

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NASA CONTRACT NO. NASW-4598
TASK ORDER NO. 27

ENVIRONMENTAL ASSESSMENT FOR
REPAIRS TO UNITARY PLAN WIND TUNNEL SHELL
BUILDING 1251

LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA

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REPAIRS TO UNITARY PLAN WIND TUNNEL SHELL
BUILDING 1251
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA

APRIL 1993

Prepared By:

Ebasco Services Incorporated

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ACRONYMS AND ABBREVIATIONS

AEDC	Arnold Engineering Development Center
CFR	Code of Federal Regulations
EA	Environmental Assessment
FONSI	Finding of No Significant Impact
KPA	Kilopascals
LaRC	Langley Research Center
LHB	Langley Handbook
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHB	NASA Handbook
PSI	Pounds Per Square Inch
SHPO	State Historic Preservation Officer
SST	Supersonic Transport

1.0 SUMMARY AND CONCLUSIONS

The proposed action is designed to support the National Aeronautics and Space Administration's (NASA) continuing studies of supersonic aerodynamics. The Unitary Plan Wind Tunnel at the NASA Langley Research Center (LaRC) is the only facility of its type at LaRC, and is one of the Center's most-active facilities. The proposed repairs of defective tunnel shell welds are necessary to maintain this research capability.

The proposed action, the No-Action alternative, and the New-Construction alternative were considered in this Environmental Assessment (EA). The No-Action alternative will not prevent limitations on future facility operation imposed by defective welds in the tunnel shell. The New-Construction alternative will be time- and cost-prohibitive.

Based on the evaluations presented in this EA, the environmental impacts associated with the proposed repairs to the LaRC Unitary Plan Wind Tunnel shell will not individually or cumulatively have a significant effect on the quality of the environment. A Finding of No Significant Impact (FONSI) is recommended.

2.0 PURPOSE AND NEED

2.1 FACILITY BACKGROUND

The Unitary Plan Wind Tunnel (Building 1251) at the National Aeronautics and Space Administration (NASA)/Langley Research Center (LaRC) is a closed-circuit, variable-pressure tunnel used for research on civil and military aircraft and for advanced development of space transportation systems. This tunnel has supported developmental tests of virtually every supersonic military airplane, missile, and spacecraft to become operational in the U.S. inventory. Most of the many aircraft configurations proposed in the National Supersonic Transport (SST) program were tested in this facility, and considerable experimental investigations in support of the Space Shuttle Program have been conducted (Jackson et al., 1981).

2.2 PROJECT OBJECTIVE

The primary objective of the proposed action is to repair defective welds of the LaRC Unitary Plan Wind Tunnel shell. As a result of the LaRC Recertification Program for Pressure Vessels, the LaRC Unitary Plan Wind Tunnel shell has undergone nondestructive examination of the most critically stressed areas. Indications of defective welds have been found that, although unacceptable, have not yet reached their critical flaw size. Nevertheless, repair of the most serious of these indications is essential to ensure the safe and efficient operation of this facility. Delay in proceeding with the necessary repairs to the tunnel shell may result in continued growth of the known defective welds to their critical flaw size. Under this circumstance, the facility would have to (a) severely limit its annual usage rate, (b) operate at lower pressures, or (c) completely shut down operations. This would hinder much of the essential supersonic research conducted at LaRC.

2.3 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This Environmental Assessment (EA) addresses environmental issues related to the proposed repair of the tunnel shell, and operation of the LaRC Unitary Plan Wind Tunnel after the repairs are completed. This EA was prepared in accordance with the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) (40 CFR Parts 1500 - 1508) and NASA's regulations implementing the provisions of NEPA (14 CFR Part 1216.3, as addressed in NHB 8800.11 and LHB 8800.1).

3.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

3.1 FACILITY DESCRIPTION

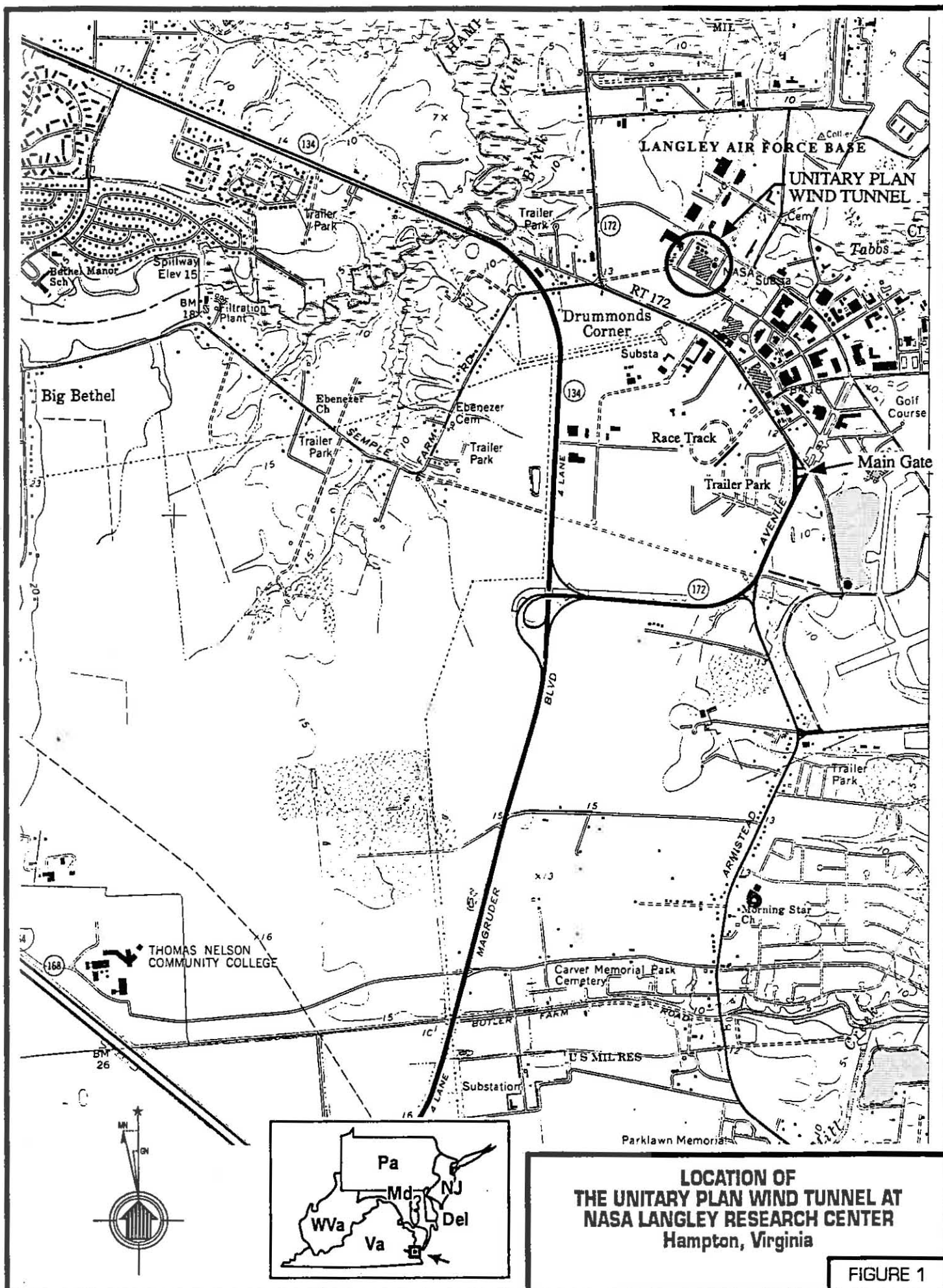
The existing LaRC Unitary Plan Wind Tunnel is located south of Langley Boulevard in the West Area of Center, in the Hampton Roads area of southeastern Virginia (Figure 1). The facility is located in a densely developed area of LaRC. The LaRC Unitary Plan Wind Tunnel is a closed-circuit, variable-pressure tunnel used for research on civil and military aircraft, and for advanced development of space transportation systems. The test medium is recirculated dry air. The facility operates in the supersonic mode at Mach numbers from 1.47 to 4.63, and a normal operating pressure range from near-vacuum (0.1 atmosphere) to 10 atmospheres. The tunnel has two 4- by 4- by 7-foot (1.22- by 1.22- by 2.13-meter) test sections (Figure 2).

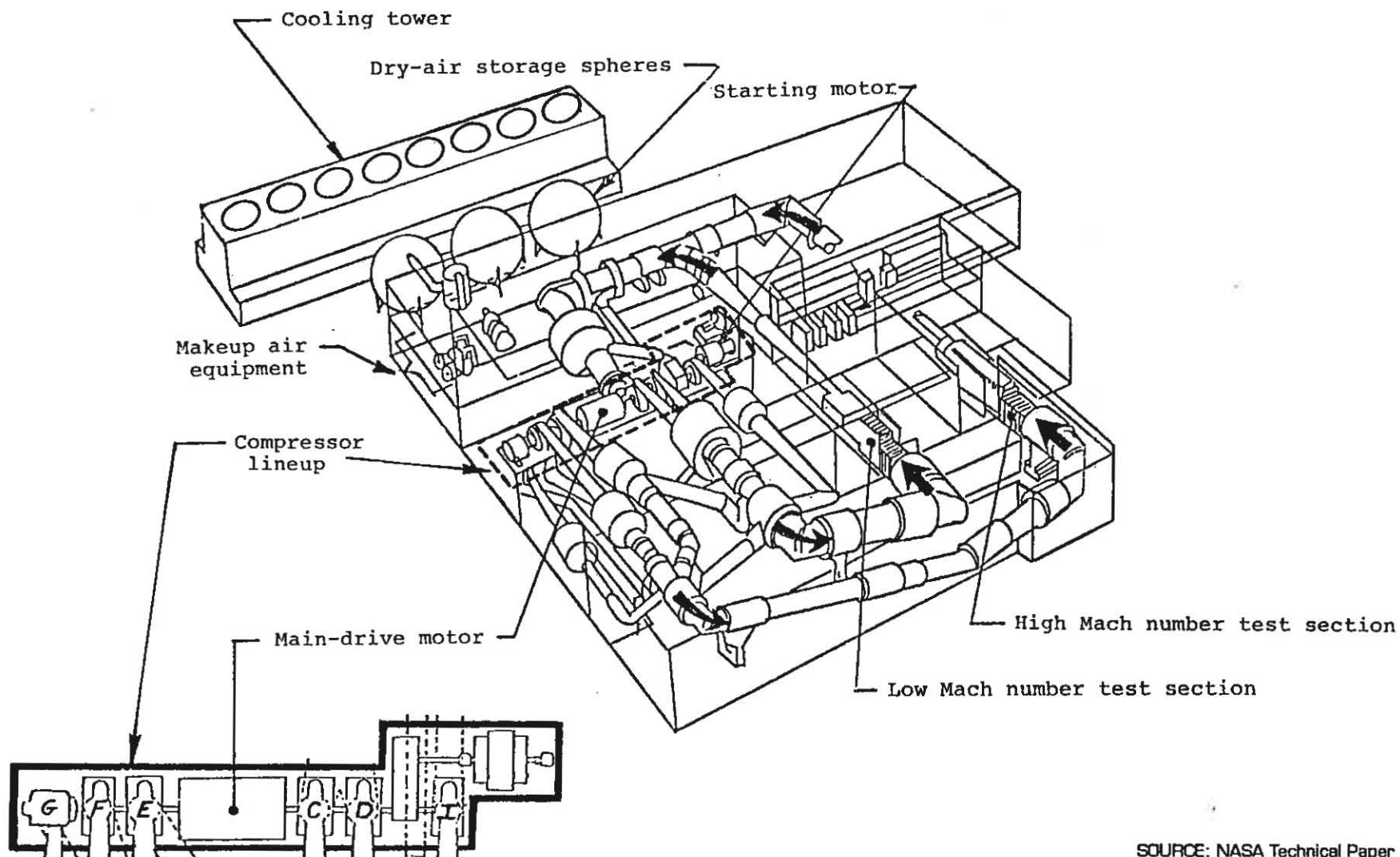
The major elements of the LaRC Unitary Plan Wind Tunnel are the 100,000-horsepower drive system, a dry air supply and evacuation system, a water cooling system, and the interconnecting ducting. The dry air system consists of three 31-foot (9.4-meter) air storage spheres charged to 150 psi (1,034 kPa), compressors, and an activated-alumina air dryer. The cooling system consists of heat exchangers and a cooling tower. These systems are powered by electricity.

The LaRC Unitary Plan Wind Tunnel is the only facility of its kind at LaRC, and is one of the most heavily used facilities at LaRC. Since coming on line in 1955, this facility has operated approximately 1,000 to 1,220 hours per year, not less than 800 hours and up to as much as 2,400 hours. The tunnel facility operates two shifts per day from 10 PM until 2 PM, running at night to take advantage of reduced power costs. The tunnel facility is operational 9 months of the year; regular maintenance is scheduled for the three summer months (July through September) when sufficient electricity may not be available to operate the facility.

3.2 PROPOSED ACTION

The proposed action consists entirely of repairing defective welds in the LaRC Unitary Plan Wind Tunnel shell, with the most serious unacceptable indications being given priority. This project provides for the repair of approximately 1,800 linear feet (550 meters) of defective welds in the tunnel shell. These repairs represent approximately 44 percent of the project total repair effort required to re-certify the LaRC Unitary Plan Wind Tunnel under the NASA/LaRC Recertification Program for Pressure Vessels. This is the first time the Unitary Plan Wind Tunnel has undergone this type of repair program.





SOURCE: NASA Technical Paper 1905

**SCHEMATIC DRAWING OF
THE UNITARY PLAN WIND TUNNEL AT
NASA LANGLEY RESEARCH CENTER
Hampton, Virginia**

FIGURE 2

The work required under this project includes removal of asbestos insulation, removal of defective weld material, re-welding of the tunnel shell, radiographic examination of the new welds, and re-insulation of the repaired areas. Due to the large size of this facility and its heavy usage rate, the repairs to the tunnel shell are being performed in phases under this project to minimize the impact on the ongoing research activities. The contract for the total repair project will be awarded with the work scheduled and coordinated to coincide with the annual facility maintenance shutdown periods over a 27-month time span. The repairs will be performed for three months (beginning in July) during summer 1993 and during the same period in 1994.

3.3 NO-ACTION/NEW-CONSTRUCTION ALTERNATIVES

The alternatives considered in this EA are the proposed action described in the preceding section, the No-Action alternative, and the New-Construction alternative. Inclusion of the No-Action alternative in an environmental analysis is prescribed by the Council on Environmental Quality Regulations Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Parts 1500 - 1508). The No-Action alternative provides the benchmark against which the proposed action is evaluated. The No-Action alternative will maintain the status quo, and will entail continued use of the LaRC Unitary Plan Wind Tunnel in its present condition.

The No-Action alternative will result in no impacts on the environment from either construction or operation; however, this alternative will not result in the needed repairs to the tunnel shell welds. Ultimately, as the defective welds continue to grow and the LaRC Unitary Plan Wind Tunnel cannot be recertified, supersonic testing will need to be transferred to another facility outside of LaRC, such as the U.S. Air Force's Arnold Engineering Development Center (AEDC) in Tennessee or NASA's Ames Research Center in California. However, given the high usage rate of LaRC Unitary Plan Wind Tunnel, it may not be feasible for these other facilities to absorb the demand from LaRC. It is imperative to the nation's aeronautical research capability that the LaRC Unitary Plan Wind Tunnel be maintained in an operational and productive state.

The New-Construction alternative will entail construction of a new wind tunnel facility to replace the function of the Unitary Plan Wind Tunnel. The New-Construction alternative will be time- and cost-prohibitive.

4.0 ENVIRONMENTAL IMPACTS

4.1 PROPOSED ACTION

4.1.1 Water Quality

Construction of the proposed action will not impact water quality. The proposed action will not result in sediment or erosion impacts, and will not alter stormwater management at LaRC because it will not require land clearing or ground disturbance, and will not increase the amount of impervious surface at LaRC. The proposed action will not change the quantity or quality of LaRC's domestic wastewater discharge to the Hampton Roads Sanitation District.

4.1.2 Air Quality

Construction of the proposed action will not result in air emissions. The motors at the LaRC Unitary Plan Wind Tunnel are electric-powered and do not generate air emissions. The only emission from this facility is the dry air which is exhausted out of the tunnel at the end of each test. The LaRC Unitary Plan Wind Tunnel does not require a Clean Air Act permit for operation. The proposed action will not result in any new air emissions from this facility.

4.1.3 Biological Resources

The LaRC Unitary Plan Wind Tunnel is located within the densely developed western area of the Center. There are no natural habitats in the vicinity of the tunnel facility. Construction of the proposed project will occur within the interior of Building 1251, and will not require any land clearing. The consequences of the proposed action will not affect any biological resources.

4.1.4 Endangered and Threatened Species

No Federal or state-listed endangered or threatened species are known to occur at LaRC (Letter from the Virginia Department of Conservation and Recreation's Division of Natural Heritage dated 21 January 1993). However, no comprehensive field survey has been performed at LaRC. The proposed action will occur in an industrial area of LaRC which is devoid of suitable natural habitat, and will be confined to the interior of the existing facility. The consequences of the proposed action will not affect any endangered or threatened species, or their critical habitat.

4.1.5 Waste Generation, Treatment, Storage, and Disposal

Non-hazardous solid waste generated at LaRC is disposed of by burning in the on-site refuse-to-steam plant, or by disposal in an off-site permitted landfill. The proposed action will result in a negligible amount of non-hazardous solid waste, which will be

disposed of in an off-site permitted landfill. The proposed action will not affect the quantity or disposal of solid waste generated due to operation of the LaRC Unitary Plan Wind Tunnel.

LaRC will require the construction contractor to identify any hazardous wastes which will be generated during construction of the proposed action, and to submit a hazardous waste disposal plan to the Contracting Officer for approval prior to the disposal of such waste. Operation of the LaRC Unitary Plan Wind Tunnel after the proposed action is complete will not result in the generation of hazardous waste.

4.1.6 Noise

Noise will be produced during repair of the defective welds in the tunnel shell from grinding and welding operations. However, the noise will only be evident in the immediate vicinity of the tunnel within the industrialized testing complex. Activities in other nearby LaRC facilities will not be disrupted due to the noise. Furthermore, the noise will not be audible at any residential receptor. Completion of the proposed weld repairs will not cause operational noise levels to differ from those currently experienced.

4.1.7 Toxic Substances

Construction of the proposed action will require the removal and disposal of asbestos insulation from the tunnel. The asbestos will be managed in accordance with applicable Federal, state, and local regulations (including 40 CFR Subpart M, National Emissions Standard for Asbestos; 29 CFR Part 1926.58 Asbestos; and Part 54-145 of the Code of Virginia) and the LaRC "Facility Safety Requirements" (LHB 1740.2) and the "Langley Safety Requirements" for contractors, Section 01060 (SPECSINTACT).

The asbestos removal for this project will be performed by the construction contractor in accordance with the LaRC SPECSINTACT, which requires the contractor to perform all necessary agency notifications, and to submit an asbestos operational plan to the Contracting Officer for approval prior to undertaking the asbestos removal. The contractor will be responsible for transporting properly packaged asbestos waste to a specified staging area at LaRC. From there, the asbestos waste will be disposed of off site in an asbestos-licensed landfill.

Other toxic substances, such as lead paint, encountered during the project construction will be managed in accordance with applicable Federal, state, and local regulations, and with the LaRC SPECSINTACT. The contractor will be required to submit a facility-specific lead paint plan to the Contracting Officer for approval prior to undertaking any necessary lead paint removal and disposal.

4.1.8 Historic, Archeological, and Cultural Factors

The LaRC Unitary Plan Wind Tunnel has not been surveyed for historical significance. LaRC presently is developing a contract with the National Park Service to survey the West Area standing structures for potential historical significance. NASA has a Programmatic Agreement with the National Council of State Historic Preservation Officers (SHPO) and the Advisory Council on Historic Preservation (signed 20 September 1989) to streamline consultation and mitigation on projects (e.g., demolition, alteration, new construction) involving National Historic Landmarks.

The proposed action consists of making repairs to welds in the tunnel shell. The integrity and the function of the LaRC Unitary Plan Wind Tunnel will not be changed as a result of the proposed project. Given the age of the facility (38 years) and the non-disruptive nature of the proposed project, consultation with the SHPO is not necessary. The proposed project will comply with the Programmatic Agreement.

4.1.9 Economic, Population, and Employment Factors

The current work force at the LaRC Unitary Plan Wind Tunnel is 20 persons. The proposed action will not change the work force at this facility.

4.1.10 Radioactive Materials and Non-ionizing Radiation

Construction of the proposed project will require the use of radiation producing machinery for x-ray of the tunnel welds. This activity will be managed in accordance with applicable Federal, state, and local regulations (including 10 CFR Part 34) and the LaRC Safety Manual (LHB 1710.5) and the "Langley Safety Requirements" for contractors, Section 01060 (SPECSINTACT). Radiographic operations will be performed under the surveillance of the assigned NASA Inspector and radiographic work will be scheduled, and work areas will be controlled, to prevent unauthorized entry of personnel.

4.1.11 Wetlands and Floodplains

LaRC has large areas of tidal marsh wetlands associated with Brick Kiln Creek and Tabbs Creek, and small areas of forested wetlands scattered throughout the Center. The 100-year floodplain at LaRC is at 8.5 feet (2.6 meters) above mean sea level (MSL). There are no wetlands in the vicinity of the LaRC Unitary Plan Wind Tunnel, and this facility is above the 100-year floodplain elevation. No wetlands or floodplains will be affected by the proposed action.

4.1.12 Coastal Resources Management

LaRC is located within Tidewater Virginia, but by definition is excluded from the boundaries of the Virginia coastal management area. The proposed action will not affect Virginia's coastal resources, and will be consistent with the Virginia Coastal Resources Management Program.

4.1.13 Energy

The LaRC Unitary Plan Wind Tunnel is a major electricity user, and is covered by the LaRC-wide energy management program for energy conservation and efficient usage. The proposed action will not affect the electricity usage of the tunnel facility.

4.2 NO-ACTION ALTERNATIVE

The No-Action alternative will result in no impacts to the environment from either construction or operation; however, this alternative will not prevent limitations on future facility operation imposed by defective welds in the tunnel shell.

4.3 NEW-CONSTRUCTION ALTERNATIVE

The New-Construction alternative will require the construction of a new wind tunnel facility to replace the function of the Unitary Plan Wind Tunnel. The New-Construction alternative will be time- and cost-prohibitive.

5.0 REFERENCES

- Jackson, C.M., Jr., W.A. Corlett, and W.J. Monta. November, 1981. Description and Calibration of the Langley Unitary Plan Wind Tunnel. NASA Technical Paper 1905.
- NASA. November, 1988. Construction of Facilities FY 1991 Discrete Program. Requirements Document for Repairs to Tunnel Shell, Unitary Plan Wind Tunnel (1251). Langley Research Center; Hampton, Virginia.
- NASA. April, 1980. Implementing the Provisions of the National Environmental Policy Act. NHB 8800.11.
- NASA/Langley Research Center. March 1992. Langley Research Center Safety Manual. LHB 1710.5.
- NASA/Langley Research Center. November 1991. Langley Research Center Environmental Program Manual. LHB 8800.1.

6.0 AGENCIES RECEIVING A COPY OF THE ENVIRONMENTAL ASSESSMENT

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7.0 LIST OF AGENCIES AND PERSONS CONSULTED

Ms. Cindy Schultz

U.S. Department of the Interior, Fish and Wildlife Service

ENDANGERED SPECIES REVIEW



ADMINISTRATION
NATURAL HERITAGE
PLANNING AND RECREATION RESOURCES
SOIL AND WATER CONSERVATION
STATE PARKS

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

DIVISION OF NATURAL HERITAGE

Main Street Station, 1500 East Main Street — Suite 312

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21 January 1993

Dottie Keough
Ebasco
2111 Wilson Blvd. Suite 435
Arlington, Virginia 22201

Re: Resources Management Document for NASA Langley Research
Center

Dear Ms. Keough:

In response to your request for information, the Department of Conservation and Recreation's Division of Natural Heritage (DNH) has searched its Biological and Conservation Datasystem (BCD) for occurrences of natural heritage resources from the area outlined on the submitted map. Natural heritage resources (NHR's) are defined by the Virginia Natural Area Preserves Act as "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest" (sec. 10.1-209 et seq. of the Code of Virginia).

According to the information currently in our files, there are no natural heritage resources documented at the Langley Air Force Base and Langley Research Center. The absence of data does not necessarily mean that natural heritage resources do not exist on or adjacent to the study site, but rather that our files do not currently contain information to document their presence.

To most accurately identify those species with a good potential to occur at the Langley Research Center, I have enclosed lists of natural heritage resources that have been documented on the Poquoson West, Newport News North, and Hampton USGS Quadrangles. All of these resources could occur at Langley in appropriate habitat, however, their presence can only be verified through field surveys. There are no NHR's documented on the Poquoson East Quadrangle.

Due to the delay in responding to your request, I am providing this information to you at no charge. Please note that DNH has recently revised the Information Services provided through

Dottie Keough
21 January 1993
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environmental review. An updated fact sheet and order form are included for your reference.

DNH's Biological and Conservation Datasystem is constantly growing and revised. Please contact DNH for an update on this natural heritage information if a significant amount of time passes before it is utilized.

An explanation of species rarity ranks and legal status abbreviations is enclosed for your reference. Thank you for the opportunity to comment on this project.

Sincerely,


Timothy D. O'Connell
Environmental Review Coordinator

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF POQUOSON WEST QUAD

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
** AMPHIBIANS					
AMBYSTOMA MABEEI	MABEE'S SALAMANDER	G4	S1		LT
AMBYSTOMA TIGRINUM	TIGER SALAMANDER	G5	S1		LE
HYLA GRATIOSA	BARKING TREEFROG	G5	S1		LT
** BIRDS					
ARDEA HERODIAS	GREAT BLUE HERON	G5	S3		
IXOBRYCHUS EXILIS	LEAST BITTERN	G5	S2		
** COMMUNITIES					
COASTAL PLAIN SINKHOLE POND			S1		
ESTUARINE HERBACEOUS VEGETATION					
ESTUARINE SCRUB					
LOW HERBACEOUS WETLAND					
OLIGOTROPHIC SEASONALLY FLOODED WOODLAND					
OLIGOTROPHIC SEMIPERMANENTLY FLOODED WOODLAND					
SUBMESOTROPHIC FOREST					
** MAMMALS					
CONDYLURA CRISTATA PARVA	STAR-NOSED MOLE	G5T4	S2	3C	
** NON-VASCULAR PLANTS					
SPHAGNUM MACROPHYLLUM VAR MACROPHYLLUM	LARGE-LEAF PEATMOSS	G3G4T3	S2		
** VASCULAR PLANTS					
BOLTONIA CAROLINIANA	CAROLINA BOLTONIA	G20	S2		
CAREX COLLINSII	COLLINS' SEDGE	G4	S3		
CUSCUTA INDECORA	PRETTY DOODER	G5	S27		
ELEOCHARIS TENUIS VAR VERRUCOSA	SLENDER SPIKERUSH	G5T3T5	S1		
FIMBRISTYLIS PERPUSILLA	HARPER'S FIMBRISTYLIS	G2	S1	C2	LE
LYTHRUM ALATUM VAR ALATUM	WINGED LOOSESTRIPE	G5T5	S2		
SABATIA CAMPANULATA	SLENDER MARSH PINK	G5	S2		
TILLANDSIA USNEOIDES	SPANISH MOSS	G5	S2		

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DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE
NATURAL HERITAGE RESOURCES OF NEWPORT NEWS NORTH QUAD

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
** AMPHIBIANS					
AMBYSTOMA MABEEI	MABEE'S SALAMANDER	G4	S1		LT
** VASCULAR PLANTS					
CAREX LUPULIFORMIS	FALSE HOP SEDGE	G3G4Q	S1		
CYPERUS DIANDRUS	UMBRELLA FLATSEDEGE	G5	SH		
QUERCUS SHUMARDII	SHUMARD'S OAK	G5	S2		
TRILLIUM PUSILLUM VAR VIRGINIANUM	VIRGINIA LEAST TRILLIUM	G3T2	S2	C2	

5 Records Processed

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF HAMPTON QUAD

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
** BIRDS					
CASMERODIUS ALBUS	GREAT EGRET	G5	S82SN4		
CHARADRIUS MELODUS	PIPING PLOVER	G3	S2	LT	LT
RYNCHOPS NIGER	BLACK SKIMMER	G5	S2		
STERNA ANTILLARUM	LEAST TERN	G4	S2		
STERNA HIRUNDO	COMMON TERN	G5	S3		
** INVERTEBRATES					
CICINDELA DORSALIS DORSALIS	NORTHEASTERN BEACH TIGER BEETLE	G4T2	S2	LT	C
** OTHER					
CHAMPION TREE					
** VASCULAR PLANTS					
CAREX PEDUNCULATA	LONGSTALK SEDGE	G5	S2		
CUSCUTA INDECORA	PRETTY DODDER	G5	S27		
DESMODIUM STRICTUM	PINELAND TICK-TREFOIL	G3G4	S2		
DESMODIUM TENUIFOLIUM	SLIM-LEAF TICK-TREFOIL	G3G4	S2		
DROSERA BREVI-FOLIA	DWARF SUNDEW	G5	S2		
IVA IMBRICATA	SEA-COAST MARSH-ELDER	G57	S1S2		

13 Records Processed

Definition of Abbreviations Used on Natural Heritage Resource Lists
of the
Virginia Department of Conservation and Recreation

Natural Heritage Ranks

The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources, or "NHR's," are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The primary criterion for ranking NHR's is the number of populations or occurrences, i.e. the number of known distinct localities. Also of great importance is the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals. Other considerations may include the quality of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of populations or occurrences such that ranks will be an index of known biological rarity.

- S1 Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.
- S2 Very rare; usually between 5 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.
- S3 Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- S4 Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- S5 Very common; demonstrably secure under present conditions.
- SA Accidental in the state.
- SB# Breeding status of an organism within the state.
- SH Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- SN# Non-breeding status within the state. Usually applied to winter resident species.
- SR Reported without persuasive documentation
- SU Status uncertain, often because of low search effort or cryptic nature of the element.
- SX Apparently extirpated from the state.
- SZ Long distance migrant whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.

Global ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a character. Note that GA and GN are not used and GX means apparently extinct. A "Q" in a rank indicates that a taxonomic question concerning that species exists. Ranks for subspecies are denoted with a "T". The global and state ranks combined (e.g. GZ/S1) give an instant grasp of a species' known rarity.

These ranks should not be interpreted as legal designations.

Federal Legal Status

The Division of Natural Heritage uses the standard abbreviations for Federal endangerment developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation.

- | | |
|----------------------------|---|
| LE - Listed Endangered | 3A - Former candidate - presumed extinct |
| LT - Listed Threatened | 3B - Former candidate - not a valid species under current taxonomic understanding |
| PE - Proposed Endangered | 3C - Former candidate - common or well protected |
| PT - Proposed Threatened | NF - no federal legal status |
| C1 - Candidate, category 1 | |
| C2 - Candidate, category 2 | |

State Legal Status

The Division of Natural Heritage uses similar abbreviations for State endangerment.

- | | |
|------------------------|----------------------------|
| LE - Listed Endangered | PE - Proposed Endangered |
| LT - Listed Threatened | PT - Proposed Threatened |
| C - Candidate | NS - no state legal status |

For information on the laws pertaining to threatened or endangered species, contact:

U.S. Fish and Wildlife Service for all FEDERALLY listed species
Virginia Department of Agriculture and Consumer Services Plant Protection Bureau for STATE listed plants and insects;
Virginia Department of Game and Inland Fisheries for all other STATE listed animals.