ENVIRONMENTAL ASSESSMENT
DECOMMISSIONING OF THE PLUM BROOK REACTOR FACILITY
NASA GLENN RESEARCH CENTER, PLUM BROOK STATION
ERIE COUNTY, OHIO

LEAD AGENCY:	National Aeronautics and Space Administration (NASA), Glenn Research Center (GRC) Plum Brook Station
PROPOSED ACTION:	NASA GRC proposes to decontaminate and decommission the Plum Brook Reactor Facility (PBRF), located at GRC Plum Brook Station, to allow release for unrestricted use.
POINT OF CONTACT: FOR INFORMATION:	Mr. Michael Blotzer Chief, Environmental Management Office NASA John H. Glenn Research Center at Lewis Field 21000 Brookpark Road Mail Stop 6-4 Cleveland, Ohio 44135 (216) 433-8159
DATE:	January 24, 2001
ABSTRACT:	NASA GRC Plum Brook Station has no further need to use the PBRF in support of its mission and proposes to terminate the license according to the requirements of 10 CFR Part 20, Subpart E. The NASA PBRF was shutdown in 1973, but a U. S. Nuclear Regulatory Commission (NRC) license is still in effect for the facility. The Proposed Action is to decontaminate the PBRF to levels consistent with NRC's unrestricted release criteria, to take measurements to verify that decontamination is complete, to demolish the buildings and regrade the area, and then to request that NRC terminate the license without restrictions. As required by the National Environmental Policy Act (NEPA), alternatives to the Proposed Action were evaluated, including Entombment and the No Action alternative.

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EXECUTIVE SUMMARY

National Aeronautics and Space Administration (NASA) Glenn Research Center (GRC) currently has a U.S. Nuclear Regulatory Commission (NRC) license to "possess but do not operate" the Plum Brook Reactor Facility (PBRF) at the GRC Plum Brook Station. NASA GRC has no further need for the PBRF to support the NASA mission and is proposing to decontaminate the facility, dispose of waste in a licensed, permitted disposal facility, and terminate the NRC license.

Three alternatives were considered: the Proposed Action which is prompt decontamination and license termination, Alternative 1 which is the no action alternative as required by the National Environmental Policy Act (NEPA), and Alternative 2 which is entombing the PBRF in concrete to allow radioactive decay and subsequently decontaminating and decommissioning the facility. The Proposed Action is to promptly decontaminate and decommission the PBRF to meet NRC's unrestricted use criteria. Even though the facility and residual contamination would be removed to allow unrestricted use, NASA would retain the PBRF property as part of the Plum Brook Station.

Environmental impacts from implementing the Proposed Action were evaluated and no significant impacts were identified. Impacts on Plum Brook Station would occur primarily in the work area within the PBRF area with some impact occurring along site roads. Since this area was previously disturbed to construct the reactor facility and protective measures would be taken during decontamination, there would be no significant environmental impact. Table 1 compares impacts to the environment from implementing the Proposed Action and alternatives. The Proposed Action would have minimal incremental impact to the environment and population offsite of the Plum Brook Station. The impacts would occur because of: (1) controlled discharges to the air and water during reactor decontamination and dismantlement as well as site regrading and (2) increases in local offsite traffic from a increased site workforce. However, these impacts would not be intensive, would be highly localized, and would be transient in nature. Actions would be taken to mitigate these impacts.

GRC considered cumulative impacts to the environment, principally the air quality and traffic, from implementing the Proposed Action in the context of other reasonably foreseeable actions, both Federal and non-Federal, in the vicinity of the PBRF. These other actions include (1) Ohio Department of Transportation (DOT) widening of Route 250 which borders the eastern boundary of Plum Brook Station, (2) NASA relocating certain facilities currently located at GRC Lewis Field in Cleveland, Ohio to the Plum Brook Station, and (3) a developer constructing a housing development along Taylor Road near the entrance to Plum Brook Station. GRC determined that cumulative impacts on Plum Brook Station itself would be minimal. GRC also determined that the Route 250 widening project would have considerably more environmental impact on the air quality and traffic in the local area than the Proposed Action because of the magnitude of the project and the associated disturbed land and traffic congestion.

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Table 1. Comparison of Impacts

Measure of Impact	Existing Environment	Proposed Action	No Action	Entombment
Air Quality	Attainment Area	No change. Transient localized impacts including fugitive dust and filtered air from decontamination operations during implementation	No change	No change. Transient localized impacts including fugitive dust and filter air from decontamination operations during implementation
Hydrology	Regional groundwater flow is to the north; cone of depression in groundwater at the PBRF from sump pumping.	No change in regional flow; cone of depression at the PBRF would be eliminated	No change	No change in regional flow; cone of depression may be eliminated when sump pumping discontinued
Surface Water	PBRF drains to Pentolite Ditch	No change in flow. Increased surface water runoff during implementation	No change	No change in flow. Increased surface water runoff during implementation
Wetlands and Floodplains	PBRF is neither located in a 100-year or 500-year floodplain; no wetlands identified in this area.	No change	No change	No change
Biologic Resources	No threatened and endangered species identified at the PBRF.	Earthmoving activities would result in the localized, temporary loss of habitat, displacement or death of plant and animal communities either along the Pentolite Ditch or in areas where contaminated soil would be excavated. Disturbed areas would be reseeded with native plant and grass species	No change	Earthmoving activities would result in the localized, temporary loss of habitat, displacement or death of plant and animal communities either along the creek or in areas where contaminated soil would be excavated.
Population and Land Use	Erie county population is 79,000. Land used for business, housing, and farming. Plum Brook Station is used as a NASA test site. Proposed housing development along Taylor Road Route 250 would be widened.	No change	No change	No change
Cultural and Historical Resources	Ohio Historic Preservation Office agrees with NASA's assessment that PBRF is not eligible for listing on the National Register of Historical Places.	No change	No change	No change

Table 1. Comparison of Impacts (Continued)

Measure of Impact	Existing Environment	Proposed Action	No Action	Entombment
Socioeconomics and Environmental Justice	NASA employs a small labor force (120 people out of about 40,000) **Only census blocks several miles north of PBS are likely to have minority and low income communities**	Temporary increase in employment (about 100 additional people) during decommissioning The minority and low income communities are not closest to the site or along the candidate waste transportation routes	No change No change	Temporary increase in employment while PBRF is entombed The minority and low income communities are not closest to the site or along the candidate waste transportation routes.
Transportation	Average daily traffic count south on Route 250 is 16,600 vehicles. Plum Brook traffic is primarily from site employees (~100 vehicles per day).	Increase in traffic by a factor of 2 from employment. Truck traffic for consumables and waste disposal could increase by 2 per week.	No change	Small increase during entombment phase
Noise	Transient noise from test facilities, construction activities, and traffic	Localized increase in construction and traffic noise	No change	Localized increase in construction and traffic noise
Waste Management	Current Plum Brook Station waste disposal rates are 8,400 to 45,000 ft^3 of industrial waste per year	Radioactive Low-Level Waste shipments involving about 37,000 ft^3 per year (assuming a 2 year shipping schedule). Industrial waste shipments of 114,000 ft^3 per year (if offsite disposal and assuming a 2 year schedule).	No change	Some Low-Level Waste shipments following decontamination prior to entombment.
Radiation exposure	Background exposure from natural sources about 300 millirem/yr. Total background estimated at 360 millirem/yr.	Incremental offsite exposure would be below measurable levels. Peak occupational exposure around 1000 millirem/yr (regulatory limit of 5000). Average around 500 millirem/yr.	No change	Offsite dose during entombment would be below measurable levels. Occupational exposure would be below regulatory limits

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ACRONYMS AND ABBREVIATIONS

ac	acre(s)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter(s)
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
DOT	U.S. Department of Transportation
ft	foot/feet
ft^3	cubic feet
gal	gallon(s)
GRC	Glenn Research Center
ha	hectare(s)
in	inch(es)
km	kilometer(s)
LLW	low-level waste
m	meter(s)
m^3	cubic meter(s)
mi	mile(s)
mt	metric ton(s)
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NRC	U.S. Nuclear Regulatory Commission
ODNR	Ohio Department of Natural Resources
PAH	polycyclic aromatic hydrocarbons
PBRF	Plum Brook Reactor Facility
PCB	polychlorinated biphenyls
ppb	parts per billion
ppm	parts per million
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
rem	unit of dose with the letters historically meaning Roentgen Equivalent Man
SVOC	Semivolatile Organic Compound
UST	Underground Storage Tank
VOC	Volatile Organic Compound
yd^3	cubic yard(s)

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1. PURPOSE AND NEED FOR ACTION

The National Aeronautics and Space Administration (NASA) Plum Brook Reactor Facility (PBRF) was shut down in 1973, and NASA currently has a "possess but do not operate" U.S. Nuclear Regulatory Commission (NRC) license for the facility. NASA Glenn Research Center (GRC) has no further need for the PBRF located at Plum Brook Station and wants to terminate the license according to the requirements of 10 CFR Part 20, Subpart E. This Environmental Assessment (EA) evaluates the impacts from implementing the Proposed Action and alternatives for terminating the license.

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The Proposed Action and the alternatives considered for the PBRF decommissioning are listed below:

- Proposed Action (Prompt Decontamination and License Termination)
- Alternative 1 (No Action-SAFSTOR)
- Alternative 2 (Entombment)

2.1 PROPOSED ACTION (PROMPT DECONTAMINATION)

NASA GRC proposes to decontaminate and decommission the PBRF to levels consistent with NRC's unrestricted release criteria, take measurements to verify decontamination, and then request NRC terminate the license without restrictions. Implementing the Proposed Action would involve performing the following major tasks: removing contaminated equipment, components, and systems from buildings and underground areas; removing contaminated material and soil; decontaminating buildings and structures; demolishing all structures above grade and within 1 meter (m) (3 feet (ft)) below land surface and backfilling the remaining below grade portions (the portions greater than 1 m (3 ft) beneath the surface) with clean soil and/or concrete and masonry rubble. These actions are those characterized as DECON in the NRC Generic Environmental Impact Statement on Decommissioning Nuclear Facilities (NRC 1988).

All of these activities would occur within the 11-hectare (ha) (27-acre (ac)) fenced area that comprises the PBRF (Figure 1). Mitigative measures would be taken during decommissioning operations to minimize releases of contaminants to the atmosphere and discharges to surface waters as described in Section 5.

While the decontamination work is in progress, remedial action status surveys would be conducted to ensure that the contamination has been removed to the required limits. Final status surveys would also be conducted. Approximately 3,170 cubic meters (m^3) (112,000 cubic feet (ft^3)) of radioactive waste would be generated during the PBRF decommissioning and shipped offsite for either disposal or processing for decontamination or volume reduction. Approximately 1,163 m^3 (20,255 ft^3) of contaminated soil and 2.8 m^3 (99 ft^3) of asphalt would be excavated as part of the decommissioning actions. Prior to initiating decommissioning actions, asbestos removal and friable lead paint abatement would be performed in affected buildings.

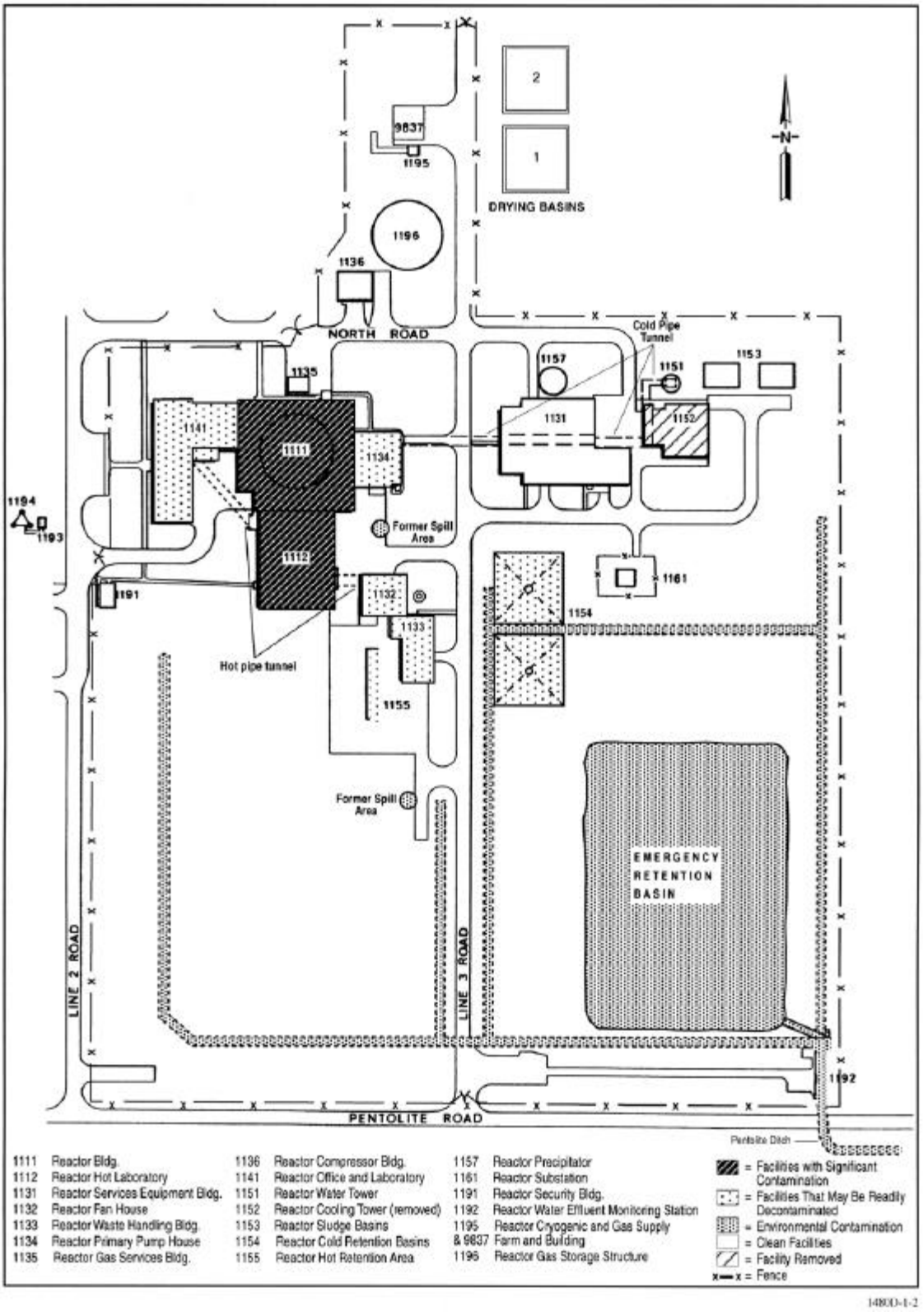

Figure 1. Plot Plan of Plum Brook Reactor Facility

Approximately 6,435 m^3 (227,200 ft^3) of non-radioactive building demolition debris consisting of concrete and metal would be generated.

This demolition debris may be used onsite as backfill if it meets the Ohio definition of clean hard fill; metal debris would be recycled if possible or disposed of offsite at an industrial landfill. If the demolition debris does not meet the Ohio definition of clean hard fill, it would be disposed of as construction debris in an Ohio State licensed construction and demolition debris facility. Details on the activities that would be implemented as part of the Proposed Action are described in the decommissioning plan for the PBRF (NASA 1999).

2.2 ALTERNATIVE 1 (NO ACTION - SAFSTOR)

Under Alternative 1, the PBRF would be maintained in a safe storage condition (SAFSTOR) for decades to allow further decay of radioactivity and subsequently decontaminated to a level to allow unrestricted release of the property. These actions are those characterized as SAFSTOR in NRC (1988). Alternative 1 would require that a NRC license remain in effect until future decontamination is verified.

2.3 ALTERNATIVE 2 (ENTOMBMENT)

Under Alternative 2, reactor internals would be removed and accessible areas of major contamination would be removed. The remaining portion of the reactor building would be encased in a structurally long-lived material such as concrete. Materials that could not be released would be confined within the entombment structure. These actions are those characterized as ENTOMB in NRC (1988). Alternative 2 would require that an NRC license remain in effect. The entombed structure would be maintained and surveillance would continue until the radioactivity decayed to a level permitting release of the property.

3. AFFECTED ENVIRONMENT

The PBRF is an 11-ha (27-ac) complex located in the northern portion of the 2,950-ha (6,400-ac) Plum Brook Station. The Plum Brook Station is located about 6-kilometers (km) (4-miles (mi)) south of Sandusky, Ohio (Figure 2).

An aerial view of the PBRF taken from the north is shown in Figure 3. The photograph identifies the boundary for the PBRF, the area that would be decommissioned. The figure shows wooded areas surrounding much of the developed PBRF. Figure 3 shows the reactor building in the northwest corner of the PBRF area. The drained emergency retention basin can be seen in the southeast corner of the PBRF area. A second aerial photograph of the PBRF taken from the southwest of the PBRF is presented in Figure 4. This figure also shows the boundary for the PBRF. It more clearly shows the buildings within the area to be decontaminated and decommissioned.

This section describes the environment around the PBRF that could be impacted by the proposed decommissioning operations. Although scoping is not required in the EA process, GRC

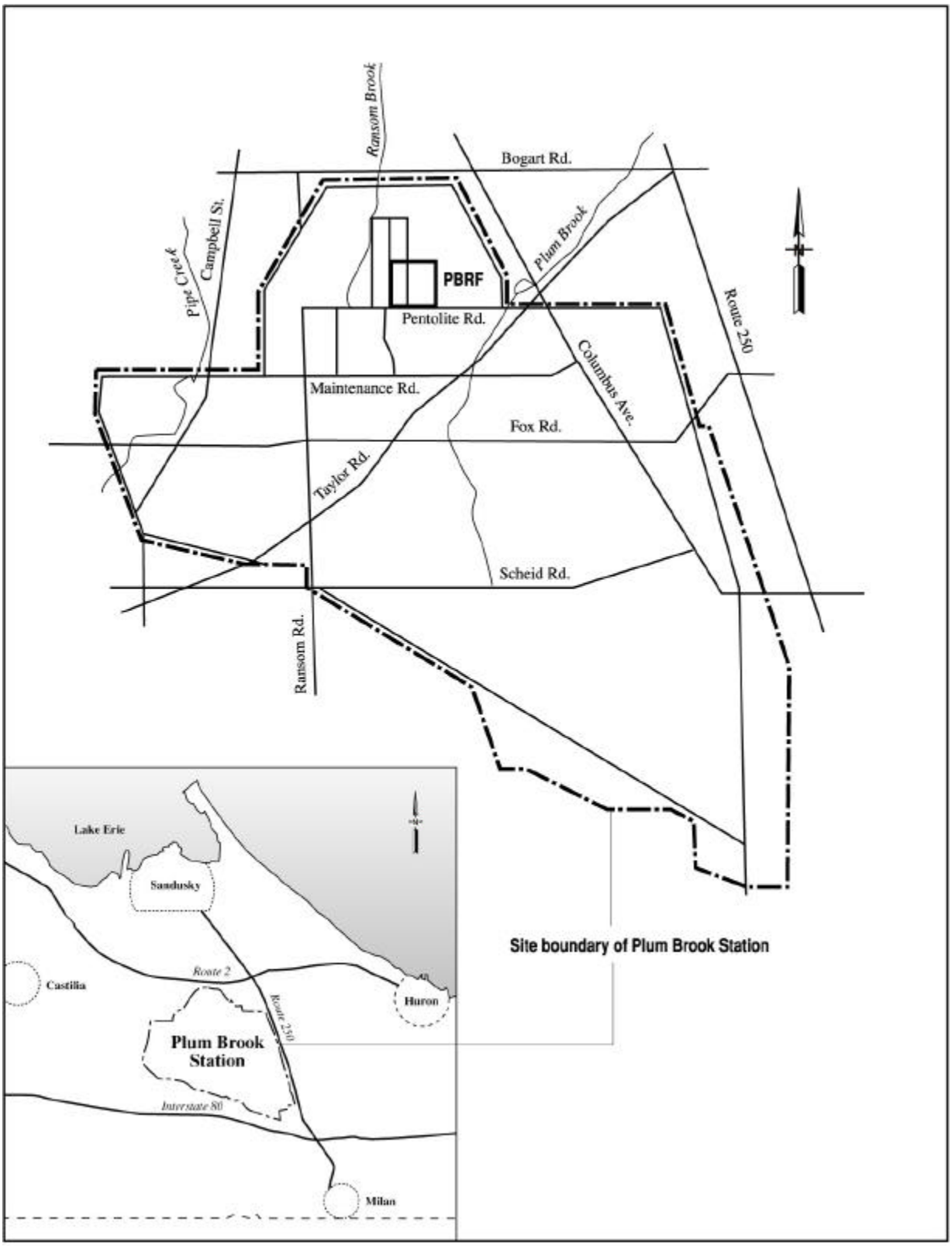

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Figure 2. Location of the Plum Brook Reactor Facility at Plum Brook Station

Figure 3. Aerial View of PBRF looking South

reviewed information about the potentially affected environment and the actions involved in decontamination and decommissioning to narrow the discussion of aspects of the environment in the EA. This section summarizes information about those portions of the environment that could potentially be affected by the Proposed Action and alternatives.

3.1 TOPOGRAPHY, GEOLOGY, AND SOILS

Plum Brook Station is situated in the Ohio Lake Plain physiographic region. The topography is relatively flat and slopes gently northward toward Lake Erie. The average slope of the land is less than 6 percent. Elevations range from about 191 to 207 m (625 to 680 ft) above sea level. The elevation at the PBRF is about 191 m (625 ft) above sea level (SAIC 1991).

Bedrock formations underlying Plum Brook Station consist of carbonates and clastics (sandstones and shales) of Devonian age: Columbus Limestone, Delaware Limestone, Plum Brook Shale/Prout Limestone, and Ohio Shale. Bedrock outcrops at certain locations on

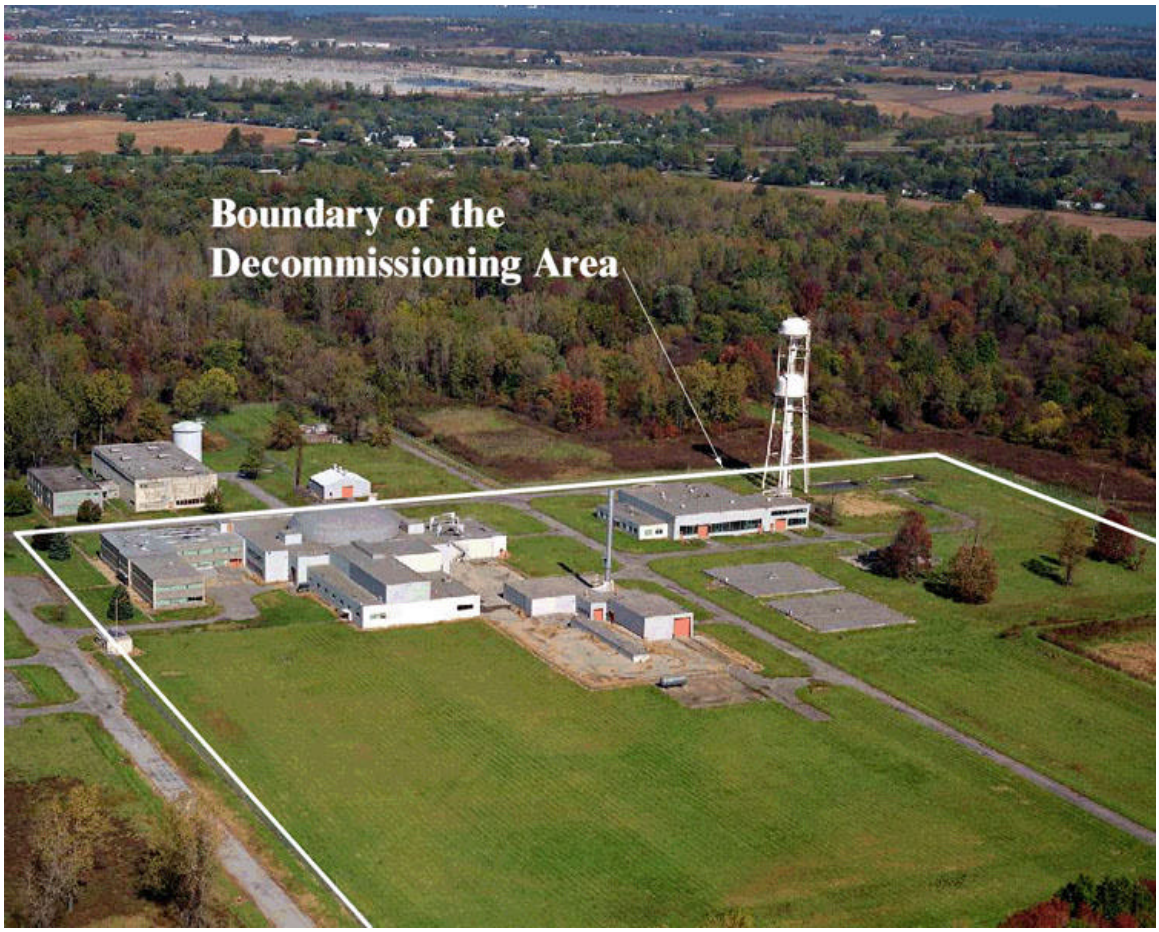

Figure 4. Arial View of PBRF looking Northeast

Plum Brook Station and has been encountered at depths ranging from 0.7 to 7.6 m (2 to 25 ft) below land surface.

Two soil associations occur at Plum Brook Station. The Arkport-Galen association occurs in the northern and western areas of Plum Brook Station, including the PBRF, and the Prout association occurs in the southern and eastern areas. Soils are highly variable in thickness and permeability.

The Arkport-Galen association is characterized by deep, nearly level to moderately sloping, well-drained to moderately well-drained soils that have a subsoil of loamy fine sand and fine sand and occur on sand hills and ridges (SAIC 1991). The Arkport soils are gently to moderately sloping and well drained. The Galen soils are nearly level and moderately well drained. The minor soils occur in level to depressional areas and in the flat areas between the sand hills and ridges. The minor soil associations are either very poorly or somewhat poorly drained.

The Prout association has moderately deep to deep, nearly level to gently sloping, somewhat poorly drained soils that have a subsoil of heavy silt loam to silty clay loam. This association occurs on uplands, such as the sides of stream valleys, shale outcrop ridges, along drainage ways, and in some steeper areas. The Prout soils are nearly level to gently sloping, dark

colored, and somewhat poorly drained. These soils are underlain by shale bedrock at a depth ranging from 51 to 102 centimeters (cm) (20 to 40 inches (in)) for the Prout soils and 102 to 152 cm (40 to 60 in) for deep variant Prout soils. The minor soils in this association include a broad spectrum from nearly level to depressional and very poorly drained to nearly level to gently sloping and well drained (SAIC 1991).

The PBRF is uniformly graded toward the southeast corner of the fenced area to facilitate drainage to Pentolite ditch.

3.1.1 Nature and Extent of Soil Contaminants at the PBRF

Investigations of the PBRF in 1985 and 1998 identified localized areas with contaminated soil or sediment. Areas of environmental contamination include (1) the emergency retention basin, (2) the drainage system, (3) portions of the Pentolite ditch, and (4) two areas where spills occurred. The emergency retention basin had average concentrations of Co-60, Cs-137, and Sr-90 of 22, 32, and 2.4 pCi/g, respectively and reflect the most contaminated soils at the PBRF. Sediments in the Pentolite ditch ranged from 2 to 15 pCi/g of Cs-137 and 0 to 1 pCi/g of Co-60.

An investigation was conducted in 2000 to identify non-radiological contaminants in the soils at the PBRF. Twenty six samples were taken and analyzed for volatile organic compounds (VOC), metals, and polychlorinated biphenyls (PCBs). Only low levels of contamination were found in a few samples. Two samples detected fuel-related compounds in a very low range (between 10 and 20 ppb). One sample showed a low level (less than 100 ppb) of PCBs. Several samples had a low level (less than 500 parts per billion (ppb)) of polycyclic aromatic hydrocarbons (PAH). Metal concentrations in soils were consistent with soil concentrations seen in other parts of Ohio and no outliers were identified in the data set. Overall, the environmental sampling results are not indicative of widespread environmental contamination and soil remediation would not be necessary for non-radiological contaminants.

3.2 SEISMICITY

Plum Brook Station is located in Seismic Zone 1 according to the 1994 Uniform Building Code zone map, meaning that Plum Brook Station is located in an area that would experience only limited shaking in the event of an earthquake. Review of the distribution of earthquake epicenters in Ohio indicates that no earthquake epicenters have been located in Erie County (Ohio Division of Geological Survey 2000).

3.3 CLIMATE AND AIR QUALITY

The climate at Plum Brook Station is continental in character and influenced by its proximity to Lake Erie. Summers are moderately warm and humid, with temperatures occasionally exceeding 32°C (90°F). Winters are cold and cloudy, with temperatures falling below –18°C (0°F) an average of 5 days per year. Annual temperature extremes typically occur after late June and in December. The first frost typically occurs in October (NASA 1997). The predominant wind direction is from the southwest throughout the year. In spring and summer, northerly and northeasterly breezes also blow from the lake (NASA 1997). Average annual

precipitation at Plum Brook Station for the period from 1961 to 1990 data was about 86 cm (34 in) (OSU 1997).

There are occasional severe weather storms in northern Ohio. A review of the National Climate Data Center information on storm events (e.g., heavy snow, blizzard, flood, high winds, tornado) identified 187 storms during the period January 1993 to September 2000 or an average of about 27 storms per year. These severe weather events will be considered in the planning and conduct of decommissioning operations and in the preparation of contingency plans.

Erie County is in attainment for all National Ambient Air Quality Standards (Carbon monoxide, nitrogen dioxide, ozone, lead, particulate, and sulfur dioxide). Because of the limited operation of facilities at Plum Brook Station, there are limited emissions to the atmosphere and the site is not classified as a major emission source under the Clean Air Act Title V permitting program (NASA 1997). There are no permitted emission sources at the PBRF.

3.4 HYDROLOGY

3.4.1 Groundwater

Plum Brook Station is underlain by an overburden aquifer and two principal bedrock aquifers (SAIC 1991). A fractured limestone aquifer occurs in the western portion of Erie County, and groundwater flow in this aquifer is to the north. A fine-grained shale aquifer to the east of the limestone aquifer has low yields, and the Ohio Department of Natural Resources (ODNR) has delineated three groundwater zones based on well yield. The PBRF overlies the limestone bedrock aquifer. Wells completed in the limestone aquifer have yields ranging from 19 to 95 liters (5 to 25 gallons (gal)) per minute (SAIC 1991).

The bedrock aquifer is overlain by unconsolidated deposits of glacial origin. These unconsolidated deposits comprise the overburden aquifer. The thickness of the overburden ranges from less than 1.5 m (5 ft) to greater than 8 m (25 ft). The overburden is the thickest in the vicinity of the PBRF where it is thought to fill in a low in the underlying bedrock surface (IT 1999). A sitewide groundwater investigation at Plum Brook Station is being conducted by the U. S. Army under the Defense Environmental Restoration Program formerly utilized sites (IT 1999). The PBRF area has been included in this investigation. A total of ten wells have been completed in this area as part of this program since it was initiated in 1997. Four wells have been completed in the bedrock aquifer and the remaining six wells are completed in the overlying overburden aquifer. A second groundwater investigation is being conducted under the Resource Conservation and Recovery Act (RCRA) program in the PBRF area at the former underground storage tank (UST) location shown on Figure 5. Three USTs were removed from a common excavation near Building 1131 in the vicinity of the PBRF in 1989 and groundwater remediation has been proposed (URS 2000). NASA submitted an amended closure plan for the area of the former USTs to Ohio EPA. The amended plan was approved by Ohio EPA with modification.

The elevation of the groundwater surface is measured quarterly and the groundwater quality is measured semi-annually as part of the sitewide groundwater investigation.

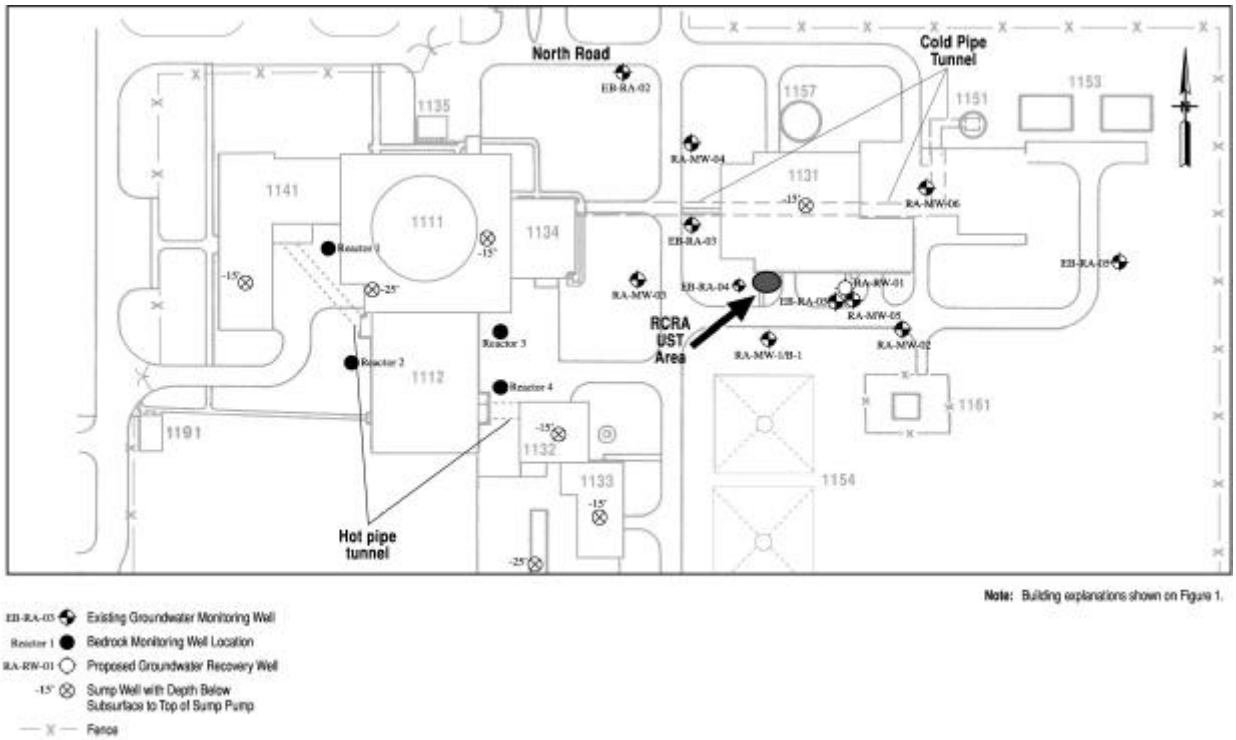

Figure 5. Groundwater Monitoring Wells at the Plum Brook Reactor Facility

Groundwater flow in both the bedrock and overburden aquifers in the vicinity of the PBRF is thought to be affected by the eight sump pumps located in this area. The pumping in this area has created a localized cone of depression in the groundwater surface. Water levels in bedrock wells completed in this area have fluctuated as much as 8 m (25 ft) (IT 1999).

3.4.1.1 Nature and Extent of Groundwater Contaminants at the PBRF

As part of the sitewide groundwater investigation, one well completed in the overburden aquifer in the vicinity of the PBRF (monitoring well IT-MW06) has been sampled for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), nitroaromatic explosives, metals (total and dissolved), cyanide, and water quality parameters. One VOC was detected but at a concentration less than the risk-based concentration (RBC). No SVOCs, explosive compounds, or cyanide were detected. The metals iron and manganese were detected at concentrations exceeding the RBCs; however, neither metal was detected in the dissolved phase indicating that the total metal exceedances were due to suspended solids in the unfiltered sample (IT 1999). The analytical results from these sampling events indicate that the groundwater quality of the overburden aquifer at the sampled locations has not been impacted by past site activities (IT 1999).

One bedrock monitoring well (REACTOR 1) was sampled for VOCs, SVOCs, nitroaromatic explosives, metals (total and dissolved), cyanide, and water quality parameters. Two VOCs (benzene and total xylene) were detected, but only benzene was detected at a concentration above the RBC. One SVOC was detected at a concentration above the RBC.

Neither cyanide nor explosives were detected. The metals barium, manganese, and iron have been detected at concentrations above the RBCs in filtered samples. However, these inorganic RBC exceedances are suspected to be naturally occurring but would require further evaluation (IT 1999).

Five groundwater monitoring wells were installed as part of the RCRA actions at the UST location. These wells were sampled for VOCs, SVOCs, pesticides, PCBs, and metals. Dissolved phase VOCs were detected at concentrations above remediation standards in the overburden aquifer. No contamination was detected in the soils (URS 2000). The groundwater contamination would be addressed by a pump-and-treat remediation system consisting of one groundwater recovery well shown on Figure 3.

Overall, the groundwater sampling at the PBRF does not indicate the presence of any large or concentrated groundwater plumes that could have any impact on offsite wells.

3.4.1.2 Drinking Water

One hundred seventy-nine private drinking water wells were located within a 6-km (4-mi) radius of Plum Brook Station based on a 1991 record search of the Erie County Health Department (SAIC 1991). A recent record search in May, 2000 of the Ohio Department of Natural Resources files for wells located in Perkins township (*i.e.*, wells located down gradient of the PBRF) indicated that three monitoring wells, one test well, and one exploratory well for oil and gas has been drilled since the previous record search in 1991. A review of records did not identify any down gradient groundwater wells used for industrial or agricultural purposes. A review of the records of permits for residential wells in Perkins township indicated there have been no permits for residential wells issued by the Ohio Department of Public Health since the 1991 search (General Health District 2000). The closest recorded down gradient well for Plum Brook Station is located at 6115 Schenk Road, which is approximately 1.6 km (1 mi) cross gradient from the PBRF.

3.4.2 Surface Water

Plum Brook Station is located in the Lake Erie watershed. The Huron River and its branches constitute the major surface water system. Eleven streams cross Plum Brook Station, the largest of which are Pipe Creek, Kuebler Ditch, Ransom Brook, and Plum Brook. Streams generally flow northward and converge into Ransom Brook, Storrs Ditch, Plum Brook, and Sawmill Creek and eventually flow north into Lake Erie approximately 6 km (4 mi) to the north. Seventeen isolated ponds and reservoirs are located on Plum Brook Station (NASA 1997).

The PBRF area is drained by Ransom Ditch which has been extensively modified for drainage (ODNR 1995). The stream is characterized by steep banks (2 to 1 slope) and vegetated with a mixture of grasses, herbaceous weeds, and shrubs. The stream channel is relatively straight because of past dredging activities. Surface water flow is intermittent in the summer and fall with small isolated pools (ODNR 1995). Runoff during the decommissioning actions would be the only surface water discharges from the PBRF.

Surface water from Lake Erie is used as the primary drinking water supply for the City of Sandusky, located about 8 km (5 mi) north of Plum Brook Station (SAIC 1991). In 1998, approximately 12.9 billion liters (3.4 billion gal) of water were distributed to City of Sandusky customers and the surrounding area (Keller 2000).

The combined commercial and sport fishery catch from Lake Erie is estimated to exceed 20 million fish (SAIC 1991). Most commercial fishing takes place near Sandusky Bay on Lake Erie. The lake is also used for recreational purposes.

3.4.3 Wetlands and Floodplains

Portions of Plum Brook Station lie within the 100-year and 500-year floodplains (SAIC 1991). However, the PBRF is not located in either the 100-year or 500-year floodplain based on review of floodplain maps. Review of the national wetlands inventory map indicates no wetlands have been delineated in the immediate vicinity of the PBRF (FWS 1977). Most of the identified wetlands are small, isolated palustrine emergent, scrub shrub, or forested (FWS 1977). There are no wetlands at the PBRF. The site was developed to have grade sloping to the southeast to drain the area and to prevent accumulation of standing water. Figures 3 and 4 shows the absence of wetlands within the PBRF.

3.5 BIOLOGIC RESOURCES

Plum Brook Station is part of a regional ecosystem encompassing Sandusky, parts of Lake Erie, and several Lake Erie islands. The station contains significant areas of grassland, bushland, and woodlands. A biological survey conducted in 1994 determined that no significant plant communities were located at Plum Brook Station. About 330 vascular plant species were collected or observed during the 1994 survey, and, of these, 251 species are indigenous to the area. Areas of greatest plant diversity are in the central and southern portion of Plum Brook Station and not near PBRF (NASA 1997). The grounds of the PBRF itself is classified as urban turf and have been surrounded by a fence since its construction over forty years ago.

Wildlife at Plum Brook Station includes white tailed deer, raccoons, woodchucks, moles, starlings, pigeons, coyotes, hawks, Canada geese, and turkey vultures. The PBS lies within the range of the Indiana bat (*Myotis sodalis*) which is a Federally listed endangered species. There is however no summer habitat (dead trees and snags, live trees with exfoliating bark) within the bounds of the PBRF. There are periodic controlled deer hunts to manage wildlife populations and to control overgrazing. A total of 116 bird species have been identified at Plum Brook Station (NASA 1997). Of these, 92 species were either confirmed or likely nesters. Five species were considered to be late migrants and nine species visitors only. Common birds at Plum Brook Station include the American robin, song sparrow, field sparrow, indigo bunting, common yellowthroat, blue jay, and house wren. Nineteen reptile and 13 fish species have been identified. The 1994 PBS reptile survey specifically looked for habitat or evidence of the eastern massasauga rattler (*Sistrurus catenatus catenatus*) which is a Federal candidate species. The survey did not identify any satisfactory habitat for the eastern massasauga rattler within the bounds of the PBS. The nearest reported sighting of a eastern massasauga was more than 8 km (5 mi) from the PBS about ten years ago. All of the fish species are common State-wide and

tolerant of water quality and habitat degradation except for the brook stickleback. During the 1994 biological survey one Federally-listed species, the bald eagle (*Haliaeetus leucocephalus*), three State-listed endangered, four threatened, six potentially threatened, and three species of special concern were identified as summarized in Table 2. None of these protected or special status species or their habitats were identified at the PBRF.

Table 2. Ohio Threatened and Endangered Species at Plum Brook Station

Status	Species	Common Name
Endangered	*Hypericum gymnanthum*	Least St. John's-wort
	Cistothorus platensis	Sedge wren
	Carex cephaloidea	Thin-leaf sedge
Threatened	*Arenaria laterifolia*	Grove sandwort
	Carex conoidea	Field sedge
	Helianthus mollis	Ashy sunflower
	Bartramia longicauda	Upland sandpiper
Potentially threatened (plants)	*Baptisia lactea*	Prairie false indigo
	Carex alata	Broad-winged sedge
	Gratiola virginiana	Round-fruited hedge-hyssop
	Hypericum majus	Tall St. John's-wort
	Rhexia virginiana	Virginia meadow-beauty
	Viola lanceolata	Lance-leaved violet
Special concern (animals)	*Emydoidea blandingii*	Blanding's turtle
	Elaphe vulpina gloydi	Eastern fox snake
	Opheodrys vernalis	Smooth green snake

Source: NASA (1997).

3.6 POPULATION AND LAND USE

The 1990 population of Erie County was 76,779 people. The City of Sandusky had a population of 29,764 people, and Perkins township, located immediately north of Plum Brook Station has a population of 10,793 people (Erie County Chamber of Commerce 2000). The estimated current Erie County population is 79,000 (GEM 2000). During the summer, the population at Sandusky increases by approximately 50 percent because of tourism (NASA 1997).

Plum Brook Station is located primarily in Perkins and Oxford townships and covers approximately 2,950 ha (6,400 ac). The PBRF encompasses 11 ha (27 ac). The area surrounding Plum Brook Station is largely rural and agricultural. To the north there is more urban development associated with Sandusky. Most of the land at Plum Brook Station consists of forestland and old fields. About 25 percent of the acreage is used for offices, test facilities, roads, and infrastructure. Other state and Federal agencies maintain office space at Plum Brook Station. The remaining portions of the installation are unused.

Several wildlife areas or nature preserves are located in the vicinity of Plum Brook Station. The Erie Sand Barrens State Nature Preserve and the Milan State Wildlife Area are located approximately 305 m (1,000 ft) and 5 km (3 mi) to the south, respectively. The Sheldon Marsh State Nature Preserve and Resthaven Wildlife Area are located approximately 6 km (4 mi) and

10 km (6 mi) to the northwest, respectively. Old Woman Creek, a National Estuarine Research Reserve and State Nature Preserve, is east of the City of Huron (NASA 1997).

3.7 CULTURAL AND HISTORICAL RESOURCES

The Spacecraft Propulsion Research Facility (B-2 Facility) at Plum Brook Station has been designated a National Historic Landmark. Native American archaeological sites have been identified outside the Plum Brook Station fence line (NASA 1997).

3.8 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Plum Brook Station currently employs about 120 people (NASA 1997). Large manufacturing employers in the area employing more than 500 people include Visteon (Ford Motor Company) located in Margaretta township, Delphi Automotive located in Perkins township, Clevite Elastomers located in the Village of Milan, and Lear Seating located in the City of Huron (GEM 2000). Large non-manufacturing employers in Sandusky employing more than 500 people include Cedar Point Amusement Park (employs 3,700 people in season), Firelands Community Hospital, Sandusky City Schools, The Providence Corporation, and the Ohio Veteran's Home (GEM 2000).

The *Environmental Justice Implementation Plan for NASA Lewis Research Center* identified a minority population of approximately 4,650 people in Sandusky (Jones Technologies, Inc. 1996). This represents about 15 percent of the total population of Sandusky which is 29,764 people. The minority population of Erie County is about 10 percent (Erie County Chamber of Commerce 2000). *The Environmental Justice Implementation Plan for NASA Lewis Research Center* identified six census tracts within 8 km (5 mi) of the PBS site that are likely to meet the EPA environmental justice criteria for minority or low income communities. All of these tracts were in Sandusky and several miles north of PBS. No census tracts along Routes 250 and 4 between PBS and the Interstate 80 were identified as likely to meet the criteria for minority or low income communities.

3.9 TRANSPORTATION

Plum Brook Station includes a 101-km (62.5-mi) internal paved road system. There is also a 25-km (15.7-mi) rail line that is currently unused (NASA 1997). Several State roads service the area. Route 250 is located to the east of Plum Brook Station and serves as a major route to the installation. The Ohio Turnpike (Interstate 80 and 90) is located 8 km (5 mi) south of the main entrance to Plum Brook Station. Route 4 is a north-south road west of Plum Brook Station. The average 24-hour traffic volume on Route 250 between the Ohio Turnpike and Bogart Road, the main entrance to Plum Brook Station, is 16,610 vehicles (GEM 2000). Over 90 percent of the vehicular traffic on Route 250 is passenger cars and Class A commercial vehicles (GEM 2000). The average 24-hour traffic volume on Route 4 near Plum Brook Station, but south of Route 2 ranges from 5,490 to 9,840 vehicles (GEM 2000).

A major construction project is planned by the Ohio (DOT) to widen Route 250 from two lanes to five between Bogart Road and the Ohio Turnpike at Avery (366 m (1,200 ft) south of Mason Road).

3.10 NOISE

Noise sources at Plum Brook Station include an airstrip, transient noise blasts from test facilities, construction activities, and traffic noise. The Army Reserves and the Ohio Air National Guard also discharge pyrotechnic devices at Plum Brook Station (NASA 1997). None of these activities is a significant noise source.

3.11 WASTE MANAGEMENT

Both solid and hazardous waste are generated at Plum Brook Station. The annual volume of solid waste disposed at the municipal landfill is approximately 260 to 1,248 m^3 (312 to 1,665 cubic yards (yd^3)). Hazardous wastes consist of used solvents, oils, laboratory chemicals, fuels, lab packs, and wastes generated from maintenance operations and are managed in accordance with the Resource Conservation and Recovery Act (RCRA) permit OH3800015379 issued by Ohio EPA (NASA 1997).

Municipal waste and some construction and demolition debris can be disposed at the Erie County landfill. The annual landfill disposal is 86,200 metric tons (mt) (95,000 tons) with an estimated volume of 53,000 m^3 (1.9 million ft^3). Certified non-friable asbestos can be disposed at the municipal landfill (Erie County Solid Waste District 2000). Asbestos waste can also be disposed at the Ottawa County Landfill (Erie Co. Solid Waste District 2000). No hazardous waste disposal facilities are located in Erie County.

3.12 BACKGROUND RADIATION LEVELS

The public is continuously exposed to ionizing radiation from natural sources, primarily from (1) cosmic radiation; (2) external radiation from natural material in the earth and global fallout; and (3) internal radiation from natural radioactive materials taken into the body via air, water, and food. The public receives radiation exposures from medical x-rays, nuclear medicine procedures, and consumer products. On average, a member of the public in the United States receives approximately 300 millirem/yr from natural sources of radiation; 50 millirem/yr from medical procedures; and 10 millirem/yr from consumer products, for a total of 360 millirem/yr (NCRP 1987). A comprehensive background radiological survey was conducted at Plum Brook Station in 1986-1987 (Teledyne 1987). The survey showed variability in background activity levels at the ground surface depending on the nature of the material at the surface. Surface soils near the Engineering Building showed gross alpha activity ranging from less than 5 to 14 pCi/g with an average of 7 pCi/g and gross beta activity ranging from 24 to 36 pCi/g with an average of 24 pCi/g. Shale outcroppings have higher activity levels (up to three times the soil levels) as a result of naturally occurring Radium-266 and Thorium-228 in the rock. This type of variability in activity levels with changes in soil or rock type is common.

4. ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

4.1 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This section describes the potential impact to human health and the environment from implementing the Proposed Action. The human health impacts are described in Section 4.1.1 and impacts to the environment are described in Section 4.1.2.

4.1.1 Human Health Effects

Expected impacts to workers and people offsite from normal PBRF decommissioning activities and potential accidents are described below. The general nature of industrial and radiological hazards associated with decommissioning the PBRF are discussed in this section. A detailed listing of the radiological and industrial hazards associated with the PBRF decommissioning and identification of measures to be taken to minimize the hazard are provided in NASA (1999).

4.1.1.1 Industrial Hazards

The decontamination and decommissioning operations would involve several hundreds of thousands of labor hours. Activities would include soil excavation, concrete removal, piping and equipment removal, and building demolition. Workers could be exposed to industrial hazards including those associated with mobile equipment, power tools, airborne particulates, flammable materials (fuel for vehicles and equipment), toxic and hazardous substances (lead and asbestos are known to be present), and heat or cold stress. NASA and its contractors would take measures to manage these hazards.

The project would implement a risk management program and health and safety program consistent with NASA, federal, and state requirements to ensure that hazards are identified and controlled to prevent and minimize worker health and safety impacts. The estimated number of construction worker hours over the four year duration of the project is estimated at 100,000 hours. If the accident rate during decommissioning was consistent with that reported in Bureau of Labor Statistics for the construction industry, four injuries could occur over the duration of the project. The number of statistical fatalities calculated is less than one (0.006 fatalities over the project duration); therefore no fatalities would be expected.

4.1.1.2 Radiological Hazards

A radiation safety program consistent with NASA and NRC requirements would be implemented to ensure that exposures to workers and the public are maintained as low as reasonably achievable. While the PBRF is being decommissioned, workers would be exposed to direct radiation, airborne radioactivity, and radioactivity contained in loose contamination. The public could be exposed to very low levels of radiation as a result of discharges to the atmosphere that would occur during the decommissioning process and when the waste is shipped offsite for disposal. This section evaluates the radiological exposure to workers and the public.

When evaluating the dose to populations, the unit person-rem is used as the measure for collective dose to the population. Collective dose is calculated for a population and is obtained by summing the individual dose to each member of a population. For example, if 100 workers each received 0.1 rem, then the collective dose would be 10 person-rem or 100 x 0.1 rem. There are no standards for collective dose to populations, but the number provides a measure of total radiological impact and can be compared to the collective dose due to background for the same population. The collective dose for the action under consideration can also be compared to the collective dose for other actions. The average dose to the members population can be calculated by dividing the population dose by the population.

Estimated Worker Exposure. The average annual dose to individual project personnel is estimated to be 500 millirem per year which is well below the regulatory limit of 5,000 millirem per year for occupational exposure.

The occupational exposure from shipping low-level waste is estimated to be 5 person-rem. This dose was calculated by scaling occupational exposure information for shipping radioactive waste presented in the *Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-licensed Nuclear Facility* (NUREG-1496). The annual dose to the individual transportation worker would be well below the regulatory limit of 5,000 millirem (5 rem) per year.

Estimated Public Exposure. The dose to the public offsite from routine releases during decommissioning is expected to be small because of the mitigative measures that would be taken to limit discharges to the atmosphere and local streams. The NRC presented an estimate of the population dose to the public resulting from releases during decommissioning of a reference test reactor (PBRF) and concluded that the dose over the duration of the project was negligible (less than 0.1 person-rem) (NRC 1988). NASA concurs with NRC's estimate that decommissioning the PBRF will result in a very small dose to the surrounding population.

For the proposed action, the dose to the average Erie County individual is 0.000001 millirem over the 4 year project duration. For perspective, the average background dose is 300 millirems per year (see section 3.12). This average individual dose is also far less than applicable standards including 10 CFR 20.1101 which limits the exposure of members of the public to 10 millirem per year from air emissions.

The offsite dose from shipping radioactive waste for disposal would also be small. The population dose from shipping waste is estimated to be 0.5 person-rem. This public exposure dose estimate is scaled using information in NUREG-1496. This additional population dose would be a negligible addition to that received by the population along the transportation route from background sources.

The dose to the public from potential accidents would also be small. A conservative accident analysis evaluated the total effective dose equivalent to a member of the public at the boundary of Plum Brook Station. Six different accident scenarios were evaluated that could result in radiological releases to the environment (NASA 1999). The results of this analysis show that the offsite dose to a member of the public at the site boundary would be less than 0.5 millirem for each of the evaluated accident scenarios. The U. S. EPA's protective action

guideline limit is 1,000 millirem. This guideline requires the preparation of emergency plans if the projected dose from accidents is greater than 1,000 millirem. The projected dose from the largest PBRF accident is 1/2000 of the EPA protective action guideline limit. The calculated dose is also comparable to that assessed in NUREG-0586, which showed the maximum dose from an onsite accident as 0.25 millirem to the lung (NRC 1988).

The potential public exposure after the license has been terminated is also expected to be negligible. The PBRF would be released to allow unrestricted use meaning the maximum dose to the "average member of the critical group" (a hypothetical person who would use the PBRF site for a residence with a garden) would be less than 25 millirem per year. The actual dose to the average member of the critical group would be less than 25 millirem/yr for two reasons. First, the decontamination activities would be more extensive than required to meet minimum license termination requirements. In addition, NASA intends to retain the property, so public exposure from contact with the PBRF soils would not occur for the foreseeable future. If the land were to be used by the public sometime in the future, the dose would be further reduced because it is dominated by the short-lived nuclides Cs-137 and Co-60, which have half-lives of 30 and 5 years, respectively. (The half-life of a radionuclide is the time required for half of the nuclide to decay.)

4.1.1.3 Transportation Impact

Transportation of waste would be conducted in accordance with applicable U.S. DOT, U.S. EPA, and NRC regulations. Transportation routes are not known at this time. Routes 250 and 4 are among the leading candidate routes for moving material away from PBRF. The final selection of transportation routes would be coordinated with Ohio DOT and local communities. Even though exact routes are not identified, impacts can be estimated. The radiological impacts of incident-free transportation would be minimal as in Section 4.1.1.2. It is estimated that there would be 1 to 2 truck shipments per week during the decontamination and decommissioning operations. Any radioactive waste being shipped by rail would be trucked to Bellevue, the closest railhead located about 16 km (10 mi) southwest of Plum Brook Station and transported via rail to the Envirocare Site located in Clive, Utah. A small portion of the radioactive waste would be shipped by truck to Chem Nuclear waste disposal site in Barnwell, South Carolina.

The major roads in the area of the site (Route 250 and Route 4) carry more than 100,000 and 30,000 vehicles respectively per week. The projected waste shipments would represent a negligible increase in traffic. During transport, hazardous and radioactive materials would be handled in compliance with applicable DOT and NRC regulations. The primary non-radiological impacts would be from 1) truck or train noise and emissions and 2) potential accidental injuries and fatalities.

The estimated waste volumes, expected waste disposal locations, and transportation fatality rate (3.8×10^{-8} fatalities per km) were used to estimate non-radiological transportation fatalities associated with transporting low-level waste generated by decommissioning activities. The estimated number of statistical fatalities would be less than 0.01 (much less than one); therefore no fatalities would be expected. Using historical transportation accident and injury rates to estimate shipment impact, it is estimated that one transportation accident injury would occur.

4.1.2 Air Quality

Several decommissioning-related activities would have a short-term localized impact on air quality from operating both mobile and stationary source emissions. Mobile sources (*e.g.*, backhoes, cranes, trucks, and cars) would discharge engine exhaust such as carbon monoxide and nitrogen oxides. The impact of these emissions on air quality would be minimal.

4.1.3 Hydrology

Groundwater is currently pumped at the PBRF to prevent groundwater flow into the basement. The mitigative measures will be specifically identified in a Storm Water Pollution Prevention Plan prepared according to the Ohio EPA requirements. A Notice of Intent (NOI) will also be prepared and submitted to Ohio EPA. If Ohio EPA determines it is necessary, a individual NPDES permit would be requested. Demolition will not commence until the necessary permit is received. The groundwater pumping has created a localized cone of depression in the groundwater surface, but it has no impact on regional groundwater flow. After groundwater pumping has ceased, the general groundwater flow pattern (flow to the north and north east) would be reestablished over the PBRF area.

Increased surface water runoff could occur during implementation of the action; however, mitigative measures would be implemented to minimize soil loss, down gradient sedimentation, and surface water degradation. The PBRF is not located in a floodplain; therefore, there would be no impacts to floodplains from the Proposed Action.

4.1.4 Biologic Resources

The PBRF is an developed research and development site within the confines of Plum Brook Station. No threatened or endangered species were identified at the PBRF during the 1994 biological survey. Therefore, there would be no impact to threatened or endangered species from the Proposed Action. Implementing the Proposed Action would result in an overall decrease in extent of contaminated ground surface and the residual contaminant concentration. Plant and animal communities along the Pentolite ditch or in areas where contaminated soil is be removed would temporarily loose their habitat, be displaced, or killed by earthmoving activities. After removal of contaminated soil, the area would be regraded and reseeded. The use of native plant and grass species would be specified when detailed revegetation plans are developed. The use of native plant and grass species will be consistent with Executive Order 13148. A specification will be written for the seed to minimize the potential for the introduction of any invasive species consistent with Executive Order 13112. The disturbed plant and animal communities would reestablish themselves after earthmoving activities have ceased and the terrain has been restored.

4.1.5 Population and Land Use

The Proposed Action would involve about 100 additional employees at Plum Brook Station over the duration of the project (*i.e.*, four years). There would be no change in land use as a

result of the Proposed Action. The PBRF area would be retained as part of the buffer zone for Plum Brook Station.

4.1.6 Cultural and Historical Resources

No adverse impacts to significant archeological resources would occur from implementing the Proposed Action since the area would have previously been severely disturbed during construction of the PBRF during the 1950s. Portions of the basement in the PBRF were excavated to depths of 17 m (56 ft); likewise, excavation of the emergency retention basin, the former spill area, and subsequent activities along the drainage ditches would have previously disturbed any archeological resources in this area.

NASA conducted an assessment of the PBRF and found that it did not appear to be eligible for listing in the National Register for Historic Places. The Ohio Historic Preservation Office agreed with NASA's assessment and stated that the property was not eligible for listing on the National Register of Historical Places and that the proposed decommissioning would not affect historic properties (Ohio Historic Preservation Office 2000).

While decommissioning will not impact any historical properties, NASA recognizes the potential historical significance of items at the PBRF. NASA will inventory the artifacts at PBRF and will preserve the artifacts of historical significance.

4.1.7 Aesthetics

Several decommissioning-related activities would have a short-term localized impact on air quality from operating both mobile and stationary source emissions. Mobile sources (*e.g.*, backhoes, cranes, trucks, and cars) would discharge engine exhaust such as carbon monoxide and nitrogen oxides. The types of number of pieces of equipment that would be used for PBRF decommissioning would be similar to those for the construction to relocate test facilities from the South Area Facilities at GRC Lewis Field to PBS. The EIS for the FAA relocation action (FAA 2000) analyzed the air quality impacts and determined that the impact would be below de minimus levels. Based on this analysis, it is concluded that the impact from the PBRF decommissioning on air quality would also be minimal.

4.1.8 Socioeconomics and Environmental Justice

About 100 people would be employed for the decommissioning of the PBRF over the four-year duration of the project. This labor force would be a small fraction of the total Erie County labor force, which is about 40,000 (People Vision 1996). The offsite socioeconomic impact of decommissioning the PBRF would be minimal.

The minimal offsite impacts will be primarily to those in the immediate area of the Plum Brook Station and along the potential transportation routes heading south from PBS, Routes 250 and 4. The environmental justice characterization did not indicate there was a potential for minority or low income population around PBS or along the roads heading south and so the minimal impact will not occur in these populations.

4.1.9 Noise

During the PBRF decommissioning activities, noise would be generated by equipment such as jackhammers, scabblers, and concrete saws. However, the noise would be localized at the PBRF location. Backhoes and other heavy equipment could be used for partial dismantling activities. Onsite workers would be outfitted with hearing protection devices. Noise from PBRF decommissioning activities would be of limited duration, and since the closest offsite receptors are over 914 m (3,000 ft) away from the PBRF, there would be no offsite noise impact.

4.1.10 Waste Management

Implementing the Proposed Action would generate radioactive waste, mixed waste, and industrial (scrap, demolition debris) waste volumes. In addition, about 283 m^3 (10,000 ft^3) of asbestos would be generated from decommissioning actions. The estimated radioactive waste volumes are 3,060 m^3 (108,044 ft^3) of low-level waste (LLW) to be disposed of at the Envirocare site located in Clive, Utah and 303 m^3 (10,700 ft^3) of LLW to be disposed of Barnwell, South Carolina. The Envirocare site would receive the waste with the lower levels of contamination and has lower unit disposal costs. The Barnwell site would receive the waste with the higher levels of contamination and has the higher unit disposal costs.

The 1998 annual disposal volume at Envirocare is approximately 30,579 m^3 (1,079,750 ft^3) (Fuchs 1999). Assuming that 1,133 m^3 (40,000 ft^3) per year is shipped from the PBRF for disposal, this volume represents approximately 3.7 percent of the annual volume received at Envirocare. It is estimated that 303 m^3 (10,700 ft^3) would be shipped to Barnwell for disposal. The annual disposal volume at Barnwell is approximately 5,509 m^3 (194,516 ft^3) (Fuchs 1999). Assuming that approximately 113 m^3 (4,000 ft^3) per year is shipped to Barnwell from the PBRF for disposal, this volume represents approximately 2.1 percent of the 1998 annual volume received at Barnwell.

Approximately 14 m^3 (485 ft^3) of mixed waste comprised of radioactively contaminated asbestos and paint scrapings would be generated, and the non-radiological industrial waste volume is estimated to be 6,434 m^3 (227,200 ft^3). Temporary waste storage would occur at PBRF, but waste shipments would be made as soon as is practical. The waste would be removed by a licensed contractor and disposed of at a licensed facility.

Some nonhazardous solid waste would be generated during decontamination and decommissioning. The material that has scrap value (*e.g.*, copper wire and steel plate) would be recycled. Clean demolition debris that meets Ohio definition of clean hard fill would be used as fill material for decontaminated below grade structures. Material that has no scrap value and is not acceptable for fill would be disposed offsite in an industrial landfill. If the industrial solid waste generated by the decommissioning actions were disposed at the Erie County landfill and disposal occurred over a two year period, the industrial solid waste volume generated from the PBRF decommissioning would represent about 5 percent of the disposal capacity. Hazardous and asbestos waste would be disposed in permitted facilities in the region.

4.2 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE 1 (NO ACTION -SAFSTOR)

Under Alternative 1 (No Action-SAFSTOR) the PBRF would continue to be monitored and maintained. Occupational exposures for the No Action alternative would be less than for the Proposed Action and for Alternative 2 (Entombment); however, there would be substantial monitoring and maintenance costs. Eventually, decontamination and decommissioning of the facility would be required. The radiological impacts of delayed decontamination and decommissioning to workers and the public would be comparable to or slightly less than those for the Proposed Action since there would be more time to allow for radioactive decay. As with the proposed action, the occupational doses would be within regulatory limits and the public doses would comply with regulatory limits and be a small fraction of background radiation exposure. The dose for decontamination and decommissioning actions taken in the current timeframe would be dominated by cesium-137, cobalt-60, and strontium-90, which have half lives of 30 years, 5 years, and 28 years respectively.

The environmental impacts of the No Action alternative can be divided into two time periods: a monitoring and maintenance period followed by a subsequent decommissioning period. During the monitoring and maintenance period, impacts to the environment would be comparable to that currently reported in annual environmental monitoring reports to the NRC. There would be no ground disturbance in the near term; therefore, there would be no impacts to air quality, biologic resources, cultural resources, or surface water quality impacts from earthmoving operations. There would be no socioeconomic impact or changes in land use. After decommissioning was initiated, the impacts would be comparable to that described above for the Proposed Action. Transportation impacts would be less since more time would have passed to allow radioactive decay. During implementation of the action, there would still be short-term impacts on air quality, surface water quality and to biologic resources. Impacts to groundwater quality, land use, cultural resources, and socioeconomic impacts would be comparable to that described for the Proposed Action.

4.3 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE 2 (ENTOMBMENT)

Under Alternative 2 (ENTOMB), the PBRF would be kept under surveillance and maintained for a substantial time period to allow the radioactivity to decay to minimal levels. The time period decay to minimal levels has not been determined for the PBRF. However, information presented in NUREG-0586 (NRC 1988) and preliminary dose analyses conducted by NASA suggest the entombment period would be on the order of a hundred years at the PBRF. The occupational dose to workers under Alternative 2 would be comparable to those under the Proposed Action (70 person-rem) since there would be increased occupational exposure to remove contamination and then to construct the entombment structure. The dose to the public while constructing the entombment structure was estimated to be negligible, ranging from 0.1 to 1.3 person-rem (NRC 1988). There would be costs associated with such long-term monitoring and maintenance. As with the proposed action, the occupational doses would be within regulatory limits and the public doses would comply with regulatory limits and be a small fraction of background radiation exposure.

The environmental impacts from implementing Alternative 2 would be comparable to that described for the Proposed Action except waste generation and transportation impacts would be less. Under Alternative 2, the land area (estimated at about 0.2 ha (0.5 ac)) would be committed until such time that the radioactivity had decayed to levels to allow release for unrestricted use of the property. The near-term impacts to air quality, biologic resources, cultural resources, surface water quality would approach those described for the Proposed Action since some decontamination and earthmoving activities would be initiated to construct the entombment structure. There would be a near-term socioeconomic impact comparable to that described for the Proposed Action from the employment of workers to construct the entombment structure. However, this effect would be of limited duration and insignificant with respect to the overall economy of the area.

4.4 CUMULATIVE IMPACTS

Cumulative impacts on the environment result from the incremental impact of an action when added to other past, present, and reasonably foreseeable actions. Other ongoing and reasonably foreseeable actions include ongoing the RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigations at Plum Brook Station, the relocation of South Area facilities at GRC Lewis Field to Plum Brook Station as part of the proposed expansion of the Cleveland Hopkins International Airport, the widening of Route 250 into five lanes, and the construction of a housing development along Taylor Road near the entrance to Plum Brook Station (IT 1999; FAA 2000; ODOT 1998; URS 2000).

The RCRA and CERCLA investigations involve site assessment work, including soil and groundwater remediation, either at the PBRF or across Plum Brook Station. The RCRA actions include UST closures at three locations on Plum Brook Station including the reactor area, the space power facility area, and at the garage and maintenance area. The groundwater contamination at the PBRF discussed in Section 3.4.1.1 would be addressed by a pump-and-treat remediation system consisting of one groundwater recovery well shown on Figure 3. Although remediation is also planned at both the garage and maintenance areas and the space power facility, these facilities are located approximately 0.8 km (0.5 mi) south and 4.8 km (3 mi) southwest of the PBRF, respectively. The planned remediation at these distant areas would have no measurable adverse impact on the PBRF environment.

The CERCLA actions include an ongoing sitewide assessment of environmental contamination from historic explosives manufacturing that occurred at Plum Brook Station in the 1940s. The U. S. Army Corps of Engineers is managing the characterization and cleanup of Plum Brook Station under the Formerly Used Defense Sites Program. The work is primarily in the characterization phase. The characterization and any future remediation work would involve small crews (10 people or less) for either weeks or years, respectively (Meadows 2000). Based on the actions that have been identified to date, no measurable adverse impacts are expected on the PBRF or surrounding environment.

The relocation of facilities from the South Area at the GRC at Lewis Field to Plum Brook Station as part of the proposed expansion of the Cleveland Hopkins International Airport was also identified as a reasonably foreseeable action (FAA 2000). The Propellant Densification Test Site, the Cryogenic Component Laboratory Test Cell 1 and Test Cell 2 facilities currently at the

South Area have been proposed for relocation to the K Site vicinity at Plum Brook Station, located nearly 1.6 km (1 mi) southwest of the PBRF. Approximately 1.6 ha (4 ac) of old field/scrub-scrub habitat at PBRF would be converted to Urban-Industrial Turf during the construction of these replicated facilities. The FAA notes that there would be temporary water quality impacts at PBRF during the construction phase. No other environmental impacts are expected. According to the generalized proposed development schedule for the airport expansion project, these actions would be complete by 2003 (FAA 2000).

The widening of Route 250 into five lanes and a housing development along Taylor Road were identified as a reasonably foreseeable actions. The widening of Route 250 began in the fall 2000 and is scheduled to be completed in approximately two years. A Categorical Exclusion was prepared by the Ohio Department of Transportation for this project (ODOT 1998). The Categorical Exclusion discussed the noise that would occur as a result of the road widening (61 to 80 dBA) and the displacement of people and businesses (5 residences and 2 businesses). The Categorical Exclusion concluded that the impacts were such that preparation of an Environmental Assessment or an Environmental Impact Statement was not required.

An 85-home development has been zoned along Taylor Road outside the Plum Brook Station fenceline near the bus parking lot (Lamb 2000). The homes would be single family dwellings and have county water and sewer. Installation of the sewer and water lines will occur first. Construction of the houses is expected to occur over several years (Lamb 2000).

After reviewing the information on the proposed action as well as other reasonably foreseeable actions, GRC determined that cumulative impacts on the PBRF environment would be minimal. There would be very small, localized impacts on air and water quality and increases in PBS traffic because of K-site construction and PBRF decommissioning. GRC also determined that the cumulative impacts in the environment surrounding the PBS would be to the air quality, local traffic, and changes in land use but that these impacts would be dominated by the Route 250 widening project and the construction of a housing development rather than the Proposed Action.

NASA also considered the cumulative impact at offsite radioactive waste disposal locations. NASA determined that the impacts of waste disposal at these locations were analyzed as part of the licensing processes that determined the volume and waste composition limits for the disposal site.

5. MITIGATION MEASURES

The implementation actions under the Proposed Action would generate waste with the potential for releases to air and water. Pollution prevention practices would be implemented in response to Executive Order 12856, *Federal Compliance with Right to Know Laws and Pollution Prevention Requirements.* During implementation of the Proposed Action, increased amounts of dust (particulates) would be generated from digging and hauling, but these would be generated for a short duration. Best engineering practices would be used to control the release of particulate matter including wetting of unvegitated surfaces and minimization of areas being actively worked.. Radioactive waste would be transported in sealed packages that comply with NRC and DOT regulations. Soil having non-radiological contaminants and debris that is not

radiologically contaminated would be transported in covered trucks to reduce or prevent spillage and wind erosion during transport.

During implementation of the Proposed Action, unavoidable impacts to surface water would occur from increased runoff and downstream sedimentation. Best engineering erosion control practices would be used to mitigate surface runoff. Also a storm water pollution prevention plan would be prepared, submitted to OEPA for approval, and followed during decommissioning. If the event that any trees with exfoliating bark must be cut to facilitate decommissioning, they will not be cut between April 15 and September 15 to assure that potential summer habitat of the Indiana bat is not destroyed while it could be in use. After each area at the PBRF was excavated, the ground surface would be regraded, reseeded, and revegetated. The use of native plant and grass species such as prairie grass would be specified when detailed revegetation plans are developed. This latter action would be in keeping with Executive Orders 13148 and 13112.

6. AGENCIES AND INDIVIDUALS CONSULTED

NASA formally contacted three agencies during the preparation of this EA. These agencies were the Ohio Historic Preservation Office, the U.S. Fish and Wildlife Service, and the Ohio Environmental Protection Agency. The results of these consultations were integrated into this EA.

7. LIST OF PREPARERS

This EA was prepared by the Environmental Management Office, NASA John H. Glenn Research Center at Lewis Field, Cleveland, Ohio. Patricia Swain and James Hammelman, Science Applications International Corporation (SAIC), supported preparation of the EA.

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