National Aeronautics and Space Administration

Draft Environmental Assessment

Decontamination and Decommissioning of Building 140 at Glenn Research Center Lewis Field

February 2015

Draft Environmental Assessment Decontamination and Decommissioning of Building 140 at Glenn Research Center Lewis Field

National Aeronautics and Space Administration
Glenn Research Center
Lewis Field
Cleveland, OH 44135

Lead Agency: National Aeronautics and Space Administration (NASA)

Proposed Action: Implement and complete the decontamination and decommissioning of Building 140, known as the Cyclotron Facility.

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Abstract: NASA is proposing to implement and complete the decontamination and decommissioning of Building 140, known as the Cyclotron Facility, at the NASA Glenn Research Center. Limited decontamination and removal of equipment was accomplished between 1991 and 1994 to permit the reuse of ancillary spaces in Building 49, the Materials and Structures Laboratory (which connects to Building 140) and to provide environmental stabilization of Building 140 for long-term decay in storage. The environmental assessment analyzes the environmental consequences of the Proposed Action to decontaminate and decommission the Cyclotron Facility, which would essentially restore the site to pre-construction conditions, and the No Action Alternative. Cumulative impacts were also evaluated.

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
dB	decibel
dBA	A-weighted decibel
DCGL	derived concentration guideline level
DNL	day–night average sound level
DOT	U.S. Department of Transportation
EA	environmental assessment
FONSI	Finding of No Significant Impact
FSS	Final Status Survey
FY	fiscal year
GE	General Electric
GHG	greenhouse gas
GRC	Glenn Research Center
LCF	latent cancer fatality
LLW	low-level radioactive waste
MeV	megaelectron-volts
NAAQS	National Ambient Air Quality Standards
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act of 1969
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
OHPO	Ohio Historic Preservation Office
OSHA	Occupational Safety and Health Administration
PM_n	particulate matter with an aerodynamic diameter less than or equal to *n* micrometers
RADTRAN 6	Radioactive Material Transportation Risk Assessment Code 6
RCRA	Resource Conservation and Recovery Act
TRAGIS	Transportation Routing Analysis Geographic Information System

TWA	time-weighted average
U.S.C.	*United States Code*
VOC	volatile organic compound

MEASUREMENT UNITS

The principal measurement units used in this document are SI units (the abbreviation for the Système International d'Unites). The SI system is an expanded version of the metric system that was accepted in 1966 in Elsinore, Denmark, as the legal standard by the International Organization for Standardization. In this system, most units are made up of combinations of seven basic units, of which length in meters, mass in kilograms, and volume in liters are of most importance. Exceptions are radiological units that use the English system (e.g., rem, millirem).

SCIENTIFIC (EXPONENTIAL) NOTATION

Numbers that are very small or very large are often expressed in scientific, or exponential, notation as a matter of convenience. For example, the number 0.000034 may be expressed as 3.4×10^{-5} or 3.4E-05, and 65,000 may be expressed as 6.5×10^{4} or 6.5E+04.

Multiples or submultiples of the basic units are also used. A partial list of prefixes that denote multiples and submultiples follows, with the equivalent multiplier values expressed in scientific notation.

Prefix	Symbol	Multiplier	
atto	a	0.000 000 000 000 000 001	1×10^{-18}
femto	f	0.000 000 000 000 001	1×10^{-15}
pico	p	0.000 000 000 001	1×10^{-12}
nano	n	0.000 000 001	1×10^{-9}
micro	μ	0.000 001	1×10^{-6}
milli	m	0.001	1×10^{-3}
centi	c	0.01	1×10^{-2}
deci	d	0.1	1×10^{-1}
deka	da	10	1×10^{1}
hecto	h	100	1×10^{2}
kilo	k	1,000	1×10^{3}
mega	M	1,000,000	1×10^{6}
giga	G	1,000,000,000	1×10^{9}
tera	T	1,000,000,000,000	1×10^{12}
peta	P	1,000,000,000,000,000	1×10^{15}
exa	E	1,000,000,000,000,000,000	1×10^{18}

The following symbols are occasionally used in conjunction with numerical expressions:

<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to

CONVERSIONS

English to Metric			Metric to English		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Length			**Length**		
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Temperature			**Temperature**		
degrees Fahrenheit	Subtract 32, then multiply by 0.55556	degrees Celsius	degrees Celsius	Multiply by 1.8, then add 32	degrees Fahrenheit
Volume			**Volume**		
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight			**Weight**		
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons

EXECUTIVE SUMMARY

The National Aeronautics and Space Administration's (NASA's) Glenn Research Center (GRC) needs to amend its radioactive license with the U.S. Nuclear Regulatory Commission (NRC) by decommissioning the Cyclotron Facility, reduce the burden of facility surveillance, maintenance and monitoring activities, and reduce the inventory of surplus facilities. In support of these needs, NASA proposes to complete the decontamination and decommissioning of Building 140, also known as the Cyclotron Facility, which has been radioactively impacted and no longer serves a useful purpose for research and development.

The Proposed Action, as well as the No Action Alternative, is analyzed in this *Environmental Assessment for the Decontamination and Decommissioning of Building 140 at GRC Lewis Field* (*Cyclotron EA*).

> **No Action Alternative:** Building 140 would remain in place and no additional decontamination or decommissioning would occur. This course of action would require that GRC amend its NRC license requesting that no decommissioning of the Cyclotron Facility be performed, contrary to NRC regulations. Long-term surveillance and maintenance would continue indefinitely and minimal utility service would be provided to the facility.
>
> **Cyclotron Removal with Decontamination, Decommissioning and Demolition (Proposed Action):** The cyclotron machine and all ancillary equipment would be removed from Building 140, and all above- and below-grade structures would be demolished. A Final Status Survey would be prepared to support unrestricted release of the facility from GRC's radioactive license with the NRC. The property would be backfilled to its original grade and landscaped.

Environmental impacts evaluated in this *Cyclotron EA* were determined to range from none to negligible. Resource areas evaluated as not having the potential for adverse impacts under the Proposed Action include land use, visual resources, geology and soils, ecological resources, cultural resources, utilities infrastructure, socioeconomics, and environmental justice. Resource areas that have the potential for some, but still negligible, adverse impacts include air quality, noise, water resources, waste management, transportation, and health and safety. Implementing best management practices and maintaining compliance with Federal, state, and local environmental laws and regulations will ensure adverse impacts remain negligible for these resource areas.

NASA consulted with the Ohio Historic Preservation Office, as required by Section 106 of the National Historic Preservation Act; however, Building 140 is not a contributing element to GRC's historic district and it does not have any other historical significance. The public has been notified of the opportunity to review and comment on the draft *Cyclotron EA* via announcements in local newspapers and a posting on NASA's GRC and National Environmental Policy Act (NEPA) websites (http://netspublic.grc.nasa.gov and http://nasa.gov/agency/nepa). The document is available for review on NASA's website and in local libraries; copies will be mailed to individuals upon request. Comments on the draft *Cyclotron EA* may be submitted during the 30-day comment period.

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1. PURPOSE AND NEED FOR THE ACTION

1.1 INTRODUCTION

This *Environmental Assessment for the Decontamination and Decommissioning of Building 140 at GRC Lewis Field* (*Cyclotron EA*) has been prepared by the National Aeronautics and Space Administration (NASA) to assist in the decision making process in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (42 *United States Code* [U.S.C.] 4321 et seq.); the Council on Environmental Quality's NEPA implementing regulations (Title 40 of the *Code of Federal Regulations*, Parts 1500–1508 [40 CFR Parts 1500–1508]); and NASA's NEPA regulations (14 CFR 1216.3). This environmental assessment (EA) considers the environmental impacts associated with implementation of the Proposed Action to decontaminate and decommission Building 140 at NASA's Glenn Research Center (GRC) – Lewis Field, known as the Cyclotron Facility. A No Action Alternative is also considered. No final action will be taken on this proposal until the decision making process under NEPA has been completed. Decontamination, decommissioning, and demolition activities discussed in this EA would not begin until the necessary Federal, state, and local permits and approvals have been obtained.

1.2 BACKGROUND

The NASA GRC facilities have their origin in 1941, when construction began on the National Advisory Committee for Aeronautics (NACA) Aircraft Engine Research Laboratory near Cleveland, Ohio. Construction was on a 142 hectare (351 acre) site of land acquired from the City of Cleveland at the southwest boundary of the city (SAIC 2012).

In the late 1940s, General Electric (GE) began construction of the Cyclotron Facility under a 'turn-key' agreement with NACA. In 1955, after about seven years of construction, the 152-centimeter (60-inch) cyclotron became operational and was turned over to NACA for materials research. It was used in performing material irradiation studies. The system was a charged-particle accelerator capable of accelerating alpha particles to energies of 40 megaelectron-volts (MeV) and protons and deuterons to energies of 20 MeV. The system operated extensively until 1970, when it was shut down to perform a significant upgrade to the machine. Dismantlement of the old cyclotron equipment was performed from October of 1970 until July of 1971, when installation of the modified equipment began. Work continued on the upgrade installation until January of 1973, when startup testing began. The modified system was a 175-centimeter (69-inch) cyclotron with the capability of producing variable energy. It was a more versatile system capable of accelerating alpha particles to energies of 24 to 58 MeV, protons to energies of 10 to 55 MeV, deuterons to energies of 7 to 29 MeV, and helium-4 nuclei to energies of 15 to 65 MeV. In addition, the system could produce neutron beams that follow a parallel path by bombardment of beryllium target materials. The modified machine had a much higher efficiency, meaning that less particle impingement would occur inside the machine, resulting in less radioactive activation of the materials of construction.

In 1975, the facility was modified to prepare for treatment of oncology patients under a program with the Cleveland Clinic Foundation. The building was remodeled to provide for a patient receiving area, and additional particle-beam control systems were installed to allow generation of collimated neutron beams in a patient treatment center. From 1975 through 1990, treatment of oncology patients continued until the Cyclotron Facility was permanently shut down in December of 1990, after treating about 1,200 patients (SAIC 2012).

Throughout the operational period, cyclotron operations were carefully controlled by written procedures and policies and a written safety manual. The operations were subjected to extensive review and oversight by GRC's Radiation Safety Committee, made up of senior management personnel with extensive technical expertise in the areas of health physics and radiation protection. The same health physics technical staff that performed radiation monitoring and safety activities throughout the GRC also provided monitoring and radiation protection activities at the cyclotron (SAIC 2012).

In 1991, NASA implemented a plan to decontaminate the Cyclotron Facility. The plan included decontamination of laboratories and rooms in Building 49, the Materials and Structures Laboratory, which connects at the basement level with Building 140; decontamination of adjacent rooms in Building 140 and conversion for use by the Health Physics staff; and closure of the cyclotron itself for decay-in-storage status. In 1994, NASA planned a major renovation to Building 49 to establish the Comparative Technology Research Center. Decontamination was performed under the supervision and oversight of radiation protection personnel. Nearly all of the loose radioactive material in the facility was packaged and shipped for disposal as radioactive waste. When the project was completed in late 1994, Building 140 was left secured to allow further radioactive decay of the cyclotron and the beam equipment. Affected areas of Building 49 were decontaminated and released for unrestricted use before beginning the Building 49 renovation project (SAIC 2012).

The cyclotron machine itself was contaminated with activation products and the decision was made to proceed with dismantlement at the time. The magnet coils and other beam control components were supplied with a source of de-ionized water for cooling. Records indicate that complete drainage of the cooling system could not be confirmed. It was drained to the extent practical by opening the accessible drain valves. During storage, the cyclotron area has been subjected to frequent radiological monitoring and physical inspection. Maintenance has been performed to assure the continuation of reasonably good ventilation and heat in the area (SAIC 2012).

A chronology of major milestones is provided below. Emphasis is on operations with radioactive materials that could affect the facility conditions (SAIC 2012).

- Late 1940s – GE began construction of the 152-centimeter (60-inch) cyclotron.
- 1955 – Cyclotron operations began after seven years of construction.
- 1955 through 1970 – Cyclotron was used extensively for material irradiation studies, general nuclear physics research, and some production of radioisotopes by bombardment of targets.
- October 1970 through July 1971 – Significant upgrade to the cyclotron was performed. The 152-centimeter (60-inch) cyclotron was disassembled and replaced by a more efficient 175-centimeter (69-inch) cyclotron. Testing and research resumed following the upgrade.

- 1975 – Facility modifications were performed to prepare for treatment of Cleveland Clinic oncology patients through neutron radiation therapy.
- 1975 through 1990 – Cyclotron operations continued. A majority of the run time was dedicated to treatment of oncology patients. However, records indicate some production of radioisotopes occurred for medical administration to human patients.
- December 1990 – Cyclotron operations were terminated.
- 1991 – Facility decontamination plan was implemented, which included some removal of unnecessary equipment/materials, general decontamination of laboratories and impacted rooms located in Buildings 49 and 140, and closure of the cyclotron for decay-in-storage status.
- 2014 – NEPA review was initiated for the Proposed Action of completing the decontamination, decommissioning, and demolition of Building 140.

1.3 PURPOSE AND NEED

The purpose of NASA's action to decontaminate and decommissioning Building 140 is to amend and remove the licensed radioactive materials associated with the Cyclotron Facility from GRC's U.S. Nuclear Regulatory Commission (NRC) byproduct materials license. In accordance with the Energy Policy Act of 2005 (42 U.S.C. 15801 et seq.), wherein the NRC revised its definition of byproduct material, the activated components and materials of the cyclotron and beam control systems along with the activated infrastructure became NRC-licensed byproduct material as of October 2008 and were listed on NASA GRC's License No. 34-00507-16. The Proposed Action would also allow NASA to reduce the burden of surveillance, maintenance, and monitoring costs and to reduce its surplus facilities inventory. Upon completion of the Proposed Action, NASA GRC's NRC license would still be in effect for other radioactive byproduct materials used for research at Lewis Field that are not associated with the Cyclotron Facility.

Decommissioning of the Cyclotron Facility is required to be completed in accordance with the NRC regulation "Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas" (10 CFR 30.36). NASA GRC has been working with, and, submitting appropriate licensing actions to NRC Region III to adjust the time schedule for decommissioning process milestones as needed to address the scope and complexity of the project as well as resource availability at GRC.

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2. PROPOSED ACTION AND NO ACTION ALTERNATIVE

This chapter describes Building 140, known as the Cyclotron Facility; the Proposed Action evaluated in this *Environmental Assessment for the Decontamination and Decommissioning of Building 140 at GRC Lewis Field* (*Cyclotron EA*); and the No Action Alternative.

2.1 DESCRIPTION OF CYCLOTRON FACILITY

NASA GRC consists of two sites in Ohio: Lewis Field in western Cuyahoga County (near Cleveland) and Plum Brook Station in west-central Erie County, approximately 6 kilometers (4 miles) south of Sandusky, Ohio, and 81 kilometers (50 miles) west of Lewis Field. Building 140 is located at GRC Lewis Field as illustrated in **Figure 2–1**. Building 140 is made up of approximately 560 square meters (6,000 square feet) of floor space and the Cyclotron Facility project area encompasses approximately 0.3 hectares (0.7 acres). Building 140 interconnects at the basement level with Building 49, the Materials and Structures Laboratory, via an access corridor and a service trench. Building 140 is not currently occupied and all research activities using the Cyclotron Facility and its equipment have ceased. Building 140 is primarily a below-grade structure. Above-grade structures include ventilation hoods, exposed roof above the Hot Storage Room, the Skylight Room access panels, a stairway entrance, and the Mechanical Equipment Room. The above- and below-grade details of Building 140 are illustrated in **Figures 2–2** and **2–3**, respectively.

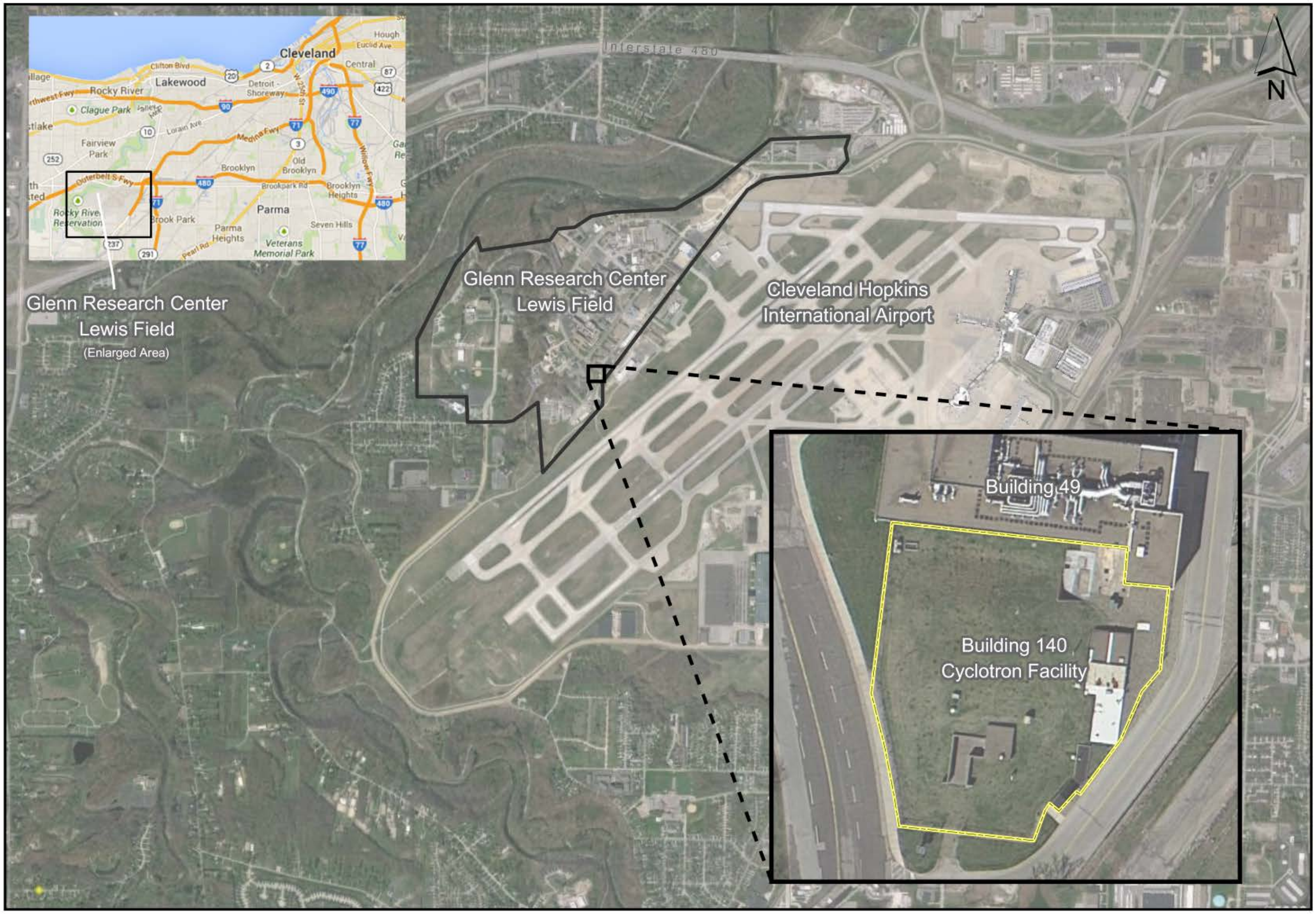
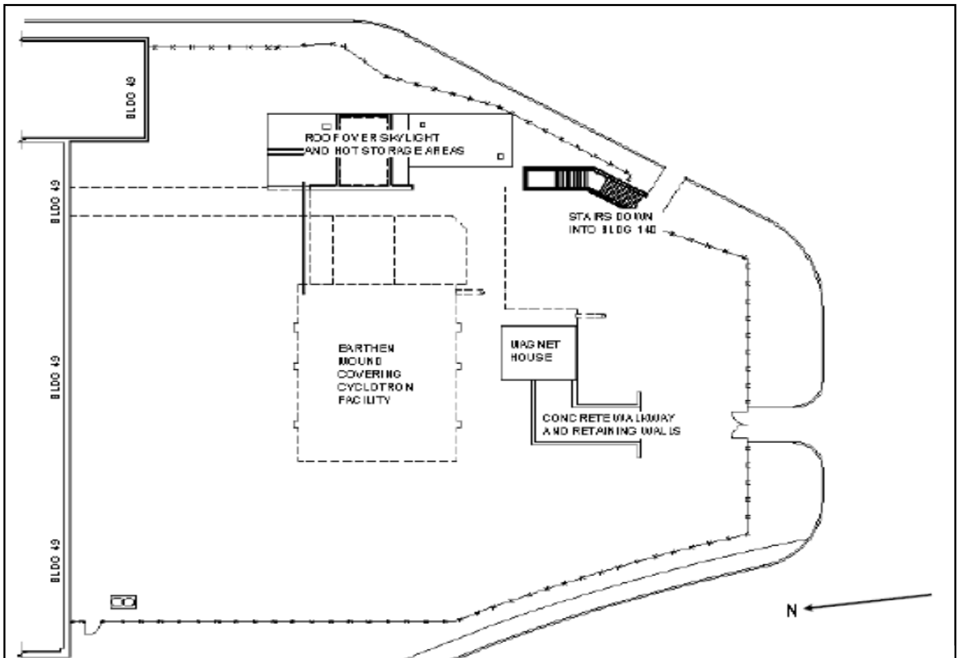
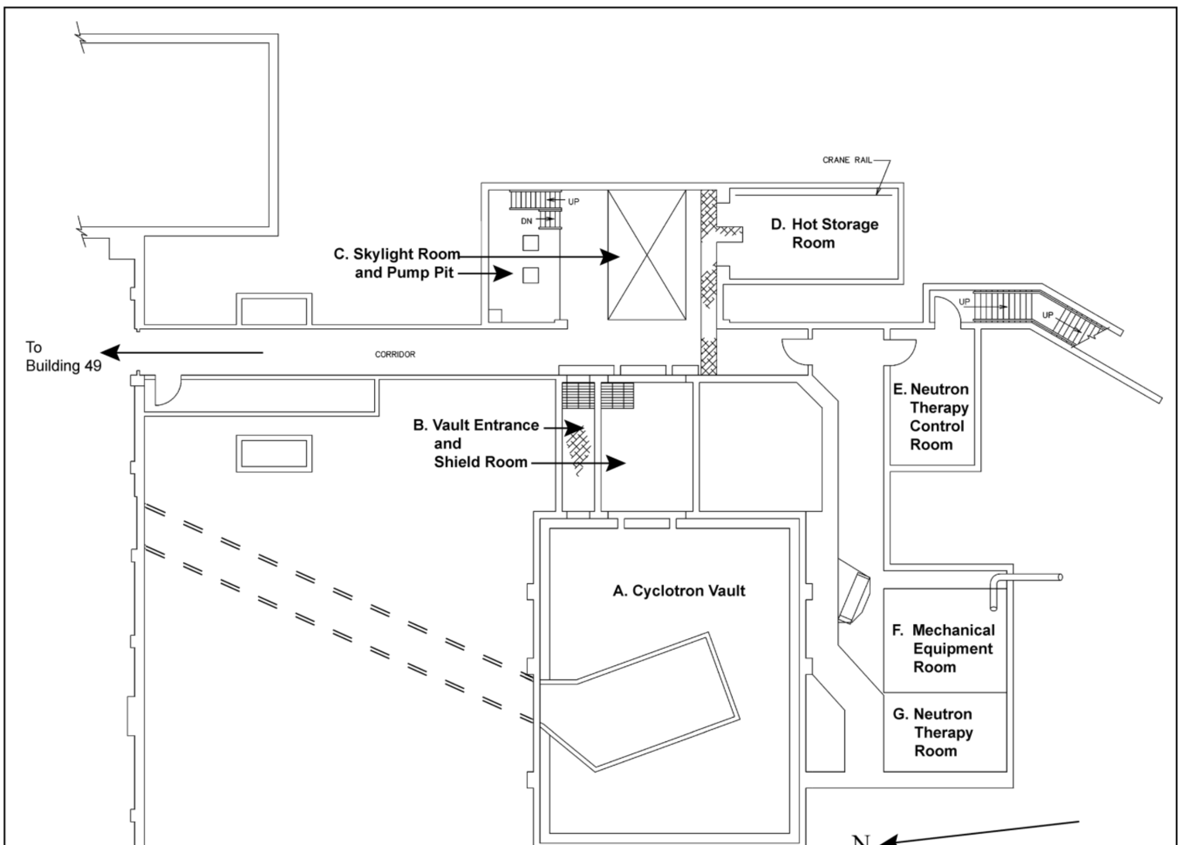


Figure 2–1. Location of Building 140 at Glenn Research Center Lewis Field



Source: SAIC 2012.

Figure 2–2. Above-Grade Diagram of Building 140



Source: SAIC 2012.

Figure 2–3. Below-Grade Diagram of Building 140

The main functional areas of Building 140 are described below and labeled in Figure 2–3. The photographs reflect the general state of the rooms as they exist today, after limited equipment removal took place in 1991. As seen in the photographs, the cyclotron machine and a large portion of the ancillary equipment was left in place to allow decay-in-storage of radioactively contaminated components.

A. Cyclotron Vault – The Cyclotron Vault houses the 175-centimeter (69-inch) particle accelerator, beam tubes, an overhead 9.1-metric-ton (10-ton) double girder manual crane, electrical panels, pumps, motors, cable trays, and an upgraded electrical heating system. The room is constructed of reinforced concrete walls, floor, and ceiling. Floor dimensions are 12.2 by 15.2 meters (40 by 50 feet) with a ceiling height of approximately 6.0 meters (19.5 feet). A service trench approximately 1.2 meters wide by 0.6 meters deep (4 feet wide by 2 feet deep) runs from the Cyclotron Vault to Building 49 and contains a conduit for cables. The room can be accessed either through the Vault Entrance or Shield Room. Large equipment can be moved in or out of the vault through the Shield Room watertight doors.

Source: SAIC 2012.

B. Vault Entrance and Shield Room – The Vault Entrance and Shield Room provide access to the cyclotron machine for equipment and personnel. The Vault Entrance is a narrow personnel entryway. Floor dimensions are 1.5 by 6.1 meters (5 by 20 feet) with a ceiling height of approximately 2.4 meters (8 feet). The Shield Room floor dimensions are 4.3 by 6.1 meters (14 by 20 feet) with a ceiling height of 6.1 meters (20 feet). Two large doors provide access to the vault and allow large equipment to be moved in or out of the Cyclotron Vault for maintenance. The Vault Entrance and Shield Room are watertight and can be flooded during particle accelerator operation to provide radiation shielding.

Source: SAIC 2012.

C. Skylight Room and Pump Pit – The Skylight Room houses the circuit breakers for Building 140, various cable trays, an overhead hoist, building ductwork, a stainless steel sink, and a pumping system for the Shield Room and Vault Entrance. Most of the pumping system has been dismantled and removed from the pit area. Floor dimensions are 10.7 by 8.5 meters (35 by 28 feet) with a ceiling height of 6.1 meters (20 feet). A 3.7-by-6.1-meter (12-by-20-foot) removable roof cover allowed for large components to be lowered into or removed from the facility.

Source: SAIC 2012.

D. Hot Storage Room – The Hot Storage Room contains 12 caves built into the wall that were once used to store high-radiation target materials. The iconel linings of the caves have been removed, surveyed and dispositioned as either scrap or low-level radioactive waste. Each cave had a separate steel-jacketed lead door that could be raised by means of an electric winch to provide access to the storage cavity. The room also contained a beam splitter that could be connected to the cyclotron through a series of removable beam tube sections. The cave doors and beam splitter have been removed from the room. Floor dimensions are 4.3 by 6.1 meters (14 by 20 feet) with a ceiling height of 6.1 meters (20 feet).

Source: SAIC 2012.

E. Neutron Therapy Control Room – The Neutron Therapy Control Room housed control equipment necessary to conduct patient therapy operations. The room is generally free of cyclotron equipment except for a sump, cabinets, and a heating system. A stairway located to the east leads to grade level outside the building and a connecting corridor provides a walkway from the Control Room to the Neutron Therapy Room. Floor dimensions for the Neutron Therapy Control Room are 4.3 by 6.1 meters (14 by 20 feet) with a ceiling height of approximately 2.4 meters (8 feet).

Source: SAIC 2012.

F. Mechanical Equipment Room – The Mechanical Equipment Room was added as part of the Neutron Therapy Room modification to house the beam tubes and steering magnets for the vertical collimator. Floor dimensions for the Mechanical Equipment Room are 4.3 by 5.5 meters (14 by 18 feet). The room is directly above the Neutron Therapy Room and is accessed by a concrete driveway from outside the facility.

Source: SAIC 2012.

G. Neutron Therapy Room – The Neutron Therapy Room was originally added to the Cyclotron Facility in 1956 as an additional target area. In 1975, the room was converted to a neutron therapy facility for the treatment of cancer patients. A series of beam tubes and steering magnets provided a vertical and horizontal collimator to accommodate the various treatment requirements. Two beam tubes run through the south wall of the Cyclotron Vault into the Neutron Therapy Room. One of the beam tubes penetrates through the ceiling and runs to the Mechanical Equipment Room. Floor dimensions are 8.8 by 7.3 meters (29 by 24 feet) with a ceiling height of approximately 3.4 meters (11 feet).

Source: SAIC 2012.

2.2 DESCRIPTION OF PROPOSED ACTION AND NO ACTION ALTERNATIVE

2.2.1 Cyclotron Removal with Decontamination, Decommissioning and Demolition (Proposed Action)

As discussed in Chapter 1, NASA is proposing to decontaminate and decommission the Cyclotron Facility. The desired objectives are as follows:

- Amend GRC's U.S. Nuclear Regulatory Commission (NRC) license by decommissioning the Cyclotron Facility in accordance with NRC regulation as discussed in Chapter 1, Section 1.3.
- Reduce the overall burden of surveillance, maintenance, and monitoring costs associated with the Cyclotron Facility.
- Reduce NASA's inventory of surplus facilities.

The Proposed Action involves the removal of the cyclotron machine and ancillary equipment and support systems and byproduct materials, including both loose and fixed contamination, to a level that permits release of the site for unrestricted use, followed by the demolition of Building 140. **Figure 2–4** illustrates the project area boundary including the building structures and equipment that will be impacted by the Proposed Action. Radiological surveys will be performed to confirm that end point criteria have been met. NASA will submit an application to NRC for license amendment to remove the facility from license controls. The criteria used to determine the final site release is described in "Radiological criteria for unrestricted use" (10 CFR 20.1402), which states, "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE [total effective dose equivalent] to an average member of the critical group that does not exceed 25 mrem [millirem] (0.25 mSv [millisieverts]) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)." The Proposed Action will not be implemented until a final EA has been issued and either a Finding of No Significant Impact has been made or NASA completes the National Environmental Policy Act (NEPA) process by preparing an environmental impact statement.

In general, the decontamination and decommissioning of the Cyclotron Facility would be accomplished in several steps: (1) Interference Equipment Removal, (2) Cyclotron Machine Removal, (3) Concrete and Soil Removal, and (4) Final Status Survey (FSS).

Interference Equipment Removal - All non-essential equipment and materials from Building 140 including piping, conduits, electrical systems, beam tubes, steering magnets, beam targets, and instrumentation, except for the cyclotron machine itself, would be recycled to the maximum extent practical or removed and packaged for appropriate offsite disposal.

Cyclotron Machine Removal - The cyclotron machine would be disassembled and removed from the building, and then would be packaged and transported to a licensed radioactive waste disposal facility in accordance with "Shippers: General Requirements for Shipments and Packaging" (49 CFR Part 173).

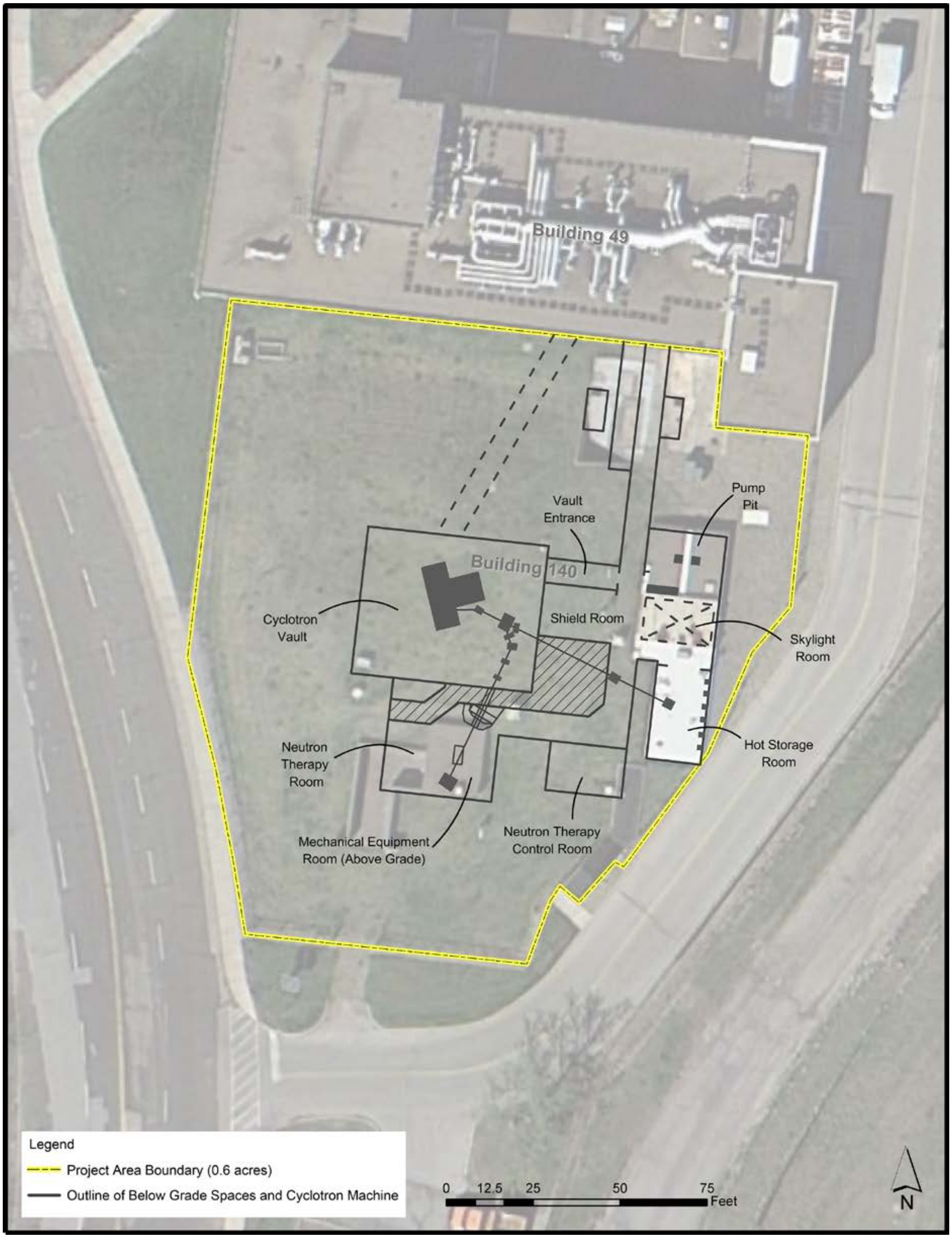


Figure 2–4. Cyclotron Removal with Decontamination, Decommissioning and Demolition

Concrete and Soil Removal - All remaining structural materials (i.e., concrete walls, footings, floors, and ceilings), exterior piping and structures would be demolished. Structural materials associated with the Cyclotron Vault are assumed to be radioactively contaminated and would be packaged in appropriate shipping containers and transported to a licensed radioactive waste disposal facility. Any potentially contaminated soil would also be packaged and transported to a licensed low-level radioactive waste disposal facility.

Final Status Survey - An FSS report would be prepared and submitted to the NRC for review and approval. The FSS report would be used to demonstrate that the site meets the radiological criteria for unrestricted use and the project would conclude with the amendment of the current GRC NRC license and removal of the Cyclotron Facility from license control.

The property would be backfilled to its original grade and landscaped. The facility would be removed from NASA's surplus inventory, no longer requiring resources to maintain. All of the objectives would be met under the Proposed Action.

2.2.2 No Action Alternative

Under the No Action Alternative, Building 140 would remain in place and no decontamination or decommissioning would occur. This course of action would require that GRC amend its NRC license requesting that no decommissioning of the Cyclotron Facility be performed, contrary to NRC regulations. However, it is unlikely that the NRC would approve an amendment request to not decommission the Cyclotron Facility. Long-term surveillance and maintenance would continue indefinitely and minimal services would be provided to the facility, as required. The facility would be secured and access restricted. The property would remain in NASA's surplus facility inventory. None of the objectives would be met under this alternative.

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3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the affected environment and potential environmental and human health impacts that may be associated with implementation of the Proposed Action considered in this *Environmental Assessment for the Decontamination and Decommissioning of Building 140 at GRC Lewis Field (Cyclotron EA)*, including the No Action Alternative. As presented in Chapter 1, the National Aeronautics and Space Administration (NASA) Glenn Research Center (GRC) proposes to complete the decontamination and decommissioning of Building 140, known as the Cyclotron Facility. A detailed description of the Proposed Action is provided in Chapter 2, Section 2.2, and a summary of the project's environmental impacts is presented in Section 3.14 of this chapter. Environmental impacts are discussed in this chapter for the following resource areas: land use, visual resources, geology and soils, air quality, noise, water resources, ecological resources, cultural resources, waste management, transportation, health and safety, utilities infrastructure, socioeconomics, and environmental justice. These resource areas were analyzed in a manner commensurate with their importance or the relative expected level of impact using the sliding-scale assessment approach. The general impact assessment methodology used to evaluate each resource area, and mitigation and monitoring, as applicable, are also discussed in this chapter.

3.1 LAND USE

3.1.1 Affected Environment

Lewis Field encompasses approximately 124 hectares (307 acres) of land and contains over 180 buildings, structures, and other facilities that support NASA's wide array of research, technology, and development programs. Most of Lewis Field is considered fully developed with offices, test facilities, and support facilities; however, approximately 69 hectares (170 acres) of Lewis Field are considered undeveloped (NASA 2013a).

The Cyclotron Facility is located at the NASA GRC at Lewis Field. The facility is located in Building 140, which is predominantly below-grade and interconnects at the basement level at the south end of Building 49. The two buildings are located between Wolcott Road and the northwestern edge of the Cleveland Hopkins International Airport boundary fence near the southeastern boundary of NASA property. Building 140 is made up of approximately 560 square meters (6,000 square feet) of floor space, and the project area encompasses approximately 0.3 hectares (0.7 acres) on previously disturbed land.

Adjacent to Lewis Field is Cleveland Hopkins International Airport, which operates with Class B airspace and has several runways. The airport borders Lewis Field and is generally to the southeast. Building 140 is approximately 305 meters (1,000 feet) at a perpendicular from the midway point of runway 24R-06L. The end of runway 10 is very near the main entrance to GRC Lewis Field. GRC Lewis Field lies within the inner ring of Class B airspace from the surface to 2,400 meters (8,000 feet) above mean sea level. GRC Lewis Field is connected to Cleveland Hopkins International Airport via gated taxiways. Cleveland Hopkins International Airport averages 495 operations per day and has various published precision and non-precision instrument approach procedures (FAA 2014).

3.1.2 Environmental Consequences

No changes in land use would be expected to occur under the No Action Alternative. The Proposed Action would require the disturbance of 0.3 hectares (0.7 acres) of previously disturbed land, and result in complete removal of all man-made structures; the property would be backfilled to its original grade and landscaped. Site restoration and landscaping will incorporate, to the maximum extent practicable, plants that are beneficial to pollination and avoid using pesticides that are detrimental to pollinator habitat (White House 2014). At this time NASA has no plans to rebuild on this site, however, if any new construction is anticipated, NASA would have to evaluate the proposal to meet the requirements of the Federal Aviation Administration protection zones for Cleveland Hopkins International Airport. Impacts on adjacent onsite facilities would not be anticipated and no disturbance would be expected to occur on previously undeveloped areas.

A crane would likely be required for implementation of the Proposed Action; however, its operation is not expected to adversely impact or interfere with daily operations at Cleveland Hopkins International Airport. However, pursuant to “Safe, Efficient Use, and Preservation of the Navigable Airspace” (14 CFR Part 77), NASA would be required to file a notification of construction activity 45 days prior to erecting the crane. Notification allows the Federal Aviation Administration to identify potential aeronautical hazards in advance, thus preventing or minimizing adverse impacts on the safe and efficient use of navigable airspace. The likely outcome of such a filing would be the publication of a Notice to Airmen during the time that the crane would be operational.

3.2 VISUAL RESOURCES

3.2.1 Affected Environment

The topography near Lewis Field consists of gently rolling uplands created by glacial outwash. Lewis Field itself is generally level due to extensive cut-and-fill operations that reclaimed much of the area from steep drainage swales that once crossed the site. This overall topography contrasts sharply with the deeply eroded valleys and sloping banks of Abram Creek and Rocky River. These ravines are 15 to 30 meters (50 to 100 feet) deep, with an estimated maximum sidewall slope of 75 degrees (NASA 2013b).

Elevations in Lewis Field range from approximately 229 meters (750 feet) above sea level on the majority of the site to approximately 195 meters (640 feet) above sea level at the bottom of the Abram Creek valley. Most of this area is flat with the natural topography only slightly altered by the construction of buildings (EnviroScience 2012).

The Cyclotron Facility is predominantly below-grade. The below-grade structures are roughly 1 meter (3 feet) above the street-level-grade and are covered with soil, forming a mound 3 to 4 meters (10 to 13 feet) high at the center. Above-grade structures visible to the project area include a concrete driveway, a stairway leading to below ground, various ventilation systems protruding through the top of the mound, and a chain link fence enclosing the entire area (SAIC 2012).

3.2.2 Environmental Consequences

No impacts on visual resources would occur under the No Action Alternative. Any visual impacts during implementation of the Proposed Action would be temporary and would include increased construction activity, including the use of some heavy equipment and a crane. The Proposed Action would result in altering the land area to a level field void of structures; this would be perceived as an enhancement to visual resources at the project site. No adverse impacts on visual resources would result from the Proposed Action.

3.3 GEOLOGY AND SOILS

3.3.1 Affected Environment

In many cases, the natural soils and parent materials at Lewis Field have been removed or covered with fill, including a variety of undifferentiated soils and gravels, construction debris, and industrial and domestic waste. In the immediate vicinity at Lewis Field, bedrock is composed of the Cleveland Shale Member of the Ohio Shale. The surface is primarily covered by a thin layer (several inches to a few feet) of lacustrine clay and silt deposits that are underlain by glacial tills. Naturally occurring soils include the Mahoning Association, the Brecksville silt loam, the Chagrin silt loam, and Jimtown loam (NASA 2008; 2013a).

Soil samples were collected from Buildings 140 and 49, land area directly above Building 140, south of Building 49, and selected background reference areas during a survey conducted between 2010 and 2011. No cyclotron-related radioactivity was detected in the samples or during walkover surveys (SAIC 2012).

3.3.2 Environmental Consequences

Under the No Action Alternative, no decontamination or demolition would occur; therefore, potentially contaminated soil would not be removed under this alternative. Long-term surveillance and maintenance and monitoring would, however, continue indefinitely as necessary.

The Proposed Action would include the demolition of all below-grade structures. The cyclotron machine and all ancillary equipment would be removed from Building 140, and all above- and below-grade structures, including the service trench running between Buildings 49 and 140, would be demolished. Surrounding soil would be excavated 0.9 meters (1 yard) extending from the bottom and side edges of the Cyclotron Vault Room. Over-excavation (excavation beyond 0.9 meters [1 yard]) would not be necessary for other below-grade structures. The project area would be backfilled to its original grade, using approximately 3,160 cubic meters (111,000 cubic feet) of imported fill, and then landscaped. The resources necessary for the fill would consist of commonly available materials, and the necessary quantities would not be anticipated to impact regional supplies. Because disturbance of soils under the Proposed Action is not expected to extend into native soils and would remain within the extent of previous excavations for original construction of Building 140, there would be no adverse impacts on geology and soils.

Adherence to best management practices for erosion and sediment control would be implemented to mitigate impacts due to soil erosion and loss. All soil excavated would be characterized for radioactive contamination, and excavated soil exceeding U.S. Nuclear Regulatory Commission (NRC) approved derived concentration guideline levels (DCGLs) would be segregated for disposal as radioactive waste. DCGLs would be developed in accordance with "Standards for Protection Against Radiation" (10 CFR Part 20).

3.4 AIR QUALITY

3.4.1 Affected Environment

Air quality at Lewis Field is regulated through the National Ambient Air Quality Standards (NAAQS) promulgated under the Federal Clean Air Act (CAA). **Table 3–1** identifies the criteria pollutants regulated by the CAA.

Lewis Field is classified as a major source of air emissions and operates under a Title V permit. The majority of emissions from Lewis Field result from the combustion of fuels, including natural gas, No. 2 fuel oils, and jet fuels. Other sources include air heaters, boilers, and steam generators. Cuyahoga County is designated as a nonattainment area for particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) and the 8-hour ozone standards. Cuyahoga County is also designated as a maintenance area for particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), carbon monoxide, and sulfur dioxide (NASA 2008).

Table 3–1. Summary Air Quality Standards

Criteria Pollutant	Federal[a] and State of Ohio Standards μg/m^3 (ppm)	
Carbon Monoxide (CO) 1-hour Average 8-hour Average	 40,000 (35) 10,000 (9)	 Primary Primary
Lead (Pb) Quarterly Average	 1.5	 Both Primary and Secondary
Nitrogen Dioxide (NO_2) Annual Arithmetic Mean	 100 (0.053)	 Both Primary and Secondary
Ozone (O_3) 1-hour Average 8-hour Average (1997 standard) 8-hour Average (2008 standard)	 (0.12) (0.08) (0.075)	 Both Primary and Secondary
Particulate Matter (PM_{10}) 24-hour Average	 150	 Primary
Particulate Matter ($PM_{2.5}$) Annual Arithmetic Mean 24-hour Average[b]	 15 35	 Both Primary and Secondary
Sulfur Dioxide (SO_2) Annual Arithmetic Mean 24-hour Average 3-hour Average	 80 (0.03) 365 (0.14) 1,300 (0.5)	 Primary Primary Secondary

[a] Federal primary standards are levels of air quality necessary, with an adequate margin of safety, to protect the public health. Federal secondary standards are levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[b] Ohio has not adopted the newly changed 24-hour average for $PM_{2.5}$.

Key: μg/m3 = micrograms per cubic meter; ppm = parts per million.

Source: NASA 2008.

3.4.2 Environmental Consequences

The environmental impacts of the Proposed Action on local and regional air quality are estimated based on the potential increases in regulated pollutant emissions relative to existing conditions and ambient air quality. According to the General Conformity Rule, impacts on air quality require further analysis if the proposed Federal action would result in an increase of a nonattainment or maintenance area's emissions inventory by 10 percent or more for one or more nonattainment pollutants, or if such emissions would exceed threshold levels for individual nonattainment pollutants or for pollutants for which the area has been redesignated as a maintenance area. The thresholds are similar, in most cases, to the definitions for major stationary sources of criteria and precursors to criteria pollutants under the CAA's New Source Review Program. The applicable threshold levels are 100 tons per year of nitrogen oxide or 50 tons per year of volatile organic compounds (VOCs) for a moderate ozone (8-hour) nonattainment area and 100 tons per year of particulate, sulfur dioxide, nitrogen oxides, VOCs, or ammonia for a moderate $PM_{2.5}$ (particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers) (annual averaging) nonattainment area as defined in "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (40 CFR Part 93).

Under the No Action Alternative, there would be no land disturbance or heavy equipment use. Therefore, there would be no increase in air pollutant emissions and thus, no impacts on air quality. Under the Proposed Action air emissions would be from burning diesel fuel for operating heavy equipment (e.g., crane and excavators) and fugitive dust from exposure of soils during excavation. Truck emissions from the transport of waste materials are discussed in Section 3.15.4. Approximately 38,000 liters (10,000 gallons) of diesel fuel are expected to be burned on site and a maximum of 0.1 hectares (0.25 acres) of disturbed ground would be exposed at any given time. The predicted air emissions would be 0.797 tons per year, 0.103 tons per year, 0.307 tons per year, 0.001 tons per year, and 1.828 tons per year for nitrogen oxide, VOCs, carbon monoxide, sulfur oxide and PM_{10} or $PM_{2.5}$ respectively. For conservative analysis, it was assumed that all air emissions from the Proposed Action would occur within the same year.

Since Cuyahoga County is within a nonattainment area for the 8-hour ozone and $PM_{2.5}$ standards and is also designated as a maintenance area for PM_{10}, carbon monoxide, and sulfur dioxide, General Conformity Rule requirements are applicable. The conformity emissions thresholds are 100 tons per year for nitrogen oxide, carbon monoxide, sulfur oxide and PM_{10} or $PM_{2.5}$, and 50 tons per year for VOCs. The Proposed Action would generate emissions well below conformity threshold limits, and be expected to have a negligible impact on air quality in the vicinity of the project area. Any air emissions would be temporary and short-lived.

Radiological air emissions are not expected to occur. All decontamination, decommissioning, and demolition of radioactively contaminated building components would be done under controlled circumstances, as necessary, to prevent any radioactive contamination from being dispersed into the air.

Emissions from heavy construction equipment would be mitigated by maintaining the equipment and using best available control technologies to control emissions. Fugitive dust emissions would occur as a result of land disturbance by heavy equipment, causing suspension of soil particles in the air. Fugitive dust emissions would be mitigated using standard mitigation techniques, including watering and/or using surfactants to control dust emissions from exposed areas, revegetating exposed areas, watering roadways, and minimizing construction activity during dry or windy conditions. An environmental monitoring program would be established to ensure air emissions are kept to a minimum and would not negatively impact the environment. Air monitoring is one of the major components of an environmental monitoring program, as radioactive material may become airborne during decontamination, decommissioning, and demolition activities. If necessary, decontamination, decommissioning, and demolition activities may be conducted under containment or controlled circumstances.

3.5 NOISE

3.5.1 Affected Environment

Noise-induced hearing loss is caused by hazardous noise energy damaging the nerve cells of the inner ear; the hearing loss is permanent and will affect a person's ability to understand speech under everyday conditions. Standards for workplace noise were developed by the Occupational Safety and Health Administration (OSHA) under "Occupational noise exposure" (29 CFR 1910.95). OSHA's permissible noise exposure limits are as follows: 90 decibels on an A-weighted scale (dBA), as an 8-hour time weighted average (8-hour TWA), using a 5 decibel (dB) exchange rate; no exposures shall exceed the ceiling limit of 115 dBA, 15 minutes/day; impulse noise shall not exceed 140 dBA. When employees are subjected to hazardous noise exposures exceeding these limits, their noise exposure shall be controlled, reduced, or eliminated through a hierarchical combination of engineering controls, administrative controls, and hearing protection devices. Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

NASA has set a more conservative noise exposure limit of 85 dBA, as an 8-hour TWA exposure using a 3 dB exchange rate. At GRC Lewis Field, hearing protection shall be provided to all employees exposed to noise equal to or exceeding 82 dBA, and employees are required to wear hearing protection in areas, or when using equipment, where noise levels are equal to or exceed 85 dBA. If single hearing protection (plugs or muffs) cannot reduce employee exposure levels to less than 85 dBA, as an 8-hour TWA, then double hearing protection (plugs and muffs) shall be used. Double hearing protection is recommended for sound levels exceeding 100 dBA. The workers' allowable exposure limit with the use of hearing protection is restricted to 85 dBA, as an 8-hour TWA. Should employee exposures exceed this limit engineering or administrative controls shall be implemented to restrict employee time spent in the hazardous noise (NASA 2008).

Noise generated at GRC Lewis Field is from research operations (wind tunnels and engine test cells) and transient noises such as valve releases, aircraft, construction activities, and traffic. The Central Process air system can generate high noise levels from its compressors, exhausters, heaters, chillers, and other equipment. Recent surveys indicate that, with the exception of transient noise spikes, the highest onsite noise levels measured near operating systems are in the 90–95 dBA range, with a maximum of 102 dBA. Transient peaks in noise levels may occur due to the action of relief valves, vent noise, etc. Aircraft operations can generate maximum environmental noise levels between 80 and 90 dBA in nearby pedestrian areas at Lewis Field. Onsite construction generates machinery and vehicular traffic noise (NASA 2008).

3.5.2 Environmental Consequences

Under the No Action Alternative, noise impacts would not occur. Intermittent, short-term, adverse impacts from noise would be expected from implementing the Proposed Action. Noise sources would include heavy equipment (i.e., trucks, excavators, and cranes) and hand tools (i.e., drills and cutting saws). Predicted noise levels at a distance of 15 meters (50 feet) from Building 140 would be approximately 80–85 dBA for heavy equipment and 85–90 dBA for cutting saws (FHWA 2006). Hand tools such as cutting saws or drills would be predominantly used in below-grade spaces, closed off from open spaces where noise could travel outside of the project area; however, personnel inside Building 140 would potentially be exposed to noise levels that would require the use of hearing protection in accordance with NASA policy. Excavation using heavy equipment would occur, however, crane use would be very limited.

The nearest offsite receptor, a commercial office building, is located approximately 300 meters (1,000 feet) southwest of Building 140. Noise levels from any equipment associated with the decontamination, decommissioning, and demolition of Building 140 would be expected to attenuate to below 60 dBA, which is the typical sound level of an urban residential area. At these levels, noise might be perceptible to offsite receptors, but would be unlikely to have any notable impact. Noise would probably be noticeable in the immediate vicinity of the project site on GRC Lewis Field, but would generally blend in with other noise sources from Cleveland Hopkins International Airport and within GRC Lewis Field. Noise impacts would be expected to be limited to Building 140 project workers and those GRC Lewis Field employees located within adjacent Building 49. Noise would be intermittent and transitory and would cease at the completion of the project. Restricting decommissioning activities on weekends and holidays and maintaining normal working hours during weekdays would serve to further minimize potential adverse noise impacts associated with these activities.

3.6 WATER RESOURCES

3.6.1 Affected Environment

3.6.1.1 Surface Water

Lewis Field is located in the Rocky River drainage basin, which drains approximately 756 square kilometers (292 square miles) of northeastern Ohio, and ultimately discharges 8 kilometers (5 miles) to the north, into Lake Erie. In 2012, 16 streams, totaling 2,327 linear meters (7,636 linear feet), and a single palustrine open water body, 0.22 hectares (0.54 acres), were identified and delineated at Lewis Field (EnviroScience 2012). The primary features at the site are the Rocky River and its tributary, Abram Creek.

The majority of surface water runoff from Lewis Field flows through the storm sewer system and natural swales to Abram Creek and Rocky River. Precipitation is believed to predominantly flow overland; however, several low-volume seeps have been observed on the Abram Creek valley walls after periods of heavy rainfall (NASA 2008; 2013a). Stormwater discharges are regulated under two separate Ohio Environmental Protection Agency National Pollutant

Discharge Elimination System permits. The stormwater permits require NASA GRC to implement a stormwater management program to prevent stormwater pollution from discharging to Abram Creek and Rocky River (NASA 2008).

Wastewater at Lewis Field is made up of sanitary, stormwater, non-contact and contact cooling, cooling tower blowdown, and miscellaneous process discharge. There are three wastewater collection systems at Lewis Field, including sanitary, stormwater, and industrial. The sanitary sewer system discharges by permit to the Southerly Wastewater Treatment Plant of the Northeast Ohio Regional Sewer District (NASA 2008).

Floodplains at Lewis Field occur at Abram Creek. Though Abram Creek fulfills the criteria for an area of special flood hazard, which is defined as an area of land that would be inundated by a flood having a 1 percent chance of occurring in any given year, no facilities at Lewis Field are within the 100-year floodplain (NASA 2008; 2013a).

3.6.1.2 Groundwater

Groundwater is rarely used in the vicinity of Lewis Field. Consequently, less information is available for groundwater than surface water. Groundwater at Lewis Field occurs in two distinct lithologic zones: in the shale bedrock and in perched lenses in the overlying unconsolidated materials. No aquifer at Lewis Field has been designated as a sole or principal drinking water source under the Safe Drinking Water Act, nor are there any underground injection wells at Lewis Field. A Phase I Remedial Investigation Feasibility Study found no evidence of groundwater contamination at Lewis Field (NASA 2008, 2013a).

3.6.1.3 Wetlands

In 2012, wetlands were formally delineated at Lewis Field, and the palustrine system was the only type of wetland system identified. A palustrine system is defined as “including all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean driven-derived salts is below 0.5 percent.” Following the formal wetland delineation, a total of 17 wetlands accounting for 0.87 hectares (2.15 acres) were affirmed by the U.S. Army Corps of Engineers. The wetlands were composed of Palustrine Emergent, Palustrine Emergent/Scrub-Shrub, and Palustrine Forested communities (EnviroScience 2012). There are currently no activities located in wetlands at Lewis Field. Ohio has developed a Coastal Zone Management Plan, which has received Federal approval. Lewis Field is not located in the Ohio Coastal Zone (NASA 2008, 2013a).

3.6.2 Environmental Consequences

Under the No Action Alternative, no decontamination, decommissioning, or demolition would occur; therefore, there would be no potential adverse impacts on water resources

Under the Proposed Action, no adverse impacts on floodplains, wetlands, or the coastal zone are anticipated. The Cyclotron Facility (Building 140) is not located within any of the floodplains or wetlands at Lewis Field, nor is the facility situated in the coastal zone (EnviroScience 2012). Fugitive dust control using water suppression may be performed under the Proposed Action, and could contribute to runoff to the existing stormwater system. Similarly, precipitation during open excavation may lead to pooling surface water or stormwater runoff.

Best management practices for erosion and sediment control would be implemented during excavation to mitigate potential adverse impacts from exposed soils to surface water runoff. Additionally, proper emergency response plans and deployment of equipment to promptly contain and clean up accidental spills from motorized equipment would be put into place to mitigate adverse impacts on groundwater and surface water quality.

An environmental monitoring program would be established to ensure that water resources in the vicinity of the project site are not adversely impacted. Groundwater monitoring would include routine sampling of Building 140 sumps and potentially could include the installation and monitoring of wells downgradient of the site. Surface water sampling would be performed, as necessary, during soil excavations in areas prone to surface water runoff. Measurements of gross alpha and gross beta radioactivity may be used as a screening technique, or if required, specific radionuclide analysis may also be performed.

3.7 ECOLOGICAL RESOURCES

3.7.1 Affected Environment

3.7.1.1 Flora

Most of Lewis Field is too highly disturbed to support significant numbers of indigenous Ohio plant species. Approximately 69 ha (170 acres) at Lewis Field are considered undeveloped. The gorge of Abram Creek and the tops of the bluffs above the valley are the only areas that retain natural qualities similar to their original types. The extensive development of Lewis Field as a research facility has limited the extent and recovery of natural plant communities. These communities contain few rare species. The Abram Creek gorge and adjacent blufftops contain the most significant natural plant communities (NASA 2013a).

In a recent survey, Lewis Field upland areas were found to include new fields, old fields, and forested areas. Common plants found in new field areas were bluegrasses (*Poa* spp.), meadow fescue (*Festuca pratensis*), Canada thistle (*Cirsium arvense*), and wild carrot (*Daucus carota*). Old field areas contained similar herbaceous species but were also found to have low amounts of gray dogwood (*Cornus racemosa*), Tartarian honeysuckle (*Lonicera tatarica*), box elder (*Acer negundo*), and American elm (*Ulmus americana*). The majority of forested areas consist of American beech (*Fagus grandifolia*), white oak (*Quercus alba*), red oak (*Quercus rubra*), red maple (*Acer rubrum*), shagbark hickory (*Carya ovata*), fibrousroot sedge (*Carex communis*), yellow trout lily (*Erythronium rostratum*), bloodroot (*Sanguinaria canadensis*), cutleaf toothwort (*Cardamine concatenata*), Mayapple (*Podophyllum peltatum*) and Canadian hemlock (*Tsuga canadensis*) (EnviroScience 2012; NASA 2013a).

Wetland areas onsite contained emergent, shrub-scrub, and forested plant communities, or a combination of these. Dominant plants within the emergent wetlands surveyed at Lewis Field are soft rush (*Juncus effusus*), narrow-leaf cattail (*Typha angustifolia*), stalk-grain sedge (*Carex stipata*), fox sedge (*Carex vulpinoidea*), Torrey's rush (*Juncus torreyi*), and fowl manna grass (*Glyceria striata*). The shrub-scrub wetlands were found to contain soft rush (*Juncus effusus),* woolgrass (*Scirpus cyperinus*), fox sedge (*Carex vulpinoidea*), Torrey's rush (*Juncus torreyi*), fowl manna grass (*Glyceria striata*), northern arrowwood (*Viburnum dentatum*), and red osier dogwood (*Cornus alba*). Dominant plants within the forested wetlands of Lewis Field included swamp white oak (*Quercus bicolor*), box elder (*Acer negundo*), red maple (*Acer rubrum*), pin oak (*Quercus palustris*), cottonwood (*Populus deltoide*s), American elm (*Ulmus americana*), gray dogwood (*Cornus racemosa*), red osier dogwood (*Cornus alba*), spicebush (*Lindera benzoin*), creeping Jenny (*Lysimachia nummularia*), stalk-grain sedge (*Carex stipata*), fox sedge (*Carex vulpinoidea*), fowl manna grass (*Glyceria striata*), and drooping sedge (*Carex prasina*) (EnviroScience 2012; NASA 2013a).

The Ohio Department of Natural Resources Natural Heritage Database lists six endangered, 14 threatened, and 20 potentially threatened plants species that have the potential to be found in Cuyahoga County (ODNR 2012). None of the current federally or state-listed plant species for Cuyahoga County have been identified on Lewis Field.

3.7.1.2 Fauna

Animals that inhabit Lewis Field are those typical of urban areas, including squirrels, chipmunks, rabbits, deer, and groundhogs. Previous surveys have identified common birds that inhabit Lewis Field including the European starling, house sparrow, American robin, chimney swift, and house finch. The "wooded, successional, and grassland habitats" in this area were judged to be too small and fragmented to support other species of birds. A few amphibian species, one reptile, many species of butterflies and moths, and three common bat species have also been identified at Lewis Field (NASA 2013a).

The Ohio Department of Natural Resources Natural Heritage Database lists four endangered and four threatened animal species that have the potential to be found in Cuyahoga County (ODNR 2012). Additionally, Cuyahoga County is within the known ranges of three federally listed endangered species, one threatened species, and one proposed endangered species (USFWS 2014). None of the current federally or state-listed animal species have been encountered on Lewis Field.

3.7.2 Environmental Consequences

No current federally or state-listed threatened or endangered plant or animal species have been known to occur at Lewis Field and the Cyclotron Facility lies within a highly developed area of Lewis Field; therefore no adverse direct or indirect impacts to ecological resources would occur under the No Action Alternative or from implementation of the Proposed Action. Site restoration and landscaping will incorporate, to the maximum extent practicable, plants that are beneficial to pollination and avoid using pesticides that are detrimental to pollinator habitat. Taking these measures will help to reverse pollinator losses and help restore populations to healthy levels (White House 2014).

3.8 CULTURAL RESOURCES

3.8.1 Affected Environment

Federal agencies are required to protect and preserve cultural resources in cooperation with state and local government under the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA) (16 U.S.C. 470 et seq.). Cultural resources are any prehistoric or historic building, structure, object, site, or district considered important to a culture, subculture, or community for scientific, traditional, religious, or other purposes. They include architectural resources, archaeological resources, and traditional resources. Architectural resources include standing buildings, dams, canals, bridges, and other structures of historic or aesthetic significance. Archaeological resources are locations where prehistoric or historic activity measurably altered the earth or produced deposits of physical remains (e.g., arrowheads, bottles). Traditional resources are associated with cultural practices and beliefs of a living community that are rooted in its history and are important in maintaining the continuing cultural identity of the community (NASA 2008).

3.8.1.1 Architectural Resources

A number of Federal laws, regulations, and guidelines have been established for the management of cultural resources. Regulations include Section 106 of the NHPA, as amended, which requires Federal agencies to take into account the effects of their undertakings on historic properties. Historic properties are cultural resources that are listed in, or eligible for listing in, the National Register of Historic Places (NRHP). Eligibility evaluation is the process by which resources are assessed relative to NRHP significance criteria for scientific or historic research, for the general public, and for traditional cultural groups.

NASA has been inventorying and identifying resources eligible for listing in the NRHP at Lewis Field since the 1990s (OHI 1996). Two Lewis Field facilities were designated as National Historic Landmarks (NHLs) under the “Man in Space” theme (Butowsky 1984). One NHL, the Rocket Engine Test Facility, was demolished in 2003 to accommodate an airport runway expansion. The other NHL, the Microgravity Research Laboratory (Zero Gravity Facility, Building 110), remains at Lewis Field (Gray & Pape 2008).

In 2007, NASA completed a survey of test facilities nationwide to determine their relative historical significance in terms of contributions to the development of the space transportation system. Two facilities at NASA GRC, the 8 × 6 Supersonic Wind Tunnel and the Abe Silverstein Memorial Wind Tunnel (the 10 × 10 Supersonic Wind Tunnel), are considered eligible for listing on the NRHP (NASA 2008).

Over the past decade, NASA GRC has continued its effort to identify and evaluate additional historic architectural resources at Lewis Field. Surveys were conducted in 2000, 2002, and 2013. The surveys identified an NRHP-eligible historic district in the GRC Lewis Field Central Area (Gray & Pape 2008; mbi/k2m and Westlake 2013). The district encompasses buildings and structures that supported initial missions under the National Advisory Committee for Aeronautics through the reorganization to NASA (1942 to 1958), and the Apollo Era mission ending in 1965, or that have distinctive architectural or construction features (NASA 2008).

3.8.1.2 Archaeological Resources

While detailed archaeological surveys do not exist for the entirety of Lewis Field, a 1998 Gray & Pape cultural resources survey of Lewis Field created an archaeological resource predictive model and resulted in a cultural resources sensitivity map. The portion of Lewis Field that includes the Cyclotron Facility is considered to have a low potential for the presence of intact archaeological resources because of the extent of disturbance from construction and utility installation (Gray & Pape 2008).

Several archaeological surveys have been conducted at Lewis Field in 1998 and 2002 in conjunction with proposed Cleveland Hopkins International Airport expansions. The surveys indicate that no significant or potentially significant archaeological sites are located at Lewis Field (FAA 2000; NASA 2008; Parsons 2000).

3.8.1.3 Traditional Cultural Resources

Traditional cultural resources are associated with cultural practices and beliefs of a living community that are rooted in its history and are important in maintaining the continuing cultural identity of the community. Traditional cultural resources have not been identified at Lewis Field.

3.8.2 Environmental Consequences

Under the No Action Alternative, no portion of the Cyclotron Facility would be removed; therefore, impacts on cultural resources would not occur. NASA would continue to manage its cultural resources in compliance with Federal laws and regulations, guided by the GRC Cultural Resources Management Plan (Gray & Pape 2008).

Although the Cyclotron Facility lies within the boundaries of the proposed historic district, it does not meet these criteria for inclusion in the historic district as a contributing element, nor does NASA consider the Cyclotron Facility to be individually eligible for listing on the NRHP. Therefore, NASA determined that the Cyclotron Facility (Building 140) and the equipment it houses (including the cyclotron itself) are not eligible for listing on the NRHP. NASA initiated NHPA Section 106 consultation with the Ohio Historic Preservation Office (OHPO) on August 30, 2013 (NASA 2013b). The OHPO has not commented on the determination of eligibility or on the request for consultation.

Because of its low profile (the majority of the Cyclotron Facility lies below grade) and its position at the southeast edge of the historic district, removal of this facility would not have an adverse visual effect on any historic property within the district.

There are no known archaeological sites within the area of potential effects, and it is extremely unlikely that undisturbed archaeological resources remain within the area of potential effects. Therefore, the Proposed Action would have no effect on archaeological historic properties.

The Proposed Action would not excavate soils that have not been previously disturbed. In the event that archaeological resources are unexpectedly discovered while demolishing the concrete vault, procedures are in place at Lewis Field to properly manage the discovery site, as outlined in the GRC Cultural Resources Management Plan's "Protocol for Unanticipated Discovery of Archeological Materials" (Gray & Pape 2008). In the extremely unlikely event that human remains are encountered while implementing the Proposed Action, the procedures outlined in the GRC Cultural Resources Management Plan's "Protocol for Treatment of Human Remains" will be implemented (Gray & Pape 2008).

3.9 WASTE MANAGEMENT

3.9.1 Affected Environment

As part of ongoing activities, GRC Lewis Field receives and stores various quantities of hazardous materials. GRC Lewis Field is a Large Quantity Hazardous Waste Generator, which is defined as a facility that generates more than 1,000 kilograms (2,200 pounds) of hazardous waste or more than 1.0 kilogram (2.2 pounds) of acute hazardous waste per calendar month. All hazardous materials and hazardous waste are managed in accordance with applicable Federal, state, and local rules and regulations in accordance with the NASA GRC Environmental Programs Manual. The Environmental Programs Manual contains detailed policies and procedures related to the management of hazardous materials and hazardous waste (NASA 2008).

At GRC Lewis Field, oversight and guidance for the handling, storage, and disposal of hazardous waste are provided by the GRC Energy and Environmental Office. Hazardous materials and waste are transferred to Building 215, the Central Chemical Storage Facility, for temporary storage (90-day maximum for hazardous waste) while a means of reuse, recycling or disposal is determined. Once the determination is made, the Energy and Environmental Office arranges for a waste disposal contractor to pick up and deliver the hazardous waste to an appropriate offsite disposal facility (NASA 2008). GRC Lewis Field does not maintain long-term, onsite storage capabilities for waste. On a case-by-case basis, some projects may require a custom waste management plan developed by the Energy and Environmental Office.

3.9.2 Environmental Consequences

Under the No Action Alternative, decontamination, decommissioning, and demolition activities would not occur. Therefore, there would be no waste management impacts under the No Action Alternative.

Under the Proposed Action, various waste streams would be generated during decontamination, decommissioning, and demolition activities. These may include nonhazardous, nonhazardous but otherwise regulated, hazardous, and low-level radioactive waste (LLW).

Any nonhazardous solid waste generated during decontamination, decommissioning, and demolition of Building 140 would be packaged and transported in conformance with standard industrial practices. Solid waste, such as uncontaminated metal items that can be recycled, would be sent off site for that purpose. The remaining debris derived from demolition of uncontaminated structures would be packaged in roll-off containers for transport to an offsite permitted commercial or municipal disposal facility in accordance with applicable regulations.

Regulated waste would be packaged in U.S. Department of Transportation- (DOT-) approved containers in a manner appropriate to the specific waste type, and shipped off site to permitted commercial recycling, treatment, and disposal facilities. Regulated waste would be shipped off site as it is generated from decontamination, decommissioning, and demolition activities. Therefore, long-term waste storage facilities would not be required. Regulated waste associated with Building 140 would include building materials containing asbestos, equipment containing mercury, equipment containing polychlorinated biphenyls, and building components that have lead-based paint. Building materials containing friable asbestos would be required to be abated prior to building demolition. Building components such as thermostats, switches, and fluorescent lights that contain mercury and light ballasts that contain polychlorinated biphenyls would be segregated from other waste for shipment off site to an appropriate disposal and/or recycling facility. Components with lead-based paint would also need to be characterized prior to disposal in accordance with Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.) regulations for determining whether the waste should be considered a hazardous waste.

LLW would be packaged in roll-on/roll-off containers, lift liners, 55-gallon drums, B-25 boxes, or similar containers, depending on the waste classification and type. If necessary, shielded casks may also be used for components characterized with higher levels of radioactivity. Drums and B-25 boxes would primarily be used to package LLW consisting of removed interferences, smaller system components and equipment, piping, conduit, and dry activated waste (e.g., personal protective equipment, contaminated monitoring and cleanup supplies, radiologically impacted samples, etc.) Roll-on/roll-off type containers would primarily be used for concrete debris. Large cyclotron components may be placed in similar containers or possibly palletized for transport on a flat-bed trailer. Lift liners or lined roll-ons/roll-offs would primarily be used to package contaminated soil for disposal.

For purposes of analysis in this *Cyclotron EA*, all waste generated from decontamination, decommissioning, and demolition of Building 140 is assumed to be Class A LLW as defined by the NRC in accordance with “Licensing Requirements for Land Disposal of Radioactive Waste” (10 CFR Part 61) and would be shipped to an appropriate LLW waste disposal facility. Under the No Action Alternative, no waste would be generated. Under the Proposed Action, the entire subgrade structure of Building 140 would be demolished. Up to approximately 2,200 cubic meters (78,000 cubic feet) of LLW could be generated under the Proposed Action.

Only a few commercial LLW disposal facilities exist in the United States. LLW from Building 140 would go to one of two Energy Solutions, Inc. facilities located in Bear Creek, Tennessee or Clive, Utah. However, it is anticipated that a large portion of the estimated volume of waste generated would not be radioactively contaminated but considered solid waste and disposed in accordance with the RCRA requirements.

Waste management includes provisions for minimizing the amount of waste generated, as well as for waste collection, treatment, packaging, and shipment off site for processing and disposal. The most effective radioactive waste disposal strategies and mitigation measures would include (1) performing sampling and analysis activities to accurately define the range of contamination and further reduce the quantity of specific waste streams; (2) reusing materials in radioactively contaminated areas to minimize waste generation; (3) performing onsite decontamination when shown to be cost-effective if doing so would not generate significant quantities of secondary waste; and (4) performing volume reduction techniques, where practical, by crushing and cutting components and equipment to size to eliminate void spaces in the waste packages.

3.10 TRANSPORTATION

3.10.1 Affected Environment

Lewis Field is served by a transportation system that connects it to local, regional, and national points. Interstate Highways 480 and 71 are located within 1.6 kilometers (1.0 mile) and connect Lewis Field regionally and nationally. Cleveland Hopkins International Airport is located adjacent to Lewis Field and provides easy access to numerous daily commercial flights. Cleveland's network of freeways and local roadways provides quick access to residential areas and business clusters located throughout the metropolitan area. The onsite transportation system at Lewis Field provides quick, convenient circulation to all points within Lewis Field (NASA 2008).

Three primary vehicle access points serve GRC Lewis Field. The vehicle access points include three controlled security gates: Main Gate and West Gate. The majority of employees and all visitors must access the campus through the Main Gate at Brookpark Road. As currently configured, there are two ingress lanes and two egress lanes, and the current configuration requires truck and automobile traffic to pass through the same gate (NASA 2008).

The principal arterial road providing access to the main entrance of Lewis Field is Ohio State Highway 17 (Brookpark Road), which parallels Interstate 480 from Ohio State Highway 10 to Interstate 71 along the northern limits of the campus. Brookpark Road carries two lanes of traffic in each direction with a total average daily traffic count of approximately 10,000 vehicles per day near the Main Gate. The primary arterial feeder to Brookpark Road is Interstate 480, which carries an average daily traffic count of approximately 129,000 vehicles. The Interstate 480 (east to west) and Interstate 71 (north to south) interchange is approximately 1.6 kilometers (1.0 mile) east of the Main Gate (NASA 2008).

3.10.2 Environmental Consequences

Under the No Action Alternative, transportation impacts would not occur. Under the Proposed Action, transportation of waste from the site to appropriate disposal facilities would be required. Transportation accidents involving radioactive materials have the potential for both radiological and nonradiological risk to transportation workers and the public. The potential risk associated with incident-free and accident conditions for transportation routes to potential waste disposal facilities are estimated for the Proposed Action, and discussed in this section.

Risk, the primary metric for assessing transportation impacts, is expressed in terms of latent cancer fatalities (LCFs) except for nonradiological risk, where it refers to the number of traffic accident fatalities. In determining transportation risks, per-shipment risk factors were calculated for incident-free and accident conditions using the RADTRAN 6 [Radioactive Material Transportation Risk Assessment Code 6] computer program (SNL 2009), in conjunction with the TRAGIS [Transportation Routing Analysis Geographic Information System] computer program (Johnson and Michelhaugh 2003). RADTRAN 6 was used to estimate the impacts on transportation workers and members of the public. For incident-free transportation, the potential human health impacts of the radiation field surrounding the transportation packages were estimated for transportation workers and the general population along the route (off-traffic or off-link), as well as for people sharing the route (in-traffic or on-link) and at rest areas and other stops along the route. For incident-free operations, the affected population included individuals living within 0.8 kilometers (0.5 miles) of each side of the road or railroad.

The total radiological dose-risk estimate was obtained using RADTRAN and summing the individual radiological risks from all reasonably conceivable accidents for the affected population within 81 kilometers (50 miles) of the accident.

Radiological health impacts are expressed in terms of additional LCFs. Nonradiological accident impacts are expressed as additional immediate (traffic accident) fatalities. LCFs associated with radiological exposure were estimated by multiplying the occupational (worker) and public dose by a dose conversion factor of 0.0006 LCFs per rem or person-rem of exposure (DOE 2003). The assumptions and resulting risk estimates are presented in the subsections below.

3.10.2.1 Offsite Route Characteristics

Route characteristics that are important to the transportation impacts analysis include the total shipment distance and population distribution along the route. TRAGIS was used to map transportation routes in accordance with DOT regulations. The TRAGIS program also provided population density estimates for rural, suburban, and urban areas along transportation routes based on 2010 census data. Route-specific accident and fatality rates for commercial truck and rail transports were used to determine the risk of traffic accident fatalities (Saricks and Tompkins 1999) after adjusting for possible under-reporting in truck rates (UMTRI 2003).

Potential disposal facilities include LLW facilities in Clive, Utah, and Bear Creek, Tennessee, both operated by Energy Solutions, Inc. The one-way distance from GRC Lewis Field to Clive, Utah, is approximately 2,700 kilometers (1,700 miles) by truck and 3,200 kilometers (2,000 miles) by rail. The one-way distance to Bear Creek, Tennessee, is 900 kilometers (560 miles) by truck and 860 kilometers (540 miles) by rail. For purposes of analysis, it is conservatively assumed that all waste would be shipped to the Clive, Utah, facility; any potential shipments that might be diverted to the Bear Creek, Tennessee, facility would result in a decrease in exposure and accident risk due to the corresponding decrease in one-way distance traveled.

3.10.2.2 Packaging and Shipments

Shipping packages containing radioactive materials emit low levels of radiation; the amount of radiation depends on the kind and amount of transported materials. DOT regulations "Shippers: General Requirements for Shipments and Packaging" (49 CFR Part 173) require shipping packages containing radioactive materials to have sufficient radiation shielding to limit the radiation dose rate to 10 millirem per hour at a distance of 2.0 meters (6.6 feet) from the outer lateral surfaces of the transporter. Radioactive material would be released during transportation accidents only when the package carrying the material is subjected to forces that exceed the package design standard. Only a severe fire or a powerful collision, both events of extremely low probability, could damage a transportation package of the type used to transport radioactive material to the extent that radioactivity would be released to the environment with significant consequences.

Several types of containers may be used to transport radioactive materials. The various containers analyzed to transport LLW in this *Cyclotron EA* include 55-gallon drums, B-25 boxes, lift liners, roll-on/roll-offs, and, if necessary, shielded casks. However, the need to use shielded casks for this project is unlikely. **Table 3–2** lists the types of containers assumed for the analysis, along with their volumes and the number of containers in a shipment.

In this environmental assessment (EA), risk associated with shipments of radioactive waste was calculated assuming that waste would be transported using either only commercial truck or only commercial rail; risk associated with waste shipments split between the two available modes of transportation would be between the range of the calculated risk for truck and rail. A shipment is defined as the amount of waste transported on a single truck or rail car.

Table 3–2. Low-Level Radioactive Waste Container Characteristics

Container	Container Volume (cubic meters)	Shipment Description
Shielded cask (Model 14-210H)[a]	2.8	1 per truck/2 per rail car
55-gallon drum	0.2	80 per truck/160 per rail car
B-25 box	2.6	5 per truck/10 per rail car
Roll-on/roll-off	15.3	1 per truck/2 per rail car
Lift liner	7.3	2 per truck/4 per rail car

[a] The Model 14-120H Type A shielded cask is designed to accommodate up to 14, 55-gallon drums or approximately 5 cubic meters of non-drummed waste. For purposes of analysis, the maximum volume used for the cask is 14, 55-gallon drums or 2.8 cubic meters. However, the need to use shielded casks for this project is unlikely.

Note: To convert cubic meters to cubic feet, multiply by 35.315.

Source: DOE 1997; Energy Solutions 2014; MHF 2014; RUDCO 2014.

In general, the number of shipping containers per shipment was estimated on the basis of the dimensions and weight of the shipping containers, the Transport Index,[1] and the transport vehicle dimensions and weight limits. The various materials and waste were assumed to be transported on standard truck semi-trailers or rail cars.

The predicted number of packages requiring offsite transportation and the calculated number of truck or rail shipments is based on the volume of waste assumed to be generated under the Proposed Action (see Section 3.9.2) and the volume each container can hold (see Table 3–2), and is presented in **Table 3–3**, in the following subsection.

3.10.2.3 Risk Assessment

For transportation accidents, the risk factors are given for both radiological impacts, in terms of potential LCFs in the exposed population, and nonradiological impacts, in terms of number of traffic fatalities. LCFs represent the number of additional latent fatal cancers among the exposed population in the event of an accident. Under accident conditions, the population would be

[1] The Transport Index is a dimensionless number (rounded up to the next tenth), placed on the label of a package, to designate the degree of control to be exercised by the carrier. Its value is equivalent to the maximum radiation level in millirem per hour at 1 meter (3.3 feet) from the package.

exposed to radiation from released radioactivity if the package were damaged and would receive a direct dose if the package were breached.

Per-shipment risk factors were calculated for the crew and for collective populations of exposed persons for each container type. Radiological risk factors per shipment by truck or rail for incident-free transportation and accident conditions are presented in Table 3–3. For incident-free transportation, both dose and LCF risk factors are provided for the crew and exposed population. The radiological risks would result from potential exposure of people to external radiation emanating from the packaged waste. The exposed population includes the off-link public (people living along the route), the on-link public (pedestrian and car occupants along the route), and public at rest and fuel stops. LCF risk factors were calculated by multiplying the accident dose risks by a health risk conversion factor of 0.0006 cancer fatalities per person-rem of exposure (DOE 2003).

For purposes of accident with release analysis, it is conservatively assumed the inventory of radioactive materials in containers would be associated with the maximum concentrations that potentially could be shipped in each container. The nonradiological risk factors are nonoccupational traffic fatalities resulting from transportation accidents.

Using the number of shipments by container type and the per-shipment risk presented in Table 3–3, total risk to crew and the general population is extrapolated for the total number of shipments projected under the Proposed Action. **Table 3–4** summarizes the predicted transportation risk considering all shipments of radioactive waste under the Proposed Action. There would be no radioactive waste generated under the No Action Alternative, and therefore there would be no shipments and associated transportation risks.

The highest risk due to incident-free transportation would be transport by truck, where the risk to the crew would be 2×10^{-3} LCFs and the risk to the public would be 9×10^{-4} LCFs. This risk can also be interpreted as meaning that there is a chance of approximately 1 in 500 that an additional latent fatal cancer could be experienced among the exposed workers and a chance of 1 in 1,100 that an additional latent fatal cancer could be experienced among the exposed population residing along the transport route.

The nonradiological accident risk (the potential for fatalities as a direct result of traffic accidents) is greater than the radiological accident risk. The highest risk of a nonradiological accident is 0.02 for truck shipments. For comparison, in the United States in 2010 there were over 3,900 fatalities due to crashes involving large trucks (DOT 2012a) and over 32,000 traffic fatalities due to all vehicular crashes (DOT 2012b).

Table 3–3. Risk per Shipment of Low-Level Radioactive Waste

Container	Number of Packages	Number of Shipments[b]	Incident-Free[a]				Accident	
			Crew		Population		Radiological Risk (LCF)[c]	Non-Radiological Risk (fatalities)[c]
			Dose (person-rem)	Risk (LCF)[c]	Dose (person-rem)	Risk (LCF)[c]		
Truck Shipments								
Shielded cask[d]	8	8	8.0×10^{-2}	5×10^{-5}	4.6×10^{-2}	3×10^{-5}	1×10^{-14}	1×10^{-4}
55-gallon drum	311	4	3.3×10^{-2}	2×10^{-5}	2.1×10^{-2}	1×10^{-5}	8×10^{-14}	1×10^{-4}
B-25 box	133	27	2.7×10^{-2}	2×10^{-5}	1.1×10^{-2}	6×10^{-6}	6×10^{-14}	1×10^{-4}
Lift liner	61	61	3.6×10^{-2}	2×10^{-5}	1.2×10^{-2}	7×10^{-6}	8×10^{-14}	1×10^{-4}
Roll-off	114	57	3.3×10^{-3}	2×10^{-6}	8.8×10^{-4}	5×10^{-7}	4×10^{-16}	1×10^{-4}
Rail Shipments								
Shielded cask[d]	8	4	4.9×10^{-2}	3×10^{-5}	9.0×10^{-2}	5×10^{-5}	3×10^{-14}	1×10^{-4}
55-gallon drum	311	2	9.5×10^{-3}	6×10^{-6}	1.3×10^{-2}	8×10^{-6}	3×10^{-13}	1×10^{-4}
B-25 box	133	14	9.5×10^{-3}	6×10^{-6}	1.3×10^{-2}	8×10^{-6}	2×10^{-13}	1×10^{-4}
Lift liner	61	31	1.1×10^{-2}	7×10^{-6}	1.4×10^{-2}	9×10^{-6}	3×10^{-13}	1×10^{-4}
Roll-off	114	29	7.5×10^{-4}	4×10^{-7}	1.4×10^{-3}	7×10^{-7}	1×10^{-15}	1×10^{-4}

[a] Based on available characterization data for the Cyclotron Facility, it is conservatively assumed that the dose rate for shielded casks would be at the regulatory limit of 10 millirem per hour at 2.0 meters (6.6 feet); the dose rate for drums, B-25 boxes, and roll-on/roll-offs would be 1.0 millirem per hour at 1.0 meter (3.3 feet); and the dose rate for lift liners containing mostly soil would be 0.1 millirem per hour at 1.0 meter (3.3 feet).

[b] Number of shipments assumes waste would be shipped using either all truck or all rail.

[c] Risk is expressed in terms of LCF, except for the nonradiological risk, where it refers to the number of traffic accident fatalities. Radiological risk is calculated for one-way travel while nonradiological risk is calculated for two-way travel. Accident dose-risk can be calculated by dividing the risk values by 0.0006 (DOE 2003). The values are rounded to one non-zero digit.

[d] Assumes Model 14-120H Type A shielded cask. However, the need to use shielded casks for this project is unlikely.

Key: LCF=latent cancer fatality.

Table 3–4. Total Dose and Risk from Transporting Radioactive Waste

Transport Mode	One-Way Distance Traveled (km)	Number of Shipments[a]	Incident-Free				Accident	
			Crew		Population		Radiological Risk (LCF)[b]	Non-Radiological Risk (fatalities)[b]
			Dose (person-rem)	Risk (LCF)[b]	Dose (person-rem)	Risk (LCF)[b]		
Truck Shipments	424,000	157	3.8	2×10^{-3}	1.5	9×10^{-4}	6×10^{-12}	2×10^{-2}
Rail Shipments	255,000	80	0.69	4×10^{-4}	1.0	6×10^{-4}	1×10^{-11}	8×10^{-3}

[a] Number of shipments assumes waste would be shipped using either all truck or all rail.

[b] Risk is expressed in terms of LCF, except for the nonradiological risk, where it refers to the number of traffic accident fatalities. Radiological risk is calculated for one-way travel while nonradiological risk is calculated for two-way travel. Accident dose-risk can be calculated by dividing the risk values by 0.0006 (DOE 2003). The values are rounded to one non-zero digit.

Key: km=kilometers; LCF=latent cancer fatality.

Note: To convert kilometers to miles, multiply by 0.6214.

Based on the analysis discussed above, the risk to the crew and the general population from the maximum number of potential shipments of LLW associated with the Proposed Action would be considered negligible.

Both radiological and nonradiological impacts would result from shipment of radioactive or hazardous materials from the Cyclotron Facility to offsite disposal sites. To the extent practicable, transportation routes would be selected to minimize the impacts from potential exposure to radiation during both incident-free transport and postulated accidents, as well as to minimize the potential for traffic fatalities. Measures that could be used to mitigate radiological impacts on individuals and populations along transportation routes include scheduling the transport of materials or waste only during periods of light traffic volume. The packaging and transport of radioactive and other hazardous materials would be in compliance with the applicable NRC, DOT, and state regulations. Waste would be shipped for direct disposal using various containers such as roll-ons/roll-offs, lift liners, B-25 boxes, and 55-gallon drums. Shielded casks may also be used to reduce dose rates for certain shipments of cyclotron equipment that might contain higher concentrations of low-level radioactive waste.

Handling, staging, and shipping packaged radioactive waste will be conducted in accordance with “Transfer for disposal and manifests” (10 CFR 20.2006); “Hazardous Materials Regulations” (49 CFR Parts 171-180); “Licensing Requirements for Land Disposal of Radioactive Waste” (10 CFR Part 61); “Packaging and Transportation of Radioactive Material” (10 CFR Part 71); and the disposal or processing facility license conditions. Waste may be shipped to a licensed processing facility for disposition or may be disposed of directly at a licensed disposal facility.

3.11 HEALTH AND SAFETY

3.11.1 Affected Environment

3.11.1.1 Health and Safety Programs

A comprehensive health and safety program is in place at GRC Lewis Field, including components for radiation protection and occupational health and institutional safety. The Occupational Health Programs Manual contains detailed policies and procedures related to ionizing and non-ionizing radiation sources. GRC’s Radiation Protection Program establishes the administrative requirements, technical guidelines, regulatory compliance, and health physics practices and procedures for facilities and users of ionizing and non-ionizing radiation sources and equipment. GRC has a “specific materials license of limited scope” with the NRC and is allowed to possess those radioactive sources specifically listed in that license. GRC also possesses other sources that are generally licensed by the NRC (NASA 2013a).

3.11.1.2 Annual Dose Limits for Radiation

Annual dose limits for exposure to radiation have been established for workers and the public. The annual dose limit for occupational exposures to workers is 5 rem per year pursuant to NRC regulations “Standards for Protection Against Radiation” (10 CFR Part 20). NASA has established more-stringent administrative dose limits for radiation workers at GRC to be 10 percent of the regulatory limit. Administrative limits would not be increased without specific authorization of the NASA Radiation Safety Officer. The annual dose limit for members of the public would be consistent with NRC regulations at 0.1 rem total effective dose equivalent, exclusive of the dose contributions from background radiation, medical administration, and disposal of radioactive material in sewage.

3.11.1.3 Background Radiation Levels in the Vicinity of Building 140

During the period from June 2010 through April 2011, characterization data were collected from Buildings 140 and 49, land area directly above Building 140 and south of Building 49, and selected background reference areas (SAIC 2012). The characterization report identified a list of radionuclides that can be expected to be encountered in Building 140, based on samples collected from building concrete, smears (loose-surface contamination), metals (cyclotron components), and sediment (sumps and pipe trenches). The radionuclides of interest include the following: hydrogen-3 (tritium), sodium-22, aluminum-26, cobalt-60, nickel-63, strontium-90, technetium-99, silver-108m, antimony-125, cesium-137, europium-152, europium-154, and radium-226. No radionuclides of interest were identified in water (sump) samples, and activity levels in soil samples were identified as being consistent with normal background levels. Detailed information can be found in the *Site Characterization Report, NASA GRC Cyclotron Facility* (SAIC 2012).

3.11.2 Environmental Consequences

The principal health and safety impacts projected for the Proposed Action are impacts on workers at the facility performing the decontamination, decommissioning, and demolition activities. These impacts are primarily controlled, planned occupational exposures to radiation associated with the radioactively contaminated materials within the Cyclotron Facility and the potential for industrial incidents and accidents. Each of these risks to workers is controlled and managed by existing NASA programs at GRC. Because each of the projected activities are contained and controlled, no health and safety impacts on either onsite personnel or the general public are projected.

3.11.2.1 Industrial

Nonradiological hazards associated with Cyclotron Facility decontamination, decommissioning, and demolition would continue to be managed according to the NASA GRC Health Programs Manual and the NASA GRC Safety Manual or through guidance provided by a site-specific procedure. These manuals provide the safety and health requirements necessary to protect the life, health, and physical well-being of all NASA GRC employees, contractor employees, visitors, and others; to ensure the safety of the public from hazards, incidents, and/or operations from construction activities; to prevent damage to property, supplies, and equipment; and to prevent accidents that might interrupt work, thereby delaying NASA programs and/or negatively affecting NASA property. All persons engaged in construction activities must meet or exceed the minimum safety and health requirements defined in these manuals and must comply with all applicable Federal, state, and local codes and standards where required, including NASA agency and center policies and/or procedures.

No unusual industrial safety hazards to the workers would be anticipated under the Proposed Action. Collectively, the Industrial Safety Program that would be in place for the decontamination, decommissioning, and demolition activities should be adequate to minimize worker incidents and accidents.

3.11.2.2 Radiological

No radiological exposure impacts on offsite members of the public are expected; therefore this section focuses on the potential radiological impacts on workers. The estimated cumulative worker doses for each work task under the Proposed Action are presented in **Table 3–5**. These worker doses were estimated using the assumed labor hours for each task and the exposure rates measured during characterization surveys. It was assumed that all radiation doses to workers would occur through direct external exposure to ionizing radiation. The dose estimated considered only external exposure and did not include inhalation or dermal absorption pathways as these exposure pathways are expected to be minimal.

Table 3–5. Estimated Worker Dose

Task Description	Estimated Hours in Radiation Field	Estimated Dose Rate (mrem/hr)	Dose Reduction Factor[a]	Dose Rate Shielded (mrem/hr)	Person-Rem Estimate
Interference Removal, Package and Dispose of Waste	3,420	0.05	0.5	0.025	0.085
Cyclotron Machine Removal, Package and Dispose of Waste	8,340	0.2	0.5	0.1	0.834
Concrete and Soil Removal, Package and Dispose of Waste	2,480	0.009	0.8	0.0072	0.018
Final Status Survey[b]	0	0	0	0	0
Total Hours	**14,240**	**Person-Rem Estimate Total**			**0.937**

[a] Anticipated dose rate reduction factor due to shielding installation, source removal, or decontamination.

[b] No dose was estimated for Phase 4 since essentially all cyclotron-related radioactive material is expected to be removed during remediation.

Key: mrem/hr=millirem per hour.

Under the No Action Alternative, no decontamination, decommissioning, or demolition would take place. Long-term surveillance and maintenance would continue indefinitely and minimal services would be provided to the facility, as required. There would be small, but negligible, worker doses associated with those activities.

Under the Proposed Action, the estimated worker dose would be 0.937 person-rem, with most of that dose (98 percent) associated with the cyclotron machine removal, packaging, and disposal of waste. Conservatively assuming that one-third, or 5 employees per year, would be doing most of the work with radioactive fields, this would equate to each employee being exposed to 0.03 rem per year. These estimated exposures are well below the regulatory limit of 5 rem per year and NASA’s more-conservative 0.5-rem-per-year threshold.

A Radiation Protection Program is currently in place and would continue for all aspects of decontamination, decommissioning, and demolition at the Cyclotron Facility. The program ensures that operations are performed to ensure that potential risks resulting from ionizing radiation exposures are maintained as low as reasonably achievable (ALARA). Potential doses from inhalation of airborne radioactivity are expected to be mitigated by incorporating ALARA concepts and sound radiological controls practices into procedures and work control documents. Examples of ALARA measures include minimizing time spent in the field of radiation, maximizing distances from sources of radiation, using shielding whenever possible, and/or reducing the radiation source.

Mitigation measures used to protect workers from radiological and chemical exposure hazards during decontamination, decommissioning, and demolition activities would be derived from formal radiation protection programs and chemical hazards management programs. Radiation protection mitigation measures would include formal analysis by the workers, supervisors, and radiation protection personnel of the work in a radiological environment and identification of methods to reduce exposure of workers to the lowest practicable level. Contamination and engineering controls would be used to reduce the potential for airborne radioactivity. The primary methods to control occupational exposures at the Cyclotron Facility would be controlling facility access; communicating area hazards through proper training and postings; maintaining knowledge of the current radiological conditions by facility monitoring; using personnel protection equipment (e.g., protective clothing and respirators); and using Radiation Work Permits. Examples of specific measures include personal protective equipment (e.g., Tyvek® suits, face masks), shielding, and training for specific work activities. Entry to the Cyclotron Facility (Building 140) would be controlled by Health Physics staff during operating hours. During non-operating hours, the building would be locked, posted, and/or secured to prevent unauthorized access. These mitigation measures would comply with applicable Federal and state safety requirements.

3.12 UTILITIES INFRASTRUCTURE

3.12.1 Affected Environment

The primary utilities infrastructure at Lewis Field include domestic water supply, electrical power, and fuels. Domestic water is purchased from the City of Cleveland, and distributed through water supply lines, with an average daily water consumption in 2013 of approximately 1,750,000 liters (460,000 gallons). Power is supplied by the local electric utility and distributed at voltages ranging from 13.8 kilovolts down to 120 volts. The total annual power consumption in 2013 was approximately 190,000 megawatt-hours. Lewis Field is provided natural gas by contract, the commodity with Energy Services Provider Group of Baltimore, Maryland, and the distribution with Dominion East Ohio Gas Company of Ohio. The total annual natural gas consumption at Lewis Field in 2013 was 13.4 million cubic meters (473 million cubic feet) (Patton 2014).

3.12.2 Environmental Consequences

This section evaluates the infrastructure and utility resource demands and associated assumptions for the decontamination, decommissioning, and demolition of Building 140.

Under the No Action Alternative, Building 140 would remain intact and the cyclotron machine would not be removed. GRC Lewis Field would continue to conduct a variety of research and development projects. There would be no incremental increase in water, electrical, or fuel usage; therefore, no impacts on the existing utility infrastructure at GRC Lewis Field would occur.

Under the Proposed Action, water and fuel consumption would increase, and there would be a negligible change in electricity. Water consumption would increase approximately 276,000 liters (72,900 gallons) of water for personnel use, dust suppression, and cutting tools. Fuel consumption would be approximately 38,000 liters (10,000 gallons) of fuels for operation of a crane, excavation equipment and light trucks (this does not include the estimated amount of fuel used to transport waste to offsite disposal facilities). The negligible change in electricity would reflect the use of small hand tools such as drills and saws. Under this scenario, heavy equipment usage would be intermittent and anticipated to be less than 25 percent of the time during normal working hours. Utility consumption would be largely offset by a net decrease in utilities used to sustain the operability of Building 140, once the utility connections have been terminated.

3.13 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

3.13.1 Affected Environment

3.13.1.1 Socioeconomics

This section addresses the existing socioeconomic conditions and characteristics in the Lewis Field regional area, which includes portions of Lorain, Medina, Summit, Cuyahoga, Geauga, Lake, Erie, Portage, Huron, Ashland, Wayne, Stark, Trumbull, Ashtabula, Richland, and Ottawa Counties (NASA 2008).

3.13.1.1.1 Population

Table 3–6 provides population estimates for the State of Ohio, the Lewis Field regional area, and Cuyahoga County based on 2010 census data. A comparison of race, ethnicity, and income statistics for the population is provided in Section 3.13.1.2.

Table 3–6. Population Estimates for the State of Ohio, Lewis Field Regional Area, and Cuyahoga County

Location	2010 Census
State of Ohio	11,536,504
Lewis Field Regional Area	3,938,102
Cuyahoga County	1,280,122

Source: He 2013.

3.13.1.1.2 Economy

This section provides an overview of the economy by describing employment and occupations, places of residence for employees, revenues, and expenditures.

The NASA GRC labor force is made up of two components: civil service employees and local contractors. In fiscal year (FY) 2012, NASA GRC employed approximately 1,690 on- or near-site contractors and approximately 1,660 civil service employees. The number of contractors reflects the NASA GRC's need for specific tasks and services, and therefore fluctuates depending on the amount and nature of work at the site. Significant employment is provided in the following civil service occupational categories: administrative professional, clerical, scientists and engineers, and technicians. Scientists and engineers accounted for the largest occupational category of civil service employees at 67 percent in FY 2012. Between FY 2009 and FY 2010, the number of local contractors grew by approximately 2 percent, but decreased by approximately 12 percent from FY 2010 to FY 2012. The number of civil service employees is relatively constant, allowing for retention of core experts. Civil employment peaked in FY 2011, but has since decreased by 3 percent through the end of FY 2012. The vast majority of Lewis Field's workforce lives in Cuyahoga County or other surrounding counties that make up northeast Ohio (Lendel and Lee 2013).

3.13.1.2 Environmental Justice

Minority individuals are defined as members of the following population groups: American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, Black or African American, some other race, and Hispanic or Latino. The "some other race" category includes all other responses not included in the White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander race categories. Respondents reporting entries such as multiracial, mixed, interracial, or a Hispanic or Latino group (for example, Mexican, Puerto Rican, Cuban, or Spanish) in response to the race question are included in this category. The Hispanic or Latino category includes all persons who identify themselves as Hispanic or Latino regardless of race. People reporting two or more races are considered minority individuals (SAIC 2013).

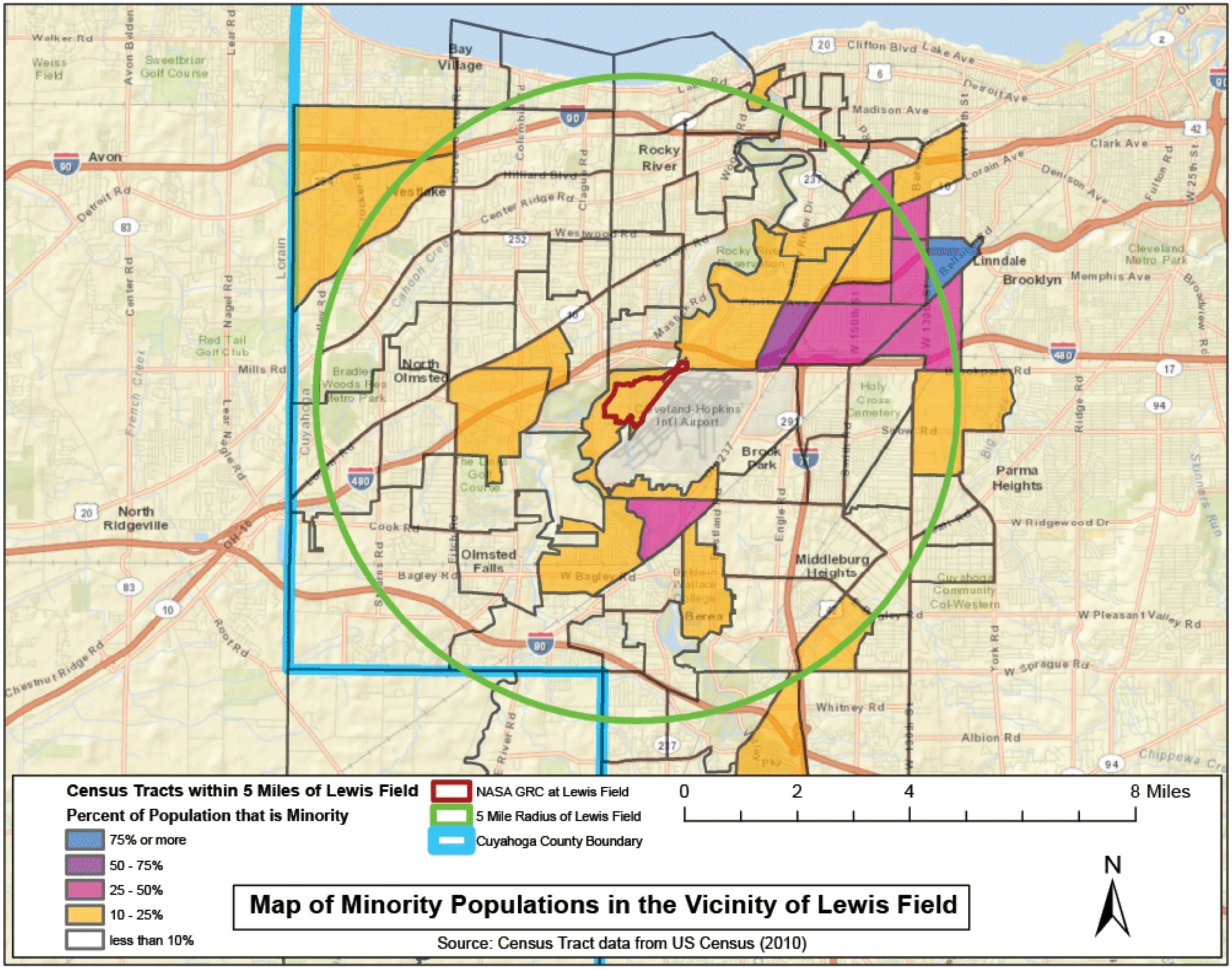
Persons whose incomes are less than the poverty threshold are defined as low-income persons by the Council on Environmental Quality (CEQ 1997). In 2010, the poverty threshold for a family of four with two related children was $22,113 (SAIC 2013).

NASA GRC updated its Environmental Justice Implementation Plan in 2013 (SAIC 2013). **Table 3–7** provides a comparison of race, ethnicity, and income statistics from the 2013 Environmental Justice Implementation Plan for nearby neighborhoods, the City of Cleveland, Cuyahoga County, and the State of Ohio within an 8-kilometer (5-mile) radius of Lewis Field. **Figures 3–1** and **3–2** are maps of the minority populations and low-income populations in the vicinity of Lewis Field, respectively.

Table 3–7. Lewis Field Comparative Race, Ethnicity, and Income Statistics

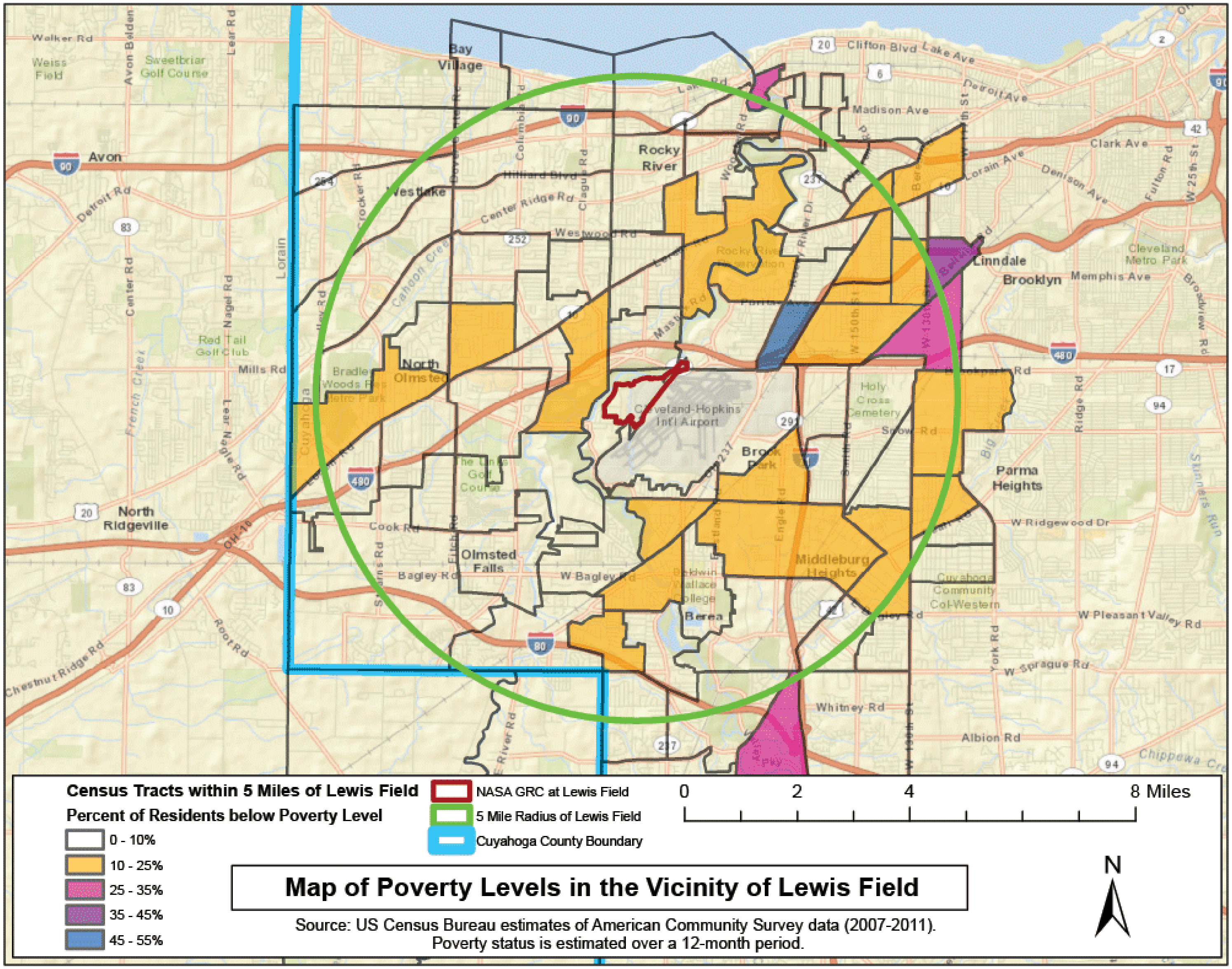
Indicator	Brook Park	Fairview Park	North Olmsted	City of Cleveland	Cuyahoga County	State of Ohio
Total Population	19,212	16,826	32,718	396,815	1,280,122	11,536,504
Percent White, Non-Hispanic	90	92.2	90.4	33.4	61.4	81.1
Percent Minority	10	7.8	9.6	66.6	38.6	18.9
Percent Black or African American	3.2	1.8	2.0	53.3	29.7	12.2
Percent Hispanic[a]	3.4	3.3	3.5	10	4.8	3.1
Median Household Income in Dollars[b]	51,967	54,011	57,668	27,470	44,088	48,071
Percent Below Poverty Level[b]	7.4	6.7	6.3	32.6	17.1	14.8

[a] Includes all persons who indicated Hispanic or Latino ethnicity regardless of race.
[b] American Community Survey 2007–2011 estimates in 2011 dollars.
Source: SAIC 2013.



Source: Reproduced from SAIC 2013.

Figure 3–1. Minority Populations Near Lewis Field



Source: Reproduced from SAIC 2013.

Figure 3–2. Low-Income Populations Near Lewis Field

3.13.2 Environmental Consequences

3.13.2.1 Socioeconomics

Additional employees would not be required under the No Action Alternative; therefore, there would be no impacts on socioeconomic conditions (i.e., overall employment and population trends).

Under the Proposed Action, it is estimated that a workforce of approximately 15 employees per year would be needed until project completion, which is anticipated to require three years. The Proposed Action activities would require a combination of civil service employees and local contractors. The professional and construction-related work would be intermittent and varied, depending on the nature of the decontamination, decommissioning, and demolition activities. For example, removal of the cyclotron machine and interference equipment would involve mostly craft labor using hand tools, whereas heavy equipment operators would be needed for demolition of subgrade building structures.

The increase in employees required under the Proposed Action would account for less than 1 percent of the total number of employees employed by NASA GRC in 2012 (1,690 on- or near-site contractors and 1,660 civil service); therefore, the impacts on socioeconomic conditions would be minor.

3.13.2.2 Environmental Justice

Council on Environmental Quality (CEQ) guidance recommends identifying minority populations where either the minority population of the affected area exceeds 50 percent or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. Meaningfully greater is defined here as 20 percentage points greater than the minority population percentage in the general population. The thresholds used to identify low-income populations follow the same methodology as described above for identifying minority populations, using data relative to income (SAIC 2013).

The region of potential influence for Lewis Field includes the immediately surrounding communities of the City of Cleveland to the east, Brook Park to the south and west, Fairview Park to the north, and North Olmsted to the west. For evaluation purposes, the region of potential influence is also assumed to contain those portions of Cuyahoga and Lorain Counties within an 8-kilometer (5-mile) radius of Lewis Field. Since the majority of the 83 potentially affected census tracts lie within Cuyahoga County (only 2 tracts are in Lorain County) within the 8-kilometer (5-mile) radius, the general population was defined as the State of Ohio and Cuyahoga County (SAIC 2013).

According to the 2010 census, the minority population percentage of the state of Ohio and Cuyahoga County was 18.9 percent and 38.6 percent, respectively. Therefore, the threshold for identifying minority populations is 50 percent, which is less than 58.6 percent (20 percentage points above the minority population percentage of Cuyahoga County). According to the

2007–2011 American Community Survey 5-Year Estimates, the low-income population percentage of the State of Ohio and Cuyahoga County was 14.8 percent and 17.1 percent, respectively. Therefore, the threshold for identifying low-income populations is 37.1 percent—20 percentage points above the low-income population percentage of Cuyahoga County (SAIC 2013). Utilizing these threshold values, two tracts were identified in the 2013 Environmental Justice Implementation Plan as containing meaningfully greater minority populations, and the same two tracts were also identified as containing meaningfully greater low-income populations. The nearest minority and low-income census tract is approximately 1.6 kilometers (1.0 mile) from Lewis Field. This tract is within Cleveland's Riverside Neighborhood and contains the Cuyahoga Metropolitan Housing Authority's Riverside Park subsidized housing complex. The other minority and low-income tract lies greater than 6.4 kilometers (4 miles) northeast of Lewis Field in Cleveland's Puritas-Longmead neighborhood. The environmental impacts of the Proposed Action would be none to negligible for all resource areas. Therefore, there would be no high and adverse impacts on the minority or low-income populations identified in the 2013 Environmental Justice Implementation Plan.

3.14 SUMMARY OF IMPACTS

Table 3–8 presents a summary description of impacts for the Proposed Action and the No Action Alternative. Environmental impacts evaluated in this *Cyclotron EA* were determined to range from none to negligible. Resource areas evaluated as not having the potential for adverse impacts under the Proposed Action include land use, visual resources, geology and soils, ecological resources, cultural resources, utilities infrastructure, and socioeconomics and environmental justice. Resource areas that have the potential for some, but still negligible, adverse impacts include air quality, noise, water resources, waste management, transportation, and health and safety. Implementing best management practices and maintaining compliance with Federal, state, and local environmental laws and regulations would ensure adverse impacts remain negligible for these resource areas. The Proposed Action would require three years to complete all work.

Table 3–8. Summary of Impacts

Resource Area	No Action	Proposed Action
Land Use	No impacts. Access and use of building would remain restricted.	Approximately 0.3 hectares (0.7 acres) of land disturbance to excavate entire Building 140.
Visual Resources	No impacts.	Above-grade structures and mound would be removed and restored to level grade.
Geology and Soils	No impacts.	Approximately 3,160 cubic meters (111,000 cubic feet) of import fill would be required.
Air Quality	No impacts.	Criteria pollutants from combustion of approximately 38,000 liters (10,000 gallons) of diesel fuel. Fugitive dust from exposed earth.
Noise	No impacts.	Potential noise sources from hand tools such as cutting and drilling, as well as some heavy equipment use (crane, excavators, trucks, etc.). Noise generated during decontamination and decommissioning activities would generally blend in with noise from other sources at Lewis Field or the adjacent airport; however, some noise during normal working hours may intermittently affect NASA employees in adjacent buildings such as Building 49.
Water Resources	No impacts on water resources. No wetlands or flood zones associated with the project.	No impacts on water resources. No wetlands or flood zones associated with the project. Best management practices for erosion and sediment control would be implemented during excavation to prevent potential adverse impacts from stormwater runoff.
Ecological Resources	No impacts on flora or fauna expected. Project site and surrounding area are highly developed with no protected species known to be associated with the project site.	
Cultural Resources	Cyclotron Facility lies within the GRC Lewis Field National Register of Historic Places-eligible historic district; however, it is a non-contributing element.	
Waste Management	No impacts.	Up to 2,200 cubic meters (78,000 cubic feet) of low-level radioactive waste. Some hazardous building materials (e.g., polychlorinated biphenyl ballasts and asbestos).
Transportation[a]	No Impacts.	Up to 157 truck shipments (or 80 rail shipments). For truck shipments, the cumulative dose would be 3.8 person-rem to the crew and 1.5 person-rem to the public. For rail shipments, the cumulative dose would be 1.0 person-rem to the crew and 0.69 person-rem to the public. No fatalities would be expected under either incident-free or accident scenarios.
Health and Safety[a]	Radiological contamination would remain in place.	Cumulative worker dose would be approximately 0.937 person-rem. All radiological contamination would be removed from Building 140.
Utilities Infrastructure	No incremental change in consumption of utilities used to maintain Building 140 in its current state.	Building 140 would no longer exist and utilities would be disconnected. Use of utilities would decrease to zero.
Socioeconomics and Environmental Justice	No impacts.	Approximately 15 full-time equivalent employees would be required per year. Any impacts of the Proposed Action would be contained within the boundary of GRC Lewis Field and would be negligible for all resource areas. Therefore, there would be no high and adverse impacts on minority or low-income populations.

[a] A person-rem is the collective radiation dose to a population or group of people.

Key: GRC=Glenn Research Center; NASA=National Aeronautics and Space Administration; rem=Roentgen equivalent man.

3.15 CUMULATIVE IMPACTS

The cumulative impacts analysis has been conducted in accordance with the CEQ regulations that implement the NEPA and the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997).

3.15.1 Methodology and Analytical Baseline

The CEQ regulations implementing NEPA (40 CFR Part 1508) define cumulative effects as "impacts on the environment which result from the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." The regulations further explain that "cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." The cumulative impacts assessment is based on both geographic and time considerations.

Cumulative impacts are evaluated in this *Cyclotron EA* for past, present, and foreseeable activities within Lewis Field and in nearby portions of Cuyahoga and Lorain Counties. The general approach to the analysis involves the following process:

- Baseline impacts from past and present actions were identified.
- The potential impacts anticipated by the decontamination, decommissioning, and demolition of the Cyclotron Facility were identified.
- Reasonably foreseeable future actions were identified.
- Cumulative impacts of the Proposed Action were estimated.

The analysis of the decontamination, decommissioning, and demolition of the Cyclotron Facility at GRC Lewis Field determined that impacts on the various resources areas would be negligible in all cases. In keeping with CEQ regulations, where impacts on resources are predicted not to occur or would be negligible, cumulative impacts were not analyzed since there would be either no, or only a very small incremental increase in, impacts on the resource area. This does not mean that other site activities associated with the resource areas are negligible; it means that impacts associated with the decontamination, decommissioning, and demolition of the Cyclotron Facility would have a negligible contribution to their cumulative impacts.

3.15.2 Potential Cumulative Impacts from Onsite and Offsite Activities

Actions that may contribute to cumulative impacts include on- and offsite projects conducted by government agencies, businesses, or individuals that are within and nearby Lewis Field. A review of possible cumulative impacts indicates a very low potential for any significant contribution to offsite cumulative environmental impacts under the Proposed Action when combined with other activities at Lewis Field or offsite. The proposed activities from the GRC Master Plan Environmental Assessment (NASA 2008) that were considered are provided in **Table 3–9**. Other activities near Lewis Field with potential cumulative environmental impacts include: transportation arteries (Interstate Highways 480 and 71) around the site, Cleveland Hopkins International Airport, Ford Motor Company, General Motors Corporation, and a shopping complex (SAIC 2013).

Table 3–9. Actions from the Glenn Research Center Master Plan Environmental Assessment that May Contribute to Cumulative Impacts

Location	Description
Onsite NASA Action	Proposed Construction of Facilities (2012–2016): • Rehabilitation of: Compressor and Turbine Research Facility, Propulsion Systems Laboratory (PSL), Power Substation, Instrument Research Laboratory, Supersonic Wind Tunnel Complex Building, Liquid Metals Power Laboratory, Part of PSL Complex, Fuel Cell Testing Facility, New Security Fencing, Sewer System, Storm and Industrial Waste Sewer System • Construction of: PSL Engine Testing Building
	Capping the landfill in the South Area of Lewis Field
Offsite Action	Continued operations and improvements at Cleveland Hopkins International Airport
	Continuing development in the City of Cleveland

Key: NASA=National Aeronautics and Space Administration.

3.15.3 Potential Cumulative Impacts from Offsite Transportation

The impacts from transportation in this *Cyclotron EA* are quite small compared with overall cumulative transportation impacts. The collective worker dose from all types of shipments was estimated to be about 421,000 person-rem (253 LCFs) for the period from 1943 through 2073 (131 years). The general population collective dose was estimated to be about 437,000 person-rem (262 LCFs). Worker and general population collective doses as estimated in this *Cyclotron EA* range from 0 to 3.8 person-rem and from 0 to 1.5 person-rem, respectively, for truck shipments, with no LCFs expected. Doses associated with rail shipments are expected to range from 0 to 0.057 person-rem for worker collective dose and from 0 to 1.0 person-rem for general population collective dose, with no LCFs expected. To place these numbers in perspective, the National Center for Health Statistics indicates that the annual average number of cancer deaths in the United States from 1999 through 2004 was about 554,000, with less than a 1 percent fluctuation in the number of deaths in any given year (CDC 2012). The total number of LCFs (among the workers and the general population) estimated to result from radioactive material transportation over the period between 1943 and 2073 is 515, or an average of about 4 LCFs per year. The transportation-related LCFs represent about 0.0002 percent of the overall annual number of cancer deaths; therefore, it is indistinguishable from the national fluctuation in the total annual death rate from cancer. Note that the majority of the cumulative risks to workers and the general population would be due to the general transportation of radioactive material unrelated to activities evaluated in this *Cyclotron EA*.

3.15.4 Climate Change

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere; the accumulation of these gases in the atmosphere has been attributed to the regulation of Earth's temperature. Thus, regulations to inventory and to decrease emissions of GHGs have been promulgated. At this time, a threshold of significance has not been established for the emissions of GHGs, but CEQ has released the *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions* (CEQ 2014), which suggests that proposed actions that would reasonably emit 25,000 metric tons or more of carbon-dioxide-equivalent gases should be evaluated by quantitative and qualitative assessments. CEQ considers this is an appropriate reference point that would allow agencies to focus their attention on proposed projects with potentially large GHG emissions. This is not a threshold of significance, but rather a minimum level that would require consideration in NEPA documentation.

The six primary GHGs, defined in Section 19(i) of Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* and internationally recognized and regulated under the Kyoto Protocol, are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Each GHG has an estimated global warming potential, which is a function of its atmospheric lifetime and its ability to absorb and radiate infrared energy emitted from the Earth's surface. The global warming potential allows GHGs to be compared to each other by converting the GHG quantity into the common unit "carbon-dioxide equivalent."

In the case of the Proposed Action, the primary source of carbon dioxide emissions would be from heavy equipment operating on site and the transportation of waste for offsite disposal. Under the Proposed Action, assuming all waste would be transported by truck to Clive, Utah, the total estimated carbon dioxide emissions that could be released into the atmosphere is 660 metric tons. Due to the relatively short construction period and small project (in terms of number of workers and pieces of equipment necessary), the GHG emissions would not approach or exceed 25,000 metric tons of carbon-dioxide-equivalent gases. Furthermore, the estimated amount of carbon dioxide emissions for this Proposed Action would be insignificant in relation to the estimated 5.98 billion metric tons of carbon dioxide emissions in the United States in 2006 (EPA 2008).

3.16 INCOMPLETE OR UNAVAILABLE INFORMATION

NASA conducted a limited site characterization study that identified hazardous building materials and surface and volumetric radiological contamination (SAIC 2012). However, these characterization results are limited and may not be relied upon for waste profiling or determining the exact extent of decontamination, decommissioning, or demolition that would be required for the Proposed Action. Proper characterization is important for waste minimization and it is required by Federal and state regulations that relate to transportation and disposal facilities. Waste materials would be surveyed and characterized as they are generated and then packaged for shipment and disposal. Procedures would be developed that adequately implement the waste acceptance criteria imposed by the licenses held by disposal sites and waste processors used by the project. Processes would be implemented to assure that nonradioactive building demolition debris disposed of in commercial landfills meets the disposal criteria imposed by regulation or permit requirements at the disposal facility. It is possible that a large portion of the waste generated would not be radioactively. Recent and limited removal and waste profiling of some equipment in Building 140 support this conclusion (SAIC 2012). This *Cyclotron EA* conservatively assumes that all waste projected to be generated under the Proposed Action would be Class A LLW; therefore, the environmental impacts associated with managing and disposing of radioactive waste are potentially overstated. Also, no soil samples beneath Building 140, particularly the Cyclotron Vault Room, have been analyzed for contamination; however, the potential presence of any radioactive contamination in underlying soils is perceived to be low based on previous characterization results.

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4. AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED

4.1 INTRODUCTION

National Aeronautics and Space Administration (NASA) procedures for implementing the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.) provide the option of making this *Environmental Assessment for the Decontamination and Decommissioning of Building 140 at GRC Lewis Field* (*Cyclotron EA*) and the preliminary Finding of No Significant Impact (FONSI) available for public review and giving stakeholders an opportunity to comment. Stakeholders include Federal, state, and local governments; business interests; landowners; residents; and environmental organizations.

4.2 DRAFT ENVIRONMENTAL ASSESSMENT

The public was notified of the opportunity to review and comment on the draft *Cyclotron EA* by announcements published in local newspapers (Cleveland Plain Dealer, Sun Newspapers, and West Life Weekly Newspaper) and by posting the draft *Cyclotron EA* on the National Aeronautics and Space Administration's (NASA's) website (http://netspublic.grc.nasa.gov). The draft environmental assessment (EA) is also available for public review at the following locations:

North Olmsted Library
27403 Lorain Road
North Olmsted, OH 44070

Fairview Park Library
21255 Lorain Road
Fairview Park, OH 44126

NASA Headquarters Library
300 E Street SW, Suite 1J22
Washington, DC 20546

Comments on the draft *Cyclotron EA* may be submitted during the 30-day comment period.

Comments submitted by mail should be addressed to:

Attn: NEPA Manager
NASA Glenn Research Center
21000 Brookpark Road, Mail Stop 21-2
Cleveland, Ohio 44135

In summary, NASA solicited public and agency review and comment on the environmental impacts of the draft *Cyclotron EA* through:

- Announcement of the availability of this draft EA in local newspapers
- Publication of this draft EA on the NASA NEPA website: http://netspublic.grc.nasa.gov
- Consultations with Federal, state, and local agencies
- Direct mailing of this draft EA to interested parties

Copies of this draft EA can be downloaded from NASA's website or are available upon request by contacting:

Mr. David S. Ebner
NASA Glenn Research Center
Facilities Division, Project Management Branch
21000 Brookpark Road, Mail Stop 21-13
Cleveland, OH 44135

Public comments on the draft *Cyclotron EA* and NASA's responses will be included in the final *Cyclotron EA*. The final *Cyclotron EA* is planned for completion in the spring of 2015. Availability of the final EA and FONSI will be published in local newspapers and on NASA's website.

4.3 CONSULTATIONS

Certain statutes, such as the Endangered Species Act (16 U.S.C. 1531 et seq.), Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq., and National Historic Preservation Act (16 U.S.C. 470 et seq.), may require consultation and coordination by NASA with other governmental entities, including other Federal agencies and state and local agencies. Most of these consultations are related to ecological resources and cultural resources.

The ecological resource consultations generally pertain to the potential for activities to disturb sensitive species or habitats. The project area is a small parcel of previously developed land within the Glenn Research Center (GRC) Lewis Field complex. There have been no Federal or state-listed proposed or candidate, threatened, or endangered species or critical habitats found near the project area. There is no potential for impacts from implementation of the Proposed Action. Therefore, consultation with the U.S. Fish and Wildlife Service or Ohio Department of Natural Resources was not necessary.

Cultural resource consultations relate to the potential for disruption of important cultural resources and archaeological sites. NASA consulted with the Ohio Historic Preservation Office (OHPO), as required by NEPA and Section 106 of the National Historic Preservation Act. A consultation letter was sent to OHPO on August 30, 2013; however, a response was not received prior to publication of the draft *Cyclotron EA*.

4.4 DISTRIBUTION

NASA provided a copy of the draft *Cyclotron EA* to the following stakeholders of record, as listed.

FEDERAL AGENCIES

U.S. Nuclear Regulatory Agency

U.S. Department of Energy

Office of Energy Efficiency and Renewable Energy

U.S. Department of the Interior

Bureau of Land Management
U.S. Fish and Wildlife Service

U.S. Department of Transportation

Federal Aviation Administration – Great Lakes Division

U.S. Environmental Protection Agency

Office of Federal Activities
Region 5 Office

STATE AGENCIES

State of Ohio

Cleveland Metroparks
Ohio Department of Natural Resources
Ohio Department of Transportation
Ohio Environmental Protection Agency
Ohio Historic Preservation Office
State of Ohio, Office of Governor
State of Ohio, Senate
State of Ohio, House of Representatives

LOCAL AGENCIES

Cuyahoga County

Board of Commissioners
County Administrator
Cuyahoga Regional Planning Commission
Mayor of Brook Park
Mayor of Fairview Park
Mayor of North Olmsted

City of Cleveland

Mayor of Cleveland
City Commission
City Manager

LOCAL ORGANIZATIONS

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6. REFERENCES

Butowsky, H.A., 1984, *Man in Space National Historic Landmark Theme Study*, National Park Service, accessed through http://www.cr.nps.gov/history/online_books/butowsky3/spacet.htm.

CDC (Centers for Disease Control and Prevention), 2012, Deaths, Percent of Total Deaths, and Death Rates for the 15 Leading Causes of Death in 5-Year Age Groups, by Race and Sex, United States, 1999–2008, National Center for Health Studies, March 30.

CEQ (Council on Environmental Quality), 1997, *Considering Cumulative Effects Under the National Environmental Policy Act*, Executive Office of the President, Washington, D.C., January.

CEQ (Council on Environmental Quality), 2014, *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*, December.

DOE (U.S. Department of Energy), 1997, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, New Mexico, September.

DOE (U.S. Department of Energy), 2003, *Air, Water, and Radiation Info Brief: Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE)*, ISCORS Technical Report No. 1, Office of Environmental Policy and Guidance, DOE/EH-412/0015/0802, Rev. 1, Washington, D.C., January.

DOT (U.S. Department of Transportation), 2012a, *Motor Carrier Safety Progress Report (as of 9/30/12)*, DOT-HS-809-919, Federal Motor Carrier Safety Administration, Washington, D.C., accessed through www.fmcsa.dot.gov/ facts-research/art-safety-progress-report.htm, September.

DOT (U.S. Department of Transportation), 2012b, *Traffic Safety Facts 2010 Data*, DOT HS 811 630, National Highway Traffic Safety Administration, National Center for Statistics and Analysis, Washington, D.C., June.

Energy Solutions, 2014, *Cask Book for Model 14/210 and 14/215H*, Rev. 19, Columbia, South Carolina.

EnviroScience (EnviroScience, Inc.), 2012, *Wetlands and Other Waters Delineation Report: NASA Lewis Field, Approximately 300 Acres in Cleveland, Cuyahoga County, Ohio*, November 19.

EPA (U.S. Environmental Protection Agency), 2008, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2006*, April 15.

FAA (Federal Aviation Administration), 2000, *Cleveland Hopkins International Airport Final Environmental Impact Statement*, June.

FAA (Federal Aviation Administration), 2014, Cleveland-Hopkins International Airport Information, accessed through http://airnav.com/airport/KCLE, February 6.

FHWA (Federal Highway Administration), 2006, *Construction Noise Handbook*, FHWA-HEP-06-015, accessed through http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm, August.

Gray & Pape (Gray & Pape, Inc.), 2008, *Cultural Resources Management Plan for NASA Glenn Research Center at Lewis Field and Plum Brook Station*, Cincinnati, Ohio.

He, J., 2013, *Population Projections: Ohio County Totals for 2015–2040*, Ohio Development Services Agency, accessed through http://development.ohio.gov/files/research/P6090.pdf, March 30.

Johnson, P. E., and R. D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS) – User's Manual*, ORNL/NTRC-006, Rev. 0, U.S. Department of Energy, Oak Ridge National Laboratory, accessed through http://apps.ntp.doe.gov/tragis/tragis.htm, June.

Lendel, I., and E. Lee, 2013, *The NASA Glenn Research Center: An Economic Impact Study Fiscal Year 2012*, Cleveland State University, Maxine Goodman Levin College of Urban Affairs, Center for Economic Development, Cleveland, Ohio, June.

mbi/k2m and Westlake (mbi/k2m Architecture Inc. and Westlake Reed Leskosky), 2013, *Architectural Resources Survey for NASA Glenn Research Center at Lewis Field*, January.

MHF (MHF Services), 2014, *Lift Liner Product Information*, U.S. Patent Number 6,079,934, 2014.

NASA (National Aeronautics and Space Administration), 2008, *Final Environmental Assessment for the NASA Glenn Research Center Master Plan*, Cleveland, Ohio, December 12.

NASA (National Aeronautics and Space Administration), 2013a, *Final Environmental Resources Document for National Aeronautics and Space Administration Glenn Research Center at Lewis Field and Plum Brook Station*, July.

NASA (National Aeronautics and Space Administration), 2013b, *Section 106 Review Project Summary, Demolition of Materials and Structures Auxiliary Building 140, The Cyclotron*. Form provided to Ohio Historic Preservation Office Resource Protection and Review with cover letter from Leslie A. Main, NASA Glenn Research Center Historic Preservation Office, to Mr. Mark J. Epstein, Ohio State Historic Preservation Office, August 30.

ODNR (Ohio Department of Natural Resources), 2012, "Ohio Division of Wildlife Natural Heritage Database State-listed Species for Cuyahoga County," accessed through http://wildlife.ohiodnr.gov/species-and-habitats/state-listed-species-by-county, November 8.

OHI (Ohio Historic Inventory), 1996, Historic Building Inventory Forms, Lewis Field. Forms on file at OHI and NASA Glenn, Lewis Field.

Parsons (Parsons Engineering Science, Inc.), 2000, *Phase I Archaeological Report, Proposed Facility Relocation Site NASA Glenn Research Center at Plum Brook Station, Erie County, Ohio*. Prepared for Cleveland Hopkins International Airport and NASA Glenn Research Center. Principal Authors: J. Sanderson Stevens and Sheila Kohring, September.

Patton, E.J., 2014, NASA Glenn Research Center, Lewis Field, personal communication (email) to D. Ebner, NASA, "*GRC Energy and Water Consumption Report*," October 8.

RUDCO (RUDCO Products, Inc.), 2014, *Roll-Off Container Fact Sheet*, Vineland, New Jersey.

SAIC (Science Applications International Corporation), 2012, *Final Site Characterization Report, NASA GRC Cyclotron Facility, Cleveland, Ohio*, Sandusky, Ohio, October.

SAIC (Science Applications International Corporation), 2013, *Final Environmental Justice Plan for National Aeronautics and Space Administration Glenn Research Center, Cleveland, OH*, June.

Saricks, C., and M.M. Tompkins, 1999, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150, Center for Transportation Research, Argonne National Laboratory, U.S. Department of Energy, Argonne, Illinois, April.

SNL (Sandia National Laboratories), 2009, *RadCat 3.0 Users Guide*, SAND2009-5129P, Albuquerque, New Mexico and Livermore, California, May.

UMTRI (University of Michigan Transportation Research Institute), 2003, "Evaluation of the Motor Carrier Management Information System Crash File, Phase 1," UMTRI-2003-6, Ann Arbor, Michigan, March.

USFWS (U.S. Fish and Wildlife Service), 2014, "Ohio Federally-Listed Threatened, Endangered, Proposed, and Candidate Species' County Distribution," accessed through www.fws.gov/midwest/endangered/lists/ohio-cty.html, December.

White House (The White House), 2014, "*Presidential Memorandum – Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators*," June 20.

<u>Code of Federal Regulations</u>

10 CFR Part 20, U.S. Nuclear Regulatory Commission, "Standards for Protection Against Radiation."

10 CFR 20.1402, U.S. Nuclear Regulatory Commission, "Radiological criteria for unrestricted use."

10 CFR 20.2006, U.S. Nuclear Regulatory Commission, "Transfer for disposal and manifests."

10 CFR 30.36, U.S. Nuclear Regulatory Commission, "Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas."

10 CFR Part 61, U.S. Nuclear Regulatory Commission, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 71, U.S. Department of Energy, "Packaging and Transportation of Radioactive Material."

14 CFR Part 77, National Aeronautics and Space Administration, "Safe, Efficient Use, and Preservation of the Navigable Airspace."

14 CFR 1216.3, National Aeronautics and Space Administration, "Procedures for Implementing the National Environmental Policy Act (NEPA)."

29 CFR 1910.95, Occupational Safety and Health Administration, "Occupational noise exposure."

40 CFR Part 93, U.S. Environmental Protection Agency, "Determining Conformity of General Federal Actions to State or Federal Implementation Plans."

40 CFR Parts 1500–1508, Council on Environmental Quality, Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.

49 CFR Parts 171–180, U.S. Department of Transportation, "Hazardous Materials Regulations."

49 CFR Part 173, U.S. Department of Transportation, "Shippers: General Requirements for Shipments and Packaging."

Executive Orders

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, October 8, 2009.

United States Code

16 U.S.C. 470 et seq., National Historic Preservation Act.

16 U.S.C. 661 et seq., Fish and Wildlife Coordination Act.

16 U.S.C. 1531 et seq., Endangered Species Act.

42 U.S.C. 4321 et seq., National Environmental Policy Act of 1969.

42 U.S.C. 6901 et seq., Resource Conservation and Recovery Act of 1976.

42 U.S.C. 15801 et seq., Energy Policy Act of 2005.