Chapter 2. Existing Facilities, Operations, and Their Impacts

2.1 Overview

This chapter discusses current missions and goals for NASA and ARC. It also presents an overview of environmental regulatory requirements, as well as an overview of the effects of ARC facilities and operations on the environment. Specific environmental conditions related to facilities and operations are discussed in subsequent chapters in this document. The information presented in this chapter was obtained from the November 2009 NASA ARC ERD (NASA 2009), various internal documents, and other sources.

2.1.1 NASA Vision and Mission

The NASA Vision is "To reach for new heights and reveal the unknown, so that what we do and learn will benefit all humankind." The NASA Mission is to "Drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth." In practice, the execution of NASA's Vision and Mission involves undertaking a wide range of space exploration and aeronautical activities; conducting and supporting research to expand knowledge of the Earth and of phenomena in the atmosphere and space; and reaching out to provide educational opportunities and materials related to NASA activities (NASA 2011a).

2.1.2 Missions of NASA Ames Research Center

ARC enables exploration through selected development, innovative technologies, and interdisciplinary scientific discovery. Ames provides leadership in astrobiology; robotic lunar exploration; technologies for the Crew Exploration Vehicle, the Crew Launch Vehicle, and the Heavy Lift Vehicle; the search for habitable planets; supercomputing; intelligent/adaptive systems; advanced thermal protection; and airborne astronomy. Ames develops tools for a safer, more efficient national airspace and unique partnerships benefiting NASA's mission (NASA 2008).

2.2 Major Environmental Laws, Regulations, and Policies

As a major federal facility, ARC is governed by a variety of laws, regulations, policies, and other guidance. These regulatory directives are enforced by federal, state, regional, and local agencies. Following is a selected list of regulatory directives that are applicable to facility operations.

2.2.1 Federal

- Migratory Bird Treaty Act of 1918 (16 USC §701-715)
- Fish and Wildlife Coordination Act of 1958 (16 USC §661–666c)
- Wilderness Act of 1964 (16 USC §1131 *et seq*.)
- Wild and Scenic Rivers Act of 1965 (16 USC §1271 *et seq*.)

- National Historic Preservation Act of 1966
- National Environmental Policy Act of 1969
- Clean Air Act of 1970
- Marine Mammal Protection, Research, and Sanctuaries Act of 1972 (16 USC §1361 *et seq*.)
- Coastal Zone Management Act of 1972 (16 USC §1451 *et seq*.)
- Federal Water Pollution Control Act (Clean Water Act) of 1972, as amended (33 USC §1251–1376 *et seq*.)
- Noise Pollution and Abatement Act of 1972 (42 USC §7641)
- Endangered Species Act of 1973
- Safe Drinking Water Act of 1974
- Archeological and Historic Preservation Act of 1974 (16 USC §469–469c)
- Toxic Substances Control Act of 1976
- Resource Conservation and Recovery Act of 1976 (42 USC § 6901-6993 *et seq*.)
- Archaeological Resources Protection Act of 1979
- Fish and Wildlife Conservation Act of 1980
- Farmland Protection Policy Act of 1981 (7 USC §4201 *et seq*.)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980
- Emergency Planning and Community Right-To-Know Act of 1986
- Hazardous Waste Source Reduction and Management Review Act of 1989
- Native American Graves Protection and Repatriation Act of 1990 (25 USC §3001–3013)
- Pollution Prevention Act of 1990
- Oil Pollution Control Act of 1990 (33 USC §2701 *et seq*.)
- Federal Facilities Compliance Act of 1992
- Presidential Executive Order 11514 (amended by Presidential Executive Order 11991), *Protection and Enhancement of Environmental Quality*
- Presidential Executive Order 11593, *Protection and Enhancement of the Cultural Environment*
- Presidential Executive Order 11738, *Providing for Administration of the CAA and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants or Loans*

- Presidential Executive Order 11988 (amended by Presidential Executive Order 12148), *Floodplain Management*
- Presidential Executive Order 11990, *Protection of Wetlands*
- Presidential Executive Order 12088 (amended by Presidential Executive Order 12580), *Federal Compliance with Pollution Control Standards*
- Presidential Executive Order 12114, *Effects of Major Federal Actions Abroad*
- Presidential Executive Order 12843, *Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances*
- Presidential Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*
- Presidential Executive Order 12969, *Federal Acquisition and Community Right-To-Know*
- Presidential Executive Order 13287, *Preserve America*
- Presidential Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*
- Presidential Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*

2.2.2 **California**

- California Aboveground Petroleum Storage Act
- California Clean Air Act
- California Endangered Species Act of 1984
- California Fish and Game Code
- California Health and Safety Code
- California Native Plant Protection Act of 1977
- California Oil Pollution Control Act
- California Porter-Cologne Water Quality Control Act
- CCR Title 17, *Drinking Water Supplies*
- CCR Title 22, *Environmental Health*
- CCR Title 23, *Waters*
- CCR Title 26, *Toxics*
- Medical Waste Management Act
- State noise guidelines and regulations

2.2.3 Local Regulations and Locally Enforced Codes

- Bay Area Air Quality Management District Rules and Regulations
- Bay Conservation and Development Commission Bay Plan
- San Francisco Bay Basin Water Quality Control Plan (Basin Plan)
- Santa Clara County Hazardous Materials Storage Ordinance
- Santa Clara County Toxic Gas Ordinance
- Santa Clara County Medical Waste Management Plan Guidelines
- Santa Clara Valley Water District Well Standards
- City of Palo Alto Sewer Use Ordinance
- Palo Alto Industrial Wastewater Ordinance
- City of Sunnyvale Industrial Wastewater Ordinance
- Uniform Fire Code
- Uniform Plumbing Code

2.2.4 NASA's Procedural Requirements

- NPD 8500.1C, *NASA Environmental Management*
- NPD 8510.1, *Cultural Resources Management*
- NPR 8530.1A, *Affirmative Procurement Program and Plan for Environmentally Preferable Products*
- NPR 8553.1B, *NASA Environmental Management System*
- NPR 8570.1A, *NASA Energy Management Program*
- NPR 8580.1A, *Implementing the National Environmental Policy Act and Executive Order 12114*
- NPR 8570.1, *Energy Efficiency and Water Conservation*
- NPR 8590.1A, *Environmental Compliance and Restoration Program*

2.2.5 NASA Ames Research Center's Procedural Requirements

- APD 8500.1, *Ames Environmental Policy*
- APR 8500. 1, *Ames Environmental Procedural Requirements*
- APR 8553.1, *Ames Environmental Management System*

Table 2-1. Environmental Regulatory Agencies Overseeing NASA Ames Research Center Operations

Federal	U.S. Environmental Protection Agency U.S. Army Corps of Engineers U.S. Fish and Wildlife Service U.S. Department of Transportation Advisory Council of Historic Preservation
State of California	Office of Emergency Services California Environmental Protection Agency California Department of Fish and Game Department of Toxic Substances Control
Regional	Bay Area Air Quality Management District Regional Water Quality Control Board, San Francisco Bay Region Bay Conservation and Development Commission
Local	Santa Clara County Health Department Palo Alto Regional Water Quality Control Plant Sunnyvale Wastewater Treatment Plant
Source: NASA 2009.	

2.3 NASA Ames Research Center Operations

NASA's facilities include the Unitary Plan Wind Tunnels, motion-based flight simulators, atmosphere-entry heat simulators, advanced digital computation systems, and free-flight ballistic test facilities. In addition, there are a wide range of well-equipped ground-based and airborne laboratories that are dedicated to the study of solar and geophysical phenomena, life synthesis, life detection, and life environmental factors. ARC has a number of support buildings as well, including aircraft hangars, machine shops, warehouses, a cafeteria, post office, and numerous office buildings.

A description of each building's specific function follows in the sections below, listed by organizational code. ARC is divided into directorates, each designated by a letter code. The directorates that make up ARC are:

D. Office of the Director

A. Office of the Director of Aeronautics

B. Office of the Director of New Partnerships

C. Office of the Chief Financial Officer

J. Office of the Director of Center Operations

H. Office of the Director of Resource Capital

I. Office of the Director of Information Technology

P. Office of the Director of Program and Projects

Q. Office of the Director of Safety and Mission Assurance

R. Office of the Director of Engineering

S. Office of the Director of Science

T. Office of the Director of Exploration Technology

U. U.S. Air Force Full-Scale Aerodynamics Complex

V. Office of the Director of Strategic Communications and Education

W. NASA Office of Inspector General

Y. Aeroflight Dynamics Directorate, Aviation and Missile Research Development and Engineering Center, U.S. Army Research Development and Engineering Command

V. Strategic Communications

For completeness, all of the Codes are listed here, but not all are currently active. Codes B, C, D, H, P, Q, V, and W are primarily involved in administrative and computer-related functions that do not have environmental impacts. The following sections describe the potential impacts associated with the facilities administered by other directorates.

2.4 Facilities in Code A: Office of the Director of Aerospace

2.4.1 Flight Systems Research Laboratory, N-210

The Flight Systems Research Laboratory contains offices and computer laboratories for developing air traffic management automation tools and rotorcraft flight performance analysis software. The computer labs contain high-performance computer workstations in systems furniture to provide an interactive environment for software development and scientific analysis. At the north end of the building there is a high bay that is used for storage. The work conducted in the Flight Systems Research Laboratory is the core of NASA's contribution to the fields of airspace operations.

2.4.2 Flight and Guidance Simulation Laboratory, N-243 and N-243A

The Flight and Guidance Simulation Laboratory, houses the Vertical Motion Simulator (VMS), with its 18.3-meter- (60-foot) vertical motion capability, is the world's largest motion-based simulator. The VMS was designed to provide large-amplitude motion to aid in the study of helicopter and Vertical/Short Take-Off and Landing (V/STOL) issues specifically relating to research in controls, guidance, displays, automation, and handling qualities of existing or proposed aircraft. The VMS was used extensively to train space shuttle pilots on landing and roll-out. The VMS is also used to develop new techniques for flight simulation and to define the requirements and develop the technology for both training and research simulators.

2.4.3 Crew-Vehicle Systems Research Facility, N-257

Crew-Vehicle Systems Research Facility (CVSRF) is an unparalleled national resource that supports NASA, the Federal Aviation Administration (FAA), and many industry research programs. Designed to provide researchers with an environment where they can study how and why aviation errors occur, CVSRF stands out in the area of human factors research. The goal for this facility and operations is to offer researchers a suite of simulation facilities and utilities that can be used to analyze flight crew performance and to develop and improve new simulation and training tools.

The CVSRF houses several simulators capable of full-mission simulation. These simulators interact with each other (as well as with other SimLabs facilities) by means of a High Level Architecture, allowing for enormous flexibility and customization. Using CVSRF's highly sophisticated simulators (the Boeing 747-400, the Advanced Concepts Flight Simulator, and the Air Traffic Control Laboratory), researchers are able to study the effects of automation and advanced instrumentation on human performance.

2.4.4 Fluid Mechanics Laboratory, N-260

The NASA Ames Fluid Mechanics Laboratory houses small scale wind tunnels and a water channel that are used for aerodynamics testing and flow visualization. The low cost of testing and short lead-time for facility availability provide crucial information to guide design decisions and fundamental research. The Fluid Mechanics Laboratory also develops flow-visualization techniques for wind tunnel testing such as: Pressure Sensitive Paint, Particle Image Velocimetry, High-Speed Schlieren Imaging, Retroreflective Background Oriented Schlieren and Fringe Imaging Skin Friction. They also develop low-cost techniques for aeroacoustic measurement and analysis.

2.4.5 3.5-Foot Hypersonic Wind Tunnel Auxiliaries, N-229A

This facility contains two large (5,500-horsepower) reciprocating compressors and the auxiliary equipment required to operate the compressors. Included in N-229A is the control room for distribution of high-pressure air across ARC, a mechanic shop, a switchgear room, a welding shop, and a boiler room.

2.4.6 Outdoor Aerodynamic Research Facility, N-249

Originally built in 1969 and upgraded in 1994, the OARF is currently mothballed. It was used for static testing of V/STOL models and rotary wing models, for acoustic testing, and for the analysis of aircraft models prior to testing in the 40- by 80-foot or 80- by 120-foot wind tunnels.

The OARF consists of an open-air test facility with a model mounting test pad, data acquisition equipment, control room, and other necessary support equipment for remote model or aircraft operation.

2.4.7 12-Foot Pressure Wind Tunnel, N-206 and N-206A

Restored in 1994, this tunnel was the only large-scale, pressurized, low turbulence, subsonic wind tunnel in the United States. It provided unique high-Reynolds number testing capabilities for the development of high-lift systems on commercial transport and military aircraft, and for high angle-of-attack testing of maneuvering aircraft. This facility was closed in 2003 due to budgetary constraints. The model preparation rooms in N-206 provide support for the Unitary Plan Wind Tunnels. Also N206A provides make-up air for the Unitary Plan Wind Tunnels.

2.4.8 Balance Calibration Laboratory, N-207

Operations at the lab include calibrating balances for the ARC Wind Tunnels, as well as for outside projects. NASA Ames is setup to calibrate taper sting balances, single piece cylindrical fit balances, rotor balances, flow through balances and custom configurations. NASA Ames has a Sandberg Serrell Automated Balance Calibration Machine which can apply multiple combined loads on a wind tunnel balance. The lab's current inventory of machine-to-balance adapters can accommodate 2.5 to 4.0 inch TASK balances. The machine is a unique tool in wind tunnel balance calibration technology. It can generate simultaneous combinations of three forces and three moments within its load envelope. Without the physical limitations of dead weight manual loading, the Automated Balance Calibration Machine can be used to bring calibration load schedules closer to real tunnel load conditions, thus increasing the accuracy of the calibration.

2.4.9 Unitary Plan Wind Tunnel, N-227 and N-227A-D

The Unitary Plan Wind Tunnel facility is one of the most heavily used wind tunnel in all of NASA. The Unitary Plan Wind Tunnel facility has been instrumental in the development of virtually every domestic commercial transport and military fixed-wing airframe since the 1960's and is one of the busiest wind tunnels in NASA. Researchers use the Unitary Plan Wind Tunnel facility extensively for airframe testing and aerodynamic studies and the facility has played a vital role in every manned spaceflight program, including testing of models of the Mercury, Gemini, and Apollo capsules. Models of the space shuttle and NASA's Orion space capsule were tested here.

This facility is a unique system of wind tunnels comprised of three test sections: the 11- by 11-Foot Transonic Wind Tunnel, the 9- by 7-Foot Supersonic Wind Tunnel, and the 8- by 7-Foot Supersonic Wind Tunnel. The 8-by 7-Foot Supersonic Wind Tunnel is currently mothballed. Subsonic, transonic, and supersonic aerodynamics research is performed at this facility. The major common element of the tunnel complex is its electric power plant, which consists of four interconnected motors capable of producing a total of 134-megawatt (180,000-horsepower) continuously or 161-megawatt (216,000-horsepower) for 1 hour.

The wind tunnel represents a unique national asset of vital importance to the nation's defense and its competitive position in the world aerospace market. In 1985, the Unitary Plan Wind Tunnel facility was designated as a National Historic Landmark by the National Park Service because of "its significant associations with the development of the American Space Program." The Unitary Plan Wind Tunnel facility has undergone major modernization, including automatic controls, a new data system, and other improvements to increase productivity.

2.5 Facilities in Code I: Office of the Director of Information Technology Directorate

2.5.1 Central Computer Facility, N-233 and N-233A

The Central Computer Facility houses the computer and networking systems that provide the basic IT infrastructure for the day-to-day operation of ARC. Included in this suite of

systems are a large number of UNIX–based servers that provide the center's email and messaging services, the internal (intranet) web sites, and external web sites used for public outreach. This facility also houses the Network Operations Center from which the center's ARCLAN campus network is managed and operated, along with its related server systems and user help desk. The Central Computer Facility also houses ARC's business data processing and database systems, which support personnel and financial resource management functions throughout the center. The N-233A wing of this facility houses an archival data storage system used by the Numerical Aerospace Simulation Supercomputer Facility (located in N-258). This storage system utilizes robotic magnetic tape storage "silos" to provide very high-capacity file storage for their R&D users. This storage system is linked to the N-258 supercomputers via a high-speed fiber optic communications system. In addition, N-233A houses an IT systems development and integration laboratory supporting the activities of the Central Computer Facility and the advanced computer-networking projects.

2.5.2 Telecommunications Facility N-254

This facility houses office space and telecommunications equipment. It originally had an area of 7,967 square feet. A 2,000 square foot addition was constructed in 2003.

2.6 Facilities in Code J: Office of the Director of Center Operations

2.6.1 Imaging Technology Laboratory, N-203

This facility contained offices and laboratories for the processing of color (AR-5) and black and white aerial film for the Airborne Remote Sensing Research Program. Four persons operate and maintain the 1811 and 11CM Versamat film processors located on the second floor and the effluent treatment plant located in the basement. Photo processing no longer takes places within this facility. Facility currently houses administrative support staff for center.

2.6.2 Magnetic Standards Laboratory and Test Facility, N-217 and N-217A

Two magnetic test facilities are located at ARC in Buildings N-217 and N-217A. They were used infrequently during the late 1990s and were being considered for closure in 2000. The 3.7-meter (12-foot) facility located in Building N-217 is designed to calibrate magnetic sensor systems, determine magnetic cleanliness, and measure low-frequency electromagnetic radiation of items not exceeding 1 meter (3.3 feet) in any dimension. The 6-meter (20-foot) coil facility, located in N-217A, was built to accommodate testing of items that are too large for the 3.7-meter (12-foot) facility. In addition to the capabilities of the 3.7-meter (12-foot) facility, the 6-meter (20-foot) facility can duplicate the strength and direction of the earth's magnetic field anywhere on earth, in earth orbit, or in deep space. The ambient field in the working area of the coils can be canceled to permit engineering or biological studies in near-zero fields. Noninvasive measurements of the magnetic field produced by the human heart, for example, were performed in this facility. This facility has measurement sensitivities of less than 1 microgauss.

2.6.3 Motor Pool, N-251

The Motor Pool contains facilities for the management of ARC's transportation needs. It includes a fuel station, offices, equipment repair bays, vehicle wash area, and parking areas for conducting the operation, maintenance, and repair of the diverse vehicular fleet.

2.6.4 Facility Supply Support Center N-255

This 81,639 square foot building houses the postal and supplies operations for Ames Research Center.

2.6.5 Disaster Area Relief Team, N-267

This 6,367 square foot building houses the Disaster Area Relief Team (DART) facilities. Training and exercise drills are conducted at this facility.

2.7 Facilities in Code JQ: Environmental Management Division

2.7.1 Hazardous Substances Transfer Site, N-265

This facility serves as an accumulation and packaging area for hazardous wastes generated at various locations throughout the center. Hazardous wastes are accumulated and packaged in areas segregated by hazard class and type.

2.8 Facilities in Code R: Office of the Director of Engineering

2.8.1 Model Development, Advanced Composites Group, N-212

This facility houses the Advanced Composites Group. The Advanced Composites Group is a technical support group for all research disciplines at ARC. Its capabilities include composite fabrication, plastic fabrication, and other non-metallic fabrication processes. The Advanced Composites Group contributes to the design and manufacturing of a variety of test equipment and models. The Advanced Composites Group's expertise with many materials and processes has made this facility vital to the success of many high-profile projects at ARC. This facility contains spray booths for finish applications, autoclaves for composite fabrication, and many machine tools.

2.8.2 Technical Services, N-220

The Development Machining and Electromechanical Instrumentation Branch, in Building N-220, is a branch of the Aeronautics and Space Flight Hardware Development Division. Machining, instrumentation, mechanical inspection, electronic, and CAD/CAM services occur at this facility. This facility primarily develops prototype hardware for the ARC Research Community. That hardware includes experimental scientific apparatus for shuttle or airborne missions, aerospace wind tunnel models, facility modifications, and biosensors. The personnel at this facility consist of highly skilled engineering technicians that assist with designs and perform all fabrication on complex scientific instruments and models.

2.8.3 Airborne Missions and Applications Laboratory, N-240 and N-240A

The Airborne Missions and Applications Laboratory is occupied by the Life Sciences Division offices, the C-130 Data Facility, and the wet chemistry lab. This facility contains offices and laboratories supporting the NASA Space Station Biological Research Payload Office, which performs planning, testing, and hardware integration for life sciences payloads. Biology laboratories and a high-bay test area are used for experiment verification tests in which payload experiments are performed by the experiment science teams and space lab crew using flight hardware, ground operations procedures, and space-lab crew procedures. Flight hardware is prepared and shipped from this site to Kennedy Space Center. The wet chemistry laboratory houses a variety of testing equipment for environmental testing. The wet chemistry laboratory is equipped with thermograin metric analysis and digital scanning calorimetry capabilities for materials characterization. Projects of interest that have been conducted by the materials group in the wet chemistry area include hygrothermal analysis of composite specimens and exposure testing of aluminum.

2.8.4 Space Projects Facility N-244

The Space Projects Facility contains the offices and laboratories for developing and managing space projects. It includes facilities for conducting mission operations and laboratories for developing infrared detectors, cryogenics, control systems, communication systems, data systems, and other support systems and experiments for space projects. It also includes a clean room facility and an environmental test laboratory.

2.9 Facilities in Code S: Office of the Director of Astrobiology and Space Research

2.9.1 20-G Centrifuge, N-221A

The 20-G Centrifuge is 17.7 meters (58 feet) in diameter and can be used to evaluate flight hardware and test the effects of hyper-gravity on humans, other animals, and plants. Mounted on the centrifuge are three enclosed cabs. Cab A, mounted at one end of the rotating arm, contains a modified jet fighter ejection seat in which a human volunteer sits during tests. Cab B, at the other end of the rotating arm, contains a swing frame often used for non-human subjects or can be configured to meet an investigator's needs. Cab C, located near the center of the arm (the center of rotation), can be adapted to an investigator's needs or can be used as a near-center control for angular velocity or to study the effects of gravity gradients. The 20-G Centrifuge is capable of producing forces up to 20 times that of terrestrial gravity. During centrifuge operations, a combination of 47 control and 56 instrumentation slip rings allows control of onboard experiments from the control room and communication between control room operators and onboard subjects. The centrifuge speed is computer-controlled, allowing for the development of preprogrammed gravity profiles. A programmable logic controller monitors all critical mechanical and electrical systems to ensure that the systems are within design specification limits.

2.9.2 Biosciences Laboratory, N-236 and N-236A-E

The Biosciences Laboratory is used for biomedical research and animal care.

2.9.3 Life Sciences Research Laboratory, N-239 and N-239A

The Life Sciences Research Laboratory contains the human environmental test facility and environmental chamber. Research conducted at this facility includes, biomedical, extraterrestrial research, ecosystem science, closed ecological life-support systems, nanotechnology research, and search for extraterrestrial intelligence. Some laboratories in this facility are operated by Code A personnel.

2.9.4 Vestibular Research Facility, N-242

The Vestibular Research Facility contains state-of-the-art equipment for ground-based studies of vestibular function (which affects one's sense of balance). This facility hardware enables the study of responses to smooth, linear motion, or to combinations of linear and angular motion over the frequency range of natural head movement.

The Vestibular Research Facility permits the study of how complex linear and/or rotational accelerations are transduced, encoded by the vestibular system, and processed by the brain. Interactions between linear and angular vestibular stimuli, and visual and proprioceptive inputs (peripheral, central, and motor), are examined using electrophysiological, reflexive, and behavioral methods.

2.9.5 Space Sciences Research Laboratory, N-245

The Space Sciences Research Laboratory is dedicated to research in astrophysics, exobiology, and planetary science. These research programs are structured around the study of origins and evolution of stars, planets, planetary atmospheres, and biological organisms.

The Space Science Division's programs include: (1) the study of interstellar gas and dust that form the raw material for stars, planets, and life; (2) the processes of star and planet formation; (3) the search for planetary systems around other stars; (4) the evolution of planets and their atmospheres; (5) the structure, dynamics, and chemistry of planetary atmospheres; (6) the origin of the biogenic elements and molecules and their distribution in space; (7) the origin of life and its early evolution on Earth; and (8) the search for past or present life throughout the solar system.

2.9.6 Biomedical Research Facility, N-261

The Biomedical Research Facility is utilized for neuroscience research. This facility contains a darkroom, electron microscopy facilities, computer areas, testing booths, and surgery facilities.

2.10 Facilities in Code T: Office of the Director of Exploration Technology

2.10.1 Space Technology, N-204A

This facility conducts R&D on arc jets and thermal protection systems that enable hypervelocity flight in planetary atmospheres. Such R&D was essential for the Apollo, Shuttle, and Galileo Probe vehicles. Advances in thermal protection also support the ongoing exploration of Mars and the outer planets, as well as the development of reusable launch vehicles (for example, the X-33 experimental aircraft). Also under development are aerobraking and advanced regenerative life support technology to permit human exploration of Mars without the need for new, larger launch vehicles.

Other R&D at this facility includes sensor development, particularly in the infrared, and the application of information technology (IT) in intelligent systems, integrated design systems, computational fluid dynamics, and nanotechnology for electronics.

2.10.2 Research Facility, N-223

This facility supports materials development for thermal protection systems and plasma experiments.

2.10.3 Electric Arc Shock Tube East, N-229

The Electric Arc Shock Tube is used for basic science research on flow phenomena at hypervelocity speeds. The electric arc driven shock tube facility consists of one driver system and two parallel-driven tubes. The driver can be operated in a variety of configurations depending on test requirements. The energy to the driver is supplied by a capacitor energy storage system consisting of 220 capacitors. By using different combinations of series-parallel connections, the capacitance of the bank can be varied. This facility contains two large (5,500-horsepower) reciprocating compressors and the auxiliary equipment required to operate the compressors. Included in N-229 is the control room for distribution of high-pressure air across ARC, a mechanic shop, a switchgear room, a welding shop, and a boiler room.

2.10.4 Physical Sciences Research Laboratory, N-230

This facility houses the Photophysics, Materials Research, and ISP Sensor Development Laboratories.

The Photophysics Laboratory includes two laser-application laboratories for spectroscopic research and optical instrumentation development, a small supersonic wind tunnel facility for the demonstration of laser diagnostic techniques in high-speed flows, and a large stratosphere-simulation vacuum chamber where laser diagnostic methods were developed for use during space shuttle flight. The lab's high-energy pulsed lasers include ultraviolet (UV) excimer gas lasers, multi-wavelength Nd:YAG (neodymium-yttrium, aluminum, and garnet) lasers, and tunable dye lasers.

Research at the Materials Research Laboratory includes an investigation of graphite-epoxy composites and metal matrix composites. The laboratory's hydraulic testing machines are used for mechanical experiments on composite materials used in aeronautic applications.

The ISP Sensor Development Laboratory supports the manufacture of heat flux gauges approximately 0.5 inch in diameter and 0.022 inch thick, used in the Arc Jet Facility, Building 234. To produce the gauges, screen-printed sensors are fired in a furnace to 1550º Celsius to eliminate organics and achieve a solid metal film. The laboratory is used for material inspections and calibration. The calibration process involves repeated temperature steps of up to 1100° Celsius.

2.10.5 **Arc Jet Complex, N-238, N-234, and N-234A**

ARC currently operates a variety of arc-heated facilities within the Arc Jet Complex. These facilities are used to generate flow environments that simulate the aerothermal environment that an object experiences when traversing the atmosphere of a planet. They are used primarily to test heat shield materials and thermal protection system components for planetary entry vehicles, planetary probes, and hypersonic flight vehicles, although other investigative studies are performed in some of these facilities. In the arc jet facilities, thermal protection system components are exposed to the aerothermodynamic heating conditions that they will encounter during high-speed flight.

The facilities of the Arc Jet Complex are located in Buildings N-234 and N-238. The Aerodynamic Heating Facility and the Turbulent Flow Duct Facility are located in Building N-234; the Panel Test Facility and the Interaction Heating Facility are located in Building N-238; Building N-234A houses the boiler for the Steam Vacuum System.

The arc jet facilities are serviced by common facility support equipment, including two direct-current power supplies, a steam-ejector vacuum system, a de-ionized water cooling system, high-pressure gas systems, a data acquisition system, and other auxiliary systems. The magnitude and capacity of these support systems distinguishes the Arc Jet Complex as unique in the aerospace testing world. In particular, the large power supply can deliver 75 megawatts for 30 minutes. High-power capability, in combination with the high-volume steam-ejector vacuum system, yields a unique suite of facilities that simulate high-altitude atmospheric flight on relatively large test objects.

2.10.6 **Hypervelocity Free-Flight Facility, N-237**

The Hypervelocity Free-Flight Facilities (HFFF) provide a unique suite of testing capabilities to study the aerodynamics of hypervelocity flight, atmospheric entry, and the response of materials to hypervelocity impact. The HFFF comprise two ballistic ranges: the Hypervelocity Free-Flight Aerodynamic Facility (HFFAF) and the Hypervelocity Free-Flight Gun Development Facility (HFFGDF).

The HFFAF is NASA's only Aeroballistic Range and consists of a model launching gun, a sabot separation tank/vacuum chamber, a test section with 16 orthogonal photo stations, a test cabin, and the largest combustion-driven shock tube in the United States. This multifaceted facility can be configured to perform shock tunnel testing, aeroballistic testing, counterflow aeroballistic testing, or hypervelocity impact testing. The 22.9-meter (75-ft) long test section can be filled with various gases to simulate flight in planetary atmospheres. The 40.6-cm (16-in) diameter shock tube is capable of producing high-enthalpy airflow at Mach 7. This flow may be used for fixed-model testing or as a counter-

current to the gun-launched models for combined velocities up to 11 kilometers/second (36,000 feet/second).

The HFFGDF consists of a model launching gun, a sabot separation tank/vacuum chamber, a flight tube, and an impact chamber. This facility is primarily used to expand and enhance the performance characteristics of the model launching guns used in the HFFF. This range can also be used to perform hypervelocity impact studies to simulate micro-meteoroid and orbital debris impact.

Both ranges were constructed in 1964 and utilize an arsenal of light-gas and powder guns to accelerate particles that range in size from 3.2 to 25.4 millimeters (0.125 to 1 inches) in diameter to velocities ranging from 0.5 to 8.5 kilometers/second (1,500 to 28,000 feet/second).

2.10.7 **Mars Unit, N-242**

This facility supports testing in a small wind tunnel simulating surface conditions on Mars. It also houses production of thermal protection tiles primarily used in support of the arc jet facility.

2.10.8 **Numerical Aerodynamic Simulation Facility, N-258**

Since 1984, the Numerical Aerodynamic Simulation Facility has provided innovative supercomputing technology solutions and services for aeronautics scientists and engineers at NASA, universities, and in industry. The Numerical Aerodynamic Simulation Facility plays a major role in NASA programs dedicated to researching, developing, and transferring IT to support NASA's missions.

This facility houses unique supercomputing resources that are constantly being updated and augmented. These computers are used on a nationwide timesharing basis to perform calculation-intensive programs for simulation of aerodynamic flows, chemical reactions, and atmospheric physics. This building is home to NASA's Columbia Super Computer.

2.10.9 **Human Performance Research Laboratory, N-262**

Research at the Human Performance Research Laboratory focuses on human performance and automation in aerospace systems. Areas of study include human vision, audition, attention, motor control, fatigue, human factors maintenance, communication, team problem-solving, training, human workload, control theory, virtual reality, and virtual environments. Areas of development include: (1) computational models of human perceptual, cognitive, and decision systems; (2) perceptual optimization of visual displays and imaging systems; (3) three-dimensional auditory displays; (4) machine vision algorithms for autonomous vehicle control; (5) advanced human-centered IT; and (6) human factors expertise to address high-priority aerospace challenges.

2.10.10 **Automation Sciences Research Facility, N-269**

The Automation Sciences Research Facility provides an integrated environment for investigating the interaction between humans and highly automated systems. Within the Automation Sciences Research Facility, the neuro-engineering library is used to support

intelligent flight control (neural networks applied to flight systems). The DARWIN testbed connects the wind tunnels with the aircraft manufacturers for better design and testing control and result dissemination. The intelligent mechanism laboratory has been the site of several field missions demonstrating remote/telecontrol and presence. The photonics laboratory supports the study of bacteriorhodopsin for optical processing.

N-269 also houses the Future Flight Central facility, administered by Code A. The Future Flight Central facility provides a 360-degree view/simulation of an air traffic control tower. Examples of current projects at this facility include: (1) implementation of terrain mapping visualization systems for remotely operated vehicles; (2) acquisition, processing, and visualization of acoustic data in wind tunnel tests; and (3) investigation of bacteriorhodopsin (an experimental protein) as an optical processing and sensing medium.

2.10.11 Groundwater Reverse Osmosis Facility, N-271

The Industrial Wastewater Treatment Facility (IWWTF) was reconfigured into the Groundwater Reverse Osmosis Facility (GROF). The GROF produces two streams from the groundwater, the permeate (or purified stream) which is used for boiler feed water for the Arc Jet Facility, and a concentrate that is currently discharged to the Palo Alto Publicly-Owned Treatment Works (POTW) as waste. Under the Permit with Palo Alto NASA Ames is obligated to continue to pursue an environmental discharge for the concentrate since Palo Alto would prefer not to accept this waste stream. Treatment and reuse of ARC's treated groundwater lessens the demand for San Francisco Water Department potable water supply. Additional information on the GROF is provided in Chapter 15 ("Public Services, Utilities, and Energy").

2.11 Facilities in Code Y: Aeroflight dynamics Directorate, Aviation and Missile Research Development and Engineering Center, US Army Research Development and Engineering Command

2.11.1 AEROMECHANICS LAB AND 7- BY 10-FOOT WIND TUNNEL NO. 1, N-215AND N-216

The tunnel is closed circuit, low speed, and operates at atmospheric temperature and pressure. Tunnel No. 1 is used for research in support of low-speed aerodynamics, using small-scale aircraft, V/STOL aircraft, and space vehicle reentry body models. Wind speeds within the tunnel are continuously variable up to 402.5 kilometers per hour (250 miles per hour). This facility is currently operated by the Aeroflight Dynamics Directorate (AFDD).

2.11.2 Model Preparation Area, N-216A and B

This area is a shop used in the development of models to be run in the 7- by 10-Foot Wind Tunnel and the development of parts for the tunnel. Facilities in Code U: US Air Force National Full-Scale Aerodynamics Complex

2.11.3 National Full-Scale Aerodynamic Complex, N-221 and N-221B – Air Force Lease

The National Full-Scale Aerodynamics Complex (NFAC) is the largest wind tunnel complex in the world and consists of the 40- by 80-Foot Wind Tunnel, 80- by 120-Foot Wind Tunnel, and OARF. The NFAC was primarily used to determine the low- and medium-speed aerodynamic characteristics of high-performance aircraft, rotorcraft, and fixed wing, powered-lift V/STOL aircraft. Operated and used by NASA, the NFAC was also used by industry, the DOD, and other government agencies. The NFAC is currently being used by the Air Force. The 40- by 80-foot wind tunnel has been determined to be eligible for listing in the National Register of Historic Places.

2.12 Other Facilities at NASA Ames Research Center

2.12.1 Hangar 1

Hangar 1, built in 1933, is the dominant structure at ARC. The 35,767-square-meter (385,000-square-foot) building was originally built for maintenance and storage of lighter-than-air craft. More recently, it has been used for instruction, administration, and aircraft maintenance. Hangar 1 was recently found to be the source of polychlorinated biphenyl (PCB) contamination of sediments transported by storm water runoff. The Navy has agreed to make Hangar 1 part of the Navy's site remediation program and began work on Hangar 1 in 2003. Hangar 1 is closed pending successful remediation of PCB contamination.

2.12.2 Hangars 2 and 3

Hangars 2 and 3, built in 1942, are 32,226 square meters (346,875 square feet) and 40,296 square meters (433,738 square feet) respectively. Both hangars today contain office space and are used for light industrial uses such as aircraft maintenance and storage.

2.12.3 Runways

The two parallel runways at the airfield are situated northwest to southeast between Hangar 1 and Hangars 2 and 3. The runways were constructed in 1933. Their area is 150 hectares (370 acres).

2.12.4 Maintenance and Other Support Facilities

Numerous other facilities include ordnance storage, maintenance, personnel support facilities, housing, public works facility, boilers, cafeteria, other laboratories, and administrative offices.

2.13 Research and Development partners at Ames Research Center

R&D partners include Carnegie Mellon University Silicon Valley, Santa Clara University, Singularity Education Group and numerous business and industry concerns. Table 2-2 lists R&D partners along with their key activities and/or areas of research.

Table 2-2. ARC Research and Development Partners

R&D Partners (Academic, Non-Profit, Industry)	Activities/Area of Research
AECOM	Global provider of professional technical and management support services to the transportation, facilities, environmental and government markets.
All One Quantum Energy Research, Inc.	Performs research and development in the field of Quantum Medicine.
Astrotecture	Global provider of Space Architecture design services.
Bloom Energy	Developer of clean, high-efficiency and reliable solid oxide fuel cell systems.
Carnegie Mellon University Silicon Valley	West Coast campus, opened 2003; instruction for engineering, science and technology. Participate and support basic and applied research for Ames spacecraft technology, human factors, mobility, collaboration science and space biology projects.
Chandah Space Technologies	Small satellites design, development and operations.
Changene	Development of a drug therapy to treat bone loss.
Digiproofs	Development of digital compression technology.
Ecliptic Enterprises Corp.	Creator of on-board imaging systems for use with rockets, spacecraft, and other remote platforms.
ELORET Corp	Developer of a sensitive chemical vapor sensor for mobile devices to accurately sense low levels of various gasses.
Flight Research Associates, Inc.	Expanded aviation services to NASA, including the design and development of manned and unmanned flight test activities.
Game Changers	Technology development to advance the readiness and marketability of breakthrough technologies.
Leonis Medical Corporation	Support design and development of innovative medical technologies to improve patient quality of life.
GOLL, LLC	Consulting and engineering solutions for spacecraft integration and testing, spacecraft command, control and communications, and autonomous operations.
Google	Partnering with Ames on large-scale data management, massively distributed computing, bio-info-nano convergence and R&D activities to encourage the entrepreneurial space industry.
InformArt/GaryAir	Provides information technology solutions for the transportation industry with a particular focus on the air tax sector.
IntraPoint	Leader in Operational Resilience by providing a fully integrated software and services solution used to manage incidents, crises, and continuity of operations.
Intrinsyx Technologies	Supports NASA Constellation Data Systems Projects at Ames, including system engineering, enterprise architecture, and IT security.
Kentucky Science and Technology Corporation	Kentucky Science and Tech students interact with Ames engineers and Stanford faculty on spacecraft design. Students build, launch and test satellites.
KleenSpeed Technologies, Inc.	Developer of high performance electric propulsion systems and components.
LatIPNet	Entrepreneurial education, technology licensing and commercialization
Logyx, LLC	Provides intelligent solutions to support Ames programs such

R&D Partners (Academic, Non-Profit, Industry)	Activities/Area of Research
	as LADEE. Industry-recognized leader of the Federal Information Security Management Act.
Machine-to-Machine Intelligence Corp.	Leading innovator in Data Center Automation software for Grid and Private Cloud computing environments.
Mars Institute	Focus on advancing the scientific study and exploration of Mars
Millennium Engineering & Integration Company	Provides end-to-end mechanical engineering and analysis for NASA and DOD space vehicles.
Mission Critical Technologies, Inc.	Provides specialized technical and professional expertise in the field of IT and IT solutions.
Moon Express	Privately funded Lunar Transportation and Data Services company to establish new avenues for commercial space activities beyond Earth orbit.
Moffett Field Historical Society	Educator about the military history and contributions of Moffett Field and the rich history of Ames.
Neerim Corporation	Provides systems engineering services on a broad range of projects that include design and manufacture, test programs, validations and simulations.
Neurovigil, Inc.	Neuroscience, non-invasive wireless brain recording technology and advanced computational algorithms.
NXAR LLC	Licenses unique technology from Ames to develop new applications to deliver powerful, innovative new software solutions to solve difficult content and document-driven business processes.
Orbital Sciences Corporation	World's leading developer and manufacturer of smaller, more affordable space and launch systems.
Photozig, Inc.	Provides integrated digital photo technology.
Planners Collaborative	Provides integrated communications and public marketing services to public agencies. Support services to Ames include scientific and technical information, educational programs, and related administrative programs.
Pragati Synergetic Research	Provides customized knowledge-engineering software to enhance and integrate information systems efficiently and accurately.
Quintessence Labs Inc.	Developed a new generation of quantum cryptographic technology to enable unbreakable, secure storage and communication of sensitive information through the generation of an ultra-secure cryptographic key.
reQall, Inc.	Developed a context-aware, voice activated virtual assistant (memory aid) that can operate from any network, application or mobile device.
Rhombus Power, Inc.	Developing the next generation neutron detectors for space, defense and geological applications.
RMV Technology Group, LLC	Provides mitigation services for advanced & engineered materials, satellite systems, robotics, space technology and medical device sectors.
S3 USA Holdings	Small satellite development.
Santa Clara University (Center for Nanostructures)	Partnering with Ames on the Thermal and Electrical Nano-scale Transport project.
Scanadu, Inc.	Developer of a Medical Tricorder, packed with sensors that provide its customers with valuable data about the body.

R&D Partners (Academic, Non-Profit, Industry)	Activities/Area of Research
Science and Technology Corporation	Offers a broad range of advanced research and engineering services and provides quality technical support services from test planning to results documentation.
Singularity Education Group	Educator to empower leaders to apply exponential technologies to address humanity's grand challenges.
Skytran, Inc.	Developer of a sustainable Personal Rapid Transit technology as an alternative to today's automobile-based transportation technology.
Space Grant Education and Enterprise Institute	Provides experiential learning opportunities to university students in space sciences, engineering, science administration, and related fields at NASA ARC.
Space System/Loral	Leading provider of geostationary commercial satellites and spacecraft systems.
Stellar Exploration	Small aerospace product-oriented company supporting NASA and DOD, focused on practical near-term solutions with an emphasis on rapid design-test-validate product cycle.
Stinger Ghaffarian Technologies	Provides systems engineering, technical management, and engineering analysis processes and capabilities to government and private industries.
Takshashila University	Not-for-profit, independent, institution of higher learning, engaged in research and development projects and education activities.
Tesla Motors	Developer of an advanced battery systems that are safer and a more reliable form of energy storage.
UAV Collaborative	Promotes the research and development of unmanned aerial vehicles for scientific, civil and commercial use.
University Associates – Silicon Valley LLC	A partnership with University of California, Santa Cruz, a major step toward NASA's vision of creating a world class center for research, education, innovation and related commercial development.
Vasper Systems California, LLC	Developed a technology designed to stimulate the production of natural human growth hormone by using a revolutionary patent device in conjunction with traditional exercise equipment.
Verdigris Technologies	Technology development to solve global carbon emissions and climate change.
Wattminder, Inc.	Creator of a web platform to enable hands-on STEM learning utilizing a cloud-based lesson delivery system.
Wyle Laboratories, Inc.	Support provider for specialized engineering, scientific, and technical services to NASA, DOD, and a variety of commercial customers.
Zenpire Corp	Create software with complete solutions for semiconductor and flat panel industries.
Source: NASA Research Park Office 2014.	

2.14 NASA Research Aircraft

ARC no longer has any research aircraft. Only small unmanned aerial systems vehicles are flown at the center and those are either electrically powered or utilize a small gasoline engine. The helicopters listed below are operated by the U.S. Army Aviation Development Directorate (ADD)-AFDD at ARC.

2.14.1 EH-60L Blackhawk

The Blackhawk helicopter is a twin-turbine, single main rotor modified for aeronautical research. Recently conducted research has consisted of development and testing modernized flight control laws, full spectrum technology approaches for safe operations in degraded visual environments (such as brownout conditions), stabilization of externally slung loads, and autonomous formation flight. Typical annual usage of the EH-60L is 120 flight hours

2.14.2 JUH-60A Rotorcraft-Aircrew Systems Concepts Airborne Laboratory

The Rotorcraft-Aircrew Systems Concepts Airborne Laboratory (RASCAL) is a highly modified UH-60A Black Hawk helicopter developed for advanced flight control research. Its purpose is to provide the capability for in-flight investigations of advanced control, guidance, and display systems that allow both high agility and maneuverability and the ability to fly close to the ground in poor visibility conditions. The RASCAL contains a full-authority, programmable, digital fly-by-wire control system, advanced sensors in the fixed and rotating systems for health and usage monitoring research, and active flight controllers for envelop limiting and cueing work. This facility is presently used by Army researchers. Annual usage of the RASCAL is typically 120 flight hours.

2.14.3 OH-58C Kiowa

The Kiowa is a two-seat, side-by-side, single-engine helicopter used at ADD-AFDD for pilot proficiency and chase operations during the conduct of flight tests. Typical annual usage of the OH-58C is 60 flight hours.

2.15 Significant Aspects Summary

Table 2-3 contains a listing of the significant aspects and environmental impacts resulting from Ames Research Center Operations.

Table 2-3. Significant Aspects Summary for NASA Ames Research Center

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N200	1943	2,571 (27,670)	Administration Building	Flammable liquids, corrosives (boiler treatment chemicals, used batteries), other regulated materials.
N202	1950	2,463 (26,508)	Space Technology	Corrosives: boiler treatment chemicals, used batteries.
N203	1942	2,144 (23,080)	Imaging Technology Laboratory	Oxidizers/peroxides, corrosives, poisons, other regulated materials Batteries Beneficial: Photo-laboratory treatment systems reduce hazardous waste and industrial wastewater
N204	1955	1,364 (14,681)	Vertical Gun Range	Hazardous cleaning agents Explosives, compressed gasses, flammable liquids, poisons, used batteries. Class 4 laser Paints
N204A	1955	587 (6,314)	Same as above	(Same as above)
N206	1946	2,264 (24,368)	12Foot Pressure Wind Tunnel	Hazardous coatings/cleaning agents Wind tunnel cooling tower blowdown Gasses, flammable liquids, corrosives, other regulated materials 8 ASTs (hydraulic oil, 60850 gallons) Beneficial: CFC Replacement, Minimization of hazardous waste Occupational Noise
N206A	1969	1,114 (11,996)	12Foot Pressure Wind Tunnel Auxiliaries Building	(Same as above)
N207	1946	2,531 (27,239)	Balance Calibration Laboratory	Hazardous coatings/cleaning agents

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N207A	1949	279 (3,000)	(Same as above)	Gases, flammable liquids, corrosives, used batteries, other regulated materials Solvents, adhesives/catalysts Transformer (<50 parts per million [ppm])
N210	1947	7,365 (79,279)	Flight Systems Research Laboratory	Hazardous cleaning agents Corrosives, flammable liquids, other regulated materials HVAC blow-down Batteries
N211	1945	14,305 (153,976)	Flight Support Facility	Paints Hazardous cleaning agents Non-halogenated oil, oil filters, contaminated solids; batteries; cleaners; fuel filters 3 aboveground storage tanks (ASTs) (diesel, 50 gallons; Jet A, 5,000 and 19,500 gallons)
N212	1950	1,429 (15,380)	Model Development	Hazardous coatings/cleaning agents Gases, flammable liquids, corrosives, poisons, other regulated materials Paints, paint thinner, and paint contaminated solids and rags; batteries; adhesives; aerosol cans Source reduction of paint booth debris (paint sprayer and liquid management system)
N213	1950	9,275 (99,833)	Research Support Building	Flammable liquids, corrosives, poisons, other regulated materials Class 4 lasers 1 AST (diesel, 350 gallons) Batteries; misc. laboratory reagents and chemicals Hazardous cleaning agents
N215	1941	2,672 (28,763)	Army Aeroflightdynamics Directorate 7x10-Foot Wind Tunnel 1	Solvents, hazardous cleaning agents Medical waste, batteries Flammable liquids, gases, corrosives, poisons, other regulated materials 1 AST (diesel, 175 gallons)
N216	1941	211 (2,273)	Army Aeroflightdynamics Directorate 7x10--Foot Wind Tunnel 2	Solvents, hazardous cleaning agents Laser cooling water Class 3 and 4 lasers Solvents, oily rags

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
				Flammable liquids, corrosives, poisons, gases, other regulated materials Transformer (<50 ppm PCBs) Motor coolant water recycling
N216A	1973	555 (5,973)	Army Aeromechanics Lab Model Preparation Building	(Same as above)
N216B	1973	462 (4,971)	–	
N217	1969	79 (846)	Magnetic Standards Laboratory	Transformer (<50 ppm PCBs) Coolant Recovery System (recycles used machine coolant – 3,000 gallons/year)
N217A	1972	200 (2,158)	Magnetic Test Facility	(Same as above)
N220	1940	3,520 (37,888)	Technical Services	Solvents, hazardous coatings/cleaning agents Gases, flammable liquids, corrosives, poisons, other regulated materials Batteries, oil-contaminated water and rags, inorganic compounds, contaminated solids, solvents and adhesives Transformers (<50 ppm PCBs) Community and occupational noise Waste minimization reusable steel grit to remove lead-based paint; Acoustic foam
N221	1944	14,020 (150,906)	40 by 80Foot Wind Tunnel	Gasses, corrosives, flammable liquids, oxidizers, poisons, other regulated materials Combustion products (engine testing), hazardous coatings/cleaning agents Class 4 laser 5 ASTs (hydraulic oil, 350 – 3,000 gallons), 1 AST (jet fuel, 500 gallons) Mercury-containing wastes, fluorescent tubes, batteries, paints, oily water Chiller condensate
N221B	1985	1,879 (20,223)	80 by 120 Foot Wind Tunnel	(Same as above)

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N221A	1964	794 (8,546)	20G Centrifuge	28 transformers (<50 ppm PCBs) Occupational noise
N223	1955	2,145 (23,092)	Visitor Center	Hazardous cleaning agents Corrosives, flammable liquids/solids, gasses, poisons, oxidizers, other regulated materials 1 AST (diesel, 85 gallons) Display aircraft washing (oils/grease, heavy metals) Contaminated solids, solvents, corrosives, batteries, mercury-containing wastes, ethylene glycol, organics
N225B	1975	8,984 (96,706)	Substation North	1 AST (oil, 1,000 gallons) Compressed gases, flammable and combustible liquids.
N226	1964	3,101 (33,383)	6 by 6 Foot Supersonic Wind Tunnel	Gasses, flammable liquids, oxidizer/peroxides Combustible liquid (transformer.)
N227	1955	6,100 (65,665)	Unitary Plan Wind Tunnel	Gases, flammable liquids, and corrosives, oxidizer/peroxide, poisons, other regulated materials Hazardous coatings/cleaning agents Class 4 laser 14 ASTs (hydraulic and DTE oil, diesel, 80 8,000 gallons) Batteries; nonhalogenated oil, oil filters, oily rags, and oily water; kerosene; paints and solvents; contaminated solids; fluorescent tubes Wind tunnel cooling tower blowdown Historical buildings
N227A	1955	1,854 (19,960)	11 Foot Transonic Wind Tunnel	(Same as above)
N227B	1955	1,841 (19,820)	9x7 Foot Supersonic Wind Tunnel	(Same as above)
N227C	1955	1,282 (13,800)	8x7 Foot Supersonic Wind Tunnel (Storage)	(Same as above)
N227D	1955	1,125 (12,110)	Unitary Plan Wind	(Same as above)

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
			Tunnel Auxiliaries Building	
N229	1961	4,313 (46,426)	Electric Arc Shock Tube	Hazardous cleaning agents Gases, corrosives, flammable liquids, other regulated materials Batteries, contaminated solids, organic compounds Five Transformers (Rm. 156, Shop >500 ppm PCBs, all others <50 ppm PCBs) Class 4 laser
N229A	1976	2,223 (23,926)	3.5Foot Hypersonic Wind Tunnel	Hazardous coatings/cleaning agents Laboratory chemicals 4 ASTs (300 – 4,000 gallons, Fryquel, waste oil, waste oil/water)
N229B	1978	450 (4,847)	3.5Foot Hypersonic Wind Tunnel Model Storage	(Same as above)
N230	1960	2,929 (31,523)	Physical Sciences Research Laboratory	Gasses, flammable liquids, poisons, corrosives, other regulated materials Hazardous cleaning agents Solvents Class 3B, 4 lasers 6 ASTs (oil, 100 gallons)
N231	1960	687 (7,398)	Fluid Dynamic Laboratory	Solvents, hazardous cleaning agents Flammable liquids, gasses, other regulated materials
N233	1960	5,613 (60,422)	Central Computer Facility	Inorganic liquids, toner Combustible Flammable liquids, corrosives, oxidizer/peroxide, Lead Acid batteries, other regulated material Transformer (<50 ppm PCBs)
N233A	1973	2,945 (31,700)	(Same as above)	(Same as above)

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N234	1962	2,292 (24,667)	Thermal Protection Laboratory	Hazardous coatings/cleaning agents Flammable liquids/solids, poisons, corrosives, gasses, oxidizer/peroxide, other regulated materials Class 3B, 4 lasers, x-ray diffraction machine (60 kilovolts [kV]), electron microscope (25 kV) Batteries, organic compounds, solvents and cleaners 1 AST (hydraulic oil, 100 gallons)
N234A	1962	206 (2,215)	Thermal Protection Laboratory Boiler	Boiler scrubber, plenum spray maintenance Gases, flammable liquids/solids, oxidizers/peroxides, poisons, corrosives, other regulated materials Cooling tower sludge, used containers, barium compounds, organic compounds Combustion products (boiler for arc jet)
N235	1964	1,008 (10,850)	Cafeteria	Gasses, corrosives, other regulated materials Kitchen usages
N236	1964	6,052 (65,141)	Biosciences Laboratory/ Animal Research Incinerator	Animal facility and cage cleaning Gases, flammable liquids/solids, corrosives, poisons, oxidizer/peroxide, batteries, other regulated materials Medical/pathological waste, solvents, photo developer/fixer, organic compounds, contaminated solids, used containers Radiographic machines (76 kV, 150 kV) PCB capacitors and solids 2 ASTs (diesel, 80120 gallons)
N237	1964	5,599 (60,270)	Hypervelocity FreeFlight Facility	Hazardous cleaning agents Heating, ventilation, and air conditioning (HVAC) blowdown Batteries Gasses, flammable liquids, corrosives, poisons, explosives, other regulated materials Four transformers (<50 ppm PCBs) Class 4 lasers Elimination of copper from treatment chemicals, oil/water separator Occupational noise

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N238	1964	1,582 (17,030)	Arc Jet Complex	Combustion products (arc jet heating), hazardous coatings/cleaning agents Gasses, flammable liquids, poisons, corrosive, other regulated materials Batteries, solvents and thinners, contaminated solids, oil and oily rags Class 3b, 4 lasers
N239	1965	11,694 (125,876)	Life Sciences Research Laboratories	Hazardous cleaning agents HVAC blowdown, laboratory glassware washing machine, laboratory sinks Gases, flammable liquids/solids, poisons, corrosives, oxidizer/peroxide, other regulated materials Medical/pathological waste, batteries, organic and contaminated solids, organic liquids and solvents, inorganic acids, adhesives and misc. laboratory chemicals, nonhalogenated oil and oily wastes, mercury-containing wastes, used containers, mercuric chloride Class 4 laser (radioactive sources), electron microscopes (30 kV, 60 kV, 80 kV, 200 kV) Transformer (< 50 ppm PCBs) 2 ASTs (diesel, 500 gallons)
N239A	1966	2,800 (30,136)	Life Sciences Research Laboratory High Bay	(Same as above)
N240	1965	3,844 (41,376)	Airborne Missions and Applications Laboratory	Ethylene oxide (sterilizer), hazardous cleaning agents HVAC blowdown Gasses, flammable liquids/solids, poisons, corrosives, oxidizers, other regulated materials Electron microscope (20kV) Batteries, paints and resins, ethylene glycol
N240A	1982	1,226 (13,200)	Life Sciences Flight Experiments	(Same as above)

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N241	1965	5,794 (62,370)	Administrative Management Building	Flammable liquids, corrosives 1 AST (diesel, 250 gallons) Oily water, contaminated solids, paints, batteries, lead-containing debris HVAC blowdown
N242	1966	2,582 (27,794)	Vestibular Research	Solvent usage, hazardous cleaning agents Gasses, flammable liquids/solids, corrosives, oxidizers, poisons, other regulated materials Contaminated solids, batteries, used containers Three Transformers (<50 ppm PCBs) Source Reduction of Paint Booth Debris (includes High Volume Low Pressure paint sprayer and Liquid Management System), 3 Air Compressor Oil/Water Separators Class 3b laser
N243	1967	12,263 (132,000)	Flight and Guidance Simulation Laboratory	Hazardous cleaning agents HVAC blowdown Gasses, flammable liquids, oxidizers/peroxides, poisons, corrosives, other regulated materials 1 AST (hydraulic oil, 800 gallons) Batteries, paints, oily water and rags
N243A	1967	920 (9,900)	Simulation Equipment Building	(Same as above)–
N244	1967	7,583 (81,626)	Space Projects Facility	Hazardous coatings/cleaning agents HVAC blowdown Gasses, flammable liquids, poisons, corrosives, other regulated materials Batteries, adhesives and solvents, oils 2 Transformers (<50 ppm PCBs) Class 3b lasers (radioactive sources)

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N245	1970	7,079 (76,200)	Space Sciences Research Laboratory	Hazardous cleaning agents Batteries, methanol, ethylene glycol, inorganic acids, compressed gasses and cylinders, oil, contaminated solids Gases, flammable liquids/solids, corrosives, oxides/peroxide, poisons, other regulated materials 1 AST (diesel, 110 gallons) Radioactive sources HVAC blowdown Occupational Noise
N246	1973	3,387 (36,455)	Model Construction Facility	Gasses, flammable liquids, poisons, other regulated materials Hazardous coatings/cleaning agents Oil, batteries Model prep. cooling water
N247	1975	1,043 (11,224)	40 by 80Foot Wind Tunnel Offices	Combustion products (engine testing) Batteries
N248	1973	3,212 (34,573)	Aircraft Servicing Facility	Organic vapor (washrack oil/water separator), Hazardous coatings/cleaning agents Aircraft washrack Gasses, flammable liquids, other regulated materials Petroleum hydrocarbons, oil and grease Replace trichloroethylene use with aqueous cleaner Batteries, oily water, Jet A, contaminated solids, nonhalogenated oils, used containers, misc. paints and solvents, grease and lubricants, alodine, aerosol cans, misc. chemicals
N248A	1973	373 (4,010)	Ground Support Equipment Building #1	(Same as above)
N248B	1976	279 (3,000)	Ground Support Equipment Building #2	(Same as above)
N248C	1987	533 (5,738)	RSRA Calibration Facility	(Same as above)
N248D	1995	372 (4,000)	Aircraft Services	(Same as above)

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
			Storage Building	
N248E	1995	93 (1,000)	Aircraft Washrack Facility	(Same as above)
N249	1975	18,299 (196,968)	Outdoor Aerodynamic Research Facility	Hazardous cleaning agents Compressed gas cylinders Aircraft maintenance (oils, petroleum products, heavy metals) Vehicle/Engine care
N250	1974	292 (3,140)	High-Pressure Facility	Gasses, corrosives, flammable liquids 1 AST (oily water, 4,000 gallons)
N251	1977	348 (3,744)	Motor Pool	Gasses, flammable liquids, other regulated materials Fuel dispensing, hazardous coatings/cleaning agents 2 underground storage tanks (USTs) (4,000 gallons, gasoline; 2,500 gallons, diesel); 3 ASTs (65 gallons, misc. oils and lubricants); 4 ASTs (500 – 2,000 gasoline and diesel fuel, inactive) Runoff from fleet parking (oil and grease, antifreeze, fuel); vehicle fueling; vehicle maintenance and wash rack (oil and grease, fuel, heavy metals, etc.) Diesel fuel, ethylene glycol, nonhalogenated oil and oil filters, aerosol cans, used containers, oily waters and rags, gasoline, sump water, contaminated solids Vehicle wash rack
N254	1980	706 (7,600)	Telecommunications Gateway Facility	Flammable liquids, corrosives, poisons 1 AST (diesel, 800 gallons)
N255	1978	7,118 (76,619)	Facility Supply Support Center	Gasses, flammable liquids, corrosives, poisons, other regulated materials Runoff from fleet vehicle parking (oil and grease, antifreeze, fuel) Toner, misc. chemicals Particulates (shredder, permitted equipment)
N257	1982	1,378 (14,828)	Crew Vehicle Systems Research Facility	Batteries, contaminated solids, oily rags 2 ASTs (hydraulic oil, 220 – 400 gallons) Gasses, flammable liquids/solids, poisons, other regulated materials Hazardous coatings/cleaning agents

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
N258	1986	8,133 (87,540)	Numerical Aerodynamic Simulation Facility	Gasses, flammable liquids, corrosives and other regulated materials Batteries, fluorescent tubes 1 AST (diesel, 110 gallons)
N259	1984	539 (5,800)	Support Facility High Altitude Aircraft	Gasses, flammable liquids, poisons, other regulated materials Hazardous coatings/cleaning agents
N260	1987	2,382 (25,636)	Fluid Mechanics Laboratory	Flammable liquids, other regulated materials Organic compounds, paints and solvents, aerosol cans, nonhalogenated oils, oily rags, batteries Hazardous coatings/cleaning agents 1 AST (hydraulic oil, 150 gallons) Class 4 lasers
N261	1989	1,319 (14,200)	Biomedical Research Facility	Gasses, corrosives, other regulated materials Organic liquids and solids, contaminated solids, used containers, solvents, batteries
N262	1990	4,244 (45,685)	Human Performance Research Facility	Hazardous cleaning agents Batteries, solvents Corrosives, flammable liquids/solids
N263	1989	234 (2,520)	Digital Telecommunications Systems Building	Flammable liquids, corrosives 1 AST (diesel, 300 gallons)
N265	1988	495 (5,329)	Hazardous Substances Transfer Site	Gasses, flammable liquids/solids, oxidizers, poisons, other regulated materials (Note: this location is a waste consolidator rather than a waste generator.)
N267	1991	597 (6,427)	Maintenance Operation Building	Gasses, flammable liquids, corrosives, oxidizer/peroxide, other regulated materials Radioactive source Runoff from fleet vehicle parking (oil and grease, antifreeze, fuel) Particulates, combustion products (tub grinder and brush chipper and engines)
N269	1990	5,355 (57,643)	Automation Sciences	Class 3b lasers Batteries, contaminated solids, resins, adhesives, solvents

Facility Number	Date of Construction	Size square meters (square feet)	Facility Name	Significant Aspects
				Flammable liquids, corrosives, other regulated materials
N271	1999	229 (2,464)	Industrial Wastewater Pre-treatment Plant	Corrosives, other Contaminated solids Pretreatment facility discharge to municipal sewer (29,510 gallons per day [gpd])
1	1933	35,795 (385,290)	Hangar 1	Hazardous Materials/Waste Usage and Storage: Petroleum hydrocarbons, Oil and Grease Organic vapor (aircraft wash oil/water separator) Waste oil, oil filters, oil rags, oil-contaminated solids and water; batteries; contaminated fuel; paints, adhesives, and organic compounds; aerosol cans Conserved: Shenandoah Plaza Historic District
46	1942	32,226 (346,875)	Hangar 2	(Same as above)
47	1942	40,296 (433,738)	Hangar 3	(Same as above + AST [50 gallons diesel])
ARC All Facilities				Solvents, hazardous coatings/cleaning agents, Combustion products (boilers, emergency and mobile generators) Debris and remediation waste (soil), used oil and oily water, PCB-containing wastes, jet fuel, laboratory and shop wastes (satellite and 90day accumulation areas), universal wastes, solid (sanitary) waste 235,000 gpd (includes sanitary, industrial, cooling, and irrigation uses) 115,000 gpd 27,700kWh/year Vegetation, wetlands, fish, and wildlife preservation; historical resource preservation; groundwater and soil restoration Sundry chemicals/usages
Source: NASA 2009, 2014a.				

2.16 NASA Ames Research Park and Eastside Airfield Operations

2.16.1 Facility Usage

ARC contains many specialized and unique facilities that support the mission of ARC and the missions of the resident agencies. Resident agency organizations use dedicated facilities for specified periods of time, ranging from a few days to years. Presently, there are more than a dozen different resident agencies using ARC facilities.

2.16.2 Resident Agencies

Under NASA's oversight, the family of resident agencies at ARC has grown considerably. The different organizations using a variety of facilities include:

- CANG, 129th Rescue Wing
- Defense Energy Supply Center
- Defense Commissary
- Federal Emergency Management Agency
- U.S. Postal Service

2.16.3 Airfield Operations

The airfield at ARC is a fully functional federal airport with all the necessary facilities needed for aircraft operations. Aircraft facilities include:

- Two parallel runways, 2,804 meters (9,200 feet) and 2,469 meters (8,100 feet) long
- Three large hangars, approximately 305 by 91 meters (1,000 by 300 feet)
- Aircraft wash facilities
- Aircraft fuel terminal facility
- 24-hour crash, fire, and rescue
- 16-hour air traffic control tower
- More than 70 structures related to airfield operations
- Extensive ramp space
- Instrument landing system
- Pilot weather briefings
- Flight planning service

Hangar 1 is a contributing element in the Shenandoah Plaza Historic District. It is one of the largest hangars in the world, and until recently housed hangar, administrative, warehouse, maintenance, and classroom space. Hangar 1 is one of the buildings contributing to the historic Shenandoah Plaza District.

2.16.4 Military Facilities

Military facilities at the Center include the CANG facilities located in the Eastside/Airfield area and Army Reserve military housing (Wescoat Village) located south of the NRP area. These facilities are discussed in more detail in Chapter 4, "Land Use."

2.16.5 Multipurpose Facilities

ARC has a wide range of facilities suitable for administration activities, aircraft and vehicle maintenance, warehouse space, and living quarters. With varying degrees of alterations, these facilities can be tailored for many different uses. Almost 400,000 square meters (4.3 million square feet) of space are available, including:

- Storage/hangar space/maintenance/shops, 135,856 square meters (1,462,344 square feet)
- Office space, 246,886 square meters (2,657,464 square feet)

The NADP includes planning for more office space and additional housing.

2.16.6 Amenities Infrastructure

Other facilities and infrastructure that support the quality of life at NASA include:

- Bike/hiking trail access
- U.S. Post Office
- Golden Bay Federal Credit Union
- Cafeteria/deli
- Moffett Training and Conference Center
- Base police/security force
- World-class communication infrastructure
- Satellite and fiber optic links
- Recreation and fitness facilities