoid peak traffic periods.
Cultural Resources	
Known Archaeological/Historic Sites	The cultural resources site survey and evaluation program will be completed. If significant cultural resources are found, the measures listed below will be applied. Significant archaeological sites that cannot be avoided will be excavated for recovery of scientific data in consultation with the State Historic Preservation Officer and will meet the standards of the National Historic Preservation Act and its implementing regulations. Significant architectural structures and historic sites will be recorded, photographed, excavated, and provided with archival documentation. These recording effects will be planned in consultation with the State Historic Preservation Officer and will meet the standards of the National Historic Preservation Act and its implementing regulations.
Native American Sites	Significant Native American heritage sites will be avoided or replacement will be provided in consultation with the State Historic Preservation Officer and state coordinating agencies for Indian Affairs.

Discipline	Mitigative Measure
Cultural Resources (Cont'd)	
Unknown Archaeological Sites	Heavy equipment operators and other construction personnel will be instructed on how to identify buried archaeological sites during construction and to halt ground disturbing operations if buried sites are found.
	If buried cultural resources are found during construction or operation of the ASRM production or testing facilities, construction will be halted in the immediate vicinity of the find until a qualified archaeologist is available to evaluate the find. The State Historic Preservation Officer will be consulted to evaluate the site's significance and plan mitigative measures, if necessary.
Visual Resources	
	Areas to be cleared and graded will be minimized.
Toxic/Hazardous Substances and Pesticides	
	All toxic/hazardous substances and pesticide procurement, use, storage, application, collection, and disposal will comply with all federal, state, and local laws, regulations, and guidelines. Storage and use of such substances will be minimized.
	Where possible, nontoxic and/or alternative less toxic formulations will be substituted for toxic substances.
	A hazardous/toxic substances control plan, inventory, and emergency response plan will be generated and periodically updated to reflect status.
	Equipment and chemicals identified in the emergency response plan will be available at strategic locations throughout the facility.
	Employees will receive emergency response training with periodic updates/refresher courses.
	All individuals handling hazardous materials will have and maintain the appropriate state and federal certifications.
	PCBs and asbestos, especially in the motor, will be avoided.
Solid Waste Management	
	A solid waste disposal plan will be developed in conjunction with facility design, specifying waste disposal procedures and facilities.
	Wastes will be segregated to allow special handling for selected waste categories (e.g., special packaging and disposal of hazardous wastes, reuse of recyclable wastes, etc.).

TABLE 2-4

OVERALL PROJECT MITIGATIVE MEASURES COMMITTED TO BY NASA

Discipline	Mitigative Measure
Noise	
Static Test Firing	The test stand will be located away from population centers, structures, wildlife, and highways to the degree possible to minimize any potential adverse impacts.
	NASA-owned or controlled areas will be used as buffers between the test area and population centers.
	The rocket motor test stand will be oriented to the extent possible to minimize the impacts of the generated noise.
	Testing will be conducted only on days when atmospheric conditions are favorable (i.e., no significant atmospheric focusing of noise intensity at ground level in populated areas). Atmospheric focusing would occur during temperature inversions.
	An exhaust deflector will be installed to redirect the plume upwards.
	Minimizing wildlife impacts will be considered when determining the direction of the test stand.
	NASA will comply with applicable noise criteria when scheduling tests and/or launches.
	For static tests near navigable waters, the Coast Guard will be contacted so they can issue a Marine Warning.
	The public will be informed by newspaper, TV, and/or radio for the expected time of the tests.
Construction Equipment	Equipment will be fitted with partial engine closures, mufflers, and enclosed operator compartments, etc., in accordance with OSHA or state regulations.
	Equipment will be tested periodically and maintained to meet OSHA or state regulations.
Operation Equipment	Noise control measures will be applied as practicable to blowers, fans, motors, gears, and pumps; diesel equipment; valves and vents; and generators to meet OSHA or state regulations.
	Potential noise sources such as pumps and blowers etc., will be enclosed as needed in buildings to meet OSHA or state regulations.
Radiation	
Ionizing Radiation	Engineered barriers (shielding), distance, and access control will be used to protect workers from radiation associated with particle acceleration and x-ray diffraction.
	Robotics will be used to the extent possible to minimize worker safety hazards.
	Quantities of radioactive material will be limited. For devices containing radioactive materials, device use and disposal will be controlled according to state and federal regulations.

OVERALL PROJECT MITIGATIVE MEASURES COMMITTED TO BY NASA

Discipline	Mitigative Measure
Radiation (Cont'd)	
Ionizing Radiation (Cont'd)	Engineered barriers will be used to meet performance criteria (0.5 mR/hr). Maintenance procedures and access control will also be implemented.
Nonionizing Radiation	Enclosures, access control, maintenance procedures, and performance standards will be developed to protect workers exposed to electromagnetic equipment. Radio frequency effects will be minimized through enclosures, access control, maintenance procedures, and distance.
Worker and Public Health and Safety	
Worker Health and Safety	NASA and the ASRM contractor will carry out all operations in a manner well-planned to give due regard to the health and safety of employees. To accomplish these goals, the following will be important parts of the project: • Design features such as fences, barriers, and covers, etc., in areas that might imperil the life, safety, or property of employees • Suitable storage for hazardous materials, such as explosives, fuels, etc., and appropriate labelling of such locations • Training and refresher courses for all employees regarding working procedures and potential hazards • Protective equipment or clothing for use in handling hazardous materials, working in noisy areas, etc. • Health care facilities and staff on the site for treatment of injuries
Public Health and Safety	The ASRM contractor will demonstrate compliance with all applicable local, state, and federal laws designed to protect public health and safety, including applicable air quality, water quality, and noise standards and compliance with hazardous waste management regulations (CERCLA/SARA, TSCA, and RCRA). Adequate personnel training and emergency response capabilities will be developed and maintained. ASRM facilities will be constructed with adequate QD clear zones to separate ASRM activities from the public and other existing facilities. ASRM facilities will be sited in accordance with QD separations.
Miscellaneous	
Coordination with FAA	The FAA will be notified of the expected location of the static test plume to inform pilots not to fly planes through the cloud.
Monitoring	Activities will be regularly inspected to ensure compliance with stipulated mitigative measures.

TABLE 2-5

SITE-SPECIFIC MITIGATIVE MEASURES COMMITTED TO BY NASA

Page 1 of 2

Discipline	Mitigative Measure
STENNIS SPACE CENTER	
Water Resources	
Groundwater Recharge	Where groundwater sources are utilized, pumpage will be minimized. Nongroundwater sources will be used where nonpotable water quality is not necessary and the use of this alternative is feasible.
Transportation	
Construction Worker Traffic	Construction work will be timed to avoid overlap with permanent employee traffic. Turning lanes at on-site intersections will be developed, as appropriate.
Noise	
Static Test Firing	In areas of major impact, lights that flash will be installed on major highways or interstates to alert motorists before and during static test firings.
Worker and Public Health and Safety	
Worker Health and Safety	Prior to ASRM facility development in the Hazards Test Range area, a comprehensive explosive ordnance sweep will be conducted to identify any existing ordnance for removal.
KENNEDY SPACE CENTER	
Air Quality	
Static Testing	Test firing will take place only during favorable winds (i.e., when the winds are toward the ocean).
Water Resources	
Groundwater Recharge	The facilities will be sited to avoid critical groundwater recharge areas, especially in Area B.
	Stormwater retention and percolation basins will provide for ample recharge of the freshwater surficial aquifer.
	If supplemental water supplies are needed beyond what could be provided by the city of Cocoa, withdrawals of either surface or groundwater will be limited to protect the recharge characteristics of the surficial freshwater aquifer.
Geology and Soils	
Soil Erosion	Only oceanside testing, with plume directed over water, will be allowed to minimize blast impact on the terrain.

TABLE 2-5

SITE-SPECIFIC MITIGATIVE MEASURES COMMITTED TO BY NASA

Discipline	Mitigative Measure
Wetlands and Floodplains	
Wetlands	Wetlands will be mapped. Because Area B contains wetlands under the permitting jurisdiction of the U.S. Army Corps of Engineers, and because it is unlikely that any large facility could be located entirely in upland areas, the need for a dredge and fill permit will be evaluated. If required, a permit will be applied for and obtained prior to construction.
	Mitigation of wetlands will involve either the creation of new wetlands from existing uplands and/or the enhancement of existing wetlands. The amount of area involved in mitigation will be determined in conjunction with state and federal resource management agencies and will depend on the functional values of the wetlands that would be dredged or filled as a result of the project.
	To mitigate the loss of any wetlands filled during construction, marginal wetland areas will be enhanced. The areas will be managed both for mosquito control and wildlife resources.
Land Use	
Recreation	Testing apparatus will be directed such that noise impacts to Playalinda Beach, the NASA Spaceport Visitor Center, and city of Canaveral beaches are minimized.
Compatibility with Land Management Plans/Other Agency Plans	No site within the existing STS launch impact limit lines will be considered for ASRM facilities.
	NASA will negotiate with the Air Force on use of Pad 37 (Area C) in terms of QDs, lines-of-sight, and the ALS project at CCAFS.
YELLOW CREEK	
Geology and Soils	
Soil Dynamics	Areas prone to landsliding will be identified through subsurface investigation or by identifying previous landslide areas. These areas will be avoided, or surface loadings will be designed to meet allowable levels.

2.2.1 Propellant Alternatives

The propellant ingredients and their respective proportions are the primary factors by which the propellant alternatives are compared. The preferred propellant formulation was selected based on criteria such as the following (NASA 1988b):

- performance
- processing
- availability of propellant constituents
- safety and environmental effects
- previous experience, and
- cost

NASA specified in its Design and Performance Requirements Document (DPRD) certain minimum standards which propellant alternatives must attain. These include the following:

- performance requirement of 12,000 lb of additional payload above that achievable by the RSRM;

- propellant burn rate of 0.35 inches/second; and

- thrust-time profile more stringent than the previous design.

The alternatives that use the common formulation containing ammonium perchlorate (AP) are discussed first, followed by alternatives that employ nonchlorinated oxidizers.

<u>AP/Al/Binder Formulations</u>

The primary difference among AP propellant formulations is the type of binder selected. Three different propellant alternatives are discussed in this section as indicated below (NASA 1988b):

- the polybutadiene acrylonitrile (PBAN) binder formulation from the present RSRMs;

- a hydroxyl terminated polybutadiene (HTPB) binder formulation similar to the Pershing II rocket motor propellant; and

- a high-performance HTPB formulation with a larger weight percent of aluminum than the Pershing propellant.

PBAN Propellant:

The PBAN propellant has a solids content of 86 percent and an aluminum content of 16 percent. This propellant has a long record of experience including the Stage I Minuteman, Stage I Poseidon, Titan III, and Space Shuttle SRM/High Performance Motor and RSRM. The major advantage of PBAN propellant is the simplicity of its formulation, which contains only five major ingredients: ammonium perchlorate, aluminum, iron oxide, PBAN polymer, and an epoxy curing agent. This advantage assures reproducible ballistic and mechanical properties using low complexity processing with a propellant mix time of under one hour (NASA/MSFC 1977). The well known characteristics have resulted in good flight safety and reliability records. Static testing of PBAN propellant creates emissions of aluminum oxide (Al_2O_3) and hydrogen chloride (HCl). The plume constituents from static testing are presented in Table 2-6. However, neither the RSRM formulation nor any other current PBAN propellant meets the ASRM performance requirement in a motor whose diameter and length are compatible with the existing shuttle system hardware (NASA 1988b).

HTPB Propellant:

HTPB propellant (88 percent solids) has a higher solids loading than PBAN (86 percent solids), which provides a performance gain. For this reason, an HTPB formulation similar to the Pershing II SRM is under prime consideration for use in the ASRM. The proportions of the propellant ingredients are shown below on a weight percent basis:

Aluminum (Al)	19.0	percent
Ammonium Perchlorate (AP)	69.0	percent
Iron Oxide	<1.0	percent
HTPB	10.0	percent
Isophorone Diisocyanate (IPDI)	<1.0	percent
Dioctyl adipate	1.0	percent
TOTAL	100.0	percent

A HTPB propellant combined with other system changes meets the performance requirements of 12,000 lb additional payload and a burn rate of 0.35 in/second in a motor configuration which does not necessitate changes to hardware in the remainder of the Shuttle system. Hazard evaluation results for the HTPB propellant are similar for those of PBAN propellant. The composition of static firing emissions for this propellant is listed in Table 2-6.

High-Performance HTPB Propellant:

The high-performance HTPB propellant has a solids content of 88 to 89 percent and contains 20 to 21 percent aluminum. The increased aluminum level improves performance of the propellant. Mechanical properties of the propellant are improved compared to the regular HTPB formulation described above because the HTPB binder bonds to aluminum (20 to 21 percent vs. 19 percent) better than it does to AP. The high-performance HTPB propellant also employs the aziridine bonding agent that eliminates ammonia formation during mixing, and is characterized by relatively easy processing.

Emissions from static testing of high-performance HTPB propellant will be similar to emissions from a test firing of the HTPB formulation shown in Table 2-6, although the proportion of aluminum oxide will likely be greater due to the higher aluminum content. Specific emission data for high-performance propellant is currently unavailable. There is presently no production experience with 20 to 21 percent aluminum content propellant.

TABLE 2-6

COMPARISON OF STATIC TESTING EMISSIONS FROM BURNING PBAN PROPELLANT VS. HTPB PROPELLANT

Compound	Percent by Weight of Emissions	
	PBAN Formulated Propellant	HTPB Formulated Propellant
Aluminum oxide	30	36
Carbon Monoxide	24	21
Carbon Dioxide	3.5	2.5
Hydrogen Chloride	21	21
Water	9.5	8.5
Nitrogen	9	8.5
Hydrogen	2	2
Other	1	0.5
TOTAL	100 percent	100 percent

Source: Derived from Crochet et. al. (1988)
U.S. Army (1988a)

Nonchlorinated Propellants

The AP/Al solid propellant formulations have a good background of safe and reliable use, but have the environmental disadvantages of generating HCl and Al_2O_3 emissions and causing damage to the ozone layer (NASA 1977). Propellants that contain neither aluminum nor chlorine would not produce these compounds; however, complete elimination of AP and aluminum would result in unacceptable propellant performance. Several alternatives have been evaluated, including ammonium nitrate and other oxidizers.

AN Formulation:

Ammonium nitrate (AN) is an impractical replacement for AP. Propellants formulated with AN are low in performance and would generate emissions of other pollutants, such as nitrogen oxides and nitric acid (NASA/MSFC 1977).

HMX Formulation:

Cyclotetramethylene tetranitramine (HMX) is an impractical replacement for AP because it is highly explosive (rated as detonating) and much more expensive than AP propellants (NASA/MSFC 1977).

Composite Formulation:

Experimental AN and HMX composite propellants were evaluated by the Space Shuttle Environmental Assessment Workshop on Stratospheric Effects (NASA 1977). Two alternatives were selected for further evaluation and testing, one containing HMX and the other not. Both contain AP and aluminum in order to achieve acceptable properties but in lesser concentrations than PBAN or HTPB. The propellant formulations and exhaust compositions for these alternatives are presented in Table 2-7. The composite propellant alternatives would reduce, but not eliminate, ozone depletion by a factor of 2.5 to 5 compared to an AP/Al propellant (NASA 1977). Emissions of Al_2O_3 and HCl would be lower but the composite alternative would result in greater nitrogen compound emissions. Development and production costs for composite propellants make them more expensive than an AP/Al propellant (NASA 1977).

Clean Propellants:

The U.S. Air Force is conducting research on innovative clean-burning propellants (e.g., AlH_3, aluminum hydride) but such exotic concepts are many years away from being usable in the Shuttle program. One rough estimate is that clean propellants will not be available until the year 2000 (Berlinrot 1988, personal communication).

2.2.2 Configuration Alternatives

A segmented design is the preferred configuration for the ASRM. The only environmental issue associated with the number of segments into which the motor is divided is the quantity of propellant. The alternatives considered are motors with two, three, or four segments. The approximate quantity of propellant in the largest and smallest segments are shown below for each configuration (NASA 1988b):

Segments	Largest Segment	Smallest Segment
2	612,000 lb	567,000 lb
3	464,000 lb	390,000 lb
4	325,000 lb	280,000 lb

The consequences of an accident are potentially greater for a segment containing a larger quantity of propellant. However, more processing steps would be required for a configuration with additional segments, resulting in a potential increase in the risk of an accident occurring. The risk of an accident during production or transport of ASRM segments is extremely small, however, regardless of the number of segments used.

TABLE 2-7

PROPELLANT FORMULATIONS AND EXHAUST GAS COMPOSITIONS FOR COMPOSITE PROPELLANT ALTERNATIVES

	Percent by Weight	
	HMX/AN Composite Propellant	AN Composite Propellant
PROPELLANT FORMULATION		
Ammonium Perchlorate (AP)	10	10
Ammonium Nitrate (AN)	44	61
HMX	17	--
Aluminum	15	15
Binder and Additives	14	14
EXHAUST GAS COMPOSITION		
Aluminum Oxide	28	28.5
Carbon Monoxide	32	19.5
Carbon Dioxide	4	6.5
Hydrogen Chloride	3	3
Water	6	16
Nitrogen1/	23	23
Hydrogen	3.5	3
Other	0.5	0.5

1/ Includes diatomic nitrogen, nitrogen oxides, and nitric acid.

Source: NASA (1977)

2.2.3 Waste Propellant Disposal Alternatives

Waste propellant and propellant-contaminated wastes have traditionally been disposed of by open burning in earthen pits. RCRA rules now require that permits be obtained for operation of new burning pits, but the rules for design and operation of such pits have not been finalized. Consequently, any application for a permit for open pit burning must prove to EPA through a less specific approach to permitting that it meets environmental standards (52 FR 46949). Since open burning has become less acceptable and could even be prohibited in the future, it is necessary to consider alternative methods of waste propellant disposal.

The worst-case amount of waste propellant requiring disposal is estimated to be in the range of 950,000 to 1,500,000 lbs (NASA 1988b), as presented previously in

Table 2-3. Waste material is of two different varieties. The first source, generated from rocket motor manufacturing, is a predictable waste stream. It includes:

- excess cured and/or uncured propellant;
- waste propellant removed in trimming operations;
- spills or droppings; and
- quality control samples.

This type of waste propellant will consist of approximately 300,000 lb/yr, of which 200,000 lb/yr will be samples.

The second category is rejected rocket motor segments. This is an unpredictable waste stream which is created when defects are detected in motor segments during NDE. The quantity of this waste type is estimated to range from 650,000 lb to 1,200,000 lb, where 650,000 lb is the equivalent of rejecting the largest segment of a 2-segment motor or the two aft (largest) segments of a 4-segment motor, and 1.2 million lb is the equivalent propellant of one entire motor. The historical record of SRM segment rejections over more than a decade of production indicates that the probability of rejecting a cast segment is very low, and averages much less than one segment per year (NASA 1988b). For purposes of analysis in this EIS, annual waste propellant disposal needs are estimated at 1.0 million lb, the rough equivalent of 300,000 lb of waste from manufacturing and 650,000 lb of propellant from rejected segments.

The alternatives for disposal of propellant wastes which are evaluated in this section are open burning, AP recovery, incineration, heat recovery, and several emerging technologies.

Open Burning

Open burning occurs in an excavated pit surrounded by an earthen berm. Propellant and contaminated materials are placed in the pit and ignited remotely by a resistance wire in contact with a portion of the waste. Propellant that has begun to cure is placed in plastic bags and sent to the burn pit where the bags are placed in a matrix configuration prior to ignition. However, uncured propellant waste is dumped directly into the pit in bulk form. Burn time for the cured propellant is about half that of the uncured propellant since more surface area is exposed for burning (Battelle 1983).

The amount of waste disposed by open burning is assumed to be 1.0 million lb annually. This amount includes refuse contaminated with propellant in addition to the various forms of waste propellant as estimated in Section 2.1.3. Contaminated refuse is estimated to be between 20 percent of the waste propellant and 30 percent of the total waste by weight.

Regulation:

Licensing of new open pit burning facilities has become more stringent. The EPA is currently developing specific design and operating standards for open burning of propellants and explosives. Until these standards take effect, open burning is covered by Subpart X of RCRA which requires a potential licensee to prove that its proposed facility meets environmental requirements. The applicant would do this by a a combination approach using any or all of the following five Subpart X permitting methods (52 FR 46950):

- Facility specific risk assessment
- Environmental performance standards
- Containment standards
- Technical performance standards
- Design and operating standards.

Emissions:

The emissions from open pit burning are different from those of static testing and consequently will have a different impact on the surrounding area. Emissions from open burning of HTPB and PBAN propellant formulations are presented in Table 2-8. The constituent percentages for both formulations include the effect of afterburning in the plume. Air entrained into the hot buoyant cloud over the burn pits causes chemical reactions, or "afterburning," to occur that can reduce the concentration of carbon monoxide by converting it to carbon dioxide, and redistribute the form of the chlorine.

TABLE 2-8

ESTIMATED EMISSIONS FROM OPEN BURNING OF WASTE PROPELLANT

Combustion Products	Percent of Emissions by Weight HTPB	Percent of Emissions by Weight PBAN a/
Aluminum Oxide (Al_2O_3)	14	12.5
Carbon Monoxide (CO)	0	0
Carbon Dioxide (CO_2)	15	17.1
Hydrogen Chloride (HCl)	8	7.9
Water (H_2O)	11	12
Nitrogen (N_2)	49	49
Nitrogen Oxides (NO_x)	0	0.6
Chlorine (Cl)	b/	0.9
Other	3	0

a/ Data converted to a basis of 49 percent nitrogen for comparison with HTPB data.

b/ Data not available.

Source: U.S. Army (1988a); Derived from Crochet et al. (1988).

The most significant emission is hydrogen chloride (HCl) for its reactive and irritant properties. Another possible irritant is nitrogen oxide (NO_x), although the effects of afterburning in the plume leave undetectable amounts as shown in Table 2-8. Fugitive dust from the burn pit is a minor concern.

Other concerns from open burning include the disposal of remnants and ash remaining after a burn, and the potential for soil and groundwater pollution. Contamination of groundwater can be prevented through the use of a lined pit. This introduces an additional concern of disposal of washwater used to clean the burn pit (Canter 1988).

Ammonium Perchlorate Recovery

A promising alternative to open pit burning is recovery of ammonium perchlorate (AP) from waste propellant. Recovery of AP yields a potentially marketable product using a process considered environmentally acceptable (Poulter et al. 1984; U.S. Navy 1984). In addition, a solid residue rich in aluminum and propellant binder can be recovered from cured propellant waste. Large-scale AP reclamation from cured propellant has not yet been demonstrated.

Process Description:

The AP recovery process is based on the highly temperature-dependent solubility of AP. The solubility of AP is 44 percent by weight in aqueous solution at 180°F but only 14 percent by weight at 50°F (Crochet et al. 1988). An AP recovery facility is comprised of four major operations, which are as follows (NASA 1988b; Crochet et al. 1988; Poulter et al. 1984; U.S. Navy 1984):

- waste propellant is reduced to a manageable size using one of the size reduction methods explained below,
- AP is extracted from the propellant in heated water and the solution is separated from the solid residue,
- AP is crystallized when the solution is cooled with process chilled water, and
- the dilute solution from the crystallizers is recycled to the extraction step after the AP crystals are removed in a centrifuge.

An example of a closed loop AP recovery system is shown in Figure 2-3.

Size Reduction:

Several techniques are available for reducing propellant chunks to a size that can be processed. Hydraulic maceration combines size reduction and AP extraction by cutting the propellant into small pieces with high pressure water jets, and then extracting AP from the propellant in a countercurrent process (Poulter et al. 1984). The cryofracture method employs liquid nitrogen to cool propellant to the cryofracture temperature at which point the propellant is crushed in a remotely controlled press. Mechanical means, such as sawing, grinding, and shearing, can

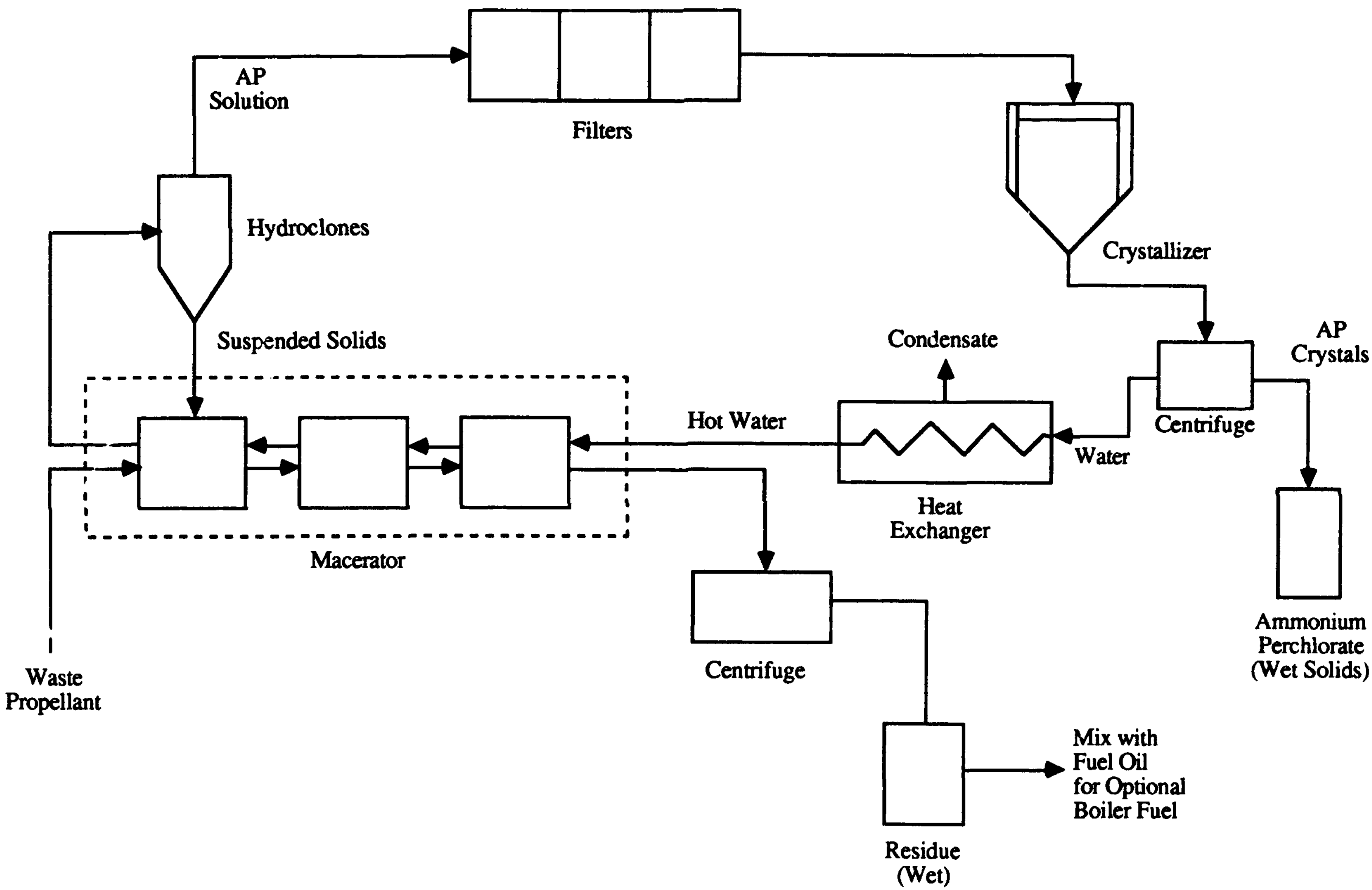


Figure 2-3. Closed-Loop AP Recovery Process Schematic.

also be used for size reduction. Collection methods for waste propellant could be changed and smaller containers of an easily processed size could be used (El Dorado 1988).

Most of the currently available methods for propellant size reduction are dangerous. The possibility of a piece of propellant igniting or detonating is real and unpredictable. Even the use of a water jet such as in a hydraulic macerator provides no guarantee that the propellant will not ignite (Crochet et al. 1988).

Results of Demonstration Studies:

An AP recovery pilot plant operated by Morton Thiokol demonstrated a high degree of success. AP recovery rates ranged from 90.1 to 98.3 percent with no adverse environmental impacts from the process (Poulter et al. 1984). Reclaimed AP exceeded the chemical purity specification

Closed-Loop AP Recovery Process Schematic

limits imposed on newly manufactured material (NASA 1988b) and generally equaled the purity of vendor supplied AP as demonstrated in Table 2-9. Reclaimed AP can be used in propellant oxidizer and reduce the need for additional new AP manufacturing.

Environmental Effects:

AP recovery is a closed loop system with little or no effluent stream to cause adverse effects on the environment (Poulter et al. 1984). An effluent stream would be generated by hydromining, or water washout, a process used to remove propellant from the case of a segment that fails NDE. This water would require treatment before it would be discharged or reused. The solid residue created could be used as an aluminum substitute in slurried explosives and blasting agents, or disposed by incineration or landfill (NASA 1988b). Recovery of the aluminum from this solid residue would further the conservation of strategic raw materials achieved by AP recovery (Poulter et al. 1984).

<u>Incineration</u>

Incineration of waste propellant in a closed incinerator is another alternative to open burning. Like AP recovery, incineration requires that the waste propellant be reduced in size to chunks of approximately 3 to 5 lbs to feed into the incinerator (NASA 1988b). The size reduction methods discussed in Section 2.2.3 (Ammonium Perchlorate Recovery) also apply for incineration although the use of high pressure water jets is not as favorable for incineration.

Types of Incinerators:

There are three existing incinerator systems that have been designed to burn propellant-contaminated waste. Several other incinerator designs have the potential for disposal of propellant and associated waste. These types are briefly described below.

TABLE 2-9
TYPICAL PROPERTIES FOR AMMONIUM PERCHLORATE

Property	Reclaimed Wet Cake	Reclaimed Dry/Blended	Vendor Supplied
Moisture (percent)	5	0.01	0.01
Acid Insolubles (percent)	0.004	0.004	0.006
pH of solution	5.1	6.1	6.1
Chloride as NH_4Cl (percent)	<0.001	<0.001	0.034
Sulfated ash as $NaClO_4$ (percent)	0.15	0.4	0.23
Bromate as NH_4BrO_3 (percent)	<0.001	<0.001	<0.001
Chlorate as NH_4ClO_3 (percent)	<0.001	<0.001	<0.004
Iron as Fe_2O_3 (ppm)	10	10	4.7
Perchlorate as NH_4ClO_4 (percent)	93.5	98.5	99.0
Phosphonate as TCP (percent)	Not recovered	0.15	0.15
SAMPLE OF TRACE IMPURITIES (PPM)			
Na	10	10	330
K	120	120	70
Mg	7	7	23
Ca	15	600	600
Al	10	10	5.5
Cu	1.5	1.5	1.7
Zn	1	1	--
P	0.1	300	300
Si	6	6	34
Pb	1.5	1.5	1.1
Cr	2	2	1.7
Ni	2	2	0.67

Source: Poulter et al. (1984).

Contaminated Waste Processor (CWP)

This system was specifically designed to treat contaminated wastes generated by army propellant and/or explosive manufacturing and loading plants. It consists of a modified commercial carbottom furnace, a basket loading and feed system, a pollution control system and a central microprocessor control. The CWP has an air injector system to provide combustion air for complete and rapid burning of combustibles. A project is now underway to investigate burning actual propellant in the CWP. Testing should be complete by Summer 1989 (El Dorado 1988).

Explosive Waste Incinerator (EWI)

The EWI system was designed and developed for disposal of bulk propellant and explosives, munition components, and explosive wastes generated at Army Ammunition Plants or Depots. The system includes an internally fired rotary kiln furnace installed within a reinforced concrete structure, a combination feed and control room, and a pollution control system similar to the one described for the CWP. However, a scrubber for HCl removal would have to be added to the air pollution control system in order to burn the AP/Al propellants (Clayson 1988). Additional testing of the EWI with AP/Al propellants is planned for the Summer 1989 (El Dorado 1988). A combination of the EWI and CWP systems would provide the versatility of either furnace but with only one pollution control system.

Radford Rotary Kiln

The Radford Rotary Kiln utilizes a refractory lined kiln installed on a slope to burn a water slurry of ground up propellant. This slurry is fed to the kiln by a propellant or explosive waste grinding and slurry feed system. Exhaust gases exit the kiln to the afterburner then pass through a water quench and wet scrubber for HCl removal before the flue gases are released to the atmosphere. The biggest concern with this system is reliability due to its excessive down time caused by corrosion (El Dorado 1988).

Other Systems

There are three other systems which are considered to have the potential to incinerate waste propellant, although none have been tested to date. These systems are (Crochet et al. 1988):

- Fluidized Bed Reactor
- Wet Air Oxidizer
- Pressure Vessel Incinerator

Environmental Impacts:

Waste propellant is considered a hazardous waste because it is ignitable and reactive. Incineration of propellant is therefore subject to Code of Federal Regulations requirements for control of hydrogen chloride (HCl) and particulates, and destruction and removal of organic hazardous compounds (U.S. Navy 1984). HCl is very hygroscopic; i.e., it is readily absorbed by moist membranes of the eye and respiratory tract (Crochet et al. 1988). It is also highly corrosive to materials, including some of those used for incinerator linings and pollution control systems (El Dorado n.d.). The scrubbing liquid from an air pollution control system on an incinerator would require neutralization and precipitation of salts prior to discharge or reuse. The resultant residue would require disposal.

Propellant by design burns very rapidly causing temperature spikes and pressure surges. This limits the amount of propellant that can be fed to an incinerator in a given period of time (El Dorado n.d.). The unpredictability in the supply of propellant creates problems in the sizing of an incineration facility (Crochet et al. 1988). This problem is compounded by the hazards of storing waste propellant for a lengthy time. Other hazards associated with propellant incineration include ignition during size reduction and propagation of burning from the furnace into the feed line (U.S. Navy 1984).

Heat Recovery

Materials classified as hazardous that have a minimum heat energy content of 5,000-8,000 Btu/pound and a low-chlorine content can be legally burned for heat recovery. The composite propellants proposed for use with the ASRM have a Btu value in excess of 8,000 Btu/lb, but also a high chlorine content. The corrosive effects of chlorine and the rapid burning rate of propellant make it impractical to add waste propellant directly to other wastes to improve the heating value. An evaluation of propellant addition was made for the Jackson County Municipal Waste incineration plant, which found it to be impractical due to equipment damage (Crochet et al. 1988).

Many types of wastes have been burned in solution with the proper solvent, but these have all been soluble explosives. The ASRM propellants require a special solvent to dissolve the binder which will not dissolve aluminum and AP. Water will extract AP but neither aluminum nor binder are soluble in water. Thus, no simple method exists for combustion of ASRM propellants with solvents (Crochet et al. 1988).

Alternative Uses

Alternative uses can be identified for two different forms of propellant: unprocessed waste propellant and reclaimed materials for processed waste propellant.

Waste Propellant:

Unprocessed propellant can be used in small quantities as a supplement for explosives. It has also been used as a fire starter by the Forest Service.

Reclaimed Materials:

AP and aluminum reclaimed from waste propellant can be reused in manufacturing of new propellant and for other uses. Recovered AP is chemically pure enough to be used in ASRM propellant manufacturing as discussed in Section 2.2.3 (Ammonium Perchlorate Recovery). Both reclaimed AP and aluminum could be used in propellant for unmanned vehicle rocket motors. The Trident, Polaris, and Pershing missile motors are examples of this type of use. Perchloric acid, which is manufactured from AP, could use reclaimed AP in its formulation. The aluminum rich residue from AP recovery is being evaluated for use as a substitute for pure aluminum in slurried explosives and blasting agents (Poulter et al. 1984).

2.3 THE NO ACTION ALTERNATIVE

2.3.1 The No Action Alternative Defined

Inclusion of the no action alternative in an EIS is required by the regulations implementing NEPA (40 CFR 1502.14(d)). The no action alternative defines a set of baseline conditions which would prevail in the absence of the proposed project. Impacts of the proposed project and its alternatives may then be compared to the impacts associated with the baseline, no action alternative. In this case, the no action alternative is a continuation of the RSRM program. If the ASRM program were terminated, RSRMs could continue to be produced through the current contractor in Utah and/or by a second source RSRM contractor at an unknown location. Environmental impacts of the RSRM program under the current contractor are similar to those which have already been assessed in two separate EISs for the SRM program (NASA/MSFC 1977; Battelle 1983). If a second source contractor were selected for dual facilitization, then a new site-specific EIS would be necessary.

2.3.2 RSRM Production

The SRM manufacturing process (that is, the program in place prior to initiation of the RSRM program in 1986), has been described in previous environmental documents (NASA/MSFC 1977; Battelle 1983). The SRM and RSRM manufacturing processes are similar. The ASRM program described in Section 2.1.1 is expected to achieve the following changes in manufacturing:

- ASRM manufacture will include more automation, replacing some of the RSRM's labor intensive manufacturing processes.
- RSRM case preparation includes asbestos-bearing materials, which are used to insulate the motor case from hot gasses during firing. Eliminating asbestos materials from the ASRM will reduce worker health and safety risks.

2.3.3 Static Test and Transportation

Static test procedures for the RSRM are similar to those described for ASRM in Section 2.1.2, except that the RSRM plume during static testing is directed into a hillside for deflection and not into a man-made deflection ramp. Test fire plume compositions from RSRM and ASRM propellant mixes are discussed in Section 2.2.1. Differences in the air and noise emissions resulting from the ASRM versus the RSRM are expected to be within the error range of predictive methods. Consequently, differential air quality and noise impacts are not distinguishable.

Transport of the RSRM from the Morton-Thiokol Wasatch Plant to KSC is currently by rail, with truck transport to the railhead. For the long-term ASRM program, barge transportation is expected to provide greater public safety because water transport would expose fewer people to possible accidents than rail transport.

2.3.4 Launch and Recovery/Refurbishing

Both the RSRM and ASRM will be launched from KSC. Only slight differences exist between ground-level launch emissions between the two motors, even though the ASRM contains more fuel. There is only a 1.5\percent increase in the mass of propellant burned during the first ten seconds during launch with the ASRM versus the RSRM (Jones, K. 1988, personal communication). This small increase is within the error range of air and noise emissions prediction methods.

Recovery and refurbishing processes of the RSRM and ASRM are similar except for the following. During ASRM recovery and refurbishing processes, worker health and safety risks are reduced by the elimination of asbestos insulation. Automation of the ASRM refurbishing process for grit blasting will expose workers to lower risks. Improved ventilation proposed for the ASRM will reduce worker risks of exposure to release of vapors from cleaning solvents used for RSRM refurbishing.

2.3.5 Summary of RSRM Impacts

For the purpose of establishing a set of impacts resulting from continuation of the RSRM program, the following NEPA environmental documents are referenced:

1) Environmental Analysis of SRM Production at Thiokol/Wasatch (Battelle 1983)

2) Final Environmental Statement for SRM DDT&E Program at Thiokol/Wasatch (NASA/MSFC 1977)

3) Final Environmental Impact Statement for the Kennedy Space Center (NASA 1979b)

4) Final Environmental Impact Statement for the Space Shuttle Program (NASA 1978)

The ASRM program proposes the production of 30 motors per year. Twenty-eight motors will be used for flight (14 flights at 2 motors each) and 2 motors for testing after the initial development phase. The 1977 Final Environmental Statement for the SRM program at Thiokol/Wasatch (NASA/MSFC 1977) assessed the impacts for testing 7 motors. The 1978 Final EIS for the Shuttle Program (NASA 1978) assessed impacts for 40 shuttle launches per year.

The 1983 Environmental Analysis of SRM production at Thiokol/Wasatch (Battelle 1983) updated the 1977 Environmental Statement at Thiokol/Wasatch for a production total of 48 SRMs per year. Environmental impact summaries for SRM launches are discussed in the FEIS for KSC (NASA 1979b) and the FEIS for the Shuttle Program (NASA 1978). These four environmental documents have already assessed impacts for up to 7 SRM tests, annual production of 48 SRMs and 40 shuttle launches. In these previous studies, no significant adverse impacts were found except for low probability accident consequences.

The environmental impact summary for SRM production (Battelle 1983) describes adverse impacts to:

- Air quality
  - incidental releases of solvents during manufacture of raw materials
  - exhaust fumes from trucks and locomotives in transport
  - incidental releases of Al_2O_3 and HCl from open burning of waste propellant
- Water quality
  - incidental discharges of solvents and other chemicals to sewage systems during manufacture of raw materials, SRM production, and refurbishment
  - water use increases during manufacture of raw materials
  - runoff from waste propellant burn pits
  - discharges of microscopic asbestos to sewer systems
- Solid waste disposal
  - generation of waste propellant requiring disposal
  - generation of asbestos waste from washout refurbishment facility
  - generation of charred insulation from spent motors requiring landfill disposal
- Human health and safety
  - potential worker asbestos exposure during manufacture and refurbishment
- Accident consequences
  - possible explosion, fire, and loss of life during manufacture of raw materials and production
  - possible truck or rail accidents resulting in material spills, with possible explosion or fire
  - accidental detonation resulting in loss of life or production capability
  - accidental releases of asbestos, chemical vapors and discharge of solvents during refurbishing

Similarly, the environmental impact summary for testing of SRMs (NASA/MSFC 1977) included:

- Air quality
  - temporary, localized, small degradation of air quality downwind of the test site
- Noise
  - large area subjected to modest levels of low frequency noise
  - possible annoyance to some people, but no population centers affected due to low population density near Utah plant
  - temporary disturbance to nearby wildlife
  - case rupture from an accident could startle or annoy perceivers
- Water quality
  - no effect

- **Solid waste disposal**
  - **no effect from normal test operations**
  - **debris from accidental case rupture would require disposal**

- **Human health and safety**
  - **no effect**

- Biotic resources
  - small areas at test site would be degraded under normal or accidental test scenarios

For the RSRM no action alternative, 17 annual launches are required to equal the payload of 14 launches using ASRMs. The environmental impact summary of 40 annual launches using SRMs (NASA 1978) include:

- Air quality of the lower atmosphere
  - temporary and localized degradation of air quality in regions where the cloud passes

- Air quality of the stratosphere
  - a 0.25 percent ozone reduction resulting in a 0.5 percent increase in ultraviolet radiation to the surface of the earth

- Noise
  - large areas subjected to moderate sound levels of predominately low frequencies for one to two minutes
  - at launch, the peak sound levels at the nearest-to-pad boundary at KSC is about 80\dB(a)
  - the peak sound level at the KSC viewing stand is about 95\dB(A)
  - the A-weighted 24-hour average sound levels (Leq) to which the public is exposed are less than the EPA daytime guideline value of 70\dB(A)
  - no effects on humans are expected
  - the low frequency sound may briefly rattle loose windows near the launch area

- Sonic booms
  - sonic booms are produced during both launch and reentry
  - the launch boom occurs entirely over the Atlantic Ocean and does not produce a significant environmental impact
  - the reentry booms occur over populated areas of Florida and California
  - the low intensity of these booms produces only a slight startle reaction in about half of the people who bear the boom

- Biotic resources
  - depression of pH levels from HCl dissolved in quench water sprayed on the launch pad has been implicated as the potential reason for the mortality of small fish in a lagoon near the launch facility (Hawkins et al. 1984)

A summary of impacts associated with production and testing of SRMs at Morton-Thiokol Wasatch are provided in Section 2.4 for comparison with ASRM site alternatives.

2.4 COMPARISON OF ALTERNATIVES

The tables which follow compare the impacts of the no-action alternative to the impacts of locating ASRM production and/or testing facilities at each of the alternative sites. Impacts of the no-action alternative are taken from the Environmental Analysis of SRM Production at Thiokol/Wasatch (Battelle 1983) and the Final Environmental Statement for SRM DDT and E Program at Thiokol/Wasatch (NASA/MSFC 1977). Impacts shown for the no-action alternative apply only to continuing operations with the existing contractor alone. If the ASRM program were cancelled or delayed and a second RSRM contractor were being considered, a new EIS would be required to evaluate impacts at the second contractor's site.

The tables which follow provide a comparison of impacts from facility construction (Table 2-10), ASRM manufacturing (Table 2-11), static testing (Table 2-12), and transportation of filled ASRM segments between the manufacturing site and the test and launch site(s) (Table 2-13).

NASA's preferred alternative includes ASRM manufacturing at the Yellow Creek site and static testing at Stennis Space Center.

TABLE 2-10

COMPARATIVE IMPACTS OF CONSTRUCTING ASRM FACILITIES

Environmental Effect Area	No Action	Stennis Space Center	Yellow Creek	Kennedy Space Center - Area B	Kennedy Space Center - Area C
Air Resources	Not Applicable	Insignificant impacts associated with fugitive dust from land clearing and vehicle emissions from construction and commuter traffic.	Insignificant impacts associated with fugitive dust from land clearing and vehicle emissions from construction and commuter traffic.	Insignificant impacts associated with fugitive dust from land clearing and vehicle emissions from construction and commuter traffic.	Insignificant impacts associated with fugitive dust from land clearing and vehicle emissions from construction and commuter traffic.
Water Resources	Not Applicable	Minor, short-term impacts of canal excavation and dredging.	Insignificant impact since site is partially developed.	Moderately significant impacts from filling small surface ponds. Insignificant impact from salt-water intrusion to the surface aquifer from covering recharge areas.	Insignificant impact to surface aquifer from covering recharge areas.
Land Resources (Soils)	Not Applicable	Small, temporary soil disturbance. Insignificant erosion potential. Insignificant landslide potential.	Insignificant soil erosion impact due to existing control measures. Small landslide potential.	Small, temporary soil disturbance. Insignificant erosion potential. Insignificant landslide potential.	Small, temporary soil disturbance. Impact on dune erosion uncertain pending deflection ramp design. Insignificant landslide potential.
Wetlands and Floodplains	Not Applicable	No wetlands.	Insignificant impact to wetlands.	Moderately significant impact from filling wetlands.	No wetlands impacted.
		Floodplain should be avoidable. No impairment of floodway anticipated.	Floodplain completely avoided	Floodplain cannot be avoided. Insignificant impairment to the floodway.	Floodplain should be avoidable. No impairment of floodway anticipated.
Biotic Resources	Not Applicable	Moderately significant disturbance or elimination of diminishing vegetation types or communities (bottomland hardwoods and pitcher plant bags).	Insignificant impact on vegetation.	Moderately significant elimination of diminishing vegetation (wetlands).	Moderately significant elimination of diminishing vegetation (coastal dune and beach).
		Moderately significant elimination of wildlife habitat.	Insignificant impact on wildlife.	Moderately significant elimination of wildlife habitat.	Moderately significant elimination of wildlife habitat.
		Insignificant impacts on aquatic species and habitats from erosion or dredging.	Insignificant impacts on aquatic species and habitats from erosion or dredging.	Moderately significant impact on aquatic habitats from filling wetlands and ponds.	No impacts to aquatic habitats or species.

TABLE 2-10
(CONTINUED)
COMPARATIVE IMPACTS OF CONSTRUCTING ASRM FACILITIES

Environmental Effect Area	No Action	Stennis Space Center	Yellow Creek	Kennedy Space Center - Area B	Kennedy Space Center - Area C
Biotic Resources (Continued)		Moderately significant impact to ringed sawbacked turtle, a threatened species.	Moderately significant impact to state sensitive species.	Moderately significant impact to woodstork, Florida scrub jay, and eastern indigo snake, threatened or endangered species.	Significant impact to Atlantic green turtle, an endangered species. Significant impact to loggerhead turtle, a threatened species.
Land Use	Not Applicable	Consistent with SSC Master Plan. Area under permit to to MSAAP being returned to NASA for use.	Consistent with TVA Pickwick Reservoir Plan.	Consistent with KSC Master Plan. Consistent with Florida Coastal Zone Program.	In conflict with planned Air Force uses. Consistent with Florida Coastal Zone Program.
				Consistent with Florida Coastal Zone Program.	Consistent with Florida Coastal Zone Program.
Socioeconomics and Infrastructure		(Similar to manufacturing impacts - See Table 10-2)			
Transportation	Not Applicable	Moderately significant impact to local road network from commuter traffic. No drop below LOS D.	Moderately significant impact to local road network from commuter traffic. Drop to LOS D on two segments of MS-25.	No significant impact to local road network from commuter traffic if planned expansion of North Courtenay Parkway occurs within the next 3 years. Significant impact without expansion.	No significant impact to local road network from commuter traffic if planned expansion of North Courtenay Parkway occurs within the next 3 years. Significant impact without expansion.
		Insignificant impact due to construction vehicles.	Insignificant impact due to construction vehicles.	Insignificant impact due to construction vehicles.	Insignificant impact due to construction vehicles.
Historic Archaeological and Cultural Resources	Not Applicable	No known archaeological or historic sites.	No significant impact to known archaeological or historic sites due to previous TVA mitigation.	Two prehistoric sites located within boundaries. Significant impact if not avoided.	Five prehistoric sites, one historic site, and two potential historic sites located within boundaries. Significant impact if not avoided.
Solid and Hazardous Waste, Toxic Substances and Pesticides	Not Applicable	Insignificant impact on solid waste disposal system.	Insignificant impact on waste disposal system.	Insignificant impact on waste disposal system.	No impact.
Radiation	Not Applicable	No impact.	No impact.	No impact.	No impact.

TABLE 2-10
(CONTINUED)
COMPARATIVE IMPACTS OF CONSTRUCTING ASRM FACILITIES

Environmental Effect Area	No Action	Stennis Space Center	Yellow Creek	Kennedy Space Center - Area B	Kennedy Space Center - Area C
Noise	Not Applicable	Impacts to biota above. Insignificant impacts to humans and property.	Impacts to biota above. Insignificant impacts to humans and property.	Impacts to biota above. Insignificant impacts to humans and property.	Impacts to biota above. Insignificant impacts to humans and property.
Health & Safety	Not Applicable	Insignificant impacts.	Insignificant impacts.	Insignificant impacts.	Insignificant impacts.

TABLE 2-11

COMPARATIVE IMPACT OF RSRM and ASRM MANUFACTURING

Environmental Effect Area	No Action	Stennis Space Center	Yellow Creek	Kennedy Space Center - Area B
Air Resources	Insignificant release of solvent emissions.	Insignificant release of solvent emissions.	Insignificant release of solvent emissions.	Insignificant release of solvent emissions.
	Insignificant emission of air pollutants from commuter traffic and fuel burning equipment.	Insignificant emission of air pollutants from commuter traffic and fuel burning equipment.	Insignificant emission of air pollutants from commuter traffic and fuel burning equipment.	Insignificant emission of air pollutants from commuter traffic and fuel burning equipment.
	Insignificant localized degradation of air quality due to Al_2O_3 and HCl elease from open burning of waste ropellant.	Insignificant localized degradation of air quality due to Al_2O_3 and HCl release from open burning of waste propellant.	Insignificant localized degradation of air quality due to Al_2O_3 and HCl release from open burning of waste propellant.	Insignificant localized degradation of air quality due to Al_2O_3 and HCl release from open burning of waste propellant.
Water Resources	Adequate water supply from ground-water sources.	Adequate water supply from ground-water sources.	Adequate water supply from surface water sources.	Adequate potable water supply from existing system.
	No significant impact on ground-water quality.	No significant impact on ground-water quality.	No significant impact on ground-water quality.	Moderately significant impact to ground-water quality from saltwater intrusion if process water is pumped from on-site wells.
	No significant impact to surface water quality. Discharges will meet applicable federal and state effluent guidelines.	No significant impact to surface water quality. Discharges will meet applicable federal and state effluent guidelines.	No significant impact to surface water quality. Discharges will meet applicable federal and state effluent guidelines.	No significant impact to surface water quality. Discharges will meet applicable federal and state effluent guidelines.
	Discharge of microscopic asbestos to sewer system.	No asbestos used.	No asbestos used.	No asbestos used.
Land Resources (Soils)	No Impact	Moderately significant impact of corrosive soils on underground facilities.	Soils not corrosive. No impact on underground facilities.	Soils not corrosive. No impact on underground facilities.
Wetlands and Floodplains	No Impact	Not Applicable	Not Applicable	No Impact
Biotic Resources	No Impact	No Impact	No Impact	No Impact
Land Use	No Impact	No Impact	Moderately significant noise impact to local residences from manufacturing operations.	No Impact

TABLE 2-11
(CONTINUED)
COMPARATIVE IMPACT OF RSRM and ASRM MANUFACTURING

Environmental Effect Area	No Action	Stennis Space Center	Yellow Creek	Kennedy Space Center - Area B
Socioeconomics and Infrastructure	Insignificant impact on local population.	Moderately significant increase in population of Hancock and Pearl River counties. Insignificant change elsewhere.	Moderately significant increase in population of Tishomingo County. Insignificant (change elsewhere. Reversal of recent trend of declining population.	Insignificant increase in population of Brevard County
	Comparable information not available for unemployment, income, services, schools, utilities, or housing impacts.	Very significant decrease in unemployment in Pearl River, Hancock, and Harrison counties.	Very significant decrease in unemployment in Tishomingo, Hardin, Colbert, Alcorn, and Lauderdale counties.	Insignificant decrease in unemployment in Brevard County.
		Insignificant positive effect on employment and income.	Insignificant positive effect on employment and income.	Insignificant positive effect on employment and income.
		Moderately significant impact on ratio of law enforcement personnel to population in Pearl River County. Insignificant effect elsewhere.	Moderately significant impact on ratio of law enforcement personnel to population in Tishomingo County. Insignificant effect elsewhere.	Insignificant impact on ratio of law enforcement personnel to population in Brevard County.
		Moderately significant impact on physician-to-population ratio in Hancock and Pearl River counties. Insignificant change elsewhere.	Very significant impact on physician-to-population ratio in Tishomingo. Insignificant change elsewhere.	Insignificant impact on physician-to-population ratio in Brevard County
		Significant impact on teacher-to-student ratio in Hancock and Pearl River counties. Insignificant change elsewhere.	Moderately significant impact on teacher-to-student ratio in Tishomingo. Insignificant change elsewhere.	Moderately significant impact on teacher-to-student ratio in Brevard County.
		Insignificant impact on public utilities.	Insignificant impact on public utilities. Need for new landfill currently exists.	Moderately significant impact to water and sewer system for Titusville.
		Insignificant impact on housing prices. Current oversupply of houses can absorb new demand.	Moderately significant impact on housing prices in Tishomingo County. Although current housing market is depressed, price speculation is already apparent.	Insignificant impact on housing prices. New construction supply able to meet planned KSC growth demands.

TABLE 2-11
(CONTINUED)
COMPARATIVE IMPACT OF RSRM and ASRM MANUFACTURING

Environmental Effect Area	No Action	Stennis Space Center	Yellow Creek	Kennedy Space Center - Area B
Transportation	Comparable information not available.	Moderately significant impact of increased commuter traffic on local road network, although no reduction in LOS to service level D.	Moderately significant impact of increased commuter traffic on local road network from commuter traffic. Reduction to LOS D on MS 25 and Red Sulpher Springs Road.	No significant impact. Same as construction impact.
	Insignificant impact on rail from transport of raw materials or RSRM segments.	Insignificant impact on rail and/or barge systems from transport of raw materials or ASRM segments.	Insignificant impact on rail and/or barge systems from transport of raw materials or ASRM segments.	Insignificant impact on rail and/or barge systems from transport of raw materials or ASRM segments.
Historical Archaeo-logical and Cultural Resources	No Impact	Insignificant indirect impact on cultural resources from construction of houses, businesses, etc. associated with additional population	Insignificant indirect impact on cultural resources from construction of houses, businesses, etc. associated with additional population.	Insignificant indirect impact on cultural resources from construction of houses, businesses, etc. associated with additional population.
Solid and Hazardous Waste, Toxic Sub-stances and Pesticides	Generates 80% of solid waste disposed in on-site landfill.	Insignificant impact on sanitary landfill.	(see Socioeconomics and Infrastructure)	Moderately significant due to limited capacity of existing landfill.
	Generation of up to 1.2 million pounds of waste propellant requiring disposal.	Generation of approximately 1 million pounds of waste propellant requiring disposal.	Generation of approximately 1 million pounds of waste propellant requiring disposal.	Generation of approximately 1 million pounds of waste propellant requiring disposal.
	Generation of asbestos waste requiring disposal.	Insignificant impact on existing toxic substance control programs. No asbestos used.	Toxic substance control program to be instituted. No asbestos used.	Insignificant impact on existing toxic substance control programs. No asbestos used.
	Insignificant iimpact on existing pesticide programs.	Insignificant impact on existing pesticide programs.	Pesticide control program to be instituted.	Insignificant impact on existing pesticide programs.
Radioactive Materials and Nonionizing Radiation	Comparable information not available.	Insignificant increase in radiation from NDE equipment.	Insignificant increase in radiation from NDE equipment.	Insignificant increase in radiation from NDE equipment.
Noise	No noise audible to the public.	Insignificant impact on public due to distance of manufacturing site from SSC boundary.	Moderately significant noise impact to local residences.	Insignificant impact on public due to distance of manufacturing site from KSC boundary and visitor center.
Health & Safety	Potential worker exposure to asbestos.	No asbestos used.	No asbestos used.	No asbestos used.

TABLE 2-11
(CONTINUED)
COMPARATIVE IMPACT OF RSRM and ASRM MANUFACTURING

Environmental Effect Area	No Action	Stennis Space Center	Yellow Creek	Kennedy Space Center - Area B
Health & Safety (Continued)	Potential worker exposure to hazardous chemicals and spills is moderately significant. Insignificant public exposure to open burn emissions.	Potential worker exposure to hazardous chemicals and spills is moderately significant. Insignificant public exposure to open burn emissions.	Potential worker exposure to hazardous chemicals and spills is moderately significant. Insignificant public exposure to open burn emissions.	Potential worker exposure to hazardous chemicals and spills is moderately significant. Insignificant public exposure to open burn emissions.

TABLE 2-12

COMPARATIVE IMPACTS OF RSRM and ASRM STATIC TESTING

Environmental Effect Area	No Action	Stennis Space Center	Kennedy Space Center - Area B	Kennedy Space Center - Area C
Air Resources	Temporary localized degradation of air quality from Al_2O_3, and HCL emissions. Emissions within all federal and state standards.	Temporary localized degradation of air quality from Al_2O_3, and HCL emissions. Emissions within all federal and state standards.	Temporary localized degradation of air quality from Al_2O_3, and HCL emissions. Emissions within all federal and state standards.	Temporary localized degradation of air quality from Al_2O_3, and HCL emissions. Emissions within all federal and state standards.
		No cumulative effect.	Insignificant cumulative effect on air quality when added to launches at KSC and CCAFS.	Insignificant cumulative effect on air quality when added to launches at KSC and CCAFS.
Water Resources	No Effect	Insignificant impact from temporary reduction in surface water pH.	Insignificant impact from temporary reduction in surface water pH.	No effect
		No cumulative effect.	Insignificant cumulative effect on surface water quality when added to launches at KSC and CCAFS.	No effect.
Land Resources (Soils)	Small area around test site degraded.	Moderately significant impact from deposition of residue from rocket exhaust.	Moderately significant impact from deposition of residue from rocket exhaust.	Moderately significant impact from deposition of residue from rocket exhaust.
	Small area around test site degraded.	Insignificant degree of soil erosion from rocket blast.	Insignificant degree of soil erosion from rocket blast.	Insignificant degree of soil erosion from rocket blast.
Wetlands and Floodplains	No Effect	Not applicable	See Biotic Resources	No effect.
Biotic Resources	Insignificant impact of hot exhaust plume on vegetation or wildlife outside immediate vicinity of test stand and deflection ramp.	Insignificant impact of hot exhaust plume on vegetation or wildlife outside immediate vicinity of test stand and deflection ramp.	Insignificant impact of hot exhaust plume on vegetation or wildlife outside immediate vicinity of test stand and deflection ramp.	Insignificant impact of hot exhaust plume on vegetation or wildlife outside immediate vicinity of test stand and deflection ramp.
	Insignificant impact of noise on wildlife.	Insignificant impact of noise on wildlife.	Insignificant impact of noise on wildlife.	Insignificant impact of noise on wildlife.
	No impact on aquatic species.	No impact on aquatic species.	No impact on aquatic species.	No impact on aquatic species.

TABLE 2-12
(CONTINUED)
COMPARATIVE IMPACTS OF RSRM and ASRM STATIC TESTING

Environmental Effect Area	No Action	Stennis Space Center	Kennedy Space Center - Area B	Kennedy Space Center - Area C
Biotic Resources (Continued)	No Impact	Moderately significant impact of noise on ringed sawbacked turtle and/or bald eagle possible. Biological Assessments recommended for both species.	Moderately significant impact of noise on woodstork, Florida scrub jay and and eastern indigo snake. Biological Assessments required for each species.	Moderately significant impact of noise on Atlantic green turtle and loggerhead turtle. Biological Assessments required for each species.
Land Use	Consistent with existing uses.	Consistent with SSC Master Plan. Moderately significant noise impact at Jourdan River as Inventory River for designation under federal Wild and Scenic Rivers program.	Consistent with KSC Master Plan.	In conflict with planned Air Force uses.
Socioeconomics and Infrastructure	No Impact	Insignificant impact to all socioeconomic and infrastructure indicators.	Insignificant impact to all socioeconomic and infrastructure indicators.	Insignificant impact to all socioeconomic and infrastructure indicators.
Transportation	Comparable information not available.	Insignificant impact from increased commuter traffic. Insignificant impact on rail and/or large systems from transport of ASRM segments.	Insignificant impact from increased commuter traffic. Insignificant impact on rail and/or large systems from transport of ASRM segments.	Insignificant impact from increased commuter traffic. Insignificant impact on rail and/or large systems from transport of ASRM segments.
Historic Archaeological and Cultural Resources	No effect.	No effect.	No effect.	No effect.
Solid and Hazardous Waste, Toxic Substances, and Pesticides	No effect.	No effect.	No effect.	No effect.
Radioactive Materials and Nonionizing Radiation	Not applicable.	Not applicable.	Not applicable.	Not applicable.
Noise	Large area subjected to modest levels of low frequency noise. No population centers near site.	Moderately significant impact of noise at Interstate 10 and at residential, commercial, and recreation sites.	Moderately significant impact of noise at KSC and CCAFS developed sites.	Moderately significant impact of noise at KSC and CCAFS developed sites.

TABLE 2-12
(CONTINUED)
COMPARATIVE IMPACTS OF RSRM and ASRM STATIC TESTING

Environmental Effect Area	No Action	Stennis Space Center	Kennedy Space Center - Area B	Kennedy Space Center - Area C
Public Health and Safety	No effect.	Insignificant public exposure to static test emissions.	Insignificant public exposure to static test emissions.	Insignificant public exposure to static test emissions.

TABLE 2-13

COMPARATIVE IMPACT OF TRANSPORTING RSRM AND ASRM SEGMENTS

Environmental Effect Area	No Action	Manufacture at Yellow Creek: Yellow Creek to Stennis Space Center	Manufacture at Yellow Creek: Yellow Creek to Kennedy Space Center	Manufacture at Stennis Space Center: Stennis Space Center to Kennedy Space Center	Manufacture at Kennedy Space Center: Within KSC
Consequences of Routine Shipments by Rail	Insignificant effect on system capacity.	Insignificant effect on system capacity.	Insignificant effect on system capacity.	Insignificant effect on system capacity.	Not applicable.
Consequence of Routine Shipments by Barge	Not applicable.	Insignificant effect on system capacity.	Insignificant effect on system capacity.	Insignificant effect on system capacity.	Not applicable.
		No impact on environmental resources.	Moderately significant impact on endangered Florida manatee.	Moderately significant impact on endangered Florida manatee.	Not applicable.
Number of Railcar Trips1/ 2/	128 to KSC	8-16 if test at SSC	112 if test at SSC 128 if test at KSC	112 if test at SSC 128 if test at KSC	Not applicable.
Number of Barge Trips2/	Not applicable.	1-2 if test at SSC	14 if test at SSC 15-16 if test at KSC	14 if test at SSC 15-16 if test at KSC	Not applicable.
Distance (Duration) per Trip - Rail	2,500 miles	350 miles	700-750 miles (7-8 days)	600-700 miles (7 days)	Not applicable.
Distance (Duration) per Trip - Barge	Not applicable.	570 miles	1650 miles (15 days)	Not estimated (8 days)	Not applicable.
Probability of Nonexplosive Incident - Rail	0.00001 per car mile.	0.00001 per car mile.	0.00001 per car mile.	0.00001 per car mile.	Not applicable.
Probability of Fire and/or Explosive Accident - Rail	0.0000035 per car mile.	0.0000035 per car mile	0.0000035 per car mile	0.0000035 per car mile	Not applicable.
Probability of Fire and/or Explosive Accident - Barge	Not applicable.	Believed to be lower than rail.	Believed to be lower than rail.	Believed to be lower than rail.	Not applicable.

1/ Assumes each rail car carries one segment of a four-segment motor.
2/ Transport of ASRMs would be by rail or barge, not both.

TABLE 2-13
(CONTINUED)
COMPARATIVE IMPACT OF TRANSPORTING RSRM AND ASRM SEGMENTS

Environmental Effect Area	No Action	Manufacture at Yellow Creek: Yellow Creek to Stennis Space Center	Manufacture at Yellow Creek: Yellow Creek to Kennedy Space Center	Manufacture at Stennis Space Center: Stennis Space Center to Kennedy Space Center	Manufacture at Kennedy Space Center: Within KSC
Consequences of Accident - Rail	Loss of human life, structures, system capacity.	Loss of human life, structures, system capacity.	Loss of human life, structures, system capacity.	Loss of human life, structures, system capacity.	Not applicable.
Consequences of Accident - Barge	Not applicable.	Same as rail, except believed to be less because transportation corridors are wider	Same as rail, except believed to be less because transportation corridors are wider.	Same as rail, except believed to be less because transportation corridors are wider.	Not applicable.

3.0 STENNIS SPACE CENTER, MISSISSIPPI

3.1 THE AFFECTED ENVIRONMENT

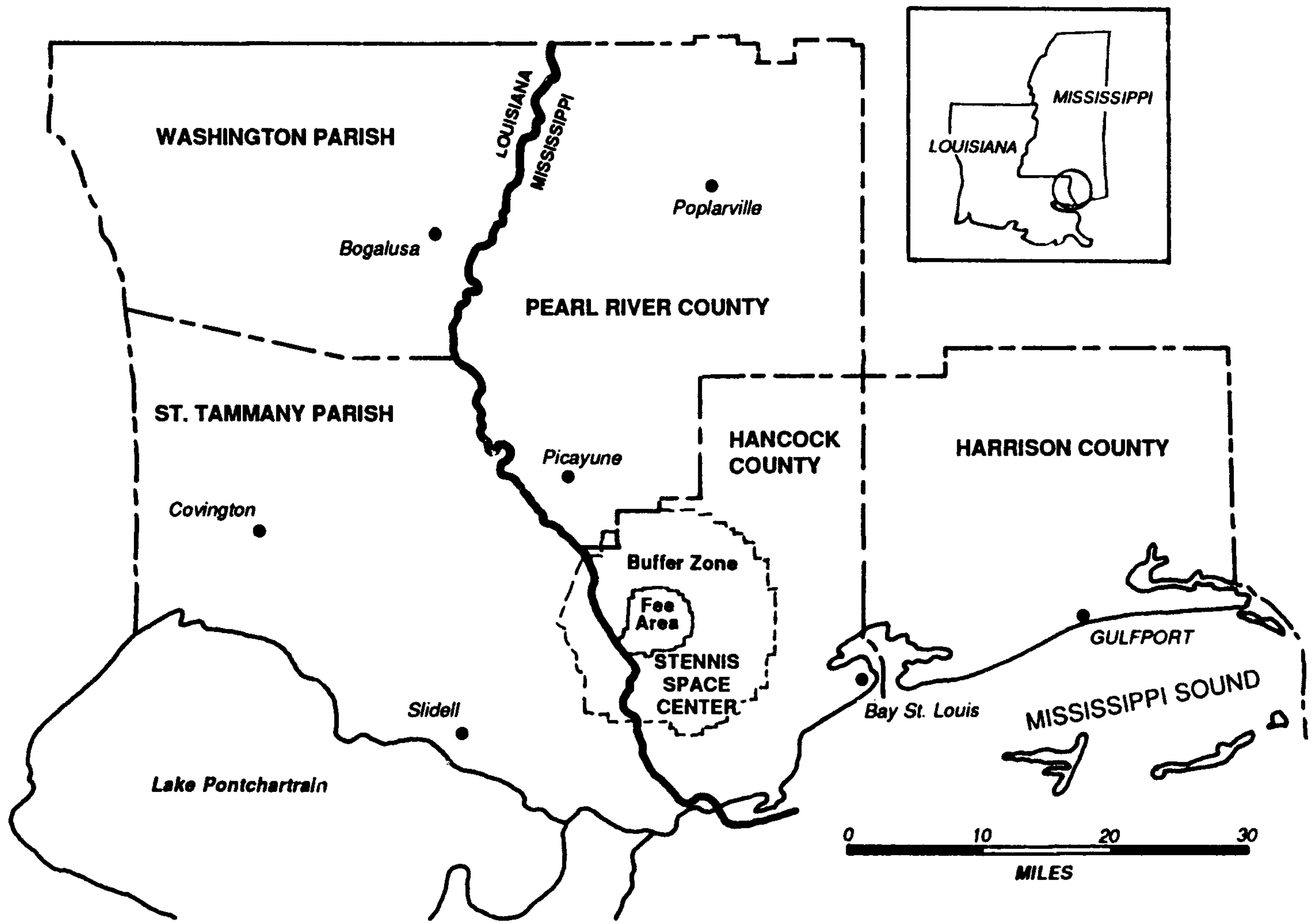
3.1.1 Site Description

Stennis Space Center (SSC) and its surrounding buffer zone occupy a large portion of Hancock County, Mississippi (Figure 3-1). The Space Center, located within 12 miles of the Gulf Coast, is comprised of a NASA fee ownership area and a buffer zone. The fee area, upon which all NASA-approved institutional and industrial development takes place, occupies approximately 22 square miles. The buffer zone, set aside as a safety and acoustical buffer, consists of about 200 square miles extending outward five miles from the fee area perimeter. The buffer zone is primarily in private ownership. NASA has a perpetual easement in the buffer zone, allowing only those uses which do not include potentially habitable structures (USACOE 1967).

As shown in Figure 3-1, the buffer zone extends into St. Tammany Parish, Louisiana and Pearl River County, Mississippi. Interstate 10 and U.S. Route 90 traverse the south half of the buffer zone (see Section 3.1 9). The Louisiana-Mississippi state line is at the Pearl River, which is the only navigable waterway linking SSC with the Intracoastal Waterway. An eight mile network of canals branching off the Pearl River serves SSC. The towns of Pearlington, Waveland, Bay St. Louis, Kiln, Picayune, and Slidell (Louisiana) are located just outside the boundary of the buffer zone.

SSC, formerly known as the National Space Technology Laboratories (NSTL), was built between 1963 and 1966. The facility was established to perform developmental and acceptance tests for large liquid-propellant rocket systems for the U.S. space program. From 1965 through 1970, SSC was the site of static tests for the Saturn V rocket stages which were used in the Apollo missions to the moon. Currently, SSC is the site for development and testing of the Space Shuttle main engines. Additionally, part of NASA's responsibilities at SSC are to provide a program and institutional base upon which to transfer NASA technology to the user community. NASA programs at SSC include research into the beneficial application of NASA-developed technology in the fields of remote sensing, and other space and terrestrial applications programs.

Several agencies and private contractors also occupy offices at SSC. These include the National Oceanic and Atmospheric Administration (NOAA); National Park Service; U.S. Geological Survey; U.S. Fish and Wildlife Service; Environmental Protection Agency; Mississippi State University; Louisiana Office of Science, Technology, and Environmental Policy; U.S. Department of the Navy; and U.S. Department of the Army. A thorough discussion of NASA and agency operations can be found in the Facilities Master Plan (NASA 1979a) and Environmental Resources Document (NASA 1980b).



NASA
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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 1
STENNIS SPACE CENTER
AND VICINITY

Date: December 1988 | EBASCO SERVICES INCORPORATED

The Department of the Army operates the Mississippi Army Ammunition Plant (MSAAP) at SSC and also controls most of the northern half of the fee area. The MSAAP operates under permit from NASA and is engaged in the production of 155 mm artillery rounds.

The site being considered for ASRM production and/or testing is located in the northeastern part of the fee area as indicated in Figure 3-2. The proposed site consists of about 2,100 acres, most of which is now forested with managed slash pine plantations.

3.1.2 Air Resources

Climatology

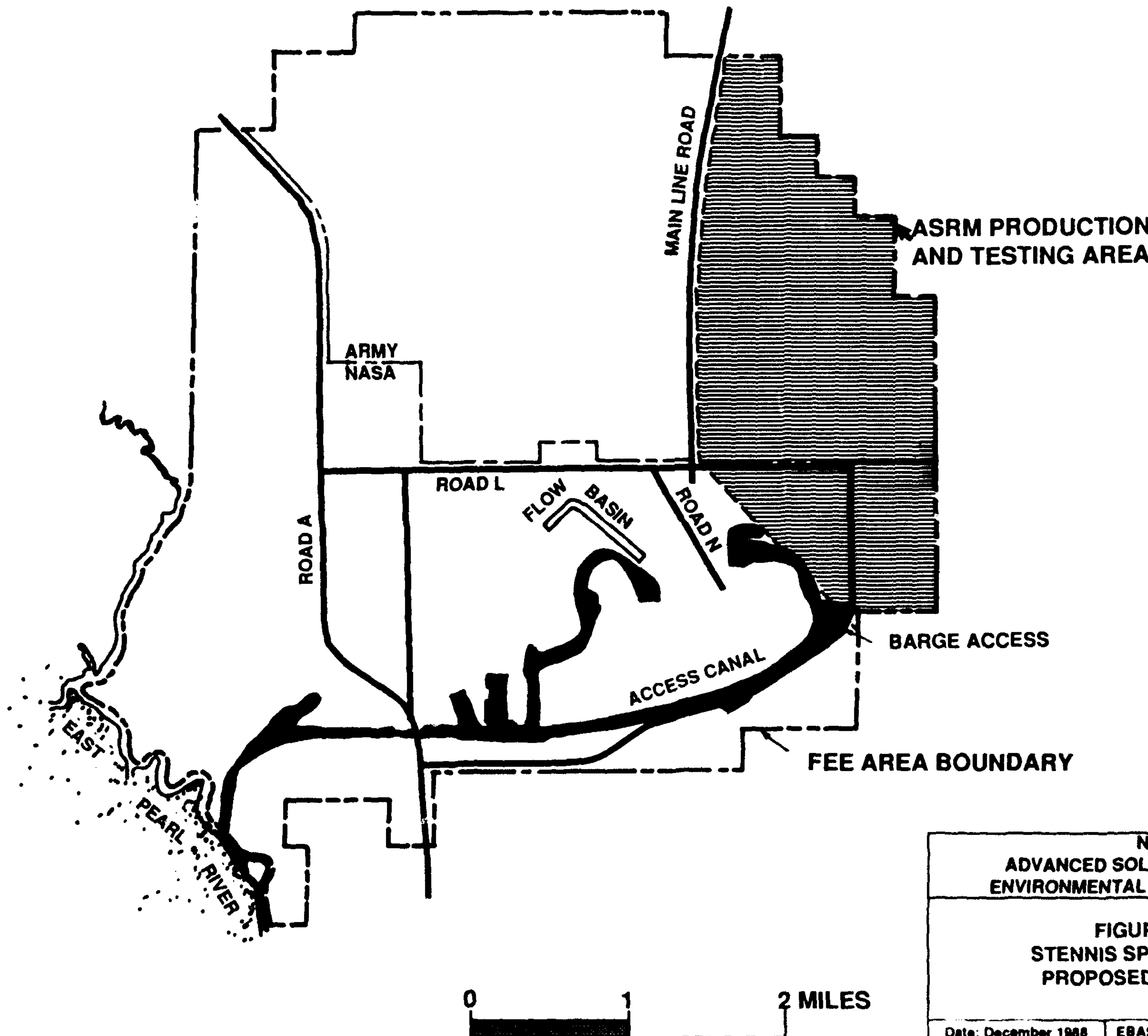
A description of the climatology and meteorology of SSC is given in both the Facilities Master Plan (NASA 1979a) and the Environmental Resources Document (NASA 1980b). The climate is classified as humid subtropical, and is characterized by an approximately uniform distribution of rainfall throughout the year. There is no clearly established pattern of wet and dry months. Rainfall in the summer months is typically showery in nature, while winter rainfall is more steady, associated with subtropical winter storms. The average precipitation is about 60 inches per year, but varies by plus or minus 20 inches per year.

Temperatures average about 66°F near the Gulf Coast. Cold weather is experienced during winter, but extended periods of freezing are rare. The summer months will have extended periods of temperatures over 90°F and high humidity. Climatologic extremes include high temperatures of about 100°F observed in June, July, and August and a low of 7°F observed in December. More than 13 inches of rain fell in one 24-hour period, as recorded in nearby Slidell, LA. Sunshine occurs approximately 58 percent of the possible hours. Annual averages include 84 clear days, 114 partly cloudy, and 167 cloudy.

Winds at SSC prevail from the north about one-third of the time and from the south and southeast much of the rest of the time (see Appendix A). Winds from the north occur most often during August through February. Wind speeds are less than 10 miles per hour more than 90 percent of the time. Tropical cyclone season is from June to October, and approximately one storm of hurricane force (wind speeds greater than 75 mph) is experienced per year. There are presently no meteorological observations taken at SSC. Observations representative of SSC are routinely made at New Orleans and several other Gulf Coast cities.

Atmospheric Transport and Dispersion

Conditions which relate to air pollution dispersion and transport are summarized in Holzworth (1972). Generally, SSC is in an area where wind speeds are low and the potential for limited dispersion conditions may cause air pollution episodes near urban areas.



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 2
STENNIS SPACE CENTER
PROPOSED ASRM SITE

Date: December 1988 | EBASCO SERVICES INCORPORATED

Existing Sources of Air Pollution

SSC is located in a rural area, removed from urban sources of air pollution. As described in the ASRM Environmental Assessment (CH2M Hill 1987), SSC ispresently a minor source of air pollution, having no sources which emit more than 250 tons of a regulated pollutant per year. The Mississippi Army Ammunition Plant is a major source of air pollution (as defined by the federal Clean Air Act) and has received a Prevention of Significant Deterioration permit for both SO_2 and TSP.

Existing Test-Related Emission Sources

NASA motor testing at SSC presently involves the Space Shuttle main engine, which is a liquid oxygen/liquid hydrogen fuel motor. The exhaust product of these tests consists mainly of water and water vapor. Therefore, from an air pollution standpoint, the existing testing at SSC has a low potential for direct atmospheric emissions. Some incidental particulate and gaseous emissions result from exhaust impingement on the test stands. The size of the SSC facility and the buffer zone ensures that these incidental emissions are insignificant beyond the facility boundaries.

Local Ambient Air Quality

The local air quality for SSC is good, based on its attainment status for all air pollutants. Air quality standards and observed ambient air quality are summarized in Table 3-1. Air pollution control agencies which have authority over emissions originating at SSC include the following: United States Environmental Protection Agency Region IV Office located in Atlanta, GA, and the Mississippi Department of Natural Resources, Bureau of Pollution Control, located in Jackson, MS.

3.1.3 Water Resources

Groundwater

Stratigraphy and Aquifer Identification:

The strata underlying SSC (consisting of interbedded sands and clays of Miocene and Pliocene age, respectively) dip southward to southwestward at approximately 50 feet (ft) per mile (Newcome 1967). The stratigraphic section containing fresh water bearing sand is approximately 2,750 ft thick, has one unconfined near-surface aquifer, and has ten or more confined aquifers at depth. This sequence of alternating sands and discontinuous clay layers, causing the confining nature of the deeper aquifers, is a portion of the Coastal Lowlands Aquifer System (Grubb 1986) or the Southeastern Coastal Plain aquifer system (Miller and Renken 1988).

The aquifers of the region have plentiful, almost untapped supplies of fresh water (Newcome 1967). Three wells installed at SSC for potable water supply are 1,434 to 1,524 ft deep and have produced 1,100 to 2,500 gallons per minute (gpm) by natural flow. Water for cooling rocket test stand deflectors is obtained from three wells with depths of 1,873, 1,695, and 672 feet which have production rates of 3,100, 4,500, and

TABLE 3-1

AMBIENT AIR QUALITY STANDARDS AND OBSERVED AMBIENT CONCENTRATIONS FOR SSC

Pollutant	National Primary Standard a/	National Secondary Standard a/	Mississippi Standard a/	Observed Ambient Concentration 1987 b/
Suspended Particulate Matter <10µ				
Annual Average	50	50	50	43 c/
24-Hour Maximum	150	150	150	84 c/
Sulfur Dioxide				
Annual Average	80	d/	80	18
24-Hour Maximum	365	d/	365	127
3-Hour Maximum	d/	1,300	d/	699
Carbon Monoxide				
8-Hour Maximum	10 mg/m^3	10 mg/m^3	10 mg/m^3	Not Measured
1-Hour Maximum	40 mg/m^3	40 mg/m^3	40 mg/m^3	
Nitrogen Dioxide				
Annual Average	100	100	100	Not Measured
Ozone				
1-Hour Maximum	240	240	240	224 e/
Hydrogen Chloride 10-Minute Maximum	6 mg/m^3 f/	d/	d/	Not Measured

Note: *Concentrations are in µg/m^3 unless otherwise noted.*

a/ Ambient standards, except those based on annual averages, are not to be exceeded more than once per year.
b/ Values given are for closest site, Gulfport (15 miles east of SSC), unless otherwise noted.
c/ Total suspended particulates (TSP) used as surrogate measure of 10µ suspended particulates.
d/ No standard.
e/ Measured at Port Bienville, Hancock County.
f/ Not an ambient air quality standard. Recommended value, see Section 3.2.15.

1556K

5,000 gpm, respectively. These wells producing cooling water are capable of supplying 18 million gallons per day. SSC currently withdraws less than 10 percent of this existing water capacity.

Hydraulic Properties:

Aquifer transmissivities determined in pumping tests of the water supply wells at SSC range from 81,000 to 200,000 gallons/day/ft (Newcome 1967). Specific capacities of the wells range from 15 to 47 gpm per foot of drawdown.

Water Levels and Flow Directions:

The deeper aquifers have greater artesian pressure than shallow aquifers. The deeper confined aquifers tapped by water supply wells at SSC generally have artesian pressures sufficient to produce free flowing wells at the ground surface. The potable wells on site (1,434-1,524 ft deep) have artesian pressures sufficient to produce a static head as high as 90 ft above the land surface. Artesian head for the wells designed for cooling water ranges from 104 ft above land surface for the deepest aquifer to 15 ft for the shallowest. Shallow confined aquifers have lower artesian pressures and are not free flowing. Groundwater flow is generally consistent with the downdip direction of the strata, south to southwest.

Existing Groundwater Quality:

Groundwater beneath SSC is soft because it contains sodium bicarbonate, a good buffering agent. It has a relatively high pH (above 8), relatively high concentrations of iron and silica, and considerably higher mineral content than surrounding surface waters. Dissolved solids concentrations are as high as 315 parts per million. Chemical analyses by the U.S. Geological Survey for the several existing wells near SSC are presented in Appendix B. These waters are corrosive to distribution and pumping systems (NASA 1980b) unless treated.

Regulatory Aspects:

Water quality standards for groundwater that is usable for drinking water are the same as for potable surface water. Federal and State of Mississippi drinking water standards are shown in Appendix C. Sole source aquifers are not present beneath SSC (Mikulak 1988, personal communication). The Mississippi Department of Natural Resources granted NASA six permits to divert or withdraw groundwater at SSC for beneficial use (NASA 1986). The permits were granted on March 11, 1986 and expire March 11, 1996. Appendix D shows the permit numbers, well use, depth of well, location, gallons per day, and maximum rate of discharge for each of the six wells.

Surface Water

Description:

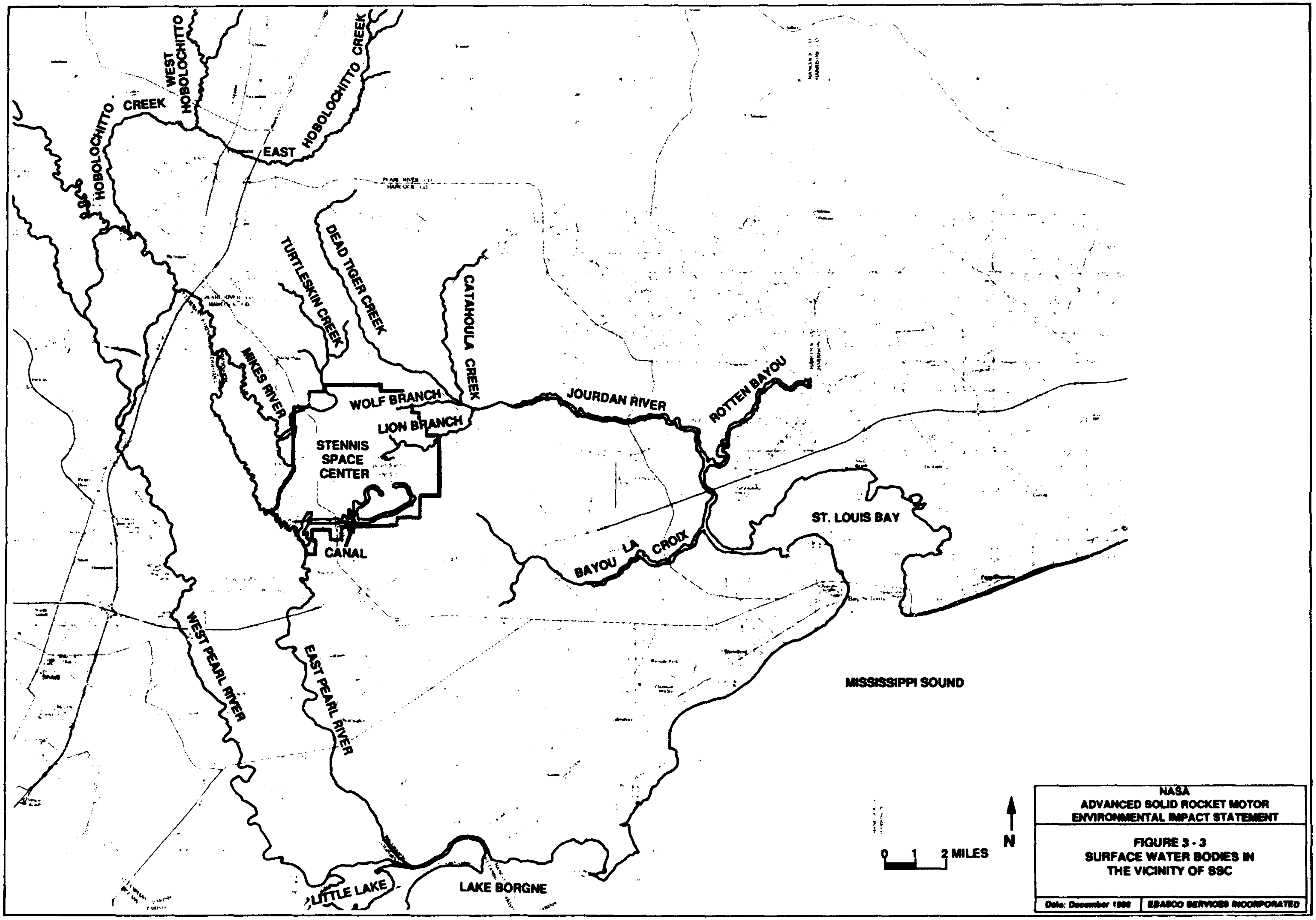
A description of the surface waters in the vicinity of SSC is given in both the Facilities Master Plan (NASA 1979a) and the Environmental Resources Document (NASA 1980b). The following characterization is compiled primarily from those descriptions.

The major surface waters near the SSC complex are the East Pearl River (commonly known as the Pearl River), which flows along the southwest boundary of the fee area, and the Jourdan River, which flows in a southeasterly direction through the eastern portion of the buffer zone. Several tributaries which drain the fee area are hydraulically connected to these two rivers. These tributaries include the Mikes River and Turtleskin Creek in the East Pearl Basin, and the Lion and Wolf Branches of Catahoula Creek in the Jourdan Basin. Devil's Swamp lies to the southeast of the fee area. A small oxbow lake, known as Little Lake, lies to the southwest adjacent to the East Pearl River. There are also approximately 8.5 miles of man-made canals in the fee area, connected to the East Pearl River through locks. These features are shown in Figure 3-3.

The Pearl River System is one of Mississippi's principal rivers, draining an area of 8,760 square miles. West of Picayune, Mississippi, it divides into two distinct channels. The main stem, known as the West Pearl River, flows for 44 miles discharging into the Rigolets, the principal outlet from Lake Pontchartrain into Lake Borgne. The eastern channel (East Pearl River) is formed by confluence of Farr's Slough, a cross-channel from the main stem, and Hobolochitto Creek west of Picayune. This channel forms the boundary between Louisiana and Mississippi in its 45-mile course to Lake Borgne. Under conditions of minimum flow, less than 5 percent of the flow in the Pearl River main stem is transmitted via Farr's Slough to the eastern channel and the East Pearl River can be considered an extension of Hobolochitto Creek. When the main stem is at flood stage, however, the entire floodplain containing the two channels is utilized and the eastern channel (East Pearl River) carries the greater part of the flow in the system. The 10-year, seven day average low flows for these two channels are 1,750 cfs for the West Pearl and 80 cfs for the East Pearl. Both the West Pearl and the East Pearl rivers are subject to salt water intrusion. The extent to which the salt water wedge extends up the river depends on tides, streamflow, wind direction and velocity and stream channel configuration.

The Jourdan River System is formed by confluence of Dead Tiger Creek and Catahoula Creek in the northeast portion of the buffer zone in Hancock County, Mississippi. Two intermittent streams, Wolf Branch and Lion Branch, drain the eastern section of the proposed ASRM site and join these headwater streams. The Jourdan River empties into St. Louis Bay. There are no long-term streamflow statistics on this river; however, maximum and minimum flows for Catahoula Creek (below Dead Tiger Creek) are given as 16,600 cfs and 8.2 cfs. This indicates the wider variations of flow associated with streams fed mainly by stormwater runoff. The Jourdan system is also subject to salt water intrusion, with saline water reported 10 miles upstream of the mouth (USGS 1986a).

The fee area surface water drainage conditions vary from good to moderately deficient, partly because of the sluggish surface water movement on low, flat areas. Elevation ranges from only about 10 ft above mean sea level (msl) in the southeastern corner to about 35 ft on the northeast. The administrative, test, and storage areas of SSC are well drained; however, water movement and percolation are reduced by the high ground water table and by heavy, comparatively impervious subsoils.



NASA
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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 3
SURFACE WATER BODIES IN
THE VICINITY OF SSC

Date: December [illegible] | EBASCO SERVICES INCORPORATED

The fee area contains five small watersheds, but major drainage is essentially through three runoff areas as follows: The west sector of the fee area drains west primarily into the Mikes River via Turtleskin Creek; Mikes River joins the East Pearl River at the southwest corner of the fee area. The northeastern portion of the fee area drains to the east through Wolf and Lion Branches of Catahoula Creek. It is primarily this watershed that will be impacted by the proposed facilities. The southeastern portion of the fee area drains southward into the canal system. Overflow from the canal drains into Devil's Swamp and enters Bayou LaCroix (NASA 1979a).

The canal system is an important part of the fee area drainage system, with drainage structures placed at strategic locations. Normal elevation for the canal is 18.0 ft above msl maximum with allowance for a drawdown to 17.0 ft above msl minimum, permitting use of the canals as storage for abnormal runoff. The natural and man-made drainage elements of the SSC fee area are shown in detail in the Site Master Plan (NASA 1979a).

Dredge and Fill History:

In 1962, the Corps of Engineers excavated approximately 8.5 miles of transport canals at the Stennis Space Center, yielding approximately 5,610,000 cubic yards of displaced soil. This soil was placed along the banks of the canals and into the low areas adjacent to the canals as fill. A similar volume of sediment was removed from the Pearl River at the entrance to the lock at SSC. The spoils were placed along the banks of the river in what is now the Louisiana Wildlife Reserve. Additional dredging was conducted at the mouth of the Pearl River in Little Lake, resulting in approximately 1,560,000 cubic yards of material placed along the banks of the channel (NASA 1988g).

In 1984 the Pearl River was dredged to remove accumulated silt, resulting in approximately 60,000 cubic yards of spoils placed along the banks of the Pearl River. In 1986 maintenance dredging was performed in Little Lake, accounting for approximately 45,000 cubic yards of spoils which were placed and contained in an abandoned off-site oil tanker slip (NASA 1988g). Appropriate permits (Corps Section 10/404) were obtained through or by the Corps of Engineers prior to the dredging activities.

Existing Surface Water Quality:

Existing regional surface water quality data are limited. The USGS maintains two water flow/quality monitoring stations on the Pearl River near Bogalusa (Stations 02489500 and 2490193), approximately 25 miles northwest of the fee area. A third USGS Station (02492600) monitors flow only on the West Branch of the Pearl River at Pearl River, some seven miles directly west of the fee area.

On the Jourdan System, there do not appear to be any permanent water quality stations. The data are historic, dating to a fisheries study in 1964-1968 and 1974 monitoring in the head waters (NASA 1980b).

Ranges of the water quality data for the Pearl River system together with other pertinent data are presented in Appendix B. On the basis of these data and a USGS evaluation of the regional water quality (USGS 1985), it is evident that surface waters in the streams of the area are generally suitable for most uses. Chemical analyses indicate that the water in freshwater streams is generally soft, slightly acidic (5.0 to 7.0 pH units), with low concentrations of dissolved solids. Hardness is usually less than 50 mg/l and the dissolved solids concentrations less than 100 mg/l. The concentrations of dissolved oxygen are usually greater than 4 mg/l. Dissolved solids derived from groundwater discharges increase the dissolved mineral content of streams during low flow periods. Tannic acid, leached from decaying vegetation, is a source of high color in some streams. Suspended-sediment concentrations in streams generally are low but occasionally exceed 100 mg/l during periods of storm runoff. The movement of saltwater upstream during high tide causes mixing with freshwater and increases the dissolved solids concentrations in the lower reaches of the Pearl and Jourdan rivers.

In the fee area, NASA maintains a surface water quality monitoring program. Recent results are summarized in Appendix B. The water quality in this area, as indicated by the monitoring data, is similar to the regional water quality described above with the following exceptions. The pH in the canal is usually slightly alkaline, with typical values between 7.0 and 8.0 units. Dissolved solids levels in the Pearl River adjacent to the area and in the canal tend to be higher, typically between 60 to 120 mg/l. Approximately 15 to 20 percent of the reported dissolved solids concentrations are extremely high, ranging from several hundred to several thousand mg/l. This observation is likely attributable to residual saline intrusion from the lower estuary. There are no recent data for the Jourdan system or its tributaries, including Wolf Branch and Lion Branch creeks.

Regulatory Aspects:

The Federal Water Pollution Control Act as amended by the Clean Water Act of 1977 and reauthorized in 1987 (CWA) requires each state to adopt water quality standards. State compliance with the CWA has been delegated to the Mississippi Air and Water Pollution Control Commission by EPA. These standards are established on the use and values of waters for public water supplies, propagation of fish and wildlife, recreation, agriculture, industry, and navigation. In addition, federal standards and guidelines have been established for the protection of aquatic life and protection of human health through consumptive pathways. The Safe Drinking Water Act has established standards (primary and secondary) for potable waters. All of the pertinent water quality standards and criteria are summarized in Appendix C, Water Quality Criteria and Standards.

The SSC sewage treatment system consists of five permitted treatment facilities and five lift stations. The complete system is designed to adequately collect, treat and dispose of sewage from on-site buildings and facilities. Each treatment system at SSC is designed to produce an effluent that meets standards for secondary sewage treatment facilities (NASA 1979a). National Pollution Discharge Elimination System (NPDES) permits are operating permits which ensure compliance. Relevant NPDES Permit data are summarized in Appendix D.

3.1.4 Land Resources

Geology

Regional Geology:

Geology at SSC is characterized by a thick sequence of sedimentary deposits dipping to the south and west, over a broad scale, from the Appalachian Plateau in northern Alabama toward the Mississippi embayment and the Gulf of Mexico (Wait, et al. 1986). Strata nearest the surface are unconsolidated alluvium and coastal deposits, both of Holocene age and mixtures of interbedded clay, silt, and sand, with organic materials common, including peat lenses (CH2M Hill 1987). Underlying these layers is the Pliocene-age (3-13 million years ago) Citronelle Formation which is generally composed of sands and gravels with lesser amounts of clay. Beneath the Citronelle (which is about 150 feet thick in the area) is over 2,000 feet of layered Miocene-age (13-25 million years ago) sediments varying from clays to gravels. Consolidated bedrock is thought to lie as much as 10,000 to 12,000 feet below the surface (NASA 1979a); rock aggregate, which may be needed for construction on the ASRM site, such as for riprap or armoring, will not be available locally.

Local Conditions:

Near-surface strata (0 to 70 ft depths) below SSC generally are alternately clays and sands (NASA 1979a), a sequence typical of alluvial deposits, with some silty materials at the surface. Recent soil borings have been made to a maximum depth of about 250 feet within the proposed ASRM site (Thompson Engineering 1988). The borings indicate 5 to 25 feet of silty sand and organic materials at the surface, underlain by a firm to stiff clay of moderate to high plasticity and normal to slightly overconsolidated characteristics to a depth of 45 to 90 feet, with interstratified lenses of silty sand. Below this level the materials are less consistent, but include silty sands, clays, and gravels, generally becoming more and more competent. Preliminary recommendations made following the borings included a design bearing capacity of 1500 to 2000 pounds per square feet (psf) for shallow foundations (varying according to foundation type). Higher loadings can be attained using pile or other deep foundations.

Structure and Seismicity:

SSC lies on the eastern edge of the Mississippi Embayment, an area of geological subsidence and known faulting and seismicity in Missouri much further north. SSC itself is considered to be under low to moderate danger from earthquakes. The Uniform Building Code (1988) locates it in Seismic Zone 0, which indicates no special seismic design considerations. The two largest historic earthquakes occurring near the site have been a 1975 Richter magnitude 2.9 and a 1955 Modified Mercalli (MM) intensity V earthquake, each located about 25 miles from SSC (CH2M Hill 1987).

Physiography and Topography

SSC is located within the East Gulf Coastal Plain physiographic province, and in the Pine Meadows geomorphic unit (NASA 1979a). The slopes in the proposed ASRM site, based on mapped soil characteristics, are in the range of 0 to 5 percent (USDA 1981), generally with the lowest slopes atop the east-west trending uplands and the higher slopes forming the valleys around the major drainageways (Lion and Wolf Branches of Catahoula Creek). Elevations on the site vary from about 35 ft above sea level to less than 10 ft according to the USGS quadrangle maps, with the highest elevations in the northern portion of the site and the lowest in the southern.

Soils

Soils in Hancock County, including SSC, have been mapped by the Soil Conservation Service (USDA 1981). The soils maps indicate that most of the proposed ASRM site is dominated by soils of the Atmore-Smithton- Escambia association, i.e., the Atmore silt loam, the Smithton fine sandy loam, and the Escambia loam soil series. This combination of soil types is described as "nearly level to gently sloping, poorly drained and somewhat poorly drained silty and loamy soils; on broad, wet upland flats and drainageways and low upland ridges" (USDA 1981). These are siliceous soils, are strongly or very strongly acidic, and are mainly limited in their uses by problems with wetness or corrosivity. Erosion potential is slight because of the cohesive nature of the soils and the low relief.

3.1.5 Wetlands and Floodplains

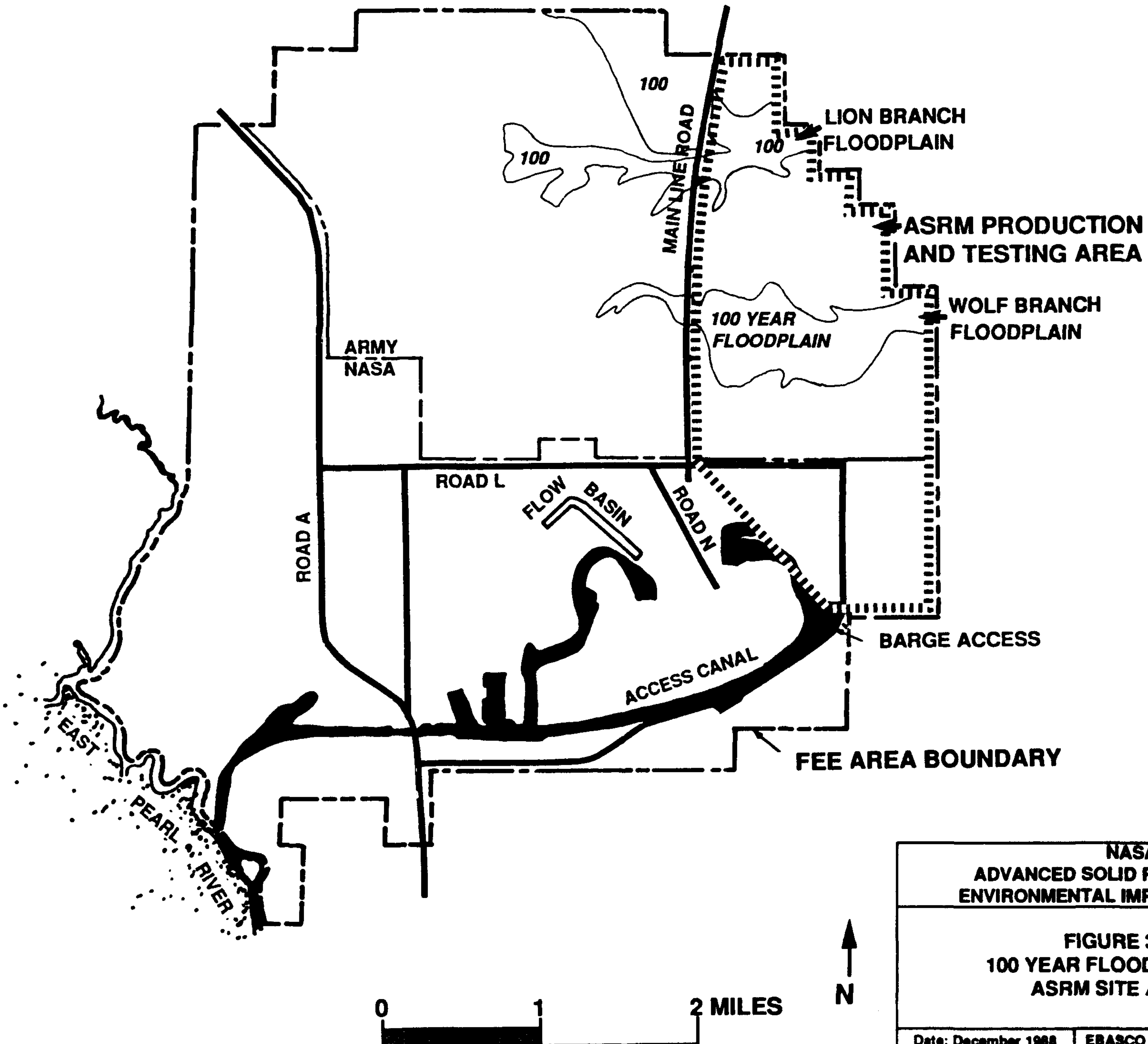
Wetlands

National Wetland Inventory maps, prepared by the U.S. Fish and Wildlife Service (USFWS), are not available for the SSC fee area. A vegetation reconnaissance conducted in the spring of 1988 did not identify any wetland areas within the ASRM site (Esher and Bradshaw 1988). Since the survey was conducted in spring when evidence of seasonal wetlands would be abundant, it is unlikely that wetlands are present within the ASRM site that meet the Army Corps of Engineers' criteria for wetlands. One seasonal wetland has been reported in the Lion Branch vicinity (CH2M Hill 1987) but was not confirmed by the 1988 vegetation survey.

Floodplains

The 100-year floodplain at SSC, including the proposed ASRM site, has been mapped by the Federal Emergency Management Agency (FEMA 1983) and for the Facilities Master Plan (NASA 1979a). These two floodplain maps differ in that the Facilities Master Plan maps the 100-year and 500-year floodplain on the western edge of the SSC fee boundary indicating that the floodplains do not occur within the proposed ASRM site. The FEMA map shows the 100-year floodplain occurring within the proposed ASRM site. The 500-year floodplain was not mapped by FEMA, but would certainly cover a larger area within the proposed ASRM site than the 100-year floodplain. The FEMA floodplain map is assumed to be correct, but will require confirmation by FEMA and SSC floodplain planners.

Two FEMA mapped floodplains exist within the proposed area: the Lion Branch and the Wolf Branch of Catahoula Creek, as shown in Figure 3-4. There are no existing facilities in either of these floodplains. The Lion Branch and Wolf Branch floodplains begin near Main Line Road and continue eastward past the fee area boundary of SSC and the proposed ASRM site. At its widest point, the Lion Branch floodplain is approximately 2,000 feet across. The Wolf Branch floodplain is approximately 800 feet across.



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 4
100 YEAR FLOODPLAIN FOR
ASRM SITE AT SSC

Date: December 1988 | EBASCO SERVICES INCORPORATED

3.1.6 Biotic Resources

Vegetation

Four major plant community types have been identified on the proposed ASRM site at SSC: 1) pine forest; 2) bottomland hardwood; 3) pitcher plant bogs; and 4) grasslands (Esher and Bradshaw 1988) (Figure 3-5). The dominant species in each of these communities are listed in Appendix Table E-1. A complete list of the vascular plants identified on the ASRM site has been compiled by Esher and Bradshaw (1988). Most of the undeveloped area within the SSC fee area and the buffer also consists of pine forest and bottomland hardwood.

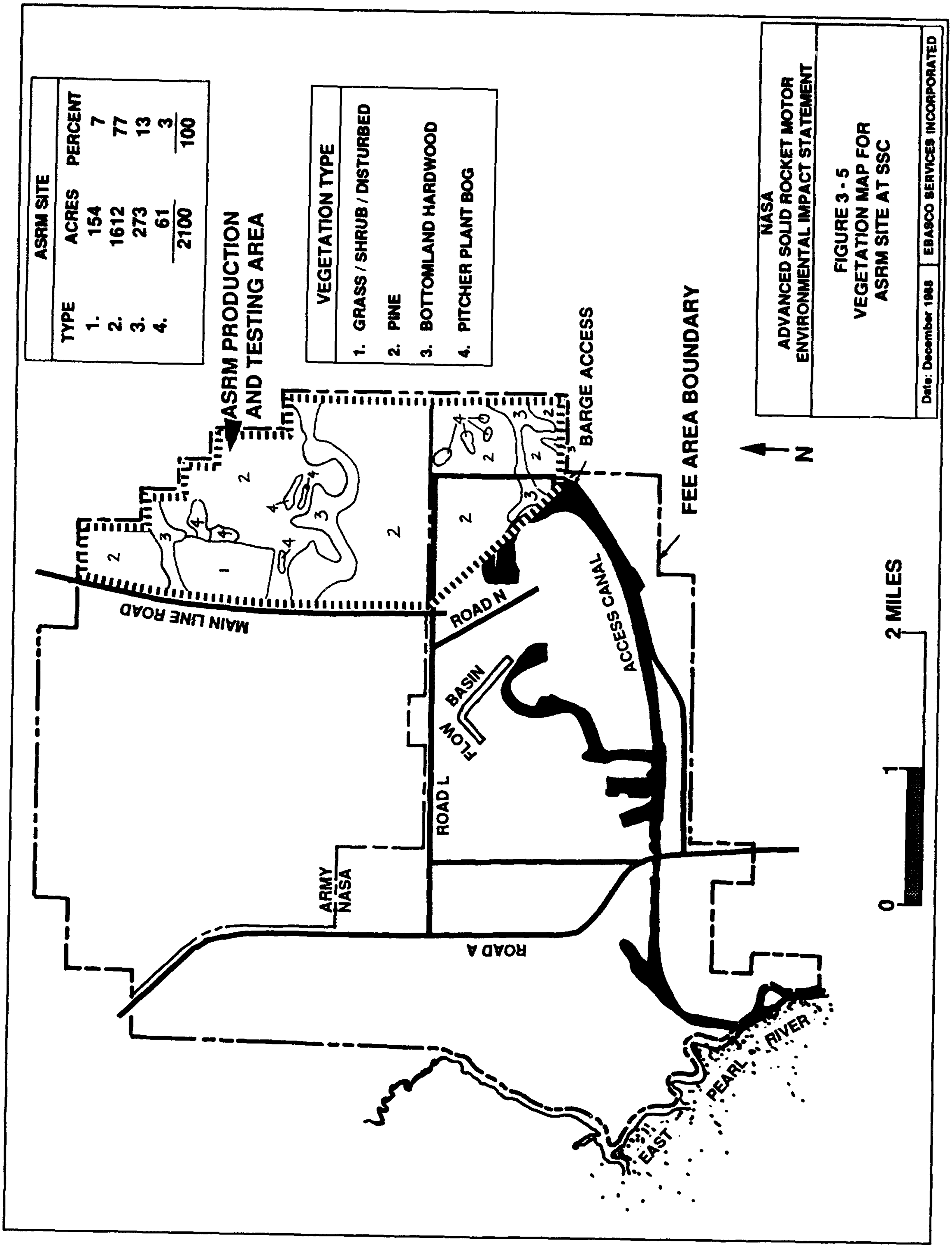
The pine forest is the predominant plant community on the ASRM site. This community covers approximately 1,612 acres or 77 percent of the site. Most of the pine forest is even-aged because it has been managed for pulpwood production (Esher and Bradshaw 1988). The most dominant tree species is slash pine (*Pinus elliotti)*, although loblolly pine (*P. taeda*) also occurs. Pond cypress (*Taxodium ascedeus*) and tupelo (*Nyssa sp.*) are co-dominant with slash pine on wetter sites, and oaks (*Quercus sp.*) are found in drier areas. A wide variety of understory shrubs, forbs, and grasses occur in the pine forests south of Stanley Road, an area which has not been burned recently. Management of the pine forest north of Stanley Road has involved burning every two to three years, and the understory in this area is much less diverse (Esher and Bradshaw 1988).

The bottomland hardwood community is restricted to drainages in the proposed ASRM site. This community represents about 273 acres or 13 percent of the site. The most dominant tree species is blackgum (*Nyssa biflora*) and the most common herbaceous species is lizard's tail (*Saururus cernuus*) (Esher and Bradshaw 1988).

Several pitcher plant bogs, ranging in size from 2 to 22 acres, also occur on the proposed ASRM site (Esher and Bradshaw 1988). These bogs occupy about 61 acres or 3 percent of the site. Pitcher plant bogs are found in regularly burned areas with poorly drained, infertile soil. They are unique to the lower Coastal Plain of the southeast U.S. (Folkerts 1982). The pitcher plant bogs in the ASRM site are dominated by herbaceous species, including orchids (Orchidaceae) and several carnivorous plants, such as sundews (*Drosera sp.*), pitcher plants (*Sarracenia sp.*) and pipeworts (*Eriocaulon sp.*) (Esher and Bradshaw 1988).

The only grasslands found in the proposed ASRM site are on the hazards test range (Esher and Bradshaw 1988). This area is highly disturbed and represents about 154 acres or 7 percent of the ASRM site.

A total of 11 plant species with ranges that overlap the proposed ASRM site are currently under consideration by the USFWS for classification as threatened or endangered (Appendix E, Table E-2). Two of these candidate species, holly (*Ilex amelanchier*) and lilaeopsis (*Lilaeopsis carolinensis)*, have been documented on the ASRM site, and an additional five candidate species may occur (Esher and Bradshaw 1988). All of these species are also proposed by the Mississippi Department of Wildlife Conservation (MDWC) as endangered, threatened, rare or of special concern in


ASRM SITE
TYPE ACRES PERCENT
1. 154 7
2. 1612 77
3. 273 13
4. 61 3
2100 100
VEGETATION TYPE
1. GRASS / SHRUB / DISTURBED
2. PINE
3. BOTTOMLAND HARDWOOD
4. PITCHER PLANT BOG
ASRM PRODUCTION AND TESTING AREA
BARGE ACCESS
FEE AREA BOUNDARY
N
MAIN LINE ROAD
ROAD N
ACCESS CANAL
FLOW BASIN
ROAD L
ARMY
NASA
ROAD A
EAST PEARL RIVER
0 1 2 MILES
NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT
FIGURE 3 - 5
VEGETATION MAP FOR
ASRM SITE AT SSC
Date: December 1988
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Mississippi (Wiseman 1988). An additional four species proposed as rare in Mississippi have been documented in the SSC buffer area and may also occur on the ASRM site (Wiseman 1988).

Wildlife

During surveys conducted on the proposed ASRM site in the spring of 1988, 13 species of amphibians, 26 species and subspecies of reptiles, 86 species of birds and 8 species of small mammals were observed or collected. Over a six-year period, 10 other mammalian species have been observed at SSC and are likely to occur on the proposed ASRM site. A complete list of the animal species identified on SSC has been compiled by Esher and Bradshaw (1988).

The forested and open areas on SSC, including the proposed ASRM site, are used by passerine birds (song birds) for nesting and feeding during migration along the Mississippi Flyway. The robin (*Turdus migratorius)* is the most common species observed in the area but the cardinal *(Cardinalis cardinalis)*, bluebird (*Sialia sialis)*, and yellow warbler (*Dendroica petcchia*) have also been noted (CH2M Hill 1987; McCaleb 1988c).

Fish

The topographic relief at SSC is characteristically low and flat with streams having low gradient. In April and May 1988, Esher and Bradshaw performed an ecological survey of the streams on or near the ASRM site. This survey included sampling for fish in Lion Branch, Wolf Branch, the access canal, and the Pearl River adjacent to SSC. Overall, the investigators found a total of 44 fish species. Of these, the predominant sport fish species recorded were bluegill *(Lepomis macrochirus)*, largemouth bass (*Micropterus salmoides)*, white and black crappie (*Pomoxis annularis* and *P. nigromaculatus*), redear sunfish (*Lepomis microlophus)*, and a variety of sunfish (U.S. Army 1976). Little or no commercial fishing occurs in the vicinity of the ASRM site or the adjacent areas.

Esher and Bradshaw (1988) characterized Lion Branch and Wolf Branch as intermittent drainageways that are sluggish and support only species that do not require moving water. They recorded 11 fish species in these waterways. The only sport fish species found was bluegill.

The Pearl River is large, has a high flow rate, and is tidally affected at SSC. A navigation lock in the access canal controls water levels upstream of the lock. The river and canal support a wider diversity of fish species than Lion Branch and Wolf Branch. Combined, the Pearl River and the canal have over 30 fish species (Esher and Bradshaw 1988), including all of the sport fish species found in the vicinity of SSC.

Threatened and Endangered Fish and Wildlife Species

A total of seven wildlife species classified by the USFWS as threatened or endangered have ranges that overlap SSC and the buffer area (Table 3-2). Current USFWS records indicate that two threatened species, the gopher tortoise (*Gopherus polyphemus*) and ringed sawback turtle (*Graptemys oculifera)* and one endangered species, the bald eagle (*Haliaeetus leucocephalus)* occur in the SSC buffer area

TABLE 3-2
FISH AND WILDLIFE SPECIES WITH RANGES THAT INCLUDE JOHN C. STENNIS SPACE CENTER
THAT ARE CLASSIFIED AS THREATENED OR ENDANGERED
BY THE USFWS OR WITH SPECIAL STATUS IN MISSISSIPPI

Species	Common Name	Status		Documented at:		
		Federal	State	SSC	SSC Buffer	ASRM Site
FISH						
Acipenser oxyrhynchus	Atlantic sturgeon	--a/	PEb/		Xc/	
Notropis chalybaeus	ironcolor shiner	--	PP	Xd/		
Notropis welaka	bluenose shiner	--	PRe/		Xd/	
Noturus munitus	frecklebelly madtom	C2f/	LEg/			
Polydon spathula	paddlefish	--	PCh/	Xd/		
REPTILES AND AMPHIBIANS						
Bufo valliceps	Gulf coast toad	--	PPi/		Xd/	
Drymarchon corais couperi	eastern indigo snake	Tj/	PE	Xc/		
Farancia erythrogramma	rainbow snake	--	LE			
Gopherus polyphemus	gopher tortoise	T	PE	Xd/c/	Xk/	
Graptemys oculifera	ringed sawback turtle	T	PE	Xc/	Xk/	
Heterodon simus	southern hognose snake	--	PE			
Pituophis melanoleucus lodingi	black pine snake	--	PE			
BIRDS						
Falco peregrinus	peregrin falcon	E	PE			
Grus canadensis pulla	Mississippi sandhill crane	--	PE			
Haliaeetus leucocephalus	bald eagle	E	PE		Xk/	
Picoides borealis	red cockaded woodpecker	E l/	PE			
Thryomanes bewickii	Bewick's wren	--	PE			
Vermivora bachmanii	Bachman's warbler	--	PE			
MAMMALS						
Felis concolor coryi	Florida panther	E	PE	Xd/		
Ursus americanus	black bear	--	PE	Xc/		

a/ -- = no status.
b/ PE = Proposed endangered, MDWC.
c/ Esher and Bradshaw (1988).
d/ Documented by MDWC (9-9-88 letter).
e/ PR = proposed rare, MDWC.
f/ C2 = Category 2 species are under review for possible classification as threatened or endangered by the USFWS but substantial evidence of biological vulnerability and/or threats is lacking.
g/ LE = listed endangered, MDWC.
h/ PC = proposed special concern, MDWC.
i/ PP = Proposed peripheral, MDWC.
j/ T = threatened.
k/ Documented by USFWS (9-1-88 letter).
l/ E = endangered.
Source: Goldman, personal communication, 1988; Wiseman, personal communication, 1988; Esher and Bradshew, 1988.

(Goldman 1988). An active bald eagle nest in the buffer near Logtown was recorded in April 1988 but has not yet been confirmed by USFWS biologists (Bagly 1988, personal communication; Tucker 1988, personal communication). There are no USFWS records documenting any federally designated endangered, threatened, or proposed species or their critical habitats within the proposed ASRM site on SSC (Goldman 1988). However, NASA records indicate that there is a small population of gopher tortoises at the northern edge of SSC (Esher and Bradshaw 1988). In addition, the ringed sawback turtle has been recently observed near Building 2423 on SSC and several turtles with similar characteristics were observed in a small creek on the ASRM site during surveys conducted in 1988 (Esher and Bradshaw 1988). No other threatened or endangered species were observed during these surveys and it is unlikely that the ASRM site contains suitable habitat for the gopher tortoise, eastern indigo snake (*Drymarchon corais couperi*), red cockaded woodpecker (*Picoides borealis)* or the peregrin falcon (*Falco peregrinus*) (Esher and Bradshaw 1988). SSC, including the proposed ASRM site, does contain habitat suitable for the Florida panther (*Felis concolor coryi)* and the MDWC has records of 15 confirmed sitings on SSC between 1968 and 1979 (Wiseman 1988). However, a 1987 survey conducted in southern Mississippi that included SSC found no evidence of panthers in the area (Esher and Bradshaw 1988). The habitat requirements of each federally designated threatened or endangered species that may be affected by ASRM construction or testing at SSC are briefly described in Appendix Table E-3.

All 7 federally protected species are classified by the MDWC as endangered in Mississippi. An additional 13 fish and wildlife species with ranges that overlap SSC or the buffer area are proposed or listed by the MDWC as endangered, peripheral, rare, or of special concern in Mississippi (Wiseman 1988). A total of 5 of these species have been documented on SSC or the buffer area by the MDWC. The Atlantic sturgeon (*Acipenser oxyrhynchus*), a proposed endangered species in Mississippi, was observed in the Pearl River during surveys conducted in 1988 (Esher and Bradshaw 1988). This species appears to be abundant in deep holes in the Pearl River during the warmer months; however, no species listed by the MDWC have been observed on the ASRM site (Esher and Bradshaw 1988).

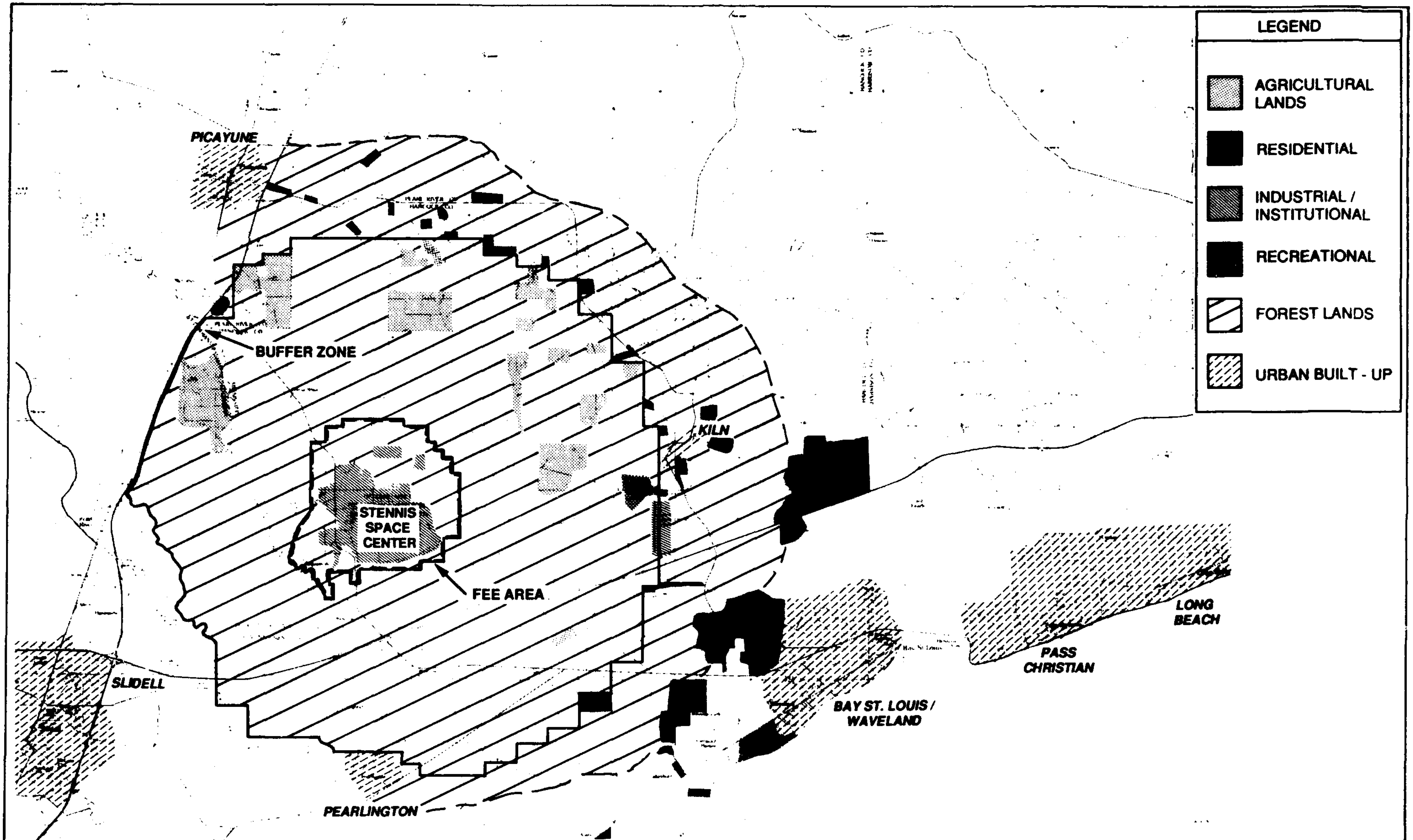
3.1.7 Land Use

Land Use Characterization

Fee Area and Buffer Zone:

The proposed ASRM testing and manufacturing site consists of approximately 2,100 acres located in the northeastern part of the NASA fee area. Figure 3-6 shows the distribution of land uses within the vicinity. Currently at SSC, the lands needed for ASRM production and testing are primarily in open space land uses.

Approximately 1,700 acres of the site is currently under permit for use by MSAAP and is in the process of being transferred back to NASA (NASA/NSTL 1988a). About 180 acres of the ASRM site within the MSAAP permit area is currently used as a high explosives Hazards Test Range (CH2M Hill 1987). The Hazards Test Range is used for explosives testing by NASA for the military (NASA 1979a). Except for the Hazardous Test Range, the ASRM site under MSAAP permit is not currently used.



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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 6
GENERALIZED LAND USE
IN THE SSC VICINITY

Date: December [illegible] | EBASCO SERVICES INCORPORATED

The ASRM site at SSC contains several small areas which would be classified as Prime and Unique Farmland at most rural locations within the county. However, under the federal regulations for the Farmland Protection Act, Prime Farmland does not include land already in or committed to urban development (7 CFR Part 658). The definition of lands committed to urban development includes dedicated facilities such as SSC, where a comprehensive land use plan has been adopted and the land is committed to nonagricultural uses.

Adjacent to the proposed ASRM site are the propulsion test complex, the MSAAP facilities, and the SSC buffer area. The propulsion test complex consists of the large (up to 228 ft high) NASA test stands, which are located at the ends of the SSC barge canals. Small buffer zones surround each test stand allowing for an explosive safety zone. The MSAAP facilities occupy about 600 acres within their larger permit area and are typical of a military industrial area.

Outside the SSC fee area, within the buffer zone, the majority of the land is in commercial evergreen forests. The area immediately east of the proposed ASRM site is owned by International Paper Company (NASA/SSC 1988). The area which will potentially be affected by ASRM production and testing activities extends approximately 8 miles east and north of the fee area. Most of this area is within the buffer zone in Hancock County. Besides commercial forestry, other uses within the buffer zone include wildlife management areas, nature preserves, cattle grazing, limited cropland, and small mineral operations. Special or unique land uses within and along the perimeter of the buffer zone include McLeod Park and Stennis International Airport. McLeod Park is a 426 acre recreational facility along the banks of the Jourdan River. The park is operated by Hancock County and is open year around for camping and day use. McLeod Park receives approximately 22,000 visitors per year (Curet 1988, personal communication). Stennis International Airport is a county-run airfield located partially within the buffer zone. There is a small industrial park located adjacent to the airfield.

Regional Land Use:

The SSC fee area and buffer zone occupy 36 percent of the Hancock County land base. Outside the buffer zone, land uses vary from the southern coastal area to the northern uplands. Urban areas are scattered along the coast, with interspersed open spaces such as coastal wetlands. Rural and agricultural uses, primarily commercial forestry and cropland, occupy most of the northern half of the county. Institutional and industrial uses occupy areas with water access, such as SSC and Port Bienville Industrial Park, and are generally located near the coast. Recreational uses are scattered along open water bodies. The main transportation arterial is Interstate 10, traversing the county from east to west and coming within three miles of the proposed ASRM site.

Several residential areas are located immediately east and north of the buffer zone perimeter. Homes are located just outside the buffer zone on Bayou La Croix Road, Texas Flat Road, and off County Road 43. The partially built subdivisions of Shiloh Ranch Estates and Bayside Park are within one mile of the buffer zone just outside the town of Waveland.

Land Use Plans, Policies, and Controls

Hancock County has no zoning ordinances and no comprehensive plan. The area within city limits, such as Waveland and Bay St. Louis, have zoning regulations in place. Regulations imposed upon development in the county include: 1) the Mississippi Coastal Program, 2) NASA's master plan for SSC, and 3) the restrictive easement imposed upon land holdings in the SSC buffer zone.

Mississippi Coastal Program - The Mississippi Coastal Program is administered by the Mississippi Bureau of Marine Resources. The program is intended to protect coastal wetlands, and the jurisdiction of the program extends to those wetlands affected by tidal influence. Within the proposed ASRM site, no lands are affected by tidal influences. Nevertheless, within the buffer zone, portions of Bayou Croix, Mulatto Bayou, and the Pearl River are designated as being below the watermark of the ordinary high tide (MDOWC 1982). Any proposed work landward of the coastal wetlands does not require a permit unless tidal areas may be indirectly affected, or work is performed directly in the water course.

SSC Master Plan - The master plan for SSC was prepared in 1979 and established controls and criteria to guide future growth and development (NASA 1979a). The plan is not intended to be a detailed guide for design purposes, but rather a general planning tool to guide orderly site growth and expansion. The land use plan assumes an expansion of the existing test facilities (the test stands) in the southeastern part of the fee area. While the MSAAP controls (by permit) much of the proposed ASRM site, this land is currently in the process of being transferred back to NASA (NASA/NSTL 1988a).

SSC Buffer Zone Easement - The SSC buffer zone is under NASA control through a perpetual easement prohibiting the maintenance or construction of buildings suitable for human habitation. The purpose of the buffer is to provide an acoustical and safety protection zone for NASA testing operations (NASA 1980b).

Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968 (16 USC 1274) requires the identification of rivers designated as wild and scenic or rivers with potential for designation when a significant federal action may affect those rivers. Many rivers across the country were given eligibility status under the act so that studies could be initiated to determine their suitability for inclusion under the act. In the late 1970s, the National Park Service identified several additional rivers which also could have potential for inclusion under the act. These rivers, known as Inventory Rivers, are not strictly protected under the act (Brittain 1988, personal communication). Inventory Rivers are protected by guidelines issued August 10, 1980 by the Council on Environmental Quality (CEQ). The CEQ guidelines recommend that federal agencies consider the effect significant federal actions may have upon Inventory Rivers.

There are two Inventory Rivers within the SSC buffer zone. The Pearl River, extending through the buffer zone, and the Jourdan River, designated from the confluence of Catahoula Creek to Bay St. Louis, are both Inventory Rivers which are potentially affected by the proposed action. The Jourdan River, located approximately five miles east of the proposed ASRM site, has been identified as having significant recreational and archaeological resources, while the Pearl River, used for SSC barge traffic, has been identified as having "Numerous endangered, threatened and rare species; excellent example of large Gulf Coastal Plain river with extensive swamplands; upper reach very scenic" (USDI 1982).

3.1.8 Socioeconomics and Infrastructure

Study Area Definition

For analysis purposes, the SSC study area has been defined as those counties/ parishes which are included within a one-hour commuting distance from the site (U.S. Army 1976) (Figure 3-7). As defined, this area includes Hancock, Harrison, and Pearl River Counties in Mississippi, and St. Tammany and Washington Parishes in Louisiana. Major cities within the study area include Picayune, Poplarville, Long Beach, Pass Christian, Bay St. Louis, Gulfport, and Biloxi in Mississippi and Covington, Slidell, and Bogalusa in Louisiana. The study area varies from very rural in Washington Parish to somewhat urban along the Gulf coast. In general, the study area can be categorized as semi-rural with several bedroom community enclaves associated with the more urban Gulf coast cities.

The demographic characteristics discussed in this section include population, employment, income and housing. Infrastructure factors include police, fire, schools, health services and public utilities. All figures reflect the most current data available.

Demographic Characteristics

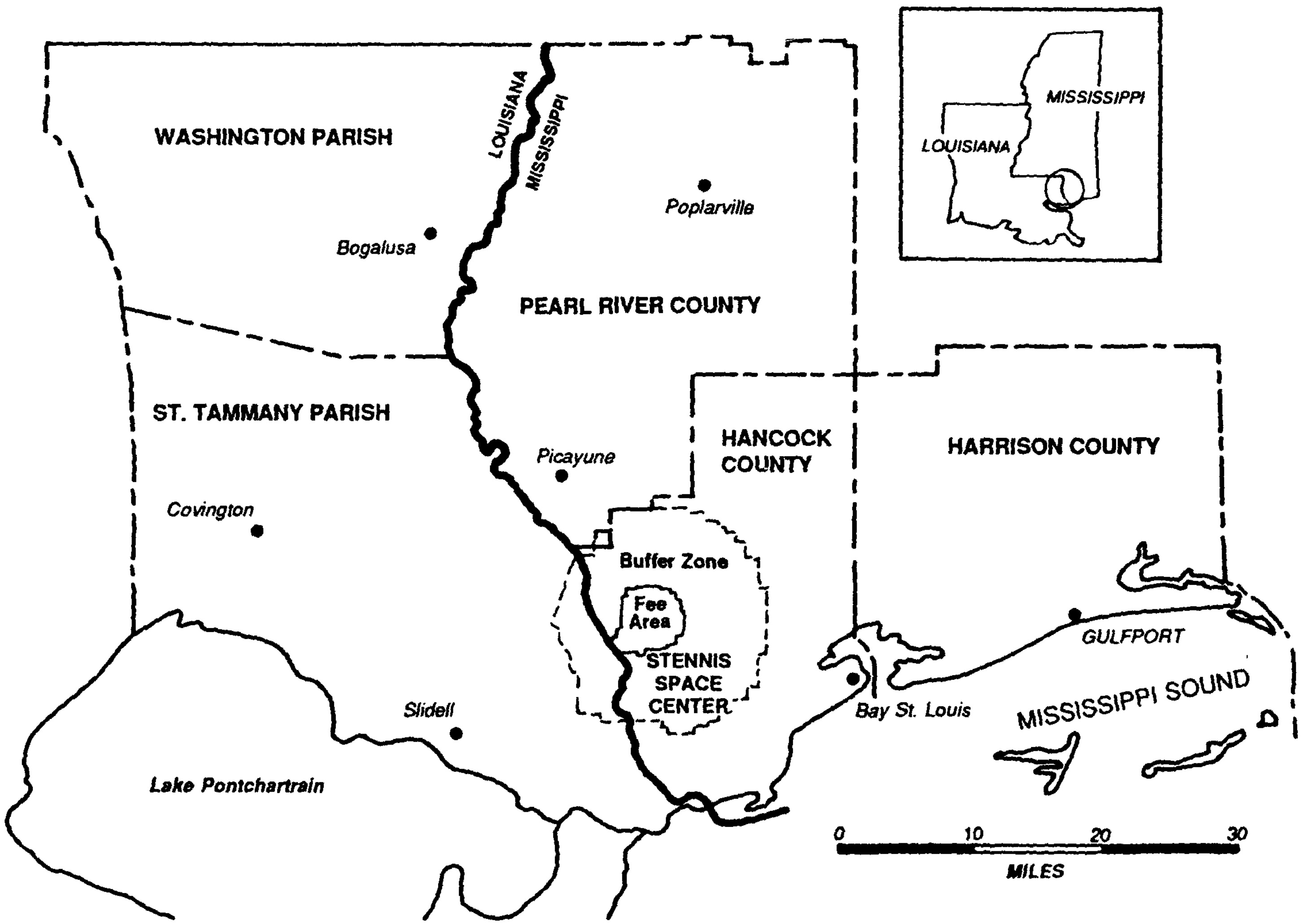
Population:

Total population in the five county/parish study area was 443,100 persons (Table 3-3) in 1987, with a 2.6 percent average annual increase since 1980. This is significantly faster growth than that experienced by Mississippi and Louisiana overall, which had average annual population increases of 0.6 and 0.8 percent, respectively, during the same period. St. Tammany Parish, Louisiana, and Hancock County, Mississippi, currently project the highest average annual growth rates between 1985 and 2000, 3.3 percent and 2.4 percent, respectively (Table 3-4).

The population along the central Gulf coast is concentrated in the New Orleans, Louisiana, and Mobile, Alabama, metropolitan areas. The SSC study area is located between these cities and many of the people who reside in the area are closely tied to these cities. In 1987, 9 percent of Mississippi's population and 4 percent of Louisiana's population resided within the five county/parish study area.

Employment:

Both states have had unemployment rates at or above the national average since 1970 (Table 3-5). During the 1970's, Hancock and Pearl River Counties and St. Tammany Parish had unemployment rates higher than their respective state averages. In the 1980's, Pearl River County and Washington Parish experienced unemployment rates higher than the state averages. In 1985, all counties and parishes in the study area experienced higher rates of unemployment than the national average of 7.2 percent.



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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 7
STENNIS SPACE CENTER
SOCIOECONOMIC STUDY AREA

Date: December 1988 | EBASCO SERVICES INCORPORATED

Table 3-3. Population Distribution - Stennis Space Center Study Area.

Location	1980[1]	1987[2]	Percent Change
Mississippi	2,520,638	2,625,000	+4
Hancock County	24,537	32,700	+33
Harrison County	157,665	173,200	+10
Pearl River County	33,795	39,700	+17
Louisianna	4,205,900	4,461,000	+6
St. Tammany Parish	110,869	149,800	+35
Washington Parish	44,207	47,700	+8
Study Area Total	371,073	443,100	+19

Source: [1] U.S. Department of Commerce, 1983
[2] Brenner, 1988

Table 3-4. Population Projections - Stennis Space Center Study Area.

Location	1985[1]	1990	1995	2000
Mississippi	2,614,000	2,700,700[2]	2,764,600[2]	2,802,300[2]
Hancock County	30,600	36,380[2]	40,750[2]	43,330[2]
Harrison County	170,500	182,760[2]	191,630[2]	196,870[2]
Pearl River County	38,600	43,230[2]	46,660[2]	48,670[2]
Louisiana	4,486,000	4,849,038[3]	5,182,325[3]	5,496,835[3]
St. Tammany Parish	140,800	162,440[3]	196,492[3]	230,400[3]
Washington Parish	47,500	46,433[3]	47,896[3]	49,211[3]
Study Area Totals	428,000	471,243	523,428	568,481

Source: [1] Brenner, 1988
[2] McNeec, 1988
[3] Lopez, 1988

Table 3-5. Unemployment Rates (Percent)- Stennis Space Center Study Area.

Location	1970	1975	1980	1985
Mississippi[1]	5.2	8.3	7.4	10.3
Hancock County[1]	6.5	5.3	4.8	7.6
Harrison County[1]	4.9	7.1	5.6	8.2
Pearl River County[1]	5.3	9.6	7.5	11.6
Louisiana[2]	6.7	7.4	6.7	11.5
St. Tammany Parish[2]	6.9	7.7	6.5	10.3
Washington Parish[2]	5.5	8.8	10.0	13.6
United States[3]	4.9	8.5	7.1	7.2

Source: [1] Lewis, 1988
[2] Lopez, 1988
[3] Sadler, 1988

One reason for the high rates reported in 1985 was the sharp decline in the oil industry. The Gulf coast area is heavily tied to this industry and was especially hard hit when the price of oil fell during the mid-1980s.

In 1987 the overall labor force (aged 16 and over) in the five county/parish study area consisted of 184,455 people (Mississippi Employment Security Commission, 1988; Lopez 1988). Table 3-6 shows the breakdown of this labor force by the major employment sectors. Major sectors include Government in Hancock County; Wholesale and Retail Trade in Harrison and Pearl River counties; and Services in Washington and St. Tammany Parishes.

Figure 3-8 shows the residential distribution of current (1987) SSC employees. According to this figure, 74 percent reside in all the Mississippi counties in the study area, with an additional 7 percent residing in Mississippi counties outside the study area. Pearl River County has the highest number with 33 percent. Nineteen percent of the SSC employees reside in Louisiana, with 15 percent of them residing in St. Tammany Parish.

Income:

In 1986, per capita income in Hancock and Harrison Counties was 6 and 10 percent, respectively, above the state average of $9,697, while Pearl River County was 12 percent below the state average. Per capita income in St. Tammany Parish was $12,913 per year, 15 percent above the Louisiana state average of $11,191 per year, while Washington Parish was $8,563 per year, 23 percent below the state average (Table 3-7). One reason for the high per capita income in St. Tammany Parish is its proximity to New Orleans. Many of the residents commute to New Orleans to work, where salaries are higher, and live in St. Tammany Parish where the cost of living is lower. Washington Parish is much more rural in character and less densely populated. Most of the parish is beyond a reasonable commuting distance to New Orleans and therefore does not receive many of the bedroom community benefits that have accrued in St. Tammany Parish. All counties and parishes averaged per capita incomes considerably lower than the national average of $14,612. This is due in part to the decline in the oil industry in the mid-1980s.

The percent of persons with incomes below the poverty level was below the state percentages in all areas except Washington Parish, where the rate was substantially higher. The only area with a poverty level percentage below the national percentage of 14 percent was St. Tammany Parish, with 10.3 percent (Table 3-7).

Housing:

The average selling price in the study area of a three-bedroom, 2-bath home is $50,000, with a range of $45,000 to $75,000 being standard (Chamberlain 1988; Sconiers 1988; Dickson 1988). Most homes in the study area stay on the market for 3 to 6 months (Rose 1988). Many homes that would normally be on the market are being rented until the market improves (Chamberlain 1988). Housing prices in the study area have experienced a 25 to 30 percent decrease over the last 5 years (Chamberlain 1988; Sconiers 1988) due primarily to the depression in

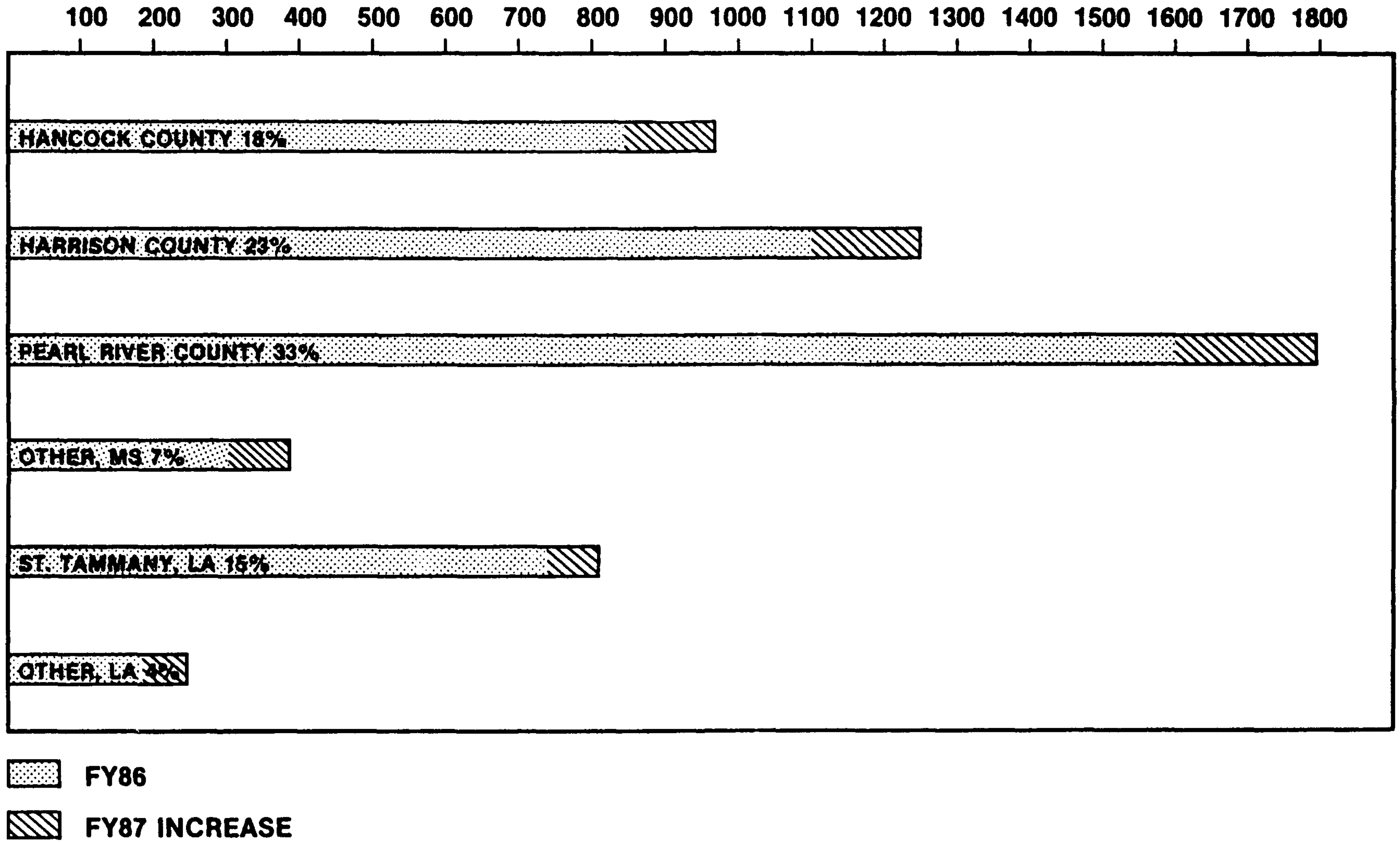
Table 3-6. Labor Force Breakdown by Sector - Stennis Space Center Study Area, 1987.

Employment Sector	Mississippi[1]	Hancock County[1]	Harrison County[1]	Pearl River County[1]	Louisiana[2]	St. Tammany Parish[2]	Washington Parish[2]
Manufacturing	228,000	2,380	6,930	1,090	163,978	1,470	2,052
Mining	6,000	10	60	90	54,993	140	73
Construction	33,900	310	2,910	120	90,488	1,764	448
Transporation and Public Utilities	42,000	220	3,630	270	118,178	1,777	531
Wholesale and Retail Trade	185,500	1,520	15,740	2,000	363,516	10,361	2,392
Fiance, Insurance, and Real Estate	38,500	220	3,150	260	83,478	1,526	463
Service and Miscellaneous	138,400	2,160	10,520	1,190	473,436	11,067	3,046
Government	191,500	2,910	15,660	1,860	79,111	1,240	760
Public Education	86,700	560	4,090	1,160	NR	NR	NR
Agriculture	27,800	80	370	300	46,468	390	125
Other Nonagricultural Workers	84,100	1,010	6,150	1,530	NR	NR	NR
Unemployed	117,000	1,200	6,860	1,680	234,000[3]	6,100[3]	2,325[3]
Civilian Labor Force	1,151,000	13,310	75,470	14,400	1,954,000[3]	62,800[3]	18,475[3]

Totals may not add due to rounding.
NR = Not reported separately.
Source: [1] Mississippi Employment Security Commission, 1988
[2] Louisiana Department of Labor, 1988
[3] Lopez, 1988

FIGURE 3 - 8

RESIDENTIAL DISTRIBUTION OF STENNIS SPACE CENTER PERSONNEL BY LOCATION



SOURCE: NASA / SSC 1987

Table 3-7. Per Capita Income - Stennis Space Center Study Area.

Location	Per Capita Income (1986)	Percent Below Poverty Level (1980)[4]
Mississippi[1]	$9,697	23.9
Hancock County	$9,161	19.7
Harrison County	$10,684	16.0
Pearl River County	$8,511	22.2
Louisiana[2]	$11,191	15.1
St. Tammany Parish	$12,913	10.3
Washington Parish	$8,563	21.0
United States	$14,612[3]	12.4

Source: [1] Barry, 1988
[2] Hughes, 1988
[3] Pitts, 1988
[4] U.S. Dept. of Commerce, 1984.

the oil industry so prominent along the Gulf coast. Most of this decline in the housing market has been caused by the employment uncertainty that has paralleled the depression in the oil industry over the last five years. High unemployment rates and low income levels have further weakened this market.

Infrastructure and Services

Law Enforcement:

Each county and major city in the study area is currently serviced by a law enforcement agency. The rural areas are serviced by sheriff's departments and the urban areas by city police departments. Table 3-8 provides a breakdown of the number of law enforcement personnel currently employed in each jurisdiction. A 1982 federal government study termed the BLM Social Effects Project (USDI 1982) established an optimal officer staffing level of 2.1 officers/1,000 population. St. Tammany Parish is the only parish in the study area to exceed this guideline. Washington Parish and Hancock County follow close behind with 1.99/1,000 and 2.00/1,000 population, respectively. Pearl River County has the lowest ratio at 1.08/1,000 population. Representatives of many Pearl River County departments surveyed indicated that they were understaffed.

Fire Protection:

Each major city and most counties/parishes in the study area are currently serviced by a fire protection agency. Rural fire departments are usually supported by an extensive volunteer team of fire fighting personnel. Some urban fire departments are also supported by a volunteer team. Table 3-8 also provides a breakdown of the personnel of each fire department in the study area.

Fire protection capabilities are measured by a fire insurance capability rating system. This system ranks fire departments on a 1 to 10 scale based on the number of persons being protected, the number of dwellings being protected, fire fighting equipment availability, proximity to water sources, proximity to major hazards, department staffing and skill levels, and adequacy of the transportation network (SMPDD 1985). Ratings for the study area fire departments were not readily available from all sources. Ratings that were available varied from a high of 4 in Gulfport to a low of 10 for many of the rural fire departments.

Schools:

Table 3-9 shows the number of public schools, school enrollment, and student/teacher ratios for each parish and county in the study area for the 1988/89 school year. The latest student/teacher ratio figures available for the five-county/parish area are for the 1986-87 school year. The BLM Social Effects Project guideline is one teacher for every 18 students (USDI 1982). Only Washington Parish meets or exceeds this guideline. Pearl River County has the highest ratio of 1 teacher to 21 students. In addition to the numerous public schools, there are 8 two-year colleges and technical schools and 2 four-year colleges and universities in the study area (Castell 1988; Bunch 1988). There are also many private and religious schools located throughout the study area.

Table 3-8. Law Enforcement and Fire Protection.

Location	Law Enforcement			Fire Protection	
	Full Time	Part Time	Number of Patrol Cars	Full Time	Volunteer
Hancock County (Rural)[1]	14	20	9	--	--
Bay St. Louis[2]	15	15	9	12[16]	10[16]
Waveland[19]	14	10	9	8[20]	17[20]
Harrison County (Rural)[3]	181	100	60	10[16]	222[16]
Gulfport[4]	62	39	64	95[16]	--
Long Beach[5]	28	15	10	29[16]	--
Pass Christian[6]	12	15	11	8[16]	21[16]
Biloxi[7]	64	50	25	85[16]	--
Pearl River County (Rural)[8]	16	1	11	--	--
Picayune[9]	21	20	15	33[16]	--
Poplarville[10]	6	2	3	1[16]	15[16]
St. Tammany Parish (Rural)[11]	253	38	163	91[17]	148[17]
Covington[12]	30	19	14	--[18]	26[18]
Slidell[13]	50	28	72	70[17]	30[17]
Washington Parish (Rural)[14]	62	30	10	37[17]	73[17]
Bogalusa[15]	33	10	19	36[17]	--

-- Information not available or nonexistent.

Source:
1 Tarlavoule, 1988
2 Burleson, 1988
3 Rhodes, 1988
4 Ripply, 1988
5 Pell, 1988
6 Ruspoli, 1988
7 Carmel, 1988
8 Ware, 1988
9 Hennes, 1988
10 Armstrong, 1988
11 Coco, 1988
12 Shary, 1988
13 Phillips, 1988
14 Bryant, 1988
15 Evans, 1988
16 SMPDD, 1988
17 Oliver, 1988
18 Coner, 1988
19 R. Tarlavoulle, 1988
20 Kronauer, 1988

Table 3-9. Public School Information (1988/89 School Year).

Location	Number of Public School Districts	Number of Schools	Total Enrollment	Teacher/Student Ratio (86/87 School Year)
Hancock County[1]	2	8	4,768	1:19.7[6]
Harrison County[2]	5	47	28,242	1:19.3[6]
Pearl River County[3]	3	12	8,005	1:21.5[6]
St. Tammany Parish[4]	1	44	26,739	1:20.0[7]
Washington Parish[5]	1	12	5,395	1:17.5[7]
Totals	--	111	66,487	

Source:
[1] Dean, 1988 and Oge, 1988
[2] Rosetti, 1988; Collins, 1988; Ehlers, 1988; Theobald, 1988; Redmond, 1988; Tagge, 1988; Price, 1988; and Harrison, 1988
[3] Spiers, 1988; Tyner, 1988; and S. Jones, 1988
[4] Tauzin, 1988
[5] Warren, 1988
[6] L. Cannon, 1988
[7] Urbatsch, 1988

Table 3-10. Health Care Facilities - Stennis Space Center Study Area, 1987/88.

Location	Number of Hospitals	Number of Beds	Number of Physicians	Number of Reg. Nurses
Hancock County	1[1]	60[1]	24[3]	113[5]
Harrison County	8[1]	719[1]	286[3]	1,064[5]
Pearl River County	2[1]	125[1]	44[3]	197[5]
St. Tammany Parish	9[1]	1,340[2]	274[4]	1,113[6]
Washington Parish	3[1]	273[2]	45[4]	258[6]
Study Area Total	23	2,517	673	2,745

Source:
[1] Eggar, 1988
[2] Rome, 1988
[3] Fulcher, 1988
[4] Ferrata, 1988
[5] Robinson, 1988
[6] Washington, 1988

Health Services:

There are 23 hospitals in the five-county/parish study area providing 2,517 beds for patient care (Table 3-10). St. Tammany Parish alone provides over half of the patient beds at its nine hospitals. In addition to these primary care facilities, there are numerous private physician-run clinics and nursing homes in the area (SMPDD 1985), as well as numerous dental clinics (SMPDD 1985).

Currently, Mississippi and Louisiana both suffer statewide physician, dentist and nurse shortages (U.S. Army 1976). According to the American Medical Association (King 1988), there were 131 doctors per 100,000 people in Mississippi in 1986. Louisiana reported 189 physicians per 100,000 people (King 1988). The entire study area has an average of 152 physicians per 100,000 people. Hancock County has the lowest ratio of 73 per 100,000 and St. Tammany Parish has the highest with 183 physicians per 100,000 people. These averages are 19 to 68 percent below the national average of 225 doctors per 100,000 people (King 1988).

Registered nurse staffing standards are harder to derive. The total registered nurse figures presented in Table 3-10 include nurses who work in hospitals, doctors' offices, nursing homes, home patient care programs and even those who are not actively practicing at this time. Each of these facilities has its own unique staffing needs which vary by location. The Mississippi Department of Health (Armstrong, H. 1988) estimates a national nursing shortage of approximately 20 percent of current levels. Application of this figure may understate or overstate the problem depending on the county/parish examined, but the study area may be more than 20 percent understaffed if the nursing staff follow the same pattern demonstrated by doctors in the study area.

Public Utilities:

Table 3-11 illustrates the current public water, sewer, and solid waste disposal capabilities and capacities for the five counties/parishes and major cities in the study area. While many of these facilities are currently at or approaching capacity, the environmental assessment previously done for this proposed ASRM site states that the existing systems can handle any project-induced increase in use (CH2M Hill 1987).

3.1.9 Transportation

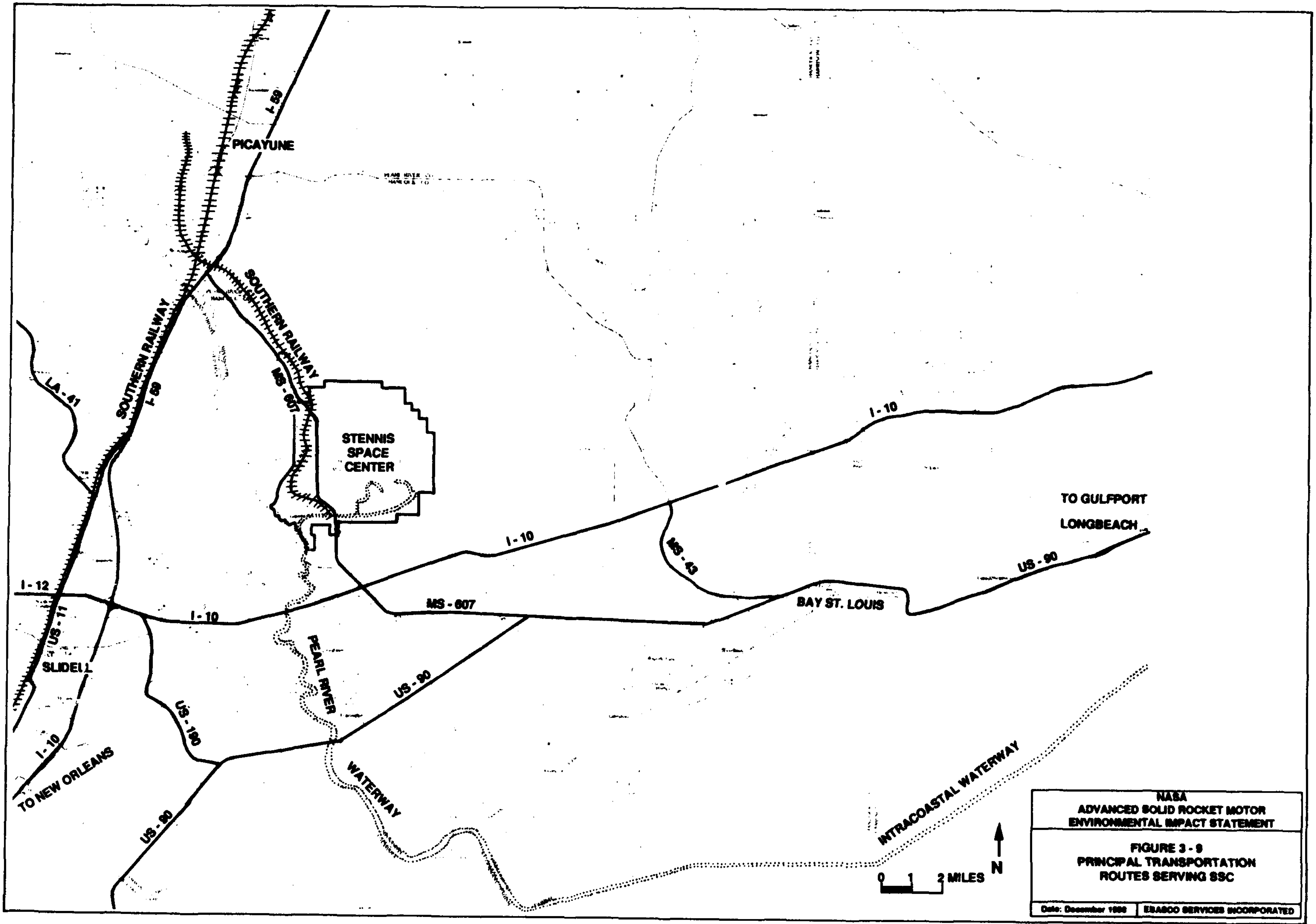
Local Road Transportation

The principal highways serving the SSC study area are Interstates 10 and 59, U.S. Highway 90, and Mississippi Highway 607 (Figure 3-9). Interstate 10 roughly parallels the Gulf coast and is the primary corridor linking Biloxi, Gulfport, Bay St. Louis, and other coastal cities with New Orleans. It is located approximately three miles south of SSC. Interstate 59 joins I-10 near Slidell and extends northeastward to Hattiesburg and on into Alabama, passing within about five miles of the northwestern corner of SSC. Mississippi Highway 607, a generally north-south route, provides direct access to and through SSC from both I-10 and I-59. Check points exist at both entrances to SSC, and the highway is closed to the general public within the fee area (NASA 1980b). Highway 607 connects with U.S. 90 about 9 miles southeast of SSC; from there, U.S. 90 passes through all of the Mississippi coastal

Table 3-11. Water, Sewer, and Solid Waste Disposal Facility - Stennis Space Center Study Area.

	Water			Sewer and Solid Waste				
Unit of Government	Source	System Capacity Gal/Day	Storage Capacity Gallons	Type of Treatment Plant	Capacity Million Gal/Day	Present Load (Percent)	Storm Sewer Percent Comm. Covered	Method of Solid Waste Disposal
Hancock County[1]	Wells	--	--	--	--	--	--	Landfill/dump
Bay St. Louis[1]	Wells	533,000	500,000	Lagoon	2.0	65	60	Sanitary landfill
Harrison County[1]	Wells	--	--	--	--	--	--	Landfill
Gulfport[1]	Wells	12,000,000	3,050,000	Trickling filter	10.25	90	90	Sanitary landfill
Long Beach[1]	Wells	5,000,000	500,000	Trickling filter	2.3	55	28	Sanitary landfill
Pass Christian[1]	Wells	3,140,000	375,000	Activiated sludge	0.735	--	none	Sanitary landfill
Biloxi[1]	Wells	11,600,000	5,000,000	Activiated sludge	12.0	80	75	Sanitary landfill
Pearl River County[1]	Wells	2,652,000	257,000	--	--	--	--	Landfill
Picayune[1]	Wells	8,294,400	850,000	Trickling filter	3.125	50	50	Sanitary landfill
Poplarville[1]	Wells	1,440,000	320,000	Activated sludge	0.40	95	100	Sanitary Landfill
St. Tammany Parish[2]	Wells	--	--	--	--	--	--	Landfill
Covington[3]	Wells	4,000,000	400,000	Trickling filter and oxidation pond	1.4	99	20	Landfill
Slidell[4]	Wells	11,000,000	750,000	Activated sludge	4.1	95	55	Landfill (Private Contract)
Washington Parish[5]	Wells	--	--	--	--	--	--	Landfill
Bogalusa[6]	Wells	7,260,000	2,250,000	Trickling filter	15.0	33	--	Landfill

Source: [1] SMPDD, 1985 [2] T. Smith, 1988 [3] Harmon, 1988 [4] Polivick, 1988 [5] MacMillan, 1988 [6] Gann, 1988, Harvey, 1988



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 9
PRINCIPAL TRANSPORTATION
ROUTES SERVING SSC

Date: December 1989 | EBASCO SERVICES INCORPORATED

communities. This portion of U.S. 90 is a four-lane highway, and Mississippi 607 has four lanes from U.S. 90 to the intersection, with Upper Gainesville Road midway through the fee area (NASA 1980b).

Several other highways provide connections between I-10 and U.S. 90. These roads include Mississippi 43 from I-10 to Bay St. Louis, U.S. 49 into Gulfport, I-110 to Biloxi, and Mississippi 63 into Pascagoula. These highways and U.S. 90 represent the principal arterials in the local road and street network serving the coastal communities. In Louisiana, Interstate 12, U.S. Highways 11 and 190, and Louisiana 41 are other major roads serving the area around Slidell.

The portion of Highway 607 that is within the fee area is designated as Road A. It is part of a complex on-base network of arterials, parkways, collectors and local streets that provide road access throughout the fee area (NASA 1979a).

Commuting patterns in the area around SSC are relatively dispersed. The major flow of commuting traffic in the general region is traffic into and within the New Orleans metropolitan area, which does not include SSC. SSC is a major traffic generator, although commuter traffic to the facility originates from a variety of communities and does not flow in any single predominant direction. Approximately four-fifths of all SSC workers live outside Hancock County and commute to the facility from Picayune or elsewhere in Pearl River County, the Slidell area, and the westernmost coastal cities in Mississippi. A third major commuting flow in the region is into Gulfport and Biloxi from nearby outlying areas.

Public transportation service to SSC and in nearby communities is limited. Coast Area Transit operates eight bus routes, including an SSC on-base shuttle and express service from SSC to Gulfport (Coast Area Transit 1988). Service capacity is limited compared to the total commuter population, so private automobile is the commuting method for most SSC employees.

Existing traffic loads and service levels are generally satisfactory. Average daily traffic (ADT) volumes in 1987 for selected road segments are provided in Table 3-12. The highest volumes indicated in the table are on Interstate 10 around the U.S. 49 exit to Gulfport, with ADT of over 27,400 vehicles east of this junction in 1987. I-10 carried ADT loads of nearly 18,000 vehicles east of Mississippi 607 and nearly 22,000 vehicles west of 607. Traffic on 607 north of I-10, toward SSC, averaged about one-fifth of the I-10 loads at 3,850 vehicles per day. Highway 607 just north of SSC, carried an average of 3,090 vehicles per day. Due to the closure of SSC to through traffic, the vast majority of these Highway 607 traffic flows can be attributed to SSC.

<u>Rail and Water Transportation</u>

Rail service to SSC is provided by a spur line of the Southern Railway Company system that enters the northwest corner of the facility (NASA 1979a). Connecting on-base spur lines, totaling approximately nine miles of track (including track in the MSAAP area), serve a number of locations within the western half of the fee area, including linkages with the on-base canal system. Propellants, cryogenics and other materials currently arrive at SSC by rail.

Mainline rail routes that could be utilized in the ASRM program are identified in Figure 3-10. There are four basic route alternatives for ammonium perchlorate

TABLE 3-12

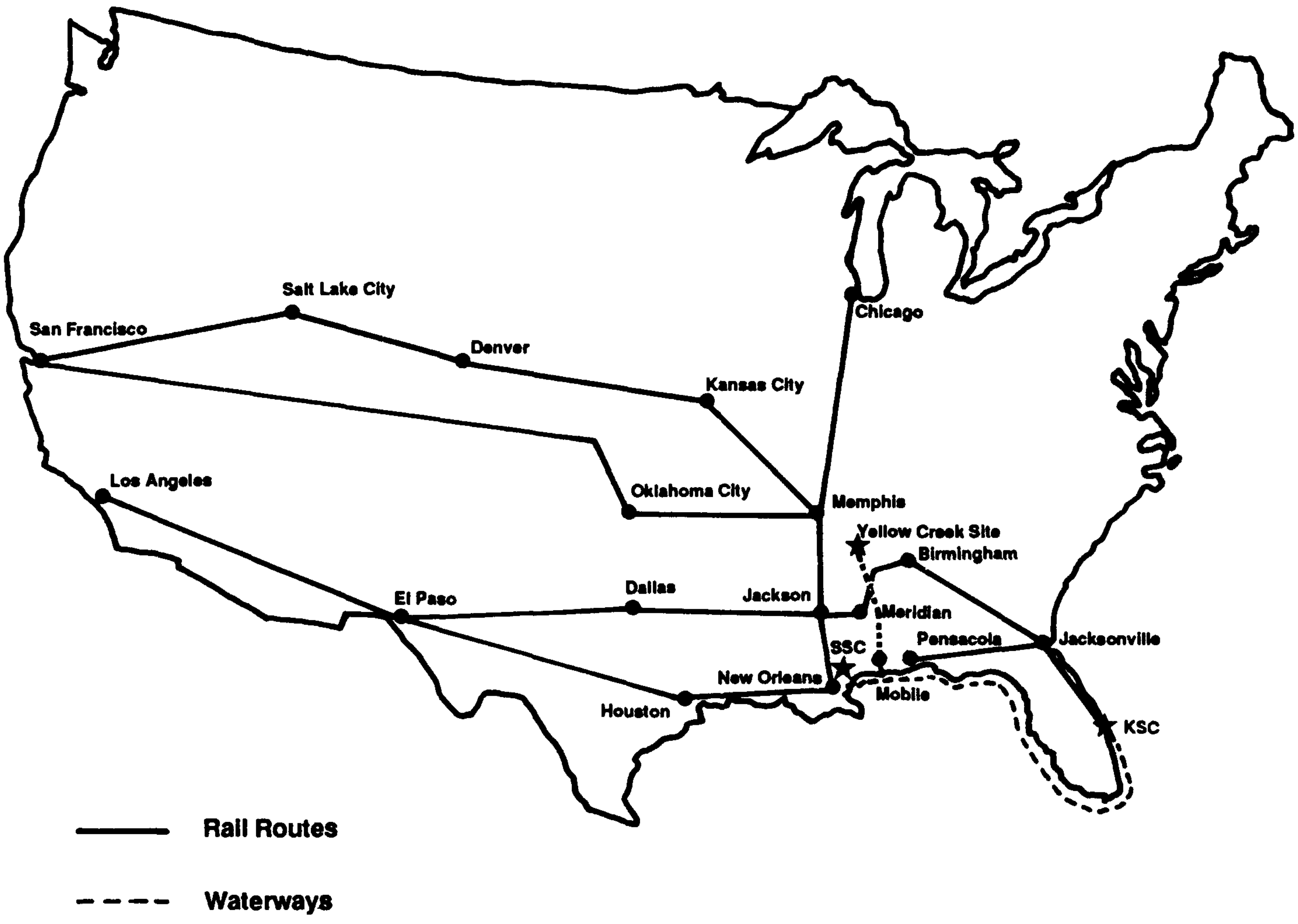
AVERAGE DAILY TRAFFIC (ADT)
SELECTED ROAD LOCATIONS NEAR SSC, 1987
(Number of Vehicles)

Road	Segment Location	ADT
Interstate 10	East of MS 607	17,950
Interstate 10	West of LA/MS line	21,880
Interstate 10	East of U.S. 49	27,420
Interstate 10	West of U.S. 49	21,840
Interstate 59	South of MS 607	13,740
Interstate 59	North of MS 607	14,220
Interstate 59	North of MS 43	8,510
U.S. 90	Waveland, east of MS 43	16,630
U.S. 90	Waveland, west of MS 43	9,650
U.S. 90	Southwest of MS 607	2,080
Mississippi 607	South of I-10	6,030
Mississippi 607	North of I-10/South of SSC	3,850
Mississippi 607	North of SSC	3,090
Mississippi 607	South of I-59	5,310

Source: Mississippi State Highway Department, 1988.

shipments from Henderson, Nevada to SSC. These include a northerly routing through Salt Lake City, Denver, and Kansas City to Memphis, then south to Jackson and on to SSC via New Orleans or Meridian; a parallel route through Oklahoma City to Memphis; and southerly routes via El Paso and Dallas to Jackson, or El Paso and Houston to New Orleans. Aluminum powder and case forgings would likely travel from or through the Chicago area south to Memphis and Jackson. Finished ASRM segments could be shipped eastward through Mobile and Chattahoochee (Florida) to Jacksonville, then south to KSC. An alternate but longer route would be northeast from SSC to Meridian and Birmingham, then southeast to Jacksonville.

SSC is linked to the national waterway transportation system via the East Pearl River. On-base main and secondary canals, totaling about seven miles of waterway, provide water access to several storage areas and the "A" and "B" test areas (NASA 1979a). These canals are 150 feet wide and 15 feet deep. From the main canal entrance to SSC, it is 21 miles along the East Pearl River to the Gulf Intracoastal Waterway. The river has been dredged to a minimum width of 150 feet and a depth of



NASA
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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 10
RAIL AND BARGE ROUTES
PROPOSED FOR ASRM PROGRAM

Date: December 1988 | EBASCO SERVICES INCORPORATED

12 feet, and all curves in this reach have been modified for a minimum 600-foot radius to allow passage by large, shallow-draft vessels. The Gulf Intracoastal Waterway connects with the Mississippi River system approximately 65 miles west of the Pearl River mouth. To the east, the waterway passes the Gulf coastal cities, connects with the Mobile River and Tennessee-Tombigbee Waterway, and eventually provides access to the eastern seaboard.

Water transportation is currently used to deliver large volumes of propellants and general heavy cargo to SSC (NASA 1979a). Off-site trips for propellant totaled 67 in 1987 and 70 through the first eight months of 1988 (an annual pace of 105 trips), and total on-site barge movements in 1987 numbered 204 (NASA 1988b).

3.1.10 Historical, Archaeological, and Cultural Resources

Mississippi Gulf coastal prehistory begins with the Paleo-Indian period (ca. 10,000 B.C.). A few archaeological sites along the Gulf coast provide evidence that human hunters, probably subsisting on large mammals, including some now-extinct species such as mastodon and mammoth, inhabited the project area at this time (Greenwell 1984). Sites dating after 8000 B.C. and belonging to the Archaic period are common by comparison, especially along the natural levees of major rivers and in the coastal estuaries.

The Woodland era, commencing with the Early Woodland Period, starts with the introduction of fiber-tempered pottery at around 1200 B.C. Beginning with this period, there is evidence of an economy based on marshland resources and supplemented by small-scale agriculture. The Middle Woodland Period, beginning around 300 B.C., is also the first period during which project area cultures participated in the developing pan-Eastern Woodlands burial mound ceremonial complex. The Late Woodland (A.D. 400-900) cultures in the region saw the emergence of platform substructure mounds along the Gulf coast. Along with this development came the emergence of more complex societies and an agricultural complex based on the growing of maize, beans, and squash.

During the Mississippian period (A.D. 900-1700) large settlements with temple and residential substructure mounds were built near the project area. Mississippian cultural pattern climaxed at around 1300 A.D., but continued on a smaller scale in a few places in the southeast until first European contact.

The lower Pearl River was inhabited at the time of first European contact by the Acolapissa, possibly a subtribe of the Choctaw. There are no ethnographic records of the Acolapissa, and in 1718, they were assimilated by the Houma tribe (Swanton 1911; Kniffen et al. 1987; Giardano 1984).

The initial exploration of the project area by Spanish and French adventurers took place between 1500 and 1700. The earliest European settlement in the region was Biloxi, founded in 1699 by Pierre Le Moyne, Sieur d'Iberville, a French Canadian sent to Louisiana in an attempt to control Mississippi River navigation and check Spanish and English expansion (Skates 1979).

Spain acquired the project area after 1795. During the next 15 years, land along the Pearl River was granted to settlers of mostly American and English origin. The area became part of the United States in 1810 and Mississippi became a state in 1817.

Three alternative ASRM sites at SSC were surveyed for cultural resources in May 1988 (USACOE 1988a). The survey team, in consultation with the Mississippi State Historic Preservation Office, determined that the sites have low potential for archaeological resources, based on the results of previous surveys in the pine barrens and swampland border biotic zones in the region (McGahey 1988; Sever 1988). Consequently, they performed a selective survey of the portions of the alternative ASRM sites considered to have the most potential for archaeological sites. These included areas at or higher than the 30 feet elevation contour, higher ground adjacent to swamps, and areas within 100 feet of streams. The survey party also checked road cuts, fire breaks, food plots, and eroded gullies for evidence of buried sites.

The survey discovered no archaeological sites within the alternative ASRM areas. They noted that archaeological sites had previously been recorded in the SSC fee area, each along the Pearl River, outside of the area which might be directly affected by the ASRM project. The site of Gainesville, a historic town founded in 1819 (Sever 1988), is also within the SSC fee area, but contains no structures potentially eligible for nomination to the National Register of Historic Places.

Saturn rocket test stands A1, A2 and B1/B2 are located within 2 miles of the proposed ASRM facility and are designated as National Historic Landmarks because of their role in the U.S. space program (Butowsky 1988a; USDI 1981, 1987).

3.1.11 Solid and Hazardous Waste Management

Solid Waste Management

SSC operates a 21 acre sanitary landfill on-site under the authority of Permit No. SW02401B0376, issued July 30, 1987, by the Mississippi Natural Resources Permit Board. Total capacity of the landfill is approximately 1,000,000 cubic feet, with an estimated remaining life-span of 18 years. To ensure environmental safety, the landfill has groundwater monitoring wells strategically placed to check for subsurface contamination. Surface water run-off is also monitored periodically. Solid wastes generated at SSC are collected in dumpster-type containers located throughout the fee area. The containers are picked up twice daily, five days a week, and are transported and emptied into the permitted sanitary landfill (McCaleb 1988d). Current rates of disposal are estimated to be about 48,360 cubic feet per year (Warden 1988, personal communication).

An adjacent 30 acre sanitary landfill site was operated by SSC under permit from the State Board of Health from 1979 to 1987. This facility has been closed in accordance with the Natural Resources Permit Board closure regulations (Warden 1988, personal communication).

Hazardous Waste Management and Emergency Response

Hazardous Waste Compliance:

The regulation of treatment, storage, disposal and transportation of hazardous waste is administered by the Mississippi Department of Natural Resources, Bureau of Pollution Control. Mississippi was granted authorization to administer the federal Resource Conservation and Recovery Act (RCRA) program June 13, 1984 (49 FR 24377). Amendments to RCRA were passed by the U.S. Congress in the Hazardous and Solid Waste Amendments of 1984 (HSWA). The U.S. EPA Region IV office in Atlanta, Georgia retains the authority to administer the HSWA provisions of the program which includes the important corrective action program.

Currently at SSC, hazardous wastes are generated at several scientific and photographic laboratories operated under contract to NASA or by the U.S. Navy, U.S. EPA, or USGS. RCRA-listed wastes generated at the scientific laboratories vary widely. Some of the common wastes include benzene, carbon tetrachloride, chloroform, methyl cyanide, carbon disulfide, xylene, phenolics, hydrochloric acid, sulfuric acid, nitric acid, ammonium hydroxide, and sodium hydroxide, acetonitrile, chromium, and ferrocyanide (NASA 1980b). Currently only about 4 gallons of these chemicals are generated each week.

Currently, SSC is subject only to the RCRA/HSWA standards for small quantity generators due to the small quantities produced and SSC's practice of shipping hazardous wastes off-site to RCRA permitted facilities. The generator standards consist primarily of guidance for the proper implementation of a Uniform Hazardous Waste Manifest system for transportation off-site to permitted facilities. According to the most recent manifests, flammable/combustible wastes are sent to a Rollins Environmental Service facility in Deer Park, Texas. Corrosive and acidic wastes are sent to a Chemical Waste Management, Inc., facility in Emelle, Alabama. Certain laboratory wastes (formaldehyde solution), solvent wastes (trichloroethylene), metallics (mercury) and waste petroleum oil are shipped to PSC Environmental Management, Inc., in Pecatonica, Illinois (NASA/NSTL 1988b). In addition, SSC sends some miscellaneous wastes to: 1) SCA Chemical Service in Chicago, Illinois; 2) National Electric in Coffeyville, Kansas; and 3) Trade Waste Incineration in Saugat, Illinois (McCaleb 1988b).

The U.S. Army munitions manufacturing facility at SSC also generates certain waste streams (e.g., paint sludge, wastewater treatment sludges) which must be handled as a hazardous waste because of hazardous constituents contained in the sludges (U.S. Army 1976). These sludges are shipped off-site to RCRA permitted facilities. In addition, off-specification explosives are disposed of on-site at a RCRA-permitted rotary kiln incinerator. The original permit for the incinerator was issued in 1983. The most recent modification was issued September 13, 1988 (Penkow 1988, personal communication)

Emergency Response Compliance:

Also applicable to operations on-site at SSC are the emergency response requirements called for under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Section 103. Under this authority, NASA and its contractors are responsible for reporting a release of a reportable quantity

(RQ) of a hazardous substance to the National Response Center within 24 hours (40 CFR 302). Quantities are specified on a constituent-by-constituent basis.

SSC implements this program through a June 18, 1985 standard operating procedure (SOP) that provides a comprehensive emergency plan. This plan includes procedures for eight types of emergencies including one for fires and explosions and one for spills of oil and hazardous substances (Hlass 1985). The plan is written to meet both Occupational Safety and Health Administration (OSHA) and NASA regulations, including the requirement to report accidental spills of hazardous chemicals and toxic substances in excess of RQs listed at 40 CFR 302. Section 3.1.15 discusses some aspects of the comprehensive emergency plan in more detail.

NASA has complied with the reporting requirements of the Superfund Amendments and Reauthorization Act (SARA), and the Community Right-to-Know Act (otherwise known as SARA Title III). SARA requires the development of Material Safety Data Sheets (MSDS) for chemicals used on-site, and submission of these documents to: 1) the local emergency planning committee; 2) the State Emergency Response Commission; and 3) the fire department in the local jurisdiction. MSDSs provide information on the toxic effects of chemicals and risks associated with certain exposure routes and levels of exposure. SARA also requires the preparation of Toxic Chemical Release Forms (TCR) to inventory routine annual releases or emissions from the site (McCaleb 1988b).

On January 6, 1986, SSC issued an SOP for guiding the preparation of (MSDSs), and initiated a Hazard Communication Standard Program as required by the Occupational Safety and Health Act (Hlass 1986). This training/educational program is aimed at ensuring employee protection against potential hazards in the workplace. Facility operators required to issue MSDSs under the Hazard Communication Standard are also required to report information on the location and quantities of certain chemicals stored on-site. These reports are submitted to state and local governments under Section 312 of SARA Title III. SSC provided information on three specific chemicals (sulfuric acid, chlorine, and nitric acid) to the Hancock County Fire Marshall on February 24, 1988 (McCaleb 1988a). NASA maintains an ongoing personnel training program at SSC (Section 3.1.15) to ensure that the above noted emergency response and reporting and notification requirements are met (Oberg 1988).

3.1.12 Toxic Substances and Pesticides

Toxic Substances

Toxic substances used and/or produced at SSC include a number of manufactured chemicals, as well as naturally-occurring heavy metals and other materials. The Toxic Substances Control Act (TSCA) requires the EPA to develop and keep current a comprehensive chemical inventory of the chemicals used for commercial purposes in the United States. TSCA is applicable only to those chemicals in commercial use, not those used for research and development. Its primary applicability at SSC relates to the decommissioning/decontamination of PCB contaminated equipment (transformers and other electrical equipment) and the handling of asbestos building materials and pipes. None of these substances will be used in ASRM production.

Pesticides

Pesticides, defined as chemical or biological substances used to control unwanted plants, insects, fungi, rodents or bacteria, can be extremely toxic and can cause serious harm if spilled on the skin, inhaled, or otherwise misused. EPA regulates pesticides under both the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Pesticide Amendment to the Federal Food, Drug, and Cosmetic Act (FFDCA).

At SSC, pesticides and herbicides are routinely used in small quantities for the control of mosquitoes, hornets, termites, fire ants, mice, rats, and weeds. In 1987, 21 different pesticides and/or herbicides were used (NASA/NSTL 1988c). All handling, storage and disposal is conducted in accordance with FIFRA regulations at 40 CFR 165. This includes the handling and application of these substances by certified personnel. These personnel are fully trained in the use of proper dermal and respiratory protection equipment suitable for safe and effective handling and application. Examples of the types of pesticides used include: 1) pyronyl concentrate for mosquitoes, gnats and flies; 2) dursban for roach control; 3) 797-A for lice, ants, fleas and termites; 4) diphacinone for mice; and 5) baygon for wasps and hornets. Applications are typically by ULV spray, aerosol spray mist, spray emulsion or bait setting (McCaleb 1988e). Total annual usage by volume for the combined substances covered by FIFRA is typically around 577 gallons for liquid pesticides and 13 pounds for solid pesticides (NASA 1980b).

3.1.13 Radioactive Materials and Nonionizing Radiation

Human exposure to ionizing radiation results from naturally occurring radioactive materials, from radionuclides introduced into the environment by man (nuclear power, weapons testing, etc.), and from cosmic radiation. The route of exposure can be either external, as in the case of cosmic radiation, or internal when radionuclides are deposited in the body via inhalation or ingestion. Specific levels of exposure are a function of many variables, including location, altitude, nuclide concentration in the soil, food consumption, and recreational habits. Annual whole-body radiation dosage at SSC is assumed to be about 330 millirem (mrem), based on the location of SSC and measurements typical of the southern U.S. No site-specific measurements are available. Minute quantities of radioactive substances are used in various laboratories at SSC (NASA 1980b).

3.1.14 Noise and Vibration

Background Noise Levels

The effect of sound levels and vibrations depends on site-specific factors, including the location of major receptors, topography, and meteorological conditions. Site topography is described in Section 3.1.4 and site meteorology is discussed in Section 3.1.2. Noise levels are measured by two different scales. One scale, the overall sound pressure level (OASPL), gives equal weighting to all frequencies. A second scale, the A-weighted sound level, accounts for the insensitivity of the human ear to low level frequencies. Some familiar sound sources are listed below with their associated dB(A) levels (Laney 1978):

Jet plane (100 ft)	140 dB(A)
Rock and roll music	120
Cub Scout meeting (at times)	110
Automobile (inside, window open)	95-110
Normal conversation	60-70
Quiet office	40-60

One-hour noise measurements were taken at four locations within SSC in 1974 when no rocket motor tests were being conducted. The results of these noise surveys are presented in Table 3-13 (NASA 1980b). The measurement sites are shown in Figure 3-11. Sites where measurements were taken in October 1988 (Rice 1988a) are also provided in Figure 3-11. Background noise levels along Interstate 10 at the Highway 607 interchange are 60-75 dB(A) depending on traffic, while those at the Slidell/Interstate 10 interchange range from 55 to 70 dB(A) at a distance of 500 to 1,000 ft from I-10.

Local Regulations

The State of Mississippi has no noise regulations (Hamil 1988, personal communication). EPA Region IV has not had a program for noise standards since 1981 (Orban 1988, personal communication). In the absence of noise regulations, SSC has established testing guidelines which depend on the predicted OASPL at the buffer zone boundary (CH2M Hill 1987). A static test may be conducted if the predicted OASPL is less than or equal to 110 dB at the buffer zone boundary. If the predicted OASPL is between 110 and 120 dB, the decision to test is made by the project manager. No test firing is approved for predicted sound levels above 120 dB at the buffer zone outer boundary.

Public responsiveness to test firings is another measure of appropriate sound levels outside the buffer zone. There have been no documented complaints as a result of current testing of the Space Shuttle main engines; however, noise from the ASRM tests should be 9 dB higher than the tests of the main engines (CH2M Hill 1987). Noise from previous Saturn rocket testing caused 160 complaints, of which 18 resulted in financial settlements totaling $38,500 (NASA 1980b). ASRM testing should produce lower noise levels by approximately 6 dB when compared with the Saturn/Apollo rocket engine tests (NASA/SSC 1988b).

Vibration and Other Site-Specific Factors

The SSC site and surrounding areas are susceptible to an acoustic- seismic effect due to the swamps, quicksand, and generally unconsolidated layer of soil about 65 ft deep. This effect has been observed in the form of swaying and falling objects in locations far enough from the test site that no sound was audible (Dalins 1988, Dalins 1985). See Appendix F for a discussion of this phenomenon.

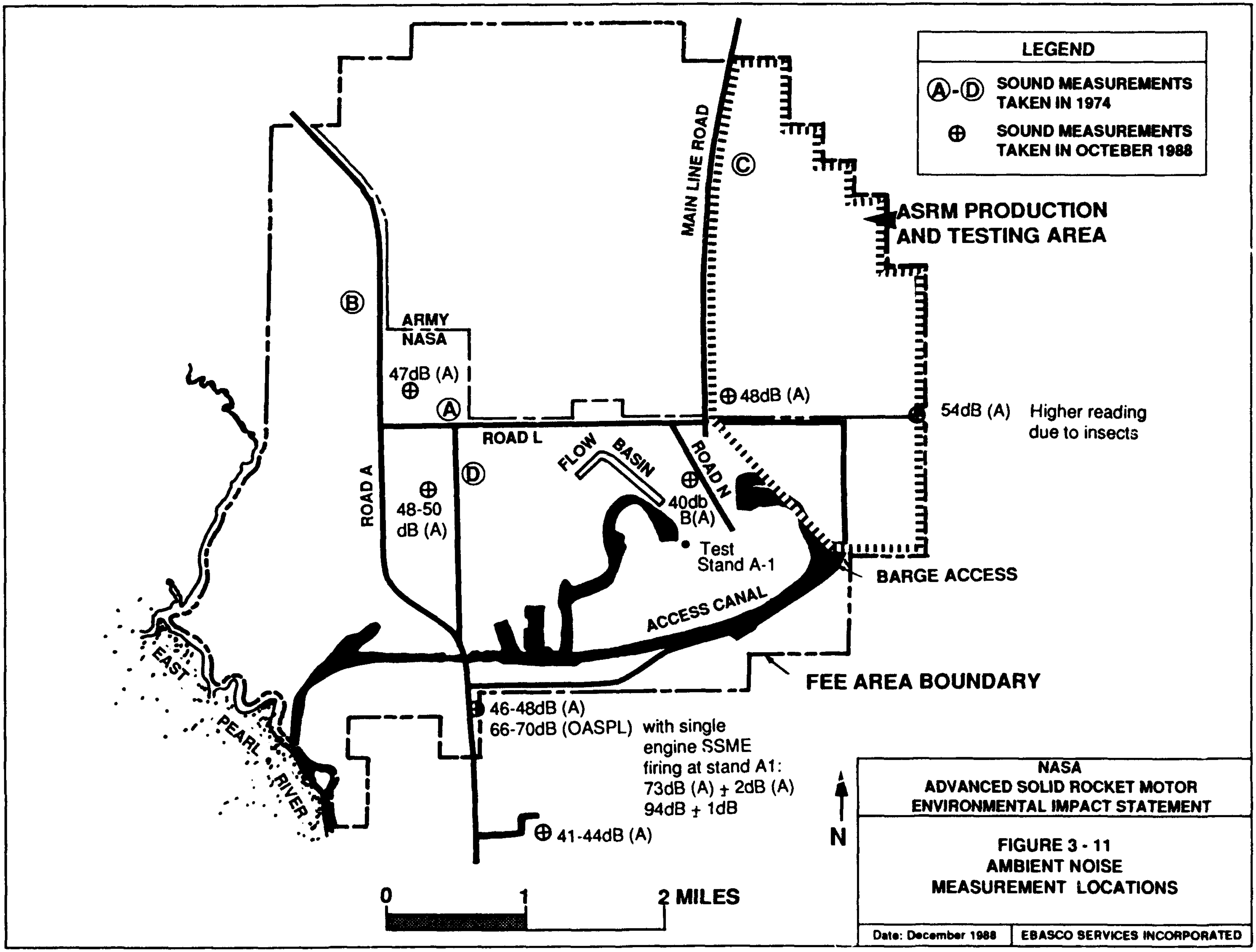
TABLE 3-13
AMBIENT NOISE SURVEY AT SSC (1974)

Site	Location and Characteristics	Noise Levels - dB(A) L_{eq} 1/	L_{10} 2/
A	Site is adjacent to Sewage Lagoon and heavily wooded. Daytime noise from vehicles on Highway 43 and birds. Night time noise sources are insects and wildlife. There is no perceivable noise from sewage operations.	41.1	43
B	Site is located in a grassy field between Dean Road and Road A. Day time noise sources include cars on Road A, light truck traffic on Gravel Pit and southern Dean Road, and insects. The field is surrounded by forests on all sides.	37.8	45
C	The measurement site is located on Navy Road north of the old Bombing Range and just off Mainline Road. The Bombing Range (north of Bombing Range Road and east of Mainline Road) is a large grassy expanse with very few trees. The remainder of the area is heavily forested with much undergrowth. Noise sources include birds and insects.	38.7	41
D	This site is directly in front of the parking lot for Building 1100. The area consists of mown grass with several large office buildings. Noise sources include vehicles and air handling units for the surrounding buildings.	41.6	45

1/ L_{eq} The equivalent continuous noise level having the same energy as the actual time-varying noise during the observation period.

2/ L_{10} The noise level that is exceeded 10 percent of the time (90th percentile) during the observation period.

Source: NASA 1980b.



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 11
AMBIENT NOISE
MEASUREMENT LOCATIONS

Date: December 1988 | EBASCO SERVICES INCORPORATED

3.1.15 Public and Employee Health and Safety

SSC was located and designed to minimize risks to public health and safety (NASA 1979a). As noted in Section 3.1.7, SSC is located in an area of relative isolation from populated areas, although several large population centers lie within commuting distance. The 200 square-mile buffer zone provides a safety buffer between SSC operations and the low density, primarily rural, population of the immediate area.

Operations at SCC are regulated by federal, state, and local environmental laws and permit requirements as described in the previous sections. Environmental permits issued to SSC regulate discharges and emissions to the surface water, groundwater, and air to protect the public health and safety. Additionally, the physical placement of various operations within the SSC complex is determined by their hazard potential. Facilities housing hazardous operations are separated from other facilities by quantity-distance (QD) requirements designed to isolate a hazardous facility and minimize damage to other facilities should an explosion or release of a hazardous substance occur. Programs to manage hazardous waste, toxic substances and pesticides, and radioactive materials have been designed and implemented at SSC to meet regulatory requirements to protect public health and safety.

SSC has implemented an emergency response program to protect both on-site personnel and the public at large. The SSC Emergency Plan (Hlass 1985) sets forth the responsibilities to be assumed and action to be taken by SSC for three classes of emergencies:

- Class I Emergency - a minor or minimum emergency which can be contained or controlled by an Emergency Team;
- Class II Emergency - an emergency situation beyond the capabilities of the Emergency Team, requiring the assignment of additional effort or assistance; and
- Class III Emergency - an emergency of disastrous proportions which will require action on the part of all SSC personnel and might also require off-site assistance.

Specific emergency plans have been prepared at SSC dealing with tornadoes and severe weather, hurricanes, fire and explosions, serious accidents, civil disturbances, Civil Defense, and community disaster relief. The Director, SSC, makes or approves any final policy decision regarding emergency or disaster matters. Responsibility for direction and implementation of policy is shared by the SSC Emergency Director, SSC Safety Officer, resident agencies and contractors, and the Facility Operating Services Contractor.

There is an ongoing training program at SSC to enhance facility environmental compliance and emergency preparedness. Programs include new employee orientation, films, seminars, workshops, and drills to assess the effectiveness of training and facility emergency response readiness (Oberg 1988). SSC has also made arrangements with several outside contractors to handle emergencies involving large oil or hazardous chemical spills (Oberg 1988). Specific environmental control plans developed and in effect at SSC include a Contingency Plan for Response to Spills of Oil and Hazardous Substances (Hlass n.d.), Management Instruction for of Hazardous Materials (Hlass 1986), and Asbestos Removal/Disruption Operations (Holt and Gorham 1985).

Because of the nature of work performed at SSC, the Center maintains a strict security system, designed to protect both site personnel and the public from security threats or sabotage. Security services at SSC are contracted (NASA n.d.) and are comprised of:

- Physical Security Services (armed uniformed 24-hour patrols, entry control points, motorized and stationary security posts, restricted areas, and random inspections);

- Administrative Security Services (receptionists, badging, vehicle registration and decals, visitor control);

- Industrial Security Services (sensitive position investigations; classified storage, defense investigative services); and

- Law Enforcement Activities (criminal investigator, local sheriff's department support, other law enforcement agency support as required).

3.2 ENVIRONMENTAL CONSEQUENCES

3.2.1 Facility Options at SSC

Evaluations of ASRM activities at SSC were made following the method described in Section 1.6. Worksheets used to evaluate the types of impacts and their significance are included in Appendix G, Section G-2.

The impacts of manufacturing alone, testing alone, and both manufacturing and testing at SSC were evaluated. Placement of buildings and assumptions concerning additional site access were based on preliminary site designs provided by NASA (NASA 1988b).

If both testing and manufacturing were located at SSC, the test stand would be located in the southeast portion of the ASRM site and the nozzle would be pointed toward the southeast. If testing alone were located at SSC, the test area would be shifted slightly north and the nozzle would be pointed due north. An access road would be needed from the existing barge facility to the test stand. The differential effects of locating the test stand at either of these two places are discussed in Section 3.2.14, Noise. Other resources would not be affected at all, or to such a small degree that the differential impacts would be inconsequential.

3.2.2 Air Resources

Construction:

Construction activities at SSC can be characterized in two distinct phases: ASRM manufacturing facility construction, and test stand construction. Construction of the ASRM manufacturing facilities would have a greater potential for air quality impacts due to the greater area of land which would be cleared prior to erecting new buildings. Soil exposed during clearing operations will be a source of fugitive dust emissions.

Fugitive dust emissions will be significantly attenuated by the high frequency of precipitation days at SSC. The U.S. EPA has developed emission factors to quantify the rate of fugitive emissions from exposed land during construction activities. The calculations for construction at SSC are shown in Table 3-14. Modeling of the fugitive dust emissions results in a maximum 24-hour ambient impact of 74 ug/m^3 (less than the ambient air quality standards), as shown in Table 3-14.

Fugitive dust emissions due to construction vehicle traffic have been quantified based on a representative number of vehicles to construct the manufacturing and testing facilities at SSC. These emissions are summarized in Table 3-15. The maximum 24-hour particulate concentrations resulting from construction traffic will be 33 ug/m^3. Construction vehicles will also emit oxides of nitrogen, carbon monoxide, and small quantities of sulfur oxides and particulate matter. These exhaust emissions are considered negligible, and are not discussed further here.

Construction related air quality impacts are insignificant at SSC for the combination of ASRM manufacturing and testing. If only testing were to be conducted at SSC, the emissions during construction would be substantially less than those shown in the tables.

Commuter Traffic Exhaust Emissions:

The maximum concentration of carbon monoxide (CO) at the site boundary due to commuter traffic exhaust emissions during construction and operation of the ASRM facility was modeled using the CALINE3 dispersion model and is given in Table 3-16. These values are considered insignificant.

Manufacturing:

There are two significant sources of air pollutants associated with ASRM manufacturing: solvent cleaning operations, and the fuel-burning units (Table 3-17). Solvents are used in several processes during construction (see Section 2.0 and CH2M Hill 1987). Overall annual solvent emissions are estimated to be 17.4 tons per year (see Section 3.2.15). These emissions will result in a maximum off-site concentration of 0.2 ppm. Solvents are one component of hydrocarbon compounds, which are generally recognized as precursors to formation of ozone, a criteria air pollutant. The incremental increase in hydrocarbons is unlikely to result in substantial elevation of existing ozone levels.

Fuel-burning equipment is not a significant source of air pollutant emissions. The two steam generators consume only 7.0 gallons per minute of high-quality fuel oil. Modeling of the emissions using the ISCST model indicates that the maximum off-site concentrations will be significantly less than all applicable ambient air quality standards, as shown in Table 3-17.

TABLE 3-14

FUGITIVE DUST EMISSIONS FROM EXPOSED LAND DURING CONSTRUCTION AT SSC

1. Exposed construction areas:

Nozzle Manufacturing	4 acres
Case Preparation	5 acres
Misc. Processes	9 acres
Final Assembly	1 acre
Administration	4 acres

2. Emission factor:

$E = 2x10^{-4} \times (s) \times (365 - p) \times (f)$ lb/(day-acre)

where:

s = soil silt content (50 percent)
p = number of days with greater than .01 inch rain (114)
f = time winds greater than 12 miles per hour (21 percent)

3. Emission rates:

E = 53 lb/day

4. Maximum ambient air quality impact (particles <10 microns, ug/m^3):a/

	LOCATION	ANNUAL	24-HOUR
At facility boundary			
	(1.4 mi)	2.6	--
	(1.1 mi)	--	73.8
At outer control zone			
	(5.5 mi)	0.7	--
	(5.0 mi)	--	11.5
At residences			
	(5.0 mi)	0.7	11.5

5. Ambient air quality standard, ug/m^3:

	ANNUAL	24-HOUR
Federal (PM-10)	60	150
Mississippi (TSP)	60	260
Mississippi (PM-10)	60	1 50

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a/ Air quality impact analysis was performed with the ISCST (USEPA 1987) model, 1979 surface meteorological data from New Orleans, LA, and 1979 upper air data from Lake Charles, LA.

TABLE 3-15
FUGITIVE DUST EMISSIONS DUE TO CONSTRUCTION VEHICLE TRAFFIC DURING CONSTRUCTION AT SSC

1. General site traffic on unpaved roads:
   Number of 6-wheeled 20 ton trucks on site = 15
   Average length of trip on unpaved roads = 3 miles
   Site speed limit during construction = 15 mph

2. Emission factor (pounds per vehicle miles traveled):

   $E = 3x10^{-6} x (s) x (S) x (W^{.7}) (w^{.5}) (365 - p)$ lb/VMT
   where:
   - s = silt content of road (50 percent)
   - S = mean vehicle speed (20 mph)
   - W = average vehicle weight (15 tons)
   - w = average number of wheels (6)
   - p = number of days with >.01 inch rain (114)

3. Emission rate:

   E = 12.1 lb/VMT

4. Maximum ambient air quality impact (assumes particles <10 microns, ug/m^3[a]

LOCATION	ANNUAL	24-HOUR
At facility boundary		
1.4 mi	1.2	
1.1 mi		33.2
At outer control zone		
5.5 mi	0.3	
5.0 mi		5.2
At residences (5.0 mi)	0.3	5.2

5. Ambient air quality standard (ug/m^3)

	ANNUAL	24-HOUR
Federal (PM-10)	60	150
Mississippi (TSP)	60	260
Mississippi (PM-10)	60	150

a/ Air quality impact analysis was performed with the ISCST (USEPA 1987) model, 1979 surface meteorological data from New Orleans, LA, and 1979 upper air data from Lake Charles, LA.

TABLE 3-16

VEHICLE EMISSIONS FROM COMMUTER TRAFFIC AT SSC

Assumptions

Greatest impact will occur at site boundary gate during shift change from night shift to day shift.

Number of vehicles passing gate is as follows:

Construction Phase		Operation Phase	
No. Arriving	No. Leaving	No. Arriving	No. Leaving
992	124	712	89

Vehicle mix is as follows (percent):

Type of Vehicle	Construction Phase	Operation Phase
Light duty vehicles	50	75
Light duty trucks	40	20
Heavy duty gas trucks	5	5
Heavy duty diesel trucks	5	0

Wind speed = 2.5 m/sec; stability class = F (moderately stable).

Resulting Carbon Monoxide Concentrations (ppm)

Phase	Maximum 1-hour	Applicable Standard
Construction	1.1	35
Operation	0.7	35

TABLE 3-17

AIR POLLUTANTS FROM ASRM MANUFACTURING AT SSC

1. Activities:
   Process solvents = 17.4 tons per year of hydrocarbons
   Boiler (2 units) = 7.0 gallons No. 2 fuel oil per minute

2. Emission factors for boilers:

Carbon monoxide (CO)	5 lb/1,000 gal
Nitrogen oxides (NOx)	22 "
Sulfur oxides (SOx)	71 "
Hydrocarbon (HC)	1 "
Exhaust particulate matter (PM-10)	2 "

3. Emissions from boilers:

Carbon monoxide (CO)	3.7 tons per year
Nitrogen oxides (NOx)	16.2 "
Sulfur oxides (SOx)	52.1 "
Hydrocarbon (HC)	0.5 "
Exhaust particulate matter (PM-10)	0.2 "

4. Ambient air quality impact on site boundary (1.1 mi):a/

Pollutant and Averaging Time	Concentration	Standard
Sulfur dioxide		
3-hour	19.8 ug/m^3	1,300 ug/m^3
24-hour	4.4 ug/m^3	365 ug/m^3
Annual	0.5 ug/m^3	60 ug/m^3
Nitrogen oxide		
Annual	0.1 ug/m^3	100 ug/m^3
Carbon monoxide		
1-hour	0.05 ppm	35 ppm
8-hour	0.008 ppm	9 ppm
Hydrocarbons (Boilers)		
1-hour	0.001 ppm	none
Hydrocarbons (Process Solvents)		
1-hour	0.02 ppm	none

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a/ Air quality impact analysis was performed using the ISCST (USEPA 1987) model, 1979 surface meteorology from New Orleans, LA, and 1979 Lake Charles, LA, upper air data.

Static Testing:

Emission rates of air pollutants during static test firing of motors has been quantified in several documents (c.f., CH2M Hill 1987). Table 3-18 summarizes the major chemical compounds emitted during static test firing and resulting off-site concentrations. Since static test firing combines a unique set of source characteristics not amenable to traditional dispersion modeling (e.g., ground-level, rapid, high temperature combustion resulting in a highly buoyant plume), a dispersion model (PCAD) which includes a combustion module was used to evaluate the short-term impact of static testing. Static test firing will occur on four occasions during initial development, and two occasions each year thereafter. In order to simulate the ambient impacts, selected meteorological conditions were modeled with PCAD to determine worst-case concentrations. The model predicts that neutral atmospheric conditions (C-stability) and high wind speeds (10.7 m/s) produced the highest ground-level ambient concentrations at a distance of about 12 kilometers (km) downwind. Other meteorological conditions typical of daytime conditions in the southeast U.S. tend to allow the plume to rise to greater elevations, resulting in lower ground-level concentrations.

The results of the model indicate that a peak HCl concentration of 1 to 10 parts per million can be experienced for a short-time as the cloud of combustion products passes over a given receptor. The modeled concentrations are less than guideline values designed to protcct public health. Impacts to public health and safety of static test firing are discussed in Section 3.2.15.

Comparing modeled concentrations to ambient standards designed to protect public health and welfare is difficult in the case of a short-term, isolated event. Most of the standards are for the purpose of protecting air quality from adverse impacts associated with continuously operating sources. Ambient standards specify a maximum concentration not to be exceeded during a given period of time, typically 1-hour to 1-year. The PCAD results are based on two minutes of static firing. The most appropriate way to compare the short-term predicted impacts to longer term standards in cases such as this, is to use a ratio of averaging times. For example, the PCAD model predicts a maximum ambient concentration of HCl of 11.8 mg/m^3 at 12 km downwind. The most applicable ambient standard for HCl is 6 mg/m^3 taken for a 10-minute averaging time (see Section 3.2.15). Using a ratio of 2-minute firing time to 10-minute standard provides a ratio of one to five. The ambient impact for comparison is 2.4 mg/m^3, using the ratio. Other comparisons of predicted ambient concentrations to standards are given in Table 3-18.

Waste Burning:

Burning of waste propellants is analogous to static test firing in that short-term concentrations of combustion products are experienced at downwind receptors. The time average concentrations are quite low. The results of the combustion/dispersion model are shown in Table 3-19. The concentrations are less than any applicable air quality standard. Impacts to public health and safety of open-burning of waste propellants is discussed in Section 3.2.15.

TABLE 3-18

AIR POLLUTANTS FROM ASRM STATIC TESTING

Assumed Test Specifications

Amount of propellant: 1,200,000 lb (544,218 kg) per static test
Burn time: 2 minutes
Wind speed: 10.7 m/sec
Air stability class: C (neutral)
Number of tests per year: 4 (to be reduced to 2 in later years)
Maximum concentration occurs 12.0 km downwind.

Emissions and Concentrations Predicted by PCAD Model

Combustion Product	Emission Rate (g/sec)	Total Emissions Per Test (kg)	Total Annual Emissions (kg)	2-Minute Concentration (mg/m^3)	Time Average Concentration (mg/m^3)	Applicable Standard (mg/m^3)
CO	32,100	3,910	15,640	0.44	0.01 (1-hour)	40 (1-hour)
NO_x a/	22,170	2,700	10,800	0.31	0.00 (annual)	0.1 (annual)
Cl_2	115,131	14,023	56,092	1.60	none	none (2-minute)
HCl	850,544	103,596	414,384	11.83	2.4 (10-minute)	6 b/ (10-minute)
Particulate Matter (Al_2O_3)	1,351,014	164,554	658,216	18.80	0.03 (24-hour)	0.15 (24-hour)

a/ NO plus NO_2.

b/ NRC recommendation - see Section 5.2.15.

1781K

TABLE 3-19

AIR POLLUTANTS FROM OPEN BURNING OF WASTE PROPELLANT

Assumed Test Specifications

Amount of propellant: 25,000 lb (11,338 kg) per open burn
Burn time: 2 minutes
Wind speed: 10.7 m/sec
Air stability class: C (neutral)
Number of tests per year: 40 (total propellant burned = 1,000,000 lb)
Maximum concentration occurs 4.0 km downwind.

Emissions and Concentrations Predicted by PCAD Model

Product	Emission Rate (g/sec)	Total Emissions Per Open Burn (kg)	Total Annual Emissions (kg)	2-Minute Concentration (mg/m^3)	Time Average Concentration (mg/m^3)	Applicable Standard (mg/m^3)
CO	80	5	200	0.02	0.00 (1-hour)	40 (1-hour)
NO_x a/	15	0.9	36	0.76	0.00 (annual)	0.1 (annual)
Cl_2 7,095	426	17,040	1.64	none	none	(2-minute)
HCl	33,462	2,008	80,320	7.73	1.6 (10-minute)	6b/ (10-minute)
Particulate Matter (Al_2O_3)	57,137	3,428	137,120	13.21	0.02 (24-hour)	0.15 (24-hour)

a/ NO plus NO_2.

b/ NRC recommendation - see Section 5.2.15.

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HCl Scavenging:

The principal combustion product of concern for static test firing, launches, and waste propellant disposal is hydrogen chloride (HCl). HCL will occur as a gas in the hot exhaust plume of the motor firings and open-burning. As the plume cools down, water vapor in the exhaust plume and the ambient air combines with the HCl to form droplets of hydrochloric acid mist. Modeling of HCl scavenging from the environment by acidic precipitation indicates that effects would be highly localized, temporary, and not significant (NASA 1978, Sverdrup 1987).

Impacts on Planned Future Projects and Secondary Growth:

Site specific factors to mitigate air pollutant emissions and impacts will be analyzed fully during the permitting phase of the project. If emissions of a regulated air pollutant from static testing are greater than 250 tons per year, the facility may be a major stationary source subject to the provisions of Prevention of Significant Deterioration (PSD) under the federal Clean Air Act and the rules of the MDNR. PSD requires that each pollutant be analyzed on a case-by-case basis to ensure that Best Available Control Technology (BACT) is being implemented, and ambient impacts must comply with PSD increments. The results of modeling indicate that the static firing can comply with PSD increments, however, more detailed and site specific modeling will be required in the permitting phase of the project to confirm this.

3.2.3 Water Resources

Groundwater

Construction:

NASA has agreed that critical recharge areas to the unconfined aquifer will be avoided, and all areas temporarily disturbed by construction activities will be revegetated. Surface recharge should therefore not be changed significantly. In addition, the area contains more than a sufficient supply of groundwater for both current needs and additional requirements for production and testing the ASRMs. Therefore, construction impacts on the groundwater system should be insignificant. The unconfined aquifer may also be affected by dewatering operations during construction. However, it is expected the water table will recover quickly after dewatering operations have stopped. The impacts will be insignificant because of the short duration and small extent of any impact.

Manufacturing:

The six existing wells at SSC are capable of producing up to 18 million gal/day of water and are permitted to pump over 3 million gal/day. The anticipated requirements for manufacturing and testing the ASRMs are less than 550,000 gal/day above current needs at the site. These water requirements are primarily associated with potable needs, hydroblasting, steam generation, cooling water, feedline bleed water and washdown waters. The actual production process is considered "dry," with minimal water requirements associated with facilities cleaning (NASA 1988g). The yield of the aquifers supplying the six existing wells is sufficient to provide present and potential ASRM uses.

NASA may decide to withdraw small amounts of water from the unconfined aquifer in areas that are not within easy access of the centralized water supply system. However, these small yield, isolated needs are not anticipated to lower the water table appreciably or significantly affect other users of the shallow aquifer.

When an aquifer is contaminated, the effect on quality is considered irreversible or irretrievable because of the very long time it would take to naturally flush the aquifer. Even when a contaminated aquifer is remediated, residues may remain. NASA has therefore agreed to implement a number of measures designed to avoid groundwater contamination, including discharging wastewater to lined trenches or ponds only, or to unlined ponds and trenches if water is of good quality; avoiding liquid disposal in landfills, covering landfills to prevent infiltration, and placing new landfills above the water table; and burning waste propellant only in lined pits with a leachate collection system. Due to these measures, impacts to groundwater quality are expected to be insignificant.

Static Testing:

If static testing resulted in significant plume deposition, the pH of surface water could be lowered by HCl, and the aluminum oxide concentration could be raised. Consequently, the surface water might then contaminate groundwater. Groundwater at SSC contains bicarbonate, which is a good buffering agent. However, the unconfined aquifer may have a reduced amount of bicarbonate depending on its recharge from surface water. Water from a dewatering well at the site had a pH of 6.9, which is much lower than deeper aquifers at around 8 or 9, and indicates that much of the recharge to the unconfined aquifer is from surface water which is low in bicarbonate. Test-firing rocket motors without protecting the soil or surface water bodies from contamination could subject the unconfined aquifer to potential contamination from downward percolating water. NASA has agreed to design firing pads to prevent infiltration of surface water and they will be properly drained for runoff control. Groundwater impacts are therefore considered insignificant.

Accidents:

Liquid contaminants or contaminated water might be accidentally spilled on the ground or in surface water bodies, and in turn, might eventually percolate to the water table. Storms and catastrophic explosions might disrupt waste water processes, allow contaminated water to reach surface water bodies or the unprotected ground, and contaminate groundwater through the normal infiltration process.

NASA has agreed to several mitigative measures to minimize the impact of accidental releases of hazardous liquids or contaminated water. The mitigative measures include control plans and training as detailed in Sections 3.1.11 and 3.1.15. The impacts of spills to groundwater is considered insignificant because of the protection offered by the overlying soils and the mitigative measures. The time necessary to percolate through the soils provides ample time for emergency response and cleanup before contaminants reach the water table.

Surface Water

Construction:

The primary surface water concern associated with both ASRM manufacturing facility and test stand construction is the erosion of surface soils during clearing, grading, and construction. The potential exists for increases in suspended solids, turbiditv and color of receiving waters. However, erosion of soil is expected to be minimal at SSC given the low topographic relief of the site (CH2M Hill 1987). Best management practices, including storm drainage control and temporary sedimentation basins will also be used. Therefore, soil erosion and associated impacts are not expected to be significant.

If the barge transport canal is extended to serve ASRM facilities, temporary, localized increases in turbidity and suspended solids are anticipated during excavation and dredging. These impacts are not expected to differ greatly from the impacts associated with the previous construction and dredging at SSC, and are therefore considered insignificant to moderately significant. Any construction or dredging in the canal will require U.S. Army Corps of Engineers Section 404 permits.

The influx of construction personnel will increase potable water demand and associated sanitary sewer requirements to a maximum of over 120,000 gal/day for the peak construction workforce of 2,000. The existing water supply and treatment facilities appear to be adequate to handle these increased demands (NASA 1979a). Therefore, no significant impacts to water supply and sanitary treatment are anticipated during construction.

The possibility exists that watershed runoff zones, flows, or channel beds in Wolf Branch and Lion Branch Creeks may be permanently redirected or altered, depending upon detailed facility layout and design. Since both of these streams are considered seasonal or intermittent, this direct impact is considered only moderately significant.

Manufacturing:

The surface water concerns associated with ASRM manufacturing cover two distinct aspects: water demands (supply requirements) and effluent discharges (with potential consequences to quality of receiving water bodies). No significant surface water impacts are associated with water supply requirements because adequate groundwater supplies are available.

NASA, as stated in Section 2.1.7, is committed to comply with regulatory criteria and guidelines covering effluent discharges and receiving water bodies (Appendix C). This will require the construction or expansion of waste water treatment facilities, and possible initiation of compliance monitoring. Sanitary wastewaters, accounting for up to 60,000 gal/day of the effluent, will require secondary level treatment. Expansion of the existing sanitary facilities is anticipated. The balance of the wastewater streams will require varying levels of industrial treatment prior to discharge. The majority of this remaining water will be relatively clean and may require only settling/filtering (suspended solids removal), oil skimming, and possibly pH adjustment prior to discharge. Some of the water, primarily from hydroblasting, will require more elaborate solvent recovery treatment processes. A small stream of about 15,000 gal/day of process and washdown wastewaters may require intensive treatment prior to discharge due to high dissolved solids content (Section 2.1.3). Flow regulation may also be necessary if effluents are discharged into the Jourdan watershed, due to the occasional low flows experienced in this drainage system (NASA 1988g). Treatment system configurations, specifications, discharge locations, and flows will not be determined until the detailed design phase. Systems will be designed so that effluents at the mixing zone boundary will equal or surpass the existing receiving surface water quality as described in Section 3.1.3. Therefore, no significant surface water quality impacts are anticipated from effluent discharges.

Static Testing:

Products of combustion, aluminum oxide and hydrochloric acid, released during static tests present a possible surface water quality concern. The majority of the combustion products, however, will be dispersed over a large area (Section 3.2.2). To mitigate any local effects, NASA has agreed to runoff control (stormwater collection systems) with pH adjustment to contain unanticipated HCl washout. They will also monitor potentially affected water bodies, and consider addition of lime to deposition areas for pH control. The monitoring program will measure total and soluble aluminum and pH. Given that the deposited aluminum is primarily in the oxide form, its behavior will parallel a natural mineral system of gibbsite-(boehmite-diaspore) kaolinite (Garrels and Christ 1965) and may not necessarily result in significant elevated dissolved free aluminum in the surface waterbody. This can be effectively determined only by monitoring. Any pH effect and associated impacts are considered to be insignificant to surface water quality.

Open Burning:

The possibility exists for surface water contamination because of leaching/storm water washout of open pit burning ash. However, NASA has committed to build lined burn pits, a leachate collection/treatment system, and a storm water collection/treatment system (Section 2.1.7). Discharges will comply with the regulatory criteria as described in Section 3.1.3. Therefore, no significant surface water quality impacts are expected from open pit burning.

Accidents:

NASA has agreed to several mitigative measures to minimize impacts to surface water quality associated with spills or discharges. These measures are explained in Section 3.1.11 and 3.1.15. Spills or other accidental uncontrolled releases would be expected to have only a moderately significant impact on surface water quality.

3.2.4 Land Resources

Construction / Manufacturing:

Construction of the facility could lead to exposure of the soil under particular buildings (mainly the static test stand and adjacent buildings) to dynamic effects, failure under excessive bearing pressures, erosion, and corrosion (to subsurface utilities due to corrosive soils all over the site). Mitigation by appropriate engineering design of structures at SSC (i.e., proper foundations) will avoid the occurrence of any significant soil dynamics effects or soil bearing strength effects. The use of erosion control procedures of various sorts (along with the relatively cohesive soils at the site) will eliminate any significant erosion during construction. Operation of the facility could, in rare instances, lead to hazardous substance releases and consequent soil contamination. The use of an emergency response plan and spill prevention, control, and countermeasure plan will minimize impacts to soils. Although the use of cathodic protection and protective coatings for buried utility lines will reduce corrosion problems, the overall impact remains moderately significant. Preliminary assessments of the conceptual design for the static testing exhaust deflection ramp have not been completed at time of report preparation. There are indications, however, of moderately significant impacts in additional soil erosion, during both construction and operational phases and of soil bearing problems with the ramp structure. These assessments will be completed in conjunction with the refinement of the design.

Static Testing:

The installation of an exhaust deflection ramp for the rocket motor static tests will reduce the impact of blast erosion by minimizing heat and high velocity gas exposures to the soil. Possible erosion will be reduced by maintaining a vegetative cover and monitoring the adequacy of that vegetation. Also, the use of the ramp, in combination with the high water table at the site, will eliminate the possibility of ignition of subterranean fires.

The deposition of exhaust residue in the immediate area of testing, is probable even with the exhaust deflection ramp. The affected area in the path of the exhaust plume is estimated to be 50 to 100 acres. The effect of deposition will be monitored by sampling the soil, but the impact is expected to be moderately significant due to the large extent of the affected area, the long duration, and the probability that this impact will occur.

Accidents:

The accident scenario of greatest concern is that hazardous materials may be released during a catastrophic manufacturing failure of such magnitude that the waste management system breaks down. An explosion could scatter hazardous materials over a large area. The impacts to soils at SSC are, however, relatively minor because cleanup of the soils would be relatively simple, due to their generally low permeability. Impacts of such an accident on public health or to the groundwater environment are discussed in Sections 3.2.3 and 3.2.15.

3.2.5 Wetlands and Floodplains

Wetlands

Since there is no evidence of wetlands occurring within the ASRM site, there are no impacts anticipated from construction or operation. Impacts to wetland biota near or adjacent to the ASRM site resulting from air emission fallout would be insignificant as discussed in Section 3.2.6. Impacts to nearby wetlands from surface water discharge from production processes would also be insignificant as discussed in Section 3.2.3.

Floodplains

Preliminary ASRM facility layouts show a few production and storage buildings located within or near the mapped 100-year floodplain of Lion Branch, but not Wolf Branch (NASA 1988b, CH2M Hill 1987). There are sufficiently large areas outside the floodplain within which to place ASRM buildings. In the unlikely event that the floodplain could not be completely avoided, FEMA and SSC floodplain planners would need to resolve the discrepancy between the FEMA floodplain map (U.S. FEMA 1983) and the SSC master plan (NASA 1979a) concerning the exact floodplain boundaries.

If the Lion Branch floodplain is confirmed and cannot be completely avoided, then building and construction access will be designed to National Flood Insurance Program Standards (33 CFR 1216.2) to protect them from flooding. Construction in the 100-year floodplain will not impair the floodway. Impacts on the floodplain are therefore ranked insignificant.

3.2.6 Biotic Resources

Vegetation

Construction:

The ASRM production and static test facilities at SSC are each expected to require about 1,000 acres of land each. Construction of both facilities at SSC would therefore require about 2,000 acres. Regardless of the facilities constructed, the required area will include buildings, roads, parking lots, and the stipulated QD arcs. Areas not needed for access or facilities will be left intact and all land temporarily disturbed by construction activities will be revegetated. Therefore, the actual area to be permanently disturbed or developed by ASRM activities at SSC is expected to be considerably less than the required acreage. Based on preliminary facility layouts, it is estimated that the static test and production facilities will each require clearing of about 250 acres of land (NASA 1988b). Consequently, construction of both production and test facilities will require clearing of 500 acres, or about 25 percent of the site.

The ASRM site at SSC contains several pitcher plant bogs as well as areas of bottomland hardwood. Pitcher plant bogs are unique to the southeastern United States and approximately 97 percent of the original bogs have been destroyed or severely altered (Folkerts 1982). Bottomland hardwood communities are also an important and diminishing resource in the southeastern United States. Both pitcher plant bogs and bottomland hardwood stands provide habitat for a number of the plants proposed by the MDWC as rare, endangered or of concern in Mississippi. Based on the preliminary ASRM facility layouts at SSC, it appears that several pitcher plant bogs may be eliminated by buildings associated with production. Little if any bottomland hardwood stands should be impacted by construction of ASRM production facilities. The access road and static test stand can probably be designed to avoid the pitcher plant bogs in the southeastern corner of the ASRM site. However, maintenance of these bogs will likely require active management. Construction of the static test facilities will probably impact the bottomland hardwood stands in the southeast corner of the ASRM site.

Construction of any of the ASRM-related facilities on the SSC sites will require removal of about 25 percent of the vegetation in the affected area and will probably also permanently disturb or eliminate one or two unusual or diminishing plant communities. Consequently, the impact on vegetation from construction of the entire ASRM facility or either the test or production facility is considered moderately significant.

Manufacturing:

No impacts on the vegetation at the ASRM site at SSC are expected from normal operations of the production facility or transportation activities. NASA is expected to implement safe material handling procedures for propellant and materials (CH2M Hill 1987).

Static Testing:

Exhaust from the test firing will release large quantities of hydrogen chloride (HCl) and aluminum oxide (Al_2O_3) into the atmosphere. The type and extent of observable injury to plants from HCl gas are dependent upon species, concentration, and exposure time. Exposure of a variety of forb and tree species to less than 10 ppm (16 mg/m^3) HCl gas for 20 minutes to 4 hours resulted in traces of discoloration, necrosis or tip burning, indicating the threshold of visible injury (NASA/MSFC 1977, Lerman et al. n.d.). In a study conducted by NASA on the effects of the exhaust from solid rocket motors on plants, threshold injury concentrations of HCl for the most sensitive agricultural species tested (radish and soybean) were 9 and 16 ppm (14 and 26 mg/m^3), respectively, for a 10-minute exposure. Threshold injury concentrations of HCl for the most sensitive native species (pennywort and arrowhead) were 5 and 12 ppm (8 and 20 mg/m^3), respectively, for a 10-minute exposure (NASA 1980c). High humidity or water on the leaf surface increases plant sensitivity to HCl. Plants also tend to be more sensitive to HCl exposure during the fall and spring (NASA 1980c).

Any vegetation immediately adjacent to the gravel pad may be damaged by the HCl produced by static testing, particularly if the humidity is high (NASA 1980c). However, under normal atmospheric conditions maximum HCl concentrations will occur 7 miles (12 km) from the test stands. Peak concentrations of HCl gas are estimated to be 7.2 ppm (11.8 mg/m^3) for several minutes following each of the two to four annual static tests. These concentrations and the duration of exposure are below doses of HCl that cause observable injury to plant foliage. In the unlikely event that atmospheric conditions prevent dissipation of the exhaust cloud and result in HCl deposition, some minor damage may occur to the vegetation in the buffer northeast of the ASRM site. This damage would likely involve traces of discoloration or necrosis and may be reversible (Lerman et al. n.d.).

Under normal atmospheric conditions, static testing will produce Al_2O_3 at a peak concentration of 6 to 19 mg/m^3 for several minutes. These maximum concentrations are expected to occur 7 miles (12 km) from the test stand. However, no studies to date have demonstrated any visible direct effects on plants from high doses of Al_2O_3 (Lerman et al. n.d.; NASA/MSFC 1977). In a study on the effects of solid rocket motor exhaust on plants, exposures of up to 50 mg/m^3 of Al_2O_3 for 60 minutes did not injure or affect the growth of the plants tested (NASA 1980c). This same study did indicate that the Al_2O_3 in solid rocket motor exhaust may act as a carrier of HCl and thus cause indirect injury to plants (NASA 1980c). In a study on the phytotoxicity of missile exhaust products, the addition of Al_2O_3 did not lower the threshold level of

HCl needed to initiate visible damage. However, the magnitude of injury to plants exposed to a mixture of Al_2O_3 and HCl was greater than the injury caused by the same concentration of HCl alone (Lerman et al. n.d.). Al_2O_3 and HCl could also damage plants by increasing the aluminum (Al) concentration in soil since free Al^{+++} is toxic to plants (NASA 1980c). However, Al_2O_3 is relatively insoluble in acids and also on complexes in clay soils. Consequently, static testing is not likely to elevate soil concentrations of Al^{+++} and cause plant damage at SSC. Furthermore, NASA is planning to implement a soil monitoring program downwind from the test site (see Section 3.2.4) and if necessary, lime may be added to soils to prevent increased acidity. No adverse affects to plants are expected from the additional of lime. In summary, the impacts of static testing on vegetation in and adjacent to the ASRM site at SSC are expected to be insignificant.

Open Burning:

Open burning of waste propellant will occur about 40 times a year. Each burn will generate HCl at maximum levels of 4.7 ppm (7.7 mg/m^3) at 1.6 miles (4.0 km) from the source in the direction of prevailing winds. Some HCl deposition may occur near the burn site, but the level and duration of exposure is less than that causing visible injury in sensitive plants. Soil acidification and Al+++ effects on plants may occur, but most of the area in the burn pit vicinity will be cleared and maintained with little vegetation. Consequently, no significant impacts on vegetation are expected from open burning of propellant (NASA 1978).

Wildlife

Construction:

ASRM development at SSC will require 1,000 to 2,000 acres of land, depending on whether production and test facilities are constructed alone or together. However, about 75 percent of this area will not be disturbed and will thus continue to provide wildlife habitat. Construction of either ASRM production or test facilities will eliminate or displace wildlife from about 250 acres of upland habitat. Construction of both production and test facilities will eliminate about 500 acres of wildlife habitat. The 250 to 500 acres required for ASRM development at SSC is relatively small compared to the available habitat in the adjacent SSC buffer. However, construction and development may also disturb wildlife inhabiting the unimpacted areas of the ASRM site and may disrupt the movements of large game animals such as deer. Since the impacts of ASRM construction on wildlife habitat at SSC are long term and unavoidable, they are considered moderately significant.

Increased traffic on local roads during ASRM construction may occasionally disturb wildlife in adjacent areas but the impact should be insignificant.

Operation:

Increased traffic on local roads due to the operation of the ASRM production facility at SSC may temporarily disturb wildlife in adjacent areas but the impact is expected to be insignificant.

Static Testing:

Any wildlife in the 92-acre area in the vicinity of the test stand and the deflection ramp will be killed by the gases and heat generated during static test firing (NASA/MSFC 1977). However, since this area will be covered by a gravel pad and subject to disturbance associated with pretest activities, few, if any, animals or birds are likely to be present during tests.

Exhaust from the static test contains large quantities of HCl and Al_2O_3. The type and severity of observable injury to animals from HCl is dependent upon species, concentration, and exposure time. Rabbits exposed to 30 ppm (49 mg/m^3) HCl for 10 minutes experienced cessation of ciliary activity without recovery (NASA/MSFC 1977). Guinea pigs exposed to 320 ppm (520 mg/m^3) HCl showed signs of sensory irritation in less than 1 minute (USEPA 1986b). In a study on the toxicity of rocket motor exhaust, LC_{50} values for rats and mice exposed to HCl for 60 minutes were 3,124 and 1,108 ppm (5,090 and 1,805 mg/m^3), respectively (Wohlslagel et al. n.d.). Exposure of guinea pigs to 0.1 ppm (0.2 mg/m^3) HCl for 2 hours per day over a period of 28 days produced no effects; exposure of 10 ppm (16 mg/m^3), 2 hours/day for 28 days caused no changes in lung function (USEPA 1986b).

Maximum concentrations of HCl will occur 7 miles (12 km) from the static test stand. Under normal atmospheric conditions, peak concentrations of HCl are expected to be 7.2 ppm (11.8 mg/m^3) following each of the two to four annual static tests. This concentration and the duration of exposure is far below doses of HCl that cause observable injury to animals. In the unlikely event that atmospheric conditions prevent the dissipation of the exhaust cloud, it is possible that some animals, particularly migrating birds in the SSC buffer northeast of the ASRM site, may experience temporary irritation from HCl gas. If static tests were not conducted during the fall and spring periods of peak migration, the potential for temporary injury to flying birds would be reduced. This scheduling cannot be assured, however.

Very little is known about the potential effects of Al_2O_3 on terrestrial wildlife. However, in a study on the toxicity of solid rocket motor exhaust, rats and mice were exposed to an average of 478 mg/m^3 of aluminum dust for 60 minutes. Symptoms included irritation to the eyes and nasal passages and excessive grooming. The lungs of animals sacrificed immediately after exposure contained significant amounts of aluminum. However, no toxic effects were observed immediately after exposure or within the 14 following days (USEPA 1986b). Maximum concentrations of Al_2O_3 produced by static testing are estimated to be 6 mg/m^3 at a distance of 7 miles (12 km) from the test stand. This concentration and the duration of exposure are much lower than the levels demonstrated to injure laboratory animals (NASA/MSFC 1977; USEPA 1986b). Similarly, levels and/or duration of exposure to NO_x and Cl resulting from static testing are expected to be below those that cause observable injury to animals (NASA/MSFC 1977).

In summary, the effects of the exhaust plume from static testing on wildlife in or near the ASRM site at SSC are expected to be insignificant.

In addition to exhaust gases, static testing will generate noise. The effects of noise on animals is variable, not only between different species but also between individuals (Evans and Cooper 1978). In general, field studies on a variety of animals have demonstrated few, if any, measurable lasting physiological or reproductive effects from impulse or steady state nose, particularly at levels below 120 dB (Evans and Cooper 1978). However, many animals, including cattle and raptors (birds of prey), often exhibit a "startle reflex" in response to sudden impulse noise. Sonic booms often cause grazing cattle to run or walk. Impulse noise greater than 85 dB have been shown to cause the startle reflex in birds (Evans and Cooper 1978). Sonic booms have ben shown to cause flight in passerine (song) birds feeding or resting on the ground. Ducks either lifted for a short flight or interrupted their behavior. Other birds showed increased alertness and many temporarily abandoned their nests, thus leaving the eggs open to predation (Evans and Cooper 1978). Nesting raptors have been observed to interrupt their behavior and leave the nest. However, studies conducted on the response of raptors to sonic booms and noise from low level flights by military jets found no evidence of nest site abandonment or reproductive failure (Institute for Raptor Studies 1981).

Each static test will last about 2 minutes. Noise levels of 140 to 150 dB are expected within and immediately adjacent to the 92-acre cleared area that surrounds the deflection ramp. The duration and level of noise in this area may cause permanent or temporary hearing loss in those animals present (NASA/MSFC 1977; CH2M Hill 1987). However, it is likely that increased human disturbance and noise near the test stand prior to firing would cause most large mammals and birds, if any, to leave the area (NASA/MSFC 1977).

Noise levels of 110 db are estimated for about one-third of SSC and about 24 sq mi of the buffer. Noise levels within the remainder of the buffer and fee areas are estimated to be between 90 and 100 dB. These noise levels may temporarily disturb wildlife in the SSC buffer or fee area but are not expected to cause reproductive failure, changes in productivity, or use of the area. Consequently, the impact of noise from ASRM testing on wildlife outside the immediate vicinity of the test stand are expected to be insignificant.

Aquatic Resources

Construction / Operations:

There are large areas outside both Lion Branch and Wolf Branch within which to place ASRM buildings. If these creeks cannot be completely avoided, the impact to aquatic resources is considered only moderately significant because these are intermittent drainageways which have limited fish resources (see Section 3.1.6).

Erosion, siltation, and loss of sediment to aquatic systems can potentially cause significant impacts to aquatic resources. This can occur by a number of mechanisms such as elimination of aquatic habitat through smothering by silt or other sediment, reduction of light penetration into water which, in turn, can decrease photosynthetic activity of algae and disruption of feeding by fish. These impacts are expected to be insignificant at SSC for three reasons:

1) Erosion or sedimentation control measures will be implemented for the construction and operation of the ASRM facilities. These measures are expected to contain any potential silt or sediment losses, with any resultant discharges being within state and federal water quality standards;

2) The local relief is generally low and flat, thus reducing the potential runoff from erosion or mass failure as might occur in steeper areas; and

3) There are only limited areas of water (i.e., Lion Branch and Wolf Branch) on the ASRM site that will be affected by project construction.

Static Testing:

The exhaust plume from test firing contains hydrogen chloride (HCl) as one of its components (see Section 3.2.2). At SSC, the impact of static testing on aquatic resources is considered insignificant for several reasons, including:

1) Adequate dispersion of the plume will occur prior to contact with significant nearby water systems (see Section 3.2.2).

2) A water quality and biomonitoring program will be in place to take corrective measures should any significant impact be detected. Corrective measures can include adding calcium carbonate (either as crushed limestone or oyster shells) to water systems where pH depression results in significant impacts. The amount needed would be determined as part of the monitoring plan.

3) NASA plans to conduct test firings only during periods of adequate plume dispersion and no precipitation.

Aluminum oxide deposition from the exhaust cloud may occur in local waters. The characteristics of this material are similar to naturally occurring substances (see Section 3.2.3). According to EPA, no aluminum oxide bioaccumulation data are available because, in past studies, none of the reported tissue concentrations had measured water concentrations for comparison (USEPA 1986a). Accumulation of aluminum oxide in the aquatic environment is not expected to cause any adverse impact (CH2M Hill 1987). To verify this, NASA plans to implement a water quality and biomonitoring program during project operation, which will include evaluation of possible effects of aluminum oxide deposition on local water systems as a result of test firing.

Open Burning:

Impacts on aquatic resources due to waste propellant burning are expected to be similar to test firing and therefore, insignificant.

Accidents:

Accidental spills of oil or hazardous waste are not anticipated during normal construction or operation of the facility because NASA plans to implement oil and hazardous waste handling procedures and contingency measures for spill prevention and cleanup. Therefore, for routine construction and operation, this potential impact is expected to be insignificant. If accidental spills occur near water bodies such as the barge access canal, direct mortality to fish and other aquatic organisms could result. The duration and extent of the impact would depend on the location of the spill, type of material released, and the quantity.

In the event of an accidental explosion near a water body, mortalities or injury to fish and alteration of aquatic habitat could occur. This could result in a moderately significant impact to aquatic organisms. NASA plans to implement safe handling procedures to prevent such accidents.

Threatened and Endangered Fish and Wildlife Species

No federally threatened or endangered fish or wildlife species have been documented on the ASRM site at SSC. However, two threatened and one endangered species have been documented by the USFWS in the SSC fee area. Under Section 5.0 of the Endangered Species Act (1973), Biological Assessments are required if impacts to these species are possible from ASRM activities at SSC.

The ringed sawback turtle, a threatened species, occurs in the SSC fee and buffer areas and may occur on the ASRM site in a small creek that drains into the Pearl River (Esher and Bradshaw 1988). If this species occurs on the ASRM site, it may be at least temporarily impacted by testing, construction or operations. These impacts are expected to be moderately significant. A Biological Assessment will be prepared and, if necessary, surveys will be undertaken to determine the presence of the ringed sawback turtle on the ASRM site.

The bald eagle, an endangered species, is believed to nest within the SSC buffer near Logtown (Goldman 1988, Tucker 1988). Impacts from construction or operation on this species are unlikely. However, noise from static testing is estimated to be 100 dB at the nest site and during the nesting season could cause a startle response and result in temporary nest abandonment. No impacts on the productivity or reproductive success of raptors have been demonstrated from temporary nest desertion due to impulse noise (Institute for Raptor Studies 1981), but the effects of noise levels of 100 dB for 2 minutes are unknown. Noise impacts from ASRM static testing on the bald eagle are considered to be moderately significant, and a Biological Assessment will be prepared.

The gopher tortoise, a threatened species, occurs in the SSC buffer just north of the fee area. It is unlikely that ASRM activities will have an impact on this species and a Biological Assessment will probably not be necessary.

In addition to creating impacts at SSC, location of manufacturing facilities at SSC would also affect the Florida manatee at KSC if ASRM segments are transported by barge to KSC. Potential impacts to the Florida manatee, a federally endangered species, are considered moderately significant. Potential impacts are discussed further in Section 5.2.6.

3.2.7 Land Use

Existing Land Use

Construction / Operations:

Land use impacts resulting from siting the ASRM project at SSC are expected to be insignificant. This is primarily due to NASA's existing jurisdictional land use control over the fee area and large buffer zone. Direct land use impacts are associated with the 2,100 acres needed for ASRM manufacturing and testing as well as adjacent lands affected by testing operations. Indirect land use impacts are not expected to be significant in the region, but would include commercial or residential development stimulated by the presence of the project in the local area.

The Department of the Army and NASA are finalizing transfer of MSAAP controlled land to NASA for ASRM project development. This land is currently managed for timber production and would be cleared for facilities construction and for elimination of fire hazards in the vicinity of the test stand and waste propellant disposal areas. The loss of lands in timber production is considered insignificant because these lands have been primarily designated to support NASA's missions, rather than for timber production. The 180-acre Hazard Test Range within the MSAAP land would be preempted by the project, but could be relocated on other areas of SSC if needed. Small areas of prime soils would be disturbed, and precluded from future agricultural use. Since these areas of prime soils are common throughout the county and have already been committed to nonagricultural uses through the SSC master plan and NASA fee ownership, the impacts of taking these areas out of potential production is considered insignificant. Visual impacts from the presence of a large building, testing structures, and disturbed areas is expected to be insignificant given the isolation of the proposed site from the public.

Static Testing:

Commercial forest land in the buffer zone (timber used for pulpwood by paper companies) adjacent to the proposed test area are unlikely to be affected by exhaust plumes from ASRM tests. NASA would pay for any damages attributable to testing or ASRM operations according to existing land use agreements (Estes 1988, personal communication). Grazing lands are the only other agricultural use in the buffer area zones where the plume from motor tests might affect use. Dispersion models predict that concentrations of pollutants will not adversely impact vegetation in the areas of maximum concentration.

While the testing of ASRMs would produce a high decibel, low frequency noise, no land uses in the buffer zone are incompatible with this noise level. The periods of audible intrusion could affect recreationists such as hunters or visitors to McLeod Park. During the fall hunting season, hunters could be within a few miles of the proposed test stand location. Several residences along the east and north perimeter of the buffer zone, off Highway 43 and in Shiloh Ranch Estates and Bayside Park, would be adversely affected by noise up to four times per year, for the duration of each 2-minute test. Because people in adjacent recreational and residential areas, if present, will be exposed to noise levels of 75 db(A) or greater, this impact is rated moderately significant.

There is a potential for structural damage due to sound pressure levels outside the buffer zone (Sverdrup 1987). NASA would be responsible for damages in these cases. Motorists on a 3 mile stretch of Interstate 10 would be exposed to sound levels of about 85 db(A) during testing. This sound level is not predicted to be harmful to humans, although it may startle motorists. NASA will work with the Highway Department to install flashing lights and/or warning signs to alert motorists of a testing operation at the discretion of the Highway Department.

ASRM Compatibility with Land Use Plans, Policies, and Controls

Construction / Operations:

The master plan for SSC allows for expansion of the existing hazardous test facilities. The forested land in the north part of the ASRM site controlled by the Department of the Army under permit from NASA is in the process of being transferred back to NASA for ASRM use. The NASA control of buffer zone land uses through a perpetual easement is highly compatible with the anticipated operation of the ASRM facility. Through Hancock County's Floodplain Regulations, any structures placed in the floodplain of Lion Branch (if it is confirmed; see Section 3.2.5) will be required to be raised to an appropriate elevation to avoid floodwaters.

Static Testing:

The ASRM tests will produce audible intrusions along portions of the Jourdan River, an Inventory River under the federal Wild and Scenic River Program. While Inventory Rivers are not given protection under the Wild and Scenic River Act, the CEQ guidelines do advise federal agencies to consider impacts to these rivers resulting from federal actions. An increase in audible intrusions upon the Jourdan River area is considered a moderately significant impact. While the increased level and frequency of audible intrusions would be out of character with the Jourdan River's environmental setting, the short duration and infrequency of the testing periods would limit the negative effect since it would create only minor disturbance on an annual basis. If it is determined that the exhaust plume from testing could affect those parts of the Jourdan River, Bayou Croix, or the Pearl River that are influenced by tides, then a permit may be required by the Mississippi Bureau of Marine Resources, which administers the Mississippi Coastal Program.

Transportation:

An increase in barge traffic on the Pearl River, an Inventory River, will occur if manufacturing and/or testing take place at SSC. The increase in navigation traffic on the Pearl River is not out of character with the river because the river is currently used for navigation purposes, but the impact is considered moderately significant because of the rivers' status. The increase in traffic is expected to be minor. Land uses, both on-site and off-site, would be exposed to the transient risk of transporting hazardous materials to and from the ASRM site. Property and environmental impacts from transportation accidents are discussed in Section 3.2.9.

3.2.8 Socioeconomics and Infrastructure

The U.S. Army Corps of Engineers Economic Impact Forecast System (U.S. Army 1988b) was used to assess the magnitude of potential socioeconomic impacts of the project. The estimates of magnitude, in combination with estimates of extent, duration and probability, were used to determine the overall significance of impacts. In general, impacts of major magnitude (greater than 3 percent change) correspond to an overall rating of significant (U.S. Army 1988b). Changes of 1 to 3 percent are considered moderately significant and changes less than 1 percent are considered insignificant. These percentages may appear conservative, and at worst may overstate the potential significance of project impacts. As noted in some cases, these determinations of significance are qualified by site-specific circumstances.

Demographic Characteristics

Population:

During the construction phase of the project, up to 2000 employees will be required to construct both the manufacturing and static test facilities (NASA 1988i). This phase is expected to last 6 years with the greatest hiring requirements occurring in 1991. The operational phase of the project will be a staged process reaching a full complement of 1,650 employees (1,500 for production, 150 for testing) in 1996. In addition, up to 500 employees will be working at dispersed sites throughout the U.S. on the design phase of the project. Due to the numerous uncertainties that exist about these employees, they are not included in further analysis.

If all employees required to construct and operate the ASRM facility at SSC were to move to the area from elsewhere, and each employee has an average household size equal to the national average of 2.64 persons/household (Kehm 1988), a maximum of 5,280 and 4,360 persons could be added to the area during the construction and operational phases, respectively. Assuming these new employees followed a residential distribution pattern similar to that of the existing Stennis Space Center employees, the population change in each county would be as shown in Table 3-20.

It is not likely, however, that all of these employees and their families will be drawn from points outside the study area. Unemployment rates within the study area counties are currently high. Additionally, NASA currently has over 20,000 key job applications on file at the SSC. These skilled applicants include engineers, computer scientists, electronic technicians, electrical and mechanical inspectors, and many types of maintenance mechanics (NASA/SSC 1988a). It is therefore reasonable to assume that there could be a more than adequate supply of applicants for new positions from persons within the study area who are currently unemployed, underemployed, or otherwise seeking a new position. On the lower end of the spectrum, therefore, one could assume that all jobs would be filled locally and there would be no project-related population change.

As an intermediate estimate, if 50 percent of the hiring needs could be met by the existing labor force, population change would be as indicated in Table 3-20. The population impacts based on this assumption would be insignificant (i.e., less than 1 percent increase) in three of the counties and parishes, and only moderately significant (1 to 3 percent increase) in Hancock and Pearl River counties. The potential also exists for indirect population growth to occur in association with the indirect employment discussed later in this section. While this impact is acknowledged, the likelihood and magnitude of its occurrence is speculative. Given the relatively high unemployment rates in the study area, most of the indirect jobs

Table 3-20. Stennis Space Center Population Change Projections.

Location	Maximum Effects[1]				Intermediate Effects[2]			
	Construction Phase		Operation Phase		Construction Phase		Operation Phase	
	Change	% Change	Change	% Change	Change	% Change	Change	% Change
Hancock County	950	2.9	785	2.4	475	1.5	390	1.2
Harrison County	1,215	0.7	1,000	0.6	605	0.4	500	0.3
Pearl River County	1,745	4.4	1,440	3.6	870	2.2	720	1.8
St. Tammany Parish	790	0.5	655	0.4	400	0.3	330	0.2
Washington Parish	210	0.4	175	0.4	105	0.2	90	0.2
Study Area Total	4,910	1.1	4,055	0.9	2,455	0.6	2,030	0.5
Other Counties	370	--	305	--	185	--	150	--
Total	5,280	--	4,360	--	2,640	--	2,180	--

Numbers have been rounded.

[1] Assumes all direct project-related jobs are filled by persons who move to the area.

[2] Assumes 50 percent of direct project-related jobs are filled by newcomers; 50 percent by current residents.

created will probably be filled by current study area residents or by members of the in-migrating families.

It is also possible that location of the ASRM facilities at SSC would produce a phenomenon termed "growth-inducing impacts" in the study area. This term is used to describe the catalytic effect that a new facility might have in drawing other new businesses to an area. For example, suppliers for the ASRM project could decide to relocate nearby to reduce transportation costs and improve their competitive advantage or increase their profit margin. Other manufacturing companies could decide to locate nearby in order to take advantage of a labor force trained to the highest standards of quality control. Under the right circumstances, each addition to growth induces yet more growth. The potential for this impact is acknowledged, but the probability of its occurring and the potential magnitude of such an impact is entirely speculative. Growth-inducing impacts are therefore not evaluated or addressed further.

Employment:

Employment impacts are generally defined as direct or indirect. Direct employment is directly attributable to the project (i.e., those who construct or operate the plant). Indirect employment effects are generated when new jobs in one sector create an additional demand in other sectors. For example, the ASRM contractor may buy some materials locally and the employees will buy groceries, automobiles and so on. Indirect effects have a rippling effect throughout the economy as each increase in demand creates the wherewithall to create yet more demand.

An economic multiplier can be used to determine indirect employment impacts. One commonly used source of employment multipliers is the U.S. Bureau of Economic Analysis (BEA). Using the RIMS II Model, BEA estimates state-specific employment multipliers for each sector based on millions of dollars of total project output. Suitable estimates of output were not available for the project, however; thus, an alternative source of region and/or sector specific multipliers was sought. A survey of published studies and similar environmental analyses yielded a range of estimates for the construction phase of 0.2 to 1.1 indirect workers per direct worker, or multipliers of 1.2 to 2.1, where total change in employment is equal to the direct change times the multiplier. Multipliers for the operations phase ranged from 1.7 to 2.5, indicating 0.7 to 1.5 indirect workers per direct worker. Multipliers are usually smaller in areas with poorly developed trade and service facilities, and larger in areas with more self-sufficient economies (Weber and Howell 1982). The multipliers are generally smaller for individual towns than for counties, and smaller for a single county than for a multicounty area (Weber and Howell 1982).

Multipliers used in this analysis to estimate the number of jobs indirectly attributable to the project were 1.4 during construction phase and 1.8 during operations. Although at the low end of the ranges studied, these values are in line with values used in a recent study of potential Space Station impacts at Michoud Assembly Facility in New Orleans (Ryan and Jeffries 1986). Both direct and indirect effects are shown by county/parish on Table 3-21. The figures shown represent the maximum employment during each phase and are annual figures.

Table 3-21. Stennis Space Center Estimated Employment Impacts.

Location	Direct Project Employment		Indirect Project Employment	
	Construction Phase	Operation Phase	Construction Phase	Operation Phase
Hancock County	180	150	70	120
Harrison County	230	190	90	150
Pearl River County	330	270	130	220
St. Tammany Parish	150	125	60	100
Washington Parish	40	30	20	20
Study Area Total	930	765	370	610
Other (commuters	70	60	30	50
Local Area Total	1000	825	400	660
Inmigrating Workers	1000	825	400	660
Total	2000	1650	800	1320

Numbers have been rounded.

Under the assumption that 50 percent of the new direct employment jobs would be filled by study area residents or commuters, there would be 1,000 and 825 new jobs created for existing local residents during the construction and operation phases, respectively. If these new direct employment positions were filled from the existing unemployment rolls or through movement within the job market, then unemployment level (see Table 3-5) reductions would be significant (i.e., greater than 3 percent change) in Pearl River County (19.6 percent), Hancock County (15 percent), and Harrison County (3.4 percent). The addition of indirect employment opportunities would reduce unemployment still further.

Should the project be cancelled, the overall effect on unemployment could be significant. Not only would the direct employees from the study area lose their jobs along with those additional employees that moved into the study area, but the indirect employment effects would ripple through the local economies as well. The overall net employment effect would be greater than if the project had never been started.

Income:

Since local unemployment levels are relatively high, the construction phase of the project should have little effect on average wages and salaries (CH2M Hill 1987). The operation phase might have a small, positive effect on wage rates. NASA has agreed (see Section 2.1.7) to maintain project salaries at or above the Davis-Bacon Act levels determined by the U.S. Department of Labor. These wage rates are derived from manufacturing and construction sector wages along the Gulf Coast.

Revenues:

If the ASRM project were to bring in enough new residents to make construction of any new infrastructure facilities necessary, local governments could have to spend money on the facilities in advance of increased revenues (CH2M Hill 1987). That outcome is not expected at SSC because facilities should be adequate (see the Public Facilities discussion in this section).

To the extent that public facilities and services are funded through property taxes, federal projects sometimes fail to pay their own way in the long run (CH2M Hill 1987), because the projects are not subject to property taxes. Given the apparently adequate infrastructure in the study area, this is not likely in this case.

Sales and use taxes will probably generate the most revenue to local governments. Without more project-specific wage and output information, these impacts are impossible to estimate. They should, however, add positively to total government revenues.

Housing:

Based on discussions with representatives of the local economic development districts in the five county study area, it was determined that the currently depressed housing market will more than adequately meet any project-induced housing demand (Chamberlain 1988; Sconiers 1988; Dickson 1988). Since housing prices have seen a 25 percent decrease in the last five years, the project could exert some upward pressure on housing prices but would not induce enough demand to increase prices significantly. The study area is sufficiently large and has a sufficient diversity of homes at various prices to accommodate most housing needs (Chamberlain 1988).

Housing around SSC appears to be readily available because of the ongoing contraction in the oil industry (CH2M Hill 1987). No published housing price figures are available for the study area market.

Infrastructure and Services

Law Enforcement:

The ratio of full-time law enforcement officers to 1,000 population for the counties and parishes in the study area vary from a high of 2.2 in St. Tammany Parish to a low of 1.1 in Pearl River County (1987 data). Only St. Tammany Parish has a ratio above the BLM Social Effects Project guideline of 2.1 sworn officers per 1,000 population (see Section 3.1.8). The additional population expected, under the assumption that 50 percent of new jobs would go to new residents, would necessitate the addition of 1 additional officer in Hancock and Harrison Counties and St. Tammany Parish to maintain existing ratios. Two additional officers would be needed to maintain existing ratios in Pearl River County. While some fiscal impact will be evident, only Pearl River County is considered moderately impacted. The remaining counties and parishes would be insignificantly impacted.

Quantitatively, these figures show that the impacts of the project on officer to population ratios would be moderately significant to insignificant based on changes from current levels. However, these results do not take into account that current staffs are already under the planning guideline in each county except St. Tammany Parish. Representatives of many departments indicated that they are currently understaffed. The addition of new project-induced population would make the situation marginally worse.

Fire Protection:

Fire protection levels are measured by the numerous factors discussed in Section 3.1.8. Population is one of those factors, as is the number and variety of structures protected. The increase in population due to the project was judged moderately significant in Hancock and Pearl River counties. Therefore, these counties have the greatest potential for impact on the fire protection systems due to the increasing population served. There would be a less than proportional increase in the number of structures protected, since many newcomers could move into currently vacant homes or apartments. Given the other factors that determine fire protection levels, it is reasonable to assume that the population increase anticipated due to the project would have an insignificant effect on fire protection levels overall.

Schools:

Most of the local school systems are currently expanding or are near capacity conditions (NASA 1980b). For analysis purposes, it is assumed that each household has 0.9 children (Kehm 1988) (the national average of children under 18 per household). Furthermore, assuming 50 percent of the jobs are filled through in-migration, enrollments in Hancock and Pearl River counties would increase more than 3 percent, a very significant impact during the construction phase. During operation only Pearl River County would experience a significant impact. Hancock County school enrollment would increase by about 2.8 percent during the operation phase, a moderately significant impact. All other areas will be insignificantly impacted. To maintain current teacher/student ratios, these enrollment increases would necessitate the addition of teachers, as follows: 14 in Pearl River County, 11 in Harrison, 8 in Hancock, 7 in St. Tammany, and 2 in Washington Parish. These estimates are based on the assumption that all in-migrating children are of school age, and therefore probably overstates the potential impact. Some overcrowding in the Hancock and Pearl River county school systems will be likely, however. The existing overcrowding, as evidenced by high teacher/student ratios (see Section 3.1.8), will be compounded in all areas except Washington Parish which has the only teacher/student ratio above the planning guideline.

Health Services:

The study area, as well as the rest of Mississippi and Louisiana, currently has a lower physician-to-population ratio than the U.S. average. The project induced impacts in Hancock and Pearl River counties during construction will have moderately significant impacts (1-3 percent decrease in these ratios). During operation only Pearl River County will be moderately impacted. The remaining counties will show insignificant decreases (<1 percent). While these impacts do not by themselves appear to be significant, they will add to the existing problems in the area.

No attempt to quantify the existing nursing shortage is made here. If the 20 percent shortage noted in Section 3.1.8 is assumed to be relatively accurate, the project itself will marginally add to this shortage.

The American Hospital Association Guide to the Health Care Field (1987) shows average occupancy rates in study area hospitals vary from 26.7 to 94.5 percent with an average of 61.3 percent, depending on the location and type of facility. The project will, in general, insignificantly impact the hospital facilities in the study area.

Public Utilities:

Study area water systems are capable of handling any project induced increase in use. All of the systems surveyed are based on groundwater wells with system capacities far above current use (SMPDD 1985).

Earlier studies accepted by NASA (CH2M Hill 1987) conclude that the local sewer systems should be able to handle any project-induced increase in demand. The impact on sewer systems should therefore be insignificant unless this increase becomes concentrated in communities such as Poplarville, Covington, and Slidell, where systems exceed 95 percent of capacity.

The same studies conclude that the solid waste generated by the employees and their families associated with the project will be only a small fraction of current generation. Solid waste disposal capacity in the study area is very limited at the present time and new landfill areas will be needed with or without the ASRM project (CH2M Hill 1987). Impacts on the solid waste facilities will therefore be insignificant.

Additional Mitigation Measures

In addition to the mitigation measures adopted by NASA and presented in Section 2.1.7, NASA could lessen the adverse impacts on the employees should the ASRM project be cancelled by providing timely notice of the cancellation and a severance pay package to all employees affected. They could also develop a program to assist displaced workers in their job search activities.

In order to lessen the impact on the study area school systems, NASA could support an impact aid program to provide financial assistance to those districts that may be adversely affected. Construction grants could be made available to construct new schools if funding is available.

If this project becomes a net drain on the local governments, which is not expected, assistance in lieu of taxes could be provided to local governmental bodies to defray some of the expenses.

3.2.9 Transportation

Three types of transportation impacts potentially associated with the ASRM program were investigated. Commuter traffic generated by project construction and operations workers could strain the capacity of the local road network. Transportation of ASRM material inputs and finished products could also have noticeable effects through similar congestion effects on road, rail, or waterway networks. Finally, transportation of inputs or finished products could produce impacts as a result of transportation accidents.

Local Traffic Generation

The assessment of ASRM project traffic effects is based on the transportation planning and engineering concept of level of service. The concept addresses the quality of operational conditions for a given element of the highway/street transportation network, as generally perceived by motorists (Transportation Research Board 1985). Level of service (LOS) is described in terms of travel time, maneuvering freedom, comfort, and safety. These factors are determined by the volume of traffic and road capacity. Six levels of service, designated as A through F, are defined for the various types of road facilities. LOS A always represents the best operating condition, with free flow of traffic and motorists unaffected by the rest of the traffic stream. LOS F represents breakdown conditions where traffic volume at a point exceeds capacity, queues form, and vehicles typically move in stop-and-go waves. LOS D is often used in development-related traffic analyses as a benchmark level indicating the need for service improvement. Traffic flow is stable but heavy at LOS D, and users experience discomfort and inconvenience due to restricted speed and maneuverability.

Level-of-service effects that could be attributed to ASRM-related traffic were assessed by estimating the existing level of service for selected key roads used by SSC workers, projecting the level and geographic distribution of ASRM traffic, and determining whether the expected traffic increase would reduce the operating condition on each selected road to LOS D or below. The assessment approach was based on the planning analysis procedures for various roadway types specified in the Highway Capacity Manual (Transportation Research Board 1985).

Seven specific segments of Interstates 10 and 59, U.S. 90, and Mississippi 607, representing the most likely travel routes to key population centers, were selected for analysis. Based on the average annual daily traffic flows reported in Section 3.1.9, existing levels of service for these road segments were estimated to range from LOS C (I-10 west of the state line) to LOS A. Apparent available capacities on these road segments between existing volumes and the volumes corresponding to LOS D were calculated to range from 650 to 2,000 vehicles during the peak hour.

The ASRM Environmental Analysis (CH2M Hill 1987) assumed the workforce would be 1,000 persons, and predicted that an ASRM workforce of 1,000 at SSC would generate 835 vehicle trips daily. Applying the same ratio to current workforce estimates, the project would generate approximately 1,920 vehicle round trips per day at the construction peak and 1,380 trips during full operation at SSC. A geographic distribution for this traffic was developed on the basis of the demographic analysis presented in Section 3.2.8, which allocated workers to counties on a percentage basis. Given the most likely travel routes to reach the major population centers in these counties, approximately 35 percent of the vehicle trips would enter and exit SSC from the north, and would be associated with workers residing in Pearl River County (the vast majority) and other counties in Mississippi and Louisiana beyond the specified study area. These vehicle trips would all use Mississippi 607 north of SSC, and most would also be using Interstate 59.

The remaining 65 percent of the vehicle trips would be distributed among various routes that ultimately enter and exit SSC via Mississippi 607 to the south. This traffic component would have essentially a three-way split among traffic flows to/from the east, southeast and west. The eastern flow, representing some Hancock County workers and all those residing in Harrison County and farther east, would use Interstate 10 and represent about 30 percent of total project vehicle trips. Southeastern traffic to and from the Bay St. Louis area would use Mississippi 607/U.S. 90 and account for an estimated 16 percent of the vehicle trips. Traffic generated by workers living in St. Tammany Parrish and the outskirts of the New Orleans area would use I-10 to the west of SSC, and account for 19 percent of total project vehicle trips. The absolute number of vehicle trips in each directional flow during the construction phase would range from about 310 in the southeastern direction to 680 in the northern flow.

Additional traffic volumes of these levels in the prescribed distribution pattern would not result in significant adverse traffic impacts, as measured by level of service criteria. The projected project traffic flows, when treated as a peak-hour addition to existing peak flows and service levels, would not cause the level of service on any of the road segments analyzed to decrease to LOS D. The key data for this analysis are summarized in Table 3-22. As indicated in the table, in all cases project construction traffic flows are lower than the available capacity, as measured by the service flow rate differential between the existing LOS and LOS D. Operations traffic volumes are lower than for construction, and would use less of the available capacity. Project construction traffic would reduce the estimated level of service in most cases, but in no case would the resulting service be below LOS C. The greatest level-of-service change would be for Mississippi 607 south of Interstate 10, where the projected change is from LOS A to LOS C.

Project traffic impacts generally cannot be conclusively determined without detailed studies of specific intersections or other potential bottlenecks. It is possible or even likely that some intersections in the area around SSC have lower service levels than those indicated in Table 3-22. However, the capacity margin for each roadway segment analyzed is sufficiently large to suggest that ASRM traffic would also not create problems at key intersections on these routes. Detailed studies of such key intersections is therefore considered unnecessary.

The projected traffic volumes and service levels described above apply to the case of both manufacturing and testing at SSC. Location of manufacturing only at SSC would have virtually the same effects, because the manufacturing component accounts for 95 percent of the construction workers and vehicle trips and 91 percent of the operations workers and trips. Conversely, if only testing were conducted at SSC, the peak associated work force at any time would be 150 persons, who would generate 125 daily vehicle trips. This level of traffic would be minimal compared to existing traffic flows, and would have no effect on level of service for local roads.

Based on the projected level of service changes, ASRM traffic would have a minor effect on local traffic flows, primarily on Mississippi 607 and possibly on Interstate 10. This would be a long-term effect, lasting throughout the project life, and would be very likely to occur. Under pre-selected definitions (see Appendix G), the extent would be considered medium, as it would occur at multiple locations, but would primarily affect roads serving SSC. Considering all four factors on balance, the local traffic increase must be rated as a moderately significant impact. This would apply to both the manufacturing-and-testing and the manufacturing-only situations.

Despite the moderately significant projected impact, no special mitigation measures are proposed. This is partially due to the fact that the effect of the increased traffic will be felt almost exclusively by new and current SSC employees, rather than the public at large. More importantly, it is because projected ASRM traffic flows would not decrease service at any location to or below LOS D, which is a standard threshold measure used to determine whether road improvements are required as a condition of development. Through the ASRM contractor, NASA will encourage project workers to use ride-sharing and other transportation arrangements (as is current practice) to reduce the number of vehicle trips. No other specific measures to reduce traffic or increase capacity are warranted.

The preceding analysis has focused on the effects of commuter traffic generated by ASRM construction and production workers. Construction vehicle traffic is an additional variable that currently is unknown. At this stage in project planning, the identity and location of construction contractors, quantity of materials excavated, spoil disposal locations, and transportation modes and volumes for construction materials have not yet been identified. Therefore, it is not possible at this point to determine the pattern of heavy vehicle traffic flows during construction.

It is reasonable to assume that considerable numbers of trucks and other heavy vehicles will be entering and exiting SSC during the construction period, and that construction traffic will create some degree of traffic congestion. However, the duration of this effect will be limited to the construction period, and the construction traffic will be distributed throughout the day rather than concentrated during peak hours. Any noticeable effects of construction vehicle traffic will not likely have a large magnitude relative to peak-hour traffic, and will probably be confined to Mississippi 607 or other road locations very close to SSC. In view of these characteristics, the effects of construction vehicle traffic are considered insignificant.

TABLE 3-22

PROJECTED TRAFFIC AND LEVEL OF SERVICE (LOS) CHANGES, SSC

Segment	Existing Peak Volume a/	Existing LOS b/	Available Capacity c/	Construction Traffic d/	Projected LOS b/
MS 607 N. of SSC	3,090 (AADT) e/	B	2,200	1,360 (AADT)	C
I-59 N. of MS 607	1,850	B	850	680	C
MS 607 S. of SSC	500	A	2,000	1,240	B
I-10E. of MS 607	1,750	B	950	580	C
MS 607 S. of I-10	800	A	1,700	310	A
U.S. 90 W. of MS 43	900	A	1,600	280	A
I-10 W. of MS 607	2,150	C	650	370	C

a/ Vehicles per peak hour in peak direction, estimated from AADT figures reported in Table 3-12 using formula specified in Highway Capacity Manual (Transportation Research Board 1985).

b/ Estimated from existing or projected volume and corresponding LOS from Highway Capacity Manual tables.

c/ Estimated as the difference between existing volume and the maximum service flow rate for LOS C.

d/ Allocated on basis of worker residence distribution by county.

e/ Reported on daily rather than hourly basis, as is standard for analysis of two-lane highways.

Materials Transportation Requirements

Two types of environmental concerns are associated with transportation of materials to and from the ASRM production and testing site(s). Collectively, rail and/or water transportation of materials used in the production process and transport of ASRM segments between production, test and launch sites could conceivably result in capacity problems in the transportation system. If existing rail or water traffic in a given region is at or near the capacity of the system, additional ASRM traffic could cause congestion. It is also possible that the size or weight of desired ASRM shipments could not be accommodated within the existing system. The second type of concern results from the hazardous nature of some ASRM materials, which requires assessment of potential accident risks.

The ASRM production process involves shipment of several raw material inputs to the production site, as well as shipment of finished ASRM segments to the testing site (if located elsewhere) and to KSC for launch. As described in Section 2.1.4, the key raw material shipments are aluminum powder from Joliet, Illinois, ammonium perchlorate from Henderson, Nevada, and case forgings from Cudahy, Wisconsin; based on past experience and available modes, all of these movements will be by rail. Finished ASRM segments will be transported by barge or high-capacity rail flatcar.

Maximum annual material input requirements for aluminum powder, ammonium perchlorate and case forgings are 3,700 tons, 13,200 tons, and 1,300 tons, respectively. These tonnage figures correspond to 42 railcars carrying aluminum powder, 151 cars of ammonium perchlorate, and 15 cars of case forgings arriving at the ASRM production site over the course of a year (based on an average carrying capacity of 87.5 tons/year) (Grove 1988).

The specified peak ASRM production rate is 30 motors per year, equating to 90 or 120 individual motor segments. High-capacity rail flatcars are assumed to be capable of carrying only one segment; therefore, up to 120 railcar trips per year would be required to transport finished ASRM segments to testing and launch sites. As described in Section 2.1.4, NASA barges would each carry 1 complete motor (up to 4 segments), thus, up to 15 trips of 2 barges each would be required per year. The maximum number of trips for either rail or barge options would be required only if testing were not conducted at the production site.

There do not appear to be any significant constraints on the capacity of the transportation system serving SSC to accommodate either raw material or finished ASRM shipments. Rail (or highway) shipment of raw materials does not require any specialized transportation technology; standard types of rolling stock can be and are currently used for existing solid rocket motor production processes. The number of railcars arriving at the ASRM plant would not be large in the context of the rail system in the region, as measured by traffic through New Orleans, Jackson or other key points, and is not expected to create any congestion problems. It also represents an increase in the number of average monthly railcar arrivals at SSC, which should be within the capacity of local service.

Shipment of finished or refurbished ASRM segments does require specially designed railcars or barges. However, the size and configuration of these vehicles are not so unusual that obstacles to transportation would be encountered. Space Shuttle motor segments have previously been shipped by rail from Utah to KSC, so rail transportation clearly is technically feasible. Preliminary design information (NASA 1988b) indicates that requirements for horizontal and vertical clearances pose some limitations on routing, but these are not severe due to the complexity and flexibility of the rail network.

NASA currently has barges of sufficient size to transport the ASRM segments; they are the same size as barges used to transport the external tanks from Michoud to KSC. The SSC canals and the East Pearl River have sufficient depth and width to accommodate these barges, which are 265 feet long, 48 feet wide, and draw 8 feet when fully loaded. If barge transportation were used for ASRM segments, the 14 roundtrips per year would represent an increase of 8 percent over 1987 barge operation levels at SSC. Additional barge operations with an average frequency of one every 13 days would not be expected to have any measurable or significant environmental effects at or near SSC. However, there are environmental concerns associated with additional barge operations on the receiving end at KSC, as described in Section 5.2.6.

As described above, location of ASRM production or production and testing at SSC would have at most a minor impact on the capacity of the existing rail and waterway system. Extremely localized load size or configuration constraints could occur with rail shipment of ASRM
segments, but these problems could be avoided through routing flexibility. No other adverse effects from normal transportation of ASRM materials are anticipated, so this type of impact is rated insignificant.

Transportation Hazards

Assessment of the potential impacts from transporting ASRM materials classified as hazardous requires a step-wise progression through several components. These include identification of the specific hazards involved, the potential accident mechanisms, the consequences associated with different types of accidents, and the probabilities of occurrence. These factors are discussed below, followed by an overall assessment of absolute transportation hazards and a relative comparison involving rail vs. water transportation.

Hazardous Material Transportation Regulations:

None of the raw material inputs to the ASRM process is considered unusually hazardous (NASA 1978), although no transportation operation is totally free of hazards, and some of the ASRM raw materials are subject to federal and state regulations on the transportation of hazardous materials. Ammonium perchlorate is toxic if ingested (NASA 1978). Some degree of fire hazard exists for all of the propellant ingredients, and there is a remote possibility of explosion for ammonium perchlorate and aluminum powder. All ASRM materials will be transported in compliance with the U.S. Department of Transportation Hazardous Materials Regulations (49 CFR 171-179). These regulations impose detailed requirements for packaging, marking, recording, storing, handling, and shipping of specified materials. Adherence to these requirements will minimize the potential for raw material transportation accidents, and the resultant consequences. While the probability for such accidents is very small, it is an adverse effect that cannot be avoided due to the separation of source and production locations and the need to ship bulk products by road and/or rail.

Accident Mechanisms:

The primary ASRM transportation hazard concerns relate to the potential for accidents involving finished ASRM segments. Each ASRM segment will contain from 300,000 to 600,000 lbs of propellant. As indicated above, it is physically possible for an ASRM segment to ignite and burn at a high rate. Depending on location and surrounding conditions, such an event could potentially have serious consequences.

Several different types of accident mechanisms that could produce such an explosion or rapid-burning event were identified in previous environmental documents related to the Space Shuttle program (Battelle 1983, NASA/MSFC 1977). At the most general level, ignition of an ASRM segment could be caused by high temperature, static discharge, or impact. The primary sources of such causes would be a transportation accident, such as a collision or train derailment, and vandalism or sabotage. Environmental influences are unlikely causes, although static discharge in the form of lightning could ignite an ASRM segment. Specific triggering mechanisms from a train or barge accident could include fires or explosions resulting from the ignition of other hazardous materials in the same shipment; because ASRM water transportation would be by dedicated barge, these accident mechanisms would apply only to rail transportation. ASRM ignition from vandalism or sabotage could be caused by arson, the use of explosives, or high-velocity rifle fire.

Accident Consequences:

The initial consequences of accidental ignition of an ASRM segment can be estimated on the basis of the propellant volume and its ignition characteristics. NASA (NASA/MSFC 1977) has previously determined that the accident scenarios identified above, including sabotage with high explosives, would at most cause rapid burning with a low equivalent explosive yield; a worst-case scenario involving detonation of other explosives on a nearby railcar would not detonate the SRM segment. Blast wave damage for rapid burning with low explosive yield would cause total destruction for light frame construction within 56 meters, and major repair would be required for such buildings within 105 meters. As an indicator of potential human health consequences, a blast of this level would rupture ear drums of people within 60 meters of the accident site. These figures applied to the original SRM segments, so the slightly larger ASRM segments would be capable of causing marginally greater damage, but the general magnitude would be the same. Ignition of an ASRM segment would also produce potentially hazardous air emissions, particularly HCl and Al_2O_3, but evaluation of the peak concentrations and duration indicated that little or no health impact from these emissions would result (NASA/MSFC 1977). Additional assessment of the potential impacts to public health and safety appears in Section 3.2.15.

The ultimate consequences of an accident causing ASRM ignition would depend upon the characteristics of the receiving environment. Direct damage from an ASRM blast wave and burning, plus potential secondary fires or explosions, would clearly be greater in urban or built-up areas. This relationship creates variance in the magnitude and extent of possible damage between rail and water transportation modes, and between site alternatives due to route distances and characteristics.

With respect to transportation modes, the likely consequences of a serious ASRM transportation accident are significantly less for barge travel as opposed to rail. Based on preliminary analysis (NASA 1988b), the development characteristics along waterway and rail routes are such that public exposure would generally be less for barge transportation. Specifically, lands adjoining waterways generally tend to be more rural and less developed than lands along rail routes. Except when docked, barges are also in a channel and separated by water from nearby people, buildings, or transportation equipment. Given this buffering effect and the smaller probability of nearby development, an ignition accident on a barge would be less likely to cause extensive human or property damage than the same accident on a train.

Accident Probability and Risk Factors:

The final individual aspect of the transportation hazard assessment involves the risk element, namely the probability that an accident with the above consequences would happen on an individual trip or over a period of time.

Experience with SRM shipments by rail indicate that 20 incidents have occurred during the shipment of over 200 Space Shuttle SRMs (over 800 segments) from Utah to KSC, a distance of about 2,500 miles (NASA 1988b). These incidents have generally involved objects near the track which strike the gondolas, specially designed railcars which carry the segments. The high number of incidents (averaging 1 in every 10 trips or .00001 incidents per railcar mile) are due to the fact that the segment-carrying gondolas constitute an oversized load. Additionally, a train carrying RSRM segments to KSC was involved in a fatal car-train accident in Gulfport, Mississippi in 1987. In none of these accidents were the motors damaged (Adler et al. 1988).

Solid-fuel rocket motors have also been transported around the country for other rocket programs for more than 30 years without an accident that compromised the integrity of a motor (U.S. Army 1988a). This lengthy history includes more than 4,500 shipments of Minuteman motors and 75 Titan III motors (Battelle 1983), plus numerous smaller motors for Pershing missiles and other programs.

Environmental analysis prepared to support the original Space Shuttle SRM program estimated the probability of an SRM segment being involved in a fire or explosion accident during a shipment from Utah to KSC at .00022, or .022 percent per trip (Battelle 1983). It should be noted that this is not actually the probability of an SRM segment fire or explosion, but simply the probability that an accident would occur on the train; whether the accident could cause SRM ignition would be problematic. This estimate was based on aggregate U.S. five-year average rail accident statistics, on a car-mile basis, for the period 1976 through 1980. During this period, an average of 37 rail accidents per year involved explosions and 1,197 involved fires. The overall rate for accidents of all types was .0000035 per car mile, while there were .000000085 accidents per car-mile involving explosions or fires. If we assume that accidents involving ASRM trains are more likely to occur than other train accidents (.00001 per car mile vs. .0000035 per car mile), and that the same ratio (2.9 to 1) is also applicable to the number of accidents involving explosions or fires, we can conclude that the probability of such an accident involving ASRMs is approximately .0000002 per railcar mile (.000000085 times 2.9). Accident probabilities are therefore extremely low. Furthermore, the rail distance from SSC to KSC is approximately 600 to 700 miles, so the accident probability for an SSC-KSC trip would be approximately one-fourth as high as for a Utah-KSC trip.

In addition to accident probability, the overall risk is also determined by transit time, route length, and route characteristics for each mode. As described in Section 3.1.9, there are two main alternative rail routes from SSC to KSC. The northerly route through Birmingham would be approximately 950 miles long and would likely pass through Meridian, Tuscaloosa, Birmingham, Columbus and Jacksonville on the way to KSC. These urban areas range from about 50,000 to 900,000 persons in size, and collectively total over 1,800,000 residents. Relatively very few of these people would be situated near the route and subject to ASRM accident exposure, but the population figures represent a useful relative indicator. The southern route would be shorter, at about 650 miles, and would pass through or near communities such as Gulfport, Biloxi, Pascagoula, Mobile, and Pensacola on the way to Jacksonville. While most of these communities are of moderate size, the overall population in urban areas along the route would be generally comparable to the northern rail route.

Barge - Comparable accident figures for barge transportation are unavailable, but water transportation is generally considered to be safer than the rail option. This is partially because average speeds are much greater for train travel, at about 40 miles per hour versus about 6 miles per hour for barge travel, thus, there is much less chance that the impact from a barge collision would be capable of igniting an ASRM segment. The buffering situation described previously, i.e., that barges move through undeveloped corridors (rivers, canals) which are wider than railroad rights-of-way, also means that ASRM segments transported by barge would be much less likely to be ignited by nearby fires or explosions, or to create secondary fires or explosions that would cause more extensive consequences. Finally, water transport offers better opportunities for climate control and security, in addition to full control of scheduling on dedicated NASA barges. Consequently, it is reasonable to conclude that the accident probability for barge shipment of ASRM segments would be significantly less than for comparable shipment by rail.

The water route from KSC to SSC would follow primarily the Gulf Intracoastal Waterway along the Gulf coast and the Intracoastal Waterway along the Atlantic coast. The former waterway roughly parallels the southerly rail route to KSC, but has greater distance separation from the urban concentrations in Mississippi, Alabama, and the Florida Panhandle. The Intracoastal Waterway is much closer to major populations on the Florida east coast, however, including the Miami, Fort Lauderdale, West Palm Beach, and Melbourne areas. The total population of these specific cities is about 750,000 people, although the total population along the south Florida coast is much higher. As with the rail routes, the total area population figures are much higher than the actual maximum population that might be exposed in the unlikely event of a serious accident. The water route is a significantly longer distance due to the need to travel around most of the Florida coast, but the trip time by water has been estimated at about 8 days versus 7 days by rail (NASA 1988b).

Overall, the impacts of shipping hazardous materials to and from SSC must be considered moderately significant, if ASRM production occurs at SSC. While the probability of an accident would be extremely unlikely and the effects would be localized in extent, the long-term duration (throughout the projects life) and magnitude of the possible consequences require an impact rating of moderately significant. Specifically, a worst-case accident involving shipment of an ASRM segment could cause major property damage and loss of human life if the accident occurred in a built-up area. The potential for such adverse effects would also be essentially irreversible once ASRM production facilities were constructed at SSC.

Additional Mitigation Measures:

Selection of mitigation measures that could be applied to reduce the potential transportation hazards are limited. The hazard will exist over the life of the ASRM program, and therefore is long-term by definition. It would be impossible to select a rail or water route that would completely avoid built-up areas, so the potential for major accident damage will always exist. The only possible mitigation measures that could be employed would be a few actions designed to further reduce the already low probability of an accident. Barge transportation has a presumed lower accident probability than does rail transportation, and NASA would have greater schedule and route flexibility with barge shipments, therefore, transportation hazards and consequences can be minimized by using water transportation for ASRM shipments. If rail transportation must be used for some portion of ASRM shipments, protective measures used on prior SRM rail shipments should be employed. These include separation of ASRM railcars from other hazardous or shiftable cargos, and use of a comprehensive tracking system for each shipment (Battelle 1983).

3.2.10 Historical, Archaeological, and Cultural Resources

Construction / Operations:

Construction and operation of the ASRM production and testing facilities at SSC would not directly affect known prehistoric archaeological sites or historic structures. It is possible, however, that significant buried cultural resources sites might be found during construction activities that involve earth moving. If this occurs, NASA would halt construction in the immediate vicinity of the find and consult with the State Historic Preservation Officer (SHPO) to determine whether the resource discovered is significant. If the resource discovered were determined significant, then NASA would plan and implement mitigation measures in consultation with the SHPO. These mitigation measures might include site protection and scientific excavation to recover data.

Indirect impacts to cultural resources resulting from the growth inducing effects of plant construction and operation in the project locality are also possible. If the project were to stimulate increased housing and business construction in the area, these new developments would very likely affect some cultural resources sites, leading to potential cumulative impacts on the region's cultural resources. While the likelihood is high that some archaeological resources would be affected due to this community growth, the area within 50 miles of the project site that would contain most of the workers' housing for the project contains nearly 1500 square miles. Since the project area is not highly developed, the cumulative impacts to cultural resources resulting from housing and business construction would be small and relatively insignificant.

Testing:

Testing of the ASRMs at SSC could affect two sites listed as part of a National Historic Landmark (Butowsky 1988a; USDI 1981). These are the NASA rocket test stands A1 and B1/B2, located within the Hazardous Test Area at SSC. These test stands were designed to withstand noise and vibration impacts from testing Saturn rocket motors, which generate noise levels higher than the ASRMs. Therefore, noise vibration resulting from testing the ASRMs would not have a significant adverse effect on test stands A1 and B1/B2. They were recently used on the space shuttle program (USDI 1987).

3.2.11 Solid and Hazardous Waste Management, Toxic Substances and Pesticides

Solid Waste Management

SCC's on-site, permitted sanitary landfill has an estimated remaining life of 18 years (Warden 1988, personal communication). This landfill has been built to meet existing Mississippi landfill design specifications, including the requirement for a "natural or artificial liner" (Mississippi Department of Natural Resources, Bureau of Pollution Control, Regulation No. PC/S-1). SSC has installed groundwater monitoring wells on the perimeter of the landfill to detect groundwater contamination. At present, there is no evidence of subsurface migration of contaminants. Although the remaining life of the landfill is likely to decrease with ASRM operations, depletion of the existing capacity is of minor magnitude. The life of the existing landfill exceeds 7 years and a subsequent facility will be constructed to accommodate the increased volume on an as-needed basis. The potential for groundwater contamination is always present with land-based disposal of solid waste. To mitigate this potential, NASA prohibits the disposal of liquids in the sanitary landfill, and covers the active surface area daily. Covering at this frequency reduces infiltration of surface water, and reduces the potential for vectors. This practice will be continued throughout the life of the facility.

Hazardous Waste

The current practice of shipping hazardous wastes to off-site RCRA permitted facilities will be continued under the scenario of siting the ASRM production and/or testing facilities at SSC. On-site disposal of the waste propellent is discussed in Section 2.2.3 of this EIS. Site specific mitigation for hazardous materials management include continuation of the Special Protective Services training program (Oberg 1988), training of construction and operations personnel for the ASRM facility on the NASA Contingency Plan for Response to Spills of Oil and Hazardous Substances (Hlass, n.d.); and routine execution of NASA GAOO/Installation Operations standard operating procedure for control of hazardous materials (Hlass 1986).

Multiple on-site operations of the ASRM will utilize hazardous materials and generate hazardous wastes. Mitigation measures for ensuring maximum protection of worker's health and safety are noted in Section 3.2.15. Mitigation for new underground storage tanks would include the installation of cathodic protection and secondary containment. The handling of hazardous wastes will occur throughout the life of the facility. The environmental impact will be insignificant because handling will be conducted accordance with regulations.

Additional Mitigation Measures

Three remaining impacts for solid and hazardous waste management are possible after site-specific mitigation measures are employed. First, the effect of the EPA proposed rule on engineering design and environmental performance standards for municipal landfills will be to emphasize source separation and recycling (53 FR 33314). This mitigative measure, if instituted, would increase the life-span of the existing on-site sanitary landfill. Second, the storage of hazardous waste on-site for greater than 90 days would require that a RCRA Part B permit be obtained for the storage unit. Design and operation of the storage facility in accordance with RCRA requirements would comprise the mitigative measure for this potential impact. Third, the storage of petroleum product or other "regulated substances" require notification of the Mississippi Department of Natural Resources.

Emergency Response

Accidents or spills of hazardous materials that occur during operations will be handled according to the procedure set forth in the Contingency Plan for Response to Spills of Oil and Hazardous Substances (Hlass, n.d.). This Plan provides the name and office and home telephone numbers of emergency response team representatives, and a map showing the access roads throughout the facility (Hlass, n.d.). As a mitigation measure this Plan should be revised upon completion of the ASRM facility.

3.2.12 Toxic Substances and Pesticides

NASA will not utilize any equipment containing asbestos or PCB fluids in the construction of the ASRM facility. Product substitutions are currently widely available for these materials. NASA currently conducts a comprehensive Pest Control Program at the SSC. The current program includes application of pesticides, herbicides, fungicides and rodenticides by certified personnel. These personnel wear appropriate level personal protective equipment, including respiratory protection, when handling FIFRA substances. The only direct effect of ASRM development on the Pest Control Program might be an increase in the inventory of chemicals needed to ensure a pest-free working environment. The impacts of the project are therefore considered insignificant.

3.2.13 Radioactive Materials and Nonionizing Radiation

At SSC, there may be several sources of radioactivity or ionizing radiation associated with ASRM operations. The most significant of these are x-ray generating devices used for nondestructive examination of the motor components, including a 50 MeV particle accelerator. Other sources may include radioactive materials found in devices such as density gauges and analytical detectors.

X-ray generating devices can be intense sources of ionizing radiation requiring substantial shielding and other controls to maintain exposures to personnel within regulatory limits. The accelerator poses the additional hazard to operators and other personnel of neutron exposure and exposure to components that have become radioactive via neutron activation. The primary hazard is to those personnel in the vicinity of the x-ray facility. Radioactive materials contained in instruments and articles present negligible levels of extreme exposure.

The health impacts on workers and the public from sources of ionizing radiation at SSC will be negligible due to controls required to keep exposures within regulatory limits. Distance and engineered controls effectively reduce exposure levels to the affected environment to nondetectable levels for both routine and accident conditions.

3.2.14 Noise and Vibration

Noise

Typical effects of various noise levels on humans are presented in Table 3-23. Noise is a recognized occupational hazard through exposure of workers. This aspect is discussed in Section 3.2.15 and is not a source of off-site exposure to the general population.

Construction and Vehicular Traffic:

Construction and vehicular peak noise levels for various pieces of typical equipment are presented in Table 3-24 along with attenuation levels as a function of distance from the source. Normal free field attenuation (not taking into account topographic effects, surface attenuation, or engineered barriers) is a 6 db(A) decrease for every doubling of distance from the source. The table shows that noise from construction and vehicular movement during operation is between 37 and 59 dB(A) at a distance of 3,200 feet from the source. At these levels the noise from construction and vehicular traffic will be close to background levels [45 - 50 dB(A) as shown in Section 3.1.14] at the interior boundary of the buffer zone, assuming no engineered barriers or other attenuation. As a result, noise levels from construction, vehicular traffic, and facility operations will be indistinguishable to the general public.

Static Testing:

Test firings of the ASRM will produce noise levels that will be heard over a large area. Predictions of the noise levels generated by these tests have been made using the approach described in Appendix F. This approach was used to develop overall sound pressure level (OASPL) contours for the static test firing of the ASRM. The acoustic energy generated by the ASRM is concentrated in the lower frequency range, since the higher frequency noise is more rapidly attenuated by passage through the atmosphere. Another scale, the A-weighted scale, was then used to account for the hearing range of the human ear. This adjusted scale, where sound pressure is measured in dB(A), accounts for the insensitivity of the human ear to low frequencies.

The position and direction of the rocket test stand during ASRM static test firing was chosen to minimize noise to the surrounding communities. Figures 3-12 and 3-13 show the OASPL [dB] and A-weighted [dB(A)] sound pressure level contours,

TABLE 3-23
EFFECTS OF NOISE ON HUMANS

dB(A) level	Potential Effect
25	Hearing threshold
35	Slight sleep interference
50	Moderate sleep interference
65	Communication interference
75	Changed motor coordination
80	Moderate short-term hearing loss
90	Affect mental and motor behavior
100	Awaken everyone
125	Pain threshold
140	Potential hearing loss high
185	Ear drum rupture

Source: Adapted from Edward E. Clark (1986).

TABLE 3-24
SELECTED CONSTRUCTION AND VEHICULAR NOISE SOURCES

	Noise Level, dB(A)				
	Peak	Distance from Source			
Source	Level	50 ft	400 ft	1,600 ft	3,200 ft
Construction[b]					
Dump Trucks	108	88	70	58	52
Concrete Mixer	105	85	67	55	49
Jackhammer	108	88	70	58	52
Crane	104	75-88	55-70	43-58	37-52
Caterpillar	103	88	70	43-58	37-52
Forklift	100	95	77	65	59
Vehicles					
Diesel Train	98	80-88	62-70	50-58	44-52
Mack Truck	91	84	66	54	48
Compact Auto	90	75-80	57-62	45-50	39-44

a/ Assume 6 dB(A) decrease for every doubling of distance.
b/ The peak noise levels shown for construction are comparable to operations associated with the manufacture of the ASRM.
Source: Adapted from Edward E. Clark (1986).

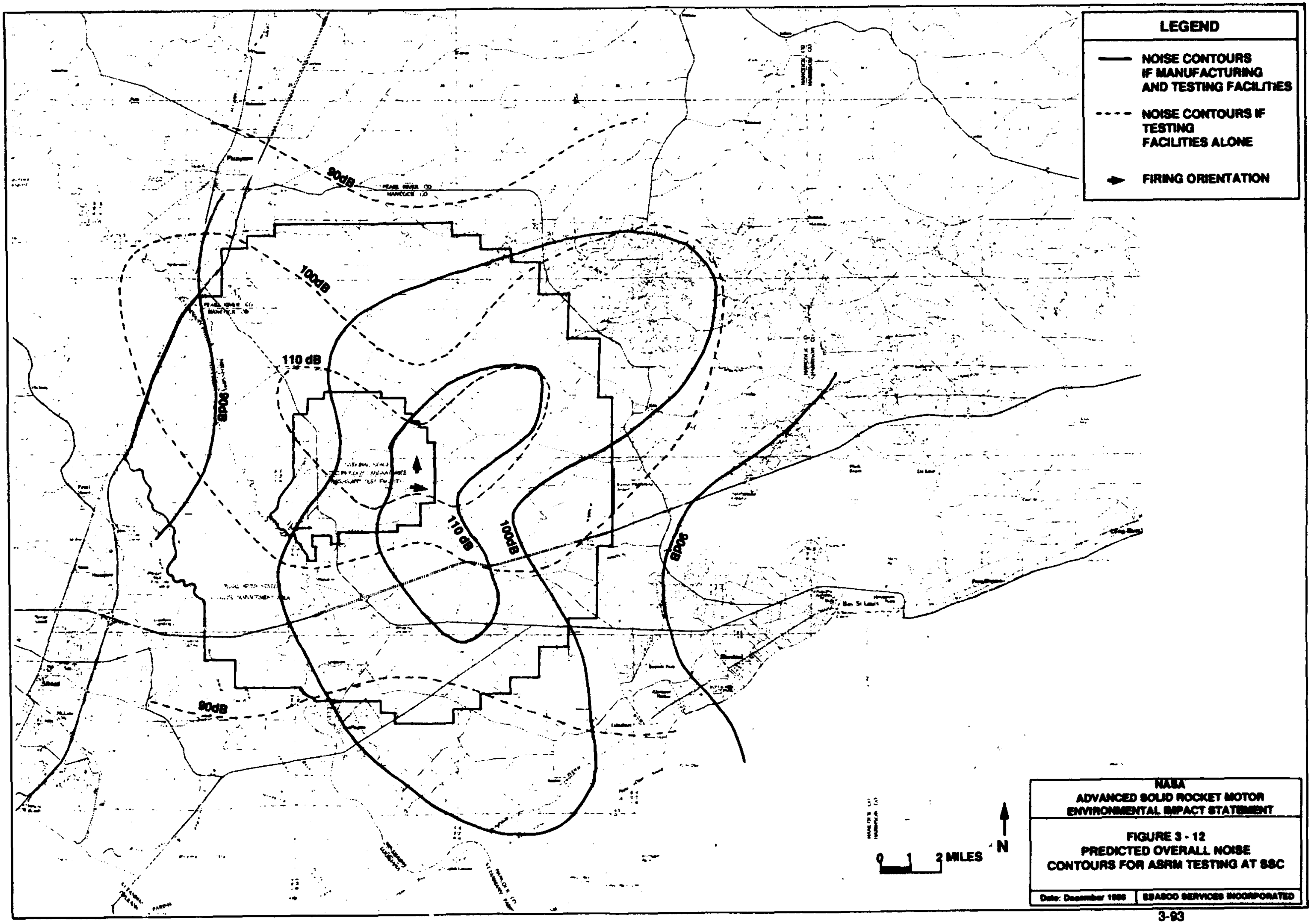
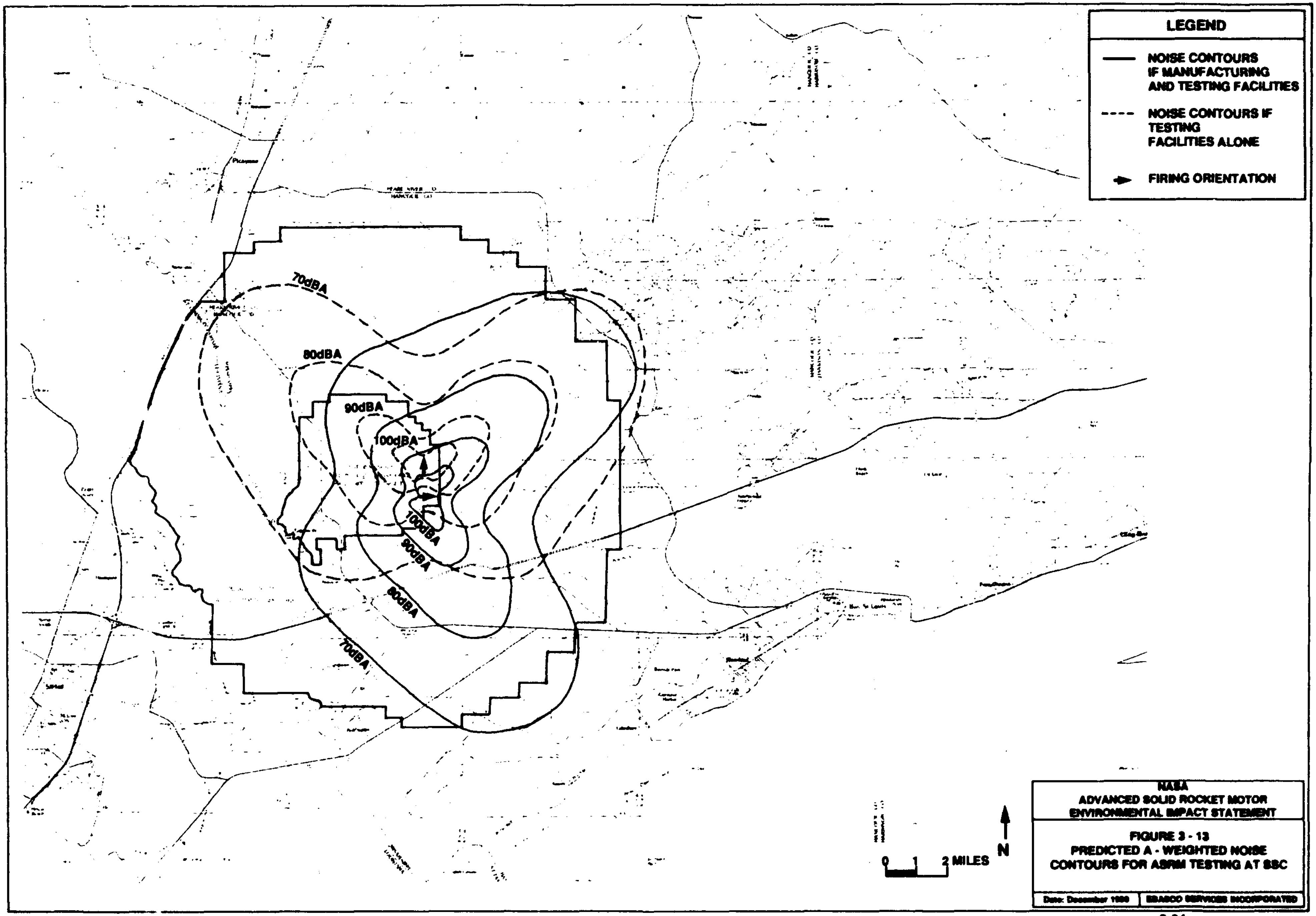


FIGURE 3 - 12
PREDICTED OVERALL NOISE CONTOURS FOR ASRM TESTING AT SSC



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3 - 13
PREDICTED A - WEIGHTED NOISE
CONTOURS FOR ASRM TESTING AT SSC

Date: December | EBASCO SERVICES INCORPORATED respectively, for two possible static test configurations. The test stand would be located in the southeast corner of the fee area and the motor pointed southeast if both production and testing occur at SSC. If testing alone is performed, the test motor would be directed due north and the test stand would be located further north. The predictions used here may be overestimated by about 5 to 10 dB (Rice 1976, 1978, 1988a). Recent data from an SRM test in August 1988 also supports this position (NASA/SSC 1988b).

The incline exhaust deflector at the test site is expected to provide a trivial reduction in the noise levels predicted (see Appendix F for discussion). Because of the relatively flat terrain at SSC and surrounding areas, topographic features will not play an important part in modifying the noise patterns so indicated.

Acoustic focusing can present a problem due to certain meteorological conditions. When the speed of sound due to temperature and/or wind profile increases with altitude, sound energy is refracted causing higher noise levels at a given distance than would normally be expected. This factor is discussed in more detail in Appendix F. However, NASA will monitor meteorological conditions in order to predict when focusing would occur. If focusing is predicted to be significant, the static test would be postponed. Also, NASA will establish a noise monitoring program to determine the actual levels of noise in the far field being generated by the ASRM static tests.

In conclusion, large areas including SSC and surrounding areas will be subjected to modest levels of predominately low frequency noise. Some perceivers, who happen to be close by, may be annoyed; however, no population centers should be affected. Drivers along Interstate 10 may likely be exposed to noise levels in the range of 80-85 dB(A) for a distance of about 3 miles along I-10 for a duration of approximately 2 minutes (assuming the motor is fired in the east-southeasterly direction). If the northern firing configuration is selected, the drivers along I-10 would be exposed to noise levels on the order of 70 dB(A). Sections 3.2.6, 3.2.7, 3.2.10 and 3.2.15 further discuss possible effects of noise on biota, land use, cultural resources, and public health and safety, respectively.

Accidents:

During a static test firing, the only accident that would cause different noise levels from that of a normal static test firing would be a pressure rupture of the motor case. The maximum conceivable energy release for a case rupture would be 6.7 million Btu, or the equivalent of about 3,300 lb of TNT (NASA/MSFC 1977). A blast wave would be perceived as a brief noise pulse that would probably be audible at considerable distances. The pulse is an increase in pressure followed by a decrease in pressure (expansion).

Low probability accidents involving handling, manufacturing, or transportation of an ASRM segment or AP container could also cause noise impacts. Ignition and burning of an ASRM segment is the most severe of such accidents. Deflagration, or rapid burning of a segment could create a blast wave that would break glass up to 780 ft away and rupture ear drums up to 200 ft from the accident.

Vibration

Static testing of the ASRM could result in a seismic effect causing 4 Hz wavetrains with an amplitude up to 50 micrometers. Test firings during the Apollo Program, however, showed this effect to be relatively harmless to buildings. Since there are no structures in the 6-mile-wide Buffer Zone, and the likelihood of the effect occurring is low, it should not be of significant concern to structures. Possible effects from seismic vibrations could include falling objects in buildings, which might startle the occupants. See Appendix F for additional discussion of this effect.

3.2.15 Health and Safety

General health and safety practices and programs currently in place at SSC have been described in Section 3.1.15. Public and industrial health and safety impacts associated specifically with production and testing of the ASRM at SSC are described in this section. Briefly, these impacts include:

- possible routine exposure of workers to minimal quantities of hazardous chemicals as part of normal production processes;
- accidental exposure of workers to hazardous chemicals as a result of spills or leaks;
- potential explosive and/or fire hazards to workers and the public associated with ASRM production, static testing, transport, and waste propellant disposal; and
- air quality impacts associated with planned or unplanned combustion of the ASRM propellant during static testing, or during waste propellant disposal.

Most of these hazards would exist to some degree at any of the three proposed ASRM production sites, however, due to certain site-specific considerations, certain health and safety issues may be of more concern at one site relative to another. This section discusses the health and safety issues associated with production and testing of the ASRM generally, while highlighting health and safety issues of specific concern at SSC when pertinent.

Routine Exposure of Workers to Hazardous Materials

Large quantities of hazardous materials will be used in the ASRM production process, presenting a potential for worker exposure. However, the degree of actual worker exposure will be determined by the efficacy of the health and safety-related work practices and control technologies used.

In terms of volume, ammonium perchlorate (AP), used as the primary ingredient in the production of the rocket propellant, is the hazardous material that would be used in largest quantity. However, because this chemical is nonvolatile and virtually all handling of the material is expected to be conducted remotely in a separate building, actual worker exposure is unlikely (NASA 1988b; Wharton 1979). The possible explosive and fire hazards associated with AP are discussed below. More important, in terms of the potential for actual worker exposure, are several volatile solvents used to apply paints and primers, and to degrease equipment. Solvents will be used to apply paints and primers. 1,1,1-Trichloroethane is the primary solvent that will be used to degrease the solid rocket motor casings. Toluene, xylene, and methyl-ethyl ketone are general cleaning solvents. Sverdrup (1987) has estimated the annual release of these solvents assuming no emission controls (Table 3-25). All of these solvents act generally as central nervous system depressants, producing such symptoms as headache and nausea at high concentrations. However, if proposed ASRM vapor control technologies and work practices are implemented, actual solvent exposure levels should be below levels necessary to produce adverse health effects. Some of the proposed control technologies and work practices include:

- safety dispensing cans (designed to prevent vapor loss);
- ventilated, controlled-access paint spray booths;
- implementation of controlled-use and restricted access procedures (including guards, permit requirements, and lock-out devices);
- use of robots for case degreasing;
- storage of solvents in a ventilated storage area;
- the use of degreasing equipment with built-in vapor loss covers; and
- periodic monitoring to ensure that vapor concentrations do not exceed OSHA standards (NASA 1988b).

In addition, NASA is currently seeking safer alternatives to the solvents listed above. To the extent safer alternative solvents are identified and determined to be feasible, those solvents will be used preferentially.

Other hazardous chemicals to which workers may be exposed routinely during production include zirconium silicate and aluminum powder. Zirconium silicate will be used as a grit to grit-blast motor cases during refurbishment. Aluminum powder is an important component of the rocket fuel. Safe handling procedures will be implemented for these chemicals to prevent measureable suspension in the ambient air and subsequent inhalation exposure.

Implementation of the control technologies and health and safety work practices described above should prevent worker exposure to contaminant levels injurious to health. Impacts associated with routine exposure of hazardous materials during production are therefore judged to be insignificant.

<u>Accidental Exposure of Workers to Large-Scale Spills and Leaks of Hazardous Materials</u>

Spills of hazardous materials are possible, but highly unlikely, if proper hazardous material handling and storage procedures are implemented. Development of an emergency response plan and proper training of workers or other appropriate personnel is required to minimize the adverse consequences of such an accident. This may require an upgrading of existing emergency response capabilities at SSC. The present emergency response capabilities of SSC are discussed in Section 3.1.15.

The potential for exposure of workers to large-scale spills and leaks, though unlikely, is possible, and could result in injury. The impact associated with large-scale spills and leaks was therefore considered to be moderately significant.

TABLE 3-25

ESTIMATED UNCONTROLLED SOLVENT EMISSIONS ASSOCIATED WITH ASRM PRODUCTION

Solvent	Annual Emissions (lb/yr)
Methyl cellosolve	400
Methylethyl ketone	1,010
Toluene	1,980
1,1,1-Trichloroethane	29,980
Xylene	1,370
TOTAL	34,740 (17.4 tons/yr)

Source: Sverdrup (1987).

Explosive and Fire Hazards

Manufacturing:

The first step in the production process at which a potentially significant explosion or fire hazard exists is the aluminum premix stage. During this stage of production, wet, finely divided aluminum powder is mixed with the binder. Fine aluminum powder is an important component of the rocket fuel. Detonation of aluminum powder in air or mixed with AP and binder in the propellant may occur through electrostatic charging. To minimize the possibility of such an explosion, the selected facility design is expected to include adequate electrical grounding of all piping or vessels used in transferring the aluminum or aluminum/binder mix. In addition, handling of the aluminum will be carried out remotely and in an inert atmosphere comprised primarily of nitrogen, with insufficient oxygen to support combustion (NASA 1988b). These safety precautions should minimize the explosion hazard.

One of the most potentially explosive operations associated with ASRM production is mixing of the AP propellant. In general, the AP is most likely to rapidly burn under circumstances that result in the unplanned application of additional energy, typically in the form of heat or an electrical charge, directly to the propellant. Heat is most likely to initiate deflagration as the result of friction between the propellant and the moving parts used in the mixing process. Electrical charge initiation may occur through inadvertent electrostatic charging of the system. Specific circumstances which may lead to deflagration or an explosion include:

- sudden loss of vaccuum in the mixing vessel resulting in adiabatic compression of the propellant;
- propellant impingement during mixing;

- friction from a contaminant that may have inadvertently entered the mixing bowl; and
- viscous shear heating of the propellant (NASA 1988b).

To minimize the potential for an explosion during the mixing process the following control technologies are typically employed (NASA 1988b; Wharton 1979). These control technologies are expected to be employed in the ASRM production facility:

- mixer designs which prevent the propellant from entering the mixer bearings;
- mixer designs which prevent mixer blades from striking the mixing bowl;
- no smoking policy in the manufacturing facility;
- use of nonsparking materials;
- automatic deluge systems for immediate quenching in the event of fire;
- remote handling of propellant in a remotely located building;
- electrical grounding of all equipment;
- continuous monitoring of process parameters (mixer speed, mix temperature, mix time, and viscosity); and
- placement of screens on the mixing bowl to prevent entry of foreign objects.

A potential for deflagration and/or explosion also exists during the casting process. Of concern here is the possibility of introducing air/gas pockets in the uncured propellant during casting. Air pockets provide an increased surface area for burning, which may cause motor case rupture during static test firing, or cause a transition from deflagration to detonation. Voids may also produce subsurface ignition via adiabatic compression that may occur during ignition load shocks or vibration testing. Subsurface ignition may cause motor case rupture and detonation. The introduction of air pockets into the motor during casting is minimized by conducting the casting under vaccuum. To avoid worker exposure in the case of an explosion, casting can be done remotely (Wharton 1979). Both of these safety features are expected to be in place at SSC.

Finally, a fourth potentially important cause of rapid burning or explosions during production exists when the mandrell is removed from the cured rocket motor. Friction between the cured motor and the mandrell during extraction may generate heat or an electrostatic discharge, resulting in ignition of the propellant. Safety precautions expected to be employed to prevent this from occurring and minimize worker exposure include remote extraction of the core, slow core removal speed to reduce friction and electrostatic charging, and grounded mold components to limit electrostatic charging (NASA 1988b).

Although an unlikely event, an explosion during the mixing and casting process could result in damage to structures several thousand feet from the processing area. In March of 1984, at the Morton Thiokol plant in Utah, an explosion occurred while pouring uncured propellant. A blast over-pressure equivalent of 15 tons of TNT resulted from a violent explosion of a quarter million pounds of uncured propellant. The rapid explosion of uncured propellant resulted in a great increase in surface area of the propellant and enhanced the blast over-pressure of the propellant burning. Due to quick personnel response and fortuitous circumstances, no injuries occurred beyond smoke inhalation and minor cuts and bruises. Blast and incendiary effects were observed several thousand feet from the point of explosion. Structural damage occurred to buildings 1,400\feet from the blast area. Window breakage occurred as far as 4,000 feet from the explosion area (NASA 1984a).

Explosion or Fire During Transport:

Although unlikely, in the event of the rapid deflagration of an ASRM segment containing 325,000 lb of propellant (aft segment), a blast wave equivalent to the detonation of 4540 lb of TNT could be created (assuming an explosive yield of 1.4 percent) (Dinsdale 1975). The blast overpressures associated with an explosion of this magnitude were estimated using the methods described by JANNAF (1971) and are shown in Figure 3-14. The calculated overpressures would have the following effects:

- structural damage of massive multistory buildings at distances of up to 75 ft;
- total structural damage of light-frame construction at distances of up to 190 ft;
- ear drum rupture at distances of up to 260 ft; and
- window glass breakage at distances of up to 820 ft.

Another explosion scenario could involve a mishap occurring during transport of a 5000 lb shipping container of ammonium perchlorate. Assuming the maximum theoretical explosive yield for ammonium perchlorate of 38 percent, such an accident could result in an explosion equivalent to 1900 lbs of TNT. Estimated blast overpressures as a function of distance are presented in Figure 3-14. These overpressures would have the following effects:

- structural damage of massive multistory buildings at distances of up to 56 ft;
- total structural damage of light-frame construction at distances of up to 141 ft;
- ear drum rupture at distances of up to 190 ft; and
- window glass breakage at distances of up to 580 ft.

Deflagration During Static Testing:

The presence of voids in the rocket motor propellant may result in a locally increased burning rate within the motor. This may produce excess pressure inside the case, leading to case rupture during static testing. Case rupture may also occur as the result of structural flaws in the case, including the insulation, seals, adhesives, or other case materials. Explosive effects associated with the case rupture of a motor have been evaluated (NASA 1977). If the case rupture were to occur near the end of the test firing, when the maximum volume of pressurized gases was contained in the case, an explosion equivalent to about 3300 lb of TNT would occur. This is the maximum conceivable energy release for a case rupture. An explosion of this magnitude would have the following effects:

- structural damage of massive multistory buildings at distances of up to 82 ft;
- total structural damage of light-frame construction at distances of up to 164 ft;
- ear drum rupture at distances of up to 180 ft; and
- window glass breakage at distances of up to 720 ft.

Case rupture would also allow propellant to spill out onto the ground as an uncontrolled fire (NASA 1977). Since the test firing area will be free of other combustible materials, a fire of this type would simply burn until the available fuel was consumed.

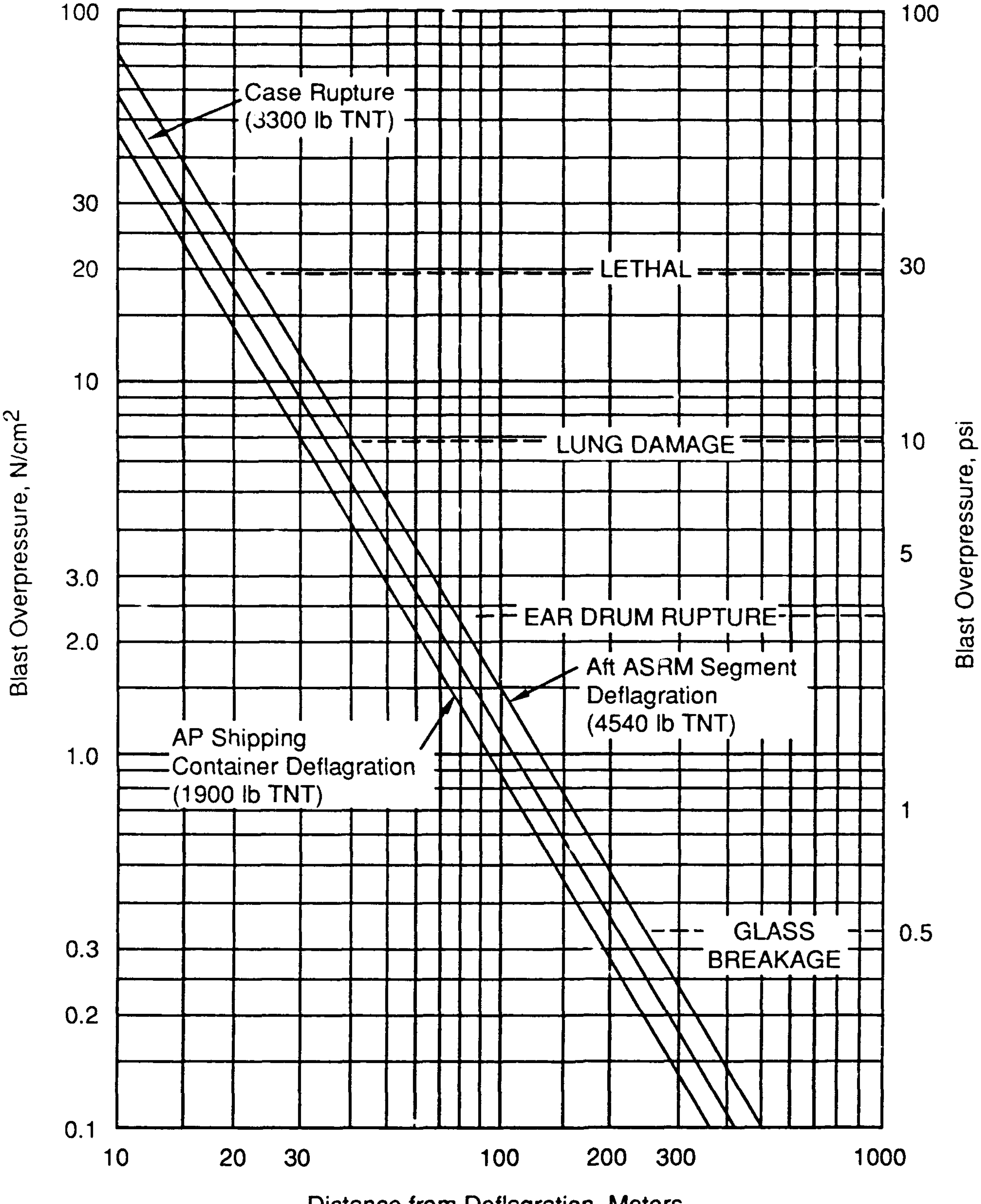


FIGURE 3 - 14

CALCULATED BLAST OVERPRESSURES RESULTING FROM AN INADVERTENT IGNITION OF ASRM OR AP SHIPPING CONTAINERS

Other Explosion Hazards:

A 200-acre area immediately north of the ASRM site at SSC, currently referred to as the Hazards Test Range, was used as the target area for bombing practice during World War II. Investigations conducted in this area to date have discovered only dummy rounds and there are no records to determine whether any live ammunition was used at the site (CH2M Hill 1987). NASA has indicated that this area will be cleared of all ordnances prior to development of the ASRM complex (McCaleb 1988, personal communication).

Quantity-Separation Distances:

Quantity-Separation Distances (QD arcs) are the minimum safe distances required to separate two given sites or buildings where at least one of the sites has a potential for explosion or fire. This potential arises from either the use or storage of explosive or combustible materials at the site. QD distances between a potentially-explosive site and an inhabited building are the most protective (largest) to minimize the risk from exposure of the public. The QD arc between an explosive site and a public traffic route is less protective (smaller), since any public exposure would presumably be of short duration. Finally, the QD arc between an explosive site and another building used only by workers as part of the production process is the least protective. This latter QD is termed the "intraline distance". Preliminary designs provide QDs for various facilities which range from about 100 ft for minor manufacturing processes to over 5,000 ft for the static test facility. In calculating these QD arcs, all explosive or combustible materials were rated as Class/Division 1.3 (mass fire) with the exception of the static test area where such materials were rated at 1.1 (mass detonating).

Internal QD requirements at SSC are acceptable with the possible exception of a few areas where the intraline distances overlap. Preliminary designs include overlap among some process facilities, the static test area, and the barge loading area. Although overlap of QD arcs is not strictly prohibited, it is considered less desirable than nonoverlapping QD arcs. None of the inhabited building arcs impinge on other inhabited buildings.

A QD circle associated with ammunition storage at the MAAP will impinge on the northwestern edge of the proposed ASRM production site (CH2M Hill 1987). No buildings are in contact with this QD circle. This type of overlap has been allowed by both MAAP and NASA in the past, however, approval is required by the commanders of each of the sites. In addition, the SSC Master Plan indicates that the existing Space Shuttle main engine test stand may be used for testing engine clusters. The QD associated with this future use may impinge on the proposed ASRM facility.

Significance of Explosive and Fire Impacts

In summary, a potential for explosions and fires injurious to human health exists by the very nature of the ASRM production process, which requires the extensive use of explosive and combustible materials. Implementation of the control technologies discussed above and maintenance of adequate QD separations, however, should make this an unlikely event. The potential for deflagration, explosion, or fire associated with production or testing was therefore considered to be a moderately significant impact.

Air Quality Impacts Associated With Planned or Unplanned ASRM Combustion

Combustion of the ASRM, whether occurring during static testing, waste propellant open burning, or through accidental ignition, will result in the release of an exhaust cloud containing large amounts of hydrogen chloride (HCl) and aluminum oxide (Al_2O_3). A potential for short-term (less than 10 min.) human inhalation exposure to concentrations of these chemicals exists for both workers and the public.

Regulatory Guidelines and Standards:

Authoritative air contaminant standards should be used to evaluate the significance of the HCl and Al_2O_3 levels expected to result from ASRM combustion. Toward this end, a survey of available state and federal standards and guidelines was conducted to identify the most appropriate ambient air quality standard. This survey included phone interviews with key regulatory officials in the states of Colorado, Mississippi, and Massachusetts to determine the recent status of any HCl standards or guidelines these states may have developed. This survey also included reviewing recommendations of various independent expert groups, particularly those of the National Research Council's Committee on Toxicology and the American Conference of Governmental Industrial Hygienists (ACGIH) (NRC 1987; ACGIH 1988). This survey indicated that no federal standards for HCl have been established, however, guideline values of 15 ug/m^3 (annual-average) and 150 ug/m^3 (3 min-average) have been proposed as part of EPA's municipal combustion regulations (USEPA 1987). Several states have also developed HCl guideline values. Massachusetts has adopted a maximum allowable concentration of 2 ug/m^3 based on a 24 hr-average and a value of 700 ug/m^3 based on a 3-5 min averaging time. Colorado has modified the Massachusetts value, deriving a 24-hr average guideline value of 10 ug/m^3. Finally, Mississippi uses 1 percent of the HCl threshold limit value (TLV) as the appropriate maximum air concentration. Based on the ACGIH TLV of 7 mg/m^3, the Mississippi guideline is equivalent to 0.07 mg/m^3 (70 ug/m^3).

Several nongovernmental expert groups have also developed HCl exposure limits. The ACGIH, an independent group of industrial hygiene experts, has recommended a ceiling limit for worker exposures of 7 mg/m^3 (ACGIH 1988). This limit is designed to protect workers when exposed over a normal work schedule of 8 hours/day, 5 days/week. It is a level that should not be exceeded at any time during the workday. The most appropriate guideline however, is the limit of 6 mg/m^3 recommended by the Committee on Toxicology of the National Research Council (NRC 1987). This guideline is the maximum 10-minute average concentration in air to which the general public should be exposed. It is more applicable to the assessment of the ASRM HCl impacts because it was developed for protection of the general public rather than workers only, and it was specifically intended for exposures that occur predictably, infrequently, and for a duration (10 minutes) that coincides closely with the duration of the combustion period (2 minutes). Furthermore, the NRC guideline value was designed specifically to address human exposure to toxic chemicals released as a result of rocket firings (NRC 1971). This standard was used as the basis for evaluating significance of HCl exposures.

With the exception of occupational standards, no standards have been developed specifically for acceptable levels of Al_2O_3 in ambient air. However, because Al_2O_3 is considered an inert particulate (ACGIH 1988), the national ambient air quality standard for particulate matter of 260 ug/m^3 is a reasonable standard for evaluation. This standard is a 24-hour average, so it should ensure protection of health when applied to an exposure duration of about 10 minutes or less. This standard was used as the basis for evaluating significance of Al_2O_3 exposures. High blood serum levels and high brain levels of aluminum have been suggested as a possible factor in the development of Alzheimer's disease in humans (NRC 1982). However, at the present time insufficient evidence is available to determine whether aluminum is a causative agent or only a related factor (NRC 1982; USEPA 1987c). Further, aluminum is a common chemical element with many routes of human exposure. The expected doses of aluminum associated with periodic test firings would be insignificant in comparison to normal aluminum exposures, and insufficient to produce the blood serum or brain levels of aluminum that have been implicated in Alzheimer's disease.

Static Tests:

During the initial phase of production, four static tests per year of the ASRM are proposed; in subsequent years, two tests will be conducted per year. Complete combustion of an ASRM containing 1.2 million lbs of propellant occurs in about two minutes and, based on studies of the SRM, can be expected to release approximately 99 tons of HCl and 158 tons of Al_2O_3 during each static test (CH2M Hill 1987). For very short time releases of air pollutants which occur during static tests, ambient concentrations can be computed using dispersion models. Short-term concentrations can be related to longer term standards by taking a ratio of the burn time to the averaging time for standards. Air dispersion modeling studies using the PCAD model indicate a maximum downwind HCl concentration of 2.4 mg/m^3. The maximum 24 hr-average concentration of Al_2O_3 is estimated to be 0.03 mg/m^3 (30 ug/m^3), based on the ratio of burn time to 24 hours. These projected levels are below the NRC HCl and federal suspended particulate matter air standards discussed above, indicating that no adverse health effects will be expected as a result of the static testing.

Open Burning:

Although NASA is actively examining other more environmentally-benign disposal alternatives, particularly water extraction, open-burning is currently the only method to dispose of waste rocket propellant (Crochet et al. 1988). Therefore, for the purposes of this assessment it was assumed that this disposal method will be used at SSC. It is expected that about 1 million lbs of waste propellant will be generated per year. Complete disposal of this quantity will require approximately 40 burns of 25,000 lbs each. Air dispersion modeling was conducted using the PCAD model to determine the maximum air concentrations of HCl and Al_2O_3 expected to result from each waste propellant burn. Using this model, the maximum 10-min average concentration of HCl was determined to be 1.6 mg/m^3, and the maximum 24-hr average Al_2O_3 concentration was projected to be 0.02 mg/m^3 (20 ug/m^3). Since both of these levels are below the appropriate standards, it is expected that no adverse health effects will occur.

Accidents:

Combustion of an ASRM segment may also occur via accidental ignition. Accidental ignition of an ASRM segment would most likely occur during casting, particularly mold disassembly, or as the result of a transportation accident. After the ASRM propellant has been cast and cured, the mandrel is removed. In the absence of adequate safeguards this process has a significant potential for igniting the motor via friction-induced heat gain or electrostatic charging that occurs as the mandrel is extracted from the segment (NASA 1988b). A transportation accident may also ignite the motor if the accident resulted in a fire or generated enough friction or sparking to cause ignition. Air quality impacts associated with accidental ignition of an ASRM or ASRM segment would be severe, but limited to nearby workers if ignition occurred indoors (in the casting building). If ignition occurred outdoors, air quality impacts in the immediate area would also be severe. Injuries to both workers and the public may result if the accident occurs near populated areas. Air quality impacts and hence potential health impacts associated with accidental ignition would be proportional to the size of the ASRM segment ignited. Further, because such events are unplanned, the potential for human exposure is substantially greater and the need for adequate emergency response programs is critical to limiting the potential for human injury.

Significance of Air Quality Impacts

Air quality impacts associated with static testing and waste propellant burning are expected to be of short duration, local in extent, and below health guideline concentrations. These impacts were therefore considered to be insignificant. Unplanned combustion of an ASRM segment, though also of small extent and short duration, presents a potential for injury to workers and the public since an accidental combustion is more likely to result in exposure of nearby individuals. Impacts associated with unplanned combustion were therefore considered to be moderately significant.

4.0 YELLOW CREEK, MISSISSIPPI

4.1 AFFECTED ENVIRONMENT

4.1.1 Site Description

The Yellow Creek site is located in the extreme northeastern corner of Mississippi in Tishomingo County (Figure 4-1). The site is located within 4 air miles of both the Tennessee and Alabama borders. The 1,168 acre site is situated along the shoreline of the Yellow Creek embayment of Pickwick Lake. Pickwick Lake and the Yellow Creek embayment are the result of the impoundment of the Tennessee River at Pickwick Dam, located 12 miles downstream of the Yellow Creek site. The elevated land mass upon which the Yellow Creek site sits can be roughly described as a 3 mile by 5 mile peninsula extending out into Pickwick Lake. The Yellow Creek State Inland Port is across the embayment from the site.

Both Pickwick Lake and the adjoining Yellow Creek embayment are used for commercial navigation and recreation. The main stem of Pickwick Lake is part of the Tennessee River Navigation System, providing access to the Mississippi and Ohio River Systems. The Yellow Creek embayment adjoins the Tennessee-Tombigbee Waterway, which connects the Tennessee River System with the Gulf Coast and Intracoastal Waterway at Mobile, Alabama.

The Yellow Creek site is the location of the Tennessee Valley Authority's (TVA) partially built Yellow Creek Nuclear Plant Units 1 and 2. The nuclear plants were under construction from 1978 through 1982, when construction was deferred. In 1984 TVA officially cancelled the project because the demand for additional electric power was not sufficient to warrant bringing the plant to completion and on line (Peck 1988; Fox 1988, personal communication).

The site includes a control area over about 400 acres of water around nearby Goat Island (NASA 1988b; Winborn 1988, personal communication). This water control area was originally part of the exclusion zone associated with the nuclear plant, and will be maintained to provide a Q/D safety zone for ASRM production activities (NASA 1988b). The site is about two-thirds cleared of trees and has nearly 10 miles of gravel roads, potable water, electrical power, rail access, and a barge dock with crane. There is about 700,000 square feet of building space in existing warehouses and other structures (NASA 1988b). A partially dismantled sewage treatment plant and concrete batch plant, as well as abandoned equipment and foundations for a cooling tower and other buildings, are on-site (Winborn 1988, personal communication). Currently about 11 TVA employees work at the abandoned nuclear plant site, surplusing construction materials and maintaining security.

The Yellow Creek site is located in a rural area with low population density. The nearest town is Iuka, Mississippi, a community of about 2,800 people located approximately 10 miles away. Road access to the site is generally through Iuka off Highway 25 and Red Sulphur Springs Road.

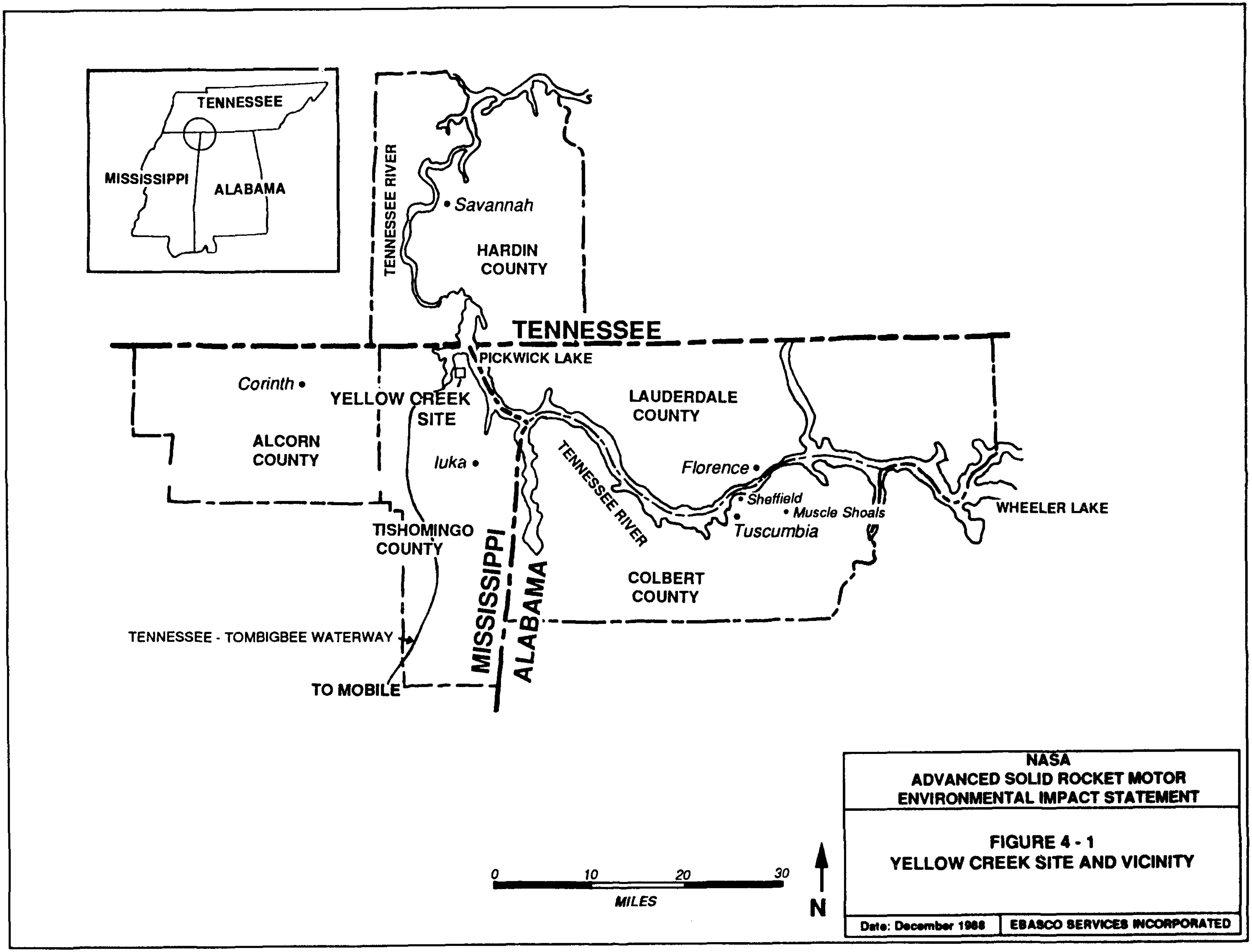


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FIGURE 4 - 1
YELLOW CREEK SITE AND VICINITY

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4.1.2 Air Resources

Climatology

A description of the climatology and meteorology of the Yellow Creek site is included in the Final Environmental Statement for Yellow Creek Nuclear Plant Units 1 and 2 (TVA 1978). Although this site is approximately 300 miles inland, its climate is heavily influenced by warm, moist air originating over the Gulf of Mexico. Prevailing southerly flow during the summer months brings that air mass northward, resulting in fair nights and warm, sunny days with frequent afternoon thundershowers. During the fall, a closed anticyclonic circulation (high pressure) often becomes established over the southeastern United States, resulting in prolonged periods of fair weather, light winds, and occasional widespread atmospheric stagnation. From late fall through early spring, cold continental air masses from the north often interact with the warm, moist Gulf of Mexico airmass forming frontal systems that induce widespread cloudiness and precipitation over this region. Winter is normally the wettest season and fall is the driest; however, rainfall occurs with regularity in all seasons. The average annual rainfall in the area is approximately 50 inches.

Temperatures in the Yellow Creek site area are characteristically warm in summer and mild in winter, and are probably moderated to some degree by the local water influence of the Yellow Creek embayment of Pickwick Lake (see Appendix A). Daily maximum and minimum temperatures in winter average approximately 50-55°F and 30-35°F, respectively. In summer, the average maximum temperature exceeds 90°F, while the average minimum is about 70°F. Temperature extremes of greater than 100°F and less than 0°F have been recorded in summer and winter, respectively. Relative humidity averages near 70 percent year around.

Southerly winds are most common in the summertime. Wintertime winds are variable, often veering (rotating clockwise) with the passage of transient front systems. In general, wind speeds are low at the Yellow Creek site, averaging less than 6 mph more than 60 percent of the time.

Severe weather is a rare occurrence at the Yellow Creek site. Hurricanes penetrating this far inland have usually degenerated to tropical depressions, resulting in widespread heavy rainfall and possible flooding, but little damage otherwise. Historical tornado frequencies in the region indicate that the probability of a tornado occurring at the site is very small. The estimated extreme wind speed (100-year return period) at the site is 80 mph, with peak gusts to over 100 mph. The estimated extreme maximum rainfall for a 24-hour period is 7.6 inches.

Long-term meteorological data are available for Memphis, Huntsville, Corinth, and Pickwick Dam. On-site meteorological observations were made at Yellow Creek during 1977-1981. No on-site data are currently being collected.

Atmospheric Transport and Dispersion

Conditions which relate to air pollution dispersion and transport are summarized in Holzworth (1972). The Yellow Creek site is in a region where light winds and stable atmospheric conditions, particularly during the fall months, may cause air stagnation and air pollution episodes near urban areas. This site has the greatest potential for limited dispersion conditions of the three government-owned sites under consideration.

Existing Sources of Air Pollution

The Yellow Creek site is in a rural area, removed from urban sources of air pollution.

Local Ambient Air Quality

The Yellow Creek site is in an area designated as "attainment" for all applicable air quality standards. Table 3-1 in Section 3.1 summarizes the air quality standards. There are no ambient air quality monitoring stations within 20 miles of the site. Air pollution control agencies which have authority over emissions originating at Yellow Creek include the following: the United States Environmental Protection Agency, Region IV Office, located in Atlanta, Georgia; and the Mississippi Department of Natural Resources, Bureau of Pollution Control, located in Jackson, Mississippi. The Bureau will have primary authority over air pollutant emissions at the Yellow Creek site.

4.1.3 Water Resources

Groundwater

Stratigraphy and Aquifer Identification:

The Yellow Creek site is underlain by unconsolidated clay, silt, fluvial gravel deposits, and cherty residuum derived from weathering of the underlying bedrock. These unconsolidated sediments range in thickness from less than one foot to over 230 ft at the southern portions of the site. Underlying the unconsolidated sediments is the Fort Payne Formation, which is a siliceous limestone.

Most of the available groundwater beneath the site is within the unconsolidated sediments above bedrock. Saturated thickness of the sediments ranges from 2 ft to 63 ft and averages about 25 ft at the site. Results of foundation exploration drilling (TVA 1976) indicate that bedrock is of extremely low permeability and contains almost no water.

Hydraulic Properties:

Measurements of permeability at the Yellow Creek site were estimated from particle size and distributions of soil rather than more reliable well test data. Approximately 90 percent of the values were estimated to be lower than 0.09 ft/day. Using a conservatively high value for hydraulic conductivity (21 ft/day), groundwater velocity was calculated at 18.5 ft/day (TVA 1976). Using a much more realistic 0.9 ft/day value for conductivity gives a groundwater velocity of 0.8 ft/day. Further evidence of low hydraulic conductivities was provided by piezometers that did not stabilize for two to three months after installation.

Water Levels and Flow Directions:

Groundwater in the unconsolidated sediments is largely unconfined and flows generally westward into Pickwick Lake. In the vicinity of Slick Rock Branch (a stream), the groundwater flows toward and discharges to the stream, which, in turn, flows westward to southwestward into Pickwick Lake. Any discharge of water from the site that reaches the water table will eventually flow into Pickwick Lake. Elevations of the water table range from a high of about 540 ft above sea level north of the site to the elevation of Pickwick Lake, about 414 ft above sea level (TVA 1976). An average gradient for the water table is approximately 200 to 250 ft per mile, which is a high gradient that is consistent with the estimates of low permeability.

Existing Groundwater Quality:

Groundwater in weathered materials above bedrock at the Yellow Creek site is soft, has a dissolved solids content of less than 50 mg/l, and has a pH of less than 7. Groundwater in the bedrock is moderately hard to hard, generally has a dissolved solids content of greater than 50 mg/l, and has a pH of 7 or greater. Groundwater quality data are summarized in Appendix B (TVA 1976).

Regulatory Aspects:

Wastewater discharged at the site would affect surface water much greater than groundwater because of the low permeability of the site soils (assuming no ponding). In the absence of regulations concerning groundwater specifically, the standards for surface water are assumed to apply to groundwater also. Water standards are shown in Appendix C. Aquifers beneath the Yellow Creek site are not considered (or proposed) to be sole source aquifers (Mikulak 1988, personal communication).

Surface Water

Description:

The surface waters in the vicinity of the Yellow Creek site have been previously described in the Final Environmental Statement and the Environmental Report for TVA's Nuclear Plant Units 1 and 2 (TVA 1978, TVA 1976). Although these descriptions pre-date the Tennessee-Tombigbee Waterway, they anticipated completion of this waterway and still represent the most complete characterization and data base for this site. The following discussion is based primarily on these reports.

The major surface water bodies in the Yellow Creek area include Pickwick Lake (Tennessee River) and Yellow Creek, forming the northern terminus of the Tennessee-Tombigbee Waterway. Several additional tributaries to these waterbodies are located within 10 to 20 miles of the site (Figure 4-2).

The 30-year average discharge (release) at Pickwick Dam is approximately 56,000 cubic feet per second (cfs). The minimum 7-day flow with a 10-year recurrence interval is estimated to be 12,100 cfs, while the maximum discharge was 585,400 cfs.

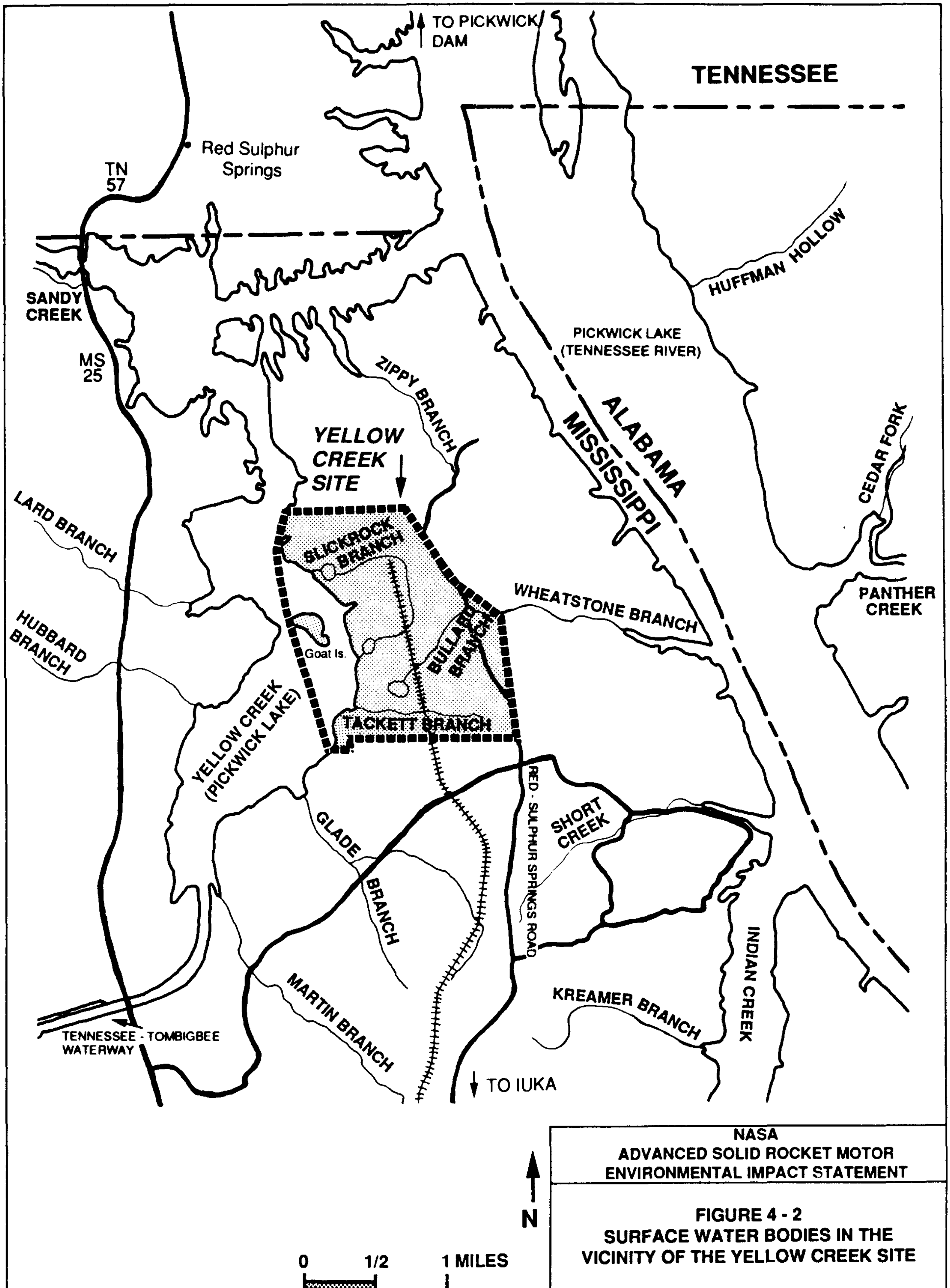

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FIGURE 4 - 2
SURFACE WATER BODIES IN THE VICINITY OF THE YELLOW CREEK SITE

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Yellow Creek is formed in Prentiss County, Mississippi, about 20 miles southwest of the site. It flowed northeastward into Pickwick Lake at Tennessee River Mile 215.1 until completion of the Tennessee-Tombigbee Waterway in the early 1980s.

Pickwick Lake is formed by Pickwick Dam approximately 12 miles downstream from the site on the Tennessee River. Pickwick Lake, at normal full pool elevation of 414 ft, backs water up Yellow Creek for 14 miles. Flows at the site are also affected by the operation of Wilson Dam, 44 miles upstream from the mouth of the Yellow Creek at Tennessee River Mile 259.4. Both reservoirs are operated for flood control, navigation, and power production. Stream flow in Yellow Creek embayment comes primarily from Pickwick Lake rather than the headwaters of Yellow Creek (TVA 1978).

In the immediate vicinity of the site three small branches enter Yellow Creek: Slick Rock Branch, Bullard Branch, and Tackett Branch (Figure 4-2). Slick Rock and Bullard Branches have been rechanneled by the previous construction for the nuclear power plant. The largest off-site tributary of Yellow Creek is Little Yellow (Marlow) Creek, with two branches draining into the canal channel.

Dredge and Filling History:

Extensive dredging has occurred immediately adjacent to the site. The Yellow Creek embayment of Pickwick Lake serves as the junction of the Tennessee-Tombigbee Waterway with the Tennessee River (Figure 4-2). The Tennessee-Tombigbee Waterway begins in the embayment as a 300-foot wide, 30-mile long channel that continues to the head of Bay Springs Lake.

Dredge materials were used to form canal banks or were disposed on upland areas adjacent to the canal. No material was disposed in the immediate vicinity of the Yellow Creek site. The nearest disposal was across the embayment north of Goat Island.

Existing Surface Water Quality:

The waters of Yellow Creek embayment are poorly buffered, with average pH values generally less than 7 (TVA 1978, TVA 1976). Total alkalinity of the embayment water averages about 15 mg/l, while the Tennessee River portion of the reservoir averages about 50 mg/l alkalinity. The total hardness averages about 15 mg/l in Yellow Creek embayment, which is very soft, while the Tennessee River area of the reservoir is moderately hard, averaging about 60 mg/l total hardness. Color in the water entering the reservoir as Yellow Creek drainage is considerably higher than levels normally found in the Tennessee River near the site. Dissolved solids concentrations average less than 100 mg/l in both areas of the reservoir near the site.

In the summer, the thermal structure of Yellow Creek embayment and Pickwick Lake may exhibit a warm surface layer 5 to 10 ft deep on warm, sunny days with the lower layer being essentially isothermal. During a diurnal cycle under adverse meteorological conditions, temperatures greater than 86°F can be expected near the water surface. Since natural inflow into Yellow Creek embayment is small, flows come primarily from Pickwick Lake. Although Pickwick Lake exhibits only weak thermal stratification, fairly strong dissolved oxygen stratification does occur during the summer months.

Lower Pickwick Lake has historically been noted for having good overall water quality. The industrial wastewaters discharged in the upstream Muscle Shoals area are effectively diluted and assimilated in the upper portion of the reservoir. Historical data indicate that, except for iron and manganese, the mean concentrations of minerals and trace metals satisfy standards for finished drinking water. However, the maximum measured concentrations of arsenic, lead, and mercury have exceeded these limits on occasion. Yellow Creek averaged less than 2 mg/l biological oxygen demand (BOD_5) and about 10 mg/l chemical oxygen demand (COD), while the Tennessee River averaged about 1.2 mg/l BOD_5 and less than 10 mg/l COD. The log mean fecal coliform concentrations were less than 10 per 100 ml in the Yellow Creek embayment.

Regulatory Aspects:

The regulatory aspects at this site in Mississippi are similar to the other Mississippi site, Stennis Space Center, previously discussed in Section 3.1.3. TVA no longer maintains an NPDES permit at the Yellow Creek site. The permit which applied to the proposed nuclear plant was rescinded effective October 27, 1987. Additionally, a Department of the Army Permit was issued to TVA for a barge terminal, coffer dam, and associated water intake at the proposed Yellow Creek Nuclear Plant Units 1 and 2. The permit expired on January 27, 1988.

4.1.4 Land Resources

Geology

Regional Geology:

The northeastern corner of Mississippi is a transition between two major geologic regions. To the south and west extends the Gulf Coastal Plain and its extension up the Mississippi embayment, with areas of thick deposition of unconsolidated sediments from the Jurassic age (135 to 180 million years ago) to the present. To the east and north lie the Appalachian Mountains and associated regions, with areas affected by the uplift and erosion of the mountains and the attendant sediment. Thus, the highest geological strata in the area are generally sands and gravels, with a smaller amount of silt and clay deposited by the main rivers, tributaries of the Tennessee River (TVA 1978). These sediments have been dissected, however, by descendents of the same streams which deposited them, as are the underlying unconsolidated materials deposited during the Mesozoic Era (the Eutaw and Tuscaloosa Formations of Cretaceous age, 63 to 135 million years ago) and the more consolidated Paleozoic Era sedimentary rocks (of Devonian through Mississippian ages, 310 to 400 million years ago).

Local Conditions:

The Yellow Creek site contains several strata exposed through the downcutting of the Tennessee River and Yellow Creek. Uppermost strata are unconsolidated, mainly sand and gravel fluvial terrace deposits left by these same rivers (TVA 1988) of undifferentiated Tertiary and Quaternary age (less than 63 million years ago). Underlying these are the Eutaw and Tuscaloosa Formations, sand and clay or gravel and sand respectively, which are of late Cretaceous age (USDA 1983). The next stratum beneath is the Fort Payne Formation of Mississippian age, consisting of a cherty residuum as the upper member and a silty limestone as the lower member. These materials are successively underlain by the Maury Shale, the Chattanooga Shale, and the Ross Formation. These formations date from Mississippian to Devonian. The Ross is the lowermost unit exposed at reservoir level (TVA 1978). The rocks at the site, mainly those in the Fort Payne Limestone, have unconfined compressive strengths of 15,000 to 47,000 lb/in^2 (TVA 1978).

Structure and Seismicity:

The site is located between the Nashville Dome tectonic province and the relatively active East Embayment block, approximately on the "bending zone" of the transition (TVA 1978). The maximum earthquake assumed to occur at the site, for the purposes of the earlier proposed nuclear plant, was a Modified Mercalli Intensity IX with maximum acceleration 0.3 g (acceleration due to gravity). Due to the conservative standards for nuclear facilities, this design earthquake is probably much more severe than any which are likely to occur at the site during the project life. The area is included in Seismic Zone 1 in the Uniform Building Code (1988), which indicates some consideration of seismic effects in the construction of conventional structures.

During the subsurface investigations for the proposed nuclear plant at the site, numerous borings were carried out to determine soil properties and to find any evidence of faulting in the vicinity. The borings showed no indication of faulting within a 5-mile radius of the site (TVA 1978).

<u>Physiography and Topography</u>

The Yellow Creek site is located in an eight mile wide transition zone between the Eastern Gulf Coastal Plain to the west and the Highland Rim section of the Interior Low Plateaus to the east (TVA 1978). In the immediate vicinity of the site, the upper parts of the valleys are gently sloped, similar to coastal plain topography, while the lower portions are incised into more resistant cherts and limestones and thus are narrow and steep-sided, similar to those in the Highland Rim. Elevations on the site vary from the nominal 414 ft water surface of Pickwick Lake to a high of about 625 ft at the top of the ridge (USGS various dates). Slopes range from virtually zero at the plateau along the ridgeline to or above 100 per cent at the bottom of the slopes near the edge of the reservoir. The average slope within the working area of the site, from the top of the ridge to the drop-off of the reservoir, is about 2.5 percent.

<u>Soils</u>

The soils of Tishomingo County were mapped by the Soil Conservation Service between 1972 and 1980 (USDA 1983). According to this mapping, most of the Yellow Creek site is covered with soils of the Saffell-Smithdale association (hilly). A smaller portion at the upland (eastern) edge of the site has Smithdale-Ruston association soils (hilly), or Ruston sandy loam, with 5 to 8 percent slopes (eroded). The Saffell-Smithdale soils are described as steep, well-drained soils in a hilly landscape of narrow ridgetops (Smithdale soils) and steep side slopes dissected by numerous short drainageways (where Saffell soils are found). Limestone outcrops are common on the lower side slopes. Both subtypes in the association are loamy with gravel or sand, siliceous, strongly acid (but not highly corrosive), moderately permeable, low in natural fertility, and readily erodible in the rapid runoff which commonly occurs there. Groundwater is typically more than 6 ft below ground surface. The main limitation of these soils for development is the hazard of erosion. It is not certain to what extent the construction activities which have already taken place on the site have modified these soils from their natural condition described by the soil survey.

4.1.5 Wetlands and Floodplains

Wetlands

The Yellow Creek site was mapped for wetlands by the USFWS National Wetland Inventory using 1980 aerial photographs taken prior to major site modifications for the Yellow Creek nuclear plant (USFWS 1988). Two small forested wetlands and two small marsh wetlands were mapped but inspection of 1983 (TVA 1986c) and 1986 (USGS 1985) aerial photographs indicate they have since been cleared or graded. The U.S. Geological Survey 7.5 minute Quadrangles do not show any marsh symbols signifying a wetland. No wetlands were mapped within the Yellow Creek site on the TVA wetlands and land use map compiled from 1980 photography. Two-thirds of the proposed site has been previously graded and stormwater runoff facilities have been at least partially constructed. A visual inspection of the area presented no evidence of the potential for wetlands at the site due to slope steepness, which averages 2.5 percent from the top of the site to the drop off above the lake. Three sediment control ponds, however, support aquatic vegetation and wildlife habitat (Beddow 1986). Wildlife habitat associated with these ponds is discussed in Section 4.1.6.

Floodplains

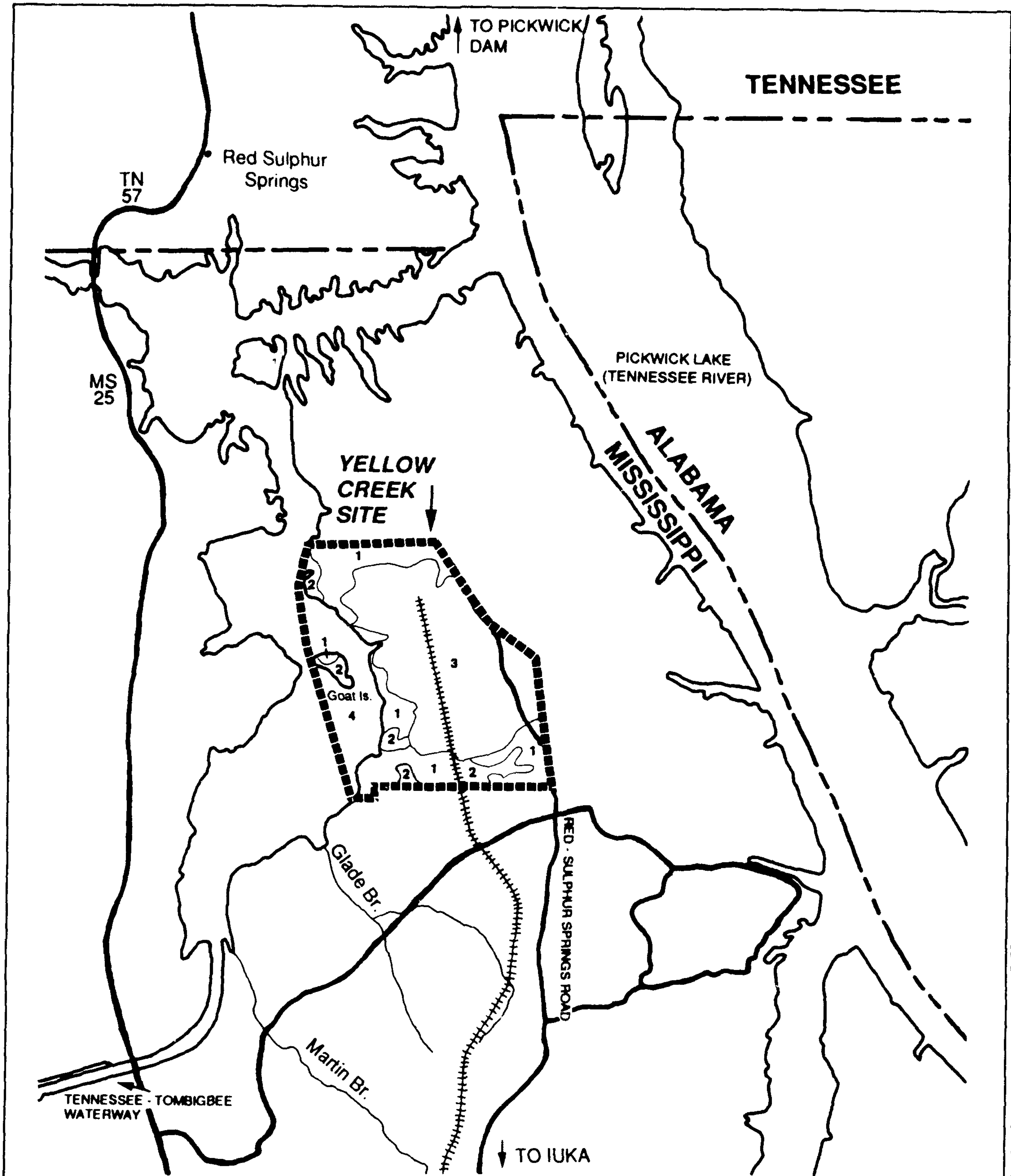
All 100 year and 500 year floodplains near or adjacent to the Yellow Creek site are partially controlled by TVA dams on the Tennessee River. The top spill gate elevation at Pickwick Dam is 418 ft, while normal pool elevation is 414 ft (TVA 1978). The 100-year flood elevation is 420 ft and the 500-year flood elevation is 421.5 ft at the Yellow Creek site (Lance 1988, personal communication). Ultimately, the adequacy of Pickwick Dam to withstand flood events will determine the extent of any flooding. As noted in Section 4.1.3, Pickwick Dam can accommodate flood period flows far in excess of historical unregulated flows in Yellow Creek. Two of the three streams on the site are channelized. The flooding periods and flooding extent for these streams are unknown. Overall, any impacts on the floodplain are expected to be insignificant.

4.1.6 Biotic Resources

Vegetation

Three major plant community types have been identified in the Yellow Creek site: 1) upland forest; 2) bottomland forest; and 3) forb-dominated clearings (Figure 4-3).

The upland forest type is the predominant undisturbed plant community on the Yellow Creek site. This community represents about 339 acres or 29 percent of the site. The upland forest type is dominated by loblolly pine (*Pinus taeda*). Some nearly



		ACRES
1 - UPLAND CONIFER / PINE	29%	339
2 - HARDWOOD	7%	82
3 - DISTURBED / DEVELOPED	64%	747
4 - WATER		1168

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FIGURE 4 - 3
VEGETATION MAP FOR YELLOW CREEK SITE

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pure stands of this species are remnants of old pulpwood plantations. Other upland forest areas include oaks (*Quercus sp.*), hickories (*Carya sp.*), black gum (*Nyssa sylvatic*), and American beech (*Fagus grandifolia*). A wide variety of shrubs, midstory trees, forbs, and vines are present in the understory of mesic upland forest sites (TVA 1978, USACOE 1982).

The bottomland hardwood community on the Yellow Creek site is restricted to the land adjacent to Pickwick Reservoir. This community represents about 82 acres or 7 percent of the site. Dominant tree species are sweetgum (*Liquidamber stryaciflua*), elm (*Ulnus sp.*), black gum, and red maple (*Acer rubrum*). Small trees, including sassafras (*Sassafras albidum*) and redbud (*Cercis canadensis)* form the midstory. Vines, such as honeysuckle (*Lonicera japonica*), are the primary groundcover (TVA 1978).

A total of 747 acres, or 64 percent, of the Yellow Creek site has been cleared. The cleared areas that are not covered with buildings or pavement have been planted with a mixture of tall fescue (*Festuca elatior*), weeping lovegrass (*Eragrostois curvula*) and sericea lespodza (*Lespodza cuneata*). A few eastern cottonwood (*Populus deltoides)* and loblolly pine are recolonizing portions of the cleared area, mainly along roads and ditches. A 1974 survey conducted prior to construction of the TVA nuclear facility at Yellow Creek documented the occurrence of crested fringed orchid (*Platanthera cristata*) on the site. This species is currently under consideration by the USFWS for classification as threatened or endangered (Wiseman 1988). This species is also proposed as endangered in Mississippi by the MDWC. An additional 14 plant species documented on the Yellow Creek site in 1974 are proposed by the MDWC as threatened, rare, or peripheral in Mississippi (Wiseman 1988, personal communication) (Appendix Table E-4). The occurrence of the these species currently on the Yellow Creek site is unknown.

Wildlife

During surveys conducted on the Yellow Creek site in 1974-1975, prior to the start of construction on the TVA nuclear facility, a total of 16 amphibian, 33 reptile, 112 bird, and 22 mammal species was observed. An additional 196 species have ranges that include the Yellow Creek site but were not observed and probably did not occur due to lack of suitable habitat (TVA 1978). Since two-thirds of the Yellow Creek site was cleared during construction, the current species diversity is probably much lower than that recorded in 1974. Small mammals and passerine birds are probably abundant in the cleared areas and are prey for raptors. These areas also provide good habitat for white-tailed deer (*Odocoileus virginianus*) and hawks (*Buteo sp.* and *Accipiter sp.*) (Beddow 1986). Bald eagles (*Haliaeetus leuocephalus*), bobwhite (*Colinus virginianus*), and hummingbirds (*Archilochus colubris)* have recently been observed on or near the Yellow Creek site (Beddow 1986; Winborn 1988, personal communication). In addition, three sediment control ponds on the Yellow Creek site provide habitat for migrating and wintering waterfowl and resident nesting wood ducks (*Aix sponga*). A wide variety of waterfowl, including the common goldeneye (*Bucephala clangula*), bufflehead (*B. albeola*), lesser scaup (*B. affinis*) and canvasback (*A. valisineria*) also have been observed on the spray-down ponds on the site (Beddow 1986).

Aquatic Resources

Two small streams, Slick Rock Branch and Tackett Branch, were present on the Yellow Creek site prior to site construction activities for the nuclear plant. These streams originally supported various small stream fish populations typical for this area. Except for portions of Tackett Branch, most streams have been rerouted or channelized. The relatively shallow Yellow Creek embayment has both shoreline and open water that provide spawning and nursery habitat for a variety of fish populations such as centrarchids (sunfishes) and cyprinids (shiners/minnows) (TVA 1976, TVA 1978).

Pickwick Reservoir contains about 98 species of fish (TVA 1986a). The upper portion of the reservoir is nationally known for its smallmouth bass fishery. Other important sport fish in the reservoir include largemouth bass, blue catfish (*Ictalurus furcatus*), channel catfish (*I. punctatus)*, crappie (*Pomoris sp.*), white bass (*Morone chrysops)*, and sunfish. Commercial species harvested from Pickwick Reservoir include paddlefish (*Polydon spatula*), buffalo (*Ictiobus sp.*), blue catfish, and flathead catfish (*Pylodictis olivaris*).

Freshwater mussels are also important aquatic species found in Pickwick Reservoir. Surveys conducted in July 1977 in the vicinity of the site found sparsely scattered mussels throughout the Yellow Creek embayment but no large beds (TVA 1978).

Threatened and Endangered Fish and Wildlife Species

USFWS records indicate that no federally designated endangered, threatened, or proposed species or their critical habitats occur within the Yellow Creek site (James 1988). Bald eagles have been observed during the winter at nearby Cooper Falls Natural Area (see Section 4.1.7).

A total of 13 wildlife species proposed as rare, peripheral, or of special concern in Mississippi have been documented on the site (Appendix Table E-5) (Wiseman 1988). Most observations of these species were made in or before 1974 and their current status on the Yellow Creek site is unknown. However, some of these species could still be present in the undisturbed areas at the Yellow Creek site.

4.1.7 Land Use

Land Use Characterization

Yellow Creek Site:

The Yellow Creek site consists of approximately 1,168 acres of which two-thirds are industrial lands, with the remaining one-third in forest/open space uses. The site is already highly disturbed and no prime soils are found on-site (Soil Conservation Service 1988, personal communication). Prior to site grading of the abandoned Yellow Creek nuclear plant, prime soils were found on about 105 acres of the site (TVA 1978).

Regional Land Use:

Figure 4-4 shows the distribution of land uses within the project vicinity. The Yellow Creek area can generally be classified as rural. Forestry, recreation, and rural residential use predominate. The nearest cropland is found about 5 miles west of the site. The Yellow Creek embayment as well as the rest of Pickwick Lake are heavily used for recreation.

Adjacent to the site are forest lands owned by the Tennessee River Pulp and Paper Company and rural residences with scattered pasturelands. The paper company owns one 500-acre parcel adjacent to the north boundary of the site. Trees on this parcel are about 10 to 12 years into a 30-year harvest cycle (Carpenter, J. 1988, personal communication).

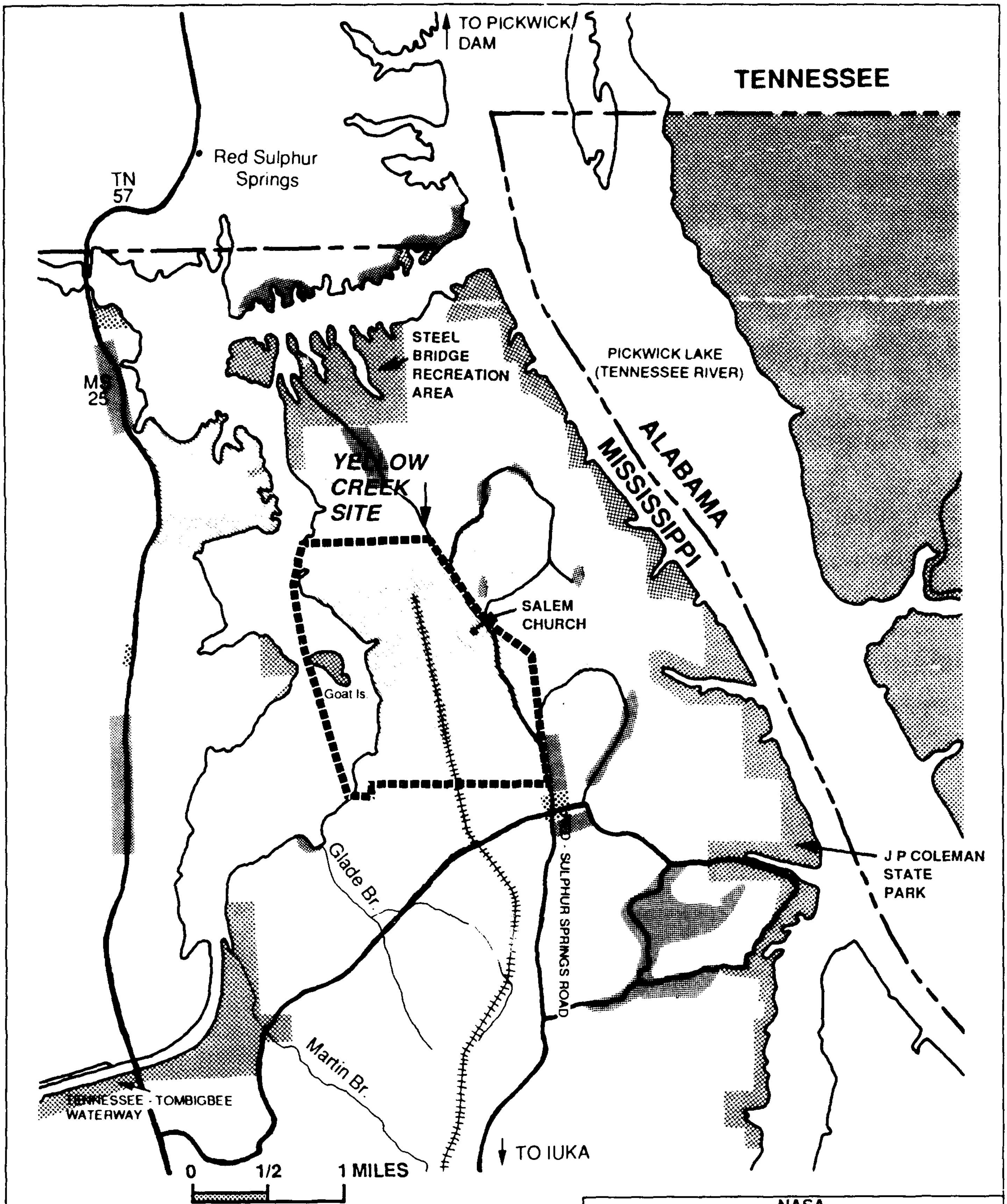
The Salem Church and cemetery are situated on a 2.7 acre parcel along Red Sulphur Springs Road adjacent to the Yellow Creek site. About 15 to 20 houses are situated near the site and across Red Sulphur Springs Road (also known as Steel Bridge Road). Red Sulphur Springs Road continues north, passing by the site and a barricaded site access road. One mile north from the site at the end of Red Sulpher Springs Road are the semi-developed Steel Bridge State Recreation Area and an additional dozen homes and summer cabins.

Within one half-mile of the Yellow Creek site is a small commercial development at the Coleman-Short intersection. The Yellow Creek Port and associated industrial areas are located across the Yellow Creek embayment along with several water related recreation facilities. The 200-acre Yellow Creek Port serves commercial barge traffic on both the Tennessee River and Tennessee-Tombigbee Waterway. The port also leases 2,900 acres to an industrial district whose only major tenant is Monotech Steel Fabricators, with 60 employees (Knight 1988, personal communication; Cook Goggin Engineers Inc. 1975).

J.P. Coleman State Park is a highly developed recreation facility located two miles directly east of the Yellow Creek site. The 1,400 acre park consists of cabins, full hookup campsites, fishing pier, marina, boat launches, picnic facilities and a restaurant. Annual visitation to the park is about 150,000. The Steel Bridge Recreation Area falls under the jurisdiction of Coleman State Park. The Steel Bridge Recreation Area consists of a boat ramp and gravel parking area. No records of visitation are kept for the recreation area, although observations have shown that about a dozen campers use the facility on any given summer weekend (Marker 1988, personal communication).

The Cooper Falls Natural Area is located adjacent to J.P. Coleman State Park. This natural area is part of TVA's Wildlife and Natural Heritage Resources Program. Cooper Falls Natural Area consists of 73 acres primarily accessible by boat. The natural area was set aside in 1974, and was enlarged in 1980 to protect the scenic beauty of the area as well as to protect winter habitat for bald eagles (Marker 1988, personal communication).

Directly across the Yellow Creek Site is a TVA recreation area known as Goat Island Recreation Area. The facility consists of a mainland area and an island. The mainland area has campsites, a boat ramp, and day use facilities on about 30 acres.



LEGEND

- RESIDENTIAL
- COMMERCIAL
- FOREST / OPEN SPACE
- PASTURE
- INDUSTRIAL
- RECREATIONAL

NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 4 - 4
GENERALIZED LAND USE IN THE VICINITY OF YELLOW CREEK SITE

Date: December 1988 | EBASCO SERVICES INCORPORATED

Adjacent to the mainland area is a small marina which TVA has recently leased to a private operator. All recreation facilities were removed from the island portion (Goat Island) when it was part of the exclusion zone associated with the proposed nuclear plant. Some dispersed recreation use does occur on the island, and no restrictions are currently imposed.

Several other recreation facilities exist around Pickwick Reservoir and Yellow Creek embayment. Within Yellow Creek embayment are two large private marinas with over 600 slips and seven boat ramps for recreational use. Some commercial fishing occurs near public access points in the embayment (Harris 1988, personal communication; Counce 1988, personal communication). The last count of total recreation visits for the entire Pickwick Reservoir was done by TVA in 1978. At that time, annual recreation visits for the entire reservoir was 6,324,000 (Marker 1988, personal communication). Estimates for the area immediately adjacent to the Yellow Creek site are not available.

Land Use Plans, Policies, and Controls

Tishomingo County has no zoning ordinances and no comprehensive plan. The Northeastern Mississippi Planning and Development District in Booneville, Mississippi had prepared land use plans for northeastern Mississippi several years ago, although those plans were never adopted or widely utilized (Falkner 1988, personal communication).

Although no land use controls are implemented by local and state authorities, TVA has jurisdictional authority over the shorelines of Pickwick Reservoir. Section 26a of the TVA Act of 1933 states that any placement of a structure along the highwater line of a TVA reservoir requires TVA approval. TVA has control over the reservoir shoreline up to the maximum shoreline contour of 423 ft elevation (TVA et al. 1981). TVA has also prepared a reservoir plan for Pickwick Reservoir and the 17,370 acres of adjoining lands which TVA owns (TVA et al. 1981). This plan, prepared in 1981, is a decision-making tool rather than a master plan. As a decision-making tool, the plan identifies alternative sites for a variety of uses to assist TVA in handling requests for use of its lands.

Three parcels of TVA land are within one and one-half miles of the Yellow Creek site. All three sites are currently undeveloped and are located on the Yellow Creek peninsula. The future use allocations given to the three sites include general forest management, safety harbor designation, and minor commercial landing capabilities, as well as access for future development.

The only known land use proposals in the area include an expansion of Coleman State Park and a potential subdivision near the Coleman-Short intersection. If lands are appropriated by the Mississippi Legislature in 1988, Coleman Park and Steel Bridge Recreation Area will undergo a four million dollar expansion, primarily designed to add new facilities. Other future use developments include a 93-acre area just south of the Yellow Creek site, which is planned for a future subdivision. Several lots have already been sold (Harris 1988, personal communication).

4.1.8 Socioeconomics and Infrastructure

Study Area Definition

For analysis purposes, the Yellow Creek study area is defined as those counties which are included within a one-hour commuting distance from the site (Figure 4-5). As defined, this area includes Tishomingo and Alcorn Counties, Mississippi; Hardin County, Tennessee; and Colbert and Lauderdale Counties, Alabama. Major cities within the study area include Iuka and Corinth in Mississippi, Savannah in Tennessee, and Tuscumbia, Sheffield, Muscle Shoals, and Florence in Alabama. Most of Lauderdale County is beyond the one-hour commuting distance but is included in the study area because of Florence's proximity to Tuscumbia and Sheffield.

The study area is mainly rural in nature with the Tuscumbia-Sheffield- Muscle Shoals-Florence-area (the Quad Cities) being the only major urban center in the area. Huntsville, Alabama, and Memphis, Tennessee are the closest major metropolitan areas. They lay directly east and west of the study area, respectively.

Demographic Characteristics

Population:

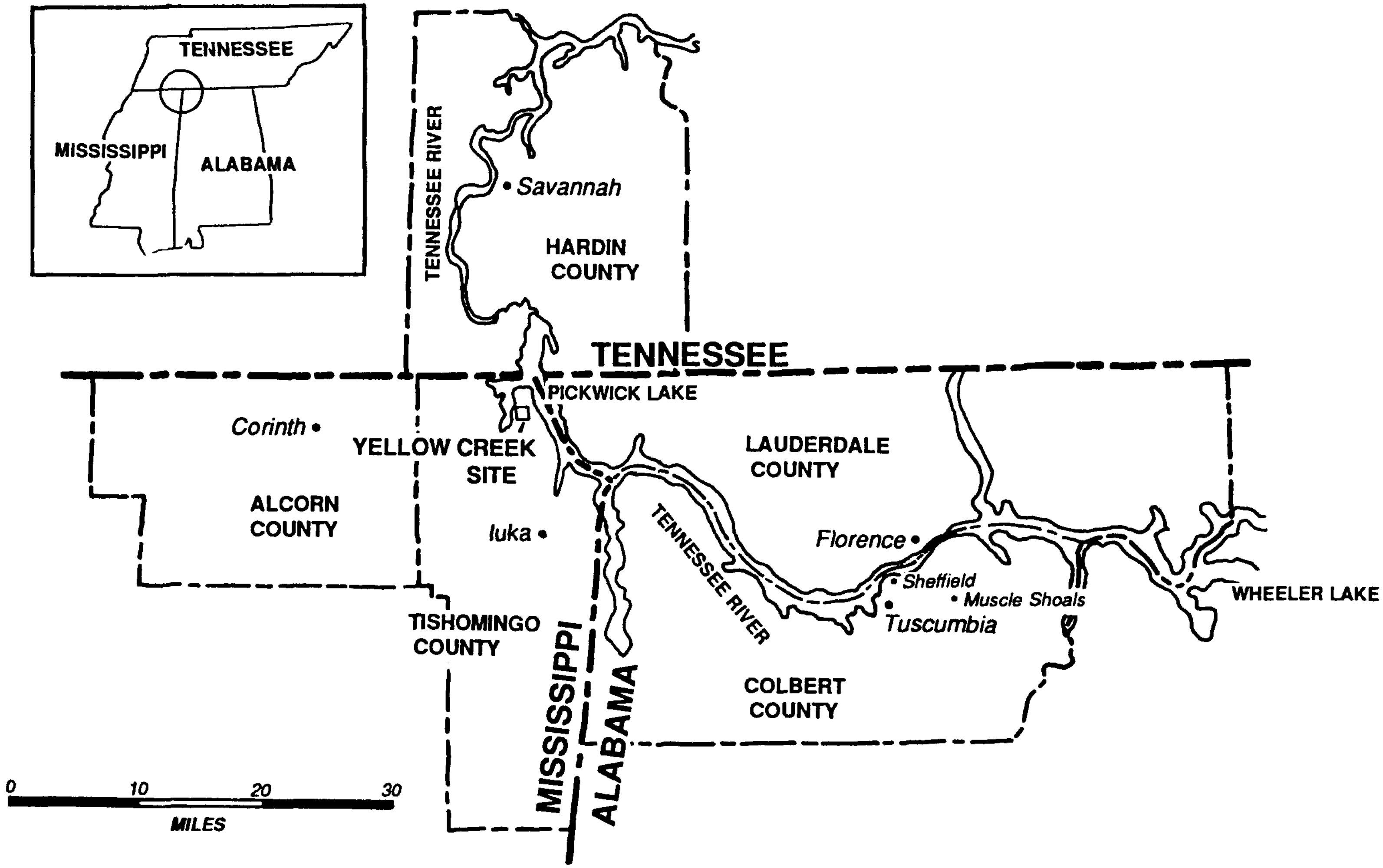
Total population in the five county study was 208,900 in 1987 (Table 4-1). There was no measurable change in population since 1980. This compares to a growth rate for the same time period in Mississippi, Tennessee, and Alabama of about one-half percent per year. Tishomingo County, Mississippi and Hardin County, Tennessee currently project the highest average annual growth percentages between 1985 and 2000, 1.6 and 1.2 percent, respectively (Table 4-2).

Population is concentrated in the Quad Cities area of Alabama, on the eastern edge of the study area. In 1987, 2 percent of Mississippi's population, 0.5 percent of Tennessee's population and 3 percent of Alabama's population resided within the study area.

Employment:

As noted in Table 4-3, all three states have had unemployment rates at or above the national averages during the 1980s. The states had somewhat better records in the 1970s. During the 1970s and 1980s, all of the counties in the study areas consistently had unemployment rates above their respective state averages. Tishomingo and Alcorn counties had particularly high rates in 1985, 22.4 and 17.2 percent, respectively. This was due in part to the cancellation of construction at the Yellow Creek Nuclear Plant.

In 1987 the overall labor force (aged 16 and over) in the five county study area consisted of 93,710 people (Table 4-4). Table 4-4 shows the breakdown of this labor force by the major employment sectors. Manufacturing was the dominant sector in all five counties.



NASA
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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 4 - 5
YELLOW CREEK SITE
SOCIOECONOMIC STUDY AREA

Date: December 1988 | EBASCO SERVICES INCORPORATED

Table 4-1. Population Distribution - Yellow Creek Study Area.

Location	1980[1]	1987[2]	Percent Change
Mississippi	2,520,638	2,625,000	+4
Tishomingo County	18,434	18,100	-2
Alcorn County	33,036	32,700	+1
Tennessee	4,591,120	4,855,000	+6
Hardin County	22,280	22,100	-1
Alabama	3,893,888	4,083,000	+5
Colbert County	54,519	53,600	-2
Lauderdale County	80,546	82,400	+2
Study Area Total	208,815	208,900	0

Source: [1] U.S. Department of Commerce, 1983
[2] Brenner, 1988

Table 4-2. Population Projections - Yellow Creek Study Area.

Location	1985	1990	1995	2000
Missisppi	2,614,000[1]	2,700,700[2]	2,764,600[2]	2,802,300[2]
Tishomingo County	18,000[1]	20,300[2]	21,600[2]	22,800[2]
Alcorn County	32,700[1]	34,000[2]	35,700[2]	37,000[2]
Tennessee	4,767,000[1]	5,068,811[3]	5,258,926[3]	5,514,832[3]
Hardin County	22,400[1]	24,449[3]	25,446[3]	26,655[3]
Alabama	4,021,517[4]	4,194,783[4]	4,360,640[4]	4,524,851[4]
Colbert County	54,298[4]	54,990[4]	55,376[4]	55,485[4]
Lauderdale County	81,898[4]	85,443[4]	88,722[4]	91,751[4]
Study Area Totals	209,296	219,182	226,844	233,691

Source: [1] Brenner, 1988
[2] McNeec, 1988
[3] University of Tennesse, 1986
[4] Alabama Department of Industrial Relations, 1988

Table 4-3. Unemployment Rates - Yellow Creek Study Area.

Location	1970	1975	1980	1985
Mississippi[1]	5.2	8.3	7.4	10.3
Tishomingo County[1]	10.6	10.3	8.0	22.4
Alcorn County[1]	6.9	15.3	13.0	17.2
Tennessee[2]	4.3	8.3	7.3	8.0
Hardin County[2]	5.7	10.0	9.2	15.4
Alabama[3]	Not Comparable		7.1	7.2
Colbert County	Not Comparable		11.0	13.4
Lauderdale County	Not Comparable		9.8	10.9
United States[4]	4.9	8.5	7.1	7.2

Source: [1] Lewis, 1988
[2] Ferguson, 1988
[3] Alabama Department of Industrial Relations, 1988
[4] Sadler, 1988

Table 4-4. Labor Force Breakdown by Sector - Yellow Creek Study Area, 1987.

Employment Sector	Mississippi[1]	Tishomingo County[1]	Alcorn County[1]	Tennessee[2]	Hardin County[2]	Alabama[3]	Colbert County[3]	Lauderdale County[3]
Manufacturing	228,000	2,480	680	495,400	3,060	367,600	12,620	*
Mining	6,000	40	10	NR	NR	NR	NR	*
Construction	33,900	100	20	96,600	90	NR	2,120	*
Transporation and Public Utilities	42,000	180	40	103,300	120	NR	1,540	*
Wholesale and Retail Trade	185,500	900	220	474,000	1,110	NR	10,660	*
Fiance, Insurance, and Real Estate	38,500	150	50	102,000	140	NR	1,690	*
Service and Miscellaneous	138,400	520	250	407,100	480	NR	6,050	*
Government	191,500	820	550	323,500	1,250	NR	10,720	*
Public Education	86,700	340	280	NR	NR	NR	NR	*
Agriculture	27,800	90	110	--	--	NR	--	*
Other Nonagricultural Workers	84,100	470	1,360	6,600	50	1,134,600	--	*
Unemployed	117,000	1,400	1,990	154,000	940	147,000	5,420	*
Civilian Labor Force	1,151,000	7,410	15,950	2,335,000	9,990	1,893,000	60,360	*

Totals may not add due to rounding.
-- = Not reported.
NR = Not reported separately.
* = Colbert and Lauderdale Counties are reported as the Florence M.S.A.
Source: [1] Mississippi Employment Security Commission, 1988
[2] Tennessee Department of Employment, 1988a
[3] Alabama Department of Industrial Relations, 1988

Figure 4-6 shows the residential distribution of the Yellow Creek Nuclear Plant construction personnel by location. Although this number represents construction rather than operations personnel, it gives some indication of commuting patterns. Construction personnel were fairly evenly distributed throughout the study area, with Tishomingo county having the highest percentage at 27 percent.

Income:

Per capita income in Tishomingo County in 1986 was 10 percent below the Mississippi State average of $9,697, while Alcorn County was 6.5 percent above the state average (Table 4-5). Hardin County per capita income was nearly 23 percent below the Tennessee State average of $11,995. Colbert and Lauderdale were 9 and 8 percent, respectively, below the Alabama State average of $11,315. One reason for the low per capita income figures in the area is the high unemployment rates in the area. All counties averaged per capita incomes considerably lower than the national average of $14,612.

The percent of persons with incomes below the poverty level was below the state figures in all counties except Hardin, where the rate was substantially higher. All of the counties and states had percentages above the national average of 12.4 percent (Table 4-5).

Housing:

Local real estate ads and conversations with Chamber of Commerce personnel indicate the average selling price for a three-bedroom, 2-bath home in the study area is between $50,000 and $75,000 (Russell, 1988; Neese, 1988; Alabama Association of Realtors, 1988). Most homes in the area stay on the market for 4 to 6 months (Neese, 1988; Alabama Association of Realtors, 1988). The cancellation of the nuclear plant during construction has left an excess supply of homes (Russell, 1988). Rental prices are reasonable because home prices are low (Russell, 1988). High unemployment rates and low per capita income levels further burden the housing market.

<u>Infrastructure and Services</u>

Law Enforcement:

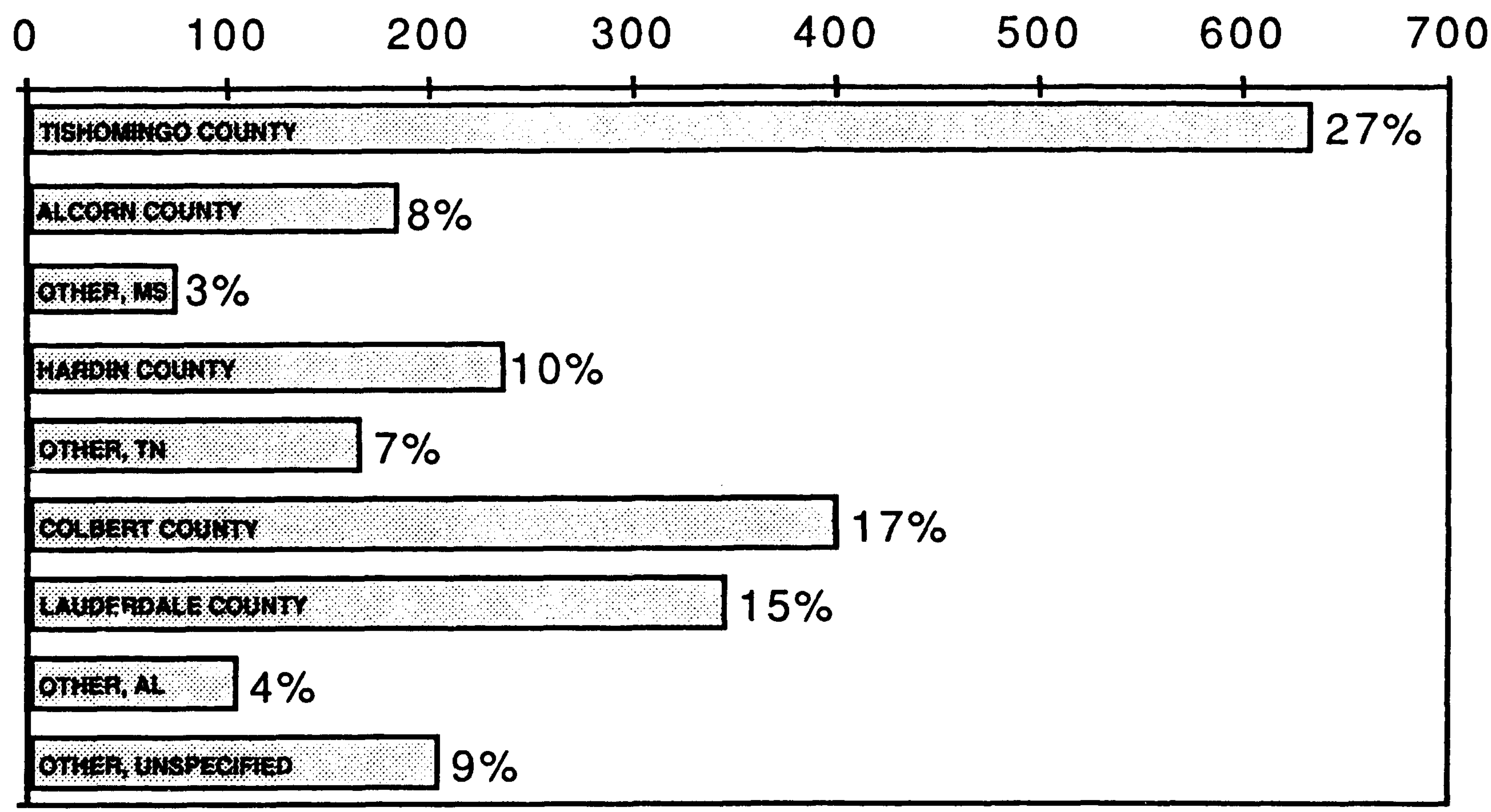
Each county and major city in the study area is currently serviced by a law enforcement agency. The rural areas are serviced by sheriff's departments and the urban areas by city police departments. Table 4-6 provides a breakdown of the number of law enforcement personnel currently employed in each jurisdiction. A recent federal study established a 2.1/1,000 officer to population staffing guideline for assessing the adequacy of current staffing levels (USDI 1982). All counties in the study area are below this level. Colbert County has the highest ratio of 1.82/1,000, and Tishomingo County has the lowest with .72/1,000.

Fire Protection:

Each county and major city in the study area is currently serviced by a fire protection agency. The Mississippi Forestry Commission provides wildfire control services in the area. Rural fire departments are usually supported by an extensive volunteer team of firefighting personnel. Some urban fire departments are also supported by a

FIGURE 4 - 6

RESIDENTIAL DISTRIBUTION OF YELLOW CREEK NUCLEAR PROJECT CONSTRUCTION PERSONNEL BY LOCATION



SOURCE: Walters, 1981

Table 4-5. Per Capita Income - Yellow Creek Study Area.

Location	Per Capita Income (1986)	Percent Below Poverty Level (1980)[5]
Mississippi	$9,697[1]	23.9
Tishomingo County	$8,735[1]	13.5
Alcorn County	$10,327[1]	18.5
Tennessee	$11,995[2]	16.5
Hardin County	$9,255[2]	20.4
Alabama	$11,315[3]	18.9
Colbert County	$10,268[3]	14.5
Lauderdale County	$10,381[3]	14.8
United States	$14,612[4]	12.4

Source: [1] Mississippi Employment Security Commission, 1988
[2] Tennessee Department of Employment Security, 1988b
[3] Alabama Department of Industrial Relations, 1988
[4] Pitts, 1988
[5] U.S. Dept. of Commerce, 1984

Table 4-6. Law Enforcement and Fire Protection - Yellow Creek Study Area.

Location	Law Enforcement			Fire Protection	
	Full Time	Part Time	Number of Patrol Cars	Full Time	Volunteer
Tishomingo County (Rural)[1]	6	0	8	3[13]	75[13]
Iuka[2]	7	0	3	12[13]	10[13]
Alcorn County (Rural)[3]	16	0	8	0[14]	200-225[14]
Corinth[4]	26	0	8	37[14]	0[14]
Hardin County (Rural)[5]	14	3	10	0[15]	250[15]
Savannah[6]	13	8	6	5[15]	30[15]
Colbert County (Rural)[7]	30	10	10	31[16]	11[16]
Tuscumbia[8]	20	8	8	10[16]	14[16]
Muscle Shoals[9]	25	0	4	18[17]	0[17]
Sheffield[10]	23	0	5	23[18]	0[18]
Lauderdale County (Rural)[11]	22	6	12	N/A	N/A
Florence[12]	70	0	32	71[19]	0[19]

-- Information not available or nonexistent.
N/A - Not applicable to this study.

Source:
[1] Eaton, 1988
[2] Brumly, 1988
[3] V. Jones, 1988
[4] Johnson, 1988
[5] Rohert, 1988
[6] D. Cannon, 1988
[7] Mays, 1988
[8] Kelly, 1988
[9] Klinger, 1988
[10] Holt, 1988
[11] Townsend, 1988
[12] Wilson, 1988
[13] Biggs, 1988
[14] Young, 1988
[15] Beckhim, 1988
[16] McKee, 1988
[17] Lesley, 1988
[18] Isbell, 1988
[19] Minor, 1988

volunteer team. Table 4-6 also provides a breakdown of the personnel of each fire department in the study area. Ratings for the current service level provided by these fire departments are not available.

Schools:

Table 4-7 shows the number of public schools and school enrollment for each county in the study area for the 1988/89 school year. The latest student/teacher ratio figures available for the study area counties are for the 1986/1987 school year. The planning guideline (USDI 1982) is 1 teacher for every 18 students. Alcorn County has the highest ratio at 1:17 and Hardin County has the lowest at 1:21. In addition to the numerous public schools, there are 6 two-year colleges and technical schools and 1 four-year college or university (Russel 1988; Bunch 1988; Tennessee Department of Employment Security 1988b) in the five county study area. There are also several private and religious schools located throughout the study area.

Health Services:

There are 7 hospitals in the five county study area providing 1,205 beds for patient care (Table 4-8). Colbert and Lauderdale Counties provide over three quarters of the patient beds at their 4 hospitals. In addition to these primary care facilities, there are several private physician run clinics and nursing homes in the area, as well as many dental clinics. Currently, all three states suffer statewide physician, dentist, and nurse shortages (U.S. Army 1976). According to the American Medical Association (King 1988), there were 131 doctors per 100,000 people in Mississippi in 1986. Tennessee reported 194 physicians per 100,000 people and Alabama had 157 physicians per 100,000 people (King 1988). These averages are well below the national average of 225 physicians per 100,000 people (King 1988). The entire study area has an average of 246 physicians per 100,000 people. Tishomingo County has the lowest ratio of 28 per 100,000 and Colbert County has the highest with 360 physicians per 100,000 people. Only Colbert and Lauderdale Counties have ratios above the state and national averages.

As noted in Section 3.1.8, there is an estimated 20 percent nursing shortage in the United States (Armstrong, H. 1988). Rural areas such as the Yellow Creek study area are generally even more understaffed because of a lack of facilities, low incomes, and a sparse population.

Public Utilities:

Table 4-9 illustrates the current public water, sewer, and solid waste disposal capabilities and capacities for the five counties and major cities in the study area. While some of these facilities are currently at or approaching capacity (CH2M Hill 1987), the majority seem capable of handling the additional demand that the project may create.

Table 4-7. Public School Information (1988/89 School Year).

Location	Number of Public School Districts	Number of Schools	Total Enrollment	Teacher/Student Ratio (86/87 School Year)
Tishomingo County[1]	2	8	2,850	1:18.4[6]
Alcorn County[2]	2	10	4,110	1:17.0[6]
Hardin County[3]	1	12	4,000	1:21.3[7]
Colbert County[4]	4	27	8,862	1:17.3[8]
Lauderdale County[5]	2	20	13,167	1:18.9[8]
Totals	11	77	32,989	

Source: [1] Stone, 1988, Green, 1988
[2] Walker, 1988
[3] Howard, 1988
[4] Clemmons, 1988; Tomberlin, 1988; R. Moore, 1988; Boyd, 1988
[5] Bebis, 1988
[6] L. Cannon, 1988
[7] Blackman, 1988
[8] Ramey, 1988

Table 4-8. Health Care Facilities - Yellow Creek Study Area, 1987/88.

Location	Number of Hospitals	Number of Beds	Number of Physicians	Number of Reg. Nurses
Tishomingo County[1]	1	99	5	20
Alcorn County[2]	1	178	30	110
Hardin County[3]	1	83	15	34
Colbert County[4]	2	313	193	220
Lauderdale County[5]	2	532	271	273
Study Area Total	7	1,205	514	657

Source: [1] Parsons, 1988
[2] Witfield, 1988
[3] May, 1988
[4] Clark, 1988; McGuire, 1988
[5] B. Smith, 1988; O'Neil, 1988

Table 4-9. Water, Sewer, and Solid Waste Disposal Facility - Yellow Creek Study Area.

	Water			Sewer and Solid Waste				
Unit of Government	Source	System Capacity Gal/Day	Storage Capacity Gallons	Type of Treatment Plant	Capacity Million Gal/Day	Present Load (Percent)	Storm Sewer Percent Comm. Covered	Method of Solid Waste Disposal
Tishomingo County	Contract Purchase[1]	Unlimited	--	--	--	--	--	Landfill[18]
Iuka	Wells[1]	1,000,000	900,000	Conventional Lagoon[11]	180	70	65	Landfill[19]
Alcorn County	Wells[2]	500,000	240,000	--	--	--	--	Landfill[20]
Corinth	Wells[3]	7,002,000	4,200,000	Activiated Sludge[12]	3	100	60	Landfill[21]
Hardin County	Wells[4]	1,106,000	900,000	--	--	--	--	Landfill[22]
Savannah	Wells[5]	2,500,000	1,625,000	Aerated Lagoon[13]	3.6	22	50	Landfill[22]
Colbert County	Contract Purchase[6]	Unlimited	1,950,000	--	--	--	--	Landfill[23]
Tuscumbia	Spring[7]	2,000,000	1,000,000	Sedimentation Digestion[14]	1.62	37	100	Landfill[24]
Muscle Shoals	Reservoir[8]	6,000,000	1,600,000	Activated Sludge[15]	1.3	50	25	Landfill[25]
Sheffield	River[9]	3,000,000	7,000,000	Standard Aeration[16]	3.9	33	70	Landfill[26]
Lauderdale County	*	*	*	*	*	*	*	*
Florence	Creek[10]	14,000,000	500,000	Activated Sludge[17]	10	75	50	Landfill[27]

-- Information not available or nonexistent. * Information not collected.

Source:
1 Butler, 1988
2 Maxcy, 1988
3 Lilly, 1988
4 Franks, 1988; Hopper, 1988a
5 T. Smith, 1988
6 Head, 1988
7 Ricks, 1988
8 Burcham, 1988
9 L. Moore, 1988
10 Armstead, 1988
11 Butler, 1988
12 Glover, 1988
13 T. Smith, 1988
14 Sims, 1988
15 Burcham, 1988
16 Bolton, 1988
17 Doyle, 1988
18 Cooley, 1988
19 Biggs, 1988
20 Joiner, 1988
21 Bynum, 1988
22 T. Smith, 1988
23 Ricks, 1988
24 Sims, 1988
25 Clanton, 1988
26 L. Moore, 1988
27 Inman, 1988

4.1.9 Transportation

Local Road Transportation

The principal highways serving the Yellow Creek study area are U.S. Highway 72; Mississippi Highways 25, 350, and 365; and the Iuka-Red Sulphur Springs Road, a county highway that is part of the federal-aid system (Figure 4-7). Mississippi 25 becomes Tennessee 57 north of the state line. U.S. 72 has four lanes from Burnsville, Mississippi eastward, and is being upgraded to four lanes from Burnsville west toward Corinth. Other highways in the area are two-lane roads. Direct access to the Yellow Creek site is via the Iuka-Red Sulphur Springs Road, which intersects with Mississippi 25 about 2 miles north of Iuka. Alternately, two other county roads intersect Mississippi 25 approximately 5 and 7 miles north of Iuka and lead toward the site. All travelers to the site therefore must use Mississippi 25 at some point. Beyond the immediate site area, U.S. 72 provides linkages with Corinth to the west and the Quad Cities area of Alabama to the east, and Mississippi 25/Tennessee 57 connects with the Hardin County area of Tennessee.

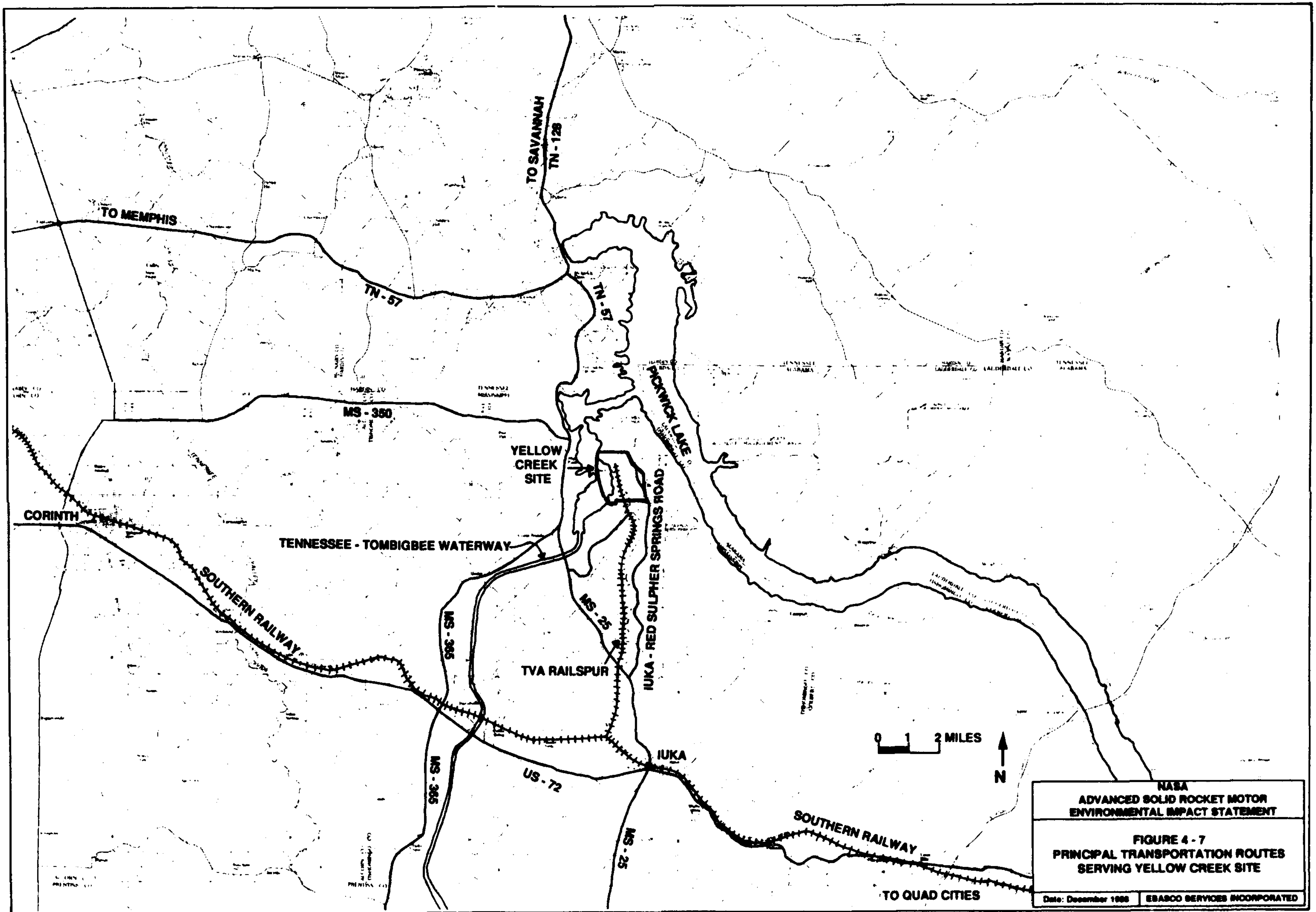
Mississippi 365 provides an alternate route to Mississippi 25 from the west side of Yellow Creek embayment southward to U.S. 72. Mississippi 350 is an east-west route from U.S. 45 north of Corinth directly to Mississippi 25 at the Yellow Creek Port, and therefore is an alternate route to U.S. 72. Tennessee 128 extends northward from Tennessee 57 to Savannah.

With the exception of the Quad Cities area, commuting patterns in the study area are relatively indistinct due to the comparative absence of major population and employment centers. Communities such as Corinth and Iuka, and scattered industrial sites near Pickwick Lake, generate modest commuting volumes. The largest commuting flows in the study area are into the Quad Cities, particularly the Colbert County portion. In 1980, an average of more than 10,000 workers commuted into Colbert County for employment (Alabama Department of Economic and Community Affairs 1988; Gilder 1988). There currently are no public transit services available in the study area. Efforts to establish transit service were underway in 1986 (TVA 1986b), but have not yet been successful. TVA operated a bus and van pool program for Yellow Creek nuclear plant workers during construction, which served workers residing in the Quad Cities and elsewhere (Walters 1981).

Existing traffic volumes on selected road segments in the study area are indicated in Table 4-10. Among these locations, average daily traffic (ADT) in 1987 was highest on Mississippi 25 north of its junction with US 72, with a volume of 7,520 vehicles. East of Iuka traffic on US 72 ranged from about 4,800 to over 6,600 ADT, while west of Iuka volumes were generally between 6,000 and 7,000 ADT. Traffic flows on Mississippi 25 declined to 1,760 vehicles north of the Iuka-Red Sulphur Springs Road, but increased again to nearly 3,300 north of Mississippi 365.

Rail and Water Transportation

A rail spur to the Yellow Creek site from a Southern Railway System mainline was built as part of nuclear plant infrastructure, and would be used to serve the ASRM plant. Immediate rail connections via this rail line are with Corinth to the west and



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 4 - 7
PRINCIPAL TRANSPORTATION ROUTES
SERVING YELLOW CREEK SITE

Date: December 1988 | EBASCO SERVICES INCORPORATED

TABLE 4-10

AVERAGE DAILY TRAFFIC (ADT)
SELECTED ROAD LOCATIONS NEAR YELLOW CREEK
1987
(Number of Vehicles)

Road	Segment Location	ADT
U.S. 72	West of AL state line	4,820
U.S. 72	West of Iuka, east of MS 25	5,120
U.S. 72	West of MS 25	6,640
U.S. 72	West of MS 365	6,130
Mississippi 25	North of U.S. 72	7,520
Mississippi 25	South of Red Sulphur Spr. Rd.	2,950
Mississippi 25	North of Red Sulphur Spr. Rd.	1,760
Mississippi 25	South of MS 365	2,150
Mississippi 25	North of MS 365	3,270
Mississippi 365	North of U.S. 72	1,160
Mississippi 350	West of MS 25	NA
Tennessee 57	North of MS state line	NA
Tennessee 128	North of TN 57	NA
Iuka-Red Sulphur Springs Road	North of MS 25	450

NA = not available

Source: Mississippi State Highway Department, 1988.

Iuka and the Quad Cities to the south and east. Interchanges with other major regional lines exist at Corinth and the Quad Cities.

Mainline rail routes from ASRM suppliers to the Yellow Creek site can be identified from Figure 3-10 introduced previously, and are very similar to the route alternatives discussed for SSC. Ammonium perchlorate shipments could use two northerly routes from Nevada that both pass through Memphis, from whence trains would proceed southeast to Corinth and on to Yellow Creek. A third alternative would be via El Paso and Dallas to Jackson, then northeast to Corinth. Aluminum powder and case forgings would likely travel south to Memphis, then southeast to Corinth. The probable route for finished ASRM segments would be southeast from Yellow Creek to the Quad Cities, Birmingham, Jacksonville and KSC.

The Yellow Creek site has direct access to two major inland waterways. Pickwick Lake is part of the Tennessee-Ohio-Mississippi River navigation system, providing water transportation to much of the central and southeastern U.S. The Yellow Creek embayment is also one terminus of the Tennessee-Tombigbee Waterway, a recently developed water route from Pickwick Lake to the Black Warrior River in southwestern Alabama, then on to Mobile and the Gulf of Mexico (Figure 3-10). The Tennessee-Tombigbee would be the probable route for water shipments of ASRM segments from Yellow Creek to KSC and SSC. It has a minimum depth of 9 ft and a minimum width of 280 ft. The Tennessee-Tombigbee covers a distance of about 234 miles from Yellow Creek to Demopolis, Alabama, from where the Black Warrior-Tombigbee Waterway extends 217 miles to Mobile (T-TWDA 1988).

4.1.10 Historical, Archaeological, and Cultural Resources

The earliest evidence of human occupation in the Yellow Creek area dates to approximately 9500 B.C.. Archaeological sites of this age, called Paleo-Indian, are relatively common in the Tennessee and Kentucky plateau lands, compared with elsewhere in eastern United States. Some Paleo-Indian sites are associated with remains of extinct faunal species (Walthall 1980).

The Archaic era began about 8000 B.C. Archaic people practised a prehistoric hunting and gathering economy adapted to increasingly dry conditions after the glacial retreat. As the prehistoric climate stabilized under modern conditions about 4,000 years ago, economic activity became more focused on a few staple resources, including shellfish, deer, and acorns.

The introduction of pottery marked the beginning of the Woodland era at around 1000 B.C. During most of this period, settlement was concentrated along river bottoms near shellfish beds and in upland areas, especially near the fall line hills. Other Woodland era developments included the increased participation of cultures in the Yellow Creek area in a pan-Eastern Woodlands burial mound ceremonial complex after about A.D. 1. Extensive trading networks developed during this period as well (Jenkins and Krause 1986).

The Mississippian period was characterized by the development of a more complex society beginning around A.D. 1000. This period featured larger settlements containing large, rectangular platform substructure mounds and an economy based on maize horticulture.

By the time of first European contact, the largest Mississippian political centers had been abandoned. The historic inhabitants of the Yellow Creek vicinity were the Chickasaw tribe, Muskhogean speakers closely related to the Choctaw and Creek. The Chickasaw core territory centered on several villages in northwestern Alabama, and later, northeastern Mississippi.

The DeSoto expedition of 1542 was probably the first European entry into northern Mississippi. Accounts of the expedition tell of DeSoto's stay in the Chickasaw towns, their attack on his army, and his subsequent narrow escape (Gibson 1985).

In the 1830s, the Chickasaw ceded their land to the United States government. Euroamerican farmers and planters settled northern Mississippi soon after. Railroads built in the 1850s linked the area with the Mississippi and Ohio valleys, and contributed to the prosperity of the area prior to the Civil War. The project area became an important battle ground during the Civil War because of strategically located railroad intersections located at nearby Corinth (Iuka 1987). Prosperity declined in the region in the aftermath of the war and as soil fertility decreased (Doster and Weaver 1987).

Archaeological surveys of the Yellow Creek site were undertaken in 1971, 1976, 1977, and 1978 (Marshall 1971; Thorne et al. 1980) as a part of environmental assessments of the Yellow Creek nuclear power plant site. When completed, the surveys had resulted in discovery of 227 archaeological sites within the power plant site boundaries. Archaeologists interpreted nearly all of these sites in terms of the prehistoric collection of chert, a raw material for the manufacture of stone tools. The power plant site was a preferred location for chert quarrying because of the presence of large outcroppings of the Fort Payne chert along the dissected slopes extending from the hilltops to the Yellow Creek bottoms. The sites are of three main types: 1) primary quarry sites situated on stream bottom flats near the chert outcrops, 2) small sites of undetermined function on ridge crests near streams, and 3) quarry blank production workshops, located mainly on bluffs overlooking the Yellow Creek bottom (Johnson 1981).

Because of the high density of sites, their relative rarity, and their scientific significance as a collection of lithic quarry workshops, the TVA nominated the entire Yellow Creek power plant site for listing on the National Register of Historic Places as a National Historic District. The archaeological survey was not complete at the time the nomination was first submitted, so that only 76 of the 227 individual sites are listed on the nomination form.

Another area property listed on the National Register of Historic Places is the old Tishomingo County Courthouse. It is located in the town of Iuka, ten miles from the project site.

4.1.11 Solid and Hazardous Waste Management

This section describes existing solid and hazardous waste practices at the Yellow Creek site. The focus in this section is on the existing conditions and the local, State of Mississippi, and federal regulatory context for solid and hazardous waste management and emergency response at the site.

Solid Waste

Tishomingo County is subject to Mississippi Department of Natural Resources (MDNR), Bureau of Pollution Control, Regulation No. PC/S-1. These rules provide for a state-wide permitting authority, a permit application that is supplemented by a Site Development and Operating Plan and a Hydrological and Geological Investigation Report, and storage and collection regulations. The rule also provides operating and closure standards for sanitary landfills, rubbish disposal facilities, solid waste processing facilities and solid waste landfarming operations. The rule also provides a process to significantly reduce pathogens at the sanitary landfill facility.

Tishomingo County currently operates a 10-acre sanitary landfill located 9 miles south of Iuka on Highway 25. The MDNR granted the County Permit in September 1981 (Warden 1988, personal communication). The permitted life of the facility is 10 years. It is currently 75-80 percent full, with an estimated remaining life of approximately 2 years (Shields 1988, personal communication). Tishomingo County also operates a county-wide "green box" collection system. Front-loading trucks collect refuse twice weekly and transport it to the county landfill. In addition, there are at least two private collection companies that collect refuse on an as-needed basis (Shields 1988, personal communication). Wastes currently generated by TVA's Distribution Center at the Yellow Creek site are disposed of in the Tishomingo County landfill. County trucks pick-up at the site twice weekly (West 1988, personal communication).

Hazardous Waste Management and Emergency Response

Currently, the Yellow Creek site contains only the abandoned nuclear plant facilities described in Section 4.1.1. There are no known hazardous wastes currently being stored on-site. There are no known solid waste management units (SWMUs) or abandoned hazardous waste sites currently at the facility.

As an inactive construction site, there are no emergency response procedures for dealing with potential releases of extremely hazardous materials (see Section 3.1.11 for a discussion of the regulatory requirements) and no current efforts to develop material safety data sheets. There are no routine emissions from the Yellow Creek site; consequently, there are no Toxic Chemical Release inventory forms for the facility. The need to institute each of these hazardous materials management communications programs will be discussed in Section 4.2.11.

4.1.12 Toxic Substances and Pesticides

Since the termination of site operations at the Yellow Creek nuclear plant site there have been no programs for PCB decommissioning or asbestos removal under TSCA (see Section 3.1.12 for an explanation of the regulatory framework), or for pesticide/insecticide handling, storage, and applications under FIFRA. No herbicide control program is currently in effect at the site. A limited rodent control program is conducted for indoor pests. Baits have been set in accordance with the directions printed on the labels (West 1988, personal communication). The need to institute a comprehensive pest control program if the ASRM production facility is sited at Yellow Creek will be discussed in Section 4.2.12.

4.1.13 Radioactive Materials and Non-ionizing Radiation

At the Yellow Creek site, the average annual dose from cosmic radiation is assumed to be 27 millirem (mrem), while that from terrestrial, atmospheric, and other naturally occurring radionuclides is about 300 mrem, for a total of roughly 330 mrem. These values are typical of the southern U.S. (NCRP 1988). There are no man-made sources of radiation currently at the site.

4.1.14 Noise and Vibration

The Yellow Creek site is described in Section 4.1.1, including typical ground cover and adjacent bodies of water. Natural topography of the site is generally rugged, although certain parts were leveled prior to the beginning of TVA construction. Meteorology of the site is discussed in Section 4.1.2.

Background Noise Levels

There are no manufacturing facilities at or near the Yellow Creek site. Ambient noise levels are from birds, light vehicular traffic, and occasional maintenance on TVA structures. Ambient noise measurements taken in October 1988 indicate the background levels to be in the range of 35 to 45 dB(A) on site and along local roads when there is no traffic (Rice 1988a).

Local Regulations

As previously stated, there are no noise regulations in the Code of the State of Mississippi (Hamil 1988, personal communication) nor any administered in the state by EPA Region IV (Orban 1988, personal communication). No known records exist of public complaints of noise at the Yellow Creek site during TVA's nuclear plant construction.

4.1.15 Public Health and Safety

No current emergency response or public health and safety operations exist at the Yellow Creek site (Walters 1981). Some emergency response services and emergency medical services are available in the surrounding communities, such as the volunteer fire departments of Short Creek-Coleman and North Crossroads (Dobbs 1988) which were mentioned in Section 4.1.8. Emergency medical services are available at the Tishomingo Hospital, a 105-bed facility in Iuka, Mississippi, and the Magnolia Hospital, a 114-bed facility in Corinth, Mississippi (AHA 1987).

4.2 ENVIRONMENTAL CONSEQUENCES

4.2.1 Facility Options at Yellow Creek

Evaluations of ASRM activities at Yellow Creek were made following the method described in Section 1.6. Worksheets used to evaluate the types of impacts and their significance are included in Appendix G, Section G-3.

Only ASRM manufacturing is being considered at Yellow Creek. NASA is considering an additional area around the site for an explosive safety clear zone. The effect of this requirement, which is unique to the Yellow Creek site, is discussed in Section 4.2.7, Land Use.

4.2.2 Air Resources

Construction:

Since the Yellow Creek site has already been cleared, fugitive dust emissions from land clearing will be significantly less than at the other potential sites. Fugitive dust emissions due to construction vehicle traffic have been quantified based on a representative number of vehicles to construct the manufacturing facilities at Yellow Creek. These emissions are summarized in Table 4-11, along with modeling results which show that construction vehicle emission impacts of the facility are insignificant.

Commuter Traffic Exhaust Emissions:

The maximum concentration of carbon monoxide (CO) at the site boundary due to commuter traffic exhaust emissions during construction and operation of the ASRM facility is given in Table 4-12. These values are considered insignificant.

Manufacturing:

Two point sources of air pollutants associated with ASRM manufacturing are of interest: solvent cleaning operations, and boilers for steam production. Solvents are used in several processes during construction (see Section 2.0 and CH2M Hill 1987). Overall annual solvent emissions are estimated to be 17.4 tons per year. These emissions will result in a maximum 1-hour concentration of 0.16 ppm on the site boundary. The incremental increase in hydrocarbons is unlikely to result in substantial elevation of existing ozone levels.

Modeling of the emissions from the boilers indicates that the maximum off-site concentrations will be significantly less than all applicable ambient air quality standards, as shown in Table 4-13.

Waste Burning:

About 1 million pounds of waste propellant would be burned at the site each year, based on 40 batches of 25,000 pounds each. The estimated ambient air quality impact from open burning was determined by modeling several types of meteorological conditions and selecting the worst-case (highest ground-level concentration). Normally, high ambient air quality impacts are associated with stagnant conditions with low wind speeds, conditions which are quite common in the area. However, for open burning of waste propellant, the extreme heat generated during burning results in a highly buoyant plume of gases and particulate matter which rises to extreme altitudes under low wind speeds. After rising to a high altitude, the plume is dispersed over a large area, producing small ambient concentrations. Conversely, during times of high winds (neutral atmospheric stability), the plumes are bent over more quickly by the wind and do not rise to extreme altitudes. The result is higher ambient concentrations than predicted for periods of low wind speeds. This result is not unique to the Yellow Creek site, and the same worst-case ambient concentrations

TABLE 4-11

FUGITIVE DUST EMISSIONS DUE TO CONSTRUCTION VEHICLE TRAFFIC DURING CONSTRUCTION AT YELLOW CREEK

1. General site traffic on unpaved roads:
   Number of 6-wheeled 20 ton trucks on site = 15
   Average length of trip on unpaved roads = 3 miles
   Site speed limit during construction = 15 mph

2. Emission factor (pounds per vehicle miles traveled [VMTß):

   $E = 3x10^{-6} x (s) x (S) x (W^{.7}) (w^{.5}) (365 - p)$ lb/VMT
   where:
   - s = silt content of road (25 percent)
   - S = mean vehicle speed (20 mph)
   - W = average vehicle weight (15 tons)
   - w = average number of wheels (6)
   - p = number of days with greater than 0.01 inches of rain (106 days)

3. Emission rate.

   E = 62 lb/VMT

4. Maximum ambient air quality impact (assumes particles less than 10 microns, ug/m^3)a/

LOCATION	ANNUAL	24-HOUR
At facility boundary (0.3 mi)	13.0	116.7
At outer control zone (1.9 mi)	0.9	30.0
At residences (3.1 mi)	0.3	9.6

5. Ambient air quality standard (ug/m^3)

LOCATION	ANNUAL	24-HOUR
Federal (PM-10)	60	150
Mississippi (TSP)	60	260
Mississippi (PM-10)	60	150

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a/ Air quality impact analysis was performed using the ISCST (USEPA 1987b) model, 1978 surface meteorology from the Yellow Creek nuclear power plant, and 1978 Nashville, TN, upper air data (Blackwell 1988, personal communication).

TABLE 4-12

VEHICLE EMISSIONS FROM COMMUTER TRAFFIC AT YELLOW CREEK

Assumptions

Greatest impact will occur at site boundary gate during shift change from night shift to day shift.

Number of vehicles passing gate is as follows:

Construction Phase		Operation Phase	
No. Arriving	No. Leaving	No. Arriving	No. Leaving
1,008	126	720	90

Vehicle mix is as follows (percent):

Type of Vehicle	Construction Phase	Operation Phase
Light duty vehicles	50	75
Light duty trucks	40	20
Heavy duty gas trucks	5	5
Heavy duty diesel trucks	5	0

Wind speed = 2.5 m/sec; stability class = F (moderately stable).

Resulting Carbon Monoxide Ambient Concentrations (ppm)

Phase	Maximum 1-hour Concentration	Applicable Standard
Construction	1.1	35
Operation	0.7	35

TABLE 4-13

AIR POLLUTANTS FROM ASRM MANUFACTURING AT YELLOW CREEK

1. Activities:
   Process solvents = 17.4 tons per year of hydrocarbons
   Boiler (2 units) = 7.0 gallons No. 2 fuel oil per minute

2. Emission factors for boilers:

Carbon monoxide (CO)	5 lb/1,000 gal
Nitrogen oxides (NOx)	22 "
Sulfur oxides (SOx)	71 "
Hydrocarbon (HC)	1 "

3. Emissions for boilers:

Carbon monoxide (CO)	3.7 tons per year
Nitrogen oxides (NOx)	16.2 "
Sulfur oxides (SOx)	52.1 "
Hydrocarbon (HC)	0.5 "

4. Ambient air quality impact at site boundary (0.2 mi):a/

Pollutant and Averaging Time	Concentration	Standard
Sulfur dioxide		
3-hour	88.2 ug/m^3	1300 ug/m^3
24-hour	25.8 ug/m^3	365 ug/m^3
Annual	2.5 ug/m^3	60 ug/m^3
Nitrogen oxide		
Annual	0.8 ug/m^3	100 ug/m^3
Carbon monoxide		
1-hour	0.1 ppm	35 ppm
8-hour	0.05 ppm	9 ppm
Hydrocarbons (Boilers)		
1-hour	0.002 ppm	none
Hydrocarbons (Process Solvents)		
1-hour	0.16 ppm	none

a/ Air quality impact analysis was performed using the ISCST (USEPA 1987b) model, 1978 surface meteorology from the Yellow Creek nuclear power plant, and 1978 Nashville, TN, upper air data (Blackwell 1988, personal communication).

are predicted for each of the sites. The results of the combustion/dispersion model for waste propellant open-burning are the same as the results for SSC (Table 3-19). The concentrations are less than any applicable air quality standard. Impacts to public health and safety from open-burning of waste propellants at Yellow Creek are discussed in Section 4.2.15.

HCl scavenging is discussed in Section 3.2.2. Since only open-burning of waste propellants will occur at Yellow Creek, the total HCl emissions are somewhat smaller than for sites that could have static testing in addition to open burning.

Site specific factors to mitigate air pollutant emissions and impacts will be analyzed fully during the air permitting phase of the project. The facility will not be subject to the provisions of Prevention of Significant Deterioration (PSD) under the federal Clean Air Act and the rules of the Mississippi Department of Natural Resources because emissions will be less than 250 tons per year of a regulated air pollutant. If open burning of waste propellant is allowed by the Mississippi Department of Natural Resources, periodic review of alternatives to open burning will be required.

4.2.3 Water Resources

Groundwater

Construction:

Groundwater availability could be reduced by constructing buildings, parking lots, and other ground cover that would inhibit the natural recharge from precipitation, or by removing the natural vegetative cover, thereby causing a greater percentage of precipitation to run off rather than infiltrate. Inhibiting infiltration could lower the water table. Other water supply users in the area are unlikely to be affected since most of the impact will be downgradient, toward Pickwick Reservoir.

Manufacturing:

Due to natural hydrogeologic conditions at the site and mitigation measures agreed to by NASA, manufacturing will result in insignificant impacts to the groundwater system. Groundwater supply will not be affected by the project since potable and industrial water will be supplied by other sources, as discussed in the surface water section.

Accidents:

Accidents during operations at Yellow Creek present a possible groundwater quality concern. NASA has agreed to several mitigative measures to minimize the impact of accidental releases of hazardous liquids or contaminated water (see Section 3.2.3). The impacts of spills to groundwater is considered insignificant because the overlying low permeability soils provide ample time for emergency response and cleanup before contaminants reach the water table.

Surface Water

Construction:

The primary surface water impact during construction is the erosion of soils. However, soil erosion is expected to be minimal given that the Yellow Creek site has already been cleared and graded, and storm drainage control and temporary sedimentation basins are already in place. Best management practices will also be employed during construction. Therefore, soil erosion and associated water quality impacts are expected to be insignificant. A detailed investigation of soil erosion potential prior to construction of the Tennessee-Tombigbee Waterway near the site also supports this conclusion (Whittle 1980).

The influx of about 1,900 construction personnel will increase potable water demand and sanitary sewer requirements. The existing water supply from the Short, Coleman and Park Water Association and on-site 10,000-gal/day treatment facilities have previously supported a construction workforce of up to 3,500 and are adequate to handle these increased demands (West 1988, personal communication). Therefore, no significant impacts due to construction water supply and sanitary treatment are anticipated.

Two small creeks, Slick Rock Branch and Bullard Branch, pass through the site. However, these creeks have already been rechanneled and altered by previous construction and have incorporated sedimentation basins. Therefore, no significant impacts are anticipated through any additional diversion or alteration of these streams due to construction.

As noted in Section 4.1.3, TVA was issued a Department of the Army Permit for a barge terminal, cofferdam, and associated water intake at the proposed Yellow Creek Nuclear Plant Units 1 and 2. That permit expired in 1988. NASA will probably need a new permit pursuant to Section 10 and/or Section 404 due to the different impacts on public safety and navigation from its use of the previously permitted facilities or deviations from previous plans. NASA will also be required to obtain new NPDES permits for any discharges to surface waters from refurbished, reinstalled, or new wastewater treatment systems or discharges from runoff collection systems.

Manufacturing:

The surface water impacts concerning manufacturing would be similar to those discussed in Section 3.2.3 for SSC. Since employment for manufacturing is less than that for construction, the existing potable water supply is more than adequate to supply all potable/pure water requirements and most industrial needs. The existing site industrial water system supply from Pickwick Lake/Yellow Creek is maintained and operational (West 1988, personal communication), and may be used to supply water for fire protection and to supplement industrial supplies, if necessary. Therefore, no significant surface water impacts are expected associated with water supply requirements.

Compliance with regulatory criteria and guidelines for effluent discharges (Appendix C) will require expansion of waste water treatment facilities, and compliance monitoring, as described in Section 3.2.3 for SSC. The existing 10,000-gal/day sanitary wastewater treatment system is inadequate, and will require the reinstallation of the two 30,000-gal/day systems previously on-site (West 1988, personal communication). Other treatment system specifications will not be available until the detailed design phase of the ASRM project. However, systems must be designed so that effluents at the mixing zone boundary will equal or surpass the existing receiving surface water quality as described in Section 4.1.3. Therefore, no significant surface water quality impacts are anticipated from effluent discharges.

Open Burning:

Surface water may be contaminated with leaching/storm water washout of open pit burning ash. However, NASA has committed to lined burn pits, a leachate collection/treatment system, and a storm water collection/treatment system (Section 2.1.7). The site already has a functioning stormwater collection system with sedimentation basins that can be modified as required for the new facilities. Discharges will comply with the regulatory criteria as described in Section 4.1.3. Therefore, no significant surface water quality impacts are expected from open burning of waste propellant.

Accidents:

NASA has agreed to several mitigative measures to minimize accidents and their severity, as noted in Section 4.1.11 and Section 4.1.15. Impacts to surface water quality associated with spills or discharges are also typically reversible; i.e., the receiving water body can normally be treated and/or recover its original quality through dilution and natural assimilation. Therefore, spills or other accidental uncontrolled releases of processing/recycled solvents, untreated effluents, or fuel components directly or indirectly into the surface water bodies would be expected to have only a moderately significant impact on surface water quality.

4.2.4 Land Resources

Construction:

Construction of particular buildings could lead to dynamic soil effects (such as severe damage during earthquakes), failure under excessive bearing pressures, plus erosion, but little corrosion to subsurface utilities since soils are not significantly corrosive. Mitigation by appropriate engineering design of structures at Yellow Creek renders soil dynamics effects and soil bearing strength effects insignificant. The use of erosion control procedures of various sorts will eliminate any significant erosion during construction.

This last effect, the possibility of erosion during construction, was considered closely. Under conditions which existed here prior to the beginning of construction of nuclear plant facilities, there was a possibility of a significant impact in this regard because of the steep slopes and generally erodible soils. However, by locating ASRM facilities to make use of the terracing and sediment control ponds already in place, further impacts from erosion will be reduced to insignificant levels.

Accidents:

Operation of the facility could, in rare instances, lead to hazardous substance releases and consequent soil contamination. The use of an emergency response plan and spill prevention, control, and countermeasure (SPCC) plan will avoid any significant possibility of hazardous substance releases to the soil.

The accident scenario of greatest concern is that hazardous materials may be released during a catastrophic manufacturing failure which could scatter hazardous materials over a large area. The impacts of such an accident to soils at the site are, however, relatively minor because the relatively low permeability soils would allow cleanup to be limited to shallow depths.

4.2.5 Wetlands and Floodplains

Wetlands

There are no wetlands mapped and there is no evidence of the potential of wetlands at the Yellow Creek site due to the previous disturbance and drainage system installed for the terminated nuclear plant. The three silt control ponds that support aquatic vegetation would not be disturbed by ASRM facilities according to preliminary site layouts (NASA 1988b). Therefore, wetlands impacts anticipated at the Yellow Creek site are considered insignificant. Wildlife habitat associated with these ponds is discussed separately in Section 4.2.6.

Floodplains

TVA dams on the Tennessee River reduce the risk of potential floodplain impacts at the Yellow Creek site. Since all ASRM facilities would be located above the 500-year floodplain elevation of 421.5 feet (NASA 1988b) , there are no potential floodplain impacts. Data are not available to estimate what, if any, effects may be from any periodic flooding from the on-site streams.

4.2.6 Biotic Resources

Vegetation

Construction:

Currently, about 860 acres, or 67 percent of the Yellow Creek site, has been cleared and consists of roads, buildings, parking lots, and areas planted with a grass/forb mix for erosion control. It is expected that most of the construction for the ASRM production facility will occur in this disturbed area. Most of the remaining forest at Yellow Creek occurs along the southern periphery of the site and will probably require little, if any, clearing. Therefore, construction impacts on the vegetation at Yellow Creek are expected to be insignificant because little, if any, undisturbed vegetation will be removed.

If additional clearing is needed, facility siting and construction will avoid sensitive plant communities, such as bottomland hardwood stands, whenever possible. Prior to any construction in forested areas, a survey will be conducted to locate any of the 14 sensitive plant species documented on the site in 1974. Disturbance of these species will be avoided, if possible.

Operations:

No impacts on the vegetation at Yellow Creek are expected from normal operation of the ASRM production facility, routine burning of waste propellant, or transportation activities. Open burning of waste propellant will not cause adverse impacts (see Section 3.2.6). Based on the EIS for the Space Shuttle Program, no significant effects on vegetation are expected (NASA 1978). NASA is expected to implement safe material handling procedures for propellant and materials. Therefore, accidental propellant spills from transportation or storage of raw materials will be confined to the accident site and should not significantly affect vegetation.

<u>Wildlife</u>

Construction:

Areas not disturbed during construction will continue to provide wildlife habitat. Most construction will probably occur in currently disturbed areas. Most of these disturbed areas have been seeded with grasses and forbs and currently provide good habitat for small mammals and birds. These species would be displaced by ASRM facility construction. In addition, construction and development may disrupt the feeding patterns of raptors that prey on the small mammals in the open areas at Yellow Creek, and the feeding and movements of white-tailed deer. Human activity at the site and reuse of the sediment control and spray-down ponds during construction would also disturb and possibly displace the waterfowl that currently use these ponds. Construction will also likely disturb the wildlife inhabiting the peripheral forested areas at Yellow Creek. However, the Yellow Creek site is relatively small and there is adequate habitat for wildlife in adjacent undeveloped areas and parks. Consequently, ASRM construction impacts on regional wildlife populations and distribution are expected to be insignificant.

Operation:

Increased traffic on local roads during ASRM facility construction and operation may temporarily or occasionally disturb wildlife in adjacent areas, and deer/automobile collisions are possible. However, the impacts of ASRM operations on wildlife should be minor and are considered insignificant.

<u>Aquatic Resources</u>

Construction / Operation:

Potential impacts to the aquatic environment include erosion, sedimentation, and siltation due to runoff or dredging during construction or operation; the effect of additional barge traffic on sport and commercial fishing activities; accidental spill of oil or chemicals; and entrainment of fish in water supply intakes. These impacts have all been rated insignificant at the Yellow Creek site, as outlined below.

Runoff can create impacts by a number of mechanisms, as noted in Section 3.2.6. Runoff is not expected to cause significant impacts at Yellow Creek because extensive site preparation associated with development of the abandoned nuclear project has already occurred. Additionally, erosion, siltation and sediment control practices will be implemented to prevent runoff problems. Similarly, control practices will be implemented to minimize potential impacts of dredging (e.g., siltation and turbidity increases). Federal and state water quality standards will be met. These measures will avoid or minimize any potential effects from runoff, and thus, the remaining effect will be insignificant. As an additional mitigation measure, NASA will consider scheduling instream construction activities to avoid spawning periods of locally important fish species.

Another potential impact is related to an increase in barge traffic that could interfere with sport or commercial fishing activities. It is anticipated that this impact will be insignificant because of the relatively few barge landings (see Section 4.2.9) and the confinement of the barge traffic to existing navigation channels, such as the Tennessee-Tombigbee Waterway. Therefore, any conflicts should be avoidable.

Spills of oil or chemicals are not anticipated during normal construction or operation activities. NASA plans to have oil and chemical handling and spill prevention measures in effect during these periods. Also, NASA will have contingency plans for cleanup that will be implemented in case an accidental spill occurs. If an accidental spill occurs near water bodies such as the Yellow Creek embayment, direct mortality to fish or other aquatic organisms could result. The duration and extent of the impact would depend on the location of the spill, type of material released, and the quantity.

Raw water intake from Yellow Creek will be relatively small (less than 0.5 cfs). This source will be used primarily to supplement other supplies and for fire protection. Entrainment of larval fish and plankton and the impingement of juvenile and adult fish on raw water intake screens may result in direct mortality of these organisms. However, this loss will be insignificant due to the small intake volume relative to available water and aquatic resources in the Yellow Creek Embayment.

Accidents:

The accidental explosion of materials could occur at this site and cause mortalities or injury to fish and alteration of aquatic habitat. This is considered an unlikely event because safe handling procedures are to be implemented by NASA. The impact to aquatic organisms and habitat is considered only moderately significant because the event would be confined to the accident site.

Threatened and Endangered Fish and Wildlife Species

No impacts on the bald eagles wintering at nearby Cooper Falls Natural Area are expected from ASRM activities at Yellow Creek. No federally-designated threatened or endangered species have been documented at the Yellow Creek site (James 1988). Therefore, no impacts on federal threatened or endangered species are expected from ASRM construction or operations at Yellow Creek.

A total of 13 wildlife and fish species that are proposed as peripheral, rare, or of special concern in Mississippi were recorded at Yellow Creek prior to TVA construction in 1974 (Wiseman 1988). However, the current status of these species is unknown and some may still inhabit undisturbed areas on the site. Prior to clearing areas that are currently undisturbed, a survey will be conducted for species of special concern, but avoidance is unlikely since fish and wildlife species are mobile. ASRM construction impacts on state species proposed as rare, peripheral, or sensitive are therefore considered to be moderately significant.

Also associated with ASRM manufacturing at Yellow Creek are potential impacts to the Florida manatee at KSC if ASRM segments are barged from Yellow Creek to KSC for space shuttle launches. Potential impacts to the Florida manatee are considered moderately significant, and are described further in Section 5.2.6.

4.2.7 Land Use

Existing Land Use

Land use impacts resulting from siting the ASRM project at Yellow Creek are expected to be minor. The site is already highly disturbed and partially cleared. Small areas of prime soils, identified by TVA prior to construction of the abandoned nuclear plant, have been radically disturbed by previous grading and site alteration. Direct project impacts to land uses around the site would also not be significant, as most are nonintensive land uses such as commercial forestry and rural residential housing. No additional land off-site is required for roads, transmission lines, railways, and so on, because these facilities are already in place. Aesthetic impacts due to the presence of large structures and disturbed areas are expected to be insignificant, because the site is generally not visible from Pickwick Lake and the site is already extensively disturbed.

Recreational use of Pickwick Reservoir and adjoining lands will be slightly affected by the project. Both Steel Bridge Recreation Area and Coleman State Park are very close to the Yellow Creek site and will be affected by ASRM project construction and operations. The Steel Bridge Recreation Area is accessed via Red Sulphur Springs Road, which also provides access to the Yellow Creek site. An increase in the recreational use of Steel Bridge Recreation Area could occur as a result of new workers in the area but no quantitative estimates are currently available. It is estimated that more visitation will occur since a significant increase in use was observed and attributed to construction activities during nuclear plant construction (Walters 1981). Since the recreation area receives light usage, mostly by locals, additional users could cause crowding or displace local users. J.P. Coleman State Park also has access via Red Sulphur Springs Road and could also experience some increase in use. Nevertheless, an anticipated expansion and improvement to Coleman State Park, as well as Steel Bridge Recreation Area, should help to minimize impacts.

The recreational use of waters between Goat Island and the Yellow Creek site will be discontinued due to required Q/D separations. Fish locator poles, set by TVA, would likely be removed in the restricted areas. It is also likely that Goat Island itself will be restricted for recreation usage, eliminating the current use of the island. While no estimates of use on Goat Island are available, it is assumed to be low compared to total recreational use of the Pickwick Reservoir. Furthermore, several other island areas are still available for recreational use. Because the restriction of recreational use on Goat Island would be in effect over the life of the project, however, this impact is rated moderately significant.

There is the potential that commercial forestry lands, pasture lands, the Salem Church, and about 15-20 residences would be impacted by industrial noises associated with ASRM operations, particularly since ASRM production activities will be continuous. Based upon project noise analysis, this increase in background noise is probable and although the extent of impact is small, the impact would occur over the life of the project. For these reasons, this impact is predicted to be moderately significant. A buffer zone or easement adjacent to the boundary would be advantageous.

As described in Section 3.2.15, buildings with potential fire or explosion hazards will be separated from other buildings by a predetermined Q/D circle. Adequate Q/D separations would not eliminate all direct impacts, however, to the church or nearby residences if there were a fire and/or explosion at the site. Although an unlikely event, an explosion during the mixing and casting process could result in broken windows or similar damage to structures several thousand feet from the point of the explosion. Further discussion of the effects of explosions are described in Section 4.2.15.

ASRM Compatibility with Land Use Plans, Policies, and Controls

TVA has the only local land use control in the Yellow Creek area. Any ASRM project feature that is placed along or below the high water line of Pickwick Reservoir will require a permit from TVA. TVA's Pickwick Reservoir Plan identifies three parcels of land on the Yellow Creek Peninsula which at present are undeveloped. All three of these sites have been identified as having capabilities and access for future development. Although no proposals for development exist, any future development would probably require an upgraded road system as well as utilities. There are no apparent conflicts between the ASRM project and future development of these sites.

Indirect land use impacts resulting from siting ASRM facilities at Yellow Creek include potential land speculation and potentially rapid subdivision growth. A 93-acre parcel adjacent to the Coleman-Short intersection one-half mile from the site is currently approved for a subdivision. ASRM activity in the area would probably hasten development. Section 4.2.8 addresses housing development as a result of the project.

Additional Mitigation

At Coleman Park, and at Steel Bridge Recreation Area, a large influx of park users was attributed to the construction workers associated with the nuclear plant construction. NASA will work with local and state offices to develop mitigation plans as appropriate. Additionally, NASA will consider relocation of the fish locator poles, which could help lessen the impact of the restrictions on water use between Goat Island and the mainland.

Because the noise level associated with ASRM manufacturing will be slightly above the ambient noise level beyond the site boundary, NASA could consider curtailing operation during church services at the nearby Salem Church.

4.2.8 Socioeconomics and Infrastructure

Demographic Characteristics

Population:

Because Yellow Creek is not being considered as a test site, the numbers of employees associated with the construction and operations phases of the project are slightly less than those discussed previously at SSC. During the construction phase of the project, the maximum number of employees will be 1,900 (NASA 1988i). This phase is expected to last 6 years, with the greatest hiring requirements occurring in 1990 and 1991. The operational phase will reach a full complement in the mid-1990s with about 1,500 employees. A study done during construction of the nuclear plant indicates that 82 percent of the workers resided within the study area or commuted to work (Walters 1981). While this study dealt only with construction workers, it offers the most site-specific data for the project area. Normally, construction workers are much more transient than operations workers, and frequently relocate temporarily to a community near a work site. At the Yellow Creek Nuclear Plant site, however, most workers were hired from the local labor force. Therefore, this same percentage (82 percent local labor) was adopted for this analysis. The high unemployment rate in the area also suggests that a similarly high percentage of local residents might fill jobs created by the ASRM project. Assuming only 18 percent of new jobs are filled by newcomers to the area and that each employee has an average family size equal to the national average of 2.64 persons/household (Kehm 1988), a maximum of about 695 and 550 persons could be added to the study area during the construction and operational phases, respectively. Assuming these new employees follow a residential distribution pattern similar to those employees hired to build the Yellow Creek Nuclear Plant in 1980 (see Section 4.1.8, Figure 4-6), the population change in each county would be as shown in Table 4-14.

Using the U.S. Army Corps of Engineers Economic Impact Forecast System's (U.S. Army 1988b) threshold of 3 percent or more change to identify economic changes which might be considered significant, the population impacts of this project would be insignificant in all of the counties with the exception of Tishomingo, where the effect would be moderately significant. Considering that Tishomingo County has had a 2 percent decrease in population since 1980, this growth would bring about the reversal of that trend. The potential also exists for indirect population growth to occur in association with the indirect employment discussed in the next section. While this impact is acknowledged, the likelihood and magnitude of its occurrence is speculative. Given the high unemployment rates in the study area, most of the indirect jobs created will probably be filled by current study area residents, commuters, or members of the in-migrating families.

Employment:

Given the assumptions outlined in the previous section, there would be about 1,200 construction jobs and 950 operations jobs created for existing study area residents and 340 construction and 270 operations jobs created for people who move into the study area (Table 4-15). The remaining 360 construction and 280 operations jobs would be filled by persons commuting from outside of the study area. If the new positions were filled from the existing unemployment roles or by internal movement in the job market, which seems highly likely given the high levels of unemployment

Table 4-14. Yellow Creek Study Area Population Change Projections.[1]

Location	Construction Phase		Operation Phase	
	Population Change	Percent Change	Population Change	Percent Change
Alcorn County	70	.2	55	.2
Tishomingo County	245	1.3	195	1.1
Hardin County	90	.4	70	.3
Colbert County	155	.3	120	.2
Lauderdale County	135	.2	110	.1
Study Area Total	695	.3	550	.3
Other Areas	210	- -	165	- -
Total	905	- -	715	- -

Numbers have been rounded.

[1] Assumes 82 percent of jobs filled by local residents and 18 percent filled by newcomers.

Table 4-15. Yellow Creek Study Area Estimated Employment Impacts.

Location	Direct Project Employment		Indirect Project Employment	
	Construction Phase	Operation Phase	Construction Phase	Operation Phase
Tishomingo County	420	330	170	265
Alcorn County	125	100	50	80
Hardin County	155	125	60	100
Colbert County	265	210	105	165
Lauderdale County	235	185	95	150
Study Area Totals	1200	950	480	760
Others (commuters)	360	280	140	225
Local Area Total	1560	1230	620	985
Inmigrating Workers	340	270	140	215
Total	1900	1500	760	1200

Numbers have been rounded.

in the study area (see Tables 4-3 and 4-4), then unemployment level reductions would be very significant. All counties in the area would see unemployment level reductions of greater than 3 percent, with Tishomingo County experiencing the greatest reduction.

Indirect employment impacts (Table 4-15) were estimated using the same multiplier described in Section 3.2.8. This methodology yielded an estimated 480 and 760 indirect jobs in the study area during the peak construction and operating phase of the project, respectively. These numbers do not include the indirect jobs induced in the study area or elsewhere by the commuting workers.

Should the project be cancelled, the overall effect on unemployment could be significant. Not only would the direct employees from the study area lose their jobs along with those additional employees that moved into the study area, but the indirect employment effects would ripple through the local economies as well. The overall net employment effect would be greater than if the project had never been built.

Income:

Per capita income levels in the five county study area are significantly below the national average of $14,612 (see Table 4-5). The percent of persons with wages below the poverty level is significantly above the national average of 12.4 percent. Unemployment rates are substantially above the national average of 7.2 percent (see Table 4-3). In short, the area is economically depressed. NASA has already agreed (see Section 2.1.7) to maintain project salaries at or above the U.S. Department of Labor figures discussed in Section 3.2.8. These figures are above the wages seen in the manufacturing and construction sectors of the study area. The direct salaries will filter through the system generating more income with each transaction. The net effect will be an increase in per capita and average income, a drop in unemployment, and a possible decrease in the number of persons with salaries below the poverty level (assuming some of these people are classified as unemployed). Although it is not possible to calculate changes in total area income without more detailed information, the improvement in payrolls is estimated to be moderately to very significant.

Revenues:

Analysis of the infrastructure and services in the study area conclude that the project should not induce enough additional demand on the public utility systems to warrant construction of new facilities. However, additional fire and police protection may be needed, in addition to relief of overcrowding in the Tishomingo County School system. Moreover, to the extent that public services and facilities are funded through property taxes, which would not be paid by a government facility, it is possible that the ASRM project could lead to a local revenue shortfall. This situation could be alleviated by various development programs funded by the State of Mississippi. Sales and use taxes will generate the most revenue to local governments. Without more project specific wage and output information, these impacts are impossible to estimate. They will, however, add to total government revenues.

Housing:

Based on discussions with representatives of the local chambers of commerce in the five county study area and the Alabama Association of Realtors, it was determined that the currently depressed housing market will more than adequately meet any project-induced housing demand. Since housing prices have seen a 25 to 30 percent decrease since the termination of nuclear plant construction, the project is expected to exert some upward pressure on housing prices. Some speculative buying is already in evidence, but its extent cannot be measured. The study area is sufficiently large and has a sufficient diversity of homes at various prices available to accommodate most housing needs (Neese, 1988).

Infrastructure and Services

Law Enforcement:

Current ratios of law enforcement (full-time) officers to 1,000 population for the five counties in the study area vary from a high of 1.83 in Colbert County to a low of 0.72 in Tishomingo County. None of the counties have ratios above the BLM Social Effects Program guideline of 2.1/1,000 (USDI 1982). The project induced population increase would necessitate the addition of one law enforcement officer in Tishomingo County in order to maintain current the ratio of officers to population. This change would be moderately significant. All other counties would be insignificantly affected.

Quantitatively, the project induced impacts are moderately significant to insignificant based on changes from current levels. However, these results do not take into account whether or not current staffs are already overburdened, which is the case throughout the study area. Representatives of many departments supported this assessment when they indicated they are currently understaffed. The addition of new project-induced population would make the existing situation marginally worse.

Fire Protection:

Fire protection levels are measured by the numerous factors discussed in Section 3.1.8. The increase in population as a result of the project is only one of those factors. The increase in population is moderately significant in Tishomingo County, thus it has the greatest potential for impact. Given the population decrease of the last decade, any impact should be insignificant. This does not mean, however, that the existing staffing levels of the fire departments surveyed are necessarily considered adequate. Representatives of many departments surveyed expressed the opinion that they are currently understaffed. Currently, two of the departments rely on volunteers exclusively while an additional five are staffed mainly with volunteers. Additional volunteers, possibly from the in-migrating workers, may be able to augment the permanent staff to temper any problem that may arise.

Schools:

Many of the school systems in the study area expanded in the early 1980s to accommodate the anticipated growth associated with the nuclear plant. The growth never materialized. In fact, since 1980 the population in three counties of the study area has declined. Overall population in the study area has shown no measurable change since 1980. However, some adverse impact on certain school systems may be anticipated if newcomers to the area distribute themselves as we have assumed. Tishomingo County would be moderately impacted (over 2 percent increase in enrollment). The remaining counties will be insignificantly impacted. The project-induced enrollment increase could necessitate the addition of as many as five new teachers in Tishomingo County, three in Colbert and Lauderdale Counties, and one in Alcorn and Hardin Counties if all in-migrating children were of school age in order to maintain current teacher/student ratios. Some overcrowding in the Tishomingo County school system could occur. Currently, Tishomingo, Hardin and Colbert counties have teacher/student ratios above the planning guideline of 1:18. The additional project induced students will add marginally to the existing problem.

Health Services:

Colbert and Lauderdale Counties currently have far more physicians than the national average of 225 physicians per 100,000 population. The project induced population increase will insignificantly impact them. The remaining counties are well below the national average of 225 physicians per 100,000 people, but only Tishomingo County will be significantly impacted (greater than 3 percent). The remaining counties will be relatively unaffected. Any impact in Tishomingo, Alcorn and Hardin Counties will add to the existing shortage.

No attempt to quantify the existing nursing shortage is made here. The 20 percent shortage noted in Section 4.1.8 is assumed to be relatively accurate which means that the project itself will add marginally to this shortage.

The American Hospital Association Guide to the Health Care Field (1987) shows average occupancy rates in the study area vary from 35.2 to 86.9 percent with an average of 60.5 percent, depending on the location and type of facility. The project will insignificantly impact the facilities in the study area.

Public Utilities:

Current study area water systems seem capable of handling any project induced increase in use. Given the rural nature of the study area, any additional demand could be met by individual well systems. All of the systems surveyed are based on groundwater wells or stream siphoning with system capacities far above current use (SMPDD 1985).

The average wastewater flow expected to be generated by the new employees and their families would not have a significant impact on the study area sewer systems. Should the entire population increase assumed for Alcorn County locate in Corinth, then the already overburdened system for that city would be significantly impacted. This is not likely, however, since fewer than 100 persons are expected to locate in the entire county.

The solid wastes which would be generated by new families are only a small fraction of current levels. A new landfill in Tishomingo County is needed but will be needed with or without the project because the existing site is almost full. Impact of the project to solid waste systems is therefore insignificant.

4.2.9 Transportation

Transportation effects for the Yellow Creek site will be addressed in the same manner noted in Section 3.2.9 for SSC. The types of transportation impacts at Yellow Creek would be the same, involving increased traffic on local roads, potential rail or waterway capacity problems, and transportation of hazardous materials. The level of these impacts will generally vary somewhat compared to the other two sites, primarily because only production and not testing would be conducted at Yellow Creek. The degree of variance is not large, however, so effects at Yellow Creek are often described in terms of marginal changes compared to SSC. Generic methodology and impact discussions from Section 3.2.9 are also not repeated here.

Local Traffic Generation

A traffic analysis was conducted for seven key road segments on four roads that would serve the ASRM work force at Yellow Creek. The methodology employed for this analysis was the same as described previously in Section 3.2.9 concerning traffic impacts at SSC. Existing traffic service levels were estimated for selected key travel routes, ASRM commuter trips were projected and distributed among these routes, and the resulting level of service with the additional traffic was determined for the respective routes.

The peak work force levels at Yellow Creek would be 2,100 workers during construction (this includes 1,900 peak construction personnel and 200 operating personnel that may be on line at this time) and 1,500 during operations; these figures apply to the production-only project configuration, as testing would not be conducted at Yellow Creek. The traffic analysis conducted for the Yellow Creek Nuclear Plant EIS assumed an average of 2 workers per vehicle during commuting for that project, and an overall ratio of peak-hour trips to project workers of 0.4 (TVA 1978). These figures are considerably different than the corresponding numbers of 1.2 workers per vehicle and a ratio of 0.835 used previously for the SSC analysis. Average commuting distances may be greater at Yellow Creek compared to the other, more urbanized sites, and the transportation geography produces a funneling effect into Yellow Creek from the south rather than a more unrestricted radial pattern. Both of these factors are likely to contribute to a higher proportion of ride-sharing at Yellow Creek than the other sites. To achieve a balance between the ratios reported above, the Yellow Creek traffic analysis was based on or assumed occupancy rate of 1.67 workers per vehicle, which corresponds to a trips/workforce ratio of 0.6. Consequently, peak-hour ASRM trips were estimated at 1,260 during construction and 900 in the production phase.

The demographic analysis in Section 4.2.8 indicates the expected distribution of ASRM workers among various counties in Mississippi, Alabama, and Tennessee. Based on this distribution, commuter trips were allocated to specific roads by selecting the most likely travel routes from larger population centers to the site. Consequently, the major traffic flows to the Yellow Creek site would break down approximately as follows:

- 23 percent of all ASRM traffic coming from the north, via Mississippi 25 and Tennessee 57, and northwest, via Mississippi 350 and 25;

TABLE 5-1

AMBIENT AIR QUALITY STANDARDS AND OBSERVED

- 39 percent from the east, primarily Alabama, via U.S. 72 and Mississippi 25;
- 23 percent originating from Iuka and areas further south, traveling to the site via Mississippi 25; and
- 15 percent from the west via Mississippi 365 and 25, including traffic feeding into 365 from U.S. 72.

All project traffic would ultimately reach the site along Red Sulphur Springs Road, and all traffic would also use some segment of Mississippi 25. The northern and western flows, totalling 38 percent of the total, would approach the Yellow Creek area southbound on Mississippi 25 and probably use Patrick Church Road to connect with Red Sulphur Springs Road. ASRM traffic flows from the east and south, accounting for 62 percent of project traffic, would approach from the south on Mississippi 25 through Iuka.

The results of the traffic analysis, based on existing and projected service levels, are presented in Table 4-16. These figures indicate significant service decreases would occur on Mississippi 25 south of Red Sulphur Springs Road and in the Cross Roads vicinity during the construction period. ASRM traffic is estimated to lower service on Mississippi 25 between Iuka and Red Sulphur Springs Road from LOS C to LOS D, by increasing the average daily traffic volume by over 50 percent. North of Mississippi 365, the service level is estimated to decrease from LOS A to LOS D. The analysis did not project a service decline to LOS D for any of the other road segments. Peak-hour traffic on Red Sulphur Springs Road would increase by a factor of more than 12, and total daily traffic would quadruple, but the resulting service level was still estimated at LOS C.

Due to the projected service level decrease on Mississippi 25 to LOS D, the magnitude of the ASRM traffic impact is rated as moderate. The service decrease would be long-term and probable, while the extent would be rated medium because it would be confined to portions of one road. Given these impact attributes, the overall impact of increased traffic due to the ASRM project is rated as moderately significant.

This impact projection and rating is based upon peak construction commuter traffic, rather than traffic during the production period, and is therefore a conservative assessment. However, this possible overestimate allows would compensate for growth in traffic volumes over the next several years, the possibility of fewer workers per vehicle in actual experience, and possible overestimation of road capacity due to unknown physical constraints, without altering the conclusion regarding significance of the impact.

The significance of the projected traffic impacts indicates a possible need for site specific mitigation measures to improve future service levels along two segments of Mississippi 25. More detailed studies of traffic patterns and actual road capacity should be conducted before specific mitigation measures are selected or adopted. If mitigation is determined to be warranted, it could take the form of physical improvements to increase capacity and/or employee programs to reduce the number of ASRM commuter vehicles. Potential capacity improvements could include construction of additional vehicle lanes throughout the affected segments, construction of passing lanes in key locations, or realignment to eliminate some no-passing zones. A reduction in projected vehicle trips to the site could be

TABLE 4-16

PROJECTED TRAFFIC AND
LEVEL OF SERVICE (LOS) CHANGES, YELLOW CREEK

Segment	Existing Volume 1/	Existing LOS 2/	Available Capacity 3/	Construction Traffic 4/	Projected LOS 2/
U.S. 72 E. of MS 25	670	A	1,930	490	A
U.S. 72 W. of MS 365	800	A	1,800	90	A
MS 25 N. of U.S. 72	980	A	1,620	780	B
MS 25 S. of RSS Rd.	2,950	C	550	1,560	D
MS 25 N. of MS 365	3,270	A	230	520	D
MS 365 N. of U.S. 72	1,160	A	4,140	380	A
Red Sulphur Springs Rd.	450	A	3,050	1,560	C

1/ Volume figures represent peak-hour values for first three segments estimated by the formula from the Highway Capacity Manual (Transportation Research Board 1985), and AADT values for latter four segments.

2/ Estimated from existing or projected volume and corresponding LOS from Highway Capacity Manual Tables.

3/ Estimated as difference between existing volume and the maximum volume for LOS C.

4/ Allocated on basis of worker residence distribution by county.

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accomplished through sponsorship of bus and/or vanpool programs for ASRM workers, including provision of various incentives. Maintaining service at LOS C on Mississippi 25 south of Red Sulphur Springs Road would require a reduction of over 500 peak-hour vehicle trips, or about 65 percent of the total estimated ASRM traffic in this area.

As discussed foı SSC, ASRM construction will also generate a significant amount of heavy vehicle traffic. The specific distribution of this traffic is unknown, but it likely will be concentrated on Mississippi 25 and Red Sulphur Springs Road. While this could create some congestion, the magnitude and timing would be such that insignificant incremental effects on peak traffic are expected.

Materials Transportation Requirements

Maximum annual material input requirements for the ASRM program are estimated at 3,700 tons of aluminum powder, 13,200 tons of ammonium perchlorate, and 1,300 tons of case forgings. As reported previously in Section 3.2.9, these tonnage figures correspond to 42 railcars carrying aluminum powder, 151 cars of ammonium perchlorate and 15 cars of case forgings, arriving at the Yellow Creek site over the course of a year (based on an average carrying capacity of 87.5 tons per car) (Grove 1988). Shipment of finished ASRM segments to launch and testing sites would require up to 128 railcar trips per year or up to 16 barge trips per year.

The generic impact discussion presented in Section 3.2.9 indicated that these shipments would not represent unusual capacity problems for the rail and waterway transportation network, a conclusion that is also applicable to ASRM production at Yellow Creek. The tonnage and frequency of raw material shipments should be within the capacity of the rail system, even considering the relatively small size of the Corinth and Counce Railroad currently serving Yellow Creek. Rail shipments of finished ASRM segments would need to be routed so as to avoid restricted clearance sites, but this could be readily accomplished.

The dimensions of the Tennessee-Tombigbee Waterway (TTW) are sufficient to accommodate the NASA barges that would be used to transport ASRM segments, as are the dimensions of the Black Warrior-Tombigbee Waterway (BWT) below its junction with the TTW. The environmental analysis for the TTW acknowledged that projected TTW barge traffic would cause congestion on the lower BWT (USACOE 1982). However, actual TTW traffic has been much lower than the projections, and the maximum 16 annual NASA barge trips would be an extremely small portion of total BWT traffic. Actual BWT traffic movements were reported at 3,529 tows in 1981, and over 8,300 tow movements were projected for 1987 (USACOE 1982). The incremental traffic represented by ASRM barge shipments would therefore cause no noticeable waterway congestion.

Overall, location of ASRM production at Yellow Creek would have at most a minor impact on the capacity of the existing rail and waterway system. Extremely localized load size or configuration problems could occur with rail shipment of ASRM segments, but these problem sites could be avoided through routing flexibility. Rail and/or barge traffic would increase, but not to the point that congestion effects would be expected. Consequently, effects from normal transportation of ASRM materials and products to and from Yellow Creek would be insignificant.

Transportation Hazards

A generic assessment of transportation hazards for the ASRM program was presented in Section 3.2.9. Briefly, transportation of ASRM raw materials would represent some degree of hazard, which would be minimized through compliance with U.S. Department of Transportation regulations. The primary hazard results from transportation of finished ASRM segments, which was determined to be a moderately significant impact due to potential major impact magnitude over a long period. The prior discussion also concluded that barge transportation was the safest mode for ASRM segments. The remainder of this section will not duplicate this generic assessment, but will only address differential hazard aspects for the Yellow Creek site.

The probable rail route from Yellow Creek to KSC, representing at least 88 percent of all ASRM shipments (if testing were conducted at SSC), is approximately 700 to 750 miles long. Metropolitan areas along this route include Birmingham, Jacksonville, and Daytona Beach, which collectively total approximately 2 million residents. The water route from Yellow Creek to KSC would be approximately 1,650 miles, via the TTW, BWT, Gulf Intracoastal Waterway and the Intercoastal Waterway along the Atlantic. Major population centers along or near the water route include the Mobile, Pensacola, Miami-Fort Lauderdale, West Palm Beach and Melbourne areas. The aggregate population of these metropolitan areas is over 4.6 million people.

Comparison of rail and water transportation for Yellow Creek indicates that the general advantages of water transportation described previously would probably still exist. The water route is much longer in distance, and would require a transit time estimated at 15 days versus 7 to 8 days for rail (NASA 1988b). The water route is also proximate to a much larger aggregate population (4.6 million versus 2 million). However, most of this population could be avoided by traveling in open water instead of through the Intracoastal Waterway near metropolitan areas. These relative disadvantages should be more than offset by the lower probability of initial and secondary accidents with barge transportation.

Transportation of hazardous materials, primarily ASRM segments, to and from Yellow Creek would represent a moderately significant impact. While the probability of an accident would be extremely low, a worst-case accident could still cause major property damage and loss of human life.

4.2.10 Historical, Archaeological, and Cultural Resources

Construction of the ASRM production facilities at the Yellow Creek site would affect the proposed Yellow Creek Power Plant National Register Archaeological District, which encompasses the entire proposed ASRM production site. The project effect would not be adverse, however, because of the mitigation program carried out by the Tennessee Valley Authority (TVA) with the assistance of the University of Mississippi Center for Archaeological Research. The TVA found that archaeological resources within the Yellow Creek District are significant only collectively and only in terms of their potential to yield scientific data. They completed a program to recover scientific data from sites within the district. After doing so, the TVA concluded that effects of the proposed Yellow Creek Power Plant on the Yellow Creek Archaeological District would not be adverse because mitigation measures were properly applied (Ripley 1977). TVA requested a determination of no adverse effect from the Advisory Council on Historic Preservation (Council) for the Yellow Creek Nuclear Plant site on July 25, 1977. This request was made in consultation with the Mississippi State Historic Preservation Officer (SHPO). The Council formally concurred with the TVA's and SHPO's determination of no adverse effect for the Yellow Creek Power Plant Archaeological District in October of 1977 (Utley 1977).

Since the Yellow Creek Power Plant site and the proposed ASRM production facility site are the same, the 1977 determination of no adverse effect would be applicable to the ASRM program. NASA would incorporate the Yellow Creek Nuclear Plant documents in a separate request for determination of no adverse effect for the ASRM facilities to satisfy the consultation requirements of Section 106 of the National Historic Preservation Act. Thus, construction and operation of the ASRM facility would have no adverse effect on historic properties within the plant site boundary.

It is possible that significant buried cultural resources sites, unassociated with the chert quarrying activities that were the subject of scientific investigation as part of the Yellow Creek Power Plant Archaeological District data recovery effort, might be found during construction activities that involve earth moving. If this occurs, NASA would halt construction in the immediate vicinity of the find and consult with the SHPO to determine whether the resource discovered is unique and unrelated to other resources within the proposed archaeological district. If the resource discovered was determined unique, then NASA would plan and implement mitigation measures in consultation with the SHPO.

Indirect impacts to cultural resources resulting from the growth inducing effects of plant construction and operation in the project locality are also possible. The project is expected to stimulate some housing and business construction in the area (see Section 4.2.8), and these new developments would very likely affect cultural resources sites, leading to potential cumulative impacts on the region's cultural resources. In the absence of federal involvement in new construction projects, the construction-related impacts would not be mitigated due to the the lack of state or local protection for cultural resources. While the likelihood is high that archaeological resources would be affected during the construction process, the area within 50 miles of the project site that would contain most of the new employee housing covers nearly 2000 square miles. Since the area is not densely developed, the potential for the project to contribute to severe cumulative cultural resources impacts resulting from housing and business construction would be insignificant.

4.2.11 Solid and Hazardous Waste Management

The Yellow Creek site, as an abandoned construction site, does not currently have existing on-site systems for solid and hazardous waste management. Upon selection of Yellow Creek as the ASRM production facility site, NASA would have to establish the operational programs for: 1) off-site disposal of solid and hazardous waste; and 2) emergency management plans, procedures, contacts, and training programs.

Solid Waste Management

Construction / Operation:

The main impact to the Tishomingo County solid waste management system (discussed in Section 4.1.11), would be the increased volume of waste generated during construction and operation of the ASRM facility at Yellow Creek. Currently, the County's 10-acre landfill is estimated to be 75 to 80 percent full. The existing landfill has a very short remaining lifespan (estimated to be about 2 years). The County will have to extend the life of the existing landfill or site a new landfill, regardless of this project.

To dispose of its solid waste, NASA could either: 1) transport solid wastes off-site to the Tishomingo County landfill or, 2) locate, build, and permit a dedicated NASA sanitary landfill. Building a NASA-dedicated landfill would reduce the potential impacts on the county-operated landfill. The NASA facility would be constructed to meet all current solid waste disposal regulations issued by the Mississippi Department of Natural Resources, as noted in Section 2.1.7.

If new Tishomingo County landfill facilities are available to NASA, the impact of ASRM solid waste would not be a significant impact on the landfill.

Any open burning of shrubs and brush from site clearing would be conducted in accordance with Mississippi Department of Natural Resources (DNR) requirements for protecting air quality.

Hazardous Waste

Currently there are no hazardous wastes being generated at the Yellow Creek site. Small quantities of paint products and solvents from the previous construction activities at the site were shipped to RCRA interim status facilities in 1981. Construction activities are likely to generate similar types of waste streams at Yellow Creek. Discarded commercial chemical products and other construction-related wastes will be shipped off-site for disposal in a RCRA-regulated unit.

Hazardous wastes to be generated during operations will be stored in a fully-enclosed storage unit with cement floors. Wastes will be stored less than 90 days before being shipped to RCRA-permitted disposal facilities. NASA will utilize off-site RCRA-permitted facilities that are in compliance with environmental regulations and that offer cost-effective disposal when accounting for transportation costs. The probability of a spill or leakage in the short time-period that wastes will be stored on-site is very small.

Emergency Response

In the unlikely event of a spill or release at Yellow Creek, the implementation of an emergency response consistent with the requirements of CERCLA, Section 103 would be implemented. NASA will develop a sitewide Emergency Response Plan including provisions for responses to spills of oil or hazardous substances. NASA will complete material safety data sheets (MSDSs) for all chemicals used on-site. NASA will also complete the SARA, Title III Tier-Two report form for the Tishomingo County Fire

Marshall on the Extremely Hazardous Substances stored on-site during construction and operation.

4.2.12 Toxic Substances and Pesticides

A comprehensive pest control program will be instituted at the site. Personnel handling the substances will hold and maintain certification for FIFRA-regulated pesticides. Where possible, less toxic formulations will be utilized.

4.2.13 Radioactive Materials and Nonionizing Radiation

At Yellow Creek, there may be several sources of radioactivity or ionizing radiation associated with ASRM manufacturing. The most significant of these are x-ray generating devices, used for nondestructive examination of the motor components. Other sources may include radioactive materials found in devices such as density gauges and analytical detectors. The impacts from sources of ionizing radiation at Yellow Creek will be negligible due to the controls required to keep exposures within regulatory limits, thus any impact will be insignificant.

4.2.14 Noise and Vibration

Construction, Manufacturing, and Transportation:

Noise from construction, facility modifications, production activities, and use of transport vehicles could cause some impact to local residents. There are 15 residences and a church located between 2,000 and 4,000 feet from the proposed manufacturing area where noise levels would likely exceed background levels around the clock. This noise would range from approximately 42 to 64 dB(A) at a distance of 2,000 ft and from 36 to 58 dB(A) at 4,000 ft (see Table 3-24), compared to background levels of 35 to 45 dB(A). For these nearby residences, the impact is considered moderately significant as described in Section 4.2.7. Sections 4.2.6, 4.2.10 and 4.2.15 further discuss possible impacts of noise on biota, cultural resources, and public health and safety, respectively.

Accidents:

Noise impacts could also occur from low probability accidents involving handling, processing, or transportation of an ASRM segment. These impacts are described in Section 3.2.14. A mishap during handling of a 5,000 lb container of AP could also create a blast wave but would be less forceful than one caused by rapid segment burning.

4.2.15 Health and Safety

Only about 11 TVA employees presently work at the Yellow Creek site. These employees primarily inventory construction materials and maintain security. Due to the limited operations at the Yellow Creek site, there are currently virtually no formally adopted health and safety practices or programs at this site.

Public and industrial health and safety impacts associated with production and testing of the ASRM have been discussed in detail in Section 3.2.15. Because most of these impacts would be very similar at each of the three proposed sites, that discussion will not be repeated here. Instead, this section will highlight only those impacts specific to the Yellow Creek site.

Establishment of Worker Health and Safety Practices

Production of the ASRM at the Yellow Creek site will require extensive health and safety training of personnel, formal establishment of safe work practices, and implementation of the control technologies discussed in Section 3.2.15 in order to maintain both a safe work environment and limit the potential for any public health impacts. In addition, development of an emergency response program for handling large hazardous chemical spills, explosions and other emergencies is necessary.

Explosions and Fires

The health and safety aspects of explosions and fires have been discussed in detail in Section 3.2.15. This section addresses only certain considerations relating to Quantity-Distance (QD) requirements specific to the Yellow Creek site. Additional background information regarding QD requirements is also provided in Section 3.2.15.

Theoretical QD requirements for the Yellow Creek site are the same as for SSC, except that no static testing will take place at Yellow Creek. QD arcs stipulated in preliminary designs (NASA 1988b) for the Yellow Creek site indicate potential overlap of intraline distances between several process facilities, waste storage/treatment facilities, the barge loading area, and a motor surge area. Although overlap of QD arcs is not strictly prohibited, it is considered less desirable than nonoverlapping QD arcs.

In addition, the Yellow Creek site is located on the shoreline of the Pickwick Lake embayment, which is used for both recreational and commercial navigation purposes. About 400 acres of water closest to the site and nearby Goat Island are part of an exclusion zone originally set up as part of the proposed nuclear plant design. This zone will be maintained during production of the ASRM to provide a QD safety zone for recreational and commercial users of the area (NASA 1988b; Winborn 1988, personal communication).

Salem Church, attended by the public, is located at the northeast corner of the site. According to preliminary facility designs (NASA 1988b), the church would be at least 2,000 ft beyond the nearest QD arc for inhabitable buildings, indicating that the explosive hazards potential for the church is significantly below that required by the Department of Defense explosives safety standards. It is close enough, however, that windows could be shattered by an explosion, and persons in or near the church could be injured by flying glass.

Air Quality Impacts

Air quality impacts on public health and safety at Yellow Creek are similar to impacts at SSC except that no static testing will be conducted at Yellow Creek (see Section 3.2.15). All impacts are insignificant.

5.0 JOHN F. KENNEDY SPACE CENTER

5.1 AFFECTED ENVIRONMENT

5.1.1 Site Description

John F. Kennedy Space Center (KSC) is located on the east central coastline of Florida (Figure 5-1). KSC occupies 139,890 acres on the northern end of Merritt Island. NASA has direct control over 6,507 acres; the remainder is managed by the USFWS as the Merritt Island National Wildlife Refuge and by the National Park Service as the Canaveral National Seashore. Cape Canaveral Air Force Station (CCAFS) adjoins KSC to the southeast. About 56,000 acres of KSC are in wetlands, brackish waters, and other water bodies.

KSC is relatively long and narrow, approximately 35 miles long and varying between 5 and 10 miles wide. The installation is bordered on the west by the Indian River, which is part of the Intracoastal Waterway, and on the east by the Atlantic Ocean and the CCAFS. The northernmost end of the Banana River lies between KSC and CCAFS. The Merritt Island Barge Canal connects the Intracoastal Waterway to the Atlantic Ocean via the Banana River and Port Canaveral, located at the southern tip of Cape Canaveral.

KSC is predominantly within Brevard County, but extends into Volasa County to the north. The cities of Oak Hill, Titusville, Cocoa, and Cape Canaveral, and unincorporated Merritt Island, surround the coastal installation.

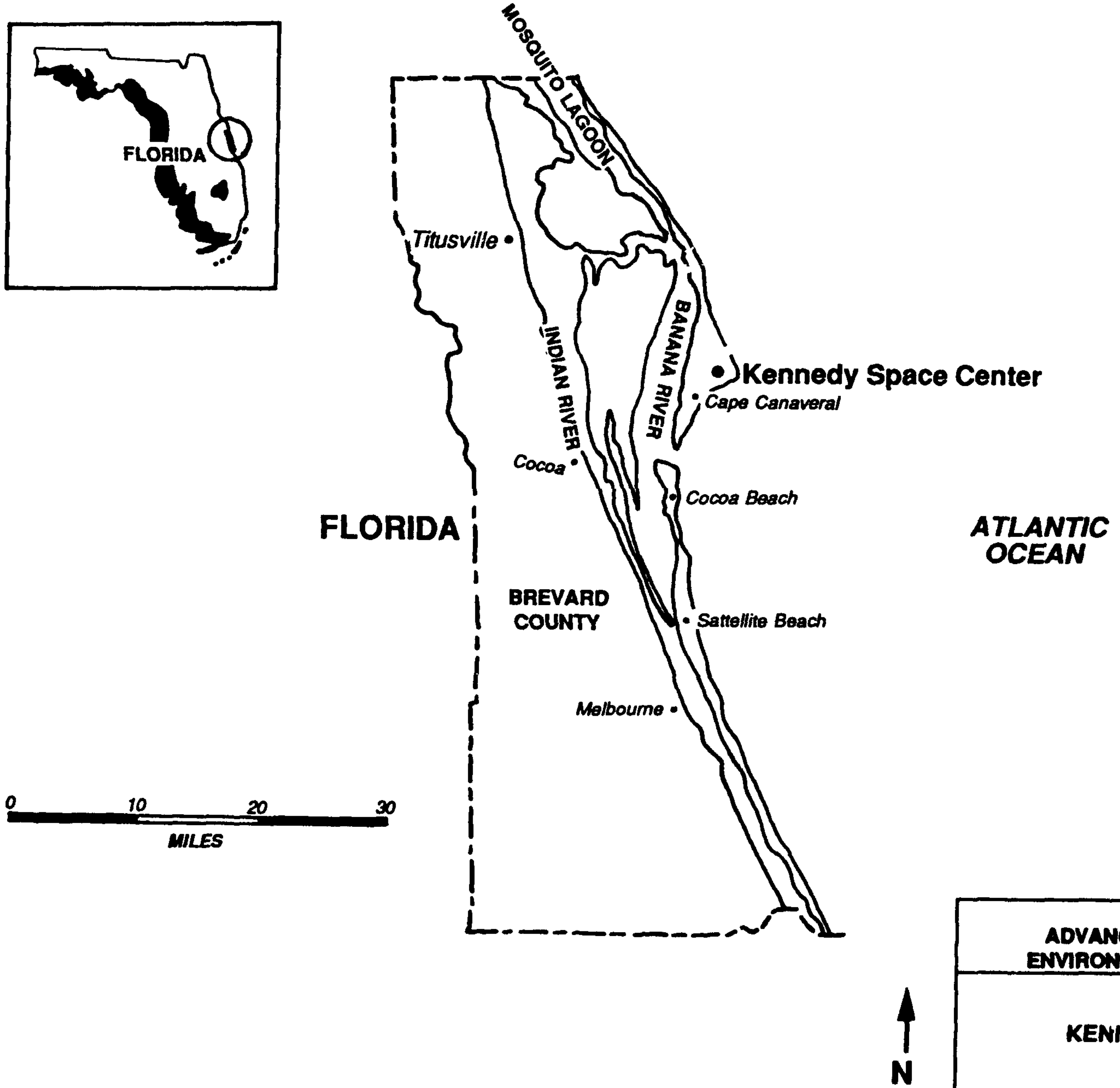
KSC and CCAFS are currently rocket launch sites. KSC has most recently been used for launches of the Space Shuttle, using solid rocket boosters very similar to the ASRM. Delta and Atlas/Centaur rockets are launched from CCAFS.

Two sites at KSC have been identified as potential ASRM facility locations (Figure 5-2). Area B contains about 2,600 acres and is located southwest of Launch Complex 39 nearly adjacent to the Banana River. Area B was reduced in size after evaluation in the ASRM Environmental Analysis (CH2M Hill 1987) to remove areas within the Launch Impact Zone and to concentrate development on uplands rather than wetlands. Area C is located on the coastal side of CCAFS and occupies roughly 1,200 acres.

5.1.2 Air Resources

Climatology

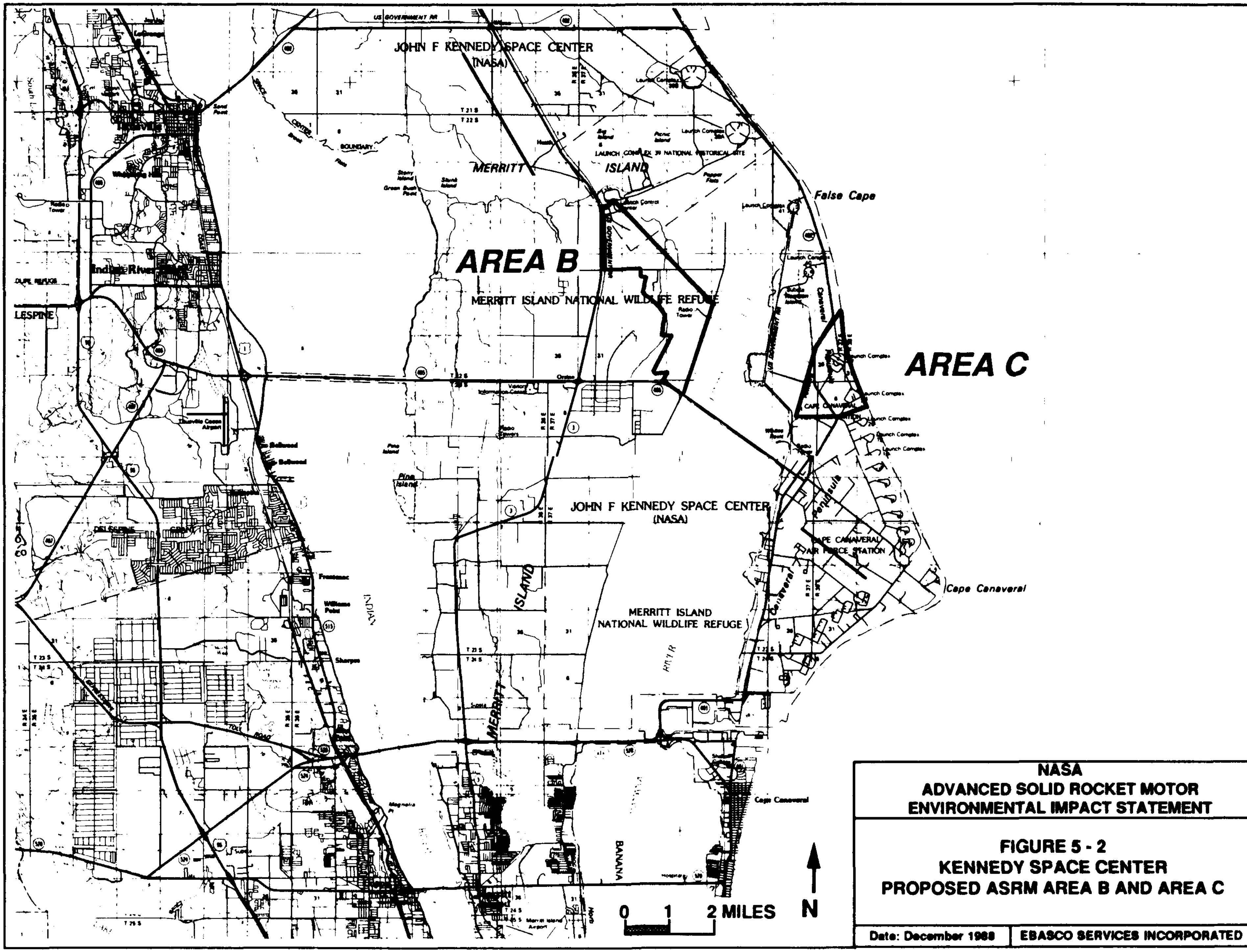
A description of the climatology and meteorology of KSC is given in both the KSC Master Plan (NASA 1984) and the Environmental Resources Document (Edward E. Clark 1986). The climate of KSC is classified as subtropical, with relatively dry, mild winters and hot, humid summers. Spring and fall seasons are not discernable. The winter season is typically short, lasting from about January through March, during which time the weather patterns are influenced by cold continental air masses.



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 5 - 1
KENNEDY SPACE CENTER
AND VICINITY

Date: December 1988 | EBASCO SERVICES INCORPORATED



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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 5 - 2
KENNEDY SPACE CENTER
PROPOSED ASRM AREA B AND AREA C

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During this period, light and steady rain can occur when such continental air masses meet relatively warm and moist marine air from the ocean. The summer season (April through December), during which the majority of the annual rainfall occurs, is characterized by frequent thunderstorms accompanied by intermittent heavy rain. The annual average rainfall at KSC is approximately 45 inches. Relative humidity is high during most of the year, averaging 89 percent during the early morning hours and 64 percent in the early afternoon. Humidity is highest during June through September. Cloud cover is remarkably uniform throughout the year, averaging five- to six-tenths sky cover for all months.

The annual average temperature is 71°F. Average daytime high temperatures range from over 85°F in the summer to about 70°F in the winter. Nighttime average temperatures range from about 73°F in the summer to 60°F in the winter. Climatological extremes include a high temperature of 98°F in June and a low of 25°F in December and February.

Winds during the summer season are predominantly from the south, southeast, or east. During the winter, north to northwest winds typically prevail. Average wind speeds are in the range of 6 to 10 mph year-round, although maximum wind speeds in excess of 40 mph have been recorded for each calendar month. Wind direction, particularly during the summer, is strongly influenced by a thermally induced sea breeze circulation, in which daytime winds are directed onshore (easterly winds) with increasing strength in the afternoon, and nighttime winds are light and variable with a net offshore component.

Severe weather associated with tornadoes and hurricanes has been known to occur at KSC, although such occurrences are rare, and damage has been slight. The hurricane season runs from about June through October. Between 1887 and 1986, only 24 hurricanes passed within 100 nautical miles (nm) of KSC. The major effect of hurricanes and tropical storms on the Florida Atlantic coast is usually confined to heavy rain, which may persist for several days during a storm passage.

KSC and the adjacent nearshore waters are well covered by numerous instrumented meteorological towers. Two Permanent Air Monitoring System (PAMS) stations also routinely measure ambient air quality on site.

Atmospheric Transport and Dispersion

Conditions which relate to air pollution dispersion and transport are summarized in Holzworth (1972). Conditions at KSC, with frequent convective activity (thunderstorms) during much of the year and a persistent sea breeze circulation, are not normally conducive to the accumulation of pollutants.

Existing Sources of Air Pollution

KSC is in an area currently designated as attainment for all state air quality standards and is removed from urban sources of air pollution. KSC is a minor air pollution source, having no sources that emit more than 250 tons of a regulated pollutant per year. Air quality at KSC is affected by NASA operations, land management practices, vehicle traffic, utilities fuel combustion, standard refurbishment and maintenance operations, and incinerator operations. Air quality is also influenced by two regional power plants located within 10 miles of KSC. Episodic events such as space launches, training fires, and fuel load reduction burns also influence air quality.

Local Ambient Air Quality

The local air quality for KSC is good, based on its attainment status for all air pollutants. Applicable air quality standards and observed ambient air quality are summarized in Table 5-1. Air pollution control agencies which have authority over emissions originating at KSC include the following: the United States Environmental Protection Agency, Region IV Office, located in Atlanta, Georgia; and the Florida Department of Environmental Regulation, Bureau of Air Quality Management, located in Tallahassee, Florida.

5.1.3 Water Resources

Groundwater

Hydrology:

Three hydrogeologic units underlie KSC (Edward E. Clark 1986). In descending order they are a surficial aquifer 30 to 60 ft thick composed of sand with some silty layers, coquina, sandy shells, and inland marsh deposits; a middle confining zone of interbedded clay, silt, sand, and limestone that is about 60 to 160 ft thick and contains aquifers; and the Floridian Aquifer that is 1,500 to 1,650 ft thick and composed of limestone. Groundwater in the surficial aquifer apparently does not communicate with in the Floridian Aquifer due to the thickness and relatively impermeable nature of the confining units (Edward E. Clark 1986).

The surficial aquifer has a high permeability in the coquina and sandy shell layers but low permeability in the sand and silt beds. Hydraulic conductivity ranges from 0.2 to 25 ft/day. Hydraulic conductivities in the middle zone range from 0.001 to 0.5 ft/day to relatively impermeable. Wells tapping discontinuous sandy or limestone units yield moderate flow and demonstrate artesian conditions. Limestones of the Floridian Aquifer have very high permeability. Transmissivity ranges from 1 million to 3 million gallons/day/ft and wells tapping this aquifer yield large quantities of water (Edward E. Clark 1986).

Recharge to the surficial, unconfined aquifer comes from direct infiltration of precipitation. The water table has two mounds along Merritt Island, a groundwater divide. The Banana River, the Indian River, and the Atlantic Ocean are discharge areas (Edward E. Clark 1986). Recharge of the surficial aquifer by fresh water is the major factor in maintaining the equilibrium of the freshwater/saltwater interface in surficial aquifers. Should the recharge be restricted, surface water bodies could become more saline.

TABLE 5-1

AMBIENT AIR QUALITY STANDARDS AND OBSERVED AMBIENT CONCENTRATIONS FOR KSC

Pollutant	National Primary Standard a/	National Secondary Standard a/	Florida Standard a/	Observed Ambient Concentration 1985 b/
Suspended Particulate Matter <10µ				
Annual Average	50	50	50	31 c/
24-Hour Maximum	150	150	150	89
Sulfur Dioxide				
Annual Average	80	none	60	Not computed
24-hour Maximum	365	none	260	47
3-hour Maximum	none	1,300	1,300	70
Carbon Monoxide				
8-Hour Maximum	10 mg/m^3	10 mg/m^3	10 mg/m^3	1 mg/m^3
1-Hour Maximum	40 mg/m^3	40 mg/m^3	40 mg/m^3	3 mg/m^3
Nitrogen Dioxide				
Annual Average	100	100	100	Not measured
Ozone				
1-Hour Maximum	240	240	240	204
Hydrogen Chloride d/ (HCl)	6 mg/m^3	none	none	Not measured

Note: Concentrations are in µg/m^3 unless otherwise noted.

a/ National standards, except those based on annual averages, are not to be exceeded more than once per year

b/ Concentrations observed during 1985 at KSC unless otherwise noted.

c/ Concentrations measured during 1987 at Titusville. Total suspended particulates (TSP) used as surrogate measure of 10µ suspended particulates.

d/ Recommended value, see Section 3.2.12.

Groundwater flow in the Floridian Aquifer is northerly and northwesterly (Edward E. Clark 1986). Artesian pressures are greater with depth. The elevation differential between the Floridian Aquifer recharge areas (e.g., Polk and Orange counties) and discharge areas along the Atlantic coast provide the potential for the flowing artesian pressure experienced at KSC.

Groundwater Quality:

The water quality of the surficial aquifer (Appendix B) is currently of good quality, but it is very susceptible to contamination. Locations with known groundwater contamination are the Cape Canaveral National Seashore and Park Service headquarters area, Schwartz Road landfill, Ransom Road landfill, launch complexes 39A and 39B, fire and rescue training area, and the VIC bus maintenance facility (Edward E. Clark 1986 and Edward E. Clark 1985-1987).

The Floridian Aquifer at KSC is highly mineralized due to seawater intrusion. A Brevard County study (Post et al. 1981) ranked the Floridian Aquifer beneath KSC as having a low potential for well field site acceptability.

The state of Florida Department of Environmental Regulation (FDER) classifies groundwater into one of four categories based on quality (Chapter 17-3, F.A.C.). Class G-II, potable water use, is defined as groundwater in aquifers which has a total dissolved solids (TDS) content of less than 10,000 mg/l, unless otherwise classified by the Environmental Regulatory Commission (ERC). Groundwater at KSC is probably in this Class G-II. No sole source aquifer is present beneath the Kennedy Space Center (Mikulak 1988, personal communication).

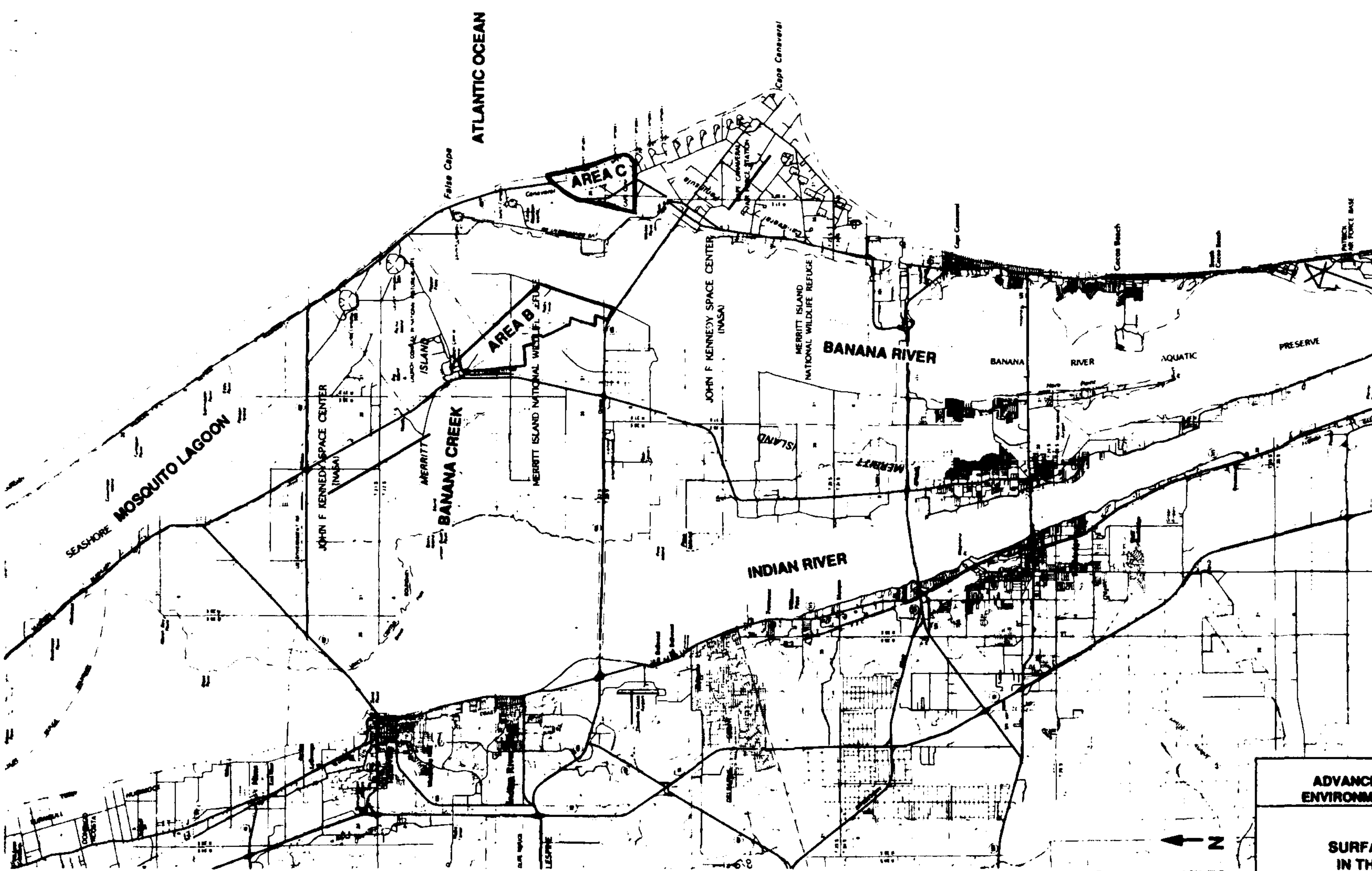
<u>Surface Water</u>

Description:

The surface waters of KSC have been described previously in the KSC Environmental Resources Document (Edward E. Clark 1986). These waters are best characterized as shallow estuarine lagoons. Depths are generally less than 5 ft and influences from the adjacent Atlantic Ocean on the lagoons are minimal. The key water bodies include portions of the Indian River, the Banana River, Mosquito Lagoon, and all of Banana Creek (Figure 5-3). The total surface area of these major lagoons exceeds 88,000 acres and extends beyond the KSC boundaries. The remoteness of these estuarine waters from oceanic influence and the restrictions imposed by constructed causeways minimize water circulation within the lagoon basins.

Dredge and Filling History:

There have been extensive dredging and filling activities at KSC. There are several causeways, lock systems, and the Haulover Canal. The Intracoastal Waterway and the turning basin access channel are also excavated waterways. Dredged material from the construction of the Intracoastal Waterway and the turning basin access channel was deposited along the waterways as small islands (Edward E. Clark 1986). The Intracoastal Waterway has a variable width and a design depth of 12 feet. There



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ENVIRONMENTAL IMPACT STATEMENT

FIGURE 5 - 3
SURFACE WATER BODIES
IN THE VICINITY OF KSC

Date: December 1988 | EBASCO SERVICES INCORPORATED

are no available estimates of dredged material volume, but it appears to be a significant quantity.

Existing Water Quality:

Water quality has been described in the Environmental Resources Document (Edward E. Clark 1986). The major surface water bodies (lagoons) are characterized as estuarine waters, with salinities ranging from 22 to 44 parts per thousand (ppt). Water temperatures range from 45 to 88°F, resulting from shallow depths and significant solar heating. The waters are alkaline (pH 8.1 units), with pH from 7.3 to 8.8 units. Given the high salinities and observed pH stability, the waters have reasonable buffering capacity. Dissolved oxygen ranges from about 4.0 to 13.0 mg/l, while turbidity is low, ranging from approximately 0.8 to 10.5 Jackson turbidity units (JTU). Nutrients range from below detection to high values of 0.12 mg/l nitrate and 0.14 mg/l phosphate.

These surface waters have little circulation and flushing, and are subject to variation in water quality with both point and nonpoint discharges. The Indian River receives runoff from citrus groves and the city of Titusville sewage treatment plant discharges. The Banana River receives nonpoint runoff from surrounding facilities resulting in lower salinities north of the causeway. South of the causeway, the Banana River receives treated discharges. Despite these inputs, the water within the Banana River is characterized as good quality (Edward E. Clark 1986). Mosquito Lagoon remains largely unaffected by anthropogenic sources, which may account for the higher salinities reported in this lagoon (Edward E. Clark 1986).

The depression of pH in surface waters adjacent to the launch stand has been monitored during launch (Hawkins et al. 1984, Dreschel and Hall 1985). The pattern occurs as a sharp spike, with pH depression of several units lasting one to two hours followed by a rapid recovery to a lower baseline pH. This depression is attributed to the discharge of stand quench water, which dissolves HCl combustion gas from the solid rocket motors.

Waters in the deeper dredged channels exhibit a significant density stratification, and a salt wedge on the bottom. In bottom waters, salinities are consistently above 30 ppt and pH is below 8.0 units. Dissolved oxygen is depleted (less than 1.0 mg/l), with high sulfide (S_2) levels. As a result, these waters serve as a sink for both nutrients and metals (Hinkle et al. 1987).

Measurements in some of the freshwater swales indicate that ponded surface fresh waters are acidic, with moderately low conductivities and generally low dissolved oxygen levels. Day/night fluctuations in dissolved oxygen indicate high levels of photosynthesis and biological respiration. These waters also appear to be enriched in organic matter (Hinkle et al. 1987).

Regulatory Aspects:

The Clean Water Act and Safe Drinking Water Act have been previously discussed in Section 3.1.3. In Florida, state compliance with the CWA is administered through the FDER. The pertinent water quality standards and criteria are summarized in Appendix C.

FDER has classified the surface waters surrounding KSC. All of Mosquito Lagoon within KSC boundaries and the northernmost segment of the Indian River are designated as Class II - Shellfish Propagation or Harvesting. The discharge of treated wastewater effluent is prohibited. Dredge and fill projects require a plan to adequately protect the area from significant damage. The remainder of the surface waters surrounding KSC are designated as Class III - Recreation-Propagation and Management of Fish and Wildlife. Surface waters adjacent to the Merritt Island Wildlife Refuge are designated as Outstanding Florida Waters (OFW). The OFW designation supersedes other classifications, and standards are based on ambient conditions. This level of protection prohibits any activity which will reduce water quality below existing levels, and contains restrictions on dredge and fill projects (Edward E. Clark 1986).

KSC has several NPDES permitted facilities (Appendix D) that meet local, state, and U.S. EPA standards for secondary sewage treatment facilities.

5.1.4 Land Resources

Geology

Regional Geology:

The deep structural foundation for the entire state of Florida (the Florida Platform) has carbonate deposits (predominantly limestones) of great thickness, up to 15,000 to 18,000 ft (Edward E. Clark 1986 and Salvador and Buffler 1982). Overlying the carbonates and extending to present-day ground surface elevation are some clastic (sand, silt, or clay) materials less than 30 million years old.

Local Conditions:

Based on a number of borings in the vicinity of the sites at KSC (Edward E. Clark 1986), a stratigraphic column for the proposed sites can be constructed. Near-surface materials are sandy soils, either fine to medium sand or sandy shell beds, about 40 ft thick, which were laid down less than 2.5 million years ago. The present-day landscape is dominated by beach ridges and swales parallel to the coastline. In these borings, there do not appear to be any layers of compressible organic soils in the areas proposed for ASRM activities. Underlying surface materials are undifferentiated silts, sands, and clays about 70 ft thick. These strata are underlain by the Hawthorn Formation, which is made up of calcareous marine clays and silts, or sandy phosphatic limestone or clay, which is variable in thickness (averaging about 50 ft) depending on the erosion of the surface of the Ocala limestone below. This underlying Ocala limestone was deposited approximately 40 million years ago, and is eroded into a karst topography of sinks, cavities, and solution channels. The thickness of this deposit varies, but averages about 100 ft. Deeper strata are continuous limestones to a considerable depth.

Structure and Seismicity:

Despite the stability of the Florida Platform, tectonic activity in the past may be evident in faulting which has been interpreted to exist in the vicinity of KSC (NASA 1984). Most pronounced is the Osceola Low, a wedge-shaped block bounded on the northwest and east by normal faults and open to the southwest. The eastern edge of this block is along the St. Johns River, some 16 miles (mi) west of the site. Total displacement along this normal fault appears to be more than 500 ft. Some additional faulting in the Ocala Group limestones and Hawthorne Formation appears in a cross section based on shallower borings done in the vicinity of Area B. The nearest fault shown is a short distance north of the site (NASA 1984). Displacement on these faults is indicated to be on the order of 30 ft, although no evidence of movement in the last 2.5 million years is shown. Later, cross sections (Edward E. Clark 1985-87) do not show evidence of faulting. These faults do not pose a danger to the proposed facility.

The generally low seismicity of the area is reflected in the fact that the KSC sites are included in Seismic Zone 0 of the Uniform Building Code (1988), which indicates that no special structural design is required for seismic loads. The strongest historical earthquake felt in the area was a 1975 Modified Mercalli Intensity V (minor damage) event located some 30 mi northwest of KSC (CH2M Hill 1987).

Physiography and Topography

KSC is located on barrier islands (Merritt Island and Canaveral Peninsula) just off the coastal lowlands of Florida. The sandy near-surface geology has been configured into relic beach ridges (dunes and swales), parallel to the coastline, with crests at about elevation 10 ft separated by troughs at about sea level (USGS various dates). Generally the ridges are a few hundred feet apart, making the maximum slopes no more than 1 or 2 percent.

Soils

The soils of Brevard County were mapped between 1964 and 1969 by the Soil Conservation Service (USDA 1974). According to this survey, the two areas (Area B and Area C) being considered for the ASRM facility are considerably different in their soil characteristics. Area B is dominated by the influence of dry ridges and wet sloughs with stands of flatwood to produce soils of the Myakka-EauGallie-Immokalee association. In Area C, the more prominent ridge landform leads to development of soils of the Canaveral-Palm Beach-Welaka association. Soils in both areas are sandy and very erodible.

Area B is located in an area of relict beach ridges and sloughs and even some areas of submerged marsh, with differing soils developing in the high and low portions. The predominant soils are Pomello sand on the ridges, Immokalee sand both on the ridges and between them, and Felda sand and Myakka sand, generally found in the sloughs which are frequently flooded. The soils are mostly composed of loose, erodible sand, are low in organic material and natural fertility, and are strongly acidic and thus highly corrosive, especially to steel installations.

Area C soils are mainly Welaka sand, Pomello sand, and Canaveral complex, as well as urbanized variations of these soils. They are all nearly level sandy soils, well-drained to moderately well-drained, with low organic matter and natural fertility. The Pomello sand is strongly acidic; the Welaka is extremely to slightly acidic in its upper portions and moderately alkaline below; the Canaveral complex is neutral to moderately alkaline apparently due to its composition of shell fragments along with the sand. The latter two soil types are moderate in their corrosivity to buried steel, and less corrosive to concrete.

5.1.5 Wetlands and Floodplains

Wetlands

Roughly 41 percent of KSC can be considered wetlands (Edward E. Clark 1986). These wetlands are considered unique habitat for many fish, wildlife, and plant species because they provide transitional ecosystems between uplands and open water. Of the species listed by the USFWS as threatened or endangered, 70 percent depend heavily on wetlands (Edward E. Clark 1986). KSC wetlands are also used for discharge of stormwater and domestic secondary treatment effluents as part of a mitigation program permitted by the FDER. Interior wetlands at KSC are found primarily in interdunal swales within scrub or slash pine flatwoods. Many of the wetlands along the periphery of Merritt Island have been modified by impoundments for mosquito control. During the wet season, additional acreages of wetlands could occur if the network of drainage canals did not exist.

Within the 2,600 acres of Area B, twenty percent, or 525 acres, are covered by wetlands (NASA n.d.). These wetlands are relatively uniformly interspersed throughout Area B.

Vegetation types in Area C have not been mapped by NASA (Edward E. Clark 1986), but have been mapped by the USFWS in the National Wetland Inventory (USFWS 1988). Roughly 25 percent of the 1,600 acres of Area C are mapped as wetlands, primarily a shrubby wetland type with scattered graminoid marsh areas. Extensive discussions of wetland vegetation types can be found in Edward E. Clark (1986, Chapter 2 and Chapter 5). Filling or otherwise modifying wetlands is subject to permits of the FDER (Edward E. Clark 1986) and the Army Corps of Engineers (CH2M Hill 1987).

100-Year Floodplain

The 100-year and 500-year floodplains have been mapped for Area B and Area C (Edward E. Clark 1986, Figure 5-4). The 100-year floodplain at KSC is established at 4 feet above sea level. Approximately 78 percent of the KSC land area falls within this designation. Within the boundaries of Area B, roughly 60 percent of the area is mapped within the 100-year floodplain. The 500-year floodplain covers all of Area B. Roughly 25 percent of the 1,600 acres of Area C is mapped as occurring within the 500-year floodplain, but none of the site is covered by the 100-year floodplain (Edward E. Clark 1986).

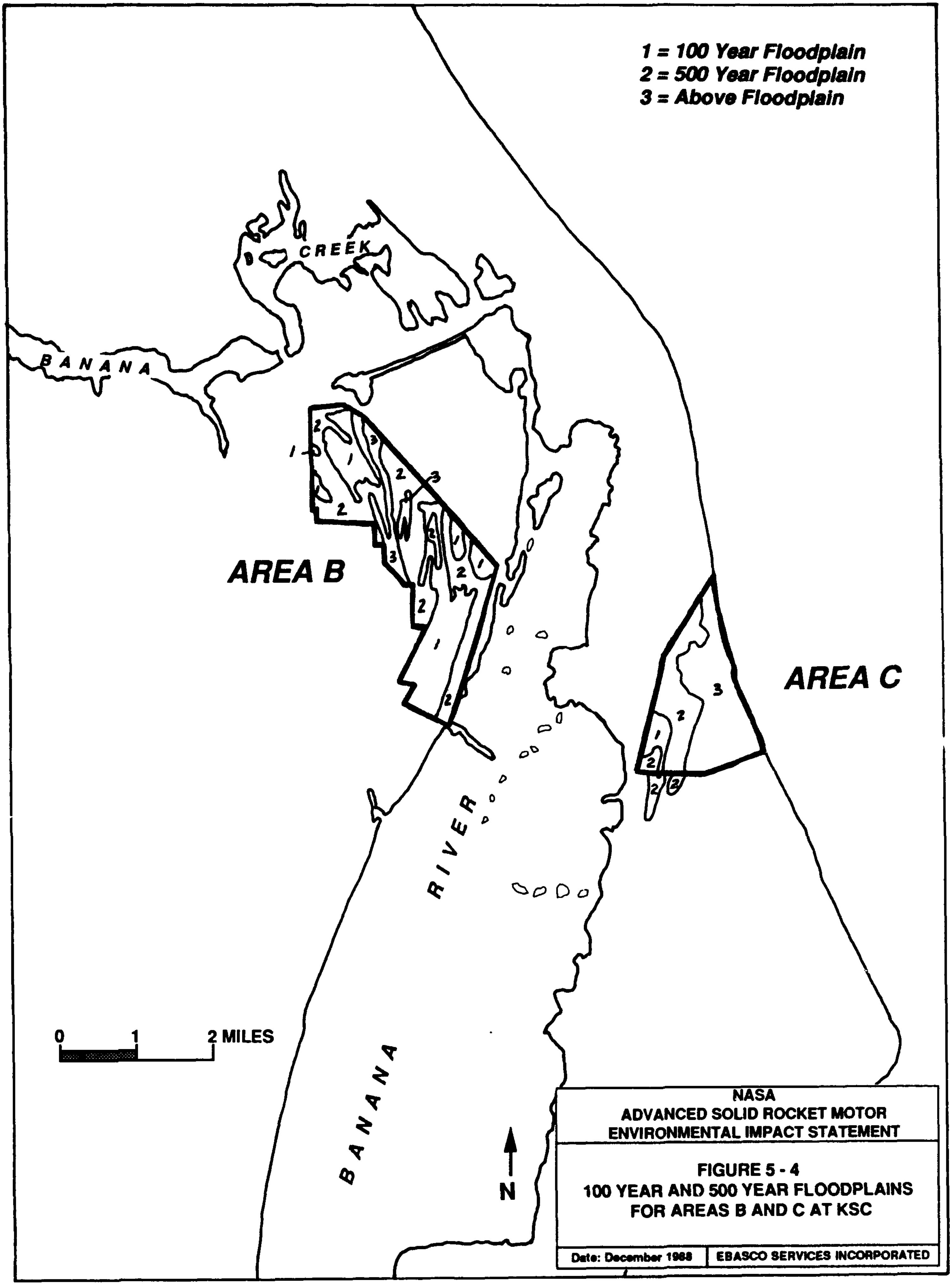

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FIGURE 5 - 4
100 YEAR AND 500 YEAR FLOODPLAINS
FOR AREAS B AND C AT KSC

5.1.6 Biotic Resources

Vegetation

Two major plant community types, mixed oak/saw palmetto and freshwater wetlands, compose over 72 percent of Area B at KSC (Figure 5-5). Over 15 percent of Area B includes dikes, roads, and plant communities that have been disturbed or created by past human activity. A total of six different plant community types are represented in the remaining 13 percent. Area C is comprised of only two plant communities, the coastal dune and coastal strand. Detailed descriptions of all the plant communities represented in Areas B and C and the dominant plant species in each are included in the KSC Environmental Resources Document (Edward E. Clark 1986). A complete list of plant species found on Merritt Island, including KSC and Cape Canaveral, has been compiled by Sweet (1975). Each of the four major plant community types in the ASRM sites on KSC is briefly described below.

The mixed oak/saw palmetto is the predominant plant community on Area B. This community covers 1,365 acres or about 52 percent of the area. It is a dense inland shrub community that occurs on relict dunes and is dominated by myrtle oak (*Quercus myrtifolia*), Chapman oak (*Q. chapmanii*), sand live oak (*Q. virginiana*), and saw palmetto (*Screnoa repens*). In general, the oak scrub dominate on well drained sites. On similar, less well-drained sites, saw palmetto dominates (Edward E. Clark 1986).

Most of the wetlands in Area B occupy interdunal swales within the mixed oak/saw palmetto community. The dominant wetland type in Area B is the graminoid marsh. This community covers 345 acres or about 13 percent of Area B. There are three subtypes of graminoid marsh. Shallow swales or the edges of large marshes are comprised mainly of several species of breadgrass (*Andropogon sp.)*. Sites with longer hydroperiods are dominated by sand cordgrass (*Spartina bakeri*). In areas with relatively deep water and long hydroperiods, sawgrass (*Cladium jamaicense*) is dominant (Edward E. Clark 1986). Other freshwater wetlands in Area B include willow swamp (99 acres), hardwood swamp (68 acres) and cattail marsh (14 acres).

Other undisturbed plant communities represented in Area B include: sand pine (2 acres), slash pine flatwoods (86 acres), live oak/cabbage palm hammock (35 acres), red bay/laurel oak/live oak (121 acres), cabbage palm hammock (9 acres) and cabbage palm savanna (63 acres). The coastal dune community occurs on the first dunes adjacent to the Atlantic Ocean and is restricted to the eastern boundary of Area C. The dominant species is sea oats (*Uniola paniculata*), but other grasses, forbs, and small shrubs also occur (Edward E. Clark 1986, George n.d.).

The coastal strand community occurs inland from the coastal dunes on older, more stabilized dunes. It is characterized by a dense shrub cover including saw palmetto, sea grape (*Coccoloba urifera*), wax myrtle (*Myrica cerifera*), and tough buckthorn (*Bumelia tenax*) (George n.d., Edward E. Clark 1986).

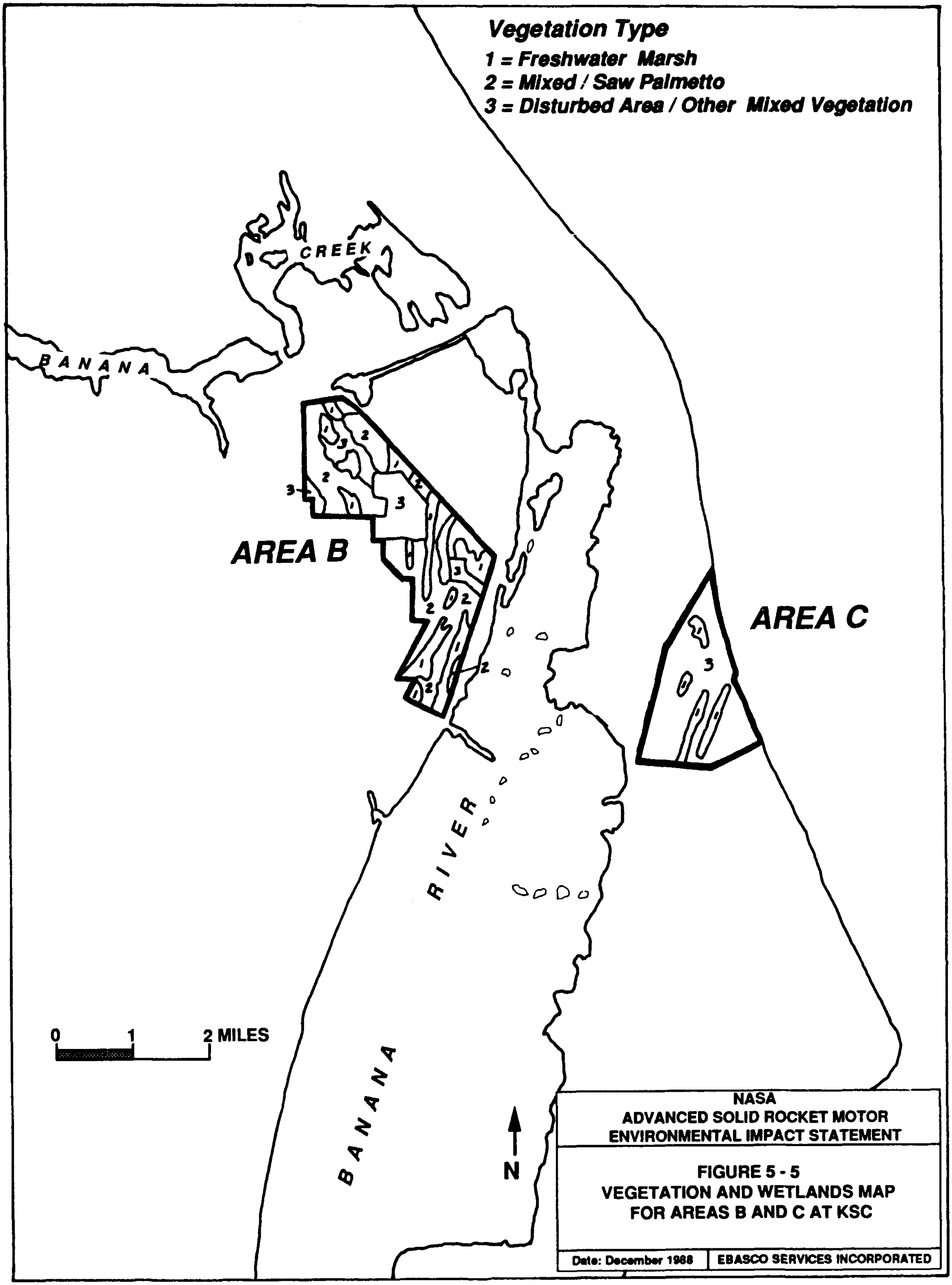

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FIGURE 5 - 5
VEGETATION AND WETLANDS MAP
FOR AREAS B AND C AT KSC

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Part of Area C is comprised of ocean beach. This area is devoid of vegetation and extends from mean low water to the coastal dune community. The rest of Area C has been disturbed or developed.

A total of 61 plant species with ranges that include KSC are listed as protected in Florida by the USFWS, Convention of International Trade in Endangered Species of Fauna and Flora (CITES), Florida Department of Agriculture and Consumer Services (FDA), Florida Committee on Rare and Endangered Plants and Animals (FCREPA), or Florida Natural Areas Inventory (FNAI) (Edward E. Clark 1986). The occurrence of 31 of these species has been confirmed on KSC and 2 are believed to have been eliminated (Edward E. Clark 1986). A total of 19 of these protected species may occur in the scrub and freshwater wetland habitats are that are predominant in Area B. (Appendix Table E-6). Additional protected species may occur in other, less dominant plant communities in Area B. A total of 7 protected species may be found in the coastal strand and coastal dune habitats represented in Area C (Appendix Table E-6). The presence of protected species in either area has not been confirmed at this time. A complete list of the protected plant species potentially found on KSC, plus life history information, has been compiled as part of the KSC Environmental Resources Document (Edward E. Clark 1986).

Wildlife

KSC is part of the Merritt Island National Wildlife Refuge and Cape Canaveral National Seashore. Consequently, much of KSC remains undeveloped and is protected. The protected status of KSC and its combination of subtropical and tropical climate and plant communities result in a wide variety of wildlife. KSC provides habitat for approximately 60 amphibian and reptile species, 300 bird species, and 54 mammal species (Edward E. Clark 1986). No specific wildlife surveys have been conducted on the proposed ASRM sites at KSC. However, the major plant communities represented in Area B most likely provide habitat for 58 amphibian and reptile species, 124 bird species, and 22 mammal species. Similarly, it is expected that Area C provides habitat for 36 amphibian and reptile species, 93 bird species, and 19 mammal species (Appendix Tables E-8, E-9, and E-10). A comprehensive list of all wildlife species identified on KSC and their habitats is found in the KSC Environmental Resources Document (Edward E. Clark 1986).

Fish

The KSC Environmental Resources Document (Edward E. Clark 1986) indicates that the fresh and brackish waters of KSC support 141 species of fish. Adjacent areas such as the southern Indian River lagoon may support more than 337 fish species, because this area combines habitat for tropical, oceanic, and freshwater species. The coastal waters adjacent to KSC have been described as one of the most productive marine fishery areas along the southern Atlantic coast (Edward E. Clark 1986). Sea trout (*Cynoscion rebulosis*) and redfish (*Sciaenops ocellata*) are major sport species taken from inland waters. The lagoonal system at KSC also provides important recreational fishing opportunities for other fish species and shrimp. Commercial species taken from lagoons and rivers include blue crab (*Callinectes sapidus*) and black mullet (*Mugil cephalus*). Important recreational and commercial shellfish species include hard shell clams (southern quahogs - *Mercenaria campechiensis*), calico scallops (*Pectin gibbus*), and oysters (*Ostrea virginica*)).

Natural fish kills occur in the inshore water bodies at KSC. These occur in the winter due to sudden drops in water temperature and during the summer due to low levels of dissolved oxygen. Fish kills of fewer than 100 small fish in a lagoon near the launch facility have been reported following each of the first three shuttle launches. These mortalities are attributed to a pH depression of 1 to 7 pH units that occurs when cooling water sprayed on the launch stand dissolved HCl gas from the solid rocket motors. The pH depression lasts only a few hours, with recovery to ambient conditions over several days (Hawkins et al. 1984).

Threatened and Endangered Fish and Wildlife Species

Merritt Island has more federally designated threatened or endangered fish and wildlife species than any other national wildlife refuge in the United States (CH2M Hill 1987). USFWS records indicate that three threatened and endangered species may occur in Area B, six in Area C, and three in adjacent areas or waterways that may be affected by ASRM activities (Wesley 1988; Lau 1988). In addition, six species potentially found in Area B and three in Area C are currently under review for threatened or endangered status by the USFWS (Table 5-3) (Wesley 1988). All federally listed protected and candidate species in Areas B and C are also designated as threatened, endangered, or of special concern by the Florida Game and Fresh Water Fish Commission (GFC). An additional four species potentially found in Area B, three in Area C, and one in an adjacent water body are designated by the GFC as threatened or of special concern (Lau 1988) (Table 5-3).

Complete life history information on all fish and wildlife species on KSC classified as protected or under review by the USFWS or of special concern by GFC has been compiled by NASA (Edward E. Clark 1986). The habitat requirements of each federally designated threatened or endangered species that may be affected by ASRM construction or testing at KSC are briefly described in Appendix Table E-11.

5.1.7 Land Use

Land Use Characterization

The proposed ASRM sites are Area B, comprised of about 2,600 acres, and Area C, consisting of about 1,200 acres. Figure 5-6 shows general land use in the project vicinity.

Area B is primarily in open space land uses, lying just outside the NASA operational areas of the VAB and KSC Industrial Area. Small areas of other NASA-related uses occur in the 2,600-acre area. A sanitary landfill, Fire and Rescue Training Area, as well as a Florida Power and Light Company transmission line occupy portions of Area B (NASA 1984b). In addition, several apiarian (beekeeping) sites exist within Area B (CH2M Hill 1987; U.S. FWS 1984). No areas of prime farmland are found in the area, but the Soil Conservation Service considers all citrus groves in Brevard

TABLE 5-3

WILDLIFE SPECIES POTENTIALLY FOUND IN OR ADJACENT TO AREAS B AND C THAT ARE CLASSIFIED BY THE U.S. FISH AND WILDLIFE SERVICE OR THE FLORIDA GAME AND FRESH WATER FISH COMMISSION AS THREATENED, ENDANGERED, UNDER REVIEW, OR OF SPECIAL CONCERN--JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Status		Area B	Area C	Adjacent Areas[c]
		GFC[a]	USFWS[b]			
Caretta caretta caretta	Atlantic loggerhead turtle	T[d]	T		X	
Chelonia mydas mydas	Atlantic green turtle	E[e]	E		X	
Dermachelys coriacea	Leatherback turtle	E	E		X	
Drymarchon corais couperi	Eastern indigo snake	T	T	X	X	
Gopherus polyphemus	Gopher tortoise	SSC[f]	C2[g]	X	X	
Nerodia faciata taeniata	Atlantic salt marsh water snake	T	T			X
Rana areolata	Gopher frog	SSC	C2	X	X	
Ajaia ajaja	Roseate spoonbill	SSC	--[h]	X		
Aphelocoma coerulescens coerulescens	Florida scrub jay	T	T	X	X	
Charadrius melodus	Piping plover	T	T		X	
Egretta caerulea	Little blue heron	SSC	--	X		
Egretta rufescens	Reddish egret	SSC	C2	X		
Egretta thula	Snowy egret	SSC	--	X		
Egretta tricolor	Tricolored heron	SSC	--	X		

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TABLE 5-3 (CONTINUED)

WILDLIFE SPECIES POTENTIALLY FOUND IN OR ADJACENT TO AREAS B AND C THAT ARE CLASSIFIED BY THE U.S. FISH AND WILDLIFE SERVICE OR THE FLORIDA GAME AND FRESH WATER FISH COMMISSION AS THREATENED, ENDANGERED, UNDER REVIEW, OR OF SPECIAL CONCERN--JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Status GFC a/	Status USFWS b/	Area B	Area C	Adjacent Areas c/
Falco sparverius paulus	Southeastern American kestrel	T	C2	X		
Haematopus palliatus	American oystercatcher	SSC	--		X	
Haliaeetus leucocephalus	Bald Eagle	T	E			X
Mycteria americana	Woodstork	E	E	X		
Pelecanus occidentalis	Brown pelican	SSC	--		X	
Sterna antillarum	Least tern	T	--		X	
Peromyscus floridanus	Florida mouse	SSC	C2	X	X	
Sciurus niger shermani	Sherman's fox squirrel	SSC	C2	X		
Trichechus manatus	Florida manatee	E	E			X
Centropomus undecimalis	Common snook	SSC	--			X

a/ GFC = Florida Game and Freshwater Fish Commission
b/ USFWS = United States Fish and Wildlife Services
c/ Adjacent areas = nest sites or waterbodies (rivers, lagoons, etc.) near or adjacent to Areas B or C or part of the ASRM transportation route.
d/ T = Threatened
e/ E = Endangered
f/ SSC = Species of Special Concern
g/ C2 under review for federal listing, but substantial evidence of biological vulnerability and/or threat is lacking.
h/ -- = no listing
Source: Lau 1988; Wesley 1988.

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FIGURE 5 - 6
GENERALIZED LAND USE
FOR KSC

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County to be Unique Farmland (Prewitt 1988, personal communication). A 21 acre citrus grove is situated adjacent to Area B.

Area C consists of former industrial-type uses associated with Launch Complexes E5, 34, 37A and 37B. Both launch pads were utilized in the Apollo space program and have subsequently been dismantled (Wiese et al. 1987).

Land uses around both Areas B and C consist of industrial uses associated with NASA and USAF launch programs, open space uses associated with wildlife habitat management, and agricultural uses consisting of citrus groves and apiarian operations. In addition, some recreational use occurs along the beachfront and in natural areas to the north of Areas B and C and at the KSC Visitor Information Center (VIC) just west of Area B.

KSC has many transmitters, receivers, camera pads and visual observation points that result in the requirements for open lines-of-sight between various points. Several of these points are on the CCAFS and traverse both Area B and C. When siting a new structure, NASA gives consideration to line-of-sight requirements before a decision is made.

The CCAFS is approximately 30 percent developed and consists of launch complexes and support facilities, with the remaining 70 percent in open space uses (Wiese et al. 1987). KSC consists of approximately 140,000 acres, of which NASA has operational control over 6,507 acres or roughly 5 percent. The NASA operational areas include Space Shuttle Launch Pads 39A and B and associated crawlerway, the shuttle landing facility, the KSC Industrial Area, a contractors area, the KSC General Area containing the VAB, and the VIC. Most of these facilities are within 4 miles of Areas A and B and except for the VIC, are industrial uses. The VIC is the fourth largest tourist attraction in Florida, with a 1986 annual visitation of 2,032,000 (NASA 1984; Whitmore 1988, personal communication). The VIC is located within 3 miles of Area B.

The USFWS manages the open space lands of KSC as part of the Merritt Island National Wildlife Refuge (MINWR). These lands surrounding the NASA operational areas are managed for the protection of wildlife. There are recreational day use areas about 5 miles north of Area B. These facilities include a visitor center, nature drives, and developed trails. In total, all MINWR facilities have experienced an annual visitation of about 500,000 for the past few years (Whitmore 1988, personal communication).

The Canaveral National Seashore is located approximately 5 miles north of Area B and 8 miles north of Area C. The recreational use areas of the seashore include a 25-mile stretch of beach. Playalinda Beach, the closest beach to the NASA operational areas, receives about 600,000 visitors per year (Smith, S. 1988, personal communication).

Land Use Plans, Policies, and Controls

Brevard County Comprehensive Plan:

Brevard County has a newly adopted comprehensive plan and areawide zoning regulations in place. Although KSC is within Brevard County, it is not under the jurisdiction of the county and the land use plan does not address planning issues at KSC or CCAFS (Brevard County Board 1988).

KSC Master Plan:

KSC has developed a master plan to establish policies and guidelines for orderly use and development. KSC is the major NASA launch facility for manned and unmanned space missions. It is also the lead center within NASA for development of land procedures, technology, and facilities in support of launching manned space vehicles, planetary probes, and earth resources satellites. One of the major capabilities of KSC is in the development, validation, activation, and maintenance of launch preparation hardware and supporting resources (NASA 1984b).

The master plan specifies three broad classes of zoning: Launch Impact Zone, Launch Support Zone, and a General Support Zone (Figure 5-7). Area C is within the Launch Impact Zone, while Area B is within the Launch Support Zone.

The Launch Impact Zone is the area of high sound pressure during Space Shuttle launches, and no personnel are allowed in this zone during a launch. Unmanned support structures, remote instrumentation facilities, and other launch support facilities are sited within this zone.

The Launch Support Zone contains manned facilities which are essential to launch operations. Facilities involving Space Shuttle rockets, liquid propellant, solid propellant, and ordnance, and maintenance operations are sited within this zone. Facilities within this zone typically require special design and support equipment to protect personnel from toxic materials and other potential hazards.

The General Support Zone contains structures which are removed from hazardous operations and are generally safe from explosion, acoustical vibration, and toxic propellant contamination. The General Support Zone contains administrative, logistical, and industrial support facilities.

Other Federal Plans:

The USFWS administers the MINWR, which includes lands such as Area B not under NASA operational control. CCAFS has jurisdiction over Area C. The primary function of CCAFS is to provide launch, tracking, and other facilities in support of DOD, NASA, and other range user programs.

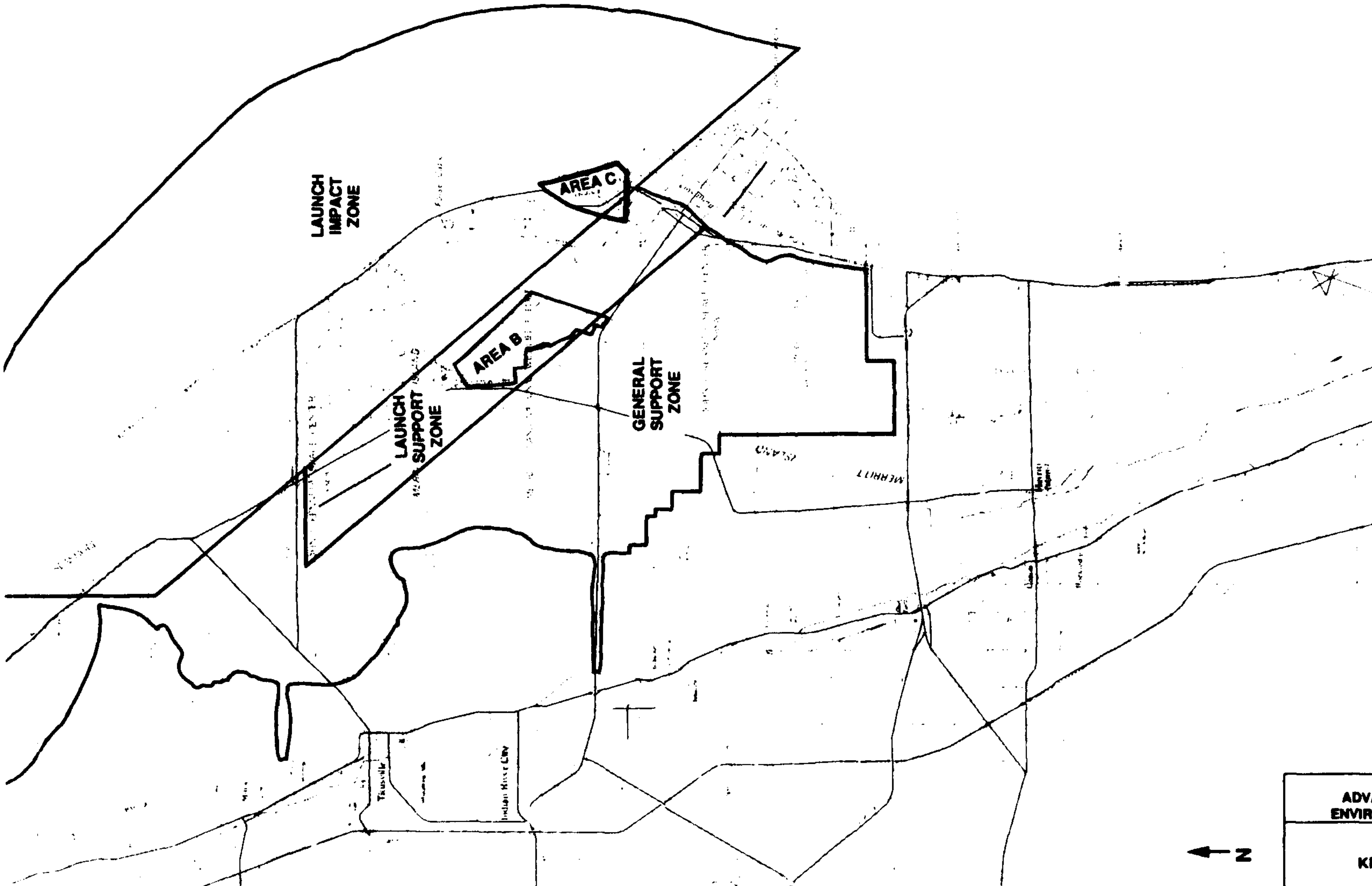

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FIGURE 5 - 7
KENNEDY SPACE CENTER
ZONING

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Coastal Zone Management:

Federal agencies such as NASA are subject to the provisions of the Coastal Zone Management Act of 1977 (CZMA). In rules promulgated to implement the Act, federal agencies are to review their activities with regard to direct effects in the coastal zone. Any activities affecting the state's coastal zone are subject to a determination of consistency with the state's Coastal Management Program. The Florida Department of Environmental Regulation is in charge of the state's coastal zone program. To achieve intergovernmental coordination and review, the review of consistency is coordinated through the Governor's Office. According to guidelines issued by the Governor's Office and the Department of Environmental Regulation, all proposals for federal activities are required to make one of three determination statements. The three determination statements are:

1) The activity does not affect Florida's Coastal Zone
2) The activity is consistent with Florida's Coastal Management Program, or
3) The activity is consistent to the maximum extent practicable with Florida's Coastal Management Program.

5.1.8 Socioeconomics and Infrastructure

Study Area Definition

For analysis purposes, the KSC study area consists of Brevard County (Figure 5-8). A sampling of current Kennedy Space Center (KSC) employees indicates that 90 percent reside in Brevard County. The remainder are scattered throughout Florida. This sample was made by tallying telephone numbers of current KSC employees listed in the KSC telephone directory and determining the county of origin by the 3-digit prefixes. No tallies previously existed.

Major cities within the study area include Cocoa, Cocoa Beach, Titusville, Melbourne, and Satellite Beach. The study area is mainly semi-urban to urban with the boundaries of many cities flowing into the boundaries of the neighboring cities. It is located in the central part of Florida along the eastern seaboard, approximately halfway between Jacksonville and Miami and due east of Tampa/St. Petersburg.

Demographic Characteristics

Population:

Total population in Brevard County was 371,735 (Table 5-4) in 1987, representing a 4.5 percent annual increase since 1980. The population of Florida grew 3.1 percent annually in the same time period. Population projections show a continued increase in population in Brevard County, with a 2.8 percent average annual growth projected between 1985 and 2000 (Table 5-5).

Population along the eastern seaboard is scattered throughout the many communities that line the coast and nearby lakes. The largest cities within the study area are Titusville and Melbourne. Orlando and Daytona Beach are the nearest

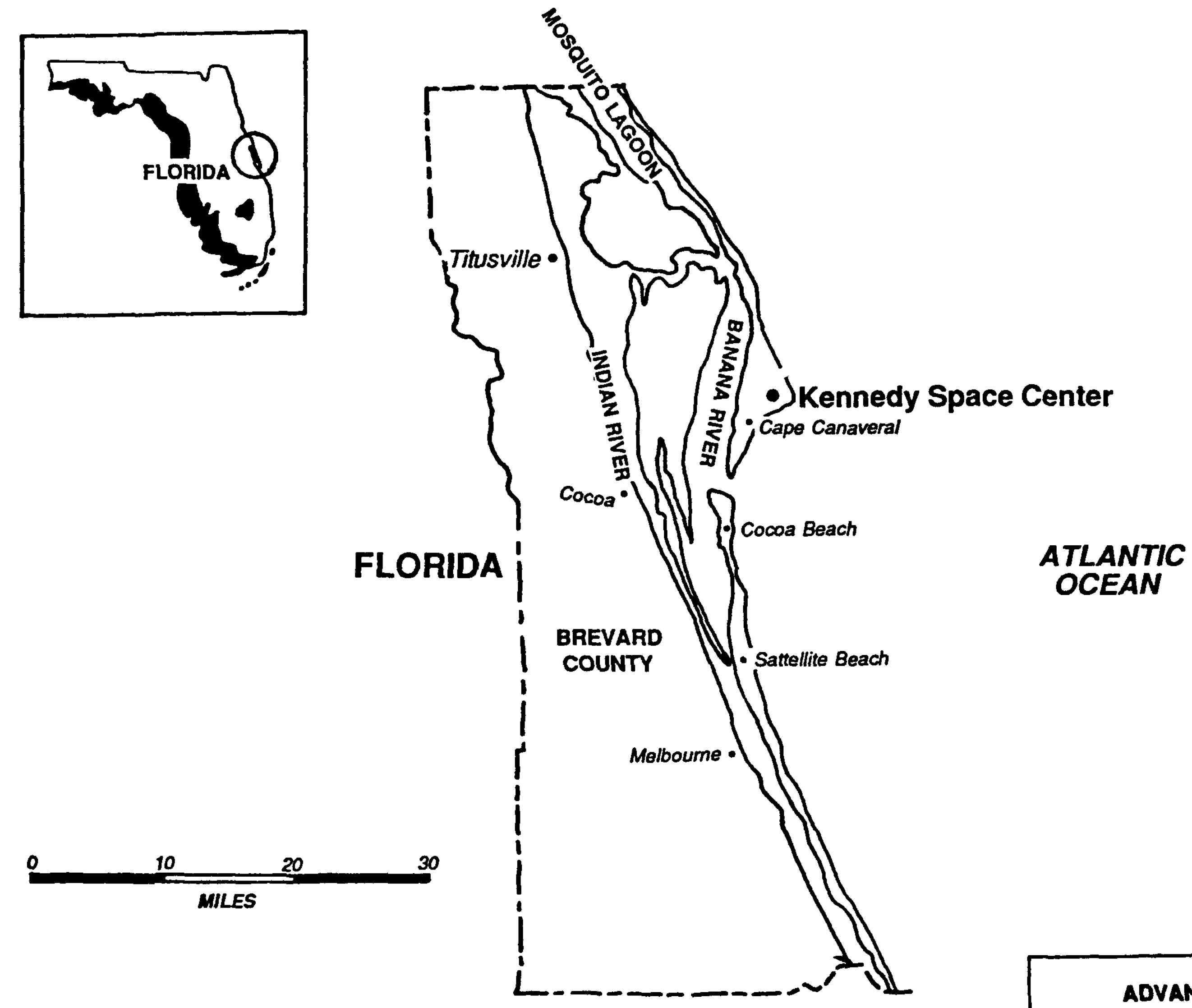

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FIGURE 5 - 8
KENNEDY SPACE CENTER
SOCIOECONOMIC STUDY AREA

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Table 5-4. Population Distribution - Kennedy Space Center Study Area.

Location	1980	1987	Percent Change
Florida	9,746,324	12,043,608	+24
Brevard County	272,959	371,735	+36

Source: Patterson, 1988

Table 5-5. Population Projections - Kennedy Space Center Study Area.

Location	1985	1990	1995	2000
Florida	11,287,932	13,036,300	14,333,708	15,431,009
Brevard County	339,473	415,992	469,336	513,424

Source: Patterson, 1988

Table 5-6. Unemployment Rates (Percent)- Kennedy Space Center Study Area.

Location	1970	1975	1980	1985
Florida[1]	NA	NA	5.9	6.0
Brevard County[1]	NA	NA	5.4	4.7
United States[2]	4.9	8.5	7.1	7.2

Source: [1] Patterson, 1988
[2] Sadler, 1988

major metropolitan areas. In 1987, 3 percent of Florida's population resided within the Brevard County study area.

Employment:

As noted in Table 5-6, Florida had unemployment rates below the national averages during the periods shown. Brevard County had unemployment rates below the state levels as well as below the national averages.

In 1987, the overall labor force (aged 16 and over) in the Brevard County study area consisted of 144,626 people (Florida Department of Labor and Employment Security, 1988). Table 5-7 shows the breakdown of this labor force by the major employment sectors. Services is the major sector throughout the study area. Wholesale and retail trade is the major sector in Florida.

Employment in the region around KSC is dominated by the influence of NASA and by two Air Force bases. NASA civilian contractor personnel represented 8.6 percent of total Brevard County employment in 1986 (CH2M Hill 1987).

Because of work force fluctuations at NASA, there has often been a substantial supply of available, well-trained workers in the KSC area. After the Challenger accident in 1986, more than 2,500 employees were laid off. Many former NASA employees have since been called back to work (CH2M Hill 1987) however, so there is not a large pool of unemployed or underemployed former employees in the area.

Income:

Per capita income in Brevard County was 6 percent below the state average of $14,193 in 1986 and 9 percent below the national average of $14,612 (Table 5-8). One explanation for this is the high number of retired persons living in the area. The percentage of persons with incomes below the poverty level was below the state and national averages.

Housing:

The average selling price of a three-bedroom, two-bath home in Brevard County is $83,200 (Suggs 1988). Homes in Brevard County stay on the market an average of two months (Suggs 1988). Demand is currently high, but construction activities have more than managed to meet it. Apartments and condominiums abound in the area, but no information is currently available on actual vacancy rates.

Infrastructure and Services

Law Enforcement:

Brevard County and each major city in the study area is currently serviced by a law enforcement agency. The rural areas are serviced by sheriff's departments and the urban areas by city police departments. Table 5-9 provides a breakdown of the number of law enforcement personnel currently employed in each jurisdiction.

Table 5-7. Labor Force Breakdown by Sector for 1987 - Kennedy Space Center Study Area.

Employment Sector	Florida	Brevard County
Manufacturing	529,900	27,900
Mining	8,700	NR
Construction	340,800	8,500
Transportation and Public Utilities	255,900	5,800
Wholesale and Retail Trade	1,317,700	33,200
Finance, Insurance, and Real Estate	360,000	5,400
Service and Miscellaneous	1,305,300	41,100
Government	734,100	20,800
Public Education	NR	NR
Agriculture	NR	NR
Other Nonagricultural Workers	NR	NR
Unemployed	312,00	9,607
Civilian Labor Force	5,870,000	174,626

Totals may not add due to rounding.
NR = Not reported separately.

Source: Florida Department of Labor and Employment Security, 1988.

Table 5-8. Per Capita Income - Kennedy Space Center Study Area.

Location	Per Capita Income (1986)[1]	Percent Below Poverty Level (1980)[2]
Florida	$14,193	13.5
Brevard County	$13,277	9.7
United States	$14,612[3]	12.4[4]

Source: [1] Patterson, 1988
[2] U.S. Dept. of Commerce, 1983
[3] Pitts, 1988
[4] U.S. Dept. of Commerce, 1984

Table 5-9. Law Enforcement and Fire Protection. - Kennedy Space Center Study Area.

Location	Law Enforcement			Fire Protection	
	Full Time	Part Time	Number of Patrol Cars	Full Time	Volunteer
Brevard County (Rural)[1]	258	60	268	200[8]	450[8]
Cocoa[2]	43	20	30	26[9]	8[9]
Cocoa Beach[3]	43	0	33	38[10]	0[10]
Titusville[4]	68	7	14	55[11]	0[11]
Melbourne[5]	120	18	33	92[12]	0[12]
Satellite Beach[6]	14	7	9	11[13]	20[13]
Cape Canaveral[7]	260	15	11	8[14]	21[14]

Source:
[1] Rollins, 1988
[2] Parham, 1988
[3] Otto, 1988
[4] Sellers, 1988
[5] Burns, 1988
[6] Harlow, 1988
[7] Eller, 1988
[8] Beukenkamp, 1988
[9] *Spell, 1988*
[10] Cornelison, 1988
[11] Thompson, 1988
[12] Dull, 1988
[13] Race, 1988
[14] Sargeant, 1988

There are currently 2.2 sworn officers per 1,000 population in Brevard County. This is slightly above the BLM Social Effects Project guideline of 2.1/1,000 (USDI 1982).

Fire Protection:

Brevard County and each major city in the study area is currently serviced by a fire protection agency. The rural county fire department is supported by an extensive volunteer team of fire fighting personnel, as are the Cocoa, Satellite Beach, and Cape Canaveral fire departments. Table 5-9 provides a breakdown of the personnel of each fire department in the study area.

Schools:

Table 5-10 shows the number of public schools, school enrollment, and student/teacher ratios in Brevard County for the 1987/88 school year. The student/teacher ratio in Brevard County is above the BLM Social Effects Project guideline of one teacher for every 18 students (USDI 1982). Brevard County public schools do not currently have excess capacity (CH2M Hill 1987). In addition to the numerous public schools, there are four 2-year colleges and technical schools and three 4-year colleges and universities (Langdon 1988) in the study area. There are also many private and religious schools located throughout the study area.

Health Services:

There are 6 hospitals in the Brevard County study area, providing 1,144 beds for patient care (Table 5-11). In addition to these primary care facilities there are numerous private, physician-run clinics and nursing homes in the area, as well as numerous dental clinics. According to the American Medical Association (King 1988), there were 241 doctors per 100,000 people in Florida in 1986. This figure is above the national average of 225 physicians per 100,000 people (King 1988). Brevard County has an average of 167 physicians per 100,000 people. This is well below the state and national averages.

Brevard County currently has 1,008 registered nurses per 100,000 people. During the data collection phase of this analysis, no concern about understaffing was expressed. However, this does not preclude the possibility that individual facilities may be understaffed.

Public Utilities:

Table 5-12 illustrates the current public water, sewer, and solid waste disposal capabilities and capacities for the four counties and major cities in the study area. Many of these facilities are currently at or approaching capacity (CH2M Hill 1987).

Table 5-10. Public School Information for Kennedy Space Center Study Area (1988/89 School Year).

Location	Number of Public School Districts	Number of Schools	Total Enrollment	Teacher/Student Ratio (86/87 School Year)
Brevard County	1	72	49,510	1:17.5

Source: Barnes, 1988

Table 5-11. Health Care Facilities - Kennedy Space Center Study Area, 1987/88.

Location	Number of Hospitals[1]	Number of Beds[1]	Number of Physicians[2]	Number of Reg. Nurses[2]
Brevard County	6	1,144	620	3,746

Source: [1] AHA, 1987
[2] Williams-Kato, 1988

Table 5-12. Water, Sewer, and Solid Waste Disposal Facility - Kenndey Space Center Study Area.

	Water			Sewer and Solid Waste				
Unit of Government	Source	System Capacity Gal/Day	Storage Capacity Gallons	Type of Treatment Plant	Capacity Million Gal/Day	Present Load (Percent)	Storm Sewer Percent Comm. Covered	Method of Solid Waste Disposal
Brevard County[1]	Well	1,000,000	65[illegible],000	Secondary Treatment	3.4	50	20[2]	Landfill
Cocoa[3]	Wells	40,000,000	15,000,000	5-stage modified Bardenpho	4.5	50	100	Landfill
Cocoa Beach	Provided by the City of Cocoa			Contact stabilization	6[4]	50	75	Landfill[5]
Titusville	Wells[6]	16,000,000[6]	3,000,000[6]	Extended aeration and secondary treatment	4.75[7]	100	75	Landfill[8]
Melbourne[9]	Lake	20,000,000	10,000,000	Activiated sludge	13.25	60	100	Landfill
Sattelite Beach[10]	Services provided by the City of Melbourne							
Cape Canaveral	Provided by the City of Cocoa[11]			Activated treatment[11]	1.8[11]	61	70[11]	Landfill

Source:
1 Striffler, 1988
2 Taylor, 1988
3 Stevenson, 1988
4 Billias, 1988
5 Striffler, 1988
6 Beeler, 1988
7 Lemke, 1988
8 Keely, 1988
9 Klaproth, 1988
10 Robertson, 1988
11 Boucher, 1988

5.1.9 Transportation

Local Road Transportation

The geography of the KSC area creates a rather distinctive transportation pattern due to the location of KSC on Merritt Island between the ocean and inland waterways bordering the mainland. The result is a strong north-south lineal orientation parallel to the coast, with relatively few east-west connections from Merritt Island to the mainland communities.

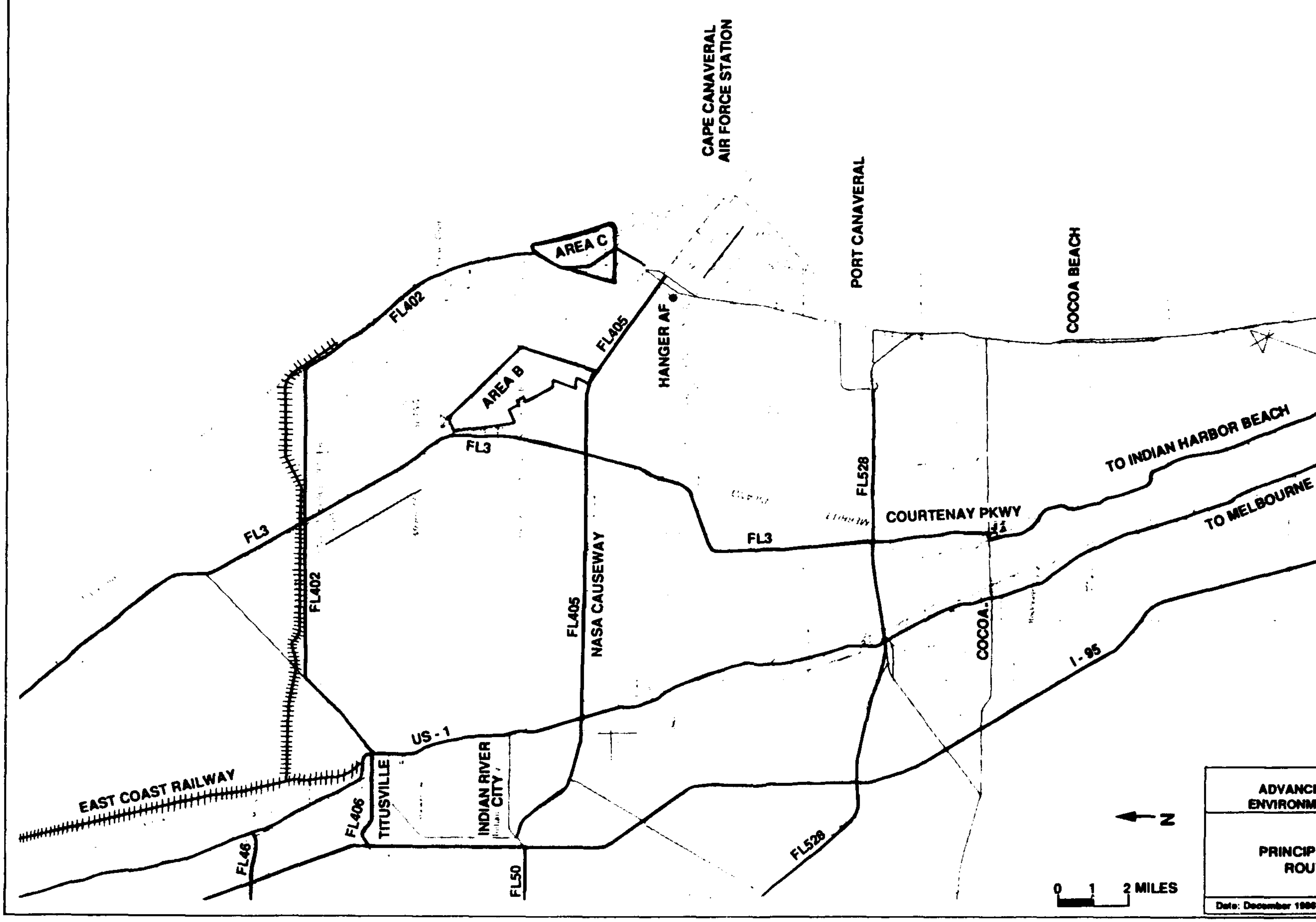
Interstate 95 is the largest traffic artery serving the area, running north-south along the inland (western) edge of Titusville, Cocoa, Melbourne, and other communities located on the Indian River (Figure 5-9). U.S. Highway 1 (also designated as Florida Highway 5 in this area) parallels I-95 to the east, passing directly through these communities. Florida Highway 3 enters KSC from the north via U.S. 1 near Oak Hill, and continues southward (as Courtenay Parkway south of KSC) to Indian Harbor Beach. Part of this road through KSC is designated as Kennedy Parkway and is closed to the public. The primary westward links from KSC are Florida 406 (Beach Road) to Titusville, via the Titusville Causeway; Florida 405 (Columbia Boulevard) to the southern part of Titusville, via the NASA Causeway; and Florida 528 to Cocoa, via the Bennett Causeway, which intersects Courtenay Parkway. Other significant highways in the local area include Florida Highways 46, 50, 402, and 407. Numerous other state highways and U.S. 192 serve the area from Cocoa south to Melbourne and beyond.

The on-base road network at KSC covers 211 miles, including 163 miles of paved roads (Edward E. Clark 1986). Primary roads are designed to high standards, including 24-foot widths for two-lane roads. The principal KSC roads are NASA Parkway West and East and Kennedy Parkway North and South.

KSC is the single largest employment source in the local area, with a total of 15,300 personnel in 1987 (Brevard County 1988), and is a major source of commuter traffic. Combined with CCAFS and other employers on Merritt Island, the major flow of commuter traffic is generally from population centers west of Indian River eastward to employment centers on the island. Commuter flows into Titusville and Cocoa from the north, west, and south are less prominent.

There currently is no public transit service to KSC. Two transit systems are active in Brevard County, but one is a flexible route service for elderly and handicapped riders and the other operates only in the Melbourne area (Brevard County 1981).

Existing traffic volumes on selected road segments in the study area are indicated in Table 5-13. As shown in the table, traffic volumes on segments of U.S. 1 and Florida 528 approach or exceed those on Interstate 95. The highest volume reported in the table was average daily traffic (ADT) of over 29,500 vehicles on I-95 north of Florida 528. Volumes on 528 on either side of U.S. 1 averaged about 25,000 ADT in 1987. Average volumes on the Florida 405 and 406 approaches to KSC were somewhat less, at about 15,200 and 17,600 vehicles per day, respectively. Traffic delays currently



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 5 - 9
PRINCIPAL TRANSPORTATION
ROUTES SERVING KSC

Date: December 1988 | EBASCO SERVICES INCORPORATED

TABLE 5-13

AVERAGE DAILY TRAFFIC (ADT)
SELECTED ROAD LOCATIONS NEAR KSC
1987
(NUMBER OF VEHICLES)

Road	Segment Location	ADT
Interstate 95	South of FL 46	19,880
Interstate 95	North of FL 405	22,528
Interstate 95	South of FL 405	20,878
Interstate 95	North of FL 528	29,573
U.S. 1	North of FL 406	21,570
U.S. 1	North of FL 405	23,455
U.S. 1	South of FL 405	26,030
U.S. 1	North of FL 528	12,428
U.S. 1	South of FL 528	20,491
Florida 406	West of U.S. 1	17,585
Florida 405	West of U.S. 1	13,380
Florida 405	East of U.S. 1	15,186
Florida 528	West of U.S. 1	27,129
Florida 528	East of U.S. 1	23,271
Florida 3 (Courtenay Parkway)	North of FL 528	12,428
Florida 3	North KSC entrance	Not available

Sources: Brevard County Research and Cartography Division (1988); Kamm (1988).

occur on Florida 3 at the southern exit to KSC; here the highway narrows from four lanes to two (Busacca 1988, personal communication).

Rail and Water Transportation

KSC is served by a rail spur across the Indian River to the Florida East Coast Railway line north of Titusville (Edward E. Clark 1986). The spur line and branches on KSC total about 40 miles of track, and provide rail service to the launch complexes, the VAB area, and the KSC industrial area.

Potential railroad routes from ASRM supplier locations to KSC are evident on Figure 3-10, introduced previously. As described for SSC, there would be four route alternatives from Nevada across the western two-thirds of the United States. From Memphis or Jackson, three of these routes would pass through Birmingham and Jacksonville on the way to KSC. The southerly route via New Orleans would likely extend along the Gulf Coast to Jacksonville. Aluminum powder and case forgings would likely travel to KSC via Memphis, Birmingham, and Jacksonville.

Port Canaveral, located at the southern boundary of KSC and CCAFS, is the primary KSC connection for water transportation. Port Canaveral serves both ocean-going vessels and Intracoastal Waterway traffic. From the port, over 19 miles of maintained canals provide water access to the launch complexes, the VAB area, and Hanger AF at CCAFS (NASA 1984, Edward E. Clark 1986). Waterway facilities at KSC are currently used for retrieval of SRB motors and receipt of external fuel tanks.

5.1.10 Historical, Archaeological, and Cultural Resources

The earliest human occupants of the Florida coast are thought to have been hunters who might have entered the area as early as 12000 B.C., at the beginning of what is called the Paleo-Indian period (Milanich and Fairbanks 1980). The subsequent Archaic era began about 6500 B.C. as sea level rose to modern levels and prehistoric people developed a hunting and gathering economy increasingly focused on accessible staple foods such as acorns, deer, and shellfish.

During the Woodland era, beginning around 500 B.C., economic patterns began to focus more on coastal resources as trade networks expanded across the eastern United States. The region first participated in the pan-Eastern Woodlands burial mound ceremonial complex during this era. Towards the end of the Woodland era, more highly organized societies began to appear, with larger settlements containing large, rectangular substructure mounds. The Mississippian period, beginning around 900 A.D. in the project area, represents the culmination of this trend. Mississippian economy was based on maize horticulture supplemented by hunting and gathering.

The Cape Canaveral locality straddled the boundary separating two Native American tribal and cultural groups at the time of European contact. On the southern side of this boundary lived the Ais, a hunter-gatherer group culturally distinct from the Timucuan horticulturists to the north. Little is known of the Ais. The Timucua, perhaps once numbering 40,000, largely disappeared by 1700, reduced by disease, warfare, and kidnapping for slave trade. The Seminoles who took their place in Florida were mostly the descendants of Creeks from Georgia and Alabama who were apprehensive of English expansion and encouraged by the Spanish to settle in Florida.

Florida was an early target of Spanish exploration. Ponce de Leon claimed the land for Spain in 1513. Others landed on Florida's west coast in the early 1500s. In 1562, the French established a colony just north of the project area, which the Spanish removed by force. The Spanish controlled Florida until 1763, when they ceded it to the British (Tabeau 1971).

Despite periodic attempts at settlement, the project area was mostly abandoned after 1700 and prior to the 1850s.

Potential ASRM production and testing sites B and C contain eight recorded prehistoric and historic archaeological sites: two at Area B and six at Area C. The site numbers and characteristics of the prehistoric sites are as follows:

Area B:	BR-61 -	the Pepper Hammock site, burial mounds located on the Banana River shore in the center of the ASRM site
	BR-206 -	artifact scatter located at the northern end of the ASRM site, near the Banana River shore
Area C:	BR-82 -	the DeSoto Grove site, burial mounds and an artifact scatter near the Banana River shore
	BR-83 -	burial mounds located near BR-82
	BR-219 -	shell midden located on the Banana River shore
	BR-220 -	shell midden located on the Banana River shore
	BR-221 -	shell midden located on the Banana River shore

Area C also contains one historic archaeological site, BR-237, a refuse dump.

It is likely that additional archaeological resources could be discovered at Areas B and C. Additional discoveries could occur when the project area is systematically surveyed in accordance with the standards of implementing regulations (36 CFR 800) of the National Historic Preservation Act (CH2M Hill 1982). Previous reconnaissance level archaeological surveys near the project area indicate that archaeological site density is relatively high (Ehrenhard 1976; Griffin and Miller 1978; Miller 1981, 1982; St. Clair and Johnson 1988; Long 1967; Smith, S. 1973, 1974; Martinez 1977).

NASA rocket Launch Complexes 34 and 37 are located within Area C. Complex 34 was used for launching Saturn I missiles, beginning in 1959. NASA launched the first manned Apollo mission, Apollo 7, with astronauts Schirra, Eisele, and Cunningham, from this complex in 1968. It was also the site of the tragic cockpit fire that killed astronauts Virgil Grissom, Edward White, and Roger Chaffee during a simulation flight in 1967. The blockhouse and several other buildings remain.

Launch Complex 37 was the site of the first unmanned Apollo lunar module launch, Apollo 5, which took place in 1968. It was also the site of seven other Saturn rocket test launches. The blockhouse and several other buildings are still standing.

Both complexes are among the 21 facilities at CCAFS that have been identified as potentially eligible for inclusion in the National Register of Historic Places as a district representative of engineering resources that supported the American space program (U.S. Department of the Interior 1981, Barton and Levy 1984). Launch Complex 34 has been officially nominated to, and is listed on, the Register (Marder 1988).

5.1.11 Solid and Hazardous Waste Management

Florida provided enabling legislation for the RCRA/HSWA equivalent program in the Florida Resource Recovery and Management Act. Solid waste regulations with stringent performance standards are provided in the Florida Resource Recovery and Management Regulations. The state has also issued separate regulations for hazardous waste management and underground storage tank control. Florida has instituted statewide comprehensive land use planning through the Environmental Land and Water Act and related statewide screening for hazardous waste facility siting.

Solid Waste

KSC currently generates solid waste from activities similar to those expected from the ASRM program. Until 1982, the sanitary landfill on-site was permitted as a Florida Class II landfill, which could accept most nonhazardous solid waste including garbage and industrial waste. Since that time the landfill has been permitted as Class III, accepting only vegetation and nonhazardous construction debris. The landfill has limited capacity and may operate for only a few more years at the current disposal rate of 92.5 tons per week (CH2M Hill 1987).

Solid waste from current production and RSRM refurbishing operations is disposed of at the Brevard County landfill on Adamson Road. This facility includes a 325-acre Class III facility and an 805-acre Class I facility. The estimated remaining life of the facility is 8 to 10 years. The county passed a bond issue in 1987 to expand this facility to its current size. This landfill serves the cities of Titusville and Cocoa, and surrounding municipalities (Ballard 1988, personal communication). The Adamson Road landfill accepts KSC's other solid wastes including garbage, paper, and nonhazardous operations waste. The total rates of disposal accepted by the county range from 1,800 to 2,000 tons per day, 6 days a week. KSC is only a partial contributor to this total volume.

For solid waste management, KSC and Brevard County are subject to rules issued by the FDER (Title 17, Chapter 17-7 of the Official Rules and Regulations of the state of Florida), last revised December 10, 1985. The state is currently in the process of integrating the U.S. EPA Proposed Rule provisions for municipal solid waste landfills into its own regulatory program (53 FR 33314) (Ballard 1988, personal communication). These new federal criteria (to be codified at 40 CFR 258) set forth minimum standards for municipal solid waste landfills, primarily in the form of performance standards, including location restrictions, facility design and operating criteria, groundwater monitoring requirements, corrective action requirements, financial assurance, and closure and postclosure care requirements.

Hazardous Waste Management and Emergency Response

KSC generates substantial quantities of hazardous waste from various development, production, and testing operations. KSC is registered with the state of Florida as a large-quantity generator and is permitted for operation of two hazardous waste storage facilities, K7-165 and M7-1361. These storage facilities are managed by the base contractor. The operating services contractor administers hazardous waste management contracts with licensed transporters and disposers in the eastern United States. Disposal of hazardous waste is provided by permitted facilities entirely outside of Florida. Reclamation or recycling of some wastes is included in the current disposal contracts (CH2M Hill 1987).

Florida received final authorization from the U.S. EPA to implement the RCRA program on February 12, 1985 (50 FR 3908). The U.S. EPA Region IV office retains the authority to administer the provisions of the HSWA program.

Section 3.1.11 discusses the requirements of SARA Title III for emergency management, planning, notification, and response. KSC issued an extensive Toxic Substances Registry in April 1988 that lists all RCRA/HSWA and CERCLA/SARA regulated substances used on-site. The registry lists the Chemical Abstracts Service (CAS) number, the chemical name, the reportable quantity, and the threshold planning quantity for each substance. Over 850 chemicals are listed in this registry. For some of the more frequently used chemicals, location codes, volumes, and container-type information is also provided on the registry. These data are provided as Tier II reports to local and state emergency planning authorities to assist these agencies in planning for potential accidents, fires, or explosions at the site (NASA 1988j).

5.1.12 Toxic Substances and Pesticides

According to the April 1988 Toxic Substances Registry, there are no PCBs in use at KSC (NASA 1988j). No information regarding any asbestos related construction/disturbance policies or events was provided. The operating services contractor issued a pesticide inventory on August 26, 1988 (NASA 1988h). The inventory included 36 insecticides, 4 rodenticides, 12 herbicides, and 2 fungicides.

5.1.13 Radioactive Materials and Nonionizing Radiation

At KSC, the average annual dose from cosmic radiation is assumed to be 27 millirem (mrem), while that from terrestrial, atmospheric, and other naturally occurring radionuclides is about 300 mrem, for a total of 327 mrem. The doses received from man-made sources are insignificant when compared to these. There are no sources of ionizing radiation inventoried in the Environmental Resources Document for KSC (Edward E. Clark 1986).

5.1.14 Noise and Vibration

Background Noise Levels

Noise levels from major sources were measured at KSC in 1979. Results of these measurements are presented in Table 5-14. Average ambient noise levels over a 24-hour period were appreciably lower than 70 dB(A) and had no impact beyond the KSC boundary (Edward E. Clark 1986). Communities near KSC/CCAFS exhibit ambient noise levels that are a function of the wind, traffic, and ocean waves. Typically, noise levels in Canaveral and Cocoa Beach are in the range of 50 to 65 dB(A) depending mostly on the proximity to local auto traffic. On KSC and CCAFS property with low wind, traffic, and ocean surf, noise levels as low as 36 dB(A) were recorded in October 1988 (Rice 1988a). Despite high noise levels associated with rocket launches (Table 5-14), there are no known records of public claims for damages as a result of launches at KSC.

Local Regulations

The state of Florida does not administer noise regulations (Starnes 1988, personal communication). Brevard County, in which KSC/CCAFS is primarily located, has noise standards that are linked to its land use zoning ordinance. The sound levels specified are not to be exceeded for more than 3 cumulative minutes in any continuous 60-minute interval (Hopper 1988, personal communication). Rocket launches are already part of the existing noise environment at KSC/CCAFS. There are no known records of public claims for damages as a result of rocket launches from KSC/CCAFS.

Vibration and Site-Specific Factors

The Cape Canaveral region exhibits the type of geological formation at the surface which makes an acoustic-seismic effect possible (Dalins 1988). This effect is explained in Appendix F. Much of the area affected by rocket launches and which could be affected by rocket motor tests is over the Atlantic Ocean. Currently, ships and aircraft are warned of impending launches because of sonic booms which are generated by ascent of the Shuttle and reentry of the SRBs and external tank.

5.1.15 Public and Employee Health and Safety

Of the 139,890 acres of the KSC, only 5 percent of the land is developed (Edward E. Clark 1986). The remaining undeveloped property provides a buffer zone to protect the surrounding communities from blasts, acoustical impacts, and the release of hazardous materials generated by KSC operations. As noted in Section 5.1.7, KSC is divided into three functional zones related to the placement of operations and their hazard potential (Edward E. Clark 1986). The personnel policies applicable to each zone are designed to protect both workers and the public from hazards associated with facility operations.

Plant and personnel protection at KSC includes fire protection, security, medical facilities and services, and emergency preparedness (NASA 1984). The fire

TABLE 5-14
MEASURED NOISE LEVELS AT KSC

Source	dBA Range Low	dBA Range High	Remarks
Reentry Sonic Boom a/			
Orbiter			101 N/m^2 max. (2.1 psf)
SRB casing			96 to 144 N/m^2 (2 to 3 psf)
External tank			96 to 192 N/m^2 (2 to 4 psf)
Launch Noise			
Titan IIIC	b/	93.7	21 Oct 1965 (9,388 m)
Saturn V	b/	91.0	15 Apr 1969 (9,384 m)
Atlas	b/	96.0	Comstar (4,816 m)
Space Shuttle a/		89.6	1.4 dBA down from Saturn V (9,384 m)
Aircraft			
F4 jet	b/	158.0	Calculated at Ground Zero
NASA gulfstream	87	109.0	Takeoff (Marker 14)
Industrial Activities			
Complex 39A	71	78.0	Transformers
Machine shop	89	112.0	Base Support Bldg. M6-486
Computer room	85	88.0	VAB - Room 2K11
VAB high bay	75	108	Welding, Cutting, etc.
Headquarters office	58	75	Room 2637 and Printers
Mobile launcher platform	82	100	2 Pumps Operating 5K Load
Industrial area	55	66	15 m From Traffic Light
Undisturbed Areas			
Seashore	50	69	Medium Waves (Nice Day)
Riverbank	48	48	Light Gusts (No Traffic)
150 m tower	50	64	Light Gusts of Wind

a/ Estimated.
b/ Not measured or not applicable.
Source: NASA 1979b.

protection program consists of around-the-clock fire and emergency response service, fire prevention audits and training, and fire service personnel certification training. Paramedics and emergency medical services are also available.

KSC security functions provide for personnel identification, access control, traffic control, law enforcement, investigations, security of classified materials, and national resource protection (NASA 1984).

Medical facilities and services are available to all NASA employees and contractor personnel. These services include medical treatment for all emergencies, treatment for occupational injury and illness, disaster planning and support, and coordination with local physicians and hospitals to ensure mutual support and cooperation in patient care and disaster contingency planning (NASA 1984).

Environmental health programs include industrial hygiene, health physics, environmental sanitation and pollution control, and environmental chemistry services. These programs provide compliance with environmental regulations and maintain the well-being of KSC employees and the surrounding environment (NASA 1984).

KSC's Emergency Preparedness Program includes a Hurricane Preparation Implementation Plan and an Emergency Preparedness Plan (NASA 1984). The Hurricane Preparation and Implementation Plan is updated annually. Upon notification of a hurricane approaching KSC, Hurricane Rideout Teams are assigned on each shift. These teams assume responsibility for controlling operations and access to critical facilities during the entire period of a hurricane alert.

The Emergency Preparedness Plan sets forth the basic policies, responsibilities, and procedures to be followed in the event of an emergency or disaster, with the exception of hurricane events (NASA 1984). This plan covers emergencies such as civil disturbance, loss of utilities, fire and explosion, defense readiness, decontamination, emergency response to civil defense and local government, emergency medical operations, and control and disposal of released hazardous materials or wastes.

5.2 ENVIRONMENTAL CONSEQUENCES

5.2.1 Facility Options at KSC

Evaluations of ASRM activities at KSC were made following the methods described in Section 1.6. Worksheets used to evaluate the types of impacts and their significance are included in Appendix G.

The impacts of manufacturing alone, testing alone, and both manufacturing and testing at KSC were evaluated. Manufacturing and waste propellant disposal were considered only in Area B. Testing could take place in Areas B or C. If testing were located in Area B, the nozzle would be pointed northeast between Pad A and Complex 41. If located in Area C, the nozzle would be pointed northeast during static tests. The differential effects of locating the test stand at either location are discussed in the following sections on biota (Section 5.2.6), land use (Section 5.2.7), and noise (Section

5.2.14). Other resources would not be affected at all, or to such a small degree that the differential impacts would be inconsequential.

Impacts associated with Space Shuttle launches would also occur at KSC. For the most part, impacts would be the same as those presented in the description of the No Action alternative (Section 2.3) and the KSC Affected Environment (Section 5.1). Launch impacts are therefore not further discussed here.

5.2.2 Air Resources

Construction:

Construction activities at KSC can be broken down into two distinct phases: ASRM manufacturing facility construction and test stand construction. Construction of the ASRM manufacturing facilities would have a greater potential for air quality impacts due to the greater area of land which would be cleared prior to erecting new buildings. Soil exposed during clearing operations will be a source of fugitive dust emissions.

Fugitive dust emissions will be significantly attenuated by the high frequency of precipitation days at KSC. The U.S. EPA has developed emission factors to quantify the rate of fugitive emissions from exposed land during construction activities. The calculations for construction at KSC are shown in Table 5-15. Modeling of the fugitive dust emissions results in an ambient impact of 48 ug/m^3, less than the 24-hour air quality standard, as shown in Table 5-15. Fugitive dust emissions due to construction vehicle traffic have been quantified based on a representative number of vehicles to construct the manufacturing and testing facilities at KSC. These emissions are summarized in Table 5-16, along with modeling results which show that construction vehicle emission impacts of the facility are insignificant.

Commuter Traffic Exhaust Emissions:

The maximum concentration of carbon monoxide (CO) at the site boundary due to commuter traffic exhaust emissions during construction and operation of both manufacturing and testing facilities is given in Table 5-17. The values are considered insignificant.

Manufacturing:

There are two significant point sources of air pollutants associated with ASRM manufacturing: solvent cleaning operations, and the fuel-burning units. Solvents are used in several processes during manufacturing (see Section 2.0 and CH2M Hill 1987). Overall annual solvent emissions are estimated to be 17.4 tons per year. These emissions will result in a maximum concentration of 0.1 ppm on the site boundary. Since the area around KSC is attainment for ozone, the incremental increase in hydrocarbons is unlikely to result in substantial elevation of existing ozone levels. Off-site modeling of the emissions from the boilers indicates that the maximum concentrations will be significantly less than all applicable ambient air quality standards, as shown in Table 5-18.

TABLE 5-15
FUGITIVE DUST EMISSIONS
DURING CONSTRUCTION AT KSC

1. Exposed construction areas:

Nozzle Manufacturing	4 acres
Case Preparation	5 acres
Misc. Processes	9 acres
Final Assembly	1 acre
Administration	4 acres

2. Emission factor:

$E = 2x10^{-4}$ x (s) x (365 - p) x (f) lb/(day-acre)

where:
s = soil silt content (3 percent)
p = number of days with greater than 0.01 inch rain (108 days)
f = time winds greater than 12 miles per hour (20 percent)

3. Emission rates: E = 2.2 lb/day-acre

4. Maximum Ambient air quality impact (assumes particles <10 microns, ug/m^3)a/

LOCATION	ANNUAL	24-HOUR
At facility boundary (0.9 mi)	0.7	47.7
At outer control area		
(4.1 mi)	0.07	--
(3.6 mi)	--	7.1
At residences		
(9.5 mi)	0.008	--
(9.1 mi)	--	0.3

5. Ambient air quality standard

(not to be exceeded)	ANNUAL	24-HOUR
Federal (PM-10)	60 ug/m^3	150 ug/m^3
Florida (TSP)	60	260
Florida (PM-10)	60	150

a/ Air quality impact analysis was performed with the ISCST (USEPA 1987b) model, 1986 Daytona Beach, FL, surface meteorology, and 1986 West Palm Beach, FL, upper air data.

TABLE 5-16

FUGITIVE DUST EMISSIONS DUE TO CONSTRUCTION VEHICLE TRAFFIC DURING CONSTRUCTION AT KSC

1. General site traffic on unpaved roads:
   Number of 6-wheeled 20 ton trucks on site = 15
   Average length of trip on unpaved roads = 3 miles
   Site speed limit during construction = 15 mph

2. Emission factor:

   $E = 3x10^{-6} x (s) x (S) x (W^{.7}) (w^{.5}) (365 - p)$ lb/VMT
   where:
   - s = silt content of road (3 percent)
   - S = mean vehicle speed (20 mph)
   - W = average vehicle weight (15 tons)
   - w = average number of wheels (6)

3. Emission rate (pounds per vehicle miles traveled (VMT)): E = 0.7 lb/VMT

4. Maximum Ambient air quality impact (assumes particles <10 microns, ug/m^3)a/

LOCATION	ANNUAL	24-HOUR
At facility boundary (0.9 mi)	0.5	2.97
At outer control area		
(4.1 mi)	0.05	--
(3.6 mi)	--	4.4
At residences		
(9.5 mi)	0.005	--
(9.1 mi)	--	0.2

5. Ambient air quality standard (not to be exceeded)

	ANNUAL	24-HOUR
Federal (PM-10)	60 ug/m^3	150 ug/m^3
Florida (TSP)	60	260
Florida (PM-10)	60	150

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a/ Air quality impact analysis was performed with the ISCST (USEPA 1987b) model, 1986 Daytona Beach, FL, surface meteorology, and 1986 West Palm Beach, FL, upper air data.

TABLE 5-17

VEHICLE EMISSIONS FROM COMMUTER TRAFFIC AT KSC

Assumptions

Greatest impact will occur at site boundary gate during shift change from night shift to day shift.

Number of vehicles passing gate is as follows:

Construction Phase		Operation Phase	
No. Arriving	No. Leaving	No. Arriving	No. Leaving
1,184	148	976	122

Vehicle mix is as follows (percent):

Type of Vehicle	Construction Phase	Operation Phase
Light duty vehicles	50	75
Light duty trucks	40	20
Heavy duty gas trucks	5	5
Heavy duty diesel trucks	5	0

Wind speed = 2.5 m/sec; stability class = F (moderately stable).

Resulting Emissions

Phase	Maximum 1-hour CO concentration (ppm)	Applicable Standard (ppm)
Construction	1.3	35
Operation	1.0	35

TABLE 5-18

AIR POLLUTANTS FROM ASRM MANUFACTURING AT KSC

1. Activities:
   Process solvents = 17.4 tons per year of hydrocarbons
   Boilers (2 units) = 7.0 gallons No. 2 fuel oil per minute

2. Emission factors for boilers:

Carbon monoxide (CO)	5 lb/1,000 gal
Nitrogen oxides (NOx)	22 lb/1,000 gal
Sulfur oxides (SOx)	71 lb/1,000 gal
Hydrocarbon (HC)	1 lb/1,000 gal
Exhaust particulate matter (PM-10)	2 lb/1,000 gal

3. Emissions from boilers:

Carbon monoxide (CO)	3.7 tons per year
Nitrogen oxides (NOx)	16.2 tons per year
Sulfur oxides (SOx)	52.1 tons per year
Hydrocarbon (HC)	0.5 tons per year
Exhaust particulate matter (PM-10)	0.2 tons per year

4. Ambient air quality impact at site boundary (0.9 mi):[a/]

Pollutant and Averaging Time	Concentration	Standard
Sulfur dioxide		
3-hour	46.9 ug/m^3	1300 ug/m^3
24-hour	13.7 ug/m^3	365 ug/m^3
Annual	1.1 ug/m^3	60 ug/m^3
Nitrogen dioxide		
Annual	0.3 ug/m^3	100 ug/m^3
Carbon monoxide		
1-hour	0.005 ppm	40 ppm
8-hour	0.001 ppm	9 ppm
Hydrocarbons (Boiler)		
1-hour	0.001 ppm	none
Hydrocarbons (process solvents)		
1-hour	0.02 ppm	none

a/ Air quality impact analysis was performed with the ISCST (USEPA 1987b) model, 1986 Daytona Beach, FL, surface meteorology, and 1986 West Palm Beach, FL, upper air data.

Static Testing:

Emissions of air pollutants during static test firing of motors has been quantified in several documents (c.f., CH2M Hill 1987). Table 3-18 summarizes the major chemical compounds emitted during static test firing and resulting off-site concentrations under worst-case meteorological conditions. As discussed in section 3.2.2, the PCAD dispersion model was used to evaluate short-term ambient concentrations from static testing. The results of the model indicate that a peak concentration of several parts per million can be experienced for a short-time as the cloud of combustion products passes over a given receptor. However, taken as a time average for periods of an hour, the concentrations do not exceed 20 parts per billion of HCl. Impacts to public health and safety of static test firing at KSC are discussed in Section 5.2.15.

Waste Burning:

Burning of waste propellants is analogous to static test firing in that a peak concentration of combustion products is experienced at a given downwind receptor. The time average concentration for typical averaging periods of one-hour are quite low concentration values, however. The results of the combustion/dispersion model for worst-case meteorological conditions are shown in Table 3-19. The concentrations are less than any applicable air quality standard. Impacts to public health and safety of open-burning of waste propellants at KSC is discussed in Section 5.2.15.

HCl scavenging is discussed in Section 3.2.2. Annual HCl emissions at KSC would be greater than any of the other sites since launches also occur at KSC. Static testing and open-burning of waste propellants differ significantly from launches in that launches involve a water deluge system. Water is used to dampen acoustic vibrations and the water serves to scavenge the HCl immediately.

Site-specific factors to mitigate air pollutant emissions and impacts will be analyzed fully during the air permitting phase of the project. As a major facility (emissions greater than 250 tons per year of a regulated air pollutant), the facility is subject to the provisions of Prevention of Significant Deterioration (PSD) under the federal Clean Air Act and the rules of the Florida Department of Environmental Conservation. PSD requires that each pollutant be analyzed on a case-by-case basis to ensure that Best Available Control Technology (BACT) is being implemented. The analysis takes into account energy, environmental, and economic factors specific to the project. In this case, the factors will include analysis of any site-specific characteristics that influence the selection of control technologies.

5.2.3 Water Resources

Groundwater

Construction:

Constructing facilities in critical recharge areas could decrease infiltration of fresh water and thereby allow saltwater intrusion in the surficial aquifer. Certain downgradient areas are already saline, and the saline conditions could migrate upgradient if adequate recharge does not occur in critical areas (e.g., Area B). The potential impact of saltwater intrusion due to reduced recharge in critical areas is considered insignificant because NASA has agreed to avoid critical areas of recharge when designing and building the facilities.

Manufacturing:

Overpumping the surficial aquifer for process water could also cause further saltwater intrusion. The effect could be similar to interfering with critical recharge (i.e., saline conditions could migrate upgradient). Since some of the small ponds, wetlands, and marshes communicate with the surficial aquifer, overpumping or restricting critical recharge could also impact the quality of these surface water bodies. The majority of water needs at the site could be met by the existing water system, which has an off-site supply. However, the surficial aquifer may provide low-yield, nonpotable process water from shallow wells in some areas. Because pumping even small quantities of water from the surficial aquifer could, over time, cause a major salinity increase in the aquifer by tilting the balance of recharge over withdrawal, and the extent of the effect could be over a fairly large area (including a potential effect on surface water recharged from groundwater), the impact of this unlikely event is considered moderately significant. Any pumping from the surficial aquifer should be monitored carefully to ensure that overpumping is not occurring. Presumably, if overpumping were the cause of saltwater intrusion, switching to another water source and reducing the pumpage would reverse the saltwater intrusion.

NASA has agreed to activities that would protect groundwater quality in areas of wastewater disposal and landfills. Contaminated water will be discharged to lined ponds and ditches, and any water discharged to unlined ponds or ditches would be of good quality (see below under Surface Water - ASRM Manufacturing). Therefore, potential impacts to groundwater quality are considered insignificant. Siting large percolation ponds in Area B would have a beneficial effect on the surficial aquifer as long as the discharged water is of good quality. It would provide additional assurance that saltwater intrusion would be minimized as much as possible in the area of influence of the recharge.

Waste Burning:

NASA has agreed that open burning will occur in a lined pit and the pit will have an attendant leachate collection system with leachate treatment if needed. No impacts to groundwater quality are expected.

Static Testing:

Firing pads for static testing will be designed to prevent infiltration of surface water and will be properly drained for runoff control. The exhaust plume will be directed over surface water and will be dispersed in the air there, reducing the opportunity for soil contamination and subsequent groundwater contamination. NASA has agreed to install groundwater monitoring wells around facilities as needed to detect any groundwater contamination and comply with EPA and applicable state and local quality standards. Therefore, the impact of static testing is considered insignificant.

Accidents:

Liquid contaminants or contaminated water could be accidentally spilled on the ground or in surface water bodies, and in turn, could eventually percolate to the water table. Storms and catastrophic explosions could disrupt waste water processes, allow contaminated water to reach the ground or surface water bodies, and contaminate groundwater through the normal infiltration process. As stated previously, NASA has agreed to several mitigative measures to minimize the impact of accidental releases of hazardous liquids or contaminated water. The mitigative measures include a spill prevention, control, and countermeasure plan for fuel handling and storage; an emergency response plan for spills, system failures, and accidents; personnel training for emergency response; required emergency equipment; and redundant treatment systems on critical portions of the processes. The impacts of spills to groundwater is considered insignificant because of the protection offered by the overlying soils and the mitigative measures. The time necessary to percolate through the soils provides ample time for emergency response and cleanup before contaminants reach the water table.

<u>Surface Water</u>

Construction:

The primary surface water concern associated with both ASRM manufacturing facility and test stand construction is the erosion of surface soils during clearing, grading, and construction. The potential exists for increases in suspended solids, turbidity and color of receiving waters, with soil deposition in wetlands. However, erosion of soil is expected to be minimal given the low topographic relief of the proposed site (NASA 1984). Best management practices, including storm drainage control and temporary sedimentation basins will also be used. A hydrogeologic survey will also be required prior to any excavation. Therefore, soil erosion and associated surface water impacts are not expected to be significant.

The influx of up to 2,000 construction personnel will increase potable water demand and sanitary sewer requirements to over 120,000 gal/day during peak periods. The City of Cocoa provides supply water to KSC and Merritt Island, and the county of Brevard operates the treatment system on Merritt Island (CH2M Hill 1987). These facilities are adequate to handle these increased demands. Therefore, no significant impacts due to construction water supply and sanitary treatment are anticipated.

The possibility exists that small wetlands and percolation recharge zones may be altered, depending upon detailed facility layout and design. This aspect is discussed further in Section 5.2.5. The hydrogeologic survey will identify sensitive areas so that impacts to these zones can be minimized through avoidance and/or replacement recharge. This potential direct impact is therefore considered moderately significant.

Manufacturing:

The surface water concerns associated with ASRM manufacturing are similar to those discussed in Section 3.2.3 for SSC. The existing potable water supply from the City of Cocoa appears to be adequate to supply the potential demands of up to 350,000 gal/day (CH2M Hill 1987). Depending upon specific requirements, costs, and system configurations determined during the detailed design phase, the option also exists to supplement this supply source with water from the City of Titusville or industrial cooling water pumped from one of the rivers. Thereiore, no significant surface water impacts are expected associated with water supply requirements.

NASA, as stated in Section 2.1.7, is committed to comply with regulatory criteria and guidelines covering effluent discharges and receiving water bodies (Appendix C). This precludes direct discharge of effluents to surface water bodies and will require the construction or expansion of waste water treatment facilities, and possibly additional compliance monitoring. Sanitary wastewaters, accounting for up to 60,000 gal/day of the effluent, will require secondary level treatment in order to satisfy the regulatory criteria. The existing facility has the capacity to handle this effluent (CH2M Hill 1987). The balance of the process wastewater streams will require varying levels of industrial treatment prior to discharge to a percolation pond. The majority of this remaining water will be relatively clean and may require only settling/filtering (suspended solids removal), oil skimming, and possibly pH adjustment prior to discharge to a percolation pond. Some of the water, primarily from hydroblasting, will require more elaborate solvent recovery treatment processes. A small stream of about 15,000 gal/day of process and washdown wastewater may require intensive treatment prior to discharge due to high dissolved solids content (Section 2.1.3). Treatment system configurations, specifications, discharge locations, infiltration ponds and flows associated with the ASRM program will be provided during the detailed design phase. These site-specific systems would be designed to satisfy the regulatory criteria. Therefore, no significant surface water quality impacts are anticipated from effluent discharges to infiltration/percolation ponds.

Static Testing:

The surface water quality concerns associated with static testing are similar to those previously discussed in Section 3.2.3 for SSC (potential minor pH depression and enhanced aluminum solubility). At KSC, many of the surface waters are brackish (high in total dissolved solids) and/or have a fairly high buffering capacity (Section 5.1.3). Therefore, any pH effects and potential aluminum release in these waters is expected to be minimal. In consideration of the remaining waters, NASA has agreed to mitigate through runoff control (stormwater collection systems), with pH adjustment to contain unanticipated HCl washout. They will also monitor potentially affected water bodies, and consider addition of lime to deposition areas for pH control. The monitoring program will identify elevated levels of aluminum (soluble) in addition to pH. As discussed in Section 5.2.3, aluminum oxide may not elevate dissolved aluminum concentrations. This can be effectively determined only by monitoring.

Given the above mitigation measures, the duration of any pH effect (on the order of hours), the proposed test firings (four per year, maximum), the limited extent of deposition, and the incremental increase these test firings represent over the existing launches, any pH effect and associated impacts to surface water quality are considered to be insignificant. There are sufficient water supplies such that, with appropriate holding pond design, water requirements for deluge cooling of the motor following the test are not considered significant.

Waste Burning:

The possibility for surface water contamination is the same as for SSC (Section 3.2.3). NASA has committed to follow the necessary procedures so that discharges will comply with the regulatory criteria (see Section 3.2.3). Therefore, no significant surface water quality impacts associated with open pit burning or site surface water runoff are expected.

Accidents:

NASA has agreed to several mitigative measures to minimize accidents, as noted in Section 3.2.3 and Section 2.1.7. These measures will ensure that accidents are unlikely and would be of short duration and small extent. Impacts to surface water quality associated with spills or discharges are also typically reversible; i.e., the receiving water body can normally be treated and/or recover its original quality through dilution and natural assimilation. Therefore, spills or other accidental uncontrolled releases of processing/recycled solvents, untreated effluents, or fuel components directly or indirectly into the surface water bodies would be expected to have only a moderately significant impact on surface water quality.

5.2.4 Land Resources

Construction:

Construction of the facility could lead to exposure of the soil under particular buildings (mainly the static test stand and adjacent buildings) to dynamic effects, failure under excessive bearing pressures, erosion, and corrosion (to subsurface utilities due to corrosive soils all over the site). Due to the relatively flat topography at the KSC site, there is no potential for landsliding to occur. Mitigation by appropriate engineering design of structures at KSC renders soil dynamics effects and soil bearing strength effects insignificant, however, and the use of erosion control procedures of various sorts will eliminate any significant erosion during construction. Revegetation of a borrow area shown on preliminary layouts (NASA 1988b) will reduce erosion impacts in that area to an insignificant level. The use of cathodic protection and protective coatings for buried utility lines will reduce the problems with their corrosion. However, the possibility that corrosive soils will continually cause damage to underground utilities despite the protective measures is still considered a moderately significant impact to these facilities and thus to the proposed uses of the site.

Manufacturing:

There are no impacts to soils anticipated as a result of routine manufacturing activities. Operation of the facility could, in rare instances, lead to hazardous substance releases and consequent soil contamination. The use of an emergency response plan and spill prevention, control, and countermeasure (SPCC) plan will avoid any significant possibility of hazardous substance releases to the soil, however.

Static Testing:

Static tests could contribute to soil dynamics effects, erosion in the blast impact zone, and deposition of soil-modifying substances (primarily hydrochloric acid). The installation of an exhaust deflection ramp and the direction of the exhaust over water for the rocket motor static tests will effectively eliminate the impact of blast erosion as well as any possibility of ignition of subterranean fires, as discussed in Section 3.2.4. Coastal dune erosion beyond the deflection ramp could affect the stability of the dunes. However, using the same erosion control measures as for construction will reduce this to an insignificant impact.

Accidents:

The accident scenario of greatest concern is that hazardous materials may be released during a catastrophic failure in the manufacturing process, which could scatter hazardous materials over a large area. The impacts to soils at the site are, however, relatively minor because remediation of soils, by either covering them or replacing contaminated areas, is relatively simple.

5.2.5 Wetlands and Floodplains

Wetlands

Impacts to wetlands from dredging for barge access are considered insignificant because there are sufficient land areas immediately adjacent to the turning basin to accommodate enlarged barge access and spoil deposition without impacting any wetlands. If dredging is necessary, all operations will be conducted in compliance with federal and state permits and will employ best management practices to avoid wetland impacts.

Construction of ASRM facilities in Area B would directly impact 125 acres of wetlands according to preliminary facility layouts (NASA 1988b). This direct impact has already been reduced to the extent possible through careful and coordinated preliminary layout. The 125 acres of wetlands which would be impacted at Area B represent 1.1 percent of the overall KSC freshwater wetlands resource. These proportions are ranked minor in terms of the wetland habitats at Area B and are small in extent for all of KSC. The impact of filling 125 acres is considered only moderately significant, rather than very significant, for this reason. A fill permit from the Army Corps of Engineers would be obtained prior to construction at KSC. As part of this permit, appropriate federal and state agencies would be consulted. Mitigation for these wetlands would involve either the creation of new wetlands from existing uplands and/or the enhancement of existing wetlands. The amount of area involved in mitigation would be determined in conjunction with state and federal resource management agencies. These mitigation areas would be managed for both mosquito control and wildlife resources at KSC. A moderately significant impact will remain even with replacement or enhancement mitigation, because filling of these 125 wetland acres would contribute to a cumulative loss of an already diminishing resource.

There are no impacts to wetlands at Area C according to preliminary KSC layouts because all facilities are located in upland areas that have been previously developed for Launch Complex 37 (NASA 1988b).

Floodplains

Of the 2,600 acres of Area B, only 30 percent is actually proposed for ASRM development. Within this, it appears likely that construction and access roads can be located to almost completely avoid the 100-year floodplain. All facilities, however, would occur within the 500-year floodplain at Area B (Edward E. Clark 1986, NASA 1988b). The area impacted cannot be accurately determined until after final facility layout and the 100-year and 500-year floodplains are mapped in detail.

At Area C, the test stand would be located at the existing Complex 37. The complex and all access roads are above the 100-year floodplain. Portions of existing access roads are within the 500-year floodplain.

For facilities in Area B or C that cannot be located outside of the floodplain, buildings will be designed to National Flood Insurance Program Standards (33 CFR 1216.2) or will be protected by dikes. Impact on the floodplains are determined to be insignificant if floodplains are avoided to the extent possible and buildings are designed properly or protected by dikes.

5.2.6 Biotic Resources

Vegetation

Construction:

The ASRM production facility in Area B at KSC is expected to require about 867 acres of land. This area will include buildings, roads, and parking lots, as well as the required explosive safety zones. Areas not needed for access or facilities will be left intact and all land temporarily disturbed by construction activities will be revegetated. Therefore, the actual area to be permanently disturbed or developed by construction of the production facility is expected to be less than the 867 acres. In addition, facility siting and construction will avoid sensitive plant communities whenever possible. A total of 7 plants considered sensitive by the USFWS and/or several state agencies potentially occur in Area B. A survey of the area would be conducted prior to construction and the locations of these species will be avoided, if possible.

Currently, about 15 percent of Area B consists of roads, clearings, and disturbed stands of mixed oak/saw palmetto. Much of the construction for the ASRM production facility will occur in these disturbed areas but approximately 125 acres of freshwater wetlands, primarily graminoid marsh, will also be affected. The 125 acres of wetlands that will be impacted by the ASRM production facility represent 24 percent of the freshwater wetlands in Area B, and about 1 percent of the 11,481 acres of freshwater wetlands at KSC. Most of these wetlands will be replaced through mitigation. However, ASRM construction will also permanently remove several hundred acres of mixed oak/sun palmetto and other vegetation types. Since the ASRM production facility will require the permanent removal of undisturbed wetland and upland vegetation, the impacts of construction on the vegetation in Area B are considered moderately significant.

An additional 100 acres will need to be cleared if static testing is conducted in Area B. Although the exact location of the test stand in Area B has not been determined, it is likely that the area to be disturbed includes some wetlands. Therefore, construction of the test stand in Area B would also have a moderately significant impact on vegetation.

If static testing occurs in Area C, nearly all of the static test facilities will be located on the existing Complex 37 and will be serviced by existing roads. The clearing associated with the deflection ramp is the only anticipated disturbance to vegetation in Area C.

The clearing associated with the deflection ramp is expected to permanently impact about 1,000 ft of beach and coastal dune, an area of about 32 acres. Approximately 200 ft of coastal dune in the vicinity of the test stand is already disturbed and has relatively little vegetative cover or dune structure remaining. However, at least 800 ft of undisturbed coastal dune vegetation would be cleared for static testing. Coastal dunes vegetation consists primarily of sea oats, a species currently protected from disturbance or removal by Florida Statute 370.41 (George n.d.). In addition, the FNAI ranks the coastal dune community as S3, vulnerable throughout the state (Nesmith 1988). Consequently, impacts from ASRM construction activities on vegetation in Area C are expected to be moderately significant.

Static Testing:

Static testing may occur in Areas B or C. The horizontal test firing position of the ASRM will result in the lateral expulsion of a hot exhaust plume. Exhaust from the test firing will release large quantities of HCl gas and $Al_2 0_3$ into the atmosphere. The potential effects of these materials on vegetation have been described in Section 3.2.6.

At both Areas B and C, the exhaust plume will be directed to the northeast, over the Atlantic Ocean and no HCl deposition on vegetation is expected. Vegetation in the immediate vicinity of the test stand and deflection ramp may be intermittently damaged from HCl, particularly when the humidity is high, but the area affected would be small. Vegetation outside the test area could be temporarily damaged in the unlikely event that a change in atmospheric conditions directs the plume over land, prevents dissipation, and results in HCl deposition. However, under normal conditions impacts on vegetation from static testing in Areas B or C are expected to be insignificant.

Open Burning of Waste Propellant:

Open burning of waste propellant in Area B is expected to occur about 40 times annually. Burning of waste propellant will generate maximum amounts of HCl at 2.5 miles (4.0 km) from the burn site in the direction of the prevailing winds. The maximum amount of HCl generated by open burning is less than that demonstrated to cause visible damage to plants. Over time HCl deposition may result in soil acidification in the vicinity of the burn site. However, much of this area will already be developed and cumulative damage to vegetation from propellant burning is expected to be insignificant.

Other Impacts:

No impacts on the vegetation in Areas B or C at KSC are expected from normal operations or transportation activities. NASA is expected to implement safe material handling procedures for propellant and materials. Accidental propellant spills or the effects of improper transportation or storage of raw materials will be confined to the accident site and should not significantly impact vegetation.

Wildlife

Construction:

Although the ASRM production facility in Area B would require about 867 acres of land, most of this area will not be disturbed and will thus continue to provide wildlife habitat. The ASRM production facility would eliminate or displace wildlife, primarily birds and amphibians, from about 125 acres of wetlands. A variety of birds, reptiles, and small mammals that inhabit disturbed as well as undisturbed areas of mixed oak/saw palmetto will also be eliminated or displaced. Construction activities in Area B would also increase traffic on existing roads and may temporarily disturb wildlife in adjacent areas. Overall, it is estimated that the ASRM production facility would permanently eliminate or disturb at least 30 percent of the available wildlife habitat in Area B. Clearing required for the static test stand and deflection ramp in Area B would permanently eliminate an additional 100 acres of wildlife habitat. Since the impacts of ASRM construction on wildlife in Area B would be long term and probable, they are considered moderately significant.

In Area C wildlife in the vicinity of the test stand and/or borrow pit would also be temporarily disturbed during construction. In addition, clearing associated with the deflection ramp would permanently eliminate about 32 acres of beach and coastal dune habitats. A variety of shore birds, small mammals and reptiles use these habitats and would be displaced or eliminated. Because of the long-term elimination of habitat from Area C, impacts from ASRM construction on wildlife are considered moderately significant.

Operation:

Increased traffic on roads in the vicinity of Areas B and C due to ASRM operations could occasionally disturb wildlife in adjacent areas. However, wildlife are currently exposed to traffic from other space-related operations and impact of traffic from ASRM operations is expected to be insignificant.

Static Testing:

Static testing in Area C would generate a hot exhaust plume that would kill any wildlife in a 1,000 foot wide area (32 acres) between the test stand and the Atlantic Ocean (NASA/MSFC 1977). Similarly, in Area B any wildlife in the 92 acres surrounding the deflection ramp would be killed by the gases and heat in the exhaust plume. However, noise and disturbance associated with pretest activities would likely prevent any wildlife from entering the cleared area in the vicinity of the deflection ramp at either test site. Consequently, few animals or birds are likely to be directly killed by the exhaust plume from static testing.

The effects of HCl and Al_2O_3 on wildlife have been described in Section 3.2.6. At KSC the exhaust plume would be directed over the Atlantic Ocean. In the unlikely event that atmospheric conditions direct the plume over land and prevent its dissipation, some wildlife, particularly birds, could experience temporary irritation from HCl gas. However, the effects of the exhaust plume from static testing on wildlife in or near Areas B or C are expected to be insignificant.

In addition to exhaust, static testing will also generate noise. In either Area B or Area C, the static test stand will be positioned so that the noise contours are directed to the northeast and southeast, over the Atlantic Ocean. The effects of noise on wildlife were summarized in Section 3.2.6. It is likely that the duration and level of noise in the immediate vicinity of the static test stand will cause permanent or temporary hearing loss in those animals present (NASA/MSFC 1977; CH2M Hill 1987). Noise and disturbance in the test area prior to firing will probably cause most birds and larger mammals, if any, to leave the area. Small mammals and reptiles may be affected but their burrows should help attenuate the impact.

In general, field studies on a variety of animals have demonstrated few, if any, measurable lasting physiological or reproductive effects from impulse or steady state noise (Evans 1988). In addition, wildlife at KSC have been subject to noise from space-related activities, including launches, for years. The impacts of noise from ASRM testing on wildlife outside the immediate vicinity of the test stand in either Area B or C are expected to be insignificant.

Open Burning of Waste Propellant:

Open burning of waste propellant will occur about 40 times per year and generate HCl at a maximum concentration of 4.7 ppm (7.2 mg/m^3) at 2.5 miles (4.0 km) from the burn site in the direction of the prevailing winds. HCl levels from open burning are below concentrations that cause visible injury to animals. The threshold of odor perception for humans is about 0.27 ppm (0.4 mg/m^3), so it is possible that wildlife downwind from the burn pit may experience temporary irritation from HCl (USEPA 1986b). However, few animals are expected to occur in the vicinity of the burn site and impacts from the burning of waste propellant are considered insignificant.

Other Impacts:

No impacts on the wildlife at KSC are expected from ASRM transportation activities. Accidental spills of propellant or the effects of improper transportation or storage of raw materials will be confined to the spill site and are expected to have an insignificant impact on wildlife.

Aquatic Resources

Construction / Operations Impacts:

Dredging and filling of wetlands during construction (see Section 5.2.5) will result in the loss or alteration of aquatic habitat. This is more evident in the development of Area B than Area C. The impact is considered moderately significant because it is a long-term loss that probably will occur.

Potential impacts to aquatic systems from erosion, siltation, and sedimentation (see Section 5.2.3) are expected to be insignificant at KSC for two reasons. First, erosion or sedimentation control measures will be implemented by NASA for construction and operation of the facility. Secondly, the local relief is generally low and flat, thus avoiding erosional impacts that may occur in areas of greater slope.

Withdrawal of fresh water from the local aquifer or use of a percolation pond for adding water to the aquifer at this site could alter the freshwater/saltwater balance in the aquifer and in surface waters (see Section 5.2.3). Sufficient information is not available to quantify the potential impacts that a change in this balance could produce. Theoretically, if operation of the pond resulted in expansion of surface freshwater areas, the composition of aquatic species and aquatic habitat in these affected areas would shift from estuarine or saltwater species to totally freshwater species. Similarly, over pumping of the aquifer could result in the reverse situation. Loss of freshwater input to the aquifer could result in a shift in the opposite direction (i.e., freshwater to estuarine or saltwater species). If this shift occurred, it could result in a long-term change that would be moderately significant.

Static Testing:

Potential impacts to aquatic resources due to test firing are discussed in Section 3.2.6. One of NASA's mitigation measures for avoiding impacts at KSC is to direct the exhaust plume from test firing over the Atlantic Ocean. It is anticipated that the rapid mixing in the ocean and the ocean's large buffering capacity will prevent any potentially significant pH depression resulting from contact of the HCl in the cloud with receiving water system (see Section 3.2.3). Also, the mixing would be expected to disperse any aluminum oxide, thus preventing any accumulation and potential impact to aquatic life. The plume could inadvertently drift over land and nearby lagoon and freshwater areas where the mixing and buffering capacity is less. In this case, short-term pH depression could occur (see Section 5.2.3). As discussed in Section 3.2.6, this impact is considered insignificant. As discussed in Section 3.2.6, there is no information about possible bioaccumulation of aluminum (USEPA 1986a). Therefore, NASA will establish a biomonitoring program to determine if any significant impacts are apparent.

Open Burning:

Impacts on aquatic resources due to waste propellant burning are expected to be insignificant due to the dispersion of the combusted materials. With dispersion over the open ocean, any HCl or aluminum oxide that may contact the water will be rapidly dispersed. The buffering capacity of the seawater would further negate any effects. Similarly, dispersion over estuarine or freshwater areas would be sufficient to avoid any significant water quality changes (see Section 5.2.3). Therefore, no significant impacts to aquatic species would be expected.

Accidents:

Accidental spills of oil or hazardous waste are expected to be insignificant during routine construction and operation activities due to implementation of mitigative measures discussed in Section 2.1.7. NASA will implement a spill prevention and cleanup plan for this site. This plan will be designed to minimize the impacts of accidents.

An accidental explosion would potentially kill fish and destroy aquatic habitat. If this occurred, the impact to aquatic resources could be moderately significant. However, during routine operation, no impacts are expected.

Threatened and Endangered Fish and Wildlife Species

Construction:

Construction of the ASRM production facility at KSC is expected to eliminate or disturb about 30 percent of the available wildlife habitat in Area B. Approximately 125 acres of wetlands and several hundred acres of mixed oak/saw palmetto will be impacted. Wetlands in Area B provide potential feeding habitat for the woodstork (*Mycteria americana*), which is classified as endangered by both the USFWS and GFC. Two species classified as of special concern by GFC, the snowy egret (*Egretta thula*) and little blue heron (*Egretta caevulea*), also commonly use freshwater wetlands for feeding and could potentially be found in Area B. Three other species of special concern in Florida, the roseate spoonbill (*Ajuia ajaja*), reddish egret (*Egretta rufescens*) and tricolored heron (*Egretta tricolor*) feed secondarily in freshwater marshes and may also occasionally use the wetlands in Area B.

The mixed oak/saw palmetto stands in Area B provide habitat for the Florida scrub jay (*Aphelocoma coerulescens coerulescens*) and the eastern indigo snake (*Drymachon corais couperi*), which are both classified as threatened by the USFWS and GFC. The gopher tortoise (*Gopherus polyphemus*) is a species of special concern in Florida and currently under review for classification as threatened by the USFWS. This species has been documented in the mixed oak/saw palmetto community in Area B. Its burrows may be used by the gopher frog (*Rana aerolata*) and the Florida mouse (*Peromyscus floridanus*), which are also species of special concern in Florida and under review by the USFWS. Construction in Area B may also potentially impact the two pairs of bald eagles that nest in the vicinity of the site. Bald eagles are classified as endangered by the USFWS and threatened by GFC and are sensitive to disturbance from humans and vehicles during nesting.

Because ASRM construction in Area B is expected to affect less than 2 percent of the available habitat at KSC for the bald eagle, Florida scrub jay, gopher tortoise, gopher snake, Florida mouse, eastern indigo snake and woodstork, impact to these species are considered moderately significant. However, in order to comply with the Threatened and Endangered Species Act (1973), Biological Assessments will be required to determine construction impacts on these species in Area B. Similarly, consultation with USFWS and GFC will be required to determine the impacts from construction on the species of special concern in Florida and/or candidates for federal classification.

Construction in Area C will require clearing beach and coastal dune vegetation in a 32 acre area between the test stand and the shoreline. Although much of the coastal dune structure and vegetation near the test stand has been disturbed, there is evidence of nesting sea turtles. The Atlantic loggerhead turtle (*Caretta caretta caretta*), a threatened species, and the green turtle (*Chelonia mydus mydus*), an endangered species, both nest in the area. Loggerhead turtle nesting density in Area C ranges between 50 and 200 nests per kilometer (Provancha et al. 1984). Therefore, the clearing of a 1,000 foot (0.3 km) wide strip of beach and coastal dune in Area C could impact the nesting habitat of 15 to 60 pairs of loggerhead turtles. This range represents 2 to 7 percent of the 886 loggerhead nests observed on Merritt Island in 1986 (Edward E. Clark 1986). Consequently, construction impacts in Area C to this species are considered very significant. Fewer green turtles nest on Merritt Island, so impacts are expected to be moderately significant.

The coastal strand vegetation in Area C potentially provides habitat for the same protected species that use the mixed oak/saw palmetto in Area B. However, the borrow pit in the coastal strand vegetation will be temporary and affect only a small area. Therefore, ASRM construction impacts on the Florida scrub jay, eastern indigo snake, Florida mouse, gopher tortoise, and gopher frog are considered moderately significant in Area C.

To comply with the Threatened and Endangered Species Act, Biological Assessments will be required to determine impacts on the green turtle, Atlantic loggerhead turtle, Florida scrub jay, gopher tortoise, gopher frog, Florida mouse, and eastern indigo snake in Area C. Similarly, consultation with USFWS and GFC will be required to determine construction impacts on the species of special concern in Florida and/or candidates for federal classification.

Operation:

No impacts on threatened or endangered species are expected from ASRM operations. Accidental spills and improper storage or transportation of raw material will be confined to the spill site and are not expected to impact threatened or endangered species.

Open Burning of Waste Propellant:

The levels of HCl released by open burning of waste propellant are below concentrations causing observable injury to animals (USEPA 1986b). In addition, few, if any threatened or endangered species are expected to occur in the area of maximum concentration. Consequently, open burning of waste propellant is not expected to impact threatened or endangered species at KSC.

Static Testing:

Static testing at Area C would generate a hot gas plume that could potentially impact threatened and endangered species using the coastal dunes or beach near the 32 acre clearance area between the test stand and the shoreline. The noise and disturbance associated with pre-launch activities will likely prevent birds from entering the affected area, including the piping plover (*Charadrius melodus*), a federally threatened species, and the American oyster catcher (*Haematopus palliatus*), brown pelican (*Pelecanus occidentalis*), and least tern (*Sterna antillarum*), all species of special concern in Florida. Similarly, sea turtles generally nest at night and are not likely to be in the area during testing. Assuming that 100 feet (0.03 km) on either side of the clearance area may be affected by hot gases during launch, the nesting habitat of 3 to 12 pairs of loggerhead turtles could be impacted. This range represents 0.3 to 1.3 percent of the 886 loggerhead turtle nests observed on Merritt Island in 1986 (Edward E. Clark 1986). Consequently, impacts on this species from static testing in Area C are expected to be moderately significant, depending on the timing of testing.

No significant impacts on animal physiology or reproduction have been demonstrated from experiments on the effects of sustained or impulse noise (Evans 1988). Since no impacts on egg hatching have been demonstrated in these studies, it is unlikely that the noise from static tests in Area C will affect nearby loggerhead or green turtle nests. Pre-test noise and disturbance will probably cause any birds to leave the area, including the Florida scrub jay, brown pelican, least tern, American oystercatcher, and piping plover. In addition, sea turtles nest at night and are not likely to be in Area C during testing. Similarly, if static testing is conducted in Area B, pre-test noise and disturbance will probably cause most, if not all federal and state protected bird species to leave the area. These species include the Florida scrub jay, woodstork, snowy egret, little blue heron, roseatte spoonbill, reddish egret, and tricolored heron. Consequently, the impacts of noise from static testing on sea turtles and all federal and state protected bird species in and near Areas B and C are considered to be moderately significant.

A number of slower moving species that are classified as federally threatened or endangered or of special concern in Florida also occur in Areas B and C. The gopher tortoise, gopher frog, eastern indigo snake, and Florida mouse could be subject to noise levels over 110 dB in both Areas B and C. Although these species may retreat to burrows which might attenuate the noise, hearing loss or impairment is a possibility. Noise impacts from static testing on these species are considered to be moderately significant.

Noise from static tests in either Area B or C may startle bald eagles and other protected raptors on Merritt Island. During nesting season, these species may temporarily leave their nests. No impacts on the productivity or reproductive success of raptors have been demonstrated from temporary nest dissertion due to impulse noise (Institute for Raptor Studies 1981) but the effects of noise levels over 100 dB for 2 minutes are unknown. Noise impacts on the bald eagle and other protected raptors are considered to be moderately significant.

In summary, impacts on federal and state protected species in Areas B and C from static testing are considered moderately significant. Biological Assessments will be required for the green turtle, Atlantic loggerhead turtle, Florida scrub jay, piping plover, bald eagle, woodstork, gopher tortoise, gopher frog, Florida mouse, and eastern indigo snake, and possibly, the leatherback turtle. Consultation with the USFWS and GFC will be required to determine the impacts of static testing on species of special concern in Florida and/or candidates for federal protection.

Transportation:

If the ASRM is not manufactured at KSC, then ASRM segments may require barge transportation to KSC for testing and/or launch. Part of this transportation system will likely include the inland section of the Banana River. This portion of the Banana River is designated as critical habitat for the Florida manatee (*Trichechus manatus*), a federally endangered species (Wesley 1988, Edward E. Clark 1986). Peak numbers of manatees in the Banana River have increased from 56 in 1976 to 297 in 1986 (Provancha and Provancha 1988). This increase could be the result of an increase in the total population or a shift in distribution. Nonetheless, the Banana River currently provides habitat for approximately 25 percent of the manatee population on the east coast of Florida (Provancha and Provancha 1988).

Between 1981 and 1985, SRB retrieval ships averaged 21 trips per year. A total of 7 barge trips occurred in 1985 (Provancha and Provancha 1988). Currently, all barge and SRB ships operate at restricted speeds on the Banana River. In addition, SRB boats are equipped with propeller guards and recessed steering units to avoid inflicting cuts on the manatee, the major cause of death (NASA 1979b). All personnel who operate SRB vessels and barges are required to take the USFWS's Manatee Awareness Course (NASA 1979b). NASA has no records of manatee deaths from barge or SRB retrieval operations in the Banana River (Busacca 1988, personal communication).

A total of 14 launches, each requiring 2 ASRMs, are projected to occur at KSC each year. Each launch will require 1 trip of 2 barges to transport ASRMs. Consequently, annual traffic on the Banana River is expected to average 14 trips of 2 barges each and 28 retrieval trips. This represents 1.5 to 2 times the current barge and retrieval ship traffic on the Banana River. Impacts to manatees from ASRM transportation are unlikely because of the existing restrictions and requirements governing barge and ship traffic in the Banana River. However, because of the manatee's endangered status, potential impacts to this species are considered to be moderately significant. A Biological Assessment for the manatee will be required to determine the impacts on this species of transporting ASRMs from SSC or Yellow Creek to KSC.

The Atlantic salt marsh water snake (*Nerodia faciata taeniata*), a federally threatened species, also may inhabit some of the side channels of the Banana River. Impacts on this species from ASRM transportation are unlikely. However, because of its protected status, any potential impacts are considered moderately significant.

5.2.7 Land Use

ASRM Impacts on Land Use

Construction / Operations:

In Area B, an estimated 2,600 acres will be taken out of the jurisdiction of the USFWS and become part of the NASA operational area. While no prime soils exist at KSC, the abundant citrus crops at KSC are considered unique farmland. Out of the thousands of acres of citrus at KSC, none appear to require removal at Area B, thus no impact is predicted. Several apiary sites may require relocation. Other existing uses might require relocation, depending on the final configuration of ASRM facilities. These include the sanitary landfill, the Fire and Rescue Training Area, and a transmission line. Based upon a preliminary site design, only the Fire and Rescue Training Area would be impacted. Although many other open space sites on KSC are potentially available for relocation of this facility, the facility does have fairly extensive structural requirements, and thus is considered a moderately significant impact.

Static Testing:

In Area C, no existing land uses will be impacted. However, NASA must negotiate for use of this area, because the Air Force has plans for use of Pad 37 in their ALS program (Appendix H). This has been rated a very significant impact because of the long-term implications of dedicating Area C to ASRM use, and the probability that the Air Force will use CCAFS in their ALS program.

Recreation use of Playalinda Beach on the CNS would possibly have further restrictions on use during periods of ASRM testing. Currently the beach is proposed to be restricted a few days before and after launch as a result of Space Shuttle activities. Since ASRM testing is an infrequent event, at most the beach would have to close an additional 4 days per year. No anticipated impacts should occur to visitors at the VIC or MINWR facilities, because testing apparatus will be directed such that noise impacts to these areas will be minimized and are considered insignificant.

Static testing at Area B would expose more structures and humans to noise than testing at Area C. Structures, such as the Titan Rocket Assembly Building on the

CCAFS, are within 3 miles of Area B. If the direction of the test stand were aligned northeastward between Launch Complex 39A and Launch Pad 41 as proposed, impacts to structures would be reduced. Testing at Area B would affect more people and structures than testing at Area C, because Area B is removed from the coastline by more than 2 miles, allowing higher noise levels to cover more extensive land areas, including developed areas. Testing at Area B or C is rated as a moderately significant impact since it is likely that humans and structures will be exposed to moderate sound levels over short periods of time.

Compatibility with Land Use Plans, Policies, and Controls

Compatibility with CCAFS Plans:

While NASA does not currently directly manage lands at either of the two potential sites, an agreement with the USFWS gives NASA priority for Space Program-related land uses at KSC (NASA 1979b). NASA must negotiate with the Air Force to use Area C on the CCAFS, although both the Air Force and NASA currently share each other's facilities at both CCAFS and KSC. As stated previously, the use of Area C for ASRM activities represents a very significant impact because the area is under Air Force jurisdiction and the Air Force currently has other plans for the use of the site.

Although Area C is on the CCAFS, it is within the Launch Impact Zone extending from KSC. Since development in the Launch Impact Zone is restricted to launch support facilities only, the master plan may require amendment. Furthermore, temporary evacuations during shuttle launch events would probably be required.

Area B is within the Launch Support Zone of KSC. Here, ASRM activities are essentially consistent with the uses allowed in that zone because the zone designation specifically allows for facilities involved in solid propellant operations.

Siting the ASRM facility at either Area B or C would require extensive negotiation between NASA and the Air Force in terms of overlapping Q/Ds and instrumentation and visual lines-of-sight. It should be possible to site all structures in areas which would avoid critical lines-of-sight.

Compatibility With Florida Coastal Zone Management Program:

In response to NASA's Notice of Intent to Prepare an EIS (NASA 1988l), the Florida State Clearinghouse coordinated a review of the ASRM project in terms of its consistency with the Coastal Zone Management Act. The project was found at this phase to be in accord with state requirements and consistent with the Florida Coastal Management Program (Florida Office of the Governor 1988, FDER 1988).

5.2.8 Socioeconomics and Infrastructure

Demographic Characteristics

Population:

During construction, up to 2,000 employees will be required to construct the manufacturing facilities (1,900 workers) and test facilities (100 workers) (NASA 1988i). During operation 1,650 employees will be required when this phase reaches a full complement of workers in 1996. An additional 150 employees, required to support Shuttle launches using the ASRMs, would be needed for the RSRM program as well. Therefore, these launch associated employees will not be included in further analysis.

If all new employees were to move to Brevard County from elsewhere and each employee has a family size equal to the national average of 2.64 persons/household (Kehm 1988), a maximum of about 5,280 and 4,355 persons could be added to the area during the construction and operational phases, respectively. Assuming these new employees follow a residential distribution pattern similar to that of the sample of current KSC employees (see Section 5.1.8), population would increase by a maximum of 1.3 and 1.1 percent during construction and operation, respectively.

The rather low unemployment rate in Brevard County makes it unlikely that the county could supply all of the needed trained personnel for the project. On the other hand, the high tech nature of the southeast Florida coast makes it highly likely that the needed skills could be found in the general area, probably without requiring too much personnel relocation. If 50 percent of the hiring needs could be met by the Brevard County labor force or by persons living within a reasonable commuting distance who wouldn't need to relocate, population increases would equal about 2,375 (0.6 percent) and 1,965 (0.5 percent) during construction and operation, respectively, in Brevard County. The remaining 265 and 215 people would reside outside of Brevard County and would commute to KSC.

Using the U.S. Army Corps of Engineers Economic Impact Forecast System's threshold of a 3 percent or more change per year to identify economic changes which might be significant (U.S. Army 1988b), the probable population impacts of this project will not be significant. Even if 100 percent of employees moved to the county from elsewhere, the impacts would only be moderately significant. In addition, the potential also exists for indirect population growth to occur in association with the indirect employment discussed in the next section. While this impact is acknowledged, the likelihood and magnitude of its occurrence is speculative. Given the moderate unemployment rate in the study area and its proximity to other major metropolitan areas which are within commuting distance (e.g., Orlando), it is highly likely that these indirect jobs will be filled by current study area residents, commuters, or by members of the in-migrating families.

Employment:

Under the assumption that up to 50 percent of the new jobs would be available to current residents and that 90 percent of the KSC employees will live in Brevard County, there would be about 900 and 745 new jobs created during the construction and operation phases, respectively. Of the remaining 1,100 construction and 905 operations jobs, about 1,000 construction and 825 operations jobs will be filled by in-migrating workers and about 100 construction and 80 operational jobs will be filled by individuals residing outside of the study area. Given that these workers are not part of the current study area labor force and are not part of the unemployment rate figures, they are not included in this discussion. If the new positions were filled from the existing unemployment roles, or by internal movement in the job market, the unemployment level would decline by 10 percent during construction and 9 percent during operations.

In addition to the direct effects on employment in the study area, an economic multiplier can be used to determine the indirect employment impacts. Multipliers used in this analysis to estimate the number of jobs indirectly produced by each project job are discussed in detail in Section 3.2.8. The 1.4 multiplier for the construction phase and the 1.8 multiplier for the operation phase will yield about 720 and 1,255 indirect jobs in Brevard County at the peak of each phase, respectively. Additional indirect jobs associated with the employees who will be living outside of the study area will also be generated.

If the proposed project were to be discontinued, resulting in layoff of the employees, the local and regional economies would suffer to a moderately significant extent. After the Challenger accident in 1986, more than 2,500 employees were laid off (CH2M Hill 1987).

The proposed project would also serve to further increase the local economy's dependence on and vulnerability to the space industry. If the project were to shut down along with other operations at KSC, the local and regional economies would be significantly damaged. The proposed project would increase the level of vulnerability. Employment at KSC represents the most important force in the region's economy. Many of the area jobs not at KSC are in retail trade and services, which are essentially support functions and are dependent upon KSC employees for their demand (CH2M Hill 1987).

Income:

Per capita income in Brevard County is higher than the other two study areas. This, coupled with low unemployment rates and a relatively healthy economy (CH2M Hill 1987), make it likely that wages in the area will be affected insignificantly.

Revenues:

The ASRM Environmental Analysis (CH2M Hill 1987) concluded that to the extent that public facilities and services are funded through property tax revenues, it is possible that the proposed facility could fail to "pay its own way." However, this analysis has concluded that most of the current public facilities and services are adequate to handle any project induced increase in demand. Property taxes paid by the in-migrating workers who may live in newly constructed homes will be a net benefit to the local governments and will help should new construction be necessary. Sales and use taxes will also be a benefit to local governments. Without more project specific wage and output information, the extent of these benefits cannot be estimated.

Housing:

Demand for housing units in Brevard County has been relatively high, but construction activities have more than managed to meet it. The ASRM Environmental Analysis concluded that the building industry in Brevard County should be able to provide the necessary housing for the incoming workers (CH2M Hill 1987). The industry is accustomed to the growth generated by NASA activities in Brevard County and should adjust easily to the demand. Housing prices should not be significantly affected given the size of the project area and the small number of persons expected to in-migrate.

Infrastructure and Services

Law Enforcement:

The current law enforcement (full-time) officer to 1,000 population ratio for Brevard County is 2.2. This is above the planning guideline of 2.1 sworn officers per 1,000 population (USDI 1982). During the construction and operation phases, the ratio would be essentially unchanged. However, to maintain the 2.2 per 1,000 staffing level, 4 to 5 additional law enforcement officers would be needed because of the project induced direct population increase. If new officers were not hired, the increase in population would insignificantly reduce the current ratio.

Fire Protection:

Fire protection levels are measured by several factors, as noted in Section 3.1.8. The increase in population as a result of the project is only one of those factors. Since this increase is insignificant, it is anticipated that any impact on fire protection would also be insignificant.

Schools:

Brevard County Public Schools do not currently have any excess capacity (CH2M Hill 1987); however, the average teacher/student ratio of 1:17.5 is above the planning guideline discussed in Section 3.1.8. Assuming 0.9 persons in each household are children and all are of school age, then this project could add about 810 and 670 school age children to the Brevard County school system during the construction and operations phases, respectively. This represents an enrollment increase of 1.6 and 1.4 percent, respectively. These figures alone are moderately significant. This translates into a need for as many as 46 new teachers in the Brevard County School System to maintain the current teacher/student ratio. Not all in-migrating children will be of school age, however, and they will be distributed throughout the grades. Some may attend private schools. While earlier studies concluded that there was no excess capacity in the Brevard County School System, the teacher/student ratio indicates that the system could probably handle the additional enrollment. There will be some impact, but it should be insignificant overall.

Health Services:

Florida is not currently suffering from a physician shortage, but Brevard County averages 167 doctors per 100,000 people. This is 21 percent below the state average of 241 doctors per 100,000 people. The increase in population will only add to the problem. The ratio would decline 0.6 percent during construction and operation, an impact judged insignificant. However, since the area is already suffering from a physician shortage, any increase in population will marginally add to the problem.

No shortage in nursing staff was ascertained during data collection. Since the population impacts will be insignificant, no significant impacts on registered nurse staffing levels is anticipated.

The American Hospital Association Guide to the Health Care Field (1987) shows average occupancy rates in the study area vary from 58.0 to 82.8 percent with an average of 69.3, depending on the location and type of facility. This is more than adequate to meet any project-induced increase in demand. Therefore, the project should insignificantly impact the current hospital facilities in Brevard County.

Public Utilities:

Given a broad enough distribution of new residents, the only system where water supply could be limited in the short term is Titusville (CH2M Hill 1987). The water supply system in Titusville is already limited and an expansion program is underway, including the consideration of obtaining water from the City of Cocoa. The current yield from the system's well field is equal to existing demand. The ASRM project could accelerate the need for completion of the expansion (CH2M Hill 1987).

Wastewater systems in Brevard County, with the exception of Titusville, currently have 39 to 50 percent unused capacity (see Table 5-12). Titusville is operating at 100 percent capacity. Given the average wastewater flow calculated in the ASRM Environmental Analysis, the systems in the area should be more than adequately capable of handling the additional load, with the exception of Titusville. More than likely, some of the population increase will occur in Titusville. This will significantly impact their already overburdened system, but the system will need to be expanded with or without the project.

Effects of the additional solid waste generated from the new in-migrating employees and their families on the landfills in the area will be minimal (CH2M Hill 1987).

5.2.9 Transportation

Transportation effects for the KSC site alternative will be addressed in the same manner as was done in Section 3.2.9 for SSC and Section 4.2.9 for Yellow Creek. The types of transportation impacts at KSC would be the same, involving increased traffic on local roads, potential rail or waterway capacity problems, and transportation of hazardous materials. Transportation hazards would low with ASRM production at KSC. Impacts at KSC are generally described in terms of marginal changes. Generic methodology and impact discussions from Section 3.2.9 are not duplicated.

Local Traffic Generation

A traffic analysis was conducted for six key road segments on five roads that would serve the ASRM work force at KSC. The methodology employed for this analysis was the same as described previously in Section 3.2.9 concerning traffic impacts at SSC. To reiterate, existing traffic service levels were estimated for selected key travel routes, ASRM commuter trips were projected and distributed among these routes, and the resulting level of service with the additional traffic was determined for the respective routes.

The peak work force levels at KSC would be 2,150 workers during construction and 1,800 during operations (including 150 workers associated with Shuttle launches), if both manufacturing and testing occur at KSC. The traffic analysis conducted for the prior ASRM environmental analysis assumed an average of about 1.3 workers per vehicle, and an overall ratio of peak-hour trips to project workers of 0.77 (CH2M Hill 1987). These figures are slightly different from the corresponding numbers of 1.2 workers per vehicle and a ratio of 0.835 used for SSC in the same analysis. Due to the more confined transportation network serving KSC and the generally higher traffic flows in the area, the KSC ratios appear to be reasonable and are carried over to this analysis.

The demographic analysis in Section 5.2.8 indicates that 90 percent of all ASRM workers are expected to reside in Brevard County, with no further geographic breakdown attempted. In order to allocate ASRM traffic flows to specific roads, an assumed distribution accounting for population and distance factors was developed. Brevard County traffic was initially allocated to specific communities of origin based on their share of total county incorporated population. These shores were subjectively decreased for more distant communities and increased for areas closer to KSC. Following these adjustments, the percentage shares were allocated to roads based on the most likely major travel route(s) to KSC. All traffic from beyond Brevard County was assumed to originate from the Orlando area. The resulting allocation of traffic is summarized as follows:

- 26 percent of total ASRM traffic coming from the Titusville area to the northwest of KSC, split evenly between the northernmost approach via U.S. 1 to Gate 4 on Florida 406 (the Brewer Parkway) and the western approach via Gate 3 on Florida 405 (the NASA Parkway);

- 10 percent from Orlando to the west via Gate 3 and Florida 405;
- 21 percent from the Cocoa Rockledge area to the southwest, via Florida 528 (the Bennett Causeway) and N. Courtenay Parkway to Gate 2;
- 33 percent from the Melbourne area to the south, one-third via Interstate 95 and Florida 405 and two-thirds via Interstate 95, Florida 528, and N. Courtenay Parkway; and
- 10 percent from the ocean front communities to the southeast, via AIA, Florida 528, and N. Courtenay Parkway.

In aggregating these flows at points closer to the actual ASRM site, 13 percent would be entering Area B from the north and 87 percent from the south. The southern component would also be split further away from Area B, with 34 percent of the overall total approaching via Florida 405 and 53 percent via Florida 528 and N. Courtenay Parkway.

The results of the traffic analysis, based on estimated existing and future service levels, are presented in Table 5-19. These figures indicate that the only problem area would be on N. Courtenay Parkway between Gate 2 and Florida 528. This road segment is an existing bottleneck, due to the heavy volume of KSC traffic on a two-lane highway and physical features including a bridge over the barge canal and a toll booth for 528. AADT counts for this segment have varied significantly over the past two years, and the existing service is LOS D at best, and possibly is LOS F (Kamm 1988, personal communication). Under current capacity conditions, ASRM traffic would reduce the service level to E or F (unless LOS F is actually the current prevailing condition).

There is a high likelihood, however, that N. Courtenay Parkway will be expanded to four lanes by the time the ASRM project is generating significant traffic, in order to alleviate the existing congestion. Brevard County has programmed $8.7 million in funding for this expansion project, while the State of Florida has also allocated $3.0 million to build another drawbridge on N. Courtenay over the barge canal (Kamm 1988, personal communication). The proposed expansion would roughly double the capacity of N. Courtenay Parkway, and accommodate the estimated 900 additional peak-hour ASRM vehicles at LOS B or C. Consequently, no significant traffic impacts will occur if N. Courtenay is expanded before the ASRM project is fully underway. This issue should therefore be reassessed with updated volume and capacity data prior to the start of construction.

No other potential traffic problems were indicated by the analysis itself or a related discussion with a local transportation official. Interstate 95 and Florida 528 are both capable of carrying about 75,000 vehicles per day, while current volumes are in the range of 25,000 to 30,000 vehicles per day (Kamm 1988, personal communication). Most of Florida 405 is also a high-capacity, four-lane road, and the two-lane highways north of KSC (Florida 402 and 406) do not have capacity problems.

TABLE 5-19

PROJECTED TRAFFIC AND
LEVEL OF SERVICE (LOS) CHANGES, KSC

Segment	Existing Volume[a]	Existing LOS[b]	Available Capacity[c]	Construction Traffic[d]	Projected LOS[b]
I-95 S. of FL 528	1,320	B	1,380	560	B
U.S. 1 N. of FL 405	1,410	B	1,090	220	B
FL 405 E. of U.S. 1	910	A	1,590	580	B
FL 528 E. of U.S. 1	1,400	B	1,100	730	C
FL 528 W. of U.S. 1	1,630	B	870	370	B
Courtenay Pkwy N. of FL 528 [e]	12,428 (AADT)	D[f]	0	1,800 (AADT)	E or F

a/ Vehicles per peak hour in peak direction, estimated from AADT figures reported in Table 5.1.9-1 using formula specified in Highway Capacity Manual (Transportation Research Board 1985).

b/ Estimated from existing or projected volume and corresponding LOS from Highway Capacity Manual tables, except as noted.

c/ Estimated as the difference between existing volume and the maximum service flow rate for LOS C.

d/ Allocated on basis of description in text.

e/ Reported on daily rather than hourly basis, as is standard for analysis of two-lane highways.

f/ From Kamm 1988, personal communication.

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ASRM construction would also generate a significant amount of heavy vehicle traffic on and near KSC. Depending upon contractor and source locations, this traffic would likely be distributed similar to commuter traffic. While construction vehicle traffic could create localized congestion, the magnitude and timing would be such that insignificant incremental effects on peak traffic are expected.

Materials Transportation Requirements

Annual material input requirements for the ASRM program are estimated at 3,700 tons of aluminum powder, 13,200 tons of ammonium perchlorate, and 1,300 tons of case forgings. As reported previously in Section 5.2.9, these tonnage figures correspond to 42 railcars carrying aluminum powder, 151 cars of ammonium perchlorate, and 15 cars of case forgings arriving at KSC over the course of a year (based on an average carrying capacity of 87.5 tons per car) (Grove 1988).

The generic impact discussion presented in Section 3.2.9 indicated that these shipments would not represent unusual capacity problems for the rail and waterway transportation network, a conclusion that is also applicable to ASRM production or production and testing at KSC. The tonnage and frequency of raw material shipments should be within the capacity of the rail system.

Development of the KSC site for ASRM production would largely or totally eliminate the need for off-site transportation of ASRM segments. If both production and testing were located at KSC, the only transportation of ASRM segments would be within KSC boundaries and on KSC systems. If testing were conducted at SSC rather than KSC, up to 4 ASRMs per year would need to be shipped from KSC to SSC. The minor transportation constraints and insignificant impacts that would apply to this situation were previously covered in Section 3.2.9 and need not be repeated here.

Transportation Hazards

A generic assessment of transportation hazards for the ASRM program was presented in Section 3.2.9. Briefly, transportation of ASRM raw materials would represent some degree of hazard, which would be minimized through compliance with U.S. Department of Transportation regulations. The primary hazard results from transportation of finished ASRM segments, which was determined to be a moderately significant impact due to potential major impact magnitude over a long period. The prior discussion also concluded that barge transportation was the safest mode for ASRM segments. The remainder of this section will not duplicate this generic assessment, but will address only differential hazard aspects for the KSC site.

As discussed above, development of both ASRM production and testing at KSC would eliminate the need for off-site shipment of ASRM segments. This project configuration would therefore create no adverse impact associated with this particular hazard, although some unavoidable degree of raw material transportation hazard would still exist.

Under the production-only scenario for KSC, four ASRM shipments per year to SSC would still be required. While this level of activity would clearly have a lower risk than 32 annual shipments, the rules used for impact rating still require assignment of a moderately significant impact to this situation. As discussed for SSC, barge transportation would be preferable to rail transportation for these test ASRMs. The testing-only option for KSC would be equivalent to production at either SSC or Yellow Creek, so the ASRM hazard evaluation for these configurations will not be repeated here.

5.2.10 Historical, Archaeological, and Cultural Resources

Construction / Operations:

Construction of ASRM production and testing facilities at KSC could affect several cultural resources sites. There are two archaeological sites within the boundaries of Area B; and six archeological sites and two historic launch complexes within Area C. NASA is in the process of determining whether all of the ground surface of each area has been surveyed (Busacca 1988, personal communication). If parts of the proposed areas have not been surveyed, then it is possible that additional archeological sites will be discovered prior to construction.

Since all of these sites are located on waterway shores that are located at the margins of the proposed ASRM facilities, it may be possible to avoid most direct effects by locating facilities and access roads to avoid the sites. If it is not possible to avoid the sites, NASA should conduct archeological test excavations to determine their significance. If significant, NASA would develop site-specific mitigation in consultation with the SHPO.

The sites might also be subject to indirect adverse effects resulting from increased vandalism due to improved accessibility during plant operation. NASA could determine the significance of this effect by monitoring the condition of archaeological sites within the project boundary that are determined significant but are not directly affected by construction and operation. If this monitoring activity demonstrated adverse effects to significant sites, NASA would develop site-specific mitigation in consultation with the SHPO.

It is possible that significant buried cultural resources sites might be found during construction activities that involve earth moving. If this occurs, NASA would halt construction in the immediate vicinity of the find and consult with the SHPO to determine whether the resource discovered is significant. If the resource discovered were determined significant, then NASA would plan and implement mitigation measures in consultation with the SHPO.

Indirect impacts to cultural resources resulting from the growth inducing effects of plant construction and operation in the project locality are also possible. If the project were to stimulate increased housing and business construction in the area, these new developments would very likely affect cultural resources sites, leading to potential cumulative impacts on the region's cultural resources. In the absence of federal involvement in new construction projects, the construction-related impacts would not be mitigated due to the lack of state or local level protection for cultural resources. While the likelihood is high that archaeological resources would be affected during the construction process, the area within 50 miles of the project site that would contain most of the worker's housing for the project contains nearly 1000 square miles. Relative to the size of the affected area, the project's impact would be small. However, since the project area is growing rapidly, the potential for significant cumulative impacts on cultural resources is greater than it would be in a relatively undeveloped area experiencing a slow rate of growth.

Static Testing:

During static testing, the same sites would be subject to soil alteration due to the effects of aluminum and hydrogen chloride deposition resulting from rocket testing. This soil alteration would be classified as an adverse effect if the sites are archaeologically significant and if the chemical composition of the archaeological soils is an important component of that significance.

ASRM testing in Area C would also have some effect on launch complexes 34 and 37, which were used for early Apollo mission launches (United States Department of the Interior 1981). Because Complex 34 is part of the National Historic Landmark associated with the American space program at KSC, and Complex 37 is potentially eligible for nomination to the National Register of Historic Places (Butowsky 1988b, Tesar 1988), consultation with the State Historic Preservation Officer and Advisory Council on Historic Preservation pursuant to fulfilling the requirements of Section 106 of the National Historic Preservation Act would be required prior to construction. Alteration or reuse of any facilities at Complex 34 or 37 would probably require recording the existing condition of those facilities and restoration to that condition after the ASRM testing program is complete (Tesar 1988).

5.2.11 Solid and Hazardous Waste Management, Toxic Substances and Pesticides

KSC is a fully operational space center with solid and hazardous waste management and emergency response programs. The current programs would be expanded to accommodate the incremental changes that would result from ASRM production and testing operations.

Solid Waste Management

Solid and hazardous wastes will be generated from general facility construction and operation, nozzle manufacturing, case preparation, case refurbishment, propellant mixing, and core preparation and cleaning. Small waste streams are likely to be generated at propellant casting and curing operations, final assembly, power plant operations, steam boiler operations, and air compressor operations.

Impacts to the existing on-site Class III landfill would be greatest during the construction phase of the project. This landfill is permitted to accept only vegetation and nonhazardous construction debris. Solid waste from current production and refurbishing operations that is currently disposed of at the Brevard County Class I landfill would increase most substantially during the operations phase of the ASRM facility. The joint effect of these impacts would be moderately significant. The impact to the on-site Class III landfill would be the greatest because it only has an operational life of approximately 2 years (CH2M Hill 1987). The Brevard County landfill has an operational life estimated to be 8 to 10 years (Ballard 1988, personal communication).

Potential environmental impacts associated with either the Class III on-site landfill or the Class I Brevard County landfill include the potential for indirect contamination of groundwater in the event of a leak in the liner. The aggregate rating of the potential for environmental impacts resulting from solid waste routine management operations is moderately significant. The location of the water table and the relative permeability of the soils affect the potential for groundwater contamination. Mitigation for this potential impact at the existing Brevard County Class I landfill has been developed in the following manner. Two of the cells at the facility are equipped with a polyvinyl chloride liner and underground pipe system for the collection of leachate. Leachate is then collected and treated to remove bacteria and contaminants. On-site monitoring wells have been installed to monitor for the movement of leachate into subsurface aquifers (Brevard County Board 1988). Any subsequent landfills built to dispose of KSC solid waste will be equipped similarly.

Hazardous Waste

Waste streams that are currently being generated at KSC are stored in RCRA-regulated units (Buildings K7-165 and M7-1361) until ultimate disposal at off-site RCRA-regulated storage units. The potential impacts at KSC of this waste management strategy are associated with: 1) the volume of wastes to be stored temporarily, and 2) the transportation impacts of the shipment of hazardous wastes to off-site facilities. NASA's permitted storage requires that the following design and operating features be in place: 1) hazardous wastes are stored in fully enclosed storage units with cement floors; 2) incompatible wastes are separated and all wastes are placed in containers (e.g., 55-gallon drums) with complete, legible labels, 3) containers and drums are placed on wooden crates to facilitate regular visual inspections for leaks and spills, 4) the storage unit is well-ventilated to ensure worker protection, 5) Level D or C respiratory and dermal protection is utilized by personnel who manage the storage facility, 6) overhead lighting has been installed to illuminate handling and inspection activities, and 7) fire extinguishers have been placed at entrances and exits to the facilities.

Transportation of hazardous wastes to off-site RCRA-permitted facilities is conducted in accordance with 40 CFR 262 standards. Impacts and mitigation measures are discussed in Section 5.2.9.

NASA may choose an operational strategy to reduce impacts to existing storage units by building another unit on-site. Alternatively, NASA may elect to increase the frequency of shipments of hazardous waste off-site providing for a shorter residence time at the KSC storage facilities. The more capital-intensive strategy will be to build and permit a third unit for short-term storage of ASRM wastes, the more labor-intensive will be to utilize existing storage units.

Emergency Response

In the unlikely event of a spill or release at KSC, the implementation of an emergency response consistent with the requirements of CERCLA Section 103 would be implemented. NASA will revise the sitewide Emergency Response Plan to account for new ASRM facilities, hazards, site locations, and access roads to the new facilities. NASA will complete and maintain material safety data sheets (MSDSs) for all chemicals used in ASRM production. NASA will also submit the Tier-Two report form detailing the quantities and locations of Extremely Hazardous Substances stored on-site.

In the unlikely event of a spill or release the protocol set forth in the site Emergency Plan will be implemented. This will include the activation of the emergency response team, the notification of the National Response Center, and the implementation of other activities judged to be appropriate by the managing personnel (e.g., evacuation of personnel). An accident report would be filed to document the event and to help emergency planners identify the cause of the emergency.

5.2.12 Toxic Substances and Pesticides

The current pest control program will be expanded to accommodate any additional ASRM needs. As is the current policy, less toxic formulations will be utilized wherever possible to provide effective and efficient pest control. Pesticides will continue to be applied by certified personnel. Associated environmental impacts would be insignificant.

5.2.13 Radioactivity and Nonionizing Radiation

There are several minor sources of radioactive materials or ionizing radiation associated with ASRM manufacturing and testing. The most significant of these are x-ray generating devices, including a 50 MeV particle accelerator, used for nondestructive examination of the motor components. Other sources include radioactive materials found in devices such as density gauges and analytical detectors. The impacts from sources of ionizing radiation at KSC will be negligible due to the controls required to keep exposures within regulatory limits, which further reduce the exposure rate.

5.2.14 Noise and Vibration

Noise Impacts

Construction / Operations:

Noise from construction, manufacturing and use of transport vehicles will not produce noise audible to the public. Representative noise sources and their respective noise levels at increasing distances from each source were presented previously in

Table 3-24. Noise from increased automobile traffic of the workforce is not considered significant.

Static Testing:

Test firings of the ASRM would produce noise heard over a large area of Brevard County. Tests would last for only 130 seconds and not occur consecutively within an hour so they would not violate the county noise ordinance. The acoustic energy generated by the ASRM is concentrated in the lower frequencies, while higher frequencies are more rapidly attenuated by passage through the atmosphere. The methods for prediction of the noise levels are summarized in Appendix F.

Figures 5-10 and 5-11 show the predicted overall and A-weighted sound pressure level contours, respectively, for the ASRM static test firings at Areas B and C. The impact from testing at Area B would be greater than the impact from testing at Area C since Area B is further inland. Because of the relatively flat terrain at KSC and surrounding areas, topographic effects are not considered to play an important part in modifying the noise contours. The effect of acoustic focusing, however, is to produce higher noise levels at a given distance than would be expected under normal conditions. Acoustic focusing occurs when meteorological conditions are such that the speed of sound due to temperature and/or wind profile increases with altitude.

Large areas including KSC/CCAFS and surrounding areas will be subjected to modest levels of predominately low frequency noise. Some perceivers who happen to be close by may be annoyed; however, no population centers should be significantly affected. Sections 5.2.6, 5.2.7, 5.2.10 and 5.2.15 further discuss possible effects of noise on biota, land use, cultural resources, and public health and safety, respectively.

Launch:

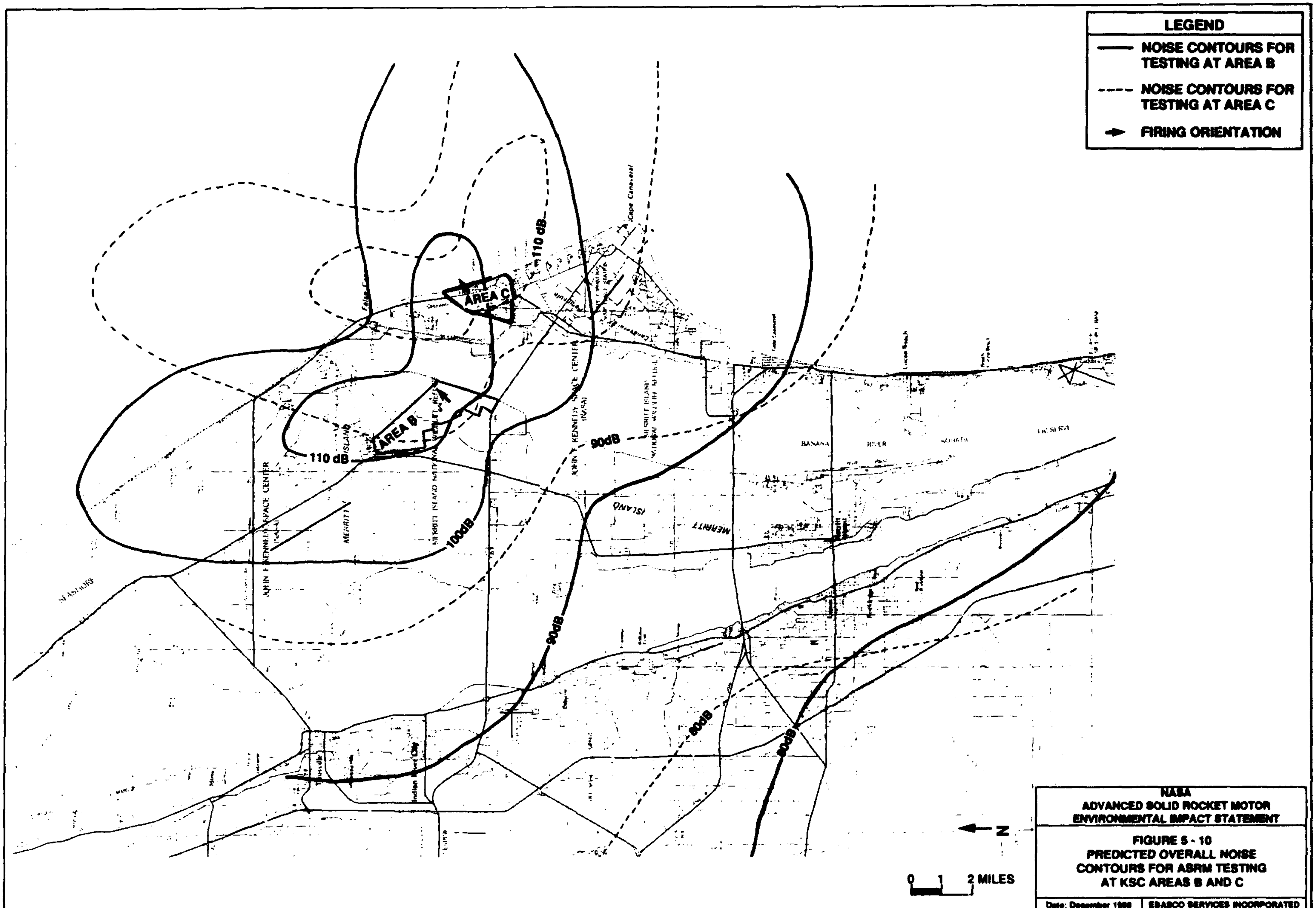
Noise levels from a single launch using ASRMs would be only slightly greater relative to a single launch using RSRMs. This change in the noise level is smaller than the level of accuracy of noise predictions (Rice 1988b) and therefore is insignificant for the purpose of modeling.

Accidents:

A pressure rupture of the motor case would cause noise different from that of a normal static test firing. Handling and transportation accidents could result in the ignition and burning of an ASRM segment. A handling mishap with a large container of AP might cause an explosion or rapid burning. Any of these scenarios could cause a blast wave, the effects of which are explained in Section 5.2.15.

Vibration

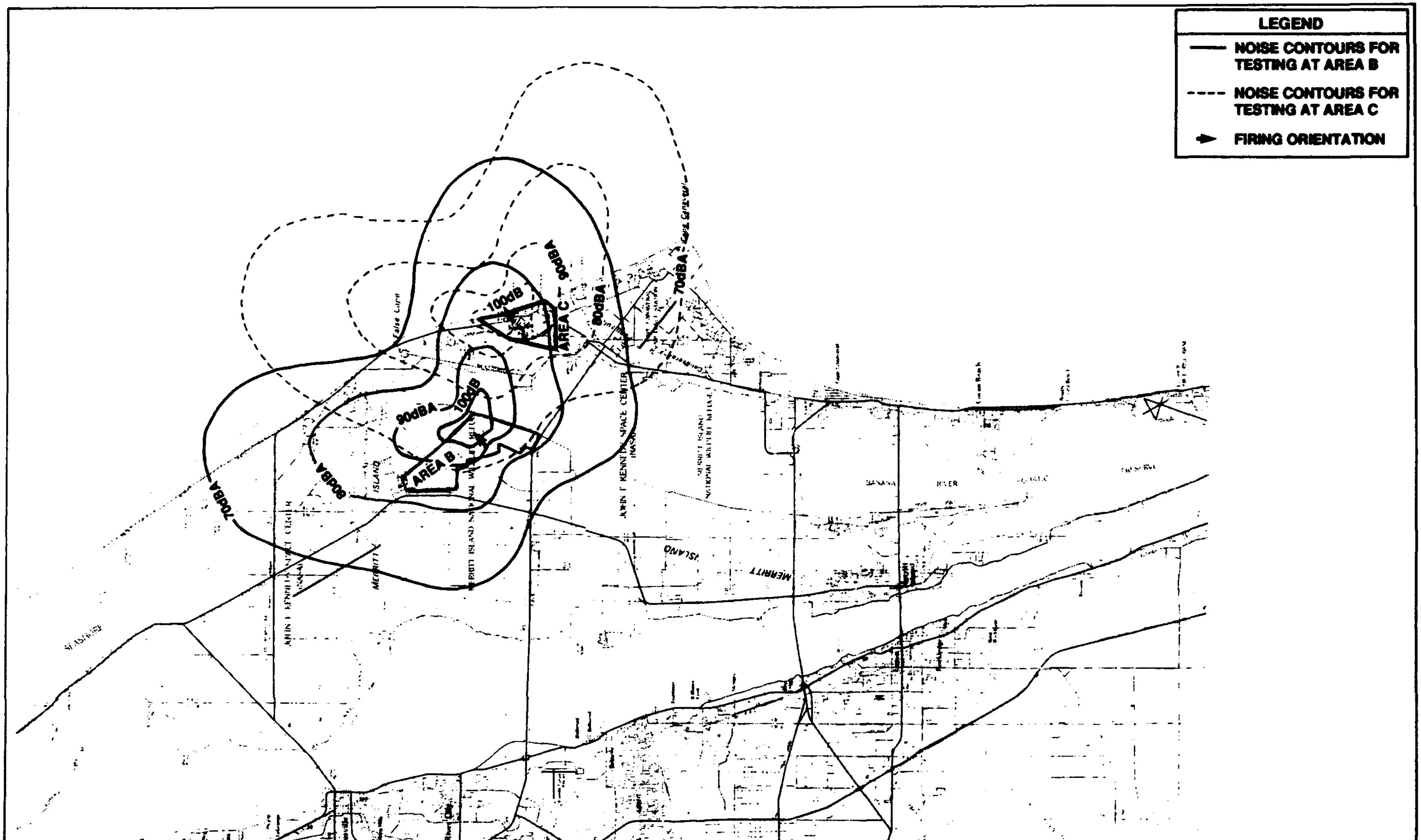
Static test firings may also produce seismic effects at great distances from the test firing site (Dalins 1975; McCarty and Dalins 1971; Ewing et al. 1957). These seismic effects, where the displacement amplitude of the ground may reach 50 micrometers at a frequency of 4 Hz, should not be of significant concern, as test firings during the



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 5 - 10
PREDICTED OVERALL NOISE CONTOURS FOR ASRM TESTING AT KSC AREAS B AND C

Date: December 1988 | EBASCO SERVICES INCORPORATED



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 5 - 11
PREDICTED A - WEIGHTED
NOISE CONTOURS FOR ASRM
TESTING AT KSC AREAS B AND C

Date: December [illegible] | EBASCO SERVICES INCORPORATED

Apollo Program showed it to be relatively harmless to buildings. This impact is explained in greater detail in Appendix F. Since the test motor would be pointed out to sea, little if any effects would be expected.

Mitigation Measures

NASA will establish a noise monitoring program to determine the actual levels of noise being generated by the ASRM static tests. Warnings could be issued to ships and aircraft in the vicinity of the test stand prior to testing. Constraints would be established by NASA to consider the atmospheric conditions related to lapse rate (change of temperature with altitude) and wind profile. If predictions indicate unfavorable noise levels in the local communities (e.g. Titusville, Cocoa, Cape Canaveral) surrounding the test site, the tests would be rescheduled.

5.2.15 Public Health and Safety

Existing health and safety programs and practices in place at KSC have been discussed in Section 5.1.15. In addition, general public and industrial health and safety impacts associated with production and testing of the ASRM have been discussed in detail in Section 3.2.15. Because most of these impacts would be very similar at each of the three proposed sites, the discussion will not be repeated here. Instead, this section will highlight only those impacts specific to the Kennedy Space Center (KSC).

Explosions and Fires

The health and safety aspects of explosions and fires have been discussed in detail in Section 3.2.15. This section addresses only certain considerations relating to Quantity-Distance (QD) requirements specific to KSC. Additional background information regarding QD requirements is also provided in Section 3.2.15.

Theoretical QD requirements at the KSC site are similar to SSC. Preliminary design QD arcs at KSC indicate potential overlap of intraline distances between certain process and waste storage/treatment facilities (NASA 1988b). With respect to external QDs at KSC (QDs originating from offsite facilities), which may limit activities at the proposed ASRM facility, the QDs associated with launching of missiles and related operations at nearby CCAFS are likely to overlap ASRM facility QDs at Area C. In addition, parts of Area B lie within the Shuttle Launch Impact Zone. This zone must be evacuated during launches, and therefore it could not be used for any ASRM facilities that require continuous operation. Furthermore, the Space Shuttle landing pattern overlies a portion of Area B, probably necessitating a halt in key ASRM production activities (grinding, mixing, casting, etc.). Although QD arc overlap is not strictly prohibited, it is considered less desirable than nonoverlapping QD arcs.

Air Quality Impacts

Air quality impacts associated with planned or unplanned combustion of the ASRM are discussed in detail in Section 3.2.15. However, unlike the SSC and Yellow Creek sites, launches will also be conducted at KSC.

6.0 OTHER SUPPORT SITES

6.1 MICHOUD ASSEMBLY FACILITY

In addition to the alternative sites discussed in previous sections, NASA has also made available 205,600 square feet of manufacturing space and 15,000 square feet of office space at the Michoud Assembly Facility (MAF) in New Orleans, Louisiana, for peripheral manufacturing activities typical of existing work already being done at that facility (NASA 1988e). These activities would include manufacturing of nonexplosive rocket motor components that are compatible with existing activities (McCaleb 1988c). For analysis purposes, it was assumed that a maximum 200 employees would be associated with these manufacturing activities at MAF. The environmental consequences of proposed ASRM activities at MAF are estimated to be insignificant.

6.1.1 Background of the Facility

The MAF is located within New Orleans metropolitan boundaries approximately 16 miles east of the central business district. The 1,000-acre site is bounded by the Gulf Intercoastal Waterway to the south, the Michoud Canal to the east, Old Gentilly Road to the north, and the New Orleans Public Service electric generating station to the west. The site on which the MAF was constructed was originally purchased in 1940 by the U.S. government. Various U.S. government and military manufacturing activities occurred at the site during WWII and the Korean War until the site was closed in 1953. The facility remained idle under the supervision of the U.S. Army until 1961 when it was selected by NASA for assembly of the first stages of the Saturn launch vehicles which were used in the Apollo program. As the Apollo program neared completion and the facility became underutilized, tenant agencies were permitted to occupy space to defray operating costs. In 1973 the MAF was selected by NASA as the site for assembling the external tank (ET), a component of the Space Transport System (STS). As a satellite organization of the Marshall Space Flight Center (MSFC) in Huntsville, Alabama, the primary mission of the MAF is to support the development of the STS Space Shuttle Program through the design and assembly of the ET. The MAF has been specifically modified and tooled for the fabrication and assembly of STS vehicle components. The previously specified manufacturing and office space at MAF is currently underutilized and could be adapted to ASRM activities without requiring any new facilities (Celino 1988). Since the MAF is a NASA facility, this proposed activity is a logically compatible one.

6.1.2 Environmental Consequences

Employment

As of January 1988, the MAF supported a total employment of 5,073. NASA-related activities accounted for 3,550 employees and tenant-related functions accounted for the remainder. Employment has historically fluctuated, with a peak of 12,000 in 1965. Since that time employment under the STS program has ranged between 3,000 and 6,000 persons. The 1987 labor force of the New Orleans Standard Metropolitan

Statistical Area was estimated as 500,000 persons (CH2M Hill 1988), of which MAF employment represents about 1 percent.

Martin Marietta is currently the NASA prime contractor for the ET and also serves as the site facility operations contractor at the MAF. NASA employs 16 people at the site to supervise the prime contractor. In 1986, Martin Marietta laid off an estimated 1,200 persons who were primarily support contractors for facility maintenance. Some of these maintenance people were replaced with Martin Marietta employees such as welders, machinists, and ET assembly workers. Many of these workers have remained at MAF but are underemployed (Celino 1988).

If MAF is used for the ASRM Program, the assumed 200 employees could be recruited from the existing trained and underemployed workforce. The proposed ASRM related workforce would represent less than 1 percent change in the available work force in the New Orleans Metropolitan Area and may be largely absorbed by these underemployed workers at MAF. The jobs vacated by the ASRM workers could then be filled by other workers from the labor pool. Since the percentage change is below the impact significance threshold described previously in Section 3.2.8, the employment impact on MAF would not be significant. Similarly, effects on housing availability and price, schools, local services demand and revenues to municipalities would not be significant. The project may have a small positive social attitude impact due to the perceived reaffirmation of the STS program at MAF. Demands for social services such as counseling, job training, and welfare, for example, may therefore decline slightly.

Transportation

Transportation facilities at MAF include access by rail, water, and motor vehicles. However, the MAF rail system has not been used for many years and would need to be refurbished if it were proposed for commercial transport use (Celino 1988). Access to surface water transportation is provided by the Michoud Slip, which connects to the Gulf Intracoastal Waterway. The Michoud Slip serves as the docking facility for the two covered ET ocean barges and three open shuttle barges. Currently, parts for the ET are delivered to MAF by trucks which enter the site on Old Gentilly Road by way of the Chef Menteur Highway, a major east-west artery north of the site. Presumably, manufactured parts for the ASRM would arrive via the same route to the MAF. Assembled rocket motor parts could leave the facility by either barge or truck. Since 15\rocket motor sets per year are planned, this could add 15 or more exits from the site and possibly more than this number bringing parts to the site. If a total of 36 commercial truck trips per year is assumed, this would amount to just 3 trips per month, a relatively insignificant number for a large industrial facility such as the MAF.

The MAF generates as much as 50 percent of the peak hour vehicular traffic on Old Gentilly Road (NASA 1980a). Planned improvements to Paris Road, which connects to I-10, include upgrading it to an Interstate (I-510). This would greatly improve traffic flow into MAF (CH2M Hill 1988). Even without these improvements the possible addition of up to 200 workers (4 percent of the MAF workforce, and therefore approximately 2 percent of the peak hour vehicular traffic) would not significantly affect traffic near MAF.

Protective Services

Both police and fire protection are available at the MAF site. Security measures for the facilities and operations at MAF are provided through a contract with a private security firm. Due to the previously stated insignificant increase in the workforce at MAF, it is anticipated that the current levels of these facility services would not need to change. Also, because the proposed manufacturing processes at MAF are neither hazardous nor explosive, emergency response and special QD related services would not be necessary.

Waste Disposal

The MAF has a new industrial waste treatment facility with a 500 gpm capacity, limited to a 250,000 gallon batch. MAF currently operates this system at 350 gpm (70 percent of capacity) (Celino 1988). This facility treats the chromium-contaminated wastewater from the ET assembly (Celino 1988). The new capacities and treatment capabilities of this system were made to eliminate underground injection wells and bring MAF into compliance with Louisiana state and federal permits (CH2M Hill 1988). MAF is also the first facility in the state to have received a RCRA permit (Celino 1988). MAF now conducts a waste minimization program for wastes such as freon.

As described in Section 2.1 above, the proposed peripheral manufacturing at MAF could include waste effluents from grit blasting, solvent cleaning and painting. The new waste water treatment facility would need to treat these wastes. Since this facility has capacity to treat an additional 200,000 gpd, equal to the entire ASRM facility needs (Table 2.2), it is clear that the MAF capacity will not be exceeded by manufacturing of only one ASRM component. The MAF is currently operated within federal and state permit requirements, and NASA will continue their compliance for any new manufacturing processes.

In summary, potential ASRM manufacturing at MAF will not produce a significant effect on employment or any employment related factors such as housing or local services. ASRM activities at MAF also will not significantly affect commercial or commuting traffic near the facility. Since no new facilities are required for these activities, no land, biotic, or cultural resources will be affected. Hazardous or explosive materials are not proposed for ASRM activities at MAF, resulting in no public health and safety impacts. Finally, new waste treatment facilities at the MAF are currently operated in compliance with state and federal permits and NASA will continue this compliance for any new waste treatment requirements. Sufficient capacity exists at this new facility to easily accommodate peripheral manufacturing processes.

6.2 SLIDELL COMPUTER COMPLEX

NASA has offered to prospective contractors approximately 9,000 ft^2 of office and computer floor space at the Slidell Computer Complex (SCC) in Slidell, Louisiana to support the ASRM program (NASA 1988k). These computer support functions for the ASRM program would be similar to SCC's current mission of supporting the Marshall Space Flight Center (MSFC), other NASA centers and other government agencies. For analysis purposes, it was assumed that approximately 25 workers would be employed at the SSC for ASRM support. The environmental consequences are expected to be extremely minor relative to other proposed ASRM sites.

6.2.1 Background of the Facility

The NASA SCC is a component installation of the MSFC. At present, the majority of SCC's computer workloads are in support of the Space Shuttle External Tank (ET) manufacturing at Michoud Assembly Facility. Other shuttle-related computer processes support Space Shuttle Main Engine testing conducted at Stennis Space Center and shuttle flight databases.

The SCC was originally developed for the Federal Aviation Administration in 1962 as an aircraft control center, but was never occupied. NASA acquired the property through government surplus and during the 1960s used SCC to support Saturn rocket activities at MAF and SSC. During the early 1970s major computer processing and database support were provided to the SKYLAB program. Space Shuttle Main Engine testing support started in 1974 along with shuttle flight data processing support. In 1973, SCC began supporting Martin Marietta in the design, development, and manufacturing of the ET.

The SCC is located on a 14 acre site at the intersection of Gause Boulevard (U.S. 190) and Robert Road (State 1091) in Slidell, Louisiana. Slidell is approximately 30 miles east of New Orleans. The grounds include a secured complex of 10 buildings (NASA 1988k). Off-site support includes three city-owned fire stations within two miles and the Slidell Memorial Hospital across the street from the SCC main entrance.

The SCC has a total of 119,671 ft^2 of computer, office, storage, and equipment floor space. The floor space offered by NASA to the ASRM program represents approximately 7 percent of the total at SCC.

6.2.2 Environmental Consequences

Employment

Total employment at SCC is currently about 300, the majority of which support NASA programs (Potts 1988). During the mid to late 1960s, SCC employed 400-500 persons. From the early 1970s until present, employment has remained stable at 300 persons. NASA anticipates that an additional 25 workers could be added for ASRM support. Slidell, located within the St. Tammany Parish, is part of the New Orleans Standard Metropolitan Statistical Area which has an estimated 1987 labor force of 500,000 workers (CH2M Hill 1988). Twenty-five new jobs would be a positive but inconsequential impact in terms of the metropolitan area workforce, but would constitute a significant (8.3 percent) change in the SCC workforce. NASA has agreements with tenant organizations to move out of SCC if additions to the workforce caused problems. However, 25 additional workers could easily be accommodated with existing facilities (Potts 1988).

The addition of 25 workers at SCC would increase commuter traffic. Since the SCC has multiple access road systems and because of the low number of additional commuters, traffic impacts are anticipated to be minor. Currently, the main entrance/exit to the SCC is from an I-10 exit to Gause Boulevard. This four-lane road is currently rated Service Level C with an average daily traffic count of 22,400 vehicles. The addition of 25 vehicles at commute house would not decrease this service level (Riccardone 1988). Parking and other infrastructure support capacities such as sewer, solid waste, and protective services can easily accommodate this anticipated increase in workers. The main parking lot currently has a 310-vehicle capacity and is generally not full. Other parking lots on site provide additional spaces (Potts 1988). In summary, impacts at the SCC from the increase of 25 workers to provide computer support to the ASRM program are minor in magnitude and therefore not significant.

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TABLE 8-1

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    Office of State Clearinghouse
Louisiana Department of Wildlife and Fisheries
Louisiana State Planning Office
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Mississippi Emergency Management Agency
Mississippi Governor's Office of Policy and Planning
Mississippi Research and Development Center
Mississippi Resource and Development Center
Northeast Mississippi Planning and Development District
Office of Federal and State Programs
    Department of Planning and Policy
Office of the Governor of Mississippi, Ray Mabus
Office of the Lieutenant Governor of Mississippi, Brad Dye
Pearl River County Chancery Clerk, D.R. Davis

Pearl River County Circuit Clerk, Peggy Staten
State of Mississippi Clearinghouse for Federal Programs
Three Rivers Planning and Development District
Tishomingo County Board of Supervisors, D.W. McKee, President
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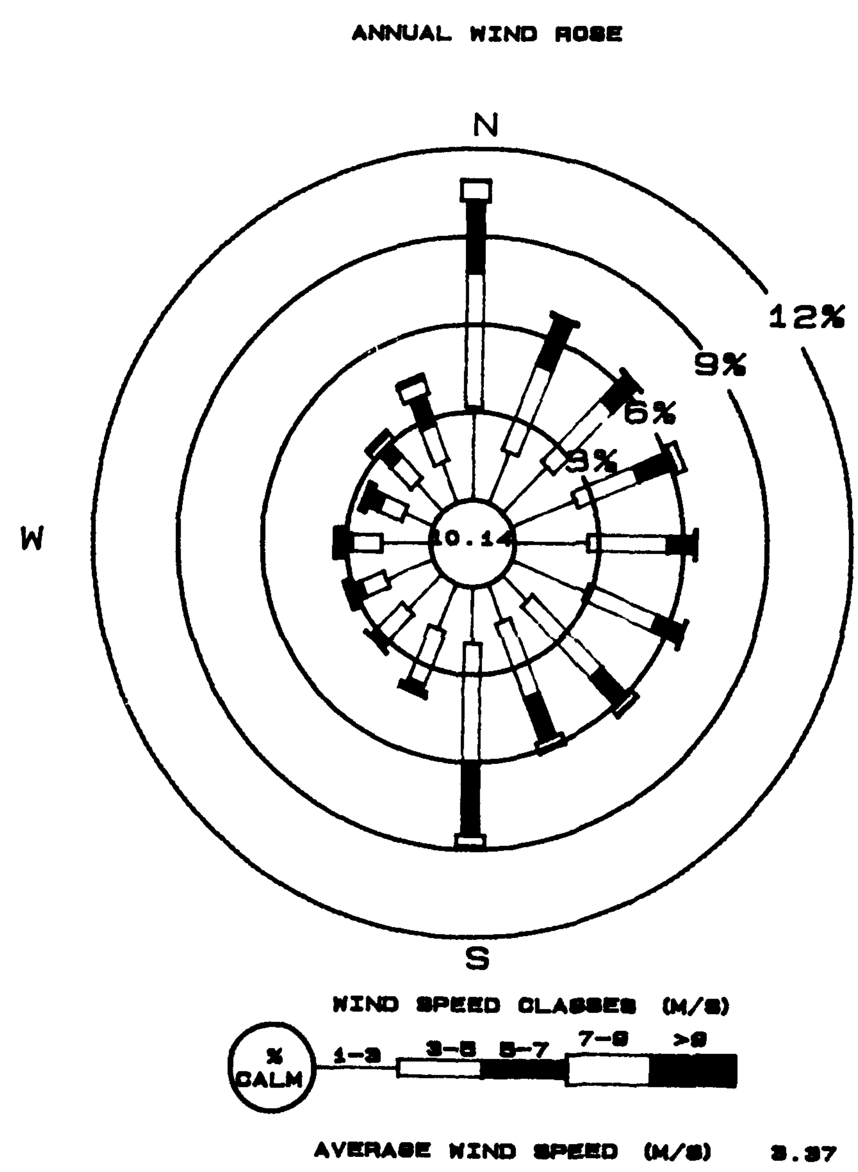
10.0 INDEX

APPENDIX A

SITE WIND ROSES

2469K

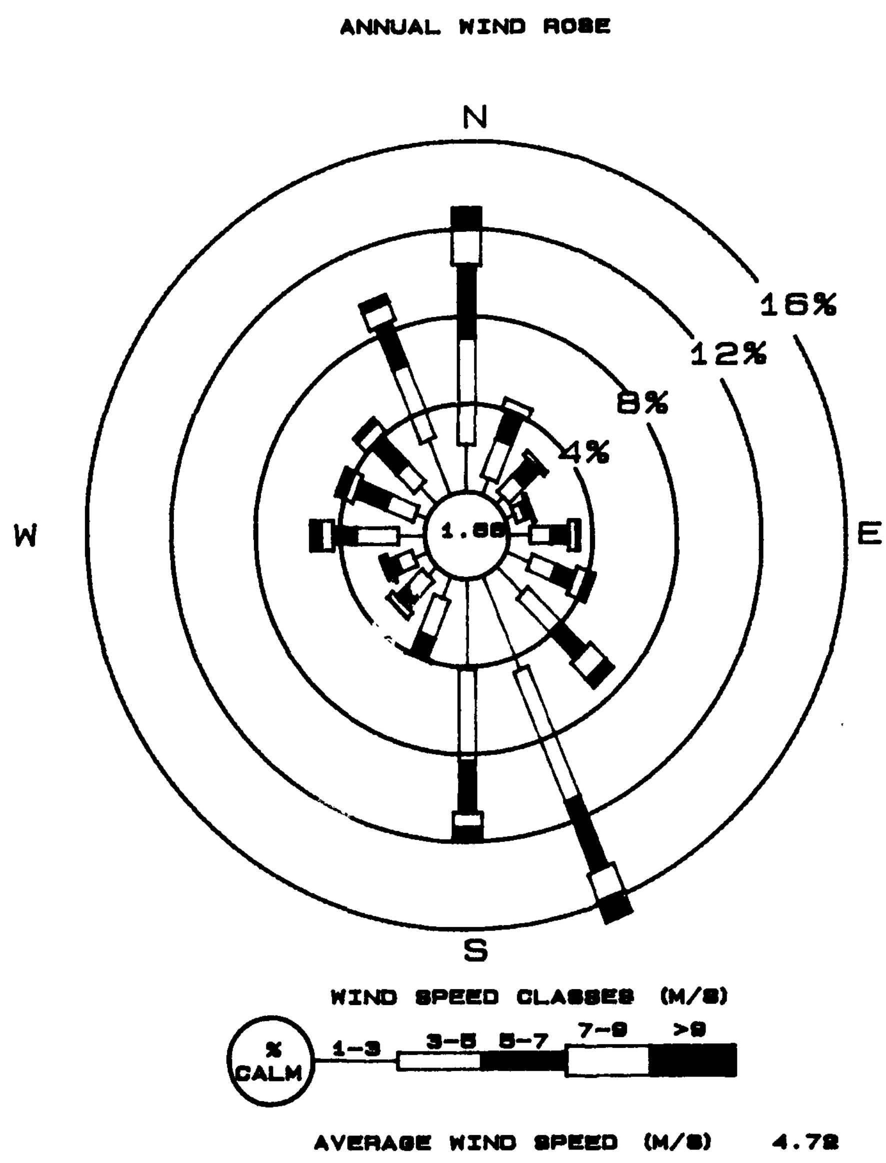
LIST OF FIGURES



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 1
ANNUAL WIND ROSE,
NEW ORLEANS - 1979

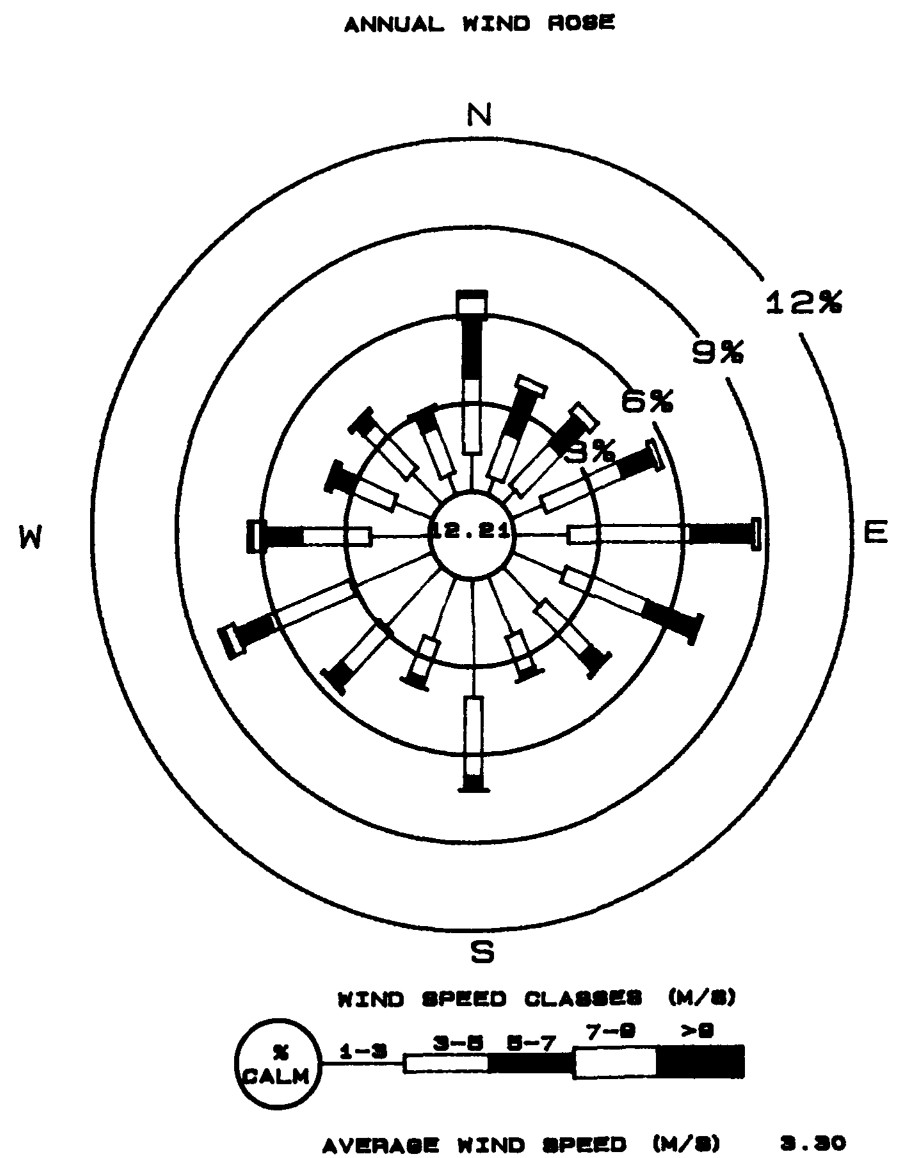
Date: December 1988 | EBASCO SERVICES INCORPORATED



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 2
ANNUAL WIND ROSE,
YELLOW CREEK - 1978

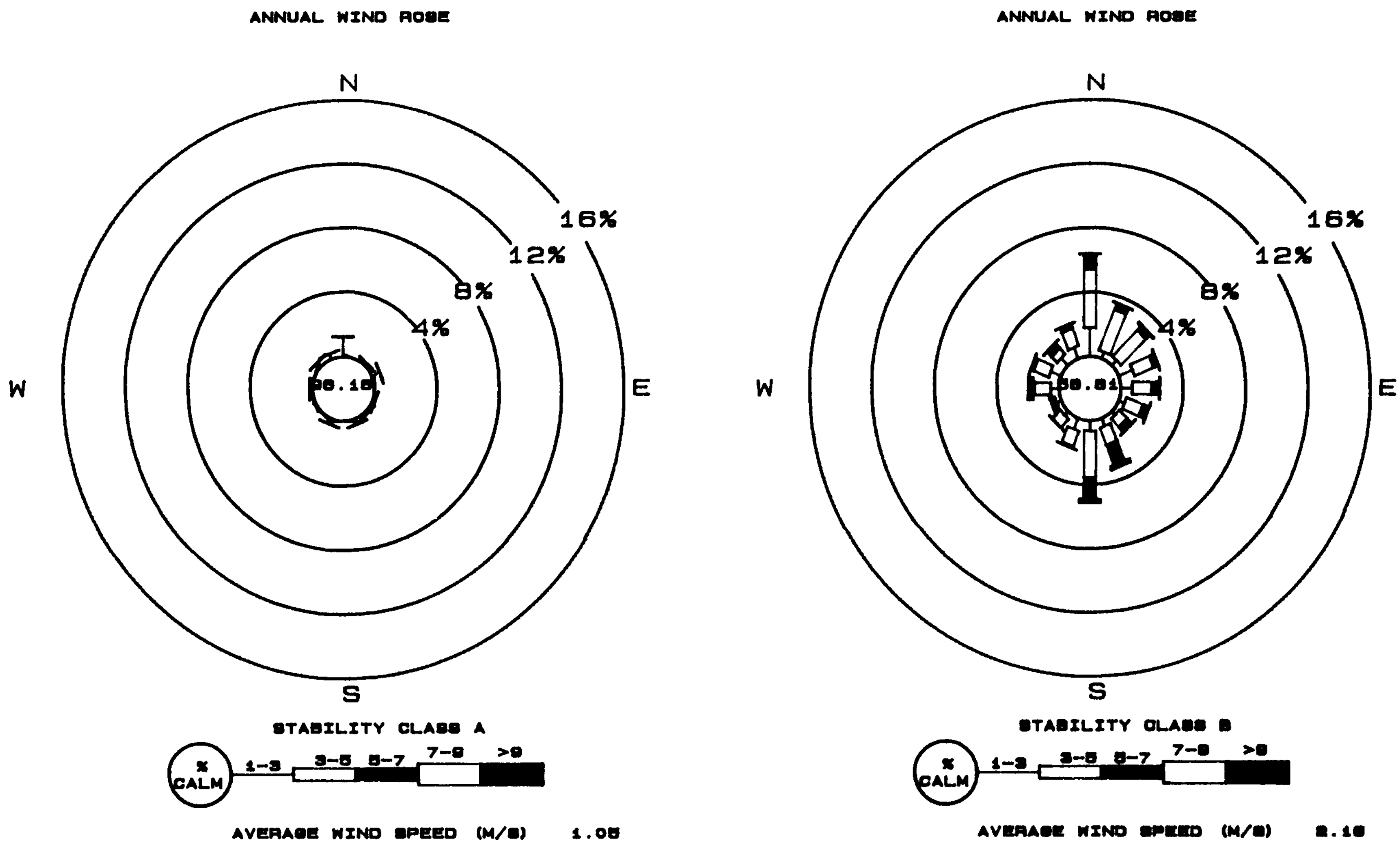
Date: December 1988 | EBASCO SERVICES INCORPORATED



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 3
ANNUAL WIND ROSE,
DATONA BEACH - 1986

Date: December 1988 | EBASCO SERVICES INCORPORATED



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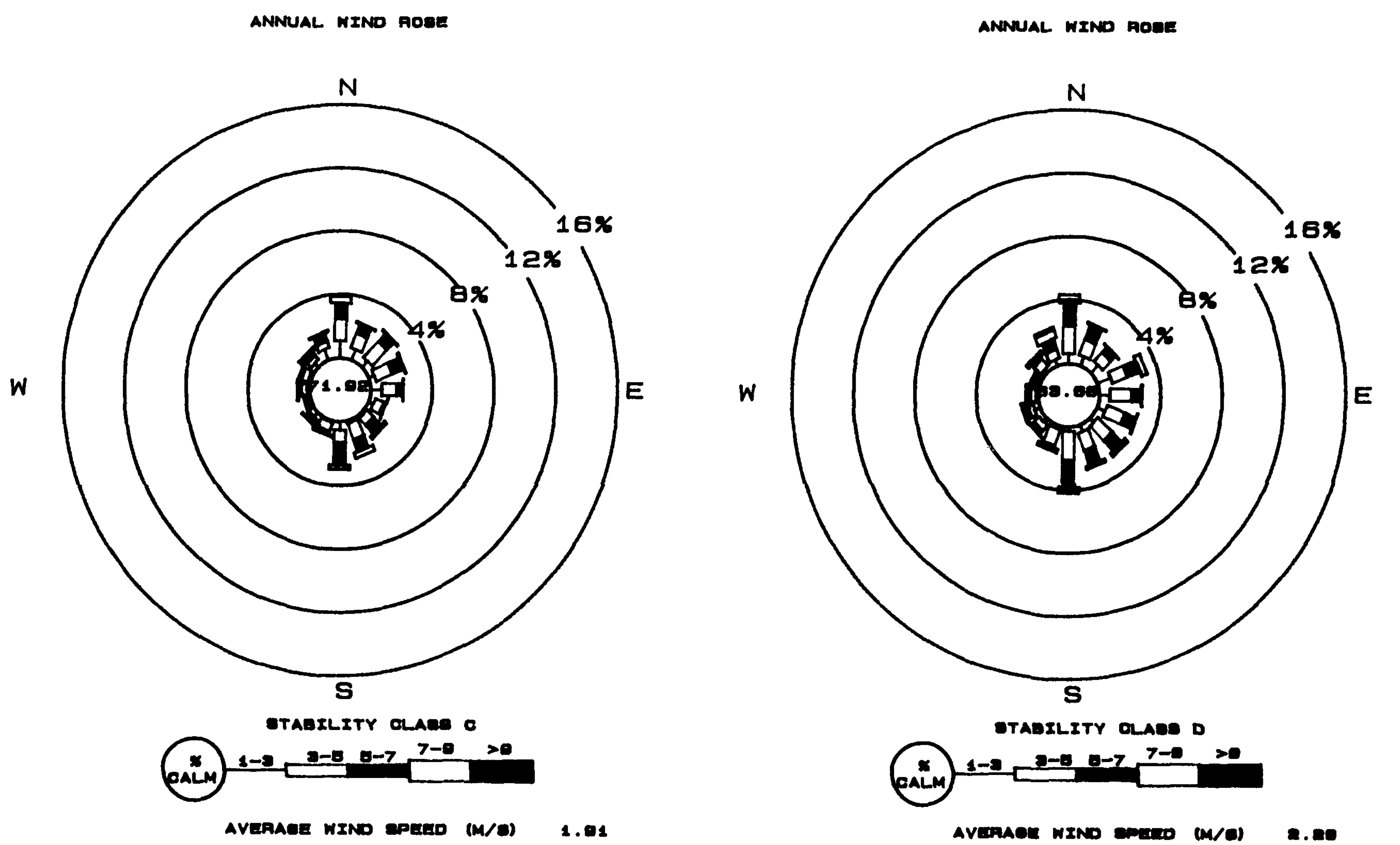
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 4
ANNUAL WIND ROSE FOR STABILITY CLASS A AND B, NEW ORLEANS - 1979

Date: December 1988 | EBASCO SERVICES INCORPORATED



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 5
ANNUAL WIND ROSE FOR STABILITY
CLASS C AND D, NEW ORLEANS - 1979

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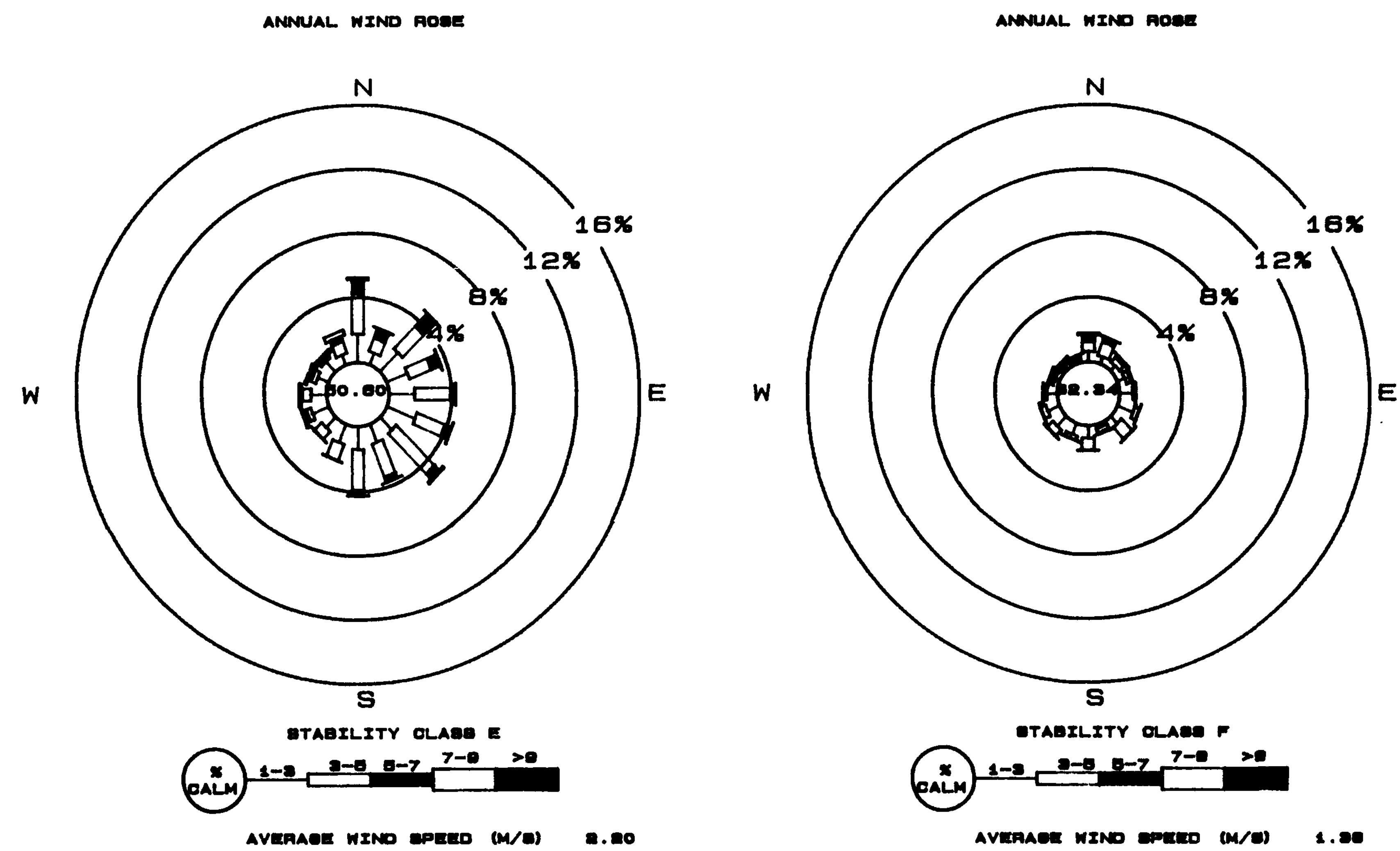
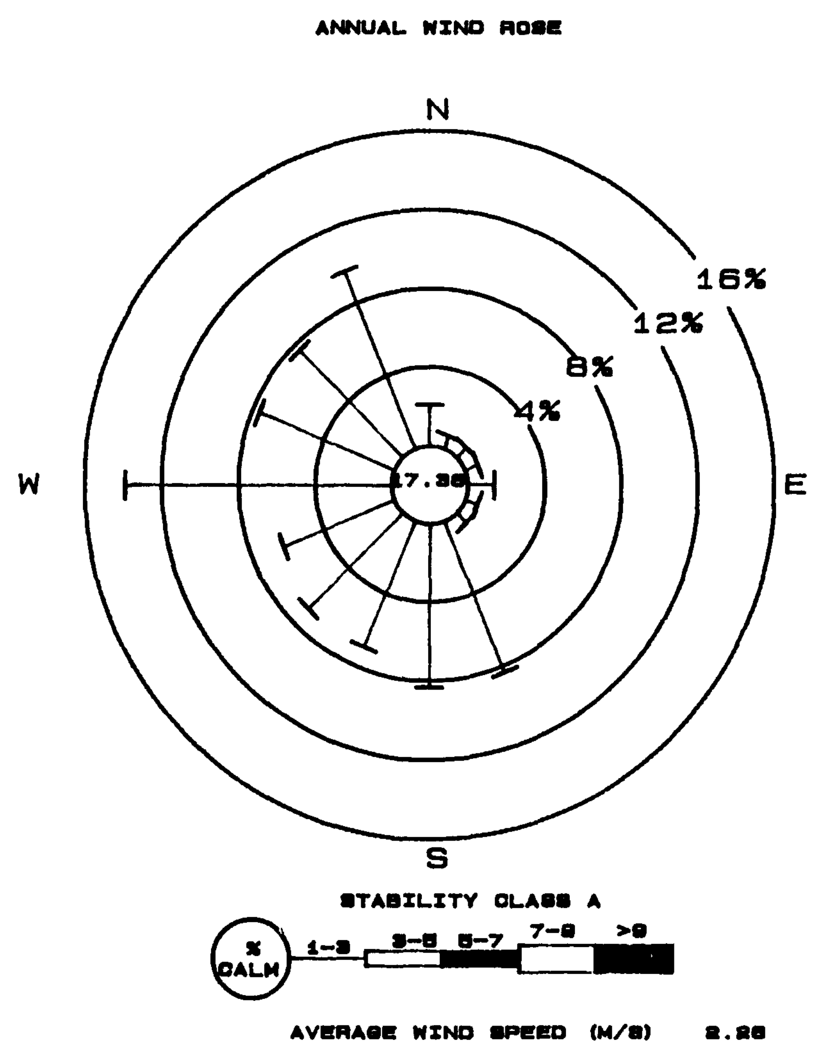
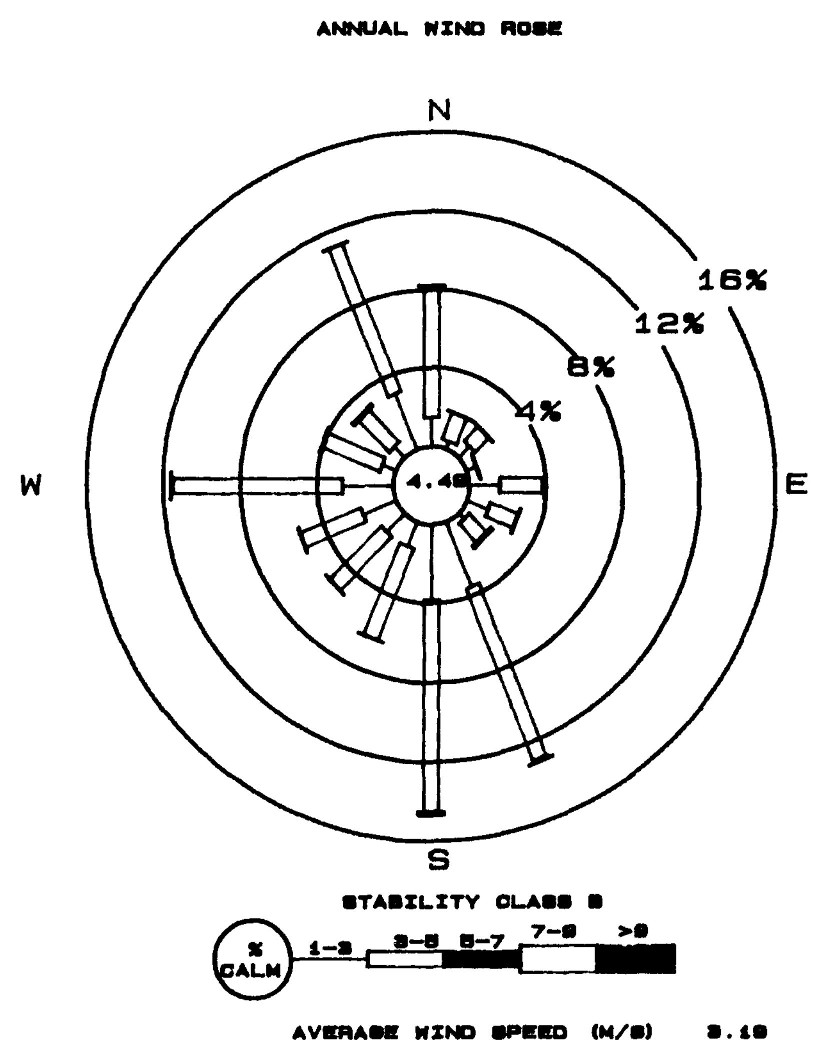


NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 6
ANNUAL WIND ROSE FOR STABILITY
CLASS E AND F, NEW ORLEANS - 1979

Date: December 1988 | EBASCO SERVICES INCORPORATED

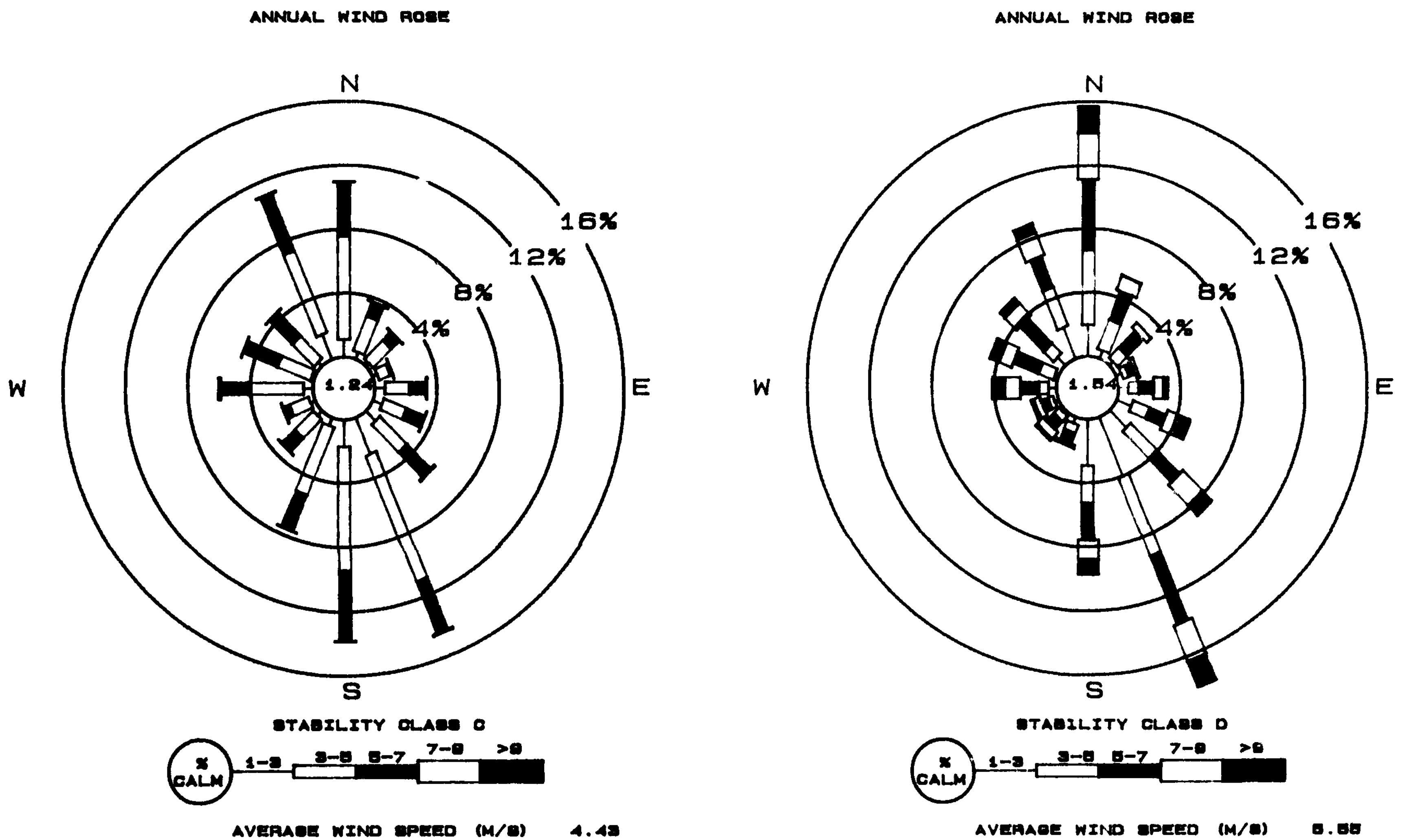




NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 7
ANNUAL WIND ROSE FOR STABILITY
CLASS A AND B, YELLOW CREEK - 1978

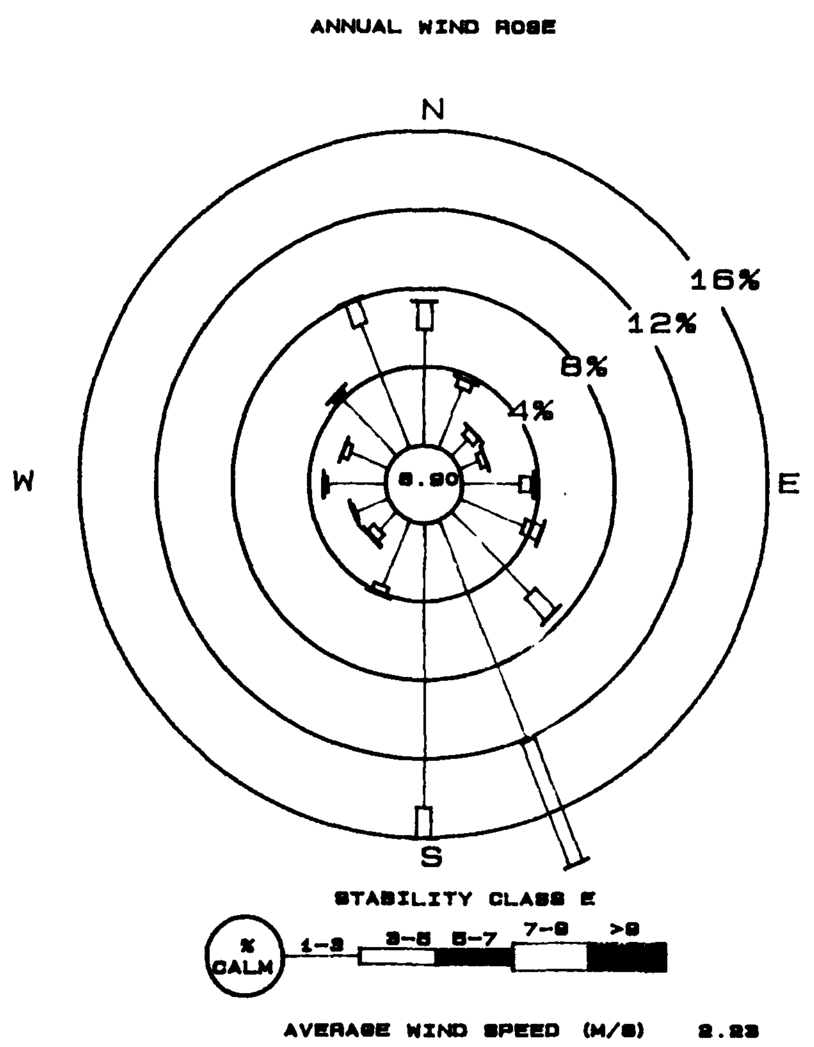
Date: December 1988 | EBASCO SERVICES INCORPORATED



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 8
ANNUAL WIND ROSE FOR STABILITY
CLASS C AND D, YELLOW CREEK - 1978

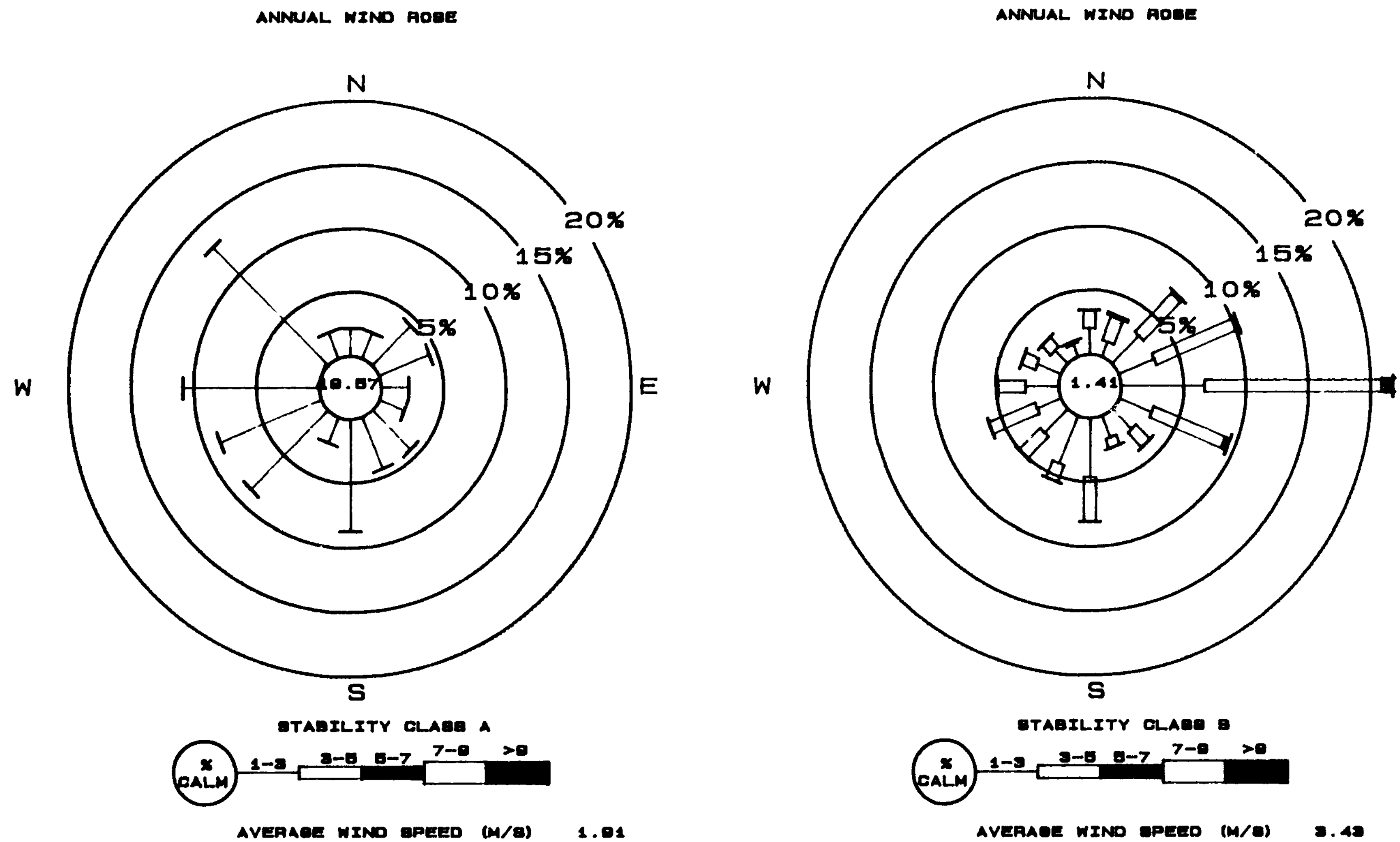
Date: December 1988 | EBASCO SERVICES INCORPORATED



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 9
ANNUAL WIND ROSE FOR STABILITY
CLASS E AND F, YELLOW CREEK - 1978

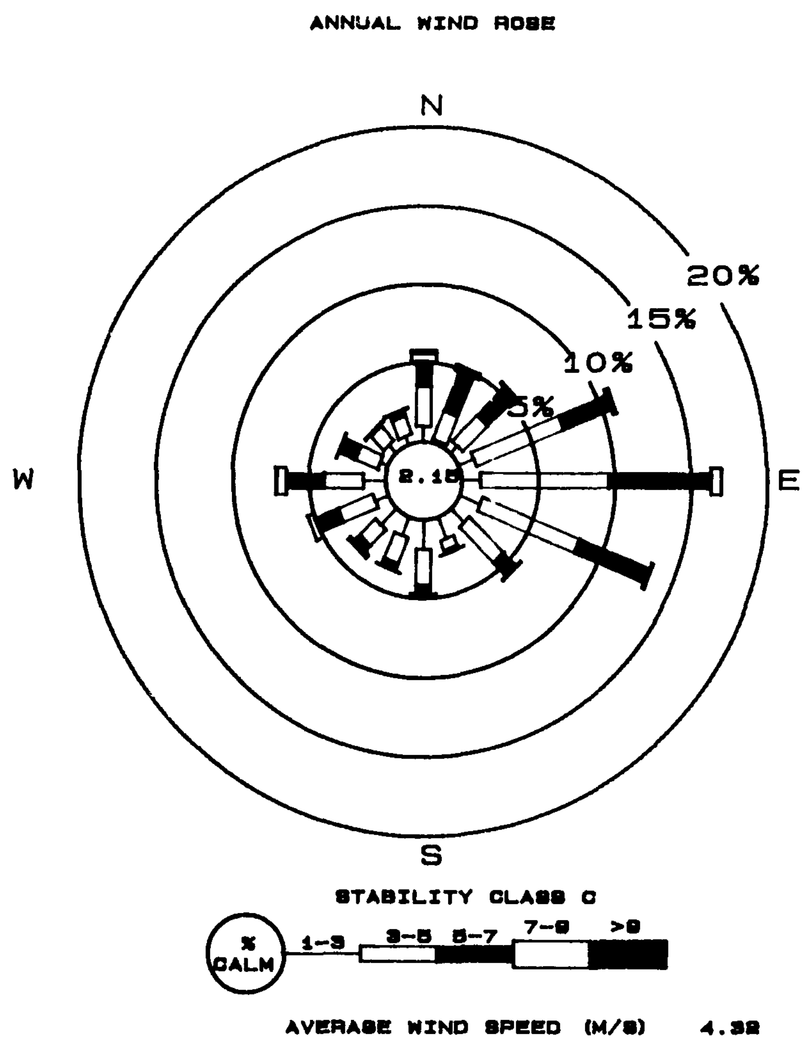
Date: December 1988 | EBASCO SERVICES INCORPORATED

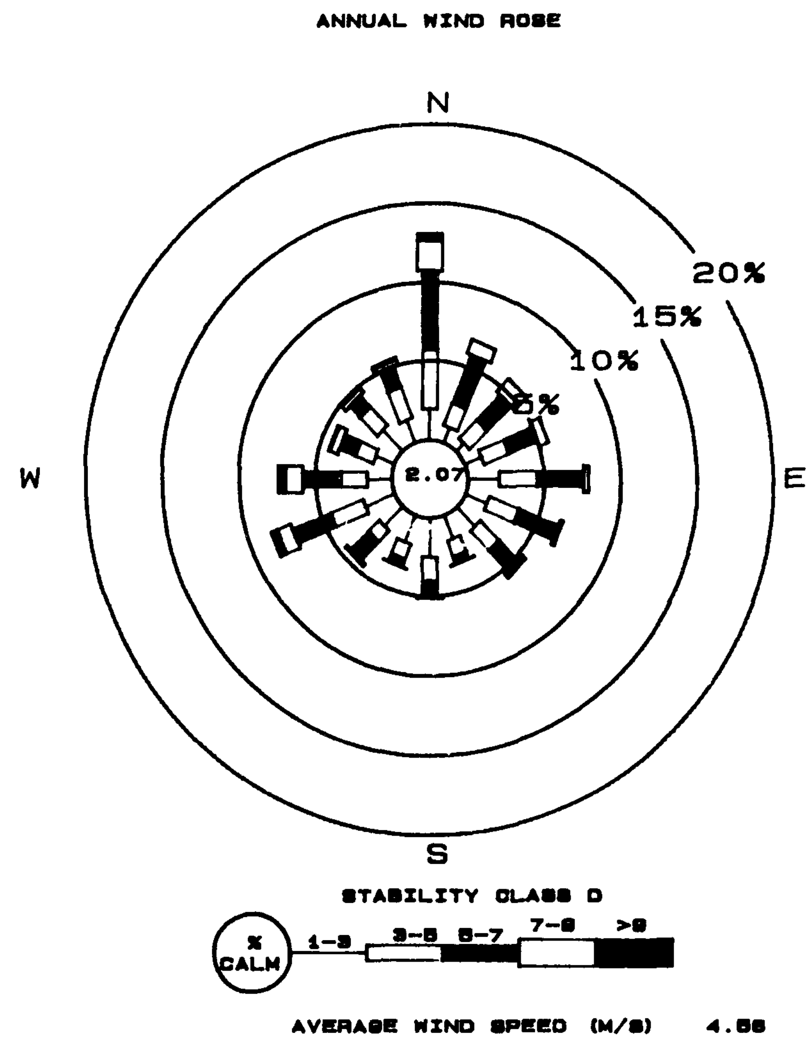


NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 10
ANNUAL WIND ROSE FOR STABILITY
CLASS A AND B, DATONA BEACH - 1986

Date: December 1988 | EBASCO SERVICES INCORPORATED

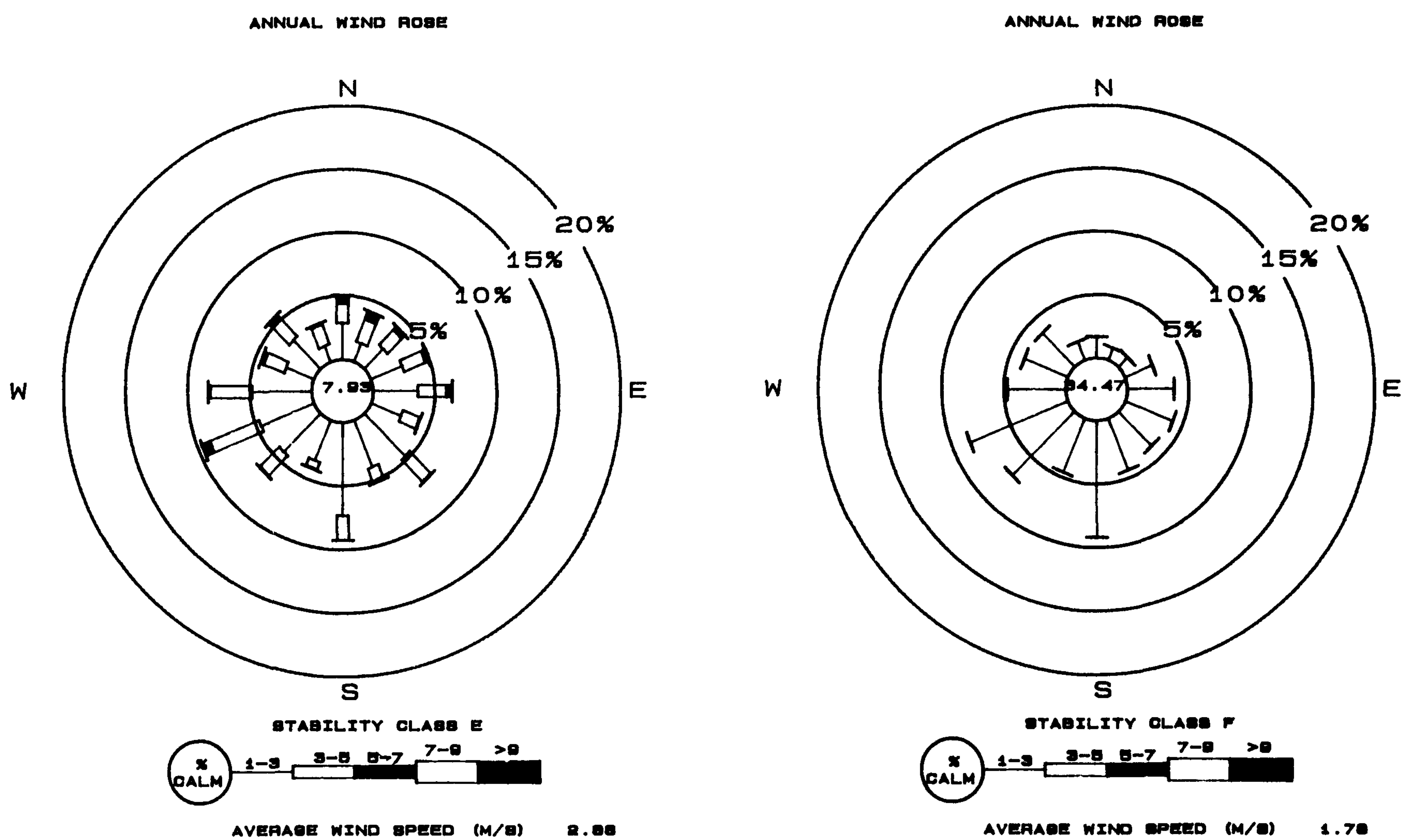




NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 11
ANNUAL WIND ROSE FOR STABILITY
CLASS C AND D, DATONA BEACH - 1986

Date: December 1988 | EBASCO SERVICES INCORPORATED



NASA
ADVANCED SOLID ROCKET MOTOR
ENVIRONMENTAL IMPACT STATEMENT

FIGURE A - 12
ANNUAL WIND ROSE FOR STABILITY
CLASS E AND F, DATONA BEACH - 1986

Date: December 1988	EBASCO SERVICES INCORPORATED

APPENDIX B

WATER QUALITY DATA

1687K

LIST OF TABLES

1687K

Table B-1. Ranges of Values for Monitored Water Quality Parameters in the Pearl River in the Vicinity of Stennis Space Center

Station	Specific Conductance		pH		Temperature		Dissolved Oxygen		Suspended Sediment	
	(umhos)	Date	Units	Date	°C	Date	(mg/l)	Date	(mg/l)	Date
Pearl River near Bogalusa, LA (02489500)1/	17	4/26/79	5.4	1/20/80	1.5	12/21/63	2.9	5/25/77	2	11/5/72
	180	9/10/65	8.4	10/21/76	35.0	7/23/81	12.9	12/1/76	576	10/24/84
Pearl River at Pools Bluff near Bogalusa, LA (02490193)2/	18	5/20/80	4.1	12/9/81	3.0	1/20/77	3.4	8/2/81	---	
	176	9/23/81	7.9	5/3/78	33.5	7/24/81	13.5	1/13/81	---	

1/ Period of record varies by parameter, intermittent 1962-1975, continuous 1975-present.

2/ Period of record continuous, 1975 to present.

Source: USGS 1986

1687K

Table B-2

Site Water Quality Data

Stennis Space Center

Station: Pearl River Above Mikes River

Date (mo/yr)	pH (units)	D.O. (mg/l)	Temp. (°C)	TOC (mg/l)	TSS (mg/l)	TDS (mg/l)	TP (mg/l)	TKN (mg/l)	BOD_5 (mg/l)	Fecal Col. (no./100 ml)
10/85	6.96			15.60	8.0	124	1.13	1.88	0.00	445
11/85	6.52			7.40	0.0	40	0.13	1.25	1.07	740
12/85	7.46			6.80	0.0	72	1.25	5.50	1.00	1,560
1/86										
2/86	6.29	8.8	18		0.0	100			0.80	60
3/86	5.80				7.2	92			1.00	10
4/86	5.86			7.78	3.2	80				425
5/86	6.56				4.8	96			0.00	50
6/86	5.78				1.6	108			0.84	
7/86	5.88				4.4	56			0.00	20
8/86					8.0	472			0.00	15
9/86	6.35				12.0	904			0.00	70
10/86	6.36				16.4	616			0.00	30
11/86	6.12				11.6	116			1.01	50
12/86										
1/87	5.89				0.0	48			2.06	40
2/87										
3/87										
4/87										
5/87										
6/87	6.00			9.19	0.0	124	0.10	0.67	0.51	170
7/87	6.11			9.18	48.0	116	0.00	0.72	1.60	
8/87	6.52			6.80	20.0	56				
9/87	5.94			2.90	8.0	112			0.00	
10/87	6.41			1.80	24.0	192			0.00	100
11/87	6.97			5.27	8.0	1,172			0.00	
12/87	6.30			9.26	0.0	60			0.00	70
1/88	5.51			8.61	20.0	104			10.30	
2/88	5.55			8.88	12.0	40			1.18	
3/88	5.44			12.70	60.0	92			1.51	
4/88	6.39			6.50	8.0	44			0.00	
5/88	5.85			4.71	8.0	72			0.00	
6/88	6.86			10.20		164			1.04	1

Source: NASA 1988o

1687K

Table B-3

Site Water Quality Data

Stennis Space Center

Station: Pearl River Between Mikes River and Canal

Date (mo/yr)	pH (units)	D.O. (mg/l)	Temp. (°C)	TOC (mg/l)	TSS (mg/l)	TDS (mg/l)	TP (mg/l)	TKN (mg/l)	BOD_5 (mg/l)	Fecal Col. (no./100 ml)
10/85	6.36			16.20	8.0	96	1.75	1.75	1.50	760
11/85	6.55			7.60	0.0	64	0.13	1.50	1.17	890
12/85	7.22			7.80	0.0	116	0.13	0.13	1.00	2,255
1/86										
2/86	6.20	8.5	17		0.0	92			1.00	130
3/86	6.61				8.4	84			0.90	20
4/86	5.86			4.30	3.6	56				240
5/86	6.81				7.2	116			0.00	55
6/86	5.78				7.2	88			1.47	40
7/86	5.92				1.6	80			3.00	180
8/86					8.0	2,088			1.17	1
9/86	6.24				12.0	4,580			1.02	70
10/86	6.37				15.6	1,812			0.00	30
11/86	6.20				16.4	188			1.13	120
12/86										
1/87	5.90				0.0	56			1.97	30
2/87										
3/87										
4/87										
5/87										
6/87	6.07			9.02	0.0	80	0.19	1.01	0.90	260
7/87	6.13			10.40	28.0	108	0.02	0.70	2.50	
8/87	6.38			7.50	28.0	72				
9/87	6.51			2.90	16.0	244			0.00	
10/87	6.57			2.10	16.0	1,364			0.00	190
11/87	6.92			4.96	4.0	1,868			0.00	
12/87	6.44			12.10	0.0	1,292			1.03	100
1/88	5.56			9.26	20.0	96			10.20	
2/88	5.62			9.16	12.0	76			1.11	
3/88	5.48			12.80	60.0	76			1.75	
4/88	6.22			7.19	4.0	44			0.00	
5/88	6.11			5.65	0.0	68			1.90	
6/88	6.76			10.10		884			1.30	1

Source: NASA 1988o

1687K

Table B-4

Site Water Quality Data

Stennis Space Center

Station: Pearl River Below Canal

Date (mo/yr)	pH (units)	D.O. (mg/l)	Temp. (°C)	TOC (mg/l)	TSS (mg/l)	TDS (mg/l)	TP (mg/l)	TKN (mg/l)	BOD_5 (mg/l)	Fecal Col. (no./100 ml)
10/85	6.29			15.00	8.0	84	1.38	1.75	1.50	500
11/85	6.47			7.40	0.0	68	0.00	1.25	1.14	760
12/85	7.06			7.10	4.0	152	0.38	5.60	1.00	2,250
1/86										
2/86	6.18	9.0	17		0.0	100			1.00	50
3/86	5.89				13.2	112			0.80	20
4/86	5.87			8.75	6.0	80				210
5/86	6.62				11.2	124			2.00	50
6/86	6.03				8.8	104			1.57	40
7/86	5.94				7.6	52			2.00	40
8/86					4.0	224			2.39	1
9/86	6.03				20.0	5,264			1.20	20
10/86	6.42				36.0	2,624			0.00	20
11/86	6.25				6.8	324			0.00	40
12/86										
1/87	5.77				0.0	64			2.24	30
2/87										
3/87										
4/87										
5/87										
6/87	6.13			9.15	0.0	116	0.10	0.78	0.97	110
7/87	6.15			9.68	36.0	104	0.00	0.72	2.50	
8/87	6.49			8.10	4.0	84				
9/87	6.33			3.10	16.0	588			0.00	
10/87	6.67			2.70	24.0	1,908			0.00	100
11/87	6.88			5.16	4.0	2,572			0.00	
12/87	6.54			8.82	8.0	1,884			0.00	120
1/88	5.61			9.18	8.0	100			10.30	
2/88	5.73			8.72	8.0	64			1.00	
3/88	5.60			12.40	84.0	76			1.82	
4/88	6.19			7.54	8.0	48			0.00	
5/88	6.02			4.98	8.0	88			1.20	
6/88	6.76			12.40		1,212			1.20	1

Source: NASA 1988o

1687K

Table B-5

Site Water Quality Data

Stennis Space Center

Station: Canal Spillway

Date (mo/yr)	pH (units)	D.O. (mg/l)	Temp. (°C)	TOC (mg/l)	TSS (mg/l)	TDS (mg/l)	TP (mg/l)	TKN (mg/l)	BOD_5 (mg/l)	Fecal Col. (no./100 ml)
10/85	7.15			8.80	0.0	112			1.10	
	7.53	7.5	23	5.40	12.0	104			0.00	
	7.84	8.9	27	7.50	0.0	92			1.00	
	7.29	8.9	26	8.90	0.0	116			2.00	
11/85	7.21	8.1	19	6.60	4.0	64			0.00	
	7.47	8.4	21	7.00	4.0	120			0.00	
	7.50	8.5	22	6.20	0.0	96			0.00	
12/85	7.39	8.5	18	7.90	0.0	100				
	7.32	8.5	13	8.20	0.0	128				
1/86	7.13			8.60	0.0	128			1.00	
	5.22	10.6	11	8.00	4.0	84			1.00	
	7.74	10.2	13	9.20	0.0	80			1.00	
	7.27	9.8	12		0.0	124				
2/86	7.04	9.4	16		0.0	116			1.00	
3/86	7.80				0.0	116			1.00	
4/86	7.81				0.0	100			1.20	
5/86	7.86				0.0	76			1.00	
6/86	7.67				0.0	104			1.10	
7/86	7.51				0.0	100				
8/86	7.51				0.0	168				
9/86	7.34				4.8	364			0.00	
10/86	7.43			3.95	0.0	1,512			0.00	
11/86	7.52				10.0	1,816			1.00	
12/86	6.90				0.0	2,036			1.20	
1/87	7.35				0.0	992			1.97	
2/87	7.40			11.80	0.0	572			1.34	
3/87	7.16				0.0	328			1.67	
4/87	7.49			9.99	0.0	232			1.44	
5/87										
6/87	8.06			10.30	0.0	152	0.04	0.48	1.41	
7/87	8.08			13.20	24.0	160	0.09	0.46	1.58	
8/87	7.43			7.00	16.0	160			0.80	
9/87	7.40			1.10	0.0	132			0.00	
10/87	7.49				0.0	436			1.20	
11/87	7.20			9.52	8.0	380			0.00	
12/87	7.61			12.70	0.0	892			0.00	
1/88	7.46				4.0	860			1.20	
2/88	7.51			10.10	0.0	644			1.69	
3/88	7.67			10.00	0.0	428			1.30	
4/88	7.51			12.20	0.0	180			1.60	
5/88	7.37			8.74	8.0	180			0.00	
6/88				11.30		156			1.20	

Source: NASA 1988o

Table B-6. **Water Quality Data for Yellow Creek in the Vicinity of the Yellow Creek Nuclear Plant Site**

Yellow Creek Mile		Water Temp	Dissolved Oxygen	Carbon Dioxide	pH	Total Alkalinity as CaCO	Hardness as CaCO	True Color	Apparent Color	Turbidity	Solids: Dissolved[6]	Solids: Suspended	Solids: Total
		°C	mg/1	mg/1		mg/1[3]	mg/1[3]	PCU	PCU	JTU	mg/1	mg/1	mg/1
15.7[1] (Bridge near Doskie)	Minimum	5.0	6.6	-	5.2	4	6	10	25	4	10	5	16
	Average	13.0	9.5	-	6.4	10	15	42	72	21	41	25	66
	Maximum	22.8	11.8	-	7.8	70	55	70	100	70	100	120	170
	No. of Samples	22	20		22	22	21	12	12	22	22	22	22
15.7[2] (Bridge near Doskie)	Minimum	3.0	4.5	1.0	4.9	5	4	8	-	10	12	-	-
	Average	14.0	9.5	16	6.2	9	12	79	-	15	31	-	-
	Maximum	25.0	13.7	86	7.5	16	61	200	-	20	61	-	-
	No. of Samples	35	34	32	35	32	31	31	-	2	30	-	-
6.0[3] (Goat Island)	Minimum	6.5	1.9	-	5.5	4	5	-	-	4	30	3	45
	Average	17.2	8.7	-	6.7	18	16	-	-	34	50	33	83
	Maximum	31.0	13.6	-	9.2	42	41	-	-	100	70	190	240
	No. of Samples	66	64	-	52	39	25	-	-	39	39	39	39
6.0[4] (Goat Island)	Minimum	6.0	1.6	0.5	5.5	4	6	-	-	1	12	0	16
	Average	16.3	8.3	8.2	6.9	17	20	-	-	44	43	63	106
	Maximum	30.0	12.4	88	8.1	37	57	-	-	200	78	278	334
	No. of Samples	131	132	42	92	42	39	-	-	81	42	42	42
1.0[5] (Pine Flat)	Minimum	6.0	1.5	0.4	6.2	7	13	-	-	2	20	0	20
	Average	16.7	8.2	6.1	7.15	36	42	-	-	23	69	29	97
	Maximum	29.0	11.4	23	8.4	57	72	-	-	70	118	336	428
	No. of Samples	219	219	57	121	57	52	-	-	108	57	54	54

1. Samples collected and analyzed by the Tennessee Valley Authority; October 1973-April 1975.
2. Samples collected and analyzed by the U.S. Geological Survey; December 1973-July 1975.
3. Samples collected and analyzed by the Tennessee Valley Authority; May 1974-April 1975.
4. Samples collected and analyzed by the U.S. Geological Survey; June 1974-June 1975.
5. Samples collected and analyzed by the U.S. Geological Survey; June 1974-August 1975.
6. All data represents 180°C drying temperature.

Source: TVA (1978)

Table B-7. Water Quality Data for the Tennessee River in the Vicinity of the Yellow Creek Nuclear Plant Site

Tennessee River Mile		Water Temperature °C	Dissolved Oxygen mg/l	pH	Total Alkalinity as CaCO mg/l[3]	Hardness as CaCO mg/l[3]	True Color PCU	Apparent Color PCU	Turbidity JTU	Solids: Dissolved mg/l	Solids: Suspended mg/l	Solids: Total mg/l
220.0[1]	Minimum	7.5	2.8	6.2	37	48	-	-	4	80	1	82
	Average	16.9	8.6	7.5	53	62	-	-	8	92	3	95
	Maximum	29.0	12.8	9.0	72	79	-	-	18	110	21	121
	No. of Samples	122	122	88	40	27	-	-	40	40	40	40
214.4 (TN-AL State Line)	Minimum	5.0	6.2	6.6	28	34	2	10	2	17	0	20
	Average	17.5	8.8	7.4	52	58	19	37	10	95	6	101
	Maximum	27.0	12.4	8.0	62	69	59	88	20	136	25	150
	No. of Samples	24	24	23	24	24	24	24	24	24	24	24
2.4.0[1]	Minimum	7.5	2.4	6.2	28	45	-	-	3	80	1	82
	Average	17.1	8.7	7.4	52	59	-	-	9	90	4	95
	Maximum	30.5	14.0	9.4	78	71	-	-	30	110	33	123
	No. of Samples	131	130	89	38	25	-	-	38	38	38	38
206.7[3] (Pickwick Dam Tail-race)	Minimum	4.0	6.0	7.0	42	45	5	10	1	20	2	24
	Average	18.7	9.7	7.4	50	62	14	23	8	85	5	90
	Maximum	30.0	16.2	7.8	58	70	25	60	22	120	10	125
	No. of Samples	120	116	18	18	17	18	16	18	18	18	18
206.7[4] (Pickwick Dam Tail-race)	Minimum	13.0	-	6.1	47	53	-	-	10	72	-	-
	Average	21.3	-	7.8	48	60	-	-	15	76	-	-
	Maximum	27.5	-	8.5	48	69	-	-	20	80	-	-
	No. of Samples	5	-	5	2	5	-	-	2	2	-	-

1. Samples collected and analyzed by the Tennessee Valley Authority, May 1974-April 1975.
2. Samples collected and analyzed by the State of Tennessee, Department of Public Health, Div. of Water,Quality Control; August 1972-December 1974.
3. Samples collected and analyzed by the Tennessee Valley Authority, January 1973-April 1975.
4. Samples collected and analyzed by the U.S. Geological Survey, March-July 1975.
5. Tennessee Valley Authority data represents 105 C temperature during 1973 and 180°C temperature during 1974 and 1975; State of Tennessee data represents 105 C temperature; U.S. Geological Survey data represents 180°C temperature.

Source: TVA (1978)

TABLE B-8. U.S.G.S. WATER QUALITY DATA, STATION 03592824, TENNESSEE-TOMBIGBEE WATERWAY AT CROSS ROADS, MISSISSIPPI

DATE	TIME	SAMPLING DEPTH (FEET)	GAGE HEIGHT (FEET ABOVE DATUM)	SPECIFIC CONDUCTANCE (US/CM)	PH (STANDARD UNITS)	TEMPERATURE (DEG C)	TRANSPARENCY (SECCHI DISK) (IN)	OXYGEN, DISSOLVED (MG/L)	OXYGEN, DISSOLVED (PERCENT SATURATION)
NOV 1985									
13...	1100	--	--	--	--	--	20.4	--	--
13...	1101	1.00	--	116	7.10	17.5	--	--	--
13...	1102	5.00	--	117	7.30	17.5	--	--	--
13...	1103	10.0	--	118	7.30	16.5	--	--	--
13...	1104	15.0	--	118	7.40	16.5	--	--	--
FEB 1986									
04...	1030	--	9.29	--	--	--	34.2	--	--
04...	1031	1.00	--	102	7.90	9.0	--	12.5	110
04...	1032	5.00	--	103	8.00	8.5	--	12.2	106
04...	1033	10.0	--	105	8.00	8.0	--	12.2	105
04...	1034	13.0	--	106	8.10	8.0	--	12.5	107
MAR									
17...	0900	--	9.30	--	--	--	11.4	--	--
17...	0901	1.00	--	72	6.90	15.5	--	8.6	87
17...	0902	5.00	--	72	7.00	15.5	--	8.4	85
17...	0903	10.0	--	72	7.00	15.5	--	8.4	85
17...	0904	14.0	--	72	7.10	15.5	--	8.3	84
JUL									
07...	0900	--	13.65	--	--	--	59.0	--	--
07...	0901	1.00	--	164	--	30.0	--	7.8	104
07...	0902	5.00	--	164	--	29.5	--	7.9	104
07...	0903	10.0	--	164	--	29.5	--	7.2	95
07...	0904	15.0	--	167	--	29.0	--	6.2	81
07...	0905	17.0	--	167	--	29.0	--	5.8	76

Source: USACOE 1988b.

TABLE B-8 (Continued)

03592824 - TENN-TOM WATERWAY AT CROSS ROADS, MS

WATER QUALITY DATA, WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984

DATE	TIME	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (STAND-ARD UNITS)	TEMPER-ATURE (DEG C)	COLOR (PLAT-INUM-COBALT UNITS)	TUR-BID-ITY (NTU)	OXYGEN, DIS-SOLVED (MG/L)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION)	OXYGEN DEMAND, CHEM-ICAL (HIGH LEVEL) (MG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./100 ML)
NOV 14...	1345	143	6.7	14.0	3	4.5	9.4	91	10	--
JAN 30...	1400	91	6.3	4.5	25	17	11.9	92	10	--
APR 17...	1445	91	6.7	15.0	20	6.5	10.4	104	<10	K6
JUL 10...	1130	135	7.0	28.0	10	12	6.0	77	<10	K60

DATE	SODIUM, DIS-SOLVED (MG/L AS NA)	ALKA-LINITY LAB (MG/L AS CACO3)	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)	SOLIDS, DIS-SOLVED (TONS PER AC-FT)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N)
NOV 14...	8.3	63	3.6	101	.14	.40	.720	.58	1.3
JAN 30...	2.5	26	7.2	72	.10	.10	<.010	--	.70
APR 17...	3.0	27	3.3	--	--	<.10	.030	2.1	2.1
JUL 10...	2.5	41	2.5	88	.12	<.10	.060	.14	.20

DATE	NITRO-GEN, TOTAL (MG/L AS N)	PHOS-PHORUS, TOTAL (MG/L AS P)	PHOS-PHORUS, DIS-SOLVED (MG/L AS P)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE)	IRON, DIS-SOLVED (UG/L AS FE)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN)	MANGA-NESE, DIS-SOLVED (UG/L AS MN)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG)	PHENOLS TOTAL (UG/L)
NOV 14...	1.7	.030	.020	490	36	30	24	.4	<1
JAN 30...	.80	.040	.020	1100	380	180	200	1.1	<1
APR 17...	--	.030	.030	540	130	60	23	1.0	<1
JUL 10...	--	.030	.020	770	110	110	11	<.1	<1

TABLE B-8 (Continued)

03592824 - TENN-TOM WATERWAY AT CROSS ROADS, MS

PESTICIDE ANALYSES, WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984

DATE	PCB, TOTAL (UG/L)	NAPH-THA-LENES, POLY-CHLOR. TOTAL (UG/L)	ALDRIN, TOTAL (UG/L)	CHLOR-DANE, TOTAL (UG/L)	DDD, TOTAL (UG/L)	DDE, TOTAL (UG/L)	DDT, TOTAL (UG/L)	DI-AZINON, TOTAL (UG/L)	DI-ELDRIN TOTAL (UG/L)	ENDO-SULFAN, TOTAL (UG/L)
NOV 14...	<.1	<.10	<.010	<.1	<.010	<.010	<.010	<.01	<.010	<.010
JAN 30...	<.1	<.10	<.010	<.1	<.010	<.010	<.010	<.01	<.010	<.010
APR 17...	<.1	<.10	<.010	<.1	<.010	<.010	<.010	<.01	<.010	<.010
JUL 10...	<.1	<.10	<.010	<.1	<.010	<.010	<.010	<.01	<.010	<.010

DATE	ENDRIN, TOTAL (UG/L)	ETHION, TOTAL (UG/L)	HEPTA-CHLOR, TOTAL (UG/L)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L)	LINDANE TOTAL (UG/L)	MALA-THION, TOTAL (UG/L)	METH-OXY-CHLOR, TOTAL (UG/L)	METHYL PARA-THION, TOTAL (UG/L)	METHYL TRI-THION, TOTAL (UG/L)
NOV 14...	<.010	<.01	<.010	<.010	<.010	<.01	<.01	<.01	<.01
JAN 30...	<.010	<.01	<.010	<.010	<.010	<.01	<.01	<.01	<.01
APR 17...	<.010	<.01	<.010	<.010	<.010	<.01	<.01	<.01	<.01
JUL 10...	<.010	<.01	<.010	<.010	<.010	<.01	<.01	<.01	<.01

DATE	MIREX, TOTAL (UG/L)	PARA-THION, TOTAL (UG/L)	PER-THANE TOTAL (UG/L)	TOX-APHENE, TOTAL (UG/L)	TOTAL TRI-THION (UG/L)	2,4-D, TOTAL (UG/L)	2, 4-DP TOTAL (UG/L)	2,4,5-T TOTAL (UG/L)	SILVEX, TOTAL (UG/L)
NOV 14...	<.01	<.01	<.1	<1	<.01	<.01	<.01	<.01	<.01
JAN 30...	<.01	<.01	<.1	<1	<.01	<.01	<.01	<.01	<.01
APR 17...	<.01	<.01	<.1	<1	<.01	<.01	<.01	<.01	<.01
JUL 10...	<.01	<.01	<.1	<1	<.01	<.01	<.01	<.01	<.01

Table B-9

Water Quality Data, Indian River

Kennedy Space River

Parameter	Segment I				Segment II				Segment III			
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
temperature (°C)	22.1	1.56	9.0	30.4	22.4	1.57	8.0	30.5	22.34	1.49	7.5	29.5
salinity (ppt)	30.2	4.77	22.0	42.0	28.4	5.15	22.0	39.0	27.83	5.48	22.0	38.0
pH (units)	8.2	0.13	7.4	8.7	8.1	0.08	7.3	8.8	8.12	0.10	7.7	8.5
dissolved oxygen (mg/l)	6.9	0.22	4.8	10.1	6.9	0.36	5.2	13.0	7.15	0.29	5.1	9.8
nitrogen (mg/l)	0.03	0.03	0.02	0.12	0.04	0.04	<0.01	0.07	0.06	0.03	<0.001	0.12
phosphorus (mg/l)	0.06	0.01	<0.01	0.09	0.06	0.01	0.03	0.10	0.051	0.039	0.04	0.14
turbidity (JTU)	3.64	1.12	1.0	10.5	3.75	1.46	0.80	10.0	5.02	0.41	2.4	8.70

Source: Edward E. Clark 1986

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Table B-10

Water Quality Data, Mosquito Lagoon Segment,
Indian River
Kennedy Space Center

Parameter	Mean	SD	Min.	Max.
temperature (°C)	22.6	1.45	8.0	31.0
salinity (ppt)	31.8	4.26	21.0	44.0
pH (units)	8.2	0.15	7.8	8.6
dissolved oxygen (mg/l)	6.9	0.22	4.0	9.4
nitrogen (mg/l)	0.03	0.01	<0.01	0.08
phosphorus (mg/l)	0.08	0.04	0.02	0.10
turbidity (JTU)	4.96	0.28	0.8	7.5

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Table B-11

Water Quality Data, Banana River,
Kennedy Space Center

Parameter	Segment I				Segment II			
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
temperature (°C)	22.5	1.1	11.0	29.5	22.4	1.57	8.0	30.5
salinity (ppt)	25.9	4.3	21.0	36.0	28.4	5.15	22.0	39.0
pH (units)	8.2	0.1	7.9	8.6	8.1	0.08	7.3	8.8
dissolved oxygen (mg/l)	6.9	0.45	4.0	8.2	6.9	0.36	5.2	13.0
nitrogen (mg/l)	0.03	0.02	0.01	0.14	0.04	0.04	<0.01	0.069
phosphorus (mg/l)	0.05	0.01	0.02	0.17	0.06	0.01	0.026	0.1
turbidity (JTU)	4.3	1.33	0.6	14.0	3.75	1.46	0.8	10.0

Table B-12
Water Quality Data, Mosquito Control Impoundments, Kennedy Space Center

Parameter	Mean	SD	Min.	Max.
temperature (°C)	22.6	5.03	19.0	29.5
salinity (ppt)	9.4	6.1	3.0	19.0
pH (units)	8.8	0.82	7.9	16.0
dissolved oxygen (mg/l)	11.1	3.0	7.5	13.0
nitrogen (mg/l)	<0.02	<0.02	<0.02	<0.02
phosphorus (mg/l)	0.31	0.38	0.03	0.89
turbidity (JTU)	14.8	24.7	0.4	58.0

TABLE B-13. KSC POLYGENERATION PROJECT BASELINE ENVIRONMENTAL MONITORING PROGRAM WATER QUALITY DATA[(1)]

	STA 1	STA 2	STA 3 SURFACE	STA 3 BOTTOM	STA 4	STA 5
Temperature (°C)						
Mean	24.5	25.5	25.1	20.0	22.9	24.6
St. Dev.	4.4	5.0	4.6	1.1	4.2	4.6
Min	18.5	18.5	18.2	18.2	15.0	15.0
Max	32.5	32.8	33.5	21.9	29.7	32.0
Salinity (PPT)						
Mean	17.2	17.0	16.4	31.7	0.0	0.0
St. Dev.	2.2	2.2	2.5	6.3	0.0	0.0
Min	14.5	14.1	9.8	19.5	0.0	0.0
Max	24.5	24.0	23.0	45.0	0.0	0.0
Dissolved Oxygen (mg/l)						
Mean	7.6	7.8	7.9	0.24	3.2	3.9
St. Dev.	1.3	1.2	1.3	0.23	1.3	2.3
Min	6.0	5.7	5.8	0.0	1.4	0.7
Max	10.0	10.5	10.8	0.7	5.9	8.3
TOT Phosphate (mg/l)						
Mean	0.10	0.17	0.14	1.91	0.31	0.33
St. Dev.	0.06	0.3	0.21	1.51	0.42	0.53
Min	0.10	.02	0.02	0.04	0.03	0.04
Max	0.25	1.09	0.95	4.60	1.29	1.81
TKN (mg/l)						
Mean	1.4	1.26	1.33	12.23	4.72	3.05
St. Dev.	0.3	0.27	0.27	11.05	5.70	2.67
Min	0.45	0.43	0.96	1.05	1.07	1.18
Max	2.09	1.73	2.07	35.59	23.9	12.50
TDS (mg/l)						
Mean	18,222.0	17,862.7	17,650.2	27,269.8	254.3	165.8
St. Dev.	4,357.2	4,554.6	4,881.6	10,488.2	94.7	34.7
Min	1,713.0	1,511.0	1,741.0	3,656.0	136.0	116.0
Max	23,160.0	22,294.0	22,278.0	40,136.0	544.0	270.0

(1) August 1983 - October 1985

Source: Edward E. Clark. 1986.

TABLE B-14. KSC STP-1 ZERO DISCHARGE WATER QUALITY SUMMARY (1)

	STA 1	STA 2	STA 3	STA 4	STA 5	STA 6
Salinity (PPT)						
Mean	0.830	0.840	1.0100	4.77	2.55	0.95
St. Dev.	0.295	0.540	0.587	4.33	5.13	1.5
Min	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Max	1.0	2.0	2.5	12.5	2.5	4.0
Dissolved Oxygen (mg/l)						
Mean	2.7	2.4	2.2	3.5	4.66	1.770
St. Dev.	1.14	1.4	1.4	1.5	1.98	0.8577
Min	1.2	0.8	0.6	1.6	1.2	0.7
Max	5.1	4.8	4.6	6.0	8.4	3.4
Temperature (°C)						
Mean	22.5	22.8	22.0	21.7	23.0	20.50
St. Dev.	8.7	9.0	8.4	8.9	9.0	8.6
Min	19.0	18.0	17.0	16.0	19.0	14.0
Max	30.0	31.0	28.0	30.0	31.0	27.0
TOT Phosphate (mg/l)						
Mean	0.44	1.34	0.61	0.34	0.28	0.27
St. Dev.	0.60	0.77	0.24	0.44	0.09	0.25
Min	0.05	0.52	0.33	0.03	0.11	0.08
Max	0.81	2.71	0.98	1.56	0.44	0.82
TKN (mg/l)						
Mean	1.32	2.56	1.23	1.93	1.26	1.95
St. Dev.	0.91	1.50	0.31	1.63	0.42	1.30
Min	0.48	0.98	0.57	0.72	0.29	0.75
Max	3.32	5.60	1.60	6.38	1.73	5.44
TSS (mg/l)						
Mean	15.5	336.7	9.80	13.0	10.70	19.20
St. Dev.	22.2	-	4.1846	8.62	4.0	18.64
Min	2.0	0.9	2.0	1.0	5.0	2.0
Max	74.0	3,230	15.0	25.0	18.0	66.0

(1) Monthly samples July 1985 - April 1986

Source: Edward E. Clark. 1986.

TABLE B-15.KSC STP-4 IMPOUNDMENT WATER QUALITY SURVEY(1)

PARAMETER	DISCHARGE POINT	100' DOWNSTREAM DISCHARGE	200' DOWNSTREAM DISCHARGE
Dissolved Oxygen (mg/l)			
Mean	4.1	4.5	4.5
Min	2.1	2.5	2.8
Max	5.3	6.2	6.0
Temperature (°C)			
Mean	16.9	16.4	16.6
Min	10.0	9.0	8.5
Max	22.0	21.5	23.0
NH_3 (mg/l)			
Mean	5.4	3.5	3.1
Min	0.3	0.26	0.25
Max	13.1	11.4	10.3
NO_2 (mg/l)			
Mean	0.77	0.65	0.51
Min	0.3	0.23	0.16
Max	1.25	1.31	1.25
PO_4 (mg/l)			
Mean	1.45	1.03	0.76
Min	0.82	0.44	0.24
Max	1.96	1.8	1.4
TKN (mg/l)			
Mean	8.35	6.20	5.2
Min	1.23	1.68	1.28
Max	25.4	19.4	15.4
TSS (mg/l)			
Mean	8.25	6.75	6.6
Min	4.0	2.0	2.0
Max	14.0	15.0	17.0
Total Phosphorus (mg/l)			
Mean	1.68	1.44	0.94
Min	1.20	0.65	0.31
Max	2.14	2.81	0.55
BOD (mg/l)			
Mean	10	8.5	8.25
Min	5	3.0	4.0
Max	16	12.0	14.0

(1) DEC 1985- JAN 1986

Source: Edward E. Clark. 1986.

Table B-16

Specification of Well Use Permits at SSC

Permit No.	Well Use	Depth	Location	Gallons per Day	Maximum Discharge (gal/min)
MS-GW-01907	Cooling Water	1,873	NE 1/4, SE 1/4 T85, R16W, Sec. 10	0.84 million	3,500
MS-GW-01908	Cooling Water	1,695	NE 1/4, SW 1/4 T85, R16W, Sec. 10	1.2 million	5,000
MS-GW-01909	Cooling Water	672	SW 1/4, SE 1/4 T85, R16W, Sec. 10	1.2 million	5,000
MS-GW-01910	Drinking	1,524	NE 1/4, SW 1/4 T85, R16W, Sec. 5	0.4 million	600
MS-GW-01911	Drinking	1,481	NE 1/4, SW 1/4 T85, R16W, Sec. 5	0.1 million	425
MS-GW-01912	Drinking	1,434	NE 1/4, NW 1/4 T85, R16W, Sec. 10	0.15 million	700

Source: NASA 1986.

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Table B-17

Chemical Analysis of Well Waters at SSC

Well	Water Bearing Interval (ft)	Date of Collection	Silica SiO_2	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarboncate (HCO_3)
Potable Water Well									
1	1,460-1,524	Oct. 1965	20	0.4	1.9	0.1	56	1.1	186
2	1,405-1,480	do	20	0.09	2.0	0	85	1.3	178
Saturn V Potable-Water Well	1,345-1,435	do	20	0.02	0.8	0.7	0.97	1.2	221
Industrial Well									
1	1,800-2,000	do	33	0.05	2.5	.3	115	2.0	268
2	1,580-1,730	do	21	0.12	2.0	0	97	1.0	211
3	455-675	do	8.1	0.23	0.7	0.5	106	0.8	248
Dewatering Well (H10)	110-140	Feb 1965	22	0.09	1.5	0.3	83	0	196

Well	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids	Hardness as $CaCO_3$	pH at well	Color1/
Potable Water Well									
1	7	11	15	0.2	0.2	236	5	8.95	10
2	7	13	18	0.2	0.2	236	5	8.95	10
Saturn V Potable-Water Well	0	11	13	0.3	0	253	5	8.95	5
Industrial Well									
1	0	7.6	22	0.4	0.2	315	7	8.75	5
2	0	11	26	0.3	0	262	5	8.45	10
3	0	4.6	20	0.3	0	263	4	9.1	10
Dewatering Well (H10)	0	4.6	14	0.5	0.3	232	6	16.9	16

1/ Expressed in terms of Hazen Pt-Co. scale.

2/ Determined in laboratory at time of analysis.

Source: NASA (1980b).

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APPENDIX C

WATER QUALITY REGULATIONS AND CRITERIA

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LIST OF TABLES

TABLE C-1

SUMMARY OF FEDERAL WATER QUALITY CRITERIA

Water Quality Criteria Summary

Note: This chart is for general information; please use criteria documents or detailed summaries in "Quality Criteria for Water 1986" for regulatory purposes.

			CONCENTRATIONS IN μg/L				UNITS PER LITER				
	Priority Pollutant	Carcinogen	Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water MCL	Date Reference	# of States With Aquatic Life Standard
ACENAPTHENE	Y	N	*1,700.	*520	*970.	*710.				1980 FR	1
ACROLEIN	Y	N	*68.	*21	*55.		320.μg	780.μg		1980 FR	1
ACRYLONITRILE	Y	Y	*7,550.	*2,600			0.058μg**	0.65μg**		1980 FR	
ALDRIN	Y	Y	3.0		1.3		0.074ng**	0.079ng**		1980 FR	16
ALKALINITY	N	N		20,000.						1976 RB	
AMMONIA	N	N	CRITERIA ARE pH AND TEMPERATURE DEPENDENT—SEE DOCUMENT							1986 FR	34
ANTIMONY	Y	N	*9,000.	*1,600			146.μg	45,000.μg		1980 FR	1
ARSENIC	Y	Y					2.2ng**	17.5ng**	0.05mg	1980 FR	21
ARSENIC (PENT)	Y	Y	*850	*48	*2,319	*13.				1986 FR	21
ARSENIC (TRI)	Y	Y	360.	190	69.	36.				1986 FR	21
ASBESTOS	Y	Y					30k f/L**			1980 FR	
BACTERIA	N	N	FOR PRIMARY RECREATION AND SHELLFISH USES—SEE DOCUMENT						<1/100ml	1986 FR	36
BARIUM	N	N					1 mg		1.0mg	1976 RB	8
BENZENE	Y	Y	*5,300.		*5,100	*700.	0.66μg**	40.μg**		1980 FR	1
BENZIDINE	Y	Y	*2,500				0.12ng**	0.53ng**		1980 FR	6
BERYLLIUM	Y	Y	*130	*5.3			6.8ng**	117.ng**		1980 FR	8
BHC	Y	N	*100		*0.34					1980 FR	
CADMIUM	Y	N	3.9 +	1.1 +	43	9.3	10.μg		0.010mg	1986 FR	21
CARBON TETRACHLORIDE	Y	Y	*35,200		*50,000		0.4μg**	6.94μg**		1980 FR	1
CHLORDANE	Y	Y	2.4	0.0043	0.09	0.004	0.46ng**	0.48ng**		1980 FR	12
CHLORINATED BENZENES	Y	Y	*250	*50	*160	*129				1980 FR	1
CHLORINATED NAPHTHALENES	Y	N	*1,600.		*7.5					1980 FR	1
CHLORINE	N	N	19	11.	13.	7.5				1986 FR	21
CHLOROALKYL ETHERS	Y	N	*238,000							1980 FR	1
CHLOROETHYL ETHER (BIS-2)	Y	Y					0.03μg**	1.36μg**		1980 FR	
CHLOROFORM	Y	Y	*28,900	*1,240			0.19μg**	15.7μg**		1980 FR	1
CHLOROISOPROPYL ETHER (BIS-2)	Y	N					34.7μg	4.36mg		1980 FR	
CHLOROMETHYL ETHER (BIS)	N	Y					0.00000376ng**	0.00184μg**		1980 FR	
CHLOROPHENOL 2	Y	N	*4,380.	*2,000.						1980 FR	1
CHLOROPHENOL 4	N	N			*29,700					1980 FR	1
CHLOROPHENOXY HERBICIDES (2,4,5,-TP)	N	N					10.μg			1980 FR	
CHLOROPHENOXY HERBICIDES (2,4-D)	N	N					100.μg			1976 RB	7
CHLORPYRIFOS	N	N	0.083	0.041	0.011	0.0056				1986 FR	
CHLORO-4 METHYL-3 PHENOL	N	N	*30.							1980 FR	
CHROMIUM (HEX)	Y	N	16	11.	1,100	50.	50.μg		0.05mg	1985 FR	34
CHROMIUM (TRI)	N	N	1,700 +	210 +	*10,300		170.mg	3,433.mg	0.05mg	1985 FR	34
COLOR	N	N	NARRATIVE STATEMENT—SEE DOCUMENT							1976 RB	
COPPER	Y	N	18 +	12 +	2.9	2.9				1985 FR	30
CYANIDE	Y	N	22.	5.2	1	1.	200.μg			1985 FR	23
DDT	Y	Y	1.1	0.001	0.13	0.001	0.024ng**	0.024ng**		1980 FR	16
DDT METABOLITE (DDE)	Y	Y	*1,050.		*14.					1980 FR	
DDT METABOLITE (TDE)	Y	Y	*0.06		*3.6					1980 FR	
DEMETON	Y	N		0.1		0.1				1976 RB	
DIBUTYL PHTHALATE	Y	N					35.mg	154.mg		1980 FR	
DICHLOROBENZENES	Y	N	*1,120.	*763	*1,970.		400.μg	2.6mg		1980 FR	1
DICHLOROBENZIDINE	Y	Y					0.01μg**	0.020μg**		1980 FR	1
DICHLOROETHANE 1,2	Y	Y	*118,000	*20,000	*113,000.		0.94μg**	243.μg**		1980 FR	1
DICHLOROETHYLENES	Y	Y	*11,600.		*224,000		0.033μg**	1.85μg**		1980 FR	1
DICHLOROPHENOL 2,4	N	N	*2,020	365			3.09mg			1980 FR	1
DICHLOROPROPANE	Y	N	*23,000	*5,700.	*10,300.	*3,040.				1980 FR	1
DICHLOROPROPENE	Y	N	*6,060	*244.	*790		87.μg	14.1mg		1980 FR	1
DIELDRIN	Y	Y	2.5	0.0019	0.71	.0019	0.071ng**	0.076ng**		1980 FR	16
DIETHYL PHTHALATE	Y	N					350.mg	1.8g		1980 FR	
DIMETHYL PHENOL 2,4	Y	N	*2,120.							1980 FR	
DIMETHYL PHTHALATE	Y	N					313.mg	2.9g		1980 FR	
DINITROTOLUENE 2,4	N	Y					0.11μg**	9.1μg**		1980 FR	
DINITROTOLUENE	Y	N					70.μg	14.3mg		1980 FR	
DINITROTOLUENE	N	Y	*330.	*230.	*590.	*370.				1980 FR	1
DINITRO-O-CRESOL 2,4	Y	N					13.4μg	765.μg		1980 FR	
DIOXIN (2,3,7,8-TCDD)	Y	Y	*0.01	*0.00001			0.000013ng**	0.000014ng**		1984 FR	1
DIPHENYLHYDRAZINE	Y	N					42.ng**	0.56μg**		1980 FR	1
DIPHENYLHYDRAZINE 1,2	Y	N	*270							1980 FR	
DI-2-ETHYLHEXYL PHTHALATE	Y	N					15 mg	50 mg		1980 FR	
Aluminum	N	N	750	87						1988 FR	

TABLE C-1 (Continued)

SUMMARY OF FEDERAL WATER QUALITY CRITERIA

ENDOSULFAN	Y	N	0.22	0.056	0.034	0.0087	74 µg	159 µg		1980 FR	10
ENDRIN	Y	N	0.18	0.0023	0.037	0.0023	1 µg		0.0002mg	1980 FR	18
ETHYLBENZENE	Y	N	*32,000		*430		1.4mg	3.28mg		1980 FR	
FLUORANTHENE	Y	N	*3,980.		*40	*16.	42 µg	54 µg		1980 FR	1
GASSES, TOTAL DISSOLVED	N	N	NARRATIVE STATEMENT—SEE DOCUMENT							1976 RB	
GUTHION	N	N		0.01		0.01				1976 RB	6
HALOETHERS	Y	N	*360.	*122.						1980 FR	
HALOMETHANES	Y	Y	*11,000.		*12,000	*6,400.	0.19µg**	15.7µg**		1980 FR	
HEPTACHLOR	Y	Y	0.52	0.0038	0.053	0.0036	0.28ng**	0.29ng**		1980 FR	12
HEXACHLOROETHANE	N	Y	*980.	*540.	*940.		1.9µg	8.74µg		1980 FR	1
HEXACHLOROBENZENE	Y	N					0.72ng**	0.74ng**		1980 FR	
HEXACHLOROBUTADIENE	Y	Y	*90.	*9.3	*32.		0.45µg**	50 µg**		1980 FR	2
HEXACHLOROCYCLOHEXANE (LINDANE)	Y	Y	2.0	0.08	0.16				0.004mg	1980 FR	12
HEXACHLOROCYCLOHEXANE—ALPHA	Y	Y					9.2ng**	31.ng**		1980 FR	
HEXACHLOROCYCLOHEXANE—BETA	Y	Y					16.3ng**	54.7ng**		1980 FR	
HEXACHLOROCYCLOHEXANE—GAMA	Y	Y					18.6ng**	62.5ng**		1980 FR	
HEXACHLOROCYCLOHEXANE—TECHNICAL	Y	Y					12.3ng**	41.4ng**		1980 FR	
HEXACHLOROCYCLOPENTADIENE	Y	N	*7.	*5.2	*7		206 µg			1980 FR	3
IRON	N	N		1,000.			0.3mg			1976 RB	18
ISOPHORONE	Y	N	*117,000.		*12,900.		5.2mg	520 mg		1980 FR	
LEAD	Y	N	82. +	3.2 +	140.	5.6	50 µg		0.05mg	1986 FR	20
MALATHION	N	N		0.1		0.1				1976 RB	7
MANGANESE	N	N					50 µg	100 µg		1976 RB	7
MERCURY	Y	N	2.4	0.012	2.1	0.025	144 ng	146 ng	0.002mg	1986 FR	17
METHOXYCHLOR	N	N		0.03		0.03	100 µg		0.1mg	1976 RB	12
MIREX	N	N		0.001		0.001				1976 RB	7
MONOCHLOROBENZENE	Y	N					488 µg			1980 FR	
NAPHTHALENE	Y	N	*2,300.	*620.	*2,350.					1980 FR	1
NICKEL	Y	N	1,400. +	160 +	75	8.3	13.4µg	100 µg		1986 FR	10
NITRATES	N	N					10 mg		10 mg	1976 RB	5
NITROBENZENE	Y	N	*27,000.		*6,680.		19.8mg			1980 FR	1
NITROPHENOLS	Y	N	*230	*150.	*4,850.					1980 FR	1
NITROSAMINES	Y	Y	*5,850.		*3,300,000					1980 FR	1
NITROSODIBUTYLAMINE N	Y	Y					6.4ng**	587 ng**		1980 FR	
NITROSODIETHYLAMINE N	Y	Y					0.8ng**	1,240 ng**		1980 FR	
NITROSODIMETHYLAMINE N	Y	Y					1.4ng**	16,000 ng**		1980 FR	
NITROSODIPHENYLAMINE N	Y	Y					4,900 ng**	16,100 ng**		1980 FR	
NITROSOPYRROLIDINE N	Y	Y					16 ng**	91,900 ng**		1980 FR	
OIL AND GREASE	N	N	NARRATIVE STATEMENT—SEE DOCUMENT							1976 RB	56
OXYGEN DISSOLVED	N	N	WARMWATER AND COLDWATER CRITERIA MATRIX—SEE DOCUMENT							1986 FR	56
PARATHION	N	N	0.065	0.013						1986 FR	8
PCB's	Y	Y	2.0	0.014	10	0.03	0.079ng**	0.079ng**		1980 FR	16
PENTACHLORINATED ETHANES	N	N	*7,240.	*1,100.	*390	*281.				1980 FR	1
PENTACHLOROBENZENE	N	N					74 µg	85 µg		1980 FR	
PENTACHLOROPHENOL	Y	N	***20.	***13.	13.	*7.9	1.01mg			1986 FR	2
pH	N	N		6.5-9		6.5-8.5				1976 RB	56
PHENOL	Y	N	*10,200	*2,560.	*5,800		3.5mg			1980 FR	23
PHOSPHORUS ELEMENTAL	N	N				0.1				1976 RB	
PHTHALATE ESTERS	Y	N	*940.	*3.	*2,944	*3.4				1980 FR	6
POLYNUCLEAR AROMATIC HYDROCARBONS	Y	Y			*300		2.8ng**	31.1ng**		1980 FR	1
SELENIUM	Y	N	20	5	300	71	10 µg		0.01mg	1987 FR	15
SILVER	Y	N	4.1 +	0.12	2.3		50 µg		0.05mg	1980 FR	14
SOLIDS DISSOLVED AND SALINITY	N	N					250 mg			1976 RB	56
SOLIDS SUSPENDED AND TURBIDITY	N	N	NARRATIVE STATEMENT—SEE DOCUMENT							1976 RB	44
SULFIDE-HYDROGEN SULFIDE	N	N		2		2.				1976 RB	
TEMPERATURE	N	N	SPECIES DEPENDENT CRITERIA—SEE DOCUMENT							1976 RB	56
TETRACHLORINATED ETHANES	Y	N	*9,320.							1980 FR	
TETRACHLOROBENZENE 1,2,4,5	Y	N					38 µg	48 µg		1980 FR	
TETRACHLOROETHANE 1,1,2,2	Y	Y		*2,400.	*9,020.		0.17µg**	10.7µg**		1980 FR	1
TETRACHLOROETHANES	Y	N	*9,320.							1980 FR	1
TETRACHLOROETHYLENE	Y	Y	*5,280.	*840.	*10,200.	*450.	0.8µg**	8.85µg**		1980 FR	1
TETRACHLOROPHENOL 2,3,5,6	Y	N				*440.				1980 FR	
THALLIUM	Y	N	*1,400.	*40.	*2,130.		13 µg	48 µg		1980 FR	2
TOLUENE	Y	N	*17,500.		*6,300.	*5,000.	14.3mg	424 mg		1980 FR	1
TOXAPHENE	Y	Y	0.73	0.0002	0.21	0.0002	0.71ng**	0.73ng**	0.005mg	1986 FR	17
TRICHLORINATED ETHANES	Y	Y	*18,000							1980 FR	
TRICHLOROETHANE 1,1,1	Y	N			*31,200.		18.4mg	1.03g		1980 FR	1
TRICHLOROETHANE 1,1,2	Y	Y		*9,400.			0.6µg**	41.8µg**		1980 FR	1
TRICHLOROETHYLENE	Y	Y	*45,000.	*21,900.	*2,000.		2.7µg**	80.7µg**		1980 FR	1
TRICHLOROPHENOL 2,4,5	N	N					2,600 µg			1980 FR	
TRICHLOROPHENOL 2,4,6	Y	Y		*970.			1.2µg**	3.6µg**		1980 FR	
VINYL CHLORIDE	Y	Y					2 µg**	525 µg**		1980 FR	
ZINC	Y	N	120. +	110 +	95	86				1987 FR	10

g grams
mg milligrams
µg micrograms
ng nanograms
f – fibers

Y YES
N NO

M.C.L. MAXIMUM CONTAMINANT LEVEL

\+ Hardness Dependent Criteria (100 mg/L used)

* Insufficient Data to Develop Criteria. Value Presented is the L.O.E.L. — Lowest Observed Effect Level

** Human Health Criteria For Carcinogens Reported For Three Risk Levels. Value Presented is the 10-6 Risk Level

*** pH Dependent Criteria (7.8 pH used)

FR FEDERAL REGISTER
RB QUALITY CRITERIA FOR WATER 1976 (REDBOOK)

APPENDIX C

TABLE C-2

QUANTITATIVE WATER QUALITY CRITERIA CORRESPONDING TO STATE OF MISSISSIPPI STREAM CLASSIFICATIONS FOR SURFACE WATERS IN NASA/NSTL AREA

Water Quality Parameters	Stream Classification: Recreation	Fish and Wildlife	Ephemeral
Dissolved Oxygen	Dissolved oxygen concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of less than 4.0 mg/l in streams, estuaries and in tidally affected portions of streams, and in the epilimnion.	Same	The dissolved oxygen shall be maintained at an appropriate level to avoid nuisance conditions.
Toxic Substances, Color, Taste and Odor Producing Substances	There shall be no substances added whether alone or in combination with other substances that will impair the use of waters from from that which it is classified. The concentration of toxic pollutants shall not exceed 1/10th of the 96-hour median tolerance limit based on available data. The concentration of toxic pollutants that are cumulative and/or persistent may be further limited on a case-by-case basis.	Same	Same

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TABLE C-2 (Continued)

QUANTITATIVE WATER QUALITY CRITERIA CORRESPONDING TO STATE OF MISSISSIPPI STREAM CLASSIFICATIONS FOR SURFACE WATERS IN NASA/NSTL AREA

Water Quality Parameters	Stream Classification: Recreation	Fish and Wildlife	Ephemeral
pH	The normal pH of the waters shall be 6.0 to 8.5 and shall not be caused to vary more than 1.0 unit; however, should background pH be outside the limits, it shall not be changed more than 1.0 unit unless after the change the pH will fall within the limits, and the Commission determines that there will be no detrimental effect on stream usage.	Same	Same
Temperature	The maximum temperature rise above natural temperatures shall not exceed 5°F in streams, lakes and reservoirs nor shall the maximum water temperature exceed 90°F. The discharge of any heated waste into any coastal or estuarine waters shall not raise temperatures more than 4°F above natural during the period October through May, nor more than 1.5°F. above natural for the months June through Sept.	Same	Same

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TABLE C-2 (Continued)

QUANTITATIVE WATER QUALITY CRITERIA CORRESPONDING TO STATE OF MISSISSIPPI STREAM CLASSIFICATIONS FOR SURFACE WATERS IN NASA/NSTL AREA

Water Quality Parameters	Stream Classification		
	Recreation	**Fish and Wildlife**	**Ephemeral**
Fecal Coliform	Fecal coliform not to exceed a geometric mean of 200 per 100 ml nor shall more than ten percent (10%) of the samples examined during any month exceed 400 per 100 ml.	Fecal coliform shall not exceed a geometric mean of 2000/100 ml, nor shall more than 10% of the samples examined during any month exceed 4000/100 ml.	The Permit Board may assign bacterial criteria where the probability of a public health hazard so warrant.
Specific Conductance	There shall be no substances added to increase the conductivity above 1000 micromhos/cm for fresh water streams.	Same	Not specified
Dissolved Solids	There shall be no substances added to the water to cause the dissolved solids to exceed 750 mg/l as a monthly average value, nor exceed 1500 mg/l at any time for freshwater streams.	There shall be no substances added to the waters to cause the dissolved solids to exceed 750 mg/l as a monthly value, nor exceed 150 mg/l at any time for fresh water streams.	Not specified
Phenolic Compounds	Not Specified	There shall be no substances added which will cause the phenolic content to exceed 0.05 mg/l (phenol).	

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TABLE C-3

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION (FDER) WATER QUALITY CLASSIFICATIONS AND STANDARDS

PARAMETER	FDER GROUND WATER POTABLE WATER STANDARDS	FDER SURFACE WATER QUALITY CLASSIFICATIONS				
		CLASS I POTABLE	CLASS II SHELLFISH	CLASS III RECREATION FISH & WILDLIFE	CLASS IV AGRICULTURAL	CLASS V INDUSTRIAL
Aldrin-Dieldrin		0.003 ug/1	0.003 ug/1	0.003 ug/1		
Alkalinity		20 mg/1 min. as CaCO		20 mg/1 min. as CaCO (fresh)	600 mg/1 max. as CaCO	
Aluminum			1.5 mg/1	1.5 mg/1 (marine)		
Ammonia, un-ionized		0.[illegible] mg/1		0.02 mg/1 (fresh)		
Antimony			0.2 mg/1	0.02 mg/1 (marine)		
Arsenic	0.05 mg/1 (P)	0.05 mg/1	0.05 mg/1	0.05 mg/1	0.05 mg/1	0.05 mg/1
Bacteriological Quality	Total coliform 4/100 ml (P)	1,000/100ml mean; 200/100ml mean fecal	70/100ml median 14/100ml median fecal	1,000/100 ml mean 200/100 ml mean fecal		
Barium	1 mg/1 (P)	1 mg/1				
Benzene	1 ug/1 (P)					
Beryllium		0.011 mg/1 soft 1.10 mg/1 hard		0.011 mg/1 soft 1.10 mg/1 hard (fresh)	0.1 mg/1 soft 0.5 mg/1 hard	
Biological Integrity		min. 75% of Diversity Index	min. 75% of Diversity Index	min. 75% of Diversity Index		
Boron					0.75 mg/1	
Bromine & Bromates			0.1 mg/1 free bromine, 100 mg/1 bromates	0.1 mg/1 free bromine 100 mg/1 bromate (marine)		

TABLE C-3 (Continued)

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION (FDER) WATER QUALITY CLASSIFICATIONS AND STANDARDS

PARAMETER	FDER GROUND WATER POTABLE WATER STANDARDS	FDER SURFACE WATER QUALITY CLASSIFICATIONS				
		CLASS I POTABLE	CLASS II SHELLFISH	CLASS III RECREATION FISH & WILDLIFE	CLASS IV AGRICULTURAL	CLASS V INDUSTRIAL
Cadmium	0.010 mg/l(P)	0.0008 mg/l soft 0.0012 mg/l hard	0.005 mg/l	0.0008mg/l soft(fresh) 0.0012mg/l hard(fresh) 0.005mg/l (marine)		
Carbon Tetrachloride	3 ug/l (P)					
Chlordane		0.01 ug/l	0.004 ug/l	0.004 ug/l		
Chlorides	250 mg/l (S)	250 mg/l	10% above background	10% above background (marine)		10% above back ground(marine)
Chlorine, Residual		0.01 mg/l	0.01 mg/l	0.01 mg/l		
Chlorophyll						
Chromium	0.05 mg/l (P)	0.05 mg/l total	0.05mg/l total	0.05 mg/l total	0.05mg/l total	0.05mg/ltotal
Color	15 color units (S)	no nuisance conditions	no nuisance conditions	no nuisance conditions	suitable for use	no nuisance conditions
Copper	1 mg/l (S)	0.03 mg/l	0.015 mg/l	0.03 mg/l (fresh) 0.015 mg/l (marine)	0.05 mg/l	0.05 mg/l
Corrosivity	Noncorrosive (S)					
Cyanide		0.005 mg/l	0.005 mg/l	0.005 mg/l	0.005 mg/l	0.005 mg/l
2,4 - D	100 ug/l (P)	100 ug/l				
DDT		0.001 ug/l	0.001 ug/l	0.001 ug/l		
Demeton		0.1 ug/l	0.1 ug/l	0.01 ug/l		

TABLE C-3 (Continued)

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION (FDER) WATER QUALITY CLASSIFICATIONS AND STANDARDS

PARAMETER	FDER GROUND WATER POTABLE WATER STANDARDS	FDER SURFACE WATER QUALITY CLASSIFICATIONS				
		CLASS I POTABLE	CLASS II SHELLFISH	CLASS III RECREATION FISH & WILDLIFE	CLASS IV AGRICULTURAL	CLASS V INDUSTRIAL
1, 2 - Dichlorethane	3 ug/l (P)					
Detergents		0.5 mg/l	0.5 mg/l	0.5 mg/l	0.5 mg/l	0.5 mg/l
Dissolved Oxygen		5.0 mg/l min.	5.0 mg/l mean 4.0 mg/l min.	5 mg/l min. (fresh) 4 mg/l min. (marine)	4.0 mg/l mean 3.0 mg/l min.	
Dissolved Solids	500 mg/l (S) (total)	500 mg/l mo. avg. 1,000 mg/l max.				
Endosulfan		0.003 ug/l	0.001 ug/l	0.003 ug/l (fresh) 0.001 ug/l (marine)		
Endrin	0.2 ug/l (P)	0.004 ug/l	0.004 ug/l	0.004 ug/l		
Ethylene Dibromide	0.02 ug/l (P)					
Fluorides	1.4-2.4 mg/l	1.5 mg/l	1.5 mg/l	5.0 mg/l (marine) 10.0 mg/l as fluoride lon	10.0 mg/l as fluoride lon	10.0 mg/l as fluoride lon
Foaming Agents	0.5 mg/l (S)					
Guthion		0.01 ug/l	0.01 ug/l	0.01 ug/l		
Heptachlor		0.001 ug/l	0.001 ug/l	0.001 ug/l		
Iron	0.3 mg/l (S)	0.3 mg/l	0.3 mg/l	1.0 mg/l (fresh) 0.3 mg/l (marine)	1.0 mg/l	
Lead	0.05 mg/l (P)	0.03 mg/l	0.05 mg/l	0.03 mg/l (fresh)	0.05 mg/l	0.05 mg/l

TABLE C-3 (Continued)

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION (FDER) WATER QUALITY CLASSIFICATIONS AND STANDARDS

PARAMETER	FDER GROUND WATER POTABLE WATER STANDARDS	FDER SURFACE WATER QUALITY CLASSIFICATIONS				
		CLASS I POTABLE	CLASS II SHELLFISH	CLASS III RECREATION FISH & WILDLIFE	CLASS IV AGRICULTURAL	CLASS V INDUSTRIAL
Lindane	4 ug/l (P)	0.01 ug/l	0.004 ug/l	0.01 ug/l (fresh) 0.004 ug/l (marine)		
Malathion		0.1 ug/l	0.1 ug/l	0.1 ug/l		
Manganese	0.05 mg/l (S)		0.1 mg/l			
Mercury	0.002 mg/l (P)	0.0002 mg/l	0.0001 mg/l	0.0002 mg/l (fresh) 0.0001 mg/l (marine)	0.0002 mg/l	0.0002 mg/l
Methoxy-Chlor	100 ug/l (P)	0.03 ug/l	0.03 ug/l	0.03 ug/l		
Mirex		0.001 ug/l	0.001 ug/l	0.001 ug/l		
Nickel		0.1 mg/l	0.1 mg/l	0.1 mg/l	0.1 mg/l	
Nitrates (as N)	10 mg/l (P)	10 mg/l				
Nitrogen Total (as N)				See 17-3.011(11)		
Nutrients		varies	varies	varies	discharge limited	discharge limited
Odor	threshold odor number 3 (S)	no nuisance conditions	threshold odor number 24	no nuisance conditions	suitable for use	suitable for use
Oils & Greases		5.0 mg/l; no taste or odor	5.0 mg/l; no taste or odor	5.0 mg/l; no taste or odor	5.0 mg/l; no taste or odor	5.0 mg/l; no taste or odor

TABLE C-3 (Continued)

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION (FDER) WATER QUALITY CLASSIFICATIONS AND STANDARDS

PARAMETER	FDER GROUND WATER POTABLE WATER STANDARDS	FDER SURFACE WATER QUALITY CLASSIFICATIONS				
		CLASS I POTABLE	CLASS II SHELLFISH	CLASS III RECREATION FISH & WILDLIFE	CLASS IV AGRICULTURAL	CLASS V INDUSTRIAL
Parathion		0.04 ug/l	0.04 ug/l	0.04 ug/l		
pH	6.5 minimum (S)	1.0 unit variation 6.0 - 8.5	1 unit variation 6.5-8.5	1 unit variation 6.0-8.5 (fresh) 6.5-8.5 (marine)	1 unit variation 6.0-8.5	5.0 - 9.5
Phenolic Compounds		0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l
Phosphorus Elemental			0.0001 mg/l	0.0001 mg/l (marine)		
Phosphorus, Total (as P)				See 17-3.011(11)		
Phthalate Esters		0.003 mg/l		0.003 mg/l (fresh)		
PCBs		0.001 ug/l	0.001 ug/l	0.001 ug/l		
Radioactive Substances	Ra:5 pCi/l (P) a: 15 pCi/l	Ra: 5 pCi/l a: 15 pCi/l	Ra: 5 pCi/l a: 15 pCi/l	Ra: 5 pCi/l a: 15 pCi/l	Ra: 5 pCi/l a: 15 pCi/l	Ra: 5 pCi/l a: 15 pCi/l
Selenium	0.01 mg/l	0.01 mg/l	0.025 mg/l	0.025 mg/l		
Silver	0.05 mg/l	0.00007 mg/l	0.000005 mg/l	0.00007 mg/l (fresh) 0.00005 mg/l (marine)		
Sodium	160 mg/l					
Specific Conductance		varies	varies	varies	varies	varies

TABLE C-3 (Continued)

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION (FDER) WATER QUALITY CLASSIFICATIONS AND STANDARDS

PARAMETER	FDER GROUND WATER POTABLE WATER STANDARDS	FDER SURFACE WATER QUALITY CLASSIFICATIONS				
		CLASS I POTABLE	CLASS II SHELLFISH	CLASS III RECREATION FISH & WILDLIFE	CLASS IV AGRICULTURAL	CLASS V INDUSTRIAL
Sulfates	250 mg/1 (S)					
Suspended Solids						
2,4,5 - TP	10 ug/1 (P)	10 ug/1				
Temperature		no nuisance conditions	no nuisance conditions	no nuisance conditions	no nuisance conditions	no nuisance conditions
Tetrachloro-ethylene	3 ug/1 (P)					
Total Dissolved Gases		110% of saturation value	110% of saturation value	110% of saturation value		
Toxaphene	5 ug/1 (P)	0.005 ug/1	0.005 ug/1	0.005 ug/1		
Transparency		min. 90% of background	min. 90% of background	min. of 90% of background		
1,1,1-Trichloroethane	200 ug/1 (P)					
Trichloro-ethylene	3 ug/1 (P)					
Trihalomethanes	0.10 mg/1 (P)					
Turbidity	1 TU month av. 5TU 2-day av. (P)	29 NTU above background	29 NTU above background	29 NTU above background	29 NTU above background	29 NTU above background

TABLE C-3 (Continued)

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION (FDER) WATER QUALITY CLASSIFICATIONS AND STANDARDS

PARAMETER	FDER GROUND WATER POTABLE WATER STANDARDS	FDER SURFACE WATER QUALITY CLASSIFICATIONS				
		CLASS I POTABLE	CLASS II SHELLFISH	CLASS III RECREATION FISH & WILDLIFE	CLASS IV AGRICULTURAL	CLASS V INDUSTRIAL
Vinyl Chloride	1 ug/l (P)					
Zinc	5 mg/l (S)	0.03 mg/l	1.0 mg/l	0.03 mg/l (fresh)	1.0 mg/l	1.0 mg/l

1 Actual standards are more complex than numbers displayed in chart (see Chapter 17-3, F.A.C).

2 These values are based on 6,000 samples from 94 lake, stream and estuary sampling stations collected from 1974-1982 by FDER. The first value is the tenth percentile, the second value is the median, and the last value is the ninetieth percentile.

(P) Primary Drinking Water Standard

(S) Secondary Drinking Water Standard

Source: Edward E. Clark 1986.

APPENDIX D

NPDES PERMIT DATA

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APPENDIX D

NPDES PERMITS

Stennis Space Center

Following is a summary of the wastewater facilities and discharges at Stennis Space Center:

Lagoon No. 1 -- This lagoon is a 7.5 acre pond with an average flow of .113 million gallons per day (MGD). The typical retention time is 91 days.

Lagoon No. 2 -- This lagoon is a 3.3 acre pond with an average flow of .034 MGD. The typical retention time is 133 days.

Lagoon No. 3 -- This lagoon is a 4.2 acre pond with an average flow of .054 MGD. The typical retention time is 107 days.

River Complex Lagoon -- This small pond is .05 acres with an average flow of .003 MGD. The typical retention time is 12 days. The pond functions as a mini water hyacinth system with primary settling.

Butler Complex Lagoon -- This small pond is .05 acres with an average daily flow of .002 MGD. The typical retention time is 18 days. The system functions as a mini water hyacinth system with primary settling.

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In addition to these facilities for domestic wastewater, SSC has a NPDES permitted facility for a lagoon which serves the photographic and chemistry laboratories. Specifications are as follows:

Photo Wastewater Lagoon	This pond is .5 acres with an average daily flow of .015 MGD. The lagoon consists of a canal 2.5 feet deep with a 28 day retention time. This lagoon handles no domestic sewage.

In addition to these permitted facilities there are 2 non-permitted wastewater facilities and 1 non-permitted pesticide washdown area listed on the NPDES permit. These are as follows:

North Gate Rock Filter	This is a 1,000 gallon septic tank with a 24 hour retention time. The filter material is reed/rock which filters drainage to a subsurface drain field.

Table D-1 provides a listing of the effluent limitations for the six permitted facilities.

TABLE D-1

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS, SSC

		Discharge Limitations				Monitoring Requirements	
		kg/day	(lbs/day)	Other Units (Specify)			
Location	Parameter	Monthly Avg.1/	Weekly Avg.1/	Monthly Avg.	Max (Min)	Measurement Frequency	Sample Type
Lagoon #1	Flow, m^3/day [MGD]	757[0.200]	N/A	N/A	N/A	1/Weekly	N/A
	Biochemical Oxygen Demand (5-day)	23(50)	34(75)	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Suspended Solids	23(50)	34(75)	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Fecal Coliform Bacteria, (Geometric Mean)	N/A	N/A	200 col/100 mL	400 col/ 100 mL	2/Monthly	Grab
	Chlorine, Residual	N/A	N/A	N/A	1.0 mg/l	2/Monthly	Grab
	pH	N/A	N/A	N/A	9.0 S.U. (6.0 S.U.)	2/Monthly	Grab
Lagoon #2	Flow, m^3/day [MGD]	341[0.09]	N/A	N/A	N/A	1/Weekly	N/A
	Biochemical Oxygen Demand (5 day)	10(23)	15(34)	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Suspended Solids	10(23)	15(34)	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Fecal Coliform Bacteria (Geometric Mean)	N/A	N/A	200 col/100 mL	400 col/100 mL	2/Monthly	Grab

1/ As derived from the 1979 permit data; all other values from 1986, 1987, and 1988 Discharge Monitoring Reports (DMRs) and the State of Mississippi Water Pollution Control Permit.

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TABLE D-1 (Continued)

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS, SSC

Location	Parameter	Discharge Limitations				Monitoring Requirements	
		kg/day	(lbs/day)	Other Units (Specify)			
		Monthly Avg.1/	Weekly Avg.1/	Monthly Avg.	Max (Min)	Measurement Frequency	Sample Type
Lagoon #2 (Cont.)	Chlorine, Residual	N/A	N/A	N/A	1.0 mg/l	2/Monthly	Grab
	pH	N/A	N/A	N/A	9.0 S.U. (6.0 S.U.)	2/Monthly	Grab
Lagoon #3	Flow, m^3/day [MGD]	379[0.100]	N/A	N/A	N/A	2/Monthly	N/A
	Biochemical Oxygen Demand (5-day)	11(25)	17(28)	30 mg/l)	45 mg/l	2/Monthly	24-Hour Composite
	Suspended Solids	11(25)	17(38)	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Fecal Coliform Bacteria, (Geometric Mean)	N/A	N/A	200 col/100 mL	400 col/100 mL	2/Monthly	Grab
	Chlorine, Residual	N/A	N/A	N/A	1.0 mg/l	2/Monthly	Grab
	pH	N/A	N/A	N/A	9.0 S.U. (6.0 S.U.)	2/Monthly	Grab
River Complex Lagoon	Flow, m^3/day [MGD]	N/A	N/A	N/A	N/A	2/Monthly	N/A
	Biochemical Oxygen Demand (5-day)	N/A	N/A	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Suspended Solids	N/A	N/A	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite

TABLE D-1 (Continued)

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS, SSC

		Discharge Limitations				Monitoring Requirements	
		kg/day	(lbs/day)	Other Units (Specify)			
Location	Parameter	Monthly Avg.[1/]	Weekly Avg.[1/]	Monthly Avg.	Max (Min)	Measurement Frequency	Sample Type
River Complex Lagoon (Cont.)	Fecal Coliform Bacteria, (Geometric Mean)	N/A	N/A	200 col/200 mL	400 col/100 mL	2/Monthly	Grab
	Chlorine, Residual	N/A	N/A	N/A	1.0 mg/l	2/Monthly	Grab
	pH	N/A	N/A	N/A	9.0 S.U. (6.0 S.U.)	2/Monthly	Grab
Butler Complex Lagoon	Flow, m^3/day [MGD]	N/A	N/A	N/A	N/A	2/Monthly	N/A
	Biochemical Oxygen Demand (5-day)	N/A	N/A	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Suspended Solids	N/A	N/A	30 mg/l	45 mg/l	2/Monthly	24-Hour Composite
	Fecal Coliform Bacteria, (Geometric Mean)	N/A	N/A	200 col/100 mL	400 col/ 100 mL	2/Monthly	Grab
	Chlorine, Residual	N/A	N/A	N/A	1.0 mg/l	2/Monthly	Grab
	pH	N/A	N/A	N/A	9.0 S.U. (6.0 S.U.)	2/Monthly	Grab
Photo Waste-Water Lagoon	Flow, m^3/day [MGD]	N/A	N/A	N/A	N/A	1/Weekly	Grab
	Silver	.0079 kg/day (max: .0411 kg/day)		.14 mg/l	.70 mg/l	1/Weekly	Grab
	Cyanide, Total	.0098 kg/day (max: .0453 kg/day)		.17 mg/l	.78 mg/l	1/Weekly	Grab
	pH	N/A	N/A	N/A	9.0 S.U. (6.0 S.U.)	1/Weekly	Grab

APPENDIX D

NPDES PERMITS

Yellow Creek

TVA no longer maintains an NPDES permit at the Yellow Creek site. The permit was rescinded effective October 27, 1987.

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APPENDIX D
NPDES PERMITS
Kennedy Space Center

KSC maintains operating permits for nine domestic waste treatment facilities. Two treatment plants, STP-1 and STP-4, located in the Industrial Area and VAB Area, respectively, provide service for approximately 80 percent of NASA and contractor personnel at KSC. The remaining permitted treatment facilities are small package plants that service outlying facilities and operational areas.

STP-1 services the Industrial Area. The plant is a secondary treatment extended aeration design, with chlorinated effluent discharge to the surface waters of the Banana River. The plant capacity is 0.375 MGD with current daily flows averaging less than 25 percent of the rated capacity. STP-1 operates under an FDER operating permit and an EPA NPDES permit. Specific conditions contained within the FDER operating permit require that STP-1 eliminate direct effluent discharge to surface waters prior to expiration of the existing permit. An alternative method of effluent discharge is currently in design and will likely consist of some form of upland disposal (CH2M Hill 1987).

STP-4 services the VAB Area. The treatment plant is a 0.2 MGD capacity extended aeration design, with effluent discharge to an isolated 75 acre impoundment. The facility operates at less than 50 percent of its rated capacity. Until December 1985, STP-4 discharged effluent directly to the surface waters of Banana Creek. Specific conditions contained in the FDER operating permit required the elimination of the point source discharge. The facility is currently operated in compliance with a FDER operating permit and efforts are underway to close an existing NPDES permit (CH2M Hill 1987).

The third largest sewage treatment facility at KSC, STP-10, services the Visitors Information Center (VIC). STP-10 is a 0.1 MGD extended aeration treatment facility with effluent discharge to an evaporation percolation pond. The VIC is a tourist facility and daily visitor levels are variable. Average daily flows from STP-10 are approximately 25 percent of the rated plant capacity. STP-10 operated under an FDER temporary operating permit that expired in March 1987. Compliance with groundwater standards must be demonstrated prior to issuance of an operating permit for this facility (CH2M Hill 1987).

Table D-2 provides a summary of the nine facilities, their respective service areas, design capacity (in MGD), average daily flows, discharge areas, and population service estimates.

Table D-3 provides a listing of 15 septic tanks that service additional outlying facilities and operational areas.

TABLE D-2

KSC DOMESTIC WASTE TREATMENT PLANT SUMMARY

STP No.	Building Number	Area	Design Capacity (MGD)	Average Daily Flow 1985	Discharge	Estimated Population Service Area, 3/86
1	M6-895	Industrial	0.375	0.0610 1/	Surface Water (Buck Creek)	5,747
4	K6-752	VAB	0.200	0.660 1/	75 Acre Impoundment	6,513
5	J8-1705	LC-39A	0.030	Emergency Overflow 1/, 2/	Percolation Evaporation Pond	336
6	J7-384	LC-39B	0.050	0.0103	Percolation Evaporation Pond	127
9	J7-464	Fluid Servicing Area	0.013	0.0026	Percolation Evaporation Pond	159
10	M6-409A	Visitors Information Center	0.100	0.0230	Percolation Evaporation Pond	4,500 3/
11	M5-1494A	S-band Antenna Site	0.015	0.0046	Percolation Evaporation Pond	135
12	K7-620	Fluid Servicing Area	0.011	0.0051	Percolation Evaporation Pond	177
16	M3-7	Gate 3 NASA Causeway West	0.003	0.0002	Percolation Evaporation Pond	10

1/ Figures for STP-1, -2, and -5 from April 21, 1987, NPDES Permit Modification Application.

2/ Occurs only under crucial conditions such as a 100-yr, 24-hr storm event.

3/ Includes average daily visitor population.

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TABLE D-3

KSC SEPTIC TANKS SUMMARY

Septic Tank Number	Building Number	Name
1	K7-188	MSS Park Site
2	K7-1557	Instrumentation Building
3	L5-683	Frequency Control and Analysis
4	J6-553	Weather Substation B
5	N6-1009	Pass and Identification Building
6	M7-531	Banana River Repeater Station
7	M7-867	Radar Range Boresight Control Site
8	Q6-82	Radar Station
9	M7-1410	Hypergol Module Storage West
10	M7-1412	Hypergol Module Storage East
11	M7-1417	Ordnance Laboratory No. 2
12	K7-557	Gate House
13	K7-506	Ordnance Laboratory No. 1
14	H7-1682	National Park Service headquarters
15	H4-1797	U.S. Fish and Wildlife Shop/Service Area
16		U.S. Fish and Wildlife MINWR Headquarters Bldg.

Source: CH2M Hill 1987.

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APPENDIX E

BIOTIC RESOURCES

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LIST OF TABLES

APPENDIX TABLE E-1

DOMINANT SPECIES OF THE PLANT COMMUNITIES AT THE JOHN C. STENNIS SPACE CENTER ASRM SITE

PINE FOREST

Trees

Slash pine	*Pinus elliotti*
Loblolly pine	*Pinus taeda*
Oaks	*Quercus sp.*
Pond Cypress	*Taxodium ascendens*
Tupelo	*Nyssa sp.*
Red Maple	*Acer rubrum*
Sweetgum	*Liquidambar styraciflua*
Sweetbay	*Magnolia virginiana*
Black Cherry	*Prunus serotina*

Shrubs

Galberries	*Ilex glabra, I. coriacea*
Wax Myrtle	*Myrica cerifera*

Vines

Bamboo Vine	*Similax laurifolia*
Poison Ivy	*Rhus radicans*
Grapes	*Vitus sp.*

Forbs and Grasses

Broomsedges	*Andropogon sp.*
Panic Grasses	*Panicum sp.*
Cane	*Arundinaria gigantea*

BOTTOMLAND HARDWOOD FOREST

Trees

Blackgum	*Nyssa biflora*
Red Maple	*Acer rubrum*
Sweetbay	*Magnolia virginiana*
Red Bay	*Persea borbonia*
Pond Cypress	*Taxodium ascendens*
Carolina Ash	*Fraxinus caroliniana*
Oaks	*Quercus spp.*
Slash Pine	*Pinus elliotti*
Loblolly Pine	*Pinus taeda*

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APPENDIX TABLE E-1

DOMINANT SPECIES OF THE PLANT COMMUNITIES AT THE
JOHN C. STENNIS SPACE CENTER ASRM SITE

Shrubs	
Virginia Willow	*Itea virginica*
Storax	*Styrax sp.*
Vines	
Poison Ivy	*Rhus radicans*
Grapes	*Vitus sp.*
Forbs	
Lizard's Tail	*Saururus cernuus*
PITCHER PLANT BOG	
Forbs	
Pitcher Plants	*Sarracenia sp.*
Pipeworts	*Eriocaulon sp.*
Sundews	*Drosera intermedia*
Yellow-eyed Grass	*Xyris sp.*
Orchids	*Calopogon* sp., *Cleistes divaricata*, *Pogonia ophioglossoides*

Source: Esher and Bradshaw, 1988.

APPENDIX TABLE E-2

PLANTS WITH RANGES THAT INCLUDE JOHN C. STENNIS SPACE CENTER THAT ARE UNDER CONSIDERATION FOR FEDERAL CLASSIFICATION AS THREATENED OR ENDANGERED OR HAVE SPECIAL STATUS IN MISSISSIPPI

Species	Common Name	Status		Identified On ASRM Site	May Occur On ASRM Site
		Federal	State		
Agalinis pseudophylla	gerardia	C2	PR		X
Amsonia ludoviciana	Louisianna blue-star	C2	PC		
Cleistes divaricata	spreading pogonia	--	PR		X
Ilex amelanchier	holly	C2	PC	X	
Ilex myrtifolia	myrtle holly	--	PR		X
Lachnocaulon digynum	bog button	C2	PT		X
Lilaeopsis carolinensis	lilaeopsis	C2	PR	X	
Lindera subcoriacea	bog spicebush	C2	PE		
Panicum nudicaule	panic grass	C2	PC		
Pinguicula planifolia	Chapman's butterwort	C2	PR		
Pinguicula primuliflora	southern bladderwort	--	PR		X
Platanthera integra	yellow fringeless orchid	C3	PR		
Platanthera integrilabia	white fringless orchid	C2	PE		X
Sarracenia psittacina	parrot pitcher plant	C3	--	X	
Utricularia purpurea	purple bladderwort	--	PR		X
Xyris drummondii	yellow-eyed grass	C2	PR		X
Xyris scabrifolia	yellow-eyed grass	C2	PE		X

C2 = Category 2 species are under review for possible classification as threatened or endangered by the USFWS but substantial evidence of biological vulnerability and/or threats is lacking.
C3 = Category 3 species are still formally under review for classification as threatened or endangered by the USFWS but are no longer considered because recent information indicates the species is more widespread or abundant than previously believed.
PR = Proposed rare, MDWC.
PC = Proposed special concern, MDWC.
PT = Proposed threatened, MDWC.
PE = Proposed endangered, MDWC.
-- = No status.

Source: Esher and Bradshaw (1988) and Wiseman (1988).

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APPENDIX TABLE E-3

HABITAT REQUIREMENTS OF FEDERALLY DESIGNATED THREATENED OR ENDANGERED SPECIES - JOHN C. STENNIS SPACE CENTER

- Bald Eagle (Haliacetus leucocephalis). The bald eagle is primarily found in association with coasts, rivers, and lakes. Bald eagles are opportunistic feeders and nest in large trees near water. The bald eagle is found throughout the United States but in the southeast, nesting is limited primarily to peninsula Florida and coastal Louisiana. A total of 30 to 33 pairs of bald eagles nest along the Louisiana coast, including the area just west of the East Pearl River. Only one bald eagle nest has been confirmed in southern Mississippi. This nest was on the Buloxi River but was destroyed last year. Another bald eagle nest near Logtown in the SSC buffer has been recorded but not confirmed (Bagly 1988).

- Ringed sawback turtle (Graptemys oculifera). The ringed sawback turtle requires riverine habitats with a moderate current and numerous logs for basking. The river must be wide enough to allow several hours of sun penetration. Nesting occurs on large, high sand and gravel bars adjacent to the river. The ringed sawback turtle occurs in the Pearl and Bogue Chetto rivers and has been recorded on SSC and in the SSC buffer.

- Gopher Tortoise (Gopherus polyphemus). The gopher tortoise requires well-drained sandy soils in transitional forests, scrub, and grasslands. It is commonly found in pine forests with an open canopy and an open grass and forb understory cover. Sunny, open areas are required for nesting and a variety of other animals also use gopher tortoise burrows. The western population of the gopher tortoise occurs from the Tombigbee and Mobile rivers in Alabama to southeastern Louisiana (Tucker 1988). A small population of gopher tortoises have been recorded near the northern edge of SSC on a sandy ridge along old Highway 43, northwest of the North Gate (Esher and Bradshaw 1988).

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APPENDIX TABLE E-4

PLANTS FOUND ON THE YELLOW CREEK SITE (1974) WITH SPECIAL STATUS IN MISSISSIPPI OR UNDER CONSIDERATION FOR FEDERAL DESIGNATION AS THREATENED OR ENDANGERED

Species	Common Name	Status Federal	Status State
Pellaea atropurpurea	purple-stem cliffbrake	--	PR
Pinus virginiana	Virginia pine	--	PP
Carex stricta	upright sedge	--	PR
Erythronium rostratum	beaked dog's tooth violet	--	PR
Camassia scilloides	wild hyacinth	--	PR
Platanthera integrilabria	white fringeless orchid	C2	PE
Platanthera cristata	crested fringed orchid	--	PR
Delphinium tricorne	dwarf larkspur	--	PR
Carya laciniosa	big shellbark hickory	--	PR
Hybanthus concolor	green violet	--	PR
Dentaria heterophylla	slender toothwort	--	PR
Chimaphila maculata	spotted wintergreen	--	PP
Dodecatheon meadia	shooting star	--	PT
Sedum ternatum	wood stonecrop	--	PR

-- = no status

PR = Proposed rare, MDWC

PP = Proposed peripheral, MDWC

PE = Proposed endangered, MDWC

C2 = Category 2 species are under review for possible classification as threatened or endangered by the USFWS but substantial evidence of biological vulnerability and/or threats is lacking.

PT = Proposed threatened, MDWC

Source: Wiseman 1988.

APPENDIX TABLE E-5

FISH AND WILDLIFE FOUND ON THE YELLOW CREEK SITE (1974)
WITH SPECIAL STATUS IN MISSISSIPPI

Species	Common Name	Status Federal	Status State
FISH			
Etheostoma sp. 2	lowland snubnose darter	--	PP
Notropis whipplei	steel color shiner	--	PP
AMPHIBIANS			
Eurycea bislineata bislineata	northern two-lined salamander	--	PR
Pseudacris brachyphona	mountain chorus frog	--	PP
Pseudotriton ruber	red salamander	--	PR
Rana clamitans melanota	green frog	--	PP
REPTILES			
Cemophora coccinea	scarlet snake	--	PR
Eumecres anthracinus	coal skink	--	PC
Lampropeltis calligaster rhombomeculata	mole kingsnake	--	PR
Lampropeltis getulus niger	black kingsnake	--	PP
Nerodia sipedon sipedon	northern water snake	--	PP
Regina septemvittata	queen snake	--	PR
MAMMALS			
Sorex longirostris	southeastern shrew	--	PR

-- = no status
PP = proposed peripheral, MDWC
PR = proposed rare, MDWC
PC = Proposed special concern, MDWC

Source: Wiseman 1988.

APPENDIX TABLE E-6

PROTECTED PLANT SPECIES POTENTIALLY FOUND IN AREA B,
JOHN F. KENNEDY SPACE CENTER

Species	Common Name	USFWS[a]/	CITES[b]/	FDA[c]/	FCREPA[c]/	FNAI[e]/
Asclepias curtissii	Curtiss milkweed			T	T	SP
Azolla caroliniana	mosquito fern			T		
Calamovilfa curtissi	Curtiss reedgrass	C2				SP
Calopogon tuberosus	grass pink		II	T		
Encyclia tampensis	butterfly orchid		II	T		
Eulophia alta	wild coco		II	T		
Habenaria odontopetala	rein orchid		II	T		
Habenaria repens	water spider orchid		II	T		
Lechea cernua	nodding pineweed	C2				SP
Malaxis spicata	Florida malaxis		II	T		
Osmunda regalis var. spectabilis	royal fern			C		
Pagonia ophioglossoides	rose pogonia		II	T		
Persea borbonia var. humilis	dwarf redbay	C3				SP
Rhynchosia cinerea	brown-haired snoutbean	C2				SP
Selaginella arenicola	sand spikemoss			T		

APPENDIX TABLE E-6

PROTECTED PLANT SPECIES POTENTIALLY FOUND IN AREA B,
JOHN F. KENNEDY SPACE CENTER

Species	Common Name	USFWS[a]	CITES[b]	FDA[c]	FCREPA[c]	FNAI[e]
Spirantes laciniata	lace-lipped ladies-tresses		II	T		
Suriana maritima	bay cedar			E		
Thelypteris palustris	marsh fern			T		
Woodwardia aerolata	netted chain fern			T		

a/ United States Fish and Wildlife Services
b/ Convention on International Trade in Endangered Species of Wild Fauna and Floras.
c/ Florida Department of Agriculture and Consumer Services
d/ Florida Committee on Rare and Endangered Plants and Animals
e/ Florida Natural Areas Inventory
T = Threatened
SP = Species of Concern
C2 = Category 2 species are under review for possible classification by the USFWS as threatened or endangered, but substantial evidence of biological vulnerability and/or threats is lacking.
II = Listed by CITES in Appendix II
C3 = Category 3 species are still formally under review for possible classification as threatened or endangered by the USFWS but are no longer considered because recent information indicates species is more widespread or abundant than previously believed.
C = Commercially exploited.
E = Endangered.
Source: Edward E. Clark 1986.

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APPENDIX TABLE E-7

PROTECTED PLANT SPECIES POTENTIALLY FOUND IN AREA C,
JOHN F. KENNEDY SPACE CENTER

Species	Common Name	USFWS[a/]	CITES[b/]	FDAC[c/]	FCREPA[d/]	FNAI[e/]
Hymenocallis latifolia	broad-leaved spider lily	C3				SP
Opuntia compressa	prickly pear cactus (unnamed)		II		T	
Opuntia stricta	prickly pear cactus (unnamed)		II		T	
Scaevola plumieri	scaevola				T	SP
Verbena maritima	coastal vervain	C2				
Sophora tomentosa	necklace pod					SP
Suriana maritima	bay cedar			E		

a/ United States Fish and Wildlife Services
b/ Convention on International Trace in Endangered Species of Wild Fauna and Floras.
c/ Florida Department of Agriculture and Consumer Services
d/ Florida Committee on Rare and Endangered Plants and Animals
e/ Florida Natural Areas Inventory
C3 = Category 3 species are still formally under review for possible classification as threatened or endangered by the USFWS but are no longer considered because recent information indicates species is more widespread or abundant than previously believed.
SP = Species of Concern
II = Listed by CITES in Appendix II
T = Threatened
C2 = Category 2 species are under review for possible classification by the USFWS as threatened or endangered, but substantial evidence of biological vulnerability and/or threats is lacking.
E = Endangered
Source: Edward E. Clark 1986.

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APPENDIX TABLE E-8

AMPHIBIANS AND REPTILES POTENTIALLY FOUND IN AREAS B AND C, JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Area B	Area B / Area C	Area C	
		Freshwater Marsh[a]	Scrub Strand[b]	Coastal Dune[c]	Ocean Beach[d]
Scaphiopus holbrooki holbrooki	Eastern spadefoot		O	Q	
Eleutherodactylus planirostris planirostris	Greenhouse frog		P		
Bufo quercicus	Oak toad	P	C	P	
Bufo terrestris	Southern toad	C	C	P	
Aeris gryllus dorsalis	Florida cricket frog	C			
Hyla cinerea	Green treefrog	C	R	Q	
Hyla fermoralis	Pine woods treefrog	P			
Hyla gratiosa	Barking treefrog	P			
Hyla squirella	Squirrel treefrog	O	O	Q	
Limnaoedus ocularis	Little grass frog	O			
Pseudacris nigrita verrucosa	Florida chorus frog	P			
Gastrophryne Carolinensis	Eastern narrowmouth toad	O	C		

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APPENDIX TABLE E-8

AMPHIBIANS AND REPTILES POTENTIALLY FOUND IN AREAS B AND C, JOHN F. KENNEDY SPACE CENTER

		Area B		Area C	
Species	Common Name	Freshwater Marsh[a/]	Scrub Strand[b/]	Coastal Dune[c/]	Ocean Beach[d/]
Rana grylio	Pig frog	C			
Rana sphenocephala	Southern leopard frog	C			
Siren intermedia intermedia	Eastern lesser siren	R			
Siren lacertina	Greater siren	O			
Amphiuma means	Two-toed amphiuma	R			
Alligator mississippiensis	American alligator	O			R
Caretta caretta caretta	Atlantic loggerhead				C
Chelonia mydas mydas	Atlantic green turtle				C
Lepidochelys kempi	Atlantic ridley				R
Dermochelys coriacea coriacea	Atlantic leatherback				R

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APPENDIX TABLE E-8

AMPHIBIANS AND REPTILES POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

		Area B		Area C	
Species	Common Name	Freshwater Marsh[a/]	Scrub Strand[b/]	Coastal Dune[c/]	Ocean Beach[d/]
Chelydra serpentina osceola	Florida snapping turtle	R			
Kinosternon bauri palmarum	Striped mud turtle	C			
Kinosternon subrubrum steindachneri	Florida mud turtle	C			
Chrysemys floridana floridana	Florida cooter	O			
Deirochelys reticularai chrysea	Florida chicken turtle	O			
Terrapene carolina bauri	Florida box turtle		C	P	
Gopherus polyphemus	Gopher turtle		C	P	
Trionyx ferox	Florida softshell	R			
Anolis carolinensis	Green anole	P	C	P	

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APPENDIX TABLE E-8

AMPHIBIANS AND REPTILES POTENTIALLY FOUND IN AREAS B AND C, JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Area B	Area B / Area C	Area C	Area C
		Freshwater Marsh[a/]	Scrub Strand[b/]	Coastal Dune[c/]	Ocean Beach[d/]
Cnemidophorus sexlineatus sexlineatus	Six-lined race-runner		C	P	
Eumeces egregius onocrepis	Peninsula mole skink		R	Q	
Eumeces inexpectatus	Southeastern five-lined skink		O	P	
Scincella lateralis	Ground skink		O	P	
Ophisauris attenuatus longicaudus	Eastern slender glass lizard		P	Q	
Ophisauris compressus	Island glass lizard		Q	O	
Ophisauris ventralis	Eastern glass lizard		Q		
Cemophora coccinea coccinea	Florida scarlet snake		O	P	
Coluber constrictor priapus	Southern black racer	O	C	P	
Diadophis punctatus punctatus	Southern ringneck	R	R	Q	

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APPENDIX TABLE E-8

AMPHIBIANS AND REPTILES POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

		Area B	Area B / Area C	Area C	
Species	Common Name	Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Drymarchon corais couperi	Eastern indigo snake	0	0	Q	
Elaphe guttata guttata	Corn snake		0	Q	
Farancia abacura abacura	Eastern mud snake	C			
Heterodon pl. tyrhinos	Eastern hognose snake		R		
Lampropeltis getulus floridana	Florida kingsnake	C			
Lampropeltis triangulum elapsoides	Scarlet king-snake		0		
Masticophis fiagellum flagellum	Eastern coachwhip		C	P	
Nerodia cyclopion floridana	Florida green water snake	C			

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APPENDIX TABLE E-8

AMPHIBIANS AND REPTILES POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

		Area B	Area B / Area C	Area C	Area C
Species	Common Name	Freshwater Marsh[a/]	Scrub Strand[b/]	Coastal Dune[c/]	Ocean Beach[d/]
Nerodia fasciata fasciata	Banded water snake	C			
Rhadinaea flavilata	Pine woods snake		R	R	
Opheodrys aestivus	Rough green snake	C	O	Q	
Pituopis melanoleucus mugitus	Florida Pine snake		R		
Regina alleni	Striped crayfish snake	R			
Storeria dekayi victa	Florida brown snake	R			
Thamnophis sirtalis sirtalis	Eastern garter snake	O			
Thamnophis sauritus sackeni	Peninsular ribbon snake	C			
Micrurus fulyius fulvius	Eastern coral snake		Q		

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APPENDIX TABLE E-8

AMPHIBIANS AND REPTILES POTENTIALLY FOUND IN AREAS B AND C, JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Area B		Area C	
		Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Agkistrodon piscivorus conanti	Florida cottonmouth	O			
Crotalus adamanteus	Eastern diamondback rattlesnake	O	O	P	R
Sistrurus miliarius barbouri	Dusky pigmy rattlesnake		C	P	

a/ Freshwater Marsh includes Graminoid Marsh found in Area B.
b/ Scrub Strand includes both the mixed oak/sand palmetto plant community found in Area B and the coastal strand community in Area C.
c/ Coastal Dunes are vegetated dunes dominated by sea oats-slender cordgrass and are found in in Area C
d/ Ocean Beach is the nonvegetated zone between many low water coastal dunes in Area C.
O = Occasional
Q = Presence questionable
P = Present, abundance unknown.
C = Common
R = Rare

Source: Edward E. Clark 1986.

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TABLE E-9

BIRDS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

		Area B		Area C	
Species	Common Name	Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Podilymbus podiceps	Pied-billed Grebe (w)	O (n)			
Anhinga anhinga	American Anhinga (iw)	O			
Butorides virescens	Green Heron (iw)	C (nr)			
Ardea herodias	Great Blue Heron (ciw)	C			R
Casmerodius albus	Great Egret (ciw)	C			
Bubulcus ibis	Cattle Egret (ciw)	O (r)			
Egretta thula	Snowy Egret (ciw)	C			
Hydranassa tricolor	Louisiana Heron	C			
Mycteria americana	Wood Stork (ciw)	O			
Egretta caerulea	Little Blue Heron (ciw)	O			
Nycticorax nycticorax	Black-crowned Night Heron (ciw)	O			
Ixobrychus exilis	Least Bittern	R (rn)			
Plegadis falcinellus	Glossy Ibis (ciw)	O			
Eudocimus albus	White Ibis (ciw)	C			
Coragyps atratus	Black Vulture	C (a)	C (a)	C (a)	
Cathartes aura	Turkey Vulture	C (a)	C (a)	C (a)	
Buteo jamaicensis	Red-tailed Hawk		R		
Buteo lineatus	Red-shouldered Hawk	O	O		
Pandion haliaetus	Osprey (w)	R			
Heliacetus leucocephalus	Bald Eagle (w)	R (r)			
Colinus virginianus	Common Bobwhite		C (n)	(Q)	
Meleagris gallopavo	Wild Turkey		P		
Gallinula chloropus	Common Moorhen (w)	C (n)			
Rallus longirostris	Clapper Rail (w)	R			
Laterallus jamaicensis	Black Rail (w)	R			
Rallus elegans	King Rail	O			

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TABLE E-9

BIRDS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Area B: Freshwater Marsh a/	Area B: Scrub Strand b/	Area C: Coastal Dune c/	Area C: Ocean Beach d/
Haematopus palliatus	American Oyster catcher (i)				R
Charadrius vociferus	Killdeer	O (r)			
Himantopus mexicanus	Black-necked Stilt	R (r)			
Larus atricilla	Laughing Gull (ciw)	R			O
Catoptrophorus semipalmatus	Willet (iw)				O
Gelochelidon nilotica	Gull-billed Tern (ciw)	R	R		
Sterna albifrons	Least Tern (ciw)				O
Thalasseus maximus	Royal Tern				O
Hydroprogne caspia	Caspian Tern				O
Columbina passerina	Common Ground Dove	R (r)	O (nr)		
Zenaida macroura	Mourning Dove	R (r)	O (n)		
Coccyzus americanus	Yellow-billed Cuckoo		R		
Tyto alba	Barn Owl (s)p/	O	O		
Strix varia	Barred Owl (s)	P			
Bubo virginianus	Great Horned Owl	P	P		
Otus asio	Screech Owl (s)		C (n)		
Caprimulgus carolinensis	Chuck-will's-widow	P	O (nra)		
Chordeilas minor	Common Nighthawk	C (a)	C (a)	P (an)	
Chaetura pelagica	Chimney Swift	P			
Megaceryle alcyon	Belted Kingfisher (w)		O (r)		
Colaptes auratus	Common Flicker (s)	R	C (n)	Q	
Dryocopus pileatus	Pileated Woodpecker (c)		R		
Centurus carolinus	Red-bellied woodpecker (s)		O (n)		
Tyrannus tyrannus	Eastern Kingbird		R (f)		

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TABLE E-9

BIRDS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Area B		Area C	
		Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Myiarchus crinitus	Great Crested Flycatcher (c)		R		
Progne subis	Purple Martin (c)	R	R (a)	R (a)	
Cyanocitta cristata	Blue Jay	R	O (rn)		
Aphelocoma coerulescens	Scrub Jay	R	C (n)	R	
Corvus ossifragus	Fish Crow (i)	R	R	R	
Thryothorus ludovicianus	Carolina Wren	R (a)	C (n)		
Mimus polyglottos	Northern Mockingbird		O (n)	R	
Toxostoma rufum	Brown Thrasher		O (n)		
Polioptila caerulea	Blue-grey Gnatcatcher		R		
Lanius ludovicianus	Loggerhead Shrike	Q	R		
Vireo griseus	White-eyed Vireo	R	C (n)		
Dendroica discolor	Prarie Warbler		O		
Geothlypis trichas	Common Yellowthroat	C (n)	C		
Icteria virens	Yellow-breasted Chat?		R		
Passer domesticus	House Sparrow		R		
Sturnella magna	Eastern Meadowlark	R			
Agelaius phoeniceus	Red-winged Blackbird (w)	C (n)	O		
Cassidix major	Boat-tailed Grackle (w)	C	R (r)		
Quiscalus quiscalus	Common Grackle	O	O	Q	
Cardinalis cardinalis	Northern Cardinal	R	C (n)	Q	
Guiraca caerulea	Blue Grosbeak ?		R		
Passerina cyanea	Indigo Bunting ?		R		
Passerina ciris	Painted Bunting ?		R		
Pipilo erythrophthalmus	Rufous-sided Towhee	R	C (n)	R	
Aimophila aestivalis	Bachman's Sparrow		R (n)		

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TABLE E-9

BIRDS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

		Area B		Area C	
Species	Common Name	Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Non-breeding Birds					
Nytanassa violacea	Yellow-crowned Night Heron	O			
Botaurus lentiginosus	American Bittern	O			
Anas platyrhynchos	Mallard	O (r)			
Anas rubripes	American Black Duck	R (r)			
Anas strepera	Gadwall	O (r)			
Anas acuta	Common Pintail	O (r)			
Anas crecca	Green-winged Teal	O (r)			
Anas discors	Blue-winged Teal	C (r)			
Anas americana	American Wigeon	C (r)			
Anas clypeata	Northern Shoveler	C (r)			
Bucephala albeola	Bufflehead				R
Clangula hyemalis	Oldsquaw				R
Melanitta deglandi	White-winged Scoter				R
Elanoides for Ficatus	Swallow-tailed Kite	R			
Accipiter Straitus	Sharp-skinned Hawk		R		
Accipiter Cooperii	Cooper's Hawk		R		
Circus cyaneus	Northern Harrier	C	O	O	
Falco peregrinus	Peregrine Falcon			R	R
Falco columbarius	Merlin		O	R	R
Falco sparverius	American Kestrel	C (r)	O (r)	R	
Rallus limicola	Virginia Rail	R			
Porzana carolina	Sora	R			
Fulica americana	American Coot	O			
Charadrius melodus	Piping Plover				C

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TABLE E-9

BIRDS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

		Area B		Area C	
Species	Common Name	Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Pluvialis squatarola	Black-bellied Plover				C
Arenaria interpres	Ruddy Turnstone				C
Capella gallinago	Common Snipe	C			
Actitis macularia	Spotted Sandpiper	R			
Tringa melanoleuca	Greater Yellowlegs	R			
Tringa flavipes	Lesser Yellowlegs	R			
Calidris alpina	Dunlin				R
Calidris alba	Sanderling				C
Larus argentatus	Herring Gull	R			C
Larus delawarensis	Ring-billed Gull	R			C
Larus philadelphia	Bonaparte's Gull	R			O
Thalasseus sandricensis	Greater Black-back Gull				O
Larus marinus	Sandwich Tern				O
Asio flammeus	Short-eared Owl	R		R	
Archilochus colubris	Ruby-throated Hummingbird		R		
Sphyrapicus varius	Yellow-bellied Sapsucker		O (r)		
Dendrocopus villosus	Hairy Woodpecker		R		
Sayomis phoebe	Eastern Phoebe	R			
Iridoprocne bicolor	Tree Swallow	C (a)	C (a)	C (a)	
Stelgidopteryx ruficollis	Rough-winged Swallow	O (a)	O (a)	O (a)	
Troglodytes aedon	House Wren		C	R	
	Sedge Wren	R			
Dumatella carolinensis	Gray Catbird	R (r)	C		
Turdus migratorius	American Robin	R	C	R	
Catharus guttatus	Hermit Thrush		O (r)		
Regulus calendula	Ruby-crowned Kinglet		C		
Anthus spinoletta	Water Pipit	R			
Bombycilla cedrorum	Cedar Waxwing		R		

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TABLE E-9

BIRDS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Area B: Freshwater Marsh a/	Area B: Scrub Strand b/	Area C: Coastal Dune c/	Area C: Ocean Beach d/
Vireo flavifrons	Yellow-throated Vireo		R		
Vireo solitarius	Solitary Vireo		Q		
Vermivora celata	Orange-crowned Warbler		O		
Dendroica coronata	Yellow-rumped Warbler	C	C	O	
Dendroica palmarum	Pam Warbler	R	C	O	
Cardvelis tristis	American Goldfinch		R		
Passerculus sandwichensis	Savannah Sparrow	R		O	
Ammodramus henslowii	Henslow's Sparrow	R			
Chondestes grammacus	Lark Sparrow			R	
Spizella passerina	Chipping Sparrow		R	Q	
Spizella pusilla	Field Sparrow	R (r)	R	R	
Passerella iliaca	Fox Sparrow		R		
Melospiza georgiana	Swamp Sparrow	C			
Melospize melodia	Song Sparrow	R	R		

a/ USFWS = United States Fish and Wildlife Services
b/ GFC = Florida Game and Freshwater Fish Commission
c/ Adjacent areas = nest sites or waterbodies (rivers, lagoons, etc.) near or adjacent to Areas B or C or part of the ASRM transportation system.
d/ T = Threatened
W = nests near water in woody vegetation, cavities, emergents or in banks depending on specific habitat requirements.
O = occasional
n = habitat used for nesting.
i = uses spoil island for nesting.
C = common
r = use of habitat restricted to certain conditions within the habitat type (i.e., edges, mudflats, etc.).
c = colonial nesting bird
R = rare
a = species uses airspace, habitat may be used to provide food or thermals or may bear little or no relationship to habitat type.
Q = presence questionable
P = abundance unknown
s = cavity nester

APPENDIX TABLE E-10

MAMMALS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

		Area B	Area B / Area C	Area C	Area C
Species	Common Name	Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Didelphis virginiana	Virginia Opossum	O	C	P	
Cryptotis parva	Least shrew	R	C	Q	
Scalopus aquaticus	Eastern mole		C	P	
Dasypus novemcinctus	Nine-banded armadillo	O	R	P	
Sylvilagus palustris	Marsh rabbit	C	R		
Sylvilagus floridanus	Eastern cottontail		C	P	
Oryzomys palustris	Marsh rice rat	O			
Peromyscus gossypinus	Cotton mouse	C	C	Q	
Sigmodon hispidus	Cotton rat	C	O	Q	
Peromyscus polionus nivieventris	Beach mouse		R	C	
Peromyscus floridanus	Florida mouse		C		
Ochrotomys nutalli	Golden mouse		R		
Neofiber alleni	Round-tailed muskrat	R			

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APPENDIX TABLE E-10

MAMMALS POTENTIALLY FOUND IN AREAS B AND C,
JOHN F. KENNEDY SPACE CENTER

Species	Common Name	Area B		Area C	
		Freshwater Marsh a/	Scrub Strand b/	Coastal Dune c/	Ocean Beach d/
Rattus rattus	Black rat		P		
Urocyon cinereoargenteus	Gray fox		O	Q	
Procyon lotor	Raccoon	C	O	C	C
Spilogale putorius	Eastern spotted skunk		C	P	Q
Lutra canadensis	River otter	R			
Felis rufus	Bobcat	O	C	P	P
Sus scrofa	Wild boar	C	C	P	
Odocoileus virginianus	White-tailed deer	R	R	R	
Ursus americanus	Black bear	Q	R	R	

a/ Freshwater Marsh includes Graminoid Marsh found in Area B.
b/ Scrub Strand includes both the mixed oak/sand palmetto plant community found in Area B and the coastal strand community in Area C.
c/ Coastal Dunes are vegetated dunes dominated by sea oats-slender cordgrass and are found in in Area C
d/ Ocean Beach is the non vegetated zone between many low water coastal dunes in Area C.
O = Occasional
C = Common
P = Present, abundance unknown.
R = Rare
Q = Presence questionable
Source: Edward E. Clark 1986

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APPENDIX TABLE E-11

HABITAT REQUIREMENTS OF FEDERALLY DESIGNATED THREATENED OR ENDANGERED SPECIES - JOHN F. KENNEDY SPACE CENTER

- Atlantic green turtle (*Chelonia mydas mydas*). The Atlantic green turtle generally inhabits the shallow water of bays, reefs, and inlets except when migrating. It requires open beaches with a sloping platform and minimal disturbance for successful nesting. Nesting on the continental United States is limited to small areas in Florida's east coast including Merritt Island. A 1985 survey estimated that the Merritt Island population of green turtles ranges from 150 to 400 individuals and identified 32 nests along the island's beaches (Edward E. Clark 1980). Several nests have also been located along the beach that is part of Area C (Provancha et al. 1984).

- Atlantic loggerhead turtle (*Caretta caretta caretta*). The loggerhead turtle species is found in a wide variety of saltwater habitats. It is found hundreds of miles offshore as well as in bays, salt marshes, and the mouths of large rivers. Open beaches or narrow bays with suitable soil are preferred nesting areas. The population of loggerhead turtles on Merritt Island beaches is estimated at 2,000 during the summer nesting season, and 886 nests were recorded in 1985 (Edward E. Clark 1986). In 1983, nest density along the approximately 5 km of ocean beach that is part of Area C was estimated to range from 50 to 200 nests per kilometer (Provancha et al. 1984).

- Leatherback turtle (*Dermachelys coriacea*). The leatherback turtle is generally found near the edge of the continental shelf. It nests on sloped beaches with coarse dry sand in close proximity to deep water and rough seas. Nesting on the continental United States is mainly restricted to Florida. One leatherback turtle nest was reported on Canaveral National Seashore in 1986 and nesting could potentially occur on the beach that is part of Area C.

- Florida scrub jay (Aphelocoma coerulescens coerulescens). The Florida scrub jay is limited to the Florida scrub shrub habitat, which includes the mixed oak/saw palmetto community in Area B and the coastal strand community in Area C. KSC supports 6,000 to 10,000 scrub jays, nearly half of the Florida population. Cape Canaveral supports a population of 3,000 to 6,000 scrub jays, the next largest concentration in Florida (Edward E. Clark 1986). Scrub jays have been observed in Area B, and they most likely occur in Area C.

- Eastern indigo snake (Drymarchon corais couperi). This species is characteristic of moist habitats in the southeastern United States although it is also found in dry, sandy areas throughout its range. In xeric habitats, the eastern indigo snake uses gopher tortoise (Gopherus polyphemus) burrows for nesting and shelter. KSC supports an estimated population of 750 eastern indigo snakes (Edward E. Clark 1986). The gopher tortoise has been observed in the mixed oak/saw palmetto community in Area B and the eastern indigo snake probably also inhabits this area. Gopher tortoises also inhabit the coastal strand community, and it is likely that the eastern indigo snake is found in Area C as well.

- Atlantic salt marsh water snake (Nerodia faciata taeniata). The salt marsh water snake inhabits the brackish water of tidal creeks and salt water marshes and is usually associated with fiddler crab burrows. It is found only along the Atlantic coast of central Florida. KSC supports an estimated population of 500 Atlantic salt water snakes, primarily along the eastern shore of Mosquito Lagoon (Edward E. Clark 1986). Since neither Areas B or C contain tidal creeks or saltwater marshes, it is unlikely that this species inhabits either ASRM site. However, this species is probably found in the Banana River, which will be part of the ASRM transportation system.

- Wood stork (Mycteria americana). The wood stork feeds primarily on small fish and aquatic animals found in shallow brackish and saltwater marshes, ditches and swamps. It nests in mangrove and cypress swamps. The wood stork is currently found only in Florida, Georgia, and South Carolina. Several rookeries exist on Merritt Island and over 200 nests were recorded in 1986 (Edward E. Clark 1986). The wood stork may use the graminoid marsh community in Area B as feeding habitat.

- Piping plover (Charadrius melodus). The piping plover is found on dry sand breaches, large sand tidal flats, or fills and mud flats. Piping plovers winter along the coasts of Texas, Florida, and the Carolinas. At KSC, piping plovers have been observed along the beaches and edges of lagoons during the winter. The beach that is part of Area C is potential wintering habitat for the piping plover.

- Bald eagles (Haliaeetus leucocephalis). The bald eagle is primarily found in association with coasts, rivers, and lakes. Bald eagles are cpportunistic feeders and nest in trees near water. The bald eagle is found throughout the United States, but in the southeast nesting is limited to peninsular Florida and coastal Louisiana. A total of 10 bald eagle nests have been documented on KSC, including 2 just west of Area B. All nest sites on KSC are protected from human activity by a 0.8 km (0.5 mi) wide buffer zone (Edward E. Clark 1986).

- Florida manatee (Trichechus manatus). The manatee inhabits sluggish rivers, shallow estuaries, and saltwater bays. Habitat requirements include the following: (1) the availability of vascular aquatic plants, (2) proximity to water at least 1.5 to 2 m in depth, (3) a source of fresh water, and (4) proximity to warm water during cold periods. Within the continental United States, the range of the manatee includes both coasts of Florida and extends as far north as North Carolina (Edward E. Clark 1986). Results of a 1986 survey indicate that about 25 percent of the approximately 1,200 manatees found in United States waters utilize the channels and lagoons of the Banana River on KSC (Provancha and Provancha 1988). This estimate represents a 10 percent increase in the number of manatees using the area over the past 10 years. The entire inland portions of the Indian and Banana rivers and all connecting waterways between these rivers have been designated as critical habitat for the manatee (Edward E. Clark 1986). Neither Areas B or C contain manatee habitat. However, the Banana River, which is part of the ASRM transportation system, is designated critical habitat for the manatee.

APPENDIX F

SOUND LEVEL PREDICTIONS
FOR THE ASRM TEST FIRINGS

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APPENDIX F - SOUND LEVEL PREDICTIONS
FOR THE ADVANCED SOLID ROCKET MOTOR TEST FIRINGS

INTRODUCTION

In static test firings of rocket motors, the major source of noise is the result of fluctuating pressures accompanying the rapid mixing of the hot, high velocity rocket exhaust with the ambient atmosphere. The mechanical power in the jet of a rocket engine is

$$W = 1/2\ TV$$

where

T = rocket thrust, Newtons
V = jet velocity, m/sec
W = mechanical power, watts

For the Space Shuttle Advanced Solid Rocket Motor (ASRM) where the average thrust, T, is 11,700,000 N and V is 2,650 m/s, the mechanical power is 15,500 megawatts. Observations of many rocket motor firings (JANNAF 1971) have shown that between 0.2 and 0.5 percent of the mechanical energy in the jet is converted into acoustic energy. A mechanical to acoustic energy conversion factor of 0.3 percent has been assumed for this analysis.

The spectrum, or distribution of energy with frequency, of the noise generated by a rocket motor depends on the size of the rocket motor, in particular, the nozzle exit diameter, and the jet velocity. In general, large rocket motors generate high levels of low frequency sound. Also, high frequency sound is attenuated more rapidly by the atmosphere than low frequency sound. As a result, at large distances from the rocket motor, much of the acoustic energy will be below the lowest frequency perceived by the human ear, about 20 Hz. With the higher frequencies severely attenuated, the noise is heard as a rumbling sound.

PREDICTED SOUND PRESSURE LEVELS

A method of predicting the sound pressure levels due to a rocket motor firing, based on acoustic theory and many observations of large rocket motor firings is given in JANNAF (1971). The equation is

$$OBSPL = 10 \log A(f) - 20 \log R - EA + DF + 10 \log f_0 - 9.5$$

where

- OBSPL = octave band sound pressure level (dB)
- A(f) = spectral power distribution, watts/Hz (Re: 10^{-13})
- R = distance from the rocket motor, feet
- EA = atmospheric and other excess attenuations
- DF = directivity factor of the rocket motor
- f_0 = center frequency of the octave band.

The spectral power distribution, A(f), is dependent on the Strouhal number, f_0 D/V, where D is the rocket nozzle exit diameter, and V is the exhaust velocity of the jet at the exit of the rocket nozzle. The relationship between A(f) and the Strouhal number is plotted in Figure 1 as derived from JANNAF (1971). A_{0a} is the total acoustic power in watts.

The values used for the attenuation of the sound by absorption in the atmosphere are those given in JANNAF (1971), which are appropriate for the SSC and KSC test sites. Figure 2 shows the assumed atmospheric attenuation as a function of frequency. The combinations of temperature and humidity existing at the test sites are such that a single curve can be used throughout the year for firings. In addition to the atmospheric attenuation given by Figure 2, a further attenuation is observed which is ascribed to atmospheric inhomogeneities and ground effects. This attenuation is highly nonlinear with respect to distance, but can be approximated by a constant attenuation of 13 dB between about 400 and 1200 Hz, provided the distance is at least 1 km.

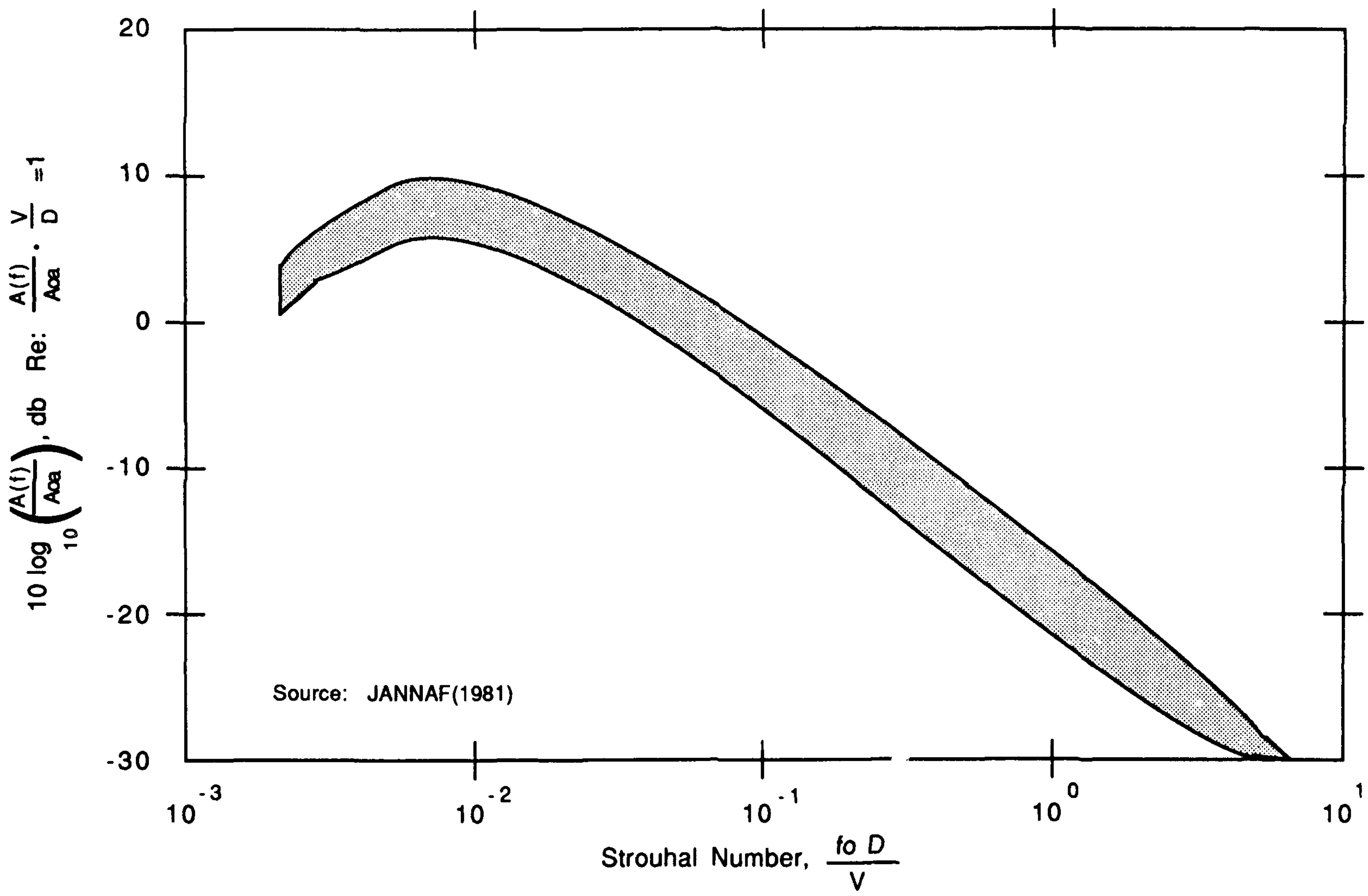


Figure 1
Dimensionless Acoustic Power Spectrum Level
for Deflected and Undeflected Rocket Exhaust Flows

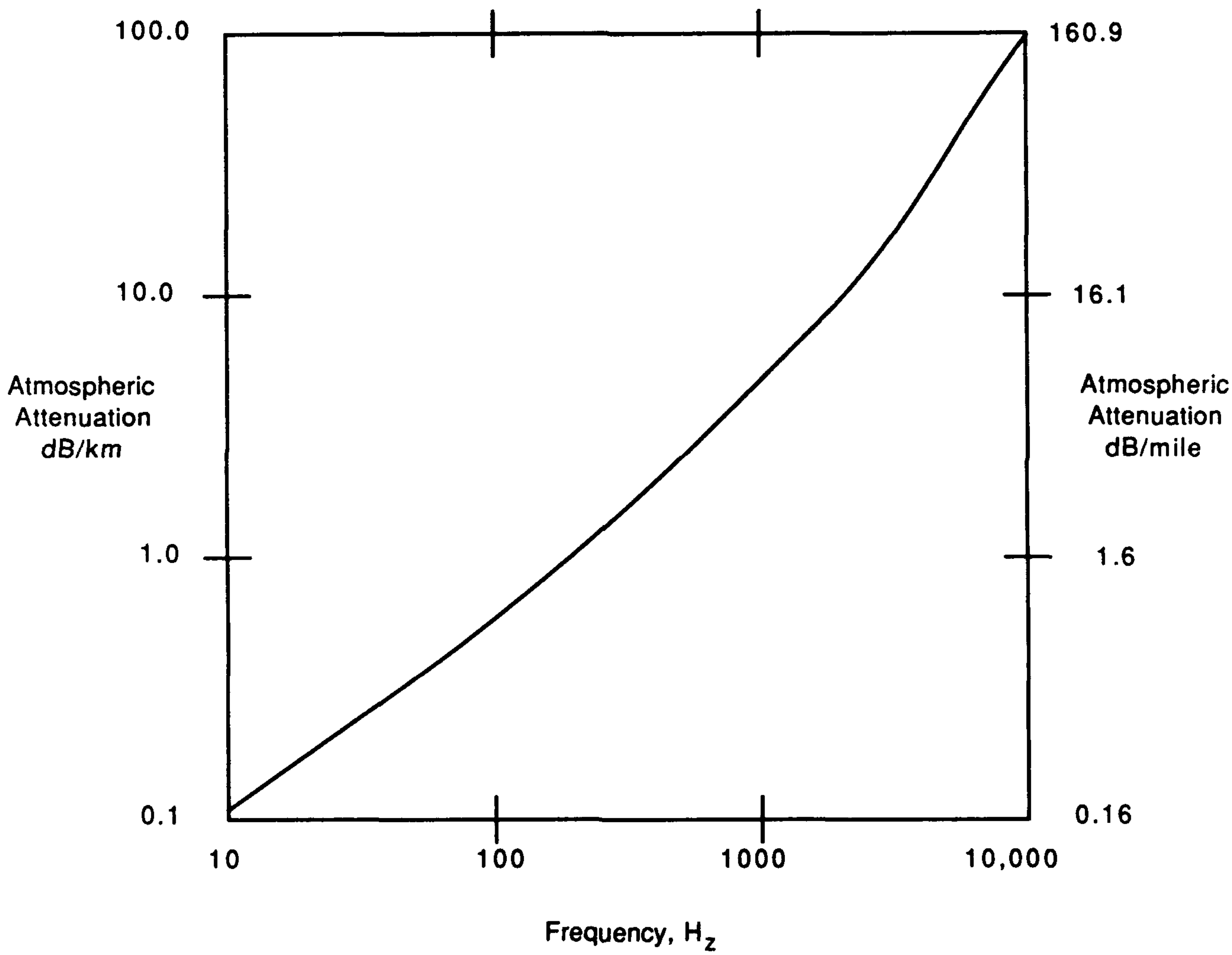


Figure 2
Atmospheric Attenuation of Sound for the Test Sites

Below 400 Hz, the attenuation decreases linearly with frequency. Above 1,400 Hz, an additional attenuation of 11 dB/km occurs. These attenuations were used in the predictions.

Figure 3 shows the calculated noise levels at various distances from the test site in octave band levels as well as the overall sound pressure level for an assumed acoustic efficiency of 0.3 percent. For this figure, the directivity of the rocket motor sound source discussed below, is not included.

EXCESS ATTENUATION DUE TO TREES AND FORESTS

An extensive review of the acoustic literature related to excess noise attenuation for trees and forests was conducted (Dneprovskoya et al. 1963; Embleton 1963; Piercy et al. 1977; Beranek 1971; and Price 1988).

Some of the best attenuation data for forests over large distances were reported in the Soviet literature (Dneprovskoya et al. 1963). For the Leningrad region, excess attenuation for forests were shown to be strongly nonlinear as a function of distance. Above 1 km, the attenuation as a function of frequency did not appear to change. This closely matches the excess attenuation acoustic model that we have used here. Attenuations of the order of 13 dB at 750 Hz, 15 dB at 1,000 Hz, 20 db at 1,600 Hz, and about 30 dB at 2000 Hz were reported for 2, 3, and 4 km distances. The additional attenuation over what has been included in the model at the higher frequencies has no effect on the results because the predicted ASRM rocket noise is concentrated in the lower frequency regions (e.g., 2 to 250 Hz). Recent work by Price (1988) indicates that tree leaves and pine needles account for the absorption of sound at the higher frequencies (greater than 1,000 Hz) and that tree trunks and branches may be playing more of a scattering role than absorption at the lower frequencies.

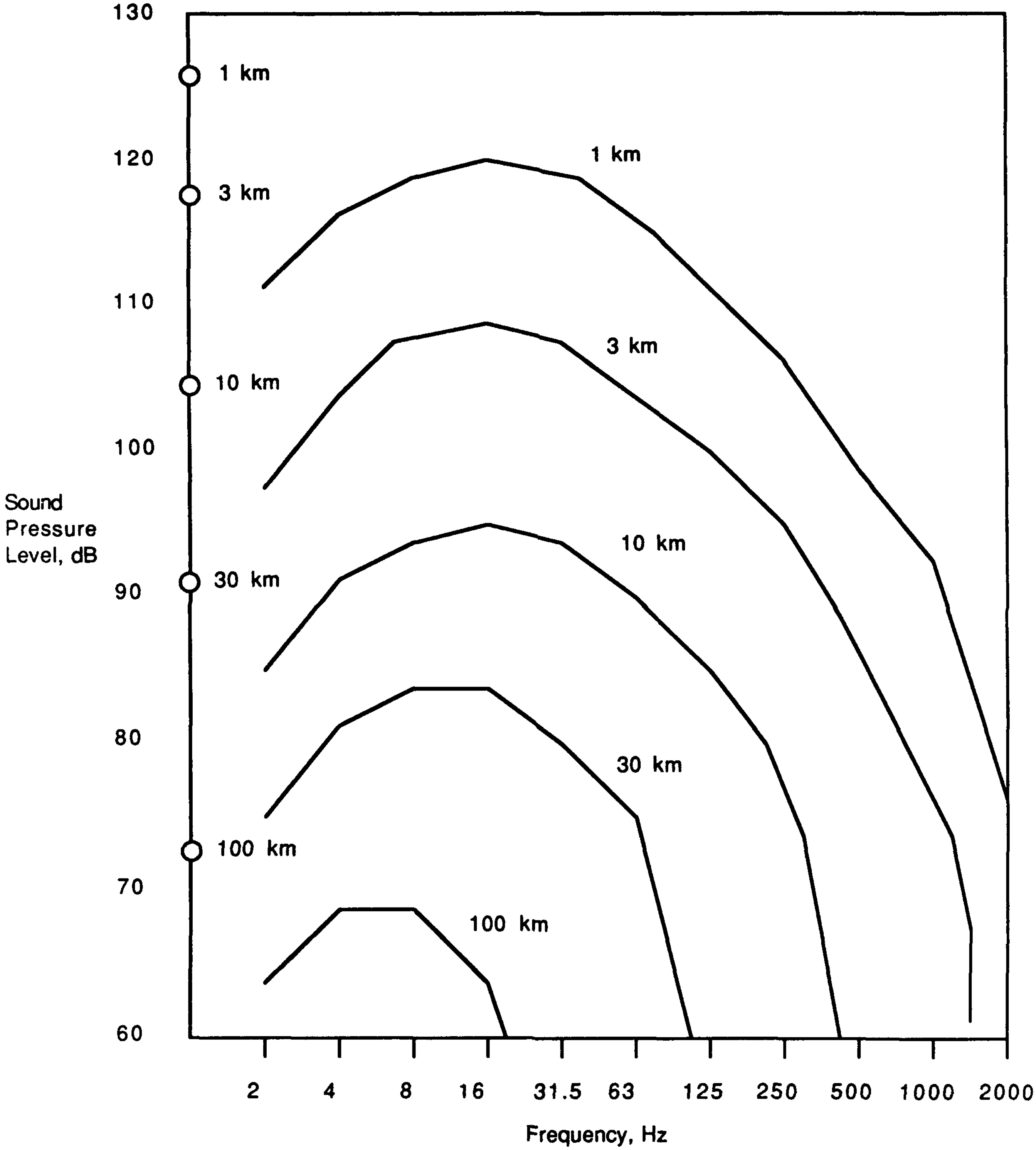


Figure 3
Predicted Overall and Octave Band Sound Pressure Levels at Various Distances from the ASRM Static Test Sites

It has been concluded that the additional excess attenuation that would be predicted is negligible in the current analysis model because:

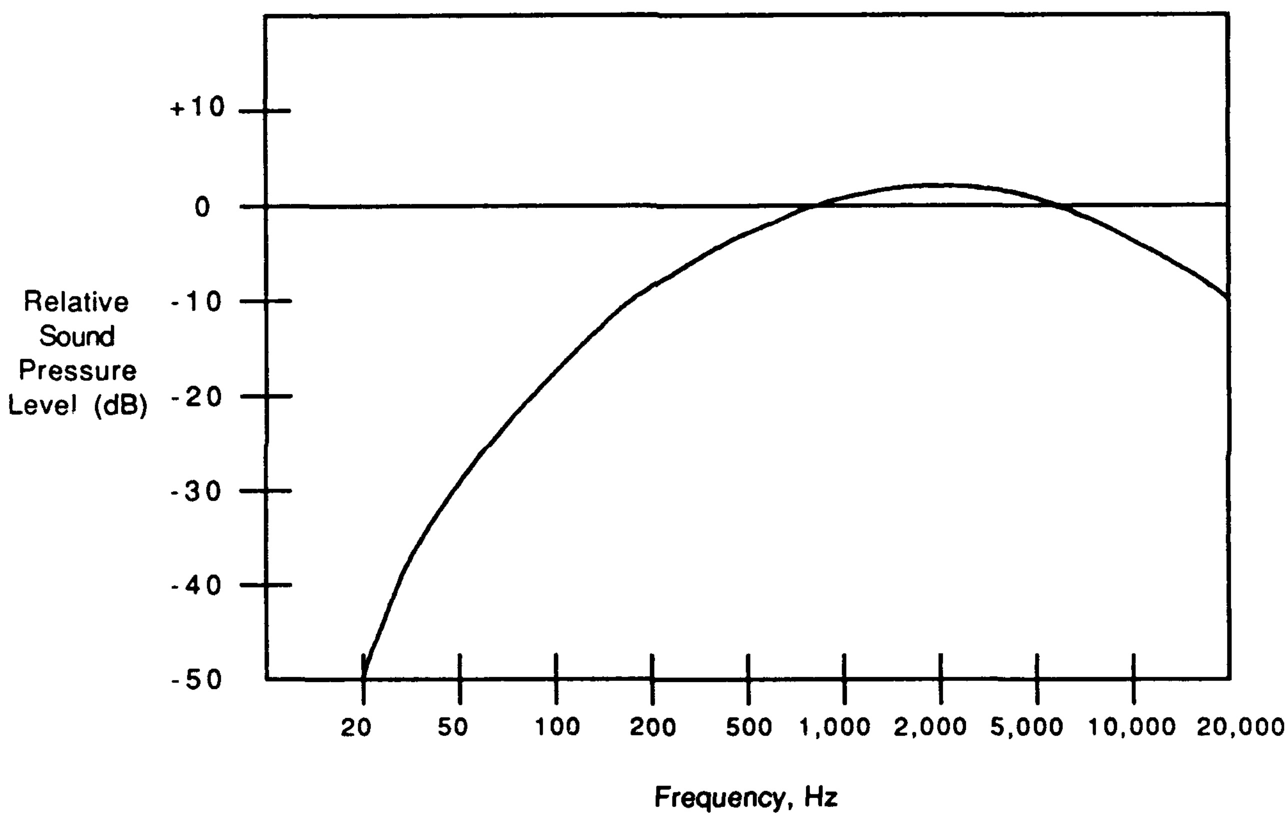
(1) the major part of the attenuation occurs at higher frequencies (greater than 500 Hz) than are prevalent during ASRM test firings; and

(2) the ground effects excess attenuation assumption already provided in the current analysis provides coverage for the low frequency (less than 750 Hz) attenuation (Rice and Teeter 1988). As a result, additional attenuation caused by trees at SSC has not been included.

"A" WEIGHTED SOUND PRESSURE LEVELS

The human ear is not equally sensitive to all sound frequencies. Rather, it is most sensitive to frequencies in the range of 1,000-6,000 Hz, and decreases in sensitivity at both lower and higher frequencies. To account for this characteristic, sound pressure levels are frequently given in the "A" weighted scale, where the sound levels at various frequencies are weighted in accordance with the normal sensitivity of the human ear. The A-weighted scale is compared to the flat scale in Figure 4.

Figure 5 presents the predicted sound pressure levels resulting from a SRM test as a function of distance both as the overall sound pressure level (unweighted) and as the A-weighted sound pressure level. It may be noted that the A-weighted levels are more than 20 dB below the unweighted levels and that the difference increases with distance due to the greater attenuation with distance of higher frequency sounds.



Source: USEPA 1973

Figure 4
The A-Weighted Scale Definition

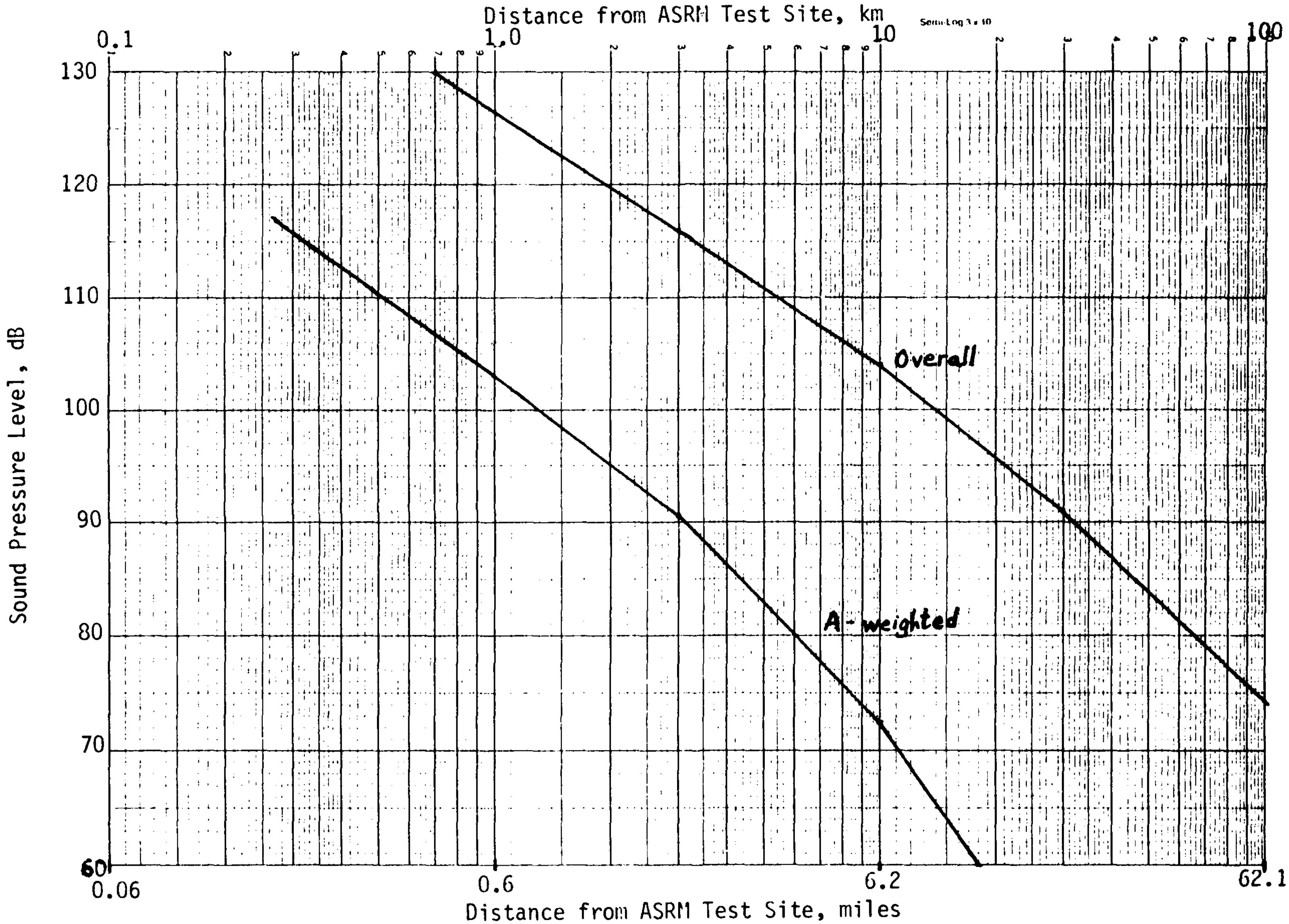


Figure 5
Overall and A-Weighted Sound Pressure Levels
Resulting from ASRM Static Test Firings

DIRECTIVITY EFFECTS

Rocket motors are highly directive sound sources. To account for this directivity (deviation from symmetrical radiation) experimental data from previous Redstone and Saturn rocket engine test firings were used to obtain curves which indicate the directivity for a given frequency as a function of the angular orientation about the centerline of the exhaust flow. These values are called the "directivity indices" and are shown in JANNAF (1971).

The overall directivity pattern is shaped such that the maximum sound energy is radiated at an angle of about 60 degrees from the direction of the jet. The sound energy radiated on the motor centerline is a minimum. The overall result is to give the lines of constant sound pressure level a somewhat butterfly shape.

Figure 6 shows the directivity as a function of the angle measured from the exhaust jet axis. When these variations are imposed upon the data given in Figure 5, the characteristic butterfly pattern can be calculated.

Figure 7 shows the "butterfly" contours of constant overall sound pressure levels, while Figure 8 shows the contours for the A-weighted sound pressure levels.

TOPOGRAPHIC AND DEFLECTOR EFFECTS

The contours of constant overall and A-weighted sound pressure levels in Figures 7 and 8 ignore the effect of topography, specifically the shielding effect of the incline exhaust deflector at SSC and KSC. The exhaust deflector rises at 5° for 600 feet for a total height of approximately 50 feet. The deflector width is 200 feet.

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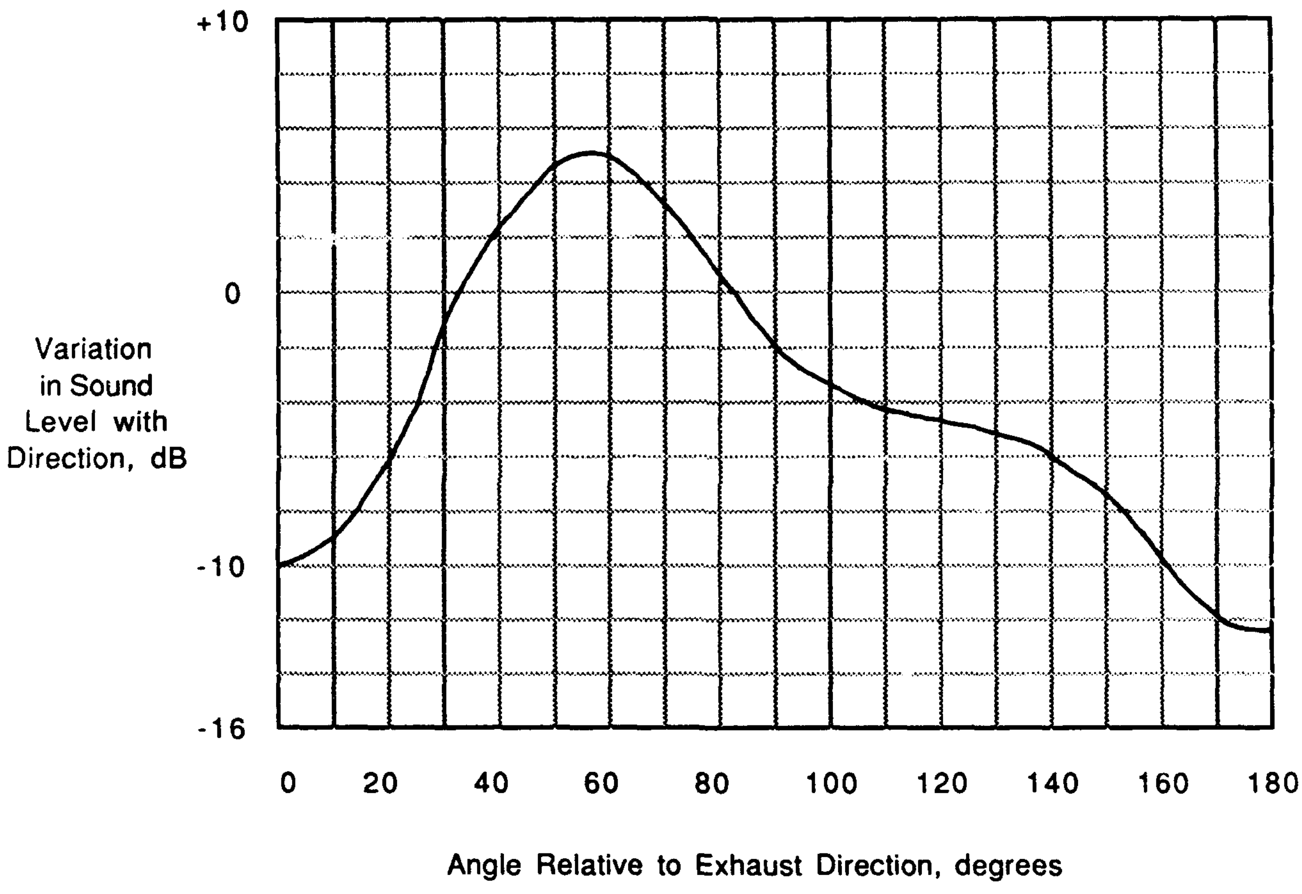

Figure 6
Directivity Characteristics of Rocket Noise

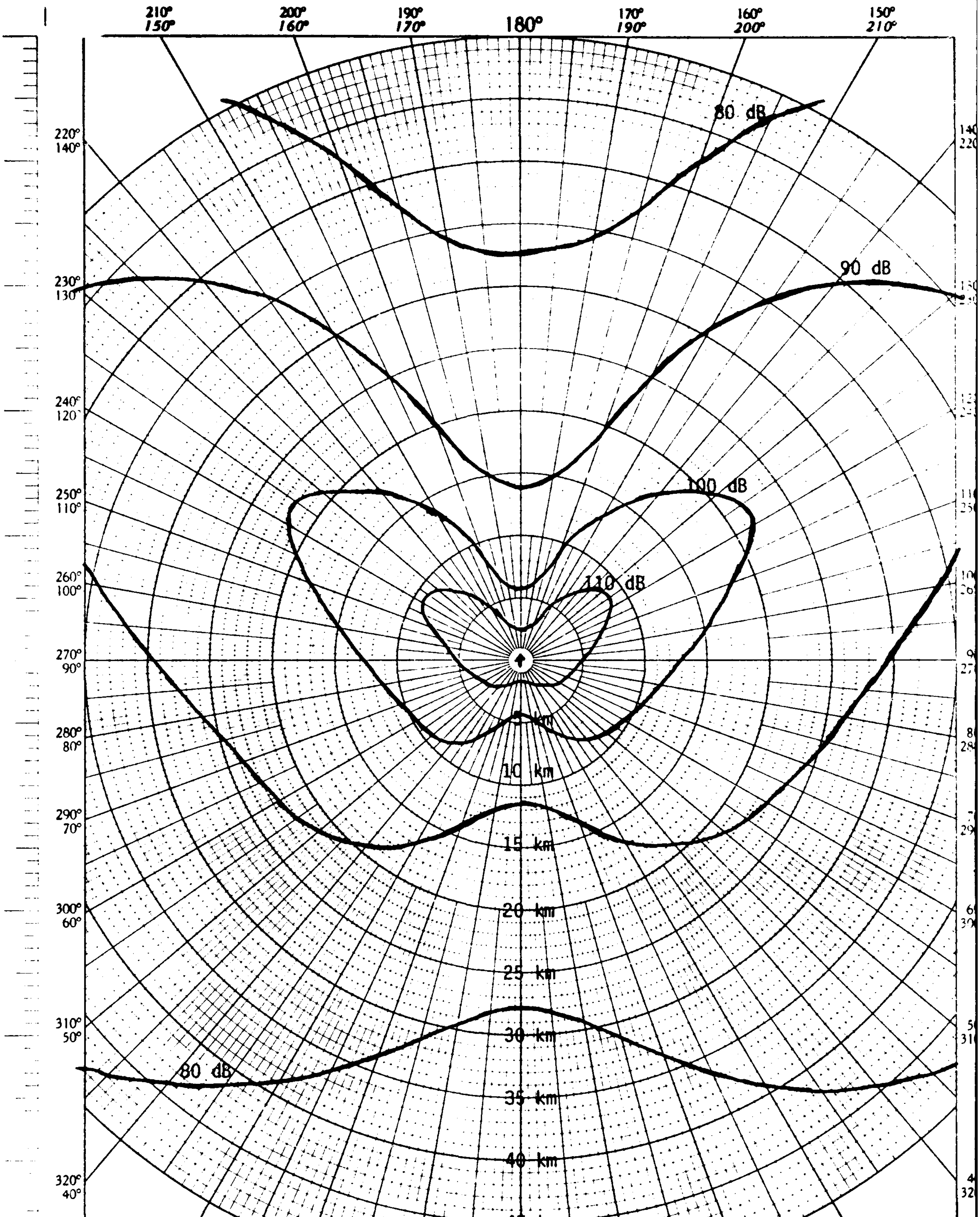

Figure 7
Predicted Overall Sound Pressure Level Contours for the ASRM Static Test Firings

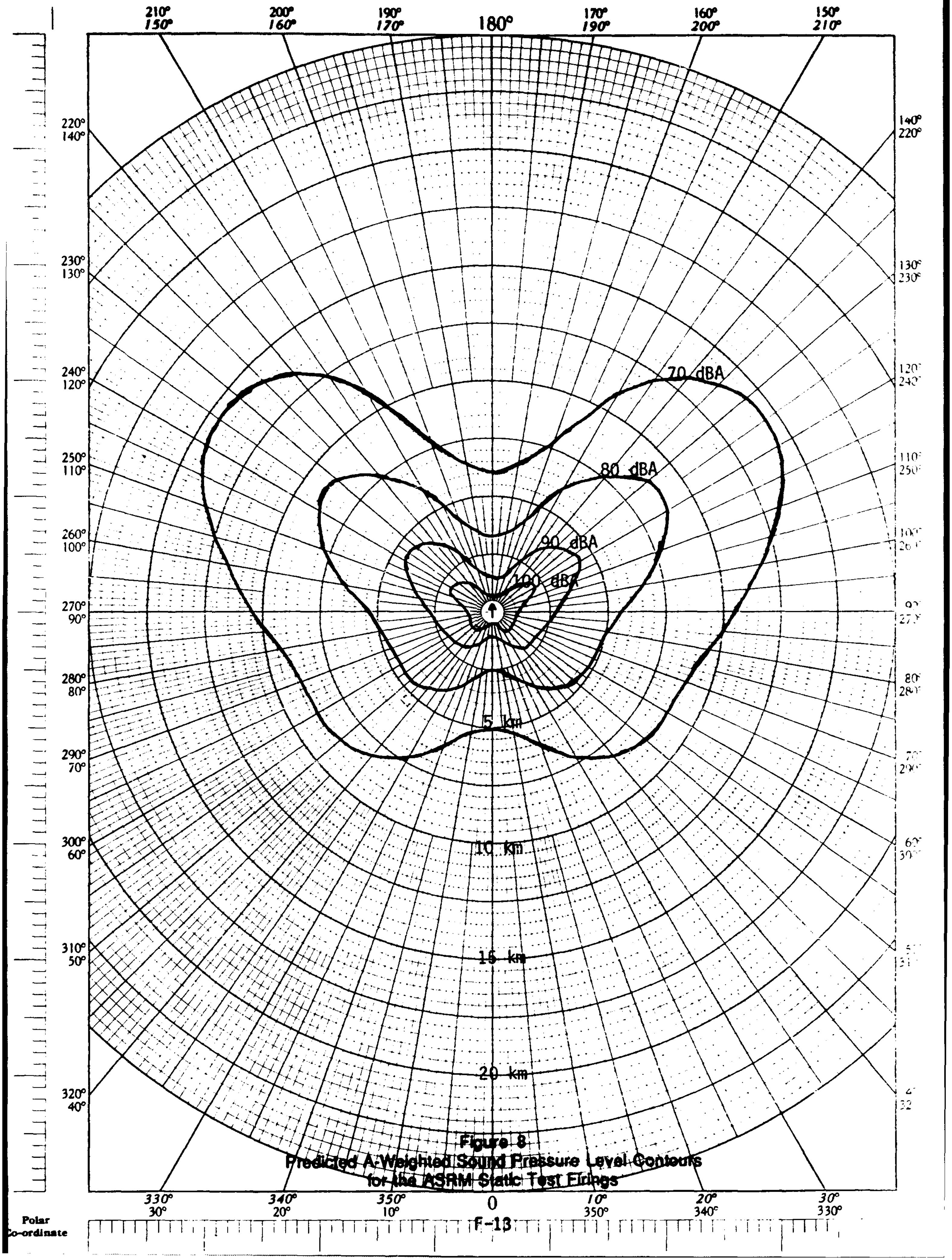

Figure 8
Predicted A-Weighted Sound Pressure Level Contours
for the ASRM Static Test Firings

The effectiveness of the ASRM static test firing deflector in reducing sound levels at the receiver, depends upon the effective height and width of the deflector, the frequency of the noise, the distance to the source and receiver, and other factors. Conventional barrier theory is borrowed from optics, where source and receiver are a very large distance (in terms of wavelengths) from any boundary. The key parameter is the Fresnel Number which is defined as follows:

$$N = [2/\lambda][d_1 + d_2 - d]$$

where:

N = Fresnel number N

λ = sound wavelength

d_1 = distance from the point source to the barrier

d_2 = distance from the barrier to the receiver

d = the straight line distance from the source to the receiver.

When the Fresnel Number is zero, the source, top of the deflector, and the receiver are exactly in line and the barrier cuts off half the sound-field from reaching the receiver. This can result in a reduction in sound level by 5 db. However, when the top of barrier is exactly in line and both are on the ground surface level, then there is no attenuation. Embleton (1982) provides a curve of attenuation vs. Fresnel Number that was used to estimate attenuation for the ASRM barrier, assuming an infinite width and a point sources at ground level. The calculated OASPL's and A-weighted levels with and without the deflector are compared below.

	OASPL, dB		A-Weighted, dB	
Distance, km	No Deflector	Deflector	No Deflector	Deflector
1	126.2	123.2	103.1	94.5
3	116.0	113.2	90.4	82.7
10	103.9	101.4	72.6	66.0
30	91.2	89.0	47.9	43.2

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Because the exhaust plume is 30- to 50-ft in diameter and has a length of 100 to 200 ft, it is not a point source when compared to the 52-ft high by 200-ft wide deflector (the approach used above assumes an infinite deflector). As a result, the magnitude of the attenuations given above are not expected for the ASRM. The expected attenuation is then well within the other variations inherent in the model.

ACOUSTIC FOCUSING

Another important factor that determines the acoustic environment is acoustic focusing due to certain atmospheric conditions (JANNAF 1971). This effect is related to the refraction of the acoustic energy from a highly directional sound source. The directivity characteristics of the source in the vertical plane must be considered. Refraction occurs when meteorological conditions are such that the speed of sound due to temperature and/or wind profile increases with altitude. This refracts the sound energy, resulting in higher levels, at a given point, than those which would be expected for a homogeneous medium. From all indications, the speed of sound profile characteristics of only the lower atmosphere (altitudes less than 4,900 ft or 1,500 m) are effective in the return of sound energy to the ground. If the local speed of sound decreases as altitude increases, a shadow zone or area of decreased sound energy, will be observed in the far field from the noise source. However, from past experience, it has been observed that because of wave length effects and dispersion due to turbulence, the shadow zone will not occur.

Figure 9 shows a speed of sound profile for conditions where refraction would produce increased levels at far field locations. From experience, it is known that sound pressure levels in the far field can increase on the order of 20 dB. ASRM static test firing constraints will be established by NASA that consider the atmospheric conditions related to lapse rate (change of temperature with altitude) and wind profile. If predictions indicate unfavorable noise levels in the local communities surrounding the test site, then the test would be rescheduled.

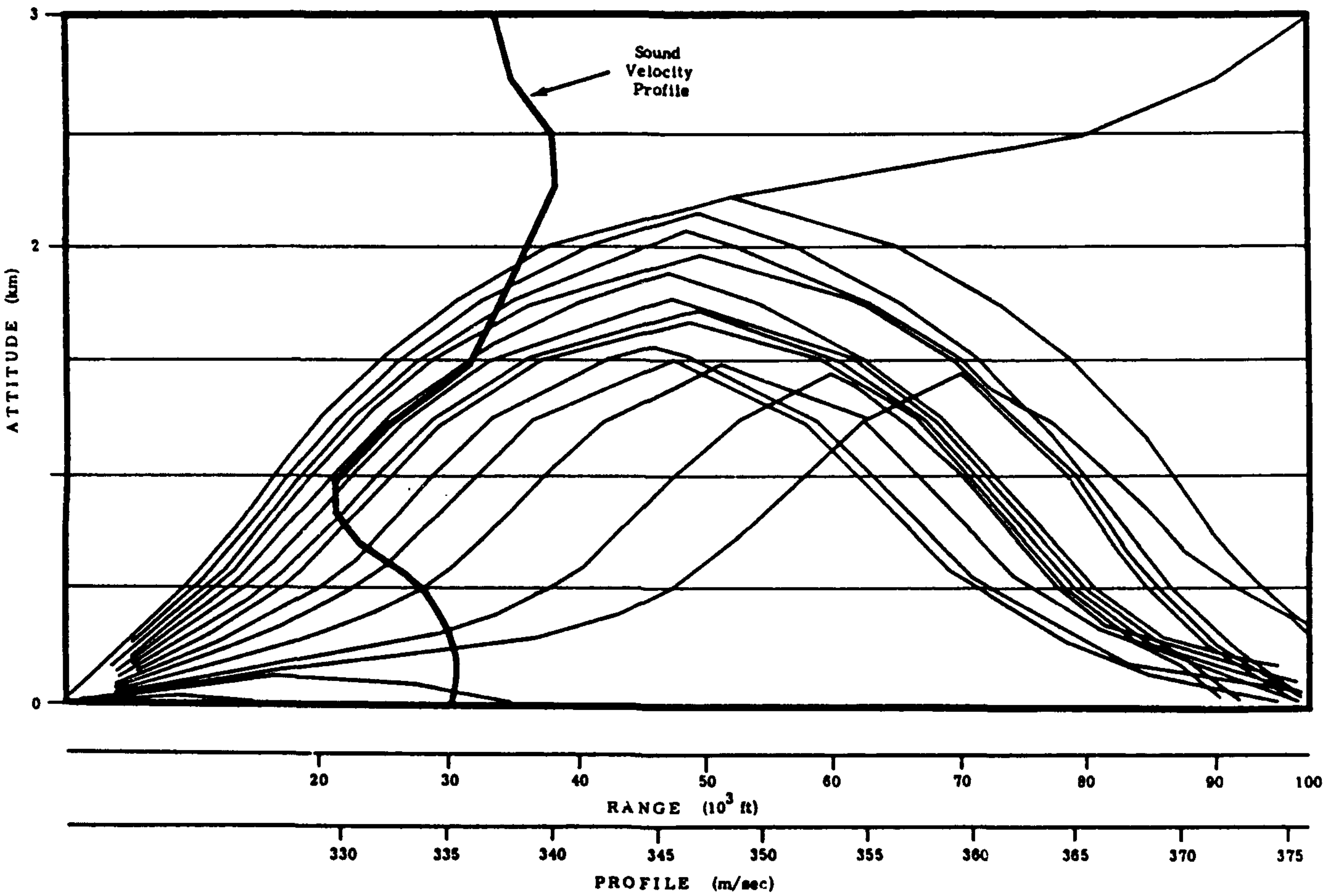

Figure 9
Acoustic Ray Paths Showing Effect of
Temperature Inversion

ACCIDENTAL ASRM STATIC TEST FIRING

The only accidental event during a static test firing that would cause noise different from that of a normal static test firing would be a pressure rupture of the motor case. Two primary causes of a motor case pressure rupture can be distinguished:

(1) an increase in motor pressure above the structural limit of the case due to increased propellant burning surface caused by grain cracks, improper propellant burning rate, or inhibitor failure; and

(2) degradation of or flaws in the case, including the insulation, seals, adhesives, and case materials.

If the case rupture were to occur near the end of the test firing, when the maximum volume of pressurized gases was contained in the case, the isentropic expansion energy of the gases would be 7.1 billion Joules (6.7 million Btu), or the equivalent of about 1,500 kg (3,300 lb) of TNT. This is the maximum conceivable energy release for a case rupture (NASA/MSFC 1977).

Figure 10 shows the blast wave overpressure that would be created by a pressure rupture of the motor case near the end of the test firing (NASA/MSFC 1977). The blast wave would be perceived as a brief noise pulse that would probably be audible at considerable distances. Shown in Figure 10 are two criteria for evaluating the potential effects of blast waves, glass breakage and ear drum rupture.

VIBRATION FROM A STATIC TEST FIRING

Static test firings may also produce seismic effects at great distances from the test firing site (Dalins 1975; McCarty and Dahlins 1971, and Ewing 1957). These seismic effects may cause the displacement amplitude of the ground to reach 50 micrometers at a frequency of

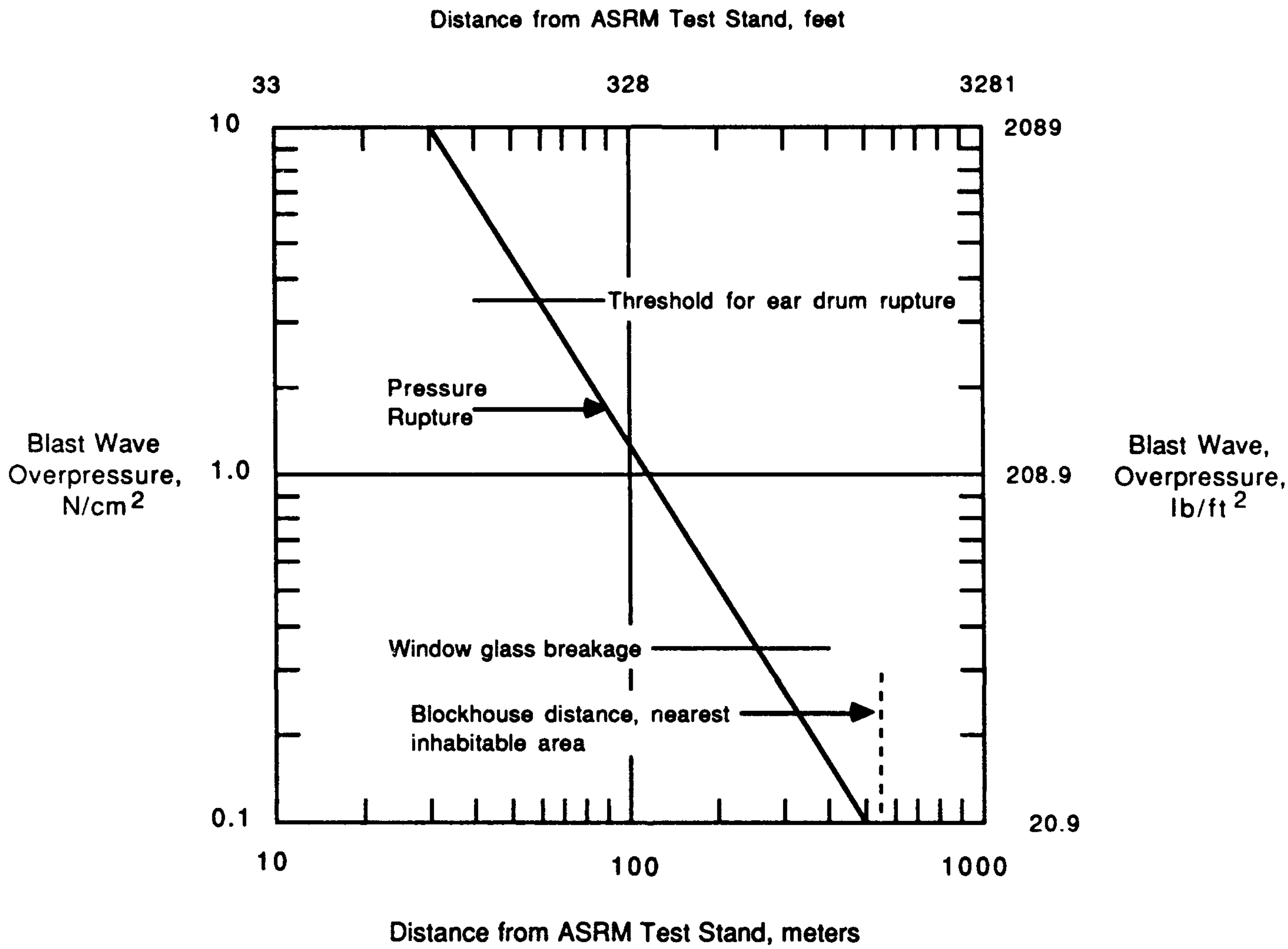

Figure 10
Calculated Blast Wave Overpressure Resulting from a
Pressure Rupture of the ASRM During a Static Test Firing

4 Hz. The ground waves should not be of significant concern, as test firings during the Saturn/Apollo Program showed them to be relatively harmless to buildings.

Intense acoustic sound levels can cause ground vibrations directly as forced oscillations, but this mechanism is quite inefficient in transferring energy across the air-ground interface into the ground from rocket firings because of the mismatch of the elastic parameters of the two media. The largest amplitudes generated in rocket tests are by a resonance effect that involves "phase velocity matching", i.e., the atmospheric sound velocity matches the phase velocity of an active ground vibration mode. The latter usually pertains to the phase velocity of a Raleigh wave which is traveling sufficiently slowly in the ground that is composed of an unconsolidated layer of soil (swamps/quicksand) approximately 65 feet thick (Dalins 1975, McCarty and Dahlins 1971; and Ewing 1957).

The relatively large seismic wave produced from static testing and large area of excitement might be a cause for some concern if there are structures in the area of the tests. Previous experience with launches at KSC and testing at SSC, however, indicate that these effects should not be expected to be significant. Acoustic levels for the ASRM would be less than those of the Saturn/Apollo Program.

APPENDIX G

ISSUE SIGNIFICANCE DETERMINATION

Appendix G1 - Criteria for Rating Impacts and Significance Definitions

Appendix G2 - Issue Significance Worksheets - Stennis Space Center

Appendix G3 - Issue Significance Worksheets - Yellow Creek Station

Appendix G4 - Issue Significance Worksheets - Kennedy Space Center

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APPENDIX G-1

CRITERIA FOR RATING IMPACTS AND SIGNIFICANCE DEFINITIONS

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TABLE G-1

CRITERIA FOR RATING IMPACTS

Impact Rating	Level of Impact			
	Magnitude	Extent	Duration	Likelihood
Very Significant				
	Major	Large or Medium	Any level	Probable
	Major	Large or Medium	Long term	Possible
Moderately Significant				
	Major	Any level	Medium term, intermittent, or short term	Possible
	Moderate	Large or Medium	Any level	Probable
	Major	Small	Any level	Probable
	Major	Small	Long term	Possible
	Moderate	Large	Any level	Possible
	Moderate	Medium or Small	Any level	Possible
	Moderate	Small	Any level	Probable
	Major	Large	Any level	Unlikely
	Major	Medium or Small	Long term	Unlikely
	Minor	Large	Any level	Probable
	Minor	Medium or Small	Long term	Probable
	Major	Medium or Small	Medium term, intermittent, or short term	Unlikely
Insignificant				
	Minor	Medium	Medium term or intermittent	Probable
	Minor	Large	Any level	Possible
	Minor	Medium or Small	Long term	Possible
	Moderate to Minor	Any level	Any level	Unlikely
	Minor	Medium	Short term	Probable
	Minor	Small	Medium term, intermittent, or short term	Probable
	Minor	Medium or Small	Medium term, intermittent, or short term	Possible

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SIGNIFICANCE DEFINITIONS

Discipline Air Quality
Criterion Ambient Air Quality

Term	Definition
Magnitude	
Major	Exceed a standard or PSD increment
Moderate	Change more than 50 percent of standard or of PSD increment
Minor	Change less than 50 percent standard or increment
Duration	
Long Term	Annual
Medium Term (limited or intermittent)	24-hour to 1 month
Short Term	1 to 8 hours
Extent	
Large	Widespread impact in several directions
Medium (localized)	A compass sector (22.5 degrees)
Small (limited)	A single receptor
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

SIGNIFICANCE DEFINITIONS

Discipline Aquatic Resources
Criterion All

Term	Definition
Magnitude	
Major	Greater than 25 percent change in important commercial, recreational, or rare, threatened, or endangered fish populations
Moderate	10-25 percent
Minor	Less than 10 percent change
Duration	
Long Term	More than 1 year
Medium Term (limited or intermittent)	1-12 months
Short Term	Less than 1 month
Extent	
Large	State, regional or national
Medium (localized)	Site and immediate environs
Small (limited)	10 percent of site or available resource
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

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SIGNIFICANCE DEFINITIONS

Discipline Cultural Resources
Criterion All

Term	Definition
Magnitude	
Major	Project will adversely affect a site listed on or eligible for listing on the National Register of Historic Places or World Heritage List, and mitigation of adverse effects is unsuccessful or not possible.
Moderate	Project will adversely affect a site listed on or eligible for listing on the National Register of Historic Places, and mitigation of adverse effects is successful.
Duration	
Long Term	More than 5 years
Medium Term (limited or intermittent)	1-5 years
Short Term	Less than 1 year
Extent	
Large	Most of historic or archaeological site or district affected (more than 50 percent)
Medium (localized)	Some of historic or archaeological site or district affected (5-50 percent)
Small (limited)	Small portion of historic or archaeological site or district affected (less than 5 percent)
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

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SIGNIFICANCE DEFINITIONS

Discipline Geotechnical Issues
Criterion Foundation Instability (Static and Dynamic

Term	Definition
Magnitude	
Major	Structural damage
Moderate	Aesthetic effects
Minor	Imperceptible settlement/movement
Duration	(Note: duration applies to dynamic effects only)
Long Term	Continuous, cumulative
Medium Term (limited or intermittent)	During each test firing (<20 min.)
Short Term	During first test firing only, or during seismic events (~5 min.)
Extent	
Large	Entire building affected
Medium (localized)	Portions of building affected
Small (limited)	Imperceptible except to trained observers
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

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SIGNIFICANCE DEFINITIONS

Discipline Geotechnical Issues
Criterion Slope Instability

Term	Definition
Magnitude	
Major	Secondary effects (e.g., building damage)
Moderate	Noticeable movement (e.g., scarp)
Minor	Imperceptible changes
Duration	
Long Term	Continuous slippage
Medium Term (limited or intermittent)	Repairable damage, subsequently stable
Short Term	Occurring only during construction activities, remediated and subsequently stable
Extent	
Large	>100 sq. yd.
Medium (localized)	~10 sq. yd.
Small (limited)	<~1 sq. yd.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

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SIGNIFICANCE DEFINITIONS

Discipline Geotechnical Issues
Criterion Erosive Soil Loss

Term	Definition
Magnitude	
Major	Secondary effects (e.g., building damage, siltation of surface water)
Moderate	Aesthetic effects
Minor	Imperceptible changes
Duration	
Long Term	Through facility life (>30 y)
Medium Term (limited or intermittent)	Recurrent (e.g., each test firing)
Short Term	During critical activities only (during construction, after first test firing)
Extent	
Large	>100 sq. yd.
Medium (localized)	~10 sq. yd.
Small (limited)	<~1 sq. yd.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

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SIGNIFICANCE DEFINITIONS

Discipline Geotechnical Issues
Criterion Chemical Degradation of Soils

Term	Definition
Magnitude	
Major	Secondary effects (loss of strength causing damage to buildings)
Moderate	Aesthetic (loss of vegetation)
Minor	Imperceptible
Duration	
Long Term	Cumulative throughout operational life
Medium Term (limited or intermittent)	Recurrent during each test firing
Short Term	Self-remediating following cause (e.g., test firing)
Extent	
Large	>100 cu. yd. (or 100 sq. yd. surface area)
Medium (localized)	~10 cu. yd. (or 10 sq. yd. surface area)
Small (limited)	~1 cu. yd. (or 2 sq. yd. surface area)
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

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SIGNIFICANCE DEFINITIONS

Discipline Geotechnical Issues
Criterion Soil Contamination Levels

Term	Definition
Magnitude	
Major	Posing secondary (e.g., health) risks
Moderate	>EP Tox levels, or visible contamination
Minor	<EP Tox levels
Duration	
Long Term	Cumulative over operational life
Medium Term (limited or intermittent)	Recurrent, or residues cumulating
Short Term	Easily cleared up or self-remediating (e.g., biological breakdown, volatilizing)
Extent	
Large	>100 cu. yd. (or 100 sq. yd. surface area)
Medium (localized)	~10 cu. yd. (or 10 sq. yd. surface area)
Small (limited)	<1 cu. yd. (or 2 sq. yd. surface area)
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Geotechnical Issues
Criterion Subterranean Fire

Term	Definition
Magnitude	
Major	Self-sustaining, spreading fire
Moderate	Easily containable fire
Minor	Susceptible strata singed
Duration	
Long Term	Self-sustaining (>1 day)
Medium Term (limited or intermittent)	During each test firing (~20 min.)
Short Term	During one test firing only
Extent	
Large	>100 cu. yd. (or 100 sq. yd. surface area)
Medium (localized)	~10 cu. yd. (or 10 sq. yd. surface area)
Small (limited)	<1 cu. yd. (or 2 sq. yd. surface area)
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Geotechnical Issues
Criterion Subsurface Facility Corrosion

Term	Definition
Magnitude	
Major	Loss of utility lines, possible spill of contents
Moderate	Shortened utility life (early replacement)
Minor	No impediment to utility use
Duration	
Long Term	Continuous throughout facility life
Medium Term (limited or intermittent)	Recurrent (e.g., during high groundwater levels)
Short Term	During very infrequent events (<1 day per year)
Extent	
Large	Entire facility affected
Medium (localized)	One (or two) portions of facility (several buildings affected
Small (limited)	Vicinity of one building
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline: Groundwater Resources
Criterion: Exceed safe yield of site wells to the extent that water table (or piezometric surface) drops

Term	Definition
Magnitude	
Major	Impacts municipalities or large companies (large drop)
Moderate	Impacts small businesses or housing developments near site (significant drop)
Minor	Impacts only a few private residences near site (small drop)
Duration	
Long Term	More than 5 years
Medium Term (limited or intermittent)	1-5 years
Short Term	Less than 1 year
Extent	
Large	Effect noticable in regional aquifer at some distance.
Medium (localized)	Impact confined to area within 10 mile radius.
Small (limited)	Immediate area surrounding sites.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

SIGNIFICANCE DEFINITIONS

Discipline Land Use
Criterion Land Use Jurisdictions

Term	Definition
Magnitude	
Major	In conflict with federal or state land use plans
Moderate	In conflict with regional or county land use plans
Minor	In conflict with nearby municipal or site specific land use plans
Duration	
Long Term	Project life is more than 20 years.
Medium Term (limited or intermittent)	Project life is 5-20 years.
Short Term	Project life is less than 5 years.
Extent	
Large	Proposed project occupies an area greater than 5 percent of the planning area jurisdiction.
Medium (localized)	
Small (limited)	Proposed project occupies an area less than 5 percent of the planning area jurisdiction.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

SIGNIFICANCE DEFINITIONS

Discipline Land Use
Criterion Wild and Scenic Rivers

Term	Definition
Magnitude	
Major	a) 5 percent increase in barge trips per year b) 100 db or more
Moderate	a) 2-5 percent increase in barge trips per year b) 75 db or more
Minor	a) Less than 2 percent change in barge trips per year b) Less than 75 db
Duration	
Long Term	More than 50 days a year
Medium Term (limited or intermittent)	5-50 days per year
Short Term	Less than 5 days per year
Extent	
Large length	Affects 75 percent or more of inventory river segment
Medium (localized)	Affects between 25-75 percent of river length
Small (limited)	Affects less than 25 percent of river length
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Land Use
Criterion Prime and Unique Farm Land

Term	Definition
Magnitude	
Major	Project impacts areas of prime and unique farm land.
Moderate	---
Minor	Project impacts areas dedicated to built-up uses, but with soils usually considered prime.
Duration	
Long Term	Project life of 20 years or more.
Medium Term (limited or intermittent)	---
Short Term	Project life of 5 years or less.
Extent	
Large	Over 1,000 acres of prime and unique farm land is taken out of the resource base.
Medium (localized)	Between 50-1,000 acres of prime and unique farm land is taken out of the resource base.
Small (limited)	Less than 50 acres of prime and unique farm land is taken out of the resource base.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Land Use
Criterion Land Use Restrictions
Recreation

Term	Definition
Magnitude	
Major	Complete closure, all uses restricted
Moderate	Certain uses restricted
Minor	One use restricted
Duration	
Long Term	Over 50 days of closure per year
Medium Term (limited or intermittent)	5-50 days of closure per year
Short Term	Less than 5 days of closure per year
Extent	
Large	a) Over 5 percent of county available recreation lands affected b) 5 percent of beach (in miles)
Medium (localized)	a) 2-5 percent of county available recreation lands b) 2-5 percent of beach (in miles)
Small (limited)	a) less than 2 percent of available recreation lands b) less than 2 percent of beach
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Land Use
Criterion Direct Noise Impacts (Audible Intrusions)

Term	Definition	
Magnitude	A-Weighted (humans)	Linear (Structures)
Major	Greater than 100 db noise levels	Greater than 130 db levels or 1.5 PSF
Moderate	Between 75 db and 100 db	Between 127 db and 130 db 1.0 to 1.5 PSF
Minor	Less than 75 db	Less than 127 db 1.0 PSF
Duration		
Long Term	More than 3 minutes	
Medium Term (limited or intermittent)		
Short Term	Three minutes or less	
Extent		
Large	More than 1,000 persons exposed to greater than 80 db, or 100 houses affected by structural damage	
Medium (localized)	Between 100-1,000 people affected, or between 30 and 100 homes affected by structural damage	
Small (limited)	Less than 100 people affected, or less than 30 homes affected by structural damage	
Likelihood		
Probable	Occurs under typical operating conditions	
Possible	Occurs under worst-case operating conditions	
Unlikely	Occurs under upset/malfunction conditions	

SIGNIFICANCE DEFINITIONS

Discipline Land Use
Criterion Agricultural Lands

Term	Definition
Magnitude	
Major	A 25 percent or greater reduction in crop yields per acre
Moderate	A 5-25 percent reduction in crop yields per acre
Minor	A less than 5 percent reduction in crop yields per acre
Duration	
Long Term	More than 1 growing season
Medium Term (limited or intermittent)	
Short Term	Damage seen within part of a growing season
Extent	
Large	5 percent of county agricultural acres
Medium (localized)	2-5 percent of county agricultural acres
Small (limited)	1 percent or less of county agricultural acres
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Noise
Criterion All

Term	Definition
Magnitude	
Major	Impacts that could cause harm or damage to humans and structures
Moderate	Annoying but not damaging or harmful
Minor	Barely audible over normal, day and night background levels
Duration	
Long Term	A continuous event of one day or greater
Medium Term (limited or intermittent)	An event lasting for one shift; 8 hours or less
Short Term	Impact lasting less than 5 minutes, such as static testing
Extent	
Large	Regional area extending away from the site and its surrounding buffer (static testing and traffic)
Medium (localized)	Beyond the facility site but not beyond the buffer or boundary for all operations and supporting facilities
Small (limited)	Within the site; not crossing into the buffer region
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Public Health and Safety
Criterion All

Term	Definition
Magnitude	
Major	Catastrophic event resulting in loss of life, severe injuries requiring hospitalization, major property damage or loss.
Moderate	Event resulting in moderate injuries which may require hospitalization, moderate property damage or loss.
Minor	Event resulting in minor injuries which do not require hospitalization minor property damage or loss.
Duration	
Long Term	> 10 years to return to normal
Medium Term (limited or intermittent)	1-10 years to return to normal
Short Term	<1 year to return to normal
Extent	
Large	Extending outside buffer zone into region, state or nation.
Medium (localized)	Confined to within buffer zone but extending outside site.
Small (limited)	Confined to site or individual facility on site
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Radiation
Criterion

Term	Definition
Magnitude	
Major	Greater than 5 percent change
Moderate	---
Minor	Less than 1 percent change
Duration	
Long Term	More than 1 year
Medium Term (limited or intermittent)	
Short Term	Less than 1 day
Extent	
Large	Extends beyond site boundary
Medium (localized)	Extends beyond building
Small (limited)	Does not extend beyond building
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Public Facilities and Services
Criterion All

Term	Definition
Magnitude	
Major	Construction or addition of new facilities or services
Moderate	Expansion of existing facilities or services
Minor	Increased level of usage of existing facilities or services
Duration	
Long Term	More than 3 years exceeding capacities (operational period)
Medium Term (limited or intermittent)	1-3 years exceeding capacities (equivalent to construction period)
Short Term	Less than 1 year exceeding capacities (temporary facilities/services may be necessary)
Extent	
Large	State, regional or national
Medium (localized)	Entire study area
Small (limited)	Portion of study area
Likelihood	
Probable	Greater than 50 percent chance of occurrence
Possible	5 to 50 percent chance of occurrence
Unlikely	Less than 5 percent change of occurrence

1668K

SIGNIFICANCE DEFINITIONS

Discipline Transportation
Criterion Local Traffic Increase

Term	Definition
Magnitude	
Major	Service level decreased to E or below
Moderate	Service level decreased to D
Minor	Service level remains at C or above
Duration	
Long Term	More than 3 years (operational period)
Medium Term (limited or intermittent)	1-3 years (generally equivalent to construction period
Short Term	Less than 1 year (associated with temporary road closures)
Extent	
Large	Multiple intersections or road segments on key access routes to community
Medium (localized)	1-3 intersections or road segments, primarily affects ASRM traffic routes
Small (limited)	1 intersection or road segment, not key location in local system
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

SIGNIFICANCE DEFINITIONS

Discipline Transportation
Criterion Rail/Waterway Network Effects

Term	Definition
Magnitude	
Major	ASRM program shipments would cause diversion of more than 5 percent of traffic on main rail or waterway link
Moderate	ASRM shipments would cause measurable congestion on key rail or water link, but no projected diversion
Minor	ASRM shipments cause congestion, but level too small to be quantified
Duration	
Long Term	More than 3 years
Medium Term (limited or intermittent)	1 to 3 years
Short Term	Less than 1 year
Extent	
Large	Effects noticeable at statewide or broader level
Medium (localized)	Effect limited to study region
Small (limited)	Effect limited to site and immediate link to rail or waterway system
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Transportation
Criterion Accident Potential - Property Damage

Term	Definition
Magnitude	
Major	More than $1,000,000 damage
Moderate	$50,000 to $1,000,000 damage
Minor	$50,000 damage or less
Duration	
Long Term	More than 3 years
Medium Term (limited or intermittent)	1 to 3 years
Short Term	Less than 1 year
Extent	
Large	Statewide or greater
Medium (localized)	Multicounty area
Small (limited)	Site and immediate environs
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Transportation
Criterion Accident Potential - Environmental Damage

Term	Definition
Magnitude	
Major	Greater than 5 percent population or habitat loss, or major water resource contamination
Moderate	1 to 5 percent loss
Minor	Less than 1 percent loss
Duration	
Long Term	More than 3 years
Medium Term (limited or intermittent)	1 to 3 years
Short Term	Less than 1 year
Extent	
Large	Statewide or greater
Medium (localized)	Multicounty area
Small (limited)	Site and immediate environs
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Transportation
Criterion Accident Potential - Human Health

Term	Definition
Magnitude	
Major	Direct loss of human life
Moderate	Multiple serious injuries requiring hospitalization, or elevated long-term hazard
Minor	Effect limited to minor, easily treatable injuries
Duration	
Long Term	More than 3 years
Medium Term (limited or intermittent)	1 to 3 years
Short Term	Less than 1 year
Extent	
Large	Statewide or greater
Medium (localized)	Multicounty area
Small (limited)	Site and immediate environs
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Socioeconomics
Criterion All

Term	Definition
Magnitude	
Major	Greater than 3 percent change (U.S. Army 1988b)), if measurable
Moderate	2 to 3 percent change
Minor	Less than 1 percent change
Duration	
Long Term	More than 10 years
Medium Term (limited or intermittent)	3-10 years
Short Term	Less than 3 years (assuming a 3 year construction phase)
Extent	
Large	State, regional or national
Medium (localized)	Entire study area
Small (limited)	Part of study area
Likelihood	
Probable	Greater than 50 percent chance of occurrence
Possible	5 to 50 percent chance of occurrence
Unlikely	Less than 5 percent chance of occurrence

1668K

SIGNIFICANCE DEFINITIONS

Discipline Solid Waste Management
Criterion Solid Waste Mgmt. Regs.

Term	Definition
Magnitude	
Major	Existing landfill capacity less than 2 years, or no existing capacity; or groundwater contamination
Moderate	Landfill capacity would be depleted in 7 to 2 years; no groundwater contamination
Minor	Landfill capacity would be depleted in more than 7 years; no groundwater contamination
Duration	
Long Term	Permitting and siting of new disposal facility would take more than 3 years; or groundwater contamination
Medium Term	Siting and permitting of new disposal facility would take from between 1 to 3 years
Short Term	Siting and permitting would take less than 1 year; no groundwater contamination
Extent	
Large	Multiple landfills needed or a large landfill needed to expand capacity (>100 acres); or large groundwater contaminant plume
Medium	Moderate size landfill needed -- 40 to 100 acres
Small	Small landfill needed -- less than 40 acres
Likelihood	
Probable	Occurs under typical facility operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Hazardous Waste Management
Criterion Hazardous Waste Management Regs.

Term	Definition
Magnitude	
Major	Large generator of hazardous waste (i.e., generates greater than 1000 kg of hazardous waste in a calendar month)
Moderate	Large intermittent generator of hazardous waste
Minor	Small quantity generator (i.e., generates less than 1000 kg of hazardous waste in a calendar month)
Duration	
Long Term	Generates hazardous waste throughout life of the project
Medium Term	Intermittent generator of hazardous waste
Short Term	Generates hazardous waste only during infrequent operations (e.g., painting buildings, using cleaning solvents)
Extent	
Large	Generates hazardous waste at each of the operational centers throughout the complex
Medium	Generates hazardous waste at about 1/2 of the operational areas
Small	Generates hazardous waste at less than 1/3 of the operational areas
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline: Water Resources
Criterion: Quantity of water needed for site processes and sanitary use that cannot be supplied from site sources

Term	Definition
Magnitude	
Major	Construction of new water supply facilities by surrounding community or communities.
Moderate	Expansion of existing water supply facilities.
Minor	Increased level of demand on current water supply facilities.
Duration	
Long Term	More than 5 years
Medium Term (limited or intermittent)	1-5 years
Short Term	Less than 1 year
Extent	
Large	Impact community(ies) that is(are) not near the site.
Medium (localized)	Impacts a community(ies) near site but not the closest community(ies)
Small (limited)	Impacts nearest community only
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Water Resources - Surface Water
Criterion Receiving Water Quality

Term	Definition	
Magnitude		
Major	a. Parameter-specific numerical criteria exceeded by order of magnitude (factor of 10) or greater, or b. Immediately observable impact (e.g., fish kill)	
Moderate	a. Parameter-specific numerical criteria exceeded, but less than order of magnitude (factor of 10), or b. Some observable biological response (e.g., avoidance)	
Minor	a. Parameter-specific numerical criteria approximately equaled, no biological response observed.	
Duration	(Duration is somewhat parameter- and criteria-specific and must be considered in that context)	
	Input Oriented	**Event Oriented**
Long Term	Sufficient period to exhibit chronic effects	Continuous series of events greater than 1-2 yrs.
Medium Term	Sufficient to exhibit acute and some subacute effects	Intermittent events over period max 1-2 yrs.
Short Term	Sufficient period to exhibit acute effects	Single Event
Extent		
Large	a. Effect over entire watershed (basin) or multiple watersheds, or b. Effect Over 40 percent of major waterbody (e.g., over 40 percent of major lake, >40 percent width and significant length (>100 ft) of major river, etc.).	
Medium	a. Effect over 25 percent of watershed (basin), or b. Effect over 50 percent of small water body, or c. >10 percent <40 percent of major water body.	

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SIGNIFICANCE DEFINITIONS

Term	Definition
Small (limited)	Effect less than 25 percent single watershed, less than 10 percent major water body. May include entire area of 1-2 small ponds (<5 acres) or small seasonal wetland.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Water Resources - Groundwater
Criterion Receiving Water Quality

Term	Definition	
Magnitude		
Major	a. Parameter-specific numerical criteria exceeded by order of magnitude (factor of 10) or greater, or b. Immediately observable impact (e.g., fish kill)	
Moderate	a. Parameter-specific numerical criteria exceeded, but less than order of magnitude (factor of 10), or b. Some observable biological response (e.g., avoidance)	
Minor	a. Parameter-specific numerical criteria approximately equaled, no biological response observed.	
Duration	(Duration is somewhat parameter- and criteria-specific and must be considered in that context)	
	Input Oriented	**Event Oriented**
Long Term	Sufficient period to exhibit chronic effects	Continuous series of events greater than 1-2 yrs.
Medium Term (limited or intermittent)	Sufficient to exhibit acute and some subacute	Intermittent events over period max 1-2 yrs.
Short Term	Sufficient period to exhibit acute effects	Single Event
Extent		
Large	a. Effect over entire watershed (basin) or multiple watersheds, or b. Effect over 40 percent of major waterbody (e.g., over 40 percent of major lake, >40 percent width and significant length (>100) of major river, etc.).	
Medium (localized)	a. Effect over 25 percent of watershed (basin), or b. Effect over 50 percent of small water body, or c. >10 percent <40 percent of major water body.	

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SIGNIFICANCE DEFINITIONS

Term	Definition
Small (limited)	Effect less than 25 percent single watershed, less than 10 percent major water body. May include entire area of 1-2 small ponds (<5 acres) or small seasonal wetland.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline: Water Resources - Groundwater
Criterion: Ponding/Draining/Flow Alterations That Affect Groundwater

Term	Definition
Magnitude	
Major	a. Large (>5 ac) waterbodies are created or drained b. Water supplies (existing and potential) are committed above capacity >10 percent of time
Moderate	a. Major streams/rivers/waterbodies are diverted b. Water supplies (existing and potential) are committed to capacity >10 percent of time
Minor	a. Minor streams/artificial waterbodies are diverted b. Water supplies (existing) are committed to capacity >10 percent of time
Duration	
Long Term	Permanent, i.e., greater than 5 years
Medium Term (limited or intermittent)	Temporary (1-5 years) or intermittent condition lasting one week or less on a periodic basis
Short Term	Less than 1 year or single event lasting 1 week or less
Extent	
Large	Impacts >50 percent of at least 1 major watershed or several small watersheds
Medium (localized)	Impacts 10-50 percent of 1 major watershed or >50 percent of small watershed
Small (limited)	Impacts less than <10 percent of 1 major watershed or up to 50 percent of single small watershed
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

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SIGNIFICANCE DEFINITIONS

Discipline Terrestrial Ecology
Criterion All

Term	Definition
Magnitude	
Major	Loss of any threatened or endangered species, loss or degradation of any critical habitat
Moderate	Loss of any sensitive species or habitats; loss or degradation of any unusual plant communities
Minor	Loss or degradation of undisturbed/developed vegetation or habitat in affected area
Duration	
Long Term	Greater than one year (or during critical periods)
Medium Term (limited or intermittent)	One month to one year
Short Term	Less than one month
Extent	
Large	Greater than 5 percent of regional (as defined by county or space center boundaries, if known) resources
Medium (localized)	2-5 percent of regional resources
Small (limited)	Less than 2 percent of regional resources
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

1668K

SIGNIFICANCE DEFINITIONS

Discipline Wetlands
Criterion All

Term	Definition
Magnitude	
Major	In conflict with federal or state wetland protection programs.
Moderate	
Minor	Wetland losses would be mitigated through consultation with federal and state agencies.
Duration	
Long Term	Project life is more than 20 years.
Medium Term (limited or intermittent)	Project life is 5-20 years.
Short Term	Project life is less than 5 years.
Extent	
Large	Greater than 5 percent of the regional resource.
Medium (localized)	2-5 percent of regional resource.
Small (limited)	Less than 2 percent of regional resource.
Likelihood	
Probable	Occurs under typical operating conditions.
Possible	Occurs under worst case operating conditions.
Unlikely	Occurs under upset/malfunction conditions.

1668K

SIGNIFICANCE DEFINITIONS

Discipline Floodplains
Criterion All

Term	Definition
Magnitude	
Major	In conflict with federal or state floodplain management.
Moderate	In conflict with regional or county floodplain management.
Minor	In conflict with nearby municipal or site specific floodplain management plans or no conflicts.
Duration	
Long Term	Project life is more than 20 years.
Medium Term (limited or intermittent)	Project life is 5-20 years.
Short Term	Project life is less than 5 years.
Extent	
Large	The floodplain cannot be avoided and the floodway would be impaired.
Medium (localized)	
Small (limited)	The floodplain cannot be avoided but would not be impaired.
Likelihood	
Probable	Occurs under typical operating conditions.
Possible	Occurs under worst case operating conditions.
Unlikely	Occurs under upset/malfunction conditions.

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APPENDIX G-1

CRITERIA FOR RATING IMPACTS AND SIGNIFICANCE DEFINITIONS

TABLE OF CONTENTS

ISSUE SIGNIFICANCE WORKSHEETS

PROCESS CODES

A	Facility construction (general)
B	Facility operation (general)
C	Nozzle manufacturing
D	Case preparation
E	Case refurbishment
F	Propellant mixing
G	Propellant casting and curing
H	Cleaning/core preparation
I	Final assembly
J	Nondestructive evaluation
K	Static testing
L	Waste propellant open burning
M	Waste propellant controlled incineration
N	Reclamation/recovery of AP
O	Transportation of raw materials to the site
P	Transportation of finished ASRM segments to test site
Q	Transportation of finished ASRM segments to launch site
R	Power plant
S	Steam boiler
T	Air compressor
U	Launch

2195K

ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

AIR QUALITY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Motor tests and launches will release air pollutants.	K, U	Ambient air quality impacts on health and welfare standards.	Moderate	Short	Medium	Probable	Moderately Significant
		Potential significant deterioration of air quality.	Moderate	Short	Medium	Probable	Moderately Significant
Associated activities may create fugitive dust.	A, B, O, P, Q	Ambient air quality impacts on health and welfare standards.	Minor	Long	Small	Possible	Insignificant
		Potential significant deterioration of air quality.	Minor	Long	Small	Possible	Insignificant
Auxiliary production facilities and activities will release air pollutants.	B, N, R, S, C-I	Ambient air quality impacts on health and welfare standards.	Moderate	Long	Large	Probable	Moderately Significant
		Potential significant deterioration of air quality.	Moderate	Long	Large	Probable	Moderately Significant
Open burning/open demolition of propellant will occur unless alternatives are available.	L, M	Ambient air quality impacts on health and welfare standards.	Moderate	Short	Medium	Probable	Moderately significant
		Potential significant deterioration of air quality.	Moderate	Short	Medium	Probable	Moderately significant

2050K

ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

AQUATIC RESOURCES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Construction and operation of the facility could affect aquatic habitats.	A, B	Alteration or elimination of aquatic habitat.	Minor	Long	Small	Probable	Moderately significant
	A	Reduction of desirable/ native/threatened and endangered species.	Minor	Short	Small	Possible	Insignificant
	A, B	Erosion, sedimentation, and siltation of aquatic habitat from construction (e.g., road construction, dredging) and operation.	Minor	Short	Small	Possible	Insignificant
	A, B, P, Q	Accidental oil or chemical spills from construction or operation of the facility.	Moderate	Short	Medium	Possible	Insignificant
Marine operating and shipping--if rocket motors are transported by water.	O, P	Conflict with commercial or sport fishing.	Moderate	Short	Medium	Possible	Insignificant
Accidental explosion	B	Mortality of fish; loss of aquatic habitat.	Major	Medium	Medium	Unlikely	Moderately significant
Effects from static testing could affect aquatic habitats.	K	Fish kills due to decreased pH resulting from HCl in exhaust cloud.	Minor	Long	Small	Possible	Insignificant
	K	Potential impact of emission products (Al).	Moderate	Long	Small	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

CULTURAL RESOURCES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Construction of the production and testing facilities will significantly and directly affect National Register eligible historical and archaeological sites.	A	Potential that ground-disturbing activities associated with construction will impact significant archaeological sites or historic structures.	Minor	Long	Medium	Probable	Insignificant
Construction of the production and testing facilities may affect the integrity of National Register eligible archaeological sites adjacent to construction areas.	A	Potential for increased erosion of archaeological sites near or adjacent to construction areas due to increased runoff that results from vegetation clearing.	Minor	Long	Medium	Probable	Insignificant
The production and testing facilities may indirectly affect the integrity of National Register eligible and archaeological sites.	A, B U	Potential for loss of site integrity due to increased vandalism and unauthorized collecting resulting from increased accessibility of archaeological and historical sites.	Minor	Long	Small	Possible	Insignificant
	A, B	Potential for population growth due to construction and operation of the production and testing facilities to cause a need for housing developments that conflict with the need to preserve historic and archaeological sites.	Minor	Long	Large	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

CULTURAL RESOURCES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Rocket motor testing may affect the integrity of National Register eligible archaeological sites.	K	Loss of significant scientific data due to unanticipated washout of HCl from the exhaust plume. This could contaminate archaeological soils and potentially damage artifacts and architectural features.	Minor	Long	Small	Unlikely	Insignificant
	K	Potential for destruction or weakening of artifacts or architectural structures due to rocket blast vibration.	Minor	Long	Large	Unlikely	Insignificant
The rocket motor testing may affect National Register sites, parks, or monuments located near the facility.	B, K	Potential for rocket motor manufacture or testing to impact the aural or visual integrity of historical sites located near the facility.	Minor	Medium	Large	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

GEOTECHNICAL ISSUES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Soil Dynamics Effects	A, K	Potential for changes in soil parameters or damages to structures or operations due to (a) seismic events and (b) vibrations from testing. Possible problems include soil liquification (mitigated by design).	Minor	Medium	Small	Probable	Insignificant
Soil Strength Issues	A	Possible weak soils under structures (poor soil bearing strength) (mitigated by design).	Minor	Long	Large	Unlikely	Insignificant
	A	Landslide potential.	Not Applicable (insignificant slopes)				
Soil Erosion/Deposition	A	Erosion due to runoff (especially during construction) (mitigated, various measures).	Minor	Short	Medium	Possible	Insignificant
	K	Blast erosion in exhaust impact zone (mitigated by exhaust deflection ramp).	Moderate	Medium	Medium	Unlikely	Insignificant
Soil contamination or modification due to substance release.	K	Residue deposition from testing, subsequent changes to soil chemistry (partially mitigated: soil sampling).	Moderate	Long	Large	Probable	Moderately Significant
	B	Hazardous substance releases due to waste management failures (mitigated: emergency response plan, spill prevention, control, and countermeasure plan).	Moderate	Short	Medium	Unlikely	Insignificant
	B	Hazardous substance releases due to waste management catastrophic accident (mitigated: emergency response plan, spill prevention, control, and countermeasure plan).	Major	Short	Large	Unlikely	Insignificant
	K	Ignition of organic soil strata due to exhaust effects (mitigated: exhaust defection ramp, hot spot investigation).	Minor	Short	Small	Unlikely	Insignificant
Soil Chemistry Issues	A	Corrosive soils causing degradation of subsurface installations (mitigated: cathodic protection, protective coatings).	Moderate	Long	Large	Possible	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

GROUNDWATER QUALITY AND HYDROLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
The rocket motor production and testing facilities could significantly affect the groundwater resources in the vicinity of the site.	A	Potential for groundwater flow redistribution due to changes in surface hydrology--diverting streams or draining ponds; vegetation removal, increased runoff; and decrease infiltration by increasing impervious surfaces.	Minor	Long	Small	Possible	Insignificant
	A, B, K	Potential for lowering the water table due to withdrawal of groundwater for facility construction and withdrawal of groundwater for facility processes.	Minor	Short	Small	Probable	Insignificant
The rocket motor production or testing facility should not adversely impact a Sole Source or Principal Aquifer.	A, B	The facility could affect supply or quality of water in the Sole Source or Principal Aquifer if constructed in an area so designated.	-----------------------Not Applicable----------------------------- (No sole source or principal aquifer)				
The rocket motor production and testing facilities could significantly affect the groundwater quality in the vicinity of the site (or in other areas as a result of transportation accidents).	A, B	Potential changes in groundwater quality due to sanitary waste water or process waste water discharged to ground or to surface impoundments.	Minor	Long	Small	Unlikely	Insignificant
	A, B	Contaminants from processes could inadvertently be discharged to sanitary system.	Minor	Long	Small	Unlikely	Insignificant
	A, B	Potential changes in groundwater quality from accidents such as accidental spills.	Moderate	Long	Small	Unlikely	Insignificant
	K	Potential changes in groundwater quality from accidents such as acid washout by unexpected rain.	Minor	Long	Small	Possible	Insignificant
	B	Potential changes in groundwater from process waste water or sanitary waste systems disrupted by 100-year flood or hurricane floodwaters.	Minor	Long	Small	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

GROUNDWATER QUALITY AND HYDROLOGY (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
	B, N	Potential groundwater contamination in areas of landfills.	Minor	Long	Small	Unlikely	Insignificant
	K, U	Potential groundwater contamination in areas of firing pads.	Minor	Long	Small	Possible	Insignificant
	L	Potential groundwater contamination in burn areas.	Minor	Long	Small	Unlikely	Insignificant
	K, U	Potential for groundwater contamination from test firing over surface water if surface water recharges aquifers.	Minor	Long	Small	Possible	Insignificant
	B, K, L, U	Potential for affecting groundwater quality (e.g., salt water invasion) by overpumping or preventing recharge.	Minor	Long	Small	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

LAND USE

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Proposed action might involve use of or infringement upon a potentially designated (inventoried) Wild and Scenic River. (SSC)	P, Q	Increased barge traffic might be out of character with the river's existing natural setting. (Pearl River)	Major	Medium	Small	Probable	Moderately significant
	K	Increased periods of audible intrusions might be out of character with the river's natural setting (Jourdan River)	Moderate	Short	Small	Probable	Moderately significant
	K	Increased periods of audible intrusions might be out of character with the river's natural setting (Pearl River)	Minor	Short	Small	Probable	Insignificant
Compatibility of project with land use policies, plans, and controls.	A, B, K, U	Incompatibility with current land uses, planned uses, or management policies.	No incompatibility or conflict				
Unique land-based resources might be affected.	A, B	Loss of prime or unique farmlands.	Minor	Long	Medium	Possible	Insignificant
Recreational opportunities limited or constrained by project.	K, U	Restrictions on use of beach areas at KSC.	----------Not Applicable----------				
	A, B	Restrictions on use of Goat Island and dispersed recreation sites near YC.	----------Not Applicable----------				
	K	Hunting opportunities in buffer areas of SSC might be restricted.	Minor	Short	Small	Probable	Insignificant
Noise impacts based upon sensitive land uses.	K	Initial ASRM testing 4 times a year will produce noise impacts many miles from test site. (SSC, KSC)	Moderate	Short	Small	Possible	Moderately significant
	K, U	Project ope[illegible]ions will create audible disturbance to residential, commercial, and recreational uses.	Moderate	Short	Small	Possible	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

LAND USE (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Noise impacts based upon sensitive land uses. (Continued)	K	Potential damage to structures outside the buffer zone. (SSC)	Minor	Short	Small	Possible	Insignificant
Acid rain and any other potential deposition upon agricultural lands.	K, U, L, M, S	Crop damage, change in agricultural practices.	Minor	Short	Small	Probable	Insignificant
Light and glare or potential aesthetic impact on adjoining areas.	A, B	Buildings and structures might be visible from from nearby beaches, roadways, recreation waterways, and parks.	Minor	Short	Small	Probable	Insignificant
Encroachment upon existing wetlands or floodplains.	A	Wetlands may be filled for project facilities.	------------------------Not Applicable------------------------ (No evidence of wetlands within ASRM site.)				
	A, B	Dredging may alter wetlands.	------------------------Not Applicable------------------------ (No evidence of wetlands within ASRM site.)				
	K, L, M, S, U	Air emission fallout may alter wetlands. See terrestrial biota impacts	Minor	Short	Small	Probable	Insignificant
	B	Surface water discharge may alter wetlands. See water quality impacts. Impacts to receiving waters from from production processes are identical for wetlands.	Minor	Medium	Small	Possible	Insignificant
	A	Construction in the floodplain may impair the floodway.	Minor	Long	Small	Unlikely	Insignificant

ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

NOISE

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Passenger and truck traffic to and from the facility	A,B,O	Increased noise levels along local highways.	Minor	Medium/ Intermittent	Medium or Small	Probable	Insignificant
Rail traffic to and from the facility	A,O,P,Q	Increased noise levels along local highways.	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Barge traffic to and from the facility	P,Q	Noise levels from the tugs and barges in estuaries and wetlands	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Loading and unloading facilities	A,O,P,Q	Increased noise levels on site	Minor	Medium or Short	Small	Probable	Insignificant
The manufacturing facility	C, D, E, F, G, H, I	Increased noise levels on site	Minor	Long	Small	Probable	Insignificant
The power plant for the generation of steam and electricity	R,S,T	Increased noise levels on site and in surrounding areas	Minor	Long	Small	Probable	Insignificant
Non-manufacturing facilities	B,L,M,N	Increased noise levels on site	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Static test firing of ASRMs	K	Noise levels that are not compatible with the existing surrounding and could cause harm or damage to humans, biota, and structures	Major	Short	Large or Medium	Probable	Moderate to Very Significant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

NOISE (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Launch	U	Noise levels that are not compatible with the existing surrounding and could cause harm or damage to humans, biota, and structures	Not Applicable (no launch at SSC)				
Vibrations from static test firing and launches	K, U	Noise levels that may cause acoustic energy transfer to the ground and result in vibrations of the surroundings	Minor	Short	Large	Possible	Insignificant
Accidents that generate noise/ overpressure	D, E, F, G, H, K	Blast waves that could cause harm or damage to humans, biota, and structures	Major	Short	Small	Unlikely	Insignificant

ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

PUBLIC HEALTH AND SAFETY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Exposure of workers to hazardous materials during production	B-N	Exposure to small amounts of hazardous materials routinely released during production	Minor	Long	Small	Probable	Moderately Significant
	B-O	Exposure to large quantities of hazardous materials as a result of spills or leaks	Major	Short	Small	Unlikely	Moderately Significant
Explosion and fire hazards to workers or the public during production, testing, transport or disposal	B, F-M	Explosion or fire hazard during production	Major	Short	Small	Unlikely	Moderately Significant
	K	Explosion or fire hazard during testing	Major	Short	Small	Unlikely	Moderately Significant
	O-Q	Explosion or fire hazard during transport	Major	Short	Small	Unlikely	Moderately Significant
	L-M	Explosion or fire hazard during disposal	Major	Short	Small	Unlikely	Moderately Significant
Air quality impacts associated with planned or unplanned combustion of ASRMs	K	Air quality impacts associated with testing (ignition outdoors)	Minor	Short	Medium	Probable	Insignificant
	L-M	Air quality impacts associated with open-burn disposal (ignition outdoors)	Minor	Short	Medium	Probable	Insignificant
	G-H	Air quality impacts associated with accidental indoor ignition of finished segment	Major	Short	Small	Unlikely	Moderately Significant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

RADIATION

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Ionizing radiation from various radiographic instruments used in motor testing.	J	Human exposure to ionizing radiation can cause adverse health impacts.	Minor	Short	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

PUBLIC FACILITIES AND SERVICES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Potential major influx of new workers and job seekers, plus dependents, to project area.	A, B	Increased demand for police services in local communities serving project site(s).	Minor to Moderate	Long	Medium	Possible	Moderately significant
	A, B	Increased demand for fire protection services.	Minor	Long	Medium	Unlikely	Insignificant
	A, B	Increased enrollment in public schools by the children of in-migrating workers.	Minor to Major	Long	Medium	Probable	Very Significant
	A, B	Need for additional health care facilities.	Minor	Long	Medium	Unlikely	Insignificant
	A, B	Need for additional physicians and nurses.	Minor to Major	Long	Medium	Possible	Moderately Significant
	A, B	Increased demand on public water systems.	Minor	Long	Medium	Possible	Insignificant
	A, B	Increased demand on public sewer systems.	Minor	Long	Medium	Possible	Insignificant
	A, B	Increased demand on public solid waste disposal sites.	Minor	Long	Medium	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

TRANSPORTATION

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Potential major increase in local traffic due to new workers, dependents, and commuting patterns.	A, B	Increased traffic congestion, decreased traffic service levels, need for road and street network improvements, and/or need for public transportation improvements.	Minor	Long	Medium	Probable	Moderately significant
Potential adverse effects on rail and waterway transportation network.	O, P, Q	Incompatibility of ASRM shipments with capacity (load and size capability) of local rail and waterway system, or rail and barge congestion.	Minor	Long	Small	Possible	Insignificant
Potential for accidents during transportation of ASRM inputs or finished products.	O, P, Q	Property, environmental, or human health damage resulting from transportation accident.	Major	Long	Small	Unlikely	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

SOCIOECONOMICS

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Population	A	Increase in population associated with in-migrating workers and families.	Minor to Moderate	Short	Medium	Probable	Moderately Significant
Employment change due to major influx of new workers and job seekers plus dependents to project area for construction phase.	A	Change in unemployment rate associated with hiring of local and in-migrating workers.	Major	Short	Medium	Probable	Very Significant
Population	B	Increase in population associated with in-migrating workers and families.	Minor to Moderate	Medium	Medium	Probable	Moderately Significant
Employment change due to major influx of new workers and job seekers plus dependents to project area for operational phase.	B	Change in unemployment levels associated with hiring of local and in-migrating workers.	Major	Medium	Medium	Probable	Very significant
Income changes during construction and operation of new facilities.	A, B	Payroll associated with new jobs.	Minor	Long	Medium	Probable	Insignificant
Rapid demand for new housing.	A, B	Need for additional housing due to increased project associated demand.	Minor	Medium	Medium	Unlikely	Insignificant
	A, B	Positive effects due to increasing real property values and rents.	Minor	Medium	Medium	Unlikely	Insignificant
	A, B	Negative effects due to increasing property values and rents.	Minor	Medium	Medium	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

SOLID AND HAZARDOUS WASTES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Facility will generate solid waste.	A-F, H, L-N, R	High volume of solid waste can impact current waste handling procedures.	Minor	Medium	Medium	Probable	Insignificant
Facility will generate hazardous wastes.	A-F, H, L-N, R	Potential impacts on air quality, surface and groundwater, and soils.	Moderate	Medium	Small	Possible	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

SURFACE WATER QUALITY AND HYDROLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
The rocket motor production and testing facilities could significantly affect the surface water quality in the vicinity of the site.	A, B K	Changes in receiving water quality due to stormwater runoff from site construction/grading areas, production facility area, and testing pads/facility.	Minor	Medium	Small	Possible	Insignificant
	A,B	Changes in receiving water quality due to sanitary waste discharges.	Minor	Long	Small	Unlikely	Insignificant
	B, D, E, G H, K, L, M R, S, U	Changes in receiving water quality due to process water discharges.	Minor	Long	Small	Unlikely	Insignificant
	L, M	Changes in receiving water quality due to runoff/washdown waters in burn pit areas or other areas.	Minor	Medium	Small	Possible	Insignificant
	B, K	Changes in receiving water quality due to water withdrawals and/or dilution.	Minor	Long	Small	Unlikely	Insignificant
	A, B, D, E-I, K-S, U	Changes in receiving water quality due to accidental spills of materials and/or facility accident or treatment failure.	Major	Short	Small	Unlikely	Moderately significant
The rocket motor production and testing facilities would significantly affect the surface water resources in the vicinity of the site.	A, B H, K	Flow redistribution due to stream diversion, groundcover alteration, surface waterbody alterations, and effluent discharges.	Moderate	Long	Small	Possible	Moderately significant
	A, B H, K	Changes to surface waterbodies (ponding or draining) due to stream diversion, groundcover alteration, draining, topographical alteration, and withdrawals/discharges.	Moderate	Long	Small	Possible	Moderately significant
	B, H, K	Impingement of water rights.	Minor	Long	Small	Unlikely	Insignificant
	A, B, E, K	Construction/expansion of water supply facilities	Minor	Long	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - STENNIS SPACE CENTER

TERRESTRIAL ECOLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Facility construction.	A	Elimination of vegetation and habitat or direct impacts on threatened and endangered (T&E) species, waterfowl/shorebirds, migratory birds, and wetlands.	Moderate	Long Term	Small	Probable	Moderately Significant
Noise from ASRM tests .	K	Disturbance to T&E species and other wildlife. (wildlife) (T&E)	Minor Major	Intermittent Intermittent	Small Small	Probable Probable	Insignificant Moderately Significant
Deposition of aluminum oxide particulates and potential hydrochloric acid fall-out from testing.	K	Vegetation and wildlife habitat damage and stress to animals at critical seasons.	Minor	Intermittent	Small	Possible	Insignificant
Increased barge traffic.	Q	Collisions with or disturbances to T & E species and other wildlife using barge channels.	See KSC				
Increased motorized traffic.	O, Q, B	Disturbance to wildlife and T&E species in adjacent areas.	Minor	Intermittent	Small	Possible	Insignificant
Open burning of waste propellant.	L	Vegetation and wildlife habitat damage.	Minor	Intermittent	Small	Possible	Insignificant
Increase in number of launches.	U	Less vegetation and wildlife habitat damage; less noise disturbance to wildlife.	See KSC				

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APPENDIX G-3

ISSUE SIGNIFICANCE WORKSHEETS -

YELLOW CREEK

TABLE OF CONTENTS

ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

AIR QUALITY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Motor tests and launches will release air pollutants.	K, U	Ambient air quality impacts on health and welfare standards.	---------- Not applicable ---------- (No testing at Yellow Creek)				
		Potential significant deterioration of air quality.	---------- Not applicable ---------- (No testing at Yellow Creek)				
Associated activities may create fugitive dust.	A, B, O, P, Q	Ambient air quality impacts on health and welfare standards.	Minor	Long	Small	Possible	Insignificant
		Potential significant deterioration of air quality.	Minor	Long	Small	Possible	Insignificant
Auxiliary production facilities and activities will release air pollutants.	B, N, R, S, C-I	Ambient air quality impacts on health and welfare standards.	Moderate	Long	Large	Probable	Moderately significant
		Potential significant deterioration of air quality.	Moderate	Long	Large	Probable	Moderately significant
Open burning/open demolition of propellant will occur unless alternatives are available.	L, M	Ambient air quality impacts on health and welfare standards.	Moderate	Short	Medium	Probable	Moderately significant
		Potential significant deterioration of air quality.	Moderate	Short	Medium	Probable	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

AQUATIC RESOURCES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Construction and operation of the facility could affect aquatic habitats.	A, B	Erosion, sedimentation, and siltation of aquatic habitat from construction (e.g., road clearing, dredging) and operation.	Minor	Short	Small	Possible	Insignificant
	A, B, P, Q	Accidental oil or chemical spills from construction or operation of the facility.	Moderate	Short	Medium	Possible	Insignificant
Marine operating and shipping--if rocket motors are transported by water.	O, P	Conflict with commercial or sport fishing.	Minor	Short	Small	Possible	Insignificant
Accidental explosion	A, B	Elimination of aquatic habitat thereby reducing production of waterbody.	Minor	Long	Small	Possible	Insignificant
	B	Mortality of fish; loss of aquatic habitat	Major	Medium	Medium	Unlikely	Moderately Significant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

CULTURAL RESOURCES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Construction of the production and testing facilities will significantly and directly affect National Register eligible historical and archaeological sites.	A	Potential that ground-disturbing activities associated with construction will impact significant archaeological sites or historic structures.	Minor	Long	Medium	Probable	Insignificant
Construction of the production and testing facilities may affect the integrity of National Register eligible archaeological sites adjacent to construction areas.	A	Potential for increased erosion of archaeological sites near or adjacent to construction areas due to increased runoff that results from vegetation clearing.	Minor	Long	Medium	Probable	Insignificant
The production and testing facilities may indirectly affect the integrity of National Register eligible and archaeological sites.	A, B U	Potential for loss of site integrity due to increased vandalism and unauthorized collecting resulting from increased accessibility of archaeological and historical sites.	Minor	Long	Small	Possible	Insignificant
	A, B	Potential for population growth due to construction and operation of the production and testing facilities to cause a need for housing developments that conflict with the need to preserve historic and archaeologic sites.	Minor	Long	Large	Possible	Insignificant
Rocket motor testing may affect the integrity of National Register eligible archaeological sites.	K	Potential for increased erosion of archaeological surface deposits due to rocket motor test firing.	---------------------------- Not applicable ---------------------------- (No testing or launch at Yellow Creek)				
	K	Loss of significant scientific data due to aluminum oxide contamination.	---------------------------- Not applicable ---------------------------- (No testing or launch at Yellow Creek)				
	K	Loss of significant scientific data due to unanticipated washout of HCl from the exhaust plume. This could contaminate archaeological soils and potentially damage artifacts and architectural features.	---------------------------- Not applicable ---------------------------- (No testing or launch at Yellow Creek)				

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

CULTURAL RESOURCES (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
	K	Potential for destruction or weakening of artifacts or architectural structures due to rocket blast vibration.	---------- Not applicable ---------- (No testing or launch at Yellow Creek)				
The rocket motor testing may affect National Register sites, parks, or monuments located near the facility.	B, K	Potential for rocket motor manufacture or testing to impact the aural or visual integrity of historical sites located near the facility.	---------- Not applicable ---------- (No testing or launch at Yellow Creek)				

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

GEOTECHNICAL ISSUES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Soil Dynamics Effects	A	Potential for changes in soil parameters or damages to structures or operations due to seismic events. Possible problems include soil liquification (mitigated by design).	Minor	Medium	Small	Probable	Insignificant
Soil Strength Issues	A	Possible weak soils under structures (poor soil bearing strength) (mitigated by design).	Minor	Short	Small	Unlikely	Insignificant
	A	Landslide potential (mitigated by design).	Minor	Short	Large	Unlikely	Insignificant
Soil Erosion/Deposition	A	Erosion due to runoff (especially during construction) (mitigated, various measures).	Minor	Short	Medium	Possible	Insignificant
		Blast erosion in exhaust impact zone (mitigated by exhaust deflection ramp).	Not applicable (No testing at Yellow Creek)				
Soil contamination or modification due to substance release.		Residue deposition from testing, subsequent changes to soil chemistry (partially mitigated: soil sampling).	Not applicable (No testing at Yellow Creek)				
	B	Hazardous substance releases due to waste management failures (mitigated: emergency response plan, spill prevention, control, and countermeasure plan).	Moderate	Short	Medium	Unlikely	Insignificant
	B	Hazardous substance releases due to waste management catastrophic accident (mitigated: emergency response plan, spill prevention, control, and countermeasure plan).	Major	Short	Large	Unlikely	Insignificant
		Ignition of organic soil strata due to exhaust effects (mitigated: exhaust deflection ramp, hot spot investigation).	Not applicable (No testing at Yellow Creek)				
Soil Chemistry Issues	A	Corrosive soils causing degradation of subsurface installations (mitigation: cathodic protection, protective coatings).	Minor	Long	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

GROUNDWATER QUALITY AND HYDROLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
The rocket motor production and testing facilities could significantly affect the groundwater resources in the vicinity of the site.	A	Potential for groundwater flow redistribution due to changes in surface hydrology--diverting streams or draining ponds; vegetation removal, increased runoff; and decrease infiltration by increasing impervious surfaces.	Minor	Long	Small	Possible	Insignificant
	A, B, K	Potential for lowering the water table due to withdrawal of groundwater for facility construction and withdrawal of groundwater for facility processes.	Minor	Long	Small	Possible	Insignificant
The rocket motor production facility should not adversely impact a Sole Source or Principal Aquifer.	A, B	The facility could affect supply or quality of water in the Sole Source or Principal Aquifer if constructed in an area so designated.	------------------------Not Applicable-------------------------- (No sole source or principal aquifer)				
The rocket motor production and testing facilities could significantly affect the groundwater quality in the vicinity of the site (or in other areas as a result of transportation accidents).	A, B	Potential changes in groundwater quality due to sanitary waste water or process waste water discharged to ground or to surface impoundments.	Minor	Long	Small	Unlikely	Insignificant
	A, B	Contaminants from processes could inadvertently be discharged to sanitary system.	Minor	Long	Small	Unlikely	Insignificant
	A, B	Potential changes in groundwater quality from accidents such as accidental spills.	Minor	Long	Small	Unlikely	Insignificant
	U, K	Potential changes in groundwater quality from accidents such as acid washout by unexpected rain.	------------------------Not applicable---------------------------- (No testing or launch at Yellow Creek)				
	B	Potential changes in groundwater from process waste water or sanitary waste systems disrupted by 100-year flood or hurricane floodwaters.	Minor	Long	Small	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

GROUNDWATER QUALITY AND HYDROLOGY (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
	B	Potential groundwater contamination in areas of landfills.	Minor	Long	Small	Unlikely	Insignificant
	K, U	Potential groundwater contamination in areas of firing pads.	----------Not applicable---------- (No test or launch at Yellow Creek)				
	L	Potential groundwater contamination in burn areas.	Minor	Long	Small	Unlikely	Insignificant
	K, U	Potential for groundwater contamination from test firing over surface water if surface water recharges aquifers.	----------Not applicable---------- (No test or launch at Yellow Creek)				
	B, L	Potential for affecting groundwater quality (e.g., salt water invasion) by overpumping or preventing recharge.	Moderate	Long	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

LAND USE

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Proposed action might involve use of or infringement upon a potentially designated (inventoried) Wild and Scenic River. (SSC)	P, Q	Increased barge traffic might be out of character with the river's existing natural setting.	---------- Not applicable ----------				
	K	Increased periods of audible intrusions might be out of character with the river's natural setting	---------- Not applicable ----------				
Compatibility of project with land use policies, plans, and controls.	A, B, K, U	Incompatibility with current land uses, planned uses, or management policies.	No incompatibility or conflicts				
Unique land-based resources might be affected.	A, B	Loss of prime or unique farmlands.	---------- Not applicable ----------				
Recreational opportunities limited or constrained by project.	K, U	Restrictions on use of beach areas at KSC.	---------- Not applicable ----------				
	A, B	Restrictions on use of Goat Island and dispersed recreation sites near YC.	Major	Long	Small	Probable	Moderately significant
	K	Hunting opportunities in buffer areas of SSC might be restricted.	---------- Not applicable ----------				
Noise impacts based upon sensitive land uses.	K	Initial ASRM testing 4 times a year will produce noise impacts many miles from test site. (SSC, KSC)	---------- Not applicable ----------				
	K, U	Project operations will create audible disturbance to residential, commercial, and recreational uses.	Minor	Long	Small	Probable	Moderately Significant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

LAND USE (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Noise impacts based upon sensitive land uses. (Continued)	K	Potential damage to structures outside the buffer zone. (SSC)	Not applicable				
Acid rain and any other potential deposition upon agricultural lands.	K, U, L, M, S	Crop damage, change in agricultural practices.	Minor	Short	Small	Possible	Insignificant
Light and glare or potential aesthetic impact on adjoining areas.	A, B	Buildings and structures might be visible from from nearby beaches, roadways, recreation waterways, and parks.	Minor	Short	Small	Probable	Insignificant
Encroachment upon existing wetlands or floodplains.	A	Wetlands may be filled for project facilities.	Not applicable (No wetlands within ASRM site)				
	A, B	Dredging may alter wetlands.	Not applicable (No wetlands within ASRM site)				
	K, L, M, S, U	Air emission fallout may alter wetlands.	Not applicable (No wetlands within ASRM site)				
	B	Surface water discharge may alter wetlands.	Not applicable (No wetlands within ASRM site)				
	A	Increase in impervious surfaces leading to increased runoff on floodplains.	Not applicable (No floodplains within ASRM site)				

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

NOISE

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Passenger and truck traffic to and from the facility	A,B,O	Increased noise levels along local highways	Minor	Medium/ Intermittent	Medium or Small	Probable	Insignificant
Rail traffic to and from the facility	A,O,P,Q	Increased noise levels along local railways	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Barge traffic to and from the facility	P,Q	Noise levels from the tugs and barges in estuaries and wetland areas	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Loading and unloading facilities	A,O,P,Q	Increased noise levels on site	Minor	Medium or Short	Small	Probable	Insignificant
The manufacturing facility	C, D, E, F, G, H, I	Increased noise levels on site	Minor	Long	Small	Probable	Insignificant
The power plant for the generation of steam and electricity	R,S,T	Increased noise levels on site and in the surrounding areas	Minor	Long	Small	Probable	Insignificant
Non-manufacturing facilities	B,L,M,N	Increased noise levels on site	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Static test firing of ASRMs	K	Noise levels that are not compatible with the existing surrounding and could cause harm or damage to humans, biota, and structures	---------------------- Not applicable -------------------- (No testing at Yellow Creek)				
Launch	U	Noise levels that are not compatible with the existing surrounding and could cause harm or damage to humans, biota, and structures	---------------------- Not applicable -------------------- (No launch at Yellow Creek)				

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

NOISE (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Vibrations from static test firing and launches	K, U	Noise levels that may cause acoustic energy transfer to the ground and result in vibrations of the surroundings	---------------------- Not applicable (No testing) --------------------				
Accidents that generate noise/overpressure	D, E, F, G, H	Blast waves that could cause harm or damage to humans, biota, and structures	Major	Short	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

PUBLIC HEALTH AND SAFETY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Exposure of workers to hazardous materials during production	B-N	Exposure to routinely small amounts of hazardous materials released during production	Minor	Long	Small	Probable	Moderately significant
	B-O	Exposure to large quantities of hazardous materials as a result of spills or leaks	Major	Short	Small	Unlikely	Moderately significant
Explosion and fire hazards to workers or the public during production, testing, transport or disposal	B, F-M	Explosion or fire hazard during production	Major	Short	Small	Unlikely	Moderately significant
	K	Explosion or fire hazard during testing	Major	Short	Small	Unlikely	Moderately significant
	O-Q	Explosion or fire hazard during transport	Major	Short	Small	Unlikely	Moderately significant
	L-M	Explosion or fire hazard during disposal	Major	Short	Small	Unlikely	Moderately significant
Air quality impacts associated with planned or unplanned combustion of ASRMs	K	Air quality impacts associated with testing (ignition outdoors)	Minor	Short	Medium	Probable	Insignificant
	L-M	Air quality impacts associated with open-burn disposal (ignition outdoors)	Minor	Short	Medium	Probable	Insignificant
	G-H	Air quality impacts associated with accidental indoor ignition of finished segment	Major	Short	Small	Unlikely	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

RADIATION

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Ionizing radiation from various radiographic instruments used in motor testing.	J	Human exposure to ionizing radiation can cause adverse health impacts.	Minor	Short	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

PUBLIC FACILITIES AND SERVICES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Potential major influx of new workers and job seekers, plus dependents, to project area.	A, B	Increased demand for police services in local communities serving project site(s).	Minor to Moderate	Long	Medium	Possible	Moderately significant
	A, B	Increased demand for fire protection services.	Minor	Long	Medium	Unlikely	Insignificant
	A, B	Increased enrollment in public schools by the children of in-migrating workers.	Minor to Moderate	Long	Medium	Probable	Moderately Significant
	A, B	Need for additional health care facilities.	Minor	Long	Medium	Unlikely	Insignificant
	A, B	Need for additional physicians and nurses.	Minor to Major	Long	Medium	Possible	Very Significant
	A, B	Increased demand on public water systems.	Minor	Long	Medium	Possible	Insignificant
	A, B	Increased demand on public sewer systems.	Minor	Long	Medium	Possible	Insignificant
	A, B	Increased demand on public solid waste disposal sites.	Minor	Long	Medium	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

TRANSPORTATION

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Potential major increase in local traffic due to new workers, dependents, and commuting patterns.	A, B	Increased traffic congestion, decreased traffic service levels, need for road and street network improvements, and/or need for public transportation improvements.	Moderate	Long	Medium	Probable	Moderately significant
Potential adverse effects on rail and waterway transportation network.	O, P, Q	Incompatibility of ASRM shipments with capacity (load and size capability) of local rail and waterway system, or rail and barge congestion.	Minor	Long	Small	Possible	Insignificant
Potential for accidents during transportation of ASRM inputs or finished products.	O, P, Q	Property, environmental, or human health damage resulting from transportation accident.	Major	Long	Small	Unlikely	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

SOCIOECONOMICS

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Population	A	Increase in population associated with in-migrating workers and families.	Minor to Moderate	Short	Medium	Probable	Moderately significant
Employment change due to major influx of new workers and job seekers plus dependents to project area for construction phase.	A	Change in unemployment levels associated with hiring of local and in-migrating workers.	Major	Short	Medium	Probable	Very significant
Population	B	Increase in population associated with in-migrating workers and families.	Minor to Moderate	Medium	Medium	Probable	Moderately significant
Employment change due to major influx of new workers and job seekers plus dependents to project area for operational phase.	B	Change in unemployment levels associated with hiring of local and in-migrating workers.	Major	Medium	Medium	Probable	Very significant
Income changes during construction and operation of new facilities.	A, B	Payroll associated with new jobs.	Moderate	Long	Medium	Probable	Moderately significant
Rapid demand for new housing.	A, B	Need for additional housing due to increased project associated demand.	Minor	Medium	Medium	Unlikely	Insignificant
	A, B	Positive effects due to increasing real property values and rents.	Moderate	Medium	Medium	Possible	Moderately significant
	A, B	Negative effects due to increasing property values and rents.	Moderate	Medium	Medium	Possible	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

SOLID AND HAZARDOUS WASTES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Facility will generate solid waste.	A-F, H, L-N, R	High volume of solid waste can impact current waste handling procedures.	Minor	Medium	Small	Probable	Insignificant
Facility will generate hazardous wastes.	A-F, H, L-N, R	Potential impacts on air quality, surface and groundwater, and soils.	Moderate	Medium	Small	Possible	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

SURFACE WATER QUALITY AND HYDROLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
The rocket motor production facilities could significantly affect the surface water quality in the vicinity of the site.	A, B K	Changes in receiving water quality due to stormwater runoff from site construction/grading areas and production facility area.	Minor	Medium	Small	Possible	Insignificant
	A,B	Changes in receiving water quality due to sanitary waste discharges.	Minor	Long	Small	Unlikely	Insignificant
	B, D, E, G H, K, L, M R, S, U	Changes in receiving water quality due to process water discharges.	Minor	Long	Small	Unlikely	Insignificant
	L, M	Changes in receiving water quality due to runoff/washdown waters in burn pit areas or other areas.	Minor	Medium	Small	Possible	Insignificant
	B, K	Changes in receiving water quality due to water withdrawals and/or dilution.	Minor	Long	Small	Unlikely	Insignificant
	A, B, D, E-I, K-S, U	Changes in receiving water quality due to accidental spills of materials and/or facility accident or treatment failure.	Major	Short	Small	Unlikely	Moderately significant
The rocket motor production facilities would significantly affect the surface water resources in the vicinity of the site.	A, B H, K	Flow redistribution due to stream diversion, groundcover alteration, surface waterbody alterations, and effluent discharges.	Minor	Long	Small	Unlikely	Insignificant
	A, B H, K	Changes to surface waterbodies (ponding or draining) due to stream diversion, groundcover alteration, draining, topographical alteration, and withdrawals/discharges.	Minor	Long	Small	Unlikely	Insignificant
	B, H, K	Impingement of water rights.	Minor	Long	Small	Unlikely	Insignificant
	A, B, E	Construction/expansion of water supply facilities	Minor	Long	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - YELLOW CREEK

TERRESTRIAL ECOLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Facility construction.	A	Elimination of vegetation and wildlife habitat or direct impacts on federal threatened and endangered (T&E) species, waterfowl/shorebirds and migratory birds.	Minor	Long	Small	Possible	Insignificant
	A	Impacts to state-sensitive wildlife species	Moderate	Long	Small	Possible	Moderately significant
Noise from ASRM tests.	K	Disturbance to T&E species and other wildlife.	-------------------- Not Applicable -------------------- (No testing at Yellow Creek)				
Deposition of aluminum oxide particulates and potential hydrochloric acid fall-out from testing.	K	Vegetation and wildlife habitat damage and stress to animals at critical seasons.	-------------------- Not Applicable -------------------- (No testing at Yellow Creek)				
Increased barge traffic.	Q	Collisions with or disturbances to T & E species and other wildlife using barge channels.	See KCS				
Increased motorized traffic.	O, Q, B	Disturbance to wildlife and T&E species in adjacent areas.	Minor	Long	Small	Probable	Insignificant
Open burning of waste propellant.	L	Vegetation and wildlife habitat damage.	Minor	Intermittent	Small	Possible	Insignificant

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APPENDIX G-4

ISSUE SIGNIFICANCE WORKSHEETS -

KENNEDY SPACE CENTER

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

AIR QUALITY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Motor tests and launches will release air pollutants.	K, U	Ambient air quality impacts on health and welfare standards.	Moderate	Short	Medium	Probable	Moderately Significant
		Potential significant deterioration of air quality.	Moderate	Short	Medium	Probable	Moderately Significant
Associated activities may create fugitive dust.	A, B, O, P, Q	Ambient air quality impacts on health and welfare standards.	Minor	Long	Small	Possible	Insignificant
		Potential significant deterioration of air quality.	Minor	Long	Small	Possible	Insignificant
Auxiliary production facilities and activities will release air pollutants.	B, N, R, S, C-I	Ambient air quality impacts on health and welfare standards.	Moderate	Long	Large	Probable	Moderately significant
		Potential significant deterioration of air quality.	Moderate	Long	Large	Probable	Moderately significant
Open burning/open demolition of propellant will occur unless alternatives are available.	L, M	Ambient air quality impacts on health and welfare standards.	Moderate	Short	Medium	Probable	Moderately significant
		Potential significant deterioration of air quality.	Moderate	Short	Medium	Probable	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

AQUATIC RESOURCES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Construction and operation of the facility could affect aquatic habitats.	A, B	Alteration or elimination of aquatic habitat.	Moderate	Long	Medium	Probable	Moderately significant
	A, B	Erosion, sedimentation, and siltation of aquatic habitat from construction (e.g., road clearing, dredging) and operation.	Minor	Short	Small	Possible	Insignificant
	A, B, P, Q	Accidental oil or chemical spills from construction or operation of the facility.	Moderate	Short	Medium	Possible	Insignificant
	A	Reduction of desirable/ native/threatened and endangered species.	Minor	Short	Small	Possible	Insignificant
Marine operating and shipping--if rocket motors are transported by water.	O, P	Conflict with commercial or sport fishing.	Moderate	Short	Medium	Possible	Insignificant
Accidental explosion	B	Mortality of fish; loss of aquatic habitat.	Major	Medium	Medium	Unlikely	Moderately significant
Effects from static testing could affect aquatic habitats.	K	Fish kills due to decreased pH resulting from HCl in exhaust cloud.	Minor	Short	Small	Possible	Insignificant
	K	Potential impact of emission products (Al).	Moderate	Long	Small	Possible	Insignificant
Groundwater percolation pond	B	Alteration of freshwater/saltwater balance in aquifer and surface waters; change in aquatic ecosystem.	Moderate	Long	Medium	Possible	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

CULTURAL RESOURCES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Construction of the production and testing facilities will significantly and directly affect National Register eligible historical and archaeological sites.	A	Potential that ground-disturbing activities associated with construction will impact significant archaeological sites or historic structures.	Minor	Long	Large	Probable	Insignificant
Construction of the production and testing facilities may affect the integrity of National Register eligible archaeological sites adjacent to construction areas.	A	Potential for increased erosion of archaeological sites near or adjacent to construction areas due to increased runoff that results from vegetation clearing.	Minor	Long	Medium	Probable	Insignificant
The production and testing facilities may indirectly affect the integrity of National Register eligible and archaeological sites.	A, B U	Potential for loss of site integrity due to increased vandalism and unauthorized collecting resulting from increased accessibility of archaeological and historical sites.	Minor	Long	Small	Possible	Insignificant
	A, B	Potential for population growth due to construction and operation of the production and testing facilities to cause a need for housing developments that conflict with the need to preserve historic and archaeological sites.	Minor	Long	Large	Possible	Insignificant
Rocket motor testing may affect the integrity of National Register eligible archaeological sites.	K	Potential for increased erosion of archaeological surface deposits due to rocket motor test firing.	Minor	Long	Medium	Possible	Insignificant
	K	Loss of significant scientific data due to unanticipated washout of HCl from the exhaust plume. This could contaminate archaeological soils and potentially damage artifacts and architectural features.	Minor	Long	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

CULTURAL RESOURCES (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
	K	Potential for destruction or weakening of artifacts or architectural structures due to rocket blast vibration.	Minor	Long	Small	Unlikely	Insignificant
The rocket motor testing may affect National Register sites, parks, or monuments located near the facility.	B, K	Potential for rocket motor manufacture or testing to impact the aural or visual integrity of historical sites located near the facility.	Minor	Medium	Large	Probable	Insignificant

ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

GEOTECHNICAL ISSUES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Soil Dynamics Effects	A, K, U	Potential for changes in soil parameters or damages to structures or operations due to (a) seismic events and (b) vibrations from testing. Possible problems include soil liquification (mitigated by design).	Minor	Medium Term	Small	Probable	Insignificant
Soil Strength Issues	A	Possible weak soils under structures (poor soil bearing strength) (mitigated by design).	Minor	Short Term	Medium	Unlikely	Insignificant
	A	Landslide potential	-------------------- Not Applicable ---------------------------- (lack of significant slope)				
Soil Erosion/Deposition	A	Erosion due to runoff (especially during construction)(mitigated various measures).	Minor	Short Term	Medium	Possible	Insignificant
	K	Blast erosion in exhaust impact zone (mitigated by: exhaust deflection ramp blast over water)	Moderate	Medium Term	Small	Unlikely	Insignificant
Soil contamination or modification due to substance release.	K	Residue deposition from testing, subsequent changes to soil chemistry (mitigated: soil sampling, blast over water).	Minor	Long Term	Medium	Possible	Insignificant
	B	Hazardous substance releases due to waste management failures (mitigated: emergency response plan, spill prevention control, and countermeasure plan).	Moderate	Short Term	Medium	Unlikely	Insignificant
	B	Hazardous substance releases due to waste management catastrophic accident (mitigated: emergency response plan, spill prevention control, and countermeasure plan).	Major	Short Term	Large	Unlikely	Insignificant
	K	Ignition of organic soil strata due to exhaust effects (mitigated: blast over water, exhaust deflection ramp, hot spot investigation).	Minor	Short Term	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

GEOTECHNICAL ISSUES (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Soil Chemistry Issues	A	Corrosive soils causing degradation of subsurface installations (mitigated: cathodic protection, protective coatings).	Moderate	Long Term	Medium	Possible	Moderately significant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

GROUNDWATER QUALITY AND HYDROLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
The rocket motor production and testing facilities could significantly affect the groundwater resources in the vicinity of the site.	A	Potential for groundwater flow redistribution due to changes in surface hydrology--diverting streams or draining ponds; vegetation removal, increased runoff; and decrease infiltration by increasing impervious surfaces.	Moderate	Long Term	Small	Unlikely	Insignificant
	A, B, K	Potential for lowering the water table due to withdrawal of ground-water for facility construction and withdrawal of groundwater for facility processes.	Moderate	Long Term	Small	Unlikely	Insignificant
The rocket motor production or testing facility should not adversely impact a Sole Source or Principal Aquifer.	A, B	The facility could affect supply or quality of water in the Sole Source or Principal Aquifer if constructed in an area so designated.	----------------------Not Applicable---------------------------- (no sole source or principal aquifer)				
The rocket motor production and testing facilities could significantly affect the groundwater quality in the vicinity of the site (or in other areas as a result of transportation accidents).	A, B	Potential changes in groundwater quality due to sanitary waste water or process waste water discharged to ground or to surface impoundments.	Minor	Long	Small	Unlikely	Insignificant
	A, B	Contaminants from processes could inadvertently be discharged to sanitary system.	Minor	Long	Small	Unlikely	Insignificant
	A, B, O	Potential changes in groundwater quality from accidents such as accidental spills.	Moderate	Long	Medium	Unlikely	Insignificant
	K, U	Potential changes in groundwater quality from accidents such as acid washout by unexpected rain.	Minor	Long	Small	Possible	Insignificant
	B	Potential changes in groundwater from process waste water or sanitary waste systems disrupted by 100-year flood or hurricane floodwaters.	Minor	Long	Small	Possible	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

GROUNDWATER QUALITY AND HYDROLOGY (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
	B, N	Potential gr [illegible]ater contaminatio[illegible] in areas of landfills.	Minor	Long	Small	Unlikely	Insignificant
	K, U	Potential groundwater contamination in areas of firing pads.	Minor	Long	Small	Possible	Insignificant
	L	Potential groundwater contamination in burn areas.	Minor	Long	Small	Unlikely	Insignificant
	K, U	Potential for groundwater contamination from test firing over surface water if surface water recharges aquifers.	Minor	Long	Small	Possible	Insignificant
	B, K, L, U	Potential for affecting groundwater quality (e.g., salt water invasion) by overpumping or preventing recharge.	Major	Medium	Large	Unlikely	Moderately Significant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

LAND USE

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Proposed action might involve use of or infringement upon a potentially designated (inventoried) Wild and Scenic River. (SSC)	P, Q	Increased barge traffic might be out of character with the river's existing natural setting.	----------Not Applicable---------- (no nearby rivers eligible)				
	K	Increased periods of audible intrusions might be out of character with the river's natural setting	----------Not Applicable---------- (no nearby rivers eligible)				
Compatibility of project with land use policies, plans, and controls.	A, B, K, U	Incompatibility with current land uses, planned uses, or management policies (Area C). (Area B is consistent.)	Major	Long	Small	Probable	Very Significant
Unique land-based resources might be affected.	A, B	Loss of prime or unique farmlands.	----------Not Applicable----------				
Recreational opportunities limited or constrained by project.	K, U	Restrictions on use of beach areas at KSC.	Major	Short	Long	Possible	Insignificant
	A, B	Restrictions on use of Goat Island and dispersed recreation sites near YC.	----------Not Applicable---------- (applies at Yellow Creek only)				
	K	Hunting opportunities in buffer areas of SSC might be restricted.	----------Not Applicable---------- (applies at SSC only)				
Noise impacts based upon sensitive land uses.	K	Initial ASRM testing 4 times a year will produce noise impacts many miles from test site. (SSC, KSC)	Moderate	Short	Small	Probable	Moderately Significant
	B	Project operations will create disturbance to residential, commercial, and recreational uses.	Minor	Short	Small	Probable	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

LAND USE (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Noise impacts based upon sensitive land uses. (Continued)	K	Potential damage to structures outside the buffer zone. (SSC)	----------Not Applicable---------- (applies at SSC only)				
Acid rain and any other potential deposition upon agricultural lands.	K, U, L, M, S	Crop damage, change in agricultural practices.	Minor	Long	Small	Possible	Insignificant
Light and glare or potential aesthetic impact on adjoining areas.	A, B	Buildings and structures might be visible from from nearby beaches, roadways, recreation waterways, and parks.	Minor	Long	Small	Possible	Insignificant
Encroachment upon existing wetlands or floodplains.	A	Wetlands may be filled for project facilities.	Minor	Long	Small	Probable	Moderately Significant
	A, B	Dredging may alter wetlands. See water quality impacts.	Minor	Long	Small	Unlikely	Insignificant
	K, L, M, S, U	Air emission fallout may alter wetlands. See terrestrial biota impacts.	Minor	Short	Small	Unlikely	Insignificant
	B	Surface water discharge may alter wetlands. See water quality impacts. Impacts to receiving waters from production processes are identical for wetlands.	Minor	Medium	Small	Possible	Insignificant
	A	Construction in the floodplain may impair the floodway.	Minor	Long	Small	Unlikely	Insignificant

ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

NOISE

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Passenger and truck traffic to and from the facility	A,B,O	Increased noise levels along local highways.	Minor	Medium/ Intermittent	Medium or Small	Probable	Insignificant
Rail traffic to and from the facility	A,O,P,Q	Increased noise levels along local highways.	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Barge traffic to and from the facility	P,Q	Noise levels from the tugs and barges in estuaries and wetland areas.	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Loading and unloading facilities	A,O,P,Q	Increased noise levels on site.	Minor	Medium or Short	Small	Probable	Insignificant
The manufacturing facility	C, D, E, F, G, H, I	Increased noise levels on site.	Minor	Long	Small	Probable	Insignificant
The power plant for the generation of steam and electricity	R,S,T	Increased noise levels on site and in the surrounding areas.	Minor	Long	Small	Probable	Insignificant
Non-manufacturing facilities	B,L,M,N	Increased noise levels on site.	Minor	Medium or Short	Medium or Small	Probable	Insignificant
Static test firing of ASRMs	K	Noise levels that are not compatible with the existing surrounding and could cause harm or damage to humans, biota, and structures	Major	Short	Large or Medium	Probable	Moderate to Very Significant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

NOISE (CONTINUED)

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Vibrations from static test firing and launches	K, U	Noise levels that may cause acoustic energy transfer to the ground and result in vibrations of the surroundings.	Minor	Short	Large	Possible	Insignificant
Accidents that generate noise/overpressure	D, E, F, G, H, K, U	Blast waves that could cause harm or damage to humans, biota, and structures.	Major	Short	Small	Unlikely	Insignificant

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ISSUE SIGNIFICANCE WORKSHEET - KENNEDY SPACE CENTER

PUBLIC HEALTH AND SAFETY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Exposure of workers to hazardous materials during production	B-N	Exposure to routinely small amounts of hazardous materials released during production	Minor	Long	Small	Probable	Moderately Significant
	B-O	Exposure to large quantities of hazardous materials as a result of spills or leaks	Major	Short	Small	Unlikely	Moderately Significant
Explosion and fire hazards to workers or the public during production, testing, transport or disposal	B, F-M	Explosion or fire hazard during production	Major	Short	Small	Unlikely	Moderately Significant Significant
	K	Explosion or fire hazard during testing	Major	Short	Small	Unlikely	Moderately Significant
	O-Q	Explosion or fire hazard during transport	Major	Short	Small	Unlikely	Moderately Significant
	L-M	Explosion or fire hazard during disposal	Major	Short	Small	Unlikely	Moderately Significant
Air quality impacts associated with planned or unplanned combustion of ASRMs	K	Air quality impacts associated with testing (ignition outdoors)	Minor	Short	Medium	Probable	Insignificant
Air quality impacts associated with planned or unplanned combustion of ASRMs	L-M	Air quality impacts associated with open-burn disposal (ignition outdoors)	Minor	Short	Medium	Probable	Insignificant
	G-H	Air quality impacts associated with accidental indoor ignition of finished segment	Major	Short	Small	Unlikely	Moderately Significant

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RADIATION

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Ionizing radiation from various radiographic instruments.	J	Human exposure to ionizing radiation.	Minor	Short	Small	Probable	Insignificant

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PUBLIC FACILITIES AND SERVICES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Potential major influx of new workers and job seekers, plus dependents, to project area.	A, B	Increased demand for police services in local communities serving project site(s).	Minor	Short to Medium	Medium	Possible	Insignificant
	A, B	Increased demand for fire protection services	Minor	Long	Medium	Possible	Insignificant
	A, B	Increased enrollment in public schools by the children of in-migrating workers	Moderate	Long	Medium	Possible	Moderately significant
	A, B	Need for additional health care facilities.	Minor	Long	Medium	Unlikely	Insignificant
	A, B	Need for additional physicians and and nurses.	Minor	Long	Medium	Unlikely	Insignificant
	A, B	Increased demand on public water systems.	Minor to Moderate	Long	Medium	Possible	Moderately Significant
	A, B	Increased demand on public sewer systems.	Minor to moderate	Long	Medium	Possible	Moderately Significant
	A, B	Increased demand on public solid disposal sites.	Minor	Long	Medium	Possible	Insignificant

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TRANSPORTATION

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Potential major increase in local traffic due to new workers, dependents, and commuting patterns.	A, B	Increased traffic congestion, decreased traffic service levels, need for road and street network improvements, and/or need for public transportation improvements.	Minor	Long	Medium	Unlikely	Insignificant
Potential adverse effects on rail and waterway transportation network.	O, P, Q	Incompatibility of ASRM shipments with capacity (load and size capability) of local rail and waterway system, or rail and barge congestion.	Minor	Long	Small	Possible	Insignificant
Potential for accidents during transportation of ASRM inputs or finished products.	O, P, Q	Property, environmental, or human health damage resulting from transportation accident.	Minor	Long	Small	Unlikely	Insignificant

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SOCIOECONOMICS

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Population	A	Increase in population associated with in-migrating workers and families	Minor	Short	Medium	Possible	Insignificant
Employment change due to major influx of new workers and job seekers plus dependents to project area for construction phase.	A	Change in unemployment levels associated with hiring of local and in-migrating workers	Major	Short	Medium	Probable	Very significant
Population	B	Increase in population associated with in-migrating workers and families.	Minor	Medium	Medium	Possible	Insignificant
Employment change due to major influx of new workers and job seekers plus dependents to project area for operational phase.	B	Change in unemployment levels associated with hiring of local and in-migrating workers.	Major	Short to Medium	Medium	Probable	Very Significant
Income changes during construction and operation of new facilities.	A, B	Payroll associated with new jobs.	Minor	Long	Medium	Probable	Insignificant
Rapid demand for new housing and commercial facilities may exceed capacity to build.	A,B,	Need for additional housing due to increased project associated demand.	Minor	Medium	Medium	Possible	Insignificant
	A, B	Positive effects due to increasing real property values and rents.	Minor	Short to Medium	Medium	Unlikely	Insignificant
	A, B	Negative effects due to increasing property values and rents.	Minor	Short to Medium	Medium	Unlikely	Insignificant

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SOLID AND HAZARDOUS WASTES

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Facility will generate solid waste.	A-F, H, L-N, R	Volume of solid waste can impact current waste handling and procedures.	Minor	Medium	Medium	Probable	Insignificant
Facility will generate hazardous wastes.	A-F, H, L-N, R	Potential impacts on air quality, surface and groundwater, and soils.	Moderate	Medium	Small	Possible	Moderately significant

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SURFACE WATER QUALITY AND HYDROLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
The rocket motor production and testing facilities could significantly affect the surface water quality in the vicinity of the site.	A, B K	Changes in receiving water quality due to stormwater runoff from site construction/grading areas, production facility area, and testing pads/facility.	Minor	Medium	Small	Possible	Insignificant
	A,B	Changes in receiving water quality due to sanitary waste discharges.	Minor	Long	Small	Unlikely	Insignificant
	B, D, E, G H, K, L, M R, S, U	Changes in receiving water quality due to process water discharges.	Minor	Long	Small	Unlikely	Insignificant
	L, M	Changes in receiving water quality due to runoff/washdown waters in burn pit areas or other areas.	Minor	Medium	Small	Possible	Insignificant
	B, K	Changes in receiving water quality due to water withdrawals and/or dilution.	Minor	Long	Small	Possible	Insignificant
	A, B, D, E-I, K-S, U	Changes in receiving water quality due to accidental spills of materials and/or facility accident or treatment failure.	Major	Short	Small	Unlikely	Moderately significant
The rocket motor production and testing facilities would significantly affect the surface water resources in the vicinity of the site.	A, B H, K	Flow redistribution due to stream diversion, groundcover alteration, surface waterbody alterations, and effluent discharges.	Moderate	Long	Small	Unlikely	Insignificant
	A, B H, K	Changes to surface waterbodies (ponding or draining) due to stream diversion, groundcover alteration, draining, topographical alteration, and withdrawals/discharges.	Moderate	Long	Small	Possible	Moderately significant
	B, H, K	Impingement of water rights.	Minor	Long	Small	Unlikely	Insignificant
	A, B, E, K	Construction/expansion of water supply facilities	Minor	Long	Small	Unlikely	Insignificant

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TERRESTRIAL ECOLOGY

Issue	Process Code	Types of Potential Impacts	Magnitude	Duration	Extent	Likelihood	Significance
Facility construction.	A	Elimination of vegetation and habitat or direct impacts on threatened and endangered (T&E) species, waterfowl/shorebirds, migratory birds, and wetlands.	(wildlife & vegetation) Moderate	Long	Small	Probable	Moderately Significant
			(T&E) Major	Long	Medium	Probable	Very Significant
Noise from ASRM tests .	K	Disturbance to T&E species and other wildlife.	(wildlife) Minor	Intermittent	Small	Probable	Insignificant
			(T&E) Major	Intermittent	Small	Probable	Moderately Significant
Deposition of aluminum oxide particulates and potential hydrochloric acid fall-out from testing.	K	Vegetation and wildlife habitat damage and stress to animals at critical seasons.	(wildlife & vegetation) Minor	Intermittent	Small	Unlikely	Insignificant
			(T&E) Major	Intermittent	Medium	Probable	Moderately Significant
Increased barge traffic.	Q	Collisions with or disturbances to T & E species and other wildlife using barge channels.	(wildlife) Minor	Intermittent	Medium	Unlikely	Insignificant
			(T&E) Major	Intermittent	Medium	Unlikely	Moderately Significant
Increased motorized traffic.	O, Q, B	Disturbance to wildlife and T&E species in adjacent areas.	(wildlife) Minor	Intermittent	Small	Possible	Insignificant
			(T&E) Major	Intermittent	Small	Possible	Moderately Significant
Open burning of waste propellant.	L	Vegetation and wildlife habitat damage.	Minor	Intermittent	Small	Possible	Insignificant

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APPENDIX H

SUMMARY OF SCOPING COMMENTS

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Scoping Comments

Letter Number	Agency	Name	Comment
1	U.S. Air Force, Patrick Air Force Base, Headquarters Eastern Space and Missile Center	Leon G. LaMarre Chief, Booster Branch, Missile Systems Safety Division	1 Do not consider a site on KSC that is within the existing STS impact limit lines. 2 If sited on CCAFS, we expect noise pollution, air pollution, and a major Q/D siting effort, and significant risk to other programs. 3 Complex 37 has been reserved for the ALS program.
2	U.S. Air Force, Patrick Air Force Base, Headquarters Eastern Space and Missile Center	Robert G. Wilfong Chief, Plans and Programs Division	1 At KSC consider interference with future launch capability. 2 Future launch programs (such as ALS) may consider KSC sites. 3 At KSC avoid any potential launch sites and associated processing or integration areas. 4 The Complex 34/37 area is reserved for ALS. 5 Critical launch and support assets would be jeopardized by either ASRM manufacturing or testing at CCAFS. 6 Environmental concerns (toxic gas, high noise, increased potential for explosion would be greater for a horizontal test firing than for a launch because of the extended burn time at ground level. 7 Prevalent offshore winds would either increase hazards to personnel and the environment (including endangered species), or impact the test schedule. 8 Required separation distances to protect personnel and national assets may prevent siting at KSC or CCAFS. 9 Operational and environmental advantages from reduced transportation and nondestructive testing (x-ray) near launch site must be considered.
3	U.S. Air Force, Patrick Air Force Base, Headquarters CCAFS	John H. Johnson Assistant to the Commander	1 Does not object to site at KSC or CCAFS, as long as it does not restrict normal activities and is located on NASA/KSC property. 2 Due to limited usable space at CCAFS, all manufacturing and processing should be on KSC property, with only testing facilities located on CCAFS if suitable sites are not found at KSC.
4	U.S. Air Force, Patrick Air Force Base, Headquarters 6550th Air Base Group	Dwayne R. Hawkins Acting Chief, Plans, Programs, Resources and Range Support Division	1 Do not foresee any environmental impact from providing communications to ASRM facilities located on CCAFS. 2 If located in Complex 37, a new, expensive cable system would be needed, which would require long-range programming.
5	U.S. Air Force, Patrick Air Force Base, Headquarters 6550th Air Base Group	James Dickerson Chief, Engineering and Environmental Planning Branch	1 Deterioration of air quality on CCAFS could limit our ability to obtain permits for additional air emission sources. 2 Acid fall-out from ground cloud of the static rocket test would be worse than the effects of Shuttle launches, which kill vegetation and fish.a/ 3 Acid fall-out could kill scrub oak vegetation, which would affect the Florida Bay Scrub Jay, a federally listed threatened species. 4 Destruction of sea oats and other sea vegetation would cause increased erosion on the beach.

a/ Comment is not accurate as stated. Static test impacts are not analogous to launch impacts.

Letter Number	Agency	Name		Comment
			5	Additional lighting at CCAFS could impact three protected species of sea turtles by causing hatchling disorientation.
			6	Acid fall-out could impact the Banana River, which is a Florida Outstanding Water.
			7	Complex 37 is potentially eligible for listing as a Historic Property.
6	U.S. Army HSG MGT Division	Stephen P. Ansley Major, USA General Staff	1	Identify whether Soviet inspectors and other foreign nationals will have access to the proposed site as part of the INF Treaty inspection privileges.
7	Brevard County, Florida, Board of County Commissioners	Sue Schmitt, Chairman	1	Brevard County strongly supports expanding their space-related industrial base.
			2	All new business should preserve the environment.
			3	Climate rarely hinders production or testing schedules.
8	Brevard County, Florida, Board of County Commissioners	Roger W. Dobson Commissioner, District 2	1	Project would have a positive impact on Brevard County economy.
			2	KSC contains the Canavarel National Seashore and the Merritt Island National Wildlife Refuge and is critical habitat for the bald eagle, the manatee, and the loggerhead turtle.
9	City of Cape Canaveral, Florida	Leo Nicholas City Manager	1	City supports facility location in Brevard County
10	South Florida Water Management District, Department of Land Management	Riesley R. Jones Director, Save Our Rivers Program	1	Aerojet Dade County Facility will not qualify because it will not be all government owned. SFWMD purchased about 21,550 acres to reestablish a more natural water regime to Florida Bay and the Everglades National Park.b/
11	Yellow Creek State Inland Port Authority, Mississippi	Cliff Mitchener Executive Director	1	The TVA Yellow Creek site is in a remote rural area in northeast Mississippi, is elevated above surrounding terrain, and is surrounded by Pickwick Lake.
			2	The sparse population near the site will minimize impacts.
			3	The elevation of the site will minimize impacts.
			4	The profusion of biological resources at the site will encourage repropagation.
			5	There are no endangered/threatened species at the site.
			6	Remote location of the site would minimize risk associated with fire, explosion, and and accidental release of hazardous and toxic materials.
12	Department of the Army, Stennis Space Center, Mississippi Army Ammunition Plant	Dana Matherly, P.E. Chief EN/OR Division	1	No comment thus far.

b/ This comment addresses a site no longer being considered.

Scoping Comments

Letter Number	Agency	Name		Comment
13	Mississippi State Senate	Margaret "Wootsie" Tate Senator, District 47	1	Stennis Space Center is most attractive location.
14	Office of Strategic Defense Initiatives Oceanic Space Navigation Company	Edgar John Decker	1	Wants study of different fuel.
15	Slidell Chamber of Commerce	Warren J. Haun, President	1	Pledge total support for site at Stennis Space Center.
16	St. Tammany Parish Economic Development Foundation	A.G. Crowe, President	1	Pledge total support for site at Stennis Space Center.
17	City of Slidell	Salvatore A. Caruso, Mayor	1	Pledge total support for site at Stennis Space Center.
18	City of Bay St. Louis	Victor J. Franckiewicz, Jr. Mayor	1	Community fully supports site at Stennis Space Center.
19	City of Picayune	G.H. Mitchell, Mayor	1	Supports site at Stennis Space Center.
20	Picayune Area Chamber of Commerce	W.B. Moody, President	1	Supports site at Stennis Space Center.
21	Pearl River County Develop. Assoc.	M. Stewart, President	1	Supports site at Stennis Space Center.
22	U.S. Air Force, Environmental Division Directorate of Engr & Svsc	Donald A. Kane, Col USAF	1	Requests cooperating agency status.
			2	Potential major air quality impacts from acid cloud affecting downwind operations at the Cape or Air Force Plant #78.[c] Incremental increases from all other sources could degrade air quality to where standards could no longer be met.
			3	Additional launches at KSC would have potentially major impacts to launches from Cape due to scheduling interferences.
			4	Acid cloud could potentially impact endangered species at KSC. Need to address mitigation and ensure coordination with natural resources staff at CCAFS.
			5	Potential major impacts from disposal of solid rocket propellant. On-site disposal could affect air quality.
			6	Potentially minor impact on water quality. Fallout could impact Banana River and Atlantic Ocean. Discharges from NASA ASRM activities could tighten controls on Air Force discharges.
			7	Potential minor impact on electrical demand. Could influence availability of electrical power for planned facilities at the Cape, Patrick AFB, and AFP #78.[c]

c/ ASRM activities would not adversely affect AFP #78, which is located in Utah near the existing RSRM contractor location. Any current RSRM impacts would be eliminated at that site.

Scoping Comments

Letter Number	Agency	Name		Comment
23	State of Florida Department of Commerce, Division of Economic Development	Nick Leslie Economist Supervisor	1	Fully supportive of locating facility in Florida because of tremendous positive impact on the state's economy.
24	State of Florida, Office of the Governor	Bob Martinez, Governor	1 2	Supports Kennedy Space Center-Cape Canaveral Air Force Station for a government-owned site. Florida offers the best sites in the country.
25	State of Florida, Department of Natural Resources	Jeremy A. Craft, Director Division of Resource Management	1 2 3	Address all possible impacts to resources lying within lands under DNR management. Florida sites under consideration are in or near wetlands. Impacts should be assessed in relation to uniquely high resource values and growing population pressure.
26	Florida Department of State, Division of Historical Resources	George W. Percy, Director Division of Historical Resources and State Historic Preservation Officer	1	Recommends an archaeological site assessment survey be conducted prior to project development.
27	Florida Department of Environmental Regulation	Gary L. Shaffer, Deputy Director, Division of Environmental Permitting	1 2	The EIS should address impacts to wetlands, threatened and endangered species, coastal resources, air quality, surface waters, and groundwater resources. Project at this phase is consistent with Florida Coastal Management Program.
28	Florida Department of State, Division of Historical Resources	George W. Percy, Director Division of Historical Resources and State Historic Preservation Officer	1 2	The interior of Area C has a low likelihood of containing additional sites; therefore, no additional survey is recommended for Area C. The archaeologist that carries out the field investigations should consult with our office about appropriate field methodology before initiating any survey.
29	State of Florida, Office of the Governor	Karen K. MacFarland, Director State Clearinghouse	1	Project has complied with the requirements of Presidential Executive Order 12372 and the Coastal Zone Management Act.

APPENDIX I

SUMMARY OF ENVIRONMENTAL REVIEW AND CONSULTATION

Table I-1. Summary of Environmental Review and Consultation

Name and Title	Agency or Organization	Location	Expertise Sought in this Consultation
HISTORIC PRESERVATION			
Rick Lance	TVA	Blue Ridge Place 45167 1101 Market St. Chattanooga, TN 37402	Cultural resources at Yellow Creek (No adverse effects after mitigation of impacts from Yellow Creek nuclear plant)
Harry Butowski	U.S. Department of the Interior, National Park Service, National Historic Landmarks Office	Washington, D.C.	National Historic Landmark status of NASA launch complexes (Launch Complex 34 National Historic Landmark; Complex 37 potential for National Register for Historic Places)
Michael Beard	Mississippi State Historic Preservation Office	Jackson, MS	Mississippi State historic preservation law (No laws for private land; NASA should submit copies of TVA determination of adverse affect with supporting documentation to obtain SHPO clearance for ASRM project)
Walter Marder, Compliance Officer	Florida State Historic Preservation Office, Bureau of Historic Resources	Tallahassee, FL	Cultural resource sites at Kennedy Space Center (Complex 34 is National Historic Landmark)
Betty Broyles, Archaeologist (retired)	Formerly with the Center for Archaeological Research, University of Mississippi	Chattanooga, TN	Potential historic structures in Yellow Creek vicinity (No outstanding structures)

Table I-1. Summary of Environmental Review and Consultation

Name and Title	Agency or Organization	Location	Expertise Sought in this Consultation
Robert Taylor, Compliance Officer	Florida State Historic Preservation Office, Bureau of Historic Resources	Tallahassee, FL	Florida State historic preservation law ([1] Chapter 267, Florida Statutes, felony to knowingly destroy or deface a human burial or monument, must first contact county coroner. If mound is over 75 years old, Bureau of Archaeological Research, Florida Dept. of State has jurisdiction. [2] Chapter 380.06, Florida Statutes, DRIs reviewed by Historic Resources Office)
Don George, Environmental Engineer	Cape Canaveral Air Force Station	Pan American World Services	Cultural resources at Kennedy Space Center (KSC and CCAFS needs to have a management plan and programmatic memo agreement for cultural resources)
Lewis Tesar, Section Head, 106 Compliance	Florida State Historic Preservation Office	Tallahassee, FL	Cultural resources at Kennedy Space Center
Mario Busacca, Ecologist	Kennedy Space Center	Kennedy Space Center, FL	Cultural resources at Kennedy Space Center (KSC and NASA go through Section 106 review with the Florida State Historic Preservation Office and Advisory Council on Historic Preservation when they want to modify or reuse the potentially eligible launch complexes)

Table I-1. Summary of Environmental Review and Consultation

Name and Title	Agency or Organization	Location	Expertise Sought in this Consultation
ENDANGERED SPECIES			
Sandy Tucker	USFWS	Daphne, AL	Bald eagle nest in SSC buffer (Confirmed)
Larry E. Goldman, Field Supervisor	U.S. Department of the Interior Fish and Wildlife Service	P.O. Drawer 1190 Daphne, AL 36526	Endangered species (None at SSC, but three protected species in SSC buffer zone)
Stephen Lau, Biological Scientist III	Florida Game and Fresh Water Fish Commission	110 43rd Avenue, S.W. Vero Beach, FL 32962	Merritt Island endangered or threatened species or species of special concern (22 species listed)
Curtis B. James, Acting Field Supervisor	U.S. Department of the Interior Fish and Wildlife Service	900 Clay Street, Room 235 Vicksburg, MS 39180	Endangered species at Yellow Creek (None)
David J. Wesley, Field Supervisor	U.S. Department of the Interior Fish and Wildlife Service	3100 University Blvd. South Suite 120 Jacksonville, FL 32216	Endangered species at Kennedy Space Center (Nine in area)
James B. Wiseman, Jr., Ph.D. Community Ecologist, Data Specialist, Protection Planner	Mississippi Department of Wildlife Conservation, Mississippi Museum of Natural Science, Mississippi Natural Heritage Program	The Fannye A. Cook Memorial 111 N. Jefferson Street Jackson, MS 39202	Threatened and endangered species
COASTAL ZONE MANAGEMENT			
Lynn Griffin, Jurisdiction Specialist	Florida Department of Environmental Regulation (FDER)	FL	Coastal zone consistency (FDER has jurisdiction over entire state of Florida and conducts consistency review)
John Ryan	NASA Environmental Management Staff	Kennedy Space Center	Consistency with Florida's Coastal Management Program (Only lands not owned by NASA are under state jurisdiction. NASA owns KSC waters

Table I-1. Summary of Environmental Review and Consultation

Name and Title	Agency or Organization	Location	Expertise Sought in this Consultation
FISH AND WILDLIFE PROTECTION			
Dr. Robert Esher	Mississippi State University Research Center	SSC	Aquatic resources at SSC (Limited fish resources)
WILD AND SCENIC RIVERS			
Wally Brittain, Outdoor Recreation Planner	National Park Service - SE Region	Atlanta, GA	Wild and scenic rivers (None in project area of three sites; potential--Jordan and Pearl Rivers in Hancock County)
PRIME AND UNIQUE AGRICULTURAL LAND			
District Supervisor	Soil Conservation Service	Iuka, MS	Prime soils in Tishomingo County (None)
Dave Prewitt	SCS - Brevard County	Rockledge, FL	Prime and unique farmland in Brevard County (No prime, consider citrus groves unique)
Linda McMann, District Conservationist	SCS - Hancock County	Kiln, MS	Prime and unique farmland in Hancock County (Nine soil types considered prime)
SAFE DRINKING WATER			
Ron Mikulak	U.S. Environmental Protection Agency Region IV, Groundwater Protection Office	345 Courtland St. Atlanta, GA 30365	Sole source aquifers (None proposed or designated at KSC, SSC, Yellow Creek)
FLOODPLAIN AND WETLANDS			
Arthur Hosey, Supervisory Biologist	U.S. Army Corps of Engineers Mobile District Office	Mobile	Wetlands permits at YC and SSC (Wetlands over 1 acre require a 404 permit under the Clean Water Act)

Table I-1. Summary of Environmental Review and Consultation

Name and Title	Agency or Organization	Location	Expertise Sought in this Consultation
Becky McCaleb	NASA	SSC	Floodplains at ASRM site (SSC has experienced 100 and 500 year flood events within the last 13 years, but no flooding occurred)