AECOM
M/S 213-8, N213, Rm 214, Rm 209
NASA Ames Research Center
Moffett Field, CA 94035-1000
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Memorandum

To: Jonathan Ikan, Cultural Resources Manager, NASA Ames Research Center

CC: Fabian Bonaldi, AECOM

Subject: Section 106 Consultation on the Arc Jet Complex Modernization Project, NASA Ames Research Center, Moffett Field, Santa Clara County, California

From: Trina Meiser, Senior Architectural Historian

Jay Rehor, RPA, Senior Archaeologist

Date: March 3, 2023

1. Introduction

The National Aeronautics and Space Administration (NASA) Ames Research Center (ARC) proposes the Arc Jet Complex Modernization Project (project or undertaking) at ARC, Moffett Field, Santa Clara County, California. NASA is the lead federal agency responsible for compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (54 United States Code 300101 et seq.), which requires federal agencies to take into account the effects of their activities and programs on historic properties, and its implementing regulations in 36 Code of Federal Regulations (CFR) Part 800. The purpose of this memorandum is to provide necessary information for compliance with Section 106, including a description of the undertaking and the Area of Potential Effects (APE), the methodology used to identify and evaluate historic properties within the APE, a description of the affected historic properties, and an assessment of potential effects resulting from the undertaking.

1.1 Project Location

The project area is located at NASA ARC at Moffett Field (Appendix A, Figures 1 and 2). The project area is within the Ames Campus at the Arc Jet Complex, which is on the west side of Mark Avenue between Walcott Road and Hunsaker Road. The Arc Jet Complex is composed of Buildings N234 and N238 and the Steam Vacuum System (SVS), and is listed in the National Register of Historic Places (NRHP). The Arc Jet Complex is powered by the 60-megawatt (MW) Power Supply Substation, [redacted]

1.2 Project Personnel

This study was conducted by cultural resources professionals who meet the Secretary of the Interior's Professional Qualifications Standards (48 Federal Register 44738). Trina Meiser, M.A., Senior Architectural Historian, served as the Principal Investigator; Tricia Forsi, M.S., addressed built environment resources; Jay Rehor, M.A., RPA, addressed archaeological resources; Rob'yn Johnston provided map figures; and Kirsten Johnson, M.A., served as the lead verifier of this document.

2. Description of the Undertaking

The purpose of the project is to install necessary improvements to update the Arc Jet Complex and the 60-MW Power Supply Substation to modern standards, specifically addressing health and safety and technological advancements. The goal of the project is to extend and sustain the lifetime of test capability for an additional 20 years beyond the current lifetime of the facility. The majority of the project work involves upgrading interior technical equipment; exterior work is limited to improvements to the 60-MW Power Supply Substation.

There are seven distinct projects, which are described below.

1) **Data Acquisition System Upgrade.** The project would replace (in kind) or update hardware of the Data Acquisition System, as necessary. The existing system was installed in the 1990s and has been modified several times to meet advancements in technology and other changing needs, but now requires more substantial modernization.

2) **Air and Argon Flow Controls.** The project would replace obsolete programmable logic controllers, controller interfaces, flowmeters, regulators, sensers, and valve actuators [redacted] Components would be replaced in kind or with suitable upgrades.

3) **Aerodynamic Heating Facility (AHF) Model Insertion.** The project would replace the existing model system with a swing arm-style model system based on the system [redacted] The project would create a more reliable, safer, and better performing system.

4) **Interaction Heating Facility (IHF) Modifications.** The project would reconfigure the existing IHF hose system and construct a new IHF enclosure. The IHF currently poses workplace safety risks and maintenance challenges that would be addressed by the project.

5) **Transformer Arc Jet Risk Reduction Project (TARRP).** The project would modify existing transformers [redacted] to prevent high risk degradation or failure.

6) **Safety and Interlock Control System.** The project would replace the existing safety and interlock control system with a modern standard system.

7) **Power Supply Improvements.** The project would repair and upgrade the 60-MW Power Supply Substation with replacement transformers and other parts as necessary to restore full functionality.

3. Area of Potential Effects

The APE is defined to address both direct and indirect impacts on historic properties. The APE encompasses areas that may be affected by both temporary and permanent construction activities. The undertaking does not include any ground-disturbing activities; therefore, the vertical APE does not extend below grade. Due to the scale and nature of the project, visual and atmospheric impacts resulting from system upgrades are unlikely to affect historic properties at a reasonable distance from the project area; therefore, the APE is limited to the Arc Jet Complex and the 60-MW Power Supply Substation. (Appendix A, Figure 3).

4. Identification of Historic Properties

Historic properties are defined as any district, site, building, structure, or object that is included in or is eligible for listing in the NRHP. The following sections address the methodology and efforts to identify historic properties in the APE.

4.1 Archaeological Resources

The land that comprises ARC has changed dramatically since the early twentieth century from predominantly agricultural use to a military airfield installation beginning in 1931 and aeronautical research and development beginning in 1939. Extensive surface disturbance occurred throughout ARC with grading and fill to create the airfield and the campuses with hundreds of buildings and structures to support operations, and no previously recorded archaeological sites were identified within the APE. The undertaking does not include any ground disturbance and the no archaeological survey was conducted.

4.2 Architectural Resources

The APE has been previously surveyed and evaluated for historic properties. The current study identified the Arc Jet Complex within the APE. The Arc Jet Complex is composed of Buildings N234, N238, and the SVS, with related features including the 60-MW power supply substation (see Appendix A, Figure 3) (Table 1).

Table 1. Architectural Resources in the APE

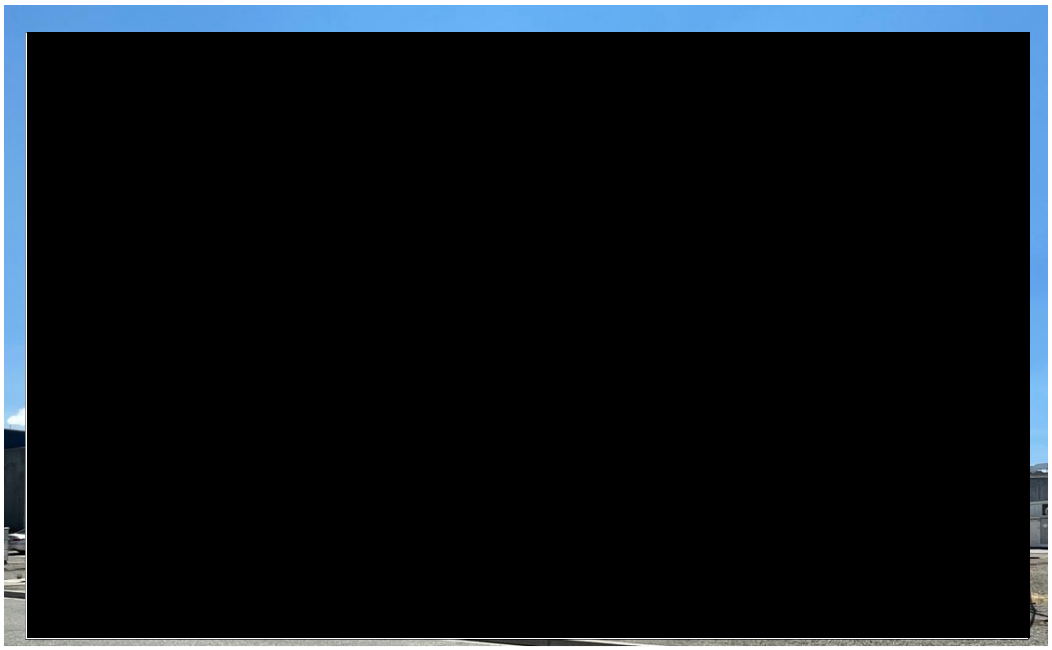
Resource	Date	Eligibility Status	Effects Analysis
Building N234 –Thermal Protection Laboratory	1962	Listed, Criteria A and C, Criterion Consideration G (Arc Jet Complex)	No adverse effect
Building N238 – Arc Jet Laboratory	1964	Listed, Criteria A and C, Criterion Consideration G (Arc Jet Complex)	No adverse effect
SVS	1962	Listed, Criteria A and C, Criterion Consideration G (Arc Jet Complex)	No adverse effect
60-MW Power Supply Substation	1962	Not eligible, non-contributing to Arc Jet Complex	No effect

4.2.1 Arc Jet Complex

The Arc Jet Complex, which includes Buildings N234, N238, and the SVS, was listed in the NRHP in 2017. The NRHP listing is available at: https://historicproperties.arc.nasa.gov/downloads/summary/nrhp_arcjet_20161101.pdf.

4.2.2 60-MW Power Supply Substation

The 60-MW Power Supply Substation (Plate 1) is a utilitarian facility that powers the Arc Jet Complex. The substation was built in 1962 to provide sufficient power to operate arc jets. However, it was not identified in the NRHP nomination for the Arc Jet Complex as a contributing feature. The substation has not acquired additional significance since the previous evaluation and nomination of the Arc Jet Complex, and the 60-MW Power Supply Station is not eligible for the NRHP individually or as a contributor.



[redacted]

5. Affected Historic Properties

The APE does not contain any known archaeological resources. One historic property, the Arc Jet Complex, is in the APE and described in this section.

5.1 Arc Jet Complex

The Arc Jet Complex was listed in the NRHP in 2017 and is significant at the national level for its contributions in the areas of science and engineering. The property is listed under Criterion A for its association with advancements in arc jet technology and research and development of Thermal Protection Systems (TPS) for NASA's spaceflight programs, including the exceptional role of the 60-MW Interaction Heating Facility arc jet in developing and refining TPS for the Space Shuttle Program (SSP). The property is also listed under Criterion C for its design and engineering, which allowed for significant innovations in arc jet technology. The period of significance is 1962, the year Building N234 and the SVS were constructed, to the end of the SSP in 2011. The property is also listed under Criteria Consideration G as a property that has achieved significance within the past 50 years in relation to its exceptional significance within the context of the SSP.

5.1.1 Building N234 – Thermal Protection Laboratory

Constructed in 1962, Building N234 and its related SVS equipment were built as the Gasdynamics Laboratory and were used for research in heat shield applications and aerodynamics for spacecraft re-entry into Earth's atmosphere. [redacted] The façade has concrete exterior walls that are scored in a grid pattern. Each story on the façade and east elevation features a series of continuous aluminum-framed windows shaded by projecting, flat concrete awnings. The windows are mostly fixed with some hopper or awning units. The offset central entrance includes a recessed pair of glazed doors with a transom and a projecting concrete awning above, flanked by full-height brick pilasters. The west elevation contains no fenestration and has an attached brick partition wall enclosing the area around it. The rear elevation is clad with corrugated metal siding and has an L-shaped plan. [redacted]

Plate 2. Building N234, view facing northwest.

[redacted] The finishes are utilitarian and fitting of an industrial space used for scientific discovery.

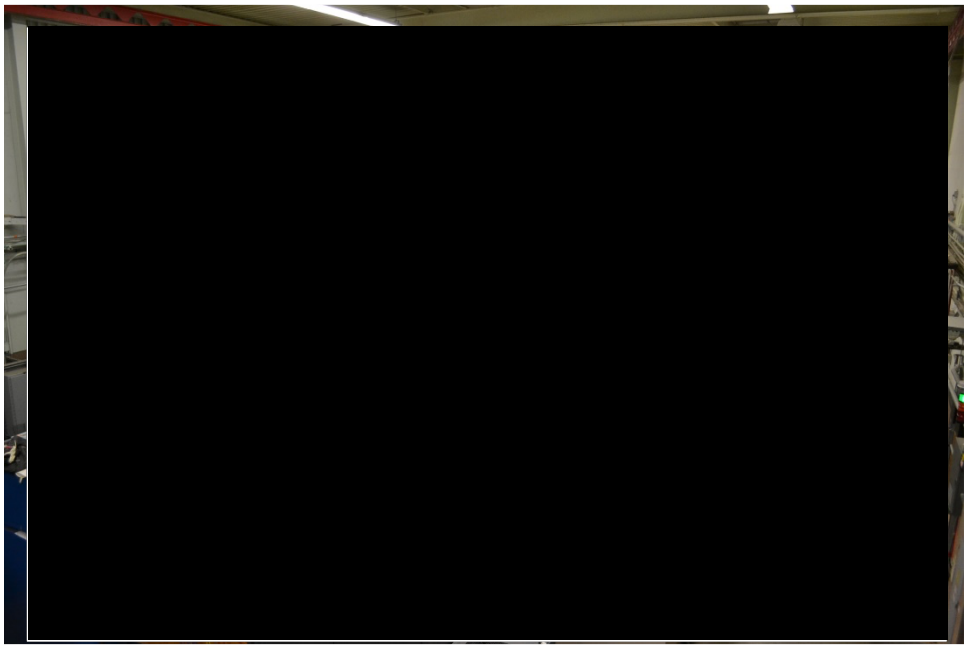


Plate 3. Building N234, typical interior.

5.1.2 Building N238 – Arc Jet Laboratory

Building N238 has a utilitarian design composed of two distinct sections – a one-story L-shaped section with brick exterior walls, and a 1.5-story corrugated metal structure situated within the ell of the brick section that extends to the south and west [redacted]

5.1.3 SVS

The SVS is composed of large-scale industrial-grade metal tubing, valves, structural supports, and tanks (Plate 6). The SVS was first built as part of Building N234 in 1962

[redacted].

[redacted]

6. Assessment of Effects

Per 36 CFR Part 800.5(a)(1), an adverse effect results when an undertaking may alter, either directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the historic property's integrity.

There are no known archaeological sites in the APE, and the undertaking does not include work that would result in ground disturbance. Therefore, no archaeological historic properties would be affected by the undertaking.

The project would modify interior equipment in the NRHP-listed Arc Jet Complex, including the data acquisition system; programmable logic controllers, controller interfaces, flowmeters, regulators, sensers, and valve actuators [redacted] and associated control software; [redacted]

The Arc Jet Complex is significant for "its association with advancements in arc jet technology and research and development of TPS for NASA's spaceflight programs, including the exceptional role of the 60-megawatt IHF arc jet in developing and refining TPS for the SSP" (AECOM 2017). During its period of significance from 1962 to 2011 and since, advancements in technology have required incremental alterations to N234, N238, and the SVS, and to the arc jet testing equipment within the complex. To facilitate continued technological advancements, the project would replace in kind or upgrade technical equipment to sustain and improve functionality and safety.

Exterior alterations are limited to transformer system upgrades to the 60-MW Power Supply Substation. The proposed work would have no effect. These changes would not indirectly affect the Arc Jet Complex.

The following is an assessment of the undertaking for compliance with the Standards for Rehabilitation and guidelines (NPS 2017).

1. *A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces and spatial relationships.*

   The historic use of the Arc Jet Complex would be prolonged by the project.

2. *The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces and spatial relationships that characterize a property will be avoided.*

   The significant characteristics of the Arc Jet Complex are its industrial/scientific laboratory spaces and the arc jet apparatuses contained within. Alterations to the existing equipment and systems would improve safety and efficiency without diminishing the industrial/scientific character of the complex. Although the IHF is an important feature of the Arc Jet Complex and conveys its significance, the proposed project alterations, including reconfiguring its hoses and replacing its enclosure, would not diminishe the IHF's integrity of design, materials, workmanship, feeling, or association. The project would allow the IHF to continue its scientific role in technological advancements. The other equipment that supports the operation of the complex would generally be replaced in kind or upgraded with modern equipment that would maintain the scientific/industrial aesthetic, feeling and association of the complex.

3. *Each property will be recognized as a physical record of its time, place and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.*

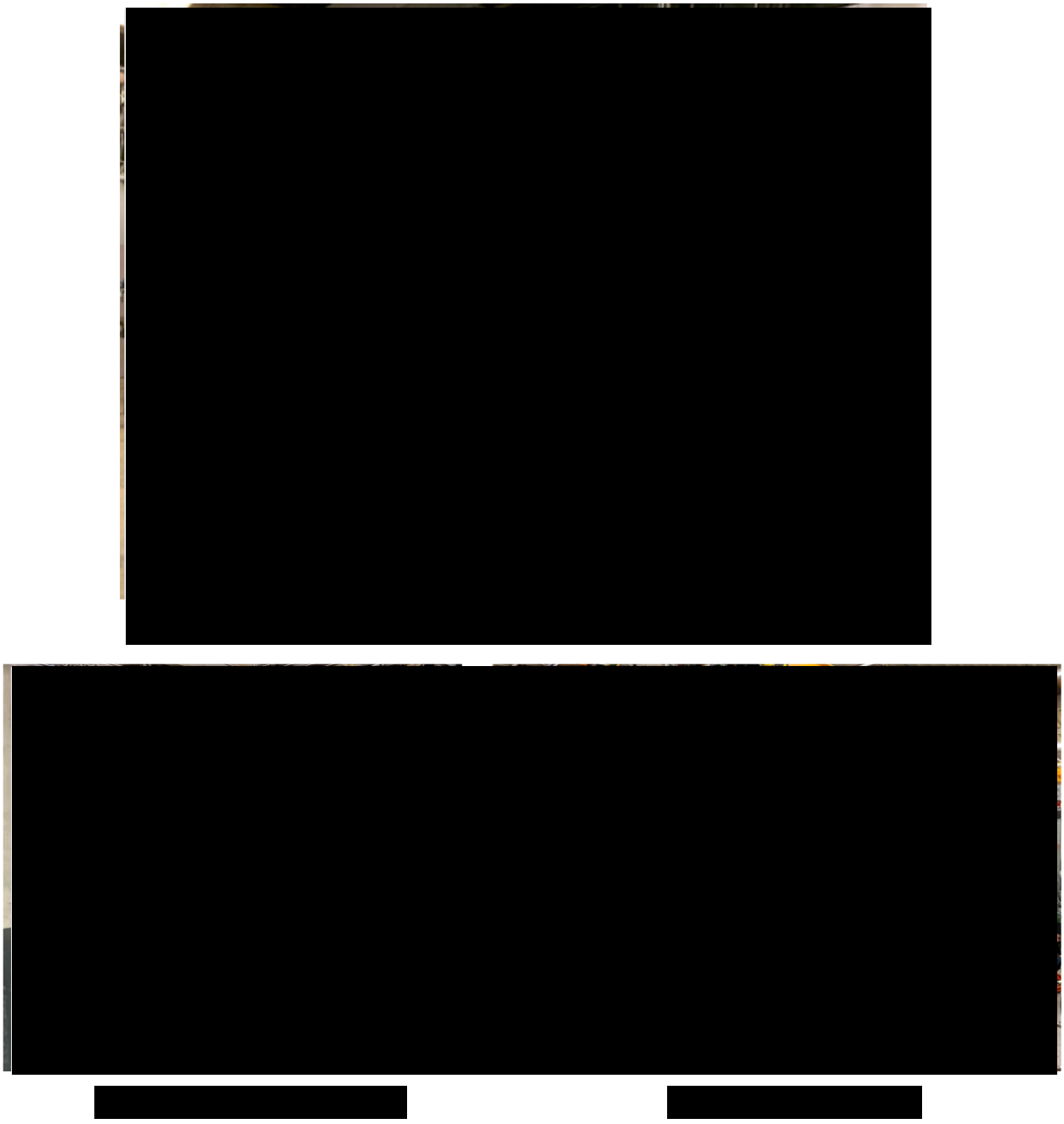
   Not applicable.

4. *Changes to a property that have acquired historic significance in their own right will be retained and preserved.*

   The incremental changes to the Arc Jet Complex and its equipment over its history have allowed it to contribute to technological advancement. Hardware and software involved in arc jet operations necessarily changes over time, and while all of it contributes to the complex, the individual components (e.g., pipes, wires, valves, controls, data systems, computing software, and utilities) are not significant in their own right.

5. *Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a historic property shall be preserved.*

   This project does not propose to remove any distinctive features that characterize the Arc Jet Complex.



6. *Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.*

   This project does not propose any work on deteriorated or distinctive historic features or replacement of missing features.

7. *Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.*

   Not applicable.

8. *Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.*

   Not applicable.

9. *New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work will be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.*

   The project would replace equipment in kind or with modern equivalents that would be compatible with the significant features of the Arc Jet Complex. Because the Arc Jet Complex has been modified over time, its significance is not conveyed by a static appearance but by its operation in a scientific/industrial setting.

10. *New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired*.

    The project would not add any new features to the Arc Jet Complex.

7. Summary of Findings

The criteria of adverse effect were applied to the project and its proposed alteration of the Arc Jet Complex. In summary, the Arc Jet Complex would retain integrity of location, design, setting, materials, workmanship, feeling, and association after implementation of the project. The continued function of the Arc Jet Complex as a laboratory aligns with the its historical associations, and its improvement will reflect the changing nature of a highly technical facility as addressed in the Advisory Council for Historic Preservation's 1991 Program Comment *Balancing Historic Preservation Needs with the Operation of Highly Technical or Scientific Facilities* (ACHP 1991).The proposed undertaking would not alter, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the NRHP. Therefore, a finding of No Adverse Effect per 36 CFR Part 800.5(b) is appropriate for this undertaking.

8. References

AECOM, 2017. *NASA Ames Research Center Archaeological Resources Study*. Accessible online (redacted) at *https://historicproperties.arc.nasa.gov/downloads/section106_achaeology_20170224_nasa_att.pdf.*

AECOM, 2017. *Arc Jet Complex (N238, N234, and Steam Vacuum System) National Register of Historic Places Nomination Package.* Accessible online at *http://historicproperties.arc.nasa.gov/downloads/summary/nrhp_arcjet_20161101.pdf*.

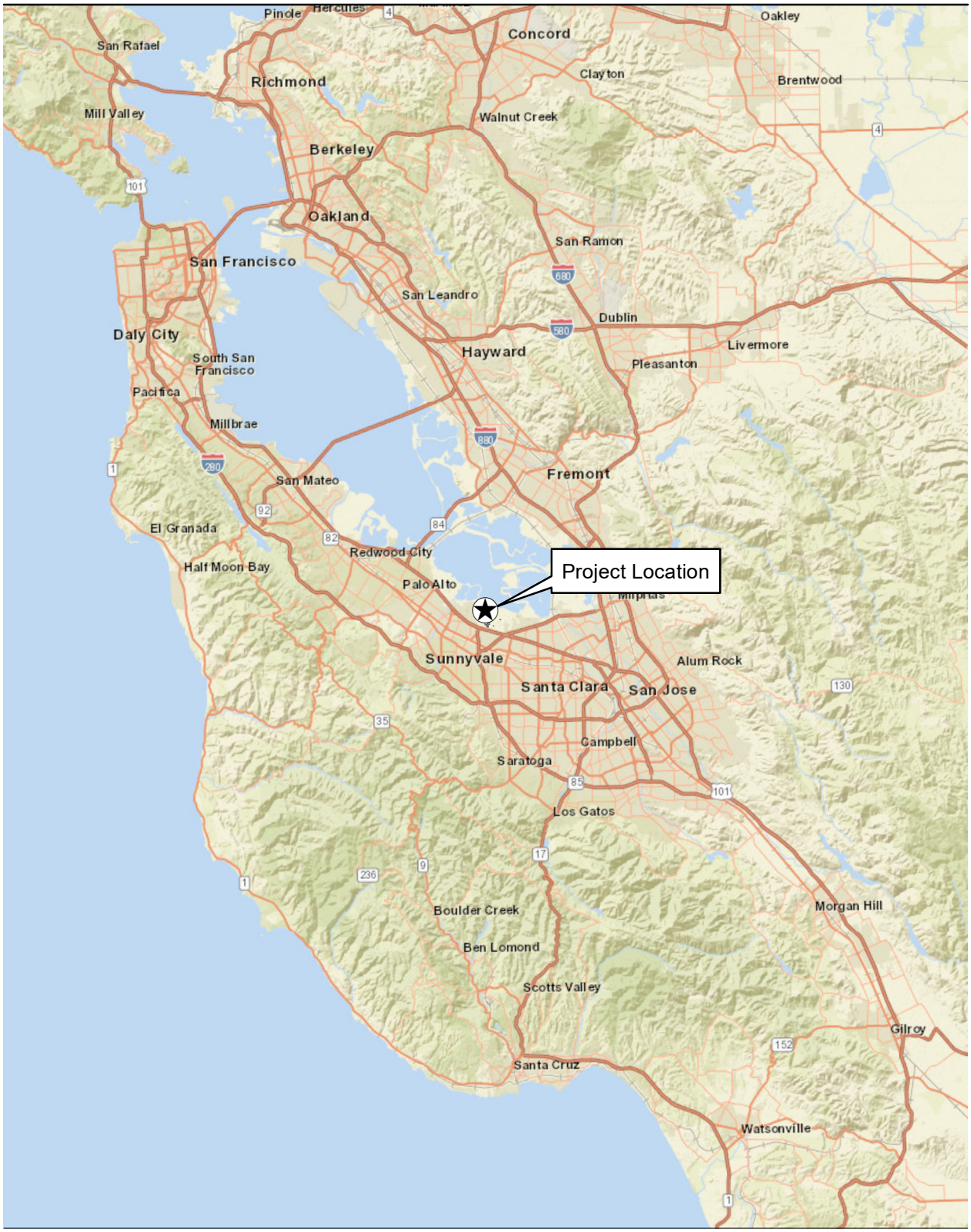
Attachments

Appendix A: Figures

Appendix A

Figures

Figure 1 – Project Location
Figure 2 – Project Site
Figure 3 – APE



Source: ESRI, AECOM, NASA

0 5 10 20 Miles

Scale: 1 = 633,600; 1 inch = 10 mile(s)

Figure 1
Project Location

Arc Jet Modernization Project

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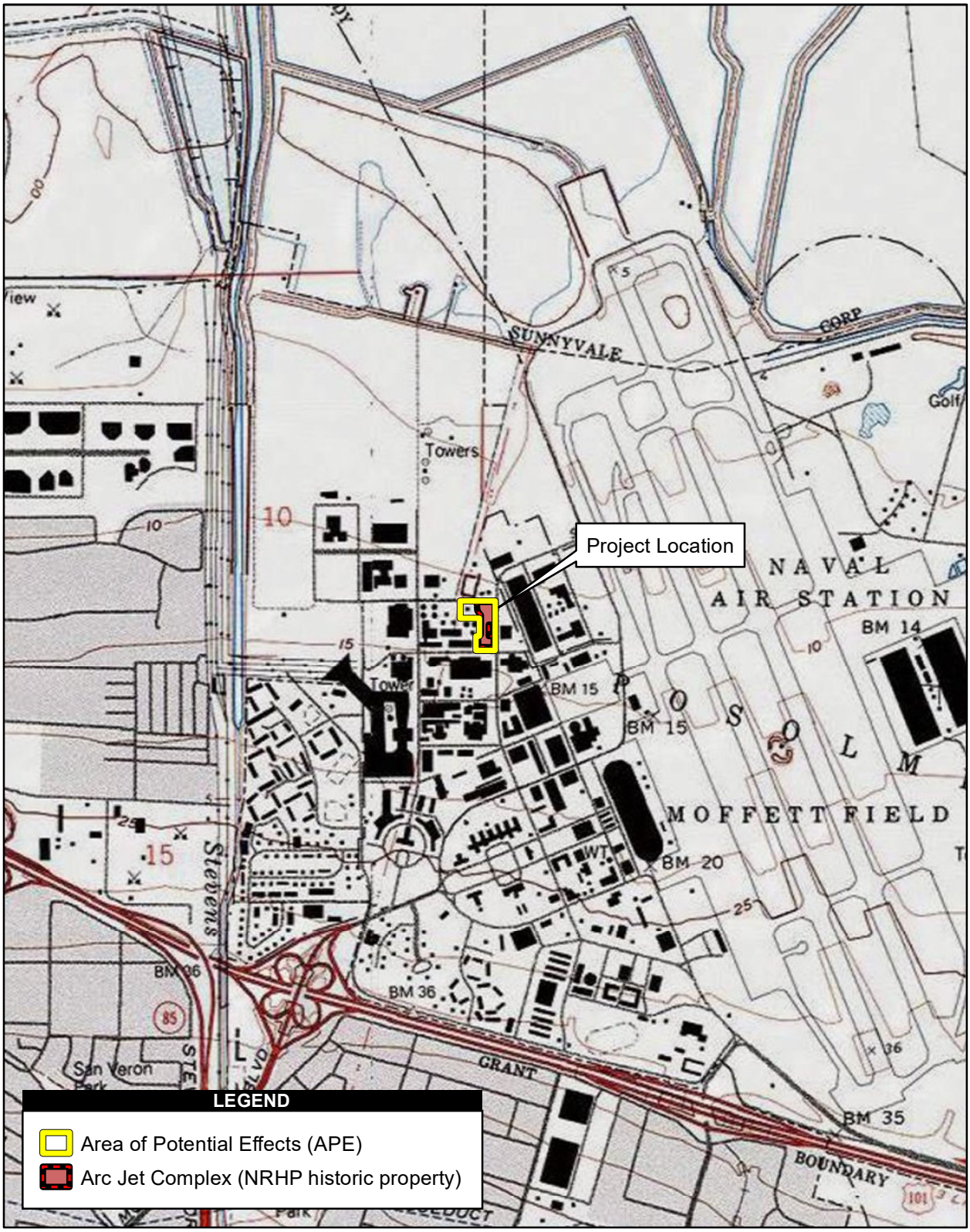

Source: ESRI, AECOM, NASA, National Geographic Society; USGS 7.5' Topographic Quadrangle: Mountain View

0 1,000 2,000 4,000 Feet

Scale: 1 = 24,000; 1 inch = 2,000 feet

Figure 2
Project Site

Arc Jet Modernization Project

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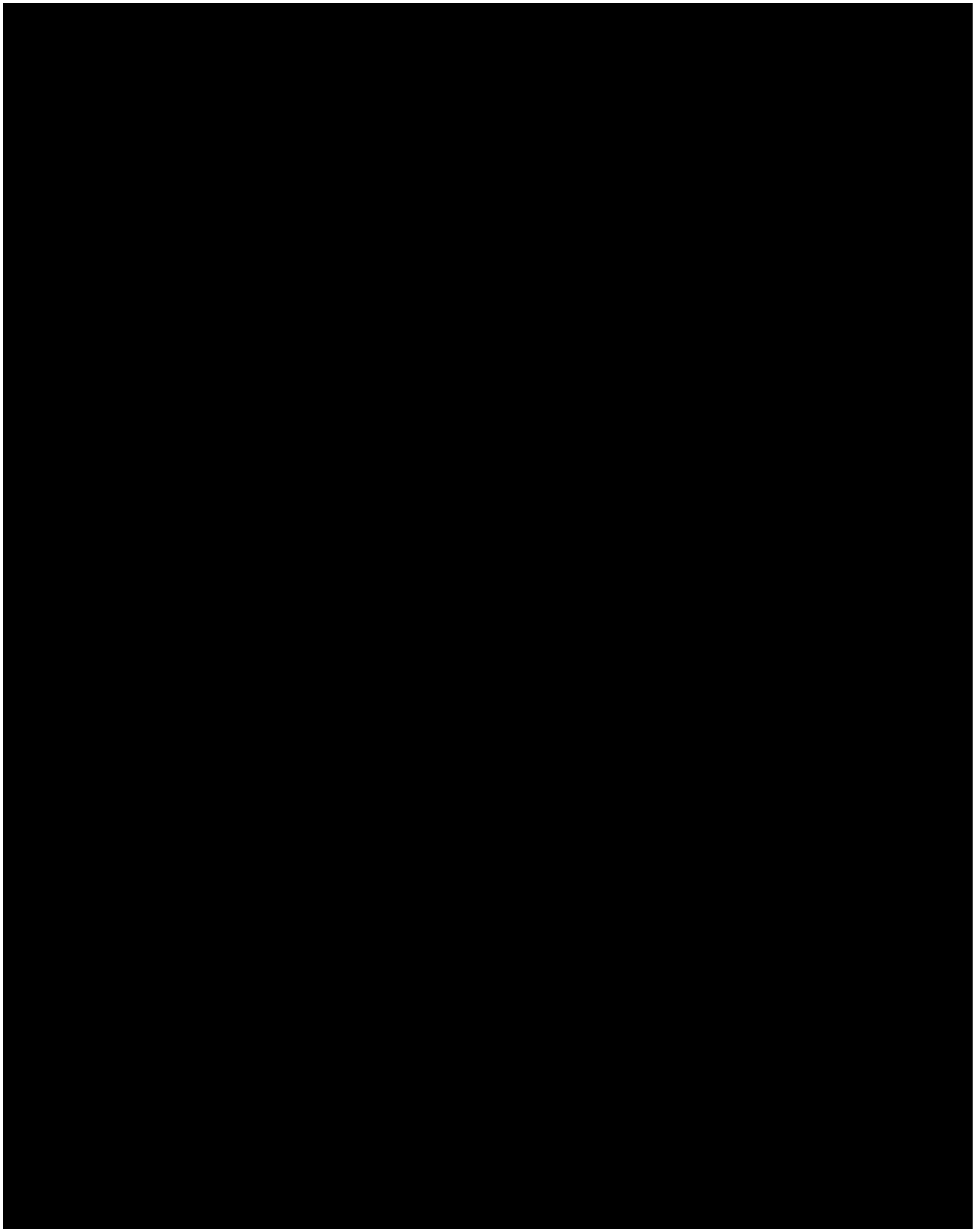

Source: ESRI, AECOM, NASA

0 100 200 Feet

Scale: 1 = 1,800; 1 inch = 150 feet

Figure 3
APE Map

Arc Jet Modernization Project

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