3.0 AFFECTED ENVIRONMENT AND CONSEQUENCES

3.1 INTRODUCTION

Chapter 3 provides a description of the baseline conditions (the affected environment) associated with each resource category at the site alternatives, followed by the potentially direct and indirect effects (the consequences) on each resource. Each major resource section (Sections 3.2 to 3.14) provides an analysis for each resource category. The methodology used to conduct the analysis is described, followed by a resource evaluation for each site alternative. Mitigation measures are described in Section 3.15. The final sections in this chapter describe Unavoidable Adverse Impacts (Section 3.16), the Relationship Between Short-Term Uses of the Environment and Long-Term Productivity (Section 3.17), and Summary of Significant Effects (Section 3.18).

This EIS evaluates the potential environmental consequences that could result from the site selection, construction, and operation of the proposed NBAF at six site alternatives and from the No Action Alternative. In preparing the NBAF EIS, DHS analyzed and considered public scoping comments on the Draft NBAF EIS received during the 60-day public scoping period (see Section 1.6).

A sliding-scale approach was the basis for the analysis of potential environmental effects in this EIS. This approach implements the Council on Environmental Quality's (CEQ's) regulations for applying the *National Environmental Policy Act* (NEPA) and its instruction that federal agencies preparing EISs "focus on significant environmental issues and alternatives" (40 CFR 1502.1) and that impacts be discussed "in proportion to their significance" (40 CFR 1502.2(b)). Certain aspects of the alternatives have a greater potential for creating environmental effects than others. Therefore, they are discussed in greater detail than those aspects that have little potential for effect. For example, because the NBAF could affect human health, in-depth information is provided. Conversely, the NBAF would have less effect on cultural resources, and as a result, there is limited discussion of effects on cultural resources. In implementing this approach, DHS adhered to CEQ's guidelines for determining significance as presented in 40 CFR 1508.27.

CEQ regulations (40 CFR 1508.8) distinguish between direct and indirect effects. Direct effects are caused by the action and occur at the same time and place as the action. Indirect effects (also referred to as secondary impacts) are reasonably foreseeable effects caused by the action that occur later in time or at a greater distance. For example, clearing a 1-acre lot would have a direct effect on the area being cleared such as loss of vegetation or any other resource on the site. Indirect effects could also occur, such as downstream sedimentation due to erosion once the site was cleared.

The analysis included potential impacts resulting from other activities not related to the NBAF that, in combination with potential impacts from the Proposed Action, could cumulatively impact areas of concern. Cumulative impacts are impacts in the environment that result from the incremental impact of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency (federal or non-federal) or person that undertakes such other actions (40 CFR 1508.7). For this EIS, the existing conditions at each site alternative as described in the affected environment sections, reflect the cumulative effects of past actions, the potential effects of the Proposed Action, and other effects of non-NBAF actions. Potential cumulative impacts of facility operations were evaluated using the sliding-scale approach, previously described. After reviewing known future actions at each site alternative, the cumulative effects on the following resources required further analysis: air quality, water resources, wastewater treatment capacity, and traffic. Cumulative impacts relative to these resources, along with reasonably foreseeable future actions, are discussed for each site alternative in the appropriate subsections of this chapter.

When details about a component of a site alternative were incomplete or unknown, a determination was made as to whether the detail is critical and would influence the effects analysis; if not, then no further action was deemed necessary. However, if the incomplete or unknown details could influence the effects analysis, then a bounding analysis approach was used. The incidents analysis in this EIS, which includes both accidents and deliberate acts, uses a bounding analysis approach. A bounding analysis entails the use of reasonable maximum assumptions, such as potential effects to livestock from air emissions because of an accidental or deliberate release of biohazardous materials. When information needed to conduct a bounding analysis was not available or there was uncertainty in the analysis, that fact was acknowledged. CEQ regulations (40 CFR 1502.22 [51 FR 15625, Apr. 25, 1986]) state that when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and information is incomplete or unavailable, the agency shall always make clear that such information is lacking and:

(a) If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, then the agency shall include the information in the EIS.

(b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the EIS:

1. A statement that such information is incomplete or unavailable;
2. A statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;
3. A summary of existing credible scientific evidence that is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and
4. The agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

For the purposes of the analysis in this EIS, “reasonably foreseeable” includes impacts that could have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence

3.1.1 Environmental Justice

An environmental justice assessment was conducted to determine potential disproportionately high and adverse affects to minority or low-income populations. This assesement is consistent with Executive Order 12898, which was issued on February 11, 1994 by the President of the United States and called for federal actions to address environmental justice in minority and low-income populations.

The environmental justice assessment recognizes the issues addressed in the Environmental Justice Guidance under NEPA (CEQ 1997), and uses the EPA Guidance for Incorporating Environmental Justice Concerns in EPA’s NEPA Compliance Analyses (EPA 1998) as a guide.

An environmental justice assessment requires an analysis of whether minority and low-income populations (i.e., “the populations of concern”) would be affected by a proposed federal action and whether they would experience disproportionate adverse consequences from the proposed action at any of the site alternatives. If there are adverse impacts, the severity and proportionality of these impacts on populations of concern must be assessed in comparison to the larger non-minority or non-low-income populations. At issue is whether such adverse impacts fall disproportionately on minority and/or low-income members of the community and, if so, whether they meet the threshold of “disproportionately high and adverse.” If disproportionately high and adverse effects are evident, then the EPA guidance advises that it should trigger consideration of alternatives and mitigation actions in coordination with extensive community outreach efforts (EPA 1998).

The environmental justice assessment focused on the potential for disproportionately high and adverse impacts to minority and low-income populations, “populations of concern,” during the construction and normal operation of the proposed NBAF. The assessment identified “populations of concern” within the region of influence for all of the site alternatives. The environmental resources discussed throughout the

NBAF EIS were reviewed to determine whether an attempt has been made to avoid, minimize, or mitigate potential disproportionately high and adverse impacts to "populations of concern." Efforts to provide appropriate mitigation to address adverse effects and increase benefits to such populations were assessed and documented (Section 3.10; Table 2.5.1-2). The assessment concluded that no disproportionately high adverse effects to minority or low-income populations were evident at any of the site alternatives

3.1.2 Construction

As described in Section 2.1.1, the NBAF would be located on a site of no less than 30 acres. The site would include the NBAF, a current good manufacturing practice (cGMP) laboratory, a central receiving facility, a guard house, and a central utility plant (CUP). Section 2.1.1 also describes the need for utility and road improvements that were identified during development of the Site Characterization Study (NDP 2008a). Since construction of the proposed NBAF is the sole reason for these improvements, their effects in the environment are included in this evaluation as connected actions. Table 3.1.2-1 provides a list of needed infrastructure to be constructed and road improvements for each site alternative for the proposed NBAF.

Construction activities would include site clearing, excavation, grading, and permanent loss of resources due to these actions. The evaluation of construction impacts includes the temporary effects that would occur during the 4-yr construction period. These effects may include construction traffic, potential erosion and runoff from the construction site, fugitive dust and emissions from vehicles and construction equipment, waste generated and disposed of during construction, economic benefit of construction jobs and expenditures, and power and water needs for construction.

3.1.3 Operations

Operation of the NBAF is described in Section 2.1.2, Operation of the proposed NBAF. Operational activities for the proposed NBAF include utility use (electricity, water, natural gas, and fuel oil); waste management and disposal (solid, sanitary, hazardous, pathologic, and radioactive wastes); employee traffic; operation of boilers, emergency generators, and incinerators; research and development; and storm water management. These activities could have diverse effects on environmental and human resources during both normal operating conditions and non-normal situations. Section 3.14, Health and Safety, provides a description of potential effects from operation of the NBAF under non-normal situations.

Table 3.1.2-1 — Infrastructure and Traffic Improvements Required for Construction and Operation of the Proposed NBAF

	South Milledge Avenue Site	Manhattan Campus Site	Flora Industrial Park Site	Plum Island Site	Umstead Research Park Site	Texas Research Park Site
Potable Water	1.3 miles of two new 12" lines buried along South Milledge Ave in existing right-of-ways to intersection of Riverbend Road	None	None	New groundwater wells and two new 200,000 gallon water towers would be required	5,000 feet of new buried 8" water line from Old Route 75 north along the ditch adjacent to Dillon Drive to NBAF site	None
Electricity	<3.0 miles of new line from each of two existing substations to NBAF site within existing right-of-ways	1 mile of new line from second existing substation to NBAF site within existing right-of-ways	A new substation would be required to meet need for redundancy specifications	Two new cables from LIPA on Long Island at Point Orient or from CL&P in Connecticut to Plum Island from independent substations	6 miles of new line from substations in Butner to NBAF site within existing right-of-ways,	<0.5 mile of new line from each of the two existing substations to NBAF site within existing right-of-ways adjacent to Lambda Drive
Natural Gas	2,900 feet of new 4" high-pressure gas line in existing right-of-way along South Milledge Ave.	None	A new 11 mile, 6” pipeline would be required	None	4,475 feet of new buried 6" natural gas line from Old Route 75north along the ditch adjacent to Dillon Drive to NBAF site	2,550 feet of 6” gas line would be required
Sanitary Sewer	<5,286 feet of new 12” sewer line along South Milledge Ave. to WWTP inlet piping	None	1,600 feet of new sewer line	1,000 feet of new sewer line from NBAF to modified WWTP or new WWTP	6,500 feet of new sanitary sewage line from the NBAF site to a 36" gravity trunk wastewater main located south of Old Route 75 north along the ditch adjacent to Dillon Drive	None
Roadways	None	None	Left turn lane (south-bound Hwy. 49) and acceleration/ deceleration lanes at NBAF entrance	None	4,100 feet of entrance road to connect site to Range Road (SR 1121), acceleration/ deceleration lanes on Range Road at NBAF entrance	Emergency exit off of Lambda Drive

3.2 LAND USE AND VISUAL RESOURCES

3.2.1 Methodology

3.2.1.1 Land Use

Several sources were consulted to determine land uses at the six site alternatives. These include the National Land Cover Database (NLCD), local land use maps, technical reports, aerial photography, and site visits. Local zoning ordinances and regulations were also reviewed. Potential changes in land use were identified for each site alternative. Effects were identified based on changes in land use and determinations of compatibility among land uses reasonably anticipated to occur as a result of the proposed action and adjacent land uses. In addition, compatibility with management plans, policies, and practices was discussed.

3.2.1.2 Visual Resources

The methodology used to assess visual resources and impacts generally conforms to the Visual Management System (VMS) developed by the U.S. Forest Service. Service (Bacon 1979). Topography, vegetation (size and shape), and developed land uses were considered in the assessment, along with the visibility of changes from sensitive viewpoints.

Visual quality is described as the visual patterns created by the combination of rural character landscapes and industrial and man-made features. There are three criteria for evaluating visual quality: vividness; integrity; and unity. Vividness can be defined as the visual power or memorability of landscape components as they combine in distinctive visual patterns. Integrity is the visual collection of the natural and man-made landscape and its freedom from encroaching elements. Visual unity can be described as the degree of visual coherence and compositional harmony of the landscape considered as a whole. Levels of visual impact were documented as low, moderate, or high.

Visual quality was evaluated using the following descriptions:

- Urban/Industrial – The landscape is common to urban areas and urban/industrial fringes. Human elements are prevalent or landscape modifications exist, which do not compatibly blend with the natural surroundings (low visual intactness and unity).
- Rural – The landscape exhibits reasonably attractive natural and human-made features/patterns, although they are not visually distinctive or unusual within the region. The landscape integrity of the area provides some positive visual experiences such as the presence of natural open space dispersed with existing agricultural areas (farm fields, etc.) or well-maintained, landscaped urban areas.
- Unique/Distinctive – The landscape exhibits distinctive and memorable visual features (landform, rock outcrops, etc.) and patterns (vegetation/open space) that are largely undisturbed—usually in a rural or open space setting. Few, if any, man-made developments are present.

Viewer sensitivity is dependent on viewer types, exposure (number of viewers and viewer frequency), viewer orientation, view duration, and viewer awareness to visual changes. Levels of viewer sensitivity were evaluated using the following criteria:

- Low – Viewer types deemed to have low visual sensitivity include mainly indoor workers. Compared with other viewer types, the number of viewers is generally considered small and the duration of view is short. Viewer activities typically limit awareness/sensitivity to the visual setting immediately outside the workplace. Landscaping or adjacent buildings are seen by screen views.
- Moderate – Viewer types deemed to have moderate visual sensitivity include highway and local travelers. The number of viewers varies depending on location but tends to be relatively large based on overall densities of surrounding areas and the resulting volume of highway commuters. Viewer

awareness/sensitivity is also considered moderate because destination travelers often have a focused orientation.

High – Residential and recreational viewers, as well as viewers congregating in public gathering places (churches, schools, etc.), are considered to have comparatively high visual sensitivity. The visual setting may in part contribute to specific building orientation or the enjoyment of the experience. Views may be of long duration and frequency. In some cases, views may contribute to property value.

3.2.2 No Action Alternative

3.2.2.1 Affected Environment

3.2.2.1.1 Land Use

Under the No Action Alternative, the NBAF would not be constructed and the existing Plum Island Animal Disease Center (PIADC), located on Plum Island, would continue operation. Plum Island, approximately 840 acres in size, is located 12 miles southwest of New London, Connecticut, and 1.5 miles off the northeast tip of Long Island, New York (i.e., Orient Point). Plum Gut separates Plum Island and Orient Point. The island is self-contained and has its own potable well water, water treatment plant, wastewater treatment facility, emergency power generators, fuel storage areas, and electrical substation. These facilities all support PIADC, the only facility on the island. Access to the island is provided by government ferries but only for the government employees, contractors, and approved visitors. Government-operated ferry services run between Orient Point, New York, and Old Saybrook, Connecticut. The Cross Sound Ferry runs between New London, Connecticut, and Plum Island, New York (Telemus 2007).

Plum Island is part of Suffolk County, New York, which occupies the easternmost portion of Long Island in the southeastern portion of New York State. The county is surrounded by water on three sides, including the Atlantic Ocean and Long Island Sound. Suffolk County is divided into 10 towns, one of which is Southold. Since June 2003, DHS has assumed the administration of Plum Island and is responsible for its security.

Land use controls for the site include the Federal Government General Services Administration regulations for federally owned property and New York and U.S. regulations regarding environmental issues. Because Plum Island is owned by the federal government, it is not zoned by Suffolk County or the Town of Southold (Telemus 2007).

Land cover on the island is shown in Figure 3.2.2.1.1-1 and consists of

- Deciduous forest (35%)
- Barren land (17%)
- Grassland (15%)
- Herbaceous wetlands (14%)
- Woody wetlands (12%)
- Scrub land (5%)
- Open water (2%) (USGS 2001)

3.2.2.1.2 Visual Resources

Overall, visual quality of the the Plum Island landscape is classified as rural in character. The topography is slightly hilly, generally sloping to the south-southwest. The landscape integrity is high; because the site is isolated, the landscape is free from encroaching elements. The island itself is a notable visual feature of Long Island Sound.

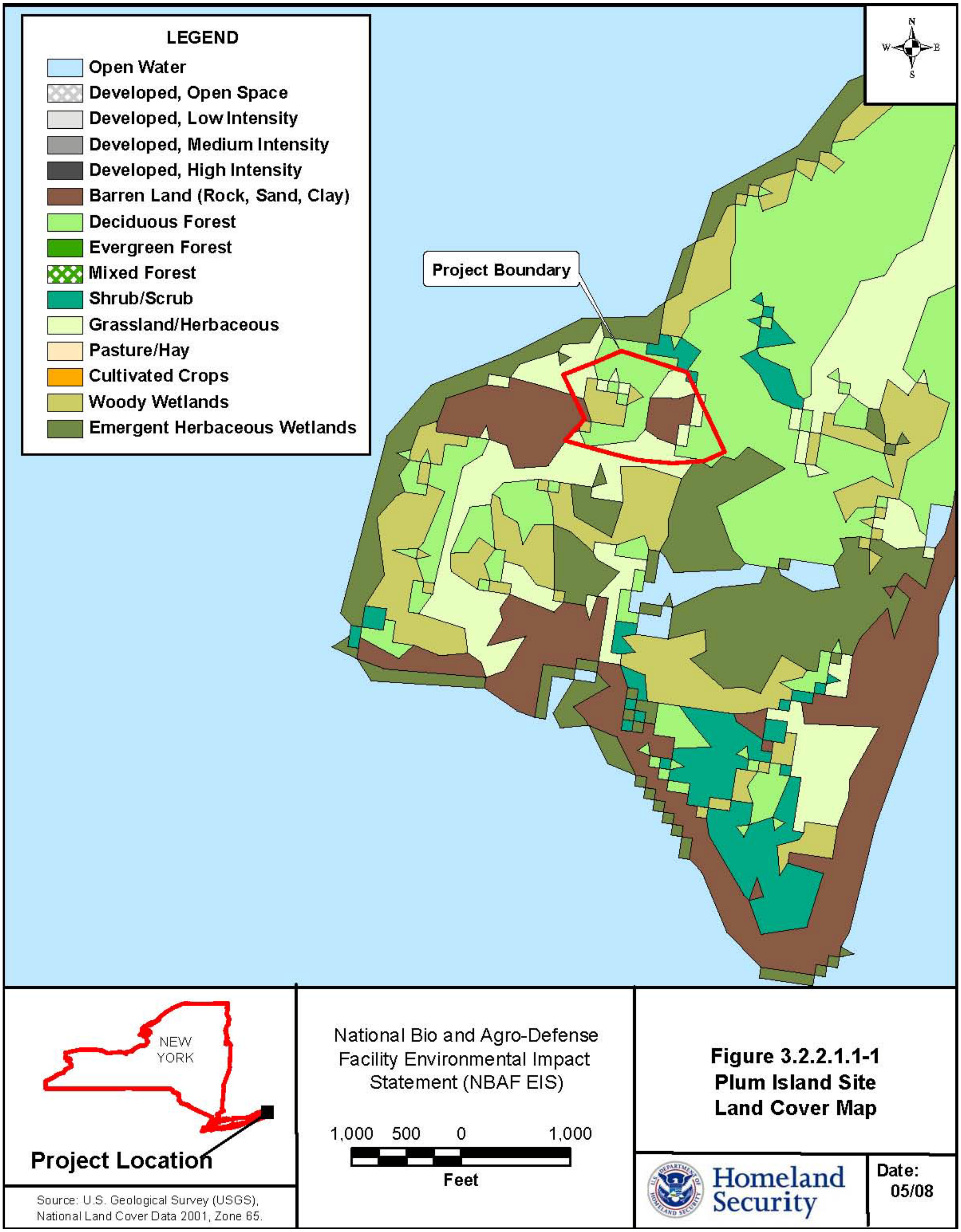

Figure 3.2.2.1.1-1 — Plum Island Existing Land Cover Map

There are few sensitive viewers to Plum Island or PIADC. The only on-site viewers are the employees of PIADC and occasional visitors. The structures that comprise PIADC are primarily visible by marine travelers, including ferry passengers and recreational boaters. Motorists, pedestrians, and residents at Orient Point, at least 1.5 miles away, also have views of Plum Island, but at this distance, PIADC is indistinct.

3.2.2.2 Construction/Operation Consequences

Neither land use nor visual resources would be affected under the No Action Alternative. The existing conditions would remain the same.

3.2.3 South Milledge Avenue Site

3.2.3.1 Affected Environment

3.2.3.1.1 Land Use

The proposed NBAF would be located on the 67-acre South Milledge Avenue Site west of the South Milledge Avenue/Whitehall Road intersection in Clarke County, Georgia. The site is part of the University of Georgia Whitehall Farm and is located near the University of Georgia Livestock Instructional Arena. It is currently undeveloped pastureland utilized by the University of Georgia Equestrian Team (Geo-Hydro Engineers 2007). Land cover types at the site are shown in Figure 3.2.3.1.1-1 and include the following:

- Pasture (72%)
- Deciduous forest (26%)
- Grassland (2%)

The South Milledge Avenue Site is surrounded by mixed density residential and single family residential land uses to the south and governmental/single family residential to the north. The site is in close proximity to a commercial/rural strip of land use to the northeast. The eastern side of the property borders governmentally designated land uses with an outer band of single family residential land uses. The proposed South Milledge Avenue Site is zoned government use. Land use controls for Clarke County include the Clarke County Zoning Ordinance and the Athens-Clarke County Comprehensive Plan of 2001 (ACC 2005). The Athens-Clarke County Comprehensive Plan establishes land planning objectives, goals, and implementation plans. The main objective for developed areas is to focus on the stabilization and revitalization of residential, commercial, and industrial areas. The South Milledge Avenue Site is designated as rural in the Comprehensive Plan. The South Milledge Avenue Site Alternative is less than half a mile from the Oconee County border. Land along the Oconee/Clarke County border is currently rural and agricultural land slated for continuing rural residential use.

3.2.3.1.2 Visual Resources

The South Milledge Avenue Site is in a portion of Clarke County that has been primarily agricultural, light industrial, and government owned over the last 98 years (Geo-Hydro Engineers 2007). Overall, visual quality of the regional landscape is classified as rural in character. The natural and agricultural landscape features and patterns are typical within the region. The topography of the site is rolling terrain, with much of the site on a hilltop. Visual sensitivity is low because the site is located in a predominantly rural environment, with few individuals observing the site on a regular basis. However, limited vegetation screening exists and topography at the site causes high visibility to viewers and travelers.

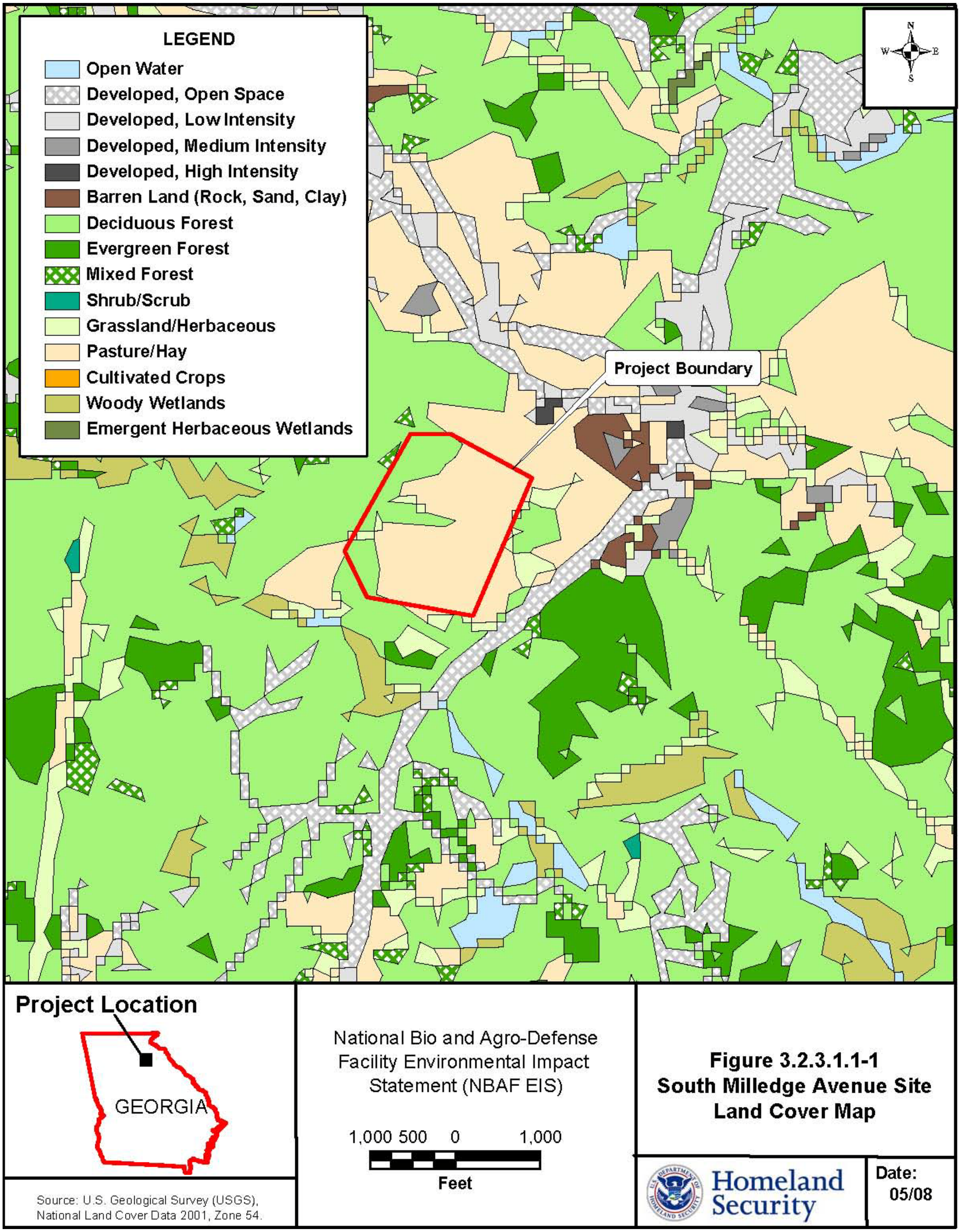

Figure 3.2.3.1.1-1 — South Milledge Avenue Site Land Cover Map

Sensitive visual receptors in the vicinity of the South Milledge Avenue Site include patrons and employees of the University of Georgia State Botanical Gardens, located approximately 0.5 miles northwest of the proposed NBAF site, and the University of Georgia School of Forestry, within 0.5 miles east of the site (Figure 3.2.3.1.2-1). Schools near the site include Timothy Road Elementary, located approximately 3 miles east of the site, and the Seventh Day Adventist School, approximately 2 miles from the site (ACC 2007a). There are no sensitive residential receptors near the proposed site.

3.2.3.2 Construction Consequences

3.2.3.2.1 Land Use

Approximately 30 acres of the 67-acre proposed NBAF site would be disturbed during construction and would be an irretrievable and irreversable use of land. Additional acreage would be affected for temporary construction areas. The size of the construction laydown area has not been determined at this time. Land use would change as a result of NBAF construction. The existing pasture, grassland, and forested land would be used as a construction site with the associated typical construction activities. The effects would be temporary and last the duration of the 4-yr construction period.

3.2.3.2.2 Visual Resources

Construction activities would disturb approximately 30 acres, plus additional acreage for temporary construction areas. During construction of the NBAF at the South Milledge Avenue Site, viewers would observe site grading and related construction activities, which would include the stripping of grass and removal of trees and other vegetation. There would be heavy equipment vehicles conducting earthwork activities on the NBAF site during the 4-yr construction period, as well as light- and medium-weight vehicles going to and from the site. Deliveries of soil, backfill, and building materials would be expected on a daily basis. Fencing and screening of the construction site would curtail sight visibility.

In general, visual impacts to the overall landscape setting resulting from construction of the NBAF would be moderate. Viewers would observe earthwork equipment, construction trailers, building construction, and cranes. A temporary security fence to prevent trespassing and control traffic entering and leaving the NBAF site would also serve to provide some visual screening of the construction area.

3.2.3.3 Operation Consequences

3.2.3.3.1 Land Use

The operation of the proposed NBAF would be consistent with the current land use patterns and the government zoning designation. There would not be an alteration of current the zoning designation as a result of operation of the proposed NBAF, although a change in land use would occur from existing pasture to a developed, government research facility. If the South Milledge Avenue Site is selected, it would require an amendment to the Clarke County Comprehensive Plan, since the current land use designation for the site is rural. The NBAF would not affect other governmental uses near the South Milledge Avenue Site, such as the University of Georgia Livestock Arena, School of Forestry, or the Botanical Gardens. Operation of the proposed NBAF would not affect Clark County's ability to regulate growth and development according to its comprehensive plan. Overall, land use effects due to operation of the NBAF would be minor.

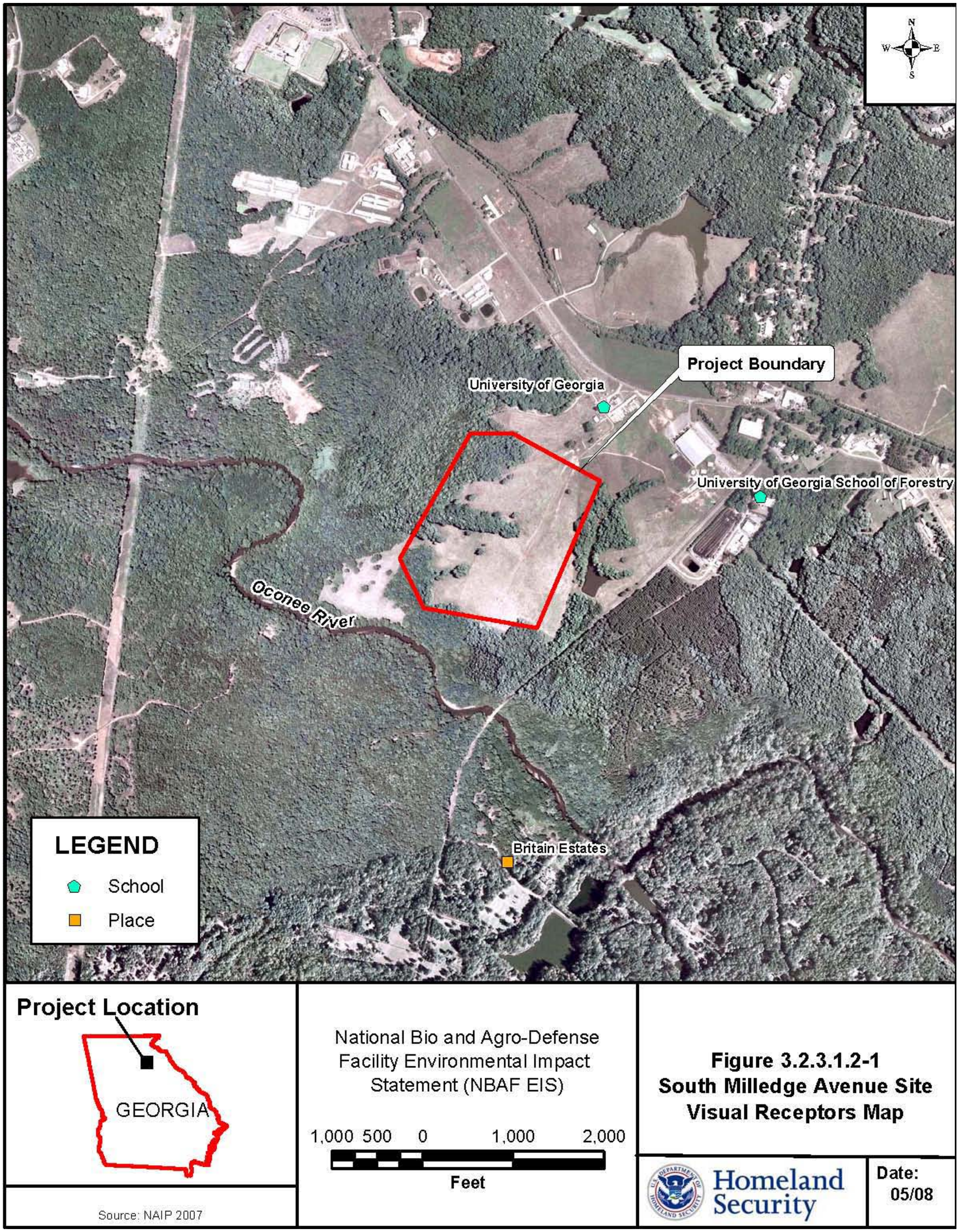

Figure 3.2.3.1.2-1 — South Milledge Avenue Site Visual Receptors Map

3.2.3.3.2 Visual Resources

Visual impacts from the proposed NBAF would be moderate. The main building would be prominent in the viewshed due to its position on a hilltop. It would be similar in size to a 400-bed hospital or a 1,600 student high school. Although portions of the main building would be underground, the heights of project components have not been finalized at this time but could be up to 90 feet high (NDP 2007a). Other ancillary elements that would likely be visible include fuel and liquid storage tanks, an electrical switchyard, emergency power generators, and power lines (NDP 2007a). If incinerators are included in the final design, stacks would likely be visible, as well. A proposed upgrade to the municipal potable water system includes the installation of a dedicated, on-site 200,000 gallon elevated water tank at the South Milledge Avenue Site that would be a prominent visible feature. The entire facility would be surrounded by a security fence, which itself would be a highly visible element.

Additional visual impacts would occur from lighting during the nighttime. The main facility, all support buildings, and the parking lot would be well-lit. Lighting is also proposed at regular intervals along the security fence. Use of shielded fixtures and the minimum intensity of lighting that are necessary to provide adequate security could mitigate the effects.

The proposed NBAF would be visible to travelers on South Milledge Avenue and East Whitehall Road. Due to the facility's topographical prominence on the landscape, visual effects would be sustained. It would also be visible from other viewpoints such as the Botanic Gardens and nearby University of Georgia facilities.

The visual impact could be partially ameliorated by limited vegetative screening and setbacks. Landscaping is planned around buildings and adjacent to parking areas. However, vegetative screening would not be used along the fence for security purposes. Additional design features that could help ameliorate visual impacts include the following:

- Some existing native trees could be maintained around the perimeter of the site to serve as landscape buffers and to increase NBAF's visual compatibility with the surrounding area.
- Trees could be planted to help screen the view of the site. These plantings could include fast-growing trees to expedite the development of a mature vegetative screen.

3.2.4 Manhattan Campus Site

3.2.4.1 Affected Environment

3.2.4.1.1 Land Use

The proposed NBAF would be located on a 48.4-acre parcel of land on the north end of the Kansas State University (KSU) in Manhattan, Riley County, and entirely surrounded by KSU property. The proposed NBAF site would be deeded to DHS if the site is selected for construction. Kansas legislature has passed a bill authorizing the transfer.

The proposed NBAF would be located in a governmentally zoned area (zoning designation "U" for University) characterized by research and development land and facilities. Currently, the proposed Manhattan Campus Site consists of two dog and horse research buildings, a residential structure used as student housing, the Biosecurity Research Institute (BRI), a flea/dog food research laboratory, and a building used for storing recycling materials and maintenance supplies (Terracon 2007c). The BRI is a biosafety level (BSL)-3 facility. Some open space is also present. The site is surrounded by a paved road and pond to the north and residential development to the east. Parking lots and large university buildings border the south, and two large buildings and baseball fields border the west (Terracon 2007c).

Land use controls for the site include the City of Manhattan Zoning Ordinance and the Manhattan Urban Area Comprehensive Plan. According to the Growth Vision of the Comprehensive Plan, the Manhattan Urbanized Area is "economically vital community which provides employment and income opportunities to its residents and financial support for quality of life programs; a caring community which offers its residents equal opportunities to seek a higher quality of life; and a community which recognizes the importance of conserving and enhancing its natural environment" (MUACP 2003).

Current land cover at the Manhattan Campus Site and surrounding area is in Figure 3.2.4.1.1-1.

3.2.4.1.2 Visual Resources

At the Manhattan Campus Site, institutional and research development structures intermixed with recreational and student housing buildings mostly determine the human-made visual character in the immediate area. The site is adjacent to the BRI, a BSL-3 facility. It also borders the research laboratories and teaching hospital of the KSU College of Veterinary Medicine.

Overall, visual quality of the landscape is classified as urban/industrial. The landscape is common to urban areas and urban/industrial fringes. Human elements are prevalent. Limited vegetation screening exists around the industrial development.

KSU athletic fields are located immediately west of the site, with the KSU football stadium west of the fields, within sight of the proposed NBAF site. Some residential development is located east of the site, also within view of the proposed NBAF site. Hospitals, schools, recreation areas, and various institutions are within 1 mile of the site, but due to the urban setting many of these potentially sensitive visual receptors are not within direct sight of the proposed NBAF site. Figure 3.2.4.1.2-1 shows the receptors surrounding the proposed NBAF site.

3.2.4.2 Construction Consequences

3.2.4.2.1 Land Use

Construction of the NBAF at the Manhattan Campus Site would result in a disturbance of approximately 30 acres during construction and would be an irretrievable and irreversable use of land. Additional acreage would be affected for temporary construction areas. The construction laydown area has not been determined at this time, and preliminary indications suggest that the area may extend beyond the 30-acre proposed construction site but not outside of the 48.4-acre site. Minor land use change would occur as a result of NBAF construction. Some of the existing open areas would be used as a construction site with the associated typical construction activities. The effects would be temporary and last the duration of the 4-yr construction period.

3.2.4.2.2 Visual Resources

In general, visual impacts to the overall landscape resulting from construction of the NBAF would be moderate. Viewers would observe site grading and related construction activities and equipment, which would include the stripping of grass and removal of trees and other vegetation. There would be heavy equipment vehicles conducting earthwork activities on the NBAF site during the 4-yr construction period, as well as light- and medium-weight vehicles going to and from the site. Deliveries of soil, backfill, and building materials would be expected on a daily basis. Fencing and screening of the construction site would curtail sight visibility. There were no sensitive visual receptors within 0.75 miles of the Manhattan Campus Site (Figure 3.2.4.1.2-1).

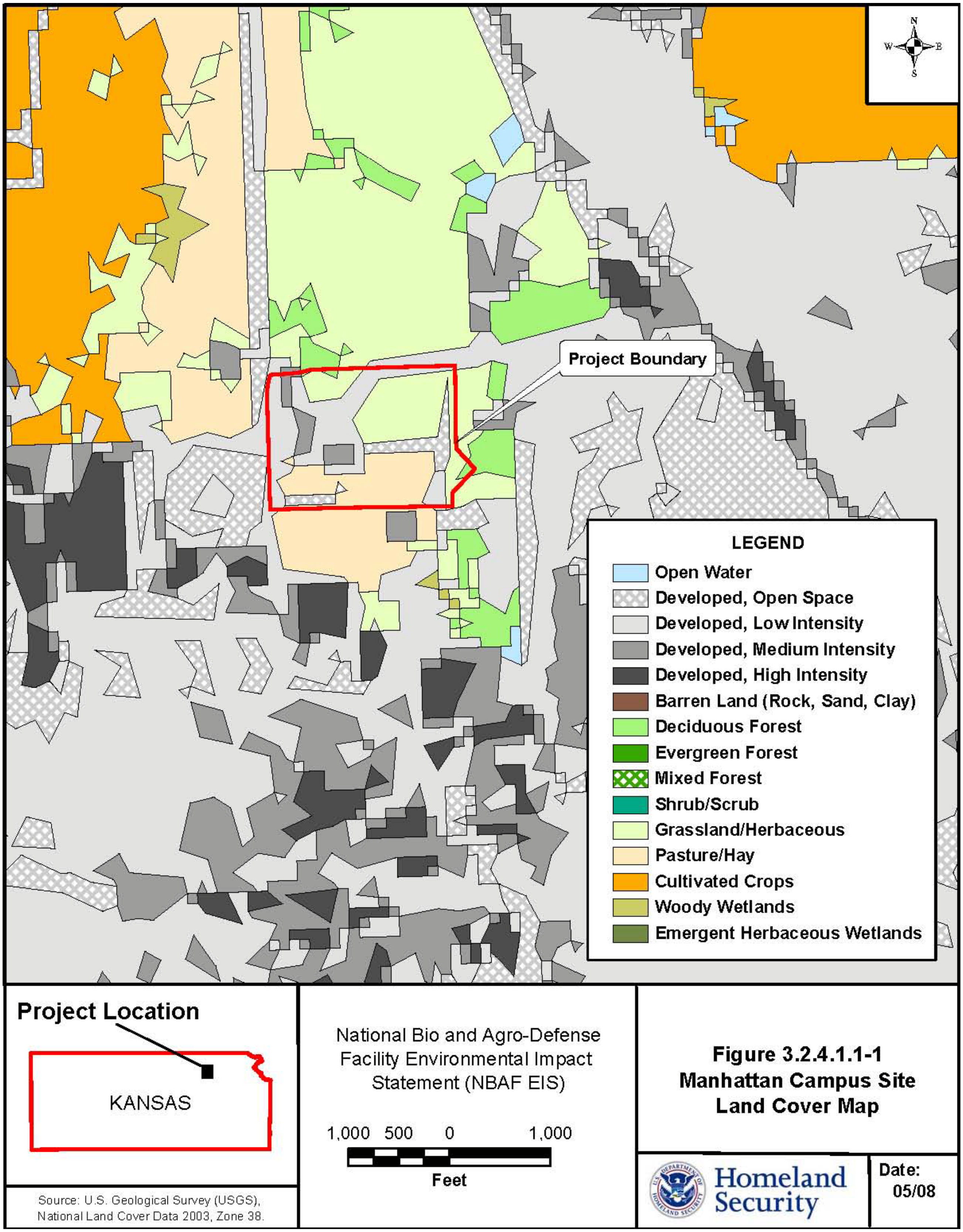

Figure 3.2.4.1.1-1 — Manhattan Campus Site Land Cover Map

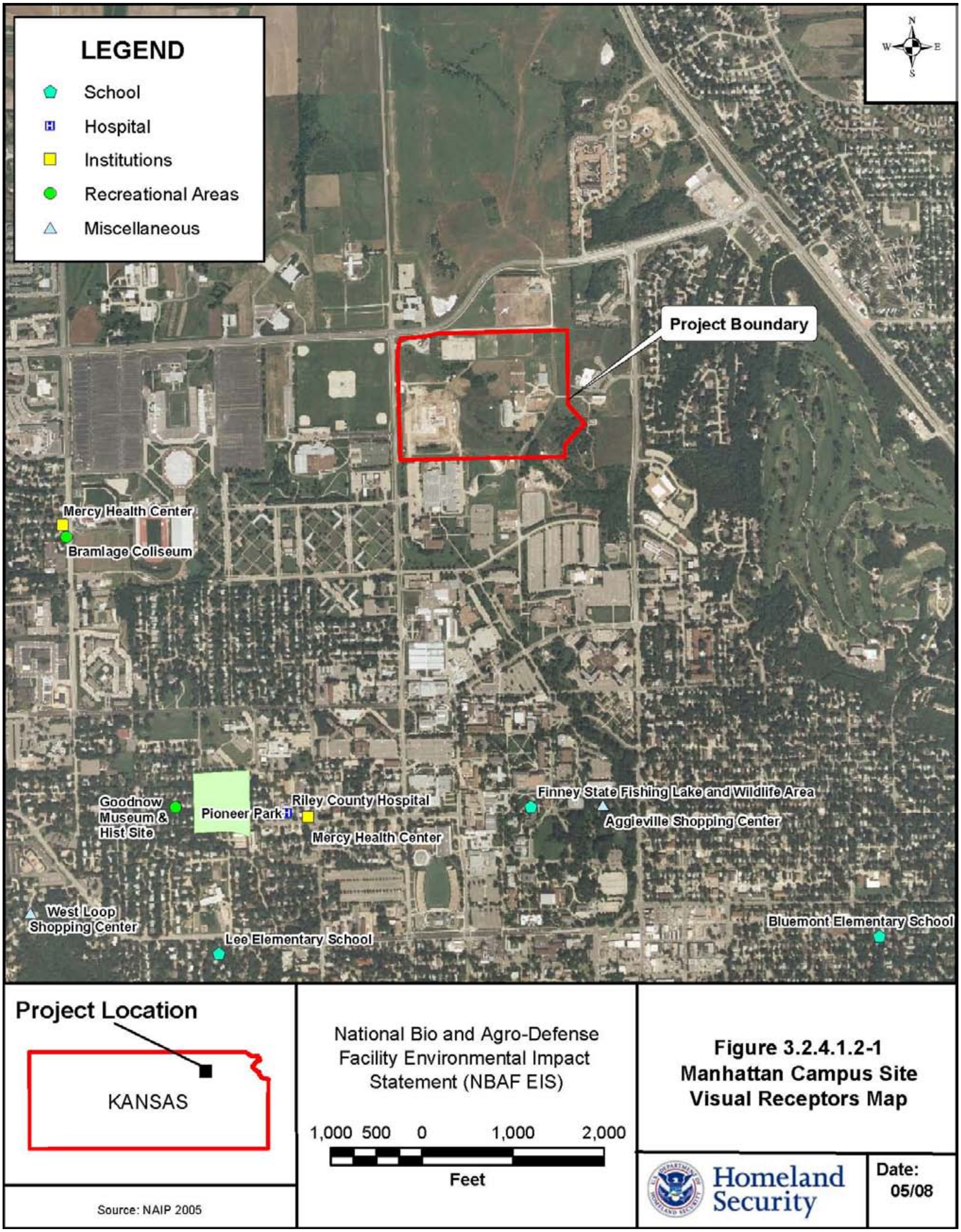

Figure 3.2.4.1.2-1 — Manhattan Campus Site Visual Receptors Map

3.2.4.3 Operation Consequences

3.2.4.3.1 Land Use

The operation of the proposed NBAF at the Manhattan Campus Site would be consistent with the current land use patterns on the KSU campus and within the immediate vicinity of the City of Manhattan. There would be minimal alteration of current land use patterns resulting from the proposed NBAF. The zoning designation of "U" for University on the City of Manhattan Zoning Map and the City of Manhattan Comprehensive Plan Existing Land Use Map would remain the same. Overall, land use impacts due to operation of the NBAF would be minor.

3.2.4.3.2 Visual Resources

Visual impacts from the proposed NBAF would be moderate. Because of its urban setting on the KSU campus with similar buildings nearby, it would not be visually distinctive. It would be similar in size to a 400-bed hospital or a 1,600 student high school, which is consistent with the campus setting. Although portions of the main building would be underground, the heights of project components have not been finalized at this time and could be up to 90 feet high (NDP 2007a). Other ancillary elements that would likely be visible include fuel and liquid storage tanks, an electrical switchyard, emergency power generators, and power lines (NDP 2007a). If incinerators are included in the final design, stacks would likely be visible, as well. The entire facility would be surrounded by a security fence, which itself would be a highly visible element.

Moderate visual impacts would also occur from lighting during the nighttime. The main facility, all support buildings, and the parking lot would be well-lit. Lighting is also proposed at regular intervals along the security fence. Use of shielded fixtures and the minimum intensity of lighting that are necessary to provide adequate security could mitigate the effects.

Residences on campus adjacent to the site and east of the campus would be considered sensitive viewers. The existing BRI located directly south of the site and other campus structures would provide some degree of visual screening, but the scale of the facility and elevated viewpoints would make the facility a visually dominant component of their view. Travelers on Denison Avenue and Kimball Avenue would also have views of the NBAF.

The visual impact could be partially ameliorated by limited vegetative screening and setbacks. Landscaping is planned around buildings and adjacent to parking areas. However, vegetative screening could not be used along the fence for security purposes. Additional design features that could help ameliorate visual impacts include the following:

- Some existing native trees could be maintained around the perimeter of the site to serve as landscape buffers and to increase NBAF's visual compatibility with the surrounding area.
- Trees could be planted to help screen the view of the site. These plantings could include fast-growing trees to expedite the development of a mature vegetative screen.

3.2.5 Flora Industrial Park Site

3.2.5.1 Affected Environment

3.2.5.1.1 Land Use

The Flora Industrial Park Site is a 150-acre parcel within the Town of Flora in Madison County. The Madison County Economic Development Agency (MCEDA) maintains the park. The parcel would be deeded to DHS if the site is selected for construction. Another tenant in the Flora Industrial Park include the Primos Manufacturing Company.

The proposed NBAF site is zoned limited industrial (I-1), which is characterized by light manufacturing, commercial facilities, and processing plants. The site consists of idle pasture at an elevation of 240 feet with two small ponds and a few scattered wooded areas. It is surrounded by rural residential, low/medium-density residential, commercial, and agricultural uses to the north, east, and west with intense commercial, low-density residential, and industrial uses to the south. Land use controls for the site include the Town of Flora Zoning Ordinance, Town of Flora Comprehensive Plan, and the Restrictive Covenants for Flora Industrial Park.

Land cover at the Flora Industrial Park Site and surrounding area is shown in Figure 3.2.5.1.1-1. Land cover classes include the following:

- Pasture/Hay (90%)
- Cultivated crops (7%)
- Deciduous, evergreen, or mixed forest (1.5%)
- Open water (1.5%)

3.2.5.1.2 Visual Resources

The proposed NBAF site at Flora Industrial Park currently has no physical structures. One tenant in the park, Primos Manufacturing Company (which manufactures hunting calls) borders the site to the south. The site is predominantly undeveloped gently rolling pastureland. An overhead power transmission line runs through the south-central and west-central portions of the site (Terracon 2007b).

Overall, visual quality of the regional landscape is classified as rural in character. The natural and agricultural landscape features and patterns are reasonably attractive and interesting but are not visually distinctive or unusual within the region.

To the north of the site, there are three small structures, a residential home, pastureland, a large pond, and Middle Road. The Illinois Central Gulf Railroad, Kearney Park Road, Woodman Hill Baptist Church, Balfour Cemetery, Harris Road Subdivision residential development, Town of Flora Fire Station, a series of individual residential lots, and small roads lined with several small structures lie to the east. To the south, there is predominantly open grass land, some wooded land, the Primos Manufacturing Company, and the Paradigm Manufacturing Plant. To the west, the site is adjacent to U.S. Highway 49 with predominantly open land with scattered residential homes along the highway.

Sensitive visual receptors are primarily located east of the site and include the Woodman Hill Church and scattered rural residences. Residential homes are also found north, west, and south of the site. The Tri-County Academy is located south of the site, but views of the site are somewhat obscured by trees and the Primos Manufacturing facility. Travelers along Highway 49, which runs west of the site, have unobscured views of the site. Figure 3.2.5.1.2-1 shows the visual receptors within and surrounding the Flora Industrial Park Site.

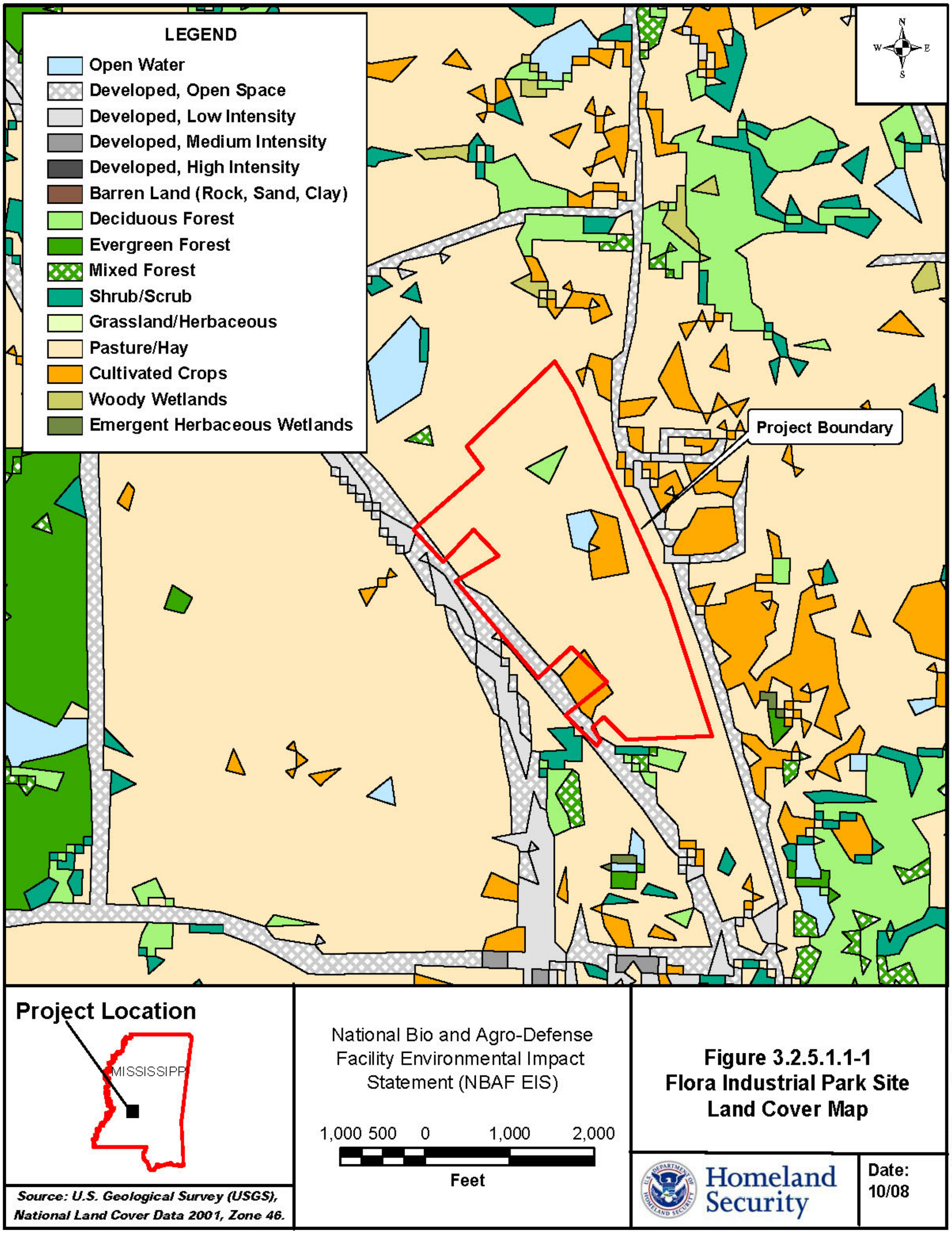

Figure 3.2.5.1.1-1 — Flora Industrial Park Land Cover Map

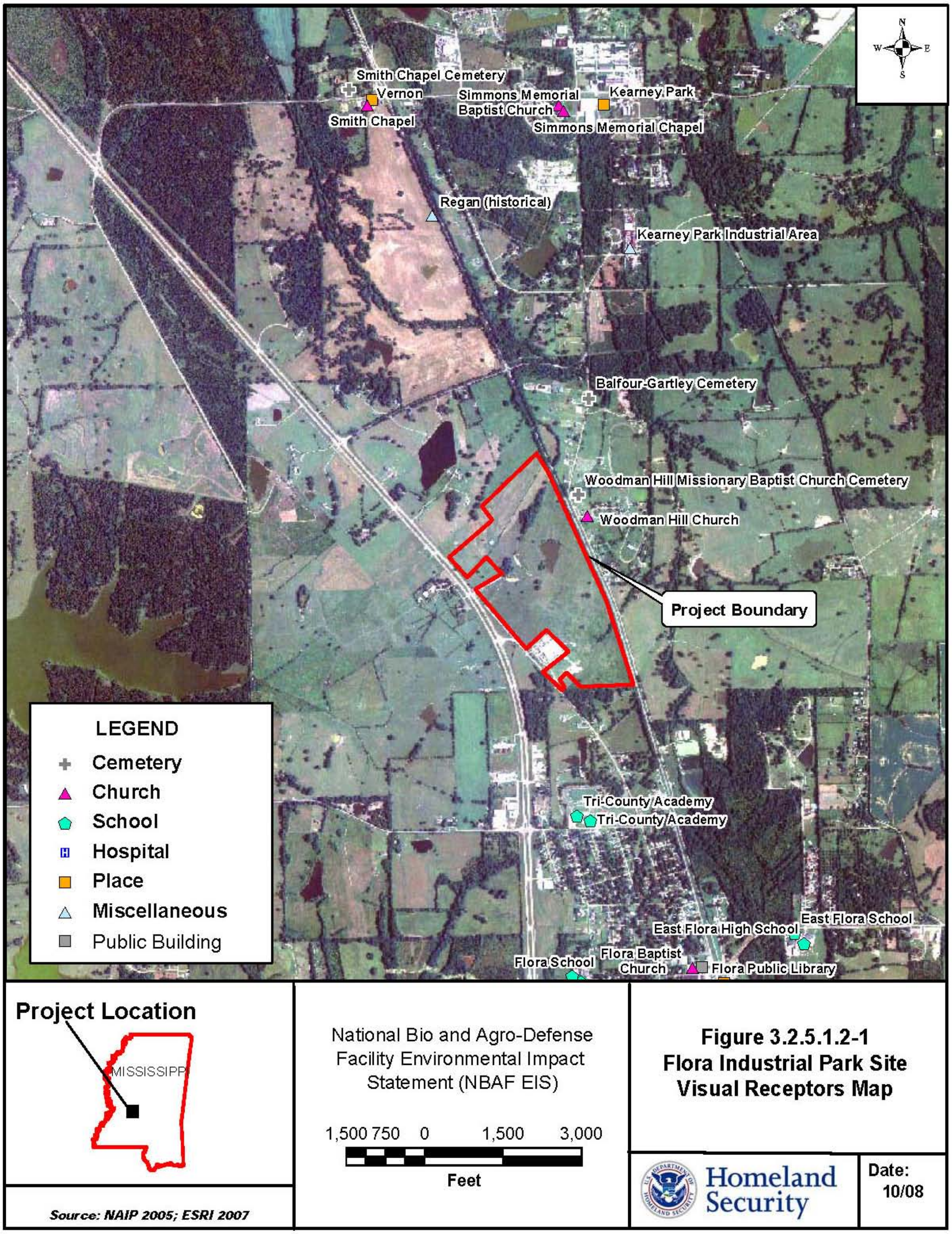

Figure 3.2.5.1.2-1 — Flora Industrial Park Visual Receptors Map

3.2.5.2 Construction Consequences

3.2.5.2.1 Land Use

Construction of the NBAF at the Flora Industrial Park Site would occur on approximately 30 acres of the 150 acre site and would result in an irretrievable and irreversible commitment of land. Additional acreage would be required for temporary construction areas. The construction laydown area has not been determined at this time, and preliminary indications suggest that the area may extend beyond the 30-acre proposed construction site but not outside the 150-acre site. Minor land use change would occur as a result of NBAF construction. Some of the existing open areas would be used as a construction site with the associated typical construction activities. The effects would be temporary and last the duration of the 4-yr construction period.

3.2.5.2.2 Visual Resources

In general, visual impacts to the overall landscape resulting from construction of the NBAF would be moderate. Viewers would observe site grading and related construction activities and equipment, which would include the stripping of grass and removal of trees and other vegetation. There would be heavy equipment vehicles conducting earthwork activities on the NBAF site during the 4-yr construction period, as well as light- and medium-weight vehicles going to and from the site. Viewers would observe earthwork equipment, construction trailers, building construction, and cranes. Deliveries of soil, backfill, and building materials would be expected on a daily basis. Fencing and screening of the construction site would curtail sight visibility.

Due to the proximity of Highway 49, travelers would view construction activity and equipment during the 4-yr construction period. Nearby locations (within 1,500 feet of the site) with potentially sensitive visual receptors that could be impacted during construction would include scattered residences, Simmons Memorial Baptist Church and Woodman Hill Church, and the Woodman Hill Missionary Baptist Church Cemetery. The Tri-County Academy and the Balfour-Gartley Cemetery are within 3,000 feet of the NBAF site.

3.2.5.3 Operation Consequences

3.2.5.3.1 Land Use

The operation of the proposed NBAF at the Flora Industrial Park Site would be consistent with the current land use patterns within the immediate vicinity of the Town of Flora and with the purposes of the industrial park. There would not be an alteration of current land use designations and planning resulting from the proposed NBAF. Overall, land use impacts due to operation of the NBAF would be minor.

3.2.5.3.2 Visual Resources

Visual impacts from the proposed NBAF would be moderate. Because of the relatively open setting, it would be visually distinctive on the landscape. It would be similar in size to a 400-bed hospital or a 1,600 student high school located in an otherwise primarily rural setting. Although portions of the main building would be underground, the heights of project components have not been finalized at this time but could be up to 90 feet high (NDP 2007a). Other ancillary elements that would likely be visible include fuel and liquid storage tanks, an electrical switchyard, emergency power generators, and power lines (NDP 2007a). If incinerators are included in the final design, stacks would likely be visible, as well. The entire facility would be surrounded by a security fence, which itself would be a highly visible element.

Visual impacts would also occur from lighting during the nighttime. The main facility, all support buildings, and the parking lot would be well-lit. Lighting is also proposed at regular intervals along the security fence. Use of shielded fixtures and the minimum intensity of lighting that are necessary to provide adequate security could mitigate the effects.

The visual impact of the NBAF on Highway 49 travelers would be ameliorated by partial screening and setbacks. Additionally, the visual effects would not be sustained for travelers. Sensitive visual receptors that would be impacted during operation include scattered residences, Simmons Memorial Baptist Church and Woodman Hill Church, and the Woodman Hill Missionary Baptist Church Cemetery, all within 1,500 feet of the proposed NBAF. The Tri-County Academy and the Balfour-Gartley Cemetery are within 3,000 feet of the NBAF site. The scale of the facility in a relatively open area would make the NBAF a visually dominant component of their view.

The visual impact could be partially ameliorated by limited vegetative screening and setbacks. Landscaping is planned around buildings and adjacent to parking areas. However, vegetative screening could not be used along the fence for security purposes and the fencing itself would provide only minimal screening. Additional design features that could help ameliorate visual impacts include the following:

- Some existing native trees could be maintained around the perimeter of the site to serve as landscape buffers and to increase NBAF's visual compatibility with the surrounding area.
- Trees could be planted to help screen the view of the site. These plantings could include fast-growing trees to expedite the development of a mature vegetative screen.

3.2.6 Plum Island Site

3.2.6.1 Affected Environment

3.2.6.1.1 Land Use

The proposed NBAF would be located on a 24-acre site located directly east of the existing PIADC, which is on the western shore of Plum Island. Land use conditions for Plum Island are described under the No Action Alternative in Section 3.2.1.1. The conditions described in that section are applicable to the affected environment for the Plum Island Site alternative.

3.2.6.1.2 Visual Resources

The visual resources of Plum Island in general are described under the No Action Alternative in Section 3.2.1.1. The conditions described in that section are applicable to the affected environment for the Plum Island Site alternative.

3.2.6.2 Construction Consequences

3.2.6.2.1 Land Use

Construction of the NBAF at the Plum Island Site would occupy the 24-acre site and would result in an irretrievable and irreversible commitment of land. Additional acreage on Long Island would be needed for temporary construction areas. Minor land use change would occur as a result of NBAF construction. Some of the existing open areas would be used as a construction site with the associated typical construction activities. The effects would be temporary and last the duration of the 4-yr construction period.

3.2.6.2.2 Visual Resources

In general, visual impacts to the overall landscape resulting from construction of the NBAF would be low. Construction-related visual impacts would occur on both Plum Island and Long Island. Viewers of the Plum Island construction site would observe site grading and related construction activities and equipment, which would include the stripping of grass and removal of trees and other vegetation. There would be heavy equipment vehicles conducting earthwork activities on the NBAF site during the 4-yr construction period. Earthwork equipment, construction trailers, building construction, and cranes would be visible. However, due to its isolation, few viewers would observe the construction activity on Plum Island. Viewers would primarily include marine travelers; some viewers on Orient Point, approximately 1.5 miles away, could observe some highly visible construction activity and equipment, such as cranes.

A temporary construction parking and material laydown area would be located at Orient Point, on the eastern tip of Long Island, accessible by State Highway 25. This site would be used to embark to Plum Island via ferry or barge transportation. Visual impacts to travelers, residents, and pedestrians would be low for this area because of the infrequency of visitors to this area and because of the fencing and screening used at the laydown area. These effects would last for the entire duration of the construction period.

3.2.6.3 Operation Consequences

3.2.6.3.1 Land Use

The operation of the proposed NBAF at the Plum Island Site would be consistent with the current land use patterns on Plum Island. State and federal regulations would apply. However, as this is federal property, local zoning designations do not apply to the site. There would be a change of the existing land use; the site would change from existing open space to an institutional-type use. Overall, land use impacts due to operation of the NBAF would be minor.

3.2.6.3.2 Visual Resources

Visual impacts from the proposed NBAF at the Plum Island Site would be moderate because of its isolation and the low number of viewers that would observe it. Other than the workers at the site and viewers on passing marine transportation, the nearest populations that would view the NBAF are located at Orient Point, approximately 1.5 miles away. At that distance, the NBAF would be relatively indistinct. The height of the project components have not been finalized at this time but could be up to 90 feet high even though portions of the main building would be underground. The taller the building is, the more likely it is to be seen from a distance. Other ancillary elements that could be visible include fuel and liquid storage tanks, an electrical switchyard, emergency power generators, and power lines (NDP 2007a). If incinerators are included in the final design, stacks would likely be visible, as well. The entire facility would be surrounded by a security fence.

Visual impacts would also occur from lighting during the nighttime. The main facility, all support buildings, and the parking lot would be well-lit. Lighting is also proposed at regular intervals along the security fence. The lights would be observed by passing marine travelers and would likely be seen from Orient Point.

Visual impact could be partially ameliorated by limited vegetative screening and setbacks. Landscaping is planned around buildings and adjacent to parking areas, including the planting of some mature trees. However, vegetative screening would not be used along the fence for security purposes. Additional design features that could help ameliorate visual impacts include the following:

- Some existing native trees could be maintained around the perimeter of the site to serve as landscape buffers and to increase NBAF’s visual compatibility with the surrounding area.
- Large native specimen trees could be planted to help screen the view of the site. These plantings could include fast-growing trees to expedite the development of a mature vegetative screen.

3.2.7 Umstead Research Farm Site

3.2.7.1 Affected Environment

3.2.7.1.1 Land Use

The Umstead Research Farm Site is a 249-acre parcel near the town of Butner in Granville County. Umstead Research Farm is part of the North Carolina Department of Agriculture. The parcel is unimproved land that was partially logged in 2000. Umstead Research Farm neighbors include the North Carolina Department of Health and Human Services, a National Guard facility, North Carolina State University Beef Cattle Field Laboratory, and federal, county, and state entities. The parcel would be deeded to DHS if the site is selected for construction.

The Umstead Research Farm Site is zoned I-1 institutional. The land use patterns surrounding the proposed NBAF site include a large tract of office and institutionally zoned areas to the north with a mixture of residential/agriculture lands on tracts larger than 5 acres and a mix of agricultural, open space, and residential (greater than 5-acre tracts) zones in the other directions. Oxford, Creedmoor, and Butner are the three largest communities within Granville County.

Land use controls for Granville County include the Granville County Zoning Ordinance and the Granville County Comprehensive Plan of 2002 (Granville County 2002). The Granville County Comprehensive Plan establishes land planning objectives, goals, and implementation plans that are compatible with the general character of the county. The Comprehensive Plan provides a foundation for zoning and subdivision regulations and the capital improvements program, which puts the goals and objectives of the land use plan into action.

The Umstead Research Farm Site is surrounded by cropland, pasture, and timberland. Land cover at the site and surrounding area is shown in Figure 3.2.7.1.1-1. Land cover classes include the following:

- Pasture (36%)
- Grassland (30%)
- Deciduous, evergreen, or mixed forest (18%)
- Barren land (11%)
- Developed open space (3%)
- Cultivated crops (2%) (NLCD 2001)

3.2.7.1.2 Visual Resources

Overall, visual quality of the landscape at the Umstead Research Farm Site is classified as rural in character. The natural and agricultural landscape features and patterns are reasonably attractive and interesting, but are not visually distinctive or unusual within the region. It abuts other vacant parcels along Dillon Drive, Range Road, and Old North Carolina Highway Road 75. Currently, the site is primarily open pasture and grassland and surrounded primarily be forest land, which provides some natural screening effect. The site has three crowned areas and an elevation change of 140 feet.

Sensitive visual receptors in the vicinity of the Umstead Research Farm Site include C.A. Dillion Youth Development Center on the southern border of the site, scatted rural residences, and travelers along Old North Carolina Highway Road 75 and Range Road. Figure 3.2.7.1.2-1 shows the visual receptors adjacent to the Umstead Research Farm Site.

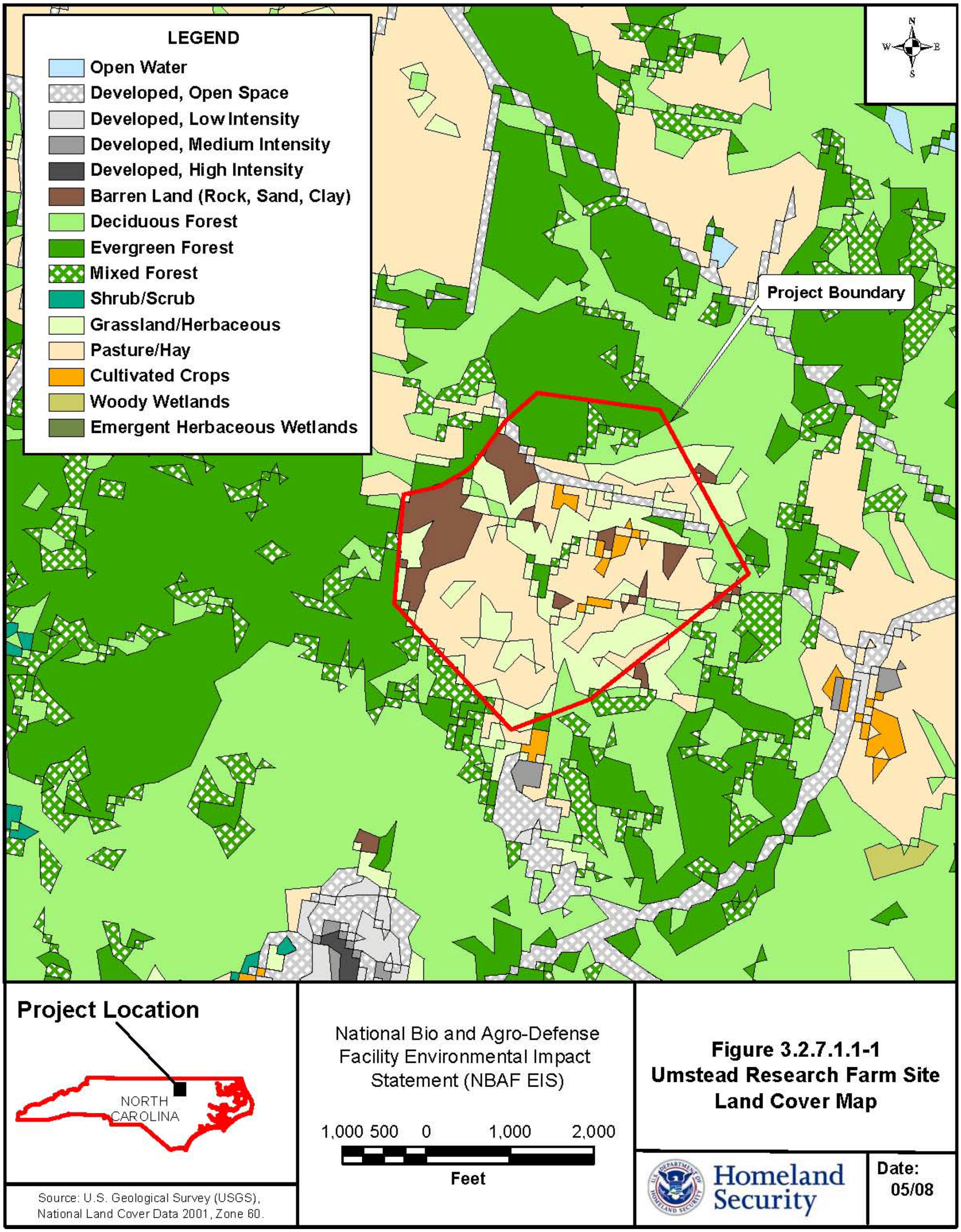

Figure 3.2.7.1.1-1 — Umstead Research Farm Land Cover Map

3.2.7.2 Construction Consequences

3.2.7.2.1 Land Use

Construction of the NBAF at the Umstead Research Farm Site would occur on approximately 30 acres of the 249-acre site and would result in an irretrievable and irreversible commitment of land. Additional acreage would be required for temporary construction areas. The construction laydown area has not been determined at this time, and preliminary indications suggest that the area may extend beyond the 30-acre proposed construction site but not outside the 249-acre site. Minor land use change would occur as a result of NBAF construction. Some of the existing open areas would be used as a construction site with the associated typical construction activities. The effects would be temporary and last the duration of the 4-yr construction period.

3.2.7.2.2 Visual Resources

In general, visual impacts to the overall landscape resulting from construction of the NBAF would be low. Viewers would observe site grading and related construction activities and equipment, which would include the stripping of grass and removal of trees and other vegetation. However, the number of viewers, including sensitive receptors, is expected to be low due to the rural setting of the site and the surrounding forested land. Construction-related impacts would last 4 years. A temporary security fence to prevent trespassing and control traffic entering and leaving the NBAF site would also serve to provide some visual screening of the construction area.

3.2.7.3 Operation Consequences

3.2.7.3.1 Land Use

The operation of the proposed NBAF at the Umstead Research Farm Site would result in an alteration of current land use patterns because the NBAF site is currently undeveloped, and this would change to an industrial/institutional use. Although the use would change, the zoning classification would remain as institutional (I-1) (Town of Butner 2007). All of the land surrounding the site is either federally or state-owned and zoned as either institutional or agricultural. Based on zoning, the NBAF would be compatible with surrounding lands. Overall, land use impacts due to operation of the NBAF would be minor.

3.2.7.3.2 Visual Resources

Visual impacts from operation of the proposed NBAF would be moderate. In general, the NBAF would be similar in size to a 400-bed hospital or a 1,600 student high school located in an otherwise primarily rural setting. Although portions of the main building would be underground, the heights of project components have not been finalized at this time but could be up to 90 feet high (NDP 2007a). Other ancillary elements that would likely be visible include fuel and liquid storage tanks, an electrical switchyard, emergency power generators, and power lines (NDP 2007a). If incinerators are included in the final design, stacks would likely be visible, as well. The entire facility would be surrounded by a security fence, which itself would be a visible.

Visual impacts would also occur from lighting during the nighttime. The main facility, all support buildings, and the parking lot would be well-lit. Lighting is also proposed at regular intervals along the security fence. Use of shielded fixtures and the minimum intensity of lighting that are necessary to provide adequate security could mitigate the effects.

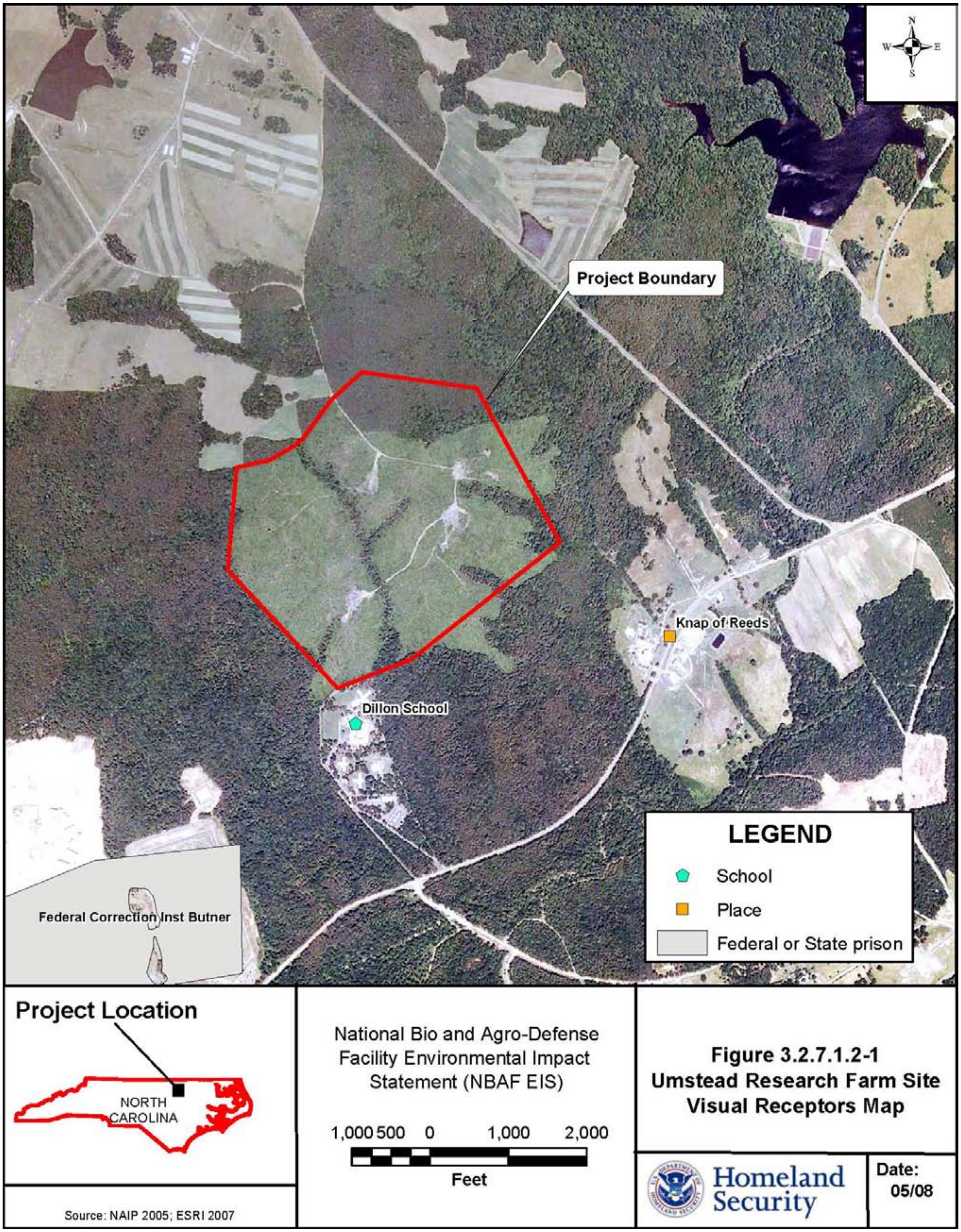

Figure 3.2.7.1.2-1 — Umstead Research Farm Visual Receptors Map

The visual impact of the NBAF to travelers along Old North Carolina Highway Road 75 and Range Road would be lessened by forested land between the NBAF and the roadways. Additionally, the visual effects would not be sustained for travelers. Sensitive visual receptors that would be impacted during operation primarily include students and staff at the Dillion Youth Development Center on the southern border of the site. The NBAF would be screened by forested land from other sensitive viewers.

Visual impacts could be partially ameliorated by limited vegetative screening and setbacks. Landscaping is planned around buildings and adjacent to parking areas. However, vegetative screening would not be used along the fence for security purposes. Additional design features that could help lessen visual impacts include the following:

- Some existing native trees could be maintained around the perimeter of the site to serve as landscape buffers and to increase NBAF's visual compatibility with the surrounding area.
- Trees could be planted to help screen the view of the site. These plantings could include fast-growing trees to expedite the development of a mature vegetative screen.

3.2.8 Texas Research Park Site

3.2.8.1 Affected Environment

3.2.8.1.1 Land Use

The proposed NBAF site is located on 100.1 acres within the Texas Research Park in San Antonio, Bexar County and a small portion of Medina County. The proposed NBAF site is owned by the State of Texas Research and Technology Foundation (TRTF), a charitable 501 (c) (3) public foundation dedicated to economic development through the recruitment of bioscience and high technology assets.

The proposed Texas Research Park Site is undeveloped, vacant land, vegetated with live oak clusters and native South Texas brush. The site is not zoned. The Texas Research Park is within the Extraterritorial Jurisdiction of the City of San Antonio under a 2004 signed agreement between the City of San Antonio, Bexar County, and the TRTF. This agreement stipulates that the park lies outside of the City of San Antonio's municipal boundaries, but the City would assume jurisdiction and the Texas Research Park would be classified as an Industrial District with all land use controls governed by the Restrictive Convenants. Other developments at the Texas Research Park include the University of Texas Health and Science Center, the Cancer Therapy and Research Center, the Southwest Oncology Group, and Genzyme Corporation.

The site is surrounded by a vacant, wooded land. Omicron Drive with Ashton Park Residential Subdivision lies to the north; Lambda Drive, wooded vacant land, and two University of Texas Health and Science Center research campuses lie to the east; vacant, wooded land and Felder Tract Residential Subdivision to the south; and vacant, wooded land with several unpaved roads to the west. Land use controls for the site include the Texas Research Park Restrictive Covenants, the San Antonio Master Plan, and the San Antonio Zoning Code.

Land cover at the site and surrounding area is shown in Figure 3.2.8.1.1-1. Land cover classes at the site include the following:

- Evergreen forest (47%)
- Deciduous forest (36%)
- Shrub/scrub land (17%) (NLCD 2001)

3.2.8.1.2 Visual Resources

Overall, visual quality of the regional landscape is classified as rural in character. The natural and agricultural landscape features and patterns are reasonably attractive and interesting but are not visually distinctive or unusual within the region. Currently, the site is undeveloped, vacant land, vegetated with live oak clusters and native South Texas brush.

Sensitive visual receptors in the vicinity of the Texas Research Park Site include the Potranco Elementary School northwest of the site in Medina County located off of County Road 381. It is within a 0.5 miles of the Texas Research Park Site.

3.2.8.2 Construction Consequences

3.2.8.2.1 Land Use

Construction of the NBAF at Texas Research Park would occur on approximately 30 acres of the 100.1-acre sitend would result in an irretrievable and irreversible commitment of land. Additional acreage would be required for temporary construction areas. The construction laydown area has not been determined at this time, and preliminary indications suggest that the area may extend beyond the 30-acre proposed construction site but not outside the 100.1-acre site. Minor land use change would occur as a result of NBAF construction. Some of the existing open areas would be used as a construction site with the associated typical construction activities. The effects would be temporary and last the duration of the 4-yr construction period.

3.2.8.2.2 Visual Resources

In general, visual impacts to the overall landscape resulting from construction of the NBAF would be low. Viewers would observe site grading and related construction activities and equipment, which would include the stripping of grass and removal of trees and other vegetation. There would be heavy equipment vehicles conducting earthwork activities on the NBAF site during the 4-yr construction period, as well as light- and medium-weight vehicles going to and from the site. Viewers would observe earthwork equipment, construction trailers, building construction, and cranes. Deliveries of soil, backfill, and building materials would be expected on a daily basis.

3.2.8.3 Operation Consequences

3.2.8.3.1 Land Use

The operation of the proposed NBAF at the Texas Research Park Site would result in an alteration of current land use patterns because the NBAF site is currently vacant, and this would change to an industrial/institutional use. Although the use would change, the zoning classification would remain as I-1. The land surrounding the site is currently compatible with the proposed NBAF because it is either part of the Texas Research Park or vacant. Future housing developments are planned near the proposed NBAF site; however, zoning is not expected to be affected should these developments take place, since the NBAF would be within the Texas Research Park and is consistent with the intended use of Texas Research Park. Overall, land use impacts due to operation of the NBAF would be minor.

3.2.8.3.2 Visual Resources

Visual impacts from operation of the proposed NBAF would be moderate. In general, the NBAF would be similar in size to a 400-bed hospital or a 1,600 student high school located in an otherwise primarily rural setting. Although portions of the main building would be underground, the heights of project components have not been finalized at this time, but could be up to 90 feet high (NDP 2007a). Other ancillary elements that would likely be visible include fuel and liquid storage tanks, an electrical switchyard, emergency power generators, and power lines (NDP 2007a). If incinerators are included in the final design, stacks would likely be visible, as well. The entire facility would be surrounded by a security fence, which itself would be a visible element on the landscape.

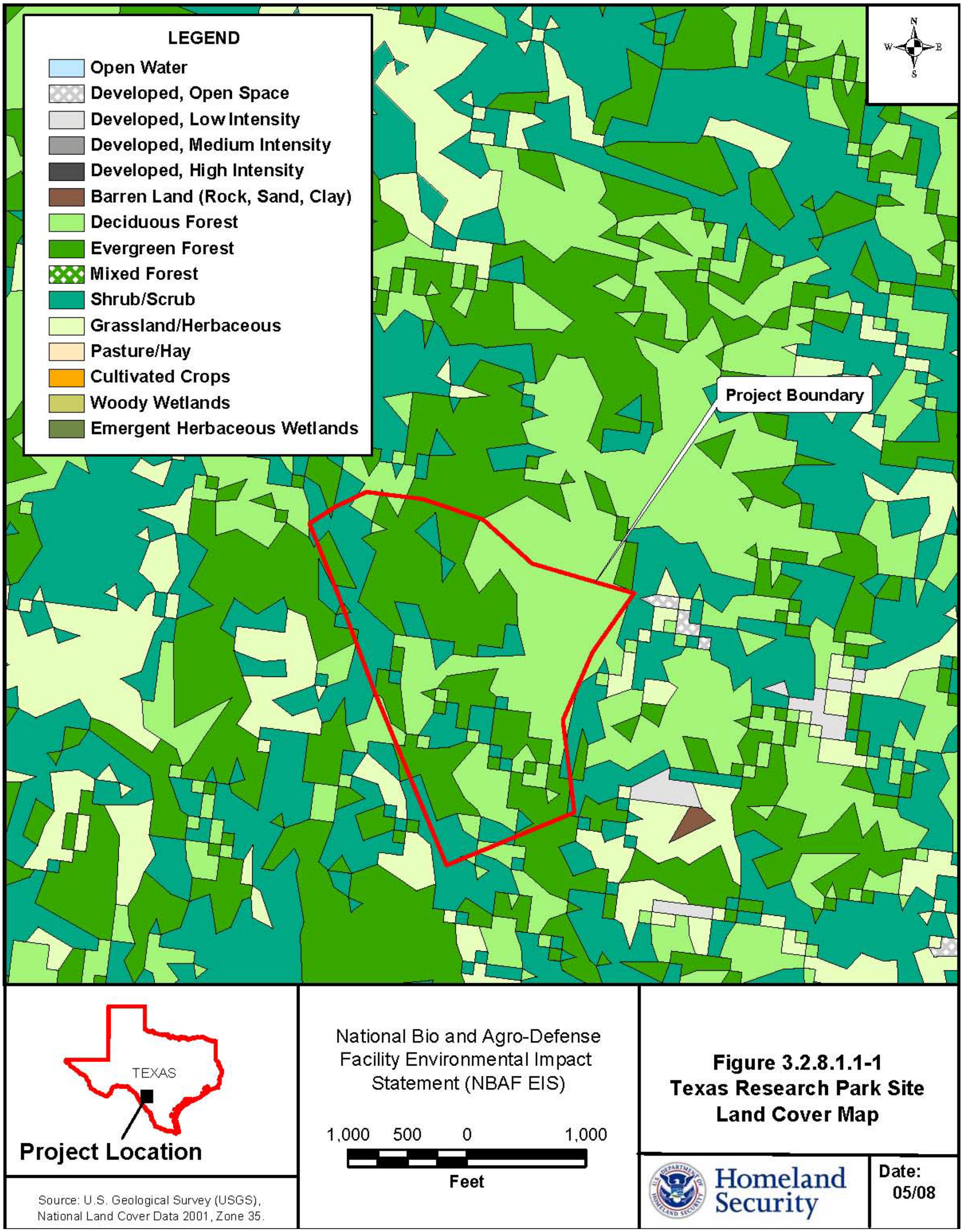

Figure 3.2.8.1.1-1 — Texas Research Park Land Cover Map

There are two approved future residential communities planned adjacent to the site. Ashton Park development, a 200-unit plus single-family residential community, would be located approximately 0.5 miles north of the Texas Research Park Site. Felder Tract, located approximately 0.5 miles south of the Texas Research Park Site, would consist of an estimated 2,590 single-family dwelling units. Both developments would have high visual sensitivity. The scale of the NBAF and elevated viewpoints would make the facility a visually dominant component of their view, and future impacts would likely be moderate.

The visual impact to travelers from the NBAF on Lambda Drive and Omicron Drive would be ameliorated by partial screening and setbacks. Because the visual effects are not sustained, impacts would be moderate. The visual impact for travelers along State Highway 211 would be relatively low because most travelers would be viewing the site from at least 1 mile distance, and the view would not be sustained.

Visual impacts would also occur from lighting during the nighttime. The main facility, all support buildings, and the parking lot would be well-lit. Lighting is also proposed at regular intervals along the security fence. Use of shielded fixtures and the minimum intensity of lighting that are necessary to provide adequate security could mitigate the effects.

Visual impacts could be partially ameliorated by limited vegetative screening and setbacks. Landscaping is planned around buildings and adjacent to parking areas. However, vegetative screening would not be used along the fence for security purposes. Additional design features that could help lessen visual impacts include the following:

- Some existing native trees could be maintained around the perimeter of the site to serve as landscape buffers and to increase NBAF's visual compatibility with the surrounding area.
- Trees could be planted to help screen the view of the site. These plantings could include fast-growing trees to expedite the development of a mature vegetative screen.

3.3 INFRASTRUCTURE

3.3.1 Methodology

The general methodology for infrastructure involved the selection and verification of current and planned site infrastructure data, identification of infrastructure design requirements, comparison of current and planned infrastructure capabilities verses design requirements, and finally, identification and evaluation of site-specific impacts resulting from construction, installation, and operations of the facility. The results are presented in the following subsections.

3.3.2. No Action Alternative

This section describes the existing infrastructure on Plum Island that would remain in use as part of the existing PIADC research mission. PIADC is owned by the federal government and operated by DHS. The day-to-day operation and maintenance (O&M) of PIADC are administered and performed by a private contractor, Field Support Services, Inc. (FSSI). FSSI is responsible for the operations of various self-contained utilities at PIADC. These utilities include the island's two potable water well fields, a sewage treatment plant, emergency power plant, and electrical substations.

3.3.2.1 Affected Environment

3.3.2.1.1 Potable Water Supply

Potable water is supplied to the site by the PIADC O&M contractor from 2 potable water well fields consisting of 14 functioning wells in a sole source aquifer. Wells 1-10 are in the shallow well field, with an average well depth of 30 feet. These wells are located near the existing facility well pump house where potable water treatment is conducted. Wells 11-14 comprise the deep well field with an average depth of about 60 feet. These wells are located at the base of the Harbor Hill End Moraine. The wells are situated northwest of the former pump house facility historically used by the military during its occupation of the island. Safe yield for the aquifer is estimated to range from 150,000 to 200,000 gpd. The existing water tower has a usable volume of 200,000 gallons (NDP 2008b).

The potable water system is permitted by the New York State Department of Environmental Conservation (NYSDEC) and currently operates in compliance with permit requirements. The PIADC potable water system is operated by operators licensed and inspected annually by the NYSDEC/Suffolk County Department of Health (SCDHS). Backflow prevention inspection/reports are provided to the SCDHS on an annual basis, and water-tower/cathodic protection inspection is conducted annually (K. Klotzer, PIADC Environmental Specialist unpublished summary of PIADC Air, Waste-Water and Potable Water Permits prepared August 30, 2007). Excess potable water not immediately available for use or distribution is stored in a 200,000-gallon water tower.

An assessment of the PIADC aquifer, designated “sole source” per Section 1424(e) of the *Safe Drinking Water Act* of 1974 and regulated by the U.S. Environmental Protection Agency (EPA), was conducted in 2000 to provide updated information regarding the condition and quality of the island’s potable water resources. The study recommended a “water budget”—the maximum amount of groundwater that may be sustainably withdrawn without adversely impacting water quality or availability—ranges from 55,000,000 gallons per year (gpy) to 75,000,000 gpy or approximately 150,000–200,000 gallons per day (gpd). The 2006 annual water report submitted to the NYSDEC indicated an annual water production of 17,412,000 gpy or an average production of 47,704 gpd. In addition, the designation of the Plum Island aquifer also requires the EPA to review all proposed projects within the designated area that receive federal financial assistance.

3.3.2.1.2 Electricity

Long Island Power Authority (LIPA), serving a territory of approximately 1,377 square miles with a total power availability of 5,357 megawatts (mW), is the electrical utility responsible for providing power to PIADC (LIPA 2004). LIPA supplies electrical power to Plum Island from Orient Point on Long Island. A single 13.2 kilovolt (kV) aerial line serves two underwater electric cables to Plum Island. The historical peak demand on the electrical service is 2.3 megawatt (mW). The current distribution isolation switches are positioned to operate the bulk of the existing facilities on one underwater service cable. The two underwater feeders to the island can each supply the 2.3-mW load at a voltage drop of the estimated 2.5 mile conductor length, but only one electrical line is used at any given time (NDP 2008b).

Annual electrical usage at the PIADC, measured in kilowatt-hours (kWh) and based on records from 2005 and 2006, ranges from 11,500 kWh to just under 12,000 kWh per year.

3.3.2.1.3 Fuels and Natural Gas

No. 2 diesel is the primary fuel source for the PIADC facility. Fuel oil is stored in underground storage tanks and aboveground storage tanks. The maximum storage capacities of the underground and aboveground storage tanks are 11,100 gallons and 634,640 gallons, respectively. Fuel oil is used in the boilers for facility heating, the generators for facility back-up power, and the incinerators for refuse disposal. The PIADC facility’s annual fuel oil usage is reported to range from 634,880 gpy (FY 2006 fuel acquisition report) to approximately 900,000 gpy (K. Klotzer, PIADC Environmental Specialist phone call from L. Bedsole, Dial Cordy, February 29, 2008).

3.3.2.1.4 Sanitary Sewage

All wastewater from the PIADC is subject to treatment prior to discharge in accordance with the operating and wastewater discharge permit requirements of the State of New York. Wastewater sources at PIADC are organized under the two general source categories of Research Waste and Non-Research Waste and are described below with regard to source and treatment.

Research wastes include wastewaters generated by laboratory sinks and drains, restroom facilities, and animal handling/holding areas within the BSL-3 areas of Building 101. The liquid research wastes (sewage) are conveyed from Building 101 via underground piping and enter Building 102 for pretreatment through grinding units for size classification, then into a series of holding tanks for mixing and heating at various temperatures and residence times under continuous flow or batch conditions. This portion of the research waste pretreatment system is collectively referred to as the "Heat Exchanger Treatment System." From the heat exchanger treatment system, the fluids are sent to one of two "Retention Tube Rooms," which houses 3,500 linear feet of piping. The pretreated effluents pass through this lengthy system to dissipate heat before being combined with non-research waste for secondary and tertiary treatment in the central wastewater treatment plant (WWTP).

Non-research waste includes all pretreated sewage from the research facility (discussed above), as well as sink, drain, and sewage wastes from the non-research support facilities on Plum Island. The largest contributor of wastes from non-research facilities is Building 100, which contains most of the employees and administrative/support functions of the PIADC facility. All combined, non-research waste is treated in the central WWTP located several hundred feet southeast of the main PIADC laboratory. The existing WWTP was built in 1995 with a major upgrade completed in 2004 (NDP 2008b). The WWTP is a state permitted tertiary treatment facility that has a maximum permitted capacity of 60,000 gpd. According to the "PIADC Research Needs and Corrective Action Project Prioritization Study" dated January 27, 2006, the PIADC WWTP is currently capable of treating up to 80,000 gpd (NDP 2008b). The facility has, therefore, requested a discharge permit modification, increasing the permitted capacity to 80,000 gpd (K. Klotzer, PIADC Environmental Specialist phone call from L. Bedsole, Dial Cordy, February 29, 2008). The WWTP currently operates in compliance with permit requirements of New York's, State Pollutant Discharge Elimination System (SPDES).

3.3.2.1.5 Steam and Chilled Water

The existing boiler plant at PIADC came on line in 2005 and has three equally sized boilers with a total installed capacity of 1,500 boiler horsepower (51,750 bl/hr). The existing chilled water plant has a total installed capacity of 1,700 tons.

3.3.2.2 Construction/Operation Consequences

The No Action Alternative would have no effect on infrastructure; however, a number of infrastructure improvements are anticipated for the PIADC facility to meet the demands of its current mission. These improvement projects would allow for the facility to continue functioning for a 10-yr period, after which additional improvements would be required for the facility to continue operating in a safe and efficient manner. However, continued operation of PIADC would result in the irretrievable use of 870 million gallons of potable water when projected over the next 50 years (for comparison to the other alternatives). Diesel fuel and gasoline would be consumed by maintenance equipment, and fuel oil would be consumed during operation of the facility. The loss of these materials would be irreversible.

3.3.3 South Milledge Avenue Site

This section describes the existing services available to support the operation of the NBAF at the South Milledge Avenue Site and the potential consequences to the existing infrastructure from the addition of the facility. The infrastructure encompasses potable water supply, electrical power, fuels and natural gas, sanitary wastewater treatment facilities, and steam and chilled water.

3.3.3.1 Affected Environment

3.3.3.1.1 Potable Water Supply

Potable water is supplied by the Athens-Clarke County Public Utilities Department. Currently, raw water comes from three sources: Bear Creek Reservoir, the North Oconee River, and the Middle Oconee River. Water from these sources is treated at the J.G. Beacham Water Treatment Plant and then delivered to the end user. Athens-Clarke County has four elevated storage tanks and one ground storage tank that collectively hold 3.75 million gallons of water. The City of Athens currently consumes an average of over 15.5 million gpd. Its peak consumption, 26.5 million gallons per day (mgd), was roughly 95% of its supply capacity of 28 mgd (ACCG 2007). The J. G. Beacham Plant is currently being upgraded to meet future demands, to ensure performance reliability, and to comply with stricter, impending drinking water regulations. With the upgrade, the capacity of the plant would be increased from its existing capacity of 28 mgd to 36 mgd (ACC 2008). Construction should be completed by the spring of 2008 (ACCG 2007).

Due to current drought conditions, Athens-Clarke County has declared a Level 4 Drought Response, completely banning all outdoor water use 7 days a week, 24 hours a day. These restrictions became effective on September 17, 2007, and will remain in effect until conditions warrant (ACC 2008). The South Milledge Avenue Site is not in a jurisdiction where reclaimed water must be used for construction, landscape, or other non-potable uses, if reclaimed water is available.

There is an 8-inch potable water force main along South Milledge Avenue that has been determined to not have sufficient capacity to accommodate future demand from the proposed NBAF.

3.3.3.1.2 Electricity

Georgia Power, serving all but 4 of Georgia's 159 counties, is the electrical utility responsible for providing power to the proposed South Milledge Avenue Site (GP 2008a). Georgia Power owns a network of 14 generating plants (coal and nuclear) and 20 hydroelectric dams spread across the State of Georgia (GP 2008b).

Georgia Power would supply three-phase electricity to the South Milledge Avenue Site through two independent electrical substations. Within a 3-mile radius of the South Milledge Avenue Site, Georgia Power currently has three electrical substations that exceed the distribution voltage and output capacity specifications for the NBAF. These existing electrical substations include the GTC Barnett Shoals Substation to the east (115 kV and 35.4 mW), the East Athens Substation to the north-east (115 kV and 28.6 mW), and South Athens Substation to the north-west (115 kV and 28.6 mW). Power from the two selected primary electrical substations would be routed to the South Milledge Avenue Site through two new and separate aboveground or underground lines that converge at a third electrical substation to step the voltage down and distribute the two independent power supplies to the site. The third electrical substation would be located on or adjacent to the NBAF site and would have dual transformers, each with the capacity to handle the entire facility demand as required.

3.3.3.1.3 Fuels and Natural Gas

Atlanta Gas Light would supply natural gas to the South Milledge Avenue Site. Atlanta Gas Light has an existing 4-inch diameter, supply pressure distribution gas line running adjacent to the site on the south side of South Milledge Avenue (phone interview with Lane Woodall, Atlanta Gas Light by Chit Christian, Tetra Tech, Inc., January 23, 2008). This line does not currently have the capacity to meet the additional demand exerted by the proposed NBAF.

The maximum allowable operating pressure (MAOP) for this line is 300 lbs per square inch (psi), and its peak capacity is 9,220 one hundred cubic feet per day (ccf/day); nominal capacity is unknown (Clarissa Hageman, Tetra Tech, Inc., February 19, 2008, e-mail from Ian Skelton, Atlanta Gas Resources). The current utilization of this natural gas source peaks at 4,420 ccf/day. The gas main has 50% excess flow rate capacity at this pressure under current conditions (Clarissa Hageman, Tetra Tech, Inc., February 19, 2008, e-mail from Ian Skelton, Atlanta Gas Resources).

3.3.3.1.4 Sanitary Sewage

Athens-Clarke County's existing Middle Oconee Wastewater Treatment Facility would treat wastewater from the South Milledge Avenue Site. The Athens-Clarke County Middle Oconee facility treats the wastewater and then discharges it into the Middle Oconee River. The wastewater treatment process includes a bar screen, grit separator, activated sludge process, clarifiers, digesters to remove biosolids, and chlorine disinfection (ACC 2008). The existing treatment system has a 6 mgd capacity and currently operates at 4.5 mgd on average. The Athens-Clarke County Middle Oconee WWTP is currently under design to be expanded from 6 mgd to 10 mgd. Construction is expected to be completed in 2012 (ACCG 2007).

Currently, the closest sewer line to the proposed South Milledge Avenue Site is approximately 9,500 feet from the site (NDP 2007b). The Athens-Clarke County Sewer Use Ordinance (2007) provides limits on specific pollutant discharges to the Middle Oconee Wastewater Treatment Facility as provided in Section 3.3.3.3.4. Additional information regarding sanitary sewage is provided in Section 3.13, Waste Management.

3.3.3.1.5 Steam and Chilled Water

The site does not have existing steam and chilled water infrastructure.

3.3.3.2 Construction Consequences

3.3.3.2.1 Potable Water Supply

Water would be required during the construction of the NBAF at the South Milledge Avenue Site for dust suppression and wash down of equipment. The water would likely be supplied via tanker truck at the point of use or obtained though a metered connection to an existing fire hydrant or similar connection. The additional demand on the water supply due to the construction of the NBAF would be negligible.

3.3.3.2.2 Electricity

There would not be additional demand on the electricity supply during construction of the South Milledge Avenue Site. Portable electrical generators would be utilized throughout construction of the facility.

3.3.3.2.3 Fuels and Natural Gas

Natural gas or No. 2 Fuel Oil would not be required for construction activities. However, construction activities would require the use of diesel and gasoline as fuel sources for mobile and stationary construction associated equipment. Volume and consumption projections of diesel and gasoline usage during construction activities are not available at this time.

3.3.3.2.4 Sanitary Sewage

Portable chemical toilets would be used during the construction of the NBAF at the South Milledge Avenue Site, which would result in only a minor increase in the sanitary sewage discharge to the local sewer system during the construction phase. Construction equipment would be washed down as necessary in a designated area with appropriate controls for collecting and managing the wash water.

3.3.3.3 Operation Consequences

3.3.3.3.1 Potable Water Supply

Potable water would be supplied to the NBAF at the South Milledge Avenue Site by the Athens-Clarke County Public Utilities Department. The NBAF designers recommended that municipal water service be brought to the NBAF via redundant or looped feeds such that maximum water demand may be satisfied even with loss of one feed line (NDP 2007b). The projected water consumption at the NBAF ranges from 50,000 gpd to 275,000 gpd, with a peak flow rate of 657 gallons per minute (gpm) at a minimum delivery pressure of 35 psi. The maximum daily consumption projections, substantially impacted by ambient temperature and humidity and, therefore, specific to a geographic region, include cooling tower make-up water for peak cooling days during the summer months and reduced usage projections for the cooler parts of the year. The estimated total annual water consumption at the South Milledge Avenue Site is 43,000,000 gallons (NDP 2007b). An irretrievable commitment of 2.15 billion gallons of potable water would be required over the 50-year project life.

The current Athens-Clarke County Public Utilities infrastructure of an existing 8-inch force main on South Milledge Avenue would not meet the potable water feed redundancy specifications or the consumption/peak flow requirements for the proposed NBAF without substantial improvements. The proposed upgrades to the municipal potable water system include the installation of a dedicated, on-site 200,000 gallon elevated water tank at the South Milledge Avenue Site. The new elevated tank can be fed from the existing 8-inch water lines on either Whitehall Road or South Milledge Avenue. Based on the information provided, the proposed improvements would not comply with the redundancy specifications and the peak flow requirements for the proposed NBAF.

An alternate infrastructure improvement plan, authored but not recommended by Athens-Clarke County, is to extend a 12-inch water line to the South Milledge Avenue Site along Whitehall Road from the intersection of Barnett Shoals Road and Gaines School Road and to extend a second, redundant 12-inch water line to the South Milledge Avenue Site from Riverbend Road. Should this alternative be selected, the alternate improvements would comply with both the redundancy specifications and the peak flow requirements.

3.3.3.3.2 Electricity

Two existing, redundant medium-voltage services with multiple feeders would be provided by Georgia Power to serve the NBAF at the South Milledge Avenue Site. Both independent substations should have sufficient capacity for 13.5 mW dedicated power to the NBAF. Power from the two primary substations would be routed to the site through two new and separate aboveground or underground lines that converge at a new Georgia Power–constructed electrical substation located on or adjacent to the South Milledge Avenue Site to step the voltage down and distribute the two independent power supplies to the NBAF.

Operating demand for electricity at the NBAF is projected at 12.8 mW (NDP 2007a). The design requirements for electrical service include a minimum of two redundant medium-voltage services with multiple feeders, an on-site utility substation at 34.5 kV with two transformers feeding 15 kV Class switchgear in a main-tie-main arrangement. The secondary feeders would provide primary electric service at 13.8 kV to the CUP and to the NBAF buildings (NDP 2008b). Based on current information, Georgia Power should be able to meet the electrical requirements of the proposed NBAF.

3.3.3.3.3 Fuels and Natural Gas

Operation of the proposed NBAF is projected to require 1,106,300 ccf/yr of natural gas. On an average basis, the NBAF would be expected to exert a natural gas demand of 3,031 ccf/day. The peak gas demand is estimated at 1,335 ccf/hr at a supply pressure of 10 psi (NDP 2008b).

The CUP, constructed as part of the proposed NBAF, would house multiple dual-fuel (natural gas and No. 2 fuel oil) boilers. The primary fuel source for the boilers is to be determined based on local availability (NDP 2007b). In the case of the South Milledge Avenue Site, natural gas would be the primary fuel source to meet peak demand. Fuel oil would be used in cases were natural gas is not available. Natural gas service would be piped to the CUP at an approximate pressure of 10 psi. Metering equipment and main pressure-reducing valve would be located outside the plant (NDP 2007b).

The existing 4-inch diameter supply pressure distribution gas line running adjacent to Milledge Avenue would not have sufficient capacity to supply the proposed NBAF and would require the utility company to upgrade the supply line to support the facility (NDP 2007a). The MAOP for the existing line is 300 psi, with an unknown nominal capacity, and a peak capacity of 384 ccf/hour (Clarissa Hageman, Tetra Tech, Inc., February 19, 2008 e-mail from Ian Skelton, Atlanta Gas Resources). This gas line currently has an excess peak flow rate capacity of 200 ccf/hr. To meet the NBAF requirements, Atlanta Gas Light would install approximately 2,900 feet of high-pressure 4-inch steel main and several regulator stations from a suitable supply distribution line to the South Milledge Avenue Site (Clarissa Hageman, Tetra Tech, Inc., February 19, 2008 e-mail from Ian Skelton, Atlanta Gas Resources). A pressure-reducing station for low-pressure gas distribution to the facility would also be required.

Fossils fuels would be irretrievably consumed during the construction and operation of the proposed NBAF. Diesel fuel and gasoline would be consumed by construction and maintenance equipment, and fuel oil and natural gas would be consumed during operation of the facility. The loss of these materials would be irreversible.

3.3.3.3.4 Sanitary Sewage

Operation of the NBAF at the South Milledge Avenue Site is projected to result in the discharge of between 50,000 gpd gpd and 150,000 gpd of wastewater to the sanitary sewage system. Annual wastewater volume is estimated at 26,500,000 gpy (NDP 2008b). If a tissue digester is utilized for carcass disposal, the waste stream from the tissue digester, estimated at 2% of the total discharge volume, would be commingled for discharge with the rest of the NBAF wastewater. The wastewater constituents in the tissue digester waste stream are estimated at 10,250 milligrams per liter (mg/l); biological oxygen demend (BOD), 19,600 mg/l chemical oxygen demand (COD); 1,400 mg/l; suspended solids, and a pH of 9.48 standard units (NDP 2008b).

Sanitary wastewater would be pumped into a new sanitary sewer force-main installed along South Milledge Avenue. Wastewater would be conveyed approximately 1 mile from the South Milledge Avenue Site to the University of Georgia (UGA) soccer/softball complex at Will Hunter Road through a redundant pumping system. From there, wastewater would flow in an existing pipeline to the Athens-Clarke County's Middle Oconee WWTP. Further information regarding the sewer system is found in Section 3.13, Waste Management.

Sewage acceptance criteria and pretreatment requirements would apply to the wastewater discharged from the proposed NBAF. The Athens-Clarke County Sewer Use Ordinance of 2007 provides limits on specific pollutant discharges to the Middle Oconee Wastewater Treatment Facility as presented below in Table 3.3.3.3.4-1 (ACC 2007c). The NBAF would be designed and operated as necessary to prevent negative impact to the Athens-Clarke County Middle Oconee WWTP treatment capabilities resulting from flow rate or potentially harmful wastewater constituents.

Pending revisions to the above local limits, which are expected to take effect before the end of 2008, would further reduce the BOD from 1,000 to 500 mg/l and total suspended solids (TSS) from 750 to 500 mg/l (e-mail communication from David Bloyer, WPC Plant Operations Coordinator for Athens-Clarke County, to Clarissa Hageman, Tetra Tech., Inc.).

Table 3.3.3.3.4-1 — Local Limits for Middle Oconee WWTP

Constituent	Limits	Units
Arsenic	0.007	mg/l
BOD	1,000.000	mg/l
Cadmium	0.008	mg/l
Copper	0.110	mg/l
Cyanide	0.300	mg/l
Lead	0.120	mg/l
Mercury	0.002	mg/l
Nickel	0.280	mg/l
Silver	0.770	mg/l
Total chromium	2.630	mg/l
Total phenols	2.130	
Total suspended solids	750.000	mg/l
Zinc	0.210	mg/l
Oils, as defined in §5-1-2(c)(6)	100.000	mg/l

3.3.3.3.5 Steam and Chilled Water

The proposed NBAF operation would require a peak steam load of 133,510 pounds per hour (lb/hr) including 55,000 lb/hr for process loads. To meet the firm capacity, six equally sized boilers at 26,702 lb/hr are required to maintain the firm capacity of 133,510 lb/hr, while meeting the requirement for total installed capacity of 160,212 lb/hr. This configuration would allow the peak capacity of the facility to be met in the event of the loss of 1 boiler (NDP 2008b).

The proposed NBAF operation would also require a peak chilled water load of 5,173 tons including 750 tons for process cooling. To achieve appropriate levels of redundancy, six equally sized chillers at 1,035 tons are required to maintain the firm capacity of 5,173 tons, while meeting the requirement for total installed capacity of 6,210 tons. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one chiller (NDP 2008b).

3.3.4 Manhattan Campus Site

This section describes the existing services available to support the operation of the NBAF at the Manhattan Campus Site and the potential consequences and effects to the existing infrastructure from the addition of the facility. The infrastructure encompasses potable water supply, electrical power, fuels and natural gas, sanitary wastewater treatment facilities, and steam and chilled water.

3.3.4.1 Affected Environment

3.3.4.1.1 Potable Water Supply

Potable water is supplied by the City of Manhattan Public Works Department. The City of Manhattan's current potable water supply capacity is 20.5 million gpd. Demand on the system averages 6.8 mgd with peak consumption of 17 mgd or 83% of supply capacity. The city is currently planning a major water treatment plant and well field improvement project, which would increase the potable water supply capacity to approximately 30 mgd and is scheduled for completed by 2009 (McIntyre 2007). Regarding a dedicated potable water supply to the Manhattan Campus Site, the Public Works Department has stated that the City of Manhattan would supply the site, from excess capacity, a volume of 1.0 mgd during the months of September through May and an excess capacity volume of 0.5 mgd during the summer months (June through August) (Ann Galbraith, Tetra Tech, Inc., February 20, 2008 e-mail from Peter Armesto, City of Manhattan).

There is a 24-inch water main adjacent to the site along Denison Avenue, which can supply water at 130 to 140 psi and 1,500 to 2,500 gpm, depending on the pumps that are running at the water treatment plant. The 24-inch water main would be dedicated to the NBAF at the Manhattan Campus Site (Ann Galbraith, Tetra Tech, Inc., February 20, 2008 e-mail from Peter Armesto, City of Manhattan).

3.3.4.1.2 Electricity

Westar Energy is the electrical utility responsible for providing power to the Manhattan Campus Site. Westar Energy would supply three-phase electricity to the Manhattan Campus Site through two independent electrical substations. The first electrical substation, designated as the KSU Substation, has a capacity of 22.4 mW and is located on the KSU campus. The second electrical substation, designated as the Matters Corner Substation, has a nearly equal capacity and is located off-campus approximately 1 mile from the site. Power from the two primary substations would be routed to the Manhattan Campus Site through two new and separate aboveground or underground lines that converge at a new Westar Energy–constructed electrical substation to step the voltage down and distribute the two independent power supplies to the site. The new electrical substation would be located on or adjacent to the proposed NBAF site and would have dual transformers, each with the capacity to supply the entire facility’s electrical energy demand as required.

3.3.4.1.3 Fuels and Natural Gas

The Kansas Gas Service (KGS) would supply natural gas to the Manhattan Campus Site through an existing 8-inch diameter, high-pressure distribution gas line running along Denison Avenue and adjacent to the proposed Manhattan Campus Site. To distribute gas to the NBAF it would be necessary to tap into this high-pressure distribution gas line.

The capacity of the KGS 8-inch natural gas distribution line at 3,000 ccf/hr is approximately 200% greater than the peak design demand of 1,480 ccf/hr for the NBAF (Kansas Gas Service, Pam Stone, March 11, 2008, letter to Kansas Bioscience, Tom Thornton).

3.3.4.1.4 Sanitary Sewage

The City of Manhattan Public Works Department WWTP includes influent screening, influent pumping, grit removal, conventional activated sludge treatment, and ultraviolet disinfection. The treatment train does not include primary sedimentation. A storm water basin is available for short-term storage during peak flow events. Solids processed at the WWTP consist of aerobic digestion before sludge is pumped to the City’s Biosolids Farm for land application. The WWTP ultimately discharges to the Kansas River. The existing treatment system has an 8.7 mgd peak flow capacity and currently operates at 5.0 mgd on average.

The NBAF would discharge sanitary wastewater into the City of Manhattan Public Works Department sewer system. There is an 8-inch sewer line near the Manhattan Campus Site to the north along Denison Avenue, with a 4-inch force main adjacent to the east of the proposed site (KSU 2007a). Additional information regarding sanitary sewage is evaluated in Section 3.13, Waste Management.

3.3.4.1.5 Steam and Chilled Water

Existing steam and chilled water utilities adjacent to the Manhattan Campus Site are not available to serve the NBAF (NDP 2008b).

3.3.4.2 Construction Consequences

3.3.4.2.1 Potable Water Supply

Water would be required during the construction of the NBAF for dust suppression and wash down of equipment. The water would likely be supplied via tanker truck at the point of use or obtained though a metered connection to an existing fire hydrant or similar connection. The additional demand on the water supply due to the NBAF construction would be negligible.

3.3.4.2.2 Electricity

There would be no additional demand on the electricity supply during construction of the NBAF at the Manhattan Campus Site. Portable electrical generators would be utilized throughout construction and installation of the facility.

3.3.4.2.3 Fuels and Natural Gas

Natural gas or No. 2 Fuel Oil would not be required for construction activities. However, construction activities would require the use of diesel and gasoline as fuel sources for mobile and stationary construction associated equipment. Volume and consumption projections of diesel and gasoline usage during construction activities are not available at this time.

3.3.4.2.4 Sanitary Sewage

The construction site would be provided with portable chemical toilets. While these portable toilets would be emptied into the local sanitary sewer system during the construction of the NBAF, the overall impact would be negligible in comparison to the total waste inflow to the WWTP. Construction equipment would be washed down as necessary in a designated area with appropriate controls for collecting and managing the wash water.

3.3.4.3 Operation Consequences

3.3.4.3.1 Potable Water Supply

Potable water would be supplied to the Manhattan Campus Site by the City of Manhattan Public Works Department. The facility designers recommend that municipal water service be brought to the site via redundant or looped feeds such that maximum water demand may be satisfied with loss of one feed line. Projected water consumption at the proposed NBAF ranges between 50,000 gpd and 250,000 gpd with a peak flow rate of 665 gpm at a minimum delivery pressure of 35 psi. The maximum daily consumption projections, substantially impacted by ambient temperature and humidity and, therefore, specific to a geographic region, include cooling tower make-up water for peak cooling days during the summer months and reduced usage projections for the cooler parts of the year. The estimated total annual water consumption for the NBAF at the Manhattan Campus Site is projected to be 37,750,000 gallons (NDP 2007b). An irretrievable commitment of 1.89 billion gallons of potable water would be required over the 50-year project life.

The current City of Manhattan Public Works Department infrastructure of a 24-inch water main adjacent to the site along Denison Avenue, with a dedicated supply capacity range of 500,000 gpd to 1,000,000 gpd and a peak flow rate of 2,500 gpm at a delivery pressure of 130 psi would meet the potable water design requirements for the NBAF. In addition, upgrades to the municipal potable water system, discussed in Section 3.3.4.1.1, would further enhance the capacity of the municipal water system.

3.3.4.3.2 Electricity

Westar Energy would supply three-phase electricity to the Manhattan Campus Site through two independent electrical substations. Both independent substations would have sufficient capacity for 13.5 mW dedicated power to the NBAF. Power from the two primary substations would be routed to the Manhattan Campus Site through two new and separate aboveground or underground lines that converge at a new Westar Energy–constructed electrical substation located on or adjacent to the proposed Manhattan Campus Site to step the voltage down and distribute the two independent power supplies to the NBAF.

Operating demand for electricity at the NBAF is projected at 13.1 mW (NDP 2007a). This demand represents only 0.43% of Westar Energy's current generating capacity of 3,082 mW. The design requirements for electrical service to the NBAF include a minimum of two redundant medium-voltage services with multiple feeders, an on-site utility substation at 34.5 kV with two transformers feeding 15 kV Class switchgear in a main-tie-main arrangement. The secondary feeders would provide primary electric service at 13.8 kV to the CUP and to the NBAF buildings (NDP 2008b). Based on current information, Westar Energy would have sufficient capacity to meet the power requirements and redundancy specifications for the NBAF (March 25, 2008 letter from Westar Energy, Chad Luce to Kansas Bioscience Authority, Tom Thornton).

3.3.4.3.3 Fuels and Natural Gas

Operation of the NBAF at the Manhattan Campus Site is projected to require 1,410,000 ccf/yr of natural gas. On an average basis, the NBAF would be expected to exert a natural gas demand of 3,863 ccf/day. The peak gas demand is estimated at 1,480 ccf/hr at a supply pressure of 10 psi (NDP 2008b).

The CUP, constructed as part of the NBAF, would house multiple dual-fuel (natural gas/No. 2 fuel oil) boilers. The primary fuel source for the boilers is to be determined based on local fuel availability (NDP 2007b). In the case of the Manhattan Campus Site, natural gas would be the primary fuel source to meet peak demand. Fuel oil would be used in cases were natural gas is not available.

Natural gas service would be piped to the CUP through an existing 8-inch diameter, high- pressure distribution gas line running along Denison Avenue and adjacent to the proposed Manhattan Campus Site. The required metering equipment and main pressure-reducing valve would be located outside the plant (NDP 2007b). The capacity of the KGS 8-inch natural gas distribution line is 3,000 ccf/hr, which is approximately 200% greater than the peak design demand of 1,480 ccf/hr for the NBAF (Kansas Gas Service, Pam Stone March 11, 2008, letter to Kansas Bioscience, Tom Thornton). Therefore, KGS considers their natural gas capacity sufficient to meet the projected and future gas needs of the NBAF and area population growth with no improvements projected (MS 2007).

Fossils fuels would be irretrievably consumed during the construction and operation of the proposed NBAF. Diesel fuel and gasoline would be consumed by construction and maintenance equipment, and fuel oil and natural gas would be consumed during operation of the facility. The loss of these materials would be irreversible.

3.3.4.3.4 Sanitary Sewage

Operation of the NBAF is projected to result in the discharge of between 50,000 gpd and 140,000 gpd of wastewater to the sanitary sewage system. Annual wastewater volume is estimated at 25,000,000 gpy (NDP 2008b). If a tissue digester is utilized for carcass disposal, the waste stream from the tissue digester, estimated at 2% of the total discharge volume, would be commingled for discharge with the rest of the NBAF wastewater. The projected wastewater constituents in the tissue digester waste stream include BOD – 10,250 mg/l; COD – 19,600 mg/l; suspended solids – 1,400 mg/l; and pH – 9.48 standard units (NDP 2008b).

The NBAF would pump sanitary wastewater into an existing force-main located on the Manhattan Campus Site. A new pump station would be installed on the existing force-main to receive and transport wastewater north through the existing infrastructure and into the Manhattan Public Works Department WWTP. The City of Manhattan is currently designing a new WWTP and is incorporating wastewater discharge projections for the NBAF into the design criteria for the new WWTP (phone conversation between Patricia Myers, Tetra Tech, Inc., and Jerry McIntyre, City of Manhattan, April 2, 2008). Further information regarding the sewer system is found in Section 3.13, Waste Management.

Sewage acceptance criteria and pretreatment requirements would apply to the wastewater discharged from the NBAF. A partial listing of the Manhattan, Kansas, technically based local limits for wastewater discharge into the Manhattan Public Work Department WWTP are presented in Table 3.3.4.3.4-1 (CoM 2007). The NBAF would be designed and operated as necessary to prevent negative impact to the City of Manhattan Public Works Department WWTP treatment capabilities resulting from flow rate or potentially harmful wastewater constituents.

Table 3.3.4.3.4-1 — Local Limits, Manhattan, Kansas, WWTP

Constituent	Limits	Units
Average Flow	<2% of average flow	gpm
TSS	350	mg/l
BOD	300	mg/l
Fats Oil and Grease	100	mg/l
pH	5.5 – 9.5	Standard Units
Temperature	<150°	Fahrenheit

3.3.4.3.5 Steam and Chilled Water

The NBAF operation would require a peak steam load of 147,865 lb/hr including 55,000 lb/hr for process loads. To meet the firm capacity of the NBAF, six equally sized boilers at 29,573 lb/hr are required to maintain the firm capacity of 147,865 lb/hr while meeting the requirement for total installed capacity of 177,438 lb/hr. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one boiler (NDP 2008b).

The NBAF operation would also require a peak chilled water load of 5,382 tons including 750 tons for process cooling. To achieve appropriate levels of redundancy, six equally sized chillers at 1,076 tons are required to maintain the firm capacity of 5,382 tons while meeting the requirement for total installed capacity of 6,456 tons. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one chiller (NDP 2008b).

3.3.5 Flora Industrial Park Site

This section describes the existing services available to support the operation of the NBAF at the Flora Industrial Park Site and the potential consequences and impacts to the existing infrastructure from the addition of the facility. The infrastructure encompasses potable water supply, electrical power, fuels and natural gas, sanitary wastewater treatment facilities, and steam and chilled water.

3.3.5.1 Affected Environment

3.3.5.1.1 Potable Water Supply

Potable water is supplied to the Flora Industrial Park Site by the Town of Flora, Mississippi. Groundwater is extracted, treated, stored in tanks (approximately 300,000 gallon capacity), then supplied to the town. In 2005, The Town of Flora consumed an average of 756,000 gpd of potable water. Its peak consumption, at

900,000 gpd, was roughly 65% of its supply capacity of 1,390,000 gpd (MDA 2005). Currently planned and funded upgrades would supply in excess of 200,000 gpd to the Flora Industrial Park Site (MS 2007).

There is a 10-inch water main adjacent to the Flora Industrial Park Site that can supply water at over 60 psi (MS 2007). The operating flow rate and available capacity of this pipe are not known.

3.3.5.1.2 Electricity

Entergy Mississippi, Inc., serving 45 of Mississippi's 82 counties, would be the electrical utility responsible for providing power to the Flora Industrial Park Site (EMI 2007). Entergy Mississippi, a subsidiary of Entergy Corporation, is an integrated energy company engaged primarily in electric power production and retail distribution operations. Entergy owns and operates power plants with approximately 30,000 mW of electric generating capacity, and it is the second-largest nuclear generator in the United States. Entergy delivers electricity to utility customers in Arkansas, Louisiana, Mississippi, and Texas (EMI 2007).

Entergy Mississippi, Inc. would build a new substation on the Flora Industrial Park Site to serve the utility load requirement of 13.1 mW. This new substation would be served by an existing 115,000 kV transmission line with the capability to serve from two sources. The new substation would have a power capacity in excess of 13.1 mW and would contain two transformers, with either transformer being capable of bearing the entire power load of the proposed NBAF. Transformer 1 would be used to serve the facility with 13.8 kV nominal voltage. Transformer 2 would serve as a back-up power source and also provide 13.8 kV normal voltage (J. Turner, Entergy Mississippi, Inc. correspondence on March 19, 2008).

3.3.5.1.3 Fuels and Natural Gas

Atmos Energy would supply natural gas to the Flora Industrial Park Site. Atmos Energy is the largest natural gas-only utility in the United States, as well as the largest natural gas distributor in Mississippi. The company serves 144 communities across Mississippi (AE 2005).

Atmos Energy would supply natural gas through an existing 6-inch diameter, supply pressure distribution gas line running adjacent to the proposed Flora Industrial Park Site. To distribute gas to the NBAF, it would be necessary to tap into this supply pressure distribution gas line.

The nominal operating pressure of this 6-inch supply pressure distribution gas line is 125 psi. The MAOP for this line is 275 psi, with a nominal capacity of 600 ccf/hr, and a peak capacity of 1,250 ccf/hr. The current utilization of this natural gas source averages 14,400 ccf/day and peaks at 30,000 ccf/day. The gas main can currently supply an excess 20,400 ccf/day of natural gas at 10 psi (E-mail correspondence from Atmos Energy, Gregory J. Williamson on January 8 and 23, 2008 to Tetra Tech, Inc., Chit Christian).

3.3.5.1.4 Sanitary Sewage

The Town of Flora treats wastewater in an aeration lagoon, passes it through a sand filter, and then discharges it into the Black Creek River. The existing treatment system has a 300,000 gpd capacity and currently operates at 100,000 gpd on average. State funding is being sought for more than a two-fold increase in capacity (MS 2007).

The NBAF would discharge sanitary wastewater into the Town of Flora sewer system. There is currently a 10-inch gravity line on-site that discharges into a 350 gpm lift station. A 6-inch force main transports the waste to the Flora treatment facility (MS 2007). The 10-inch gravity sewer line that would serve the Flora Industrial Park Site currently has no flow, so it has 100% excess flow rate capacity (Dave Holman, Town of Flora, February 5, 2008, phone call from Clarissa Hageman, Tetra Tech, Inc.). The 6-inch force main currently has 52% excess flow rate capacity. Additional information regarding sanitary sewage is provided in Section 3.13, Waste Management.

3.3.5.1.5 Steam and Chilled Water

The Flora Industrial Park Site does not have existing steam and chilled water infrastructure.

3.3.5.2 Construction Consequences

3.3.5.2.1 Potable Water Supply

Water would be required during the construction of the NBAF for dust suppression and wash down of equipment. The water would likely be supplied via tanker truck at the point of use or obtained though a metered connection to an existing fire hydrant or similar connection. The additional demand on the water supply to the Flora Industrial Park Site for NBAF construction would be negligible.

3.3.5.2.2 Electricity

There would be no additional demand on the electricity supply during construction of the NBAF. Portable electrical generators would be used throughout construction and installation of the facility.

3.3.5.2.3 Fuels and Natural Gas

Natural gas or No. 2 Fuel Oil would not be required for construction activities. However, construction activities would require the use of diesel and gasoline as fuel sources for mobile and stationary construction associated equipment. Volume and consumption projections of diesel and gasoline usage during construction activities are not available at this time.

3.3.5.2.4 Sanitary Sewage

The construction site would be provided with portable chemical toilets, which would result in only a minor increase in the sanitary sewage discharge to the local sewer system during the construction phase of the proposed NBAF. Construction equipment would be washed down, as necessary, in a designated area with appropriate controls for collecting and managing the wash water.

3.3.5.3 Operation Consequences

3.3.5.3.1 Potable Water Supply

Potable water would be supplied to the Flora Industrial Park Site by the Town of Flora. The NBAF designers recommended that municipal water service be brought to the site via redundant or looped feeds such that maximum water demand may be satisfied with loss of one feed line (NDP 2007b). Projected water consumption at the NBAF ranges between 50,000 gpd and 290,000 gpd with a peak flow rate of 669 gpm at a minimum delivery pressure of 35 psi. The maximum daily consumption projections, substantially impacted by ambient temperature and humidity and, therefore, specific to a geographic region, include cooling tower make-up water for peak cooling days during the summer months and reduced usage projections for the cooler parts of the year. The estimated total annual water consumption for the NBAF at the Flora Industrial Park Site is projected to be 48,150,000 gallons (NDP 2007b). An irretrievable commitment of 2.4 billion gallons of potable water would be required over the 50-year project life.

The current Town of Flora Public Works Department infrastructure of a 10-inch water main adjacent to the Flora Industrial Park Site, with a dedicated supply capacity of 200,000 gpd at a delivery pressure of 60 psi would meet or exceed all but the peak daily water consumption requirements for the NBAF. The planned upgrades to the municipal potable water system of an additional 300,000-gallon tank located on the site, and additional water well(s) with 720,000 gpd capacity, would further enhance the capacity of the municipal water system and are anticipated to meet all the water requirements for the NBAF (MS 2007).

3.3.5.3.2 Electricity

Entergy Mississippi, Inc. would build a new substation on the Flora Industrial Park Site to serve the utility load requirement of 13.1 mW. This new substation would served by an existing 115,000 kV transmission line with the capability to serve from two sources. The new substation would have a power capacity in excess of 13.5 mW and would contain two transformers with either transformer being capable of bearing the entire power load of the NBAF. Transformer 1 would be used to serve the facility with 13.8 kV nominal voltage to the CUP. Transformer 2 would serve as a back-up power source and would also provide 13.8 kV normal voltage to the CUP (J. Turner, Entergy Mississippi, Inc., correspondence on March 19, 2008).

The projected operating demand for electricity at the NBAF of 13.1 mW, represents 66% of the 20.0 mW of electrical load that has been allocated by Entergy Mississippi for operation of the NBAF (NDP 2007a). The design requirements for electrical service to the Flora Industrial Park Site include a minimum of two redundant medium voltage services with multiple feeders, an on-site utility substation at 34.5 kV with two transformers feeding 15 kV Class switchgear in a main-tie-main arrangement. The secondary feeders would provide primary electric service at 13.8 kV to the CUP and to the NBAF buildings. Based on current projections, Entergy Mississippi would have sufficient capacity to meet the power requirements but not the redundancy specifications for the NBAF.

3.3.5.3.3 Fuels and Natural Gas

Operation of the NBAF is projected to require 1,072,400 ccf/yr of natural gas. On an average basis, the NBAF would be expected to exert a natural gas demand of 2,938 ccf/day. The peak gas demand from the NBAF is estimated at 1,330 ccf/hr with a supply pressure of 10 psi (NDP 2008b).

The CUP, constructed as part of the NBAF, would house multiple dual-fuel (natural gas/No. 2 fuel oil) boilers. The primary fuel source for the boilers is to be determined based on local fuel availability (NDP 2007b). In the case of the Flora Industrial Park Site, natural gas would be the primary fuel source to meet peak demand. Fuel oil would be used in cases were natural gas is not available. Natural gas would be piped to the CUP through a pressure-reducing station, at an approximate pressure of 10 psi. Metering equipment and main pressure-reducing valve would be located outside the plant (NDP 2007b).

Natural gas service from Atmos Energy would be piped to the CUP through an existing 6-inch diameter supply pressure distribution gas line running adjacent to the Flora Industrial Park NBAF site. The nominal operating pressure of this gas line is 125 psi. The MAOP for this line is 275 psi with a nominal capacity of 600 ccf/hr and a peak capacity of 1,250 ccf/hr. The excess capacity of this distribution gas line, which could be dedicated to the NBAF, is currently at 40%. Based on the requirements for natural gas peak usage and annual consumption at the NBAF, the existing Atmos Energy natural gas infrastructure would meet the projection for annual natural gas consumption but not the requirement for peak utilization capacity. To serve the NBAF, Atmos Energy would need to install, at a minimum, an 11-mile long, 4-inch and 6-inch steel pipeline from the natural gas distribution input station near Jackson, Mississippi. Furthermore, Atmos Energy would need to confirm the ability of the input station to meet this additional demand (e-mail from Greg Williamson, Atmos Energy, April 1, 2008).

Fossils fuels would be irretrievably consumed during the construction and operation of the proposed NBAF. Diesel fuel and gasoline would be consumed by construction and maintenance equipment, and fuel oil and natural gas would be consumed during operation of the facility. The loss of these materials would be irreversible.

3.3.5.3.4 Sanitary Sewage

Operation of the NBAF is projected to result in the discharge of between 50,000 gpd and 150,000 gpd of wastewater to the sanitary sewage system. Annual wastewater volume is estimated at 28,250,000 gpy

(NDP 2008b). If a tissue digester is used for carcass disposal, then the waste stream from the tissue digester, estimated at 2% of the total discharge volume, would be commingled for discharge with the rest of the NBAF wastewater. The projected wastewater constituents in the tissue digester waste stream include BOD – 10,250 mg/l; COD – 19,600 mg/l; suspended solids – 1,400 mg/l; and pH – 9.48 standard units (NDP 2008b).

The NBAF would discharge sanitary wastewater into the existing Town of Flora 10-inch diameter gravity wastewater main. Approximately 1,600 feet of new sewer main would be required to tie the Flora Industrial Park NBAF to the existing 10-inch diameter sewer main. Further information regarding the sewer system is found in Section 3.13, Waste Management.

Sewage acceptance criteria and pretreatment requirements would apply to the NBAF wastewater discharge. Although Flora, Mississippi, and Madison County, Mississippi, have no specific ordinances governing pollutant limitations for discharges to the Flora WWTP, local and state review on a case-by-case basis serve as sewage use local limits. The NBAF would be designed and operated as necessary to prevent negative impact to the Flora sewage treatment capabilities resulting from flow rate or potentially harmful wastewater constituents.

3.3.5.3.5 Steam and Chilled Water

The NBAF operation would require a peak steam load of 132,883 lb/hr including 55,000 lb/hr for process loads. To meet the firm capacity of the NBAF, six equally sized boilers at 26,577 lb/hr are required to maintain the firm capacity of 132,883 lb/hr while meeting the requirement for total installed capacity of 159,462 lb/hr. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one boiler (NDP 2008b).

The NBAF operation would also require a peak chilled water load of 5,493 tons including 750 tons for process cooling. To achieve appropriate levels of redundancy, six equally sized chillers at 1,099 tons are required to maintain the firm capacity of 5,493 tons while meeting the requirement for total installed capacity of 6,594 tons. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one chiller (NDP 2008b).

3.3.6 Plum Island Site

This section describes the existing services available to support the operation of the NBAF at the Plum Island Site and the potential consequences and effects to the existing infrastructure from the addition of the NBAF facility, along with the existing PIADC facility. The infrastructure encompasses potable water supply, electrical power, fuels, sanitary wastewater treatment facilities, and steam and chilled water. The NBAF would operate concurrently with the existing PIADC operations. Current infrastructure would be utilized for the simultaneous operation of both the NBAF and the PIADC operations.

3.3.6.1 Affected Environment

A description of the existing infrastructure conditions (potable water supply, electricity, fuel oil, and sanitary sewage) associated with Plum Island is located in Section 3.3.2.1.

3.3.6.2 Construction Consequences

3.3.6.2.1 Potable Water Supply

Potable water would be supplied during construction of the NBAF at Plum Island by the existing PIADC infrastructure. Non-potable water would be required during the construction for dust suppression, wash down of equipment, and possibly soil compaction. The water would likely be supplied via tanker truck at the point of use or obtained though a metered connection to the existing PIADC water system. The additional demand on the potable water supply to the NBAF would be negligible during construction.

3.3.6.2.2 Electricity

There would be no additional demand on the electricity supply during construction of the NBAF. Portable electrical generators would be used throughout construction and installation of the facility.

3.3.6.2.3 Fuels and Natural Gas

No. 2 Fuel Oil would not be required for construction activities. However, construction activities would require the use of diesel and gasoline as fuel sources for mobile and stationary construction associated equipment. Volume and consumption projections of diesel and gasoline usage during construction activities are not available at this time.

3.3.6.2.4 Sanitary Sewage

The construction site would be provided with portable chemical toilets. While these portable toilets would be emptied into the local sanitary sewer system during construction, the overall impact would be negligible in comparison to the total waste inflow to the WWTP. Construction equipment would be washed down as necessary in a designated area with appropriate controls for collecting and managing the wash water.

3.3.6.3 Operation Consequences

3.3.6.3.1 Potable Water Supply

Potable water would be supplied to the proposed NBAF from the existing groundwater supply. The NBAF designers recommended that water service be available to the NBAF via redundant or looped feeds such that maximum water demand may be satisfied with loss of one feed line (NDP 2007a). The projected water consumption at the NBAF ranges between 50,000 gpd and 250,000 gpd with a peak flow rate of 665 gpm at a minimum delivery pressure of 35 psi. The maximum daily consumption projections, substantially impacted by ambient temperature and humidity and, therefore, specific to a geographic region, include cooling tower make-up water for peak cooling days during the summer months and reduced usage projections for the cooler parts of the year. The estimated total annual water consumption for the NBAF is 36,500,000 gallons (NDP 2007b). An irretrievable commitment of 1.83 billion gallons of potable water would be required over the 50-year project life.

Potable water would also be supplied to the current PIADC from the existing groundwater supply. The historical annual water consumption for the PIADC operations averages 17,412,000 gpy. The estimated total annual water consumption for the combined Plum Island NBAF and the PIADC is projected to be 53,912,000 gallons.

The current PIADC water supply infrastructure of 14 groundwater wells with a production capacity limited to 150,000 gpd for aquifer preservation and a 200,000 gallon water tower, as described more completely in Section 3.3.2.1.1, would not meet the peak daily consumption requirements from the concurrent operation of the NBAF and the PIADC. To meet these requirements, new wells would need to be added to ensure the maximum daily water production and two new 200,000 gallon water towers would also need to be added to allow storage of 2 days of water consumption during peak periods and to comply with supply redundancy requirements for the NBAF (NDP 2008b). The installation of the proposed NBAF at the Plum Island Site would trigger an EPA review to ensure that the groundwater source is not endangered.

3.3.6.3.2 Electricity

Operating demand for electricity at the NBAF is projected at 12.8 mW (NDP 2007a). A minimum of two new redundant medium-voltage services with multiple feeders would be required to serve the NBAF and Plum Island infrastructure. The current PIADC electrical infrastructure, detailed in Section 3.3.2.1.2., and comprised primarily of two submarine electrical cables of approximately 3.4 mW capacity each from Long Island, New York, would remain dedicated to the PIADC operation.

The required improvements in the electrical infrastructure for the operation of the NBAF would include new service from utility substations on Long Island or the Connecticut mainland at 13.2 kV or 34.5 kV, with two additional underwater cables from Long Island or Connecticut to supply feeding 15kV Class switchgear in a main-tie-main arrangement. The new underwater cables would each be supplied from separate utility transformer busses at the utility substation and would each carry a minimum of 13.5 mW of dedicated power. The secondary feeders would provide primary electric service to distribution substations with main-tie-main switchgear for 480 Volt service to support the NBAF. The distribution substations with 5kV main-tie-main switchgear for 4,160 Volt service would support the CUP chillers with the 480 Volt transformers supporting the motor control centers (NDP 2008b).

3.3.6.3.3 Fuels and Natural Gas

The CUP to be constructed as part of the NBAF would house multiple boilers. No. 2 fuel oil would be the primary fuel source and would be stored on-site in sufficient quantities to meet peak demand. It is estimated that the new facility would consume 1.6 million gallons of fuel oil per year including normal boiler operation, weekly testing, and 30 days of operation in the stand-by mode for the generators. The 660,000-gallon fuel storage capacity represents a 30-day supply during the month of January in the event the facility needed to operate solely on stand-by power (NDP 2008b).

The concurrent operation of the PIADC also utilizes No. 2 fuel oil as the primary fuel source. The historic PIADC consumption of No. 2 fuel oil is approximately 900,000 gpy. Therefore, the estimated annual total for No. 2 fuel oil consumption from the concurrent operation of the Plum Island NBAF and the PIADC is projected to be 2,500,000 gpy.

Depending on the available frequency of refueling of the tanks during the winter months, the fuel tank farm would not be deemed sufficient and would need to be doubled in capacity to meet the simultaneous operational fuel requirements of both the NBAF and the PIADC.

Fossils fuels would be irretrievably consumed during the construction and operation of the proposed NBAF. Diesel fuel and gasoline would be consumed by construction and maintenance equipment, and fuel oil would be consumed during operation of the facility. The loss of these materials would be irreversible.

3.3.6.3.4 Sanitary Sewage

Operation of the NBAF is projected to result in the discharge of between 50,000 gpd and 125,000 gpd of wastewater to the sanitary sewage system. Annual wastewater volume is estimated at 23,000,000 gpy (NDP 2008b). Currently, a tissue digester is not planned for Plum Island. Given the existing PIADC sanitary treatment system has a maximum design capacity of 120,000 gpd, the system would not meet some of the peak demand days from the combined operation of both PIADC and NBAF. Possible options for treatment of NBAF wastewater at Plum Island include:

- A new WWTP would need to be constructed to accommodate the projected NBAF loads. This new WWTP would require SPDES permitting for annual treatment capacity and pretreatment of animal feed solids removal carryover.

- Expansion of the existing PIADC facilities to handle the additional NBAF loads. This would also require permit revision and pretreatment of animal feed solids removal carryover.
- Add pretreatment holding tanks to the NBAF so that the peaks are averaged to fall within the existing permit levels. This would also require permit revision and pretreatment of animal feed solids removal carryover.

Regardless of the option selected, a new pump station would be required to move the effluent for the NBAF to the area of the selected treatment facility (NDP 2008b).

3.3.6.3.5 Steam and Chilled Water

The NBAF operation would require a peak steam load of 141,562 lb/hr including 55,000 lb/hr for process loads. To meet the firm capacity of the NBAF, five equally sized boilers at 28,312 lb/hr are required. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one boiler (NDP 2008b).

The NBAF operation would also require a peak chilled water load of 4,683 tons including 750 tons for process cooling. To achieve appropriate levels of redundancy, six equally sized chillers at 937 tons are required to maintain the firm capacity of 4,683 tons while meeting the requirement for total installed capacity of 5,622 tons. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one chiller (NDP 2008b).

3.3.7 Umstead Research Farm

This section describes the existing services available to support the operation of the NBAF at the Umstead Research Farm and the potential consequences and effects to the existing infrastructure from the addition of the facility. The infrastructure encompasses potable water supply, electrical power, fuels and natural gas, sanitary wastewater treatment facilities, and steam and chilled water.

3.3.7.1 Affected Environment

3.3.7.1.1 Potable Water Supply

Potable water is supplied by the South Granville Water and Sewer Authority (SGWASA). SGWASA utilizes surface water from Lake Holt as the potable water source for Granville County and is permitted to withdraw 7.5 mgd of raw water from Lake Holt. The water is treated in the SGWASA water treatment plant using flocculation, filtration, sedimentation, and clarification followed by chlorination and storage in a 1,000,000 gallon elevated tank. The 7.5 mgd capacity water treatment plant operates at approximately half capacity (3.0 mgd). SGWASA has indicated that the NBAF site projected water usage of 110,000 gpd [40 million gallons per year (gpy)] would be available from SGWASA on an annual basis due to the excess capacity of 4.5 mgd (April 25, 2007, letter from SGWASA, Lindsey Mize); (January 15, 2008, phone call to SGWASA, Lindsey Mize from Tetra Tech, Inc., Joe Rafferty); (January 24, 2008, phone call to SGWASA, Fred Dancy from Tetra Tech, Inc., Joe Rafferty).

The closest SGWASA water main, located approximately 4,500–5,500 feet south of the Umstead Research Farm Site, is an existing 8-inch water main running adjacent to Old Route 75. This existing water main has the capacity to deliver 783 gpm (about 1.1 mgd) at 50 psi of static pressure and has approximately 70% excess supply capacity at this operating pressure based on current consumption data (January 24, 2008, phone call to SGWASA, Fred Dancy from Tetra Tech, Inc., Joe Rafferty).

3.3.7.1.2 Electricity

Duke Energy, operating in the Carolinas Service Area, is the electrical utility responsible for providing power to the Umstead Research Farm Site (Duke Energy 2007). Duke Energy owns and operates numerous generation plants that utilize nuclear, coal, natural gas, fuel oil, and renewable energy sources (hydro) for 9,830 net mW within the Carolinas Service Area (Duke Energy 2007).

Duke Energy would supply three-phase electricity to the Umstead Research Farm Site through two independent electrical substations. The first 100 kV electrical substation with sufficient capacity for 13.5 mW of dedicated power, designated as the Butner Retail Substation located in Butner, North Carolina, is approximately 2 miles from the proposed site. The second 100 kV electrical substation with sufficient capacity for 13.5 mW of dedicated power would be the Staggville Retail substation. This would be a new substation dedicated to the NBAF and located approximately 4 miles to the west. Power from the two primary substations would be routed to the site through two new and separate aboveground or underground lines that converge at a third Duke Energy electrical substation to step the voltage down and distribute the two independent power supplies to the site. The third electrical substation would be located on or adjacent to the site and would have dual transformers, each with the capacity to supply the entire facility demand as required.

3.3.7.1.3 Fuels and Natural Gas

PSNC Energy is a regulated public utility engaged primarily in purchasing, transporting, distributing, and selling natural gas throughout a 28-county service area in north, central, and western North Carolina (PSNC 2008).

The existing PSNC Energy infrastructure to supply natural gas to the Umstead Research Farm Site includes an existing 4-inch, 60-psi supply distribution gas line running adjacent to Old Route 75 east of the intersection of State Road (SR) 1120 with Old Route 75. To supply the Umstead Research Farm Site, PSNC Energy's original intention was to extend the existing 4-inch, 60-psi service line approximately 5,600 feet north to the 249-acre site (January 11, 2008, e-mail to Joe Rafferty from Jerry O'Keeffe). The PSNC Energy extended 4-inch, 60 psi service line to service the Umstead Research Farm Site would be designed to supply a connected gas load of approximately 500 ccf/hr at a delivery pressure of 5 psi (January 11, 2008, e-mail to Joe Rafferty from Jerry O'Keeffe).

3.3.7.1.4 Sanitary Sewage

The SGWASA sewage treatment plant has a capacity of more than 5.0 mgd. The NBAF would discharge sanitary wastewater through approximately 6,500 feet of newly constructed gravity wastewater line that would connect the NBAF to the existing SGWASA 36-inch diameter gravity trunk wastewater main located south of Old Route 75 along a stream bed in the general direction of Old Route 75. This is a new sewage line (January 24, 2008 phone call to Fred Dancy from Joe Rafferty). The wastewater would subsequently flow into the SGWASA Sewage Treatment Facility. The trunk sewer line that would serve the Umstead Research Farm Site currently has 50% excess flow rate capacity. The existing SGWASA Sewage Treatment Plant has a design capacity of more than 5.5 mgd and is currently operating just below 50% capacity (February 15, 2008, consortium response to DHS data call). Additional information regarding sanitary sewage is evaluated in Section 3.13, Waste Management.

3.3.7.1.5 Steam and Chilled Water

The site does not have existing steam and chilled water infrastructure.

3.3.7.2 Construction Consequences

3.3.7.2.1 Potable Water Supply

Water would be required during the construction of the NBAF for dust suppression and wash down of equipment. Water for construction would likely be obtained through connection to a nearby fire hydrant or other connection, on which a temporary water meter could be attached, or trucked in from a nearby surface water source. The additional demand on the water supply from construction activities for the NBAF site would be negligible.

3.3.7.2.2 Electricity

There would be no additional demand on the electricity supply during construction of the NBAF. Portable electrical generators would be used throughout construction and installation of the facility.

3.3.7.2.3 Fuels and Natural Gas

Natural gas or No. 2 Fuel Oil would not be required for construction activities. However, construction activities would require the use of diesel and gasoline as fuel sources for mobile and stationary construction-associated equipment. Volume and consumption projections of diesel and gasoline usage during construction activities are not available at this time.

3.3.7.2.4 Sanitary Sewage

The construction site would be provided with portable chemical toilets in sufficient quantity to accommodate all site construction workers during construction. Periodically, the contents of the chemical toilets would be collected for ultimate discharge into the South Granville Water and Sewer Authority WWTP in Butner for treatment. The impact of this volume of sanitary waste on the treatment capacity of the WWTP would be minimal. Construction equipment would be washed down as necessary in a designated area with appropriate controls for collecting and managing the wash water.

3.3.7.3 Operation Consequences

3.3.7.3.1 Potable Water Supply

Potable water would be supplied to the NBAF by SGWASA. The NBAF designers recommended that municipal water service be brought to the site via redundant or looped feeds such that maximum water demand may be satisfied with loss of one feed line (NDP 2007b). Projected water consumption at the NBAF ranges between 50,000 gpd and 275,000 gpd, with a peak flow rate of 665 gpm at a minimum delivery pressure of 35 psi. The maximum daily consumption projections, substantially impacted by ambient temperature and humidity and, therefore, specific to a geographic region, include cooling tower make-up water for peak cooling days during the summer months and reduced usage projections for the cooler parts of the year. The estimated total annual water consumption for the Umstead Research Farm Site is projected to be 39,500,000 gallons (NDP 2007b). An irretrievable commitment of 1.98 billion gallons of potable water would be required over the 50-year project life.

The current SGWASA plans to serve the NBAF include a new 8-inch water supply main extending east from the site approximately 5,000 feet to connect with the existing 8-inch water main running adjacent to Old Route 75. The SGWASA water system is a looped system from the water treatment plant to the pumping system of the elevated water tanks, to Central Avenue (SR 1103) north to the junction of Central and 33rd Street and Old Route 75, then to the southwest along Old Route 75 to the junction of Old Route 75 and Veasey Road, then southeast on Veasey Road back to the elevated water storage tank pumping system. The 8 inch water main operating at 50 psi of static pressure along Old Route 75 where the Umstead Research

Farm Site would tie in has a current utilization of 30% and an excess capacity of 70% (January 24, 2008, phone call to Fred Dancy from Joe Rafferty). Using an average velocity constraint of 5.0 feet per second, the maximum capacity of the 8-inch water main is approximately 783 gpm or 1,127,997 gpd. At 30% utilization, the excess capacity would be approximately 790,000 gpd. The projected NBAF water usage of 110,000 gpd represents only 14% of the excess capacity from the existing 8-inch water main on Old Route 75. Based on the current SGWASA water system operating capacity of 3.0 mgd, an additional 4.5 mgd in water system treatment and delivery design capacity, and the ability to access nearby surface water sources for future capacity requirements, the SGWASA would have sufficient capacity to handle the NBAF demand in addition to other non-water intensive development within the Umstead Research Farm area (January 15, 2008, phone call to Lindsey Mize from Joe Rafferty).

According to the SGWASA Water and Sewer Regulations, Water Shortage Ordinance of January 8, 2008, the Umstead Research Farm Site is not in a jurisdiction where reclaimed water must be used for construction, landscape, or other non-potable uses, if reclaimed water is available. The SGWASA Water Shortage Ordinance was adopted due to the sustained drought conditions in the general area and relies solely on restrictions for water usage. The reuse or reclamation of raw or treated waste waters is not included in the current SGWASA strategy for coping with water shortage (SGWASA 2008a; SGWASA 2008b).

3.3.7.3.2 Electricity

Two existing, redundant, medium-voltage services with multiple feeders would be provided by Duke Energy to serve the NBAF. Each independent substation would have sufficient capacity for 13.5 mW of dedicated power to the NBAF. Power from the two primary substations would be routed through two new and separate aboveground or underground lines that converge at a new electrical substation located on or adjacent to the site to step the voltage down and distribute the two independent power supplies to the Umstead Research Farm Site.

Operating demand for electricity at the NBAF is projected at 12.8 mW (NDP 2007a), which represents 0.13% of Duke Energy's current generating capacity of 9,832 mW in the Carolinas Service Area. The design requirements for electrical service to the NBAF site include a minimum of two redundant medium-voltage services with multiple feeders, an on-site utility substation at 34.5 kV with two transformers feeding 15 kV Class switchgear in a main-tie-main arrangement. The secondary feeders would provide primary electric service at 13.8 kV to the CUP and to the NBAF buildings (NDP 2008b). Based on current information, Duke Energy would have sufficient capacity to meet the requirements of the NBAF and is confident they can supply any demand.

3.3.7.3.3 Fuels and Natural Gas

Operation of the NBAF is projected to require 1,193,900 ccf /yr of natural gas. On an average basis, the NBAF would be expected to exert a natural gas demand of 3,271 ccf/day. The peak gas demand from the NBAF is estimated at 1,480 ccf/hr at a supply pressure of 10 psi (NDP 2008b).

The CUP, constructed as part of the NBAF, would house multiple dual-fuel (natural gas/No. 2 fuel oil) boilers. The primary fuel source for the boilers is to be determined based on local fuel availability (NDP 2007b). In the case of the Umstead Research Farm Site, natural gas would be the primary fuel source to meet peak demand. Fuel oil would be used in cases where natural gas is not available. Natural gas would be piped to the CUP through a pressure reducing station, at an approximate pressure of 10 psi. Metering equipment and main pressure-reducing valve would be located outside the plant (NDP 2007b).

The PSNC Energy proposed building a 5,600 foot long, 4-inch diameter, 60-psi supply pressure distribution gas line running south from the NBAF site. The new line, which would connect to the existing 4-inch, 60-psi supply distribution gas line running adjacent to Old Route 75 east of the intersection of SR 1120 (Veasey Road) and Old Route 75, would not be sufficient to meet the annual consumption or the peak usage requirements of the NBAF without substantial improvements to the natural gas distribution infrastructure. To meet the connected load requirements for the NBAF PSNC Energy plans to enhance its current system by connecting to an additional distribution main located approximately 14,615 feet to the west of the NBAF site along Old Route 75. A new 6-inch line would then be run from the upgraded distribution main at Old Route 75 approximately 4,475 feet north to the site. Based on current PSNC Energy commitments, the natural gas infrastructure improvements should be sufficient to meet the projected and future gas needs of the NBAF.

Fossils fuels would be irretrievably consumed during the construction and operation of the proposed NBAF. Diesel fuel and gasoline would be consumed by construction and maintenance equipment, and fuel oil and natural gas would be consumed during operation of the facility. The loss of these materials would be irreversible.

3.3.7.3.4 Sanitary Sewage

Operation of the NBAF is projected to result in the discharge of between 50,000 gpd and 150,000 gpd of wastewater to the sanitary sewage system. Annual wastewater volume is estimated at 25,250,000 gpy (NDP 2008b). If a tissue digester is used for carcass disposal, the waste stream from the tissue digester, estimated at 2% of the total discharge volume, would be commingled for discharge with the rest of the NBAF wastewater. The projected wastewater constituents in the tissue digester waste stream include BOD – 10,250 mg/l; COD – 19,600 mg/l; suspended solids – 1,400 mg/l; and pH – 9.48 standard units (NDP 2008b).

The NBAF would discharge sanitary wastewater into approximately 6,500 feet of new SGWASA-installed, gravity sanitary sewer line from the Umstead Research Farm Site to the existing SGWASA 36-inch diameter gravity trunk wastewater main located south of Old Route 75 along a stream bed in the general direction of Old Route 75 (January 24, 2008, phone call to Fred Dancy from Joe Rafferty). The collected sanitary wastewater from the NBAF would flow through the newly constructed wastewater line, into the existing 36-inch wastewater main, and subsequently into the existing SGWASA Sewage Treatment Facility. Further information regarding the sewer system is found in Section 3.13, Waste Management.

Sewage acceptance criteria and pretreatment requirements would apply to the NBAF wastewater discharge. A listing of SGWASA technically based local limits for industrial wastewater discharge into the SGWASA Sewage Treatment Facility are presented in Table 3.3.7.3.4-1 (SGWASA 2007). The NBAF would be designed and operated as necessary to prevent negative impact to the SGWASA Sewage Treatment Facility treatment capabilities resulting from flow rate or potentially harmful wastewater constituents.

Table 3.3.7.3.4-1 — SGWASA Technically Based Local Limits

Constituent	Limits	Units
BOD	300	mg/l
COD	600	mg/l
Total Suspended Solids	300	mg/l
Ammonia	25	mg/l
Chlorides	200	mg/l
Total Nitrogen	50	mg/l
Total Kjeldahl Nitrogen	40	mg/l
Phosphorus	10	mg/l
Arsenic	0.005	mg/l
Cadmium	0.002	mg/l
Total Chromium	0.043	mg/l
Copper	0.061	mg/l
Cyanide	0.01	mg/l
Lead	0.02	mg/l
Mercury	0.0002	mg/l
Nickel	0.02	mg/l
Silver	0.01	mg/l
Zinc	0.175	mg/l

Source: SGWASA 2007.

3.3.5.3.5 Steam and Chilled Water

The NBAF operation would require a peak steam load of 136,232 lb/hr including 55,000 lb/hr for process loads. To meet the firm capacity of the NBAF, six equally sized boilers at 27,246 lb/hr are required to maintain the firm capacity of 136,232 lb/hr while meeting the requirement for total installed capacity of 163,476 lb/hr. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one boiler (NDP 2008b).

The NBAF operation would also require a peak chilled water load of 5,125 tons including 750 tons for process cooling. To achieve appropriate levels of redundancy, six equally sized chillers at 1,025 tons are required to maintain the firm capacity of 5,125 tons while meeting the requirement for total installed capacity of 6,150 tons. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one chiller (NDP 2008b).

3.3.8 Texas Research Park

This section describes the existing services available to support the operation of the NBAF at the Texas Research Park and the potential consequences and effects to the existing infrastructure from the addition of the facility. The infrastructure encompasses potable water supply, electrical power, fuels and natural gas, sanitary wastewater treatment facilities, and steam and chilled water.

3.3.8.1 Affected Environment

3.3.8.1.1 Potable Water Supply

Potable water is supplied to the Texas Research Park Site by Bexar Metropolitan Water District (BMWD) Texas Research Park Public Water System using existing water wells and tanks located within the Texas Research Park property (Krauss 2007). The BMWD wells draw from the Edwards Aquifer, the source for most of the potable water supplied by BMWD and other utilities serving Bexar County (BSA 2007). The groundwater is of high quality, requiring minimal treatment prior to distribution. The BMWD method of water treatment is disinfection by chlorination (BSA 2007). The BMWD has indicated that 60 million gallons of water would be available on an annual basis for use by the NBAF (York Duncan, TRP, January 30, 2007 letter from Miyoung Squire, Bexar Metro Water District).

An existing 16-inch water main located at Lambda Drive, which fronts the east property line of the Texas Research Park Site, is part of a looped system that goes through the Texas Research Park property, with the capacity to deliver 2,250 gpm at 85 to 115 psi (M. Persyn, Bexar Metro Water District, e-mail December 19, 2007, to Joe Rafferty, Tetra Tech, Inc.). The water main has approximately 90% excess flow rate capacity at this pressure under current 2006 usage (M. Persyn, Bexar Metro Water District, e-mail December 19, 2007, to Joe Rafferty, Tetra Tech, Inc.).

3.3.8.1.2 Electricity

CPS Energy, the largest municipally owned energy company in the United States, serves a 1,566 square mile area, including all of Bexar County and small portions of the adjacent counties (CPS 2007). CPS Energy owns and operates nine generation plants that utilize nuclear, coal, natural gas, and renewable energy sources to generate a total electrical capacity of 5,468 mW, with a reserve capacity in excess of 20% (York Duncan, January 30, 2007, letter from Al Lujan, CPS).

CPS Energy's current generating capacity of 5,468 mW exceeds peak electrical grid demand of 4,117 mW. CPS Energy has obtained a permit from the Texas Commission on Environmental Quality (TCEQ) and has begun construction on a 750 mW low-sulfur coal-fired generating unit that would be equipped with the latest emissions control technology. The new unit is scheduled for completion by 2010. In addition, CPS acquired renewable energy resources, including 100 mW of new wind power capacity, and 9.6 mW of capacity from a landfill gas facility, during 2005 and 2006 (CPS 2007).

CPS Energy would supply three-phase electricity (i.e., alternating current through three different conductors) to the Texas Research Park Site through two independent 35 kV electrical substations with sufficient capacity for 13.5 mW of dedicated power. Both 35 kV electrical substations are located within 0.5 miles of the Texas Research Park Site and within the Texas Research Park boundaries.

Power from the two substations would be routed to the Texas Research Park Site through two new and separate underground lines within an existing underground electric duct bank running adjacent to Lambda Drive (BSA 2007). The two separate lines would converge at a third electrical substation, to step the voltage down, and distribute the two independent power supplies to the NBAF. The third electrical substation would be located on, or adjacent to, the Texas Research Park Site and would have dual transformers, each with the capacity to handle the entire facility demand as required.

3.3.8.1.3 Fuels and Natural Gas

CPS Energy serves Bexar and Comal Counties, with purchases of approximately 20 to 25 billion cubic feet (bcf) per year for resale to natural gas customers and an additional 30 to 40 bcf per year for electrical power generation (CPS 2007).

The current CPS Energy natural gas infrastructure bordering the Texas Research Park Site is a 4-inch diameter, supply pressure distribution gas line running adjacent to Lambda Drive (Krauss 2007). The nominal operating pressure of this 4-inch supply pressure distribution gas line ranges between 12 and 25 psi. The MAOP for this line is 59 psi. The supply capacity of the 4-inch gas distribution line is 1,470 ccf/hr or 12,877,200 ccf/yr at 5 psi delivery pressure (Mark Blythe, CPS Energy, January 17, 2008, phone call from Joe Rafferty, Tetra Tech, Inc.). The current utilization of natural gas from this supply main averages 310 ccf/hr at 5 psi, resulting in a 79% excess flow rate capacity at this pressure under current conditions (Mark Blythe, CPS Energy, January 17, 2008, phone call from Joe Rafferty, Tetra Tech, Inc.).

3.3.8.1.4 Sanitary Sewage

The Texas Research Park Site would discharge sanitary wastewater into the San Antonio Water System (SAWS) 27-inch diameter gravity wastewater main located approximately 4.6 miles to the southeast, north of Highway 90 and east of SR 211. Approximately 24,000 feet of new sewer main would be required to tie the Texas Research Park Site to the existing 27-inch diameter sewer main (SAWS 2008b). Collected sanitary wastewater from the NBAF area would flow through SAWS Far West area lines and eventually into the SAWS Medio Creek Wastewater Reclamation Center (WRC). The Medio Creek WRC has a wastewater treatment capacity of 8.5 mgd (Krauss 2007; SAWS 2007). The 27-inch trunk sewer line that would serve the Texas Research Park Site currently has, or would have, contractually mandated excess flow rate capacity sufficient to accommodate the projected sanitary sewage loading from the NBAF. Additional information regarding sanitary sewage is evaluated in Section 3.13, Waste Management.

3.3.8.1.5 Steam and Chilled Water

The site does not have existing steam and chilled water infrastructure.

3.3.8.2 Construction Consequences

3.3.8.2.1 Potable Water Supply

Water would be required during the construction of the NBAF for dust suppression and wash down of equipment. The water would likely be supplied via tanker truck at the point of use or obtained though a metered connection to an existing fire hydrant or similar connection. The additional demand on water supply from construction activities for the NBAF site would be negligible.

3.3.8.2.2 Electricity

There would not be additional demand on the electricity supply during construction of the NBAF. Portable electrical generators would be utilized throughout facility construction and installation.

3.3.8.2.3 Fuels and Natural Gas

Natural gas or No. 2 Fuel Oil would not be required for construction activities. However, construction activities would require the use of diesel and gasoline as fuel sources for mobile and stationary construction associated equipment. Volume and consumption projections of diesel and gasoline usage during construction activities are not available at this time.

3.3.8.2.4 Sanitary Sewage

The construction site would be provided with portable chemical toilets in sufficient quantity to accommodate all site construction workers during the construction phase of the NBAF. Periodically, the contents of the chemical toilets would be collected for ultimate discharge into the SAWS Medio Creek WRC for treatment. The impact of this volume of sanitary waste on the treatment capacity of the WRC would be minimal. Construction equipment would be washed down as necessary in a designated area with appropriate controls for collecting and managing the wash water.

3.3.8.3 Operation Consequences

3.3.8.3.1 Potable Water Supply

Potable water would be supplied to the NBAF by BMWD. The NBAF designers recommended that municipal water service be brought to the site via redundant or looped feeds such that maximum water demand may be satisfied with loss of one feed line (NDP 2007b). Projected water consumption at the NBAF ranges between 50,000 gpd and 275,000 gpd with a peak flow rate of 656 gpm at a minimum delivery pressure of 35 psi. The maximum daily consumption projections, substantially impacted by ambient temperature and humidity and, therefore, specific to a geographic region, include cooling tower make-up water for peak cooling days during the summer months and reduced usage projections for the cooler parts of the year. The estimated total annual water consumption for the Texas Research Park Site is projected to be 51,750,000 gallons (NDP 2007b). An irretrievable commitment of 2.59 billion gallons of potable water would be required over the 50-year project life.

The current BMWD infrastructure includes a 16-inch water main located adjacent to the east property line of the Texas Research Park Site on Lambda Drive. The feeder main is part of a looped system that goes through the Texas Research Park property and has the capacity to deliver 2,250 gpm at 85 to 115 psi. This equates to the existing main having approximately 70% excess flow rate capacity at this pressure. With future improvements planned for 2008, the BMWD Texas Research Park Public Water System would have sufficient capacity to handle the NBAF demand, in addition to other non-water intensive development within the Texas Research Park (BSA 2007).

The Texas Research Park Site is not in a jurisdiction where reclaimed water must be used for construction, landscape, or other non-potable uses if reclaimed water is available according to the Code of Ordinances city of San Antonio, Chapter 34, Article IV, Division 5 – Reuse. However, if the area experiences sustained drought conditions, then water conservation requirements to include the use of reclaimed water may be implemented (SATCO 2007a).

3.3.8.3.2 Electricity

Two existing, redundant, medium-voltage services with multiple feeders would be provided by CPS Energy to serve the NBAF. Each independent substation would have sufficient capacity for 13.5 mW of dedicated power to the NBAF. Power from the two primary substations would be routed to the Texas Research Park Site through two new and separate aboveground or underground lines that converge at a new electrical substation located on or adjacent to the site to step the voltage down and distribute the two independent power supplies to the NBAF.

Operating demand for electricity at the NBAF is projected at 12.8 mW (NDP 2007a), which represents only 0.23% of CPS Energy's current generating capacity of 5,468 mW. The design requirements for electrical service to the NBAF include a minimum of two redundant medium-voltage services with multiple feeders, an on-site utility substation at 34.5 kV with two transformers feeding 15 kV Class switchgear in a main-tie-main arrangement. The secondary feeders would provide primary electric service at 13.8 kV to the CUP and to the NBAF buildings (NDP 2008b). Based on current information, CPS Energy would have sufficient capacity to meet the requirements of the NBAF, other developments at Texas Research Park, and projected area population growth (BSA 2007).

3.3.8.3.3 Fuels and Natural Gas

Operation of the NBAF is projected to require 1,002,300 ccf/year of natural gas. On an average basis, the NBAF would be expected to exert a natural gas demand of 2,746 ccf/day. The peak gas demand from the NBAF is estimated at 1,550 ccf/hr at a supply pressure of 10 psi (NDP 2008b).

The CUP, constructed as part of the NBAF, would house multiple dual-fuel (natural gas/No. 2 fuel oil) boilers. The primary fuel source for the boilers is to be determined based on local fuel availability (NDP 2007b). In the case of the Texas Research Park Site, natural gas would be the primary fuel source to meet peak demand. Fuel oil would be used in cases where natural gas is not available. Natural gas would be piped to the CUP through a pressure-reducing station, at an approximate pressure of 10 psi. Metering equipment and main pressure-reducing valve would be located outside the plant (NDP 2007b).

The existing 4-inch diameter, CPS Energy supply pressure distribution gas line running adjacent to Lambda Drive with a supply capacity of 1,470 ccf/hr at 5 psi delivery pressure would not be sufficient to meet the peak usage requirements of the NBAF. A new 6-inch high pressure distribution line, approximately 2,550 feet in length, to supply the Texas Research Park Site is recommended by CPS Energy to meet the peak capacity and annual usage requirements of the NBAF (Mark Blythe, CPS Energy, April 17, 2008, phone call from Joe Rafferty, Tetra Tech, Inc.). Therefore, CPS Energy considers their natural gas capacity sufficient to meet the projected and future gas needs of the NBAF operation, other developments at Texas Research Park, and area population growth (BSA 2007).

Fossils fuels would be irretrievably consumed during the construction and operation of the proposed NBAF. Diesel fuel and gasoline would be consumed by construction and maintenance equipment, and fuel oil and natural gas would be consumed during operation of the facility. The loss of these materials would be irreversible.

3.3.8.3.4 Sanitary Sewage

Operation of the NBAF is projected to result in the discharge of between 50,000 gpd and 150,000 gpd of wastewater to the sanitary sewage system. Annual wastewater volume is estimated at 29,250,000 gpy (NDP 2008b). If a tissue digester is used for carcass disposal, the waste stream from the tissue digester, estimated at 2% of the total discharge volume, would be commingled for discharge with the rest of the NBAF wastewater. The projected wastewater constituents in the tissue digester waste stream include BOD – 10,250 mg/l; COD – 19,600 mg/l; suspended solids – 1,400 mg/l; and pH – 9.48 standard units (NDP 2008b).

The NBAF would discharge sanitary wastewater into the nearest existing SAWS 27-inch diameter gravity wastewater main, located approximately 4.6 miles to the southeast, north of Highway 90 and east of SR 211, and eventually into the SAWS Medio Creek WRC for treatment. Approximately 24,000 feet of new sewer main would be required to tie the NBAF to the existing 27-inch diameter sewer main (SAWS 2008b). Further information regarding the sewer system is found in Section 3.13, Waste Management.

Sewage acceptance criteria and pretreatment requirements would apply to the NBAF wastewater discharge. A listing of SAWS technically based local limits for industrial wastewater discharge into the Medio Creek WRC are presented in Table 3.3.8.3.4-1 (SATCO 2007b). The NBAF would be designed and operated as necessary to prevent negative impact to the Medio Creek WRC treatment capabilities resulting from flow rate or potentially harmful wastewater constituents.

Table 3.3.8.3.4-1 — Medio Creek WRC Technically Based Local Limits

Constituent	Limits	Units
Arsenic	0.7	mg/l
Cadmium	0.7	mg/l
Chromium	5	mg/l
Copper	1.5	mg/l
Total Cyanide	0.17	mg/l
Lead	0.7	mg/l
Mercury	0.05	mg/l
Nickel	5	mg/l
Selenium	0.02	mg/l
Silver	0.5	mg/l
Zinc	2.5	mg/l
Fats Oil and Grease	200	mg/l
pH	5.5 – 10.5	Standard Units
Temperature	<150°	Fahrenheit

3.3.8.3.5 Steam and Chilled Water

The NBAF operation would require a peak steam load of 129,373 lb/hr including 55,000 lb/hr for process loads. To meet the firm capacity of the NBAF, six equally sized boilers at 25,875 lb/hr are required to maintain the firm capacity of 129,373 lb/hr while meeting the requirement for total installed capacity of 155,250 lb/hr. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one boiler (NDP 2008b).

The NBAF operation would also require a peak chilled water load of 5,162 tons including 750 tons for process cooling. To achieve appropriate levels of redundancy, six equally sized chillers at 1,032 tons are required to maintain the firm capacity of 5,162 tons while meeting the requirement for total installed capacity of 6,192 tons. This configuration would allow the peak capacity of the facility to be met in the event of the loss of one chiller (NDP 2008b).

3.4 AIR QUALITY

3.4.1 Methodology

Baseline data on local and regional climate and air quality were obtained from local, state, and federal sources. Federal sources such as the National Climatic Data Center (NCDC), the Southeast Regional Climate Center (SERCC), and the High Plains Regional Climate Center (HPRCC) were key climate data resources. Additional information on potential factors affecting air emissions from the Proposed Action were derived from projected activities described in the *NBAF Conceptual Design and Feasibility Study* and *Site Characterization Study*, current operational data from the existing PIADC, and studies conducted on similar types of facilities.

The proposed pathological waste disposal method for the NBAF has not been determined at this time and would be an influencing factor on facility air emissions. Three disposal methods are being considered: incineration fueled by natural gas and fitted with afterburner chambers that reduce intermediate gases and particulate matter; alkaline hydrolysis using sodium hydroxide or potassium hydroxide to convert biological material into a sterile aqueous solution; or rendering by converting the carcasses into carcass meal (solids), melted fat, and water using a steam-jacketed pressure vessel. Refer to Section 3.13 for additional waste disposal information. If one of the action alternatives is selected and the disposal method is determined, a state authorization would be required prior to construction and operation of that alternative.

Air emission data for the proposed NBAF, such as but not limited to process data, emission source data, and operating schedules, would be required. These data would be used in formulating a complete air emission inventory, a quantitative and qualitative comparison with area background emissions/attainment status, a federal general conformity analysis, and a compatibility assessment with State Implementation Plan (SIP) efforts. The emission inventory would account for all applicable emission sources and process rates, including potential and projected emissions. The projected emissions would be used in a federal general conformity analysis if the selected alternative is within a nonattainment area. The General Conformity Rule of the *Clean Air Act* requires that all federal projects with the potential of new or expanded air emission sources demonstrate that the proposed activity would not adversely affect a SIP. EPA has developed *de minimis l*evels, of additional/new emissions, that are considered below threshold levels necessary for further General Conformity Rule efforts. If the alternative selected is within a nonattainment area and the projected emissions exceed the *de minimis* thresholds, then a conformity analysis would be completed (EPA 2007d). Emissions from the proposed NBAF would not be anticipated to impede a state's plan for restoring an area's pollutant(s) specific National Ambient Air Quality Standards (NAAQS) compliance. Table 3.4.1-1 describes the threshold criteria pollutant emissions, in tons/year, that requires a general conformity determination.

Table 3.4.1-1 — De Minimis General Conformity Analysis Thresholds

Pollutant	Area Type	Tons/ Year
Ozone (VOC or NO_x)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NO_x)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon Monoxide, Sulfer Dioxide, and Nitrogen Dioxide	All nonattainment & maintenance	100
Particulate Matter (PM_{10})	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
Lead	All nonattainment & maintenance	25

Nonattainment area classification	Ozone design value (EPA 1999)
Serious	0.160 ppm to 0.180 ppm
Severe	0.180 ppm to 0.280 ppm
Extreme	0.280 ppm and higher

(The Ozone design value is the 3-yr average of the annual fourth-highest daily maximum 8-hr ozone concentration.)
VOC = Volatile Organic Compound.
NO_x = Nitogen Oxides.

An emission inventory would further define potential emissions, dictating the level of permitting, such as Title V applicability. EPA's Title V of the *Clean Air Act* considers potential sources of criteria pollutants in excess of 100 tons per year, single Hazardous Air Pollutant (HAP) of 10 tons per year, or combination of HAPs exceeding 25 tons per year as major sources. Through regulatory consultation and emission inventory development/assessment, a facility's operation would be permitted based on a worst-case potential emission scenario. As a Title V source under the *Clean Air Act* of 1990, the proposed NBAF would have permit requirements and conditions such as, but not limited to:

- Enforceable emissions limitations;
- Compliance schedules;
- Monitoring/analysis submittals (no less than every 6 months);
- Inspection/maintenance certifications;
- Annual fee (per ton of emissions);
- Permit applications, renewals, or modifications reviewed and commented on by EPA;
- Notification of permit actions to contiguous and potentially impacted states;
- Notification of permit action to all states within 50 miles of the source; and
- Public comment period on applications or modifications (EPA 2007a; EPA 2007b).

The EPA Screen3 model is an air contaminant concentration evalution tool. This cursory model is used to determine the potential of a point source to exceed the NAAQS at site specified distances. The screening format for each action alternative would be developed with equivalent terrain features, facility/stack characteristics, and meteorology assumptions. Estimated operational emission rates, as extrapolated from PIADC's 2002-2005 emissions evaluation, conceptual property line locations, and theoretical facility placement would be site specific.

A similar cursory level approach was taken for construction emissions as extrapolated from construction emission estimates for nitrogen oxides (NO_x) and ozone (O_3) for the University of Texas Medical Branch (UTMB) at Galveston National Biocontainment Laboratory (NBL).

The emission inventory would be used in conjunction with structural layouts, property boundaries, meteorological conditions, and background emission levels to produce, if needed, an air dispersion modeling effort that would determine emission concentrations and NAAQS compliance at the compound's property lines. Table 3.4.1- 2 below describes the NAAQS for the criteria pollutants: nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), lead (Pb), and inhalable particulate matter (PM_{10}: particles with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$: particles with an aerodynamic diameter less than or equal to 2.5 microns) (EPA 2007e).

Table 3.4.1-2 — National Ambient Air Quality Standards

	Primary Standards		Secondary Standards	
Pollutant	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m^3)	8 hour[a]	None	
	35 ppm (40 mg/m^3)	1 hour[a]		
Lead	1.5 µg/m^3	Quarterly Average	Same as Primary	
Nitrogen Dioxide	0.053 ppm (100 µg/m^3)	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (PM_{10})	150 µg/m^3	24 hour[b]	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual[c] (Arithmetic Mean)	Same as Primary	
	35 µg/m^3	24 hour[d]	Same as Primary	
Ozone	0.075 ppm (2008 std)	8 hour[e]	Same as Primary	
	0.08 ppm (1997 std)	8 hour[f]	Same as Primary	
	0.12 ppm	1 hour[g] (Applies only in limited areas)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm (1300 µg/m^3)	3 hour(1)
	0.14 ppm	24 hour[a]		

[a] Not to be exceeded more than once per year.
[b] Not to be exceeded more than once per year on average over 3 years.
[c] To attain this standard, the 3-yr average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
[d] To attain this standard, the 3-yr average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).
[e] To attain this standard, the 3-yr average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).
[f] (a) To attain this standard, the 3-yr average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
[g] (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.
(b) As of June 15, 2005, EPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas.
mg/m^3 – milligrams per cubic meter
µg/m^3 – micrograms per cubic meter
ppm – parts per million

Based on the ambient air concentrations of these pollutants, EPA evaluates individual Air Quality Control Regions to establish compliance or non-compliance with NAAQS. Areas that meet the NAAQS are classified as attainment areas, and areas that exceed the NAAQS for a particular pollutant(s) are classified as nonattainment areas for that specific pollutant(s). Ambient air monitoring networks are established nationwide to report air pollutant concentration data to EPA (EPA 2007e). An air pollution monitor may be sited to evaluate ambient air contaminant concentrations or specific facility emissions. The data generated from these networks are evaluated in terms of meeting or exceeding the established primary and secondary criteria pollutant standards. If a monitoring site persistently exceeds the EPA set standards, then the region may be classified as nonattainment for that specific pollutant. States with nonattainment areas must develop a SIP that describes proposed measures to restore NAAQS compliance to the region. In the spring of 2008, EPA reduced the primary 8 hour ozone standard from 0.08 ppm to 0.075 ppm. This reduction in the 8 hour ozone standard is included in Table 3.4.1-2 and was evaluated in each site's air quality analysis.

In an effort to describe potential construction emissions, an emission comparison was developed using 2005 construction emission estimates (ozone precursors volatile organic compounds [VOC] and nitrogen oxides [NO_x]) developed from the (NBL) at the UTMB preliminary design (UTMB 2003). This comparison was selected due to the similarities between the NBL and the NBAF as large biocontainment facilities. A comparison for potential operational traffic emissions was also developed using the Emissions Factor (EMFAC) 2002 Burden Model for California Air Resource Board. If an action alternative is selected then air emission evaluations including construction and operational sources would facilitate air permitting efforts that would be produced, submitted, and agency reviewed, with authorization, prior to operational start-up.

SCREEN3, version 96043, an EPA dispersion modeling program was used to estimate the impact of emissions from the NBAF at each site alternative on the ambient air concentrations (Earth Tech 2008). Although the program has the capability to model both area and volume sources, when applied to mobile construction sources, numerous assumptions have to be made which reduce the confidence in the results.

Predicted maximum offsite impacts for each criteria pollutant were estimated by the ratio of the calculated emission rate to the unity emission rate. The analysis also scaled the impacts for the appropriate time-averaging period for each pollutant, and added in the background concentration of each pollutant. Conservative parameters were assumed for the combined stack relative to those that might be expected for the individual source stacks (i.e. low stack height, temperature and velocity).

Emission rates were determined from existing emission estimates from similar facilities. Emissions from several sources associated with the proposed agricultural research laboratory, including boilers, generators, and an incinerator were summed, and are assumed to be emitted from a single stack. This simplifying assumption was deemed appropriate for this preliminary screening phase of the site selection process, where specific individual source stack parameters are lacking. Only emissions from operations were presented; construction activities are temporary, and would be modeled separately if required.

The model-predicted ambient impacts for each pollutant were added to the background concentrations for the state where the proposed site may be located, and this sum was then compared to the National Ambient Air Quality Standards (NAAQS). States vary how pollutant background concentrations are calculated. For the purpose of this preliminary evaluation, measured concentrations of pollutants were obtained from the EPA AirData website for locations nearest the proposed site for the year 2007.

3.4.2 No Action Alternative

3.4.2.1 Affected Environment

3.4.2.1.1 Climate and Severe Weather

The Long Island area climate, including Plum Island, is classified as temperate-humid-continental and characterized by four defined seasons. The Atlantic Ocean brings afternoon sea breezes that temper the heat in the warmer months and that routinely limit the frequency and severity of thunderstorms. This maritime influence affects the island's weather patterns and temperatures. Long Island has warm, humid summers and cold winters. Wintertime temperatures at Plum Island are warmer than inland areas, and mainland snowstorms may fall as island rain. However, in winter months more intense storms called "nor'easters" can produce blizzard conditions with snowfalls of 1–2 feet and near-hurricane force winds (BNL 2008).

The mean temperature for Suffolk County ranges from 32.4°F in the winter to 71.9°F in the summer. The highest temperature recorded at the Brookhaven National Laboratory since 1949 has been 100.5°F, and the lowest temperature recorded was -23°F (BNL 2008). Average rainfall for Suffolk County is approximately 42 inches per year and snowfall averages approximately 27 inches per year (www.longisland.com). Regional wind patterns are dominated by westerly winds, primarily northwest in the winter and southwest in the summer (BNL 2008).

3.4.2.1.2 Air Quality

Suffolk County is a nonattainment area for O_3 and $PM_{2.5}$ and usually exceeds the NAAQS limits during the summer months. This nonattainment status is based on the monitoring stations on Long Island and other densely populated areas to the west (e.g., New York City). Plum Island's relatively remote location coupled with the island's prevailing sea breezes arguably affects the potential for exceeding NAAQS for these two pollutants. Suffolk County is in compliance with all other NAAQS (EPA 2008f).

Mobile and stationary air emission sources currently operating on Plum Island may influence local air quality, and a New York State Facility Air Permit is required for all PIADC facility air emission sources, which currently include generators, boilers, and 3 incinerators. Mobile air emission sources at Plum Island are vehicles used to support the current PIADC. These mobile sources include automobiles, light trucks, and a small number of diesel-powered vehicles. Currently, there are 32 gas-powered light vehicles, 3 diesel-powered buses, 3 diesel-powered fire/rescue vehicles, 11 pieces of diesel-powered heavy equipment, and three propane-fueled forklifts operating on the island (K. Klotzer, PIADC Environmental Specialist, personal communication, January 26, 2008). Additional mobile sources include the government transport ferries and other marine traffic transiting the surrounding waters.

<u>Generators</u>

PIADC currently has two trailer-mounted generators that are used as emergency back-up power. For comparison purposes, refer to Tables 3.4.3.3.2-1 and 3.4.3.3.2-2 for operational emission estimates developed for a potential NBAF back up generator system.

<u>Boilers</u>

PIADC currently uses three low sulfur fuel oil powered boilers to provide steam for heating and decontamination procedures. The facility routinely operates one boiler 8,760 hrs/yr and the remaining two units each operate approximately 4,380 hrs/yr (K. Klotzer, PIADC, April 1, 2008). The average rated emissions for these boilers are: particulates 0.23 lb/hr; carbon monoxide 0.57 lb/hr; sulfur oxide 8.10 lb/hr; and volatile organics 0.06 lb/hr. Table 3.4.2.1.2-1 assumes one boiler operating year round and two boilers each operating for half of the year.

Table 3.4.2.1.2-1 — Average Rated PIADC Boiler Emissions

Boiler Systems	Annual Operating Hours	Particulate Emissions 0.23 lb/hr	Carbon Monoxide Emissions 0.57 lb/hr	Nitrogen Oxides Emissions 2.28 lb/hr	Sulfur Oxides Emissions 8.10 lb/hr	Volatile Organic Emissions 0.06 lb/hr
	hr	lb/year	lb/year	lb/year	lb/year	lb/year
Boiler A	8,760	2,015	4,993	19,973	70,956	526
Boiler B	4,380	1,007	2,497	9,986	35,478	263
Boiler C	4,380	1,007	2,497	9,986	35,478	263
Total by Pollutant ton/year		2	5	20	71	0.53

<u>Incinerators</u>

PIADC currently operates three incinerators, fueled by No. 2 fuel oil. In 2004, PIADC voluntarily stack tested two of the three incinerators. By applying the 2004 stack testing results to average operational hours and load rates, a facility emissions evaluation was developed for the 2002-2005 operational period. During this timeframe, the incineration procedure typically occurred 100 days per year, with an average daily burn time of 10 hours per day (1,000 hour/year). The annual average weight of incinerated refuse was 124,225 lbs/year or an actual average incineration rate of 124 lbs/hour. See Tables 3.4.2.1.2-2 and 3.4.2.1.2-3 below.

Table 3.4.2.1.2-2 — PIADC Incineration Emissions Evaluation, 2002–2005

Pollutant	Average Emissions tons\yr
Particulates	0.125
Nitrogen Oxides	0.358
Carbon Monoxide	0.002
Hydrochloric Acid	0.039

Table 3.4.2.1.2-3 — PIADC Incineration Emissions Evaluation for Metals, 2002–2005

Metals	Average Emissions lbs\yr
Mercury	0.005
Arsenic	0.009
Beryllium	0.004
Cadmium	0.011
Chromium	0.088
Lead	0.145
Total Metals	0.262

3.4.2.2 Construction Consequences

3.4.2.2.1 Climate and Severe Weather

Approved enhancements and upgrades for PIADC would meet or exceed all general construction requirements. The construction techniques would mirror current facility construction, and any new or modified construction specifications or guidelines would be complied with. The upgrade designs would not result in significant adverse environmental effects and would meet or exceed all required wind loads, site specific seismic design criteria, and would not be constructed within a floodplain. Construction upgrades for PIADC would not have an anticipated adverse effect on the region’s climate, and all necessary weather response plans would be administered during the construction phase.

3.4.2.2.2 Air Quality

Construction enhancements and upgrades for PIADC would not result in significant air emission increases. The upgrades would be serviced by existing boiler, generator, and incinerator infrastructures. During site preparation and construction, the use of heavy equipment, delivery trucks, worker vehicles, and land clearing efforts would generate short-term air emissions. These emissions would be brief and similar to those experienced during any ordinary construction effort. Through implementation of good engineering practices and overall good housekeeping, enhancements and construction at PIADC would not have an anticipated adverse effect on ambient air quality of Plum Island.

3.4.2.3 Operation Consequences

3.4.2.3.1 Climate and Severe Weather

Once the enhancements and upgrades are completed, PIADC operations would fall within current or modified weather response plans. The current infrastructure would support the upgrades, and potential infrastructure improvements would further improve the facility's compliance and response capabilities. Operation upgrades for PIADC would not have an anticipated adverse effect on the region's climate, and all inclement weather response plans would be continued.

3.4.2.3.2 Air Quality

Upgrades to the PIADC would be in accordance with the required permits. The current infrastructure would support any needed enhancements. Therefore, any enhancements to PIADC operations would not have an anticipated adverse effect on the ambient air quality at Plum Island.

3.4.3 South Milledge Avenue Site

3.4.3.1 Affected Environment

3.4.3.1.1 Climate and Severe Weather

Athens, Georgia, has a temperate, four-season climate with generally mild winters and warm summers. The climate in Georgia is primarily controlled by the clockwise air-flow that dominates the mid-Atlantic ocean known as the Azores high-pressure system. Associated sub-systems are the Gulf and Bermuda highs that regulate the summertime temperatures and precipitation. Winter conditions are dictated by systems originating in Colorado or larger systems moving southeastward out of Canada (GSCO 1998).

The monthly average maximum temperature is 72.6°F, the monthly average minimum temperature is 51.0°F, and the monthly average rain precipitation is 4.0 inches (SERCC 2007a). The Ben Epps Airport, which serves Athens, is located approximately 5 miles northeast of the University of Georgia, Whitehall Farm, and is the reporting station; the period of record for these data is July 1, 1948 to June 30, 2007.

A wind speed reporting station, located in Athens, summarized wind data gathered from 1930 to 1996. The prevailing wind direction, as compass points, is west-northwest and the mean wind speed is 7 miles per hour (mph). Six tornadoes were documented in Athens-Clarke County for the period between January 1, 1950 and April 30, 2007 (NCDC 1998). The two most severe events occurred in 1973 (Table 3.4.3.1.1- 1).

Table 3.4.3.1.1-1 — Severe Climatic Events

County	Event	Date	Time	Magnitude[a]	Property Damage ($)
Clarke	Tornado	03/31/1973	18:15	F2	$250 million
Clarke	Tornado	05/28/1973	15:20	F3	$25 million

[a]Fujita Scale; F0 = gale winds <73 mph; F1 = moderate winds 73-112 mph; F2 = significant winds 113-157 mph; F3 = severe winds 158-206 mph; F4 = devastating winds 207-260 mph; F5 = incredible winds 261-318 mph; F6 = inconceivable winds >318 mph.

3.4.3.1.2 Air Quality

The Air Protection Branch of Georgia's Department of Natural Resources (GDNR), Environmental Protection Division, operates and oversees an Ambient Monitoring Program (AMP). AMP has monitored EPA-defined criteria pollutants for over 30 years. In 2006, the Georgia air sampling network collected data at 65 locations in 37 counties (GDNR 2007). The monitoring is conducted to protect public health and air quality in Georgia. The data are used in regulatory efforts, research programs, and public information outreach. In 2005, an ambient air O_3 and $PM_{2.5}$ monitoring site was established on College Station Road in Athens. Based on the AMP 2006 Ambient Air Surveillance Report, all of Georgia is in attainment for CO, NO_2, SO_2, Pb, and PM_{10}. Statewide compliance with the O_3 and $PM_{2.5}$ standards continues to be a challenge.

Georgia adheres to the EPA major source definition and requires an issued permit before construction and operation of such facilities (GDNR 2008b). The UGA Athens is a Title V source with potential emissions exceeding 100 tons/yr of SO_2, NO_X, and CO. The Title V Permit held by the University (Number 8221-059-0059-V-02-0) has an effective date of November 16, 2007, and is valid for 5 years (GDNR 2008a). The major emission sources under the permit are eight boilers, one spray paint booth, and three pathological waste incinerators with load rates ranging from 175 to 500 lb/hr.

3.4.3.2 Construction Consequences

3.4.3.2.1 Climate and Severe Weather

Construction of the NBAF at the South Milledge Avenue Site would not have an adverse effect on meteorological or regional climatic conditions. The NBAF would be designed and built to withstand the normal meteorological conditions that are present within the geographic area of the selected site (hurricanes, tornados, etc.). Given the nature of the facility, more stringent building codes are applied to the NBAF than are used for homes and most businesses, regardless of which NBAF site is chosen. The building would be built to withstand wind pressures up to 170% of the winds which are expected to occur locally within a period of 50 years. This means the building's structural system could resist a wind speed that is expected to occur, on the average, only once in a 500 year period.

In the unlikely event that a 500-year wind storm strikes the facility, the interior BSL-3Ag and BSL-4 spaces would be expected to withstand a 200 mph wind load (commonly determined to be an F3 tornado). If the NBAF took a direct hit from an F3 tornado, the exterior walls and roofing of the building would likely fail first. This breach in the exterior skin would cause a dramatic increase in internal pressures leading to further failure of the building's interior and exterior walls. However, the loss of these architectural wall components should actually decrease the overall wind loading applied to the building, and diminish the possibility of damage to the building's primary structural system. Since the walls of the BSL-3Ag and BSL-4 spaces would be reinforced cast-in-place concrete, those inner walls would be expected to withstand the tornado. Section 3.14 includes an analysis of the potential consequences of high winds including an F5 tornado event.

Construction of the NBAF at the South Milledge Avenue Site would not result in significant adverse environmental effects, would meet or exceed all required wind loads and site-specific seismic design criteria, and would not be constructed within a floodplain. Construction would not have an adverse effect on meteorological or regional climatic conditions, and inclement weather response plans would be implemented.

3.4.3.2.2 Air Quality

Air emissions generated during construction are subject to state regulations limiting nuisance conditions such as fugitive dust. Construction activities could generate an increase in fugitive dust (airborne particulate matter that escapes from a construction site) from earthmoving and from other construction vehicle movements. Techniques would be evaluated to minimize fugitive dust generated during construction. Additionally, the construction equipment and construction workers' vehicles would generate combustion exhaust emissions. An emission comparison was developed using 2005 estimated ozone precursors (VOC and NO_x) construction emission estimates developed from the preliminary design for the NBL at the UTMB. This comparison was selected due to the similarities between the NBL and the proposed NBAF as large biocontainment facilities. The NBL project includes a seven-story biocontainment facility with an area of 82,411 square feet. The estimated construction emissions from the NBL for these NO_x and VOC were developed for a 4-yr construction period—the same construction duration of the proposed NBAF. Construction emission sources used in this evaluation included concrete trucks/paving equipment, generators, heavy equipment, non-road vehicles, delivery vehicles, and construction employees' personal vehicles (UTMB 2003). Using the proposed 500,000-square-foot area for NBAF and an equivalent 4-yr construction timeframe, Table 3.4.3.2.2-1 shows estimated annual NBAF VOC and NO_x construction emissions.

Table 3.4.3.2.2-1 — Estimated Annual VOC and NO_x NBAF Construction Emissions

Construction Year	NBAF VOCs (tons/yr)	NBAF NO_x (tons/yr)
1	32.8	135.3
2	32.8	135.3
3	28.5	62.5
4	9.7	15.2

Through implementation of approved fugitive dust control measures, good engineering practices, and overall good housekeeping, the potential adverse effects on ambient air quality from construction of the NBAF South Milledge Avenue Site would be temporary, localized, and would not have an anticipated permanent or significant adverse effect on regional air quality.

3.4.3.3 Operation Consequences

3.4.3.3.1 Climate and Severe Weather

The operation of the NBAF at the South Milledge Avenue Site would meet or exceed all general structural requirements. The NBAF would not result in significant adverse environmental effects, would meet or exceed all required wind loads and site-specific seismic design criteria, and would not be constructed within a floodplain. The operation of the NBAF would not have an anticipated adverse effect on the region's climate, and all necessary weather response plans would be executed.

3.4.3.3.2 Air Quality

Gaseous and particulate air contaminant emissions (including biological toxins, chemical agents, and hazardous air pollutants) would be generated during normal laboratory operations but would be prevented from escaping to the outdoor air through the use of engineering controls, as described in Chapter 2. For a discussion on potential accident scenarios where air contaminant emissions could be released to the outdoor air, refer to Section 3.14, Health and Safety. In addition, the proposed NBAF would provide the highest possible level of safety for investigators through the use of state-of-the-art biocontainment techniques, described in Chapter 2, as well as in the *NBAF Conceptual Design and Feasibility Study*. A discussion of potential accident scenarios posing a risk to NBAF personnel is included in Section 3.14, Health and Safety.

Operational emission estimates have been developed for a potential back-up generator system and a site-specific boiler system (Tables 3.4.3.3.2-1, 3.4.3.3.2-2, 3.4.3.3.2-3, and 3.4.3.3.2-4). The potential back-up generator emissions reflect two scenarios: an anticipated use and an extreme event. The boiler emissions would vary slightly by site climate, but following final design and site selection the total boiler(s) emissions will be quantified and used in developing a complete emissions inventory.

Table 3.4.3.3.2-1 — Operational Emission Estimates, Back-up Generators – Anticipated Routine Use (80 hr Annually Back-up Power and 2 hr/week Testing)

Pollutant	Number of Units	Operations hr/yr	Emission Factor lb/hr	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	8	184	21.6	31,795	15.9
CO	8	184	2.2	3,238	1.6
VOC	8	184	1.3	1,914	1.0

Table 3.4.3.3.2-2 — Operational Emission Estimates, Back-up Generators – Extreme Event (30-Day Back-up Power and 2 hr/week Testing)

Pollutant	Number of Units	Operations hr/yr	Emission Factor lb/hr	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	8	824	21.6	142,387	71.2
CO	8	824	2.2	14,502	7.3
VOC	8	824	1.3	8,570	4.3

Table 3.4.3.3.2-3 — Operational Emission Estimates, Boiler (Natural Gas)

Pollutant	Annual Production (MMBtu)	Emission Factor lb/MMBtu	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	110,630	0.035	3,872	1.9
PM_{10}	110,630	0.010	1,106	0.6
VOC	110,630	0.016	1,770	0.9
SO_x	110,630	0.001	111	0.1
CO	110,630	0.040	4,425	2.2

Table 3.4.3.3.2-4 — Operational Emission Estimates Generators and Boiler

Pollutant	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	146,259	73
PM_{10}	1,106	0.6
VOC	10,340	5.2
SO_x	111	0.1
CO	18,927	9.5

If incineration is the selected waste disposal method, the proposed NBAF would likely be considered a major Title V air emission source, based on an operationally flexible scenario. However, by approaching authorization with potential emissions, the facility would be in compliance with all operational scenarios.

Actual operating events would likely result in far less air emissions than those authorized under a potential worst-case scenario. Table 3.4.3.3.2-5 presents an emission correlation developed using 2002–2005 estimated annual average emissions for PIADC developed from the 2004 PIADC stack testing results. The refuse used during the 2004 evaluation was carcasses, bedding, and waste feed. The PIADC emissions evaluation used an annual average load rate of 62 tons/year and the ratio association included the PIADC permitted (worst case) rate 7,008 tons/year. The NO_x emissions, for additional conservatism, were refuse based and not fuel based. The NO_x ratio was developed from the PIADC annual average hours of operations of 1,000 hr/yr and a worst-case year-round operation (8,760 hr/yr). The ratio exercise was an order of magnitude analysis and would be refined following final alternative and waste disposal method determination.

Table 3.4.3.3.2-5 — Estimated Incinerator Emissions

Pollutants	Ratio Emissions NBAF (tons/yr)
Particulates	14.00
Carbon Monoxide	0.23
Hydrochloric Acid	4.40
Nitrogen Oxides	40.00
Mercury	0.56
Arsenic	1.01
Beryllium	0.45
Cadmium	1.24
Chromium	9.90
Lead	16.30

Employee and service vehicle emission estimates were developed using the Emissions Factor 2002 Burden Model for California Air Resource Board. The estimated emissions equation is (EFx(ET+TT)xTL). Table 3.4.3.3.2-6 describes the estimated vehicular emissions.

Table 3.4.3.3.2-6 — Vehicle Emission Estimates

Pollutant	Emission Factor EF	Employee Trips ET	Truck Trips TT	Trip Length TL	Emissions	Emissions
	lb/mile	trip/day	trip/day	miles/trip	lb/day	tons/year
CO	0.0191	700	100	30	459	84
NO_x	0.0268	700	100	30	642	117
SO_x	0.0002	700	100	30	6	1
PM_{10}	0.0009	700	100	30	21	4
VOC	0.0028	700	100	30	67	12

Most criteria pollutant impacts were less than NAAQS, Only $PM_{2.5}$ exceeded the NAAQS. The ratio of background concentration of $PM_{2.5}$ to the NAAQS ranges from 69% to 89%, making demonstration of compliance with the $PM_{2.5}$ standard difficult without further evaluation. It should be noted that $PM_{2.5}$ exceeded the NAAQS at all sites.

Further differentiation of potential sites from an air quality compliance perspective, in particular as related to $PM_{2.5}$, would likely not be cost effective from a dispersion modeling standpoint given the currently known operational parameters. Meaningful refined dispersion modeling, using the currently accepted EPA model, AERMOD, would require an extensive effort, on a site by site basis. A preferred course of action to demonstrate compliance of the $PM_{2.5}$ emissions would include one or more of the following steps:

- Enter into detailed discussions with respective state regulators to ascertain whether or not available ambient $PM_{2.5}$ background values are representative of proposed site conditions and whether or not adjustments are appropriate.
- Refine stack parameters to incorporate less conservative assumptions (higher temperature, higher velocity, taller stack, etc).
- Refine emissions inventory to better reflect the actual particle size distribution to be emitted from the proposed sources.
- Obtain a more definitive description of the proposed air emissions control technologies and associated removal efficiencies of $PM_{2.5.}$

If this approach fails to demonstrate compliance for a preferred site, then a refined dispersion modeling demonstration may be appropriate, using the refined emissions inventory and stack parameters determined in the above methodology.

<u>Cumulative Effects</u>

The economy of Clarke County was historically agricultural through World War II, after which industrial development to process poultry and timber led to substantial growth. More recently, the economy has shifted to one based on educational, health, and social services spurred by the growth of the UGA in Athens, which is the leading employer in the county. Retail trade, manufacturing, health care, and accommodation services also make up a substantial portion of the current economy and have contributed to recent development trends within the region.

The Athens area, including UGA, is home to existing biocontainment facilities including BSL-3Ag facilities at the Animal Health Research Center (AHRC) and USDA Southeast Poultry Research Lab (SEPRL), and BSL-3 facilities at UGA. Three BSL-3 laboratories are currently operational at UGA, with 10 more coming on-line soon. Two of the eight BSL-3 laboratories in the AHRC are operational and used in the development of vaccines and therapeutic agents for Sudden Acute Respiratory Syndrome (SARS) and West Nile virus. An operational BSL-3 laboratory in the College of Veterinary Medicine is used for studies of tuberculosis virus and rabbit fever virus, and four additional BSL-3 laboratories in the infectious disease intervention center will soon be operational.

According to the University of Georgia Office of the University Architects for Facilities Planning (Kevin Kirsche, UGA, January 25, 2008), the UGA has no immediate projects of significant consequence planned for areas surrounding the proposed South Milledge Avenue Site. However, the USDA – SEPRL is in the preliminary planning stages of designing new BSL-2 and BSL-3 to replace existing facilities originally constructed in the 1960s (Don Jones, USDA Chief, Ames Modernization Branch, April 23, 2008). Five significant development projects anticipated by UGA over the next 5 years, which were submitted to the University System of Georgia Board of Regents, are to be located on main campus and are not within reasonable distance of the South Milledge Avenue Site to contribute to cumulative impacts. In addition, there are no proposed regional development projects within a 2-mile radius of the site (Brad Griffin, Athens-Clark County Planning Director, January 24, 2008). UGA at Athens currently has a Title V Permit as a major source of potential air emissions.

It is unknown at this time the potential contribution of the future projects to air emissions in Clarke County. However, it is anticipated that the rapid population growth of Clarke County would continue, and air emissions from vehicular traffic would increase accordingly.

The NBAF would contribute to air emissions in the region, although the significance of contribution is not known at this time. The permitting agency would require that DHS show that the cumulative impact of the NBAF together with all other existing and proposed sources must

- Not result in a violation of a NAAQS, or
- Not significantly contribute to an existing measured and modeled violation of a NAAQS.

3.4.4 Manhattan Campus Site

3.4.4.1 Affected Environment

3.4.4.1.1 Climate and Severe Weather

The Kansas climate is generally referred to as a continental climate—areas with limited influence from major water bodies. Kansas lies across the path of warm, moist air moving north from the Gulf, and cold, dry air moving southeast from Canada. The favorable weather conditions and the arable lands account for the prominent livestock, grain, and dairy production in the state. Weather aberrations in Kansas, although normally short in duration, can result in significant property and crop damage. The western open areas of the state experience occasional dust storms during periods of drought, while intense spring and summer rain events can result in area flooding. Winter storms are regular climatic features that may include heavy snow, increased wind speed, and ice. An area from central Texas north through northern Iowa and from central Kansas and Nebraska east to western Ohio is commonly known as "Tornado Alley." This region is ideally positioned for the development of super-cell thunderstorms, resulting in the potential for tornadoes. Tornadoes can occur in any season, but by mid-summer most of Tornado Alley is active (USDOC 1948).

The monthly average maximum temperature is 67.3°F, the monthly average minimum temperature is 43.3°F, and the annual total average rain precipitation is 2.8 inches. The reporting station for this data is in Manhattan, and the period of record covers January 1, 1900 to June 30, 2007 (HPRCC 2008).

A wind speed reporting station is located in Topeka, Kansas, approximately 50 miles east of Manhattan, and has summarized the wind data gathered from 1930 to 1996. The prevailing wind direction in compass points is north, and the annual average mean wind speed is 10 mph. Twenty tornadoes were documented in Riley County from the period between January 1, 1950 and August 31, 2007 (NCDC 1998). Table 3.4.4.1.1-1 describes the worst two events in terms of property damage. The June F4 tornado in Manhattan reportedly destroyed 45 homes, damaged 142, and 637 were affected.

Table 3.4.4.1.1-1 — Severe Climatic Events

County	Event	Date	Time	Magnitude	Property Damage ($)
Riley	Tornado	June 8, 1966	16:00	F3	2.5 million
Riley	Tornado	June 11, 2008	21:48	F4	not available

3.4.4.1.2 Air Quality

The Kansas Department of Health and the Environment (KDHE) operates and oversees an ambient air monitoring network. The goals of the network are to determine if Kansas residents are exposed to criteria pollutant levels exceeding federal limits, determine attainment or nonattainment status, confirm modeled and monitored pollutant concentrations, determine air pollution trends, and evaluate public education. Kansas has positioned most of its monitors in metropolitan areas, which serve to describe the exposure of larger populations to air pollutants. Ambient air data for Kansas are reported quarterly and maintained within a national database by EPA. KDHE released the 2005-2006 Kansas Air Quality Report and has summarized the air monitoring results comparing the data to the NAAQS. Table 3.4.4.1.2-1 briefly summarizes the ambient air monitoring locations, data gathered by location, and compliance status (KDHE 2007a). Based on these data, the Manhattan Campus Site would appear as an attainment area.

Table 3.4.4.1.2-1 — 2005–2006 Ambient Data Summary Table

Community (County)	SO_2	CO	NO_2	O_3	$PM_{2.5}$	Compliant
Mine Creek (Linn County)	•	•	•	•		Yes
Coffeyville (Montgomery County)	•					Yes
Coffeyville-Buckeye (Montgomery County)	•					Yes
KC JFK (Wyandotte County)	•	•	•	•	•	Yes
Peck (Sumner County)	•		•	•		Yes
Cedar Bluff (Trego County)	•			•		Yes
Wichita Health Department (Sedgwick County)		•	•	•	•	Yes
Douglas and Main (Sedgwick County)		•				Yes
Park City (Sedgwick County)				•		Yes
Lawrence (Douglas County)				•		Yes
Heritage Park (Johnson County)				•		Yes
Leavenworth (Leavenworth County)				•		Yes
Justice Center (Johnson County)					•	Yes
McClure Elementary (Shawnee County)					•	Yes

When issuing air operating permits, the primary goals of KDHE are to protect public health, conserve air quality, control air pollution, and provide optimal service to the state's industrial customers. The air permit application evaluations are centered on the potential emissions of a facility and the associated air pollution abatement equipment the facility requires to comply with state and federal emission standards. The potential emissions of a source will determine the level or status of its air operating permit. KDHE refers to sources with potential Title V emission levels as Class I sources and issues the equivalent of a Title V operating permit. KDHE is responsible for evaluating air quality permit applications and ultimately issuing construction and operating permits that meet both state and federal air regulations. Table 3.4.4.1.2-2 describes KDHE emission thresholds that require new or modified construction permits.

Table 3.4.4.1.2-2 — Permit Thresholds

Pollutant	Emission Threshold (tons/yr)
PM	25
PM_{10}	15
SO_2	40
SO_3	40
SO_x	40
VOCs	40
NO_x	40
CO	100
Lead	0.6
Single HAP	10
Combination of HAPs	25

The hazardous air pollutants are listed at Kansas Administrative Regulations (K.A.R.) 28-19-201(a). The volatile organic compounds are listed at K.A.R. 28-19-201(b) (KAR 2007).

The Manhattan Campus Site is on the KSU campus, which holds a Class I Air Operating Permit because of the potential for the facility to emit over 100 tons/yr of NO_x, SO_x, and CO. The KSU permit has several emission sources such as, but not limited to, residential boilers, emergency generators, grain mills, and an animal carcass incinerator with a waste feed rate not to exceed 60 lb/hr. KSU reported 2005 facility emissions of 46.66 tons of $NO_{x,}$ 0.56 tons of PM_{10}, 0.32 tons of $SO_{x,}$ 24.79 tons of CO, 1.62 tons of VOCs, and 0.00 tons of HAPs.

3.4.4.2 Construction Consequences

3.4.4.2.1 Climate and Severe Weather

Construction of the NBAF Manhattan Campus Site would not have an adverse effect on meteorological or regional climatic conditions. The NBAF would be designed and built to withstand the normal meteorological conditions that are present within the geographic area of the selected site (hurricanes, tornados, etc.). Given the nature of the facility, more stringent building codes are applied to the NBAF than are used for homes and most businesses, regardless of which NBAF site is chosen. The building would be built to withstand wind pressures up to 170% of the winds which are expected to occur locally within a period of 50 years. This means the building's structural system could resist a wind speed that is expected to occur, on the average, only once in a 500 year period.

In the unlikely event that a 500-year wind storm strikes the facility, the interior BSL-3Ag and BSL-4 spaces would be expected to withstand a 200 mph wind load (commonly determined to be an F3 tornado). If the NBAF took a direct hit from an F3 tornado, the exterior walls and roofing of the building would likely fail first. This breach in the exterior skin would cause a dramatic increase in internal pressures leading to further failure of the building's interior and exterior walls. However, the loss of these architectural wall components should actually decrease the overall wind loading applied to the building, and diminish the possibility of damage to the building's primary structural system. Since the walls of the BSL-3Ag and BSL-4 spaces would be reinforced cast-in-place concrete, those inner walls would be expected to withstand the tornado. Section 3.14 includes an analysis of the potential consequences of high winds including an F5 tornado event.

Construction of the NBAF at the Manhattan Campus Site would not result in significant adverse environmental effects, would meet or exceed all required wind loads and site-specific seismic design criteria, and would not be constructed within a floodplain. Construction of the Manhattan Campus Site would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented.

3.4.4.2.2 Air Quality

Air quality construction effects for the NBAF at the Manhattan Campus Site would be similar to those described for the South Milledge Avenue Site. Refer to Section 3.4.3.2.2 for additional information.

3.4.4.3 Operation Consequences

3.4.4.3.1 Climate and Severe Weather

Operations of the NBAF at the Manhattan Campus Site would be similar to those previously described for the South Milledge Avenue Site, would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented. Refer to Sections 3.4.3.3.1 and 3.14 for additional information.

3.4.4.3.2 Air Quality

Gaseous and particulate air contaminant emissions generated during normal laboratory operations have been previously described. Refer to Section 3.4.3.3.2 and 3.14 for additional internal and external accidental release information.

Operational emission estimates have been developed for a potential back-up generator system and a site-specific boiler system. The estimated emissions vary from site to site due to variations in projected boiler use, but the estimated emissions do not vary significantly (see Tables 3.4.4.3.2-1 and 3.4.4.3.2-2).

Table 3.4.4.3.2-1 — Operational Emission Estimates, Boiler (Natural Gas)

Pollutant	Annual Production MMBtu	Emission Factor lb/MMBtu	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	141,000	0.035	4,935	2.5
PM_{10}	141,000	0.010	1,410	0.7
VOC	141,000	0.016	2,256	1.1
SO_x	141,000	0.001	141	0.1
CO	141,000	0.040	5,640	2.8

MMBtu = million British thermal units
lb = Pounds

Table 3.4.4.3.2-2 — Operational Emission Estimates Generators and Boiler

Pollutant	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	147,322	73.6
PM_{10}	1,410	0.7
VOC	10,826	5.4
SO_x	141	0.1
CO	20,142	10.1

Operational effects for the NBAF at the Manhattan Campus Site would be similar to those of the South Milledge Avenue Site. Most criteria pollutant impacts were less than NAAQS, Only $PM_{2.5}$ exceeded the NAAQS. The ratio of background concentration of $PM_{2.5}$ to the NAAQS ranges from 69% to 89%, making demonstration of compliance with the $PM_{2.5}$ standard difficult without further evaluation. As previously stated, $PM_{2.5}$ exceeded the NAAQS at all sites. Measures to demonstrate compliance of the $PM_{2.5}$ emissions were previously described in Section 3.4.3.3.2.

If the Manhattan Campus Site is selected, the potential emissions from the facility would be evaluated, release models implemented (if needed), and the applicable authorizations applied for and received prior to operation.

<u>Cumulative Impacts</u>

Riley County historically relied on agriculture and mining industries for economic growth and development. The presence and growth of KSU in Manhattan continues to drive development trends for the county, and projected expansion at Fort Riley would result in additional growth in the county, although the majority of development has traditionally occurred in adjacent Geary County. The only BSL facility currently located on the KSU campus is the Biosecurity Research Institute that conducts BSL-3 and BSL-3Ag research.

According to KSU (Ron Trewyn, KSU, January 28, 2008), KSU has two major projects planned within a 2-mile radius of the Manhattan Campus Site. These projects, the Kansas State Equine Education Center and the Flint Hills Horse and Park Events Center, are related and would be located at the same site north of Kimball Avenue and east of Denison Avenue, encompassing 85 to100 acres and include both the educational and competitive event components. These projects would result in 150 to 180 full-time and part-time jobs. The increase in traffic is estimated to be 500 to 700 vehicles per week, primarily on weekends. The projects are in the preliminary planning stages, so any increase in public service demands and environmental impacts are not known.

There are additional projects planned on the KSU campus. One noteworthy project is the Jardine Complex Phase II, which includes 544 new bedrooms. Phase I added 608 bedrooms and over 2,000 daily trips, while Phase II is adding 347 apartments and another 2,000 daily trips. Another project is the Equestrian Center Phase I for the College of Agriculture, Department of Animal Sciences, at Kansas State Athletic Department.

There are 80 equestrian team members/coaches, a 40-seat classroom, and scheduled 400-person stadium events. This project would result in over 1,000 daily trips.

The Region of Influence (ROI) for air quality is Riley County. As previously discussed, KSU is a Title V source of potential air emissions in Manhattan. The NBAF would contribute to air emissions in the region, although the amount of contribution is not known at this time.

The total overall cumulative traffic impacts would be 23,580 daily trips for the ROI. This includes the current traffic, the proposed NBAF site, the new KSU project traffic, the increase of commercial/industrial employment traffic, and additional freight traffic. Air emissions were due to the additional traffic in the ROI. The California Air Resources Board's EMFAC 2002 Burden Model was used, and its assumptions were applied herein. The cumulative impacts on air quality in the ROI are 9,926 lb/day or 0.32 tons/day for CO; 1,876 lb/day or 0.44 tons/day for NO_x; and, 1,091 lb/day or 0.46 tons/day for reactive organic gases (ROG) or VOC.

The NBAF would contribute to air emissions in the region, although the significance of contribution is not known at this time. The permitting agency would require that DHS show that the cumulative impact of the NBAF together with all other existing and proposed sources must:

- Not result in a violation of a NAAQS, or
- Not significantly contribute to an existing measured and modeled violation of a NAAQS.

3.4.5 Flora Industrial Park Site

3.4.5.1 Affected Environment

3.4.5.1.1 Climate and Severe Weather

The climate in Mississippi can be defined as temperate, with long, warm summers and short, mild winters. The terrain of Mississippi varies from rolling hills in the north to sandy beaches along the Gulf of Mexico. The coastal zone of Mississippi is influenced by and exposed to tropical weather conditions (MDA 2008).

The monthly average maximum temperature is 76.6°F, the monthly average minimum temperature is 53.8°F, and the annual total average rain precipitation is 4.10 inches (SERCC 2007b). The reporting station for these data is Jackson, Mississippi, located approximately 25 miles southeast of Flora, and the period of record for these data is January 2, 1930 to May 31, 1971.

A wind speed reporting station is located in Jackson, Mississippi, which summarized wind data gathered from 1930 to 1996. The annual prevailing wind direction by compass point is north-northwest, and the annual mean wind speed is 7 mph. Forty tornadoes were documented in Madison County for the period between January 1, 1950 and March 31, 2007; the two largest cited were level F4s (Fujita Scale). These data also show four tropical events impacting Madison County from the same time period; the largest of these systems being Hurricane Katrina, with regional impacts exceeding $5.9 billion (NCDC 1998).

3.4.5.1.2 Air Quality

The Mississippi Department of Environmental Quality (MDEQ) monitors the ambient air concentrations of PM, SO_2, O_3, and NO_2 at numerous sampling sites across the state. The ambient air quality data are used to determine regulatory compliance, progress on regulatory compliance, air contaminant reduction strategies, and successes of current air pollutant reduction strategies. Based on MDEQ 2006 data, Mississippi is in compliance with all EPA criteria pollutant standards. Table 3.4.5.1.2-1 briefly summarizes 2006 MDEQ ambient air quality monitoring data from the two sampling sites nearest the Flora Industrial Park Site (MDEQ 2007a).

Table 3.4.5.1.2-1 — Ambient Air Quality Compliance Summary

Pollutant	Averaging Times	Ambient Standards	Concentrations Reported	County	City
Ozone	Primary & Secondary 8 hr	84 ppb	72 ppb	Hinds	Jackson
$PM_{2.5}$	Primary & Secondary Annual Average	15 ug/m^3	12.5 ug/m^3	Hinds	Jackson
$PM_{2.5}$	Primary & Secondary 24 hr Average	35 ug/m^3	29 ug/m^3	Hinds	Jackson
PM_{10}	Primary & Secondary Annual Average	50 ug/m^3	20 ug/m^3	Jackson	Pascagoula
PM_{10}	Primary & Secondary 24 hr Average	150 ug/m^3	50 ug/m^3	Jackson	Pascagoula
NO_2	Primary & Secondary Annual Average	0.053 ppm	0.007 ppm	Jackson	Pascagoula
SO_2	Primary & Secondary Annual Average	0.03 ppm	0.002 ppm	Jackson	Pascagoula
SO_2	Primary & Secondary 24 hr Average	0.14 ppm	0.01ppm	Jackson	Pascagoula
SO_2	Secondary 3 hr Average	0.5 ppm	0.0 ppm	Jackson	Pascagoula

Source: MDEQ 2006 data.
ppb = parts per billion   m^3 = cubic meters
ppm = parts per million   ug = micrograms

The Mississippi Commission on Environmental Quality, which is staffed by appointed officials, adopted Air Emissions Operating Permit Regulations for the purposes of Title V compliance with the *Federal Clean Air Act* (October 27, 1993, as amended December 29, 2000). Examples of industrial activities/emissions that are considered by MDEQ as potential Title V major source are

1. Solid waste incinerators;
2. Stationary sources, potential to emit 10 tons/yr or more of a hazardous air pollutant;
3. Stationary sources with the potential to emit 25 tons/yr or more in aggregate of hazardous air pollutants; and
4. Stationary sources with the potential to emit 100 tons/yr or more of any air pollutant (MDEQ 2007d).

There are no Title V major stationary sources located in Flora, Mississippi.

3.4.5.2 Construction Consequences

3.4.5.2.1 Climate and Severe Weather

Construction of the NBAF Flora Industrial Park Site would not have an adverse effect on meteorological or regional climatic conditions. The NBAF would be designed and built to withstand the normal meteorological conditions that are present within the geographic area of the selected site (hurricanes, tornados, etc.). Given the nature of the facility, more stringent building codes are applied to the NBAF than are used for homes and most businesses, regardless of which NBAF site is chosen. The building would be built to withstand wind pressures up to 170% of the winds which are expected to occur locally within a period of 50 years. This means the building's structural system could resist a wind speed that is expected to occur, on the average, only once in a 500 year period.

In the unlikely event that a 500-year wind storm strikes the facility, the interior BSL-3Ag and BSL-4 spaces would be expected to withstand a 200 mph wind load (commonly determined to be an F3 tornado). If the

NBAF took a direct hit from an F3 tornado, the exterior walls and roofing of the building would likely fail first. This breach in the exterior skin would cause a dramatic increase in internal pressures leading to further failure of the building's interior and exterior walls. However, the loss of these architectural wall components should actually decrease the overall wind loading applied to the building, and diminish the possibility of damage to the building's primary structural system. Since the walls of the BSL-3Ag and BSL-4 spaces would be reinforced cast-in-place concrete, those inner walls would be expected to withstand the tornado. Section 3.14 includes an analysis of the potential consequences of high winds including an F5 tornado event.

Construction of the NBAF would not result in significant adverse environmental effects, would meet or exceed all required wind loads and site-specific seismic design criteria, and would not be constructed within a floodplain. Construction of the NBAF would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented.

3.4.5.2.2 Air Quality

Air quality construction effects of the NBAF at the Flora Industrial Park Site would be similar to those described for the South Milledge Avenue Site. Refer to Section 3.4.3.2.2 for additional information.

3.4.5.3 Operation Consequences

3.4.5.3.1 Climate and Severe Weather

Operation of the NBAF at the Flora Industrial Park Site would be similar to those previously described for the South Milledge Avenue Site, would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented. Refer to Section 3.4.3.3.1 for additional information.

3.4.5.3.2 Air Quality

Gaseous and particulate air contaminant emissions generated during normal laboratory operations have been previously described. Refer to Sections 3.4.3.3.2 and 3.14 for internal and external accidental release information.

Operational emission estimates have been developed for a potential back-up generator system and a site-specific boiler system. The estimated emissions vary from site to site due to variations in projected boiler use, but the estimated emissions do not vary significantly. Refer to Section 3.4.3.3.2 and Tables 3.4.3.3.2-1 and 3.4.3.3.2-2 for additional information.

Table 3.4.5.3.2-1 — Operational Emission Estimates, Boiler (Natural Gas)

Pollutant	Annual Production MMBtu	Emission Factor lb/MMBtu	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	107,240	0.035	3,753	1.9
PM_{10}	107,240	0.010	1,072	0.5
VOC	107,240	0.016	1,716	0.9
SO_x	107,240	0.001	107	0.1
CO	107,240	0.040	4,290	2.1

MMBtu = million British thermal units
lb = Pounds

Table 3.4.5.3.2-2 — Operational Emission Estimates Generators and Boiler

Pollutant	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	146,140	73.1
PM_{10}	1,072	0.5
VOC	10,286	5.1
SO_x	107	0.1
CO	18,792	9.4

Operational effects of the NBAF at the Flora Industrial Park Site would be similar to those of the South Milledge Avenue Site. Most criteria pollutant impacts were less than NAAQS, Only $PM_{2.5}$ exceeded the NAAQS. The ratio of background concentration of $PM_{2.5}$ to the NAAQS ranges from 69% to 89%, making demonstration of compliance with the $PM_{2.5}$ standard difficult without further evaluation. As previously stated, $PM_{2.5}$ exceeded the NAAQS at all sites. Measures to demonstrate compliance of the $PM_{2.5}$ emissions were previously described in Section 3.4.3.3.2.

Cumulative Impacts

In Madison County, there are several public and private activities proposed or ongoing that would have potential to impact air quality. According to the Metro Jackson Chamber of Commerce, there are several new residential projects being planned in the Town of Flora or in Madison County. Terra Subdivision is located within the town limits of Flora with 19 lots available and 60 acres being developed. Depending on the density allowed for the subdivision, there is a potential of up to 240 additional lots. Another future development project is Andover Subdivision, which is located off State Highway 22 within 5 miles of the proposed site in an unincorporated area. Phase I of the subdivision has approximately 73 lots. Numerous phases are predicted for this development over the next 5 years, but data are not available on the additional number of lots to be developed. The Highlands Subdivision is another future planned project located off Mount Leopard and would be accessed from Highway 22. It is within 5 miles of the proposed NBAF site. The data provided did not state the number of lots predicted for this development, but all of the lots would be greater than 5 acres. Other noted subdivisions that have not announced their density allocations are Magnolia Heights and Woodlands of Flora.

There is a proposed major development (Galeria-Madison) approximately 15–20 miles from the proposed NBAF site and includes a mix of single-family homes, condominiums, an office park, and a shopping center. The acreage, square footages, and density numbers are not available for this development. There are other developments occurring, but they are not of major regional significance.

The Metro Jackson Chamber of Commerce that stated no non-residential economic development projects are scheduled for Flora within the next 5 years. There are currently no BSL facilities in the region.

The ROI for air quality is Madison County. As discussed in Section 3.4.5.1, there are no Title V air emission sources in Flora. The NBAF would contribute to air emissions in the region, although the amount of contribution is not known at this time.

An air quality analysis was undertaken to calculate on-road mobile source emissions in Madison County due to projected traffic increases with future growth. The Emission Factors 2002 Burden Model was applied to derive emissions data for specified EPA air quality guidelines. The total cumulative impacts for air quality in the ROI are as follows: 9,282 lb/day or 4.91 tons/day for CO; 1,866 lb/day or 0.93 tons/day for NO_X; and, 1,080 lb/day or 0.54 tons/day for ROG or VOCs. These impacts would be in addition to the NBAF vehicle emissions presented in Table 3.4.3.3.2-6.

The NBAF would contribute to air emissions in the region, although the significance of contribution is not known at this time. The permitting agency would require that DHS show that the cumulative impact of the NBAF together with all other existing and proposed sources must

- Not result in a violation of a NAAQS, or
- Not significantly contribute to an existing measured and modeled violation of a NAAQS.

3.4.6 Plum Island Site

3.4.6.1 Affected Environment

The affected environment sections, air quality and climate, for the Plum Island Site are addressed in previous Sections 3.4.2.1.1 and 3.4.2.1.2.

3.4.6.2 Construction Consequences

3.4.6.2.1 Climate and Severe Weather

Construction of the NBAF at the Plum Island Site would not have an adverse effect on meteorological or regional climatic conditions. The NBAF would be designed and built to withstand the normal meteorological conditions that are present within the geographic area of the selected site (hurricanes, tornados, etc.). Given the nature of the facility, more stringent building codes are applied to the NBAF than are used for homes and most businesses, regardless of which NBAF site is chosen. The building would be built to withstand wind pressures up to 170% of the winds which are expected to occur locally within a period of 50 years. This means the building's structural system could resist a wind speed that is expected to occur, on the average, only once in a 500 year period.

In the unlikely event that a 500-year wind storm strikes the facility, the interior BSL-3Ag and BSL-4 spaces would be expected to withstand a 200 mph wind load (commonly determined to be an F3 tornado). If the NBAF took a direct hit from an F3 tornado, the exterior walls and roofing of the building would likely fail first. This breach in the exterior skin would cause a dramatic increase in internal pressures leading to further failure of the building's interior and exterior walls. However, the loss of these architectural wall components should actually decrease the overall wind loading applied to the building, and diminish the possibility of damage to the building's primary structural system. Since the walls of the BSL-3Ag and BSL-4 spaces would be reinforced cast-in-place concrete, those inner walls would be expected to withstand the tornado. Section 3.14 includes an analysis of the potential consequences of high winds including an F5 tornado event.

Construction of the NBAF would not result in significant adverse environmental effects, would meet or exceed all required wind loads and site-specific seismic design criteria, and would not be constructed within a floodplain. Construction of the NBAF at the Plum Island Site would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented.

3.4.6.2.2 Air Quality

The air quality construction effects at the Plum Island Site would be similar to those described for the South Milledge Avenue Site. Refer to Section 3.4.3.2.2 for additional information.

3.4.6.3 Operation Consequences

3.4.6.3.1 Climate and Severe Weather

Operations of the NBAF at the Plum Island Site would be similar to those previously described for the South Milledge Avenue Site and would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented. Refer to Section 3.4.3.3.1 for additional information.

3.4.6.3.2 Air Quality

Gaseous and particulate air contaminant emissions generated during normal laboratory operations have been previously described. Refer to Sections 3.4.3.3.2 and 3.14 for additional internal and external accidental release information.

Operational emission estimates have been developed for a potential back-up generator system and a site-specific boiler system. The estimated emissions vary from site to site due to variations in projected boiler use, but the estimated emissions do not vary significantly. Refer to Section 3.4.3.3.2 and Tables 3.4.3.3.2-1 and 3.4.3.3.2-2 for additional information.

Table 3.4.6.3.2-1 — Operational Emission Estimates, Boiler Emissions (No. 2 Fuel Oil)

Pollutant	Annual Production MMBtu	Emission Factor lb/MMBtu	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	143,700	0.187	26,872	13.4
PM_{10}	143,700	0.025	3,593	1.8
VOC	143,700	0.030	4,311	2.2
SO_x	143,700	0.520	74,724	37.4
CO	143,700	0.070	10,059	5.0

MMBtu = million British thermal units
lb = Pounds

Table 3.4.6.3.2-2 — Operational Emission Estimates Generators and Boiler

Pollutant	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	169,259	84.6
PM_{10}	3,593	1.8
VOC	12,881	6.4
SO_x	74,724	37.4
CO	24,561	12.3

Operational effects of the NBAF at the Plum Island Site would be similar to those of the South Milledge Avenue Site. As stated earlier, Suffolk County is currently categorized as nonattainment for O_3 and $PM_{2.5}$. Most criteria pollutant impacts were less than NAAQS, Only $PM_{2.5}$ exceeded the NAAQS. The ratio of background concentration of $PM_{2.5}$ to the NAAQS ranges from 69% to 89%, making demonstration of compliance with the $PM_{2.5}$ standard difficult without further evaluation. As previously stated, $PM_{2.5}$ exceeded the NAAQS at all sites. Measures to demonstrate compliance of the $PM_{2.5}$ emissions were previously described in Section 3.4.3.3.2.

If the Plum Island Site is selected, air permit requirements would be required to comply with the SIP to assist Suffolk County in becoming reclassified as an attainment area for O_3 and $PM_{2.5}$ (as does the current PIADC permit). Potential emissions from the NBAF would be evaluated, release models implemented (if needed), and the applicable authorizations applied for and received prior to operation.

Cumulative Impacts

In Suffolk County, no major development projects have been identified in the reasonably foreseeable future that would have potential to impact air quality. The only project scheduled for Plum Island in the foreseeable future consists of the expansion of the PIADC BSL-3 facilities to house more research animals, upgrade and expansion of the existing necropsy facilities, conversion of underutilized space in the existing containment facility to increase laboratory space, and upgrade and expansion of existing utility systems including the chilled water system, power distribution system, wastewater decontamination system, and potable and water supply system.

Suffolk County is typical of many communities that experienced rapid growth following World War II. Its proximity to New York City led the population of Suffolk County to quadruple between 1950 and 1970, and residential development and associated service industries and roadways were the major development categories during that time. In recent years, growth has slowed, and the population has remained stable. Major employers in the region include health care providers and retail traders. The local economy base is currently becoming more diversified, and growth sectors include health, education and social services, tourism, the arts, and emerging technologies. Currently, PIADC has the only BSL facility (BSL-3) in the county.

The ROI for the air quality assessment includes Suffolk County. Suffolk County is a nonattainment area for ozone and $PM_{2.5}$ and usually exceeds the NAAQS limits during the summer months. The nonattainment status is based on monitoring stations on Long Island and other densely populated areas to the west.

Vehicle traffic generated from the construction and operation of the NBAF, operation of boilers, emergency back-up generators, and either incineration or tissue digestion would all be sources of pollutant emissions. Because the design of the NBAF is still in the planning phase, the potential for air emissions can only be estimated.

The NBAF would contribute to air emissions in the region, although the significance of contribution is not known at this time. The permitting agency would require that DHS show that the cumulative impact of the NBAF together with all other existing and proposed sources must

- Not result in a violation of a NAAQS, or
- Not significantly contribute to an existing measured and modeled violation of a NAAQS.

3.4.7 Umstead Research Farm Site

3.4.7.1 Affected Environment

3.4.7.1.1 Climate and Severe Weather

There are three distinct geographic regions in North Carolina: the western mountains, the central piedmont, and the eastern coast. The climate of North Carolina varies significantly due to the Gulf Stream influence on the coastal counties and the Appalachian Mountains on the western counties. The Umstead Research Farm Site is located in the north-central piedmont area and experiences distinct seasonal changes.

The monthly average maximum temperature is 70.9°F, and the monthly average minimum temperature is 43.6°F. Lake Michie, North Carolina, is a reporting station located approximately 5 miles west of the Umstead Research Farm. The Butner Filter Plant reporting station provided the monthly average total rain precipitation of 3.8 inches. The period of record for temperature and precipitation data, respectively, is August 1, 1948 to January 31, 1973, and February 1, 1956 to June 30, 2007 (SERCC 2007c).

A wind speed reporting station is located in Raleigh, North Carolina, approximately 26 miles south of the Umstead Research Farm Site. Wind data summary, from 1930 to 1996, show the prevailing wind direction as southwest and the mean wind speed as 8 mph. Six tornadoes and five hurricanes have been documented in Granville County from January 1, 1950 to March 31, 2007 (Table 3.4.7.1.1-1). The most damaging tornado, in terms of property, was an F1 (Fujita Scale) in May 1989, where damage estimates approached $2.5 million. Hurricane Floyd in September 1999 resulted in devastating flooding with regional property damage reaching $3 billion (NCDC 1998).

Table 3.4.7.1.1-1 — Severe Climatic Events – Granville County

Event	Date	Time	Magnitude	Property Damage ($)
Tornado	05/05/1989	18:05	F1	2.5 million
Tornado	03/20/1998	18:55	F2	100 thousand
Hurricane Floyd	09/15/1999	16:00	-	3 billion
Hurricane Isabel	09/18/2003	09:00	-	7.3 million

3.4.7.1.2 Air Quality

The North Carolina Department of Environment and Natural Resources, Division of Air Quality (NCDAQ), Ambient Monitoring Section (AMS) operates and oversees ambient air quality monitoring program in North Carolina. The AMS manages 60 monitoring stations statewide, measuring outdoor concentrations of regulated pollutants such as O_3, Pb, PM, NO_x, SO_2, and CO (NCDENR 2007a). North Carolina continues to be challenged by two criteria pollutants, $PM_{2.5}$ and O_3. As of 2006, Charlotte, in Mecklenburg County, remains in nonattainment for O_3; however, NCDAQ expects the area to achieve attainment by mid-2010. The annual $PM_{2.5}$ standard is being exceeded in Catawba and Davidson Counties; NCDAQ believes the area will be in compliance with the annual $PM_{2.5}$ standard by the end of 2009 (NCDENR 2007d). These non-attainment areas are between 90 and 150 miles from the Umstead Research Farm Site. An ambient air O_3 monitoring site is located in Butner at the John Umstead Hospital water treatment plant. This monitoring site has been operational since 1979 and has not reported any O_3 concentrations that exceed the NAAQS (H. Kimball, DAQ, December 14, 2007). DHS notes EPA's re-designation of Granville County from non-attainment to attainment including a SIP modification for a vehicle inspection maintenance program.

The NCDAQ is also responsible for the issuance of air quality operating permits. North Carolina adheres to the EPA definition of a major source and requires an issued permit before such facilities may operate (NCDENR 2004).

3.4.7.2 Construction Consequences

3.4.7.2.1 Climate and Severe Weather

Construction of the NBAF at the Umstead Research Farm Site would not have an adverse effect on meteorological or regional climatic conditions. The NBAF would be designed and built to withstand the normal meteorological conditions that are present within the geographic area of the selected site (hurricanes, tornados, etc.). Given the nature of the facility, more stringent building codes are applied to the NBAF than are used for homes and most businesses, regardless of which NBAF site is chosen. The building would be built to withstand wind pressures up to 170% of the winds which are expected to occur locally within a period of 50 years. This means the building's structural system could resist a wind speed that is expected to occur, on the average, only once in a 500 year period.

In the unlikely event that a 500-year wind storm strikes the facility, the interior BSL-3Ag and BSL-4 spaces would be expected to withstand a 200 mph wind load (commonly determined to be an F3 tornado). If the NBAF took a direct hit from an F3 tornado, the exterior walls and roofing of the building would likely fail first. This breach in the exterior skin would cause a dramatic increase in internal pressures leading to further failure of the building's interior and exterior walls. However, the loss of these architectural wall components should actually decrease the overall wind loading applied to the building, and diminish the possibility of damage to the building's primary structural system. Since the walls of the BSL-3Ag and BSL-4 spaces would be reinforced cast-in-place concrete, those inner walls would be expected to withstand the tornado. Section 3.14 includes an analysis of the potential consequences of high winds including an F5 tornado event.

Construction of the NBAF would not result in significant adverse environmental effects, would meet or exceed all required wind loads and site-specific seismic design criteria, and would not be constructed within a floodplain. Construction of the NBAF at the Umstead Research Farm Site would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented.

3.4.7.2.2 Air Quality

Air quality construction effects at the NBAF Umstead Research Farm Site would be similar to those described for the South Milledge Avenue Site. Refer to Section 3.4.3.2.2 for additional information.

3.4.7.3 Operation Consequences

3.4.7.3.1 Climate and Severe Weather

Operations of the NBAF at the Umstead Research Farm Site would be similar to those previously described for the South Milledge Avenue Site and would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented. Refer to Section 3.4.3.3.1 for additional information.

3.4.7.3.2 Air Quality

Gaseous and particulate air contaminant emissions generated during normal laboratory operations have been previously described. Refer to Sections 3.4.3.3.2 and 3.14 for additional internal and external accidental release information.

Operational emission estimates have been developed for a potential back-up generator system and a site-specific boiler system. The estimated emissions vary, from site to site, due to variations in projected boiler use, but the estimated emissions do not vary significantly. Refer to Section 3.4.3.3.2 and Tables 3.4.3.3.2-1 and 3.4.3.3.2 2 for additional information.

Table 3.4.7.3.2-1 — Operational Emission Estimates, Boiler Emissions (Natural Gas)

Pollutant	Annual Production MMBtu	Emission Factor lb/MMBtu	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	102,190	0.035	3,577	1.8
PM_{10}	102,190	0.010	1,022	0.5
VOC	102,190	0.016	1,635	0.8
SO_x	102,190	0.001	102	0.1
CO	102,190	0.040	4,088	2.0

MMBtu = million British thermal units
lb = Pounds

Table 3.4.7.3.2-2 — Operational Emission Estimates Generators and Boiler

Pollutant	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	145,964	72.9
PM_{10}	1,022	0.5
VOC	10,205	5.1
SO_x	102	0.1
CO	18,590	9.3

Operational effects of the NBAF at the Umstead Research Farm Site would be similar to those of the South Milledge Avenue Site. Most criteria pollutant impacts were less than NAAQS, Only $PM_{2.5}$ exceeded the NAAQS. The ratio of background concentration of $PM_{2.5}$ to the NAAQS ranges from 69% to 89%, making demonstration of compliance with the $PM_{2.5}$ standard difficult without further evaluation. As previously stated, $PM_{2.5}$ exceeded the NAAQS at all sites. Measures to demonstrate compliance of the $PM_{2.5}$ emissions were previously described in Section 3.4.3.3.2.

If the Umstead Research Farm Site is selected, potential emissions from the facility would be evaluated, release models implemented (if needed), and the applicable authorizations applied for and received prior to operation. Refer to Section 3.4.3.3.2 and Tables 3.4.3.3.2-1 and 3.4.3.3.2-2 for additional information.

<u>Cumulative Impacts</u>

In Granville County, there are few other reasonably foreseeable future planned public or private projects that would have potential to impact air quality. According to the Granville County Economic Development Commission (EDC) (Leon Turner, EDC, February 20, 2008), there are currently no major new projects being planned in Granville County. Development Services has permitted around 3,000 new homes, but it is uncertain how many will be built with the current housing slowdown. It is unknown when the housing market will return to its level of previous years.

Historically, Granville County has been rural with agriculture as the main economic driver. However, recent factors have caused portions of the county to experience growth more rapidly than others. The central portion of the county is experiencing moderate growth due to economic opportunities near Oxford, and the southern portion of the county has experienced rapid growth due to spillover from Durham and Wake counties. However, indications from the Granville EDC shows that growth and residential development are slowing similar to general nationwide trends (Leon Turner, EDC, February 20, 2008).

The new Central Regional Hospital is the first of three new state-operated psychiatric hospitals and is scheduled to open sometime in 2008. The hospital has 432 private rooms and will employ a staff of more than 1,600. Although Granville County does not currently have any BSL-3 or BSL-4 facilities, several universities, research institutes, state agencies, and private companies in the Research Triangle have established and operate at least 22 BSL-3 and BSL-3Ag laboratories.

Vehicle traffic generated from the construction and operation of the NBAF, operation of boilers, emergency back-up generators, and either incineration or tissue digestion would all be sources of pollutant emissions. Because the design of the NBAF is still in the planning phase, the potential for air emissions can only be estimated. However, DHS is committed to ensuring that the NBAF project would comply with all relevant air county quality control.

The NBAF would contribute to air emissions in the region, although the significance of contribution is not known at this time. The permitting agency would require that DHS show that the cumulative impact of the NBAF together with all other existing and proposed sources must:

- Not result in a violation of a NAAQS, or
- Not significantly contribute to an existing measured and modeled violation of a NAAQS.

3.4.8 Texas Research Park Site

3.4.8.1 Affected Environment

3.4.8.1.1 Climate and Severe Weather

San Antonio, situated between a semi-arid area to the west and a coastal region to the southeast, has a subtropical climate. The area is characterized by July summers with mean temperatures of 84.7°F, and January winters with mean temperatures of 50.7°F. More than 80% of the daily summer temperatures exceed 90°F, while winter temperatures fall below freezing only about 20 days/yr (USACE 2006).

Annual precipitation for the region averages from less than 20 inches to over 40 inches. Normally, the annual average precipitation is approximately 28 inches but varies greatly from year to year. The heaviest rain events traditionally occur during spring and fall thunderstorms. Light hail frequently accompanies the springtime thunderstorms; however, damaging hail is rare (USACE 2006).

The San Antonio wind regime is dominated by northerly winds in the winter and southeasterly winds from the Gulf of Mexico during the summer. The severe weather in this area is normally associated with tornadoes, but such events are fairly rare and isolated. On April 17, 1988, the remnants of Class 5 Hurricane Gilbert generated 10 to 12 area tornadoes (USACE 2006).

3.4.8.1.2 Air Quality

The TCEQ adopted the NAAQS as the ambient air quality standards for Texas. Local air monitors have recorded O_3 levels above the allowed 8-hr concentration. In June 2004, EPA designated Bexar, Comal, and Guadalupe Counties as nonattainment areas under the 8-hr O_3 NAAQS but with a deferred Early Action Compact (EAC) agreement. Since the EPA guidance suggested that the San Antonio Metropolitan Statistical Area (MSA) be considered the boundaries of the new 8-hr O_3 nonattainment area, air quality planning has focused on Bexar, Comal, Guadalupe, and Wilson counties, termed the “San Antonio EAC Region” (SAER). Currently, the San Antonio MSA comprises the counties of Atascosa, Bandera, Bexar, Comal, Guadalupe, Kendall, Medina, and Wilson (USACE 2006). EPA set the nonattainment designation for the SAER to take effect in December 2007 (EPA 2008f). Although the procedural requirements of the General Conformity Rule would have to be determined, conformity with area SIPs or a Federal Implementation Plans still must be ensured (USACE 2006).

The closest ambient air monitoring station to the site is the Camp Bulls site located approximately 22 miles northeast of the Texas Research Park Site. The Camp Bulls station monitors for NO_x and O_3. The former Elm Creek Elementary School site, located 12.5 miles southeast in Atascosa, Texas, was deactivated in November 2007. There are no other monitored air pollutants in Bexar or Medina County.

TCEQ has issued 16 air permits for facilities in the region, but no major sources are within 10 miles of the Texas Research Park Site. The majority of the permitted operations near the proposed Texas Research Park Site are small emission sources that qualify for a TCEQ Permit by Rule. To qualify under this rule, the operation must not emit more than 25 tons/yr of SO_2, particulate matter, or VOCs and not more than 250 tons/yr of NO_x or CO. Oberthur Gaming Technologies and Maxim Integrated Products, Inc., are the two largest emission sources near the Texas Research Park Site, and both are located about 7.5 miles northeast of the proposed site.

3.4.8.2 Construction Consequences

3.4.8.2.1 Climate and Severe Weather

Construction of the NBAF at the Texas Research Park Site would not have an adverse effect on meteorological or regional climatic conditions. The NBAF would be designed and built to withstand the normal meteorological conditions that are present within the geographic area of the selected site (hurricanes, tornados, etc.). Given the nature of the facility, more stringent building codes are applied to the NBAF than are used for homes and most businesses, regardless of which NBAF site is chosen. The building would be built to withstand wind pressures up to 170% of the winds which are expected to occur locally within a period of 50 years. This means the building's structural system could resist a wind speed that is expected to occur, on the average, only once in a 500 year period.

In the unlikely event that a 500-year wind storm strikes the facility, the interior BSL-3Ag and BSL-4 spaces would be expected to withstand a 200 mph wind load (commonly determined to be an F3 tornado). If the NBAF took a direct hit from an F3 tornado, the exterior walls and roofing of the building would likely fail first. This breach in the exterior skin would cause a dramatic increase in internal pressures leading to further failure of the building's interior and exterior walls. However, the loss of these architectural wall components should actually decrease the overall wind loading applied to the building, and diminish the possibility of damage to the building's primary structural system. Since the walls of the BSL-3Ag and BSL-4 spaces would be reinforced cast-in-place concrete, those inner walls would be expected to withstand the tornado. Section 3.14 includes an analysis of the potential consequences of high winds including an F5 tornado event.

Construction of the NBAF at the Texas Research Park Site would not result in significant adverse environmental effects, would meet or exceed all required wind loads and site-specific seismic design criteria, and would not be constructed within a floodplain. Construction of the NBAF would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented.

3.4.8.2.2 Air Quality

Air quality construction effects of the NBAF at the Texas Research Park Site would be similar to those described for the South Milledge Avenue Site. Refer to Section 3.4.3.2.2 for additional information.

3.4.8.3 Operations Consequences

3.4.8.3.1 Climate and Severe Weather

Operations of the NBAF at the Texas Research Park Site would be similar to those previously described for the South Milledge Avenue Site and would not have an adverse effect on meteorological or regional climatic conditions, and all inclement weather response plans would be implemented. Refer to Section 3.4.3.3.1 for additional information.

3.4.8.3.2 Air Quality

Gaseous and particulate air contaminant emissions generated during normal laboratory operations have been previously described. Refer to Sections 3.4.3.3.2 and 3.14 for additional internal and external accidental release information.

Operational emission estimates have been developed for a potential back-up generator system and a site-specific boiler system. The estimated emissions vary from site to site due to variations in projected boiler use, but the estimated emissions do not vary significantly. Refer to Section 3.4.3.3.2 and to Tables 3.4.3.3.2-1 and 3.4.3.3.2-2 for additional information.

Table 3.4.8.3.2-1 — Operational Emission Estimates, Boiler (Natural Gas)

Pollutant	Annual Production MMBtu	Emission Factor lb/MMBtu	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	100,230	0.035	3,508	1.8
PM_{10}	100,230	0.010	1,002	0.5
VOC	100,230	0.016	1,604	0.8
SO_x	100,230	0.001	100	0.1
CO	100,230	0.040	4,009	2.0

MMBtu = million British thermal units
lb = Pounds

Table 3.4.8.3.2-2 — Operational Emission Estimates Generators and Boiler

Pollutant	Estimated Emissions lb/yr	Estimated Emissions tons/yr
NO_x	145,895	72.9
PM_{10}	1,002	0.5
VOC	10,174	5.1
SO_x	100	0.1
CO	18,511	9.3

Operational effects of the NBAF at the Texas Research Park Site would be similar to those of the South Milledge Avenue Site. Bexar County was re-designated on 4-2-08 by EPA as in attainment for O_3. Most criteria pollutant impacts modeled were less than NAAQS, only $PM_{2.5}$ exceeded the NAAQS. The ratio of background concentration of $PM_{2.5}$ to the NAAQS ranges from 69% to 89%, making demonstration of compliance with the $PM_{2.5}$ standard difficult without further evaluation. As previously stated, $PM_{2.5}$ exceeded the NAAQS at all sites. Measures to demonstrate compliance of the $PM_{2.5}$ emissions were previously described in Section 3.4.3.3.2.

If the Texas Research Park Site is selected, NBAF air permit requirements would be required so not to inhibit Bexar County from retaining attainment status for O_3. The potential NBAF emissions from construction, operations, and facility-related mobile sources would be a source of additional ozone precursor pollutants. Potential emissions from the NBAF would be evaluated, release models implemented (if needed), and the applicable authorizations applied for and received prior to operation.

<u>Cumulative Impacts</u>

In Bexar County, there are several other public and private activities proposed or ongoing that would have potential to impact air quality. Vehicle traffic generated from the construction and operation of the NBAF, operation of boilers, emergency back-up generators, and either incineration or tissue digestion would all be sources of pollutant emissions. The proposed NBAF could contribute to cumulative effects on the county's ability to meet future air quality goals. Additional analysis was performed to determine the extent to which the potential air emissions from NBAF would add to the anticipated effects on air quality from other sources. This cumulative impact analysis on air is described below.

Because the design of the NBAF is still in the planning phase, the potential for air emissions can only be estimated. However, DHS is committed to ensuring that the NBAF project would comply with all relevant air quality control requirements, including permitting requirements, to protect the air quality of Bexar County.

Prior to the mid 20th century, Bexar County was predominately agricultural, with cash crops, cotton, and livestock as the main economic drivers. World War II saw Bexar County's already large military presence grow, spurring development trends. The area's military presence has remained an important economic driver. During the 1980s and 1990s, as a result of attempts to diversify the area's economy, San Antonio and Bexar County became the site of a number of electronics and biotechnology companies. A number of BSL facilities are located in the San Antonio and Bexar County region. The Southwest Foundation for Biomedical Research currently operates three BSL-3 laboratories and one BSL-4 laboratory; the University of Texas Health Science Center at San Antonio operates three BSL-3 laboratories; the Brooks City Base has two BSL-3 laboratories, one of which is operated by the San Antonio Metropolitan Health District; and the University of Texas at San Antonio, the Veterans Administration, the Wilford Hall Medical Center, and the Brooke Army Medical Center all operate one BSL-3 laboratory.

A number of new residential development projects are planned that would result in over 13,000 new residential units in the region. The estimated population generated from these planned developments would be 31,200 people for just residential—not including commercial, office, or industrial population from employment in the area.

The air quality analysis used to calculate mobile source emissions in the ROI applied the California Air Resources Board's EMFAC 2002 Burden Model to extrapolate emissions factor data for the ROI. The total impact of both passenger vehicles and delivery trucks associated with the planned residential developments were estimated at 75,897 lb/day or 39.24 tons/day for CO; 14,417 lb/day or 9.01 tons/day for NO_X; and, 8,719 lb/day or 4.36 tons/day for ROG or VOC. These impacts would be in addition to the NBAF vehicle emissions presented in Table 3.4.3.3.2-6.

The NBAF would contribute to air emissions in the region, although the significance of contribution is not known at this time. The permitting agency would require that DHS show that the cumulative impact of the NBAF together with all other existing and proposed sources must:

- Not result in a violation of a NAAQS, or
- Not significantly contribute to an existing measured and modeled violation of a NAAQS.

3.5 NOISE

3.5.1 Methodology

To describe the existing and future acoustic environments of each alternative, data were obtained from available noise studies, records and information pertaining to noise-producing sources, and supplemented by observations from site visits. These data were evaluated by site to assess potential audible effects from construction and operation of the proposed alternatives. Baseline noise levels and construction noise levels were determined by comparing proposed NBAF site activities with standard noise levels obtained during literature review. Operational noise levels were determined relative to those currently experienced at the existing PIADC.

3.5.2 No Action Alternative

3.5.2.1 Affected Environment

PIADC is the primary source of man-made noises at Plum Island. Acoustic emissions at the current research facility include light vehicle traffic, maintenance machinery, generators, wastewater treatment, and the heating/cooling system. Additional noise sources located adjacent or near the island include navigational beacons, maritime waterway traffic, and the daily ferry traffic to and from the island. A baseline noise level survey has not been conducted; however, Table 3.5.2.1-1 presents typical source/location noise levels (NPC 2000). Considering the location and operations of PIADC, routine noise levels from the facility would likely be comparable to an urban or suburban decibel (written as dBa) range or less. A-weighted decibels are expressions used to describe a sound's relative loudness in air as perceived by the human ear.

Table 3.5.2.1-1 — Noise Levels of Common Sources

Sound Source	*Decibel*
Air raid siren at 50 ft	*120*
Maximum levels in audience at rock concerts	*110*
On platform by passing subway train	*100*
On sidewalk by passing heavy truck or bus	*90*
On sidewalk by typical highway	*80*
On sidewalk by passing automobiles with mufflers	*70*
Typical urban area background/busy office	*60*
Typical suburban area background	*50*
Quiet suburban area at night	*40*
Typical rural area at night	*30*
Isolated broadcast studio	*20*
Audiometric (hearing testing) booth	*10*
Threshold of hearing (person without hearing damage)	*0*

The island currently has no high decibel noise emission sources, and there are no noise sensitive receptors within close proximity of PIADC. Refer to Section 3.3.2.1 for additional PIADC facility information.

3.5.2.2 Construction Consequences

Ongoing PIADC enhancements would result in additional temporary noise sources associated with potential land grading and facility renovations/upgrades. The construction period and location would dictate the noise emission sources, audible levels, and potential effects. Additional temporary acoustic emissions from renovation/enhancement efforts at PIADC would likely include general vehicular traffic and heavy lift equipment. These renovation-related audible emissions would be limited in duration and would likely be restricted to specific contract hours and locations. No significant direct adverse noise effects are anticipated from renovation/enhancement efforts at PIADC.

Indirect effects from the renovation and enhancement activities would occur from construction-related traffic transporting workers and construction materials/equipment to Plum Island via the Orient Point or Old Saybrook government ferries. These noise effects would be minor, and temporary, and noise levels would not be anticipated to measurably increase over existing conditions.

3.5.2.3 Operation Consequences

Operation and maintenance of the upgraded facilities would result in minimal noise increases. The noise-levels and sources would be comparable to the current PIADC operations; however, an audible emissions reduction may be realized by facility upgrades to the heating, cooling, and filtration systems. A potential significant source of noise emissions would be the emergency generators; however, PIADC's upgraded equipment would likely include additional operational efficiencies and safety features that are not currently associated with the aged infrastructure. The generators are an emergency back-up response system and would not be a routine noise emission source. PIADC is within 1 mile of coastal shorelines and freshwater marshes; however, due to the noise emission levels and location of the the renovated facility, no adverse noise effects are anticipated on the island or surrounding area. Indirect effects to noise levels are not expected.

3.5.3 South Milledge Avenue Site

3.5.3.1 Affected Environment

The South Milledge Avenue Site is located on UGA property. The site is primarily undeveloped woodlands and pastures. The South Milledge Avenue and Whitehall Road intersection is less than 1 mile northeast of the site. South Milledge Avenue and UGA academic facilities abut the site to the north and northeast, a residence is adjacent to the northwest, undeveloped forests are to the west and east, and the Middle Oconee River is adjacent to the southern border. The State Botanical Gardens, UGA Bio-conversion Facility, Forestry Services Facility, and the UGA livestock arena are noise receptors within the proposed site's proximity (Figure 3.5.3.1-1). Forested areas to the east and west and the Middle Oconee River to the south would also represent noise receptors. The South Milledge Avenue Site baseline noise levels have not been documented; however, ambient decibel levels at the site would likely be comparable to a suburban or semi-rural location. Refer to Table 3.5.2.1-1 for typical source/location decibel levels.

3.5.3.2 Construction Consequences

The University facilities and the few non-University neighbors, including the State Botanical Gardens, may experience temporary construction noise effects. Also, construction noise would temporarily disperse wildlife from adjacent undeveloped areas. Potential noise sources would include variable pitch and volumes from vehicles and equipment involved in site clearing and grading, creating, and/or placing engineered structures and conducting interior/exterior finish work. The construction phases would dictate the equipment types, thereby influencing the audible emissions. These acoustic sources would vary with the construction timeline, such as earthwork noise emissions, progressing into concrete pours, and with transitioning to steel erection associated with framing the superstructure of the facility. These construction noises would be limited in duration and restricted to normal construction hours dictated by local noise ordinances. If blasting is required, steps would be taken to minimize the blast number(s), intensity, and duration. A blasting plan would be developed implementing blasting measures such as minimizing explosive weights, stemming depths and material, and delay configurations all to mitigate potential noise levels. Acoustical construction emissions from the South Milledge Avenue Site would not have an anticipated adverse effect on surrounding noise sensitive receptors.

Indirect effects from construction activities would occur from workers and construction materials/equipment traveling to and from the site. These effects would be temporary in nature and would be similar for all action alternatives.

3.5.3.3 Operation Consequences

Operation of the NBAF at the South Milledge Avenue Site would not result in anticipated adverse effects on noise-sensitive receptors. The most audible noises would emanate from the traffic related to the facility and the heating, cooling, and filtration systems. Wildlife would be expected to return to adjacent undeveloped areas following construction; however, operational noises from the NBAF would likely discourage on-site fauna rehabitation. Early design considerations would reduce both internal and external noise levels. Interior partitions within and between offices would have sound-attenuating insulation materials. All laboratory doors would be insulated for sound reduction, and mechanical systems would have sound-attenuation equipment based on standard design practices. Laboratory fans would have packless-type sound-reducing devices on the exhaust mains and outside air by-pass ducts.

A potentially significant noise emission source would be the emergency generators; however, the generators are a back-up response system and would not be a routine noise emission source. Operation of the NBAF would not significantly affect any adjacent noise receptors above the current audible emissions associated with South Milledge Avenue, Whitehall Road, and adjacent UGA facilities. The acoustical emissions would not have anticipated adverse effects on local noise sensitive receptors.

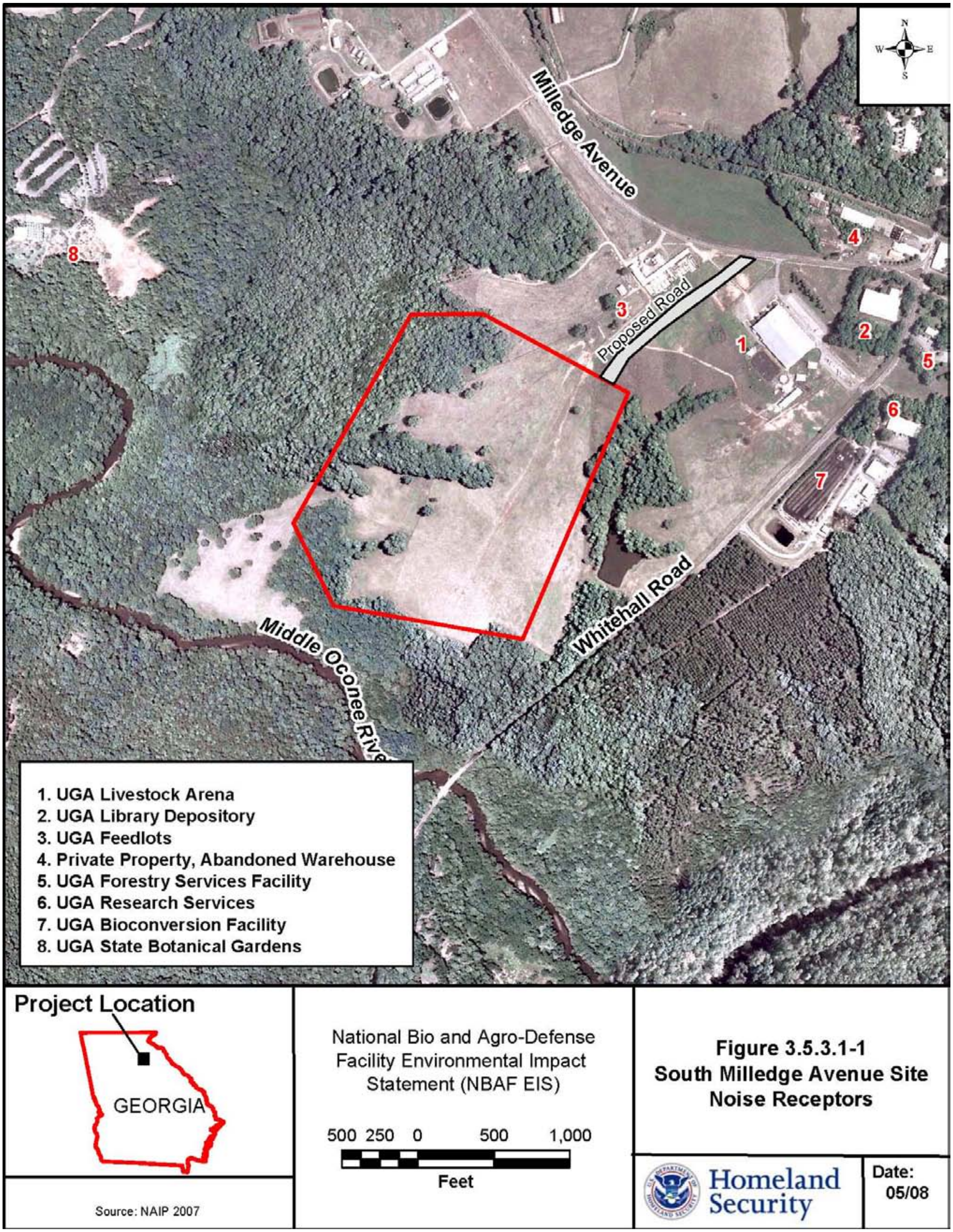

Figure 3.5.3.1-1 — South Milledge Avenue Site Noise Receptors

Indirect effects from operations would occur from traffic transporting employees, operational and maintenance materials, and equipment to the the NBAF at the South Milledge Avenue Site. These effects would be similar to other technology or research-based institutions and are similar for all action alternatives.

3.5.4 Manhattan Campus Site

3.5.4.1 Affected Environment

The Manhattan Campus Site is located on KSU's northeast campus. The site is within the City of Manhattan city limits, located adjacent to and southeast of the intersection of Kimball Avenue and Denison Avenue, and is immediately north and adjacent to the KSU BRI. The Manhattan Campus Site is improved with several university-related buildings, a material recycling storage building, and university-related open pasture areas. The baseline noise levels have not been documented; however, ambient decibel levels would likely be comparable to an urban location. Refer to Table 3.5.2.1-1 for typical source/location decibel levels. Potential anthropogenic noise receptors and locations are shown on Figure 3.5.4.1-1. Potential noise receptors include the Mercy Health Center and Bramlage Coliseum to the west, Goodnow Museum and Historical Site, Pioneer Park, Riley County Hospital, Mercy Health Center, Finney State Fishing Lake and Wildlife Area, and Aggieville Shopping Center to the south. The potential receptors are all at least 3,500 feet from the Manhattan Campus Site.

3.5.4.2 Construction Consequences

KSU's BRI is an agricultural-based research and laboratory facility, constructed in 2006. The city upgraded adjacent Denison Avenue, improving traffic flow and ingress and egress to the BRI. Audible construction emissions at the Manhattan Campus Site would be very similar to the BRI construction and the Denison Avenue improvements. If blasting is required, steps would be taken to minimize the blast number(s), intensity, and duration. A blasting plan would be developed implementing blasting measures such as minimizing explosive weights, stemming depths and material, and delay configurations all to mitigate potential noise levels. Refer to Section 3.5.3.2 for additional construction noise information. No adverse noise effects would be anticipated from construction of the NBAF at the Manhattan Campus Site. Indirect effects from construction were previously described in Section 3.5.3.2.

3.5.4.3 Operation Consequences

Audible operational emissions of the NBAF at the Manhattan Campus Site would be similar to the current KSU BRI operation, with the most audible emissions emanating from traffic and facility heating, cooling, and filtration systems. Refer to Section 3.5.3.3 for additional operational noise information. Operations at the NBAF would not have anticipated adverse effects on the surrounding area, and potential noise receptors are not close enough to experience a measurable noise level increase. Indirect effects from operations at the NBAF were previously described in Section 3.5.3.3.

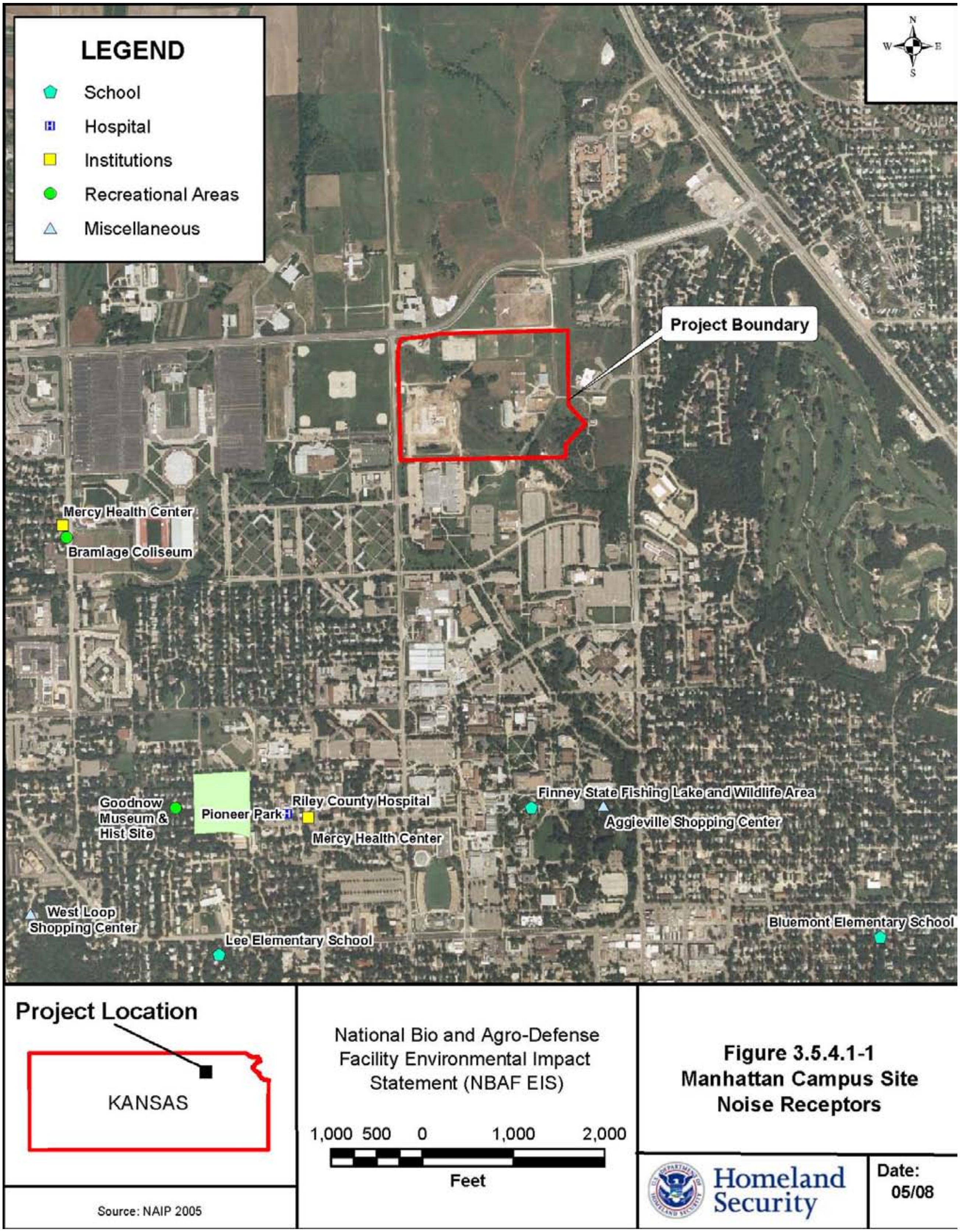

Figure 3.5.4.1-1 — Manhattan Campus Site Noise Receptors

3.5.5 Flora Industrial Park Site

3.5.5.1 Affected Environment

The Flora Industrial Park Site is primarily undeveloped open pastureland situated west-northwest of Flora, Mississippi, and 1.75 miles north of Highway 22 and U.S. Highway 49 intersection. The Flora Industrial Park Site is immediately bordered to the west by U.S. Highway 49 and to the east by the Illinois Central Gulf Railroad. Primos Manufacturing is the southern neighbor, and an open pasture with a residence abuts the site to the north. Noise receptors in the vicinity of the Flora Industrial Park Site are shown on Figure 3.5.5.1-1. The nearest potential noise receptors (Woodman Hill Missionary Baptist Church Cemetery and Woodman Hill Church) are located east of the Flora Industrial Park Site and are immediately east of the Central Gulf Railroad line. The Tri-County Academy is located approximately 2,000 feet south of the Flora Industrial Park and over 4,000 feet south of the proposed NBAF site. Baseline noise levels for the Flora Industrial Park Site have not been documented; however, ambient decibel levels at the site would likely be comparable to a suburban or semi-rural location. Refer to Table 3.5.2.1-1 for typical source/location decibel levels.

3.5.5.2 Construction Consequences

The Flora Industrial Park Site is predominately an open field pasture with limited neighboring developments. Typical construction noise effects have been previously described in Section 3.5.3.2. The Woodman Hill Missionary Baptist Church Cemetery and Woodman Hill Church, in particular, would experience noise increases during construction due to the activities previously described for the duration of the construction. However, the increase in noise levels would be less than noise levels from passing trains currently experienced at the site. If blasting is required, steps would be taken to minimize the blast number(s), intensity, and duration. A blasting plan would be developed implementing blasting measures such as minimizing explosive weights, stemming depths and material, and delay configurations all to mitigate potential noise levels. No other adverse noise effects would be anticipated. Indirect construction effects were previously described in Section 3.5.3.2.

3.5.5.3 Operation Consequences

Audible emissions from the NBAF would not adversely affect adjacent noise receptors and would be comparable to or less than those audible emissions associated with U.S. Highway 49 and Central Gulf Railroad. Refer to Section 3.5.3.3 for additional operational noise information. The acoustical emissions resulting from operation of the NBAF would not have an anticipated adverse effect on surrounding noise sensitive receptors. Indirect operational effects from the NBAF were previously described in Section 3.5.3.3.

3.5.6 Plum Island Site

3.5.6.1 Affected Environment

PIADC is the primary source of man-made noises at Plum Island. Acoustic emissions emanating from the facility include light vehicle traffic, maintenance machinery, generators, wastewater treatment, and heating/cooling systems (Section 3.5.2.1). Plum Island is somewhat isolated, limiting the anthropogenic noise receptors. The Plum Island Site is bordered by a scattered boulder/rock shoreline to the north, undeveloped woods to the east, PIADC to the west, and the PIADC wastewater treatment plant and island freshwater wetlands to the south. Baseline noise levels at the Plum Island Site have not been documented; however, ambient decibel levels at the site would likely be comparable to an urban or suburban location. Refer to Table 3.5.2.1-1 for typical source/location decibel levels.

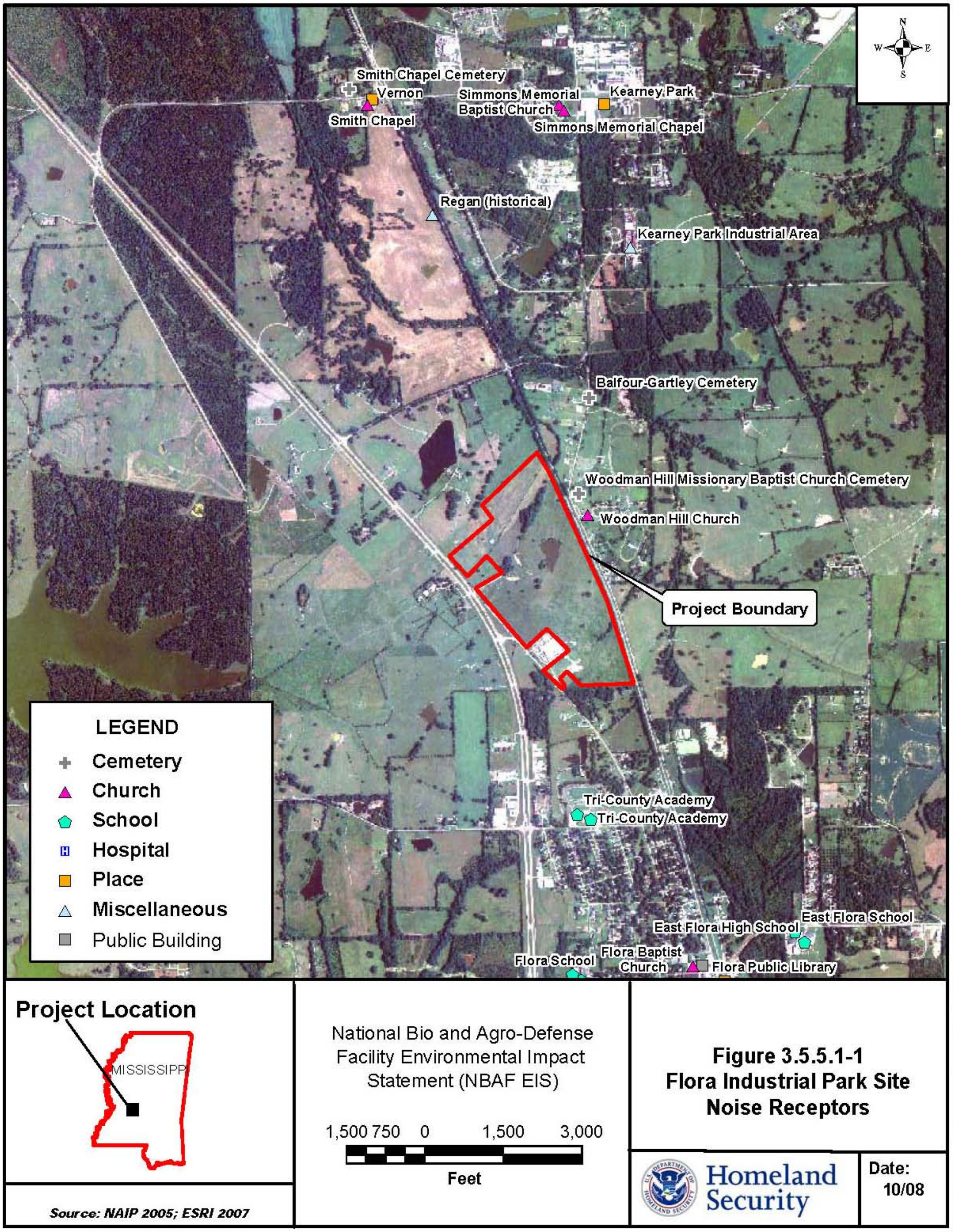

Figure 3.5.5.1-1 — Flora Industrial Park Site Noise Receptors

3.5.6.2 Construction Consequences

PIADC staff may experience temporary construction noise effects. The audible construction emissions would be similar to noise emissions from the renovation/enhancement of PIADC. Refer to Sections 3.5.2.2 and 3.5.3.2 for additional construction noise information. If blasting is required, steps would be taken to minimize the blast number(s), intensity, and duration. A blasting plan would be developed implementing blasting measures such as minimizing explosive weights, stemming depths and material, and delay configurations all to mitigate potential noise levels. No adverse noise impacts would be anticipated from construction of the NBAF at the Plum Island Site. Indirect construction effects were previously described in Section 3.5.3.2.

3.5.6.3 Operation Consequences

Operations of the NBAF at the Plum Island Site would not result in anticipated adverse effects on noise-sensitive receptors. Noise would be similar to the current PIADC operation, with most audible emissions emanating from operation-related traffic and the normal heating, cooling, and filtration systems at the facility. Refer to Sections 3.5.2.3 and 3.5.3.3 for additional operational noise information. The acoustic emissions would not have an anticipated adverse effect on the surrounding area. Indirect effects from the NBAF operations were previously described in Section 3.5.3.3.

3.5.7 Umstead Research Farm Site

3.5.7.1 Affected Environment

The Umstead Research Farm Site is northwest of Old Route 75, less than 5 miles west of Butner. The proposed site is an undeveloped woodland area located in western Granville County. Currently, local sources of ambient noises emanate from Butner, the Dillon School, Umstead Research Farm, the nearby correctional facilities, and the adjacent state roads to the west and north. Potential noise receptors within 1 mile of the proposed facility include Dillon School, the Federal Corrections Institute, Butner, and the Umstead Research Farm (Figure 3.5.7.1-1). Baseline noise levels at the Umstead Research Farm Site have not been documented; however, ambient decibel levels at the site would likely be comparable to an urban or suburban location. Refer to Table 3.5.2.1-1 for typical source/location decibel levels.

3.5.7.2 Construction Consequences

The Dillon School south of the Umstead Research Farm Site may experience temporary noise effects resulting from construction activities. Refer to Section 3.5.3.2 for a description of potential sources of construction noise emissions. If blasting is required, steps would be taken to minimize the blast number(s), intensity, and duration. A blasting plan would be developed implementing blasting measures such as minimizing explosive weights, stemming depths and material, and delay configurations all to mitigate potential noise levels. No other adverse noise effects would be anticipated from construction of the NBAF at the Umstead Research Farm Site. Indirect construction effects were previously described in Section 3.5.3.2.

3.5.7.3 Operation Consequences

Operations at the NBAF would result in audible emissions related to substantially increased traffic volumes and from the normal heating, cooling, and filtration systems at the facility. Refer to Section 3.5.3.3 for additional operational noise information. Operation of the NBAF would not have an anticipated adverse effect on surrounding noise-sensitive receptors. Indirect effects from operations of the NBAF were previously described in Section 3.5.3.3.

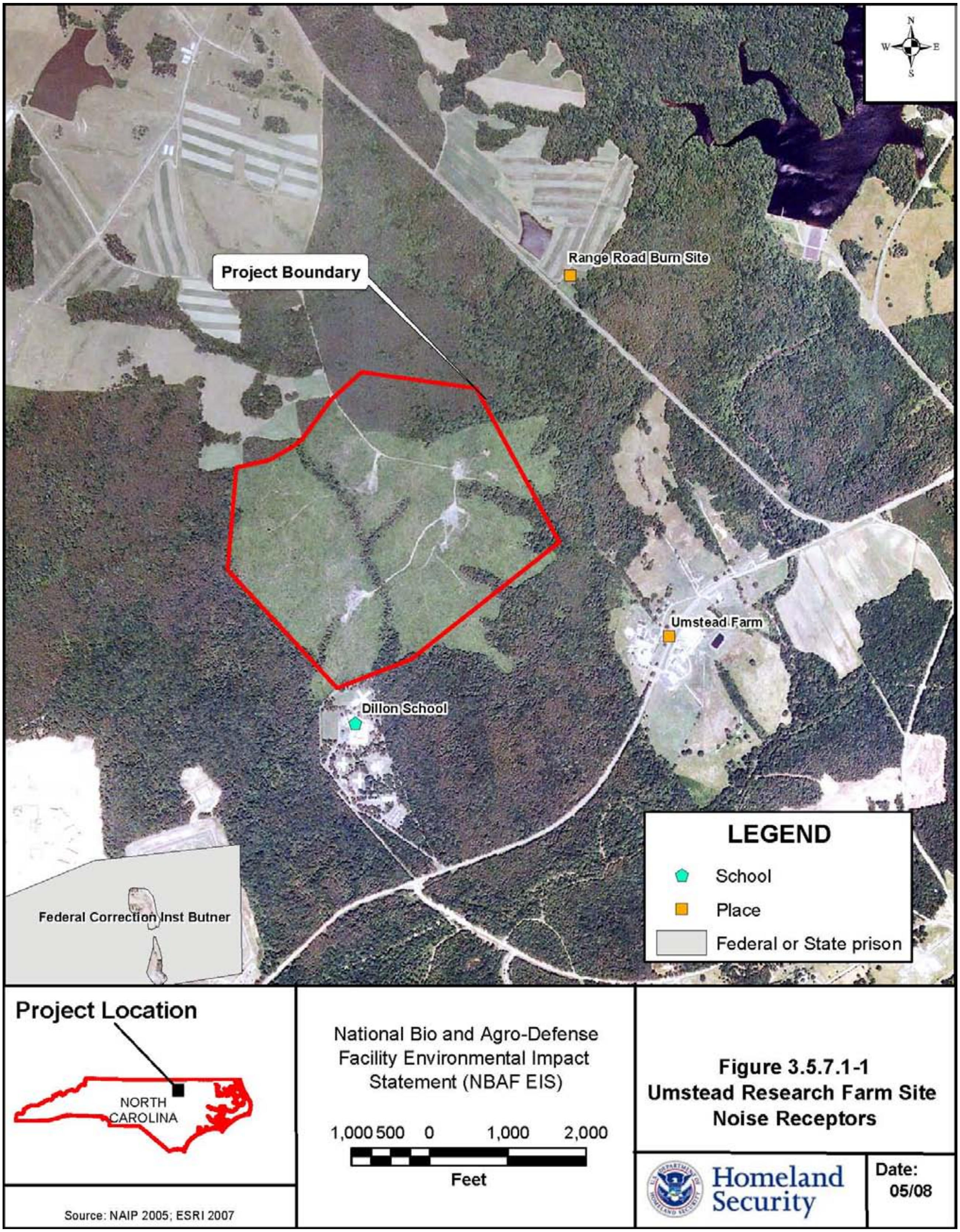

Figure 3.5.7.1-1 — Umstead Research Farm Site Noise Receptors

3.5.8 Texas Research Park Site

3.5.8.1 Affected Environment

The Texas Research Park Site is currently located in a rural, undeveloped area west of San Antonio but has been designated as a future industrial and research park site. There are no known sensitive noise receptors at the site. The size and rural location of the Texas Research Park reduce the likelihood of site-sensitive noise receptors. Baseline noise levels have not been documented; however, the ambient decibel levels at the site would likely be comparable to a suburban or semi-rural location. Refer to Table 3.5.2.1-1 for typical source/location decibel levels.

3.5.8.2 Construction Consequences

The Texas Research Park Site is predominately an open range and pastureland. No adverse noise effects would be anticipated from construction of the NBAF at the Texas Research Park Site. If blasting is required, steps would be taken to minimize the blast number(s), intensity, and duration. A blasting plan would be developed implementing blasting measures such as minimizing explosive weights, stemming depths and material, and delay configurations all to mitigate potential noise levels. Refer to Section 3.5.3.2 for additional construction noise information. Indirect construction effects were previously described in Section 3.5.3.3.

3.5.8.3 Operation Consequences

Operation of the NBAF would result in audible emissions related to increased traffic and normal heating, cooling, and filtration systems at the facility. Noise emissions from the facility would be similar to other Texas Research Park facilities. Refer to Section 3.5.3.3 for additional operational noise information. Acoustic emissions at the facility would not have an anticipated adverse effect on local noise receptors. Indirect effects from operation of the NBAF were previously described in Section 3.5.3.3.

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3.6 GEOLOGY AND SOILS

3.6.1 Methodology

Geology and soils data were obtained from site specific Phase 1 Environmental Site Assessments and preliminary geotechnical reports. Each Phase 1 Environmental Site Assessment was conducted in compliance with industry standards for determining recognizied environmental concerns. Soils and seismic information were obtained from the Natural Resource Conservation Service (NRCS) and U.S. Geologic Service (USGS), respectively.

The USGS develops estimates for mean return times of potential earthquake events of specific sizes and at a predetermined distance. Figure 3.6.1-1 depicts, by color, the estimated time of return in years for a magnitude 4.75 earthquake at a fixed distance of 31 miles for the eastern United States (USGS 2008d).

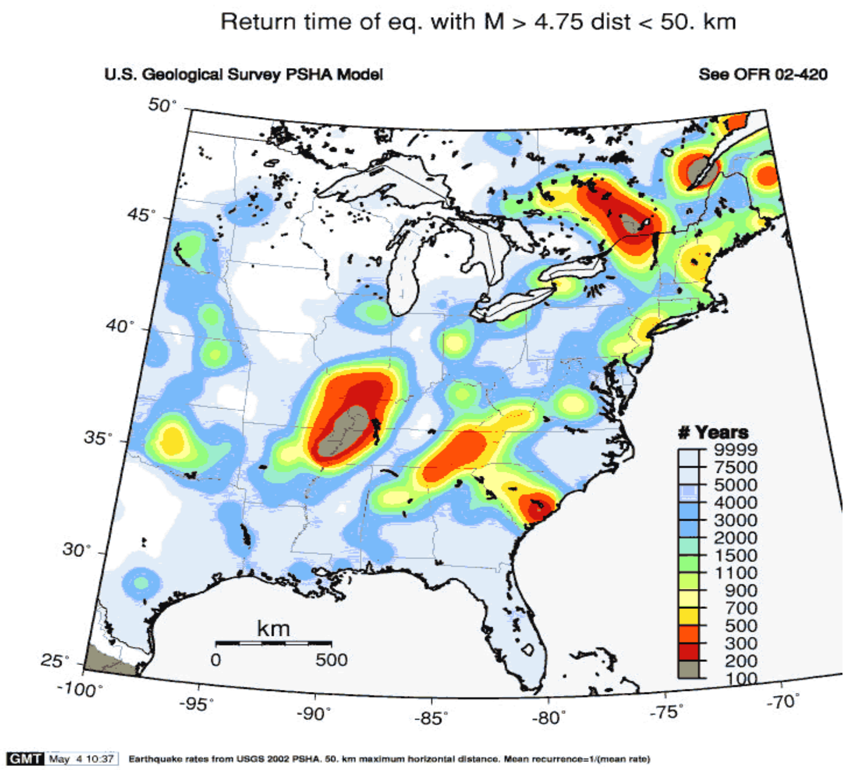


Figure 3.6.1-1 — Earthquake Return Frequency for the Eastern United States

The relative seismic hazard was evaluated based on historical seismicity and USGS seismic hazard map coverage. The USGS National Seismic Hazard Mapping Project maps depict predicted peak (ground) acceleration from earthquakes in units of percent "g" (force of acceleration relative to that of the Earth's gravity) for a given probability of exceedance. For this analysis, the maps used are based on a 2% probability of exceedance in 50 years (i.e., an annual chance of occurrence of about 1 in 2,500).

Site geologic stability was evaluated based on seismic soil classes defined in the 2006 International Building Code (IBC). The IBC would require using geotechnical seismic design criteria such as, but not limited to, seismic soil classes. The average subsurface properties in the top 100 feet of material (whether the strata include soil or rock) determine the seismic soil classification for a site. There are five seismic soil classes. Class A, which is a "hard rock" profile, is the "best" in terms of limiting ground motions on a structure. Class E soils are susceptible to liquefaction, where saturated "soft soil" ground can sometimes take on the characteristics of a fluid resulting in the loss of strength, sudden settlement, or lateral movement. All of the site alternatives have seismic soil classifications of D (soft to medium clays or sand), except the Umstead Research Farm Site in North Carolina with a C seismic soil classification (FEMA 2002).

Additionally, regulatory authorizations and planning requirements were resourced from individual state programs. These data were evaluated by site in an effort to assess potential effects of construction and operation from the proposed alternatives. Baseline geologic conditions were used to identify potential structural design considerations and potential effects as the design process proceeds. The potential area, volume, and footprint of soil disturbance were estimated in the *NBAF Conceptual Design and Feasibility Study* and NBAF *Site Characterization Study* (NDP 2007a; 2007b).

3.6.2 No Action Alternative

3.6.2.1 Affected Environment

The geology of Plum Island is dominated by sediments left during previous ice ages. The soil structure of the island is comprised of consolidated and unconsolidated sediments resting on a bed of crystalline Precambrian bedrock. The soils consist of glacial deposits dominated by sand and gravel that extend several hundred feet below land surface (bls). The sand and gravel is saturated with a freshwater lens rising from 100 feet bls to the surface (Crandell 1962; Terracon 2007a).

The upper sediment layers of the island are unconsolidated and of the Cretaceous and Quaternary age. The sediments consist of the Magothy Formation, Matawan Group, and the Raritan Formation. These sediment groups are comprised of fine clayey sands, medium to coarse sand, and gravel (Crandell 1962; Entech 2002). A preliminary geotechnical report described Plum Island as slightly hilly with a surface topography falling toward the south-southwest. Five test borings indicated groundwater levels ranging from 13.8 feet bls to 18.5 feet bls. The island's soils are generally described as topsoil and fill consisting of brown sand and silt from 0 to 3.5 feet bls, subsoil consisting of medium to fine sand from 2 feet bls to 5 feet bls, and glacial outwash consisting of coarse to fine sand from 5 feet bls to 25 feet bls (Terracon 2007a).

3.6.2.2 Construction Consequences

Construction of the NBAF would not occur under this alternative. However, infrastructure improvements at PIADC previously identified would proceed. In the Categorical Exclusion documentation prepared for these improvements, DHS indicated that numerous boulders would be encountered during excavation activities (NDP 2007a). Construction site soils would be displaced, augmented, or replaced with proper foundation bearing soil types. Erosion control and storm water management efforts would be employed through the entire construction period. Additional oversight and caution during any subsurface excavations would be required based on previous and ongoing waste disposal assessment efforts (see also Section 3.12.2.1). If below-grade structures were proposed to meet space requirements, excavation dewatering would be required. Potential for soil settlement from construction dewatering would require design assessments to confirm adequate structural specifications. Any new or expanded foundations would be designed with an appropriate factor of safety, incorporating the bearing capacity and consolidation potential of the soil. The facility upgrades would be possible without significant effects to the site soils beyond the immediate footprint of the enhancements. Refer to Chapter 2 and Section 3.1.1 for additional storm water and constructability information.

3.6.2.3 Operation Consequences

A current facility expansion would likely increase PIADC's impervious area. The additional storm water discharge would be managed, reducing downslope erosion potential and allowing for subsurface filtration and groundwater recharge. Expansion of PIADC would not have anticipated adverse effects on the geology or soil structure of the area beyond the immediate footprint.

3.6.3 South Milledge Avenue Site

3.6.3.1 Affected Environment

Sixty percent of the Oconee River Basin is located in the Georgia Piedmont Region. The area is underlain by Precambrian and older Paleozoic crystalline rocks including biotite, granite, and amphibolites gneisses. The South Milledge Avenue Site is located in the Piedmont Region of Georgia. Moderate to high grade metamorphic rock and igneous rock make up the regions subsurface geology. These type soil structures can produce karst topography; however, such potential subsurface voids result from faults and fissures more so than dissolution or suffusion. The region is known for inactive fault zones that determine surface stream patterns and groundwater resources. The two primary tectonic terranes in the Piedmont Region are the Inner Piedmont and the Carolina, each separated by the Towaliga Fault Zone. The Inner Piedmont rocks, north of the fault zone, consist mainly of granitic and biotitic gneisses, whereas the Carolina rocks are predominantly metasedimentary. Deeply weathered Saprolite bedrock underlays much of the southeastern Piedmont Region. The geology of Georgia lends itself to earthquakes of various magnitudes and intensities. Table 3.6.3.1-1 is a brief historical summary of earthquakes in or felt in Georgia (USGS 2008a).

Table 3.6.3.1-1 — Georgia Historical Earthquake Data

Date	Location	Intensity
1811-1812	New Madrid, Missouri	VI
August 31, 1886	Charleston, South Carolina	VIII
June 17,1872	Milledgeville	V
November 1, 1875	Atlanta	VI
October 18, 1902	Dalton	VI
January 23, 1903	Tybee Island	VI
June 20, 1912	Savannah	V
March 5, 1916	Atlanta	V
March 12, 1964	Haddock	V

Magnitude, as registered on seismographs, is the energy released from an earthquake, as well as intensity is the strength of shaking, determined from effects on people and structures. The following table describes the relationship between magnitude and intensity (USGS 2006).

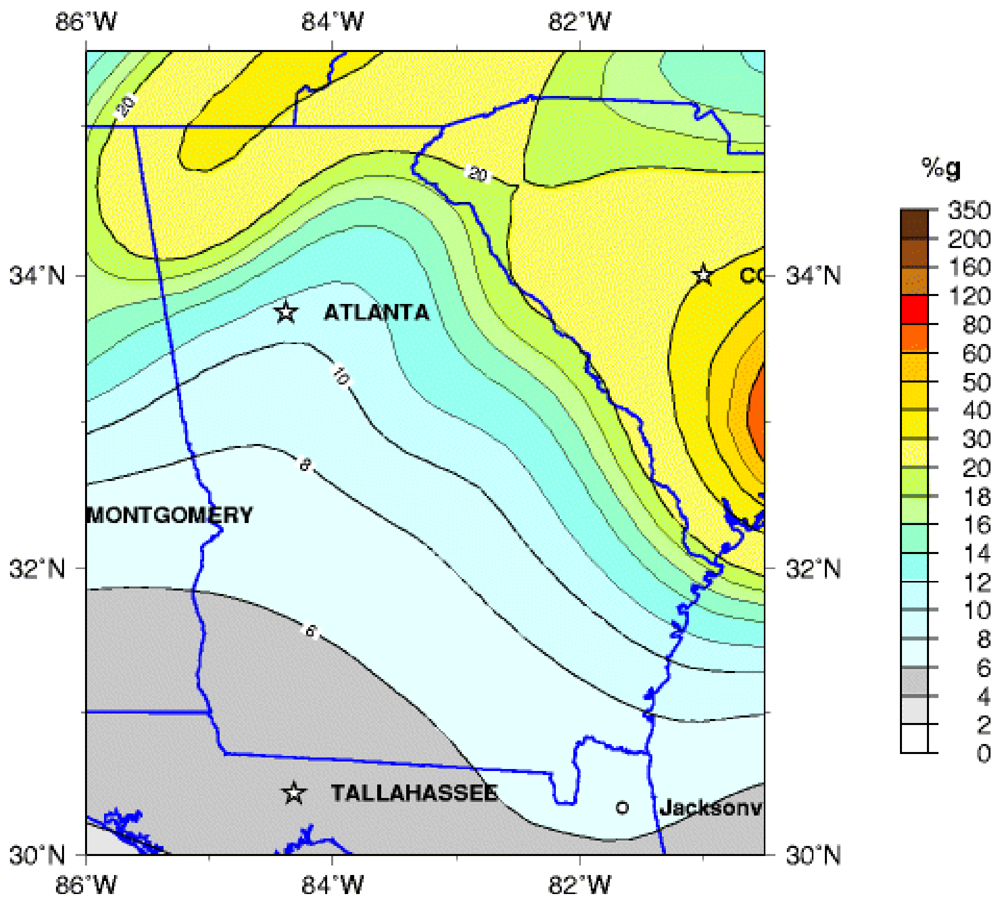
Table 3.6.3.1-2 — Magnitude vs. Intensity

Magnitude	Intensity	Intensity Description Examples
1.0 - 3.0	I	Not felt except by a very few under especially favorable conditions
3.0 - 3.9	II - III	Noticeably felt indoors, walls may creak
4.0 - 4.9	IV - V	Felt by nearly everyone, windows may break
5.0 - 5.9	VI - VII	Felt by all, heavy furniture moved
6.0 - 6.9	VII - IX	Damage considerable
7.0 and higher	VIII or higher	Most masonry and frame structures destroyed

The March 5, 1916, earthquake centered near Atlanta is considered one of the most significant in Georgia. With an intensity of V, the area of influence reached Cherokee County, North Carolina. The most recent Georgia earthquake, with a registered magnitude of 1.8, occurred on January 16, 2008, approximately 75 miles northwest of Atlanta or approximately 100 miles northwest of Athens. The USGS develops seismic hazard maps that are used in developing area building codes. Figure 3.6.3.1-1 depicts peak acceleration for Georgia, and the South Milledge Avenue Site is approximately 60 miles east of Atlanta (USGS 2008a). As the ground shakes during an earthquake, the ground also experiences acceleration. The USGS defines peak acceleration as "the largest acceleration recorded by a particular station during an earthquake." Refer to Sections 3.1.1 and 3.14 for additional constructability information.

The USGS develops estimates for mean return times of potential earthquake events of specific sizes and at a predetermined distance. The USGS estimated return time for 4.75, 5.0, and 6.5 magnitude earthquakes at a fixed distance of 31 miles exceeds 1,500 years for the Athens, Georgia, area. Refer to Section 3.6.1 for additional seismic information.

Soils at the South Milledge Avenue Site are in the Pacolet-Madison-Davidson Soil Association (Nutter and Associates 2007a). Of the several on-site soil classifications, Pacolet sandy clay loam dominates the site soil structure. The soils are well-drained with a 2% to 25% slope range. The surface texture is loam, a standard term defined according to percentages of sand, silt, and clay. In this case, "loam" is soil of 7% to 27% clay, 28% to 50% silt, and less than 52% sand. If particles coarser than sand exceed 15%, then an appropriate modifier such as "gravelly" is added. The NRCS Soils Map (Figure 3.6.3.1- 2) and Table 3.6.3.1-3 describe the soil types and locations at the South Milledge Avenue Site (USDA 2006a).



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

Figure 3.6.3.1-1 — Seismic Hazard Map for Georgia

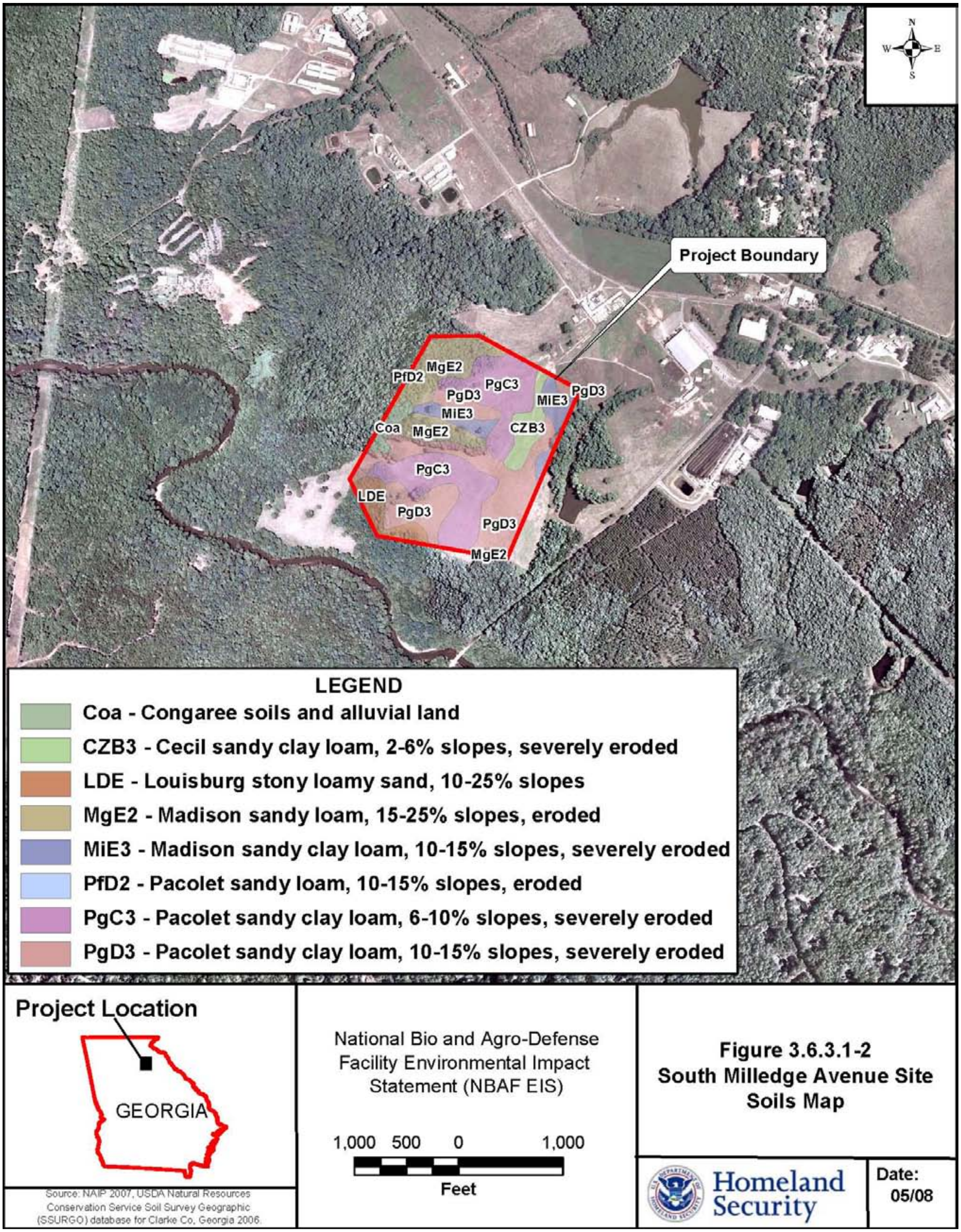


Figure 3.6.3.1-2 — South Milledge Avenue Site Soils Map

Table 3.6.3.1-3 — South Milledge Avenue Site Soil Descriptions

Map Unit	Classification	Depth Range (inches)	Drainage Class	Slope Range (%)	pH Range	Depth to Water Table (inches)
Coa	Congaree soils	0 - 80	Well drained	0 - 2	4.5 - 7.3	About 30 to 48
CZB3	Cecil sandy clay loam	0 - 75	Well drained	2 - 6	4.5 - 6.5	Greater than 80
LDE	Louisburg stony loamy sand	0 - 60	Well drained	10 - 25	4.5 - 6.0	Greater than 80
MgE2	Madison sandy loam	0 - 66	Well drained	15 - 25	4.5 - 6.5	Greater than 80
MiE3	Madison sandy clay loam	0 - 66	Well drained	10 - 25	4.5 - 6.5	Greater than 80
PgC3	Pacolet sandy clay loam	0 - 70	Well drained	6 - 10	4.5 - 6.5	Greater than 80
PgD3	Pacolet sandy clay loam	0 - 70	Well drained	10 - 15	4.5 - 6.5	Greater than 80

Of the 7 soil types, 1 (Congaree soils) is partially hydric and is also of statewide farmland importance. The National Technical Committee for Hydric Soils (NTCHS) defines hydric soils as forming under conditions of saturation, flooding, or ponding long enough to develop anaerobic conditions in the upper strata. These soils, in natural conditions, are saturated or inundated during the growing season long enough to support growth and reproduction of hydrophytic vegetation. The NTCHS definition of "hydric" identifies soil properties based on their associated wetness and further recommends that more information, such as depth to and duration of, the water table is needed to determine if a specific soil type is specifically hydric or non-hydric. Table 3.6.3.1-4 describes the site's approximate soil classification percentages, and indicates whether the soil classification is hydric, or is considered of statewide farmland importance USDA 2006a).

Table 3.6.3.1-4 — Hydric and Farmland Soils

Map Unit	Classification	Approx. Site %	Hydric Soil	Farmland Description
Coa	Congaree soils	2	Partially Hydric	Farmland of statewide importance
CZB3	Cecil sandy clay loam	5	Not Hydric	Not prime farmland
LDE	Louisburg stony loamy sand	6	Not Hydric	Not prime farmland
MgE2	Madison sandy loam	15	Not Hydric	Not prime farmland
MiE3	Madison sandy clay loam	8	Not Hydric	Not prime farmland
PgC3	Pacolet sandy clay loam	32	Not Hydric	Not prime farmland
PgD3	Pacolet sandy clay loam	32	Not Hydric	Not prime farmland

3.6.3.2 Construction Consequences

A detailed geotechnical report would be prepared once the preferred alternative is selected, and the findings and recommendations would be considered in the final design and specifications of the facility. The seismic soil class of the South Milledge Avenue Site is preliminarily considered Class D. Refer to Section 3.6.1, Table 3.6.1-1 for additional seismic information. Five preliminary geotechnical borings provided the following information: all borings were silty sand from 0 to 53 feet bls, most borings indicate partially weathered rock at varying depths of 1.5 feet bls to 71 feet bls, and dense rock was present in 1 boring at depths of 17 feet bls to 27 feet bls (Terracon 2007f). The subsurface geology of the site is formed from metamorphic and igneous rock limiting the likelihood of sinkhole development. Understanding the soil foundation and subsurface rock strata at the site are vital parameters and would influence the ultimate design and construction outlays. The proposed NBAF would be built to meet or exceed all applicable Georgia seismic building codes. The NBAF construction would not result in anticipated adverse effects on the geology of the region.

Site constructability has several variables ranging from the amount of excavation, depth to bedrock, depth to water table, and soil shrink/swell potentials. Structures built on sites with expansive clay soils should have an appreciable separation between these soils and the building foundation. With sufficient nonexpansive soil backfilling, a slab-on-grade foundation system would be considered. If the structure has more stringent movement tolerances, then a deep pile foundation system would be evaluated. Grade cut and fill needs would be anticipated to provide a fairly uniform surface for facility construction. An estimated volume of 292,000 cubic yards of on-site material would be displaced and managed during the construction phase. Additional information regarding seismic classification and construction considerations are included in Chapter 2, Sections 3.1.1 and 3.14.

The Congaree soil classification is the only soil described as of statewide farmland importance, and these soils make up less than 3% of the site soils. All federal projects are subject to the *Farmland Protection Policy Act* (FPPA) requirements if farmland would be irreversibly converted (directly or indirectly) to nonagricultural uses. The FPPA consultation would be required for all alternatives, and the NRCS local field office consultations have been initiated. A Farmland Conversion Impact Rating Form (AD-1006) was submitted to the Monroe Service Center, NRCS on April 22, 2008 and the local NRCS office determined the project is exempted by Section 1547(b) of the FPPA, 7 U.S.C. 4208(b) (Appendix G). Agency consultation would be finalized prior to construction. Good engineering and best management practices would be implemented through the entire construction phase, including implementation of approved erosion control and construction storm water pollution prevention plans. Implementation of these planning and regulatory authorizations would minimize or eliminate adverse effects on the soil classifications of the area beyond the immediate footprint of the site.

3.6.3.3 Operation Consequences

The preparation and implementation of a sediment and erosion control plans would minimize, if not prevent, any potential soil effects from the operation and maintenance of the facility. The *NBAF Conceptual Design and Feasibility Study* acknowledged the need to address the facility design and structural components to ensure sufficient stiffness minimizing structural deflection and vibration. The *NBAF Conceptual Design and Feasibility Study* discussed design goals for sustainable hydrology, such as landscaping with functional storm water management uses, and the maintenance/retention of a healthy soil structure. The NBAF would have no anticipated adverse effects on soil at the South Milledge Avenue Site other than those within the immediate site's footprint.

3.6.4 Manhattan Campus Site

3.6.4.1 Affected Environment

Riley County has many different surface rock, soil, and bedrock types as compared to most Kansas counties. These soil/rock types and ages range from younger hill top and river bed soils, sands, and gravels to the older limestone bedrock in southeastern Riley County. Most of Riley County's bedrock is Permian age limestone and shale, containing flint, the rock naming the Flint Hills region (KGS 2001). Of the 105 Kansas counties, 26 counties have reported sinkholes. The Fort Riley Limestone outcropping south of Riley County is water soluble and accounts for a large distribution of karst topography in southeastern Kansas. Western Kansas also has sinkhole erosional features that are associated with other subsurface salt and carbonate deposits.

The Mid-continent Rift System stretches from Lake Superior to southern Kansas. The Rift System contains faults or fractures including the Humboldt Fault, a 300-million year-old subterranean fracture running through Kansas. In the Manhattan area, the Humboldt Fault is broken by a series of bisecting underground fissures, which is a plausible explanation for the recorded earthquakes in Riley and adjacent Pottawatomie Counties. Field investigations have confirmed that sedimentary deposits, with moderate susceptibility for liquefaction, are present in the vicinity of Wamego and Wabaunsee Kansas, less than 25 miles from the Manhattan Campus Site. The studies suggested that liquefaction features are present but may not be regionally pervasive (KGS 2001). The Kansas Geological Survey, with offices in Lawrence, Kansas, estimated that the Humboldt Fault is capable of producing a 6.5-magnitude earthquake every 2,000 to 5,000 years.

On April 24, 1867, a 5.1-magnitude earthquake centered near Manhattan resulted in structural damage, and a 2-foot high wave was reported moving south to north on the Kansas River near Manhattan. Between September and December 1929, a series of four earthquakes, with magnitudes between 3.2 and 4.2, occurred within the area surrounding Manhattan. The Kansas Geological Survey, with partial funding by the U.S. Army Corps of Engineers (USACE), has been studying and recording seismic epicenter and magnitude data since the 1960s. Based on these studies, very small earthquakes routinely occur in Kansas; most of these are micro-earthquakes, which are defined as earthquakes too small to feel. Table 3.6.4.1-1 provides a brief historical summary of earthquakes in or felt in Kansas (USGS 2008a).

Table 3.6.4.1-1 — Kansas Historical Earthquake Data

Date	Location	Intensity[a]
April 24, 1867	Manhattan	VI
November 6, 1875	Valley Falls	V
October 31, 1895	Charleston, Missouri	ND[b]
October 27, 1904	Dodge City	V
January 7, 1906	Manhattan	VII
March 18, 1927	White Cloud	V
September 23, 1929 (2)	Manhattan	V
October 21, 1929	Manhattan	ND
December 7, 1929	Manhattan	ND
February 20, 1933	Decatur County	ND
April 9, 1952	Medicine Lodge	V
January 6, 1956	Coats	ND
April 13, 1961	Norton County	V
November 9, 1968	Eastern Kansas	VI

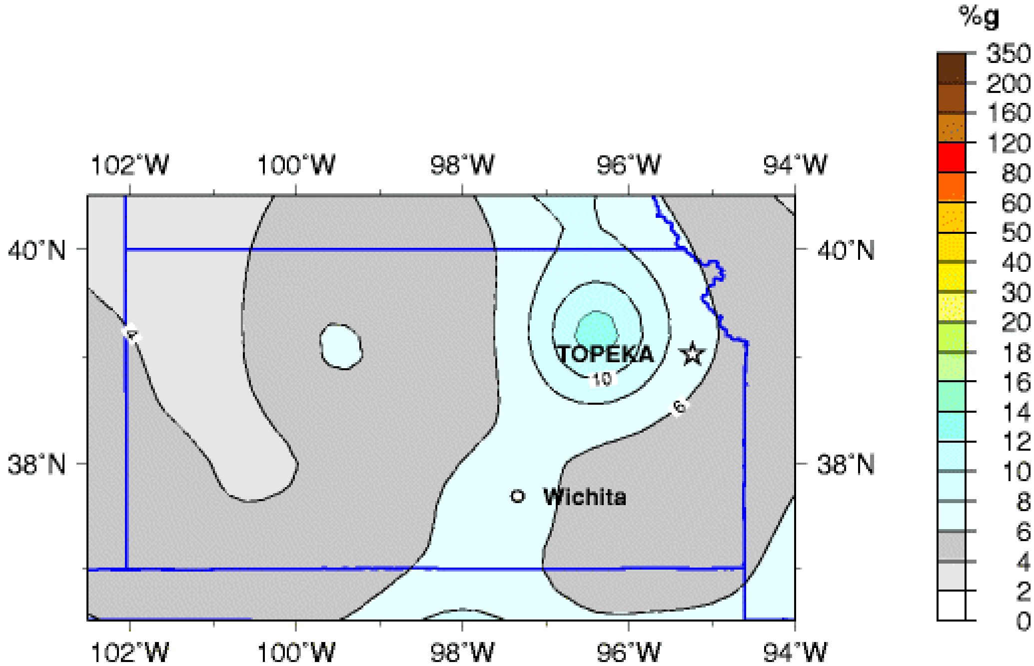
[a] Ref. Table 3.6.3.1-2 Magnitude vs. Intensity. [b] ND-No Data

The most recent earthquake, of a registered magnitude 2.7, occurred on January 1, 2008, approximately 15 miles west of Arkansas City, Kansas. Arkansas City is 149 miles southeast of Manhattan. Figure 3.6.4.1-1 shows the seismic hazard potential for Kansas; the Manhattan Campus Site is approximately 64 miles west of Topeka (USGS 2008b). The figure depicts the area of potential ground shaking hazard for the Manhattan Campus Site as 6% to 10% g. Refer to Section 3.6.1 for additional seismic information.

Figure 3.6.1-1 (Section 3.6.1) depicts the estimated time of return in years for a magnitude 4.75 earthquake at a fixed distance of 31 miles. The USGS estimated return time for 4.75-, 5.0-, and 6.5-magnitude earthquakes at a fixed distance of 31 miles exceeds 1,500 years for the Manhattan, Kansas, area.

Of the several on-site soil classifications, three dominate the Manhattan Campus Site: Tully silty clay loam, Clime-Sogn complex, and Smolan silt loam. These soils are well to moderately well drained with a 1% to 20% slope range. The site surface texture is a silt loam to a silty clay loam. Refer to Section 3.6.3.1 for additional soil information. The NRCS Soils Map (Figure 3.6.4.1- 2) and Table 3.6.4.1- 2 describe the on-site soil types and locations (USDA 2006d).

Table 3.6.4.2-3 describes approximate soil classification percentages at the site, general farmland description, and hydric determination (USDA 2006d). No on-site soil types are identified as prone to flooding or ponding, two are partially hydric, and five of six soil classifications are considered either prime or of statewide farmland importance. Refer to Sections 3.6.3.1 and 3.6.3.2 for additional hydric soil and FPPA information.



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

Figure 3.6.4.1-1 — Seismic Hazard Map for Kansas

An estimated volume of 284,000 cubic yards of on-site material would be displaced and managed during the construction phase. A detailed geotechnical report would be prepared once the preferred alternative is selected.

Table 3.6.4.1-2 — Manhattan Campus Site Soils Description

Map Unit	Classification	Depth Range (inches)	Drainage Class	Slope Range (%)	pH Range	Depth to Water Table (inches)
3919 (Sm) & 3920 (Sn)	Smolan silt loam	0 - 60	Moderately well drained	1 to 7	5.6 - 7.8	More than 80
3923 (So)	Smolan silty clay loam	0 - 60	Moderately well drained	3 to 7	5.6 - 7.8	More than 80
4590 (Cs)	Clime-Sogn complex	0 - 34	Well drained	3 to 20	6.1 - 8.4	More than 80
4783 (Tu)	Tully silty clay loam	0 - 60	Well drained	3 to 7	5.6 - 8.4	More than 80
7681 (Wn)	Wymore silty clay loam	0 - 79	Moderately well drained	1 to 3	5.6 - 7.3	About 12 to 36
7690 (Bk)	Wymore-Kennebec complex	0 - 64	Moderately well drained	0 to 17	5.6 - 7.3	About 12 to 36

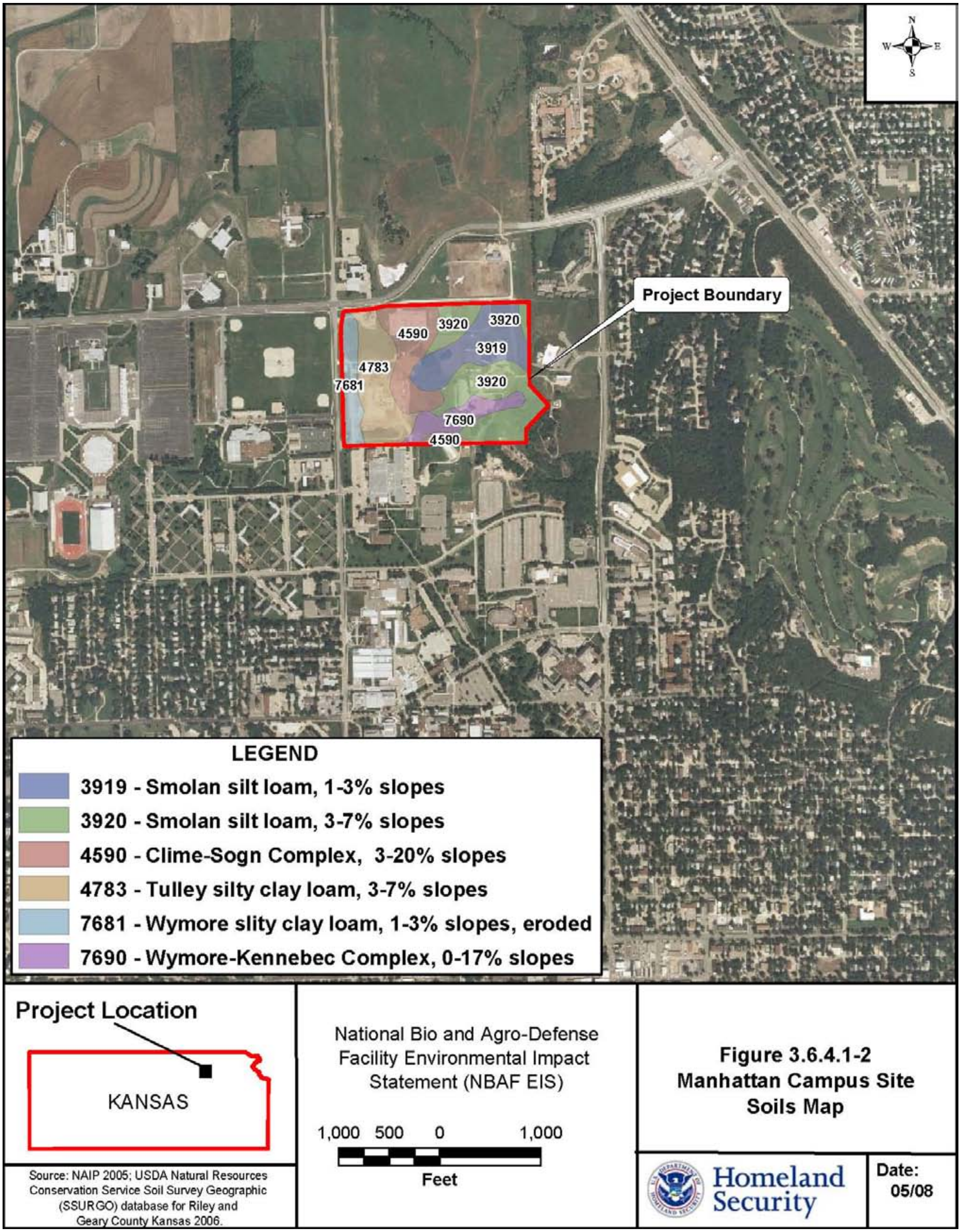


Figure 3.6.4.1-2 — Manhattan Campus Site Soils Map

Table 3.6.4.1-3 — Hydric and Farmland Soils

Classification	Approx. Site %	Hydric Soil	Farmland Description
Smolan silt loam	20	Not Hydric	All areas are prime farmland
Smolan silt loam & silty clay loam	5	Not Hydric	Farmland of statewide importance
Clime-Sogn complex	24	Partially Hydric	Farmland of statewide importance
Tully silty clay loam	28	Not Hydric	Farmland of statewide importance
Wymore silty clay loam	12	Not Hydric	All areas are prime farmland
Wymore-Kennebec complex	11	Partially Hydric	Not prime farmland

3.6.4.2 Construction Consequences

The Manhattan Campus Site is approximately 48.4 acres, and the minimum area required for the NBAF is 30 acres. Refer to Sections 3.6.3.1, 3.6.3.2, and 3.1.1 for additional facility and constructability information. There are no on-site wetlands, and only two of the six soil types are classified as partially hydric. Approximately 90% of the site soils are considered prime or of statewide farmland importance. NRCS determined that construction of the the proposed NBAF at the Manhattan Campus Site would affect 10.2 acres of prime and unique farmlands (Appendix G). Refer to Sections 3.6.3.1 and 3.6.3.2 for additional hydric soil and FPPA information and Sections 3.6.3.2 and 3.1.1 for additional regulatory and constructability information. The Manhattan Campus Site seismic soil classification would be preliminarily considered Class D. Additional information regarding seismic classification and construction considerations are included in Chapter 2, Sections 3.1.1, 3.6.1, and 3.14 and Table 3.6.1-1.

The preliminary geotechnical data described the site soils as: 0 to 5 feet bls fat clay fill with rock fragments; native clays from 7 feet bls to 25 feet bls; and, in several borings, underlying limestone and shale from 5 feet bls to 26 feet bls (Terracon 2007c). Sections 3.6.3.1, 3.6.3.2, and 3.1.1 include additional constructability information. Preliminary geotechnical investigations did not identify any geologic features that would suggest sinkhole formation. The NBAF would be built to meet or exceed all applicable Kansas seismic building codes. Construction of the NBAF would not result in anticipated adverse effects on the geology of the region.

3.6.4.3 Operation Consequences

The preparation and implementation of a sediment and erosion control plans would minimize, if not prevent, any potential soil effects from the operation and maintenance of the facility. The *NBAF Conceptual Design and Feasibility Study* acknowledged the need to address the facility design and structural components to ensure sufficient stiffness minimizing structural deflection and vibration. The *NBAF Conceptual Design and Feasibility Study* discussed design goals for sustainable hydrology, such as landscaping with functional storm water management uses, and the maintenance/retention of a healthy soil structure. The NBAF would have no anticipated adverse effects on the Manhattan Campus Site soils, other than those within the immediate site footprint. Operation of the NBAF at the Manhattan Campus Site would not result in anticipated adverse effects on the geology of the region. Refer to Section 3.14 for additional operational information.

3.6.5 Flora Industrial Park Site

3.6.5.1 Affected Environment

The Flora Industrial Park Site is located within loessial soils overlying the Yazoo Formation. The Yazoo Formation, part of the Jackson Group, is a relatively homogeneous unit made up of calcareous and fossiliferous clays (MDEQ 2008). The Yazoo Formation was marine deposited during the Eocene and covers nearly three-fourths the width of central Mississippi. Mississippi is not known for karst features; however, there are three distinct Mississippi regions with limestone outcrops. The Fort Payne Formation is in the state's northeast corner, the Ripley Formation that outcrops diagonally in the state's center from north to southeast, and the Marianna Formation the trends east to west from the state's southern central area. Ten Mississippi counties are within the three limestone regions but does not include Madison County. A shallow seaway crossed North America, from the Gulf of Mexico to the Arctic Ocean, and sediment from this seaway accumulated in a partial rift called the Reelfoot Rift. The Reelfoot Rift extends from Illinois southwest toward the Gulf of Mexico. The Reelfoot Rift is referred to as “inactive” but continues to influence the central United States. The New Madrid Seismic Zone lies within the central Mississippi Valley, and the New Madrid Fault System lies within the confines of the Reelfoot Rift. Historically, this area has been the site of some of the largest earthquakes in North America (UALR 1998).

Most earthquakes experienced in Mississippi have occurred from events outside the state boundaries. Table 3.6.5.1-1 briefly describes the earthquake history of Mississippi (USGS 2008a).

Table 3.6.5.1-1 — Mississippi Historical Earthquake Data

Date	Location	Intensity[a]
1811 - 1812	New Madrid, Missouri	VI
December 16, 1931	Tallahatchie County	VI - VII
February 1, 1955	Gulfport	V
June 4, 1967	Greenville	III
June 29, 1967	Bolivar	III
March 29, 1972	Hillhouse	IV

[a] Ref. Table 3.6.3.1.- 2 Magnitude vs. Intensity.

The earthquake of December 17, 1931, was centered in Tallahatchie County approximately 100 miles north of the Flora Industrial Park Site, and is considered one of Mississippi’s largest, with an intensity of VI. A more recent earthquake, with a registered magnitude of 1.7, occurred on January 20, 2008, near Grenada, Mississippi, approximately 95 miles north of the Flora Industrial Park Site.

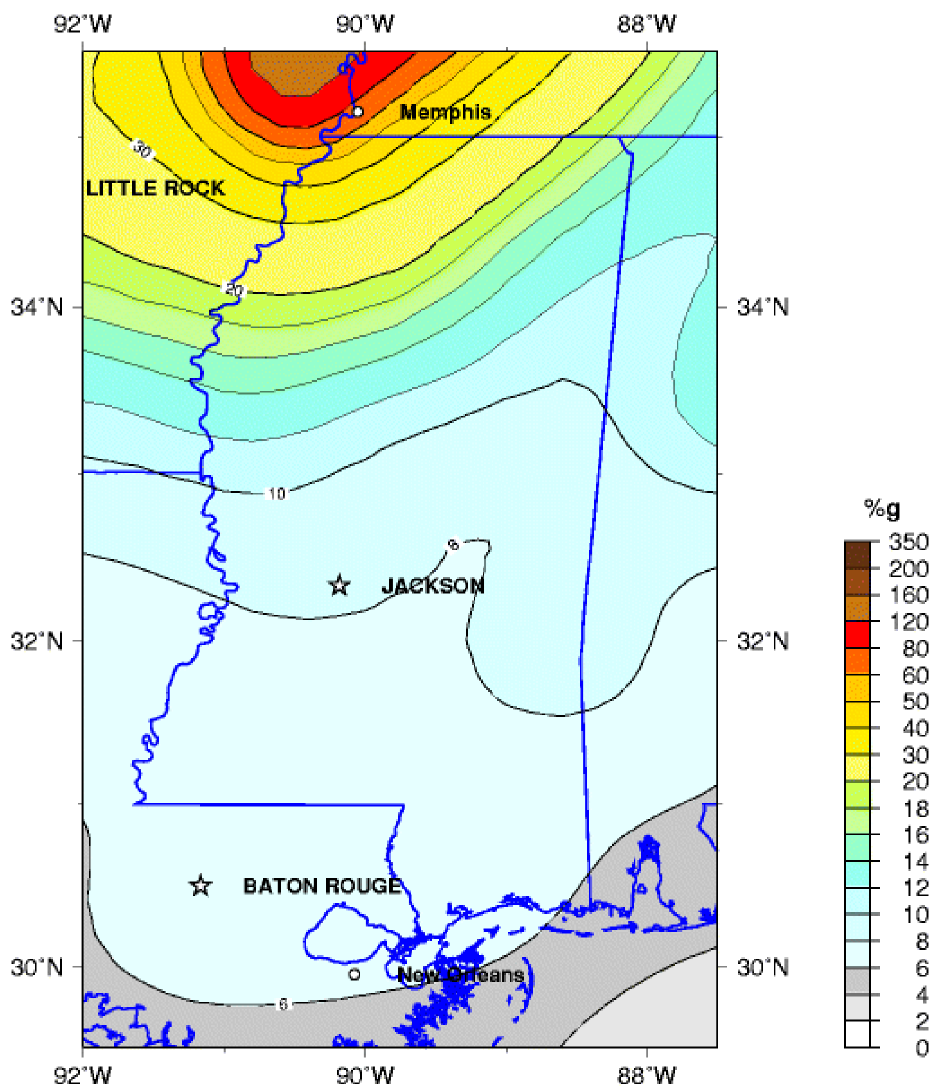
Figure 3.6.5.1-1 depicts seismic peak acceleration for Mississippi; the Flora Industrial Park Site is approximately 30 miles west of Jackson (USGS 2008c). The figure indicates that the Flora Industrial Park Site is within an area of potential ground-shaking hazard 8% to 10% g. Refer to Sections 3.6.1 and 3.6.3.1 for additional seismic information.

Figure 3.6.1-1 (Section 3.6.1) depicts the estimated time of return in years for a magnitude 4.75 earthquake at a fixed distance of 31 miles. The USGS estimated return time for 4.75-, 5.0-, and 6.5-magnitude earthquakes at a fixed distance of 31 miles exceeds 2,000 years for the Flora, Mississippi area.

The soil profile for the Flora Industrial Park Site includes the Loring-Grenada-Calloway Soils Association. These soils are well to somewhat poorly drained, with a 1% to 8% slope range. The poorly drained silty soils have a subsurface soil layer that restricts water flow and root penetration primarily on uplands and stream terraces (ATE 2007). The Flora Industrial Park Site Soils Map (Figure 3.6.5.1-2) illustrates soil type locations, and Table 3.6.5.1-2 describes the on-site soil types (USDA 2006b).

Table 3.6.5.1-2 — Flora Industrial Park Site Soils Descriptions

Map Unit	Classification	Depth Range (inches)	Drainage Class	Slope Range (%)	pH Range	Depth to Water Table (inches)
Ar	Ariel Silt Loam	0 - 65	Well drained	0 - 2	4.5 - 5.5	24 to 36
CbB	Calloway Silt Loam	0 - 68	Somewhat poorly drained	1 - 3	4.5 - 7.8	7 to 18
GrB2	Grenada Silt Loam	0 - 60	Moderately well drained	2 - 5	4.5 - 7.3	18 to 27
LoB2	Loring Silt Loam	0 - 72	Moderately well drained	2 - 5	4.5 - 6.5	24 to 32
LoC2	Loring Silt Loam	0 - 72	Moderately well drained	5 - 8	4.5 - 6.5	24 to 32
LoC3	Loring Silt Loam	0 - 72	Moderately well drained	5 - 8	4.5 - 6.5	24 to 32



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

Figure 3.6.5.1-1 — Seismic Hazard Map for Mississippi

Four soil types are partially hydric, and five of six are prime or of statewide farmland importance (Table 3.6.5.1-3) (USDA 2006b), (NRCS 2007).

3.6.5.2 Construction Consequences

A detailed geotechnical report would be prepared once the preferred alternative is selected, and the findings and recommendations would be considered in the final design and specifications of the facility. Preliminary geotechnical investigations did not identify any geologic features that would suggest sinkhole formation. The NBAF would be built to meet or exceed all applicable Mississippi seismic building codes, and the seismic soil classification of the site would be preliminarily consider Class D. Refer to Chapter 2, Sections 3.1.1, 3.6.1, 3.6.3.1, 3.6.3.2, and 3.14 and Table 3.6.1-1 for additional seismic and constructability information. An estimated volume of 145,000 cubic yards of on-site material would be displaced and managed during the construction phase. Soils at the Flora Industrial Park Site are considered 90% prime or of statewide farmland importance. NRCS determined that 150-acres of the Flora Industrial Park Site included 35.1 acres of prime and unique farmlands (Appendix G).

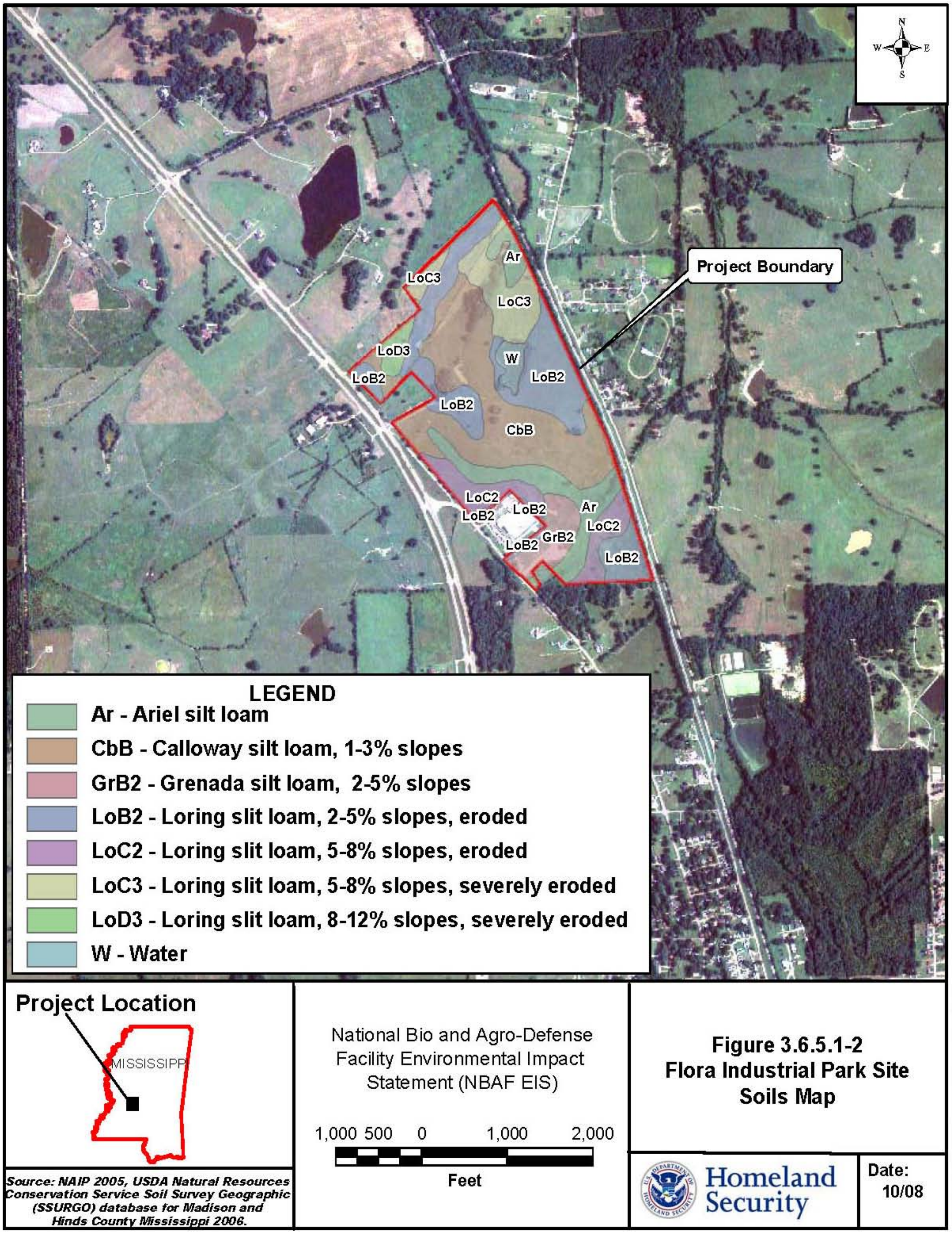


Figure 3.6.5.1-2 — Flora Industrial Park Site Soils Map

Table 3.6.5.1-3 — Hydric and Farmland Soils

Map Unit	Classification	Approx. Site %	Hydric Soil	Farmland Description
Ar	Ariel Silt Loam	15	Partially Hydric	Prime farmland if protected from flooding or not frequently flooded during the growing season
CbB	Calloway Silt Loam	35	Partially Hydric	All areas are prime farmland
GrB2	Grenada Silt Loam	5	Not Hydric	All areas are prime farmland
LoB2	Loring Silt Loam	25	Not Hydric	All areas are prime farmland
LoC2	Loring Silt Loam	10	Partially Hydric	Farmland of statewide importance
LoC3	Loring Silt Loam	10	Partially Hydric	Not prime farmland

3.6.5.3 Operation Consequences

The preparation and implementation of a sediment and erosion control plans would minimize, if not prevent, any potential soil effects from the operation and maintenance of the facility. The *NBAF Conceptual Design and Feasibility Study* acknowledged the need to address the facility design and structural components to ensure sufficient stiffness minimizing structural deflection and vibration. The *NBAF Conceptual Design and Feasibility Study* discussed design goals for sustainable hydrology, such as landscaping with functional storm water management uses, and the maintenance/retention of a healthy soil structure. The Calloway silt loam soil classification makes up a large portion of the soil classes at the site. The NBAF operations would have no anticipated adverse effects on the soil classifications of the area beyond the immediate site footprint. Refer to Section 3.14 for additional operational information.

3.6.6 Plum Island Site

3.6.6.1 Affected Environment

The surface geology of Plum Island is described in Section 3.6.2.1.

The geology of New York lends itself to occasional earthquakes. Table 3.6.6.1-1 briefly describes the earthquake history of New York (USGS 2008a).

Table 3.6.6.1-1 — New York Historical Earthquake Data

Date	Location	Intensity[a]
December 18, 1737	New York City	VII
October 23, 1857	Buffalo	VI
November 14, 1877	Lake Champlain	VII
August 10, 1884	Amityville	VII
August 12, 1929	Attica	VIII
April 20, 1931	Lake George	VII
September 4, 1944	Massena	VIII
January 1, 1966	Attica	VI

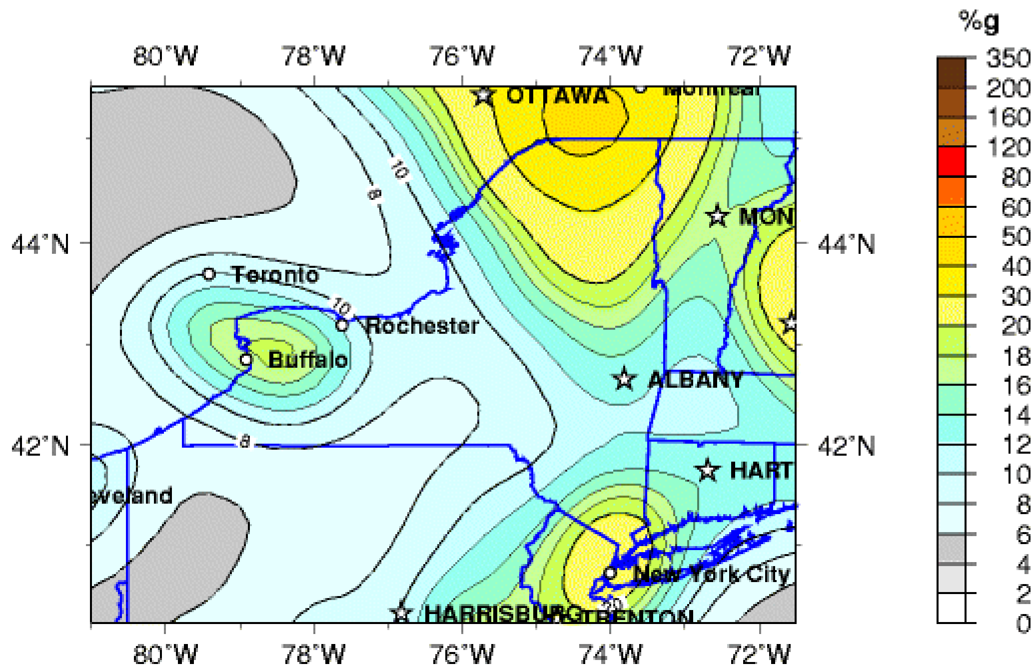
[a]Ref. Table 3.6.3.1- 2 Magnitude vs. Intensity.

The most recent earthquake in New York, with a registered magnitude of 1.9, occurred on March 15, 2008, approximately 10 miles south-southwest of Middletown or 100 miles west-northwest of Plum Island.

Figure 3.6.6.1-1 shows seismic peak acceleration for New York; Plum Island is approximately 100 miles east-northeast of New York City (USGS 2008e). The figure depicts Plum Island within an area of potential ground-shaking hazard 8% to 10% g. Refer to Section 3.6.1 for additional seismic information.

Figure 3.6.1-1 (Section 3.6.1) depicts the estimated time of return in years for a magnitude 4.75 earthquake at a fixed distance of 31 miles. The USGS estimated return time for 4.75-, 5.0-, and 6.5-magnitude earthquakes at a fixed distance of 31 miles exceeds 1,500 years for the Plum Island, New York, area.

Of the several on-site soils classifications, Haven loam (HaB) and Carver/Plymouth sands (CpE) dominate. The soil drainage classes range from moderately well drained to excessively drained, and the slopes range from 2% to 35%. The NRCS Soils Map (Figure 3.6.6.1- 2) and Table 3.6.6.1- 2 describe the onsite soil types and locations found on the Plum Island site.



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

Figure 3.6.6.1-1 — Seismic Hazard Map for New York

Table 3.6.6.1-2 — Plum Island Site Soils Descriptions

Map Unit	Classification	Depth Range (inches)	Drainage Class	Slope Range (%)	Depth to Water Table (inches)
BgB	Bridgehampton silt loam	0 - 80	Well drained	2 - 6	More than 80
CpE	Carver and Plymouth sands	0 - 60 0 - 60	Excessively drained Excessively drained	15 - 35	More than 80 More than 80
CuB	Cut and fill land, gently sloping	-	Moderately well drained	3 - 8	-
Gp	Gravel pits	-	-	-	-
HaB	Haven loam	0 - 60	Well drained	2 - 6	More than 80
PlC	Plymouth loamy sand	0 - 60	Excessively drained	8 - 15	More than 80

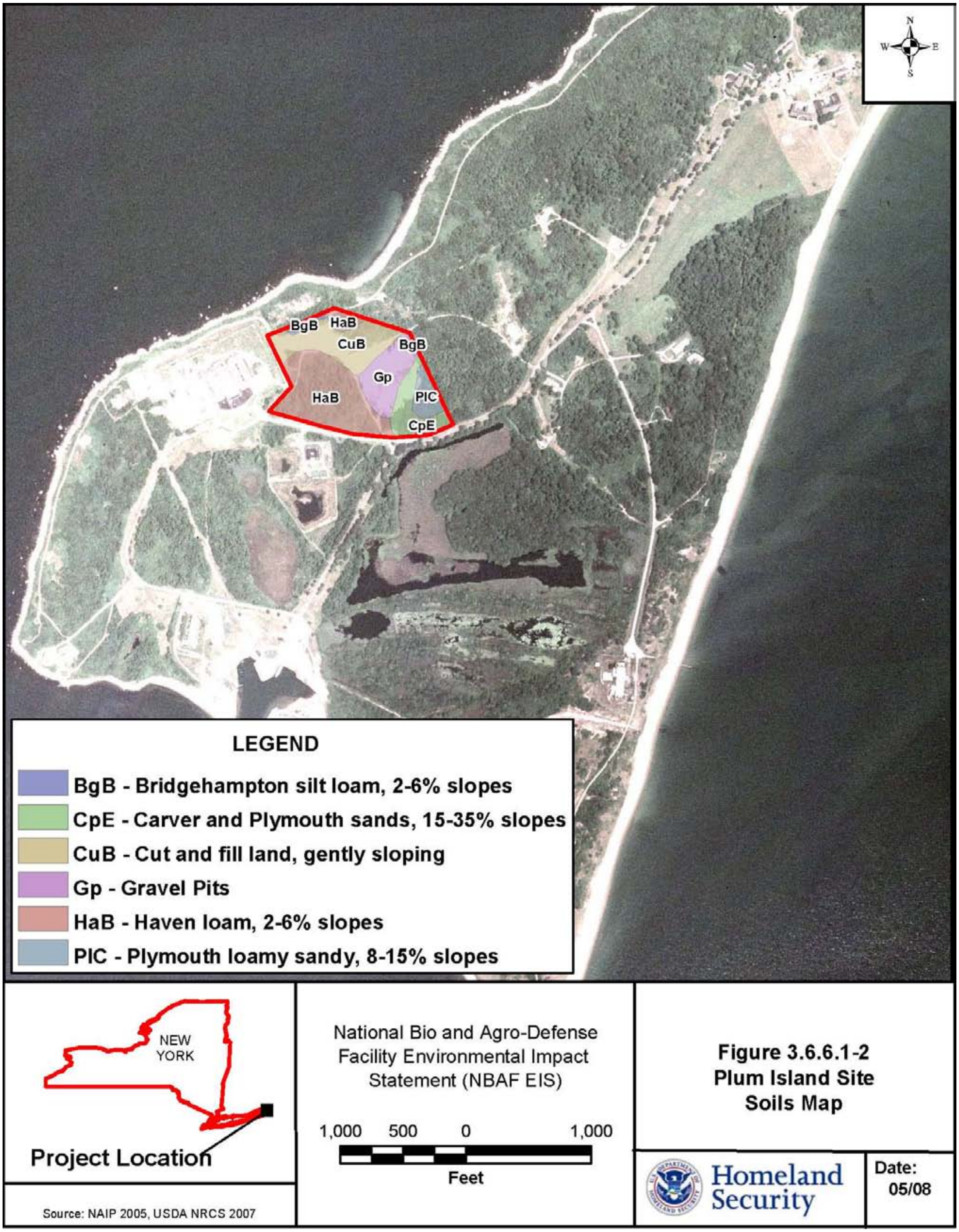


Figure 3.6.6.1-2 — Plum Island Site Soils Map

Table 3.6.6.1-3 describes the approximate soil classification percentages, general farmland description, and hydric determination for the site. No soil types are identified as prone to flooding or ponding, but two soil series are considered prime farmland.

Table 3.6.6.1-3 — Hydric and Farmland Soils

Classification	Approx. Site %	Hydric Soil	Farmland Description
Bridgehampton silt loam	4	Not Hydric	All areas are prime farmland
Carver and Plymouth sands	11	Not Hydric	Not prime farmland
Cut and fill land, gently sloping	23	Not Hydric	Not prime farmland
Gravel pits	15	Unknown Hydric	Not prime farmland
Haven loam	39	Not Hydric	All areas are prime farmland
Plymouth loamy sand	8	Not Hydric	Not prime farmland

The Plum Island Site has been mapped as Harbor Hill Ground-Moraine and Harbor Hill End-Moraine deposits of the Quaternary geologic age on the site's west and east sides, respectively (Terracon 2007a). The boundary between the ground-moraine and the end-moraine divides the site north to south at its approximate midpoint. The ground-moraine is described as glacial till, a poorly sorted mixture of clay, sand, and pebble-to boulder-sized gravel deposited by glacial ice. The end-moraine is described as glacial till overlying stratified sand and gravel. These Moraine soils are primarily light to dark brown, medium- to coarse-grain, silty sand, and gravel with some isolated gray to light brown mottled clay seams and extend approximately 60 feet bls. Abundant boulder, cobble, and gravel zones are located on the northern portion of the island (Entech 2002). Historically, there was a sand and gravel pit on the south side of the site (Terracon 2007a).

3.6.6.2 Construction Consequences

A detailed geotechnical report would be prepared once the preferred alternative is selected and the findings and recommendations would be considered in the final design and specifications of the facility. Construction of the NBAF would have no anticipated adverse effect on the geology and soils of the Plum Island Site, beyond the immediate footprint. Preliminary geotechnical investigations did not identify any geologic features that would suggest sinkhole formation.The seismic soil classification would be preliminarily considered Class D (Terracon 2007a). Refer to Section 3.6.1 and Table 3.6.1-1 for additional seismic information. An estimated volume of 264,000 cubic yards of on-site material would be displaced and managed during site construction. Approximately 45% of the Plum Island Site's soil types are considered prime or of statewide farmland importance. NRCS determined that construction of the the proposed NBAF at the Plum Island Site would affect 10.4 acres of prime and unique farmlands (Appendix G). Additional fill needs would be likely on the south side of the site at the location of a former sand and gravel pit. The soil displacement would not have an adverse effect on the regional topography. Additionally, laboratory wastes have been excavated and removed from this general area. Initial soil and groundwater assessments have been completed; however, the data have not been finalized. Supplemental construction planning efforts would be employed during soil manipulation and excavation. Refer to Chapter 2, Sections 3.1.1, 3.6.3.1, 3.6.3.2, 3.12.6, and 3.13.6 for additional soil, waste, and constructability information.

3.6.6.3 Operation Consequences

The Haven loam and Carver/Plymouth sand soil classifications make up a large portion of soil classes at the site. The conceptual layout of the Plum Island Site avoids direct impacts to island surface waters. Operation of the NBAF would have no anticipated adverse effects on the soil classifications beyond the immediate site footprint. Refer to Section 3.14 for additional operational information.

3.6.7 Umstead Research Farm Site

3.6.7.1 Affected Environment

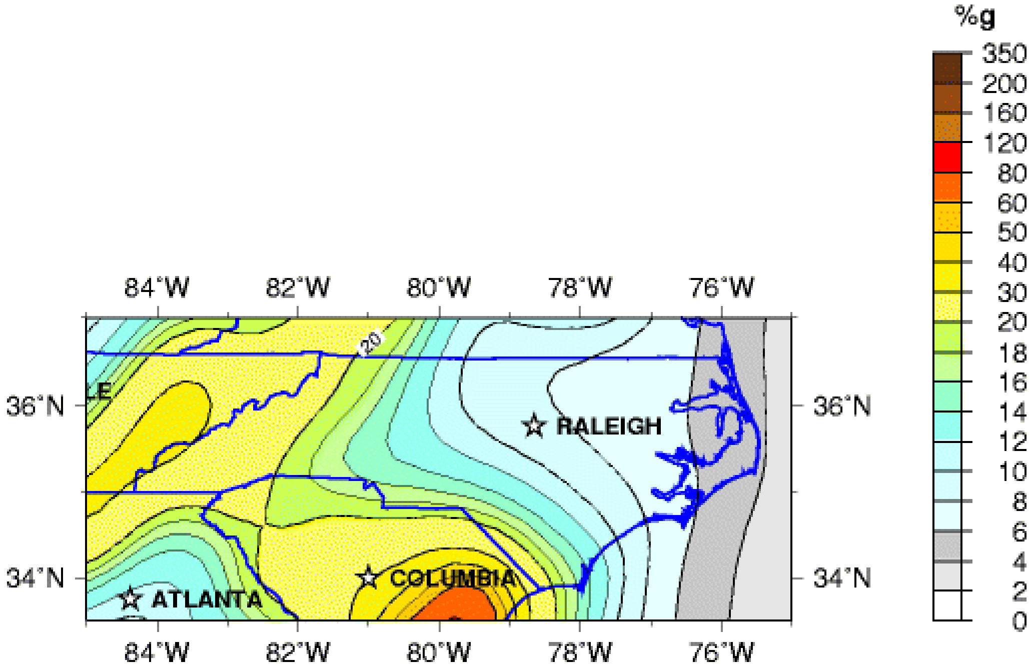
During the Triassic age, mudstones and claystones were laid down in the Durham Triassic Basin now known as North Carolina Piedmont Region. The ancient Jonesboro Fault, east of Raleigh, forms the basin's eastern boundary; these mud and clay "redbeds" became the mainstay of the North Carolina brick industry. The Carolina Slate Belt, formed from heated and deformed sedimentary rocks, bisects the Piedmont running almost from Virginia to South Carolina. The Castle Hayne limestone Formation is found primarily in the North Carolina southeastern coastal plain counties of Brunswick, New Hanover, Pender, Onslow, Jones, Lenoir, Craven, and Beaufort. The Umstead Research Farm Site is located in North Carolina's Piedmont Region and does not retain the soil structure normally seen in dissolution or suffusion limestone sinkholes. The geology of North Carolina lends itself to earthquakes of various magnitudes and intensities. Table 3.6.7.1-1 provides a brief historical summary of earthquakes that occurred in or were felt in North Carolina (USGS 2008a).

Table 3.6.7.1-1 — North Carolina Historical Earthquake Data

Date	Location	Intensity[a]
March 8, 1735	Bath	V
February 21, 1774	Virginia south	ND[b]
1811 - 1812	New Madrid, Missouri	VI
February 10 and April 17, 1874	McDowell County	V, >75 events
December 13, 1879	Charlotte	V
January 18, 1884	Wilmington	V
August 6, 1885	Blowing Rock	IV - V
August 31, 1886	Charleston, South Carolina	X
May 31, 1897	Giles County, Virginia	ND
January 1, 1913	Union County, South Carolina	ND
October 29, 1915	Marshall	V
February 21, 1916	Asheville	VI, largest within state borders
August 26, 1916	Winston-Salem	V
July 8, 1926	Mitchell County	VI
November 2, 1928	Asheville	VI
January 1, 1935	Gary	ND
May 13, 1957	Micaville	VI
July 2, 1957	Asheville	VI
March 5, 1958	Wilmington	V
December 13, 1969	Glenville	V
September 9, 1970	Boone	V

[a] Ref. Table 3.6.3.1.-2 Magnitude vs. Intensity [b] ND = no data

The February 21, 1916, earthquake, centered in the Asheville area, is considered one of the largest to occur in North Carolina. With an intensity of VI, the area of influence was approximately 200,000 square miles. The most recent earthquake, with a registered magnitude of 3.1, occurred in North Carolina on December 7, 2007, approximately 25 miles north-northwest of Spartanburg, South Carolina, or approximately 200 miles southwest of the Umstead Research Farm Site. Figure 3.6.7.1-1 shows seismic peak acceleration for North Carolina; the Umstead Research Farm Site is approximately 30 miles north of Raleigh (USGS 2008f). The figure depicts the site within an area of potential ground-shaking hazard 8% to 10% g.



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

Figure 3.6.7.1-1 — Seismic Hazard Map for North Carolina

Figure 3.6.1-1 (Section 3.6.1) depicts the estimated time of return in years for a magnitude 4.75 earthquake at a fixed distance of 31 miles. The USGS estimated return time for 4.75-, 5.0-, and 6.5-magnitude earthquakes at a fixed distance of 31 miles exceeds 4,000 years for the Umstead Research Farm Site area.

The soils on the Umstead Research Farm Site are in the White Store Creedmoor Association (USACE 2007b). Of the several on-site soils classifications, three dominate: Lignum Silt Loam, Georgeville, and Herndon. The soils are well to somewhat well drained with a 2% to 25% slope range. The NRCS Soils Map (Figure 3.6.7.1-2) and Table 3.6.7.1-2 describe the on-site soil types and locations (USDA 2006c).

Lignum silt loam is the only partially hydric soil, and six of the seven soils are considered prime or of statewide farmland importance. Table 3.6.7.1-3 describes the approximate soil classification percentages, general farmland description, and hydric determination. No on-site soil types are prone to flooding or ponding (USDA 2006c).

An estimated volume of 244,000 cubic yards of on-site material would be displaced and managed during the construction phase. A detailed geotechnical report would be prepared once the preferred alternative is selected. The findings and recommendations would be considered in the final design and specifications of the facility.

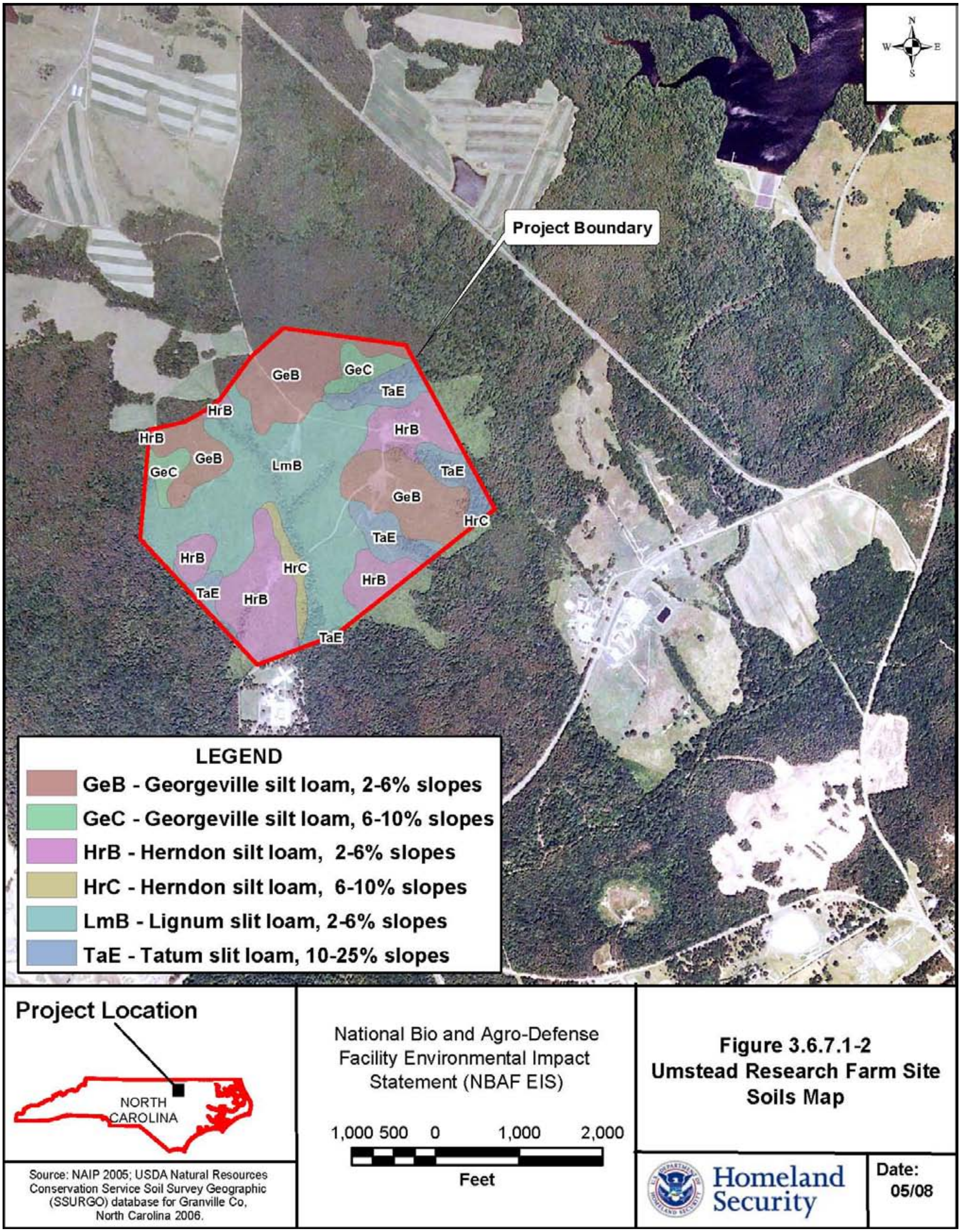


Figure 3.6.7.1-2 — Umstead Research Farm Site Soils Map

Table 3.6.7.1-2 — Umstead Research Farm Site Soils Descriptions

Map Unit	Classification	Depth Range (inches)	Drainage Class	Slope Range (%)	pH Range	Depth to Water Table (inches)
GeB	Georgeville silt loam	0 - 80	Well drained	2 - 6	4.5 - 7.3	Greater than 80
GeC	Georgeville silt loam	0 - 80	Well drained	6 - 10	4.5 - 7.3	Greater than 80
HrB	Herndon silt loam	0 - 80	Well drained	2 - 6	3.5 - 6.5	Greater than 80
HrC	Herndon silt loam	0 - 80	Well drained	6 - 10	3.5 - 6.5	Greater than 80
LmB	Lignum silt loam	0 - 80	Moderately well drained	2 - 6	2.0 - 7.2	About 12 to 20
TaE	Tatum loam	0 - 80	Well drained	10 - 25	4.5 - 5.5	Greater than 80
NaB	Nason gravelly loam	0 - 80	Well drained	2 - 6	4.5 - 5.5	Greater than 80

Table 3.6.7.1-3 — Hydric and Farmland Soils

Map Unit	Classification	Approx. Site %	Hydric Soil	Farmland Description
GeB	Georgeville silt loam	20	Not Hydric	All areas are prime farmland
GeC	Georgeville silt loam	2	Not Hydric	Farmland of statewide importance
HrB	Herndon silt loam	20	Not Hydric	All areas are prime farmland
HrC	Herndon silt loam	2	Not Hydric	Farmland of statewide importance
LmB	Lignum silt loam	50	Partially Hydric	Farmland of statewide importance
TaE	Tatum loam	6	Not Hydric	Not prime farmland
NaB	Nason gravelly loam	<1	Not Hydric	All areas are prime farmland

3.6.7.2 Construction Consequences

The Umstead Research Farm Site is approximately 249 acres, and the minimum area required for the NBAF is 30 acres. The seismic soil classification of the site would be preliminarily considered Class C. Refer to Section 3.6.1 and Table 3.6.1-1 for additional seismic information. Chapter 2 and Sections 3.1.1 and 3.14 include additional geologic and constructability information. During a preliminary subsurface investigation, soft near surface-soils were encountered, which if used in construction, would require engineered conditioning (GeoTechnologies 2008). Partially weathered rock was also encountered and would be a potential issue during excavations for utility placement. There would be no anticipated adverse effects to soil classifications of the area, beyond the immediate site footprint. Preliminary geotechnical investigations did not identify any geologic features that would suggest sinkhole formation. Approximately 95% of the site soil classifications are prime or of statewide importance. NRCS determined that the 249-acre Umstead Research Farm Site included 113.7 acres of prime and unique farmlands (Appendix G). Refer to Sections 3.6.3.1 and 3.6.3.2 for additional soil information.

3.6.7.3 Operation Consequences

Lignum Silt loam soil classification comprises the majority of the soil types at the Umstead Research Farm Site. The conceptual layout for the Umstead Research Farm Site avoids direct effects to on-site surface waters. The preliminary geotechnical data described the site surface soils at 0 to 30 feet bls as very stiff and dense, with rock encountered at approximately 30 feet bls in two of the five borings (Terracon 2007). The NBAF would have no anticipated adverse effects on the soils of the Umstead Research Farm Site other than those within the immediate site footprint. Refer to Section 3.14 for additional operational information.

3.6.8 Texas Research Park Site

3.6.8.1 Affected Environment

The proposed Texas Research Park Site lies within the regional geologic province known as the Balcones Fault Zone. The Balcones Fault Zone trends northeast-southwest and forms the boundary between the Edwards Plateau to the north and the Gulf Coast Plain to the south. The San Antonio region is underlain primarily by Cretaceous limestone, marl, and shale, with three major exposed geologic units: Anacacho limestone, Pecan Gap Marl, and Austin Chalk. The primary feature of the Texas Research Park Site is a shallow clay known as Pecan Gap Marl underlain with subsurface units comprised of Eagle Ford shale, Buda limestone, Del Rio shale, and Edwards limestone (Terracon 2007d; Raba-Kistner 1987). The topography of the Texas Research Park Site is characterized as gently sloping from the north to the south with elevations ranging from approximately 940 feet to 1,010 feet above sea level. The Balcones Fault Zone running south from Dallas to San Antonio contains Cretaceous limestone beds from the Edwards Group, Glen Rosa Formation and others. These limestone formations range between 300-700 feet thick, and the Edwards Formation outcrops at the surface north and west of San Antonio. Major caves formed by groundwater are found in Bexar and Medina Counties. The Texas Speleological Survey has documented approximately 500 caves and 231 sinks in Bexar County, and approximately 50 caves and 4 sinks in Medina County each associated with limestone karst topography.

The geology of Texas lends itself to earthquakes of various magnitudes and intensities. Table 3.6.8.1-1 is a brief historical summary of earthquakes that occurred in or were felt in Texas (USGS 2008a).

Table 3.6.8.1-1 — Texas Historical Earthquakes

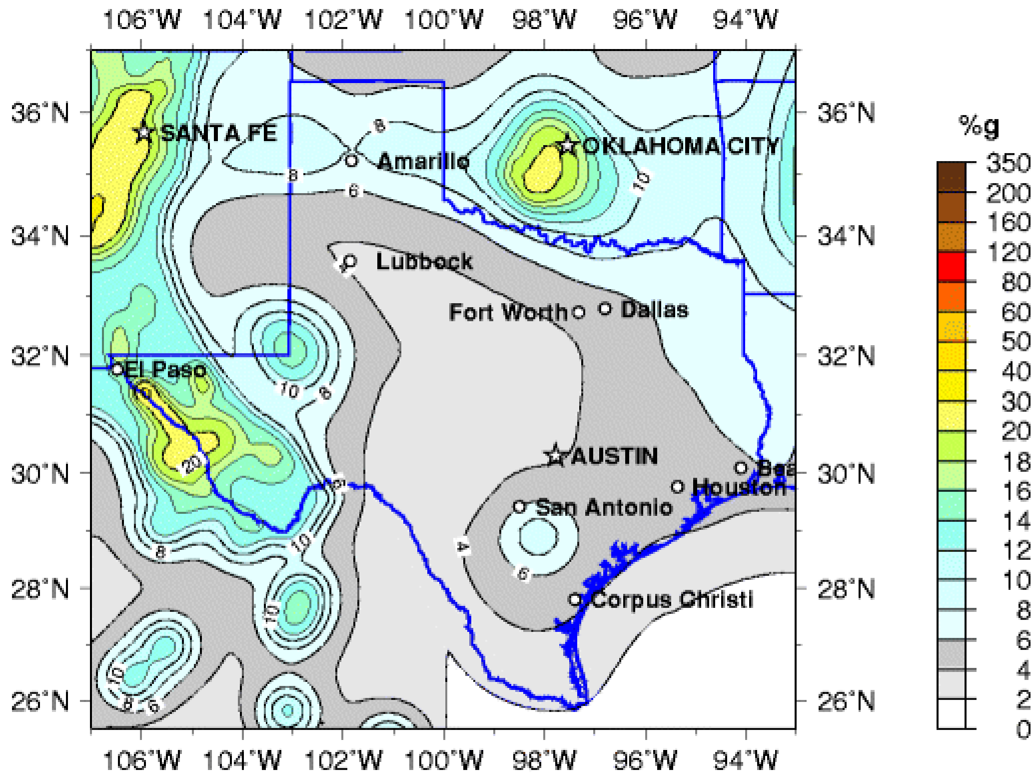
Date	Location	Intensity [a]
January 8, 1891	Rusk	VII
March 28, 1917	Panhandle	VI
July 30, 1925	Panhandle	V
August 16, 1931	Valentine	VIII
April 9, 1932	Mexia - Wortham	V-VI
June 20, 1951	Amarillo, Hereford	VI
April 28, 1964	Hemphill	V
July 20, 1966	Borger	V
May 12, 1969	El Paso	VI

[a] Ref. Table 3.6.3.1.-2 Magnitude vs. Intensity.

The most recent Texas earthquake, with a registered magnitude of 3.1, occurred on January 29, 2008, approximately 15 miles north-northeast of Snyder, Texas, or approximately 270 miles northwest of the Texas Research Park Site. The following USGS peak acceleration graphic includes San Antonio, Texas. Figure 3.6.8.1-1 depicts the seismic hazard map for Texas, including the Texas Research Park Site, which is within an area of potential ground-shaking hazard 4% to 6% g (USGS 2008g).

Figure 3.6.1-1 (Section 3.6.1) depicts the estimated time of return in years for a magnitude 4.75 earthquake at a fixed distance of 31 miles. The USGS estimated return time for 4.75-, 5.0-, and 6.5-magnitude earthquakes at a fixed distance of 31 miles exceeds 4,000 years for the San Antonio, Texas, area.

Three on-site soil series dominate at the Texas Research Park Site: Whitewright clay loam (BpC), Doss association (DSC), and Eckrant cobbly clay (TaB). All site soils are all well drained with slopes ranging up to 12%. Refer to Section 3.6.3.1 for additional soil information. The NRCS Soils Map (Figure 3.6.8.1-2) and Table 3.6.8.1-2 describe the on-site soil types and locations.



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

Figure 3.6.8.1-1 — Seismic Hazard Map for Texas

Table 3.6.8.1-3 describes the approximate soil classification percentages, general farmland description, and hydric determination for the site. No on-site soil types are prone to flooding or ponding, and only one soil series is considered prime farmland.

Table 3.6.8.1-2 — Texas Research Park Site Soils Descriptions

Map Unit	Classification	Depth Range (inches)	Drainage Class	Slope Range (%)	pH Range	Depth to Water Table (inches)
AuC	Austin silty clay	0 - 60	Well drained	1 to 5	7.9 - 8.4	More than 72
BpC	Whitewright clay loam	0 - 20	Well drained	1 to 5	7.9 - 8.4	More than 72
BrD	Brackett gravelly clay loam	0 - 30	Well drained	5 to 12	7.4 - 8.4	More than 72
DSC	Doss association	0 - 36	Well drained	Gently undulating	7.9 - 8.4	More than 72
RkD	Real and Kerrville soils	0 - 20 0 - 60	Well drained	1 to 8	7.9 - 8.4 7.4 - 8.4	More than 72
TaB	Eckrant cobbly clay	0 - 25	Well drained	1 to 5	6.6 - 8.4	More than 72

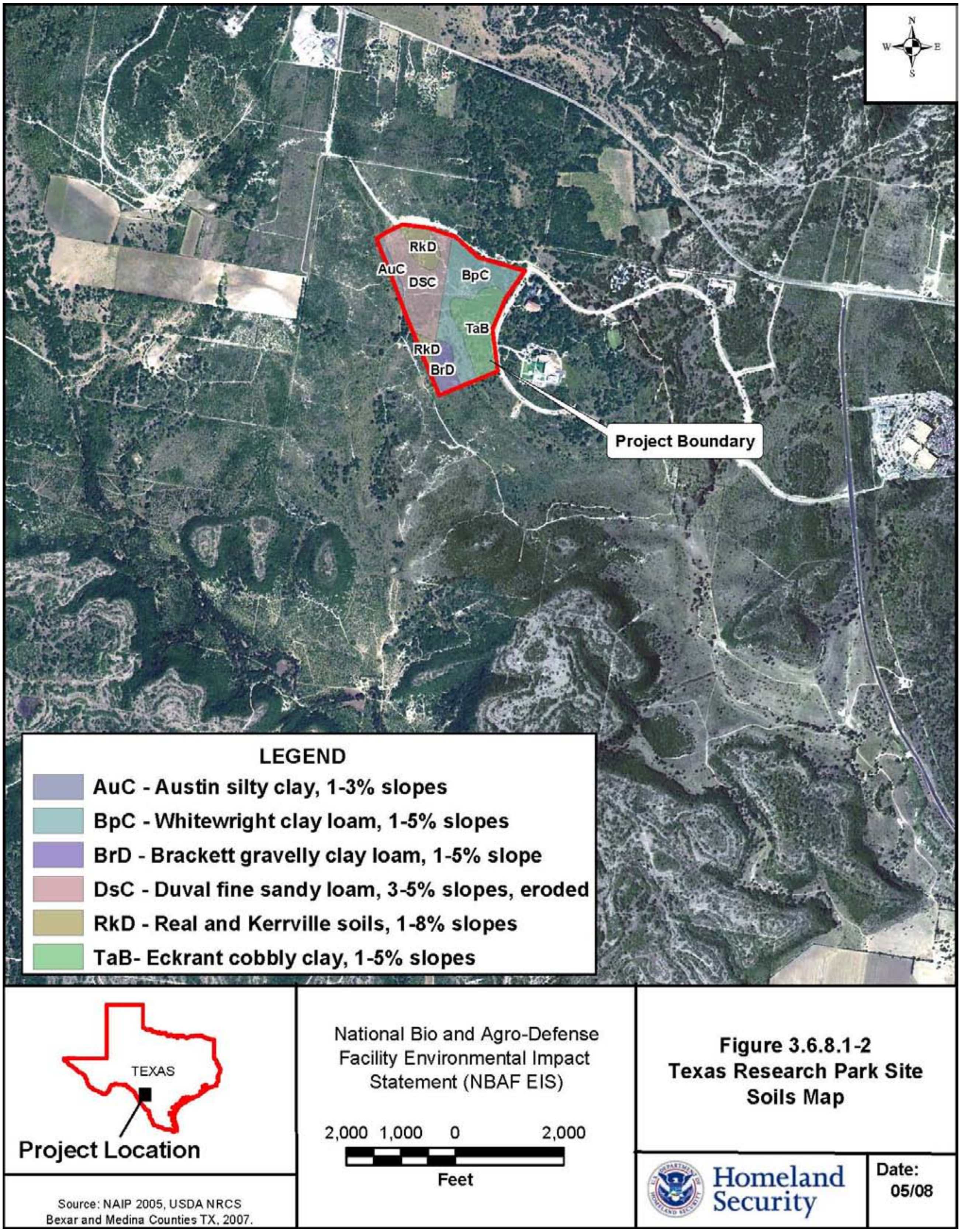


Figure 3.6.8.1-2 — Texas Research Park Site Soils Map

Table 3.6.8.1-3 — Hydric and Farmland Soils

Classification	Approx. Site %	Hydric Soil	Farmland Description
Austin silty clay	1	Not hydric	All areas are prime farmland
Whitewright clay loam	34	Not hydric	Not prime farmland
Brackett gravelly clay loam	9	Not hydric	Not prime farmland
Doss association	26	Not hydric	Not prime farmland
Real and Kerrville soils	11	Not hydric	Not prime farmland
Eckrant cobbly clay	19	Not hydric	Not prime farmland

Whitewright clay loam and Doss association soils are the primary soils at the site. Austin silty clay is the only site soil type considered prime farmland. The site soil types are susceptible to water erosion; however, terracing, contour tillage, and proper groundcover would help control erosion, conserve moisture, and maintain a healthy soil structure. These soils are best suited for natural vegetation, and maintaining a native grass cover would help control runoff and erosion.

3.6.8.2 Construction Consequences

A detailed geotechnical report would be prepared once the preferred alternative is selected. The findings and recommendations would be considered in the final design and specifications of the facility. Construction of the NBAF at the Texas Research Park Site would not have an anticipated adverse effect on the geology and soils of the area, beyond the immediate footprint. The area geology does not include any known transition or aquifer system recharge zones (Raba-Kistner 1987). The seismic soil classification at the site would be preliminarily considered Class D. Refer to Chapter 2, Sections 3.1.1, 3.6.1, and 3.14 and Table 3.6.1-1 for additional seismic and constructability information. Construction would require the excavation and removal of approximately 324,000 cubic yards of material. This soil displacement would not have an adverse effect on the regions topography. Preliminary geotechnical investigations did not identify any geologic features that would suggest sinkhole formation. The Austin silty clay represents less than 2% of the site soils and is the only class described as prime or of statewide farmland importance. NRCS determined that construction of the the proposed NBAF at the Texas Research Park Site would affect 6 acres of prime and unique farmlands (Appendix G). Refer to Sections 3.6.3.1 and 3.6.3.2 for additional soil information.

3.6.8.3 Operation Consequences

Whitewright clay loam and Doss association soils comprise the majority of the soil types at the Texas Research Park Site. The conceptual layout of the NBAF avoids direct impacts to surface waters. The NBAF would have no anticipated adverse effects on the Texas Research Park Site soils other than those within the immediate site footprint. Refer to Section 3.14 for additional operational information.

3.7 WATER RESOURCES

3.7.1 Methodology

Direct and indirect effects on water resources were determined using existing data from local, state, and federal sources. Additional studies (e.g., Phase 1 Environmental Site Assessments, geotechnical studies, and soil borings) were conducted to supplement the existing data. In addition to evaluating direct effects on water resources at the proposed sites, the NBAF construction and operation potential to indirectly affect off-site resources was assessed, including surface water runoff, groundwater contamination, and hydrologic alteration.

Germane planning and response documents are referenced within the water resources sections. Storm water Pollution Prevention Plans (SWPPPs) are developed around Best Management Practices (BMPs) to minimize or prevent direct and indirect storm water runoff effects. Spill Prevention Countermeasure and Control plans (SPCCs), as required in the *Oil Pollution Prevention Act*, are developed to address direct and indirect effects from potential spill sources and associated appurtenances. The proposed NBAF would have an anticipated 50,000-gallon on-site fuel storage capability, exceeding the cumulative volume of the on-site fuel storage threshold, thereby triggering the SPCC plan requirement. The SPCC thresholds are aboveground petroleum storage in excess of 1,320 gallons or underground petroleum storage in excess of 42,000 gallons and, in the event of a release, the potential for navigable water impacts. The SPCC plan would fully address the elements described in the Oil Pollution Prevention regulations (40 CFR part 112). Although site-specific attributes for each action alternative would be explicitly addressed, the SPCC plan would generally include the following information (EPA 2008e):

- Facility Information
    - On-site responsible individual(s) and contacts
    - Emergency response contacts
    - Petroleum types and volumes
    - Storage features and locations
    - Containment infrastructure
    - Immediate spill response equipment
    - BMP preventatives
- Security Data
    - Fencing
    - Lighting
    - Access
- Inspection Records
- Training Records

The SPCC document would include reference tables delineating petroleum inventories, tank sizes, locations, and a mobile sources inventory including location and function. Site map(s) would include tank locations, volumes, petroleum types, emergency access routes, spill kit locations, mobile source locations, and source-specific drainage patterns/receiving waters. The SPCC plan would be certified by a professional engineer and executed by the executive manager of the facility.

Additionally, floodplain databases from the Federal Emergency Management Agency (FEMA) were consulted to determine potential flood zone locations, types, and potential effects (FEMA 2007a). FEMA flood zones include: Zone X, areas having moderate or minimal potential flooding hazard; Zone AE, low-lying wetland areas subject to 100-yr flood inundation; and Zone VE, immediate coastal areas considered special flood hazard areas subject to 100-yr flood inundation with additional velocity hazards (e.g., wave action).

Area surface waters were researched as to whether they meet state-designated uses and standards. If available, pollutant-specific total maximum daily loads (TMDLs) and target recovery goals were included.

3.7.2 No Action Alternative

3.7.2.1 Affected Environment

3.7.2.1.1 Surface Water

Long Island Sound surrounds Plum Island and is the receiving waters for treated storm water and wastewater effluents from PIADC. TMDLs for nitrogen were established for Long Island Sound in April 2001. The TMDL target end point is a 58.5% reduction in nitrogen loading, facilitating improved Long Island Sound dissolved oxygen levels (EPA 2008d). Plum Island contains no streams or rivers, and the surface water features on the island are freshwater wetlands. The island has approximately 54 acres of wetlands, with the majority located on the south end of the island. Currently, surface waters are not being used as a facility water source (B. Laing 2007; BMT Entech 2007a). The surface water runoff from the island is minimal, as most of the soils are described as well drained.

3.7.2.1.2 Storm Water

Storm water collection and management are both currently and historically limited. Under early permits with the State of New York, PIADC recorded as many as 20 individual outfalls discharging storm water from Plum Island into adjacent tidal waters. No outfalls to internal areas of the island were identified. In early 2007, the PIADC environmental staff conducted an extensive investigation of these various outfalls. It was determined that, over the course of many decades, most of these discharge points were no longer functional and were essentially being carried on the NYSDEC storm water management permit (NYR00B921) without reason. These outfalls were situated in the following four general locations: Plum Gut Harbor, the Building 100/101 laboratory compound, the former Fort Terry cantonment area, and the remote East End. These conveyances, if operational, are primarily used to remove precipitation from roadways and roofs of site structures.

In March 2007, PIADC contacted NYSDEC to request that its existing storm water permit (NYR00B921) be terminated and that the seven remaining operational storm water discharge outfalls be consolidated into a revised version of the PIADC State Pollution Discharge Elimination System (SPDES) permit (Permit No. NY0008117). NYSCEC granted this petition, and the active outfalls are now addressed under the combined SPDES discharge permit.

Seven additional storm water conveyance systems, located in the East End, were also addressed in the March 2007 correspondence between PIADC and the State of New York. These systems (Outfalls No. 016 – 022) were most likely installed during the occupation of the island by the U.S. Army. These historical conveyance systems are considered inoperable. Each basin or sump system is filled with soil and gravel from the deteriorating roadbed. The originally designed use of the conveyance system was to drain roadbeds. The outfalls of these historical systems have not been located, but presumably they empty into Long Island Sound and/or Gardiners Bay.

Storm water runoff requirements for a federal project involving development or redevelopment with a footprint exceeding 5,000 square feet does not apply to the existing PIADC facility under the No Action Alternative, as per Title IV, Subtitle C, and Section 438 of the *Energy Independence and Security Act* of 2007 (USEISA 2007).

3.7.2.1.3 Groundwater

Groundwater at Plum Island is found in an unconfined aquifer that extends approximately 100 ft bls. This groundwater resource occurs in a relic glacial deposit and has a maximum elevation of approximately 2.5 feet above sea level. The Plum Gut strait separates the Plum Island freshwater aquifer from that of Long Island. Plum Island averages 45 inches of precipitation per yr, and this precipitation is the primary recharge source for the Plum Island freshwater aquifer.

Fourteen federally owned shallow groundwater supply wells are the only source of potable water at PIADC. The groundwater is treated with lime and chlorine before entering the potable distribution system (Terracon 2007a). Water use at PIADC is approximately 70,000 gpd. A 2007 groundwater study estimated the safe groundwater usage yield at 150,000 gpd. Current freshwater storage capacity at PIADC is maintained by a 200,000-gallon elevated water tower (BMT Entech 2007a). The Suffolk County Department of Health Services classifies the potable system for the island as a “non-transient, non-community public water supplier.” This public water supply classification requires the facility to meet the monitoring and reporting requirements of the *Federal Safe Drinking Water Act*.

Plum Island is documented as having aboveground and underground storage tanks of various sizes with a cumulative storage capacity of approximately 650,000 gallons. Several regulatory spill databases document

PIADC releases that vary from a broken pipe releasing approximately 30,000 gallons of partially treated sewage to an undetermined volume of No. 2 diesel fuel leaking from a 1,000 gallon aboveground storage tank. Other past PIADC fuel oil releases have resulted in the installation of remedial groundwater systems.

PIADC facilities are adjacent to the following areas of known or suspected petroleum contamination.

- A groundwater-free product petroleum plume is located behind Buildings 101, 102, and 103 fuel storage installation.
- Petroleum-contaminated soils were found behind Building 38 (Motor Pool).
- Groundwater in the harbor area tank farm contains low levels of dissolved phase petroleum product.
- An area just east of the Shallow Well Field (Waste Management Area 26/27) has been identified with hydrocarbon contamination.

A former landfill (Waste Management Area 7/8) was identified in 2007 as a motor pool waste disposal site, which included other island operation and maintenance wastes. Soil and groundwater samples have indicated various organic and inorganic contaminants.

3.7.2.1.4 Floodplains

Plum Island is divided into three FEMA flood zone categories: Zone X, minimal 100-yr floodplain hazard; Zone AE, wetlands within a 100-yr floodplain; and Zone VE, coastal flood hazards potentially intensified by wave action. FEMA has mapped PIADC in a Zone X, not within a 100-yr floodplain (FEMA 2007c). However, buildings in Zone X could be flooded by severe, concentrated rainfall coupled with inadequate drainage. The flood-prone area nearest to PIDAC is in a coastal inundation zone along the beachfront and wetland area of the island.

3.7.2.2 Construction Consequences

3.7.2.2.1 Surface Water

PIADC enhancements and upgrades would be adjacent to the current facility and within previously disturbed areas. The new construction would be hundreds of feet from any freshwater wetlands. The upgrades would require a sediment and erosion control authorization and an addendum to the current storm water management authorization. The enhancement locations, the site soil structure, and the construction/operational BMPs would minimize, if not curtail, effects to the freshwater wetlands of Long Island Sound or Plum Island. Adverse surface water effects would not be anticipated. Refer to Section 3.3.2.2 for additional infrastructure enhancement information.

3.7.2.2.2 Storm Water

PIADC enhancement and upgrade construction would result in additional disturbed soils and an increase in impervious area. A NYSDEC erosion control authorization would be required, as well as a modification to the existing storm water authorization. The additional storm water would be managed through permit stipulations, required infrastructure, and BMPs. Adverse storm water effects on Long Island Sound, Plum Island freshwater wetlands, or the groundwater aquifer would not be anticipated.

3.7.2.2.3 Groundwater

Multiple Plum Island locations currently have documented groundwater contamination, and the enhancement and upgrade construction would not exacerbate the existing contaminated groundwater conditions. PIADC construction upgrades would require additional potable water but would not exceed the projected safe groundwater yield for the island. If contaminated groundwater was encountered during enhancement construction, supplemental construction efforts would be required to address potential safety, groundwater containment, and disposal. An adverse effect on the quantity or quality groundwater at Plum Island would not be anticipated.

3.7.2.2.4 Floodplains

The enhancement areas are previously disturbed locations near the current PIADC. The upgraded areas are within a FEMA Zone X, defined as outside the 100-yr floodplain. No adverse effect is anticipated on the Plum Island floodplains.

3.7.2.3 Operation Consequences

3.7.2.3.1 Surface Water

PIADC operational upgrades would result in additional storm water and wastewater, primarily from augmented laboratories. These additional flows would be managed through existing or upgraded PIADC infrastructure, while implementing current or improved facility BMPs. NYSDEC erosion control and storm water permits or permit modifications would be required. No adverse surface water effects are anticipated on freshwater wetlands at either Long Island Sound or Plum Island.

3.7.2.3.2 Storm Water

PIADC operational enhancements would result in additional storm water runoff. A NYSDEC permit or modified permit would be required, and current or improved infrastructure and BMPs would control and treat the increased storm water volumes before discharging into Long Island Sound. The facility infrastructure and BMPs would minimize potential groundwater recharge effects and potential effects on the freshwater wetlands on the island. No adverse storm water effects are anticipated.

3.7.2.3.3 Groundwater

PIADC operational upgrades would result in additional storm water volume and potential groundwater recharge. Potential groundwater recharge increases, resulting from upgraded facility storm water sources, would be addressed by existing or improved infrastructure and BMP implementation. PIADC operations would require additional potable water but would not exceed what is considered the safe yield of the groundwater aquifer. No adverse groundwater effects are anticipated.

3.7.2.3.4 Floodplains

The PIADC operational upgrades would be located within an area classified as a FEMA Zone X or outside the 100-yr floodplain. The enhancements would not be operated in a FEMA-defined AE Zone for wetlands or VE Zone for potential wave velocity effects. Effects on the 100-yr floodplain would not be anticipated.

3.7.3 South Milledge Avenue Site

3.7.3.1 Affected Environment

3.7.3.1.1 Surface Water

The North Oconee and the Middle Oconee Rivers are the two headwater tributaries that converge just south of Athens to form the Oconee River. The Oconee River Basin is located entirely within the state of Georgia and drains a total of 5,330 square miles. The South Milledge Avenue Site is located in the Oconee River Basin, Upper Oconee River Sub-basin, and the Middle Oconee River Watershed (EPD 1998).

The South Milledge Avenue Site is primarily pastureland situated west of the South Milledge Avenue and Whitehall Road intersection. The site topography ranges in elevation from 580 to 680 feet above mean sea level. Several surface water features are located in the north-western and central-western sections of the proposed 67-acre site. The on-site first-order headwater streams feed an unnamed tributary that ultimately discharges into the Middle Oconee River located approximately 1,500 feet south of the site. The on-site stream segments have been identified as SA, SB, and SD (Table 3.7.3.1.1-1) (Nutter and Associates 2007a). Stream segment SA is a primary perennial stream forming a moderately sinuous channel, and stream segments SB and SD were documented as having flowing water. Figure 3.7.3.1.1-1 illustrates the local surface water features at the site.

Table 3.7.3.1.1-1 — South Milledge Avenue Site Surface Water Features

Jurisdictional Surface Waters	Linear Footage	Average Bankfull Width feet	Substrate Descriptions
Stream Segment A (SA)	575	4	Coarse sand, cobble and bedrock
Stream Segment B (SB)	80	4	Cobble
Stream Segment D (SD)	1,136	3	Coarse sand, gravel and cobble

There are several potable water sources near the South Milledge Avenue Site, including the Middle Oconee River, the North Oconee River, and the Jackson County Bear Creek Reservoir. The Athens-Clark County local government, with a combined withdrawal authorization from these three surface water sources of 28 mgd, provides the local potable water needs. Athens-Clark County has plans to increase the withdrawal authorization to 36 mgd by spring 2008 (ACC 2007b).

The GDNR has established six surface water use classifications: 1) Drinking Water Supplies; 2) Recreation; 3) Fishing, Propagation of Fish, Shellfish, Game, and Other Aquatic Life; 4) Wild River; 5) Scenic River; and 6) Coastal Fishing. The Middle Oconee River has been classified as a Drinking Water Supply. Drinking Water Supplies are defined by GDNR as, "Those waters approved as a source for public drinking water systems permitted or to be permitted by the Environmental Protection Division. Waters classified for drinking water supplies also support the fishing use and any other use requiring water of a lower quality" (GDNR 2008c), (GDNR 2008d).

If surface water quality standards are not being met, a water body and its use(s) can be considered partially supporting or impaired. States are required to develop a list of impaired waters, commonly known as the 303(d) lists [named from the federal *Clean Water Act* of 1972, Section 303(d)]. Once a water body is listed, states are required to establish a TMDL for the impaired water body. A TMDL is a pollutant-specific, calculated load that a water body can receive and still meet water quality standards and achieve designated uses (EPA 2007c). In 2006, parts of the Middle Oconee River and several of its tributaries were placed on the Georgia list of rivers and streams not fully supporting their designated uses, in this case primarily fishing. Fecal coliform contamination was the determining factor that resulted in the reduced use designation of the Middle Oconee; urban runoff is considered the suspected source. A coliform bacteria TMDL end point of 200 colony-forming units per 100 milliliters (cfu/100 ml) geometric mean from May to October has been established for the Oconee River (EPA 2008c).

GDNR erosion control and storm water permitting requirements protect perennial stream corridors by establishing stream-side buffer zones. Athens-Clark County has also developed buffer standards required to protect surface and groundwater supply sources (Table 3.7.3.1.1-2). According to the Athens-Clark County classifications, streams at the South Milledge Avenue Site would be classified as, "All other protected streams" (ACC 2005).

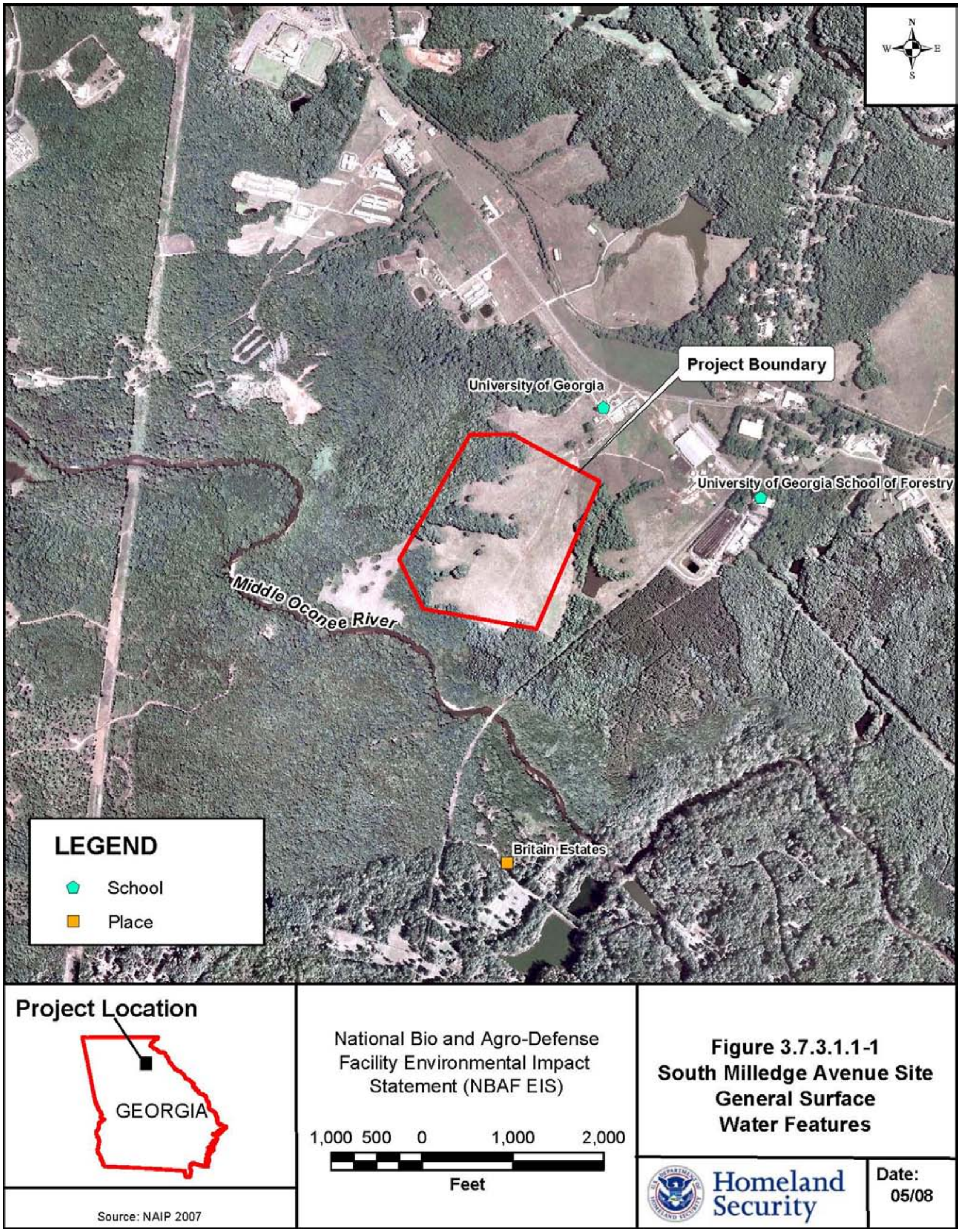


Figure 3.7.3.1.1-1 — South Milledge Avenue Site General Surface Water Features

Table 3.7.3.1.1-2 — Athens-Clarke County Buffer Standards

Hydrologic Feature	Riparian Buffer Width feet
Protected river	100
Upper North Oconee River and Sandy Creek	100
Protected streams in Industrial ("I") zones as defined in Title 9 of Athens-Clarke County Code	150
All other protected streams	75
Lake or pond	25
State waters	25

3.7.3.1.2 Stormwater

Surface water runoff from the South Milledge Avenue Site ultimately discharges through on-site, unnamed tributaries into the Middle Oconee River. The site is within 1,500 feet of the Middle Oconee River the nearest designated U.S. waters. The South Milledge Avenue Site has no existing storm water infrastructure other than natural on-site conveyances.

3.7.3.1.3 Groundwater

Georgia has an abundant supply of groundwater, and almost all groundwater in Georgia originates within the state boundaries. Groundwater aquifers provide water for almost half of the state population and about 90% of its rural residents. Groundwater quality in the state is good, but some areas do have elevated levels of iron and manganese, which cause stains and a bitter taste at high concentrations. Groundwater contamination from human activity has generally been localized and has not caused widespread aquifer contamination. There is no known public, community, or domestic groundwater supply wells on or near the NBAF South Milledge Avenue Site. Based on adjacent groundwater well and piezometer (temporary groundwater level monitoring well) data, the groundwater flow is generally toward the west-southwest (UGA 1993).

There is no known groundwater contamination at the South Milledge Avenue Site (Geo-Hydro Engineers 2007). However, the former South Milledge Avenue Landfill, located approximately 1-mile northwest of the site, was listed in the Solid and Hazardous Waste Site regulatory database (Geo-Hydro Engineers 2007). The former landfill has a known release of lead, barium, mercury, zinc, dichloromethane, 1,2-dichloroethane, chloroform, and other chemical constituents. Only lead is documented in the groundwater at concentrations exceeding the regulatory reportable quantity. Soil and groundwater at the former landfill are currently under remediation.

3.7.3.1.4 Floodplains

Elevation at the 67-acre South Milledge Avenue Site ranges from 580 to 680 feet above mean sea level. The central areas of the site have moderate slopes of 6% to 15%. Slopes get as steep as 25% at the edge of the property and near natural water conveyance features. The South Milledge Avenue Site appears to drain east, west, and south (Nutter and Associates 2007a). Surface drainage on the south portion of the site is overland toward the Middle Oconee River; surface drainage on the east and west portions converge toward natural drainage ways that also release into the Middle Oconee River. These on-site surface drainage patterns result in unnamed, perennial streams carrying surface and storm water off-site, all ultimately discharging into the Middle Oconee River. FEMA has mapped the South Milledge Avenue Site in a Zone X, an area outside the 100-yr floodplain, and the Athens-Clark County Department of Transportation and Public Works notes that the site lies outside the 100-yr floodplain (FEMA 2007a).

3.7.3.2 Construction Consequences

3.7.3.2.1 Surface Water

The South Milledge Avenue Site is approximately 67 acres of primarily undeveloped pastures and woodlands. The NBAF South Milledge Avenue Site would encompass approximately 30 acres. The South Milledge Avenue Site would include supplemental structures, such as fuel storage tanks, the utilities building, and facility maintenance buildings.

Construction of the NBAF at the South Milledge Avenue Site would trigger the need for Erosion Control and Stormwater Permits. The Erosion Control Permit would authorize land clearing and grading, while requiring sediment control devices and BMPs capable of retaining on-site sediment generated from land disturbing actions. Examples of on-site construction areas that would be evaluated for BMPs are any graded/disturbed areas, access and haul roads, material lay down areas, and construction debris piles. On-site construction management options, such as filter fabric fences, drop inlet protection, natural covered swales, and sedimentation ponds, would be evaluated. The NBAF South Milledge Avenue Site erosion control authorization would require an undisturbed 25-foot buffer along all state waters and additional buffering measures up to 75-feet from the stream banks. Following construction, the buffer zone may be thinned but the natural vegetative cover and stream canopy would be retained within the 25-foot buffer. A National Pollutant Discharge Elimination System (NPDES) SWPPP would also be required, and the South Milledge Avenue Site would have several areas where BMPs vary. Each area would be individually evaluated and included in a site-wide SWPPP. A SPCC plan would be prepared to describe potential spill sources, locations, volumes, flow directions, and response/mitigation tactics.

Based on a conceptual site drawing, the proposed facility's footprint would directly affect on-site surface water features. Direct and indirect surface water effects would be minimized through design parameters, and mitigation options for direct takes would be evaluated. Design measures could include pervious pavement in both parking lots and pedestrian walkways, capturing and using roof runoff for landscape watering, and grading parking lots to filter storm water through landscaped areas (NDP 2007a). By implementing approved erosion control/storm water pollution prevention and plans facilitating good engineering and construction BMPs, downstream facilities/resources such as the Middle Oconee River would not be adversely affected by the NBAF construction at the South Milledge Avenue Site.

3.7.3.2.2 Storm Water

Construction of the NBAF at the South Milledge Avenue Site would result in undeveloped area disturbances. Duing construction, a SWPPP would be prepared and notice given as required by the GDNR Environmental Protection Division. Under the SWPPP, BMPs would be implemented to manage and minimize potential construction storm water runoff from the NBAF. Sediment and erosion control devices (such as filter fabric and inlet protection barriers) would be installed prior to construction and would be maintained until construction is complete. A sediment basin would also likely be required during construction (NDP 2007a). Construction of the NBAF at the South Milledge Avenue Site would have no anticipated adverse effect on local surface waters from storm water runoff.

3.7.3.2.3 Groundwater

The proposed conceptual facility layout would include a basement area with a floor elevation approximately 10 feet bls and ceiling height of 25 feet to facilitate mechanical and building support equipment. The facility design would potentially require significant soil excavation and groundwater management. Proper construction management would minimize sediment erosion and pollutant transport to surface waters. Measures such as filter fabric fences, drop inlet protection, vegetated swales, and sediment basins would be evaluated. Any on-site surficial groundwater dewatering would be temporary, and the groundwater discharged from dewatered cofferdams, trenches, or other excavated areas would be directed through sedimentation basins, vegetated filters, geotextile material, or other best management options before surface water discharging. The velocity of discharged water would be managed to minimize or curtail downstream scouring. Any down gradient groundwater fed features such as wetlands or ponds would potentially be affected by the delayed or redirected groundwater flow during construction dewatering. Any on-site surficial groundwater dewatering would be temporary and would not affect the drinking water supplies of Athens. Preliminary design features would direct storm water through landscaped or natural covered swales allowing subsurface retention and filtration prior to surficial groundwater mixing. With GDNR project oversight, permit(s) stipulations, and best site management practices, potential downstream or groundwater impacts would be minimized.

3.7.3.2.4 Floodplains

The South Milledge Avenue Site is not located within the 100-yr floodplain; therefore, there would be no direct effects from construction activities on flood storage or floodways. The quality and volume of potential surface water leaving the site would be managed through approved storm water and erosion control permit stipulations, minimizing potential indirect off-site flooding effects. Construction of the NBAF at the South Milledge Avenue Site would have no adverse effects in the 100-yr floodplain.

3.7.3.3 Operation Consequences

3.7.3.3.1 Surface Water

The NBAF would be primarily a research laboratory and educational facility. Expected storm water constituents would be similar to those at most office complexes. Specific compound areas such as, but not limited to, the utilities building, fuel storage areas, and facility maintenance would have varying storm water constituents. Specific BMPs and permit recommendations would be evaluated and considered in those site-specific locations. Preliminary design efforts being considered to reduce surface water runoff are pervious pavement in both parking lots and pedestrian walkways, capturing and using roof runoff for landscape watering, and grading parking lots to filter storm water through landscaped areas.

Additionally, specific post-development storm water management criteria are required by Athens-Clark County. Storm water must be treated to remove 80% of the average annual post-development total suspended solids load, and stream channel buffers must be preserved or restored with natural vegetation. Also, all structural storm water controls must be selected and designed using applicable criteria found in the *Georgia Stormwater Management Manual*. A 75-foot buffer, measured from each stream bank, would be required along the perennial stream corridors in accordance with Athens-Clark County buffer standards (Table 3.7.3.1.1-2). There are more restrictions in the 25-foot buffer nearest the stream. No land disturbance or clearing is allowed within 25 feet of the stream bank, retaining a natural bank cover and stream canopy and no parking lots or agricultural waste pits are allowed within 75 feet of the stream bank. Limited activities such as non-mechanical clearing of vegetation less than 6-inches in diameter can occur in the remaining buffer zone 25 to 75 feet from the stream bank (ACC 2005). Operation of the NBAF is anticipated to have no adverse effect on local surface waters.

<u>Cumulative Impacts</u>

According to the University of Georgia Office of the University Architects for Facilities Planning (Kevin Kirsche, UGA, January 25, 2008), the UGA has no immediate projects of significant consequence planned for areas surrounding the proposed South Milledge Avenue Site. Five significant development projects anticipated by the University over the next 5 years and submitted to the University System of Georgia Board of Regents are to be located on main campus and are not within reasonable distance of the South Milledge Avenue Site to contribute to cumulative impacts. In addition, there are no proposed regional development projects within a 2-mile radius of the site (Brad Griffin, Athens-Clark County Planning Director, January 24, 2008).

It is unknown at this time the potential impacts of future projects on water resources in Clarke County. However, it is anticipated that the rapid population growth of Clarke County would continue, and demand for water would increase accordingly.

The geographic ROI for the South Milledge Avenue Site is the Upper Oconee watershed, which comprises part of the Oconee River basin. The Middle Oconee River joins with the North Oconee River approximately 1.75 miles southeast of the site to form the Oconee River. The watershed has been historically affected by accelerated runoff from the adjacent pasture areas, resulting in channel alteration and sedimentation.

Currently, drought conditions exist in Clarke County, as well as throughout much of the southeastern United States. Conditions are severe enough that Clarke County issued a ban on outdoor water use throughout the county. As previously discussed, operation of the NBAF at the South Milledge Avenue Site would result in the use of approximately 118,000 gpd (43 mgy), which represents approximately 0.76% of the City of Athens use of 15.5 mgd. Water use by future projects in the ROI is not known. Although the final project design would incorporate measures for water conservation whenever possible, the NBAF would still contribute to water use in the area.

<u>Wild and Scenic Rivers</u>

The nearest Georgia river designated in the Wild and Scenic River inventory is the Chattooga River, located in the Chattahoochee National Forest 68 miles northwest of Athens. Because the Chattooga River is over 60 miles northwest of the South Milledge Avenue Site, the proposed NBAF site would not impact the Chattooga River or its Wild and Scenic River designation (WSR 2008).

3.7.3.3.2 Storm Water

The Middle Oconee River would receive surface water drainage from the NBAF South Milledge Avenue Site. The design of the proposed NBAF uses Low Impact Design (LID) approaches. The LID design goal is to minimize runoff volume and preserve existing flow patterns (NDP 2007a). Increases in impervious area, higher peak runoff rates, and shorter concentration times (i.e., higher peak runoff) from the proposed NBAF would be mitigated by managing runoff and detaining storm water prior to discharging. The presence of the NBAF would result in an increase of 270,000 square feet (6.2 acres) or 9.0% of impervious area and would result in 225,000 cubic feet (1,683,000 gallons) of total runoff based on a site-specific 100-yr, 24-hour, 10-inch storm event.

Operations of the NBAF would not likely exacerbate erosion or degrade surface water runoff. There would be some hydrologic impact due to rainwater interception by paved areas where none previously existed. The paved facility footprint is 270,000 square feet (6.2 acres) compared to the total 67-acre area size of the South Milledge Avenue Site itself.

Georgia has EPA-delegated authority for both NPDES wastewater and storm water permitting. As a baseline, a NPDES SWPPP would be required for the facility. Unlike construction storm water impacts, industrial storm water impacts can persist if problematic routine activities are not monitored, evaluated, and corrected. The NBAF would be designed to minimize the need for storm drain piping and inlets in and around the building, as well as in the parking lot (NDP 2007b). The parking lot could utilize a pervious paving system to reduce storm water runoff and minimize the need for storm drainage appurtenances. Storm water overflow from parking lots could drain into landscaped areas designed to filter runoff and facilitate infiltration.

Flat roof structures with parapet edges could have emergency overflow drainage systems consisting of conventional downspouts or overflow scuppers. Primary and secondary (emergency) storm drainage systems would be sized based on a maximum rainfall rate corresponding to a 100-yr, 60-min rainfall. Some, of the storm water runoff from roofs could be collected in cisterns and used for landscaping or flushing toilets, unless local water rights or codes supersede (NDP 2007a).

A dedicated storm drainage system would convey rainwater from the roof of the building and paved areas to one or more discharge points. Belowground storm piping would be constructed of cast iron. Where soil conditions are determined unsuitable for cast iron, approved rigid corrosion resistant piping materials would be utilized. Aboveground storm water piping would be cast iron constructed, and horizontal runs would be insulated to prevent freezing, which would ensure proper function of the storm drainage system for the life of the facility. Some discharge points could be preceded by a detention facility to mitigate flow to the local drainage or receiving waters. The primary function of the storm water management system would be to clean and absorb a maximum amount of rainfall (NDP 2007a). Operation of the NBAF at the South Milledge Avenue Site is anticipated to have no adverse effect on local or downstream surface waters.

Cumulative Impacts

Although no immediate projects of significant consequence are planned by UGA for an area within a 2-mile radius of the South Milledge Avenue Site (see Section 3.7.3.3.1), it is anticipated that the rapid population growth of Clarke County would continue, and storm water runoff would increase accordingly.

The Middle Oconee River would be the ultimate receiving waters from the NBAF wastewater and storm water elimination system, and the river currently does not meet all GDNR designated uses, primarily fishing. The NBAF storm water contribution is not anticipated to be substantial; however, the effluent volume and constituents would contribute to the general trend of increased storm water runoff in the ROI.

3.7.3.3.3 Groundwater

No direct groundwater effects are anticipated from operation of the NBAF at the South Milledge Avenue Site. Athens-Clark County would provide the proposed NBAF with potable water; therefore, no on-site groundwater wells are anticipated. Specific areas such as the utilities building, fuel storage, and facility maintenance would have varying storm water components, as well as varying potential groundwater recharge constituents. To mitigate indirect groundwater effects, design features and BMPs would minimize or prevent horizontal or vertical transport of pollutants. Preliminary design efforts would be considered to direct storm water through landscaped or natural covered swales, allowing subsurface retention and filtration prior to discharge to the surficial groundwater table. A below-grade structural feature would represent a potential groundwater diversionary attribute. Any down gradient groundwater-fed features such as wetlands or ponds would be potentially affected by the delayed or redirected groundwater flow as a post-construction characteristic (DEQ 1992). As previously discussed, the proposed NBAF would trigger the need for a facility SPCC plan. This spill response plan would describe potential spill sources, locations, volumes, flow directions, and response/mitigation tactics. The NBAF is anticipated to have no direct or indirect adverse effects on groundwater resources in the area.

3.7.3.3.4 Floodplains

The South Milledge Avenue Site is not located in the 100-yr floodplain; therefore, there would be no direct effects on flood storage or floodways from operation of the NBAF. Operation of the NBAF at the South Milledge Avenue Site would have no anticipated indirect adverse effect on flood storage, floodways, or downstream facilities/resources.

3.7.4 Manhattan Campus Site

3.7.4.1 Affected Environment

3.7.4.1.1 Surface Water

The Manhattan Campus Site lies within the Kansas-Lower Republican Basin that includes all or parts of 24 counties. The Kansas-Lower Republican Basin has the largest population of 12 major river basins in

Kansas, including the Kansas River and the Big Blue River, as well as the surface water feature of Tuttle Creek Reservoir. The Tuttle Creek Reservoir is located 5 miles north of Manhattan and approximately 10 miles upstream from the confluence of the Big Blue River and the Kansas River. The Big Blue River flows south and is approximately 2 miles east of Manhattan. The Big Blue River ultimately discharges into the Kansas River—which is approximately 5 miles south of the site (USACE 2004).

The Kansas-Lower Republican Basin is further divided into sub-basins or watersheds. The Upper Kansas watershed includes Riley County, Manhattan, and many streams and tributaries, including the Kansas River and Wildcat Creek. Wildcat Creek and the Kansas River are both located primarily south of Manhattan. These waters have diverse uses, the most common being aquatic life, food procurement, and contact recreation.

The KDHE establishes water quality standards for the state. These standards define the water quality needed to fully support designated uses of the streams, lakes, and wetlands in Kansas. Examples of designated uses are domestic water supply, primary contact recreation (swimming), and secondary contact recreation (e.g., wading and fishing). KDHE further defines receiving surface waters and their uses into three tiers:

Tier 1: Provides the baseline that protects existing uses.
Tier 2: Protects high-quality waters and limits degradation.
Tier 3: Provides special protection for Outstanding Resource Waters (KDHE 2004).

The Big Blue River and its associated tributaries near Manhattan are considered "General Purpose Waters" and are included in Tier 1 or Tier 2. KDHE oversees, monitors, and enforces the state water quality standards. If water quality standards are not being met, a water body and its use(s) can be considered partially supporting or impaired, requiring state TMDL development. State-listed impairments during the 2004 cycle for the Big Blue River included the herbicide Atrazine, impaired biota, beryllium, chloride, copper, and pH, but potential sources for these impairments were not reported. In August 2007, a TMDL was established for Atrazine; the domestic water supply quality criterion for Atrazine is 3 μg/l (or 3 parts per billion). No other TMDL criteria are immediately anticipated (EPA 2008a). There are no natural streams, creeks, or ponds on-site, and the soils are described as well to moderately well draining. Refer to Section 3.7.3.1.1 for additional TMDL information.

The Manhattan Campus Site is somewhat hilly with elevations ranging from 1,050 to 1,185 feet above mean sea level. The current topography of the site directs storm water flow in a west-southwest direction toward Denison Avenue and the KSU northern campus areas.

The western surface flow of the site would intercept Denison Avenue, an area referred to as the Stadium Watershed on the Manhattan storm water watershed map (KDHE 1994). Northwest of the Kimball and Denison Avenues intersection is a small tributary, Stadium Creek. Stadium Creek flows north, ultimately discharging into the Big Blue River northeast of the Northview City Park.

The south-southwest surface flow at the site is through the KSU northeast campus area, referred to by the city as the Downtown East Watershed. The southwest surface flow at the site directs the discharges through the city storm water infrastructure under North Manhattan Avenue to Campus Creek, ultimately discharging into the Kansas River.

<u>Wild and Scenic Rivers</u>

The Big Blue River and the Kansas River are not listed in the Wild and Scenic River inventory (WSR 2008).

3.7.4.1.2 Storm Water

There are existing storm sewers that collect and convey storm water from the area, including the Manhattan Campus Site, through a series of open and closed conveyances. The current topography of the site directs storm water flow in a west-southwest direction toward Denison Avenue and the KSU northern campus areas. The Manhattan Campus Site lies outside the 100-yr floodplain. The site is approximately 2 miles west of the Big Blue River, the nearest designated U.S. waters (WSR 2008).

3.7.4.1.3 Groundwater

Kansas has appreciable quantities of groundwater found primarily in unconsolidated materials such as gravel, sand, and silt; however, some significant volumes are also found in consolidated bedrock. In total, major Kansas aquifers are estimated to hold approximately 590-million acre-feet of freshwater storage. Manhattan and the Manhattan Campus Site are located in the Upper Kansas watershed. The Alluvial Aquifer and portions of the Glacial Drift Aquifer are the primary groundwater resources in this watershed, and both are associated with the Kansas River and its tributaries (KDHE 2001). The Glacial Drift aquifer, located more northeast in the watershed, is often used for rural domestic water supply. However, the water of this aquifer is high in minerals, and nitrates are one of the primary pollutants of concern. The Alluvial Aquifer exists throughout the watershed and is the primary water source for many public water systems. The water quality of the Alluvial Aquifer is generally good, but nitrates, minerals, and pesticides are pollutants of concern. Both aquifers are used for potable water, irrigation, industry, and livestock watering. A gravel and sand layer, which retains significant water volumes, is approximately 20 feet beneath Manhattan followed by a layer of limestone bedrock. The groundwater flow in the Manhattan upper aquifer is east-northeast.

Water supply systems have population-triggered treatment requirements such as, but not limited to, chlorination, iron, and manganese removal; membrane filtration; and the addition of chemicals other than chlorine for improved water quality. The KDHE Bureau of Water monitors public water supply wells through an ambient groundwater monitoring program that ensures compliance with state and federal drinking water standards. Because the population of Manhattan exceeds 45,000, the water supply system is designated as Class IV (KDHE 2007c).

There are several groundwater wells of various uses located within a 3-mile radius of the site, but none are located immediately onsite. Groundwater elevations at the NBAF Manhattan Campus Site range from approximately 5 to 25 feet bls. The groundwater data suggests a higher water table on the eastern boundary of the site. Groundwater is potable water source for Manhattan, and it is pumped from a 16-well groundwater supply field. The well field is located near the confluence of the Big Blue River and the Kansas River, and the wells vary in size and pumping capacity. The Manhattan water treatment plant softens, fluoridates, disinfects (chlorinates), and filters the city water. The plant has a maximum daily output of 20 mgd. In 2005, drinking water for Manhattan met or surpassed all state and federal standards (CoM 2006).

The KSU Old Chemical Waste Landfill, located approximately 1 mile due west of the NBAF Manhattan Campus Site, is currently being monitored for multiple chemicals of concern including heavy metals, trichloroethylene, benzene, and trichloromethane. Approximately 36 groundwater monitoring wells are at this location, and the general groundwater movement is in a northeastern direction from the proposed site, likely intercepting Stadium Creek.

3.7.4.1.4 Floodplains

Elevations at the Manhattan Campus Site range from 1,050 to 1,185 feet above mean sea level, with a primarily west-southwest surface drainage pattern. The western drainage pattern would intercept the Denison Avenue storm water infrastructure. The southwest surface flow at the site feeds Campus Creek, discharging under North Manhattan Avenue through city drainage infrastructure, and ultimately discharging into the Kansas River.

The 2003 Manhattan Urban Area Comprehensive Plan included several guiding principles regarding the consideration and preservation of the area's natural resources. "The Kansas and Blue Rivers are significant natural features that impact the region's historic and future land use patterns. As part of the planning process, policy decisions will need to be made about the extent to which the 100-yr floodplain as well as land with the 'special flood risk' areas associated with the 1993 flood is considered to be a constraint to development." The FEMA has mapped the NBAF Manhattan Campus Site as in a Zone X, an area not within the 100-yr floodplain (FEMA 2003).

3.7.4.2 Construction Consequences

3.7.4.2.1 Surface Water

There are no natural surface water features onsite; therefore, there would be no direct surface water effects from construction. However, in an effort to eliminate or minimize indirect effects to off-site surface waters, construction storm water permits for the KDHE Stormwater Program would be required prior to land clearing. The construction general storm water permit would be triggered by the disturbance of more than 1 acre of land. Construction of the NBAF at the Manhattan Campus Site would require the development and implementation of a SWPPP plan. By implementing approved erosion control/storm water pollution prevention plans and facilitating good engineering and construction BMPs, downstream facilities/resources such as the Big Blue River and the Kansas River would not be adversely affected by construction of the NBAF.

3.7.4.2.2 Storm Water

The proposed construction of the NBAF would disturb previously undeveloped areas. During construction, a SWPPP would be prepared and notice given as required by KDHE (KDHE 2007b). Information regarding design and mitigation measures have been previously described and would be applicable to the Manhattan Campus Site.

3.7.4.2.3 Groundwater

The conceptual design would potentially require the handling and management of 284,000 cubic yards of cut or fill soils. Groundwater elevations vary from approximately 5 to 25 feet bls, requiring contact and proper management of the intercepted groundwater. Proper groundwater management during construction would minimize or curtail surface water pollutant transport and sediment erosion, as well as minimizing any potential effects to groundwater resources. Potential downstream or groundwater effects would be minimized through KDHE project oversight, permit(s) stipulations, and best site management practices.

3.7.4.2.4 Floodplains

The Manhattan Campus Site is not located within the 100-yr floodplain; therefore, the construction would have no direct effects on the 100-yr floodplain. Surface water leaving the site would eventually move through areas included in the 100-yr floodplain; however, the quality and volume of surface water leaving the site would be managed through approved storm water and erosion control permit stipulations, thereby eliminating or minimizing indirect off-site flooding effects.

Refer to Sections 3.7.3.2.1, 3.7.3.2.2, 3.7.3.2.3, 3.7.3.3.1, 3.7.3.3.2, and 3.7.3.3.3 for additional water resources information.

3.7.4.3 Operation Consequences

3.7.4.3.1 Surface Water

Operation of the NBAF at the Manhattan Campus Site would potentially trigger the need for an industrial storm water permit. The industrial storm water permit would regulate discharges, protect state waters, improve surface water quality through pollutant reduction, and meet the applicable federal statutes. Once KDHE authorizes the Notice-of-Intent, the NBAF would be assigned a state and federal permit number. The primary goal of an industrial storm water permit is to develop and implement a SWPPP for the operation of a facility such as NBAF. The SWPPP would specify BMPs that would be implemented and maintained to minimize or curtail potential storm water impacts during facility operations. Through the development and implementation of a SWPPP, the potential for adverse effects on city infrastructure to the west, Campus Creek to the southwest, or subsurface aquifers would be minimized. The anticipated 50,000-gallon on-site fuel storage capability would exceed the cumulative on-site storage threshold, thereby triggering the SPCC plan requirement. Refer to Section 3.7.1 for additional SPCC information.

Cumulative Impacts

According to KSU (Ron Trewyn, KSU, January 28, 2008), KSU has two major projects planned within a 2-mile radius of the Manhattan Campus Site. These projects, the Kansas State Equine Education Center and the Flint Hills Horse and Park Events Center, are related and would be located at the same site north of Kimball Avenue and east of Denison Avenue, encompassing 85 to100 acres and include both the educational and competitive event components. These projects would result in 150 to 180 full-time and part-time jobs. The increase in traffic is estimated to be 500 to 700 vehicles per week, primarily on weekends. The projects are in the preliminary planning stages, so any increase in public service demands and environmental impacts are not known.

There are additional projects planned on the KSU campus. One noteworthy project is the Jardine Complex Phase II, which includes 544 new bedrooms. Phase I added 608 bedrooms and over 2,000 daily trips, while Phase II is adding 347 apartments and another 2,000 daily trips. Another project is the Equestrian Center Phase I for the College of Agriculture, Department of Animal Sciences at Kansas State Athletic Department. There are 80 equestrian team members/coaches, a 40-seat classroom, and scheduled 400-person stadium events. This project would result in over 1,000 daily trips.

The ROI for water resources is the Upper Kansas watershed, which includes Riley County, the City of Manhattan, and many streams/tributaries including the Kansas River and Wildcat Creek. The Alluvial Aquifer exists throughout the watershed and is the primary water source for many public water systems.

As previously discussed in Section 3.3.4, operation of the NBAF would result in the use of approximately 118,000 gpd (43 mgy). This represents less than 6% of the City of Manhattan's projected capacity of over 20 mgd. The City of Manhattan is planning a major water treatment plant and well field improvements that would increase the capacity to 30 mgd. Projected water use of the future planned projects described above is unknown. However, in combination with the NBAF, they would cumulatively add to water use in the ROI.

Wild and Scenic Rivers

The NBAF would not have an adverse effect on any Kansas listed Wild and Scenic Rivers.

3.7.4.3.2 Storm Water

The design of the NBAF uses LID approaches. The LID design goal for the NBAF is to minimize runoff volume and preserve existing flow patterns (NDP 2007b). A dedicated storm drainage system would convey rainwater from the roof of buildings to 5 feet outside the building walls and then connect to the existing storm sewer. Existing storm sewer mains have sufficient capacity to accept flow from the NBAF and the proposed site would require multiple storm sewer service lines.

The NBAF would result in an increase of 270,000 square feet (6.2 acres) of impervious area and result in 180,000 cubic feet (1,347,000 gallons) of total runoff based on a site-specific 100-yr, 24-hr, 8-inch storm event. Operations at the NBAF would likely not exacerbate erosion or degrade the surface water runoff. After site selection, the design team would also evaluate the need for a storm water detention basin to reduce potential surface water runoff effects from the facility on local drainage ways. There would be some hydrologic impact due to rainwater interception by paved areas where none previously existed. The paved facility footprint is 270,000 square feet (6.2 acres), compared to the total 48.4-acre site area. Any associated hydrologic effect would be minimal. Kansas has EPA-delegated authority for both NPDES wastewater and storm water permitting.

3.7.4.3.3 Groundwater

There would be no direct groundwater effects from operation of the NBAF at the Manhattan Campus Site. Manhattan would provide water and sewer; therefore, no on-site groundwater wells are anticipated for the primary laboratory facilities. The proposed NBAF would have specific areas of varying storm water components as well as potential groundwater recharge constituents. The proposed NBAF would trigger the need for a SPCC plan as previously described. No indirect groundwater effects are anticipated from potential contaminants or recharge area alterations.

3.7.4.3.4 Floodplains

The Manhattan Campus Site is not located within the 100-yr floodplain; therefore, there would be no direct effects from operations on flood storage or floodways. The quality and volume of potential surface water leaving the site would be managed through approved storm water and erosion control permit stipulations, thereby eliminating or minimizing indirect off-site flooding effects. Operation of the NBAF at the Manhattan Campus Site would not result in an adverse effect on the 100-yr floodplain.

3.7.5 Flora Industrial Park Site

3.7.5.1 Affected Environment

3.7.5.1.1 Surface Water

The Flora Industrial Park Site is within the Big Black River watershed, which covers approximately 3,400 square miles and encompasses all or parts of 13 counties. The watershed is generally hilly and forested, but cattle ranching and farming are present. The area is not heavily populated; however, Hinds County and Madison County to the south are experiencing considerable growth (MDEQ 2007e).

Table 3.7.5.1.1-1 lists the surface water features located on the Flora Industrial Park Site, which are further described below (WTS 2007b):

- A 3.12-acre pond is north-centrally located and serves as a livestock watering source. This pond collects upland surface water drainage; however, there is no outlet feature connecting this pond to a discharging stream or creek.
- A 3.05-acre pond, located in the west-southwest area of the site, is a recently added aesthetic feature to the Primo Manufacturing site. Based on its design, any pond overflow during a significant rain event would move through one of the two on-site ephemeral drainage ways.
- Two narrow, shallow ephemeral drainage features are in the south-central area of the site, where they form the top of a “Y”. These two features direct storm water flow to an unnamed intermittent stream that feeds Town Creek and eventually Balfour Creek. Town Creek and Balfour Creek are both located

off-site and east of the Illinois Central Gulf Railroad. Both creeks flow north, ultimately discharging into the Big Black River.

- An on-site intermittent stream is located in the southeast area of the site and it moves surface runoff in an east-northeasterly direction. This surface drainage feature completes the previously mentioned "Y" and has an approximate bottom width of 10 feet, with bank heights approaching 5 feet.

Table 3.7.5.1.1-1 — Flora Industrial Park Site Surface Water Features

Feature	Function	Acreage	Linear Footage	Predominant Flow Direction
Pond	Livestock Water Source	3.12		none
Pond	Aesthetics	3.05		East Northeast[a]
Two Ephemeral	Site, Storm Event Drainage	0.11	1,292.7	East Northeast[a]
One Intermittent	Site Drainage	0.68	295.7	East Northeast

[a]Storm event flow.

MDEQ has developed and enforces an anti-degradation approach to preserving and enhancing waters of the state, citing that, "In no event, however, may degradation of water quality interfere with, or become injurious to, existing in stream water uses." MDEQ has developed the following water quality classifications and criteria:

- Public Water Supply: A source of raw water supply for drinking and food processing purposes.
- Shellfish Harvesting: Used for propagation and harvesting shellfish for sale or use as a food product.
- Recreation: Suitable for recreational purposes, including contact activities, such as swimming and water skiing.
- Fish and Wildlife: Intended for fishing and propagation of fish, aquatic life, and wildlife.
- Ephemeral Stream: Waters in this classification do not support a fisheries resource and are not usable for human consumption or aquatic life.

The state has classified all waters within the Big Black River watershed as Fish and Wildlife waters (MEDQ 2007b). These waters are intended for fishing and aquatic life propagation and are also suitable for secondary contact uses short of full-body immersion. The state has listed the Big Black River as impaired for pesticides (including the pesticide DDT), sediment/siltation, and the insecticide Toxaphene. The state has established TMDLs for DDT and Toxaphene and is preparing pesticide and sediment TMDL submittals. The waste load allocation factors for the DDT and Toxaphene TMDLs are zero. There are no known permitted sources for DDT or Toxaphene in Mississippi (EPA 2008d).

Wild and Scenic Rivers

Black Creek, located in the DeSoto National Forest near Wiggins, Mississippi, is listed in the Wild and Scenic River inventory (WSR 2008). The "Scenic" attribute is applicable to 21 miles in a segment from Fairley Bridge Landing upstream to Moody's Landing. Black Creek features deep, black water with contrasting white sand bars. Wiggins is approximately 100 miles east southeast of Flora.

3.7.5.1.2 Storm Water

The Flora Industrial Park Site lies in a FEMA flood Zone X, an area outside the 100-yr floodplain (FEMA 1994) and is a few hundred feet west of Town Creek and Balfour Creek, the nearest designated U.S. waters.

The site has a gently sloping topography of 3 to 5% and generally drains to the east (FEMA 1994). The site does not currently possess drainage structures other than natural conveyances, although two ponds previously described and located at the NBAF Flora Industrial Park Site collect the non-infiltrating storm water. The state has plans to develop storm water control infrastructure onsite at an estimated cost of $750,000 (MS 2007). Mississippi has EPA-delegated authority over both NPDES storm water and wastewater permitting.

3.7.5.1.3 Groundwater

Over 93% of drinking water supplies in the state originate from groundwater resources. Mississippi public water well systems have an average depth of approximately 780 feet and obtain their water from deep confined aquifers (MDEQ 2007c). In November 1991, MDEQ adopted groundwater standards equal to EPA drinking water standards or Maximum Contaminant Levels. There are several groundwater aquifers within the Big Black River watershed, and virtually the entire population within the watershed uses a groundwater aquifer as a water source. Flora withdraws its groundwater from three deep wells: one near Madison and two in downtown Flora, between Center Street and Jackson Street. These wells draw groundwater from the Sparta Aquifer for potable, industrial, and irrigation uses. The groundwater flow direction of the Sparta Aquifer in this area is south, and this deep aquifer is protected by semi-confining layers of clays and shale.

During a preliminary geotechnical investigation at the Flora Industrial Park Site, two soil borings were dry-augered to determine on-site groundwater levels. Groundwater was encountered at approximately 17 feet bls in one boring and was not encountered in a second boring that reached 20 feet bls. Historical site research revealed the former presence of on-site cisterns; however, these cisterns were removed for safety reasons in the mid- to late-1990s. No other potential on-site or off-site source of groundwater contamination was documented (Mike Goff, Wildlife Technical Services, 2007).

3.7.5.1.4 Floodplains

Elevations at the Flora Industrial Park Site range from 210 to 240 feet above mean sea level, with a primarily east-northeast surface drainage pattern, which intercepts an unnamed intermittent stream that carries surface water off-site. The intermittent stream is located in the south-central portion of the site, continues to the east-northeast beneath the Illinois Central Gulf rail lines, and discharges into Town Creek, which feeds Balfour Creek, and ultimately discharges into the Big Black River. FEMA has mapped the proposed site in a Zone X, an area outside the 100-yr floodplain (FEMA 1994).

3.7.5.2 Construction Consequences

3.7.5.2.1 Surface Water

Based on a conceptual site drawing, the NBAF Flora Industrial Park Site would not directly affect any surface water features; therefore, there would be no direct effects to surface water resources with the construction of the NBAF Flora Industrial Park Site. However, potential indirect surface water effects would occur from potential construction storm water runoff. Construction would disturb more than 5 acres, triggering the need for a MDEQ Large Construction General Permit (LCGP), which authorizes storm water discharges from a proposed construction activity. The LCGP covers land clearing, grading, and site construction. Discharges from these activities cannot cause or contribute to a violation of state water quality standards, jeopardize continued existence of listed or endangered species, or adversely impact critical habitat. A Large Construction Notice of Intent must be submitted to, and approved by, MDEQ. The permit holder may discharge construction-related storm water only after receiving written authorization of the LCGP coverage or issuance of an individual NPDES Stormwater Permit. Through proper coordination with MDEQ and implementation of approved storm water and erosion control abatement measures, construction of the NBAF Flora Industrial Park Site would result in no adverse indirect effects to surface waters or downstream resources (MDEQ 2005a).

3.7.5.2.2 Storm Water

Construction of the NBAF at the Flora Industrial Park Site would result in the disturbance of previously undeveloped areas and an increase in impervious surfaces. During the construction phase, a SWPPP would be prepared and notice given as required by MDEQ. Under the SWPPP, BMPs would be implemented to manage and prevent construction-related storm water runoff. Because of the measures required under a SWPPP, the construction of the NBAF would have no anticipated adverse indirect effect on local surface waters. Information regarding design and mitigation measures have been previously described and would be applicable to the Flora Industrial Park Site.

3.7.5.2.3 Groundwater

Construction of the NBAF would have no anticipated adverse effects on groundwater resources. However, on-site construction dewatering could occur but would be temporary and would have no effect on groundwater supply wells for Flora, which are located approximately 2 miles south-southeast in downtown Flora. Flora would provide water and sewer; therefore, no on-site groundwater wells are anticipated for the NBAF Flora Industrial Park Site. Site-specific BMPs and good engineering practices would be implemented as part of the industrial SWPPP for the facility to minimize or prevent indirect effects of both horizontal and vertical pollutant transport. The proposed NBAF would be required to prepare a SPCC plan. This spill plan would describe potential spill sources, locations, volumes, flow directions, and response/mitigation tactics. Construction of the NBAF at the Flora Industrial Park Site would have no anticipated adverse effect on the groundwater resources of the area.

3.7.5.2.4 Floodplains

The Flora Industrial Park Site is not located within the 100-yr floodplain; therefore, there would be no direct effects from construction activities on flood storage or floodways. The quality and volume of potential surface water leaving the site would be managed through approved storm water and erosion control permit stipulations. Construction of the proposed NBAF would have no anticipated adverse direct or indirect effects on the 100-yr floodplain or off-site flooding.

Refer to Sections 3.7.3.2.1, 3.7.3.2.2, 3.7.3.2.3, 3.7.3.3.1, 3.7.3.3.2, and 3.7.3.3.3 for additional water resource information.

3.7.5.3 Operation Consequences

3.7.5.3.1 Surface Water

Operation of the NBAF at the Flora Industrial Park Site would have no direct effect on surface water resources. However, indirect surface water runoff effects have the potential to occur. The Flora Industrial Park Site would have several areas where BMPs vary, and each would be individually evaluated and included in a site-wide SWPPP. The proposed facility would trigger the need for a SPCC plan. The development and implementation of a SWPPP, a SPCC plan, and good housekeeping techniques would minimize or curtail downstream effects on Town Creek, Balfour Creek, and the Big Black River. Refer to Section 3.7.1 for additional SPCC information.

<u>Wild and Scenic Rivers</u>

The NBAF would have no adverse effects on Black Creek, a designated Wild and Scenic River, located approximately 100 miles east southeast of Flora.

3.7.5.3.2 Storm Water

Operation of the NBAF at the Flora Industrial Park Site would have a direct effect on storm water, although the design of the NBAF, using LID approaches, would minimize and mitigate these effects. The LID site design goal is to minimize runoff volume and preserve existing flow patterns (NDP 2007b). The presence of the NBAF Flora Industrial Park Site would result in an increase of 270,000 square feet (6.2 acres) or 0.4% of impervious area and result in 248,000 cubic feet (1,852,000 gallons) of total runoff based on a site-specific 100-yr, 24-hr, 11-inch storm event. The paved facility footprint is, 270,000 square feet (6.2 acres), compared to the total 150 acre site area.

Mississippi has EPA-delegated authority for both NPDES wastewater and storm water permitting. A NPDES SWPPP would be required for operation of the facility. Some discharge points could be preceded by a detention facility to mitigate flow to the local drainage or receiving waters. The ultimate receiving water body from the NBAF Flora Industrial Park Site would be the Big Black River. Operation of the NBAF at the Flora Industrial Park Site would have no anticipated adverse effect on the local surface water resources (MDEQ 2005b).

<u>Cumulative Impacts</u>

According to the Metro Jackson Chamber of Commerce, there are several new residential projects being planned in the Town of Flora or in Madison County. Terra Subdivision is located within the town limits of Flora with 19 lots available and 60 acres being developed. Depending on the density allowed for the subdivision, there is a potential of up to 240 additional lots. Another future development project is Andover Subdivision, which is located off State Highway 22 within 5 miles of the proposed site in an unincorporated area. Phase I of the subdivision has approximately 73 lots. Numerous phases are predicted for this development over the next 5 years, but data are not available on the additional number of lots to be developed. The Highlands Subdivision is another future planned project located off Mount Leopard and would be accessed from Highway 22. It is within 5 miles of the proposed NBAF site. The data provided did not state the number of lots predicted for this development, but all of the lots would be greater than 5 acres. Other noted subdivisions that have not announced their density allocations are Magnolia Heights and Woodlands of Flora.

There is a proposed major development (Galeria-Madison) approximately 15-20 miles from the proposed NBAF site and includes a mix of single-family homes, condominiums, an office park, and a shopping center. The acreage, square footages, and density numbers are not available for this development. There are other developments occurring but they are not of major regional significance.

The Flora Industrial Park Site is located in the Big Black River basin. Due to the size of the basin, the ROI for water resources is limited to the Town Creek and Balfour Creek sub-basin. Groundwater from the Sparta Aquifer is the source of potable water for the area. While Flora has sufficient water and sewer capacity to serve the NBAF site, it has initiated a new water and sewer expansion and enhancement plan, which will include the construction of a new elevated water storage tank, a fourth groundwater deep well, installing and extension of a new main sewer discharge line, and installing additional water and sewer line extensions including a back-up water line for an outlying area. Due to the substantial population growth in the area, it can not be determined if there is sufficient future capacity to handle the potable water for the ROI and the Town of Flora. There is projected to be 132,000 gpd water use from the proposed NBAF; this is an 18% increase in demand from the current consumption of potable water in the Town of Flora. Additional demand on water supply would result from the proposed developments listed above.

3.7.5.3.3 Groundwater

No direct groundwater effect is expected from operation of the NBAF at the Flora Industrial Park Site. Flora would provide the NBAF with water; therefore, no on-site groundwater wells are anticipated. The below grade structural feature at the NBAF would represent a potential groundwater diversionary attribute. Any down-gradient groundwater-fed features such as wetlands or ponds would be potentially affected by the delayed or redirected groundwater flow as a post-construction site attribute. The NBAF is anticipated to have no adverse indirect effect on area groundwater resources.

3.7.5.3.4 Floodplains

The Flora Industrial Park Site is not located in the 100-yr floodplain; therefore, there would be no direct effects from operations of the NBAF Flora Industrial Park Site on flood storage or floodways. Operation of the NBAF would have no anticipated indirect adverse effect on flood storage, floodways, or downstream facilities/resources.

3.7.6 Plum Island Site

3.7.6.1 Affected Environment

3.7.6.1.1 Surface Water

Surface water features on and surrounding Plum Island are generally described in Section 3.7.2.1.1. On-site surface water features are limited to 54 acres of freshwater wetlands located several hundred feet south of the Plum Island Site. These surface water features are not used as an industrial water resource for any Plum Island activities.

3.7.6.1.2 Storm Water

Storm water features at the Plum Island Site are described in Section 3.7.2.1.2. The Plum Island Site is adjacent and east of the current PIADC. Runoff from the site is minimal since soils are described as well drained. No storm water collection system is currently associated with the NBAF Plum Island Site.

3.7.6.1.3 Groundwater

General groundwater features at Plum Island are described in Section 3.7.2.1.3. Historical records indicate the Plum Island Site was formerly used as a dumping area for various PIADC waste streams. The buried refuse varied from pesticides, petroleum products, solvents, laboratory wastes, to miscellaneous debris. As part of a complete Plum Island survey, site-specific investigations have been completed for 21 waste management areas and 15 areas of potential concern. Two waste management areas and two areas of potential concern are located near or within the Plum Island Site. These areas have been initially excavated, segregated, and screened to remove residual steel, aluminum, and treated regulated medical waste. Confirmation soil and groundwater field sampling have been completed, but the laboratory analysis and results have yet, to be finalized (Terracon 2007a).

3.7.6.1.4 Floodplains

FEMA has mapped the Plum Island Site in a Zone X, an area not within the 100-yr floodplain (FEMA 2007c). Refer to Section 3.7.2.1.4 for additional Plum Island floodplain information.

3.7.6.2 Construction Consequences

3.7.6.2.1 Surface Water

Construction of the NBAF at the Plum Island Site would not be expected to affect the surrounding surface waters or the fresh water wetlands Long Island Sound. A NYSDEC erosion control authorization and storm water authorization would be required prior to construction. Through erosion control measures, construction storm water best management practices, and general good housekeeping, construction of the NBAF Plum Island Site would be anticipated to have no adverse effect on surface waters. Indirect surface water effects from potential construction runoff would be minimized or mitigated through appropriate BMPs.

3.7.6.2.2 Storm Water

Construction of the NBAF at the Plum Island Site would result in the disturbance of previously undeveloped areas. During the construction phase, a SWPPP would be prepared and notice given as required by NYSDEC. Under the SWPPP, BMPs would be implemented to prevent construction storm water runoff; therefore, the construction phase of the NBAF would not be expected to affect local surface waters. Information regarding design and mitigation measures have been previously described and would be applicable to the Plum Island Site.

3.7.6.2.3 Groundwater

There would be no direct groundwater effect from construction of the NBAF at the Plum Island Site. Indirect effects have the potential to occur but would be minimized through appropriate construction BMPs. A detailed groundwater management plan would be prepared specifying protocols for the proper handling, storing, testing, and disposing of potentially contaminated groundwater. Proper construction management would minimize or curtail surface water pollutant transport and sediment erosion. Potential downstream or indirect groundwater impacts would be minimized through NYSDEC project oversight, permit(s) stipulations, and BMPs. Any construction dewatering would be temporary; however, considering the current PIADC facility groundwater withdrawal rates, the estimated groundwater safe yield for the island, and the likely interaction with contaminated groundwater. Construction dewatering would have to be evaluated and potential engineering options considered.

3.7.6.2.4 Floodplains

Construction of the NBAF at the Plum Island Site would not directly affect floodplains. The proposed site is outside the 100-yr floodplain and the coastal inundation zones. Coastal flooding may occur during large storm events, and coastal wetlands may become temporarily inundated. The Plum Island Site is outside these areas and no effect would be anticipated. Construction of the NBAF at the Plum Island Site would include appropriate storm water management measures appropriate for both normal and extreme climatic conditions to minimize potential indirect effects.

Refer to Sections 3.7.3.2.1, 3.7.3.2.2, 3.7.3.2.3, 3.7.3.3.1, 3.7.3.3.2, and 3.7.3.3.3 for additional water resource information.

3.7.6.3 Operation Consequences

3.7.6.3.1 Surface Water

Long Island Sound surrounds Plum Island and would be the receiving water for treated storm water and wastewater from the NBAF. Plum Island contains no streams or rivers, and the surface water features on the island are freshwater wetlands. As for other site locations, the Plum Island Site would have several areas where BMPs vary, and each would be individually evaluated and included in a site-wide SWPPP. The proposed NBAF would trigger the need for a SPCC plan and would be coordinated with PIADC's current plan. The development and implementation of a SWPPP, a SPCC plan, and good housekeeping techniques would minimize or curtail any effects on on-site or tidal wetlands and the surrounding waters of Long Island Sound. Refer to Section 3.7.1 for additional SPCC information.

3.7.6.3.2 Storm Water

New York has EPA-delegated authority for both NPDES wastewater and storm water permitting. As a baseline, a SPDES SWPPP would be required for the facility. The receiving water body at Plum Island is the Long Island Sound and the facility would require multiple storm drain service lines.

The NBAF would result in an increase of 270,000 square feet (6.2 acres) of impervious area, or 25.8% of the 24-acre site, and result in 180,000 cubic feet (1,347,000 gallons) of total runoff based on a site-specific 100-yr, 24-hr, 8-inch storm event. Operation of the NBAF at the Plum Island Site would have no anticipated adverse effect on the local surface water resources.

The current PIADC facility has a hazardous weather plan that is storm strength dependant. Typically, for any such hazardous weather event, there are essential personnel that remain on the island, the facility goes on generator power, precautions are taken (e.g., securing facilities, monitoring weather to maintain up-to-date information on extreme weather), and all non-essential personnel are removed from the island well in advance of a storm or potential flooding (C. Wenderoth, PIADC Facility Engineer, e-mail to A. Galbraith, Tetra Tech, Inc., February 8, 2008).

3.7.6.3.3 Groundwater

Operation of the NBAF at the Plum Island Site would directly affect groundwater. Groundwater is the fresh water source for the island, and operations at the NBAF Plum Island Site would require 37 million gpy (average 101,000 gpd [NDP 2007b]). This projected consumption rate, while representing a 212% demand increase compared to the 2006 PIADC average production of 47,704 gpd, is within the recommended water budget of 150,000 gpd for sustainable groundwater withdrawal with an excess capacity of approximately 32%. The existing PIADC water supply source would have sufficient capacity to meet the potable water needs for the NBAF.

Operational indirect groundwater effects of the NBAF would be minimized or eliminated by finalizing previous remedial efforts, completing a thorough geotechnical and groundwater analysis, preparing construction protocols for groundwater management, and by implementing NYSDEC storm water and erosion control permit stipulations. Refer to Section 3.7.3.3.3 for additional groundwater information.

3.7.6.3.4 Floodplain

Plum Island has three defined FEMA zones: Zone X, areas outside the 100-yr floodplain; Zone AE, wetlands inundated within the 100-yr floodplain; and Zone VE, coastal inundation with energy (wave) influence. The Plum Island Site is located within an area classified as a FEMA Zone X, outside the 100-yr floodplain. The NBAF would not be operated in a FEMA-defined AE Zone for wetlands or VE Zone for potential wave velocity effects. Operation of the NBAF Plum Island Site would have no anticipated adverse effects on the 100-yr floodplain.

3.7.7 Umstead Research Farm Site

3.7.7.1 Affected Environment

3.7.7.1.1 Surface Water

Lake Holt Reservoir is a primary surface water feature located less than 3 miles north northeast of the Umstead Research Farm Site. Lake Holt is one of several source water impoundments located within the Upper Neuse River Watershed. The Knap of Reeds Creek located southeast of Old Route 75 is the immediate receiving stream for surface water leaving the site. The Umstead Research Farm Site is approximately 249 acres of mainly undeveloped woodlands surrounded primarily by agricultural activities and forests. The site has several surface water features including perennial streams, intermittent streams, wetlands, and a small pond. Elevations at the site range from 350 to 490 feet above mean sea level, falling generally from north to south; therefore, the predominant surface water flow through the on-site surface water features is toward the south. These unnamed tributaries eventually feed the Knap of Reeds Creek located off-site and southeast of Old Route 75. Table 3.7.7.1.1-1 lists the surface water features on the NBAF Umstead Research Farm Site.

Table 3.7.7.1.1-1 — Umstead Research Farm Site Surface Water Features

Surface Water Feature	Acres	Linear Footage
Perennial & Intermittent Streams		6,937
Wetlands	0.6	

The Umstead Research Farm Site is located in the Upper Neuse River Watershed between the Lake Holt Reservoir (Lake Butner) and the Falls Lake system. The Upper Neuse River Basin covers approximately 770 square miles and drains to the Falls Lake Reservoir, the primary water source for Raleigh. Three major tributaries—the Flat River, the Little River, and the Eno River—and nine public drinking water supply reservoirs are located in the Upper Neuse River Watershed (NCDENR 1998). The North Carolina Department of Environment and Natural Resources (NCDENR) has classified the Upper Neuse River Watershed as Water Supply IV (WS-IV) and as Nutrient Sensitive Waters (NSW). A WS-IV classification, usually located within a highly developed region, is protected as a drinking and food processing water source. WS-IV waters are also protected for Class C uses such as, but not limited to, secondary recreation, wildlife, and fish consumption.

Table 3.7.7.1.1-2 provides a brief description of the primary water supply watershed classifications developed by NCDENR (NCDENR 2007b).

Table 3.7.7.1.1-2 — Water Supply Watershed Classifications

Class	Watershed Description
Class WS-I	Natural and undeveloped
Class WS-II	Predominantly undeveloped
Class WS-III	Low to moderately developed
Class WS-IV	Moderately to highly developed
Class WS-V	Upstream or draining to Class WS-IV waters
Class B	Primary recreation & Class C uses
Class C	Fishing, wildlife, & secondary recreation

In 2000, the North Carolina General Assembly enacted legislation that included a mandatory 50-foot buffer for areas directly adjacent to Neuse River Basin surface waters (Riparian Buffer Protection Rules for the Neuse and Tar-Pamlico River Basins, Non-Point Source Management Program). NSW is a supplemental classification for waters needing additional nutrient management as a result of the potential for excessive microscopic or macroscopic vegetative growth. These protected riparian areas enable the vegetative buffers to continue functioning as a natural nutrient and sediment removal mechanism. The applicability of the 50-foot buffer is determined by the presence of intermittent streams, perennial streams, lakes, ponds, and/or estuaries denoted on either soil survey maps of the or the most recent USGS 1:24,000 scale (7.5 min) quadrangle topographic maps (NCDENR 2002a).

Most Piedmont Region streams have relatively sandy substrates; however, in some portions of the Upper Neuse Basin, including parts of Granville County, the larger tributaries have stream substrates composed of larger rocks and boulders. The smaller tributaries within this Slate Belt such as the Knap of Reeds Creek have gravel, sand, clay, and silt substrate and are very susceptible to and impacted by low flow or drought conditions (NCDENR 2006a). The Knap of Reeds Creek runs from the Lake Butner Dam and eventually discharges into the Falls Lake system. NCDENR conducts surface water monitoring near Butner on the Knap of Reeds Creek and determined in 1998 that a portion of the creek was only partially supporting biological activity. Currently, 5.2 miles of the Knap of Reeds Creek from Lake Butner to Falls Lake is considered impaired for biological activity. The NCDENR ambient surface water monitoring program has documented elevated manganese, fecal coliform bacteria, and low dissolved oxygen in Knap of Reeds Creek. NCDENR is currently evaluating the need for advanced treatment options of current dischargers, as well as investigating potential contributing sources that may be exacerbating the impaired biological activity of the stream. As of 2004, potential contaminant sources have not been determined, and TMDLs have not been established (EPA 2008b). North Carolina has EPA-delegated authority for both NPDES storm water and wastewater permitting (NCDENR 2006b).

3.7.7.1.2 Storm Water

The Umstead Research Farm Site does not currently possess drainage structures other than natural conveyances. In general, the 249-acre tract slopes to the southeast, directing surface flow through on-site perennial and intermittent streams. Storm water from the NBAF Umstead Research Farm Site flows along the natural topographic slopes recharging the groundwater by infiltration, and ultimately discahrges into the Knapp of Reeds Creek. The NBAF Umstead Research Farm Site is outside the 100-yr floodplain. The closest 100-yr floodplains are located approximately 0.5 mile directly to the west and 0.5 mile to the southeast of the Umstead Research Farm Site.

3.7.7.1.3 Groundwater

The Surficial and the Fractured Bedrock are the two primary aquifer systems in the North Carolina Piedmont Region. The regolith materials of the surficial system form the unconfined aquifer that is hydraulically connected to the lower aquifer system. The Fractured Bedrock System acts as a confining or semi-confining layer and normally allows recharge from the Surficial Aquifer. As the thickness of the Surficial Aquifer increases, the groundwater yield from the fractured bedrock improves. The primary source of potable groundwater for the Butner area is typically found in the Fractured Bedrock System (NCDENR 2007c).

Based on topography alone, the groundwater flow appears to be in a general southern direction. During a preliminary subsurface inspection, nine test borings were advanced to assess the site soils (GTI 2007). During this inspection, no groundwater was encountered in borings ranging from approximately 13 to 16 feet bls. However, the fine grain soils found near the surface are indicative of a potential perched groundwater during wet periods, and the soil characteristics also suggests a fluctuating seasonal groundwater table. Groundwater is not currently being used for any on-site purpose.

State and federal records document minor petroleum underground storage tank releases, operations, and closures in proximity of the site (GTI 2007). However, there were only two sites of noteworthy groundwater contamination near the NBAF Umstead Research Farm Site. The Federal Hazardous Substance Disposal Sites and the state Inactive Hazardous Waste Sites databases reference a site known as the Range Road Burn Site, which is located approximately 2,600 feet northeast of the Umstead Research Farm Site, just north of SR 1121 or Range Road. In the 1950s and 1960s, a local manufacturing corporation produced polyvinyl chloride film and laminates. The company disposed of their hazardous waste by-products by burning the material at a nearby military firing range, now called the Range Road Burn Site. There is no confirmation of a complete groundwater/soil site assessment and the North Carolina Inactive Hazardous Waste Section includes the Range Road Burn Site on the State Priority List. The Umstead Research Farm Site is separated from the Range Road Burn Site by SR 1121, undeveloped woodlands, and an unnamed tributary of the Knap of Reeds Creek that flows north to south.

As part of the Department of Defense’s Environmental Restoration Program (DERP) in August 2004, USACE, Wilmington District, sampled several drinking water wells in the former area of the Camp Butner training facility (USACE 2007b). Multiple residential drinking water wells were sampled and analyzed to determine if the area groundwater had been affected by former Department of Defense (DOD) activities. The sample locations were selected from areas of historical ordnance use and explosive waste discoveries. USACE sampling and analysis did not confirm whether DOD activities at Camp Butner had impacted the area groundwater quality. However, the detected levels of perchlorate and lead justify further DOD investigation (USACE 2007b). USACE sampling locations were primarily north of Range Road and in the vicinity of Lake Holt Reservoir. Additional information on existing hazardous, toxic, or radiological waste at the site is found in Section 3.12.7.1

3.7.7.1.4 Floodplains

The Umstead Research Farm Site is located west of Old Route 75, south of SR 1121, and approximately 5 miles west of U.S. Interstate 85 in Granville County. Elevations at the site range from 350 to 480 feet above mean sea level, with a southern surface drainage pattern. Unnamed, perennial, and intermittent on-site streams carry surface and storm water off-site and ultimately discharge into the Knap of Reeds Creek located southeast of Old Route 75.

FEMA has mapped the Umstead Research Farm Site in a Zone X, an area outside the 100-yr floodplain (FEMA 2006). The closest 100-yr floodplains are located approximately 0.5 mile directly to the west and 0.5 mile to the southeast of the Umstead Research Farm Site.

3.7.7.2 Construction Consequences

3.7.7.2.1 Surface Water

The Umstead Research Farm Site is approximately 249 acres of primarily undeveloped woodlands. The NBAF Umstead Research Farm Site would encompass approximately 30 acres with 500,000 square feet of enclosed research facilities. Based on a conceptual site drawing, the proposed facility can be accommodated on the Umstead Research Farm Site without directly affecting surface water features.

Construction of the NBAF at the Umstead Research Farm Site has the potential to indirectly affect surface water resources. Construction would disturb more than 1 acre, triggering the requirement for a NCDENR Erosion and Sedimentation Control Permit, which authorizes land clearing, grading, and site construction. The need for a State Stormwater Permit is also triggered by the issuance of the Erosion Control authorization. The State Stormwater Management Program protects sensitive receiving waters by requiring a low density of impervious surfaces, use of vegetative buffers, and vegetated storm water conveyance swales. High-density developments would require the design and installation of structural best management practices that collect, retain, and treat the storm water runoff from the facility. The Upper Neuse River Watershed is classified as WS IV-NSW and would require BMPs to control the runoff from a 1-inch storm event and removal of 85% of the total suspended solids. By implementing an approved Erosion Control Plan and by facilitating good engineering practices and good construction techniques, downstream facilities/resources such as the Dillon School and the Knap of Reeds Creek would not be adversely affected by construction of the NBAF.

3.7.7.2.2 Storm Water

Construction of the NBAF at the Umstead Research Farm Site would result in the direct disturbance of previously undeveloped areas. During the construction phase, a SWPPP would be prepared and notice given as required by NCDENR (NCDENR 2008). Construction of the proposed NBAF would have no indirect adverse effect on local surface waters or downstream facilities/resources with appropriate BMPs to minimize potential construction runoff. Information regarding design and mitigation measures have been previously described and would be applicable to the Umstead Research Farm Site.

3.7.7.2.3 Groundwater

No direct groundwater effects would occur from construction of the NBAF. The potential for indirect groundwater effects from construction runoff does exist; however, by implementing NCDENR permit(s) stipulations and developing good engineering and best management practices, potential downstream or infiltration impacts would be minimized or eliminated. Any surficial groundwater dewatering during construction would be temporary and would have no effect on drinking water supplies for Butner.

3.7.7.2.4 Floodplains

The NBAF would not be built in a floodplain; therefore, the construction would not directly affect flood storage or floodways. The quality and volume of potential surface water leaving the site would be managed through approved storm water and erosion control permit stipulations, minimizing potential indirect effects.

Refer to Sections 3.7.3.2.1, 3.7.3.2.2, 3.7.3.2.3, 3.7.3.3.1, 3.7.3.3.2, and 3.7.3.3.3 for additional water resource information.

3.7.7.3 Operation Consequences

3.7.7.3.1 Surface Water

Operation of the NBAF at the Umstead Research Farm Site would produce a direct surface water effect as a result of supplying potable water needs. Refer to Section 3.3.7.3.1 for a description of potable water operation effects. The NBAF would be supplied water and sewer service by a local source such as the SGWASA. The Lake Holt Reservoir has a storage capacity of approximately 10 billion gallons of potable water and is a major source of local potable water. Based on the current SGWASA water system operating capacity of 3.0 mgd, an additional 4.5 mgd in water system treatment and delivery design capacity and the ability to access nearby surface water sources for future capacity requirements, the SGWASA would have sufficient capacity to provide the NBAF demand without adversely affecting the water supply for the region.

The daily wastewater effluent from the NBAF would be quantified by volume and constituents to ensure that the receiving wastewater treatment plant can integrate the additional load requirements of the NBAF without adversely affecting the capacity or permitted effluent stipulations of the treatment plant.

Based on a conceptual site drawing, the NBAF can be positioned without directly impacting surface water features. The Umstead Research Farm Site receives surface flows from areas north of the site, primarily the North Carolina State University cattle research facility. The Umstead Research Farm Site would have several areas where BMPs would vary and each potential on- and off-site source would be individually evaluated and included in a site-wide SWPPP. The proposed NBAF would trigger the need for a SPCC plan. Refer to Section 3.7.1 for additional SPCC information.

Cumulative Impacts

According to the Granville County Economic Development Commission (Leon Turner, EDC, February 20, 2008), there are currently no major new projects being planned in Granville County. Development Services has permitted around 3,000 new homes, but it is uncertain how many will be built with the current housing slowdown. It is unknown when the housing market will return to its level of previous years.

The ROI for the cumulative analysis for the Umstead Research Farm Site is the Upper Neuse River Watershed between the Lake Holt Reservoir (Lake Butner) and the Falls Lake system. The Upper Neuse River Basin covers approximately 770 square miles and drains to the Falls Lake Reservoir—the City of Raleigh’s primary water source.

Water in Southern Granville County is provided by the SGWASA. SGWASA currently has approximately 4.5 mgd of excess potable water capability with additional capacity available from Lake Holt if needed (Leon Turner, EDC, February 20, 2008). Much of the southeastern United States is undergoing a severe drought. Although the SGWASA has demonstrated the capacity to meet the potable water demands of the proposed NBAF (110,000 gpd – less than 0.4% of the total current capacity), it would still contribute to the cumulative use of surface water in the region.

Wild and Scenic Rivers

The nearest North Carolina Rivers designated in the Wild and Scenic River inventory are the New River, located in the New River State Park 153 miles west, and the Lumber River, located in the Lumber River State Park 116 miles south (WSR 2008). The NBAF would have no adverse effects on the state-designated Wild and Scenic Rivers.

3.7.7.3.2 Storm Water

Operation of the NBAF at the Umstead Research Farm Site has the potential to affect storm water. The LID site design goal is to minimize runoff volume and preserve existing flow patterns (NDP 2007a). The presence of the NBAF would result in an increase of 270,000 square feet (6.2 acres) of impervious area and result in 180,000 cubic feet (1,347,000 gallons) of total runoff based on a site-specific 100-yr, 24-hr, 8-inch storm event (NDP 2008b).

The paved facility footprint is 270,000 square feet (6.2 acres), compared to the total 249-acre site area. The associated hydrologic effect would be expected to be minimal. North Carolina has EPA-delegated authority for both NPDES storm water and wastewater permitting. As a baseline, a NPDES SWPPP would be required for the facility and multiple storm drain service lines may be required.

3.7.7.3.3 Groundwater

The SGWASA would provide the NBAF Umstead Research Farm Site with water and sewer service; therefore, no on-site groundwater wells are anticipated for the primary laboratory facilities. The NBAF Umstead Research Farm Site is anticipated to have no adverse effect on the area groundwater resources.

3.7.7.3.4 Floodplains

The Umstead Research Farm Site is primarily undeveloped woodlands with a predominant southern surface flow drainage pattern. FEMA has mapped the Umstead Research Farm Site in a Zone X, an area outside the 100-yr floodplain. Operation of the NBAF Umstead Research Farm Site would not have an adverse effect on the flood storage or floodways for the area.

3.7.8 Texas Research Park Site

3.7.8.1 Affected Environment

3.7.8.1.1 Surface Water

No surface water features exist on the Texas Research Park Site; however, two natural drainage ways are found elsewhere on the Research Park. The topography of the site is rounded hills and valleys with over 200 feet of relief. The area's regional slope tends toward the southeast. The primary drainage pattern at the Park takes surface water to the southeast and drains into Lucas Creek, located just south of Farm Road 1957 in eastern Medina County, and runs southeast for 10 miles to Leon Creek, 2 miles northwest of Macdona in southwestern Bexar County. The other natural drainage conveyance takes surface water to the west and drains into Big Sous Creek. Big Sous Creek is located 3 miles southwest of Riomedina in eastern

Medina County and runs southeast for 8 miles to the Medina River, located 3 miles west of Macdona in western Bexar County.

Lucas Creek and Big Sous Creek are the surface water features nearest to NBAF Texas Research Park Site within approximately 2 miles, and both are tributaries of the Medina River. The state has listed bacteria, low dissolved oxygen, and PCBs in fish tissue as impairments for Lower Leon Creek. As of 2004, no potential contaminant sources have been reported or TMDLs established (EPA 2008c).

3.7.8.1.2 Storm Water

The Texas Research Park Site does not currently possess drainage structures other than natural conveyances. Storm water at the NBAF Texas Research Park Site follows the natural topographic contours while infiltrating into the subsurface (BSA 2007). In general, the 100-acre tract slopes to the southeast into intermittent drainage ways and should not be affected by storm flooding (BSA 2007).

3.7.8.1.3 Groundwater

Three aquifers exist within the vicinity of the Texas Research Park Site: Edwards, Buda, and Austin aquifers, named for the respective geologic feature where they are found. Each aquifer system is geologically isolated. Water quality within the Buda and Austin aquifers is generally below drinking water standards. Currently these two aquifers are used primarily for watering livestock and crop irrigation.

The Edwards Aquifer lies approximately 450 to 750 feet bls and is the sole drinking water source for San Antonio. The Edwards Aquifer is also an important water resource to the five-county area surrounding San Antonio. The Edwards Aquifer is a feature in the Edwards Group, a geologic classification for the limestone, chert, and dolomite that comprise the rock types of the area. This feature is, on average, over 500 feet thick and is very permeable. Underlying this feature is a formation comprised of marly limestone and clay called the Glen Rose formation. This feature, along with the Del Rio formation, confines water within the Edwards Group to form the Edwards aquifer.

3.7.8.1.4 Floodplains

FEMA mapped the Texas Research Park Site as not being within a 100-yr floodplain (FEMA 2007b; BSA 2007). The closest floodplain to the Texas Research Park Site is just over 0.5 miles to the east.

3.7.8.2 Construction Consequences

3.7.8.2.1 Surface Water

Construction of the NBAF at the Texas Research Park Site would have no direct effect on surface water resources. On-site surface flow during heavy rain periods would move through natural drainage ways, but indirect adverse effects would not likely occur within the Lucas Creek or Big Sous Creek systems. The development and implementation of a SWPPP, a SPCC plan, and the development of good housekeeping techniques would minimize potential surface water effects.

3.7.8.2.2 Storm Water

Construction of the NBAF would result in disturbance of previously undeveloped areas. During the construction phase, a SWPPP would be prepared and notice given as required by TCEQ.

Under the SWPPP, BMPs would be implemented to prevent construction storm water runoff and to protect the quality of local surface waters. Construction of the NBAF would have no adverse effect on local surface waters or downstream resources/facilities. Information regarding design and mitigation measures have been previously described and would be applicable to the Texas Research Park Site.

3.7.8.2.3 Groundwater

Previous studies have concluded that utilizing the areas within the Texas Research Park would not directly or indirectly effect water quality within the Edwards aquifer (Raba-Kistner 1987). The Texas Research Park Site is south of any known transition or aquifer system recharge zones, and there is a low probability that any contamination would occur from activities relating to the construction of the NBAF at the Texas Research Park Site.

3.7.8.2.4 Floodplains

The Texas Research Park Site is not located within the 100-yr floodplain; therefore, there would be no direct effects from construction activities on flood storage or floodways. The quality and volume of potential surface water leaving the site would be managed through approved storm water and erosion control permit stipulations. Construction of the NBAF would result in no indirect adverse effect on the 100-yr floodplain.

Refer to Sections 3.7.3.2.1, 3.7.3.2.2, 3.7.3.2.3, 3.7.3.3.1, 3.7.3.3.2, and 3.7.3.3.3 for additional water resource information.

3.7.8.3 Operation Consequences

3.7.8.3.1 Surface Water

Operation of the NBAF at the Texas Research Park Site would not have a direct effect on surface water resources. Indirect surface water effects could occur from runoff. To minimize potential effects to surface water quality, a site-wide SWPPP and SPCC plan would be prepared. All potential surface water contaminant sources would be evaluated during development and implementation of the SWPPP and SPCC plan, including daily operational housekeeping techniques. Operation of the NBAF would result in no adverse effect on local surface waters or downstream resources/facilities. Refer to Section 3.7.1 for additional SPCC information.

<u>Wild and Scenic Rivers</u>

The nearest Texas river designated in the Wild and Scenic River inventory is the Rio Grande River. The Rio Grande flows from its headwaters in the San Juan Mountains of southern Colorado for 1,865 miles to the Gulf of Mexico near Brownsville, Texas. The NBAF would not affect the Rio Grande River or its designation as a Wild and Scenic River, since it is several hundred miles southwest of the Texas Research Park Site.

3.7.8.3.2 Storm Water

The proposed design of the NBAF uses LID approaches. The LID site design goal is to minimize runoff volume and preserve existing flow patterns (NDP 2007a). The presence of the NBAF would result in an increase of 270,000 square feet (6.2 acres) of impervious area and result in 300,150 cubic feet (2,245,422 gallons) of total runoff based on a site-specific 100-yr, 24-hr, 10-inch storm event (Department of Commerce 2008). The paved facility footprint is 270,000 square feet (6.2 acres), compared to the total 100-acre site area; therefore, any associated hydrologic effect would be expected to be minimal. Texas has EPA-delegated authority for both NPDES storm water and wastewater permitting. As a baseline, a NPDES SWPPP would be required for facility operation.

3.7.8.3.3 Groundwater

Operation of the NBAF at the Texas Research Park Site would not result in direct effects to groundwater resources. The BMWD would provide the proposed NBAF with water; therefore, no on-site groundwater wells are anticipated. The below-grade structural feature of the NBAF would represent a potential groundwater diversionary attribute. Potential indirect effects from groundwater contamination would be minimized through BMPs, as previously described.

3.7.8.3.4 Floodplains

The Texas Research Park Site is not located in a 100-yr floodplain; therefore, there would be no direct effects from operations of the NBAF on flood storage or floodways. Operation of the NBAF at the Texas Research Park Site would have no anticipated adverse indirect effect on flood storage, floodways, or downstream facilities or resources.

<u>Cumulative Impacts</u>

Prior to the mid 20th century, Bexar County was predominately agricultural, with cash crops, cotton, and livestock as the main economic drivers. World War II saw Bexar County's already large military presence grow, spurring development trends. The area's military presence has remained an important economic driver. During the 1980s and 1990s, as a result of attempts to diversify the area's economy, San Antonio and Bexar County became the site of a number of electronics and biotechnology companies. A number of BSL facilities are located in the San Antonio and Bexar County region. The Southwest Foundation for Biomedical Research currently operates three BSL-3 laboratories and one BSL-4 laboratory; the University of Texas Health Science Center at San Antonio operates three BSL-3 laboratories; the Brooks City Base has two BSL-3 laboratories, one of which is operated by the San Antonio Metropolitan Health District; and the University of Texas at San Antonio, the Veterans Administration, the Wilford Hall Medical Center, and the Brooks Army Medical Center all operate one BSL-3 laboratory.

In Bexar County, there are several other public and private activities proposed or ongoing that would have potential to impact water resources. Future planned projects in the vicinity of the Texas Research Park Site include a number of new residential development projects that would result in over 13,000 new residential units in the region. The estimated population generated from these planned developments would be 31,200 people for just residential, not including commercial, office, or industrial population from employment in the area.

The ROI for water resources is the BMWD, which supplies potable water to the area including the Texas Research Park. As previously discussed in Section 3.3.4, operation of the NBAF would result in the use of approximately 164,000 gpd (60 mgy). The NBAF would receive potable water from the BMWD Texas Research Park Public Water Supply System, and future upgrades planned for 2008 would be able to meet the proposed NBAF demands. However, the additional water consumption from the planned residential developments would exert additional pressure on the water supply capacity for the region.

3.8 BIOLOGICAL RESOURCES

3.8.1 Methodology

The ecological context for each site was established by characterizing the natural vegetation of each region based on review of regional natural community guides and other pertinent literature. Site-specific plant community descriptions were based primarily on floristic surveys conducted specifically for the proposed NBAF project. In addition, known occurrences of rare or significant natural communities in the vicinity of the sites were identified through review of state natural heritage program data. The naturalness and quality of plant communities at the proposed sites were evaluated based on the degree of departure from communities that would be expected to occur in the region under natural conditions. Factors such as community structure, species composition, recent or historical disturbance, and presence of non-native species were considered in evaluating the quality of plant communities. Vegetation effects were then assessed based on the quality and rarity of the affected communities and the extent of impacts.

Plant community composition and quality were used to predict wildlife utilization of on-site habitats. Additional resources that were used to evaluate wildlife resources included state Gap Analysis Program (GAP) documents and distribution maps, state wildlife action plans, species lists from adjacent nature preserves, and other relevant literature resources. Effects on wildlife were then evaluated based on the quality and rarity of the affected habitat and the extent of impacts.

Federally listed species are protected under the *Endangered Species Act* (ESA) of 1973, as amended (16 U.S.C. 1531-1543), which requires federal agencies to ensure that any actions they authorize, fund, or carry out do not jeopardize the "continued existence" of listed species or result in the destruction or adverse modification of habitat designated as critical to their existence. Site-specific plant community descriptions were used to evaluate the potential for on-site occurrences of state and federally listed threatened and endangered species. Additional resources that were used to evaluate potential occurrences of threatened and endangered species included review of state natural heritage program databases, review of U.S. Fish and Wildlife Service (USFWS) and natural heritage program county species lists, and direct correspondence with regional USFWS field offices and state natural heritage programs. When warranted, site-specific surveys for listed species and/or potential habitat were conducted. Effects were evaluated based on known occurrences of listed species and the presence of potential habitat at the sites.

The discharge of dredge or fill material into "Waters of the U.S." is regulated under Section 404 of the *Clean Water Act* (CWA), as amended. "Waters of the U.S." include wetlands and other water bodies such as streams, rivers, lakes, and tidal waters. USACE (33 CFR 328.3), and the EPA (40 CFR 230.3) define wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." In accordance with this definition, areas classified as wetlands must possess the following three diagnostic characteristics: a predominance of hydrophytic vegetation, hydric soils, and wetland hydrology.

Site visits by qualified professionals and analysis of National Wetland Inventory (NWI) and county soil survey maps were used to evaluate potential on-site occurrences of Section 404 jurisdictional wetlands. When warranted, site-specific wetland delineations were conducted by qualified professionals using methods specified in the (USACE 1987). Wetland delineations included on-site stream mapping, the description of stream channel characteristics and aquatic habitats, and the evaluation of any applicable wetland or stream buffer zone requirements. Data from the wetland delineations were used to describe on-site wetland communities and aquatic habitats, and surveyed delineation maps were used to evaluate wetland and stream impacts. The evaluation of aquatic resources (habitats and aquatic fauna) also included the review of river basin management plans, aquatic resource data collected by state agencies, and other pertinent literature resources.

3.8.2 No Action Alternative

3.8.2.1 Affected Environment

3.8.2.1.1 Vegetation

Regional Vegetation

Plum Island is located in the Coastal Lowland ecozone of the Atlantic Coastal Plain physiographic province (Edinger et al. 2002). Characteristic natural communities of the Coastal Lowland ecozone include maritime beach and dune, maritime grassland, salt marsh, maritime shrubland, maritime forest, coastal hardwood forests, pitch pine-oak forests, and freshwater wetlands.

Maritime beaches are characterized by a sparse herbaceous stratum that typically includes beachgrass (*Ammophila breviligulata*), sea-rocket (*Cakile edentula* ssp. *edentula*), seaside atriplex (*Atriplex patula*), seabeach atriplex (*A. arenaria*), seabeach sandwort (*Honkenya peploides*), salsola (*Salsola kali*), seaside spurge (*Chamaesyce polygonifolia*), and seabeach knotweed (*Polygonum glaucum*). Dunes are dominated by grasses, forbs, and low shrubs. Characteristic dune species include beach heather (*Hudsonia tomentosa*), bearberry (*Arctostaphylos uva-ursi*), beachgrass, cyperus (*Cyperus polystachyos* var. *macrostachyus*), seaside goldenrod (*Solidago sempervirens*), beach pinweed (*Lechea maritima*), jointweed (*Polygonella articulata*), sand rose (*Rosa rugosa*), bayberry (*Myrica pensylvanica*), beach plum (*Prunus maritima*), and poison ivy (*Toxicodendron radicans*). Maritime grasslands occur on rolling outwash plains within the influence of ocean winds and salt spray. The dominant grasses are little bluestem (*Schizachyrium scoparium*), common hairgrass (*Deschampsia flexuosa*), and poverty grass (*Danthonia spicata*) (Edinger et al. 2002).

Maritime shrubland communities are characterized by a dense, tall assemblage of shrubs and tree saplings. Typical species include shadbush (*Amelanchier canadensis*), bayberry (*Myrica pensylvanica*), black cherry (*Prunus serotina*), arrowwood (*Viburnum dentatum*), shining sumac (*Rhus copallinum*), beach plum, sand rose, wild rose (*Rosa virginiana*), eastern red cedar (*Juniperus virginiana*), American holly (*Ilex opaca*), black oak (*Quercus velutina*), and sassafras (*Sassafras albidum*). Maritme forests are dominated by various combinations of salt-pruned, stunted trees that are heavily influenced by coastal processes such as high winds and salt spray. Characteristic canopy trees include black oak, post oak (*Quercus stellata*), scarlet oak (*Q. coccinea*), white oak (*Q. alba*), eastern red cedar, beech (*Fagus grandifolia*), and American holly. Areas that are protected from coastal processes contain a number of deciduous coastal forest communities that are dominated by various combinations of hardwood species. Common hardwoods include white oak, black oak, scarlet oak, chestnut oak (*Q. montana*), hickories (*Carya* spp.), beech, red maple (*Acer rubrum*), sugar maple (*A. saccharum*), and yellow poplar (*Liriodendron tulipifera*). Pitch pine-oak communities occur on stabilized dunes and well drained sandy soils on glacial till and outwash plains. Characteristic species include pitch pine (*Pinus rigida*), white oak, scarlet oak, black oak, post oak and/or scrub oaks that include bear oak (*Quercus ilicifolia*) and dwarf chinkapin oak (*Q. prinoides*) (Edinger et al. 2002).

Hardwood and shrub swamp communities occur in poorly drained, freshwater depressions. Common trees of hardwood swamps include maple (*Acer rubrum*), ashes (*Fraxinus* spp.), elms (*Ulmus* spp.), yellow birch (*Betula alleghaniensis*), and swamp white oak (*Quercus bicolor*). Characteristic shrubs of hardwood and shrub swamp communities include spicebush (*Lindera benzoin*), alders (*Alnus* spp.), viburnums (*Viburnum* spp.), highbush blueberry (*Vaccinium corymbosum*), common elderberry (*Sambucus canadensis*), dogwoods (*Cornus* spp.), swamp azalea (*Rhododendron viscosum*), and willows (*Salix* spp.).

Freshwater marshes occur in the lower portions of depressions where the soils are subject to near-permanent inundation or saturation. Common emergent aquatic plants include cattails (*Typha* spp.), wild rice (*Zizania aquatica*), bur-reeds (*Sparganium* spp.), pickerel weed (*Pontederia cordata*), bulrushes (*Scirpus* spp.), arrowhead (*Sagittaria latifolia*), arrowleaf (*Peltandra virginica*), rice cutgrass (*Leersia oryzoides*), bayonet rush (*Juncus militaris*), water horsetail (*Equisetum fluviatile*), and bluejoint grass (*Calamagrostis canadensis*) (Edinger et al. 2002). Salt marshes and salt shrub communities occupy the intertidal zone along coastal shorelines that are sheltered from high-energy ocean waves. The lower portions of salt marshes are dominated by near-monospecific stands of cordgrass (*Spartina alterniflora*). Dominant species within the upper portion of the marsh include salt-meadow grass (*Spartina patens*), spikegrass (*Distichlis spicata*), black-grass (*Juncus gerardii*), and glassworts (*Salicornia* spp.) (Edinger et al. 2002).

Plum Island Vegetation

Natural communities on Plum Island have been heavily impacted by human activities that include livestock grazing, establishment of a coastal artillery fort (Fort Terry 1879 - 1948), and development associated with the existing PIADC. Existing communities are fragmented by an extensive network of roads. In addition, numerous structures, historical artillery batteries, trenches, borrow pits, utility corridors, and other mowed or disturbed areas are common across the island. Natural vegetation on the island is influenced by maritime processes that include high winds, salt spray, overwash, and dune formation and shifting. The island contains characteristic maritime communities that include beach, dune, and maritime shrub/forest. Additional communities include an extensive complex of freshwater herbaceous/shrub wetland communities on the southwestern portion of the island, and coastal hardwood forests on elevated moraine deposits that are protected from ocean salt spray and overwash. The back side of the island on Long Island Sound is actively eroding, resulting in vertical bluffs that are adjoined by unvegetated beaches consisting of sand and glacial till (gravel, cobble, and boulder). Consequently, the island lacks tidal marshes and salt shrub communities that are characteristic of barrier islands and other moraine islands in Long Island Sound.

Rare and Significant Natural Communities

The New York Natural Heritage Program (NYNHP) has identified the maritime dune community on the southeastern portion of Plum Island as a significant natural area with high ecological and conservation value. The NYNHP describes this area as a low dune field with scattered blowouts and patches of low shrubby vegetation. The report indicates that many non-native species are present along old roads within the dunes; however, the community is described as a fairly large occurrence in good condition (NYNHP 2007).

3.8.2.1.2 Wetlands

The southern portion of Plum Island contains approximately 54 acres of freshwater wetlands (Figure 3.8.2.1.2-1). These freshwater wetlands include marshes, shrub-dominated wetlands, and areas of open water. Common hydrophytic herbaceous species include cattail (*Typha latifolia*), sedges (*Carex* spp.), and rushes (*Juncus* spp.) Typical hydrophytic shrubs include button bush (*Cephalanthus occidentalis*), high bush blueberry (*Vaccinium corymbosum*), sweet pepper bush (*Clethra alnifolia*), swamp black gum (*Nyssa biflora*), and multiflora rose (*Rosa multiflora*). Section 404 jurisdiction also extends landward to the high-tide line along the unvegetated intertidal shorelines that fringe the island. The eastern intertidal shoreline consists primarily of unvegetated sand. The western edge of the island is actively eroding, resulting in vertical bluffs and unvegetated beaches consisting of sand and glacial till (gravel, cobble, and boulder). The island lacks tidal salt marsh communities that are characteristic of other islands in Long Island Sound.

In addition to the wetland areas that are regulated under Section 404 of the CWA, the State of New York regulates a 100-foot buffer zone around all freshwater wetlands and a variable buffer zone adjacent to tidal wetlands. The width of the tidal wetland buffer zone varies with the topography of the adjacent land. The regulated inland extent of the tidal buffer zone ends at the elevation contour of 10 feet above mean sea level or at the topographic crest of an adjacent bluff that is crossed by the 10-foot contour or at a distance of 300 feet inland from the wetland boundary, whichever is closest to the wetland boundary. In the vicinity of the existing PIADC, most of the tidal buffer zone along the western shoreline ends at the topographic crest of an adjacent bluff.

3.8.2.1.3 Aquatic Resources

Freshwater aquatic habitats on Plum Island consist of permanently flooded areas within the complex of freshwater wetlands on the southernmost portion of the island. These small ponds are shallow, groundwater-fed water bodies that occupy shallow depressions in the outwash plain of terminal moraine deposits. Semi-aquatic turtles that occur in freshwater habitats on or near Plum Island include snapping turtle (*Chelydra serpentina*), spotted turtle (*Clemmys guttatea*), eastern painted turtle (*Chrysemys picta picta*), and diamondback terrapin (*Malaclemys terrapin terrapin*). Information regarding amphibians that may inhabit these freshwater ponds is lacking; however, species may include those associated with similar freshwater habitats on nearby islands: spotted salamander (*Ambystoma maculatum*), marbled salamander (*Ambystoma opacum*), eastern spadefoot toad (*Scaphiopus holbrookii*), spring peeper (*Pseudacris crucifer*), American bullfrog (*Rana catesbeiana*), northern green frog (*R. clamitans*), wood frog (*R. sylvatica*), and gray tree frog (*Hyla versicolor*) (NYSCDR 2002). Fishes that are characteristic of permanently flooded coastal plain depressions include chain pickerel (*Esox niger*), banded sunfish (*Enneacanthus obesus*), and eastern mudminnow (*Umbra pygmaea*) (Edinger et al. 2002).

Plum Island is surrounded by the estuarine/marine waters of Long Island Sound, Plum Gut, Block Island Sound, and Gardiners Bay. Fish typical of the nearshore zone of the Atlantic Ocean include Atlantic menhaden (*Brevoorita tyrannus*), weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*), winter flounder (*Pleuronectes americanus*), summer flounder (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix*), tautog (*Tautoga onitis*), Atlantic mackerel (*Scomber scombrus*), black sea bass (*Centropristis striata*), Atlantic croaker (*Micropogonias undulatus*), northern kingfish (*Menticirrhus saxatilis*), spot (*Leiostomas xanthurus*), American sandlance (*Ammodytes americanus*), and silversides (*Menidia menidia*). Surf clams (*Spisula solidissima*) are abundant in nearshore benthic habitats. Marine sea turtles that occur in the nearshore zone during migration include Atlantic (Kemp's) ridley turtle (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), and loggerhead sea turtles (*Caretta caretta*). All five sea turtles are federally listed under the ESA (see Section 3.8.2.1.5). The nearshore zone provides winter habitat for harbor seals (*Phoca vitulina*) and gray seals (*Halichoerus grypus*). Other frequently occurring marine mammals include the finback whale (*Balaenoptera physalus*), minke whale (*B. acutorostrata*), and humpback whale (*Megaptera novaeangliae*). Additional commonly occurring marine mammals include the common dolphin (*Delphinus delphis*), bottlenosed dolphin (*Tursiops truncatus*), white-sided dolphin (*Lagenorhynchus acutus*), striped dolphin (*Stenella coerulealba*), and pilot whale (*Globicephala melaena*) (Edinger et al. 2002).

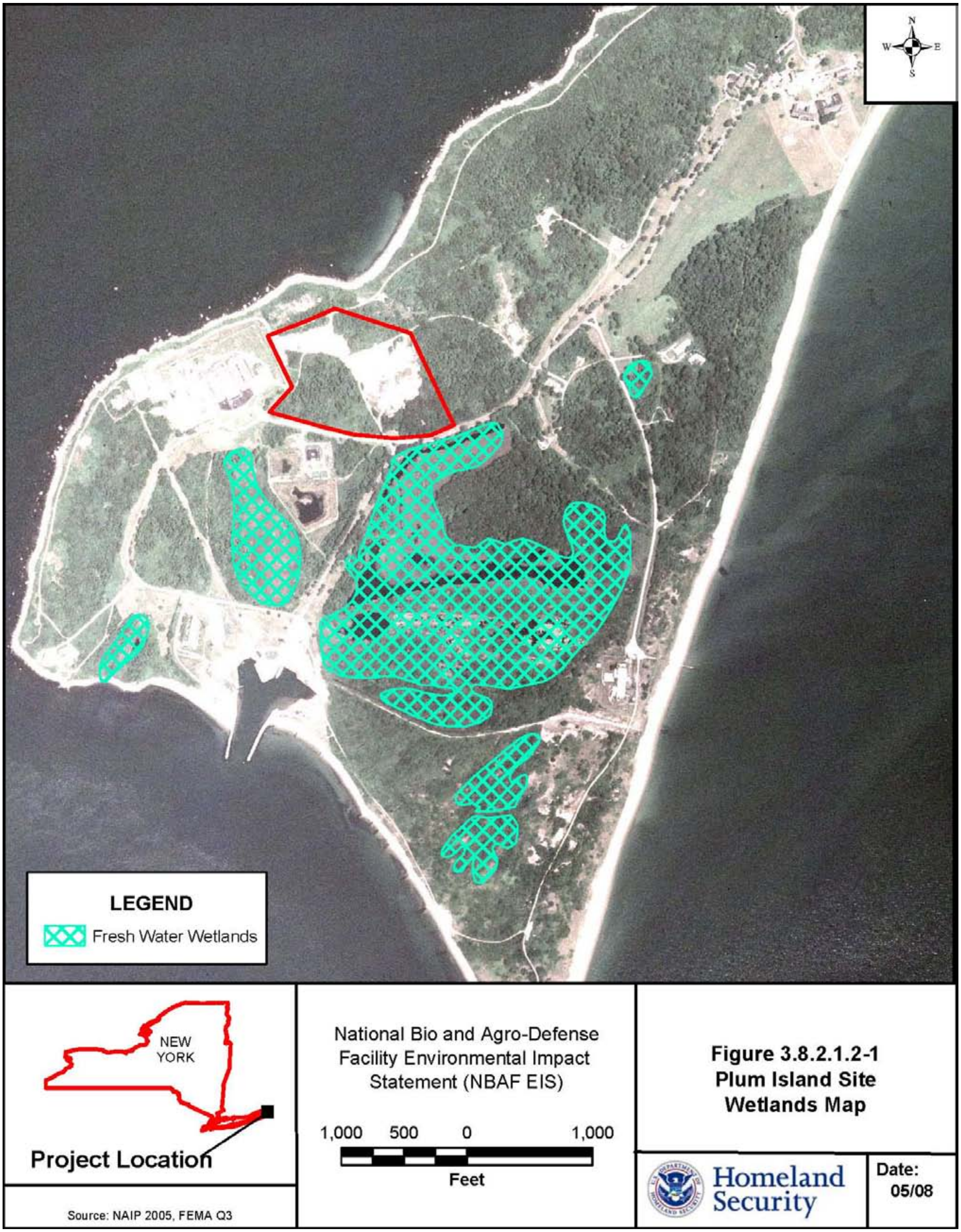


Figure 3.8.2.1.2-1 — Plum Island Site Adjacent Wetlands

The New York State Coastal Atlas, which delineates the State's Coastal Area Boundary, identifies all of Plum Island as "Federally Excluded Land" (NYSDCR 2008). Federal lands are not subject to the States Coastal Consistency Review Process. NYSDCR has designated Plum Gut (the area of open water between Plum Island and Orient Point) as Significant Coastal Fish and Wildlife Habitat. Plum Gut is a deep channel covering an area of approximately 500 acres. Plum Gut provides important foraging habitat for significant concentrations of fishes that include striped bass, bluefish, tautog, summer flounder, and scup (*Stenotomus chrysops*). Consequently, Plum Gut is an important recreational and commercial fishing resource. Plum Gut is one of two major passage corridors for striped bass, which move into Long Island Sound during the spring and fall migrations to and from their spawning grounds. Plum Gut is also considered a major corridor for Atlantic salmon (*Salmo salar*) during the spring as they return to their spawning grounds in the Connecticut and Pawtucket Rivers. Plum Gut also provides important habitat for marine mammals, particularly bottlenosed dolphin, harbor porpoise (*Phocoena phocoena*), and harbor seal. Sea turtles, especially juvenile Atlantic ridley and loggerhead sea turtles, also utilize Plum Gut (DCR 2005). In addition to coastal consistency review, projects that affect designated Significant Coastal Fish and Wildlife Habitats are subject to review under Policy 7 of the New York State Coastal Policies. Policy 7 prohibits activities that "destroy or significantly impair" the viability of significant habitats.

The *Marine Mammal Protection Act* (MMPA) of 1972 (as amended through 1997) prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the United States. The definition of "take" is "to harass, hunt, capture, or kill; or attempt to harass, hunt, capture or kill any marine mammal." In addition to the species mentioned above, marine mammals that may occur in deepwater estuarine or marine habitats in New York include the harp seal (*Phoca vitulina*), hooded seal (*Cystophora cristata*), Rissols dolphin (*Grampus griseus*), white-beaked dolphin (*Lagenorhynchus albirostris*), sperm whale (*Physeter catodon*), pygmy sperm whale (*Kogia breviceps*), sei whale (*Balaenoptera borealis*), and right whale (*Eubalaena glacialis*) (NYSDEC 2008). Harbor seals are known to haul-out (leave the water) on the southeastern shoreline of Plum Island for resting and sunning.

3.8.2.1.4 Terrestrial Wildlife

The New York GAP has developed models that predict the statewide distribution of terrestrial vertebrate species that are known to breed in New York. The New York GAP list of breeding species for the Coastal Lowlands ecozone includes 36 mammals, 158 birds, 18 reptiles, and 18 amphibians (Smith et al. 2001). Plum Island contains a diverse assemblage of wildlife habitats that include maritime beaches and dunes, rocky shorelines, maritime shrub communities, hardwood forests, freshwater wetlands, freshwater ponds, and marine habitats. The area encompassing Orient Beach State Park, Plum Island, and Plum Gut is an important foraging and breeding area for colonial waterbirds, and the North Fork Audubon Society (NFAS) has designated this area as an Important Bird Area (IBA). The NFAS conducted spring, summer, and fall bird surveys on Plum Island in 2007 (NFAS 2007). A total of 72 bird species were sighted on Plum Island. Results included 11 confirmed breeding species and six probable breeders (Table 3.8.2.1.4-1).

Beach and dune habitats along the southeastern shoreline of the island have supported large nesting colonies of great black-backed gulls. Herons, egrets, and ibises are also known to nest in the vicinity of the freshwater wetlands on the southern portion of the island. The NYNHP conducts great egret nesting surveys once every 3 years, and the past three surveys have documented an average of eight pairs on Plum Island (NYNHP 2007). Roseate and common terns from the nearby Gull Island colony frequently forage within Plum Gut, and these species utilize the rocky shoreline of southern Plum Island as resting habitat during feeding periods. Piping plovers have nested on the island in the past, and the island supports a large breeding population of Canada geese. As many as 18 active osprey nests have been documented on Plum Island during the breeding season. The 2007 NFAS surveys documented seven confirmed active osprey nests and an additional five potentially active nests (NFAS 2007). A total of 17 nesting platforms have been constructed to encourage osprey nesting on the island. The Orient Point-Plum Island IBA is also an important waterfowl wintering area for Canada geese, American black ducks, mallards, canvasbacks, scaup, long-tailed ducks, scoters, buffleheads, common goldeneyes, and red-breasted mergansers (NFAS 2007).

Table 3.8.2.1.4-1 — Results of Audubon Society 2007 Plum Island Breeding Bird Survey

Scientific Name	Common Name
Confirmed Breeders	
Pandion haliaetus	Osprey
Pipilo erythrophthalmus	Eastern towhee
Melospiza melodia	Song sparrow
Branta canadensis	Canada goose
Dumetella carolinensis	Gray catbird
Troglodytes aedon	House wren
Riparia riparia	Bank swallow
Phalacrocorax auritus	Double-crested cormorant
Somateria mollissima	Common eider
Turdus migratorius	American robin
Dendroica petechia	Yellow warbler
Probable Breeders	
Agelaius phoeniceus	Red-winged blackbird
Carduelis tristis	American goldfinch
Molothrus ater	Brown-headed cowbird
Vireo griseus	White-eyed vireo
Cathartes aura	Turkey vulture
Bombycilla cedrorum	Cedar waxwing

Mammals that are known to occur on Plum Island include white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), muskrat (*Ondratra zibethicus*), white-footed mouse (*Percomyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), and feral cats. As a standard safety procedure, measures to control the white-tailed deer population are conducted on an annual basis and none have been found on the island since 2004. Reptiles that are known to occur on Plum Island include the eastern box turtle (*Terrapene carolina carolina*), snapping turtle, and diamondback terrapin. Additional semi-aquatic turtles that are likely to occur in the freshwater ponds on the island include the spotted turtle and eastern painted turtle. Snakes that are common in the Coastal Lowlands ecozone include the common garter snake (*Thamnophis sirtalis*), northern black racer (*Coluber constrictor constrictor*), northern water snake (*Nerodia sipedon sipedon*), and northern brown snake (*Storeria dekayi dekayi*). Although no snakes have been reported on Plum Island, potential habitats for all of these species are present. Amphibians that may occur on Plum Island are discussed in Section 3.8.2.1.3.

The regional distribution of ungulate (hoofed mammal) populations has particular relevance, since they are susceptible to many of the diseases that may be studied at the existing PIADC. In addition to white-tailed deer, which occur throughout the state, moose are also known to occur in New York. The predicted New York GAP distribution for moose is limited to the northern upstate portion of New York, with the southern edge of the predicted range approximately 110 miles northwest of Plum Island (Smith et al. 2001). Therefore, moose are not likely to occur in the vicinity of Plum Island.

3.8.2.1.5 Threatened and Endangered Species

The USFWS reviews federal actions that may result in negative effects on federally listed terrestrial plants and animals and freshwater aquatic organisms. USFWS jurisdiction over sea turtles is limited to nesting habitat. The National Marine Fisheries Service (NMFS) has jurisdiction over federally listed sea turtles in the water, as well as listed marine mammals, saltwater fishes, and other marine species. Marine mammals are also protected under the MMPA, which is addressed in Section 3.8.2.1.3. Additional animal species that are listed by the state as endangered or threatened and plant species that are listed by the state as endangered, threatened, rare, or exploitably vulnerable are afforded protection under the Environmental Conservation Law of New York (Sections 11-0535 and 9-1503) and 6 New York Codes, Rules, and Regulations (NYCRR) Parts 182 and 193. Federally-listed species that are likely to occur in Suffolk County include the piping plover, roseate tern, shortnose sturgeon, five species of sea turtles, and three species of plants (Table 3.8.2.1.5-1). A list of state protected species that have been reported from the Town of Southold (including Plum Island) is provided in Table 3.8.2.1.5-2.

Federally Listed Species

Piping Plover

Piping plovers breed on dry sandy beaches, often near dunes in areas with little or no beach grass. Piping plovers begin to arrive at their breeding grounds in early March. Nests consist of shallow scrapes that are sometimes lined with pebbles and/or shells. They are usually placed well above the high-tide mark on open, generally grassless sand beaches or dredged spoil areas. An average clutch of four eggs is laid during May and June. Incubation takes 25–31 days, and the young leave the nest shortly after hatching and fledge in about 28–35 days. Piping plovers depart for their wintering areas by early September. The presence of a piping plover nest was confirmed on the northern portion of Plum Island in 2002 (NYSDEC 2008).

Table 3.8.2.1.5-1 — USFWS Federally-listed Threatened and Endangered Species for Suffolk County, New York (USFWS 2007b)

Scientific Name	Common Name	Federal Status	State Status	Habitat Utilized in New York	Habitat Present on Plum Island
Charadrius melodus	Piping plover	E	T	Maritime beaches	Yes
Sterna dougallii	Roseate tern	E	E	Maritime beaches and salt marsh islands	Yes
Caretta caretta	Loggerhead turtle	T	T	Ocean and estuaries	Yes
Chelonia mydas	Green turtle	T	T	Ocean and estuaries	Yes
Dermochelys coriacea	Leatherback turtle	E	E	Open ocean	Yes
Eretmochelys imbricata	Hawksbill turtle	E	E	Ocean and estuaries	Yes
Lepidochelys kempii	Kemp's ridley turtle	E	E	Ocean and estuaries	Yes
Acipenser brevirostrum	Shortnose sturgeon	E	E	Ocean and estuaries	Yes
Agalinis acuta	Sandplain geradia	E	E	Coastal grasslands	Yes
Amaranthus pumilus	Seabeach amaranth	T	E	Maritime beaches	Yes
Isotria medeoloides[a]	Small whorled pogonia	T	E	Hardwood stands with an open understory	Yes

[a]Record is historic, and this species is believed to be extirpated in New York.

Table 3.8.2.1.5-2 — Federally and State-listed Protected Species for the Town of Southold, New York (Including Plum Island, Gull Island, and Fishers Island) (Adapted from Scopaz 2004)

Scientific Name	Common Name	State Status[a]	Federal Status[b]
Ambystoma tigrinum	Tiger salamander	E	-
Kinosternon subrubrum	Eastern mud turtle	E	-
Charadrius melodus	Piping plover	E	E
Sterna antillarum	Least tern	T	-
Sterna dougallii	Roseate tern	E	E
Sterna hirundo	Common tern	T	-
Angelica lucida	Angelica	E	-
Aster subulatus	Saltmarsh aster	T	-
Atriplex glabriuscula	Seaside orach	E	-
Bartonia paniculata	Screw-stem	E	-
Carex hormathodes	Marsh straw sedge	T	-
Carex mitchelliana	Mitchell's sedge	T	-
Carex straminea	Straw sedge	E	-
Carex typhina	Cat-tail sedge	T	-
Chenopodium berlandieri var. *macrocalycium*	Large calyx goosefoot	E	-
Chenopodium rubrum	Red pigweed	T	-
Coreopsis rosea	Rose coreopsis	R	-
Cyperus lupulinus var. *lupulinus*[c]	Hop sedge	T	-
Cyperus polystachyos var. *texensis*	Coastal flatsedge	E	-
Digitaria filiformis	Slender crabgrass	T	-
Diplachne maritime	Salt-meadow grass	E	-
Eleocharis engelmannii	Engelmann's spikerush	E	-
Eleocharis fallax	Creeping spikerush	E	-
Eleocharis halophila	Salt-marsh spikerush	T	-
Erechtites hieraciifolia var. *megalocarpa*	Fireweed	E	-
Gnaphalium purpureum	Purple everlasting	E	-
Helianthemum dumosum	Bushy rockrose	T	-
Iris prismatica	Slender blue flag	T	-
Lemna perpusilla	Minute duckweed	E	-
Ligusticum scothicum	Scotch lovage	E	-
Myriophyllum pinnatum	Green parrot's feather	E	-
Paspalum leave	Field beadgrass	E	-
Plantago maritima ssp. *juncoides*	Seaside plantain	T	-
Polygonum glaucum	Seabeach knotweed	R	-
Polygonum hydropiperoides var. *opelousanum*	Opelousa smartweed	T	-
Polygonum setaceum var. *interjectum*	Swamp smartweed	E	-
Populus heterophylla	Swamp cottonwood	T	-
Potamogeton pulcher	Spotted pondweed	T	-
Potentilla anserina ssp. *egedii*	Silverweed	T	-
Rotala ramosior	Tooth-cup	T	-
Rumex maritimus var. *fueginus*	Golden dock	E	-

Table 3.8.2.1.5-2 — Federally and State-listed Protected Species for the Town of Southold, New York (Including Plum Island, Gull Island, and Fishers Island) (Adapted from Scopaz 2004) (Continued)

Scientific Name	Common Name	State Status[a]	Federal Status[b]
Salicornia bigelovii	Dwarf glasswort	T	-
Scirpus maritimus	Seaside bulrush	E	-
Solidago elliottii	Coastal goldenrod	E	-
Spiranthes vernalis[d]	Spring ladies'-tresses	E	
Tipularia discolor	Cranefly orchid	E	-
Tripsacum dactyloides	Northern gamma grass	T	-

[a]E = Endangered, T = Threatened, R = Rare, P = Protected
[b]E = Endangered
[c]Reported by Lamont (2006)
[d]Reported by Stalter et al. (2003)

Roseate Tern

A marine coastal species, the roseate tern breeds on salt marsh islands and beaches with sparse vegetation. Roseate terns arrive on the breeding grounds between late April and early May and begin nesting 1 month later. In New York, roseate terns are always found nesting with common terns. The nest is a depression in sand, shell, or gravel and may be lined with bits of grass and other debris. Nests are usually located in dense grass clumps. Eggs are incubated for approximately 23 days, and the young fledge in 22-29 days. Roseate terns depart for their wintering areas in late summer. Based on behavioral observations, the roseate tern was identified as a possible breeder on Plum Island in 2003 (NYSDEC 2008).

Atlantic Hawksbill

The Atlantic hawksbill rarely occurs in New York. Preferred habitat consists of warm, coastal shoal water less than 50 feet deep with abundant submerged vegetation. Coral reefs, lagoons, inlets, and bays are ideal habitats. Nesting occurs on isolated beaches in the Gulf of Mexico and the Caribbean Sea (NYSDEC 2008).

Green Sea Turtle

In the Atlantic Ocean, green sea turtles are found from Massachusetts south to Florida. They inhabit shallow waters such as shoals and lagoons with submerged vegetation. Inlets, bays, and estuaries are preferred habitats. Nesting occurs in all subtropical to tropical oceans of the world between 35 degrees north and south latitude, in waters that remain above 68°F during the coldest months (NYSDEC 2008).

Kemp's Ridley

Juvenile Kemp's ridleys inhabit the Atlantic Coast from Florida to Canada, possibly following the warm Gulf Stream. Preferred habitats include sheltered areas along the coastline such as large estuaries, bays, and lagoons. Nesting grounds are restricted to a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico. Long Island waters have been identified as critical habitat for immature Kemp's ridleys, providing important habitat for development during the early stages of life (2-5 years) (NYSDEC 2008).

Leatherback Sea Turtle

Leatherback sea turtles are the most pelagic of the sea turtles. In the North Atlantic Ocean, leatherback sea turtles are found regularly off the coast of New England and in Long Island, New York, waters. Nesting occurs on the islands of St. Croix, Vieques, and Culebra and on the mid-Atlantic coast of Florida. Recent isolated nestings have been recorded along the southeastern Atlantic coast from Georgia to North Carolina (NYSDEC 2008).

Loggerhead

In the western Atlantic, loggerheads occur from Canada south to Argentina. Loggerheads inhabit warm waters on continental shelves and areas among islands. Estuaries, coastal streams, and salt marshes are preferred habitats. In the western Atlantic, loggerheads nest along the southeastern coast of the United States, with 90% of nests occurring in Florida (NYSDEC 2008).

Shortnose Sturgeon

The shortnose sturgeon is anadramous, migrating from salt water to spawn in freshwater. Shortnose sturgeon spawn in the Hudson River from April to May. Adult sturgeon migrate upriver from their mid-Hudson River overwintering areas to freshwater spawning sites north of Coxsackie. In New York State, the shortnose sturgeon is only found in the lower portion of the Hudson River from the southern tip of Manhattan upriver to the federal dam at Troy (NYSDEC 2008).

Sandplain Gerardia

Six of the 12 known extant populations occur in coastal grassland natural communities on Long Island. The endangered status of this species is attributed primarily to loss of habitat from development and encroachment by invasive exotic competitors (NYSDEC 2008).

Seabeach Amaranth

Seabeach Amaranth is found on sandy beaches of the Atlantic coast, where it grows on shifting sands between dunes and the high-tide mark. Habitat degradation is attributed to the construction of beach stabilization structures that inhibit the natural movement of sand (NYSDEC 2008).

Small Whorled Pogonia

Small whorled pogonia occurs in dry to mesic deciduous or deciduous-coniferous forests, generally in forests with an open understory. Small whorled pogonia was historically known from Central and Eastern New York and Long Island. The NYNHP ranks this species as historical, which indicates that the species has not been seen in New York in at least 20-30 years (Young 2007).

<u>State-Listed Species</u>

Plum Island contains suitable habitat for many of the state-protected species that are listed in Table 3.8.2.1.5-2. State-protected species that are known to occur on Plum Island include the state endangered great egret, which is a recurring breeder on Plum Island. The state-threatened common tern utilizes shoreline habitats on Plum Island as resting habitat. The state-threatened northern harrier utilizes Plum Island for foraging and breeding. State-listed endangered and threatened plants that have been reported from Plum Island include hop sedge (*Cyperus lupulinus* var. *lupulinus*), coastal sedge (*C. polystachyos* var. *texensis*), and spring ladies'-tresses (*Spiranthes vernalis*). Although not protected under state law, additional state species of concern animals that occur on Plum Island include osprey and diamondback terrapin. The osprey is a recurring breeder on Plum Island, and diamondback terrapins are common in and around the freshwater ponds on the island.

3.8.2.2 Construction Consequences

3.8.2.2.1 Vegetation

New construction of approved PIADC upgrades would occur on previously disturbed grounds adjacent to the existing PIADC facility and, therefore, would have no adverse effect on native vegetation or natural communities. Repair or replacement of utility lines would have temporary adverse effects on previously disturbed vegetation within existing utility right-of-ways. Repair or replacement of other utility structures would be restricted to existing developed and/or previously disturbed areas. Therefore, the No Action Alternative would not have adverse effects on native vegetation or natural communities.

3.8.2.2.2 Wetlands

New construction of approved PIADC upgrades would occur on previously disturbed grounds adjacent to the existing PIADC facility. The proposed construction area does not contain wetlands, and no portion of the area falls within a wetland buffer zone. Therefore, new construction would have no adverse effect on wetlands.

Although wetlands in the vicinity of the utility lines have not been delineated, NYSDEC freshwater wetland maps indicate that the existing utility lines do not intersect wetlands or wetland buffer zones. However, portions of the utility lines do intersect NYSDEC check zones, which are areas that should be evaluated for the presence of wetlands. If the current NYSDEC wetland maps are accurate, repair or replacement of utility lines would have no adverse effect on wetlands or buffer zones. However, prior to the initiation of construction, additional investigations should be conducted to determine the exact locations of wetland and buffer zone boundaries in relation to utility lines.

3.8.2.2.3 Aquatic Resources

New construction of approved PIADC upgrades would occur on previously disturbed grounds adjacent to the existing PIADC facility. The waters of Long Island Sound are approximately 300 feet northwest of the proposed construction area, and freshwater ponds occur approximately 1,500 feet to the southeast. Utility lines to be repaired or replaced are located on upland areas. New construction or utility line improvements would not have any direct adverse effect on aquatic resources. Earth disturbance would be minimal, and implementation of an erosion and sedimentation control plan would minimize the potential for indirect adverse effects associated with sediment transport.

3.8.2.2.4 Terrestrial Wildlife

New construction of approved PIADC upgrades would occur on previously disturbed grounds adjacent to the existing PIADC facility and, therefore, would have no direct adverse effect on native wildlife habitat. Construction noise and dust creation could potentially discourage wildlife utilization of habitats that are immediately adjacent to the proposed construction area; however, these effects would subside with completion of the project. Repair or replacement of existing underground utility lines would have minor, temporary adverse effects on previously disturbed wildlife habitat within existing utility easements. Disturbed soils in utility corridors would be rapidly recolonized by the same weedy species that currently occupy these areas. No significant long-term impacts would result from the No Action Alternative.

3.8.2.2.5 Threatened and Endangered Species

New construction of approved PIADC upgrades would occur on previously disturbed grounds adjacent to the existing PIADC facility and, therefore, would have no direct adverse effect on federally or state-listed species. Although piping plover and roseate tern breeding activity has been extremely rare on Plum Island, both species could potentially nest on the island. However, the western shoreline in the vicinity of the PIADC is actively eroding and does not contain suitable nesting habitat for either of these species. Therefore, noise and dust creation from new construction activities would be unlikely to discourage or adversely affect breeding activity. Sea turtles do not come ashore to nest in the northeastern United States. Since these species do not occur on the island, the No Action Alternative would have no adverse effect on sea turtles. The shortnose sturgeon only occurs in the lower Hudson River and would not be affected by the No Action Alternative. Sandplain gerardia and seabeach amaranth are not known to occur on Plum Island. These species occur in grassland natural communities and maritime beach communities. No potential habitat would be affected and, therefore, the No Action Alternative would have no adverse effect on these species. Repair or replacement of existing underground utility lines would have minor, temporary adverse effects on disturbed habitat within existing utility easements and, therefore, would not result in adverse effects on listed species.

3.8.2.3 Operation Consequences

3.8.2.3.1 Vegetation

The No Action Alternative would have no adverse effect on vegetation.

3.8.2.3.2 Wetlands

The No Action Alternative would have no adverse effect on wetlands.

3.8.2.3.3 Aquatic Resources

The No Action Alternative would have no adverse effect on aquatic resources.

3.8.2.3.4 Terrestrial Wildlife

The No Action Alternative would have no adverse effect on wildlife. The current risk of an accidental pathogen release and the associated potential effects on wildlife populations would not be affected by the No Action Alternative.

3.8.2.3.5 Threatened and Endangered Species

The No Action Alternative would have no adverse effect on threatened or endangered species.

3.8.3 South Milledge Avenue Site

3.8.3.1 Affected Environment

3.8.3.1.1 Vegetation

<u>Regional Vegetation</u>

The South Milledge Avenue Site is located in the Piedmont physiographic province (Kramer et. al. 2003). Dominant natural plant communities of the southern Piedmont can be broadly categorized as dry oak-hickory forests, mesic hardwood forests, and floodplain hardwood forests. Dry oak-hickory forests occur on ridgetops, upper portions of slopes, south-facing slopes, and other dry to dry-mesic upland areas. Dominant trees include post oak (*Quercus stellata*), southern red oak (*Q. falcata*), white oak (*Q. alba*), black oak (*Q. velutina*), blackjack oak (*Q. marilandica*), mockernut hickory (*Carya alba*), and pignut hickory (*C. glabra*). Disturbed dry oak-hickory forests have greater numbers of pines and weedy hardwoods such as red maple (*Acer rubrum*) and sweet-gum (*Liquidambar styraciflua*). Typical understory trees and shrubs include sourwood (*Oxydendrum arboreum*), flowering dogwood (*Cornus florida*), blackgum (*Nyssa sylvatica*), and blueberries (*Vaccinium* spp.). The herbaceous stratum is typically sparse in dry oak-hickory communities. Dry sites that were formerly cultivated are typically dominated by even-aged pine stands, and areas that have been heavily logged may have a mixture of hardwoods and pines (Schafale and Weakley 1990).

Mesic hardwood forests occur on lower slopes, steep north-facing slopes, and ravines. The overstory includes mesophytic species such as beech (*Fagus grandifolia*), yellow poplar (*Liriodendron tulipifera*), northern red oak (*Quercus rubra*), red maple, and southern sugar maple (*Acer floridanum*). Disturbed mesic communities typically have pines and greater numbers of weedy hardwoods such as yellow poplar and sweet-gum. Typical understory trees and shrubs include flowering dogwood, hop-hornbeam (*Ostrya virginiana*), red maple, American holly, American strawberry-bush (*Evonymus americana*), and blueberries. Generally, mesic hardwood communities have a herbaceous stratum that is moderately dense and diverse (Schafale and Weakley 1990).

The overstory of larger floodplain forests is dominated by flood-tolerant species such as sweet-gum, yellow poplar, red maple, cherrybark oak (*Quercus pagoda*), swamp chestnut oak (*Q. michauxii*), overcup oak (*Q. lyrata*), willow oak (*Q. phellos*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), swamp cottonwood (*Populus heterophylla*), bitternut hickory (*Carya cordiformis*), and shagbark hickory (*C. ovalis*). Understory trees and shrubs include red maple, southern sugar maple, ironwood (*Carpinus caroliniana*), winged elm (*Ulmus alata*), pawpaw (*Asimina triloba*), hollies (*Ilex* spp.), cane (*Arundinaria gigantea*), and American strawberry-bush. Swamp forests are dominated by the most flood tolerant trees and generally have sparse shrub and herbaceous strata. Bottomland forests are more diverse and usually have a well-developed herbaceous stratum. Alluvial forests of smaller rivers and streams lack the distinct fluvial landforms of larger floodplains. These smaller alluvial communities have a mixture of mesophytic and bottomland species and typically include species such as river birch (*Betula nigra*), sycamore (*Platanus occidentalis*), and box-elder (*Acer negundo*) (Schafale and Weakley 1990).

<u>Site Vegetation</u>

Approximately 80% of the South Milledge Avenue Site consists of fenced pasture that is utilized as a grazing area for livestock. Groundcover within the pasture area is dominated by cultivated forage grasses. Natural forested communities occur on the extreme northwestern, western, and southwestern portions of the property. In addition, a narrow forested ravine extends from the western property boundary into the central portion of the property. Dry-mesic oak-hickory forest is the dominant community type at the proposed NBAF site. Typical overstory species include white oak, southern red oak, water oak, pignut hickory, mockernut hickory, yellow poplar, and sweet-gum. Understory trees and shrubs include beech, flowering dogwood, hop-hornbeam, winged elm, red maple, chalk maple (*Acer leucoderme*), painted buckeye (*Aesculus sylvatica*), and sparkleberry (*Vaccinium arboreum*). The outer edges of the forested areas have been colonized by non-native, invasive species such as Chinese privet (*Ligustrum sinense*), tree of heaven (*Ailanthus altissima*), and Japanese honeysuckle (*Lonicera japonica*). Forests in the ravine and the southwestern corner of the property are inside the pasture fence line, and livestock have compacted soils and eliminated the herbaceous stratum in these areas. Herbaceous species are very sparse to absent in the remaining forested areas, with groundcover consisting primarily of leaf litter.

A first-order tributary of the Middle Oconee River originates within the ravine, and a small (0.01-acre) alluvial hardwood forest community occurs on the narrow floodplain associated with this stream. Overstory trees include red maple, green ash, sweet-gum, water oak, and river birch. Understory trees and shrubs include ironwood, Chinese privet, and hardwood saplings. Scattered herbaceous species include lurid sedge (*Carex lurida*), false nettle, and smartweed (*Polygonum cepitosum*).

<u>Rare and Significant Natural Communities</u>

A review conducted by the Georgia Natural Heritage Program did not identify any rare or significant natural communities at the proposed NBAF site or within a 1-mile radius of the site (GNHP 2008). The Rock and Shoals Outcrop Natural Area is located approximately 2.5 miles east of the proposed NBAF site. Natural Areas are designated and managed by the GDNR for the conservation of rare species and natural communities. Granite outcrops contain thin layers of soil, small depression pools, and seepage areas that contain numerous rare, threatened, and endangered plant species. The Rock and Shoals outcrop contains occurrences of four state-listed plant species. Additional information regarding rare species at this site is provided in Section 3.8.3.1.5.

3.8.3.1.2 Wetlands

Jurisdictional wetlands and waters at the South Milledge Avenue Site were delineated by Nutter and Associates Incorporated (2007b). The area of investigation was expanded to include areas immediately outside of the proposed NBAF site boundary. Jurisdictional wetlands and other waters within the actual boundaries of the proposed NBAF site include a single 0.01-acre wetland area and 1,136 linear feet of streams. The on-site wetland area occurs on the narrow floodplain of a small headwater stream near the western property boundary. Wetland hydrology is driven by a combination of overbank flooding and seepage at the base of the adjacent upland slope. Soils consist of sandy, silt, and clay loams with a low chroma matrix and high chroma mottles. Vegetation consists of an alluvial hardwood forest community (see Section 3.8.3.1.1). Additional jurisdictional wetlands occur just outside the eastern and southeastern property boundaries.

Other jurisdictional waters on the property include three small perennial headwater stream segments, all of which originate within the boundaries of the site. The primary tributary originates in the central portion of the proposed NBAF site and flows west for approximately 575 feet before exiting the property. The primary tributary eventually discharges into the Middle Oconee River approximately 1,700 feet southwest of the proposed NBAF site. An additional tributary originates in the northwestern portion of the property and flows southwest along the property boundary, eventually discharging into the primary tributary just outside the western property boundary. The third segment is a short spur that connects to the northwestern tributary near the western-central property boundary. All of the streams that occur within the site boundaries are small headwater streams with average widths ranging from 2 to 6 feet. Additional jurisdictional waters occur just outside the eastern and southeastern property boundaries. These additional areas are described in the jurisdictional determination report (Nutter and Associates, Inc. 2007b).

Current and historical land use practices at the South Milledge Avenue Site have resulted in degradation of streams and wetlands within the investigation area. Although forested buffers currently exist along the streams, deforestation and soil compaction within the pasture areas has accelerated storm water runoff. As a result, streams at the site exhibit deep-channel incision (downward erosion of the stream channel) and large headcuts (backward erosional migration of the incised channel). Once incised, overbank flooding events are reduced, and groundwater levels adjacent to the stream channel are lowered. Both of these effects can have negative impacts on adjacent wetlands by reducing the input and retention of water.

3.8.3.1.3 Aquatic Resources

The South Milledge Avenue Site is located within the Upper Oconee watershed [Hydrologic Unit Code (HUC) 03070101], which comprises part of the Oconee River basin. The Middle Oconee River joins with the North Oconee River approximately 1.75 miles southeast of the site to form the Oconee River. The Oconee River basin is dominated by a warm-water fishery. Species of recreational importance include largemouth bass (*Micropterus salmoides*), white bass (*Morone chrysops*), crappie (*Pomoxis* spp.), chain pickerel (*Esox niger*), channel catfish (*Ictalurus punctatus*), white catfish (*Ameiurus catus*), and several species of sunfish (*Lepomis* spp.). The diverse fish fauna of the Oconee River basin includes 74 species representing 13 families. Species belonging to the minnow family (*Cyprinidae*) comprise the most diverse group of fishes in the Oconee River basin. Additional families that are represented by large numbers of species include the sunfish family (*Centrarchidae*), catfish family (*Ictaluridae*), and sucker family (*Catostomidae*). Fauna recorded from the Oconee River include 37 amphibians (17 salamanders and 20 frogs), 11 semi-aquatic turtle species, and 7 snake species that are strongly associated with aquatic habitats (Environmental Protection Division 1998). The GDNR has designated the North Oconee River as a high-priority stream for the conservation of aquatic biodiversity (GDNR 2005). The Middle Oconee River contains occurrences of the state-threatened Altamaha shiner (*Cyprinella xaenura*), and the Oconee River between Milledgeville and Dublin supports the healthiest known population of the state endangered robust redhorse sucker (*Moxostoma robustum*). GDNR has documented the occurrence of 65 fish species in the Piedmont portion of the Oconee River basin (GDNR 2005). Merrill (2001) conducted sampling of five wadeable streams in the Middle

Oconee River watershed, which resulted in the collection of 22 fish species (Table 3.8.3.1.3-1). Mussels identified by Wharton (1978) as occurring in the Oconee River basin are listed in Table 3.8.3.1.3-2.

Table 3.8.3.1.3-1 — Fish Species Collected by Merrill (2001) at Five Sampling Stations in the Middle Oconee Watershed

Scientific Name	Common Name
Ameiurus brunneus	Snail bullhead
Ameiurus platycephalus	Flat bullhead
Campostoma pauciradii	Bluefin stoneroller
Cyprinella callisema	Ocmulgee shiner
Cyprinella xaenura	Altamaha shiner
Esox niger	Chain pickerel
Etheostoma inscriptum	Turquoise darter
Hybopsis rubrifrons	Rosyface chub
Hypentelium nigricans	Northern hogsucker
Lepomis auritus	Redbreast sunfish
Lepomis cyanellus	Green sunfish
Lepomis macrochirus	Bluegill
Micropterus salmoides	Largemouth bass
Moxostoma collapsum	V-lip redhorse
Nocomis leptocephalus	Bluehead chub
Notropis cummingsae	Dusky shiner
Notropis hudsonius	Spottail shiner
Notropis lutipinnis	Yellowfin shiner
Noturus insignis	Margined madtom
Percina nigrofasciata	Blackbanded darter
Scartomyzon rupiscartes	Striped jumprock
Semotilus atromaculatus	Creek chub

All of the streams that occur within the site boundaries are small headwater streams with average widths ranging from 2 to 6 feet. These streams have moderate sinuosity and coarse sand, gravel, and cobble substrate. Accelerated runoff from the adjacent pasture areas has resulted in channel incision (downward erosion of the stream channel) and headcuts (backward erosional migration of the incised channel). Although impacted by erosion and sedimentation, these streams have retained riffle and pool habitats that are likely to support occurrences of many common aquatic species that are typically associated with small headwater streams of the Georgia Piedmont.

Table 3.8.3.1.3-2 — Mussels of the Oconee River (Wharton 1978)

Scientific Name	Common Name
Villosa delumbis	Eastern creekshell
Elliptio complanata	Eastern elliptio
Elliptio hopetonensis	Altamaha slabshell
Elliptio lanceolata	Yellow lance
Elliptio icterina	Variable spike
Lampsilis splendida	Rayed pink fatmucket
Uniomerus tetralasmus	Pondhorn

3.8.3.1.4 Terrestrial Wildlife

The Georgia GAP has developed models that predict the statewide distribution of terrestrial vertebrate species that are known to breed in Georgia (Kramer et. al. 2003). Flaute et al. (2005) used Georgia GAP data to predict species occurrences in the Clarke County area. The resulting Clarke County list of potential breeding species includes 44 mammals, 110 birds, 41 reptiles, and 27 amphibians. Non-breeding species that occur in Georgia consist primarily of over-wintering or transient migratory bird species. The list of all birds reported from Georgia includes over 400 species (GOS 2007).

Audubon has officially recognized the State Botanical Garden and Whitehall Forest as an IBA. The IBA program identifies areas that are essential for bird conservation. The State Botanical Garden and Whitehall Forest are important to many species of high conservation priority in Georgia. Significant numbers of land birds, particularly woodpeckers and neotropical migrants such as warblers, vireos, and thrushes, use this area for breeding, winter habitat, and spring and fall migration (Audubon 2008). The proposed NBAF site is located between the State Botanical Garden and Whitehall Forest. The State Botanical Garden adjoins the northwestern boundary of the proposed NBAF site, and Whitehall Forest is located west of the proposed NBAF site on the opposite side of Whitehall Road. The State Botanical Garden and Whitehall Forest are connected by a forested riparian corridor along the Middle Oconee River. This connecting corridor, which is located on the proposed NBAF site, provides an important link between the two IBA properties.

As described in Section 3.8.3.1.1, habitats at the South Milledge Avenue Site include pasture, dry-mesic hardwood forest, alluvial hardwood forest, and small headwater streams. Relatively dense forest edge habitats also contribute to habitat diversity at the site. Approximately 80% of the South Milledge Avenue Site is composed of highly disturbed pastures that do not contain native natural plant communities. Pasture areas are dominated by cultivated forage grasses, which are actively grazed by livestock. Due to their disturbed condition, lack of native vegetation, and lack of wildlife food and cover, the pasture areas have limited wildlife habitat value. Consequently, wildlife utilization of the pasture areas is most likely limited to a relatively low number of generalist species that have adapted to highly disturbed environments. However, remaining portions of the site contain valuable wildlife habitat consisting of dry-mesic forested uplands, forest edge habitats, a small area of alluvial forest, and small streams. These natural habitats represent potential habitat for many of the common species that are predicted to occur in the Clarke County area. Hard mast–producing trees (e.g., oaks/hickories) and soft mast-producing shrubs (e.g., sparkleberry) in the forested areas provide a valuable food source for wildlife. In addition, forested areas along the Middle Oconee River represent an important dispersal corridor and refuge for wildlife within the more developed portions of Clarke County.

Many of the species not covered by the Georgia GAP consist of migratory waterfowl. Athens is located within the Atlantic flyway migratory bird route, and area reservoirs serve as important resting areas for migrating waterfowl. Farm ponds may occasionally be used as resting habitat by migratory waterfowl. Most reservoirs and farm ponds are too deep for the amount of food production that is required to hold waterfowl over the winter. During the fall and winter, beaver ponds are used extensively by migrating and wintering wood ducks (*Aix sponsa*), mallards (*Anas platyrhynchos*), and teal (*Anas* spp.), and these wetlands provide valuable nesting sites for resident wood ducks during the breeding season (Balkcom et al.). A small farm pond and a complex of three small beaver ponds are located just outside of the South Milledge Avenue Site boundary. Migratory waterfowl may occasionally use these areas as resting habitat, and resident wood ducks could potentially use these areas during the breeding season. There are no managed waterfowl impoundments or extensive shallow water wetlands that would hold large numbers of waterfowl in the vicinity of the proposed NBAF site.

The distribution of ungulate populations has particular relevance, since they are susceptible to many of the diseases that may be studied at the proposed NBAF. Ungulates that occur in Georgia include white-tailed deer (*Odocoileus virginianus*) and wild boar (*Sus scrofa*). The white-tailed deer is a common species throughout Georgia, and this species is likely to occur in forested habitats at the South Milledge Avenue Site. The wild boar is widely distributed in the northern mountain and southern Coastal Plain regions of Georgia; however, the Georgia GAP predicted distribution does not include Clarke County (Kramer et. al. 2003). The predicted Georgia GAP distribution does include northwestern Jackson County approximately 25 miles northwest of the South Milledge Avenue Site. The wild boar is a non-native invasive species with the potential to negatively impact natural communities and native species. Consequently, Georgia conservation priorities include controlling wild boar populations to conserve high-priority habitats and species (GDNR 2005).

3.8.3.1.5 Threatened and Endangered Species

Federally listed status species that are known to occur in Clarke County include the federally endangered gray bat (*Myotis grisescens*) and the federal candidate Georgia aster (*Symphyotrichum georgianum*). Additional animal and plant species that are listed by the state as endangered, threatened, rare, or unusual are protected under the *Endangered Wildlife Act* of 1973 (O.C.G.A. §27-3-130) and the *Wildflower Preservation Act* of 1973 (O.C.G.A. § 12-6-170). In addition to the federally listed species mentioned above, Georgia Natural Heritage Program (GNHP) occurrence records for Clarke County include five species that are listed by the state as endangered, threatened, or rare (Table 3.8.3.1.5-1). Additional GNHP records for Clarke County include three special concern species that are not listed or protected by the state (Table 3.8.3.1.5-1).

GNHP is responsible for tracking occurrences of both federally and state-listed species within the State of Georgia. A database review conducted by GNHP did not identify any occurrences of rare, threatened, or endangered species at the proposed NBAF site or within a 1-mile radius of the site (GNHP 2008). However, occurrences of seven protected species were identified within a 3-mile radius of the proposed NBAF site (Table 3.8.3.1.5-2). These occurrences include four state-listed plants that are endemic to granite outcrops. These outcrop endemics occur at the Rock and Shoals Outcrop Natural Area approximately 2.5 miles east of the proposed NBAF site. Clarke County records include three occurrences of the state-listed Altamaha shiner (*Cyprinella xaenura*) within a 3-mile radius of the proposed NBAF site. Specific Altamaha shiner sites include the Oconee River 1 mile northeast of the proposed NBAF site, the Oconee River 2 miles southeast of the proposed NBAF site, and the Middle Oconee River 1 mile northwest of the proposed NBAF site. Additional occurrences of protected species within a 3-mile radius include the federal candidate Georgia aster at a location approximately 3 miles northeast of the site and the state-listed broadleaf bunchflower (*Melanthium latifolium*) from an unknown location in the vicinity of the proposed NBAF.

Table 3.8.3.1.5-1 — Athens-Clarke County Endangered, Threatened, and Rare Species

Scientific Name	Common Name	Federal[a] Status	State[b] Status	Habitat	Habitat Present at NBAF Site
Vertebrates					
Myotis grisescens	Gray bat	E	E	Caves with flowing water	No
Myotis austroriparius	Southeastern myotis	-	-	Caves and buildings near water	No
Cyprinella xaenura	Altamaha shiner	-	T	Medium-sized streams in runs or pools over sand to gravel substrate	No
Plants					
Anemone berlandieri	Glade windflower	-	-	Granite outcrop ecotones; openings over basic rock	No
Draba aprica	Sun-loving draba	-	E	Granite and amphibolite outcrops, usually in red cedar litter	No
Eriocaulon koernickianum	Dwarf hatpins	-	E	Granite outcrops	No
Melanthium latifolium	Broadleaf bunchflower	-	-	Mesic deciduous hardwood forests	Yes
Nestronia umbellula	Indian olive	-	R	Mixed with dwarf shrubby heaths in oak-hickory-pine woods; often in transition areas between flatwoods and uplands	Yes
Sedum pusillum	Granite stonecrop	-	T	Granite outcrops, often in mats of Hedwigia moss under *Juniperus virginiana*	No
Symphyotrichum georgianum	Georgia aster	C	T	Upland oak-hickory-pine forests and openings; sometimes with *Echinacea laevigata* or over amphibolite	Marginal

[a]Federal Status: E = Endangered, C = Candidate, FSC = Federal Species of Concern.
[b]State Status: E = Endangered, T = Threatened, R = Rare.

As described in Section 3.8.3.1.1, approximately 80% of the South Milledge Avenue Site is composed of highly disturbed, actively grazed pasture. Natural forested communities occupy the extreme northwestern, western, and southwestern portions of the property. Forested habitats are composed primarily of dry-mesic to mesic hardwood forests, with the addition of a small (0.01-acre) area of alluvial hardwood forest. Aquatic habitats include two perennial first-order streams within the forested areas.

Federally Listed Species

Gray Bat

Gray bats are strongly cave dependant and use caves or cave-like habitats for both winter hibernation and summer roosting. Winter roosting sites in Georgia include caves in the northwestern corner of the state and an isolated location in a tunnel beneath Sanford Stadium on the UGA campus. Summer roosting sites are typically caves. Summer roosting sites in Georgia include two caves in the northwestern corner of the state (Menzel et al. 2000). The Georgia GAP predicted breeding distribution is limited to the extreme northwestern corner of the state and does not include Clarke County (Kramer et al. 2003). The roosting site beneath Sanford Stadium is approximately 3.5 miles north of the proposed NBAF site. No suitable roosting sites are present at the South Milledge Avenue Site; however, gray bats could potentially forage over the Middle Oconee River to the south of the South Milledge Avenue Site.

Georgia Aster

Georgia aster is known to occur in habitats that include dry, rocky woodlands; woodland borders; roadbanks; powerline right-of-ways; and thin soils around granite flatrocks. It is found primarily in dry habitats that formerly would have burned and likely would have been post oak, blackjack oak woodlands, or savannas (Weakley 2007). Although the South Milledge Avenue Site contains extensive woodland borders, the woodlands that occur at the site are composed of dry-mesic to mesic hardwood communities. The forested areas do not contain any relict post oaks, blackjack oaks, or other species that are indicative of more xeric hardwood communities. In addition, this species was not observed during a floristic survey of the proposed project area.

State-Listed Species

Habitat for the Altamaha shiner consists of medium-sized streams in runs or pools over sand to gravel substrate (GNHP 2008). Streams that occur within the boundaries of the South Milledge Avenue Site are small headwater streams that have average widths ranging from 2 to 6 feet. These streams have moderate sinuosity and coarse sand, gravel, and cobble substrate. Accelerated runoff from the adjacent pasture areas has resulted in channel incision and the formation of headcuts. Based on the small size of these streams and the history of disturbance, the Altamaha shiner is not likely to occur within the project area. However, project area streams drain to the Middle Oconee River, which does contain suitable habitat for this species.

Suitable habitat for two state-listed plant species, broadleaf bunchflower and nestronia (*Nestronia umbellula*), may occur on forested slopes at the South Milledge Avenue Site. However, these species were not observed during a floristic survey of the project area. The South Milledge Avenue Site does not contain suitable habitat for any of the other state-listed species that are known to occur in Clarke County (Table 3.8.3.1.5-1).

3.8.3.2 Construction Consequences

3.8.3.2.1 Vegetation

Construction of the proposed NBAF would affect approximately 30 acres of land at the South Milledge Avenue Site. Under the current conceptual design plan, earth-disturbing activities would be restricted almost entirely to the pasture areas. The only exception would be construction of a fence and security road that would transect the upper portion of the forested ravine. The perimeter road and fence would affect approximately 0.2 acre of dry-mesic oak hickory forest and approximately 50 linear feet of stream. The ravine is inside the existing fence line, and the oak-hickory forest has been heavily impacted by grazing livestock. Livestock have compacted the soils and eliminated the understory strata. Based on the small area of impact and the degraded condition of the community, adverse affects on vegetation would not be significant. Off-site connected actions involving the installation of new potable water, sewer, and electrical lines would occur within existing, disturbed right-of-ways and, therefore, would not have any significant impacts on vegetation.

Potential indirect effects during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, natural communities that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on vegetation.

3.8.3.2.2 Wetlands

Earth-disturbing activities would be restricted almost entirely to upland pasture areas; and therefore, would have minimal direct impacts on streams and wetlands. The only exception would be construction of a security fence and road that would cross a stream in the upper portion of the forested ravine. Under the current conceptual design plan, the road and fence would affect approximately 50 linear feet of stream, as well as the buffer zone on either side of the stream. If the final design does not incorporate additional avoidance measures, the project could require a Section 404 permit from the USACE, a Section 401 Certification from the state, and a buffer variance from Clarke County.

Potential indirect impacts during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, wetlands and streams that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. The requirement for an approved erosion and sedimentation control plan would minimize the potential for sedimentation impacts.

3.8.3.2.3 Aquatic Resources

Earth-disturbing activities would be restricted almost entirely to upland pasture areas; and therefore, would have minimal direct impacts on streams or aquatic resources. The only exception would be construction of a perimeter security fence and road that would cross a stream in the upper portion of the forested ravine. Under the current conceptual design plan, the road and fence would directly imapact approximately 50 linear feet of stream, as well as the buffer zone on either side of the stream. The perimeter road and fence would have minor adverse effects on aquatic resources. Aquatic organisms would be displaced from approximately 50 linear feet of stream. However, a properly designed road crossing or bridge should have little or no effect on downstream aquatic resources.

Potential indirect effects would include erosion and sedimentation during the construction process. Removal of vegetation and soil disturbance within the proposed construction area would expose soils to potential erosion during storm events. Sediments that are transported into stream channels can degrade water quality by increasing turbidity. The deposition of sediments in stream channels can impact aquatic communities through the homogenization of habitat. The requirement for an approved erosion and sedimentation control plan would minimize the potential for sedimentation impacts.

3.8.3.2.4 Terrestrial Wildlife

Construction of the proposed NBAF would permanently impact approximately 30 acres of actively grazed pasture that is dominated by cultivated forage grasses. Due to their disturbed condition, lack of native vegetation, and lack of wildlife food and cover, the pasture areas have limited wildlife habitat value. The loss of pasture habitat would affect a relatively low number of generalist species that are adapted to a wide range of habitats. The perimeter road and fence would affect approximately 0.2 acre of dry-mesic oak hickory forest and approximately 50 linear feet of stream. The affected area is inside the existing fence line, and the forest has been heavily impacted by grazing livestock. The forested area has reduced wildlife value due to compacted soils and the absence of understory strata. Based on the small area of impact and the degraded condition of the community, adverse affects on vegetation would not be significant. Land-clearing activities, construction noise, and dust creation would likely discourage wildlife utilization of habitats that are adjacent to the proposed construction area; however, these impacts would subside with completion of the project. Construction of the proposed NBAF would not result in significant direct impacts on native terrestrial wildlife.

Construction would have no direct effect on the State Botanical Garden/Whitehall Forest IBA. The forested riparian corridor that connects Whitehall Forest with the State Botanical Garden would be preserved and, therefore, construction would not result in habitat fragmentation or disruption of wildlife dispersal.

Construction of a fence and security road would have minor impacts on forested habitats that are immediately adjacent to pasture areas. Since the forested portion of the proposed NBAF site will be minimally affected, no significant impacts on the State Botanical Garden/Whitehall Forest IBA are likely to occur.

3.8.3.2.5 Threatened and Endangered Species

Informal Section 7 consultation has been initiated with the USFWS Georgia Field Office. A database review conducted by GNHP did not identify any known occurrences of rare, threatened, or endangered species at the proposed NBAF site or within a 1-mile radius of the site. Earth-disturbing activities would be restricted primarily to the existing pasture areas. The perimeter road and fence would affect approximately 0.2 acre of degraded dry-mesic oak hickory forest and approximately 50 linear feet of stream. The affected forested area does not represent suitable habitat for any rare, threatened or endangered species. Therefore, construction would have no direct impact on protected species or potential habitat.

Soil disturbance during the construction process would expose soils to potential erosion. Erosion and subsequent sedimentation in stream channels have the potential for adverse impacts on aquatic organisms. Although the state-threatened Altamaha shiner is not likely to occur in the small streams of the project area, it is known to occur in the Middle Oconee River. Therefore, any increase in sediment transport could have an adverse effect on this species. However, erosion and sedimentation control measures would minimize the potential for such impacts.

3.8.3.3 Operation Consequences

3.8.3.3.1 Vegetation

Operation of the proposed NBAF would have no direct effects on native vegetation or natural communities. Indirect effects on riparian vegetation can result from increases in storm water runoff. The proposed NBAF would create 270,000 square feet of impervious surface area, which would result in 22,500 cubic feet of runoff during a 1-inch rainfall event. Increases in stream flow volume and velocity can cause stream channel incision and/or widening, resulting in the loss of adjacent terrestrial vegetation and alteration of the hydrological regime within adjacent plant communities. Storm water management systems would be designed in accordance with applicable storm water BMPs. In addition to meeting the minimum state requirements for storm water management, the proposed NBAF would employ a LID approach that would minimize storm water runoff (see Section 3.7.3.3.2). The use of LID development techniques and BMPs would mitigate most of the potential adverse effects on stream channels and adjacent terrestrial vegetation.

Plant diseases would not be studied at the NBAF; and therefore, there is no known potential for direct adverse effects on local flora or the State Botanical Garden. The accidental release of a mosquito-borne pathogen could trigger aerial spraying of insecticides, which could affect insect pollinators. The loss of insect pollinators in the immediate vicinity of the NBAF could have a short-term adverse effect on some species of flowering plants, including those at the State Botanical Garden.

3.8.3.3.2 Wetlands

Operations at the proposed NBAF would have no direct impacts on wetlands; however, increases in impervious surface area and storm water runoff have the potential for indirect wetland impacts. Potential impacts from storm water runoff would be similar to those described in Section 3.8.3.3.1.

3.8.3.3.3 Aquatic Resources

Operations at the proposed NBAF would have no direct effects on aquatic communities; however, increases in impervious surface area and storm water runoff have the potential for indirect impacts on water quality and aquatic communities. Storm water runoff from impervious surfaces such as buildings and parking lots can transport pollutants such as automotive fluids, fertilizer, pesticides, bacteria, and heavy metals into surface waters. Furthermore, rapid runoff from impervious surface areas increases the rate of flow in receiving streams. Increases in stream flow volume and velocity can cause stream channel erosion, resulting in increased turbidity and sedimentation downstream. However, the storm water management measures described in Section 3.8.3.3.1 would mitigate most of the potential adverse effects on aquatic resources.

3.8.3.3.4 Terrestrial Wildlife

Section 3.5.5.3 addresses operational noise impacts associated with the proposed NBAF. Minor noise impacts would result from an increase in traffic and operation of the facility’s filtration, heating, and cooling systems. Section 3.5.5.3 describes noise-attenuating design features that would minimize noise emissions. In the event of a power outage, operation of back-up generators could have a short-term impact on wildlife by discouraging utilization of immediately adjacent habitats. Routine operations at the NBAF would not be likely to have significant noise impacts on wildlife. Security requirements at the proposed NBAF would require continuous outdoor nighttime lighting. Nighttime lighting has the potential to impact wildlife through astronomical and ecological light pollution. Unshielded lighting can shine upward and interfere with bird migration, disorienting birds and causing them to collide with structures. Birds are attracted to lights and may collide with lighted structures. Most concerns involve lighting associated with high-rise buildings and telecommunication towers; however, even residential lighting can affect some birds. The USFWS advocates the use of shielded lighting to minimize adverse impacts on migratory birds. Shielded fixtures direct light downwards and can be used to keep light within the boundaries of the site. Artificial lighting also has the potential for ecological effects such as repulsion and/or interference with foraging behavior. The NBAF would employ the minimum intensity of lighting that is necessary to provide adequate security. Mitigation measures, such as those described above, will be considered in the final design of the NBAF. The use of shielded lighting would minimize the potential for impacts in adjacent habitats. Given the relatively low profile of the building and the use of shielded lighting, significant impacts on migratory birds would not be likely to occur. The accidental or intentional release of a pathogen would have the potential for adverse effects on native mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on wildlife.

3.8.3.3.5 Threatened and Endangered Species

Normal operations would have no direct effect on threatened and endangered species; however, the accidental or intentional release of a pathogen would have the potential for adverse effects on mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on native wildlife and endangered species. The gray bat is the only listed mammal that occurs in Clarke County. There is no evidence that bats would be susceptible to the diseases that could be studied at the proposed NBAF (see Section 3.8.9). Therefore, operations would not be likely to have adverse effects on listed species that occur in the vicinity of the proposed NBAF site.

3.8.4 Manhattan Campus Site

3.8.4.1 Affected Environment

3.8.4.1.1 Vegetation

<u>Regional Vegetation</u>

The Manhattan Campus Site is located in the Flint Hills Uplands physiographic region (Cully et al. 2002). Natural vegetation of the Flint Hills region is dominated by communities and species associated with the tallgrass prairie ecosystem. Tallgrass prairie once occupied an estimated 400,000 square miles and covered much of the midwestern United States; however, it is now nearly extinct with less than 4% of the ecosystem remaining nationwide. Historically, the structure and composition of natural tallgrass prairie communities were maintained by a combination of grazing, fire, and climate. Land use conversion to row crop agriculture has eliminated most of the tallgrass prairie ecosystem; however, the predominance of shallow, rocky soils in the Flint Hills region has discouraged row crop agriculture, thereby preserving significant remnants of the ecosystem in this region (NPS 2000).

The Konza Prairie Preserve, which is located approximately 6 miles south of the proposed NBAF site, contains natural communities that are representative of the Flint Hills region. Tallgrass prairies at the Konza Prairie Preserve are dominated by big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), and switch grass (*Panicum virgatum*), along with a diverse mixture of other graminoids and forbs. Shrubs that are locally common within the tallgrass prairie include lead plant (*Amorpha canescens*), rough-leaved dogwood (*Cornus drummondii*), smooth sumac (*Rhus glabra*), fragrant sumac (*Rhus aromatica*), and prairie wild rose (*Rosa arkansana*). Deciduous forest communities occur in bands along the margins of streams and rivers. Dominant tree species include bur oak (*Quercus macrocarpa*), chinquapin oak (*Q. muehlenbergii*), hackberry (*Celtis occidentalis*), and American elm (*Ulmus americana*). Although poorly represented, wetland communities are associated with intermittent and perennial streams, springs, and seepage areas on slopes. These wetland communities are dominated by a diverse mixture of hydrophytic herbaceous species (Freeman 1998).

<u>Site Vegetation</u>

The Manhattan Campus Site is located in a highly disturbed area that does not contain native natural communities. Most of site is covered by buildings, livestock pens, and livestock holding areas. The site is currently used by the Kansas State University (KSU) College of Veterinary Medicine and Department of Animal Science for provisional cattle grazing, animal care, and research. Vegetation at the site consists primarily of cultivated forage grasses and early successional weeds. This herbaceous assemblage is dominated by smooth brome (*Bromus inermis*), a non-native forage grass that has been planted around the facilities. Interspersed within the smooth brome are numerous non-native annual species that are characteristic of highly disturbed sites [e.g., bristle grass (*Setaria viridis*), hairy crab grass (*Digitaria sanguinalis*), and rough pigweed (*Amaranthus retroflexus*)]. Other early-successional annual herbaceous species that are abundant at the site include horseweed (*Conyza canadensis*), annual ragweed (*Ambrosia artemisiifolia*), snow-on-the-mountain (*Euphorbia marginata*), and buffalo-bur nightshade (*Solanum rostratum*). In lowlying areas, several non-native Siberian elm (*Ulmus pumila*) trees are established, with the shaded areas dominated by Kentucky bluegrass (*Poa pratensis*), poison-hemlock (*Conium maculatum*), and Japanese brome (*Bromus japonicus*). Numerous other non-native species are also prevalent [e.g., dandelion (*Taraxacum officinale*), musk-thistle (*Carduus nutans*), and curly dock (*Rumex crispus*)]. The portion of the property to the east of Serum Plant Road is occupied by native and non-native woody species such as Siberian elm, eastern red-cedar (*Juniperus virginiana*), honey locust (*Gleditsia triocanthos*), cottonwood (*Populus deltoides*), and amur honeysuckle (*Lonicera maackii*). The understory vegetation is composed predominantly of annual and biennial species such as bristle grass, annual ragweed, annual sunflower (*Helianthus annuus*), and woolly mullein (*Verbascum thapsus*).

<u>Rare and Significant Natural Communities</u>

A review conducted by the Kansas Natural Heritage Inventory did not identify any sensitive or rare natural communities at the Manhattan Campus Site or within a 1-mile radius of the site. As described above, the Manhattan Campus Site is located in a heavily disturbed area that lacks native natural communities.

3.8.4.1.2 Wetlands

An on-site wetland evaluation of the Manhattan Campus Site was conducted by Dial Cordy and Associates, Inc., on November 6, 2007. No jurisdictional surface water bodies, streams, or wetlands were observed on or immediately adjacent to the proposed NBAF site. In addition, a botanical survey conducted by KSU grassland biologist Dr. Gene Towne on November 27, 2007 found no hydrophytic vegetation or other evidence of wetlands or intermittently wet areas at the site. The nearest jurisdictional feature is Campus Creek, which originates approximately 1,500 feet south of the proposed NBAF site. NWI maps do not show any wetlands along the KSU portion of Campus Creek.

3.8.4.1.3 Aquatic Resources

The Manhattan Campus Site is located within the Upper Kansas watershed (Hydrologic Unit Code 10270101), which comprises part of the Kansas-Lower Republican River basin. Sampling conducted by the Kansas Department of Wildlife and Parks (KDWP) from 1994 to 2004 identified 50 fish species (Table 3.8.4.1.3-1) and 16 mussel species (Table 3.8.4.1.3-2) within the Upper Kansas watershed (KDWP 2006). The KDWP uses an Index of Biological Integrity (IBI) to rate the stability of fish communities as either “good,” “fair,” or “poor.” IBI values for the 20 Upper Kansas watershed sampling stations indicate “good” fish community stability at 18 of the sites and “fair” stability at the remaining 2 sites. The KDWP also uses a Macroinvertebrate Biotic Index (MBI) as an indicator of water quality. The overall MBI value for the Upper Kansas watershed indicates that it is highly impacted by nutrient and oxygen demanding pollutants (KDWP 2006).

Table 3.8.4.1.3-1 — Fish Species Collected in the Upper Kansas Watershed (KDWP 2006)

Scientific Name	Common Name	Scientific Name	Common Name
Ameiurus melas	Black bullhead	*Lythrurus umbratilis*	Redfin shiner
Ameiurus natalis	Yellow bullhead	*Micropterus punctulatus*	Spotted bass
Aplodinotus grunniens	Freshwater drum	*Micropterus salmoides*	Largemouth bass
Campostoma anomalum	Central stoneroller	*Morone chrysops*	White bass
Carpiodes carpio	River carpsucker	*Moxostoma erythrurum*	Golden redhorse
Carpiodes cyprinus	Quillback	*Moxostoma macrolepidotum*	Shorthead redhorse
Catostomus commersonii	White sucker	*Notropis atherinoides*	Emerald shiner
Cycleptus elongatus	Blue sucker	*Notropis percobromus*	Carmine shiner
Cyprinella lutrensis	Red shiner	*Notropis rubellus*	Rosyface shiner
Cyprinus carpio	Common carp	*Notropis stramineus*	Sand shiner
Dorosoma cepedianum	Gizzard shad	*Notropis topeka*	Topeka shiner
Etheostoma nigrum	Johnny darter	*Noturus exilis*	Slender madtom
Etheostoma spectabile	Orangethroat darter	*Noturus flavus*	Stonecat
Extrarius aestivalis	Speckled chub	*Percina caprodes*	Logperch
Gambusia affinis	Western mosquitofish	*Percina phoxocephala*	Slenderhead darter
Ictalurus furcatus	Blue catfish	*Phenacobius mirabilis*	Suckermouth minnow
Ictalurus punctatus	Channel catfish	*Phoxinus erythrogaster*	Southern redbelly dace
Ictiobus bubalus	Smallmouth buffalo	*Pimephales notatus*	Bluntnose minnow
Ictiobus niger	Black buffalo	*Pimephales promela*	Fathead minnow
Lepisosteus osseus	Longnose gar	*Pimephales vigilax*	Bullhead minnow
Lepisosteus platostomus	Shortnose gar	*Pomoxis annularis*	White crappie
Lepomis cyanellus	Green sunfish	*Pylodictus olivaris*	Flathead catfish
Lepomis macrochirus	Bluegill	*Scaphirhynchus platorynchus*	Shovelnose sturgeon
Lepomis megalotis	Longear sunfish	*Semotilus atromaculatus*	Creek chub
Luxilus cornutus	Common shiner		

No water bodies or aquatic habitats are present within the boundaries of the Manhattan Campus Site. Surface water runoff from the site travels south towards Campus Creek, which originates approximately 1,500 feet to the south. Campus Creek flows southeast through the KSU campus for approximately 4,500 feet, before turning east towards the Big Blue River. Campus Creek discharges into the Big Blue River approximately 2.5 miles east of the proposed NBAF site. The Big Blue River flows south and discharges into the Kansas River approximately 3 miles southeast of the proposed NBAF site.

Table 3.8.4.1.3-2 — Mussel Species Collected in the Upper Kansas Watershed (KDWP 2006)

Scientific Name	Common Name
Amblema plicata	Threeridge
Corbicula fluminea	Asian clam
Fusconaia flava	Wabash pigtoe
Lasmigona complanata	White heelsplitter
Leptodea fragilis	Fragile papershell
Ligumia subrostrata	Pondmussel
Obovaria olivaria	Hickorynut
Potamilus ohiensis	Pink papershell
Pyganodon grandis	Giant floater
Quadrula pustulosa	Pimpleback
Quadrula quadrula	Mapleleaf
Sphaeriidae	Fingernail clam
Strophitus undulatus	Creeper
Toxolasma parvus	Lilliput
Tritogonia verrucosa	Pistolgrip
Uniomerus tetralasmus	Pondhorn

3.8.4.1.4 Terrestrial Wildlife

The Kansas GAP has developed models that predict the statewide distribution of terrestrial vertebrate species that are known to breed in Kansas. The Kansas GAP list of breeding species for the Flint Hills Uplands physiographic province includes 59 mammals, 162 birds, 63 reptiles, and 19 amphibians (Cully et al. 2002). Non-breeding species that occur in Kansas consist primarily of migratory birds that occur only during the non-breeding season. The list of all birds reported from Kansas includes 467 species (KOS 2007).

Major wildlife preservation and management areas in the vicinity of the proposed NBAF site include the Tuttle Creek Wildlife Management Area (approximately 5 miles north of the proposed NBAF site) and the Konza Prairie Preserve (approximately 6 miles to the south of the proposed NBAF site). Wildlife habitats at the Konza Prairie Preserve are representative of natural tallgrass prairie habitats that occur in the Flint Hills region. The fauna of the Konza prairie includes 36 species of mammals, 208 species of birds, and 34 species of reptiles and amphibians. Manhattan is located within the Central Flyway migratory bird route, and large flocks of waterfowl and shorebirds utilize the Tuttle Creek Lake Wildlife Management Area during migration periods.

As described in Section 3.8.4.1.1, the proposed Manhattan Campus Site is located in a highly disturbed area that lacks native natural plant communities. Vegetated portions of the property are dominated by smooth brome, a non-native species that has been planted as a forage grass. The area is used for cattle grazing; and no native plant communities, wetlands, or aquatic habitats occur on the property. Generally, domestic perennial forage grasses that are used in Kansas are of low value to wildlife (KDWP 2004). Due to its disturbed condition, lack of native vegetation and lack of wildlife food and cover, the Manhattan Campus Site has very limited wildlife habitat value. Consequently, wildlife utilization is most likely limited to a relatively low number of generalist species that have adapted to highly disturbed environments. Mammals that may occur at the proposed NBAF site include Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), northern raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), red fox (*Vulpes vulpes*), house mouse (*Mus musculus*), deer mouse (*Peromyscus maniculatus*), Norway rat (*Rattus norvegicus*), eastern mole (*Scalopus aquaticus*), northern short-tailed shrew (*Blarina brevicauda*), and meadow vole

(*Microtus pennsylvanicus*). Birds that may occur at the proposed NBAF site include killdeer (*Charadrius vociferous*), rock pigeon (*Columba livia*), mourning dove (*Zenaida macroura*), northern flicker (*Colaptes auratus*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), black-capped chickadee (*Poecile atricapillus*), tufted titmouse (*Baeolophus bicolor*), American robin (*Turdus migratorius*), northern mockingbird (*Mimus polyglottus*), European starling (*Sturnus vulgaris*), northern cardinal (*Cardinalis cardinalis*), common grackle (*Quiscalus quiscula*), house finch (*Carpodacus mexicanus*), and house sparrow (*Passer domesticus*). Reptiles and amphibians that may occur at the proposed NBAF site include the common garter snake (*Thamnophis sirtalis*), lined snake (*Tropidoclonion lineatum*), black rat snake (*Elaphe obsoleta*), woodhouse's toad (*Bufo woodhousii*), and American toad (*Bufo americanus*).

The distribution of ungulate populations has particular relevance, since they are susceptible to many of the diseases that may be studied at the proposed NBAF. Ungulates that occur in Kansas include white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), bison (*Bison bison*), elk (*Cervus elaphus*), and wild boar (*Sus scrofa*). The Kansas GAP predicted distribution of white-tailed deer includes nearly all of Kansas, and its recorded distribution includes Riley County. The Kansas GAP predicted distribution for mule deer includes the western half of the state and a small outlying area centered on Riley County, and its recorded distribution includes Riley County. The Kansas GAP predicted distribution of pronghorn includes the western third of Kansas and a multi-county area in the vicinity of the Tallgrass Prairie National Preserve approximately 50 miles south of Manhattan. The recorded distribution of pronghorn includes Chase and Lyon counties approximately 50 miles south of Manhattan. The Kansas GAP program does not predict the distributions of bison or elk, as these species are considered to be extirpated and reintroduced, respectively (Cully et al. 2002). Captive herds of bison occur 6 miles south of Manhattan at the Konza Prairie Preserve and at additional scattered locations throughout Kansas. In 1981, a free-ranging herd of elk was reestablished on the Cimarron National Grassland in the extreme southwestern corner of the state; however, most animals migrated to adjacent states, and only a few elk currently remain (Fort Riley 2008). Fort Riley currently has a reintroduced, free-ranging elk herd that currently numbers 100 to 150 animals. An isolated population of wild boar was discovered on Fort Riley in 1993. However, it appears that vigorous control efforts have substantially reduced the size of this population (Fort Riley 2001). An additional isolated population of wild boar has been reported from south-central Kansas (Sweeny et al. 2003). The wild boar is a non-native invasive species with the potential to negatively impact natural communities and native species. Kansas Wildlife Action Plan conservation strategies include assessing the threat posed by feral hogs and developing a management plan for control and possible elimination (Wasson et al. 2005).

3.8.4.1.5 Threatened and Endangered Species

A total of seven federally listed species are known to occur in Riley County (Table 3.8.4.1.5-1). In addition, Kansas Natural Heritage Inventory (KNHI) occurrence records for Riley County include four species listed by the state as endangered or threatened and 16 "species in need of conservation" (Table 3.8.4.1.5-1). Species listed by the state as endangered or threatened are protected under the *Non-Game and Endangered Species Conservation Act* of 1975 (K.S.A. 32-957 – 32-963, 32-1009 – 32-1012, 32-1033, 32-960a and 32-960b, and amendments thereto). Activities that impact state-listed species require special action permits from the KDWP. The state also tracks occurrences of "species in need of conservation"; however, these species are not afforded protection under state laws.

Table 3.8.4.1.5-1 — Riley County Endangered, Threatened, and Rare Species (KDWP 2008)

Scientific Name	Common Name	Federal Status [a]	State Status [b]	Habitat[c]	Habitat Present at NBAF Site
Nicrophorus americanus	American burying beetle	E	E	Upland grassland and grassland/forest transition zones	No
Numenius borealis	Eskimo curlew [d]	E	E	Plowed fields, heavily grazed or burned grasslands, prairie dog colonies	No
Sterna antillarum	Least tern	E	E	Barren areas near water such as sand bars in river beds, shores of large impoundments, and salt flats	No
Charadrius melodus	Piping plover	T	T	Sparsely vegetated shallow wetlands and open beaches and sandbars adjacent to streams and impoundments	No
Macrhybopsis gelida	Sturgeon chub	C	T	Large, turbid, sandy rivers with small gravel and sand substrate	No
Notropis topeka	Topeka shiner	T	E	Small prairie streams with high water quality, Occurs near headwaters of streams over gravel, bedrock, or silt substrate	No
Grus americana	Whooping crane	E	E	Remote wetlands with low, sparse vegetation in level to moderately rolling terrain	No
Spilogale putorius	Eastern spotted skunk	-	T	Forest edges and upland prairie grasslands, especially those with rock outcrops and shrub clumps, woody fence rows, and abandoned farm buildings	No
Falco peregrinus	Peregrine falcon	-	E	Prefer areas near marshes, lakes, and rivers where concentrations of waterfowl and other birds provide ample prey	No
Macrhybopsis storeriana	Silver chub	-	E	Large sandy rivers	No
Haliaeetus leucocephalus	Bald eagle	-	T	Around large impoundments, rivers, and marshes	No
Charadrius alexandrinus	Snowy plover	-	T	Salt flats, beaches and bars of rivers, and wetlands	No

[a] Federal Status Codes: E = Endangered, T = Threatened, C = Candidate.
[b] State Status Codes: E = Endangered, T = Threatened.
[c] Source: KDWP Web Site, Species Information Pages.
[d] Considered extirpated in Kansas.

KNHI is responsible for tracking occurrences of both federally and state-listed species within the State of Kansas. Database reviews conducted by KNHI and KDWP did not identify any occurrences of rare, threatened, or endangered species at the proposed NBAF site or within a 1-mile radius of the site. In addition, both of these state agencies concluded that the project area does not appear to contain suitable habitat for any federal- or state-listed species. As described in Section 3.8.4.1.1, the Manhattan Campus Site is located in a highly disturbed area that lacks native natural communities. Furthermore, no wetlands or aquatic habitats occur at the site. In the absence of suitable habitat, the occurrence of any federally or state-listed species at the Manhattan Campus Site is unlikely.

3.8.4.2 Construction Consequences

3.8.4.2.1 Vegetation

Construction of the proposed NBAF would impact approximately 30 acres of land at the Manhattan Campus Site. The site is located in a highly disturbed area that does not contain native natural communities. Earth-disturbing activities would impact pasture areas that are dominated by cultivated forage grasses. Therefore, construction of the proposed NBAF would have no direct effect on natural plant communities. Since no natural communities are located adjacent to the site, construction of the proposed NBAF would have no indirect effect on natural plant communities. Off-site connected actions involving the installation of new electrical lines would occur within existing right-of-ways and, therefore, would not have any significant impacts on vegetation.

3.8.4.2.2 Wetlands

No wetlands or streams occur on or immediately adjacent to the Manhattan Campus Site. Therefore, construction would have no direct effects on streams or wetlands. Potential indirect effects during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Although Campus Creek is 1,500 feet from the proposed NBAF site, sediments transported by storm water could potentially end up in the stream channel. However, erosion and sedimentation control measures would minimize the potential for adverse effects on streams and wetlands.

3.8.4.2.3 Aquatic Resources

Earth-disturbing activities would be restricted to upland pasture areas and, therefore, construction would have no direct impact on streams or aquatic habitats. Potential indirect effects from erosion and sedimentation would be the same as those described in Section 3.8.4.2.2.

3.8.4.2.4 Terrestrial Wildlife

Construction of the proposed NBAF at the Manhattan Campus Site would impact approximately 30 acres of disturbed, actively grazed pasture that is dominated by cultivated forage grasses. Domestic perennial forage grasses that are used in Kansas are considered to have low value as wildlife habitat (KDWP 2004). The areas that would be impacted do not contain native vegetation or significant wildlife food or cover. Therefore, the loss of pasture habitat would affect a relatively low number of generalist species that are adapted to a wide range of habitats. Construction of the proposed NBAF at the Manhattan Campus Site would not result in significant direct impacts on native terrestrial wildlife.

3.8.4.2.5 Threatened and Endangered Species

Informal Section 7 consultation was conducted with the USFWS Kansas Field Office. The USFWS determined that no suitable endangered species habitats occur within the project area. The USFWS requested an assessment of the potential effects of an accidental pathogen release on federally listed species that occur in the vicinity of the site (least tern, piping plover, and Topeka shiner). The potential effects of an accidental release are assessed in Sections 3.8.4.3.5 and 3.8.9. Reviews conducted by KNHI and KDWP did not identify any occurrences of rare, threatened, or endangered species at the Manhattan Campus Site or within a 1-mile radius of the site. In addition, both KNHI and KDWP concluded that the project area does not appear to contain suitable habitat for any federally or state-listed species. The Manhattan Campus Site is located in a highly disturbed area that lacks native natural communities, and no wetlands or aquatic habitats occur at the site. Therefore, the proposed NBAF would have no direct adverse impact on listed species. Approximately 2 miles southeast of the project area, the Kansas River is designated as critical habitat for the least tern

(*Sterna antillarum*), piping plover (*Charadrius melodus*), and sturgeon chub (*Macrhybopsis gelida*); however, the KNHI determined that the project would not be likely to impact these species.

Soil disturbance during the construction process would expose soils to potential erosion during storm events. Erosion and subsequent sedimentation in stream channels have the potential for adverse impacts on aquatic organisms. Although Campus Creek is located 1,500 feet south of the project area, sediment transported by storm water runoff could potentially end up in Campus Creek and receiving downstream water bodies that include the Kansas River. However, erosion and sedimentation control measures would minimize the potential for adverse effects on protected aquatic species and critical habitat in the Kansas River basin.

3.8.4.3 Operation Consequences

3.8.4.3.1 Vegetation

The surrounding area is highly urbanized, and there are no natural plant communities in the general vicinity of the site. Therefore, operations would have no potential for direct or indirect impacts on native natural communities.

3.8.4.3.2 Wetlands

Operations at the proposed NBAF would have no direct impacts on wetlands; however, increases in impervious surface area and storm water runoff would have the potential for indirect wetland impacts. The proposed NBAF would create 270,000 square feet of impervious surface area, which would result in 22,500 cubic feet of runoff during a 1-inch rainfall event. Increases in impervious surface area can increase storm water runoff and stream flow after storm events. Increases in stream flow volume and velocity can cause stream channel incision and/or widening, resulting in the loss of adjacent wetland vegetation and alteration of the hydrological regime within adjacent wetlands. The storm water management system would be designed in accordance with applicable storm water BMPs. In addition, the proposed NBAF would employ an LID approach that would further minimize storm water runoff (see Section 3.7.4.3.2). The use of LID development techniques and BMPs would mitigate most of the potential adverse impacts on streams and wetlands.

3.8.4.3.3 Aquatic Resources

Operations at the proposed NBAF would have no direct impacts on aquatic communities; however, storm water runoff from the proposed NBAF would eventually be discharged to Campus Creek. Increases in impervious surface area and storm water runoff have the potential for indirect impacts on water quality and aquatic communities. Runoff from impervious surfaces such as buildings and parking lots can transport pollutants such as automotive fluids, fertilizer, pesticides, bacteria, and heavy metals into surface waters. Furthermore, rapid runoff from impervious surface areas can affect aquatic habitats by increasing the rate of flow in receiving streams (see Section 3.8.4.3.2). These effects can include increased turbidity and sedimentation downstream. The use of LID development techniques and BMPs would mitigate most of the potential adverse effects on streams. The proposed NBAF would have the potential for minor adverse effects associated with pollutant transport. Minor quantities of pollutants such as automobile engine fluids and fertilizers may avoid capture in the storm water management system and could end up in area streams. However, LID development techniques and BMPs would minimize the potential for these types of impacts.

3.8.4.3.4 Terrestrial Wildlife

Section 3.5.5.3 addresses operational noise impacts associated with the proposed NBAF. Minor noise impacts would result from an increase in traffic and operation of the facility's filtration, heating, and cooling systems. Section 3.5.5.3 describes noise-attenuating design features that would minimize noise emissions. In the event of a power outage, operation of back-up generators could have a short-term impact on wildlife by discouraging utilization of immediately adjacent habitats. Routine operations at the NBAF would not be likely to have significant noise impacts on wildlife. Security requirements at the proposed NBAF would require continuous outdoor nighttime lighting. Nighttime lighting has the potential to impact wildlife through astronomical and ecological light pollution. Unshielded lighting can shine upward and interfere with bird migration, disorienting birds and causing them to collide with structures. Birds are attracted to lights and may collide with lighted structures. Most concerns involve lighting associated with high-rise buildings and telecommunication towers; however, even residential lighting can affect some birds. The USFWS advocates the use of shielded lighting to minimize adverse impacts on migratory birds. Shielded fixtures direct light downwards and can be used to keep light within the boundaries of the site. Artificial lighting also has the potential for ecological effects such as repulsion and/or interference with foraging behavior. The NBAF would employ the minimum intensity of lighting that is necessary to provide adequate security. Mitigation measures, such as those described above, will be considered in the final design of the NBAF. The use of shielded lighting would minimize the potential for impacts in adjacent habitats. Given the relatively low profile of the building and the use of shielded lighting, significant impacts on migratory birds would not be likely to occur. The accidental or intentional release of a pathogen would have the potential for adverse effects on native mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on wildlife.

3.8.4.3.5 Threatened and Endangered Species

Normal operations would have no direct effect on threatened and endangered species; however, the accidental or intentional release of a pathogen would have the potential for adverse effects on mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. No federally listed mammals occur in Riley County. Federally listed birds that occur in Riley County are not likely to be adversely affected by operations at the proposed NBAF site. The state endangered eastern spotted skunk (*Spilogale putorius*) is known to occur in Riley County. Suitable habitat for the spotted skunk does not occur in the immediate vicinity of the proposed NBAF site. However, suitable habitat does occur in rural areas outside of the City of Manhattan. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on native wildlife and endangered species.

3.8.5 Flora Industrial Park Site

3.8.5.1 Affected Environment

3.8.5.1.1 Vegetation

<u>Regional Vegetation</u>

The Flora Industrial Park Site is located in the Upper East Gulf Coastal Plain ecoregion (Vilella et al. 2003). The dominant natural plant communities of this ecoregion can be broadly categorized as dry to dry-mesic hardwood forests, mesic upland forests, and bottomland hardwood/swamp forests. Dry and dry-mesic hardwood forests occur on dry ridgetops, upper slopes, and dry to moderately moist mid and lower slopes. Dominant trees include post oak (*Quercus stellata*), southern red oak (*Q. falcata*), white oak (*Q. alba*), blackjack oak (*Q. marilandica*), water oak (Q. nigra), mockernut hickory (*Carya alba*), sand hickory (*C. pallida*), and pignut hickory (*C. glabra*). Common understory species include sparkleberry (*Vaccinium arboreum*), white ash (*Fraxinus americana*), flowering dogwood (*Cornus florida*), beech (*Fagus grandifolia*), sourwood (*Oxydendrum arboreum*), and hop-hornbeam (*Ostrya virginiana*). Many of the dry and dry-mesic communities in the region have been converted to loblolly pine (*Pinus taeda*) plantations (MMNS 2005).

Mesic upland forests occur on lower slopes and high terraces of streams and rivers. Dominant trees include sweetgum (*Liquidambar styraciflua*), water oak, white oak, cherrybark oak (*Quercus pagoda*), swamp chestnut oak (*Q. michaxii*), willow oak (*Q. phellos*), pignut hickory, bitternut hickory (*Carya cordiformis*), and shagbark hickory (*C. ovalis*). Understory trees and shrubs include ironwood (*Carpinus caroliniana*), winged elm (*Ulmus alata*), red maple (*Acer rubrum*), possumhaw (*Viburnum nudum*), hackberry (*Celtis laevigata*), and pawpaw (*Asimina triloba*) (MMNS 2005).

Bottomland hardwood forests occur on low floodplain terraces and other wet lowland flats. Dominant trees include willow oak, water oak, overcup oak (*Quercus lyrata*), Nuttall oak (*Q. nutallii*), swamp laurel oak (*Q. laurifolia*), pecan (*Carya illinoinensis*), water hickory (*C. aquatica*), hackberry, American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), and sweet-gum. Cypress-gum swamps occur on low floodplain terraces, bottomland flats, and backwater areas that are seasonally to semipermanently flooded. Dominant trees include bald cypress (*Taxodium distichum*), black-gum (*Nyssa biflora*), water tupelo (*N. aquatica*), water oak, and other flood-tolerant hardwoods (MMNS 2005).

Site Vegetation

The Flora Industrial Park Site is located in a highly disturbed area that does not contain native natural communities. Most of the site consists of pasture that has been used for livestock grazing since at least 1946 (Holman 1993). Vegetation at the site consists primarily of non-native cultivated forage grasses and early successional weeds. Open field habitat consists of grasses used for cattle grazing, such as fescue (*Festuca* sp.), bahia grass (*Paspalum notatm*), and dallis grass (*Paspalum dilatatum*). The pasture areas are currently maintained by regular mowing. Woody vegetation occurs along an old fence line that transects the northern portion of the property. Woody species include native and non-native species. Native trees and shrubs include water oak, willow oak, post oak, American elm, winged elm, hackberry, eastern red cedar (*Juniperus virginiana*), and black cherry (*Prunus serotina*). Non-native species include osage orange (*Maclura pomifera*), chinaberry (Melia azedarach), Japanese privet (*Ligustrum sinense*), and Japanese honeysuckle (*Lonicera japonica*). Historically, osage orange was used as a hedgerow plant throughout the United States. Similar woody vegetation occurs along the banks of drainageways in the southeastern corner of the property.

Rare and Significant Natural Communities

A database review conducted by the Mississippi Natural Heritage Program (MNHP) did not identify any records of rare or significant natural communities within the boundaries of the proposed NBAF site. As described above, the Flora Industrial Park Site is located within a highly disturbed area that lacks native natural communities.

3.8.5.1.2 Wetlands

Jurisdictional wetlands and waters at the Flora Industrial Park Site were delineated on April 23, 2007 (WTS 2007a). Jurisdictional wetlands and other waters within the boundaries of the site include two ephemeral stream channels with a combined length of 1,293 feet and one intermittent stream channel with a length of 296 feet (Figure 3.8.3.1.2-1). The ephemeral streams originate in the southeastern corner of the site and drain towards the southeast. The two ephemeral streams join to form the intermittent stream, which drains to the southeast for a distance of 296 feet before exiting the southeastern property boundary. No jurisdictional wetlands occur along the margins of the streams. The property also contains two isolated, non-jurisdictional ponds. These two ponds include a historical farm pond on the northeastern portion of the property and a recently excavated pond near the southwestern boundary of the site. As non-jurisdictional features, these ponds are not subject to Section 404 regulations or permitting requirements.

3.8.5.1.3 Aquatic Resources

The Flora Industrial Park Site is located in the Big Black River basin (HUC 8060202). The site contains two short ephemeral stream segments that originate near the southeastern boundary of the site. These ephemeral streams drain to the southeast and join to form an intermittent stream that exits the property. This unnamed intermittent stream flows northeast to Town Creek. Town Creek is a tributary of Balfour Creek, which discharges to the Big Black River approximately 3 miles northwest of the Flora Industrial Park Site.

The Big Black River discharges to the Mississippi River approximately 55 miles southwest of Flora. Many tributaries of the Big Black River have been channelized, and the main stem has experienced extensive erosion in recent years, resulting in destabilization of the stream channel. Agriculture and other land-use practices on adjacent lands are also impacting the Big Black River and its tributaries (MMNS 2005). Generally, the Big Black River and most of its tributaries, especially in the northern part of the basin, carry large amounts of suspended sediment and are very turbid most of the time. Some of the streams in the basin are muddy and slow flowing, while others have relatively clear water and are swift with sandy bottoms. Overall, the water quality in the basin is rated as fair (MDEQ 2003).

Common fishes of the Big Black River include flathead catfish, blue catfish, channel catfish, smallmouth buffalo, bigmouth buffalo, black buffalo, freshwater drum, white crappie, black crappie, largemouth bass, gizzard shad, bluegill, longnose gar, spotted gar, blue sucker, paddlefish, blacktail shiner, emerald shiner, striped shiner, creek chubsucker, freckled madtom, blackspotted topminnow, central stoneroller, scaly sand darter, slough darter, logperch, and dusky darter (Brown et al. 2005). A total of 38 mussel species have been reported from the Big Black River. Common mussels include the mucket, rock pocketbook, butterfly mussel, southern pocketbook, and southern mapleleaf (Brown et al. 2005).

Streams on the Flora Industrial Park Site have been degraded by agricultural practices. The ephemeral streams function mainly as shallow storm water conveyances for runoff from the agricultural fields. Vegetated buffers are essentially absent, and these streams are exposed to accelerated runoff and sediment transport from the adjacent pasture areas. Due to their ephemeral nature and degraded condition, the ephemeral streams are not likely to contain significant aquatic resources. The intermittent stream has been channelized and is currently deeply incised to a depth of 5 feet below the adjacent upland areas. The intermittent stream also has limited vegetative buffers and is adversely affected by accelerated runoff and sedimentation. The perennial stream is most likely occupied by a limited number of generalist aquatic species that are able to tolerate degraded habitat conditions. Depending on stocking history, the farm pond may contain fishes such as large mouth bass, bluegill, and various species of sunfish. Semi-aquatic reptiles and amphibians that may occur onsite are described below.

3.8.5.1.4 Terrestrial Wildlife

The Mississippi GAP has developed models that predict the statewide distribution of terrestrial vertebrate species that are known to breed in Mississippi. The Mississippi GAP list of breeding species for the Flora area includes 96 birds, 46 mammals, 46 reptiles, and 27 amphibians (Vilella et al. 2003). Non-breeding species that occur in Mississippi consist primarily of migratory birds that occur only during the non-breeding season.

As described in Section 3.8.5.1.1, the proposed Flora Industrial Park Site is located in a highly disturbed area that lacks native natural plant communities. Vegetation on the site consists primarily of pasture that is dominated by non-native forage grasses. Due to its disturbed condition, lack of native vegetation, and lack of wildlife food and cover, the Flora Industrial Park Site has limited wildlife habitat value. Wildlife utilization of the site is most likely limited to a relatively low number of generalist species that have adapted to highly disturbed environments. Common mammals that are likely to occur at the site include white-tailed deer (*Odocoileus virginianus*), Virginia opossum (*Didelphis virginiana*), red fox (*Vulpes vulpes*), nine-banded armadillo (*Dasypus novemcinctus*), northern raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), striped skunk (*Mephitis mephitis*), white-footed mouse (*Peromyscus leucopus*), hispid cotton rat (*Sigmodon hispidus*), eastern harvest mouse (*Reithrodontomys humulis*), and eastern mole (*Scalopus aquaticus*). Common birds that may occur at the proposed NBAF site include killdeer (*Charadrius vociferous*), mourning dove (*Zenaida macroura*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), Carolina chickadee (*Poecile carolinensis*), tufted titmouse (*Baeolophus bicolor*), American robin (*Turdus migratorius*), northern mockingbird (*Mimus polyglottus*), brown thrasher (*Toxostoma rufum*), European starling (*Sturnus vulgaris*), northern cardinal (*Cardinalis cardinalis*), common grackle (*Quiscalus quiscula*), Carolina wren (*Thryothorus ludovicianus*), eastern bluebird (*Sialia sialis*), eastern towhee (*Pipilo erythrophthalmus*), house finch (*Carpodacus mexicanus*), house sparrow (*Passer domesticus*), and American kestrel (*Falco sparverius*). In addition, the farm pond may attract common wading birds such as the great blue heron (*Ardea herodias*) and green heron (*Butorides virescens*).

Figure 3.8.5.1.2-1 — Flora Industrial Park Wetland Map

Common reptiles and amphibians that may occur at the site include the eastern box turtle (*Terrapenne carolina*), common garter snake (*Thamnophis sirtalis*), black rat snake (*Elaphe obsoleta*), black racer (*Coluber constrictor*), green anole (*Anolis carolinensis*), fence lizard (*Sceloperus undulatus*), southeastern five-lined skink (*Eumeces inexpectatus*), woodhouse's toad (*Bufo woodhousii*), American toad (*Bufo americanus*), southern cricket frog (*Acris gryllus*), green treefrog (*Hyla cinerea*), and gray treefrog (*H. versicolor*). The farm pond may provide habitat for additional semi-aquatic turtles and amphibians such as the common snapping turtle (*Chelydra serpentina*), yellow-bellied slider (*Trachemys scripta*), eastern mud turtle (*Kinosternum subrubrum*), bullfrog (*R. catesbeiana*), green frog (*R. clamitans*), and pickerel frog (*R. palustris*).

The distribution of ungulate populations has particular relevance, since they are susceptible to many of the diseases that may be studied at the proposed NBAF. Ungulates that occur in Mississippi include white-tailed deer (*Odocoileus virginianus*) and wild boar (*Sus scrofa*). Both species occur throughout the state (Shropshire 1998).

3.8.5.1.5 Threatened and Endangered Species

A total of three federally listed species and one federal candidate species are known to occur in Madison County (Table 3.8.5.1.5-1). MNHP occurrence records for Madison County include four additional species listed by the state as endangered or threatened and 16 "species of concern" (Table 3.8.5.1.5-1). Animal species that are listed by the state as endangered or threatened are protected under the Mississippi *Nongame and Endangered Species Conservation Act* (Miss. Code Ann. 49-5-101 et seq.). Although the state tracks occurrences of animal "species of concern," these species are not afforded protection under state laws. Although the MNHP tracks occurrences of rare plant species, plants are not protected by state laws.

Table 3.8.5.1.5-1 — Federally and State-Protected Species of Madison County (MNHP 2007)

Scientific Name	Common Name	Federal [a] Status	State [b] Status	Habitat	Habitat Present at NBAF Site
Nicrophorus americanus [c]	American burying beetle	E	E	Not fully understood. Has been found in oak-pine woodlands, open fields, oak-hickory forest, open grasslands, and edge habitats.	No
Acipenser oxyrinchus desotoi	Gulf sturgeon	T	E	All saltwater habitats during the non-breeding period and major rivers that empty into the Gulf of Mexico during the spawning season.	No
Graptemys oculifera	Ringed map turtle	T	E	Generally inhabits clean rivers having a moderate current, an open canopy, and numerous nesting beaches and basking logs.	No
Falco peregrinus [d]	Peregrine falcon	-	E	Open habitats such as coastal dunes, shorelines, marshes, grasslands, cultivated fields, and cities.	Yes
Thryomanes bewickii	Bewick's wren	-	E	Open habitat with clumps of vegetation. Farmyards and rural dwellings. Windrows or slash piles created from clear-cutting operations.	Yes
Alosa alabamae	Alabama shad	C	SC	Found along sand and gravel bars in medium to large freshwater rivers.	No

[a] Federal Status Codes: E = Endangered, T = Threatened, = C = Candidate.
[b] State Status Codes: E = Endangered, SC = Species of Concern.
[c] Source: Considered extirpated in Mississippi.
[d] Non-breeder with no definable occurrences. Consequently, not of practical conservation concern in the state.

MNHP is responsible for tracking occurrences of both federally and state-listed species within the State of Mississippi. A review conducted by MNHP did not identify any state or federally listed species occurrences at the site. Correspondance from the USFWS Jackson Field Office also stated that no listed species are known to occur on the site. As described in Section 3.8.5.1.1, the proposed NBAF site is located in a highly disturbed area that lacks native natural communities. The state endangered Bewick's wren is sometimes found in farmyard habitats that are similar to those within the project area. Due to the poor quality of habitats that are present, occurrences of any additional federally or state-listed species at the site are unlikely.

3.8.5.2 Construction Consequences

3.8.5.2.1 Vegetation

Construction of the proposed NBAF would impact approximately 30 acres of land at the Flora Industrial Park Site. Earth-disturbing activities would impact pasture areas that are dominated by cultivated forage grasses and disturbed woody vegetation along an old fence row. None of the vegetated areas that occur along streams would be affected. Construction of the proposed NBAF would have no direct effect on natural plant communities. Adjacent areas consist primarily of agricultural lands with similar vegetation. Therefore, no indirect effects on natural plant communities are anticipated. Off-site connected actions involving the installation of a new gas line beneath the adjacent railroad tracks and improvements to U.S. Highway 49 at the entrance to the proposed NBAF site would affect previously disturbed areas and, therefore, would not have any significant impacts on vegetation.

3.8.5.2.2 Wetlands

Construction would occur on the northern portion of the property and would have no direct effect on jurisdictional streams that occur in the southeastern corner of the property. Potential indirect effects during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, wetlands and streams that are located downslope of the proposed construction area could be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on streams and wetlands.

3.8.5.2.3 Aquatic Resources

Construction would occur on the northern portion of the property and would have no direct effect on streams that occur in the southeastern corner of the property. The farm pond on the northwestern portion of the property would be retained and incorporated into the grounds of the proposed NBAF. The additional pond along the southwestern boundary of the property would not be affected by construction. Potential indirect effects during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, wetlands and streams that are located downslope of the proposed construction area could be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on streams and wetlands.

3.8.5.2.4 Terrestrial Wildlife

Construction of the proposed NBAF at the Flora Industrial Park Site would impact approximately 30 acres of disturbed, actively grazed pasture and a small area of disturbed woody vegetation along an old fence row. The areas that would be impacted do not contain natural plant communities or significant wildlife food or cover. The loss of these disturbed habitats would affect a relatively low number of generalist species that are adapted to a wide range of habitats. Construction of the proposed NBAF at the Flora Industrial Park Site would not result in significant direct impacts on native terrestrial wildlife.

3.8.5.2.5 Threatened and Endangered Species

Informal Section 7 consultation was conducted with the USFWS Jackson Field Office. The USFWS determined that no federally listed species occur within the project area. In addition, database reviews conducted by the MNHP did not identify any known occurrences of rare, threatened, or endangered species at the Flora Industrial Park Site. MNHP stated that the use of BMPs would preclude any impacts on listed species. The proposed NBAF site is located in a highly disturbed area that lacks native natural communities. However, the state endangered peregrine falcon and the state endangered Bewick's wren are known to utilize disturbed open areas such as farmyards. The peregrine falcon is a non-breeding species in Mississippi, and occurrences consist of migrating birds that may occur in a variety of open habitats during migration periods. Due to the lack of definabale occurrences (i.e., nesting sites), this species is not of practical conservation concern in the state. The state endangered Bewick's wren could potentially occur on the property. However, suitable farmyard habitats are abundant in the region; therefore, this species is not likely to be adversely affected by habitat loss asscociated with construction of the proposed NBAF.

3.8.5.3 Operation Consequences

3.8.5.3.1 Vegetation

No natural plant communities occur on or in the general vicinity of the Flora Industrial Park Site. Therefore, operations would have no potential for direct or indirect impacts on native natural communities.

3.8.5.3.2 Wetlands

Operations of the proposed NBAF at the Flora Industrial Park Site would have no direct impacts on wetlands; however, increases in impervious surface area and storm water runoff would have the potential for indirect impacts on jurisdictional streams that occur on and adjacent to the proposed NBAF site. The proposed NBAF would create 270,000 square feet of impervious surface area, which would result in 22,500 cubic feet of runoff during a 1-inch rainfall event. Increases in impervious surface area can increase storm water runoff and stream flow after storm events. Increases in stream flow volume and velocity can cause stream channel incision and/or widening, resulting in the loss of adjacent wetland vegetation and alteration of the hydrological regime within adjacent wetlands. The storm water management system would be designed in accordance with applicable storm water BMPs. In addition, the proposed NBAF would employ an LID approach that would further minimize storm water runoff (see Section 3.7.4.3.2). The use of LID development techniques and BMPs would mitigate most of the potential adverse impacts on streams and wetlands.

3.8.5.3.3 Aquatic Resources

Operations at the proposed NBAF would have no direct impacts on aquatic resources; however, storm water runoff from the proposed NBAF would eventually be discharged to area streams. Increases in impervious surface area and storm water runoff have the potential for indirect impacts on water quality and aquatic communities. Runoff from impervious surfaces such as buildings and parking lots can transport pollutants such as automotive fluids, fertilizer, pesticides, bacteria, and heavy metals into surface waters. As described above, rapid runoff from impervious surface areas can affect aquatic habitats by increasing the rate of flow in receiving streams. These effects can include increased turbidity and sedimentation downstream. The use of LID development techniques and BMPs would mitigate most of the potential adverse effects on streams. The proposed NBAF would have the potential for minor adverse effects associated with pollutant transport. Minor quantities of pollutants such as automobile engine fluids and fertilizers may avoid capture in the storm water management system and could end up in area streams. However, the measures described above would minimize the potential for these types of impacts.

3.8.5.3.4 Terrestrial Wildlife

Section 3.5.5.3 addresses operational noise impacts associated with the proposed NBAF. Minor noise impacts would result from an increase in traffic and operation of the facility's filtration, heating, and cooling systems. Section 3.5.5.3 describes noise-attenuating design features that would minimize noise emissions. In the event of a power outage, operation of back-up generators could have a short-term impact on wildlife by discouraging utilization of immediately adjacent habitats. Routine operations at the NBAF would not be likely to have significant noise impacts on wildlife. Security requirements at the proposed NBAF would require continuous outdoor nighttime lighting. Nighttime lighting has the potential to impact wildlife through astronomical and ecological light pollution. Unshielded lighting can shine upward and interfere with bird migration, disorienting birds and causing them to collide with structures. Birds are attracted to lights and may collide with lighted structures. Most concerns involve lighting associated with high-rise buildings and telecommunication towers; however, even residential lighting can affect some birds. The USFWS advocates the use of shielded lighting to minimize adverse impacts on migratory birds. Shielded fixtures direct light downwards and can be used to keep light within the boundaries of the site. Artificial lighting also has the potential for ecological effects such as repulsion and/or interference with foraging behavior. The NBAF would employ the minimum intensity of lighting that is necessary to provide adequate security. Mitigation measures, such as those described above, will be considered in the final design of the NBAF. The use of shielded lighting would minimize the potential for impacts in adjacent habitats. Given the relatively low profile of the building and the use of shielded lighting, significant impacts on migratory birds would not be likely to occur. The accidental or intentional release of a pathogen would have the potential for adverse effects on native mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on wildlife.

3.8.5.3.5 Threatened and Endangered Species

Normal operations would have no direct effect on threatened and endangered species. The accidental or intentional release of a pathogen would have the potential for adverse effects on listed mammals; however, no federally or state-listed mammals are known to occur in Madison County. Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF (see Section 3.8.9). Therefore, normal operations would not be likely to have adverse effects on listed species that occur in the vicinity of the proposed NBAF site. Section 3.8.9 provides an in-depth evaluation of the potential effects of an accidental release on native wildlife and listed species.

3.8.6 Plum Island Site

3.8.6.1 Affected Environment

3.8.6.1.1 Vegetation

Regional Vegetation

An overview of the Coastal Lowlands ecozone and Plum Island is provided in Section 3.8.2.1.1.

Site Vegetation

A substantial portion of the Plum Island Site consists of severely disturbed lands that have been impacted by road construction, sand mining, and other past clearing/earth-disturbing activities. The sand mine and other areas with severe soil disturbance are either devoid of vegetation or contain a sparse to moderately dense coverage of weedy herbaceous species such as woolly mullein (*Verbascum thapsus*), broom-sedge (*Andropogon virginicus*), seaside goldenrod (*Solidago sempervirens*), crown vetch (*Coronilla varia*), and pokeweed (*Phytolacca americana*). Remaining portions of the project area contain a dense shrub-scrub stratum comprised of native and non-native woody plants. Typical native species include eastern red cedar (*Juniperus virginiana*), bayberry (*Myrica pennsylvanica*), sassafrass (*Sassafras albidum*), winged sumac (*Rhus copallinum*), white oak (*Quercus alba*), black cherry (*Prunus serotina*), blackberry (*Rubus allegheniensis*), grape (*Vitis* sp.), and poison ivy (*Toxicodendron radicans*). Non-native species include Norway maple (*Acer platanoides*), tree of heaven (*Ailanthus altissima*), mutliflora rose (*Rosa multiflora*), Tartarian honeysuckle (*Lonicera tatarica*), and Japanese honeysuckle (*L. japonica*). The site also contains patches of larger mature trees that are interspersed within the shrub-scrub communities.

Rare and Significant Natural Communities

A database review conducted by the NYNHP did not identify any records of rare or significant natural communities within the boundaries of the Plum Island Site; however, the NYNHP has identified a maritime dune community on the southeastern portion of Plum Island as a significant natural area with high ecological and conservation value. This natural area is located approximately 0.5 mile south of the proposed NBAF site. The NYNHP describes this area as a low dune field with scattered blowouts and patches of low shrubby vegetation. The report indicates that many non-native species are present along old roads within the dunes; however, the community is described as a fairly large occurrence in good condition (NYNHP 2007).

3.8.6.1.2 Wetlands

Wetlands in the vicinity of the Plum Island Site were delineated by B. Laing Associates on November 7, 2007 (B. Laing Associates 2007). No wetlands were found on-site; however, jurisdictional wetlands were identified approximately 300 feet northwest and 200 feet southeast of the site (Figure 3.8.2.1.2-1). Descriptions of these wetlands and a discussion of applicable regulations are included in Section 3.8.2.1.2.

3.8.6.1.3 Aquatic Resources

No aquatic resources occur within the boundaries of the Plum Island Site. Adjacent freshwater and marine aquatic resources are described in Section 3.8.2.1.3.

3.8.6.1.4 Terrestrial Wildlife

Wildlife resources that occur on Plum Island are described in Section 3.8.2.1.4.

3.8.6.1.5 Threatened and Endangered Species

Threatened and endangered species that may occur on Plum Island are described in Section 3.8.2.1.5.

3.8.6.2 Construction Consequences

3.8.6.2.1 Vegetation

Construction of the proposed NBAF would affect approximately 24 acres of land at the Plum Island Site. The project would affect heavily disturbed areas with sparse weedy herbaceous vegetation and previously disturbed upland shrub-scrub communities that are dominated by native and non-native species. Construction would not affect any rare or significant natural plant communities. Based on the poor quality of vegetation in the affected area, the project would not have significant direct adverse effects on natural plant communities. Potential indirect effects during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, natural communities that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on vegetation.

3.8.6.2.2 Wetlands

The Plum Island Site does not contain wetlands, and no portion of the site falls within the state-regulated wetland buffer zones associated with adjacent wetlands. Therefore, construction would have no direct adverse effect on wetlands. Potential indirect effects during the construction process would include erosion and sedimentation. However, there are no conveyances connecting the site with adjacent wetlands, and the distances between the site and adjacent wetlands are considerable. These factors and the implementation of erosion and sedimentation control measures would minimize the potential for adverse effects on wetlands.

3.8.6.2.3 Aquatic Resources

The Plum Island Site does not contain aquatic resources and, therefore, construction would have no direct adverse effect on aquatic resources. Potential indirect effects during the construction process would include erosion and sedimentation. Adjacent water bodies that are located downslope of the proposed construction area could be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on aquatic resources.

3.8.6.2.4 Terrestrial Wildlife

Construction of the proposed NBAF would clear approximately 24 acres of land. Affected habitats would include upland shrub-scrub vegetation and heavily disturbed areas that are either devoid of vegetation or sparsely vegetated by weedy herbaceous species. No wetlands or aquatic habitats would be affected. Construction of the facility would have short-term and long-term effects on wildlife. Land-clearing activities, construction noise, and dust creation would likely discourage wildlife utilization of habitats that are immediately adjacent to the proposed construction area; however, these effects would subside with completion of the project. Long-term effects would result from habitat loss and permanent displacement of wildlife from the project area. Species that are likely to be affected include small mammals and songbirds. However, given the abundance of shrub-scrub habitat on the island, construction of the facility would not be likely to have significant long-term impacts on local wildlife populations.

3.8.6.2.5 Threatened and Endangered Species

Informal Section 7 consultation has been initiated with the USFWS Long Island Field Office. The Plum Island Site does not contain suitable habitat for listed species; therefore, construction would not have any direct adverse effects on listed species or potential habitat. Land-clearing activities, construction noise, and dust creation would likely discourage wildlife utilization of habitats that are immediately adjacent to the proposed construction area; however, no listed species are likely to occur in the immediate vicinity of the site. Although piping plovers and roseate terns could potentially nest on the island; suitable nesting habitat is limited primarily to the northern and eastern shorelines. The western shoreline in the vicinity of the Plum Island Site is actively eroding and does not contain suitable nesting habitat for either of these species. Suitable nesting habitats do occur on the eastern and northern beaches of Plum Island; however, the distance between the site and and potential nesting habitat would preclude any adverse effects from construction activities. Sea turtles do not come ashore to nest in the northeastern United States; thus, sea turtle occurrences are limited to marine waters that surround the island. Since sea turtles do not nest or come ashore on Plum Island, construction would have no direct or indirect effect on these species. The shortnose sturgeon only occurs in the lower Hudson River and would not be affected by the project.

3.8.6.3 Operation Consequences

3.8.6.3.1 Vegetation

Operation of the proposed NBAF would have no direct effects on native vegetation or natural communities. The proposed NBAF would create 270,000 square feet of impervious surface area, which would result in

22,500 cubic feet of runoff during a 1-inch rainfall event. Increases in storm water runoff have the potential to cause erosion within adjacent plant communities. However, the use of LID development techniques and BMPs would mitigate most of the potential for erosion-related effects. Storm water management systems would be designed in accordance with the applicable storm water BMPs. In addition to meeting the minimum state requirements for storm water management, the proposed NBAF would employ a LID approach that would minimize storm water runoff (see Section 3.7.3.3.2).

3.8.6.3.2 Wetlands

Operations at the proposed NBAF would have no direct impacts on wetlands. Increases in impervious surface area and storm water runoff have the potential for indirect erosion and sedimentation impacts on wetlands. However, there are no conveyances connecting the site with adjacent wetlands, and the distances between the site and adjacent wetlands are considerable. These factors, and the use of LID development techniques and BMPs, would mitigate most of the potential for erosion-related effects on wetlands.

3.8.6.3.3 Aquatic Resources

Operations at the proposed NBAF would have no direct impacts on aquatic resources. Potential effects associated with storm water runoff would be the same as those described above for wetlands. No adverse effects on aquatic resources would be expected.

3.8.6.3.4 Terrestrial Wildlife

Normal operations would have no direct effect on native wildlife. Routine operations would result in minimal noise emissions (see Section 3.5.3). Therefore, noise associated with normal operations would not have significant adverse impacts on wildlife. In the event of a power outage, the use of back-up generators could discourage wildlife utilization of habitats immediately adjacent to the proposed NBAF site. However, power outages would be rare, short-term events that would not have significant long-term effects on wildlife. The accidental or intentional release of a pathogen would have the potential for adverse effects on native mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on wildlife.

3.8.6.3.5 Threatened and Endangered Species

Normal operations would have no direct effect on threatened and endangered species. The accidental or intentional release of a pathogen would have the potential for adverse effects on mammals; however, no federally or state-listed mammals are known to occur in the vicinity of Plum Island. Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Therefore, operations would not be likely to have adverse effects on listed species that occur in the vicinity of the proposed NBAF site. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on native wildlife and endangered species.

3.8.7 Umstead Research Farm Site

3.8.7.1 Affected Environment

3.8.7.1.1 Vegetation

<u>Regional Vegetation</u>

The Umstead Research Farm Site is located in the Piedmont physiographic province (McKerrow et al. 2006). Natural plant communities of the southern Piedmont region are described in Section 3.8.3.1.1.

Site Vegetation

Approximately 90% of the Umstead Research Farm Site was clear-cut in the fall of 2001 (Terracon 2007e). The clear-cut areas are currently dominated by very dense thickets of early successional shrub-scrub vegetation. The shrub-scrub community is characterized by a very dense sapling/shrub stratum that is dominated by weedy mesic hardwood saplings such as sweet-gum, yellow poplar, and red maple. Additional saplings and shrubs include loblolly pine, winged-elm, persimmon (*Diospyros virginiana*), eastern red cedar (*Juniperus virginiana*), winged sumac (*Rhus copallina*), groundsel tree (*Baccharis halimifolia*), and blackberry (*Rubus* sp.). Weedy herbaceous species have colonized logging roads and other small areas where soils were severely disturbed by logging operations. Logging operations also created several small depressions that are holding water on top of compacted soils. These wet disturbed areas have been colonized by hydrophytic herbaceous species such as cattail (*Typha latifolia*), cottongrass bulrush (*Scirpus cyperinus*), black bulrush (*Scirpus atrovirens*), spikerush (*Eleocharis* sp.), common rush (*Juncus effusus*), and leathery rush (*Juncus coriaceus*). A small area of mature hardwood forest occurs near the northeastern boundary of the site. It is a closed-canopy, mesic to dry-mesic community with an overstory dominated by southern red oak, white oak, sweet-gum, yellow poplar, southern sugar maple, and loblolly pine.

The clear-cut areas contain numerous small natural wetland seeps, which occur at the upper ends of streams and at the base of the slope along streams. These seepage areas are dominated primarily by hydrophytic herbaceous species such as common rush, hop sedge (*Carex lupilina*), false nettle (*Boehmeria cylindrica*), spotted touch-me-not (*Impatiens capensis*), and netted chain-fern (*Woodwardia areolata*). These seeps also contain occasional flood-tolerant trees such as red maple and sweet-gum.

Rare and Significant Natural Communities

There are large intrusions of mafic rocks in Granville County, especially in the vicinity of Butner. These rocks weather into less acidic, circumneutral soils, which are associated with numerous occurrences of rare natural communities and rare plant species (NCNHP 2007). The Umstead Research Farm Site is located in the vicinity of the Butner Natural Areas Macrosite, a collection of seven significant natural areas associated with diabase intrusions. These natural areas include two nationally significant registered natural areas that are located approximately 1 mile from the southern boundary of the proposed NBAF site. The Knap of Reeds Creek Diabase Levee and Slopes natural area contains 12 rare plant species, including one of the best populations of the federally endangered smooth coneflower in the United States. The Knap of Reeds Creek Diabase Forest and Glades natural area contains a rare diabase glade community and occurrences of two rare plant species. Additional information regarding rare plant species at these sites is provided in Section 3.8.7.1.5.

3.8.7.1.2 Wetlands

Jurisdictional wetlands and other waters at the Umstead Research Farm Site were delineated on December 12, 2007 (Withers and Ravenel 2007b). Jurisdictional wetlands and waters that were identified within the property boundaries include 0.62-acre of wetlands and 6,937 linear feet of intermittent and perennial streams (Figure 3.8.7.1.2-1). A total of 10 wetland polygons ranging in size from 0.002 to 0.16 acre were delineated on the property. Wetlands at the Umstead Research Farm Site consist of seepage areas at the upper ends (headwaters) of streams or at the base of the slope adjacent to streams. The surrounding uplands have been recently clear-cut, and these seepage areas are currently dominated primarily by hydrophytic herbaceous species such as common rush, sedge (*Carex lupilina*), false nettle, spotted touch-me-not, and netted chain-fern. These seeps also contain occasional flood-tolerant trees such as red maple and sweet-gum.

The proposed NBAF site contains numerous small intermittent and perennial headwater stream segments, all of which originate within the boundaries of the site. All of these streams drain either directly or via other tributaries to Knap of Reeds Creek, which flows south from Lake Butner to Falls Lake. The longest stream segment on the proposed NBAF site originates near the north-central boundary of the property and flows south for approximately 3,000 feet before exiting the property. After crossing the property boundary, this stream continues southward and eventually discharges into Knap of Reeds Creek on the south side of Old Route 75. Numerous additional stream segments are scattered throughout peripheral portions of the property. These additional segments all exit the property before discharging to other tributaries of Knap of Reeds Creek. Streams on the property have average widths ranging from approximately 2 to 5 feet and are characterized by occasional to frequent meanders.

3.8.7.1.3 Aquatic Resources

The Umstead Research Farm Site is located in the Upper Neuse watershed (HUC 03020201), which comprises part of the Neuse River Basin. Freshwater fish species of recreational importance in the Neuse River and its tributaries include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), redbreast sunfish (*Lepomis auritus*), pumpkinseed (Lepomis gibbosus), warmouth (*Lepomis gulosus*), black crappie (*Pomoxis nigromaculatus*), channel catfish (*Ictalurus punctatus*), white catfish (*Ameiurus catus*), blue catfish (*Ictalurus furcatus*), flathead catfish (Pylodictis olivaris), chain pickerel (*Esox* niger), yellow perch (*Perca flavescens*), and white perch (*Morone americana*). Nongame species commonly encountered include bowfin (*Amia calva*), common carp (*Cyprinus carpio*), longnose gar (*Lepisosteus osseus*), pirate perch (*Aphredoderus sayanus*), satinfin shiner (*Cyprinella analostana*), v-lip redhorse (*Moxostoma collapsum*), swallowtail shiner (*Notropis procne*), silvery minnow (*Hybognathus regius*), and tessellated darter (*Etheostoma olmstedi*) (NCDENR 2002b).

The site contains numerous small intermittent and perennial headwater stream segments, all of which originate within the boundaries of the site. All of these streams drain either directly or via other tributaries to Knap of Reeds Creek, which flows south from Lake Butner to Falls Lake. The historical confluence of Knap of Reeds Creek and the Neuse River is now inundated by Falls Lake. The longest stream segment on the proposed NBAF site originates near the north-central boundary of the property and flows south for approximately 3,000 feet before exiting the property. After crossing the property boundary, this stream continues southward and eventually discharges into Knap of Reeds Creek on the south side of Old Route 75. Numerous additional stream segments are scattered throughout the peripheral portions of the property. These additional segments all exit the property before discharging to tributaries of Knap of Reeds Creek. Streams on the property have average widths ranging from approximately 2 to 5 feet and are characterized by occasional to frequent meanders. Streams on the property have been disturbed by a recent clear-cut timber harvest, which has caused minor sedimentation within the stream channels and a dramatic reduction in shading. However, these streams currently have aquatic habitats (e.g., riffles and pools) that are likely to support many of the common aquatic and semi-aquatic species that are typically associated with small headwater streams of the Piedmont. Fish species collected in Knap of Reeds Creek are listed in Table 3.8.7.1.3-1 (NCDENR 2007e). Mussels collected at 44 sampling stations in the Upper Neuse watershed are listed in Table 3.8.7.1.3-2 (Levine et al. 2003). The North Carolina Natural Heritage Program (NCNHP) database includes occurrence records for two state-listed threatened mussels and two state significantly rare mussels from Knap of Reeds Creek: Carolina fatmucket (*Lampsilis radiata conspicua*) (state-threatened), Creeper (*Strophitus undulatus*) (state-threatened), eastern creekshell (*Villosa delumbis*), and Chameleon lampmussel (*Lampsilis* sp. 2) (state significantly rare).

The North Carolina Wildlife Action Plan identifies Knap of Reeds Creek as a priority area for freshwater habitat conservation (NCWRC 2005). The North Carolina Division of Water Quality (NCDWQ) Biological Assessment Program conducted fish sampling within Knap of Reeds Creek in 2004 (Table 3.8.7.1.3-1). A total of 19 species were collected, with bluegill comprising 42% of the total catch (NCDENR 2007e). The state uses the North Carolina Index of Biological Integrity (NCIBI) to assess the ecological health of streams. Based on the 2004 fish data, Knap of Reeds Creek received an NCIBI rating of good-fair. The good-fair rating reflected less than optimal species richness and composition (absence of darters, suckers, and other intolerant species) (NCDENR 2006c).

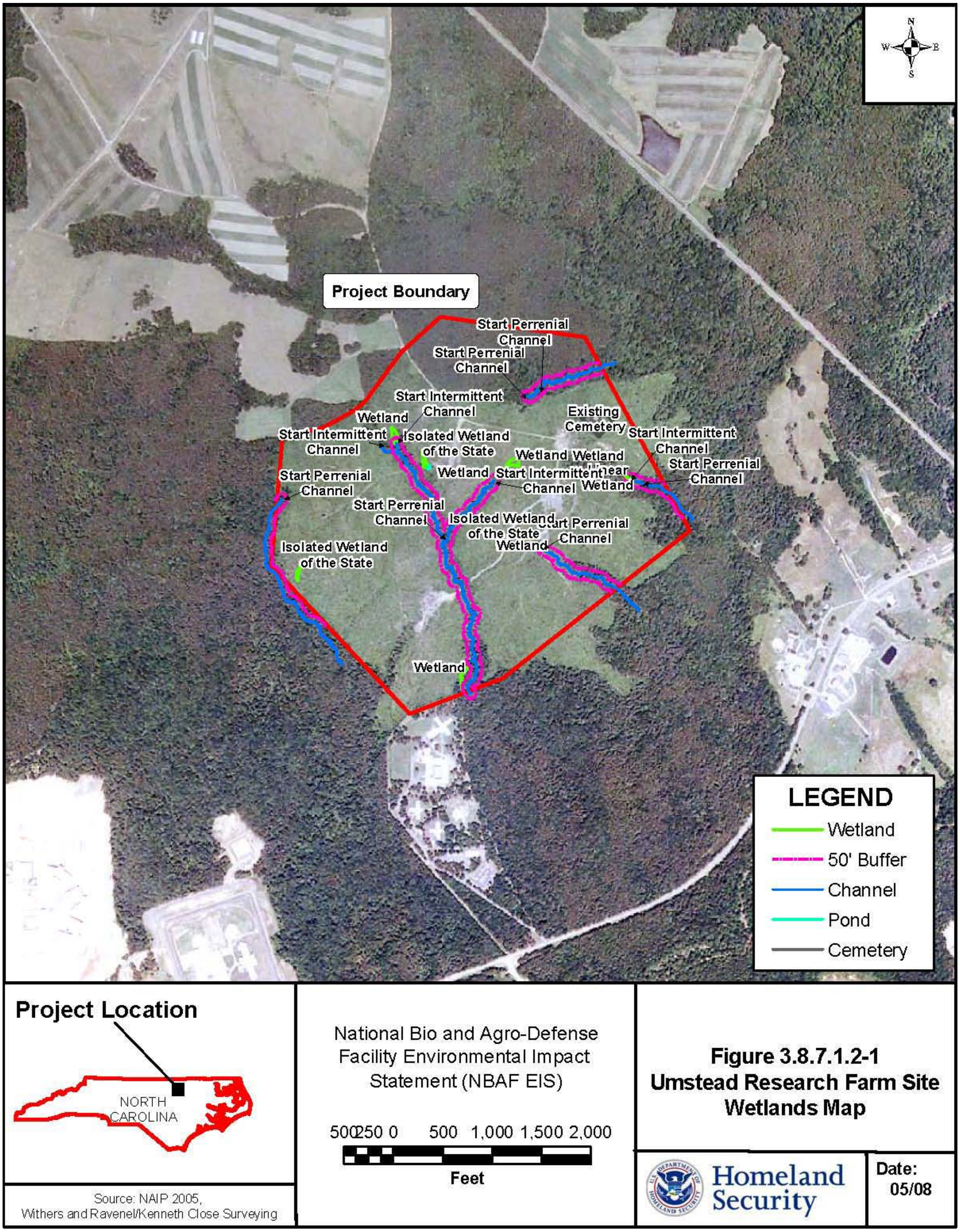


Figure 3.8.7.1.2-1 — Umstead Research Farm Site Wetlands Map

Table 3.8.7.1.3-1 — Species Collected in Knap of Reeds Creek (NCDENR 2007e)

Scientific Name	Common Name
Ameiurus brunneus	Snail bullhead
Ameiurus catus	White catfish
Ameiurus natalis	Yellow bullhead
Centrarchus macropterus	Flier
Cyprinella analostana	Satinfin shiner
Dorosoma cepedianum	Gizzard shad
Esox americanus	Redfin pickerel
Gambusia holbrooki	Eastern mosquitofish
Lepomis auritus	Redbreast sunfish
Lepomis cyanellus	Green sunfish
Lepomis gibbosus	Pumpkinseed
Lepomis gulosus	Warmouth
Lepomis macrochirus	Bluegill
Lepomis microlophus	Redear sunfish
Micropterus salmoides	Largemouth bass
Morone americana	White perch
Nocomis raneyi	Bull chub
Perca flavescens	Yellow perch
Umbra pygmaea	Eastern mudminnow

Table 3.8.7.1.3-2 — Mussels Collected at 44 Survey Locations in the Upper Neuse River Watershed (Levine et al. 2003)

Common Name	Scientific Name	Number Found
Eastern elliptio	*Elliptio complanata*	24,836
Creeper	*Strophitus undulates* [a]	191
Notched rainbow	*Villosa constricta* [b]	189
Eastern floater	*Pyganodon cataracta*	164
Eastern lampmussel	*Lampsilis radiata* [a]	54
Yellow lampmussel	*Lampsilis cariosa* [c]	45
Lampmussel	*Lampsilis* sp.	37
Atlantic pigtoe	*Fusconaia masoni* [c]	31
Green floater	*Lasmigona subviridis* [c]	2
Paper pondshell	*Utterbackia imbecilis*	1

[a] State threatened [b] State special concern [c] State endangered.

3.8.7.1.4 Terrestrial Wildlife

The North Carolina GAP has developed models that predict the statewide distributions of terrestrial vertebrate species that are known to breed in North Carolina (McKerrow et al. 2006). Non-breeding species that occur in North Carolina consist primarily of over-wintering or transient migratory bird species. The accepted list of all birds for North Carolina includes 464 species. The North Carolina GAP list of breeding species for the Upper Neuse River basin includes 50 mammals, 128 birds, 59 reptiles, and 48 amphibians. Documented fauna from the Falls Lake State Recreation Area (3 miles south of the proposed NBAF site) includes 30 mammals, 293 birds, 35 reptiles, and 21 amphibians (NCDENR 2008).

The Umstead Research Farm Site is located within the Butner-Falls of Neuse Gameland. The gameland has a total area of 40,899 acres and includes most of the surface area of Falls Lake. The Umstead Research Farm Site is managed as part of the gameland through a lease agreement between the North Carolina Department of

Agriculture and the NCWRC (NCWRC 2007). Game species that are targeted include white-tailed deer (*Odocoileus virginianus*), red and gray fox (*Vulpes vulpes* and *Urocyon cinereoargenteus*), common raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), eastern gray squirrel (*Sciurus carolinensis*), wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), mourning dove (*Zenaida macroura*), and waterfowl. The gameland includes several managed waterfowl impoundments that are located just south of the proposed NBAF site along the Flat River and Knap of Reeds Creek. The Falls Lake State Recreation Area is located approximately 3 miles south of the proposed NBAF site. The Falls Lake State Recreation Area is a collection of seven state parks that adjoin Falls Lake and the Neuse River.

As described in Section 3.8.7.1.1, approximately 90% of the Umstead Research Farm Site has been recently clear-cut and is dominated by early successional shrub-scrub vegetation. This shrub-scrub community is characterized by a very dense shrub stratum that is dominated by mesic hardwood saplings. Additional habitats include a small area of mature mesic to dry-mesic hardwood forest near the northeastern site boundary, small pockets of wetland vegetation, and small headwater streams with narrow forested buffers. Early successional shrub-scrub communities provide valuable habitat for white-tailed deer, small mammals, and numerous resident and migratory birds. Breeding birds that are most commonly associated with early successional or shrub-scrub habitats in North Carolina are listed in Table 3.8.7.1.4-1. Although mature upland hardwood forests and wetland communities comprise only a small portion of the property, these areas increase habitat diversity and increase the potential for occurrences of additional species. In addition, the numerous small headwater streams on the property represent potential habitat for numerous amphibians and other aquatic and semi-aquatic species (see Section 3.8.7.1.3 for a discussion of aquatic communities). Based on the diversity of habitats that are present, many of the species documented at the Falls Lake State Recreation Area (North Carolina Division of Parks and Recreation 2008) are also likely to occur at the Umstead Research Farm Site (excepting most waterfowl and wading birds).

Table 3.8.7.1.4-1 — Successional/Scrub-Shrub Breeding Birds in North Carolina (Sauer et al. 2007)

Scientific Name	Common Name
Colinus virginianus	Northern bobwhite
Spizella pusilla	Field sparrow
Vireo griseus	White-eyed vireo
Passerina cyanea	Indigo bunting
Geothlypis trichas	Common yellowthroat
Dendroica discolor	Prairie warbler
Dumetella carolinensis	Gray catbird
Cardinalis cardinalis	Northern cardinal
Passerina caerulea	Blue grosbeak
Carduelis tristis	American goldfinch
Troglodytes aedon	House wren
Thryothorus ludovicianus	Carolina wren
Icteria virens	Yellow-breasted chat
Toxostoma rufum	Brown thrasher
Melospiza melodia	Song sparrow
Pipilo erythrophthalmus	Eastern towhee

Note: List includes species encountered on more than 14 Breeding Bird Survey routes.

The distribution of ungulate populations has particular relevance, since they are susceptible to many of the diseases that may be studied at the proposed NBAF. Ungulates that occur in North Carolina include white-tailed deer and wild boar (*Sus scrofa*). The white-tailed deer is a common species throughout North Carolina. White-tailed deer are likely to occur in all the habitats at the proposed NBAF site. In North Carolina, the wild boar is distributed throughout the extreme western mountain counties and in numerous isolated pockets throughout the foothills, piedmont, and coastal plain regions. The nearest known populations are located near the western boundary of Granville County in Caswell and Person Counties (Southeastern Cooperative Wildlife Disease Study 2004). The wild boar is a non-native invasive species with the potential to negatively impact natural communities and native species. North Carolina Wildlife Action Plan priorities include investigating these impacts and possibly controlling wild boar populations in the near future (NCWRC 2005).

3.8.7.1.5 Threatened and Endangered Species

Federally listed species that are known to occur in Granville County include three endangered species: dwarf wedge mussel (*Alasmidonta heterodon*), smooth coneflower (*Echinacea laevigata*), and harperella (*Ptlimnion nodosum*). An additional 29 species that are known to occur in Granville County are listed by the state as endangered, threatened, or special concern (Table 3.8.7.1.5-1). Animal and plant species that are listed by the state as endangered, threatened, or special concern are afforded protection under the *North Carolina Endangered Species Act* (G.S. 113-331 – 113-337) and the *North Carolina Plant Protection Act of 1979* (G.S. 196 106-202.12 – 106-202.19). The state also tracks occurrences of species that are considered to be significantly rare in North Carolina; however, these species are not afforded protection under state laws. Other rare species that occur in Granville County include 37 species that are considered significantly rare in North Carolina (NCNHP 2008); however, these species have no legal protection.

A database review conducted by the NCNHP did not identify any known occurrences of rare, threatened, or endangered species within the boundaries of the proposed NBAF site or within a 0.7-mile radius of the site. However, occurrences of the federally endangered smooth coneflower (*Echinacea laevigata*), multiple state-listed plant species, and several state-listed mussels were identified just outside of the 0.7-mile radius.

Most of the rare plant species that occur in Granville County are associated with intrusions of mafic rocks such as diabase and gabbro. There are large intrusions of mafic rocks in Granville County, especially in the vicinity of Butner. These rocks weather into less acidic, circumneutral soils, which are associated with numerous occurrences of rare natural communities and plant species (NCNHP 2007). The Umstead Research Farm Site is located in the vicinity of the Butner Natural Areas Macrosite, a collection of seven significant natural areas associated with diabase intrusions. These natural areas include two nationally significant registered natural areas that are located approximately 1 mile from the southern boundary of the proposed NBAF site. The Knap of Reeds Creek Diabase Levee and Slopes natural area contains 12 rare plant species, including one of the largest populations of the federally endangered smooth coneflower in the United States. Additional rare species at this site include the state-listed endangered tall larkspur (*Delphinium exaltatum*) and six additional plant species that are considered significantly rare in North Carolina: Carolina thistle (*Cirsium carolinianum*), Indian physic (*Gillenia stipulata*), prairie dock (*Silphium terebinthinaceum*), hoary puccoon (*Lithospermum canescens*), Douglass's bittercress (*Cardamine douglassii*), Earle's blazing star (*Liatris squarrulosa*), Pursh's wild-petunia (*Ruellia purshiana*), and glade milkvine (*Matelea decipiens*). The Knap of Reeds Creek Diabase Forest and Glades natural area contains a rare diabase glade natural community. Rare species at this site include two significantly rare plant species: glade bluecurls (*Trichostema brachiatum*) and Pursh's wild-petunia (NCNHP 2007).

Table 3.8.7.1.5-1 — Granville County Federally and State-listed Protected Species

Scientific Name	Common Name	State Status [a]	Federal Status [b]	Habitat	Habitat Present at NBAF Site
Haliaeetus leucocephalus	Bald eagle	T	-	Mature forests near large bodies of water.	No
Lanius ludovicianus	Loggerhead shrike	SC	-	Fields and pastures.	No
Crotalus horridus	Timber rattlesnake	SC	-	Rocky upland forests.	No
Hemidactylium scutatum	Four-toed salamander	SC	-	In the Piedmont, occurs in ponds, springs, floodplain pools, marshes, and streams adjacent to or surrounded by forest with sections of dense moss and/or grass-sedge ground cover are preferred (NCGAP).	Marginal
Etheostoma collis pop. 2	Carolina darter - Eastern Piedmont population	SC	-	Backwater pools or near banks in slow-moving small streams.	Yes
Necturus lewisi	Neuse river waterdog	SC	-	Rivers and large streams.	No
Alasmidonta heterodon	Dwarf wedgemussel	E	E	Found in large rivers and small streams, often burrowed into clay banks among the root systems of trees. They may also be found associated with mixed substrates of cobble, gravel, and sand. Occasionally, they may be found in very soft silt substrates.	Yes
Alasmidonta undulata	Triangle floater	T	-	Demonstrates no particular habitat preference across its range, having been collected from silt/sand in slower moving waters, gravel/sand in riffles and runs, and from crevices in bedrock.	Yes
Alasmidonta varicosa	Brook floater	E	-	Inhabits medium size streams and rivers. It prefers clean, swift waters with stable gravel, or sand and gravel substrates.	No
Elliptio lanceolata	Yellow lance	E	-	Prefers clean, coarse to medium-sized sands as substrate. On occasion, specimens are also found in gravel substrates. This species is found in the main channels of drainages down to streams as small as 3 feet across.	Yes
Fusconaia masoni	Atlantic pigtoe	E	-	Inhabits mostly medium to large streams. It prefers clean, swift waters with stable gravel, or sand and gravel substrate.	No
Lampsilis cariosa	Yellow lampmussel	E	-	Many different habitats. Appears to slightly prefer the shifting sands downstream from large boulders in relatively fast flowing, medium-sized rivers and medium to large creeks.	No

Table 3.8.7.1.5-1 — Granville County Federally and State-listed Protected Species (Continued)

Scientific Name	Common Name	State Status [a]	Federal Status [b]	Habitat	Habitat Present at NBAF Site
Lampsilis radiata conspicua	Carolina fatmucket	T	-	Found in gravel, cobble, or boulder substrates as well as in impounded habitats.	Yes
Lasmigona subviridis	Green floater	E	-	Small- to medium-size streams. It is intolerant of very strong currents and often is found in quiet pools and eddies with gravel and sand substrate.	Yes
Orconectes carolinensis	North Carolina spiny crayfish	SC	-	Small to large streams in the Neuse and Tar Basins; under cover; rock substrates.	Yes
Orconectes virginiensis	Chowanoke crayfish	SC	-	Sluggish streams or swamps on sand or gravel substrates Chowan and Roanoke basins.	No
Strophitus undulatus	Creeper	T	-	Silt, sand, gravel, and mixed substrates. Found from headwater streams to large rivers and lakes.	Yes
Villosa constricta	Notched rainbow	SC	-	Streams with sand/gravel substrates, often in stable banks among tree root mats.	Yes
Baptisia minor var. aberrans	Prairie blue wild indigo	T	-	Glades, barrens, and open woodlands over limestone (or other calcareous rocks) and diabase (or other mafic rocks) in areas that were formerly prairies, barrens, glades, or oak savannas.	No
Delphinium exaltatum	Tall larkspur	E-SC	-	Dry to moist soils over calcareous (such as dolostone, especially Elbrook Formation) or mafic rocks (such as amphibolite, metagabbro, greenstone, and diabase).	No
Echinacea laevigata	Smooth coneflower	E-SC	E	Open woodlands and glades over mafic or calcareous rocks such as diabase, limestone, and dolostone.	No
Isoetes piedmontana	Piedmont quillwort	T	-	In seepage on granitic flatrocks; diabase glades.	No
Portulaca smallii	Small's portulaca	T	-	Granite flatrocks and diabase glades.	No
Ptilimnium nodosum	Harperella	E	E	Rocky riverbeds.	No
Ruellia humilis	Low wild-petunia	T	-	Diabase glades and woodlands.	No
Solidago ptarmicoides	Prairie goldenrod	E	-	Prairie-like barrens over mafic, ultramafic, or calcareous rock, serpentine woodlands.	No
Talinum mengesii	Large-flowered fameflower	E	-	In shallow soil over felsic rocks (granite), where periodically wet by seepage.	No

[a] State Status Codes: E = Endangered, T = Threatened, SC = Special Concern.
[b] Federal Status Codes: E = Endangered.

Federally Listed Species

Smooth Coneflower

The federally endangered smooth coneflower occurs in open woodlands and glades over mafic or calcareous rocks, such as diabase, limestone, and dolostone. Rare occurrences have also been documented in oak-pine savannas of the upper Coastal Plain over circumneutral clay sediments (Weakley 2007). Occurrences in the vicinity of the Umstead Research Farm Site are associated with diabase glades. Withers and Ravenel biologists conducted a walking survey for suitable habitat at the proposed NBAF site on June 29, 2007 (Withers and Ravenel 2007a). This survey did not identify any suitable habitat for smooth coneflower at the proposed NBAF site. As described in Section 3.8.7.1.1, approximately 90% of the site is currently occupied by a very dense shrub-scrub stratum that is dominated by weedy mesic hardwoods. A small area of mature forest at the site is a closed canopy dry-mesic to mesic hardwood forest. No dry open woodlands or glade habitats were observed at the site.

Harperella

In North Carolina, habitat for the federally endangered harperella (*Ptilimnium nodosum*) consists of rocky or gravelly shoals of clear, swift-flowing streams (NCNHP 2001). Streams occurring within the project area are small first-order headwater streams, which do not represent suitable habitat for this species.

Dwarf Wedge Mussel

The federally endangered dwarf wedge mussel is found in large rivers and small streams, often burrowed into clay banks among the root systems of trees. They may also be found in mixed substrates of cobble, gravel, and sand. Occasionally they occur in very soft silt substrates. Stream banks are stable with extensive root systems holding soils in place. The associated landscape is largely wooded, especially near streams. Trees near the stream are relatively mature and tend to form a closed canopy over smaller streams, creeks, and headwater river habitats. Water quality is typically good to excellent. In Granville County, the dwarf wedge mussel is known to occur in the Upper Tar River subbasin. The only known extant population in the Upper Neuse watershed is located in the Eno River in Orange County; however, recent sampling indicates that this population may also be extirpated (NCWRC 2005). No mussel surveys have been conducted within streams at the proposed NBAF site. However, given the recent disturbance associated with a clear-cut timber harvest and the absence of known extant populations in the area, its occurrence in the project area appears to be unlikely. Since construction of the NBAF would not affect wetlands, streams, or stream buffer zones (see Section 3.8.7.2.5), surveys are not anticipated. However, surveys would be conducted if requested by the USFWS through informal consultation.

State-Listed Species

All of the state-listed (endangered, threatened, or special concern) plant species that occur in Granville County are associated with xeric open woodlands and/or rare communities such as diabase glades that occur over intrusions of mafic rocks (i.e., diabase and gabbro). Although specific surveys for state-listed species were not conducted, surveys for the federally endangered smooth coneflower indicate that the proposed NBAF site does not contain any rare communities that would support occurrences of these species (Withers and Ravenel 2007a).

The NCNHP database includes occurrence records for two state-listed threatened mussels and one state significantly rare mussel from Knap of Reeds Creek: Carolina fatmucket (*Lampsilis radiata conspicua*) (state threatened), creeper (*Strophitus undulatus*) (state threatened), eastern creekshell (*Villosa delumbis*) (state significantly rare), and chameleon lampmussel (*Lampsilis* sp.) (state significantly rare). Small streams within the project area may represent potential habitat for the Carolina darter, North Carolina spiny crayfish, and several species of mussels that are listed by the state (Table 3.8.7.1.5-1). No aquatic surveys have been conducted within streams at the proposed NBAF site. However, given the recent disturbance associated with a clear-cut timber harvest and the absence of known extant populations in the area, the occurrence of these species in the project area appears to be unlikely. Since construction of the NBAF would not affect wetlands, streams, or stream buffer zones (see Section 3.8.7.2.5), surveys are not anticipated. The project area does not contain suitable habitat for the remaining species that are listed by the state as endangered, threatened, or special concern (Table 3.8.7.1.5-1).

3.8.7.2 Construction Consequences

3.8.7.2.1 Vegetation

Construction of the proposed NBAF would affect approximately 30 acres of land at the Umstead Research Farm Site. All effects would occur within upland shrub-scrub communities that are dominated by a very dense assemblage of shrubs and weedy mesic hardwoods. The affected area has been severely disturbed by a recent clear-cut timber harvest and does not contain rare or significant natural plant communities. Based on the poor quality of vegetation in the affected area, the project would not have significant direct effects on natural plant communities. Potential indirect effects during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, natural communities that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on vegetation. Off-site connected actions involving the installation of new electrical lines, potable water lines, sewer lines, and gas lines would occur within existing right-of-ways and/or within existing roadside easements and, therefore, would not have any significant impacts on vegetation. Improvements to the existing dirt road between the proposed NBAF site and Range Road would have insignificant vegetation impacts along the margins of the existing road. The construction of acceleration and deceleration lanes at Range Road would affect existing roadside easements and, therefore, would not have any significant impacts on vegetation.

3.8.7.2.2 Wetlands

Earth-disturbing activities would be restricted to upland shrub-scrub areas and, therefore, would have no direct effect on streams or wetlands. Potential indirect construction effects include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, wetlands and streams that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. Sedimentation in stream channels can impact both water quality and aquatic habitats (see Section 3.8.7.2.3). However, erosion and sedimentation control measures would minimize the potential for adverse effects on aquatic resources.

3.8.7.2.3 Aquatic Resources

Construction of the proposed NBAF would affect approximately 30 acres of land. Earth-disturbing activities would be restricted to upland areas and would not impact streams, aquatic habitats, wetlands, or the 50-foot vegetated stream buffers that are required in the Neuse River Basin. Therefore, the project would have no direct effect on aquatic communities. Potential indirect effects include erosion and sedimentation during the construction process. Removal of vegetation and soil disturbance within the proposed construction area would expose soils to potential erosion during storm events. Sediments that are transported into stream channels can degrade water quality by increasing turbidity, and the deposition of sediments in stream channels can impact aquatic communities through the homogenization of habitat. However, erosion and sedimentation control measures would minimize the potential for adverse effects on aquatic resources.

3.8.7.2.4 Terrestrial Wildlife

Construction of the proposed NBAF would affect approximately 30 acres of disturbed, upland shrub-scrub vegetation. The site would retain approximately 200 acres of shrub-scrub habitat, and none of the other existing habitat types on the property would be impacted. The small area of mature forest that occurs on the property would not be impacted by construction of the facility, no wetlands or streams would be affected, and all 50-foot forested stream buffers would be retained. Construction of the facility would have short-term and long-term effects on wildlife. Land-clearing activities, construction noise, and dust creation would likely discourage wildlife utilization of habitats that are adjacent to the proposed construction area; however, these effects would subside with completion of the project. Long-term effects would result from habitat loss and permanent displacement of wildlife within the 30-acre project area. However, given the retention of habitat diversity and a large area (~200 acres) of shrub-scrub habitat within the boundaries of the property, construction of the facility is not likely to have significant long-term impacts on local wildlife populations. The NBAF is surrounded by the Butner Game Lands, Falls Lake State Park, and other large areas of suitable forested habitat that are not likely to be developed as part of the on-going growth in the Butner area. These areas would provide a buffer that would minimize changes in the pattern of wildlife dispersal in the vicinity of the NBAF facility.Therefore, construction of the NBAF is not likely to have a significant effect on wildlife dipersal in the Butner area.

3.8.7.2.5 Threatened and Endangered Species

Informal Section 7 consultation has been initiated with the USFWS Raleigh Field Office. A review conducted by NCNHP did not identify any occurrences of rare, threatened, or endangered species within the boundaries of the Umstead Research Farm Site. As described above, the general area surrounding the site contains numerous occurrences of federally and state-listed plant species that are associated with rare diabase rock communities; however, surveys of the project area on did not identify any community types that would support occurrences of these species (Withers and Ravenel 2007a). The project area does contain several small headwater stream segments that represent potential habitat for the federally endangered dwarf wedge mussel, the state-listed Carolina darter, and several state-listed mussels (Table 3.8.7.1.5-1). Since construction of the proposed NBAF would not affect wetlands, streams, or the 50-foot vegetated stream buffer zones required in the Neuse River basin, specific surveys for these species have not been conducted. Earth-disturbing activities would be restricted to disturbed upland shrub-scrub areas and, therefore, would have no direct impact on protected species or potential habitat. Soil disturbance during the construction process would expose soils to potential erosion during storm events. Erosion and subsequent sedimentation in stream channels have the potential for adverse impacts on aquatic organisms. Therefore, any increases in sediment transport could have negative impacts on potential habitat for listed aquatic species. However, retention of vegetated stream buffers and the requirement for an approved erosion and sedimentation control plan would minimize the potential for such impacts.

3.8.7.3 Operation Consequences

3.8.7.3.1 Vegetation

The proposed NBAF would create 270,000 square feet of impervious surface area, which would result in 22,500 cubic feet of runoff during a 1-inch rainfall event. Increases in impervious surface area increase storm water runoff and stream flow after storm events. Increases in volume and velocity of stream flow can cause stream channel incision and/or widening, resulting in the loss of adjacent terrestrial vegetation and alteration of the hydrological regime within adjacent plant communities. Potential stream effects are especially relevant to the Knap of Reeds Creek Diabase Levee and Slopes Natural Area. This natural area contains a rare diabase levee community along the banks of Knap of Reeds Creek. Natural levees are depositional features that are formed by flooding events. Levees are positioned along the margins of streams and, therefore, are susceptible to effects associated with alterations of stream flow.

Storm water management systems would be designed in accordance with applicable storm water BMPs and additional requirements that are specific to the Neuse River basin. In addition to meeting the minimum state requirements for storm water management, the proposed NBAF would employ a LID approach that would minimize storm water runoff (see Section 3.7.7.3.2). The use of LID development techniques and BMPs would mitigate most of the potential adverse effects on stream channels and adjacent terrestrial vegetation.

3.8.7.3.2 Wetlands

Operations of the proposed NBAF would have no direct impacts on wetlands; however, increases in impervious surface area and storm water runoff have the potential for indirect wetland impacts. Increases in impervious surface area can increase storm water runoff and stream flow after storm events. Increases in stream flow volume and velocity can cause stream channel incision and/or widening, resulting in the loss of adjacent wetland vegetation and alteration of the hydrological regime within adjacent wetlands. The storm water management system would be designed in accordance with applicable storm water BMPs and specific Neuse River basin requirements. In addition to meeting the minimum state requirements for storm water management, the proposed NBAF would employ a LID approach that would minimize storm water runoff (see Section 3.7.7.3.2). The use of LID development techniques and BMPs would mitigate most of the potential adverse effects on aquatic resources.

3.8.7.3.3 Aquatic Resources

Operations at the proposed NBAF would have no direct effects on aquatic communities; however, increases in impervious surface area and storm water runoff have the potential for indirect impacts on water quality and aquatic communities. The proposed NBAF would create 270,000 square feet of impervious surface area, which would result in 22,500 cubic feet of runoff during a 1-inch rainfall event. Storm water runoff from impervious surfaces such as buildings and parking lots can transport pollutants such as automotive fluids, fertilizer, pesticides, bacteria, and heavy metals into surface waters. Furthermore, rapid runoff from impervious surface areas increases the rate of flow in receiving streams. Increases in stream flow volume and velocity can cause stream channel erosion, resulting in increased turbidity and sedimentation downstream. The storm water management system would be designed in accordance with applicable storm water BMPs and specific Neuse River basin requirements. In addition to meeting the minimum state requirements for storm water management, the proposed NBAF would employ a LID approach that would minimize storm water runoff (see Section 3.7.7.3.2). The use of LID development techniques and BMPs would mitigate most of the potential adverse effects on aquatic resources.

3.8.7.3.4 Terrestrial Wildlife

Section 3.5.5.3 addresses operational noise impacts associated with the proposed NBAF. Minor noise impacts would result from an increase in traffic and operation of the facility's filtration, heating, and cooling systems. Section 3.5.5.3 describes noise-attenuating design features that would minimize noise emissions. In the event of a power outage, operation of back-up generators could have a short-term impact on wildlife by discouraging utilization of immediately adjacent habitats. Routine operations at the NBAF would not be likely to have significant noise impacts on wildlife. Security requirements at the proposed NBAF would require continuous outdoor nighttime lighting. Nighttime lighting has the potential to impact wildlife through astronomical and ecological light pollution. Unshielded lighting can shine upward and interfere with bird migration, disorienting birds and causing them to collide with structures. Birds are attracted to lights and may collide with lighted structures. Most concerns involve lighting associated with high-rise buildings and telecommunication towers; however, even residential lighting can affect some birds. The USFWS advocates the use of shielded lighting to minimize adverse impacts on migratory birds. Shielded fixtures direct light downwards and can be used to keep light within the boundaries of the site. Artificial lighting also has the potential for ecological effects such as repulsion and/or interference with foraging behavior. The NBAF would employ the minimum intensity of lighting that is necessary to provide adequate security. Mitigation measures, such as those described above, will be considered in the final design of the NBAF. The use of shielded lighting would minimize the potential for impacts in adjacent habitats. Given the relatively low profile of the building and the use of shielded lighting, significant impacts on migratory birds would not be likely to occur. The accidental or intentional release of a pathogen would have the potential for adverse effects on native mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on wildlife.

3.8.7.3.5 Threatened and Endangered Species

Normal operations would have no direct effect on threatened and endangered species. The accidental or intentional release of a pathogen would have the potential for adverse effects on mammals; however, no federally or state-listed mammals are known to occur in Granville County. Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Therefore, operations would not be likely to have adverse effects on listed species that occur in the vicinity of the proposed NBAF site. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on native wildlife and endangered species.

3.8.8 Texas Research Park Site

3.8.8.1 Affected Environment

3.8.8.1.1 Vegetation

Regional Vegetation

The Texas Research Park Site is located at the convergence of several ecoregions that include the South Texas Plains, the Edwards Plateau, and the Blackland Praires (TPWD 2005). Texas Parks and Wildlife has mapped the area as the Mesquite-Live Oak-Bluewood Parks vegetation type (McMahan et al. 1984). The Mesquite Live Oak-Bluewood Parks vegetation type is associated with the South Texas Plains ecoregion. Common species include mesquite (*Prosopis glandulosa*), live oak (*Quercus fusiformis*), bluewood (*Condalia hookeri*), huisache (*Acacia smallii*), whitebrush (*Aloysia gratissima*), spiny hackberry (*Celtis pallida*), and lotebush (*Ziziphus obtusifolia*).

Site Vegetation

Vegetation on the Texas Research Park Site is characterized by scrubby and sparse woody vegetation intermixed with areas that are dominated by herbaceous species. The eastern and southern portions of the Texas Research Park Site contain plant communities that are representative of this community type. These portions of the site are characterized by live oak mottes with little to moderate understory. Live oak trees occur primarily in large patches that are separated by grass-dominated breaks. Additional woody species that are present in both the understory and canopy of the mottes include mesquite, bluewood, Texas mountain laurel (*Sophora secundiflora*), and Texas persimmon (*Diospyros texana*). Cedar elms (*Ulmus crassifolia*) occur as solitary individuals along the edges of the mottes. Other common understory species that are associated with the mottes include Texas kidneywood (*Eysenhardtia texana*), prickly pear (*Opunita lindheimeri*), and Arkansas yucca (*Yucca arkansana*). Additional species include guayacan (*Guajacum angustifolium*), agarita (*Berneris trifoliolata*), twist-leaf yucca (*Yucca rupicola*), Lindheimer senna (*Senna lingheimeri*), croton (*Croton manoanthogynus*), frostweed (*Verbesina virginica*), velvet-leaf mallow (*Wissadula holosericea*), Indian mallow (*Abutilon incanum*), rough cocklebur (*Xanthium strumamium*), snakeweed (*Gutierrezia dracunculoides*), and snapdragon vine (*Maurandya antirrhiniflora*) and hackbery (*Celtis reticulata*) seedlings (SWCA 2007).

Species that are common in the grass-dominated openings include Johnsongrass (*Sorghum halepense*), bristlegrass (*Setaria* sp.), Bermudagrass (*Cynodon dactylon*), sideoats grama (*Bouteloua curtipendula*), straggerler's daisy (*Calyptocarpus vialis*), pricklypear, Arkansas yucca, and toothleaf goldeneye (*Viguiera dentate*). Additional species in the grass-dominated areas include hooded windmill grass (*Chloris cucullata*), little bluestem (*Schizacyyriu, scoparium*), lovegrass (*Eragrotis trichodes*), and deergrass (*Muhlenbergia rigens*).

The western and central portions of the Texas Research Park Site contain many of the same species; however, woody vegetation is very scrubby and herbaceous species are dominant. Scattered trees consist primarily of mesquite, Texas mountain laurel, and Texas persimmon. There are a few pecan trees (*Carya illinoensis*) along the western edge of the property, and a few scattered Ashe junipers (*Juniperus ashei*) and mature hackberry trees on the central portion of the site.

3.8.8.1.2 Wetlands

Based on a preliminary wetland review conducted by Terracon (2007d), it was determined that further wetland investigations were not warranted. The preliminary review included a walking survey of the site and review of NWI maps, USGS quadrangle maps, FEMA Flood Insurance Rate Maps, and recent aerial photography. This preliminary review did not identify any wetland indicators at the proposed NBAF site. USGS quadrangle maps show two unnamed intermittent tributaries of Lucas Creek that originate just outside the northern and southern boundaries of the proposed NBAF site. Since these features occur outside of the property boundary, their jurisdictional status was not investigated.

3.8.8.1.3 Aquatic Resources

No aquatic resources occur within the boundaries of the proposed NBAF site. However, USGS quadrangle maps show two unnamed intermittent tributaries of Lucas Creek that originate just outside the northern and southern boundaries of the proposed NBAF site. These tributaries drain southeast for approximately 1 mile before joining to form Lucas Creek. Lucas Creek drains southeast for approximately 6 miles and discharges to Leon Creek just before its confluence with the Medina River. Fish communities within Lucas Creek and its tributaries are probably limited by the empheral nature of the streams (i.e., lack of permanent water). Fish species that occur in the Medina River include central stoneroller (*Campostoma anomalum*), blacktail shiner (*Cyprinella venusta*), Texas shiner (*Notropis amabilis*), sand shiner (*Notropis stramineus*), mimic shiner (*Notropis volucellus*), gray redhorse (*Moxostoma congestum*), channel catfish (*Ictalurus punctatus*), western mosquitofish (*Gambusia affinis*), redbreast sunfish (*Lepomis auritus*), green sunfish (*Lepomis cyanellus*), warmouth (*Lepomis gulosus*), bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis mega loti*), guadalupe bass (*Micropterus treculi*), and Rio Grande cichlid (*Cichlasoma cyanoguttatum*) (Linum et al. 2002).

3.8.8.1.4 Terrestrial Wildlife

The proposed NBAF site contains habitats that are representative of natural communities in the region. Therefore, the site probably supports a diverse assemblage of wildlife species that are characteristic of these habitats. Mammals that may occur in the vivinity of the proposed NBAF site include Virginia opossum (*Didelphis virginiana*), nine-banded armadillo (*Dasypus novemcinctus*), eastern cottontail (*Silvilagus floridanus*), black-tailed jackrabbit (*Lepus californicus*), hispid pocket mouse (*Chaetodipus hispidus*), fulvous harvest mouse (*Reithrodontomys fulvescens*), Texas mouse (*Peromyscus attwateri*), white-footed mouse (*Peromyscus leucopus*), hispid cotton rat (*Sigmodon hispidus*), coyote (*Canis latrans*), common gray fox (*Urocyon cinereoargenteus*), ringtail (*Bassariscus astutus*), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), and white-tailed deer (*Odocoileus virginianus*).

Resident birds that may occur in the vivinity of the proposed NBAF site include turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), killdeer (*Charadrius vociferus*), rock dove (*Columba livia*), white-winged dove (*Zenaida asiatica*), mourning dove (*Zenaida macroura*), greater roadrunner (*Geococcyx californianus*), golden-fronted woodpecker (*Melanerpes aurifrons*), blue jay (*Cyanocitta cristata*), Carolina chickadee (*Poecile carolinensis*), tufted titmouse (*Baeolophus bicolor*), Carolina wren (*Thryothorus ludovicianus*), Bewick's wren (*Thryomanes bewickii*), northern mockingbird (*Mimus polyglottos*), European starling (*Sturnus vulgaris*), northern cardinal (*Cardinalis cardinalis*), lark sparrow (*Chondestes grammacus*), eastern meadowlark (*Sturnella magna*), great-tailed grackle (*Quiscalus mexicanus*), brown-headed cowbird (*Molothrus ater*), house finch (*Carpodacus mexicanus*), and house sparrow (*Passer domesticus*). Numerous additional summer resident and migratory species are also likely to occur in the vivinity of the proposed NBAF site.

Reptiles that may occur in the vivinity of the proposed NBAF site include green anole (*Anolis carolinensis*), Texas spotted whiptail (*Aspidoscelis gularis gularis*), Texas greater earless lizard (*Cophosaurus texanus texanus*), Texas alligator lizard (*Gerrhonotus infernalis*), prairie lizard (*Sceloporus consobrinus*), Texas spiny lizard (*Sceloporus olivaceus*), little brown skink (*Scincella lateralis*), short-lined skink (*Eumeces tetragrammus brevilineatus*), eastern yellow-bellied racer (*Coluber constrictor flaviventris*), Texas ratsnake (*Elaphe obsoleta*), western coachwhip (*Masticophis flagellum testaceus*), Texas patch-nosed snake (*Salvadora grahamiae lineata*), checkered gartersnake (*Thamnophis marcianus*), Texas toad (*Bufo speciosus*), Gulf Coast toad (*Bufo nebulifer*), and Couch's spadefoot toad (*Scaphiopus couchii*).

3.8.8.1.5 Threatened and Endangered Species

A total of 15 federally listed species are known to occur in Bexar and Medina Counties (Table 3.8.8.1.5-1). Texas Parks and Wildlife Department (TPWD) occurrence records for Bexar and Medina Counties include an additional seven species that are listed by the state as endangered or threatened (Table 3.8.8.1.5-1). Species listed by the state as endangered or threatened are protected under Chapters 67 and 68 of the Texas Parks and Wildlife Code and Sections 65.171 – 65.176 of Title 31 of the Texas Administrative Code.

<u>Federally Listed Species</u>

Golden-cheeked Warbler

Typical nesting habitat for the golden-cheeked warbler consists of tall, dense, mature stands of Ashe juniper (blueberry cedar) mixed with broadleaf hardwoods. Warblers require a combination of mature Ashe juniper and hardwood trees in their nesting habitat, and nesting is dependent on the presence of Ashe juniper for fine bark strips used in nest construction. Generally, Ashe juniper trees required for nesting habitat are at least 15 feet tall with a trunk diameter of about 5 inches at 4 feet above the ground. Juniper trees must have shredding bark, at least near the base of the tree. Although the composition of woody vegetation varies within suitable warbler habitat, Ashe juniper is often the dominant species (Campbell 2003). The proposed NBAF site does not contain dense woody vegetation, and Ashe junipers are limited to a few individual trees along the edges of live oak mottes. In addition, other broad-leaved hardwoods that are preferred by this species do not occur on the site (SWCA 2007). Therefore, golden-cheeked warblers are not likely to nest or occur regularly at the proposed NBAF site.

Black-Capped Vireo

In south-central Texas, vireo habitat occurs on rocky limestone soils of the Edwards Plateau. Although Black-capped Vireo habitat throughout Texas is highly variable with regard to plant species, vegetation structure is similar. Vireos require broadleaf shrub vegetation with foliage reaching to ground level for nesting cover. They typically nest in shrublands and open woodlands with a patchy structure. Typical habitat is characterized by shrub vegetation extending from the ground to approximately 6 feet or more and covering approximately 30% to 60% or greater of the total area. In the Edwards Plateau Region, vireo habitat consists of scattered hardwoods with abundant low cover. The plant species composition appears to be less important than the presence of suitable broad-leaved shrubs with foliage to ground level and a mixture of open grassland and woody cover (Campbell 2003). The composition and structure of vegetation at the proposed NBAF site is not characteristic of typical vireo habitat in the region. The proposed NBAF site does not contain dense shrublands or extensive dense shrub patches (SWCA 2007). Therefore, black-capped vireos are not likely to nest or occur regularly at the proposed NBAF site.

Interior Least Tern

Nesting habitat for the Interior Least Tern includes bare or sparsely vegetated sand, shell, and gravel beaches; sandbars; islands; and salt flats associated with rivers and reservoirs. Feeding habitat consists of shallow water with an abundance of small fish. In Texas, Interior Least Terns nest at three reservoirs along the Rio Grande River, on the Canadian River in the northern Panhandle, on the Prairie Dog Town Fork of the Red River in the eastern Panhandle, and along the Red River. Wintering areas include counties that border the Gulf of Mexico. Bexar County is not within the known breeding or wintering range of this species (Campbell 2003). The proposed NBAF site does not contain suitable habitat for this species.

Table 3.8.8.1.5-1 — Protected Species of Bexar and Medina Counties (TPWD 2008)

Scientific Name	Common Name	Federal Status [a]	State Status [b]	Habitat	Habitat Present at NBAF Site
Dendroica chrysoparia	Golden-cheeked warbler	E	E	Mature woodlands with broad-leaved trees.	No
Vireo atricapilla	Black-capped vireo	E	E	Semi-open dense shrublands.	No
Sterna antillarum athalassos	Interior least tern	E	E	Barren areas near water such as sand bars in river beds, shores of large impoundments, and salt flats.	No
Charadrius melodus	Piping plover	E	E	Sparsely vegetated shallow wetlands and open beaches and sandbars adjacent to streams and impoundments.	No
Grus americana	Whooping crane	E	E	Remote wetlands with low, sparse vegetation in level to moderately rolling terrain.	No
Ursus americanus	Black bear	T/SA	T	Bottomland hardwoods and large tracts of inaccessible forest. Currently restricted to Trans Pecos mountain ranges.	No
Falco peregrinus anatum	American peregrine falcon	-	E	Wide range of habitats during migration.	Yes
Falco peregrinus tundrius	Arctic peregrine falcon	-	T	Wide range of habitats during migration.	Yes
Buteo albonotatus	Zone-tailed hawk	-	T	Arid open country, open deciduous or pine-oak woodland, wooded canyons and tree-lined rivers. Often near water.	No
Mycteria americana	Wood stork	-	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water.	No
Plegadis chihi	White-faced ibis	-	T	Freshwater marshes, sloughs, and irrigated rice fields.	No
Eurycea latitans complex	Cascade Caverns salamander	-	T	Springs and caves in Medina River.	No
Eurycea tridentifera	Comal blind salamander	-	T	Springs and waters of caves.	No
Circurina baronia	Robber baron cave meshweaver	E	-	Karst features.	No

Table 3.8.8.1.5-1 — Protected Species of Bexar and Medina Counties (TPWD 2008) (Continued)

Scientific Name	Common Name	Federal Status [a]	State Status [b]	Habitat	Habitat Present at NBAF Site
Cicurina madla	Madla cave meshweaver	E	-	Karst features.	No
Cicurina venii	Braken bat cave meshweaver	E	-	Karst features.	No
Cicurina vespera	Government Canyon bat cave meshweaver	E	-	Karst features.	No
Texella cokendolpheri	Cokendolpher cave harvestman	E	-	Karst features.	No
Batrisodes venylvi	Helotes mold beetle	E	-	Karst features.	No
Neoleptoneta microps	Government Canyon bat cave spider	E	-	Karst features.	No
Rhadine exilis	A ground beetle	E	-	Karst features.	No
Rhadine infernalis	A ground beetle	E	-	Karst features.	No

[a] Federal Status: E = Endangered, T/SA = Threatened due to similarity of appearance.
[b] State Status: E = Endangered, T = Threatened.

Piping Plover

In Texas, piping plovers occur as wintering birds during the non-breeding season. The wintering range in Texas includes counties that border the Gulf of Mexico. Piping Plovers in Texas prefer coastal habitats that include bare or very sparsely vegetated tidal mudflats, sand flats, or algal flats (Campbell 2003). The proposed NBAF site does not contain suitable habitat for this species.

Whooping Crane

In Texas, Whooping Cranes occur as wintering birds during the non-breeding season. Whooping Cranes use various habitats during their long migrations between northern Canada and the Texas coast. Croplands are used for feeding, and large wetlands are used for feeding and roosting. In Texas, principal wintering habitat consists of marshes and salt flats within the Aransas National Wildlife Refuge (Campbell 2003). The proposed NBAF site does not contain suitable habitat for this species.

Karst Invertebrates

A total of nine federally listed invertebrate species are known from karst features (limestone formations containing caves, sinks, fractures, and fissures) in north and northwest Bexar County. Karst areas occur where subsurface drainage leads to passages or other openings within the underground rock formations. Some of the features that develop in karst areas include cave openings, holes in rocks, cracks, fissures, and sinkholes. Habitat required by the nine karst invertebrate species consists of underground, honeycomb limestone. The USFWS has issued specific guidance for use in determining the presence or absence of karst features that may contain these species. This guidance stipulates that surveys must be conducted in accordance with Texas Commission on Environmental Quality (TCEQ) guidelines for geological assessments in the Edwards Aquifer recharge/transition zones (TCEQ 2007). A survey for karst features at the proposed NBAF site was conducted in accordance with these guidelines (SWCA 2007). This survey found no evidence of karst formations at the proposed NBAF site.

<u>State-Listed Species</u>

Suitable state-listed species habitats at the proposed NBAF site are limited to the Arctic and American peregrine falcons, which occur in a wide variety of habitats. Ocurrences of these species in the region consist of non-breeding, migratory birds that are not associated with a particular site or habitat type.

3.8.8.2 Construction Consequences

3.8.8.2.1 Vegetation

Construction of the proposed NBAF would clear approximately 30 acres of native vegetation at the Texas Research Park Site. Potential indirect effects during the construction process would include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, natural communities that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on vegetation. Off-site connected actions involving the installation of a new electrical and sewer lines would occur within existing, disturbed right-of-ways and, therefore, would not have any significant adverse effects on vegetation. Construction of an emergency exit off of Lambda Drive would affect the existing road right-of-way and, therefore, would not have any significant adverse effects on vegetation.

3.8.8.2.2 Wetlands

No wetlands occur on the site; consequently, construction would have no direct effect on wetlands. Potential indirect construction effects include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, streams that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on wetlands.

3.8.8.2.3 Aquatic Resources

No water bodies occur on the site; consequently, construction would have no direct effect on aquatic resources. Potential indirect construction effects include erosion and sedimentation. Removal of vegetation and soil disturbance within the proposed construction area would expose upland soils to potential erosion during storm events. Consequently, streams that are located downslope of the proposed construction area would be vulnerable to sedimentation impacts. However, erosion and sedimentation control measures would minimize the potential for adverse effects on aquatic resources.

3.8.8.2.4 Terrestrial Wildlife

Construction of the proposed NBAF would affect approximately 30 acres of native vegetation. Construction of the facility would have short-term and long-term effects on wildlife. Land-clearing activities, construction noise, and dust creation would likely discourage wildlife utilization of habitats that are adjacent to the proposed construction area; however, these effects would subside with completion of the project. Long-term effects would result from habitat loss and permanent displacement of wildlife within the 30-acre project area. However, given the abundance of similar habitats in the area, construction of the facility is not likely to have significant long-term impacts on local wildlife populations.

3.8.8.2.5 Threatened and Endangered Species

Informal Section 7 consultation has been initiated with the USFWS Austin Field Office. The Texas Research Park Site does not contain suitable habitat for federally listed species and, therefore, construction would have no effect on federally listed species. In the region containing the proposed NBAF site, the state-listed Arctic and American peregrine falcons are non-breeding, migratory species. Therefore neither of these species is likely to be adversely affected by construction.

3.8.8.3 Operation Consequences

3.8.8.3.1 Vegetation

Operation of the proposed NBAF would have no direct effects on native vegetation or natural communities. The proposed NBAF would create 270,000 square feet of impervious surface area, which would result in 22,500 cubic feet of runoff during a 1-inch rainfall event. Increases in storm water runoff have the potential to cause erosion within adjacent plant communities. However, the use of LID development techniques and BMPs would mitigate most of the potential for erosion-related effects. Storm water management systems would be designed in accordance with the applicable storm water BMPs. In addition to meeting the minimum state requirements for storm water management, the proposed NBAF would employ a LID approach that would minimize storm water runoff (see Section 3.7.8.3.2).

3.8.8.3.2 Wetlands

Operations at the proposed NBAF would have no direct impacts on wetlands; however, increases in impervious surface area and storm water runoff would have the potential for indirect impacts on streams that occur just outside of the property boundary. Increases in impervious surface area can increase storm water runoff and stream flow after storm events. Increases in stream flow volume and velocity can cause stream channel incision and/or widening, resulting in the loss of adjacent wetland vegetation and alteration of the hydrological regime within adjacent wetlands. The proposed NBAF storm water management system would be designed in accordance with applicable storm water BMPs. In addition, the proposed NBAF would employ an LID approach that would further minimize storm water runoff (see Section 3.7.4.3.2). The use of LID development techniques and BMPs would mitigate most of the potential adverse impacts on streams and wetlands.

3.8.8.3.3 Aquatic Resources

Operations at the proposed NBAF would have no direct impacts on aquatic communities; however, storm water runoff from the proposed NBAF may eventually be discharged to adjacent streams. Increases in impervious surface area and storm water runoff have the potential for indirect impacts on water quality and aquatic communities. Runoff from impervious surfaces such as buildings and parking lots can transport pollutants such as automotive fluids, fertilizer, pesticides, bacteria, and heavy metals into surface waters. Furthermore, rapid runoff from impervious surface areas can affect aquatic habitats by increasing the rate of flow in receiving streams (see Section 3.8.8.3.2). These effects can include increased turbidity and sedimentation downstream. The use of LID development techniques and BMPs would mitigate most of the potential adverse effects on streams. The proposed NBAF would have the potential for minor adverse effects associated with pollutant transport. Minor quantities of pollutants such as automobile engine fluids and fertilizers may avoid capture in the storm water management system and could end up in area streams. However, the measures described above would minimize the potential for these types of impacts.

3.8.8.3.4 Terrestrial Wildlife

Section 3.5.5.3 addresses operational noise impacts associated with the proposed NBAF. Minor noise impacts would result from an increase in traffic and operation of the facility’s filtration, heating, and cooling systems. Section 3.5.5.3 describes noise-attenuating design features that would minimize noise emissions. In the event of a power outage, operation of back-up generators could have a short-term impact on wildlife by discouraging utilization of immediately adjacent habitats. Routine operations at the NBAF would not be likely to have significant noise impacts on wildlife. Security requirements at the proposed NBAF would require continuous outdoor nighttime lighting. Nighttime lighting has the potential to impact wildlife through astronomical and ecological light pollution. Unshielded lighting can shine upward and interfere with bird migration, disorienting birds and causing them to collide with structures. Birds are attracted to lights and may collide with lighted structures. Most concerns involve lighting associated with high-rise buildings and telecommunication towers; however, even residential lighting can affect some birds. The USFWS advocates the use of shielded lighting to minimize adverse impacts on migratory birds. Shielded fixtures direct light downwards and can be used to keep light within the boundaries of the site. Artificial lighting also has the potential for ecological effects such as repulsion and/or interference with foraging behavior. The NBAF would employ the minimum intensity of lighting that is necessary to provide adequate security. Mitigation measures, such as those described above, will be considered in the final design of the NBAF. The use of shielded lighting would minimize the potential for impacts in adjacent habitats. Given the relatively low profile of the building and the use of shielded lighting, significant impacts on migratory birds would not be likely to occur. The accidental or intentional release of a pathogen would have the potential for adverse effects on native mammals (especially ungulates). Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on wildlife.

3.8.8.3.5 Threatened and Endangered Species

Normal operations would have no direct effect on threatened and endangered species. The accidental or intentional release of a pathogen would have the potential for adverse effects on mammals; however, no extant populations of federally or state-listed mammals are known to occur in Bexar or Medina Counties. Other wildlife groups (birds, reptiles, amphibians, and fishes) are not susceptible to the diseases that could be studied at the proposed NBAF. Therefore, operations would not be likely to have adverse effects on listed species that occur in the vicinity of the proposed NBAF site. Section 3.8.9 provides a detailed evaluation of the potential effects of an accidental release on native wildlife and endangered species.

3.8.9 Potential Operational Consequences for Wildlife

This section evaluates the potential adverse effects associated with the accidental or intentional release of a pathogen that subsequently infects native or non-native wildlife populations. This section does not evaluate the risk or probability of a release. Section 3.14 evaluates the potential for accidental and intentional releases of pathogens from the proposed NBAF. The scope of this section is limited to potential post-release impacts on wildlife populations. Potential effects on human populations are addressed in Section 3.14. For purposes of evaluating the effects of a release, representative pathogens that bound the range of potential consequences were identified for detailed analysis. The representative pathogens selected for the detailed analysis include Foot and Mouth Disease (FMD) virus, Rift Valley fever (RVF) virus, and Nipah virus. The basis for the selection of these pathogens is presented in Section 3.14.

3.8.9.1 Foot and Mouth Disease (FMD)

The host range for FMD is limited to ungulates. FMD is known to be highly contagious, with the ability to spread through aerosol transmission, animal to animal contact, and mechanical transmission via humans, animals, and inanimate objects (e.g., automobiles). Mechanical transmission involves the transport of virus particles by an uninfected organism or object. FMD also has the potential for severe effects on ungulates, and most native ungulates are known to be susceptible to this disease.

The only known occurrence of FMD in native wildlife in the United States occurred in 1924 when the virus was transmitted from cattle to mule deer (Rhyan et al. 2006). During this outbreak, over 22,000 deer were killed in an effort to eliminate a potential reservoir for the virus (USGS 2007). A study at PIADC in 1974 involved the exposure of 10 white-tailed deer to the FMD virus (McVicar et al. 1974). All 10 deer developed FMD and 4 died as a result of contracting the disease. All of the surviving deer tested positive for the virus 5 weeks after the initial exposure, and one deer tested positive at 11 weeks. The 1974 study also documented transmission from deer to deer, deer to cattle, and cattle to deer. The preliminary results of a more recent study at PIADC indicate susceptibility of other native North American ungulates to the FMD virus (Rhyan et al. 2006). This study involved the exposure of mule deer, bison, pronghorn, elk, and domestic cattle to the FMD virus. Clinical disease occurred in all inoculated animals and in all contact-exposed bison, mule deer, and pronghorn. Clinical disease did not develop in contact-exposed elk or cattle exposed to inoculated elk. All species developed oral and foot lesions. Oral lesions were described as mild in pronghorn and elk and severe in bison, mule deer, and cattle. Foot lesions were described as mild in elk and severe in all other species. Intra- and interspecific transmission occurred between all species except elk. This study indicates that bison, mule deer, and pronghorn are susceptible to FMD and are capable of transmitting the disease. Furthermore, the researchers who conducted this study concluded that the severity of the symptoms suggests the potential for high mortality in the event of a natural outbreak.

Based on the studies described above, it is apparent that white-tailed deer, mule deer, bison, and pronghorn are susceptible to FMD and are capable of intra- and interspecific transmission. Although these studies demonstrate the potential for significant impacts in the event of an accidental release, there are many uncertainties regarding transmission in the wild. Transmission of FMD within populations of wild ungulates in their native habitats may not necessarily mimic the results of direct intentional exposure in a confined laboratory setting or transmission within a large, confined herd of cattle. Distribution patterns, social interactions, habitat preferences, and other behavioral characteristics of free-ranging ungulates are likely to have a significant influence on the severity of an FMD outbreak in wildlife populations.

To prevent a widespread outbreak among wildlife and domestic livestock, an accidental release of the FMD virus would require an immediate and intensive coordinated response by federal, state, and local agencies. Given the need for rapid response, DHS would have publicly accepted, site-specific Standard Operating Procedures (SOPs) and response plans in place prior to the initiation of research activities at the facility. DHS would develop its SOPs and response plans in coordination with the public, local government, and state and federal agencies. All interested parties would have the opportunity to review the draft response plan and provide comments that DHS would consider in formulating the final document. During this process, DHS would coordinate closely with the public, state wildlife agencies, the Animal and Plant Health Inspection Service (APHIS), the National Park Service (NPS), and the USFWS. In the event of an accidental release, DHS would have the advantage of on-site diagnostic capabilities; rapid detection; site-specific SOPs and response plans; and pre-coordinated, rapid-response capabilities by local, state, and federal agencies.

In the event of an accidental release, response measures could potentially include a wide range of actions depending on site conditions, characteristics of local wildlife populations, and the nature of the outbreak. Existing applicable response plans that are already in place include the APHIS FMD response plan (USDA 2007) and the NPS Interim FMD Response Plan (NPS 2001). These existing response plans provide insight into some of the measures that could potentially be employed to protect both livestock and wildlife in the event of an accidental release from the proposed NBAF. The APHIS FMD response plan calls for the establishment of various zones of response to control and eradicate an FMD outbreak. These zones include an infected zone, a buffer surveillance zone around the infected zone, a control zone, and an outer surveillance zone. The initial infected zone includes the infected locations and an area extending outward for a distance of at least 6.2 miles beyond the perimeter of the infected site. However, the boundaries of the infected zone may be modified as surveillance results become available and other factors become better defined. The buffer surveillance zone surrounds the infected zone. The buffer surveillance zone has no minimum size, and it may initially include the entire state or states that have infected premises or known contact premises. The surveillance zone separates the buffer surveillance zone from the FMD-free zone. The surveillance zone encompasses an area that is at least 6.2 miles from the outer boundary of the buffer surveillance zone.

Although the APHIS FMD response plan focuses primarily on domestic livestock, it does contain strategies that pertain specifically to wildlife. The APHIS FMD response plan calls for the implementation of an active surveillance program to detect FMD virus that may be present in the wildlife population within the infected zone. A veterinarian or wildlife biologist trained to recognize signs of FMD would investigate suspect cases in wildlife within 24 hours. Measures include the development of a wildlife management plan within 48 hours of the identification of an index case and an assessment of the risk that wildlife pose for the transmission of FMD virus within 7 days of confirmation of an index case. Assessment of the risks posed by wildlife would consider wildlife density and distribution, social organization, habitat, contact with domestic livestock, and the length of time that wildlife could have been exposed to the virus. This assessment would be used to determine the required level of management and control measures to be applied, potentially including population reduction (if ecologically sound) or procedures to prevent or limit wildlife and livestock interaction. If wildlife populations are determined to be infected with FMD virus or otherwise pose a risk to livestock, wildlife management principles would be used to reduce exposure of wildlife to livestock. If it is determined that wildlife populations are not infected or are not a risk for transmission of FMD virus to livestock, a wildlife management plan would be implemented to prevent wildlife populations from acting as mechanical vectors. The NPS Interim FMD Response Plan relies on APHIS to establish buffer zones. Other potential NPS response strategies are outlined in Table 3.8.9-1. Depopulation or population reduction is one of ten potential FMD response strategies developed by NPS. However, NPS recommends the use of other strategies or combinations of strategies to avoid depopulating wildlife. A more likely scenario would include one or more of the non-lethal measures described in Table 3.8.9-1. In the event that depopulation or population reduction was determined to be the most appropriate course of action, hunting with firearms would be the likely method for implementing this strategy.

Ungulates that occur in the vicinity of each of the proposed NBAF sites are described in Sections 3.8.2.1.4, 3.8.3.1.4, 3.8.4.1.4, 3.8.5.1.4, 3.8.7.1.4, and 3.8.8.1.4. At all of the potential sites, white-tailed deer would have the highest potential for infection in an accidental release scenario. White-tailed deer are abundant and widespread in the vicinity of all of the sites (except on Plum Island, where no deer have been found since 2004 resulting from a removal program), and they commonly occur near urban and suburban areas. Other native species of wild ungulates are either rare or absent in the vicinity of the sites. However, white-tailed deer generally occur as solitary individuals or in small groups. Small group size and limited interaction between groups may potentially limit the spread of FMD within white-tailed deer populations. Differing habitat preferences and lack of interaction among ungulate species would likely limit interspecific transmission of FMD.

In a worst-case scenario, in which white-tailed deer are infected and become effective vectors for FMD, disease-induced mortality and the potential use of depopulation control measures could have an adverse effect on local populations. Although the local effects of mortality and depopulation measures could be significant, depopulated areas would be repopulated by deer from adjacent areas, and this process could be augmented through the translocation of deer from other areas. White-tailed deer are capable of rapid population growth, and populations are increasing throughout most of their range. Therefore, the effects of mortality or depopulation control measures would most likely be localized and short term. An accidental release of FMD could have a temporary adverse effect on white-tailed deer within a localized area, but is not likely to have long-term impacts on local or regional populations. None of the six states that contain the proposed NBAF sites have populations of federally or state-listed threatened or endangered ungulate species. Given the limited host range (i.e., ungulates) and the regional absence of listed ungulates at each of the sites, an accidental release of FMD is not likely to have adverse effects on federally or state-listed species.

Table 3.8.9-1 — National Park Service Potential Strategies and Considerations for FMD Response (NPS 2001)

Potential Strategy	Considerations
Providing education to workers, residents, and the public.	One of the most cost-effective, and most likely, strategies.
Identify the boundaries of and establish both an infected zone and a surveillance/movement control zone.	Actual zones will be established by APHIS. APHIS may be willing to negotiate some aspects of the zones, especially toward the outer boundaries.
Completely close all or part of either the infected zone or the surveillance/movement control zone.	Would have significant impacts on facilities, employees, and residents in the closed area(s).
Restrict human travel, activities, and uses in either the infected zone or the surveillance/movement control zone.	Could have significant impacts on the local tourist industry and retail trade. Restrictions may vary considerably, especially if used in conjunction with mitigating strategies such as decontamination.
Limiting the movement of animals in and around established zones.	Could have significant impacts on the local livestock industry. Limitations may vary considerably.
Require the decontamination of humans, equipment, and other property being moved out of the infected zone or the surveillance/movement control zone.	May be used as a mitigating strategy to reduce the need for travel restrictions. Will likely be required for incident personnel and equipment.
Exclude or eliminate livestock in either the infected zone or the surveillance/movement control zone.	Would have significant impacts on the local livestock industry. The most likely strategy to be used by APHIS.
Control feral and non-native species in either the infected zone or the surveillance/ movement control zone.	May or may not meet legal or policy requirements and management goals for parks or state wildlife management agencies. Consider bringing in expert assistance. Could be operationally difficult to carry out.
Vaccinate animals within the infected zone or the surveillance/movement control zone.	Research suggests that this strategy is not very effective, especially given the effort and expense that would be required to carry it out. Consider bringing in expert assistance. Operationally, this could be a very difficult strategy to carry out.
Reduce or depopulate infected wildlife in either the infected zone or the surveillance/movement control zone.	May or may not meet legal or policy requirements and management goals for parks or state wildlife management agencies. Could have significant impacts on wildlife populations for years to come. Research is inconclusive as to the efficacy of this strategy. Consider bringing in expert assistance. Consider other strategies or combinations of strategies to avoid this choice, if needed. Could be operationally difficult to carry out.

3.8.9.2 Rift Valley Fever (RVF)

RVF is a mosquito-born illness that was first reported in the Rift Valley region of Kenya in 1930. It has since spread as far north as Egypt and has crossed over to Saudi Arabia and Yemen (Kasari et al. 2008). Documented occurrences of RVF are currently limited to Africa and the Arabian Peninsula. The virus that causes RVF is transmitted primarily by infected mosquitoes. The virus is transmitted transovarially from female mosquitoes to their eggs, and the eggs that hatch give rise to a new generation of infected mosquitoes that perpetuate the outbreak. An exacerbating factor is the ability of mosquito eggs to remain viable through extended periods of desiccation. The virus can also be transmitted from an infected host to other mosquitoes, although the host must develop a very high level of viremia (presence of virus in blood) before transmission can occur (Kasari et al. 2008).

RVF is primarily a disease of domestic ungulate livestock (Britch et al. 2007); however, the disease has been reported in numerous species of mammals. The following summary of information regarding vertebrate host susceptibility to both experimental and natural RVF infection is drawn from Kasari et al. (2008).

Ungulates: Domestic sheep (*Ovis aires*), goats (*Capra aegagrus hircus*), and cattle (*Bos taurus* and *Bos indicus*) are highly susceptible to RVF. These domestic species exhibit severe clinical signs of disease that include abortion rates of 40% to 100% in sheep and goats, and abortion rates of 15% to 40% in cattle. Fatality rates are high in newborn sheep (90% to 100%), newborn goats (70% to 100%), and newborn cattle (20% to 100%). Adult fatality rates range from 20% to 70% in sheep, 10% to 70% in goats, and 10% to 30% in cattle. Domestic pigs (*Sus scrofa domestica*) are resistant or experience inapparent (i.e., asymptomatic) infection with brief viremia. Horses experience inapparent, transient (i.e., short-term) infection. Adult camels (*Camelus* spp.) experience inapparent infection, with the exception of a high risk for abortions. Newborn camels are at high risk for illness with some fatalities. Wild African buffalo (*Syncerus caffer*) experience transient viremia with possible abortions and a fatality rate of less than 10%. Waterbuck (*Kobus ellipsipyrmnus*) have tested positive for RVF antibodies; however, symptoms and fatality rates for this species are unknown.

Other Mammals: Newborn domestic puppies and kittens experience fatality rates of 60% to 100% and 70% to 100%, respectively. Juvenile and adult dogs (*Canus familiaris*) and cats (*Felis catus*) experience inapparent infection, although some females may abort. Domestic ferrets (*Mustela putorius furo*), mice, and field voles (*Microtis agrestis*) experience very high fatality rates. Several species of rats experienced highly variable fatality rates. The potential for high viremia in native African rats suggests that they may be a reservoir for the virus during interepizootic periods. The only native North American species to be evaluated is the gray squirrel (*Sciurus carolinensis*). The experimental infection of two gray squirrels resulted in the death of one of the animals, and squirrel blood was found to be infective to mice. Experimentally inoculated bats showed no clinical signs and had low amounts of virus antigen. Birds, reptiles, and amphibians have shown evidence of resistance to both natural and experimental RVF infection (Kasari et al. 2008).

Information regarding the susceptibility of native North American wildlife is essentially nonexistent, and the ability to infer potential effects based on phylogenetic relationships is very limited. Of the ungulate genera that occur in the vicinity of the proposed NBAF sites, none are represented in Africa and information regarding other North American mammals is limited to one species (gray squirrel) and two genera (ferrets and field voles). Domestic and wild African rodents generally have low resistance to RVF infection, and there is concern that wild African rodents may develop a level of viremia that is sufficient to infect other mosquitoes (Kasari et al. 2008). The susceptibility of domestic and wild African rodents suggests the possibility that North American rodents (Rodentia) could be susceptible. In addition, the high susceptibility of domestic ferrets suggests the possibility that North American members of the weasel family (Mustelidae) could be susceptible. Limited experimental data suggest that bats, birds, reptiles, and amphibians are resistant to RVF infection.

RVF is transmitted primarily by mosquitoes, although the virus can be transmitted by other biting arthropods. Experiments have documented RVF vector capability among North American arthropods of the genera *Aedes*, *Anopheles*, and *Culex*, and the range of capable vector species encompasses the entire continental United States (Kasari 2008). The virus that causes RVF is transmitted transovarially from infected mosquitoes to their eggs, thus leading to new generations of infected vectors. In addition, the eggs of some mosquito species can remain dormant through lengthy dry spells, only to hatch and emerge with the onset of rainfall. Transovarial infection and egg dormancy are important, since these factors eliminate the requirement for continuous host-vector-host transmission. Furthermore, some mosquitoes overwinter as adults, thus prolonging the period of potential transmissibility. Another concern is the short incubation and viremia phase of infection, which may allow infected animals to go undetected (Britch et al. 2007). The ability of RVF to persist in the absence of continuous host-vector-host transmission, combined with the wide range of hosts and the short detection window for infected individuals, could limit the effectiveness of eradication efforts. Therefore, there is concern that an outbreak could lead to the permanent establishment of RVF in North America.

Animal to animal contact transmission is not significant, and the virus is not readily transmitted among animals through aerosols (Kasari et al. 2008). Therefore, the initiation of an outbreak would require the accidental release of an infected vector (i.e., mosquito). If the infected mosquito finds a suitable host on which to feed and survives long enough to develop viable eggs and find suitable reproductive habitat, then an outbreak could occur through transovarial transmission of the virus that causes RVF. Assuming that the release is detected, the infected mosquito would also have to survive the aerial application of insecticides. If the initial host is infected with RVF and the host animal develops a sufficient level of viremia, then an outbreak could occur through the infection of other adult mosquitoes that subsequently feed on the initial host. The use of sterile mosquitoes in the laboratory would eliminate the potential for the initiation of an outbreak through transovarial transmission; however, an outbreak could still result from host infection. RVF infection of the initial host would establish the potential for infection of numerous adult mosquitoes, which could subsequently perpetuate the outbreak through transovarial transmission and/or the infection of additional host animals. However, it should be noted that viremia in the host must reach a very high threshold level before transmission of the virus from host to mosquito can occur (Kasari et al. 2008).

In contrast to FMD, the United States does not currently have an effective national action plan or the capability for national response in the event of an RVF outbreak (Britch et al. 2007). In order to prevent a widespread outbreak among wildlife and domestic livestock, an accidental release of vector-borne RVF would require an immediate and intensive coordinated response by federal, state, and local agencies. Given the need for rapid response, DHS would have publicly accepted, site-specific SOPs and response plans in place prior to the initiation of research activities at the proposed NBAF. RVF SOPs and response plans would likely include strategies that are similar to those described above for FMD. However, the RVF response plan would also include a mosquito control action plan. The mosquito control action plan would most likely include the aerial application of insecticides within the infection zone. Due to the ability of RVF to persist in infected mosquito eggs, repeated aerial spraying may be required over an extended time period. The use of insecticides could lead to direct adverse impacts on insect fauna, as well as indirect impacts on other wildlife species through disruption of the food chain.

The susceptibility of some domestic and wild African ungulates suggests the possibility that some North American ungulates could be susceptible to RVF infection. Among ungulates that occur in the vicinity of the proposed NBAF sites, white-tailed deer would have the highest potential for exposure in an accidental release scenario. White-tailed deer are abundant and widespread in the vicinity of all of the proposed NBAF sites, and they commonly occur near urban and suburban areas. Other native species of wild ungulates are either rare or absent in the vicinity of the proposed NBAF sites. The low resistance of some domestic and wild African rodents to RVF infection (Kasari et al. 2008) suggests the possibility that wild North American rodents could also be susceptible to infection. In addition, the low resistance of domestic ferrets (Kasari et al. 2008) suggests the possibility that native North American members of the weasel family could be susceptible to infection. However, it should be noted that these inferred potential effects are based on a very limited amount of data involving experimental inoculations. Additional data are needed before definitive conclusions can be drawn regarding the susceptibility of North American mammal taxa and the potential for RVF to spread horizontally through wildlife populations.

In a worst-case scenario, in which native wildlife species are infected and become effective reservoirs for RVF, disease-induced mortality and the potential use of depopulation control measures could have adverse effects on wildlife populations. Effects would vary depending on the extent of the outbreak and the species affected. If an outbreak is contained in close proximity to the center of origin, adverse effects on wildlife populations would most likely be localized and short term. The taxa that are most likely to be affected (i.e., white-tailed deer, rodents, and weasels) generally have high reproductive capacity. Following cessation of a contained outbreak, it is likely that the affected areas would be rapidly repopulated by animals from adjacent unaffected areas. The effects of an uncontained outbreak leading to the long-term establishment of RVF over a wide area are unknown. In Africa, clinical disease, widespread abortions, and death have not been definitively determined in wildlife. Under a worst-case scenario, in which RVF spreads horizontally through multiple counties or states, disease-induced mortality and the potential use of depopulation control measures could potentially result in significant long-term adverse effects on wild mammal populations. However, it must be reiterated that additional data is needed before definitive conclusions can be drawn regarding the susceptibility of North American taxa and the potential for RVF to spread horizontally through wildlife populations. These potential adverse effects must be weighed against the extremely low probability of an accidental release (see Section 3.14) and the potential wildlife benefits (see Section 3.8.9.4) that would be associated with the proposed NBAF.

Of the seven counties in which the proposed NBAF sites are located, none have populations of federally or state-listed ungulate species. Therefore, a contained outbreak would not affect any listed ungulate species. Occurrence records of other listed mammals in the seven counties include the federally endangered gray bat in Clarke County, Georgia; the state-threatened black bear in Medina County, Texas; and state-threatened eastern spotted skunk in Riley County, Kansas. The resistance of experimentally inoculated bats (Kasari et al. 2008) suggests that the gray bat would not be adversely affected by an accidental release of RVF. In Texas, the black bear has become restricted to the mountain ranges found within the Trans Pecos region in the extreme western portion of the state (Parker et al. 2003). Therefore, the black bear would not be adversely affected by a contained outbreak. Due to the absence of suitable habitat, the eastern spotted skunk is not likely to occur in the immediate vicinity of the Manhattan Campus Site; however, potential habitat does occur within a few miles of the site. No information is available regarding the susceptibility of members of the skunk family (Mephitidae) and, therefore, the potential for adverse effects on the eastern spotted skunk is unknown. Due to the absence of susceptible federally listed species in all of the counties containing the proposed NBAF sites, a contained outbreak would have no adverse effects on federally listed species, regardless of the point of origin. The eastern spotted skunk in Riley County is the only state-listed mammal that could potentially be exposed to RVF under a contained outbreak scenario; however, the potential for adverse effects on this species is unknown.

The effects of an uncontained outbreak leading to the long-term establishment of RVF over a wide area are unknown. A widespread outbreak originating from any of the proposed NBAF sites could affect multiple states and expose numerous federally and/or state-listed mammal species to RVF. In the absence of regional data pertaining to the susceptibility of specific taxa, it must be assumed that a widespread RVF outbreak could potentially have adverse effects on listed mammals, regardless of the point of origin. As previously stated, these potential adverse effects must be weighed against the extremely low probability of an accidental release (see Section 3.14) and the potential wildlife benefits (see Section 3.8.9.4) that would be associated with the proposed NBAF.

3.8.9.3 Nipah Virus

Compared to FMD and RVF, there have been relatively few outbreaks of disease associated with Nipah virus. Nipah virus was first reported from peninsular Malaysia in 1998 and 1999. An additional outbreak occurred in Singapore in 1999, and outbreaks were subsequently confirmed in Bangladesh in 2004 and 2005. The virus causes severe respiratory illness in pigs and severe encephalitis in humans. Transmission to humans occurs through direct contact with infected pigs, contact with bodily fluids, or aerosolization of respiratory or urinary fluids. In addition, the 2005 outbreak in Bangladesh was apparently initiated by human consumption of contaminated palm fruit juice (Center for Food Security and Public Health 2005).

Bats of the genus *Pteropus* (flying foxes and fruit bats) are the natural carrier of Nipah virus, although the bats themselves are not affected. The virus has been found in bat urine and partially eaten fruit (Center for Food Security and Public Health 2005). The world distribution of flying foxes and fruit bats extends from the sub-Himalayan region of Pakistan and India through Southeast Asia, the Philippines, Indonesia, New Guinea, the Southwest Pacific Islands, and Australia. Their range also encompasses the western Indian Ocean islands of Mauritius, Madagascar, and Comoro. They are not found on mainland Africa, Europe, Asia, or North and South America (Field et al. 2001). All of the reported outbreaks have occurred within the range of flying foxes and fruit bats.

There are few reports of infections in animals other than domestic pigs. During the first outbreak in Malaysia, Nipah virus was reportedly transmitted to domestic cats, dogs, and horses. Experimental studies subsequently confirmed the susceptibility of domestic cats. During the viremic phase, experimentally infected cats shed Nipah virus through the nasopharynx and in urine. One of the two cats recovered with a high level of neutralizing antibodies. Infected cats reportedly exhibit fever, depression, and severe respiratory signs. Of 32 cats that were captured in the immediate vicinity of a *Pteropus* bat colony, none had detectable levels of antibodies to Nipah virus (Epstein et al. 2006). Dogs reportedly exhibit distemper-like signs, with fever, respiratory distress, and nasal and ocular discharge (Center for Food Security and Public Health 2005). The serological examination of over 3,000 horses in Malaysia identified neutralizing antibodies to Nipah virus in two animals, and a third horse with a history of neurological symptoms tested positive for Nipah virus infection. All three horses came from a single property that was surrounded by infected pig farms. Field et al. (2001) sampled peridomestic small mammals and birds from disease-endemic areas of Malaysia. Species tested included domestic dog, house rat (*Rattus rattus*), other old-world rats (*Rattus* spp.), house shrew (*Suncus murinus*), jungle fowl (*Gallus gallus*), pigeons (*Columba livia*), domestic chickens, and domestic ducks. All rats, shrews, and birds tested negative for the presence of antibodies. Out of 465 dogs that were tested, 72 had antibodies to Nipah virus. Subsequent opportunistic dog testing near the end of the Malaysian outbreak found antibodies in 46 of 92 dogs that were tested. Intensive transect sampling following the cessation of the outbreak found only 4 antibody-positive dogs out of 249 animals tested. Although dogs readily acquired infection during close association with pigs, the relatively low prevalence of antibodies and restriction of infected dogs within a 3.1-mile radius of the endemic area indicates that Nipah virus does not spread horizontally within dog populations (Field et al. 2001). Additional testing of wild boar, dogs used to hunt wild boar, and rodents from infected pig farms found no evidence of antibodies (Yob et al. 2006).

Fruit bats and flying foxes do not occur in North America, and these species are the only known reservoir for the Nipah virus. Therefore, it is unlikely that an accidental release from the proposed NBAF would result in a sustained outbreak of disease. Based on the limited data described above, the disease is apparently spread through close contact with infected pigs and has little or no capability for horizontal transmission among wildlife populations. Therefore, an accidental release of Nipah virus would be unlikely to have significant adverse effects on native wildlife or listed species.

3.8.9.4 Beneficial Effects

Although there are many uncertainties regarding transmission in the wild, available data clearly demonstrate that additional research is needed to determine the potential adverse effects of foreign animal diseases on North American wildlife. Available data also demonstrate the need for effective wildlife vaccines for diseases such as FMD, RVF, and Nipah virus. Compared to an accidental release from the proposed NBAF, an unintentional foreign introduction, or an intentional introduction of a foreign animal disease as an agent of bioterror, it might go undetected for a much longer period of time. Response mobilization would take longer, thus further delaying containment of the outbreak. Delays in detection and response would increase the potential for a widespread outbreak among wildlife populations. In the event of a widespread outbreak, knowledge of potentially affected species and the availability of effective vaccines for wildlife could prevent devastating impacts on wildlife populations and could be the only means of preventing the extirpation of endangered or otherwise vulnerable native species. Therefore, the proposed NBAF has the potential to provide significant positive benefits for native wildlife.

3.9 CULTURAL RESOURCES

3.9.1 Methodology

The *National Historic Preservation Act* of 1966 (NHPA) requires federal agencies to record, evaluate, preserve, and plan for management of cultural resources. The NHPA further requires federal agencies to consult with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation before modifying, removing, or demolishing any historic structure potentially eligible, eligible, or listed in the National Register of Historic Places (NRHP). The NRHP is the official national list of cultural resources that are deemed worthy of preservation. Properties listed in the NRHP include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture. Additional historic preservation laws and executive orders that must be adhered to include the *Archeological and Historic Preservation Act* of 1974, the *Archeological Resources Protection Act* of 1979, *Native American Graves and Repatriation Act* of 1990, *American Indian Religious Freedom Act* of 1978, Executive Order 13007: Indian Sacred Sites, and Executive Order 11593: Protection and Enhancement of the Cultural Environment.

Database searches were conducted for known archaeological and historically significant resources at each of the proposed NBAF sites. Archaeological and historical sites were identified and the footprint for the conceptual design was overlaid on the site boundaries to assist in determining the potential for adverse effects from the proposed construction and operation of the proposed NBAF. Intensive archaeological surveys were performed for sites with significant potential for archaeological resources. Once compiled for each of the sites, in compliance with Section 106 consultation requirements under NHPA, the resulting information pertaining to archaeological and historical resources and potential effects from proposed construction was submitted to the appropriate SHPO for review and concurrence with the findings. In the event it is determined historic or archaeological resources that are listed or eligible for listing in the NRHP would be harmed, either a legally binding agreement would be developed to establish how DHS would address the adverse effects or the ACHP would issue advisory comments that the head of DHS must consider in making a final decision (ACHP 2002).

A list of contacts was generated for each site by the respective SHPO, identifying Native American Indian tribes whose ancestral lands could be affected by the proposed NBAF. In some instances, the contacts included state-recognized tribes. An information package was sent to each of the contacts, describing the proposed project and its anticipated effects. Copies of the coordinaiton letters and responses received are included in Appendix G.

3.9.2 No Action Alternative

3.9.2.1 Affected Environment

PIADC's continued operation constitutes the No Action Alternative. DHS indicated in their April 7, 2007 letter to the New York State Office of Parks, Recreation, and Historic Preservation (NYPR&HP) that an extensive survey of all buildings, structures, and related appurtenances on the island was undertaken by a historic preservation consultant in 1998. In 2003, a historic preservation plan was prepared for the historical features documented in the 1998 survey. The preservation plan serves to satisfy the requirements of Section 106 of the NHPA, and provides specific preservation actions for historically significant buildings and structures on the island. The plans were developed to accommodate potential future construction/expansion of

PIADC. No known archaeological studies have been conducted at PIADC to date, and it is currently unknown if any prehistoric archaeological resources eligible for listing in the NRHP or NYPR&HP are present.

3.9.2.2 Construction Consequences

No construction would occur under the No Action Alternative, although the infrastructure improvements previously authorized would proceed. A Categorical Exclusion determined that the improvements would not affect any listed or eligible for listing archaeological or cultural resources (DHS 2007). The historic preservation plan developed in 2003 provides specific preservation actions for historic buildings and structures on Plum Island. Adherence to the preservation plan will preclude adverse effects to historically significant features from any potential future construction activities.

3.9.2.3 Operation Consequences

Continued operation of PIADC is not likely to result in adverse effects to historically significant features.

3.9.3 South Milledge Avenue Site

3.9.3.1 Affected Environment

The 67-acre South Milledge Avenue Site consists primarily of pastureland, but the northwestern and southwestern portions contain mature hardwood forest. The site has been undeveloped since at least 1936, and all lands adjacent to the site currently exist as undeveloped open lands or woodlands (Terracon 2007f).

An intensive archaeological survey of the South Milledge Avenue Site was conducted in December 2007 (SAS 2007). The survey also included 26 acres southwest of the site and adjacent to the Middle Oconee River. No historical resources that are listed or eligible for listing with the NRHP or the Historic Preservation Division (HPD) of GDNR were found on or adjacent to the site. However, the field survey identified 11 archaeological sites within the South Milledge Avenue Site. None are listed or would be considered eligible for listing in the NRHP or HPD (Personal communication, Chad Braley, Southeastern Archaeological Services, Inc., January 11, 2008). A formal Section 106 review of the South Milledge Avenue Site was requested in April 2008. No response has been received from HPD.

The list of contacts generated for Native American Indian tribes whose ancestral lands could be affected by the proposed NBAF at the South Milledge Avenue Site is included in Table 3.9.3.1-1. Additonal coordination information is found in Appendix G.

Table 3.9.3.1-1 — Native American Contacts Consulted, South Milledge Avenue Site

The Cherokee of Georgia Tribal Council Mr. Ralph Crews Blackshear, Georgia	The Georgia Tribe of Eastern Cherokee Mr. Walker Dan Davis Dahlonega, Georgia
Georgia Council on American Indian Concerns Ms. Nealie McCormick, Chairman Palham, Georgia	The Lower Muskogee Creek Tribe Ms. Marian S. McConnick Whigham, Georgia

3.9.3.2 Construction Consequences

No adverse effects would likely occur to historical sites from the construction of the proposed NBAF because none are located on the South Milledge Avenue Site. Adverse effects to the 11 known archaeological sites adjacent to the proposed project area are not likely to occur from construction associated with the proposed project. Ten of the 11 archaeological sites identified within the 92-acre survey area are either highly disturbed or have low research potential and, therefore, would have little significance. These 10 sites have been recommended as ineligible for listing in the NRHP. If the review agencies concur the sites are ineligible, then no additional archaeological work would be necessary in these areas. The eleventh site is a small prehistoric site that would have research potential, and although the site would be eligible for listing, it is located well outside the 67-acre construction zone and would not likely be affected by the NBAF (SAS 2007).

3.9.3.3 Operation Consequences

Adverse effects to cultural resources would not likely occur as a result of operation of the proposed NBAF on the South Milledge Avenue Site.

3.9.4 Manhattan Campus Site

3.9.4.1 Affected Environment

The approximately 48.4-acre Manhattan Campus Site proposed for development is part of a land grant dating back to the mid-1800s. The property is open, agricultural land that has been used for agricultural purposes, primarily animal husbandry, research, and education (AEC 2007). A review of Kansas State Historical Society (KSHS) records indicated no cultural resources are listed on or in the vicinity of the Manhattan Campus Site. The nearest listed historical site is the Washington and Julia Marlatt Homestead, which is located approximately 0.6 miles west of the Manhattan Campus Site. KSHS concluded in their December 7, 2007 letter that they have no objections to the project and asserted the site has low archaeological potential. They furthered that the proposed project would have no effect on archaeological sites (Appendix G).

The list of contacts generated for Native American Indian tribes whose ancestral lands could be affected by the proposed NBAF at the Manhattan Campus Site is included in Table 3.9.4.1-1.

Table 3.9.4.1-1 — Native American Contacts Consulted, Manhattan Campus Site

Delaware Tribe of Indians Dr. Brice Obermeyer Emporia Kansas	Kaw Nation Kaw City, Oklahoma

3.9.4.2 Construction Consequences

Because no archaeological resources are known to exist on or in the immediate vicinity of the Manhattan Campus Site, no adverse effects are likely to result from the construction of the proposed NBAF. KSHS records indicate that no historical sites are in the project area. Although KSHS has requested review of final construction plans for reassurance that sites listed or eligible for listing in the NRHP or KSHS would remain unaffected, it is unlikely that any adverse effects would occur as a result of the proposed NBAF, given the distance between the nearest historical site and the Manhattan Campus Site.

3.9.4.3 Operation Consequences

Operation of the proposed NBAF at the Manhattan Campus Site would not likely cause any adverse effects to culturally significant resources.

3.9.5 Flora Industrial Park Site

3.9.5.1 Affected Environment

The Flora Industrial Park Site is open, agricultural land that has historically been used as pastureland. No cultural resources on, or in, the vicinity of the site are listed in Mississippi Department of Archives and History (MDAH) records. A Phase I Cultural Resource Survey was conducted for the site in November 2007. Neither the literature search, nor the field testing associated with this survey, revealed any cultural resources on, or near, the site (AMI 2007). In their letter dated November 27, 2007, MDAH documented their concurrence that no known cultural resources listed or eligible for listing in the NRHP would be affected and indicated that they have no objections to the proposed NBAF (Appendix G).

The list of contacts generated for Native American Indian tribes whose ancestral lands could be affected by the proposed NBAF at the Flora Industrial Park Site is included in Table 3.9.5.1-1.

Table 3.9.5.1-1 — Native American Contacts Consulted, Flora Industrial Park Site

Chickasaw Nation The Honorable Bill Anoatubby Ada, Oklahoma	Jena Band of Choctaw Indians Ms. Christine Norris, Chief Jena, Louisiana
Chickasaw Nation Ms. Gingy Nail, THPO Ada, Oklahoma	Mississippi Band of Choctaw Indians Mr. Beasley Denson, Chief Philadelphia, Mississippi
Chickasaw Nation Mr. Kirk Perry, Administrator of Cultural Preservation Ada, Oklahoma	Mississippi Band of Choctaw Indians Mr. Ken Carleton, THPO Philadelphia, Mississippi
Choctaw Nation of Oklahoma Mr. Gregory E. Pyle, Chief Durant, Oklahoma	Quapaw Tribe of Oklahoma Ms. Carrie V. Wilson, NAGPRA Representative and Program Director Fayetteville, Arkansas
Choctaw Nation of Oklahoma Mr. Terry Cole, THPO Durant, Oklahoma	Tunica-Biloxi Indians of Louisiana, Inc. Mr. Earl J. Barbry, Sr., Tribal Chairman and THPO Marksville, Louisiana

3.9.5.2 Construction Consequences

No cultural resources are known to exist on, or in the vicinity of the Flora Industrial Park Site; therefore, no adverse effects to culturally significant resources would likely result from the construction of the proposed NBAF on the site.

3.9.5.3 Operation Consequences

No adverse effects to culturally significant resources would likely result from the operation of the proposed NBAF on the Flora Industrial Park Site.

3.9.6 Plum Island Site

3.9.6.1 Affected Environment

The Plum Island Site was formerly utilized as a dumping area for various wastes associated with the PIADC but has since been remediated (Terracon 2007a). Details on the remediation efforts that have been undertaken on the site are included in Section 3.12.6. A site-specific cultural resource survey was performed and submitted to the New York State Office of Parks, Recreation and Historical Preservation for concurrence. Currently, no response has been received, and efforts to complete Section 106 coordination with the SHPO are underway. Ccoordination efforts are described in Appendix G. Additional information about the affected environment at the PIADC is included in Section 3.9.2.1.

The list of contacts generated for Native American Indian tribes whose ancestral lands could be affected by the proposed NBAF at the Plum Island Site is included in Table 3.9.6.1-1.

Table 3.9.6.1-1 — Native American Contacts Consulted, Plum Island Site

Delaware Nation Ms. Tamara Francis, NAGPRA Director Anadarko, Oklahoma	Stockbridge-Munsee Community Band of Mohican Indians Ms. Sherry White, THPO Bowler, Wisconsin
Shinnecock Nation (State Recognized) Ms. Margaret Smith, Attorney Southhampton, New York	Unkechauga Nation (State Recognized) Chief Harry B. Wallace Mastic, New York
Shinnecock Indian Nation Southhampton, New York	

3.9.6.2 Construction Consequences

Construction of the proposed NBAF would not likely affect cultural or archaeological resources at the Plum Island Site. However, as previously stated, a cultural resource survey was conducted and submitted to the New York State Office of Parks, Recreation and Historic Preservation for concurrence (Appendix G).

3.9.6.3 Operation Consequences

Operation of the proposed NBAF would not likely affect cultural or archaeological resources at the Plum Island Site. A cultural resource survey was conducted and submitted to the New York State Office of Parks, Recreation and Historic Preservation for concurrence (Appendix G).

3.9.7 Umstead Research Farm Site

3.9.7.1 Affected Environment

Prior to World War II, the 249-acre Umstead Research Farm Site was maintained as a combination of woodlands and open fields used for agricultural production. In August 1942, the Umstead Research Farm Site was included as part of an approximately 40,000-acre tract dedicated as a combat training facility that was utilized for training until the end of the war. After the war, the land was allowed to naturally regenerate back to woodlands. There are no known historic or archaeological resources on or adjacent to the Umstead Research Farm Site and in their letter dated January 17, 2008, the North Carolina State Historic Preservation Office (NCSHPO) indicated that no known cultural resources listed or eligible for listing in the NRHP would be affected by the proposed construction. No archaeological surveys are known to have been performed on the Umstead Research Farm Site, but NCSHPO asserted in their correspondence that due to the location and topography of the proposed project area, it is unlikely that archaeological sites eligible for inclusion in the NRHP would be affected.

Consultation with the NCSHPO identified no recognized Native American tribes that consider the Butner area, including the Umstead Research Farm Site, part of their ancestral lands. Native American consultation is, therefore, not required.

3.9.7.2 Construction Consequences

Because no cultural resources exist on or in the vicinity of the Umstead Research Farm Site, no adverse effects would likely result from the construction of the proposed NBAF at the Umsead Research Farm Site.

3.9.7.3 Operation Consequences

Operation of the proposed NBAF on the Umstead Research Farm Site is not likely to cause adverse effects to culturally significant resources.

3.9.8 Texas Research Park Site

3.9.8.1 Affected Environment

A desktop analysis evaluating cultural resources on or adjacent to the Texas Research Park Site was performed by Raba-Kistner Consultants, Inc. (Raba-Kistner) in December 2007. The analysis indicated that no NRHP-listed sites or Texas State Archaeological Landmarks (SALs) are located within or adjacent to the boundaries of the site proposed for development. The associated database search identified a total of six archaeological sites that have been documented within a 1-mile radius of the site. Of the six sites, one is historic and five are prehistoric, but none are considered eligible for listing in the NRHP or for designation as a SAL. An intensive cultural resource survey was performed on the proposed NBAF site by Raba-Kistner in January 2008. The survey, which included a pedestrian survey of the entire site supplemented with shovel testing, resulted in finding no cultural materials or artifacts. Cultural resource clearance was recommended (Raba-Kistner 2008), and the SHPO issued Section 106 clearance on February 4, 2008.

The list of contacts generated for Native American Indian tribes whose ancestral lands could be affected by the proposed NBAF at the Texas Research Park Site is included in Table 3.9.8.1-1.

Table 3.9.8.1-1 — Native American Contacts Consulted, Texas Research Park Site

Alabama-Coushatta Tribe of Texas Livingston, Texas	Kiowa Tribe of Oklahoma Carnegie, Oklahoma
Apache Tribe of Oklahoma Anadarko, Oklahoma	Tonkowa Tribe of Oklahoma Tonkowa, Oklahoma
Commanche Tribe of Oklahoma Lawton, Oklahoma	Ysleta del Sur Pueblo of Texas El Paso, Texas
Kickapoo Traditional Tribe of Texas Eagle Pass, Texas	

3.9.8.2 Construction Consequences

NRHP and Texas Historical Commission records indicate no historical sites on or within a 1-mile radius of the Texas Research Park Site which are considered eligible for listing in the NRHP or for designation as a SAL . No adverse effects would likely occur to historical sites from the construction of the proposed NBAF. No cultural resources were identified onsite by the intensive cultural resource survey. Of the six known archaeological sites recorded within a 1-mile radius of the site, none are considered to have enough significance to warrant protection afforded sites that are eligible for listing in the NRHP or for designation as a SAL. Any effects on these resources from construction of the proposed NBAF should therefore be considered negligible.

3.9.8.3 Operation Consequences

No adverse effects to culturally significant resources would likely result from the operation of the proposed NBAF on the Texas Research Park Site.

3.10 SOCIOECONOMICS

3.10.1 Methodology

An analysis of the socioeconomic impacts of the proposed facility was carried out identifying the possible impacts on the affected environment arising from the construction and operation of the facility. The geographic definition of the economically affected environment represents the anticipated area where workers at the proposed facility would most likely live and the facility-related industry linkages. The geographical definition was made based on an analysis of the commuting patterns to and from the proposed site location at an appropriately granular level (county, U.S. Census, or place code level), depending on the availability of data, and in relation to the metropolitan statistical area (MSA) definition where applicable. Information on commuting patterns was obtained largely from journey-to-work data contained in U.S. Census statistics describing daily commuting patterns to and from a given location. These data were used to define the affected environment by considering any county that constituted approximately 5% or more of the worker flows into or out of a selected site location as comprising the affected environment. Supporting data for this section are found in a series of tables in Appendix C.

To address anticipated concerns regarding the possible impacts of pathogen release on the local agricultural industry in each region (animal production and hunting activity in particular), an expanded area of study comprising all counties adjacent to the proposed site was defined for the agricultural livestock vulnerability analysis and discussion in Appendix D.

The socioeconomic impacts analysis first focuses on descriptive parameters of the affected environment such as the labor market environment and local employment base, the demographic composition of the population and trends in growth, the local housing inventory and housing values assessment, and quality of life measures such as access to schools, health care, and police and fire protection. The data used in this evaluation are organized into census counties, tracts, and block groups. A census tract is a geographic subdivision of a county and is further divided into U.S. Census block groups. Various analysis tools were used to examine and present the descriptive parameters. For example, school-aged children and the elderly are sensitive population groups that have additional needs and require additional services. Therefore, populations 18 years of age and under and populations 65 years of age and older are highlighted in the affected environment analyses.

Environmental Systems Research Institute (ESRI) data were used to estimate demographic statistics such as housing occupancy and median household income. These estimates are obtained using time series data from annual household surveys—to establish a trend line—in conjunction with federal sources of data including the Current Population Survey, American Community Survey and the Census of Employment and Wages from the Bureau of Labor Statistics (ESRI BIS 2007).

Housing characteristics are also described in terms of housing units and contract rent. Such characteristics describe the availability and affordability of various living arrangements in the study areas. A housing unit is defined either as a house, an apartment, a mobile home or trailer, a group of rooms, or a single room occupied as separate living quarters or, if vacant, intended for occupancy as separate living quarters. A housing unit is considered owner occupied if the owner or co-owner lives in the unit. All other occupied units that are not owner occupied are classified as renter-occupied whether rented for monthly cash rent or occupied without payment of monthly cash rent.

The socioeconomic impacts analysis then focuses on the anticipated impacts of the facility on the local community. The expected consequences of both construction and operations phases of the NBAF on the descriptive parameters are estimated and outlined. These include anticipated changes in employment opportunities, labor income, population growth, housing demand, and housing values, as well as anticipated changes in the quality of life as measured by the expected change in the demand for general public services.

Impact Analysis for Planning modeling system (IMPLAN) was used to estimate the economic effects on the study region. IMPLAN is a widely used economic impact assessment modeling system, provided by Minnesota IMPLAN Group, Inc., that allows the user to create area-specific multipliers that describe interindustry linkages and consumer spending patterns. Because the interindustry linkages and consumer spending patterns vary from region to region, the outputs of the impact analysis such as the amount of labor employed for the construction of each site, will vary according to the site-specific interindustry linkages. IMPLAN estimates the total economic effects arising from a Proposed Action by accounting for direct, indirect, and induced effects of the projected investment. Direct impacts are the changes in economic activity directly resulting from the initial investment, while indirect impacts refer to the increased economic activity from industry sectors supplying goods and services to the initial investment, and induced impacts refer to the increased consumer spending by earners in the study industry and all other supporting industries. Together, the total sum of direct, indirect, and induced impacts constitute the multiplier, effect which is defined as the ratio between the total estimated impact and the direct economic impact.

The economic impact analysis was conducted for both the construction of the facility, a 4-year period, and the operation of the facility, commencing in 2014. The facility construction and operation budgets were used as inputs into the model. The output from the model (economic effects on the study region) are reported as direct and total employment, total labor income, and federal, state, and local taxes. The total labor income is the sum of the labor compensation and proprietor income generated within the regional boundaries. The economic impact analysis is explained in more detail in the construction and operations consequences sections.

3.10.2 No Action Alternative

3.10.2.1 Affected Environment

The geographic definition of the economically affected area for the No Action Alternative was determined primarily based on journey-to-work information of the currently operating facility on Plum Island, New York. Journey-to-work data are typically obtained from U.S. Census statistics describing the daily commuting patterns of workers to and from a given location. Based on journey-to-work information, it was determined that the affected environment should include Suffolk County, New York, as well as Middlesex and New London Counties, Connecticut (Figure 3.10.2.1-1).

3.10.2.1.1 Employment and Income

3.10.2.1.1.1 Employment

In general, the civilian labor force for all three counties has grown from 923,075 in 1990 to 1,024,266 in 2006, an increase of 11% over a period of 16 years, which lags the growth rate of the national civilian labor force (20.3%) during the same time period (Table C-1[1]). This sluggish growth is exemplified in New London County, which had less than a 1% growth in its civilian labor force over the 10-year period from 1990 to 2000.

The unemployment rate in the three study area counties tracked the movement in the national unemployment rate for the 3 years observed (1990, 2000, and 2006) – dropping between 1990 and 2000 but then subsequently rising again between 2000 and 2006 (Table C-1). Individually, each county had an unemployment rate lower than the national unemployment rate, and when taken together, the unemployment rate for the combined three-county region has generally been about a percentage point lower than the national average rate over the 3 years noted.

[1] Derived from Bureau of Labor Statistics historic data.

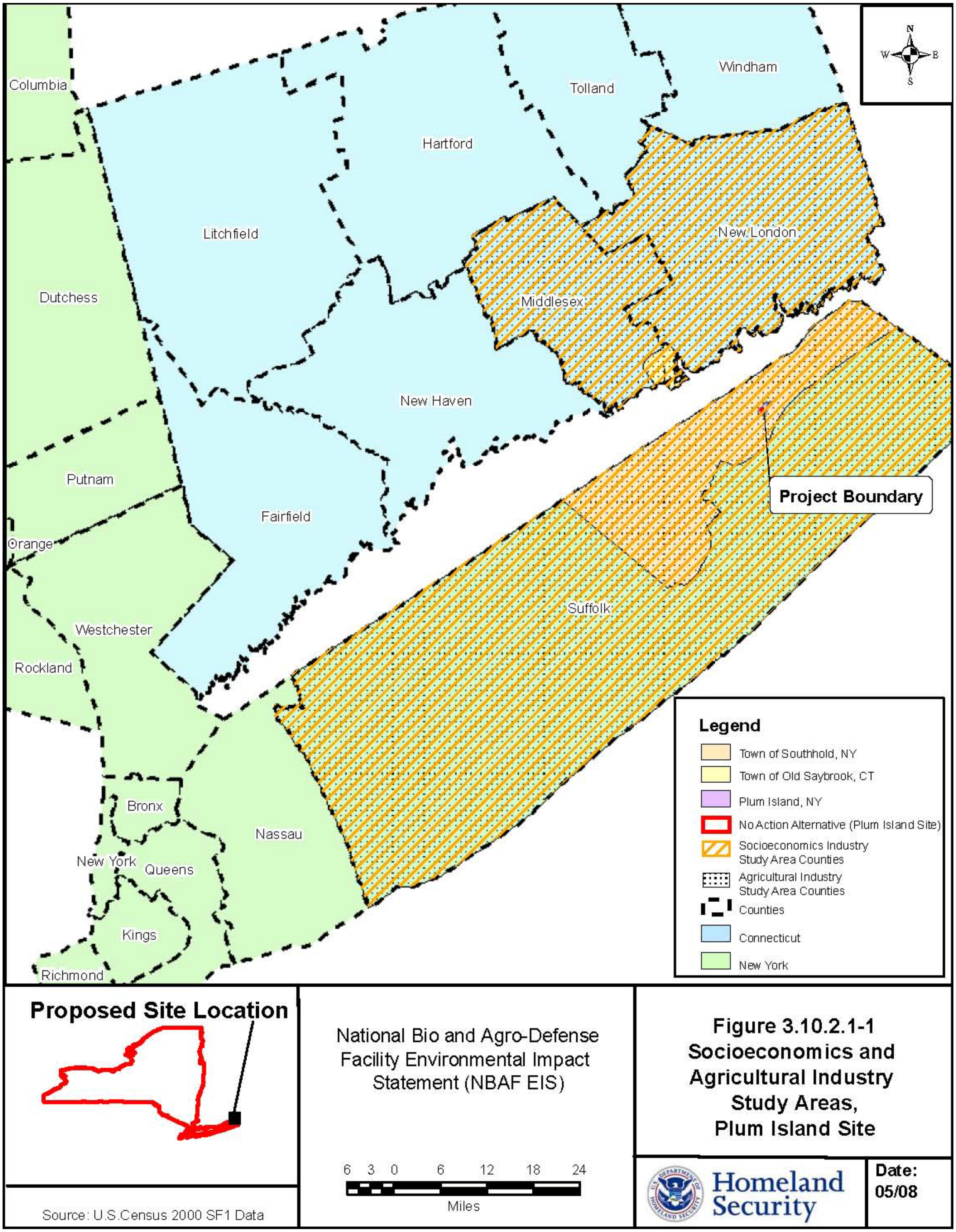


Figure 3.10.2.1-1 — Socioeconomics and Agricultural Industry Study Areas, No Action Alternative

All three counties have the majority of their labor forces commuting to work within county borders (Table C-2). Middlesex County has slightly more than half of its labor force working in Middlesex and approximately 24% working in neighboring Hartford County, which is home to Hartford—Connecticut's state capital and third largest city. Approximately 83% of New London County residents work in the county with a small fraction working in Hartford County (5.5%) and Middlesex County (3.8%). About three-quarters of Suffolk County residents work in Suffolk County, with another 14% commuting daily to neighboring Nassau County for work.

Employment can be measured as either a count of workers (e.g., see Table C-1) or as a count of actual jobs. The following employment base analysis uses the count of actual jobs in ascertaining the relative importance and proportion of various industrial sectors present in the study area (Tables C-3 and C-4).

Suffolk County was home to 793,253 of the 1,062,027 jobs held in the three-county region in 2005 (Table C-4). New London contributes 172,961 jobs, while Middlesex contributes 95,813 jobs towards the three-county total.

Government and government enterprises are the largest source of employment for both Suffolk and New London Counties. In Middlesex County, however, this sector is only the fourth most significant contributor of employment opportunities. Together with the government enterprise industry, health care and social assistance and the retail trade industries are also common major contributors to employment opportunities in all three counties (Tables C-3 and C-4).

Suffolk and Middlesex Counties show a slightly more even industry contribution to local employment compared to New London County (Table C-4). The top five industry employers in Suffolk and Middlesex account for a total of 51% and 55%, respectively, of total employment in each county, while New London's top five account for 66%. A large part of the asymmetry in New London can be explained by the size of government employment that makes up 28% of local employment in the county.

The information on leading employers in Suffolk County was obtained from sources that pooled some employer data with the adjacent Nassau County, and exact estimates of the number of employees working strictly within the county boundaries cannot be determined (Table C-5). Nonetheless, the leading employer noted in that region was the North Shore Health System, which is a network of 14 hospitals spread over the two counties that had nearly 32,000 workers in 2005. Health care-associated jobs in the county support 11% of total employment (Table C-4), and as anticipated, other health care providers, such as the Winthrop Health System and Stony Brook University Hospital, were among the leading employers in Suffolk County. Also, retail traders such as Wauldbums, Pathmark, and King Kullen Supermarkets are among leading employers in the county (Table C-4).

The information on leading employers for the two Connecticut counties was obtained from a list of the top 50 leading employers in the state. Four of the leading five companies (Table C-5) are located in New London, Connecticut and seem to be representative of the five leading industry employers (Table C-3): manufacturing, health care, and accommodation and food services. The one leading firm from Middlesex County is Middlesex Hospital, which is a health care institution supporting approximately 2,800 jobs in 2007.

Government and government enterprises are the largest sources of employment in terms of total wages paid in the three-county region and in the cases of both Suffolk and New London Counties—they comprise approximately 23% of the total wages in all three counties combined, paying out approximately $10.6 billion in wages (Tables C-6 and C-7).

3.10.2.1.1.2 Agricultural Industry

An analysis of the agricultural industry used IMPLAN and DHS data to describe the importance of the industry on the local economy. This is in response to public comments expressing concern about the possible impacts of the proposed facility's operations on agricultural production—particularly animal production—in the affected environment.

Agriculture directly supported an estimated 6,897 jobs in the three counties studied in 2006 (Table C-8), with Suffolk and New London Counties contributing 6,078 jobs (88%) towards that total. Of the 6,897 jobs directly supported by the agricultural industry, only 1,167 jobs are attributed to animal production enterprises, with the bulk of agricultural maintained and provided by crop production. The agricultural industry generally constituted less than 1% of employment both in terms of total jobs supported and in terms of total compensation paid in all three counties together and individually. The only exception is in New London County where it supports 1.3% of total jobs in the county. The employment in the agricultural industry paid out $121 million in total compensation in the three counties with most of that amount being paid out in Suffolk County ($69 million) (Table C-8).

Industry output can be measured by the total value of purchases made by intermediate and final consumers of that industry's production. Crop production generated $389 million towards the total output of the North American Industry Classification System (NAICS) code classified agriculture and hunting industry (Table C-8) with animal production contributing an additional $65 million.

The value of cattle livestock inventory was also estimated for the regional economy based on data obtained from the National Agricultural Statistics Service (NASS) (NASS 2006). There were approximately 1,473,000 head of cattle and calves at the end of 2006 within the two states of New York and Connecticut (1,420,000 and 53,000, respectively), with an estimated inventory value of $1.7 billion (averaging out to a unit value $1,170 per head). There are no sources of data describing the distribution of the total cattle population among the individual counties in New York and Connecticut in 2006, but according to the 2002 NASS census data, cattle inventory for the states of New York and Connecticut totaled 1,507,612 head of cattle; however, the three counties studied only contributed 13,062 towards that total. Therefore, it is reasonable to assume that the study area still accounted for a very small proportion of the two state's livestock population in 2006.

3.10.2.1.1.3 Hunting

An analysis of the hunting industry is used to assess the importance that hunting activity has on the local economy. Data from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation are utilized to describe the depth of this industry and address public concerns about the possible impacts of the proposed facility's operations on this industry and subsequently on the local economy.

U.S. Fish and Wildlife Service data from 2006 that are limited to the statewide level shows that total expenditures related to recreational hunting activities in the states of New York and Connecticut totaled $716 and $69 million, respectively. The data show that of the 604,000 individuals who participated in hunting activities in both states in 2006, 558,000 were involved in big game hunting (e.g., deer) (USFWS 2006).

The following sections analyze a less inclusive study area than is examined with regard to Agricultural Industry and Hunting.

3.10.2.1.1.4 Income and Poverty

In 1999, median household incomes ranged from $50,659 in New London County to $64,885 in Suffolk County. Per capita incomes showed less variation and were lowest in New London County ($24,678). Overall, the median household income in the study area was $62,006 and the per capita income $26,450.

Of the study area counties, Middlesex County had the lowest proportion of persons living below poverty in the study area, and New London County contained the highest proportion of persons living below the poverty line. The percentage of persons living below poverty in the study area was 5.9%, substantially smaller than the poverty rate in New York (14.59%), Connecticut (8.0 %), and the United States (12.4%) (Table C-9) (USCEN 2000a).

In 2007, the estimated median household income for the study area was $79,586, above the expected median household incomes for New York ($56,704), Connecticut ($68,430), and the United States ($53,154). Suffolk County was estimated to have a per capita income of $36,351, higher than in New York ($31,116) and the United States ($27,916), but lower than in Connecticut ($37,645) (ESRI BIS 2007).

3.10.2.1.2 Population and Housing

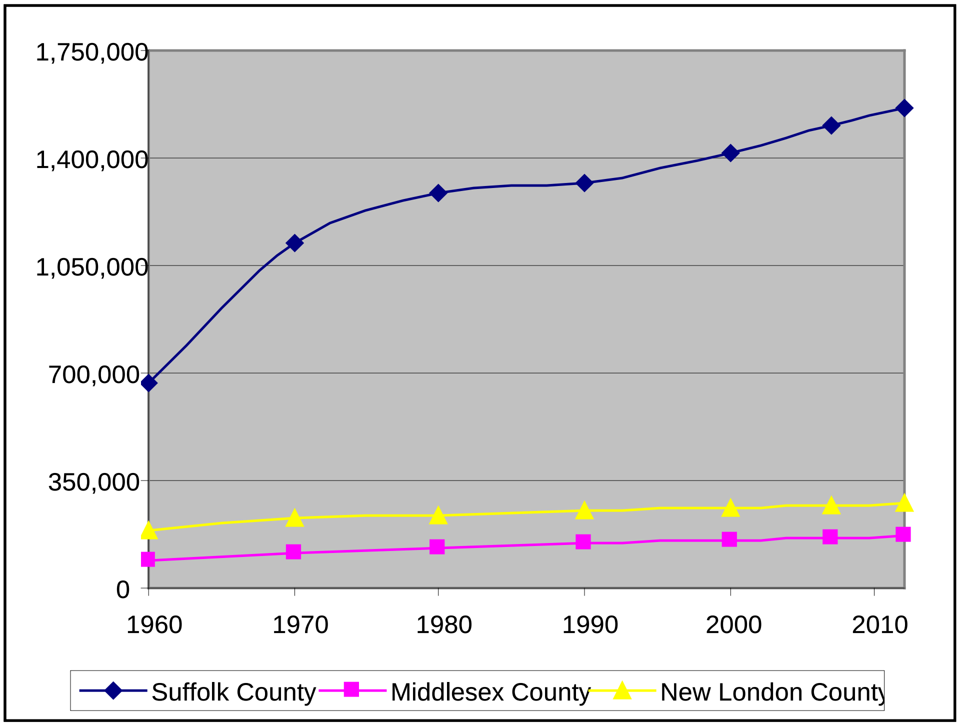
3.10.2.1.2.1 Population

According to population growth trends in the No Action and Plum Island Site area counties (Suffolk County, New York, and Middlesex and New London Counties, Connecticut), the total population of the study area has increased by 892,634 persons between 1960 and 2000. Population estimates for 2007 and 2012, the most recent forecasts available, show an additional 180,522 residents are estimated to be added to the study area between 2000 and 2012 (Figure 3.10.2.1.2.1-1) (USCEN 2000b).

While the population of all of the study area counties has increased every decade since 1960, the total population of the study area has been most influenced by the rapid growth of Suffolk County. Factors influencing the observed population trends in Suffolk County include suburban development (particularly in western Suffolk County, with workers commuting to New York City) and the location of new major institutions in the county such as State University of New York at Stony Brook in 1962 (USCEN 2000a).

Plum Island has no residential population. Although separated by approximately 1 mile of waterway, the nearest residential population is located on Orient Point. Orient Point refers to the easternmost coast of North Fork, Long Island, in the Town of Southold. Government owned and contractor operated ferries connect Orient Point to the study area island location and Old Saybrook, Connecticut. Access is restricted to the employees, contractors, and visitors of the current facility. Because the Town of Southold in Suffolk County is the nearest residential location to Plum Island within the study area, it is included in this socioeconomic discussion.

Between 2007 and 2012, the population of the study area is estimated to grow slightly faster than New York and Connecticut, but slower than the United States. Middlesex County was the fastest growing county in the study area between 1990 and 2000 and is estimated to continue to grow faster than the study area as a whole between 2000 and 2012. Suffolk County's share of the total study area population (77%) is estimated to remain relatively constant between 2000 and 2012. The Town of Southold is estimated to grow at double the rate of the study area between 2007 and 2012, adding 601 residents (Table C-10) (USCEN 2000b).



Sources: 1960-2000 population: U.S. Census Bureau. 2007 and 2012 population forecasts: ESRI BIS.

Figure 3.10.2.1.2.1-1 — Population, Suffolk County, New York and Middlesex County, and New London County, Connecticut, 1960-2012

3.10.2.1.2.1.1 Ethnicity and Race

In 2000, persons of Hispanic origin comprised the largest percentage minority group in the study area (9.1%), which was smaller than in New York (15.1%) and the United States (12.5%), but was greater than the percentage Hispanic population in Connecticut (6.5%). African Americans comprised 6.5% of the study area, which was a smaller proportion than in New York (15.9%), Connecticut (8.6%), and the United States (12.2%). Overall, the proportion of minorities in the study area (19.5%) was smaller than in the United States (30.1%), New York (38.0%), and Connecticut (22.5%) (Table C-11) (USCEN 2000b).

3.10.2.1.2.1.2 Age

In 2000, approximately 26.8% of the population of the study area was aged 18 years and under, and 12.1% was aged 65 years and older. The population of Suffolk County 18 years of age and under was the largest in the study area, and its population aged 65 years and older was the smallest in the study area (Table C-12) (USCEN 2000b).

In 2007, the proportion of the Suffolk County population estimated to be 18 years of age and under (27.7%) was greater than in New York (25.4%), Connecticut (25.7%), and the United States (25.8%). The proportion of the population of Suffolk County estimated to be 65 years of age and older (6.31%) was substantially smaller than in New York (113.0%), Connecticut (13.9%), and the United States (12.5%) (ESRI BIS 2007).

3.10.2.1.2.1.3 Educational Attainment

In 2000, 13.6% of the study area population 25 years of age and older did not graduate from high school, 50.7% of the population graduated from high school or had some college education, 7.9% had an associate's degree and 27.9% had a bachelor's degree, or higher level of education (Table C-13). The proportion of residents that did not graduate from high school in the study area (13.6%) was smaller than in New York (20.9%), Connecticut (16.0%), and the United States (19.6%) (USCEN 2000a).

3.10.2.1.2.2 Housing

In 2007, 90.8% of the housing units in the study area were estimated to be occupied, and 9.2% were estimated to be vacant (See Table C-14). The proportion of vacant units in the study area was estimated to be greater than in New York (8.7%) and Connecticut (6.1%) and similar to the United States (9.9%), yet the majority of vacant units in the study area, nearly double of those in New York and Connecticut, were used for seasonal and recreational use (ESRI BIS 2007).

In 2007, New London County was estimated to have the highest proportion of renter-occupied housing units. The percentage of owner-occupied housing units in the study area (71.9%) was estimated to be greater than in New York (50.8%), Connecticut (65.5%), and the United States (61.3%) (Table C-14) (ESRI BIS 2007).

In 2000, the single-family detached house was the predominant form of housing in the study area and comprised 544,414 units (77.7%). The majority of housing units in buildings with over 10 units were located in the Suffolk County (Table C-15) (USCEN 2000b).

In 2000, in all three study area counties, the majority of the housing stock was built before 1969, with a median year built of 1966 in Suffolk and Middlesex Counties and 1963 in New London County. In the study area as a whole, 69,136 housing units (9.9%) have been built since 1990 (Figure 3.10.2.1.2.2-1) (USCEN 2000b).

Between 2000 and 2007, housing values in the study area were estimated to grow the fastest in Suffolk County and the Town of Southold. The Town of Southold was estimated to have the highest median housing value ($456,934), and New London County was estimated to have the lowest median housing value ($279,094). In 2007, the median housing value for Suffolk County was estimated to reach $384,349, substantially higher than the estimated values for New York ($296,301), Connecticut ($297,091), and the United States ($192,285) (Table C-16) (USCEN 2000b; ESRI BIS 2007).

In 2007, the largest proportion of housing units with estimated values less than $50,000 was in New London County with 1,518 units, which represented just 2.1%. Overall, the proportion of housing units valued at over $150,000 in the study area (96.8%) was estimated to be much greater than in New York (79.3%), Connecticut (91.9%), and the United States (61.7%) (Table C-17) (ESRI BIS 2007).

Between 1990 and 2000 (the most recent available data), median monthly rent in the study area grew the fastest in the Town of Southold and Suffolk County. In 2000, Suffolk County had the highest median rent, and New London County had the lowest median rent. The 2000 median rent in the Town of Southold ($854) was higher than the median rents for New York ($605), Connecticut ($588), and the United States ($519) (Table C-18) (USCEN 2000b).

New London County had the largest proportion of housing units with a rent of less than $200. Suffolk County had the largest number and proportion of housing units with rents over $1,000. Overall, the proportion of housing units with rents over $1,000 in the study area (21.1%) was greater than in New York (13.7%), Connecticut (9.4%), and the United States (8.4%) (Table C-19) (USCEN 2000b).

In 2005, the majority of new housing units in the study area were permitted in Suffolk County relative to New London County and Middlesex County. The least expensive housing units in the study area are being constructed in Middlesex County, and the most expensive housing units are being built in Suffolk County (Table C-20) (USCEN 2000b).

3.10.2.1.3 Quality of Life (Community Services)

Quality of life encompasses those attributes of resources (man-made or natural occurring) of a region that contribute to the well-being of its residents. The relative importance of these attributes to a person's well-being is subjective. For the purposes of this study, the quality of life of the affected environment includes public schools, law enforcement, fire protection services, medical facilities, and recreation facilities.

3.10.2.1.3.1 Public Schools

There are no residents of Plum Island, and the island is not part of any school district. School districts nearest to the island on the mainland include the Oysterponds Union Free School District in Orient Point, Suffolk County, and the New London School District in New London County.

Providing education for students through grade 6, the Oysterponds Union Free School District, had a total enrollment of 103 and an average class size of 15 during the 2005-2006 school year (New York State Department of Education 2007). The New London School District consists of nine schools, serving grades kindergarten through 12. Total enrollment during the 2003-2004 school year was 3,178 with average class sizes ranging from 17.1 in kindergarten to 21.5 in grade 5. The average class size for high school was 21.7 (CSDE 2005).

3.10.2.1.3.2 Law Enforcement

The Federal Protective Service (FPS) provides full-time law enforcement on the island, as well as contract security. FPS personnel verify contractors' and visitors' backgrounds before these individuals enter the biocontainment area.

Also included in the study area was the east end of Suffolk County, which is served by numerous local police departments, including the Southold Town Police Department, the Greenport Police Department, and the East Hampton Police Department. Local police departments are supported by services available through the Suffolk County Police Department, which includes the following specialized units:

- The Emergency Services Section, which handles accidents, rescue operations, and hazardous materials.
- The Marine Bureau patrols the waters surrounding Suffolk County and includes 83 officers and maintains extensive marine search and rescue capabilities (SCPD 2007).

Likewise, New London County receives similar services from the New London Police Department and the local Old Saybrook Town Police Department (OSPD 2007; CoNL 2008).

3.10.2.1.3.3 Fire Protection

The Southold Fire Department is a volunteer fire department, with 189 volunteer members, two fire stations, and 20 support vehicles. It receives approximately 600 calls per year (SFD 2007).

The Suffolk County Department of Emergency Management and the Suffolk County Department of Fire, Rescue and Emergency Services coordinate responses to fire and other emergencies in the county (SCG 2007). Fire protection services are also provided to the study area by the New London and Middlesex County fire departments. The Plum Island Fire Department provides primary fire protection to Plum Island and PIADC. The Plum Island Fire Department participates in a mutual aid plan to provide assistance and protection for all Suffolk County communities (including Plum Island) in case of fire, medical emergencies, and other emergencies.

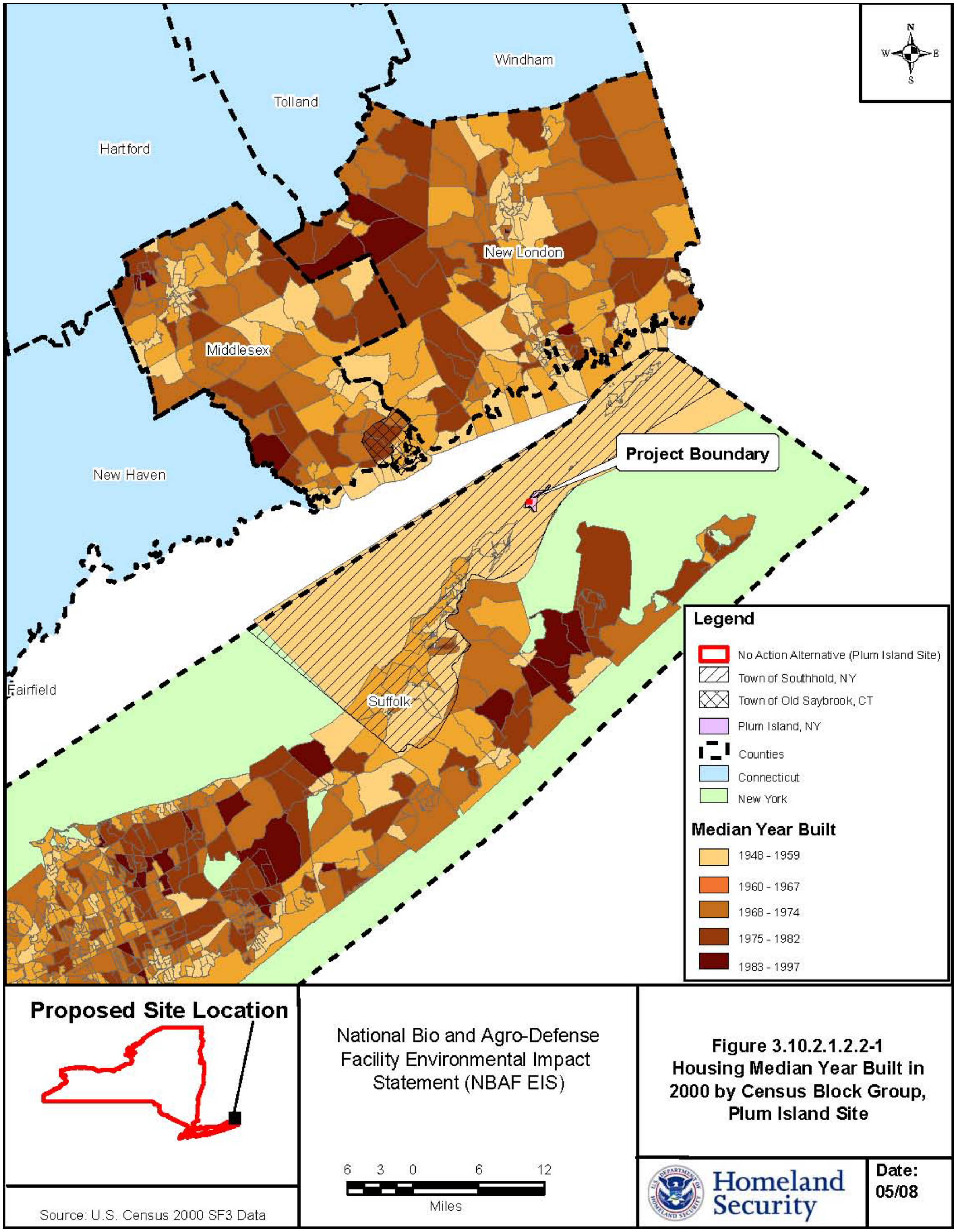


Figure 3.10.2.1.2.2-1 — Housing Median Year Built in 2000 by Census Block Group

3.10.2.1.3.4 Medical Facilities

The closest hospital to the island is the Eastern Long Island Hospital in the Village of Greenport, approximately 15 miles from Plum Island. Eastern Long Island Hospital is an 80-bed facility. The Emergency Department was expanded in 2005 to nine beds (ELIH 2007). Large regional hospitals in the area include the University Hospital at Stony Brook. The study area is also served by Lawrence and Memorial Hospital and Middlesex Hospital.

3.10.2.1.3.5 Recreation

The Suffolk County Parks Department manages over 46,000 acres of park land. Suffolk County recreational resources include numerous parks, both inland and on beaches and islands. Large county parks in eastern Suffolk County include:

- Cedar Point County Park, East Hampton – 607 acres. Features include recreational fishing, hiking, picnicking, camping, playground, rowboat rentals, bicycling, saltwater fishing, scuba diving, and hunting.
- Cupsogue Beach County Park West Hampton – 296 acres. Features include swimming and camping.
- Indian Island County Park, Riverhead – 275 acres. Features include hiking, picnicking, camping, fishing, an activity field, and a playground (SCDP 2007).

There are also numerous parks and entertainment venues located throughout New London and Middlesex Counties that offer additional recreational activities to the study area.

3.10.2.2 Consequences

3.10.2.2.1 Employment and Income

Infrastructure improvements are estimated to be made to the current operating facility on Plum Island with the No Action Alternative, but these improvements are not anticipated to increase the existing facility's impact on the local economy.

3.10.2.2.2 Population and Housing

There would be no increase in the population of the study area under the No Action Alternative. Therefore, no effects on housing availability or prices would occur.

3.10.2.2.3 Quality of Life (Community Services)

There would be no increase in the population of the study area under the No Action Alternative. Therefore, it would have no effect on the availability of public services such as schools, medical services, law enforcement, fire protection, or recreational facilities.

3.10.3 South Milledge Avenue Site

3.10.3.1 Affected Environment

South Milledge Avenue, in the city of Athens, Georgia, is the proposed location for the NBAF and the geographic definition of the affected environment for this location was determined primarily based on a journey-to-work analysis. Any county that constituted approximately 5% or more of the worker flows into or out of Athens (FIPS Place Code 03440) was considered to comprise the affected environment for the proposed site. This included Clarke, Madison, and Oconee Counties (USCEN 2000a: USCEN 2000c).

The expanded area of study to be used for the agricultural livestock vulnerability analysis and discussion in Appendix D added Barrow, Jackson, and Oglethorpe Counties to the original economically described affected area (Figure 3.10.3.1-1).

3.10.3.1.1 Employment and Income

3.10.3.1.1.1 Employment

The civilian labor force for the three counties combined has grown from 64,229 in 1990 to 95,596 in 2006, an increase of 48.8% (Table C-21). With the exception of 1990, all three counties had unemployment rates lower than Georgia's percentage, and lower than the national average percentage rate.

The unemployment rates for all three counties have followed the Georgia unemployment trend, falling between the years of 1990 and 2000, and then subsequently rising between the years 2000 and 2006. Clarke and Madison Counties had unemployment rates similar to those of the state, whereas the unemployment in Oconee County has consistently remained at least one percentage point lower than the state's average in the 3 years observed (1990, 2000, and 2006).

Clarke County is the region's primary generator of employment (Table C-22). Approximately 81% of its workers are employed within the county, and it also attracts about a half of the labor forces in Madison and Oconee Counties. This concentration of commuters into Clarke County is mainly due to the presence of the urban center of Athens, which is located in Clarke County.

Employment can be measured as either a count of workers (e.g., see Table C-21) or as a count of actual jobs. The following employment base analysis uses the count of actual jobs in ascertaining the relative importance and proportion of various industrial sectors present in the study area (Tables C-23 and C-24).

In 2005, Clarke County was home to 80,825 jobs, while Madison and Oconee Counties held 8,138 and 11,855 jobs, respectively (Table C-24). The concentration of jobs in Clarke County is consistent with the journey-to-work analysis that found the county to be a center of regional employment. Athens is home to UGA and is largely considered a college town. As a public university with associated research centers, UGA is the leading employer in the county. Of the 80,825 jobs in Clarke County, 21,155 are attributed to government and government enterprise, and approximately 15,000 of these jobs are state government enterprise and may be related to UGA.

There is a diverse mix of leading employers by industry in each county, although retail industries and government enterprise are common to all three counties. Even though Clarke County is more urbanized than Madison or Oconee, service industries are not entirely dominant in the county. Retail trade and manufacturing contribute approximately 20% of the jobs in the county. Health care and accommodation services, however, combine to generate about 16% of the jobs in the county (Tables C-23 and C-24).

A list of major employers in the study region was obtained (Table C-25). Due to the concentration of jobs in Athens, the top employers in Clarke County appear to have much larger operations with eight firms/businesses supporting over 500 jobs. Neither Madison nor Oconee Counties have any firms employing more than 500 workers. According to this list, UGA is the largest employer in the region with over 10,000. Even though Table C-24 shows only 1,091 jobs associated with educational services, the 10,000 plus jobs supported by UGA are most likely reported as "government enterprise." As already mentioned, 15,000 jobs in Clarke County are associated with state government enterprise.

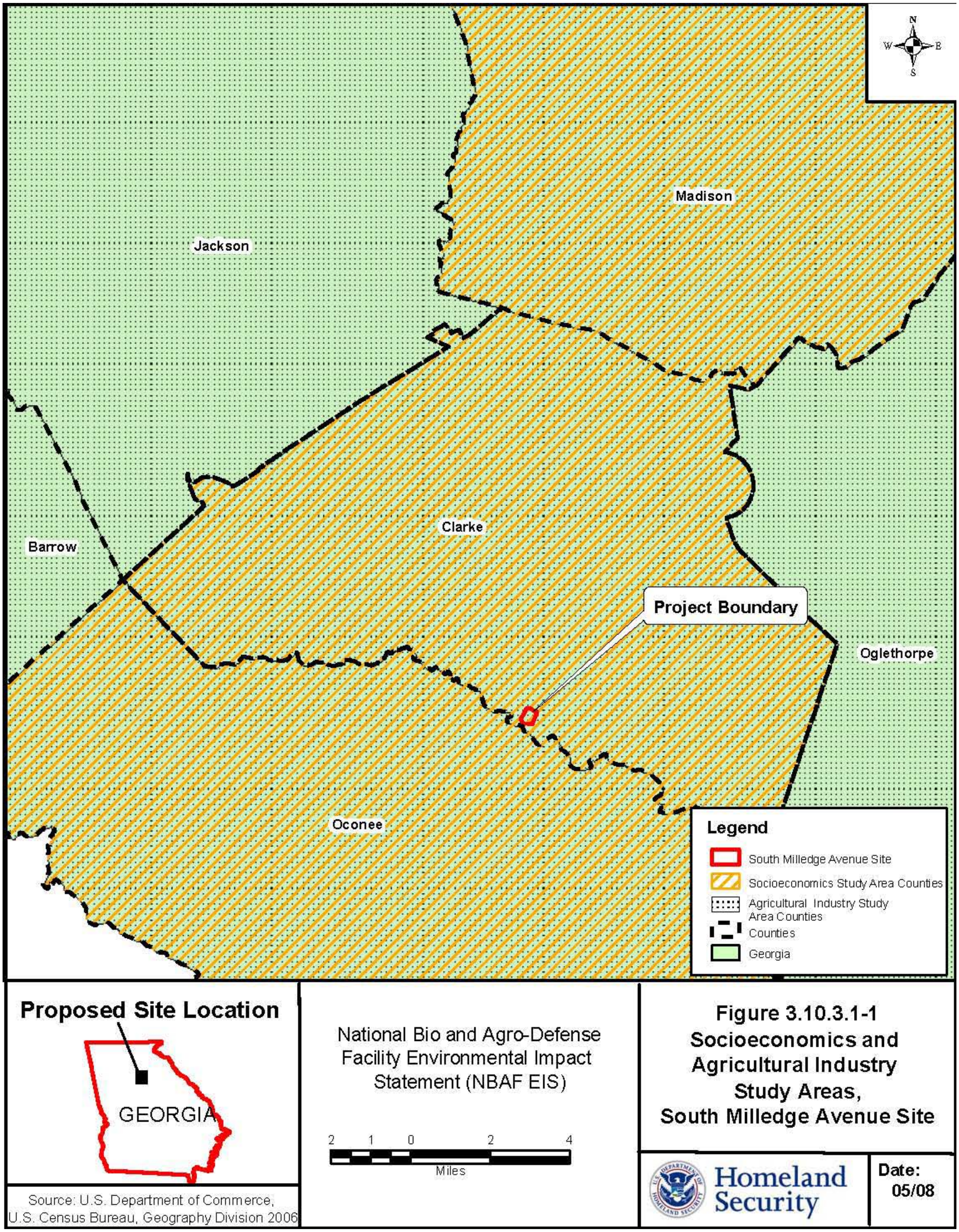


Figure 3.10.3.1-1 — Socioeconomics and Agricultural Industry Study Areas

Government and government enterprises are ranked as the largest sources of employment in terms of total wage compensation paid both for the general study area of study and for each individual county. With the exception of the manufacturing industry, which plays a significant role in employment compensation in all three counties, there is a fairly diverse mix of top contributors to employment compensation within each county. Even though Clarke County is more urbanized than the other two, its employment base in terms of wages paid is still not yet dominated by service industries — retail trade and manufacturing also play a major role (Tables C-26 and C-27).

3.10.3.1.1.2 Agricultural Industry

For the purposes of this analysis, an expanded area of study comprising all counties adjacent to the proposed South Milledge Avenue Site was defined for the agricultural livestock discussion. The relative importance of the agricultural industry was assessed in the following counties: Clarke, Madison, Oconee, Barrow, Jackson, and Oglethorpe.

In 2006, agriculture directly generated an estimated 2,866 jobs in the six counties studied (Table C-28), with Jackson County contributing 973 jobs towards that total. Animal production makes up 2,284 of the 2,886 jobs directly supported by the agricultural industry with poultry and egg production providing the bulk of those jobs in the six-county region. Agriculture makes up about 2% of all the jobs in the six-county region and ranges between 0.4% and 5.4% in the six individual counties. In Clarke, the most urban of the six, agriculture comprises less than 1% of total industry employment, while in Oglethorpe the figure is more than 15%.

The six-county region's output from the NAICS code classified agriculture and hunting industry in the six-county region totaled $644 million (Table C-28). Industry output can be measured by the total value of purchases made by intermediate and final consumers of that industry's production. Animal production generated $559 million towards the agriculture and hunting industry's total output with crop production contributing an additional $81 million. Poultry and egg production in the six-county region accounted for approximately $512 million (80%) of the agriculture and hunting industry's total output, making it the most valuable overall industrial component.

Livestock statistics in the counties surrounding the proposed facility show the total number of livestock found in the six-county region is 132,900, with Oglethorpe County providing 52,598 (40%) of the total (Table C-29). The term livestock includes all hoofed animals (e.g., cattle, hogs, sheep, goats, horses, and mules). The number of poultry in the six-county region is 48,123,119 (34%), and Madison County provides 16,500,000 of the total (NDP 2007a).

At the end of 2006, there were approximately 1,170,000 head of cattle and calves within Georgia, with an estimated inventory value of $924 million (averaging out to a unit value $790 per head within the state). The six-county region made up 7.6% of that total with 89,500 head of cattle found within those counties (NASS 2006). Based on the state's estimated unit price, the inventory value of cattle within the six-county region would be approximately $70.7 million.

3.10.3.1.1.3 Hunting

An analysis of the hunting industry is used to assess the importance that hunting activity has on the local economy. Data from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation are utilized to describe the depth of this industry and address public concerns about the possible impacts of the proposed facility's operations on this industry and subsequently on the local economy.

U.S. Fish and Wildlife Service data from 2006 that are limited to the statewide level shows that total expenditures related to recreational hunting activities in the state of Georgia totaled $678 million. The data show that of the 481,000 individuals who participated in hunting activities in 2006, 410,000 were involved in big game hunting (e.g., deer) (USFWS 2006).

3.10.3.1.1.4 Income and Poverty

In 1999, median household incomes ranged from $28,482 in Clarke County to $54,714 in Oconee County. Per capita incomes ranged from $16,998 in Madison County to $24,153 in Oconee County. Overall, the median household income in the study area was $33,514 and the 2000 per capita income $18,303.

Of the study area counties, Oconee County had the lowest proportion of persons living below poverty, and Clarke County contained the highest proportion of persons living below the poverty line. The percentage of persons living below poverty in the study area was 21.4%, substantially higher than the poverty rates in Georgia (13.0%) and the United States (12.4%) (Table C-30) (USCEN 2000b).

In 2007, the estimated median household income for the study area was $42,311, below the estimated median household incomes for Georgia ($55,102) and the United States ($53,154). Clarke County was estimated to have a per capita income of $22,403, slightly lower than in Georgia ($28,047) and the United States ($27,916) (ESRI BIS 2007).

3.10.3.1.2 Population and Housing

3.10.3.1.2.1 Population

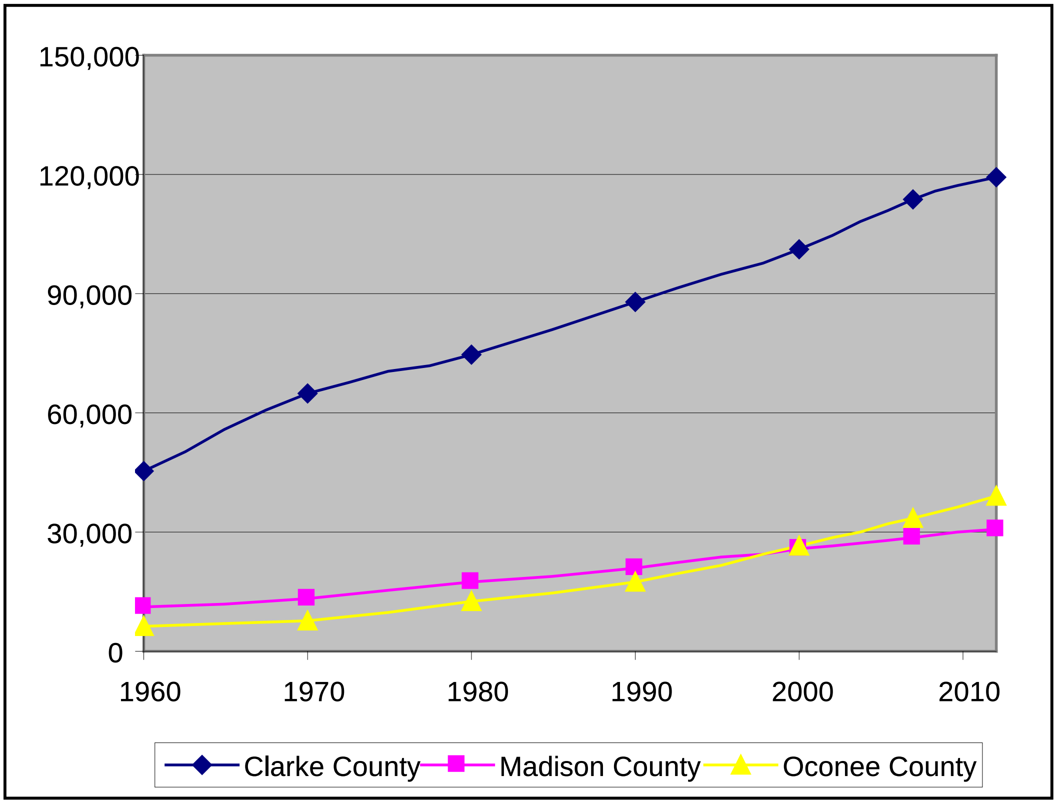
According to population growth trends in the South Milledge Avenue Site study area counties (Clarke, Madison, and Oconee Counties), the total population of the study area has increased by 90,531 persons between 1960 and 2000. Population estimates for 2007 and 2012, the most recent forecasts available, show an additional 36,029 residents are estimated to be added to the study area between 2000 and 2012 (Figure 3.10.3.1.2.1-1) (USCEN 2000b; ESRI BIS 2007).

While the population of Clarke County, where the City of Athens is located, has increased every decade since 1960, the most rapid growth occurred in the last two decades. As a result of this growth, the population of Oconee County surpassed that of Madison County in the year 2000 (USCEN 2000b).

Between 2007 and 2012, the population of the study area is estimated to grow at a slightly slower rate than Georgia but faster than the United States (Table C-31). In 2000, Clarke County made up 66.1% of the study area population; however, its share is estimated to decline relative to the fast growing Oconee County. By 2012, 20.8% of the study area population is estimated to live in Oconee County, up from 14.0% in 1990.

3.10.3.1.2.1.1 Ethnicity and Race

In 2000, African Americans comprised the largest minority group in the study area (20.5%), which was smaller than the proportion of African Americans in Georgia (28.7%) and greater than the proportion in the United States (12.2%). Clarke County had a substantially greater proportion of minority residents than Madison or Oconee Counties (Table C-32) (USCEN 2000b). The proportion of persons of Hispanic origin in the study area (5.1%) was similar to Georgia (5.3%) but substantially smaller than the United States (12.5%). The proportion of minorities in the study area (29.2%) was smaller than in Georgia (37.4%) and the United States (30.1%).



Sources: 1960-2000 population: U.S. Census Bureau. 2007 and 2012 population forecasts: ESRI BIS.

Figure 3.10.3.1.2.1-1 — Population, Athens-Clarke County, Madison County, and Oconee County, Georgia, 1960-2012

3.10.3.1.2.1.2 Age

In the study area as a whole, approximately 27.7% of the population was 18 years of age and under, and 8.7% was 65 years of age and older, which were similar to the respective proportions in Georgia (28.0% and 9.6%) and the United States (27.1% and 12.4%). In the study area, Clarke County, the largest county in the study area, had substantially smaller proportions of its population aged 18 years and under and 65 years and older (Table C-33) (USCEN 2000b).

In 2007, 19.6% of the Clarke County population was estimated to be 18 years of age and under, again smaller than in Georgia (26.7%) and the United States (25.8%). The proportion of the population of Clarke County aged 65 years and older (8.7%) was also estimated to be smaller than in Georgia (9.9%) and the United States (12.5%) (ESRI BIS 2007).

3.10.3.1.2.1.3 Educational Attainment

In 2000, in the study area as a whole, 19.9% of the population 25 years of age and older did not graduate from high school, 42.1% of the population graduated from high school or had some college education, 4.0% had an associate’s degree, and 34.1% had a bachelor’s degree or a higher level of education (Table C-34). Within the study area, Madison County exhibited the highest proportion of residents without a high school diploma and the lowest proportion of residents with a bachelor’s degree or higher (USCEN 2000a). Due to the presence of UGA and related research industries, the proportion of residents with a graduate or professional degree in the study area (15.6%) was substantially higher than in Georgia (8.3%) or the United States (8.9%).

3.10.3.1.2.2 Housing

In 2007, 93.8% of the housing inventory in the study area was estimated to be occupied, and 6.2% was estimated to be vacant (Table C-35). The proportion of vacant units in the study area was estimated to be smaller than in Georgia (9.8%) and the United States (9.9%).

In 2007, Clarke County was estimated to have the highest proportion of renter-occupied housing units in the study area. Overall, the proportion of owner-occupied housing units in the study area (52.3%) was estimated to be smaller than in Georgia (62.3%) and the United States (61.3%) (Table C-35) (ESRI BIS 2007).

In 2000, the single-family detached house was the predominant form of housing in the study area, comprising 32,971 units (53.0%). The majority of housing units in buildings with over 10 units were located in Clarke County, and the largest proportion of mobile homes were located in Madison County (Table C-36) (USCEN 2000b).

In Clarke County, 35.9% of housing units were built before 1970, compared to 27.5% in Madison County and 18.8% in Oconee County. Oconee County has a greater proportion of housing units built in the 1990 to 2000 time period than the other study area counties, reflecting the higher rate of population and household growth in Oconee County compared to the other counties. In the study area as a whole, 16,410 housing units (26.4%) have been built since 1990 (Figure 3.10.3.1.2.2-1) (USCEN 2000b).

Between 2000 and 2007, housing values in the study area were estimated to grow the fastest in Oconee and Clarke Counties. In 2007, Oconee County was estimated to have the highest median housing value ($216,428), and Madison County was estimated to have the lowest median housing value ($109,279). In 2007, the median housing value for Athens-Clarke County was estimated to reach $143,234, below the estimated values for Georgia ($148,827) and the United States ($192,285) (Table C-37) (USCEN 2000b; ESRI BIS 2007).

Overall, 41.5% housing units in the study area were estimated to be valued between $50,000 and $150,000 in 2007. The largest proportion of housing units with estimated values less than $50,000 was in Madison County (17.5%). Oconee County had the largest estimated proportion of housing units valued at over $150,000 (69.3%). Overall, the estimated proportion of housing units valued at over $150,000 in the study area (46.9%) was smaller than in Georgia (49.4%) and the United States (61.7%) (Table C-38) (ESRI BIS 2007).

Between 1990 and 2000 (the most recent data available), median monthly rent in the study area grew the fastest in Madison County to $341; however, this remained the lowest rent in the area. In 2000, Oconee County had the highest median rent in the study area ($485). The 2000 median rents in all study area counties were lower than the median rents for Georgia ($505) and the United States ($519) (Table C-39) (USCEN 2000b).

Overall, in 2000, 83.0% of housing units in the study area paid monthly rents between $200 and $749. The largest proportion of housing units with a rent less than $200 was in Madison County, and Oconee County had the largest proportion of housing units with rents over $1,000. Overall, the proportion of housing units with rents over $1,000 in the study area (3.3%) was lower than in Georgia (4.9%) and the United States (8.4%) (Table C-40) (USCEN 2000b).

In 2005, the majority of new housing units in the study area were permitted in Clarke County relative to Oconee and Madison Counties. The least expensive housing units in the study area are being constructed in Madison County, and the most expensive housing units in the study area are being constructed in Oconee County (Table C-41) (USCEN 2006).

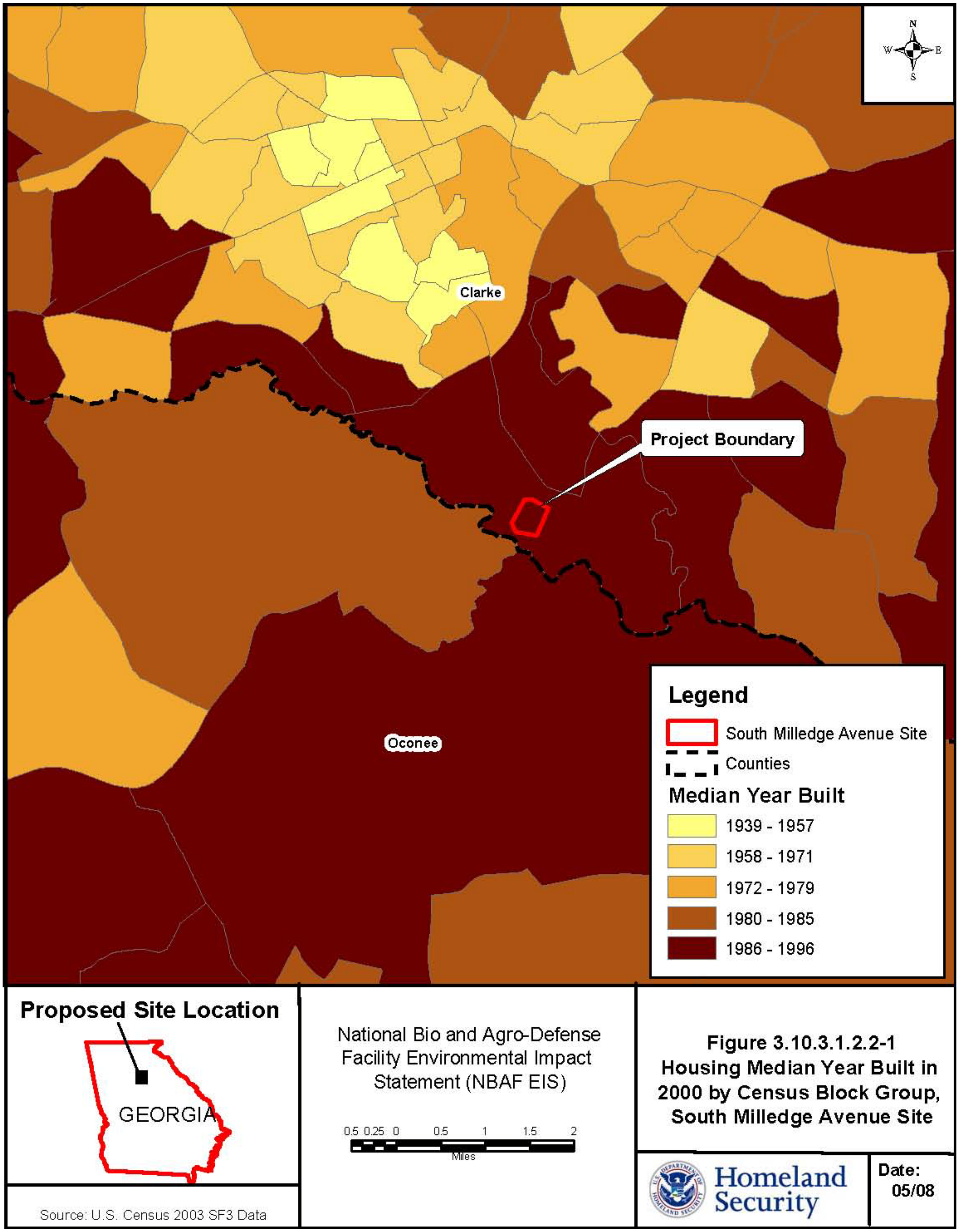


Figure 3.10.3.1.2.2-1 — Housing Median Year Built in 2000 by Census Block Group, Clark County, Madison County, and Oconee County, Georgia

3.10.3.1.3 Quality of Life (Community Services)

Quality of life encompasses those attributes of resources (man-made or natural occurring) of a region that contribute to the well-being of its residents. The relative importance of these attributes to a person's well-being is subjective. NEPA quality-of-life analyses typically address issues relating to potential impacts of the NBAF and alternatives on the availability of public services that contribute to quality of life. For the purposes of this study, the quality of life of the affected environment includes public schools, law enforcement, fire protection services, medical facilities, and recreation facilities.

3.10.3.1.3.1 Public Schools

The proposed South Milledge Avenue Site area is located in the Athens-Clarke County School District. The Athens-Clarke County School District has 13 elementary schools, 4 middle schools, 3 high schools, and 2 special programs that serve approximately 12,108 students. The student-to-teacher ratio for this district is 13 to 1 (CCSD 2008).

In addition, in the study area, Oconee and Madison Counties serve a total of 10,968 students with 10 elementary schools, 3 middle schools, and 3 high schools. The average student-to-teacher ratio for both counties is 15 to 1 (OCSS 2008; MCSD 2008). Clarke County is also served by UGA, Athens Area Technical College, and the Navy Supply Corps School.

3.10.3.1.3.2 Law Enforcement

The proposed South Milledge Avenue Site area is served by the Athens-Clarke County Police Department located in Athens. The department's authorized personnel consist of 231 sworn positions, 63 civilian positions, and 28 crossing guards. The department is organized into several divisions that include the Uniform Division, the Criminal Investigations Division, and the Information Management Division. The units provide services such as a neighborhood patrol program, follow-up investigations of crimes committed, and data collection and entry.

In addition, the Athens-Clarke County Police Department has two specialized groups: the Communications Division and the Strategic Response Team. The Communications Division provides a link between the citizens and emergency service providers. In 2003, the Athens-Clarke County Central Communications Division processed 214,520 emergency telephone calls. The calls were dispatched to 132,431 police, 2,204 fire, and 5,637 medical emergency personnel. The Strategic Response Team receives advanced training and special equipment to appropriately respond to dangerous situations and ensure the safety of all persons involved (CCSD 2008). The study area is also served by the Oconee and Madison County Sheriff's Offices.

3.10.3.1.3.3 Fire Protection

The proposed South Milledge Avenue Site area is served by the Athens-Clarke County Fire and Emergency Services. This department is dedicated to the preservation of life and property through prevention, education, mitigation, preparation, response, and recovery programs. In 2006, the Athens-Clarke County Fire and Emergency Services department employed approximately 170 firefighters. Fire protection services are also provided to the study area by the Oconee and Madison County fire departments.

The Athens-Clarke County Fire and Emergency Services operates the Community Emergency Response Team program. This program trains people to be better prepared to respond to emergency situations in their day-to-day lives as individuals and a community (ACC 2008). Data for department annual emergency response calls are not available.

3.10.3.1.3.4 Medical Facilities

The proposed South Milledge Avenue Site area is served by the Athens Regional Medical Center and St. Mary's Health Care System. The Athens Regional Medical Center is a 315-bed facility that offers specialized medical, surgical, and diagnostic procedures (ARMC 2007). St. Mary's Health Care System is a private, non-profit, acute-care network operated by a 1,400-person staff and a medical staff of approximately 270 physicians. The system's services include a hospital, long-term care facilities, community wellness, and home health care and hospice services (SMHCS 2007).

Clarke County is also served by the Athens Nurses Clinic, Clarke County Health Department, Athens Neighborhood Health Center, and Mercy Health Center. These centers provide a range of services and care for the uninsured, medically underserved, homeless, or lower income populations in Clarke County. Their services include children's health, communicable disease control, nutrition services, pharmacy, and dental care (UGA 2008). These facilities, in addition to the Cobb Health Care Center in Madison County, serve the total study area.

3.10.3.1.3.5 Recreation

The Clarke County Department of Leisure Services manages the local natural resources to provide quality leisure opportunities, experiences, and partnerships to the community with over 46,000 acres of park land. Clarke County recreational resources include numerous parks, both inland and on beaches and islands. Large county parks in eastern Athens-Clarke County include:

- Sandy Creek Park – 780 acres. Features include sports fields, boating, canoeing, hiking, a dog park, fishing and horse, and nature and walking trails (ACC DLS 2008).
- Sandy Creek Nature Center – 225 acres. Features include nature trails, hiking, creeks, rivers and historic ruins.
- North Oconee River Greenway – 3.5 miles. Features include hiking and bicycling. Connects with Cook's Greenway Trail at Sandy Creek Nature Center and follows the North Oconee River south toward downtown Athens and UGA.

In addition to several parks and nature centers, Clarke County is the location of the State Botanical Garden, a horticultural preserve set aside for the study and enjoyment of plants and nature. Several parks and historical sites located throughout Oconee and Madison Counties offer additional recreational activities to the study area (ACC DLS 2008).

Athens-Clarke County provides many opportunities for cultural enhancement, such as a variety of art galleries, dance centers, and theatres. Athens uniquely celebrates AthFest, a musical festival held in June; Twilight Festival, which is held in April; and the annual Marigold Festival, which has earned the city the title of "the marigold capital of Georgia" (CityData 2006).

3.10.3.2 Construction Consequences

3.10.3.2.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the 4-yr construction phase. Economic effects would result from regional purchases generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment.

The economic benefits of construction would be temporary and would diminish as the construction reaches completion. Direct employment (Table 3.10.3.2.1-1) refers to the jobs associated with actual construction of the facility, while total employment refers to all other employment generated as a result of the multiplier effect on the initial investment in construction of the facility. The industries that contribute to this other employment include architectural and engineering services, food services and drink establishments, wholesale trade, and general merchandise stores.

Based on the results of the impact analysis for construction (Table 3.10.3.2.1-1), the construction of the proposed facility would—over the 4-year construction phase—directly support 2,642 person-yrs (661 jobs annually) of employment with an associated total employment level of 3,910 person-yrs (978 jobs annually). The effects of this work would be short term and would only last for the duration of the construction work.

Table 3.10.3.2.1-1 — Short-Term Economic Impacts

Construction	
Total Construction Jobs (person-yrs)	2,642
Impacts	
Total Employment (person-yrs)	3,910
Total Labor Income Impact ($ millions)	150.0
Federal, State, and Local Tax ($ millions)	44.0
State and Local Tax ($ millions)	14.6

Note: In 2007 dollars.

In terms of income, minor short-term benefits would be expected. Labor income for any given region is defined as the sum of labor compensation and proprietor income generated within the regional boundaries[2]. The estimated labor income generated during the construction phase is $150 million ($37.5 million annually) measured in 2007 dollars. The total labor income of this project would correspond to 1.0% of all estimated 2006 labor income in the three-county region expressed in 2007 dollars, or 1.1% of the total estimated labor income in Clarke County.

The construction phase would generate additional taxes estimated at $44 million (Table 3.10.3.2.1-1), of which $14.6 million is estimated to be collected through state and local taxes that should flow to the local governments.

3.10.3.2.2 Population and Housing

3.10.3.2.2.1 Population

The majority of the construction workers would be drawn from the study area or would commute from the surrounding counties. Therefore, construction-related employment generated by the NBAF is not estimated to result in an increase in the study area population. Any population change during construction would be temporary and would involve a small percentage of the total construction-period employment.

3.10.3.2.2.2 Housing

As described above, the construction of the NBAF would not be expected to increase the population of the study area. Therefore, no effects on housing availability or prices would occur.

3.10.3.2.3 Quality of Life (Community Services)

The construction of the NBAF would not increase the population of the study area. Therefore, construction would have no effect on the availability of public services such as schools, medical services, law enforcement, fire protection, or recreational facilities.

[2] Proprietor income consists of payments received by self-employed individuals as income.

3.10.3.3 Operations Consequences

3.10.3.3.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the operations and maintenance phase, which would commence in the year 2014. Economic effects would result from purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the continual operations of the facility (Table 3.10.3.3.1-1).

Table 3.10.3.3.1-1— Long-Term Annual Economic Impacts

Operations	
Jobs at the Facility (jobs)	326 [a]
Impacts	
Total Employment (jobs)	483
Total Labor Income Impact ($ Millions)	27.8
Federal, State, and Local Tax ($ Millions)	3.2
State and Local Tax ($ Millions)	1.6

Note: In 2007 dollars.
[a] Actual jobs would range from 250 to 350; 326 was used for cost estimating purposes and the basis for the economic analysis.

Operation of this proposed facility would commence in 2014 and would require 145 operations, maintenance, and security staff and an additional 181 scientific and support staff. The operations and maintenance of the proposed facility would generate a total of 483 jobs including the initial 326 direct jobs required for operations and maintenance (see footnote in Table 3.10.3.3.1-1 regarding actual NBAF employment figures) (NDP 2007a).

The estimated income generated during the operation is $27.8 million annually in 2007 dollars. This corresponds to 0.7% of all estimated 2006 labor income in the three-county region expressed in 2007 dollars or 0.8% of total labor income in Athens-Clarke County. The operations phase would generate additional taxes estimated at $3.2 million (Table 3.10.3.3.1-1), of which $1.6 million is estimated to be collected through state and local taxes that should flow to the local governments.

3.10.3.3.2 Population and Housing

3.10.3.3.2.1 Population

The NBAF would directly employ 326 people. The majority of these employees would be research scientists and other specialized staff, and based on census journey to work data, 257 would be expected to relocate to the study area from elsewhere in the country. Assuming the United States Census Bureau 2006 size of 2.61 persons, this would represent a population increase of 671 (USCEN 2006).

In addition, the economic activity associated with the operation of the NBAF would employ 157 persons. The industries that would contribute to this indirect employment include those in non-specialized areas such as food services and drink establishments, wholesale trade, and general merchandise stores, among others. It is assumed that these employment opportunities would be filled by the local labor force and that the relocation of workers to the study area due to the generation of these jobs would be negligible.

In total, the population of the study area would increase by 671 as a result of the operation of the NBAF. This population increase is 4.9% of the overall estimated population growth within the study area between 2007 and 2012 (13,663 based on historic trends), which would result in a total study area population of 190,468 in 2012.

3.10.3.3.2.2 Housing

As described above, 671 additional persons would locate to the study area as a result of the NBAF. The average salary including benefits of the 326 employees employed directly at the facility would be $82,622. For comparative purposes, this figure has been adjusted to an average per capita income of $66,924 for employees employed directly at the facility, which is higher than the estimated median 2007 study area per capita income of $22,403. Over 80 NBAF research scientists and managers would earn over $125,000 annually. The estimated 2007 median value of owner-occupied housing units in the study area in 2007 would be $143,234 (Table C-37). Taking into account families with two incomes, the available study area housing stock would be affordable to the majority of the people relocating to the region.

The housing market would be able to meet the increase in housing demand (326 employees in total), relative to the estimated growth of the existing population between 2007 and 2012 (13,663). It is possible that with the relocation of highly skilled workers to the immediate area, property values could increase due to an increase in demand, and there is no empirical evidence that a facility such as the NBAF would reduce property values in the study area. Therefore, the overall effect of the NBAF on housing market conditions would be negligible.

3.10.3.3.3 Quality of Life (Community Services)

Due to the small percentage of the overall population growth that is attributed to the facility, the NBAF would have a negligible effect on the availability of public services. The study area population growth attributed to the NBAF would be 4.9% of the overall estimated population growth from 2007 to 2012. As the study area population grows, expansion of public services would be necessary, regardless of whether the South Milledge Avenue Site is selected for the location of the NBAF. In comparison to existing trends, the additional population locating to the study area as a result of the NBAF would have a negligible effect on the availability of public services.

3.10.3.3.3.1 Public Schools

The NBAF would add approximately 139 school-aged children to the study area, or a 0.6% increase in the study area's public school district's enrollment of 23,076 students during the 2006/2007 school year (GDE 2007). The 0.6% increase in school-aged children attributed to the NBAF would place minimal additional demand on the schools.

School districts in the study area have invested in educational facilities to meet the needs of the growing population of the region. The Athens-Clarke County School District is using the revenues from a special purpose local option sales tax (SPLOST) to carry out a 10-year strategic plan that would renovate existing schools and add new schools to the district. The district has 11 schools that are currently under construction or in the design stages (CCSD 2008). In addition to bond selling options, SPLOST is used, or under consideration, by other study area districts as sources of funds for new school constructions in the next decade (OCSS 2008).

3.10.3.3.3.2 Law Enforcement

The population increase associated with the NBAF (671), relative to the estimated growth of the existing population in the study area between 2007 and 2012 (13,663), would result in a negligible increase in the need for additional law enforcement services.

3.10.3.3.3.3 Fire Protection

The population increase associated with the NBAF (671), relative to the estimated growth of the existing population in the study area between 2007 and 2012 (13,663), would result in a negligible increase in the need for additional fire protection services.

3.10.3.3.3.4 Medical Facilities

The additional population associated with the NBAF (671), relative to the estimated growth of the existing population in the study area between 2007 and 2012 (13,663), would result in a negligible increase in the demand for medical services and facilities.

Due to the overall population growth in the region, medical facilities in the study area are responding to growth in the region and expanding to meet the increasing demand. For example, the Athens Regional Medical Center recently constructed a new 122,000 square foot Medical Services Building (ARMC 2007). Also, in 2005, the St. Mary's Health Care System completed a 73,000 square foot facility renovation and expansion (SMHCS 2007).

3.10.3.3.3.5 Recreation

Recreational resources would not experience a significant increase in utilization rates as a result of the population increase associated with the NBAF. The study area has abundant recreation resources available.

3.10.3.3.3.6 Health and Safety

The normal operation of the NBAF would pose no additional health or safety risks to the public because the facility would be closed off to public access at all times. Site-specific protocols would be developed in response to any appropriate local incident or pending adverse weather condition potentially affecting the NBAF, in coordination with local emergency response agencies that would consider the diversity and density of human, livestock, and wildlife populations residing within the local area. The response plans would have site-specific standard operating procedures and response plans in place prior to the initiation of research activities at the proposed the NBAF. Procedures and plans to operate the NBAF will include community representatives as described in Section 2.2.2.6 of the NBAF EIS. Further analysis with regard to health and safety during abnormal operation of the proposed facility are in Section 3.14 (Health and Safety).

3.10.4 Manhattan Campus Site

3.10.4.1 Affected Environment

The City of Manhattan, Kansas, has been proposed as the location site for the facility and the geographic definition of the affected environment for this location was determined primarily based on a journey-to-work analysis of the town. Any county that constituted approximately 5% or more of the worker flows into or out of Manhattan (FIPS Place Code 44250) was considered to comprise the affected environment for the proposed site, and this included Riley, Geary, and Pottawatomie Counties (USCEN 2000a; USCEN 2000c).

The expanded area of study to be used for the agricultural livestock vulnerability analysis added Clay, Marshall, Wabaunsee, and Washington Counties to the original economically described affected area (Figure 3.10.4.1-1).

3.10.4.1.1 Employment and Income

3.10.4.1.1.1 Employment

In general, the civilian labor force for all three counties has grown from 47,299 in 1990 to 57,359 in 2006, an increase of 21.3 %, which is close to the growth rate of the national civilian labor force (20.3%), and higher than Kansas's civilian labor force growth rate of 16% (Table C-42). Of the three counties examined, only

Geary County had an unemployment rate higher than the national average for all 3 years observed[3]. Geary County was also the only county that exhibited a decline in its civilian labor force and employment levels between 2000 and 2006.

[3] Based on data from the Bureau of Labor Statistics, the average national unemployment rate for the country in the years 1990, 2000, and 2006 were 5.6, 4.0, and 4.6 respectively.

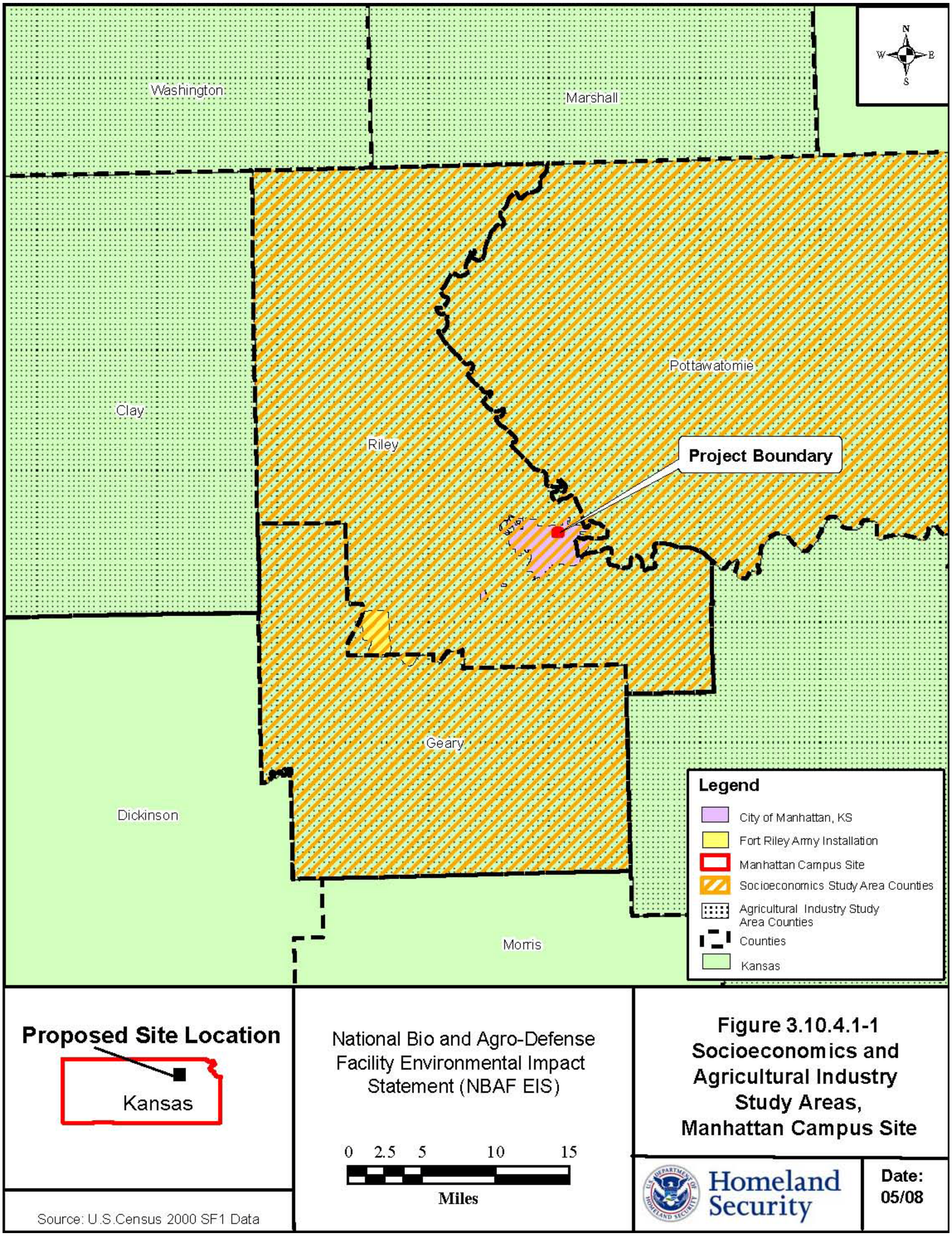


Figure 3.10.4.1-1 — Socioeconomics and Agricultural Industry Study Areas

The unemployment rate in all three counties dropped between 1990 and 2000 but then subsequently rose again between 2000 and 2006. This movement in the unemployment rate was similar to that of the State of Kansas and the national average over the same time period with the combined unemployment rate for the three-county region remaining slightly lower than the state's rate in 2000 and 2006 (Table C-42).

Riley County is the center of employment with approximately 81% of its workers employed within the county, while also attracting about one-third of the labor forces in Geary and Pottawatomie Counties (Table C-43). Riley County's attraction of workers from neighboring areas is mainly due to the local presence of KSU, which supports a large proportion of the employment opportunities in its associated urban center of Manhattan, Kansas.

Although a significant proportion of the work forces in both Geary and Pottawatomie Counties commute to Riley County, the majority of their respective labor forces work within their own county boundaries.

Employment can be measured as either a count of workers or as a count of actual jobs. The data presented in Table C-42 were compiled using the former. The employment base analysis in this section, however, uses the count of actual jobs in ascertaining the relative importance and proportion of various industrial sectors present in the study area.

The data used in this analysis also include military personnel employment. In the case of Riley and Geary Counties, which house the Fort Riley complex, this comprises a large proportion of government and government enterprise employment associated with the respective regions. A total of 10,060 military personnel were assigned to the Fort Riley base in 2006[4]. An additional 9,700 troops are expected to relocate to the Fort Riley installation by 2012. This influx of new military personnel is in turn expected to be supported by the addition of 2,000 civilian workers accompanying the military personnel increase at Fort Riley. The total growth in employment opportunities resulting from the initial relocation of troops is estimated at 18,640 new jobs[5].

Government and government enterprises are the largest sources of employment in terms of number of jobs for the general area of study. At the individual county level, however, government and government enterprise employment is only largest for Geary and Riley Counties—both of which are influenced by the large military presence of Fort Riley. Based on the 2005 Bureau of Economic Analysis Regional Economic Accounts, the vast majority of the military jobs associated with Fort Riley are concentrated in Geary County. Riley County, however, is also home to the City of Manhattan and the campus of KSU, which has 23,000 students. As a result, a large proportion of those employed in the government and government enterprise industry are affiliated with state and local education activities. In Pottawatomie, the largest contributor to employment by number of jobs is the retail trade industry (Tables C-44 and C-45).

As already mentioned, one of the major employers in Geary and Riley Counties is the U.S. Military, which in the case of Geary County housed 9,000 military staff in 2005.[6] A list of other major employers in the region of study is presented in Table C-46.

Government and government enterprises remain ranked as the largest sources of employment, even in terms of total wage compensation paid for the general area of study. At the county level, however, while government and government enterprise employment are still largest for Geary and Riley Counties, in Pottawatomie, the largest industry contributor to employment by earnings is the manufacturing industry (Tables C-47 and C-48).

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[4]RKG Associates, Inc. (prepared for the Kansas Department of Commerce), Strategic Action Plan and Growth Impact Assessment for the Flint Hills Region, October 2006, pp. II-14.(RKG 2006)

[5] Ibid, pp. II-2.

[6] Bureau of Economic Analysis Regional Economic Accounts CA25.

3.10.4.1.1.2 Agricultural Industry

For the purposes of this analysis, an expanded area of study comprising all counties adjacent to the proposed site was defined for the agricultural livestock discussion. The relative importance of the agricultural industry was assessed in the following counties: Geary, Pottawatomie, Riley, Clay, Washington, Wabaunsee, and Marshall.

Agriculture directly supported an estimated 7,481 jobs in the seven counties studied in 2006 (Table C-49), with Washington County (1,275 jobs) and Wabaunsee County (2,947 jobs) contributing 4,222 jobs towards the total. Animal production contributes 4,567 of the 7,481 jobs directly supported by the agricultural industry with Washington County and Wabaunsee County, once again providing the bulk of those jobs in the seven-county region (3,127 jobs combined). The NAICS code classified agriculture and hunting industry makes up approximately 8% of all the jobs in the seven-county region, although that percentage varies quite a bit in each individual county. In Riley—the most urban of the seven—agriculture comprises less than 2% of total industry employment, while in Wabuansee the figure is estimated at more than 60%. Agriculture is a significant contributor to employment in the region (Table C-49).

Industry output from the agriculture and hunting industry in the seven-county region totaled $627 million (Table C-49). Industry output can be measured by the total value of purchases made by intermediate and final consumers of that industry's production. Animal production generated $402 million towards the total output of the agriculture and hunting industry, with crop production contributing an additional $225 million. Cattle ranching and farming in the seven-county region accounted for approximately $336 million (83%) of total estimated output in the agriculture and hunting industry, making it the most valuable component of the overall industry.

Livestock statistics in the counties surrounding the proposed facility show the total number of livestock found in the seven counties (Table C-50) (DHS 2007). The term livestock includes hoofed animals such as cattle, hogs, sheep, goats, horses, and mules. The total number of livestock found in the seven-county region is 542,507, with Washington County providing 155,747 (29%) of the total amount. The number of poultry in the six-county region is 192,474, and Pottawatomie County provides 151,483 (79%) of the total number (NDP 2007a).

There were approximately 6,400,000 head of cattle and calves at the end of 2006 in Kansas, with an estimated inventory value of $5.38 billion (averaging out to a unit value $840 per head within the state). The seven-county region made up for about 5.4% of that total with 347,300 head of cattle found within those counties (NASS 2006). Based on the state's estimated unit price, the inventory value of cattle within the seven-county region would be approximately $291.7 million.

3.10.4.1.1.3 Hunting

An analysis of the hunting industry is used to assess the importance that hunting activity has on the local economy. Data from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation are utilized to describe the depth of this industry and address public concerns about the possible impacts of the proposed facility's operations on this industry and subsequently on the local economy.

U.S. Fish and Wildlife Service data from 2006 that are limited to the statewide level shows that total expenditures related to recreational hunting activities in the state of Kansas totaled $249 million. The data show that of the 271,000 individuals who participated in hunting activities in 2006, 142,000 were involved in big game hunting (e.g., deer) (USFWS 2006).

3.10.4.1.1.4 Income and Poverty

In 1999, the median household incomes in the study area ranged from $31,917 in Geary County to $40,176 in Pottawatomie County. Per capita incomes showed less variation and were lowest in Geary County ($16,199). Overall, the median household income in the study area was $33,627 and the per capita income $16,550 (Table C-51) (USCEN 2000b).

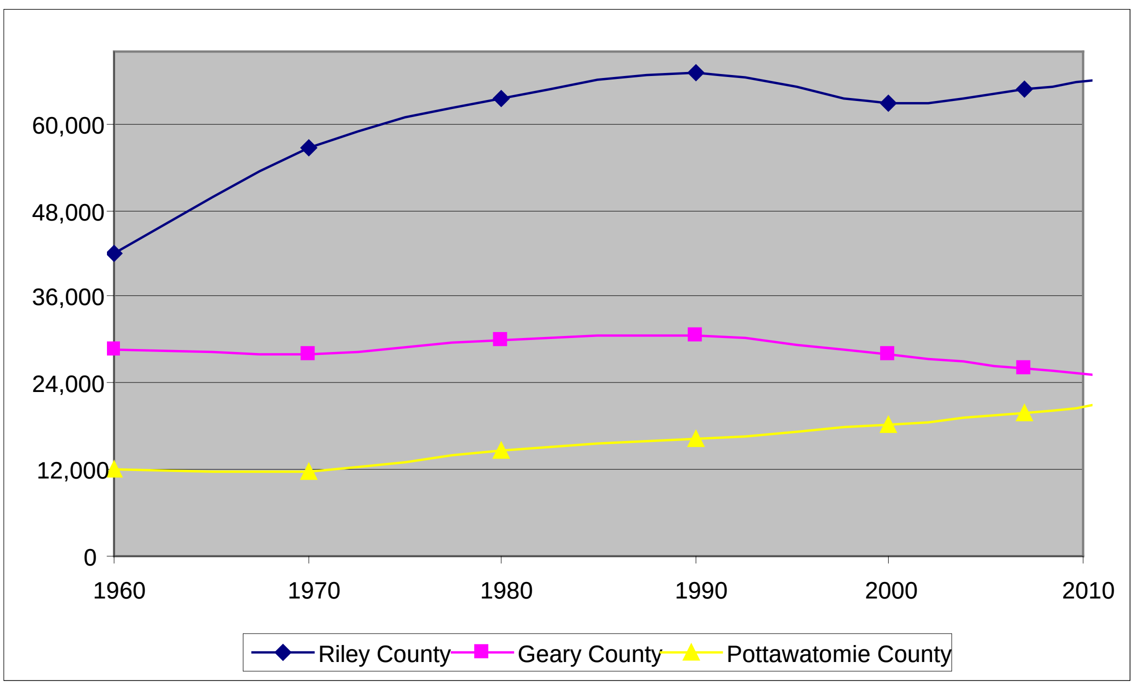
Of the study area counties, Pottawatomie had the lowest proportion of persons living below poverty in the study area, and Riley County had the highest proportion of persons living below the poverty line. The percentage of persons living below poverty in the study area (16.3%) was higher than the poverty rate in Kansas (10.1%) and the United States (12.4%) (Table C-51) (USCEN 2000b).

In 2007, the estimated median household income for the study area was $42,073, less than the estimated median household incomes for Kansas ($51,343) and the United States ($53,154). Riley County was estimated to have a per capita income of $20,899, less than in Kansas ($26,438) and the United States ($27,916) (ESRI BIS 2007).

3.10.4.1.2 Population and Housing

3.10.4.1.2.1 Population

The total population of the study area (Riley, Geary, and Pottawatomie Counties) has increased by 26,349 between 1960 and 2000. Population estimates for 2007 and 2012, the most recent forecasts available, show an additional 3,555 residents are estimated to be added to the study area between 2000 and 2012. The military personnel population associated with Fort Riley is included in the population figures reported in this section (Figure 3.10.4.1.2.1-1) (USCEN 2000b).



Sources: 1960-2000 population: U.S. Census Bureau. 2007 and 2012 population forecasts: ESRI BIS.

Figure 3.10.4.1.2.1-1 — Population, Riley County, Geary County, and Pottawatomie County, Kansas, 1960- 2012

From 1960 to 1990, the populations of Riley and Pottawatomie Counties have increased, and the population of Gear County has declined (USCEN 2000b). The historic population dynamics of the study area have been influenced by operations at Fort Riley, which is located in Riley and Geary Counties. At the time of the 2000 Census, the total population of Fort Riley was reported as 8,217[7]. As of 2006, there were 10,060 troops stationed at Fort Riley, with an associated military-dependent population of 12,518. Although not reflected in the future population estimates presented in this chapter, three DoD initiatives[8] are estimated to increase the number of military personnel at Fort Riley by 9,700 and the number of civilian employees by 2,000 by 2012. Combined with the dependents of the added military personnel and civilian employees, as well as economic migrants, the total population of the study area is estimated to increase by 26,600 between 2006 and 2012 due to the DoD initiatives at Fort Riley (KDC 2006). The City of Manhattan in Riley County is the specific location of the NBAF site within the study area and is therefore included in this socioeconomic discussion.

Between 2007 and 2012, the population of the study area is estimated to grow slower than Kansas and the United States. Pottawatomie County was the fastest growing county between 1990 and 2000 and is estimated to continue to grow faster than the study area as a whole between 2000 and 2012. The City of Manhattan's share of Riley County's total population (71.3%) estimated to remain relatively constant between 2000 and 2012, adding 993 residents (Table C-52) (ESRI BIS 2007).

3.10.4.1.2.1.1 Ethnicity and Race

In 2000, African Americans comprised the largest percentage minority group in the study area (9.7%), which was greater than in Kansas (5.7%) and smaller than in the United States (12.2%). Person of Hispanic origin comprised 5.2% of the study area, which was smaller than in Kansas (7.0%) and the United States (12.5%). Overall, there was the proportion of minorities in the study area (20.7%) was higher than in Kansas (16.9%) but smaller than in the United States (30.1%) (Table C-53) (USCEN 2000b).

3.10.4.1.2.1.2 Age

In 2000, approximately 25.7% of the study area population was 18 years of age and under, and 9.0% was 65 years of age and older. Geary County had the highest proportion of its population aged 18 years and under, and Pottawatomie County had the highest proportion of its population aged 65 years and older (Table C-54) (USCEN 2000b).

In 2007, the proportion of the Riley County population estimated to be 18 years of age and under (20.6%) was smaller than in Kansas (26.2%) and the United States (25.8%). The proportion of the population of Riley County 65 years of age and older (8.1%) was also estimated to be smaller than in Kansas (12.7%) and the United States (12.5%) (ESRI BIS 2007).

In 2007, the proportion of the Riley County population estimated to be 18 years of age and under was lower than in Kansas and the United States. The proportion of the population of Riley County aged 65 years and older was also estimated to be lower than in Kansas and the United States (ESRI BIS 2007).

3.10.4.1.2.1.3 Educational Attainment

In 2000, 9.3% of the study area population aged 25 years and older did not graduate from high school, 54.2% of the population graduated from high school or had some college education, 6.1% had an associate's degree, and 30.4% had a bachelor's degree or higher level of education. The City of Manhattan and Riley County had a substantially greater proportion of residents with a bachelor's degree or higher level of education and a smaller proportion of residents that did not complete high school when relative to Geary and Pottawatomie

[7] Fort Riley consists of two Census Designated Places (CDPs): the Fort Riley-Camp Whiteside CDP (2000 population of 103) and the Fort Riley North CDP (2000 population of 8,114).
[8] The transformation of units in the Army to Modular Forces (AMF), the implementation of 2005 Base Realignment and Closure (BRAC) decisions, and stationing changes based on the Integrated Global Presence and Basing Strategy (IGPBS).

Counties. The proportion of residents that did not graduate from high school in the study area (9.3%) was less than in Kansas (14.0%) and the United States (19.6%) (Table C-55).

3.10.4.1.2.2 Housing

In 2007, 91.3% of the housing units in the study area were estimated to be occupied, and 8.7% were estimated to be vacant. The proportion of vacant units in the study area was estimated to be smaller than in Kansas (9.8%) and the United States (9.9%) (Table C-56).

In 2007, the City of Manhatttan was estimated to have the highest proportion of renter-occupied housing units in the study area. The percentage of owner-occupied housing units in the study area (50.7%) was estimated to be smaller than in Kansas (63.9%) and the United States (63.3%) (ESRI BIS 2007).

In 2000, the single-family detached house was the predominant form of housing in the study area, comprising 24,011 units (56.3%). The majority of housing units in buildings with over 10 units were located in the City of Manhattan, and the largest proportion of mobile homes were located in Geary County (Table C-57) (USCEN 2000b).

In 2000, approximately one-half of the housing units in all of the study area counties were built before 1970. Pottawatomie County had a greater proportion of housing units built in the 1995 to 2000 time period than the other study area counties, reflecting the higher rate of population and household growth in Pottawatomie compared to Riley and Geary Counties between 1990 and 2000. In the study area as a whole, 6,115 housing units (14.3%) have been built since 1990 (Figure 3.10.4.1.2.2-1).

New housing growth has primarily occurred in the areas on the periphery of the historic population centers of Manhattan and Junction City. The northern portions of the City of Manhattan and the Townships of Manhattan, Wildcat, Smoky, and Lyon had a median housing age of post-1981, indicating that more than one-half of the housing units in these areas were built in the last 25 years.

Between 2000 and 2007, housing values in the study area were estimated to grow the fastest in Riley County and the City of Manhattan. In 2007, the City of Manhattan was estimated to have the highest median housing value ($133,663), and Geary County was estimated to have the lowest median housing value ($91,837). In 2007 the median housing value for Riley County ($126,466) was estimated to exceed the estimated value in Kansas ($112,948) and be less than the estimated value in the United States ($192,285) (Table C-58).

In 2007, over one-half of the housing units in the study area were estimated to be valued between $50,000 and $150,000. Pottawatomie had the largest proportion of housing units with estimated values of less than $50,000, and the City of Manhattan had the largest proportion of housing units with estimated values over $150,000 (39.7%). Overall, the proportion of housing units valued at over $150,000 in the study area (29.1%) was estimated to be smaller than in Kansas (34.1%) and the United States (61.7%) (Table C-59) (ESRI BIS 2007).

Between 1990 and 2000 (the most recent available data), median monthly rent in the study area grew the fastest in Pottawatomie County. In 2000, the City of Manhattan had the highest median rent, and Pottawatomie County had the lowest median rent. The 2000 median rent in Riley County ($413) was higher than the median rent in Kansas ($391) and less than the median rent in the United States ($519) (Table C-60) (USCEN 2000b).

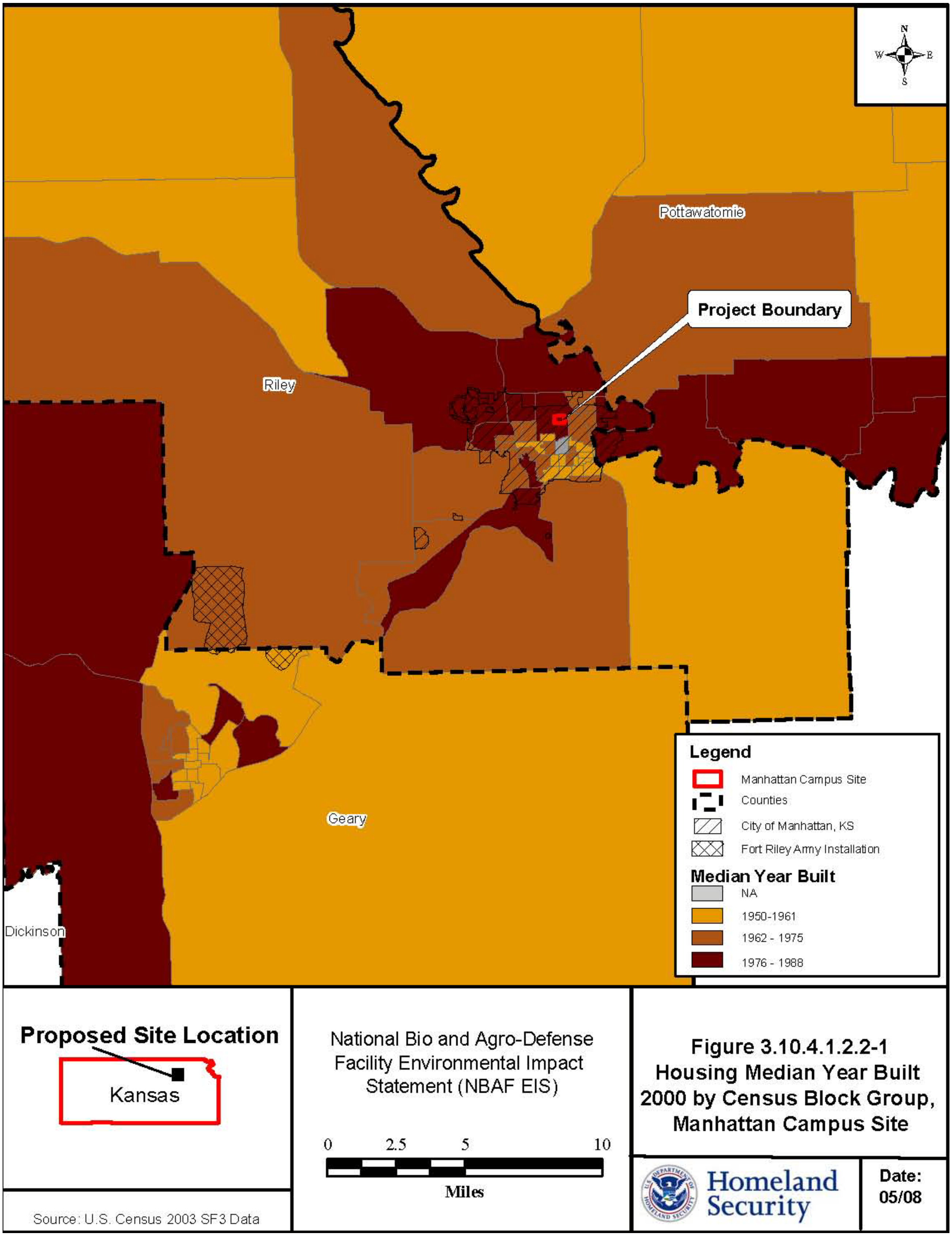


Figure 3.10.4.1.2.2-1 — Housing Median Year Built in 2000 by Census Block Group, City of Manhattan, Riley County, Geary County, and Pottawatomie County, Kansas

Overall, 85.41% of the housing units in the study area had rents ranging between $200 and $749. Geary County had the largest proportion of housing units with a rent less than $200, and Riley County had the largest proportion of housing units with rents over $1,000. Overall, the proportion of housing units with rents over $1,000 in the study area (1.8%) was smaller than in Kansas (2.8%) and the United States (8.4%) (Table C-61) (USCEN 2000b).

In 2005, the majority of new building permits in the study area were for single-family homes. The most expensive housing units in the study area are being constructed in Riley County, and the least expensive housing units are being constructed in Geary County (Table C-62) (USCEN 2006).

3.10.4.1.3 Quality of Life (Community Services)

Quality of life encompasses those attributes of resources (man-made or natural occurring) of a region that contribute to the well-being of its residents. The relative importance of these attributes to a person's well-being is subjective. NEPA quality-of-life analyses typically address issues relating to potential impacts of the NBAF and alternatives on the availability of public services that contribute to quality of life. For the purposes of this study, the quality of life of the affected environment includes public schools, law enforcement, fire protection services, medical facilities, and recreation facilities.

3.10.4.1.3.1 Public Schools

The Manhattan Campus Site is located in the Manhattan-Ogden Unified School District (USD) 383. Manhattan-Ogden USD 383 serves approximately 5,467 students primarily from the City of Manhattan and adjacent areas of Riley County and small portions of Geary County and Pottawatomie County (KDE 2008). There are eight elementary schools in the City of Manhattan, with a combined enrollment of 2,808 and a student-to-teacher ratio of 23 to 1. There are two junior high/middle schools with a combined enrollment of 710 and a student-to-teacher ratio of 18 to 1. There is one high school in the City of Manhattan (Manhattan High School), with an enrollment 1,722 and a student-to-teacher ratio of 18 to 1 (MACC 2007).

Other public school districts in Riley County include USD 384, Blue Valley, and USD 378 Riley County. In the 2007-2008 school year, USD 384 Blue Valley District had a combined total enrollment of 209 students in one elementary school, one middle school, and one high school. In the 2007-2008 school year, USD 378 Riley County School District had a combined total enrollment of 675 students in one grade school and one high school (USD Home 378 2008; KDE 2008).

Also in the study area, the primary public school district is Geary County Schools (USD 475). In the 2007–2008 school year, Geary County Schools had a combined total enrollment of 7,052 students in 14 elementary schools, 2 middle schools, and 1 high school (KDE 2008).

There are four public school districts in Pottawatomie County: Kaw Valley (USD 321), Onaga-Havensville-Wheaton (USD 322), Rock Creek (USD 323), and Wamego (USD 320). In the 2007-2008 school year, the four-district total enrollment was 3,749 students in eight elementary schools, two middle schools, four high schools, and one charter school (KDE 2008).

3.10.4.1.3.2 Law Enforcement

The Manhattan Campus Site is served by the Riley County Police Department. The Riley County Police Department has approximately 103 officers, and a total of 183 employees organized in four divisions: patrol, investigation, support, and jail. Patrols are organized into three shifts to provide 24-hour coverage. There are nine patrol areas, six in the City of Manhattan (RCPD 2007a).

Properties in the City of Manhattan owned by or adjacent to KSU are also provided law enforcement services through the KSU Police Department. The KSU Police Department assists other law enforcement agencies beyond its jurisdiction when such assistance is requested. The KSU Police Department has approximately 36 employees, including captains, sergeants, officers, communications specialists, and security officers (KSU 2007b). The study area is also served by the Geary and Pottawatomie County Sheriff's Offices.

3.10.4.1.3.3 Fire Protection

The proposed Manhattan Campus Site area is served by the Manhattan Department of Fire Services. There are a total of four stations and two major divisions: emergency services and technical services. The emergency services division is responsible for fire suppression, rescue, and hazardous material operations. The technical services division is responsible for inspections, fire investigations, development plan reviews, and public education to promote fire prevention. There is a fire station located directly across Kimball Avenue from the proposed site (MDFS 2007). Department staffing data are not available. Fire protection services are also provided to the study area by the Geary and Pottawatomie County fire departments.

3.10.4.1.3.4 Medical Facilities

The proposed Manhattan Campus Site area is served by the Mercy Regional Health Center medical facilities. Mercy Regional Health Center is a not-for-profit community medical center that consists of two inpatient campuses in Manhattan, as well as several outpatient facilities throughout the community. Additionally, Mercy manages the emergency medical services in both Riley and Pottawatomie Counties. Mercy also has a majority interest in Wamego City Hospital located in Wamego. The hospital currently has 181 medical staff members, including 102 physicians on the active staff. These physicians currently represent 30 different specialties. The hospital also has a physician development plan, which calls for the recruitment of 41 additional physicians in 22 specialties over the next 3-4 years.

Mercy Regional Health Center is currently a 150-bed facility operating at 70% capacity. The hospital's emergency department includes 2 major trauma rooms and 15 treatment rooms and is staffed 24-hours per day by board-certified emergency physicians. The hospital, working with land and air ambulance, has agreements for the immediate transfer of major neuro-trauma cases (MRHC 2008). The study area is also served by the Geary Community Hospital.

3.10.4.1.3.5 Recreation

Recreation resources in proximity to the proposed Manhattan Campus Site include Cico Park and Fairmont Park. Operated by the Riley County Parks Department, Cico Park is a 97-acre resource located west of the proposed site near the intersection of Kimball Avenue and Wreath Avenue. Large events, such as the Riley County Fair, are held in Cico Park (RCPD 2007b). The recreational facilities provided at Cico Park include a running track, baseball complex, arboretum, fitness trail, swimming pool, sledding hill, meeting facilities, picnic shelters, rodeo arena, fairgrounds, playground, and tennis courts.

Fairmont Park, a 110-acre recreational resource, is located northeast of the intersection of K-177 and the Kansas River. Ownership of the park is divided between three government agencies: the Riley County Department of Parks, the City of Manhattan, and the Kansas Department of Transportation. Key features of the park include forested wildlife habitat and views of the Kansas River.

Outside the City of Manhattan there are several large regional recreational resources, including the 1,200-acre Tuttle Creek State Park and Milford State Park near Junction City (RCDR 2007). Geary County also provides outdoor recreational sites such playgrounds, sports fields, picnic areas, walking trails, historic monuments, and memorials located in parks such as Cleary Park, Heritage Park, Homer's Pond, Buffalo Soldier Park, and the Bluffs Park (GC CVB 2008).

Each community in Pottawatomie County has a city park with features such as public swimming pools, outdoor tennis, softball fields, and basketball courts. There are also approximately 15,000 acres of wildlife refuges, one major federal reservoir, three county lakes, two private lakes, and five state parks in Pottawatomie County. The State of Kansas maintains two lakes and state parks at three locations in Pottawatomie County. There are over 100 miles of scenic drives and hiking and biking trails that have been mapped throughout the county. Individual state parks offer equestrian, hiking, and biking trails, as well as areas for hunting and RV camping (PEDC 2008; GC CVB 2008).

3.10.4.2 Construction Consequences

3.10.4.2.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the 4-yr construction phase. Economic impacts would result from material purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment.

The economic benefits of construction impacts would be temporary and would diminish as construction reaches completion. Direct employment (Table 3.10.4.2.1-1) refers to jobs associated with actual construction of the facility, while total employment refers to all other employment generated as a result of the multiplier effect on the initial investment in construction of the facility. The industries that contribute to this other employment include architectural and engineering services, food services and drink establishments, non-store retailers, and general merchandise stores.

Based on the results of the impact analysis for the construction phase (Table 3.10.4.2.1-1), the construction of the proposed facility would—over the 4-year construction phase—directly support 2,717 person-yrs of employment (679 jobs annually), with an associated total employment level of 3,848 person-yrs (962 jobs annually). The effects of this work are expected to be short term, and would only last for the duration of the construction work.

Table 3.10.4.2.1-1 — Short-Term Economic Impacts

Construction	
Total Construction Jobs (person-yrs)	2,717
Impacts	
Total Employment (person-yrs)	3,848
Total Labor Income Impact ($ millions)	138.2
Federal, State, and Local Tax ($ millions)	38.1
State and Local Tax ($ millions)	12.5

Note: In 2007 dollars.

In terms of income, minor short-term benefits would be expected. Labor income for any given region is defined as the sum of labor compensation and proprietor income generated within the regional boundaries[9]. The estimated labor income generated during the construction phase is estimated at $138.2 million ($34.5 million annually) measured in 2007 dollars. The total labor income impact of this project would correspond to 1.06% of all estimated 2006 labor income in the three-county region expressed in 2007 dollars or 2.5% of the total estimated labor income in Riley County.

The construction phase would generate additional taxes estimated at $38.1 million (Table 3.10.4.2.1-1), of which approximately $12.5 million is estimated to be collected through state and local taxes that should flow to the local governments.

[9] Proprietor income consists of payments received by self-employed individuals as income.

3.10.4.2.2 Population and Housing

3.10.4.2.2.1 Population

The majority of the construction workers would be drawn from study area or would commute from the surrounding counties. Therefore, construction-related employment generated by the NBAF is not expected to result in an increase in the study area population. Any population change during construction would be temporary and would involve a small percentage of the total construction-period employment. Construction impacts on population and housing would be very similar to those previously described in Section 3.10.3.2.2.

3.10.4.2.2.2 Housing

As described above, the construction of the NBAF is not expected to increase the population of the study area. Therefore, no effects on housing availability or prices would occur.

3.10.4.2.3 Quality of Life (Community Services)

Construction impacts on quality of life attributes would be very similar to those described in Section 3.10.3.2.3.

3.10.4.3 Operations Consequences

3.10.4.3.1 Employment and Income

The proposed facility would also stimulate the regional economy during the operations and maintenance phase, which is expected to commence in the year 2014. Economic impacts would result from material purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment (Table 3.10.4.3.1-1).

Table 3.10.4.3.1-1 — Long-Term Annual Economic Impacts

Operations	
Jobs at the Facility (jobs)	326 [a]
Impacts	
Total Employment (jobs)	471
Total Labor Income Impact ($ millions)	26.8
Federal, State, and Local Tax ($ millions)	2.8
State and Local Tax ($ millions)	1.5

Note: In 2007 dollars.
[a] Actual jobs would range from 250 to 350; 326 was used for cost estimating purposes and the basis for the economic analysis.

Operation of this proposed facility would commence in 2014 and would require 145 operations, maintenance, and security staff and an additional 181 scientific and support staff. The operations and maintenance of the proposed facility would generate a total of 471 jobs—including the initial 326 direct jobs required for operations and maintenance (see footnote in Table 3.10.4.3.1-1 regarding actual NBAF employment figures) (NDP 2007a).

The estimated income generated during the operations phase is $26.8 million annually in 2007 dollars. This corresponds to 0.8% of all estimated 2006 labor income in the three-county region expressed in 2007 dollars or 1.9% of total labor income in Riley County.

The operations phase would generate additional taxes estimated at $2.8 million (Table 3.10.4.3.1-1), of which $1.5 million is estimated to be collected through state and local taxes that would flow to the local governments.

3.10.4.3.2 Population and Housing

3.10.4.3.2.1 Population

The NBAF would directly employ 326 people. The majority of these employees are expected to be research scientists and other specialized staff, and based on census journey-to-work data, 300 would be expected to relocate to the study area from elsewhere in the country. Assuming the U.S. 2006 average family size of 2.61 persons, this would represent a population increase of 783 (U.S. Census Bureau).

In addition, the economic activity associated with the operation of the NBAF is expected to employ 145 persons. The industries that would contribute to this indirect employment include those in non-specialized areas such as food services and drink establishments, wholesale trade, and general merchandise stores, among others. It is assumed that these employment opportunities would be filled by the local labor force and that the relocation of workers to the study area due to the generation of these jobs would be negligible.

In total, the population of the study area is expected to increase by 783 as a result of the operation of the NBAF (U.S. Census Bureau). This population increase is significant when compared to the overall expected population growth, which does not include the Fort Riley expansion, within the study area between 2007 and 2012 (1,617, based on historic trends), which is estimated to result in a total study area population of 113,752 in 2012. However, the population increase associated with the NBAF is not large when compared to the increase in population due to the DoD operations at Fort Riley (23,569 between 2007 and 2012). With both the Fort Riley and NBAF additions, the total population of the study area would be 138,104.

3.10.4.3.2.2 Housing

As described above, 783 additional persons would be expected to move to the study area as a result of the NBAF. The average salary of the 326 employees employed directly at the NBAF would be $82,622, which is higher than the average study area salary. Over 80 NBAF research scientists and managers would earn over $125,000 annually. The estimated median value of owner-occupied housing units in the study area in 2007 was estimated to be $111,924 (Table C-58). Taking into account families with two incomes, the available study area housing stock would be affordable to the majority of the people relocating to the region.

A 2006 Kansas Department of Commerce Study found that 9,900 single-family units and 3,200 multi-family units were under construction or in the planning stages in the study area. With the additional population added by changes at Fort Riley, this study concluded that there would be a 2,400-unit surplus of single-family housing by 2012 (indicating that some planned projects may be canceled). Based on currently planned projects, the supply of multi-family housing would meet demand until 2010, after which additional multi-family housing may be needed. Overall, developers are positioned to meet the growing housing demand (KDC 2006).

The housing market would be able to meet the increase in housing demand (326 employees in total), relative to the combined estimated growth of the existing population and the increase in population due to the DoD operations at Fort Riley between 2007 and 2012 (25,186). It is possible that with the relocation of highly skilled workers to the immediate area, property values could increase, and there is no empirical evidence that a facility such as NBAF would reduce property values in the study area. Therefore, the overall effect of the NBAF on housing market conditions would be negligible. Developers are positioned to meet the growing housing demand associated with the Fort Riley expansion (KDC 2006).

3.10.4.3.3 Quality of Life (Community Services)

Due to the small percentage of the overall population growth that would be attributed to the facility, the NBAF would create a small increase in the demand for public services. The study area population growth attributed to the NBAF would be 3.1% of the overall combined estimated population growth and the increase in population due to the DoD operations at Fort Riley between 2007 and 2012.

As the study area population grows, expansion of public services would be necessary, regardless of whether the Manhattan Campus Site is selected for the location of the NBAF. In comparison to existing trends (e.g., the expansion of Fort Riley), the additional population locating to the study area as a result of the NBAF would have a small effect on the availability of public services.

3.10.4.3.3.1 Public Schools

The NBAF would add approximately 162 school-aged children to the study area or a 3.2% increase in the Manhattan-Ogden USD 383 total enrollment of 5,149 during the 2005/2006 school year (KDC 2006). By 2012, an additional 2,700 students are expected to attend the school district, and capacity is expected to be exceeded in 2009. A new elementary school would likely be needed. A one-quarter-cent sales tax was instituted in 2005 to fund the expansion of USD 383 to accommodate the expected increase in the school-aged population. School districts affected by the Fort Riley expansion may be eligible for federal funding to cover portions of the cost of providing additional schools and teachers (KDC 2006). The 3.2% increase in school-aged children attributed to the NBAF would add a corresponding increased demand on schools.

3.10.4.3.3.2 Law Enforcement

The population increase associated with the NBAF (783), relative to the estimated growth of the existing population and the increase in population due to the DoD operations at Fort Riley between 2007 and 2012 (25,186), would result in a small increase in the need for additional law enforcement services. However, combined with the population increase due to background growth, additional local investment in law enforcement would be required.

3.10.4.3.3.3 Fire Protection

The population increase associated with the NBAF (783), relative to the estimated growth of the existing population and the increase in population due to the DoD operations at Fort Riley between 2007 and 2012 (25,186), would result in a small increase in the need for additional fire protection services. However, combined with the population increase due to background growth, additional local investment in fire protection would be required.

3.10.4.3.3.4 Medical Facilities

The additional population associated with the NBAF (783), relative to the estimated growth of the existing population and the increase in population due to the DoD operations at Fort Riley between 2007 and 2012 (25,186), would result in a small increase in the demand for medical services and facilities. However, combined with the population increase due to Fort Riley, additional local investment in medical facilities and services would be required.

3.10.4.3.3.5 Recreation

Recreational resources would experience a small increase in utilization rates as a result of the population increase associated with the NBAF. As detailed in Section 3.10.4.1.3.5, Recreation, the study area has abundant recreation resources available and would be able to absorb the additional usage.

3.10.4.3.3.6 Health and Safety

The normal operation of the NBAF would pose no additional health or safety risks to the public because the facility would be closed off to public access at all times. Site-specific protocols would be developed in response to any appropriate local incident or pending adverse weather condition potentially affecting the NBAF, in coordination with local emergency response agencies that would consider the diversity and density of human, livestock, and wildlife populations residing within the local area. The response plans would have site-specific standard operating procedures and response plans in place prior to the initiation of research activities at the proposed the NBAF. Procedures and plans to operate the NBAF will include community representatives as described in Section 2.2.2.6 of the NBAF EIS. Further analysis with regard to health and safety during abnormal operation of the proposed facility are in Section 3.14 (Health and Safety).

3.10.5 Flora Industrial Park Site

3.10.5.1 Affected Environment

The Flora Industrial Park, Mississippi, has been proposed as the location site for the facility, and the geographic definition of the affected environment for this location was determined primarily based on a journey-to-work analysis of the Town of Flora. Any county that constituted approximately 5% or more of the worker flows into, or out of, Flora (FIPS Place Code 24940) was considered to comprise the affected environment for the proposed site, and this included Madison, Hinds, and Yazoo Counties (USCEN 2000a; USCEN 2000c).

The expanded area of study to be used for the agricultural livestock vulnerability analysis and discussion in Appendix D added Attala, Holmes, Leake, Rankin, and Scott Counties to the original economically described affected area (Figure 3.10.5.1- 1).

3.10.5.1.1 Employment and Income

3.10.5.1.1.1 Employment

In general, the civilian labor force for all three counties in the affected area combined has grown from 163,734 in 1990 to 176,171 in 2006, an increase of 7.6% (Table C-63). Between 2000 and 2006, the employment levels of Hinds and Yazoo Counties have fallen slightly, as they have tracked the trend in Mississippi, which also saw a fall in the number employed over the same period of time. Despite the decline in employment levels witnessed in these two counties, Madison County has seen a 12% increase in its employment level over the same period of time, going from 39,319 to 44,140.

The unemployment rates for Hinds and Madison Counties have consistently remained below that of Mississippi for the 3 years observed (1990, 2000, and 2006), and they have also followed the same trend—falling between the years of 1990 and 2000, and then subsequently rising between the years 2000 and 2006 (Table C-63). The unemployment rate in Yazoo County, however, has steadily risen over the 16-yr period presented. In 2000 and 2006, it was higher than that noted for Mississippi.

Although the average rate of unemployment for the three-county region has consistently been lower than the state's average in the 3 years observed, it has consistently been higher than the national average[10]. The unemployment rate in Yazoo County has been approximately two percentage points higher than the state's average rate in 2000 and 2006—it has also been close to double the national average rate in those 2 years (Table C-63).

[10] Based on data obtained from the Bureau of Labor Statistics, the average national unemployment rate for the country in the years 1990, 2000, and 2006 were 5.6, 4.0, and 4.6 respectively.

Hinds County, which is home to the city of Jackson, is the center of employment with approximately 79% of its workers employed within the county, while also attracting about one-half of the labor force in Madison County (Table C-64). Jackson is the state capital and largest city in Mississippi. Yazoo County has a much smaller civilian work force relative to the other two counties, and approximately 70% of the employment base remains focused locally, with another 14% working in Hinds County.

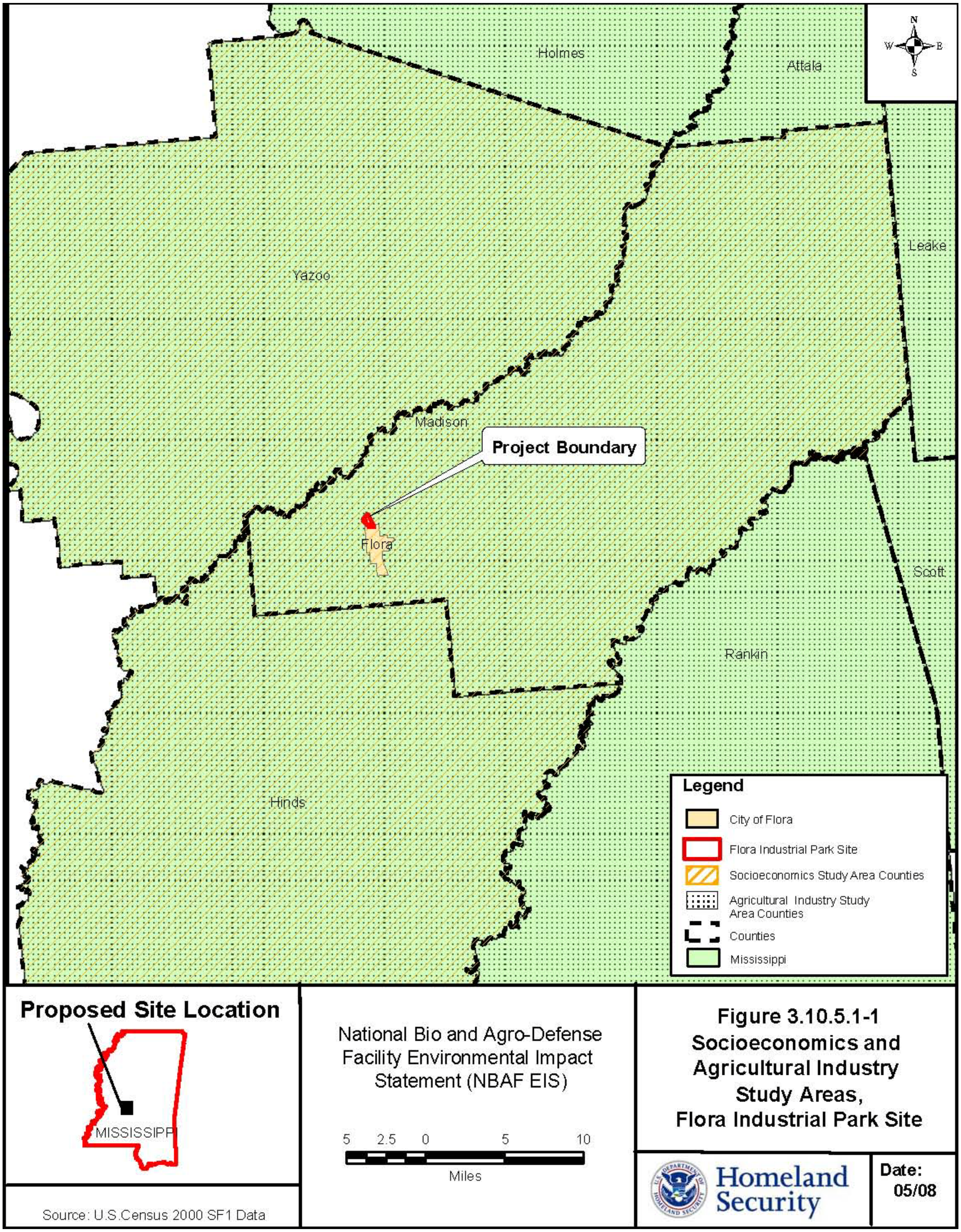


Figure 3.10.5.1-1 — Socioeconomics and Agricultural Industry Study Areas

Employment can be measured as either a count of workers (e.g., see Table C-63) or as a count of actual jobs. The following employment base analysis uses the count of actual jobs in ascertaining the relative importance and proportion of various industrial sectors present in the affected area (Tables C-65 and C-66).

Hinds County is home to 172,206 jobs, while Madison and Yazoo County hold 57,743 and 9,299 jobs, respectively (Table C-65). Hinds County, which includes Jackson, has approximately 40,388 jobs (23.5% of the 172,206 jobs in Hinds County) associated with state and local government. The University of Mississippi's hospitals and clinics also constitute a leading source of employment in the area, with over 5,000 employees.

In all three counties combined, government and retail trade are the largest industry contributors to employment by number of jobs. Hinds County's greater degree of urbanization probably explains its larger proportion of service industry employment, while Yazoo's lower population density probably explains its larger proportion of farm employment. In Madison County, the largest contributors to employment, by number of jobs, are the manufacturing and retail trade industries, with service industries also playing a leading role of lesser impact (Tables C-65 and C-66).

A list of major employers in the region of study is presented in Table C-67. In the case of Hinds County, the employers listed are those that have a workforce of over 1,000 employees, while in Madison and Yazoo Counties, the cutoffs are 250 and 100 employees, respectively.

Government and government enterprises remain ranked as the largest sources of employment, in terms of total wage compensation paid for the three counties combined. At the county level, however, government and government enterprise employment is still largest for Hinds and Yazoo Counties, but in Madison County, the largest industry contributor to employment, by earnings, is the manufacturing industry (Tables C-68 and C-69).

3.10.5.1.1.2 Agricultural Industry

For the purposes of this analysis, an expanded area of study, comprising all counties adjacent to the proposed site, was defined for the agricultural livestock discussion. The relative importance of the agricultural industry was assessed in the following counties: Madison, Yazoo, Attala, Hinds, Ranking, Scott, Leake, and Holmes.

Agriculture directly generated an estimated 6,813 jobs in the eight counties studied in 2006 (Table C-70), with Yazoo County contributing 1,180 jobs towards that total. Animal production made up 2,501 of the 6,813 jobs directly supported by the agricultural industry, with poultry and egg production providing slightly more than half of those jobs. The NAICS code classified that agriculture and hunting industry made up about 2% of all the jobs in the eight-county region, although that percentage varies quite a bit in each individual county. In Hinds, the most urban of the eight, agriculture comprises less than 1% of total industry employment, while in Leake, the figure is almost 10%.

Industry output from the agriculture industry in the eight-county region totaled just over $1 billion (Table C-70). Industry output can be measured by the total value of purchases made by intermediate and final consumers of that industry's production. Animal production generated $579 million towards the total output of the agriculture and hunting industry, with crop production and other support activities contributing an additional $432 million. Poultry and egg production in the eight-county region accounted for approximately $516 million (51%) of total output in the agriculture and hunting industry, making it the most valuable component of the overall industry.

Livestock statistics in the counties surrounding the proposed facility show the total number of livestock found in the eight-county region is 324,556, with Madison County providing 19,148 (59%) of the total (Table C-71). The term livestock includes hoofed animals such as cattle, hogs, sheep, goats, horses, and mules. The number of poultry in the eight-county region is 48,993,735, and Scott County provides 31,600,000 (64%) of the total (NDP 2007a).

There were approximately 980,000 head of cattle and calves at the end of 2006 within Mississippi, with an estimated inventory value of $755 million (averaging out to a unit value $770 per head within the state). The eight-county region made up for about 19.5% of that total with 190,700 head of cattle found within those counties (NASS 2006). Based on the state's estimated unit price, the inventory value of cattle within the eight-county region would be approximately $146.8 million.

3.10.5.1.1.3 Hunting

An analysis of the hunting industry is used to assess the importance that hunting activity has on the local economy. Data from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation are utilized to describe the depth of this industry and address public concerns about the possible impacts of the proposed facility's operations on this industry and subsequently on the local economy.

U.S. Fish and Wildlife Service data from 2006 that are limited to the statewide level shows that total expenditures related to recreational hunting activities in the state of Mississippi totaled $520 million. The data show that of the 304,000 individuals who participated in hunting activities in 2006, 285,000 were involved in big game hunting (e.g., deer) (USFWS 2006).

3.10.5.1.1.4 Income and Poverty

In 1999, median household incomes ranged from $24,795 in Yazoo County to $46,970 in Madison County. Per capita incomes showed less variation and were also lowest in Yazoo County ($12,062). Overall, the median household income in the study area was $35,753, and the per capita income was $18,529 (Table C-72) (USCEN 2000b).

Of the three study area counties, Madison County had the smallest proportion of persons living below the poverty level, and Yazoo County had the highest proportion of persons living below the poverty level. The percentage of persons living below poverty in the study area (19.6%) was similar to the poverty rate in Mississippi (19.7%) and higher than in the United States (12.4%) (Table C-72) (USCEN 2000b).

In 2007, the estimated median household income for the study area was $42,527, higher than the estimated median household incomes in Mississippi ($35,903) and lower than in the United States ($53,154) (ESRI BIS 2007). Madison County was estimated to have a per capita income of $29,755, higher than in Mississippi ($18,800) and the United States ($27,916) (ESRI BIS 2007).

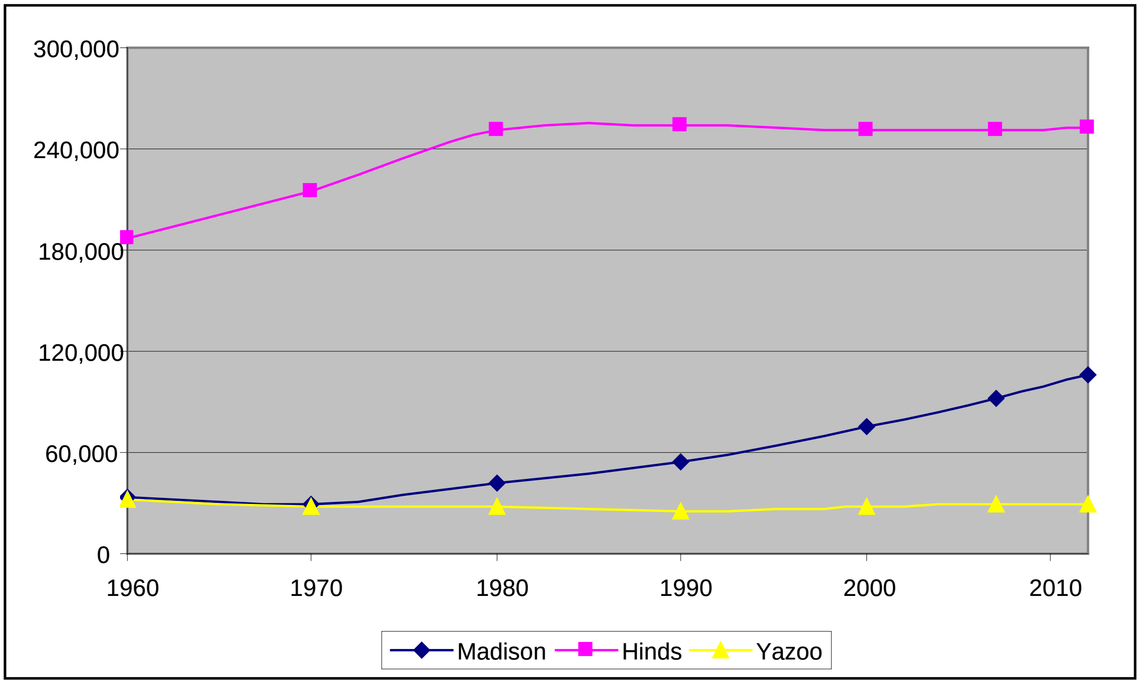
3.10.5.1.2 Population and Housing

3.10.5.1.2.1 Population

Population growth trends in the affected area counties (Madison, Hinds, and Yazoo Counties) show the total population of the study area has increased by 122,584 between 1960 and 2000. Population estimates for 2007 and 2012, the most recent forecasts available, shown an additional 34,854 residents are estimated to be added to the study area between 2000 and 2012 (Figure 3.10.5.1.2.1-1) (USCEN 2000b).

Between 1960 and 2000, Yazoo County experienced little population growth, and the population of Madison and Hinds Counties increased substantially. The most populous county in the study area, Hinds County has experienced little change in population size since 1980 (USCEN 2000b). The Town of Flora, in Madison County, is the specific location of the proposed site within the study area and is therefore included in this socioeconomic discussion.

Between 2007 and 2012, the population of the affected area is expected to grow slightly faster than Mississippi and slower than the United States. The population of the Town of Flora is estimated to increase by 488 persons between 2000 and 2012. Madison County was the fastest growing county in the study area between 1990 and 2000 and is estimated to continue to grow faster than the study area as a whole between 2000 and 2012. Madison County's share of the total study area population (21.1%) is estimated to grow to 27.4% by 2012 (Table C-73) (Figure 3.10.5.1.2.1-1).



Sources: 1960-2000 population: U.S. Census Bureau. 2007 and 2012 population forecasts: ESRI BIS.

Figure 3.10.5.1.2.1-1 — Population, Madison County, Hinds County, and Yazoo County, Mississippi, 1960-2012

3.10.5.1.2.1.1 Ethnicity and Race

In 2000, African Americans comprised the largest minority group in the study area (55.6%), which was greater than the proportion of African Americans in Mississippi (36.3%) and the United States (12.2%). The proportion of persons of Hispanic origin in the study area (1.1%) was substantially smaller than in Mississippi (1.4%) and the United States (12.5%). Overall, the proportion of minorities in the study area (57.9%) was greater than in Mississippi (39.3%) and the United States (30.1%) (Table C-74) (USCEN 2000b).

3.10.5.1.2.1.2 Age

In 2000, approximately 29.8% of the population of the study area was aged 18 years and under, and 10.8% was aged 65 years and over. The Town of Flora had the highest proportion of its population aged 18 years and under, and Yazoo County had the highest proportion of its population aged 65 years and older (Table C-75) (USCEN 2000b).

In 2007, the proportion of the Madison County population estimated to be 18 years of age and under (29.1%) was greater than in Mississippi (26.7%) and the United States (25.8%). The proportion of the population of Madison County estimated to be 65 years of age and older (9.4%) was estimated to be smaller than in Mississippi (12.2%) and the United States (12.5%) (ESRI BIS 2007).

3.10.5.1.2.1.3 Educational Attainment

In 2000, 20.3% of the study area population did not graduate from high school, 45.4% of the population graduated from high school or had some college education, 6.1% had an associate's degree, and 28.3% had a bachelor's degree or higher level of education. Of the three affected area counties, the highest proportion of the population with a bachelor's degree or higher occurred in Madison County, and the lowest proportion was in Yazoo County. The proportion of residents that did not graduate from high school in the study area (20.3%) was less than in Mississippi (27.1%) and slightly higher than in the United States (19.6%) (Table C-76) (USCEN 2000b).

3.10.5.1.2.2 Housing

In 2007, 90.6% of the housing inventory in the study area was estimated to be comprised of occupied housing units and 9.4% vacant housing units. The proportion of vacant units in the study area was estimated to be smaller than in Mississippi (9.8%) and the United States (9.9%) (Table C-77) (ESRI BIS 2007).

In 2007, Hinds County was estimated to have the highest proportion of renter-occupied housing units in the study area. The percentage of owner-occupied housing units in the study area was estimated to be smaller than in Mississippi (63.9%) and the United States (61.3%) (Table C-77) (ESRI BIS 2007).

In 2000, the single-family detached house is the predominant form of housing in the affected area, comprising 95,338 units (68.6%). The majority of apartment building housing units were located in Hinds County, and the largest proportion of mobile homes was located in Yazoo County (Table C-78) (USCEN 2000b).

In 2000, nearly half of the housing units built in Hinds and Yazoo Counties were built before 1970. Madison County had a greater proportion of housing units built in the 1995 to 2000 time period than the other study area counties, reflecting the higher rate of population and household growth in Madison County, relative to Hinds and Yazoo Counties. In the study area as a whole, 25,099 housing units (18.1%) have been built since 1990 (USCEN 2000b).

New housing growth has primarily occurred in the areas on the periphery of the historic population centers of Jackson, Canton, and Yazoo City. Areas of Madison County, north of Jackson and in between Flora and Canton, had a median year built of 1988-1997, indicating that more than one-half of the housing units in these areas were built in the last 10-20 years (Figure 3.10.5.1.2.2-1).

Between 2000 and 2007, housing values in the study area were expected to grow the fastest in the Town of Flora. In 2007, Madison County was estimated to have the highest median housing value ($149,898), and Yazoo County was estimated to have the lowest median housing value ($71,102). In 2007, the Town of Flora was estimated to have a median housing value of $98,021, higher than the estimated value in Mississippi ($92,555) and lower than in the United States ($192,285) (Table C-79) (USCEN 2000b; ESRI BIS 2007).

In 2007, over one-half of the housing units in the study area were estimated to be valued between $50,000 and $51,151. Yazoo County had the largest proportion of housing units with estimated values less than $50,000, and Madison County had the largest estimated number and proportion of housing units valued at over $150,000. Overall, the proportion of housing units valued at over $150,000 in the study area (28.5%) was estimated to be greater than in Mississippi (23.3%) and smaller than in the United States (61.7%) (Table C-80) (ESRI BIS 2007).

Between 1990 and 2000 (the most recent available rent data), median monthly rent grew the fastest in Yazoo County. In 2000, Madison County had the highest median rent, and Yazoo County had the lowest median rent. The 2000 median rent in the Town of Flora ($307) was lower than the median rents in Mississippi ($334) and the United States ($519) (Table C-81) (USCEN 2000b).

Overall, the majority of the housing units in the study area had rents ranging between $200 and $749. Yazoo County had the largest proportion of housing units with a rent less than $200, and Madison County had the largest proportion of housing units with rents over $1,000 (6.4%). Overall, the proportion of housing units with rents over $1,000 in the study area (2.0%) was greater than in Mississippi (0.9%) and smaller than in the United States (8.4%) (Table C-82).

In 2005, the majority of new housing units in the study area were permitted in Madison County. The least expensive housing units being constructed in the study area are located in Yazoo County, and the most expensive housing units are being constructed in Madison County (Table C-83).

3.10.5.1.3 Quality of Life (Community Services)

Quality of life encompasses those attributes of resources (man-made or natural occurring) of a region that contribute to the well-being of its residents. The relative importance of these attributes to a person's well-being is subjective. NEPA quality-of-life analyses typically address issues relating to potential impacts of the NBAF on the availability of public services that contribute to quality of life. For the purposes of this study, the quality of life of the affected environment includes public schools, law enforcement, fire protection services, medical facilities, and recreation facilities.

3.10.5.1.3.1 Public Schools

The proposed Flora Industrial Park Site is located in the Town of Flora. Flora maintains one public elementary school, one public middle school, and one private school for students in grades K through 12, with a total of 732 students (MDA 2005). Flora is located within the Madison County Public School District, which has a total of eight public elementary schools, four public middle schools, and three public high schools. The total enrollment within this district was 10,864 for the 2006/2007 school year. In the Madison County School District, there is also one private elementary school and two private high schools, which had a total of 1,216 students (MDE 2007).

In addition to the Madison County School District, Madison County also contains the Canton School District, which has two elementary schools, one middle school, and one high school, with a total enrollment of 3,393 students. The study area is also served by the Hinds County School District and the Yazoo County School District.

3.10.5.1.3.2 Law Enforcement

Police protection for the proposed site area in Flora, Mississippi, is provided by the Flora Police Department. The department employs approximately seven full-time police officers and three part-time officers. The study area is also served by the Madison, Hinds, and Yazoo Counties Sheriff's Departments (City Data 2006).

3.10.5.1.3.3 Fire Protection

The Flora Fire Department provides fire safety support for the citizens of Flora and the proposed site area. The department is comprised of four part-time employees (City Data 2006). Department staffing data are not available. Fire protection services are also provided to the study area by the Hinds and Yazoo Counties fire departments.

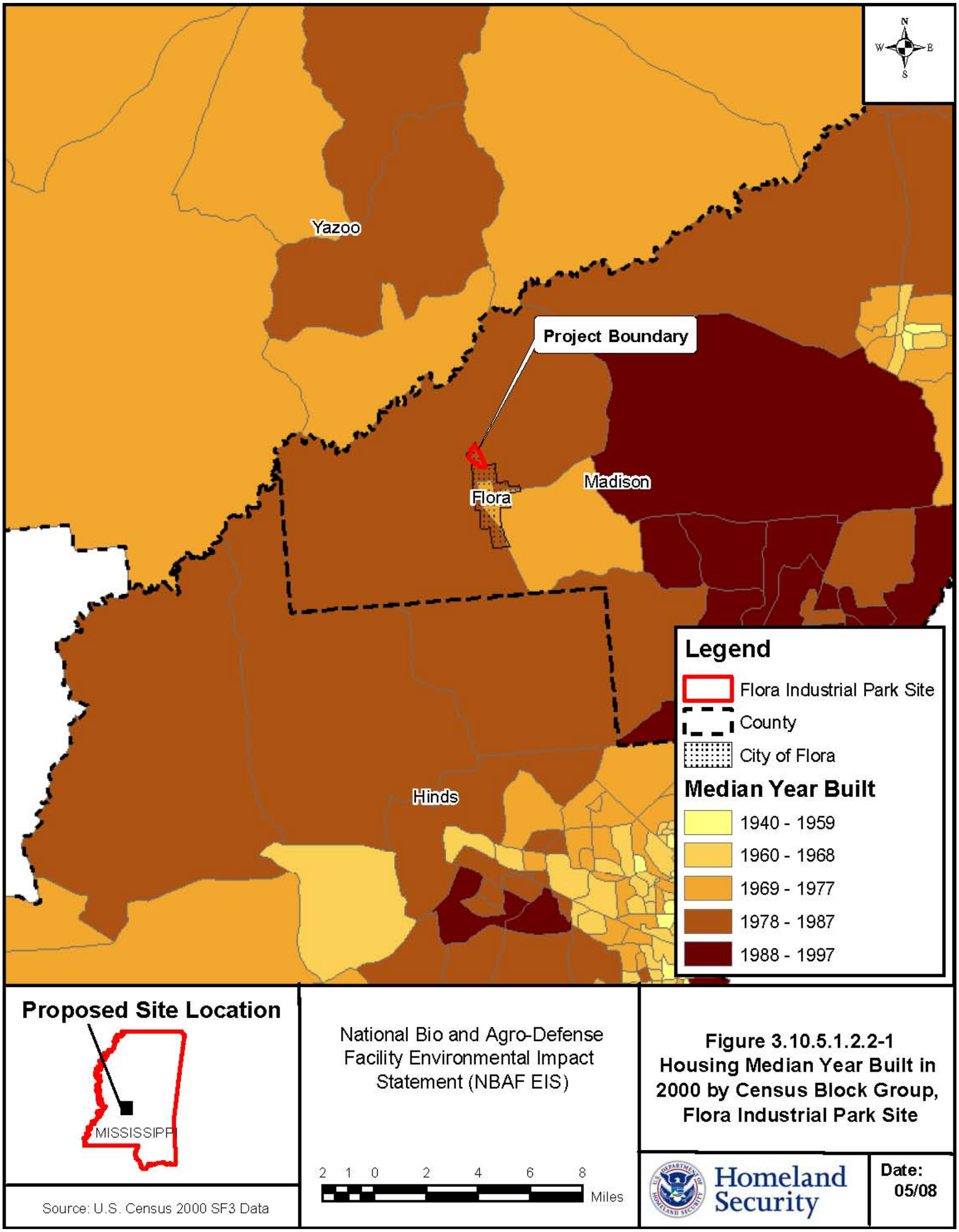


Figure 3.10.5.1.2.2-1 — Housing Median Year Built in 2000 by Census Block Group, Town of Flora, Madison County, Hinds County, and Yazoo County, Mississippi

3.10.5.1.3.4 Medical Facilities

St. Dominic Jackson Memorial Hospital is located approximately 17 miles from Flora, in Jackson, Mississippi. It is a 571-bed, not-for-profit acute-care hospital and employs a staff of 2,000 employees and over 500 physicians. In addition to providing emergency care, inpatient and outpatient surgery, and medical care, St. Dominic Health Services provides primary care to low-income families whose needs are not being met by mainstream health care via its primary health clinic (SDJMH 2008). The University of Mississippi Medical Center, also located in Jackson, maintains a 722-bed diagnostic and treatment referral center for the State of Mississippi. The hospital medical staffs are appointed from the Schools of Medicine and Dentistry. Every year, the hospital treats approximately 27,000 inpatients and over 418,000 outpatient and emergency visits (UMMC 2007).

In addition, Jackson is the home to Mississippi's only comprehensive rehabilitation hospital, the Methodist Rehabilitation Center (MRC 2007). The study area is also served by Central Mississippi Medical Center and the Kings Daughter Hospital.

3.10.5.1.3.5 Recreation

Just outside of Flora town limits is the Mississippi Petrified Forest, and there are several parks and scenic lakes within Madison County. Five museums, three historic sites, and a state park lie within 20 miles of Flora. Also, the nearby universities host a variety of arts and sports recreational activities that are often available to the public (City Data 2006). There are also parks and scenic areas located throughout Hinds and Yazoo Counties that offer additional recreational activities to the study area.

3.10.5.2 Construction Consequences

3.10.5.2.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the 4-yr construction phase. Economic impacts would result from material purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment. The IMPLAN model estimates the total multiplier effect to the regional economy due to increased expenditures and employment associated with the facility.

The economic benefits of construction would be temporary and would diminish as the construction reaches completion. Direct employment (Table 3.10.5.2.1-1) refers to the jobs associated with actual construction of the facility, while total employment refers to all other employment generated as a result of the multiplier effect on the initial investment in construction of the facility. The industries that contribute to this other employment include architectural and engineering services, food services and drink establishments, wholesale trade, and general merchandise stores.

Table 3.10.5.2.1-1 — Short-Term Economic Impacts

Construction	
Total Construction Jobs (person-yrs)	2,744
Impacts	
Total Employment (person-yrs)	3,997
Total Labor Income Impact ($ millions)	149.6
Federal, State, and Local Tax ($ millions)	41.6
State and Local Tax ($ millions)	14.4

Note: In 2007 dollars.

Based on the results of the impact analysis for the construction phase (Table 3.10.5.2.1-1), the construction of the proposed facility would—over the 4-year construction phase—directly support 2,744 person-yrs (686 jobs annually) of employment, with an associated total employment level of 3,997 person-yrs (999 jobs annually). The effects of this work are expected to be short term and would only last for the duration of the construction work.

Minor short-term benefits would be expected as a result of construction. Labor income for any given region is defined as the sum of labor compensation and proprietor income generated within the regional boundaries[11]. The estimated labor income generated during construction is $149.6 million ($37.4 million annually), measured in 2007 dollars. The total labor income impact of this project would correspond to 0.38% of all estimated 2006 labor income in the three-county region, expressed in 2007 dollars, or 1.67% of the total estimated labor income in Madison County.

The construction phase would generate additional taxes estimated at $41.6 million (Table 3.10.5.2.1-1), of which $14.4 million is estimated to be collected through state and local taxes that should flow to the local governments.

3.10.5.2.2 Population and Housing

3.10.5.2.2.1 Population

The majority of the construction workers would be drawn from the study area or would commute from the surrounding counties. Therefore, construction-related employment generated by the NBAF would not be expected to result in an increase in the study area population. Any population change during construction would be temporary and would involve a small percentage of the total construction-period employment. Construction impacts on population and housing would be very similar to those previously described in Section 3.10.3.2.2.

3.10.5.2.2.2 Housing

As described above, the construction of the NBAF would not be expected to increase the population of the study area. Therefore, no effects on housing availability or prices would occur.

3.10.5.2.3 Quality of Life (Community Services)

Construction impacts on quality-of-life attributes would be very similar to those described in Section 3.10.3.2.3.

3.10.5.3 Operations Consequences

3.10.5.3.1 Employment and Income

The proposed facility would also stimulate the regional economy during the operations and maintenance phase, which is expected to commence in the year 2014. Economic impacts would result from material purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment (Table 3.10.5.3.1-1).

[11] Proprietor income consists of payments received by self-employed individuals as income.

Table 3.10.5.3.1-1 — Long-Term Annual Economic Impacts

Operations	
Jobs at the Facility (jobs)	326 [a]
Impacts	
Total Employment (jobs)	485
Total Labor Income Impact ($ millions)	28.4
Federal, State, and Local Tax ($ millions)	3.6
State and Local Tax ($ millions)	1.9

Note: In 2007 dollars.
[a] Actual jobs would range from 250 to 350; 326 was used for cost estimating purposes and the basis for the economic analysis.

Operation of this proposed facility would commence in 2014 and would require 145 operations, maintenance, and security staff and an additional 181 scientific and support staff. The operations and maintenance of the proposed facility would generate a total of 485 jobs including the initial 326 direct jobs required for operations and maintenance (see footnote in Table 3.10.5.3.1-1 regarding actual NBAF employment figures) (NDP 2007a).

The estimated income generated during the operations phase is $28.4 million annually, in 2007 dollars. This corresponds to 0.3% of all estimated 2006 labor income in the three-county region, expressed in 2007 dollars, or 1.3% of total labor income in Madison County.

The operation phase would generate additional taxes estimated at $3.6 million (Table 3.10.5.3.1-1), of which $1.9 million is estimated to be collected through state and local taxes that should flow to the local governments.

3.10.5.3.2 Population and Housing

3.10.5.3.2.1 Population

The NBAF would directly employ 326 people. The majority of these employees would be expected to be research scientists and other specialized staff, and based on census journey-to-work data, 246 would be expected to relocate to the study area from elsewhere in the country. Assuming the U.S. 2006 average family size of 2.61 persons, this would represent a population increase of 642 (USCEN 2006).

In addition, the economic activity associated with the operation of the NBAF is expected to employ 159 persons. The industries that would contribute to this indirect employment include those in non-specialized areas such as food services and drink establishments and wholesale trade, among others. It is assumed that these employment opportunities would be filled by the local labor force and that the relocation of workers to the study area due to the generation of these jobs would be negligible.

In total, the population of the study area would be expected to increase by 642 as a result of the operation of the NBAF. This population increase is a small portion of the overall estimated population growth within the study area between 2007 and 2012 (15,512, based on historic trends), which is expected to result in a total study area population of 389,641 in 2012.

3.10.5.3.2.2 Housing

As described above, 642 additional persons would locate to the study area as a result of the NBAF. The average salary of the 326 employees employed directly at the facility would be $82,622. Over 80 NBAF research scientists and managers would earn over $125,000 annually, which is higher than the average study area salary. The estimated median value of owner-occupied housing units in the study area in 2007 was estimated to be $94,645 (Table C-79). Taking into account families with two incomes, the available study area housing stock would be affordable to the majority of the people relocating to the region.

The housing market would be able to meet the increase in housing demand (326 employees in total), relative to the expected growth of the existing population between 2007 and 2012 (15,512). It is possible that with the relocation of highly skilled workers to the immediate area, property values could increase due to an increase in demand, and there is no empirical evidence that a facility such as the NBAF would reduce property values in the study area. Therefore, the overall effect of the NBAF on housing market conditions would be negligible.

3.10.5.3.3 Quality of Life (Community Services)

Due to the small percentage of the overall population growth that is attributed to the facility, the NBAF would create a slight increase in the demand for public services. The study area population growth attributed to the facility is 4.1% of the overall estimated population growth from 2007 to 2012. As the study area population grows, expansion of public services would be necessary, regardless of whether the Flora Industrial Park Site is selected for the location of the NBAF.

3.10.5.3.3.1 Public Schools

The NBAF would add approximately 133 school-aged children to the study area, or a 1.2% increase in the 2006/2007 10,864 enrollment of the Madison County School District (MDE 2007). The 1.2% increase in school age children attributed to the facility would place minimal demand on the schools. School districts in the study area have invested in educational facilities to meet the needs of the growing population of the region.

3.10.5.3.3.2 Law Enforcement

The population increase associated with the NBAF (642), relative to the expected growth of the existing population between 2007 and 2012 (15,512), would result in a slight increase in the need for additional law enforcement services.

3.10.5.3.3.3 Fire Protection

The population increase associated with the NBAF (642), relative to the expected growth of the existing population between 2007 and 2012 (15,512), would result in a slight increase in the need for additional fire protection services.

3.10.5.3.3.4 Medical Facilities

The additional population associated with the NBAF (642), relative to the expected growth of the existing population between 2007 and 2012 (15,512), would result in a slight increase in the demand for medical services and facilities. Due to the overall population growth in the region, medical facilities in the study area are responding to growth in the region and are expanding to meet the increasing demand. For example, the Madison County Medical Center in Canton is planning to construct a new replacement medical facility, the Madison County Regional Medical Center, near the Nissan plant in Canton (MCMC 2008).

3.10.5.3.3.5 Recreation

Recreational resources would not experience a significant increase in utilization rates as a result of the population increase associated with the NBAF. The study area has abundant recreation resources available.

3.10.5.3.3.6 Health and Safety

The normal operation of the NBAF would pose no additional health or safety risks to the public because the facility would be closed off to public access at all times. Site-specific protocols would be developed in response to any appropriate local incident or pending adverse weather condition potentially affecting the NBAF, in coordination with local emergency response agencies that would consider the diversity and density of human, livestock, and wildlife populations residing within the local area. The response plans would have site-specific standard operating procedures and response plans in place prior to the initiation of research activities at the proposed the NBAF. Procedures and plans to operate the NBAF will include community representatives as described in Section 2.2.2.6 of the NBAF EIS. Further analysis with regard to health and safety during abnormal operation of the proposed facility are in Section 3.14 (Health and Safety).

3.10.6 Plum Island Site

3.10.6.1 Affected Environment

The description of the socioeconomic environment associated with the Plum Island Site's affected area is the same as that outlined under the No Action Alternative (Refer to Section 3.10.2.1).

3.10.6.2 Construction Consequences

3.10.6.2.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the construction phase. Economic impacts would result from material purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment.

Table 3.10.6.2.1-1 — Short-Term Economic Impacts

Construction	
Total Construction Jobs (person-yrs)	2,113
Impacts	
Total Employment (person-yrs)	3,374
Total Labor Income Impact ($ millions)	183.9
Federal, State, and Local Tax ($ millions)	71.5
State and Local Tax ($ millions)	24.7

Note: In 2007 dollars.

The economic benefits of construction impacts would be temporary and would diminish as the construction reaches completion. Direct employment (Table 3.10.6.2.1-1) refers to the jobs associated with actual construction of the facility, while total employment refers to all other employment generated as a result of the multiplier effect on the initial investment in construction of the facility. The industries that contribute to this other employment include architectural and engineering services, food services and drink establishments, wholesale trade, and offices of physicians and other health care services.

As indicated in Table 3.10.6.2.1-1, the construction of the proposed facility would—during the 4-year construction phase—directly support 2,113 person-yrs of employment (528 jobs annually) with an associated total employment level of 3,374 person-yrs (844 jobs annually). The effects of this work are expected to be short term and would only last for the duration of the construction work.

In terms of income, minor short-term benefits would be expected. Labor income for any given region is defined as the sum of labor compensation and proprietor income generated within the regional boundaries[12]. The estimated labor income generated during the construction phase is $183.9 million ($46 million annually), measured in 2007 dollars. The total labor income impact of this project would correspond to 0.1% of all estimated 2006 labor income in the three-county region, expressed in 2007 dollars, and also approximately 0.1% of the total estimated labor income in Suffolk County.

The construction phase would generate additional taxes estimated at $71.5 million (Table 3.10.6.2.1-1), of which approximately $24.7 million is estimated to be collected through state and local taxes that would flow to the local governments.

3.10.6.2.2 Population and Housing

3.10.6.2.2.1 Population

The majority of the construction workers would be drawn from the study area or would commute from the surrounding counties. Therefore, construction-related employment generated by the Plum Island Site is not expected to result in an increase in the study area population. Any population change during construction would be temporary and would involve a small percentage of the total construction-period employment. Construction impacts on population and housing would be very similar to those previously described in Section 3.10.3.2.2.

3.10.6.2.2.2 Housing

As described above, the construction of the NBAF is not expected to increase the population of the study area. Therefore, no effects on housing availability or prices would occur.

3.10.6.2.3 Quality of Life (Community Services)

Construction impacts on quality-of-life attributes would be very similar to those described in Section 3.10.3.2.3.

3.10.6.3 Operations Consequences

3.10.6.3.1 Employment and Income

The operation of NBAF would also stimulate the regional economy during the operations and maintenance phase, which is expected to commence in the year 2014. Economic impacts would result from purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the continual operations of the facility. Table 3.10.6.3.1-1 displays a summary of the direct impact and multiplier effects to the local economy.

[12] Proprietor income consists of payments received by self-employed individuals as income.

Table 3.10.6.3.1-1 — Long-Term Annual Economic Impacts

Operations	
Jobs at the Facility (jobs)	326 [a]
Impacts	
Total Employment (jobs)	491
Total Labor Income Impact ($ millions)	30.8
Federal, State, and Local Tax ($ millions)	5.4
State and Local Tax ($ millions)	2.7

Note: In 2007 dollars.
[a] Actual jobs would range from 250 to 350; 326 was used for cost estimating purposes and the basis for the economic analysis.

Operation of the NBAF would commence in 2014 and would require 145 operations, maintenance, and security staff and an additional 181 scientific and support staff. The operations and maintenance of the proposed facility would generate a total of 491 jobs including the initial 326 direct jobs required for operations and maintenance (see footnote in Table 3.10.6.3.1-1 regarding actual NBAF employment figures) (NDP 2007a).

The estimated income generated during the operations phase is $30.8 million annually, in 2007 dollars. This corresponds to 0.1% of all estimated 2006 labor income in the three-county region, expressed in 2007 dollars, which also corresponds to approximately 0.1% of total labor income in Suffolk County.

The operations phase of a new facility would generate additional taxes estimated at $5.4 million (Table 3.10.6.3.1-1), of which $2.7 million is estimated to be collected through state and local taxes that would flow to the local governments.

3.10.6.3.2 Population and Housing

3.10.6.3.2.1 Population

The NBAF would directly employ 326 people. The majorities of these employees are research scientists, and because no decisions have yet been made regarding the future operation of PIADC, for the purpose of this study, based on census journey-to-work data, 276 employees are assumed to relocate to the study area from elsewhere in the country. Assuming the U.S. Census Bureau 2006 average household size of 2.61 persons, this represents a population of 720.

The economic activity associated with the operation of the NBAF includes the employment of 165 persons. The industries that would contribute to this indirect employment include those in non-specialized areas such as food services and drink establishments and wholesale trade, among others. It is assumed that these employment opportunities would be filled by the local labor force and that the relocation of workers to the study area due to the generation of these jobs would be negligible.

In total, the population of the study area associated with the Plum Island Site is 720. This population is 1.0% of the overall expected population growth within the study area between 2007 and 2012 (70,562, based on historic trends). The estimated total study area population for 2012 is 2,013,919.

3.10.6.3.2.2 Housing

As described above, 720 persons living in the study area would be associated with the NBAF. The average salary, including benefits, of the approximately 326 employees employed directly at the NBAF would be $82,622. For comparative purposes, this figure has been adjusted to an average per capita income of $66,924 for employees employed directly at the NBAF, which is higher than the estimated median 2007 study area per capita income ($36,351). Over 80 NBAF research scientists and managers would earn more than $125,000 annually. The estimated median value of owner-occupied housing units in the study area in 2007 was estimated to be $294,580 (Table C-16). In the study area, 18.9% of occupied housing units were estimated to be renter occupied. The 2000 yearly median rents of renter-occupied housing units were $10,332 in Suffolk County and $6,744 in New London County (U.S. Census Bureau American Community Survey). Taking into account families with two incomes, the available study area housing stock is affordable to the majority of employees associated with the proposed facility.

The housing market would be able to meet the increase in housing demand (326 employees in total), relative to the estimated growth of the existing population between 2007 and 2012 (70,562). It is possible that with the relocation of highly skilled workers to the immediate area, property values could increase due to an increase in demand, and there is no empirical evidence that a facility such as NBAF would reduce property values in the study area.

3.10.6.3.3 Quality of Life (Community Services)

The NBAF would have a negligible effect on the availability of public services. The study area population associated with Plum Island Site, which mainly already resides within the study area, is 1.0 % of the overall estimated population growth from 2007 to 2012.

3.10.6.3.3.1 Public Schools

The number of school-aged children associated with employees of Plum Island Site is 149 or 4.6% of the combined 3,281 student 2005-2006 enrollment in the Oysterponds Union Free School District and 2003–2004 enrollment in the New London School District (NYSDE 2007; CSDE 2005).

School districts in the study area have invested in educational facilities to meet the needs of the growing population of the region. For example, the New London School District is currently constructing a new elementary school that is scheduled to open in 2008 (NLPS 2008).

3.10.6.3.3.2 Law Enforcement

The population increase associated with the Plum Island Site (720), relative to the expected growth of the existing population between 2007 and 2012 (70,562), would result in a negligible increase in the need for additional law enforcement services.

3.10.6.3.3.3 Fire Protection

The population increase associated with the NBAF (720), relative to the expected growth of the existing population between 2007 and 2012 (70,562), would result in a negligible increase in the need for additional fire protection services.

3.10.6.3.3.4 Medical Facilities

The additional population associated with the NBAF (720), relative to the expected growth of the existing population between 2007 and 2012 (70,562), would result in a negligible increase in the demand for medical services and facilities.

Due to the overall population growth in the region, medical facilities in the study area are responding to growth in the region and expanding to meet the increasing demand. For example, in 2005, the Eastern Long Island Hospital expanded its Emergency Center, and this past year has allocated $600,000 to increase surgical unit capacity (ELIH 2007).

3.10.6.3.3.5 Recreation

Recreational resources would not experience a significant increase in utilization rates as a result of the population increase associated the NBAF. The study area has abundant recreation resources available.

3.10.6.3.3.6 Health and Safety

The normal operation of the NBAF would pose no additional health or safety risks to the public because the facility would be closed off to public access at all times. Site-specific protocols would be developed in response to any appropriate local incident or pending adverse weather condition potentially affecting the NBAF, in coordination with local emergency response agencies that would consider the diversity and density of human, livestock, and wildlife populations residing within the local area. The response plans would have site-specific standard operating procedures and response plans in place prior to the initiation of research activities at the proposed the NBAF. Procedures and plans to operate the NBAF will include community representatives as described in Section 2.2.2.6 of the NBAF EIS. Further analysis with regard to health and safety during abnormal operation of the proposed facility are in Section 3.14 (Health and Safety).

3.10.7 Umstead Research Farm Site

3.10.7.1 Affected Environment

The Town of Butner, North Carolina, has been proposed as the location site for the facility, and the geographic definition of the affected environment for this location was determined primarily based on a journey-to-work analysis. Any county that constituted approximately 5% or more of the worker flows into or out of Butner (FIPS Place Code 09360) was considered to comprise the affected environment for the proposed site, and this included Granville, Durham, Vance, and Wake Counties. (USCEN 2000a; USCEN 2000c).

The expanded area of study to be used for the agricultural livestock vulnerability analysis and discussion in Appendix D added Person, Franklin, Mecklenburg (VA), and Halifax (VA) Counties to the original economically described affected area (Figure 3.10.7.1-1).

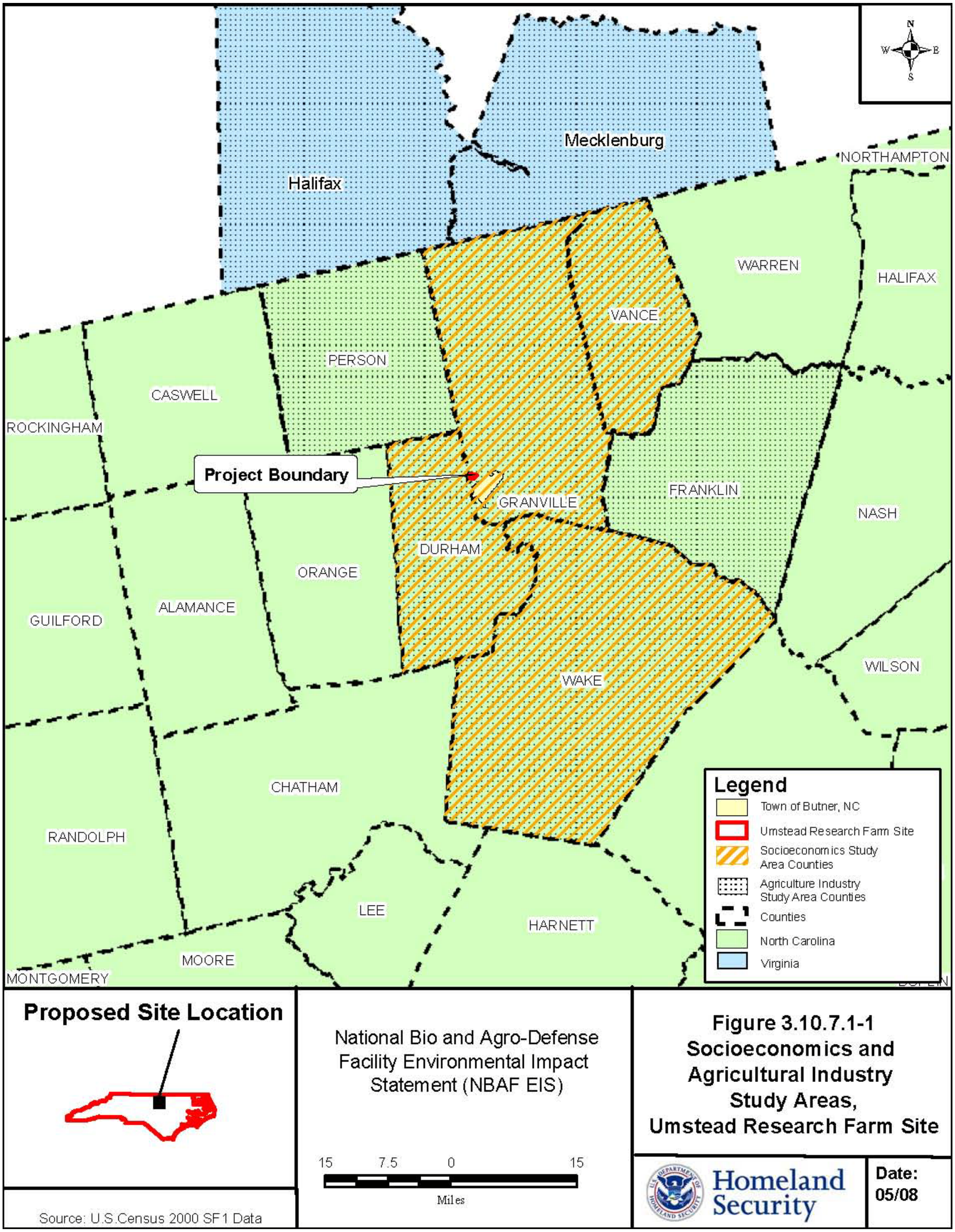


Figure 3.10.7.1-1 — Socioeconomics and Agricultural Industry Study Areas, Umstead Research Farm Site

3.10.7.1.1 Employment and Income

3.10.7.1.1.1 Employment

In general, the civilian labor force for all four counties combined has grown from 398,860 in 1990 to 605,207 in 2006, an increase of 51.7% compared to a 27.7% increase in the state's civilian labor force (Table C-84). The biggest contributor to this increase in the four-county was Wake County, which also happens to house the state's capital and is adjacent to and partly contains the Research Triangle Park, the largest research park in the world. Wake County's labor force has grown by 66% over the 16-yr period observed without an increase in the unemployment rate, demonstrating that the county offers a favorable environment for employment regionally.

The unemployment rates in all the counties studied, with the exception of Durham County, followed the state trend: falling between 1990 and 2000 and then subsequently rising between 2000 and 2006. The unemployment rates in Granville and Vance Counties have consistently been higher than the state's average rate in all 3 years observed. Vance County in particular has had a relatively higher rate than the state—almost double the state average in 1990 and surpassing the state average by more than one and a half times in 2006. This high unemployment rate may explain why Vance is the only study area county that has experienced a decline in its labor force and number employed between the years 2000 and 2006.

The combined four-county average rate consistently remains below the state's average. This is largely due to the low unemployment rate in Wake County, which weighs heavily in terms of employment in the four counties. The unemployment rate in Wake County is generally one percentage point lower than the state's average rate, and at times it has been almost 2% lower than the national average over the 3 years observed.[13]

Despite its large contribution to the overall employment numbers within the four-county region, Wake County does not attract extraordinarily large proportions of the commuters in the other three counties. Twelve to 13% of commuters in Durham and Granville work in Wake County, and an even smaller proportion of commuters from Vance County work in Wake County (Table C-85). Due to the universities and the portion of Research Triangle Park located in Durham County, many Granville residents (23%) commute to Durham County.

Employment can be measured as either a count of workers (e.g., see Table C-84) or as a count of actual jobs. The following employment base analysis uses the count of actual jobs in ascertaining the relative importance and proportion of various industrial sectors present in the study area (Tables C-86 and C-87).

Wake County was home to 508,662 of the 764,206 jobs held in the four-county region in 2006. Durham contributed 211,588 jobs while Granville and Vance contributed a much smaller number: 24,423 and 19,533, jobs respectively, towards the four-county total (Table C-87). Wake County's concentration of employment and its diverse economy is mostly attributed to the county being home to the state capital, numerous universities, a portion of the Research Triangle Park, and an international airport.

Government and government enterprise are the leading employers for the four-county region as a whole, as well as three of four individual counties. The exception is Durham where manufacturing is the leading industry. Even though each county contains a diverse mixture of leading industry employers, government enterprise and retail trade are common leaders in all four counties (BEA 2006) (Tables C-86 and C-87).

Government and government enterprises remain ranked as the largest sources of employment even in terms of total wage compensation paid for the general area of study (Table C-88). At the county level, however, Durham County's largest industry contributor to employment measured by earnings is the manufacturing industry (Tables C-89 and C-90).

[13] Based on data from the Bureau of Labor Statistics, the average national unemployment rate for the country in the years 1990, 2000, and 2006 were 5.6, 4.0, and 4.6, respectively.

3.10.7.1.1.2 Agricultural Industry

For the purposes of this analysis, an expanded area of study comprising all counties adjacent to the proposed site was defined for the agricultural livestock discussion. The relative importance of the agricultural industry was assessed in the following counties: Granville,NC; Durham, NC; Vance, NC; Wake, NC; Franklin, NC; Person, NC; Halifax, VA; and Mecklenburg, VA.

Agriculture directly generated an estimated 6,634 jobs in the eight counties studied in 2006 (Table C-91), with Wake County contributing 2,086 jobs towards that total and Franklin, Halifax (VA); and Mecklenburg (VA) supporting approximately another 1,000 agriculturally related jobs each. Of the 6,634 jobs directly supported by the agricultural industry, only 1,550 jobs are attributed to animal production enterprises, with the bulk of agricultural employment maintained and provided by crop production. Agriculture makes up less than 1% of the jobs in the eight-county region, although that percentage varies quite a bit among each individual county. Within the four-county region of Granville, Durham, Vance, and Wake, proportional employment in agriculture is highest in Granville (2.5%) followed by Vance (2.0%). In the wider eight-county region, employment in agriculture makes up 5.2% in Franklin, 6.2% in Halifax, and 6.3% in Mecklenburg.

Industry output from the NAICS code classified, agriculture and hunting industry in the eight-county region totaled $489 million (Table C-91). Industry output can be measured by the total value of purchases made by intermediate and final consumers of that industry's production. Crop production generated $391 million towards the total output of the agriculture and hunting industry, with animal production contributing an additional $69 million.

Livestock statistics in the counties surrounding the proposed facility show the total number of livestock found in the eight-county region is 156,059, with Franklin County providing 40,263 (26%) of the total sum (Table C-92). The term livestock includes all hoofed animals; cattle, hogs, sheep, goats, horses, and mules. The number of poultry in the eight-county region is 1,900,459, and Vance County provides 926,000 (49%) of the total (NDP 2007a).

There were approximately 850,000 head of cattle and calves at the end of 2006 within North Carolina with an estimated inventory value of $663 million (averaging out to a unit value $780 per head within the state). The eight-county region made up for about 10% of that total with 89,100 head of cattle found within those counties (NASS 2006). Based on the state's estimated unit price, the inventory value of cattle within the eight-county region would be approximately $69.5 million.

3.10.7.1.1.3 Hunting

An analysis of the hunting industry is used to assess the importance that hunting activity has on the local economy. Data from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation are utilized to describe the depth of this industry and address public concerns about the possible impacts of the proposed facility's operations on this industry and subsequently on the local economy.

U.S. Fish and Wildlife Service data from 2006 that are limited to the statewide level shows that total expenditures related to recreational hunting activities in the state of North Carolina totaled $431 million. The data show that of the 304,000 individuals who participated in hunting activities in 2006, 234,000 were involved in big game hunting (e.g., deer) (USFWS 2006).

3.10.7.1.1.4 Income and Poverty

In 1999, the median household incomes in the study area ranged from $31,301 in Vance County to $54,988 in Wake County. Per capita incomes ranged from $15,897 in Vance County to $27,004 in Wake County.

Overall, the median household income in the study area was $50,396 and the per capita income was $25,115 (Table C-93).

Of the study area counties, Wake County had the lowest proportion of persons living below poverty in the study area, and Vance County had the highest percentage of persons living below the poverty line. The percentage of persons living below poverty in the study area was 9.9%, lower than the poverty rate in North Carolina (12.3%) and the United States (12.4%).

In 2007, the estimated median household income for the study area was $66,558, above the estimated median household incomes for North Carolina ($49,687) and the United States ($53,154). Granville County was estimated to have a per capita income of $22,353, slightly lower than in North Carolina ($26,409) and the United States ($27,916) (ESRI BIS 2007).

The Census Bureau classifies all people not living in households as living in group quarters. There are two types of group quarters: institutional (e.g., correctional facilities, nursing homes, and mental hospitals) and non-institutional (e.g., college dormitories, military barracks, group homes, missions, and shelters). Study area federal and state group quarters population data were included in the per capita income estimates; however, it was not used to determine household income estimates (USCEN 2008).

3.10.7.1.2 Population and Housing

3.10.7.1.2.1 Population

According to population growth trends in the Umstead Research Farm Site study area (Granville, Durham, Vance, and Wake Counties), the total population of the study area (all four counties) has increased by 596,423 between 1960 and 2000. Population estimates for 2007 and 2012, the most recent forecasts available, show an additional 411,821 residents are expected to be added to the study area between 2000 and 2012 (Figure 3.10.7.1.2.1-1).

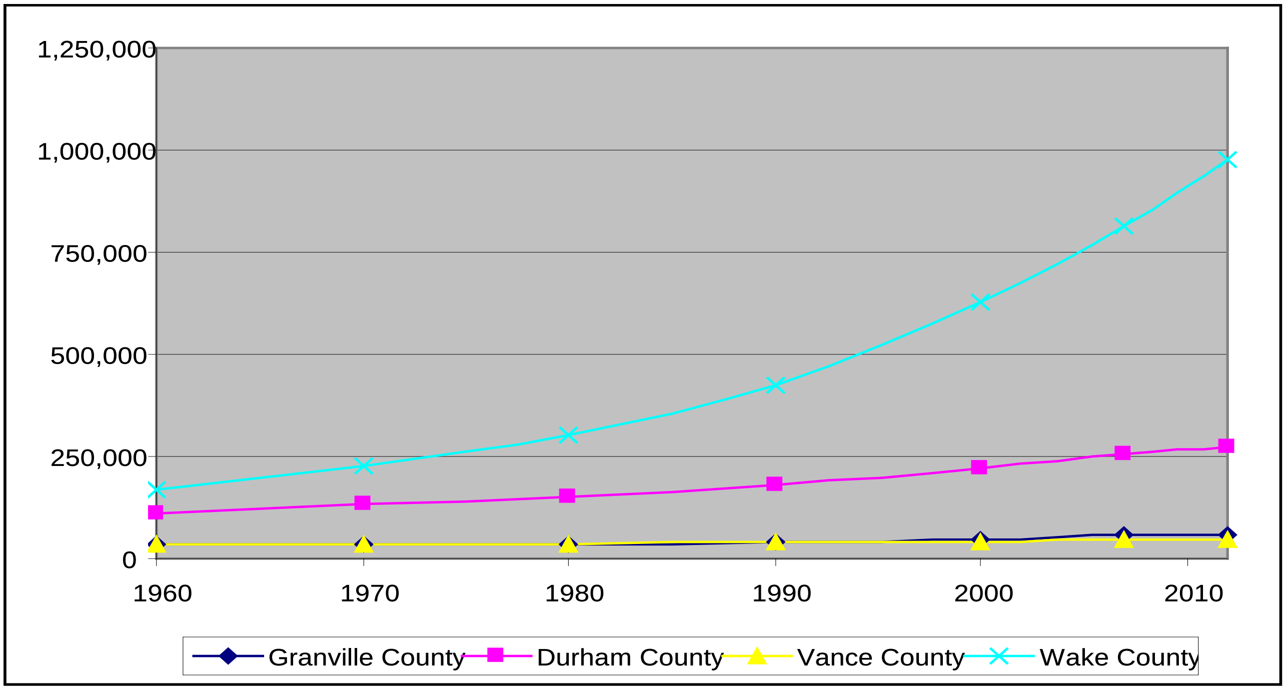
The Granville County population has increased every decade since 1960, and the population trends in Durham, Vance, and Wake Counties also experienced positive population growth between 1960 and 2000. Granville and Vance Counties have small populations relative to the Durham and Wake study area counties (U.S. Census Bureau 1960-2000).

The Town of Butner in Granville County contains the proposed site and is therefore highlighted in this socioeconomic discussion. The C.A. Dillon Youth Development Center, the Butner Federal Correctional Complex, and the John Umstead Hospital are located in the Town of Butner and are located in close proximity to the proposed site. The study area demographic profile presented in this section reflects all residential populations, including those in group quarters (e.g., correctional facilities and psychiatric hospitals) (Table C-94) (USCEN 2008).

The C.A. Dillon Youth Development Center, a state juvenile correctional facility for males 10 to 21 years of age, has 125 beds in four campus residential units located on 80 acres of land (NCDJJDR 2008). The Butner Federal Correctional Complex is comprised of three low to medium security facilities with a total population of 4,572 inmates (FBOP 2008).

The John Umstead Hospital, a state psychiatric hospital, is an inpatient facility that operates 68 beds and treats persons with psychiatric disorders. In 2008, the John Umstead Hospital will merge with local mental care centers to form the Central Regional Hospital. This new state-operated psychiatric facility will be located within approximately 1 mile of driving distance from the existing hospital, in an area located within the study area. The facility is estimated to operate 432 beds and treat the acute mental health needs of residents within the central region of the state (NCDMH 2007). The Murdoch Center, a residential care facility for persons with developmental disabilities, is located approximately 4.5 miles from the proposed site (Murdoch Center 2008).

Between 2007 and 2012, the population of the study area is expected to grow nearly two times as fast as North Carolina and the United States. Wake County, the largest and fastest growing portion of the study area, is expected to continue to grow faster than the study area as a whole between 2000 and 2012. By 2012, more than 72% of the study area population is expected to live in Wake County, up from about 63% in 1990 (ESRI BIS 2007).



Sources: 1960-2000 population: U.S. Census Bureau. 2007 and 2012 population forecasts: ESRI BIS.

Figure 3.10.7.1.2.1-1 — Population, Granville County, Durham County, Vance County, and Wake County, North Carolina, 1960-2012

3.10.7.1.2.1.1 Ethnicity and Race

In 2000, African Americans comprised the largest percentage minority group in the study area (26.5%), which was greater than in the United States (12.2%) and North Carolina (21.6%) (Table C-94). Persons of Hispanic origin comprised 5.8% of the study area population, which was less in Durham County (7.6%) and smaller in Granville County (4.0%). Overall, the proportion of minorities in the study area (36.9%) was greater than in the United States (30.1%) and North Carolina (29.8%) (Table C-95) (USCEN 2000b).

3.10.7.1.2.1.2 Age

In 2000, approximately 26.0% of the population was 18 years of age and under, and 8.4% was 65 years of age and older. Vance County had the highest proportions of its population aged 18 years and under, and Wake County had the lowest proportion of its population 65 years of age and over (Table C-96) (USCEN 2000b).

In 2007, the proportion of the Granville County population was estimated to be 18 years of age and under (24.0%), smaller than in North Carolina (24.7%) and the United States (25.8%). The proportion of the population of Granville County aged 65 years and older (11.6%) was also expected to be smaller than in North Carolina (12.2%) and the United States (12.5%) (ESRI BIS 2007).

3.10.7.1.2.1.3 Educational Attainment

In 2000, 19.75% of the population 25 years of age and older graduated from high school, 19.3% of the population graduated from high school or had some college education, 7.1% had an associate's degree, and 25.8% had a bachelor's degree or a higher level of education. Within the study area, the Town of Butner exhibited the highest proportion of residents without a high school diploma and the lowest proportion of residents with a bachelor's degree or higher. The proportion of residents without a high school diploma in the study area (14.1%) was smaller than in North Carolina (21.4%) and the United States (19.6%) (Table C-97) (USCEN 2000b).

3.10.7.1.2.2 Housing

In 2007, 92.2% of the housing inventory in the study area was estimated to be occupied, and and 7.8% were estimated to be vacant (Table C-98). The proportion of vacant units in the study area was estimated to be smaller than in North Carolina (12.1%) and the United States (9.9%).

In 2007, the Durham County was estimated to have the highest proportion of renter-occupied housing units. The percentage of owner-occupied housing units in the study area (60.0%) was estimated to be smaller than in North Carolina (62.1%) and the United States (61.3%) (Table C-98) (ESRI BIS 2007).

In 2000, the single-family detached house was the predominant form of housing in the study area, comprising 234,791 units (60.1%) in 2000 (Table C-99). The second largest structure category was apartment buildings with five to nine units. The highest proportions of mobile homes were located in Granville and Vance Counties (Table C-99) (USCEN 2000b).

Approximately one-third of the study area housing units were built before 1970. Wake County has a larger proportion of housing units that were built in 1980 to 2000 (62.7%) than the three other counties in the study area. In the study area as a whole, 130,459 housing units (33.4%) have been built since 1990 (USCEN 2000b).

New housing growth has primarily occurred in the areas on the periphery of the historic population centers of Raleigh in Wake County and the City of Durham in Durham County (Figure 3.10.7.1.2.2-1). A majority of census block groups (subdivisions of counties) in these areas have a median housing age of 1979 to 1999, indicating that more than one-half of the housing units in these areas were built in the last 20 to 30 years. In 2000, many areas to the north of Wake and Durham Counties, including Granville County, had a median housing age of 1979 to 1988.

Between 2000 and 2007, housing values in the study area were estimated to grow the fastest in Vance and Granville Counties. In 2007, Wake County was estimated to have the highest median housing value ($215,260), and Vance County was estimated to have the lowest median housing value ($106,552). In 2007, the median housing value for Granville County was estimated to reach $132,152, below the estimated values for North Carolina ($139,312) and the United States ($192,285) (Table C-100) (USCEN 2000b; ESRI BIS 2007).

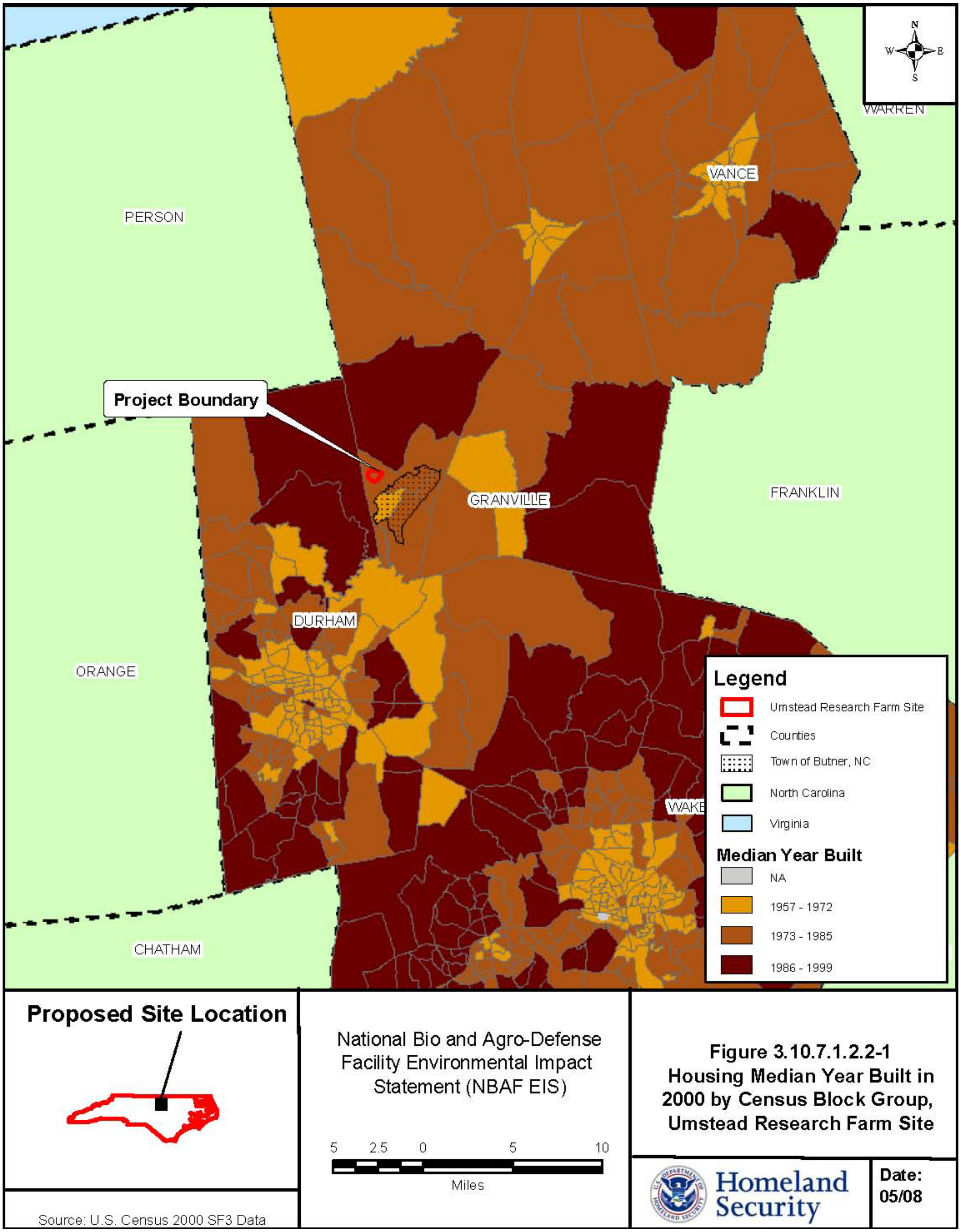


Figure 3.10.7.1.2.2-1 — Housing Median Year Built in 2000 by Census Block Group, Durham County, Granville County, Vance County, and Wake County, North Carolina

In 2007, the largest proportion of housing units with estimated values less than $50,000 was in Vance County with 2,162 units. Wake County was estimated to have the largest proportion of housing units valued over $150,000. Overall, the proportion of housing units with estimated values over $150,000 in the study area (68.7%) was larger than in North Carolina (44.8%) and the United States (61.7%) (Table C-101) (ESRI BIS 2007).

Between 1990 and 2000, median monthly rent in the study area grew the fastest in the Town of Butner and Granville County. In 2000, Wake County had the highest median rent, and Vance County had the lowest median rent. The 2000 median rent in Granville County ($352) was lower than the median rents for North Carolina ($431) and the United States ($519) (Table C-102) (USCEN 2000b).

In 2000, Vance County had the largest proportion of housing units with a rent less than $200, and Wake County had the largest proportion of housing units with rents over $1,000. Overall, the majority of the housing units in the study area had rents ranging between $200 and $749 (71.3%). The proportion of housing units with rents over $1,000 in the study area (5.7%) was greater than in North Carolina (2.9%) and smaller than in the United States (8.4%) (Table C-103) (USCEN 2000b).

In 2005, the majority of housing units permitted were located in Durham County. The least expensive housing units in the study area are being constructed in Vance County, and the most expensive housing units are being constructed in Wake County (Table C-104) (USCEN 2006).

3.10.7.1.3 Quality of Life (Community Services)

Quality of life encompasses those attributes of resources (man-made or natural occurring) of a region that contribute to the well-being of its residents. The relative importance of these attributes to a person's well-being is subjective. NEPA quality-of-life analyses typically address issues relating to potential impacts of the NBAF on the availability of public services that contribute to quality of life. For the purposes of this study, the quality of life of the affected environment includes public schools, law enforcement, fire protection services, medical facilities, and recreation facilities.

3.10.7.1.3.1 Public Schools

The Umstead Research Farm Site in the Town of Butner is served by the Granville County School District. Granville County School District has eight elementary schools, three middle schools, one intermediate school, and six high schools that serve approximately 8,500 students. The student-to-teacher ratio for this district is 16.8 to 1 (GCSD 2008).

In addition, in the study area, Durham County Public School System serves over 32,000 students with 28 elementary schools, 9 middle schools, 10 high schools, and 2 alternative schools. The average student-to-teacher ratio in Durham County is 24.5 to 1 within public schools (DCPSS 2008). Seven charter schools serve approximately 2,000 Durham County students of varying ages. Vance and Wake Counties have a combined total of 106 elementary schools, 32 middle schools, and 26 high schools with an approximate total student enrollment of 142,000 (NCSBE 2008).

The study area is home to several public and private universities of higher education, including North Carolina State University in Wake County, Duke University, and North Carolina Central University in Durham County.

3.10.7.1.3.2 Law Enforcement

Butner Public Safety is the police authority in the proposed site area, the Town of Butner. Butner Public Safety has 43 sworn officers. They serve all citizens within the territorial jurisdiction including those living in group quarters (e.g., correctional facilities and psychiatric hospitals). Butner Public Safety's director reports to the chief deputy secretary of the Department of Crime Control and Public Safety. All officers must be certified in Basic Law Enforcement. They must also have extensive knowledge of the policies, procedures, jurisdictional authority, and special populations of the 25 different federal, state, and local agencies that have facilities in Butner. Butner Public Safety has 25 police vehicles. Surrounding cities and counties provide mutual aide, if necessary (BPSD 2006). The study area is also served by the Granville County Sheriff's Department, the Durham County Police Department and Sheriff's Office, the Wake County Sheriff's Office, and the Vance County Sheriff's Office.

3.10.7.1.3.3 Fire Protection

Granville County Fire Services provides fire protection to the study area with 14 incorporated fire departments, such as Butner Public Safety, which provides fire fighting, fire training, and fire-prevention programs to the proposed site area in Butner (Granville County Fire Services 2007). All law enforcement officers must also be trained as Level I Firefighters. To maintain safety, Butner Public Safety has two class-A pumpers, one 95-foot ladder truck, one 2,000-gallon tanker, and one skid unit brush truck (Butner Public Safety Division 2004). Butner Public Safety officers regularly conduct drills and inspections in Butner's institutions, industries, and local businesses. Fire fighters also teach local children about fire safety through school presentations and community safety days. Butner Public Safety is responsible for providing secure transport of patients from N.C. Memorial Hospital to institutions in Butner. Approximately 400 transports are conducted annually (NCDCCPS 2007).

Fire protection services are also provided to the study area by approximately 25 departments located throughout Durham, Wake, and Vance Counties.

3.10.7.1.3.4 Medical Facilities

The proposed Umstead Research Farm Site is served by the Granville Medical Center. The center provides inpatient acute care, long-term residential care, obstetrical services, 24-hour emergency care, and outpatient, surgical, mental health, and diagnostic services to the Granville County community. The center operates five facilities: the 62-bed Granville Medical Center, 80-bed Brantwood Nursing Center, Harold Sherman Adult Day Center, Granville Surgical Associates, and South Granville Medical Center, which includes the Community Immediate Care Center, South Granville Specialty Clinic, and Best Care Pharmacy (GMC 2007). In addition, Butner is served by the John Umstead Hospital in Butner. The John Umstead Hospital's primary purpose is to provide an inpatient facility to diagnose and treat persons with psychiatric disorders, to restore them to an optimal level of functioning, and to return them to the community. The facility operates with 68 beds, 34 physicians, and 61 nurses (NCDMH 2007).

The proposed site is also served by the University of North Carolina Health Care System (UNC Health Care), the Duke University Medical Center, and the Durham Regional Hospital. UNC Health Care is comprised of the North Carolina Children's Hospital, the North Carolina Memorial Hospital, the North Carolina Neurosciences Hospital, and the North Carolina Women's Hospital (UNC HC 2008). The 708-bed facility treats over 31,000 patients each year. The Duke Medical Center occupies 90 buildings on 210 acres with 924 beds (DUSM 2008), and the Durham Regional Hospital operates with 369 beds and an over 500 physician medical staff (DRH 2008).

Also in the study area, Vance and Wake Counties are served by the Maria Parham Hospital, Southern Wake Hospital, Central Prison Hospital, Dorothea Dix Hospital, Duke Health Raleigh Hospital, Holly Hill Hospital, Rex Hospital, Wake Medical Center, and the Murdoch Center. The Murdoch Center provides comprehensive 24-hour care for residential persons with severe to moderate mental retardation or a related developmental disability. The center currently serves approximately 550 citizens from 18 counties in the state's Central Region with a staff of 1,720 employees (Murdoch Center 2008).

3.10.7.1.3.5 Recreation

Granville County has nine museums, four historic sites, and several areas for shopping and fine dining. The RBC Center and the Alltel Pavilion feature sporting events and concerts by leading musicians throughout the year. Granville Athletic Park offers baseball and softball facilities and a safe space for walking, playing, and picnicking. Granville County also has many lakes, rivers, and parks, such as Kerr Lake and Tar River, which offer recreational activities that span the study area and include fishing, camping, boating, skiing, sailing, wind surfing, nature walking, bird watching, golfing, and canoeing (GCCC 2008).

The study area has numerous colleges and universities that offer educational and recreational activities, such as collegiate sporting events. The Atlantic Coast Conference basketball program is top ranked in the country, and the Carolina Hurricanes hockey team and the Durham Bulls baseball team provide entertainment throughout the study area. Additionally, study area cities such as Raleigh, Chapel Hill, and Durham offer a wide range of cultural and entertainment activities (GCCC 2008).

3.10.7.2 Construction Consequences

3.10.7.2.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the 4-yr construction phase. Economic impacts would result from regional material purchases generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment.

The economic benefits of construction impacts would be temporary and would diminish as the construction reaches completion. Direct employment (jobs at the facility in Table 3.10.7.2.1-1) refers to the jobs associated with actual construction of the facility, while total employment refers to all other employment generated as a result of the multiplier effect on the initial investment in construction of the facility. The industries that contribute to this other employment include architectural and engineering services, food services and drink establishments, food and beverage stores, and general merchandise stores.

Based on the results of the impact analysis for the 4-year construction phase (Table 3.10.7.2.1-1), the construction of the proposed facility would directly support 2,447 person-yrs (612 jobs annually) of employment with an associated total employment level of 3,693 person-yrs (923 jobs annually). The effects of this work are expected to be short term and would only last for the duration of the construction work.

Table 3.10.7.2.1-1 — Short-Term Economic Impacts

Construction	
Jobs at the Facility (jobs)	2,447
Impacts	
Total Employment (jobs)	3,693
Total Labor Income Impact ($ millions)	162.1
Federal, State, and Local Tax ($ millions)	51.5
State and Local Tax ($ millions)	16.2

Note: In 2007 dollars.

In terms of income, minor short-term benefits would be expected. Labor income for any given region is defined as the sum of labor compensation and proprietor income generated within the regional boundaries[14]. The estimated labor income generated during the construction phase is estimated at $162.1 million ($40.5 million annually) measured in 2007 dollars. The total labor income effect of this project would

[14] Proprietor income consists of payments received by self-employed individuals as income.

correspond to 0.1% of all estimated 2006 labor income in the four-county region expressed in 2007 dollars or 3.7% of the total estimated labor income in Granville County.

The construction phase would generate additional taxes estimated at $51.5 million (Table 3.10.7.2.1-1), of which $16.2 million is estimated to be collected through state and local taxes that should flow to the local governments.

3.10.7.2.2 Population and Housing

3.10.7.2.2.1 Population

The majority of the construction workers would be drawn from the study area or would commute from the surrounding counties. Therefore, construction-related employment generated by the NBAF would not be expected to result in an increase in the study area population. Any population change during construction would be temporary and would involve a small percentage of the total construction-period employment. Construction impacts on population and housing would be very similar to those previously described in Section 3.10.3.2.2.

3.10.7.2.2.2 Housing

As described above, the construction of the NBAF is not expected to increase the population of the study area. Therefore, no effects on housing availability or prices would occur.

3.10.7.2.3 Quality of Life (Community Services)

Construction impacts on quality-of-life attributes would be very similar to those described in Section 3.10.3.2.3. The construction project would pose no additional health or safety risks to the public because the construction site would be closed off to public access at all times.

3.10.7.3 Operations Consequences

3.10.7.3.1 Employment and Income

The proposed facility would also stimulate the regional economy during the operations and maintenance phase, which is expected to commence in the year 2014. Economic impacts would result from purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the continual operations of the facility (Table 3.10.7.3.1-1).

Table 3.10.7.3.1-1 — Long-Term Annual Economic Impacts

Operations	
Jobs at the Facility (jobs)	326 [a]
Impacts	
Total Employment (jobs)	493
Total Labor Income Impact ($ millions)	29.4
Federal, State, and Local Tax ($ millions)	4.0
State and Local Tax ($ millions)	1.9

Note: In 2007 dollars.
[a] Actual jobs would range from 250 to 350; 326 was used for cost estimating purposes and the basis for the economic analysis.

Operation of this proposed facility would commence in 2014 and would require 145 operations, maintenance, and security staff and an additional 181 scientific and support staff. The operations and maintenance of the proposed facility would generate a total of 493 jobs including the initial 326 direct jobs required for operations and maintenance (see footnote in Table 3.10.7.3.1-1 regarding actual NBAF employment figures) (NDP 2007a).

The estimated income generated during the operations phase is estimated at $29.4 million annually in 2007 dollars. This corresponds to 0.1% of all estimated 2006 labor income in the four-county region expressed in 2007 dollars or 2.7% of total labor income in Granville County.

3.10.7.3.2 Population and Housing

3.10.7.3.2.1 Population

The NBAF would directly employ 326 people. The majority of these employees would be research scientists and other specialized staff, and based on census journey-to-work data, 263 are expected to relocate to the study area from elsewhere in the country. Assuming the U.S. Census Bureau 2006 average household size of 2.61 persons, this would represent a population increase of 686.

In addition, the economic activity associated with the operation of the NBAF would be expected to employ 167 persons. The industries that would contribute to this indirect employment include those in non-specialized areas such as food services and drink establishments and wholesale, trade among others. It is assumed that these employment opportunities would be filled by the local labor force and that the relocation of workers to the study area due to the generation of these jobs will be negligible.

In total, the population of the study area is expected to increase by 686 as a result of the operation of the NBAF. This population increase would be a very small portion of the overall expected population growth within the study area between 2007 and 2012 (188,278 based on historic trends), which is expected to result in a total study area population of 1,355,470 in 2012.

3.10.7.3.2.2 Housing

As described above, 686 additional persons would locate to the study area as a result of the NBAF. The average salary including benefits of the 326 employees employed directly at the NBAF would be $82,622. For comparative purposes, this figure has been adjusted to an average per capita income of $66,924 for employees employed directly at the NBAF, which would be higher than the estimated median 2007 study area per capita income ($26,299). Over 80 NBAF research scientists and managers would earn over $125,000 annually. The estimated median value of owner-occupied housing units in the study area is $157,715 (Table C-100). Taking into account families with two incomes, the available study area housing stock would be affordable to the majority of the people relocating to the region.

The housing market would be able to meet the increase in housing demand (326 employees in total), relative to the expected growth of the existing population between 2007 and 2012 (188,278). It is possible that with the relocation of highly skilled workers to the immediate area, property values could increase due to an increase in demand, and there is no empirical evidence that a facility such as the NBAF would reduce property values in the study area. Therefore, the overall effect of the NBAF on housing market conditions would be negligible.

3.10.7.3.3 Quality of Life (Community Services)

Due to the small percentage of the overall population growth that would be attributed to the facility, the NBAF would have a negligible effect on the availability of public services. The study area population growth attributed to the NBAF would be 0.4% of the overall expected population growth from 2007 to 2012.

3.10.7.3.3.1 Public Schools

The NBAF would add approximately 142 school-aged children to the study area or a 0.1% increase in the 2006/2007 182,500 public school enrollment in the study area public school districts (North Carolina State Board of Education 2007). The 0.1% increase in school-aged children attributed to the NBAF would place minimal demand on the schools.

School districts in the study area have invested in educational facilities to meet the needs of the growing population of the region. For example, the Durham County Public School System plans to invest over $550 million in school capacity needs over the next decade, and the Wake County Public School System will add 33 new schools to their district between 2007 and 2012 (DCPSS 2007; WCPS 2008).

3.10.7.3.3.2 Law Enforcement

The population increase associated with the NBAF (686), relative to the expected growth of the existing population between 2007 and 2012 (188,278), would result in a negligible increase in the need for additional law enforcement services.

3.10.7.3.3.3 Fire Protection

The population increase associated with the NBAF (686), relative to the expected growth of the existing population between 2007 and 2012 (188,278), would result in a negligible increase in the need for additional fire protection services.

3.10.7.3.3.4 Medical Facilities

The additional population associated with the NBAF (686), relative to the expected growth of the existing population between 2007 and 2012 (188,278), would result in a negligible increase in the demand for medical services and facilities.

Due to the overall population growth in the region, medical facilities in the study area are responding to meet the increasing demand. For example, the Duke University Medical Hospital is adding a 56,000 square feet to its facility for 11 operating rooms, family waiting rooms, and patient intake and preparatory areas (DUSM 2008). Durham Regional Hospital is renovating its Intensive Care and Coronary Care Units and adding a 22-bed state-of-the-art intensive care unit in 2008 (DRH 2008). Also, in early 2008, the John Umstead Hospital will merge with the Dorothea Dix Hospital to form the Central Regional Hospital with 432 beds and 1,100 employees to the serve acute mental health needs for more than 3 million people in the central region of the state (DDH 2008).

3.10.7.3.3.5 Recreation

Recreational resources would not experience a significant increase in utilization rates as a result of the population increase associated with the NBAF. As detailed in above, the study area has abundant recreation resources available.

3.10.7.3.3.6 Health and Safety

The normal operation of the NBAF would pose no additional health or safety risks to the public because the facility would be closed off to public access at all times. Site-specific protocols would be developed in response to any appropriate local incident or pending adverse weather condition potentially affecting the NBAF, in coordination with local emergency response agencies that would consider the diversity and density of human, livestock, and wildlife populations residing within the local area. The response plans would have site-specific standard operating procedures and response plans in place prior to the initiation of research activities at the proposed the NBAF. Procedures and plans to operate the NBAF will include community representatives as described in Section 2.2.2.6 of the NBAF EIS. Further analysis with regard to health and safety during abnormal operation of the proposed facility are in Section 3.14 (Health and Safety).

3.10.8 Texas Research Park Site

3.10.8.1 Affected Environment

The Texas Research Park in the western portion of Bexar County, Texas, has been proposed as the location site for the facility, and the geographic definition of the affected environment for this location was determined primarily based on a journey-to-work analysis. Any county that constituted approximately 5% or more of the worker flows into or out of the two census tracts most closely associated with the proposed site on Omicron Drive (U.S. Census tracts 1720.01 and 1720.02 in Bexar, TX) was considered to comprise the affected environment for the proposed site, and this included Bexar and Medina Counties (USCEN 2000a; USCEN 2000c).

The expanded area of study to be used for the agricultural livestock vulnerability analysis discussion in Appendix D added Atascosa, Bandera, Comal, Guadalupe, Kendall, and Wilson Counties to the original economically described affected area (Figure 3.10.8.1-1).

3.10.8.1.1 Employment and Income

3.10.8.1.1.1 Employment

In general, the civilian labor force for both Bexar and Medina counties has grown from 573,746 in 1990 to 761,326 in 2006, an increase of 32.7%, tracking the trend in Texas that has seen its civilian labor force grow at a rate of 33.7% over the same time period.

The unemployment rate in both counties dropped between 1990 and 2000, but then subsequently rose again between 2000 and 2006 (Table C-105). This movement in the unemployment rate was similar to that of Texas over the same time period, with the combined unemployment rate for the two counties remaining slightly lower than the state's rate in 2000 and 2006.

Bexar County is the center of the San Antonio MSA, and according to Census Bureau's County-to-County Worker Flow data, it attracts at least 30% of the workers from each of the other seven counties that constitute the San Antonio MSA[15]. Of the two counties studied in detail, approximately 96% of Bexar County workers are employed within the county, while 42% of Medina County's labor force commutes to Bexar County for work (Table C-106).

Employment can be measured as either a count of workers (e.g., see Table C-105) or as a count of actual jobs. The following employment-based-analysis in this section uses the count of actual jobs in ascertaining the relative importance and proportion of various industrial sectors present in the study area (Tables C-107 and C-108).

Bexar County is home to 915,500 jobs while Medina County holds 14,944 jobs (Table C-108). Bexar County appears to be a center of employment for the region, and this is due to the influence that the City of San Antonio has on the surrounding regions and the fact that it is located in Bexar County (Table C-106).

Government and government enterprises are the largest sources of employment in terms of number of jobs for both Bexar and Medina Counties; they comprise approximately 17% of the total jobs in both counties combined. Although government is the primary employer in both counties, the other leading industries in

[15] San Antonio MSA comprises the following counties: Atascosa, Bandera, Bexar, Comal, Guadalupe, Kendall, Medina, and Wilson.

each county differ quite a bit with the exception of the retail trade industry. Bexar County's greater degree of urbanization explains its larger proportion of service industry employment, while Medina's lower population density explains its larger proportion of farm employment (Tables C-107 and C-108).

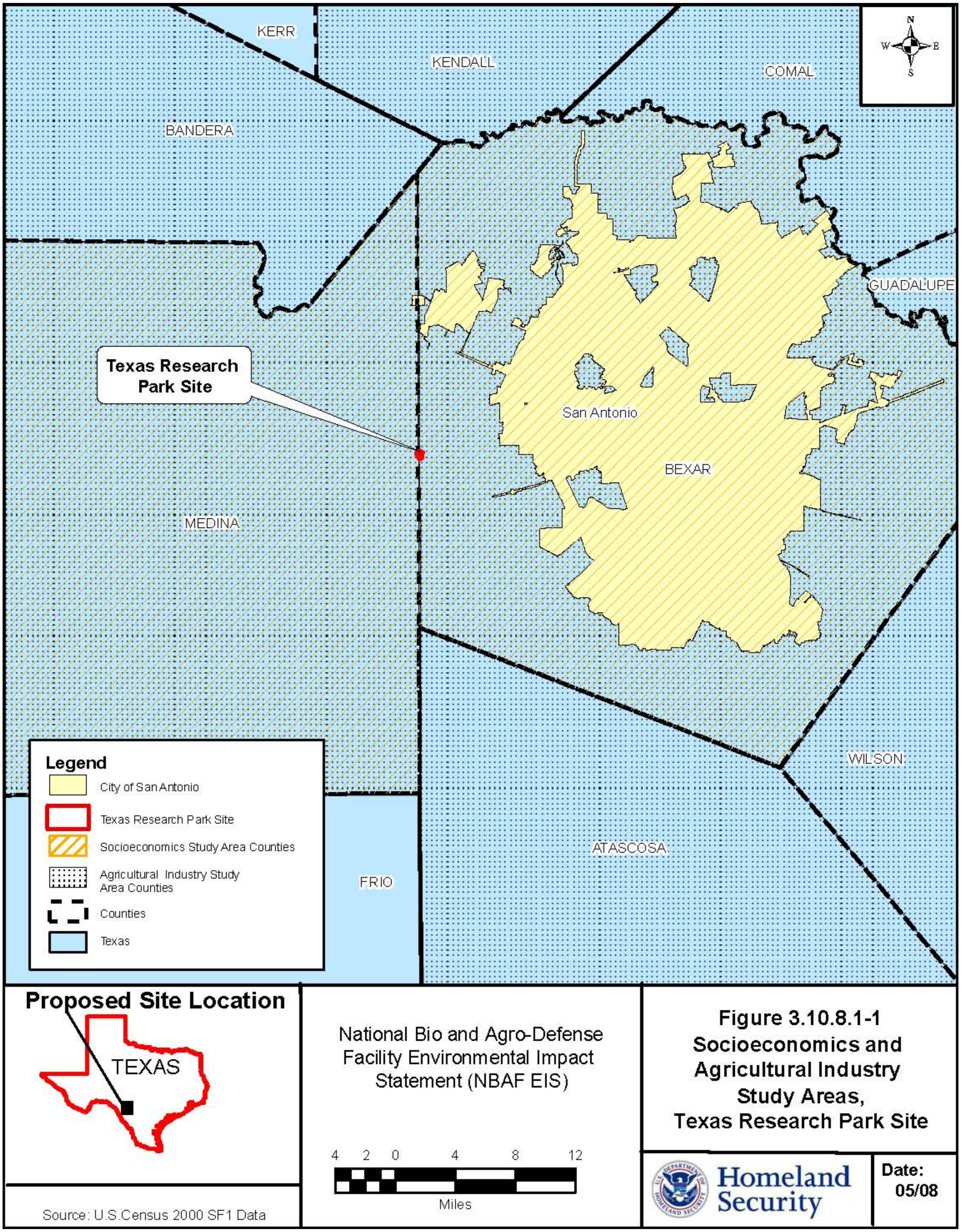


Figure 3.10.8.1-1 — Socioeconomics and Agricultural Industry Study Areas, Texas Research Park Site

The City of San Antonio acts as a center of employment in the region, and some of the major employers located in the Greater San Antonio Area are presented in Table C-109. The top three employers—H.E.B. Food Stores (14,588 workers), United Service Automobile Association (14,258), and AT&T (6,500)—are all major corporations headquartered in San Antonio, while Wachovia (3,200) and Citibank (3,000) both maintain regional/divisional offices in the city. Three of the top manufacturing firms include Cardell Kitchen and Bath Cabinetry (2,493 workers), Toyota Motors Manufacturing (2,000), and Kinetic Concepts, Inc. (1,800).

Government and government enterprises are the largest sources of employment in terms of total wages paid for both Bexar and Medina Counties; it comprises approximately 27% of the total wages in both counties combined, paying out approximately $9.5 billion in wages. In Medina County, government and government enterprises are even more prominent as a percentage of total wages where it makes up over 40% of total wages paid in the county. Bexar County's greater degree of urbanization explains its apparent larger proportion of service industry employment (Tables C-110 and C-111).

3.10.8.1.1.2 Agricultural Industry

For the purposes of this analysis, an expanded area of study comprising all counties adjacent to the proposed site was defined for the agricultural livestock discussion. The relative importance of the agricultural industry was assessed in the following counties: Bexar, Medina, Atascosa, Bandera, Comal, Guadalupe, Kendall, and Wilson.

Agriculture directly generated an estimated 14,094 jobs in the eight counties studied in 2006 (Table C-112), with Wilson County contributing 2,339 jobs towards that total. Animal production makes up 7,482 of the 14,094 jobs directly supported by the agricultural industry, with cattle ranching and farming providing approximately three-quarters of those jobs in the eight-county region (5,441 jobs). The NAICS code classified agriculture and hunting industries make up 1.4% of all the jobs in the eight-county region, although that percentage varies quite a bit in each individual county. In Bexar, the most urban of the eight, agriculture comprises less than 1% of total industry employment, while in Wilson the figure is 22%.

Industry output from the agriculture and hunting industry in the eight-county region is estimated at just over $600 million (Table C-112). Industry output can be measured by the total value of purchases made by intermediate and final consumers of that industry's production. Animal production generated $284 million towards the total output of the agriculture and hunting industry with crop production and other agricultural support activities contributing an additional $292 million. Cattle ranching and farming in the eight-county region accounted for approximately $245 million (41%) of total output in the agriculture and hunting industry, making it the most valuable component of the overall industry.

Livestock statistics in the counties surrounding the proposed facility show the total number of livestock found in the six-county region is 459,889 with Wilson County providing 94,654 (21%) of the total (Table C-113). The term livestock includes cattle, hogs, sheep, goats, horses, and mules. The number of poultry in the six-county region is 6,411,379, and Guadalupe County provides 3,626,597 (57%) of the total (NDP 2007a).

There were approximately 14,000,000 head of cattle and calves at the end of 2006 within Texas, with an estimated inventory value of $11.1 billion (averaging out to a unit value $790 per head within the state). The eight-county region made up only 2.8% of that total with 397,000 head of cattle found within those counties (NASS 2006). Based on the state's estimated unit price, the inventory value of cattle within the eight-county region would be approximately $313.6 million.

3.10.8.1.1.3 Hunting

An analysis of the hunting industry is used to assess the importance that hunting activity has on the local economy. Data from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation are utilized to describe the depth of this industry and address public concerns about the possible impacts of the proposed facility's operations on this industry and subsequently on the local economy.

U.S. Fish and Wildlife Service data from 2006 that are limited to the statewide level shows that total expenditures related to recreational hunting activities in the state of Texas totaled $2.2 billion. The data show that of the 1.1 million individuals who participated in hunting activities in 2006, 890,000 were involved in big game hunting (e.g., deer) (USFWS 2006).

3.10.8.1.1.4 Income and Poverty

In 1999, median household incomes ranged from $36,063 in Medina County to $38,358 in Bexar County. The per capita incomes were also similar throughout the study area and were lowest in Medina County ($15,210). The median household income in the study area was $38,277 and the per capita income $18,276.

Of the study area counties, Medina County had the lowest proportion of persons living below the poverty level. Overall, the percentage of persons living below poverty in the study area was 15.9%, which was higher than the poverty rate in Texas (14.0%) and the United States (12.4%) (Table C-114) (USCEN 2000a).

In 2007, the estimated median household income for the study area was $46,993, lower than the estimated median household incomes for Texas ($51,090) and the United States ($53,154). Bexar County was estimated to have a per capita income of $23,134, lower than in Texas ($25,413) and the United States ($27,916) (ESRI BIS 2007).

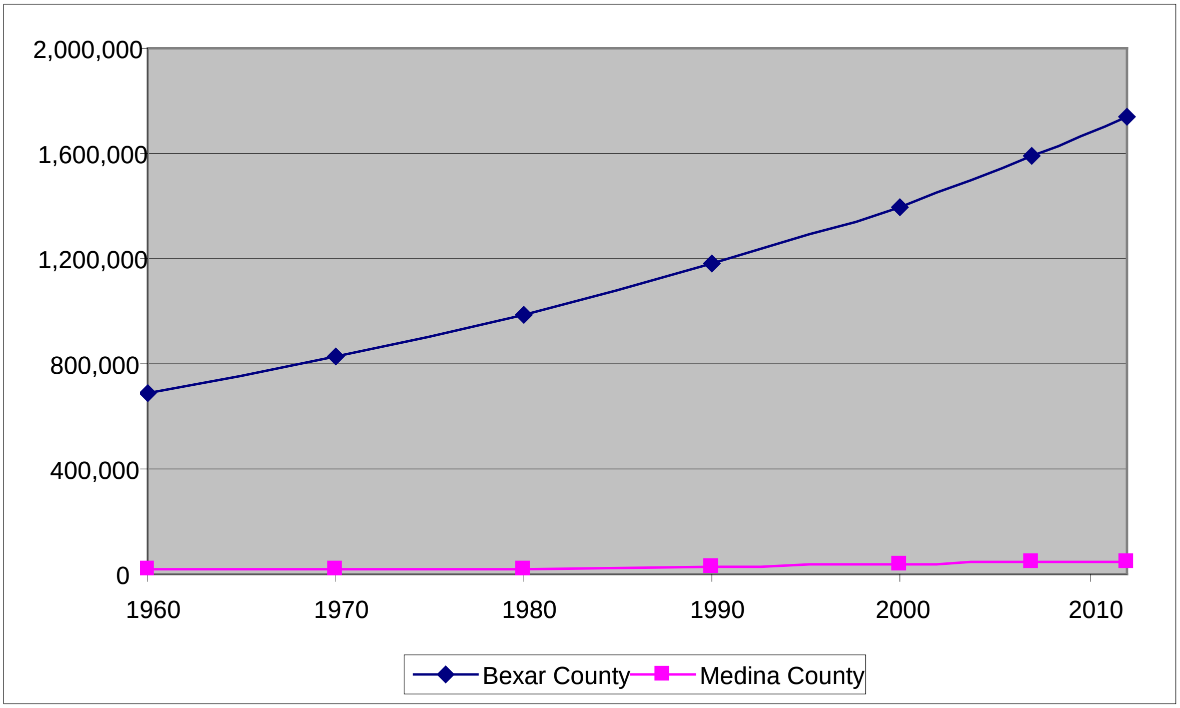
3.10.8.1.2 Population and Housing

3.10.8.1.2.1 Population

According to population growth trends for the Texas Research Park Site study area counties (Bexar and Medina Counties), the total population of the study area has increased by 726,180 between 1960 and 2000. Population estimates for 2007 and 2012, the most recent forecasts available, show an additional 351,463 residents are expected to be added to the study area between 2000 and 2012 (Figure 3.10.8.1.2.1-1) (Table C-115) (USCEN 2000b; ESRI BIS 2007).

From 1960 to 2000, the population of Bexar and Medina Counties increased every decade. Between 1990 and 2000, Medina County grew substantially faster than the historical trend reaching a total population of 39,304 in 2000 (USCEN 2000b). San Antonio (in Bexar County) is the specific location of the project, and therefore it is included in this socioeconomic discussion.

Between 2007 and 2012, the population of the study area is expected to grow at a slightly slower rate than Texas and faster than the United States. San Antonio's share of Bexar County's total population is expected to decrease from 82.2% in 2000 to 78.3% in 2012. Over 97% of the population of the study area lives in Bexar County, and this percentage is not expected to noticeably change through 2012.



Sources: 1960-2000 population: U.S. Census Bureau. 2007 and 2012 population forecasts: ESRI BIS.

Figure 3.10.8.1.2.1-1 — Population, Bexar County and Medina County, Texas, 1960-2012

3.10.8.1.2.1.1 Ethnicity and Race

In 2000, persons of Hispanic origin comprised over 50% of the population of the City of San Antonio, Bexar County, and the study area as whole, which was higher than in Texas (32.0%) and the United States (12.5%). The proportion of African Americans in the study area (7.0%) was smaller than in Texas (11.7%) and the United States (12.2%), and approximately 21.3% of the population of the study area identified themselves as "some other race alone" or "two or more races." There was a 64.0% minority population in the study area, which was substantially larger than in Texas (47.6%) and the United States (30.1%) (Table C-116) (USCEN 2000b).

3.10.8.1.2.1.2 Age

In 2000, approximately 30.1% of the study area population was 18 years of age and under, and 10.4% was aged 65 years and over. The proportions of the study area's county and city populations aged 18 years and under did not show significant variation, and the proportion of the population aged 65 years and older was slightly greater in Medina County (Table C-117).

In 2007, 28.7% of the San Antonio population was estimated to be 18 years of age and under, slightly greater than in Texas (28.4%) and the United States (25.8%). The proportion of the population of San Antonio aged 65 years and older (10.2%) was estimated to be slightly greater than in Texas (9.9%) and smaller than in the United States (12.5%) (ESRI BIS 2007).

3.10.8.1.2.1.3 Educational Attainment

In 2000, 24.0% of the study area population did not graduate from high school, 48.1% of the population graduated from high school or had some college education, 5.9% had an associate's degree, and 22.1% had a bachelor's degree or higher level of education (Table C-118). Bexar County had a greater proportion of residents with bachelor's degree or higher level of education and a smaller proportion of residents that did not complete high school compared to Medina County. The proportion of residents that did not graduate from high school in the study area (24.0%) was smaller than in Texas (24.4%) and greater than in the United States (19.6%) (USCEN 2000b).

3.10.8.1.2.2 Housing

In 2007, 92.6% of the housing inventory in the study area was estimated to be occupied, and 7.4% were estimated to be vacant (Table C-119). The proportion of vacant units in the study area was estimated to be smaller than in Texas (10.2%) and the United States (9.9%).

In 2007, San Antonio and Bexar County were estimated to have the highest proportions of renter-occupied housing units in the study area. The percentage of owner-occupied housing units estimated in the study area (58.9%) was smaller than in Texas (59.1%) and the United States (61.3%) (ESRI BIS 2007).

In 2000, the single-family detached house was the predominant form of housing in the study area, comprising 352,325 units (65.7%). The majority of housing units in buildings with over 10 units were located in San Antonio, and the largest proportion of mobile homes occurred in Medina County (Table C-120) (USCEN 2000b).

In 2000, over one-third of the study area housing units were built before 1970. Medina County had a greater proportion of housing units built in the 1990 to 2000 time period than Bexar County, reflecting the higher rate of population and household growth in Medina County compared to Bexar County between the 1990 and 2000 censuses. In the study area as a whole, 100,284 housing units (18.7%) have been built since 1990 (Figure 3.10.8.1.2.2-1) (USCEN 2000b).

New housing growth has primarily occurred in the areas on the periphery of the historic population center of San Antonio. Many areas to the north of San Antonio surrounding Camp Bullis and Camp Stanley have a median housing age of 1988 to 1998, indicating that more than one-half of the housing units in these areas were built in the last 10 to 20 years.

Between 2000 and 2007, housing values in the study area were estimated to grow the fastest in Medina County. In 2007, Bexar County was estimated to have had the highest median housing value ($105,637), and Medina County was estimated to have the lowest median housing value ($97,372). In 2007, the median housing value for the City of San Antonio was estimated to reach $97,712, lower than the estimated values for Texas ($110,551) and the United States ($192,285) (Table C-121) (USCEN 2000b; ESRI BIS 2007).

In 2007, over one-half of the housing units in the study area were estimated to be valued between $50,000 and $150,000. Medina County had the largest proportion of housing units with estimated values less than $50,000, and Bexar County had the largest estimated proportion of housing units valued at over $150,000. Overall, the proportion of housing units valued at over $150,000 in the study area (28.8%) was estimated to be smaller than in Texas (32.7%) and the United States (61.7%) (Table C-122) (ESRI BIS 2007).

Between 1990 and 2000, median monthly rent in the study area grew the fastest in Medina County. In 2000, Bexar County had the highest median rent, and Medina County had the lowest median rent. The 2000 median rent in Bexar County ($479) was lower than the median rents in Texas ($490) and the United States ($519) (Table C-123) (USCEN 2000b).

Overall, 79.6% of the housing units in the study area paid monthly rents between $200 and $749. Medina County had the largest proportion of housing units with a rent less than $200, and Bexar County had the largest proportion of housing units with rents over $1,000. Overall, the proportion of housing units with rents over $1,000 in the study area (3.9%) was lower than in Texas (4.6%) and the United States (8.4%) (Table C-124) (USCEN 2000b).

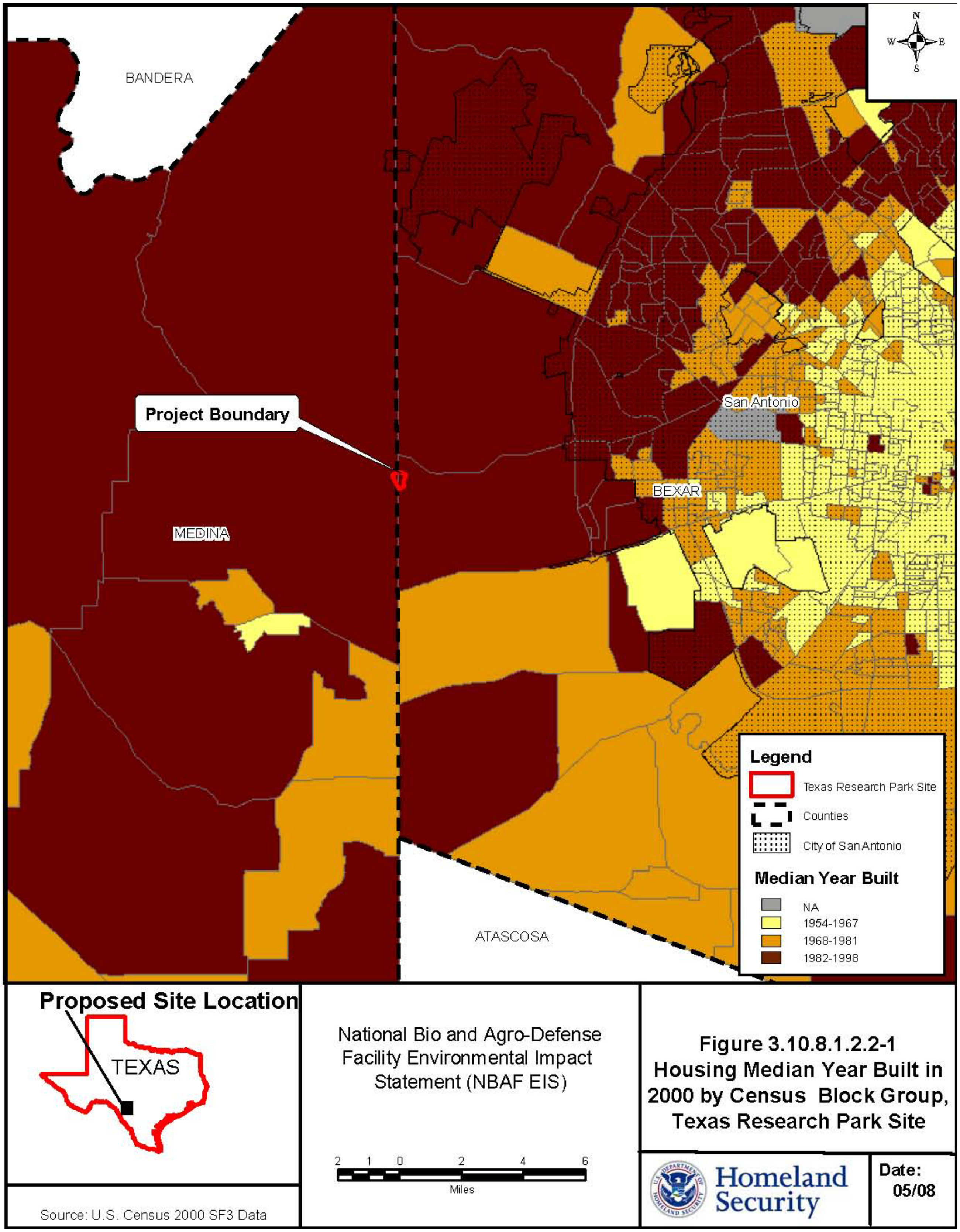


Figure 3.10.8.1.2.2-1 — Housing Median Year Built in 2000 by Census Block Group, Bexar County and Medina County, Texas

The majority of housing units permitted, as reported by the Census Bureau for 2005, were located in Bexar County. The least expensive housing units in the study area are being constructed in Medina County, and the most expensive housing units are being constructed in Bexar County (Table C-125) (USCEN 2000b).

3.10.8.1.3 Quality of Life (Community Services)

Quality of life encompasses those attributes of resources (man-made or natural occurring) of a region that contribute to the well-being of its residents. The relative importance of these attributes to a person's well-being is subjective. NEPA quality-of-life analyses typically address issues relating to potential impacts of the NBAF on the availability of public services that contribute to quality of life. For the purposes of this study, the quality of life of the affected environment includes public schools, law enforcement, fire protection services, medical facilities, and recreation facilities.

3.10.8.1.3.1 Public Schools

The proposed Texas Research Park Site is located on the border between the Northside Independent School District (ISD) in Bexar County and the Medina Valley ISD in Medina County. The 2006-2007 enrolment for Northside ISD was 81,861 students and 3,059 students for Medina Valley ISD (TEA 2007).

In addition, San Antonio has 39 other school districts. In total, 281,924 students attend 700 primary and secondary schools in which 420 are public and 109 are private. The average student body population is 460 students in elementary schools, 520 students in middle schools, and 649 students in high schools. The average student-to-teacher ratio in San Antonio is 13 to 1 within public schools and 10 to 1 within private schools. Also in the study area, Bexar and Medina Counties have a combined total of 45 school districts with a total student enrollment of 296,318 (TEA 2007).

3.10.8.1.3.2 Law Enforcement

The proposed Texas Research Park Site is served by the San Antonio Police Department (SAPD). The SAPD has approximately 2,085 actual personnel comprised primarily of lieutenants, sergeants, detectives, and patrol officers that are organized across six divisions: the Office of the Chief, the Administration Bureau, the Operations Bureau, the Patrol Division, the Investigations Division, and Internal Affairs. The SAPD serves the city through six substations and areas throughout San Antonio. In the period between 2004 and 2006, the SAPD responded to 996,515 calls, had an average emergency response time of 5.34 min, and a non-emergency response time of 17.3 min. The department provides a range of services that include community policing, traffic control, crime prevention, and family services (SAPD 2007).

Law enforcement services are also provided by the University of Texas at San Antonio (UTSA) Police Department. The jurisdiction of campus police officers who work for state institutions of higher learning includes Bexar County in which the property is owned, leased, rented, or otherwise under the control of the institution of higher education. The UTSA Police Department is divided into a Patrol Division and a Support Services Division, which includes criminal investigation and communications (UTSA 2007). The SAPD and UTSA Police Department maintain close working relationships with each other, as well as the Bexar County Sheriff's Office and federal, state, and other law enforcement agencies and routinely share investigative information. The study area is also served by the Medina County Sheriff's Office.

3.10.8.1.3.3 Fire Protection

The proposed Texas Research Park Site is served by the San Antonio Fire Department (SAFD). The SAFD mission is to prevent and minimize the loss of life and property of citizens and fire service personnel, provide Emergency Medical Services, mitigate the consequences of natural and man-made disasters, provide non-emergency support services, and safeguard the environment and economic base of our community. The SAFD operates 49 fire stations throughout the city, which maintains 49 engines in addition to approximately 60 specialized fire safety vehicles, and a staff of 1,470 career firefighters and 45 non-firefighting personnel (SAFD 2007).

The SAFD's Emergency Medical Services utilizes 29 full-time units and 8 Peak Period Units (SAFD 2007). In addition to active fire response and emergency medical services, the department provides public outreach and educational services. Fire protection services are also provided to the study area by the Bexar and Medina County fire departments.

3.10.8.1.3.4 Medical Facilities

The proposed Texas Research Park Site is served by Christus Santa Rosa Health Care, a health care organization with facilities; the Christus Santa Rosa Hospital and the Christus Santa Rosa Medical Center, located on two campuses in two different areas of San Antonio. The Christus Santa Rosa Hospital is a 400 plus bed, adult acute-care facility providing several medical specialty services, including a comprehensive cancer program, transplant and orthopedic services, a Level 3 trauma center, and a 24-hour emergency room. The 178 plus bed Christus Santa Rosa Medical Center is also an acute-care adult facility that provides highly specialized services in addition to 24-hour emergency care. Additionally, CSRHC maintains a comprehensive care Children's Hospital. The hospital has over 200 beds and treats approximately 150,000 children each year in its more than 34 primary and specialty clinics. Christus Santa Rosa Health Care is also due to open a 150-bed full-service medical complex in San Antonio in 2008 (CSRMC 2007). The study area is also served by the University Health System/University Hospital, Bexar County Hospital, and Medina Community Hospital.

3.10.8.1.3.5 Recreation

As the seventh largest city in the United States, San Antonio offers a wide range of cultural, entertainment, and sporting activities. The city is famous for four historic sites, such as the Alamo, which are part of the historic walk called Missions Trail. Also, the River Walk is a strip full of shops, restaurants, clubs, and hotels along the San Antonio River. In addition to traditional holidays, San Antonio celebrates its Mexican heritage during Fiesta, a 10-day festival throughout the city that includes music, food, and a variety of art and street parades. San Antonio has many art galleries, museums, theatres, opera houses and playhouses, and the nationally recognized San Antonio Symphony (SARW 2008; SATC 2007).

San Antonio celebrates the success of several professional sports teams, such as the San Antonio Spurs basketball team. Minor league baseball and women's pro basketball are also popular sporting events. There are over 50 golf courses in the area and 26 year-round community centers. There are well over 100 parks, which include sports fields and courts, skate parks, community pools, designated natural areas, gardens, picnic areas, hiking trails, and a dog park. Also, a short distance from San Antonio is The Hill Country, a spot where families often enjoy remote getaways complete with small-town shopping, dining, outdoor activities, river tubing, water parks, and camping (SATC 2007; SAPR 2007). There are also parks and entertainment venues located throughout Medina County that offer additional recreational activities to the study area.

3.10.8.2 Construction Consequences

3.10.8.2.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the construction phase. Economic impacts would result from material purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment.

The economic benefits of construction would be temporary and would diminish as the construction reaches completion. Direct employment (Table 3.10.8.2.1-1) refers to the jobs associated with actual construction of the facility, while total employment refers to all other employment generated as a result of the multiplier effect on the initial investment in construction of the facility. The industries that contribute to this other employment include architectural and engineering services, food services and drink establishments, wholesale trade, and employment services.

Based on the results of the impact analysis for the construction phase (Table 3.10.8.2.1-7), the construction of the proposed facility would — over the 4-year construction phase — directly support 2,429 person-yrs of employment (607 jobs annually) with an associated total employment level of 4,026 person-yrs (1,007 jobs annually) during the 4-year construction phase. The effects of this work are expected to be short term and would only last for the duration of the construction work.

Table 3.10.8.2.1-1 — Short-Term Economic Impacts

Construction	
Total Construction Jobs (person-yrs)	2,429
Impacts	
Total Employment (person-yrs)	4,026
Total Labor Income Impact ($ millions)	180.5
Federal, State, and Local Tax ($ millions)	52.4
State and Local Tax ($ millions)	13.6

Note: In 2007 dollars.

In terms of income, minor short-term benefits would be expected. Labor income for any given region is defined as the sum of labor compensation and proprietor income generated within the regional boundaries[16]. The estimated labor income generated during the construction phase is $180.5 million ($45.1 million annually) measured in 2007 dollars. The total labor income impact of this project would correspond to 0.1% of all estimated 2006 labor income in the two-county region expressed in 2007 dollars or 0.1% of the total estimated labor income in Bexar County.

The construction phase would generate additional taxes estimated at $52 million (Table 3.10.8.2.1-1), of which approximately $13.6 million is estimated to be collected through state and local taxes that would flow to the local governments.

3.10.8.2.2 Population and Housing

3.10.8.2.2.1 Population

The majority of the construction workers would be drawn from the study area or would commute from the surrounding counties. Therefore, construction-related employment generated by the NBAF is not expected to result in an increase in the study area population. Any population change during construction would be temporary and would involve a small percentage of the total construction-period employment. Construction impacts on population and housing would be very similar to those described in Section 3.10.3.2.2.

3.10.8.2.2.2 Housing

As described above, the construction of the NBAF is not expected to increase the population of the study area. Therefore, no effects on housing availability or prices would occur.

3.10.8.2.3 Quality of Life (Community Services)

Construction impacts on quality-of-life attributes would be very similar to those described in Section 3.10.3.2.3.

[16] Proprietor income consists of payments received by self-employed individuals as income.

3.10.8.3 Operations Consequences

3.10.8.3.1 Employment and Income

The proposed facility would have a small incremental benefit on the local economy during the operations and maintenance phase, which is expected to commence in the year 2014. Economic impacts would result from material purchases in the region generating local sales, payroll expenditures for labor on- and offsite, and related spending by supplying firms and laborers to satisfy the initial demand created by the project investment (Table 3.10.8.3.1-1).

Table 3.10.8.3.1-1 — Long-Term Annual Economic Impacts

Operations	
Jobs at the Facility (jobs)	326 [a]
Impacts	
Total Employment (jobs)	507
Total Labor Income Impact ($ millions)	30.4
Federal, State, and Local Tax ($ millions)	4.0
State and Local Tax ($ millions)	1.7

Note: In 2007 dollars.
[a] Actual jobs would range from 250 to 350; 326 was used for cost estimating purposes and the basis for the economic analysis.

Operation of this proposed facility would commence in 2014 and would require 145 operations, maintenance, and security staff and an additional 181 scientific and support staff. The operations and maintenance of the proposed facility would generate a total of 507 jobs including the initial 326 direct jobs required for operations and maintenance (see footnote in Table 3.10.8.3.1-1 regarding actual NBAF employment figures) (NDP 2007a).

The estimated income generated during the operations phase is $30.4 million annually in 2007 dollars. This corresponds to less than 0.1% of all estimated 2006 labor income in the two-county region, expressed in 2007 dollars, and also less than 0.1% of total labor income in Bexar County.

The operations phase would generate additional taxes estimated at $4 million (Table 3.10.8.3.1-1), of which $1.7 million is estimated to be collected through state and local taxes that would flow to the local governments.

3.10.8.3.2 Population and Housing

3.10.8.3.2.1 Population

The NBAF would directly employ 326 people. The majority of these employees are expected to be research scientists and other specialized staff, and based on census journey-to-work data, 296 are expected to relocate to the study area from elsewhere in the country. Assuming the U.S. 2006 average family size of 2.6 persons, this would represent a population increase of 772.

In addition, the economic activity associated with the operation of the NBAF is expected to employ 181 persons. The industries that will contribute to this indirect employment include those in non-specialized areas such as food services and drink establishments and wholesale trade, among others. It is assumed that these employment opportunities will be filled by the local labor force and that the relocation of workers to the study area due to the generation of these jobs will be negligible.

In total, the population of the study area is expected to increase by 772 as a result of the operation of the NBAF. This population increase is a very small portion of the overall expected population growth within the study area between 2007 and 2012 (150,919, based on historic trends), which is expected to result in a total study area population of 1,784,898 in 2012.

3.10.8.3.2.2 Housing

As described above, 772 additional persons would locate to the study area as a result of the NBAF. The average salary including benefits of the 326 employees employed directly at the NBAF would be $82,622. For comparative purposes, this figure has been adjusted to an average per capita income of $66,924 for employees employed directly at the NBAF, which is higher than the estimated median 2007 study area per capita income ($20,816). Over 80 NBAF research scientists and managers would earn over $125,000 annually. The estimated median value of owner-occupied housing units in the study area in 2007 was estimated to be $101,505 (Table C-121). Taking into account families with two incomes, the available study area housing stock would be affordable to the majority of the people relocating to the region.

The housing market would be able to meet the increase in housing demand (326 employees in total), relative to the estimated growth of the existing population between 2007 and 2012 (150,919). It is possible that with the relocation of highly skilled workers to the immediate area, property values could increase due to an increase in demand, and there is no empirical evidence that a facility such as the NBAF would reduce property values in the study area. Therefore, the overall effect of the NBAF on housing market conditions would be negligible.

3.10.8.3.3 Quality of Life (Community Services)

Due to small percentage of the overall population growth that is attributed to the facility, the NBAF would have a negligible effect on the availability of public services. The study area population growth attributed to the NBAF is 0.5% of the overall estimated population growth from 2007 to 2012.

3.10.8.3.3.1 Public Schools

The NBAF would add approximately 160 school-aged children to the study area or an 0.2% increase in the 2006/2007 school year 84,920 combined enrollment of the Northside ISD and Medina Valley ISD (TEA 2007). The 0.2% increase in school-aged children attributed to the NBAF would place minimal demand on the schools.

3.10.8.3.3.2 Law Enforcement

The population increase associated with the NBAF (772), relative to the estimated growth of the existing population between 2007 and 2012 (150,919), would result in a negligible increase in the need for additional law enforcement services.

3.10.8.3.3.3 Fire Protection

The population increase associated with the NBAF (772), relative to the estimated growth of the existing population between 2007 and 2012 (150,919), would result in a negligible increase in the need for additional fire protection services.

3.10.8.3.3.4 Medical Facilities

The additional population associated with the NBAF (772), relative to the expected growth of the existing population between 2007 and 2012 (150,919), would result in a negligible increase in the demand for medical services and facilities.

Due to the overall population growth in the region, medical facilities in the study area are responding to growth in the region and expanding to meet the increasing demand. For example, Christus Santa Rosa Health Care is planning to open a new 150-bed full-service medical complex in San Antonio in 2008 (CSRMC 2007).

3.10.8.3.3.5 Recreation

Recreational resources would not experience a significant increase in utilization rates as a result of the population increase associated with the NBAF. The study area has abundant recreation resources available.

3.10.8.3.3.6 Health and Safety

The normal operation of the NBAF would pose no additional health or safety risks to the public because the facility would be closed off to public access at all times. Site-specific protocols would be developed in response to any appropriate local incident or pending adverse weather condition potentially affecting the NBAF, in coordination with local emergency response agencies that would consider the diversity and density of human, livestock, and wildlife populations residing within the local area. The response plans would have site-specific standard operating procedures and response plans in place prior to the initiation of research activities at the proposed the NBAF. Procedures and plans to operate the NBAF will include community representatives as described in Section 2.2.2.6 of the NBAF EIS. Further analysis with regard to health and safety during abnormal operation of the proposed facility are in Section 3.14 (Health and Safety).

3.10.9 Potential Economic Consequences of Accidental Release Scenario

FMDV, RVF, and Nipah virus were selected as the pathogens to be analyzed for economic consequences. The diseases caused by these three viruses sufficiently cover the spectrum of outcomes that would likely occur if any of the pathogens to be studied at the NBAF were to escape to the surrounding areas and infect animal and human populations. This section is a summary of Appendix D which provides a more detailed assessment of potential economic damage to the U.S. economy resulting from a pathogen release from the NBAF. Appendix D utilizes a case study and literature review approach for assessing the potential economic damage to the U.S. economy if one of the pathogens proposed for study at the NBAF were to be released into the surrounding environment. Appendix D does not assess the probability of accidental release or evaluate the cause of release (e.g., accidental release or bioterrorism); these assessments are thoroughly evaluated in Chapter 3, Section 3.14. Instead, Appendix D provides a review of relevant studies and research regarding economic costs of previous outbreaks of the pathogens being evaluated or simulations having been performed by academic researchers or agencies.

FMD is the most well-known and documented of the three diseases. An FMD outbreak has the capacity to wreak havoc on the livestock economy. The RVF and Nipah viruses pose potential threats to both livestock and human populations. A release of pathogens could also potentially affect wildlife populations. Information is limited on the possible role of wildlife in the maintenance and amplification of these pathogens. However, it is likely that the release would negatively impact regional hunting-related industries (see Section 3.10.3.1.1.3 for a description of the State's hunting industry). Hunting positively contributes to many state economies. In 2006, hunting expenditures by recreational hunters in the states with NBAF proposed alternative sites were significant, ranging from $69 million in Connecticut to $2.2 billion in Texas (the total economic activity generated by recreational hunting is higher becausethese figures do not include the "ripple effect" of these direct expenditures) (USFWS 2006).

Due to the combination of Nipah's epidemiology and the prevailing livestock and human health management practices in the United States, the anticipated negative economic consequences resulting from a loss of containment scenario involving the Nipah virus are likely to be much lower than those involving FMD or RVF viruses. As a result, the focus of a worst-case scenario centers on the possible effects of FMD and RVF on local human and animal populations.

FMD is a highly contagious viral disease that affects all cloven-hoofed animals including cattle, pigs, sheep, goats, deer, and bison. The virus can also be carried by a variety of animals that are not susceptible to the disease such as birds, dogs, cats, and rodents, as well as feed trucks, fomites, etc. Because pigs shed the virus much more heavily than other hosts and because cattle are the most susceptible to infection, outbreaks of the disease are most likely to occur in environments where there is a dense livestock population that includes large numbers of both cattle and pigs and also where significant movements of livestock occur, usually in areas with a relatively high concentration of commercial agriculture.

Several studies have been carried out to estimate the potential economic impacts that would arise from an FMD outbreak in the United States and various states with due consideration given to the effects of export bans on U.S. livestock products. Projected impacts to the U.S. livestock industry of an FMD outbreak, depending on the release scenario, have been estimated to range from $3 to $30+ billion, with individual states facing losses to farm income in smaller ranges depending on each state's economic reliance on cattle and pork industries. The economic costs arising from foreign trade bans on U.S. livestock products regardless of the location of the accidental release accounted for the majority of the projected impact. Foreign trade bans would remain in effect until the U.S. was declared foreign animal disease free. More information on these studies are provided in Appendix D (Ekboir 1999; Pendell et al. 2007).

RVF can affect many species of animals including domestic livestock such as cattle, sheep, goats, buffalo, camels, and non-domestic animals such as monkeys, gray squirrels, mice and other rodents. In humans, RVF manifests itself as an acute onset of fever in the majority of individuals that become infected. Severe illness occurs in about 1% to 3% of cases, and overall mortality rate is approximately 1%. Establishment of RVF would primarily rely on the amenability of the geographical location to a competent disease carrier's (e.g., *Aedes* and *Culex* mosquito species) presence and the availability of susceptible hosts (animals and humans) to maintain a sufficiently large virus reservoir for retransmission to biting mosquitoes.

The Rift Valley Fever Working Group developed a bioterrorist RVF release scenario that estimated 114 human deaths and the economic impact on the United States to exceed $50 billion due to losses in livestock and related industries (Pendell et al. 2007). Most nations would almost certainly ban the export of U.S. meat products, which in 2006 totaled more than $4 billion, while damage to the domestic industry could also be significant given that the value of the major livestock (cattle, calves, hogs, and sheep) in the U.S. meat industry alone was estimated at $95.9 billion in 2006 (NASS 2006). The accidental release of the virus from the proposed research center would not likely lead to such dire consequences in the short term; although, if the virus were to become established in the environment surrounding the facility, it would likely spread over time to other areas, eventually causing the magnitude of losses projected for the bioterrorism scenario. Appendix D provides a more details on potential economic impacts to the U.S. economy resulting from a pathogen release from the NBAF.

3.11 TRAFFIC AND TRANSPORTATION

3.11.1 Methodology

The general methodology for the inclusion of traffic and transportation data for each site involved the collection and verification of current/planned site and regional traffic and transportation data, the identification of NBAF design-based traffic and transportation conditions, and finally the identification and evaluation of site-specific and/or regional impacts resulting from construction and facility operation. The results of this methodology are presented in the following subsections.

3.11.2 No Action Alternative

This section presents an overview of the transportation modes and corridors that are currently used to transport biological or other hazardous materials and supplies to and from the PIADC.

3.11.2.1 Affected Environment

3.11.2.1.1 Highways, Roads, and Marine Transportation

The PIADC is located on the southeastern coast of Plum Island, New York. Plum Island is 840 acres in size and is situated approximately 1.5 miles northeast of Long Island and about 12 miles southwest of New London, Connecticut (Figure 3.11.2.1.1-1). A strait known as Plum Gut separates Plum Island from Orient Point, the easternmost tip of Long Island's North Fork. Other bodies of water surrounding the island include Long Island Sound to the north, Block Island Sound to the east, and Gardiners Bay to the south. Primary access points to Plum Island include Long Island, New York and Old Saybrook, Connecticut. Restricted access ferry service to Plum Island is available from Orient Point, New York, and Old Saybrook, Connecticut.

From Long Island, New York, the Long Island Expressway (Interstate 495) provides a high-volume east-west artery from New York City and between communities on Long Island (Nassau and Suffolk Counties). East of the terminus of I-495 at the Town of Riverhead, traffic destined for the North Fork of Long Island from the west is serviced by NYS Route 25 and CR 48, two-lane highways that represent the primary collector road systems for the area. Routes 25 and 48 traverse the Town of Southold west to east, eventually merging into Route 25 and reaching Orient Point where restricted ferry service is available to Plum Island from the Plum Island ferry terminal. According to traffic studies conducted by the Town of Southold, traffic has increased steadily in the North Fork area, averaging 38% from 1993 to 2006 for an annual increase of 2.9% per year based on New York State Department of Transportation (NYSDOT) data. Although the increase in traffic results in decreasing mobility and increasing congestion at times and may result in significant congestion in the future, the study concluded that there are currently no major congestion issues.

Cross Sound Ferry Services operates ferry service from Orient Point, on Long Island to New London, Connecticut, for cars, trucks, and passengers. In addition, Sea Jet Service is available for passengers only. The Plum Island Ferry at Old Saybrook is a restricted ferry service operating from the Old Saybrook dock to Plum Island for the transport of PIADC employees only. Plum Island ferry transportation services from the Old Saybrook dock do not include the transportation of heavy and/or bulk materials. For transportation of these items from Connecticut, ferries must depart from New London (or other ports) on commercial ferries, as PIADC has no freight loading or transport capabilities at its docking facility at Old Saybrook. Transportation from these alternate ports require more than 1 hour each way to complete the passage of heavy/bulk loads.

Ferry access to Plum Island is restricted and limited to employees, contractors, and visitors of PIADC. Transportation on the island is essentially restricted to government-owned vehicles; however, contractor- and privately owned vehicles are occasionally allowed on the island by special permission. All employees and visitors to PIADC use the government-owned and contractor-operated marine transportation to and from Plum Island. The government ferries depart daily from Orient Point, New York, and Old Saybrook, Connecticut. Docking or landing of private marine vessels is prohibited unless specifically authorized by PIADC's security department. Non-governmental marine access is exclusively restricted to landings of cargo and equipment (e.g., construction materials and heavy construction vehicles, fuel oil tankers) that PIADC's marine fleet cannot safely or effectively transport.

The Long Island public ferry facilities are located in Orient Point. The North Ferry Company operates year-round ferry service from Shelter Island to Greenport for cars, trucks, and passengers. The Cross Sound Ferry Services operates ferry service from Orient Point to New London, Connecticut, for cars, trucks, and passengers. In addition, Sea Jet Service is available for passengers only. The Plum Island Ferry is a restricted ferry service operating from Orient Point to Plum Island and transports employees, contractors, and visitors of PIADC only. The Plum Island ferry terminal is located adjacent to the public ferry terminal of Cross Sound Ferry Services. Orient Point is the closest land mass to Plum Island and affords the best and most expedient means for transporting people and heavy and/or bulk materials to/from Plum Island. Transit times between the terminals at Orient Point and Plum Island's Plum Gut Harbor are approximately 20 to 30 minutes depending on sea conditions.

Figure 3.11.2.1.1-1 — Plum Island Site Roads

From Connecticut, Interstate 95 is the major high-volume highway serving through traffic and the communities of the Connecticut coast, including Middlesex and New London Counties. From I-95, access to Plum Island is from the Old Saybrook Dock in the Town of Old Saybrook, Connecticut. The Old Saybrook Dock is located approximately 2 miles south of the intersection of Highway 95 and SR 9. Several transportation routes including U.S. Highway 1 and State Highway 154 are available from I-95 to the PIADC's docking facilities. These routes are largely limited to two-way, multi-lane light commercial streets.

3.11.2.2 Construction Consequences

There would be no construction consequences to existing highways, roads, or marine transportation infrastructure or traffic patterns from the No Action Alternative.

3.11.2.3 Operation Consequences

There would be no operation consequences to existing highways, roads, or marine transportation infrastructure or traffic patterns from the No Action Alternative.

3.11.3 South Milledge Avenue Site

3.11.3.1 Affected Environment

3.11.3.1.1 Highways and Roads

The South Milledge Avenue Site is located in the southern part of Clarke County, near Athens, Georgia. Athens Perimeter Highway, a freeway encircling the city of Athens, is approximately 1 mile north of the South Milledge Avenue Site. Athens Perimeter Highway (Georgia 10 Loop) connects with many highways, including U.S. 29 and State Highway 316, which run west from Athens towards Atlanta. U.S. 441 and U.S. 129 provide access to Interstates 85 and 20, which are both less than 30 miles from the South Milledge Avenue Site. The South Milledge Avenue Site is accessed from the eastbound lane of Athens Perimeter Highway by exiting South Whitehall Road and proceeding south for 1 mile. Figure 3.11.3.1.1- 1 shows the significant roads near the South Milledge Avenue Site.

3.11.3.2 Construction Consequences

3.11.3.2.1 Highways and Roads

Vehicles (such as light trucks) and heavy machinery (bulldozers, dump trucks, cranes, and cement mixer trucks) would be used onsite during construction of the South Milledge Avenue NBAF. Construction vehicles would operate primarily during the daylight hours and be parked onsite over night. Parking for site or construction workers during hours of construction activities would be on or adjacent to the South Milledge Avenue NBAF construction site. During construction activities, some vehicular and pedestrian traffic may be rerouted to avoid the construction areas. Any roadway or pedestrian walkway closures and associated rerouting would be limited to the immediate area of construction and would not include general area traffic within the immediate vicinity or effect regional traffic patterns. The construction phase would be temporary and in some cases may be intermittent, occurring only during certain construction stages or times of day.

Mobilization and demobilization would result in trips of heavy equipment and light- and medium-weight vehicles for the entire 4-yr construction period. Deliveries of soil, backfill, and building materials are expected to occur an average of twice daily for a 6-month window of time (NDP 2007a).

3.11.3.3 Operation Consequences

3.11.3.3.1 Highways and Roads

According to traffic analysis performed by the Georgia Department of Transportation and Public Works, critical traffic flow would occur at the intersection of Whitehall Road and South Milledge Avenue, as well as at Milledge Avenue and the South Milledge Avenue Site entrance (ACC 2007a).

At Whitehall Road and South Milledge Avenue, critical movement would occur at the northbound left turn from Whitehall Road onto South Milledge Avenue and the eastbound left turn onto Whitehall Road from South Milledge Avenue. The northbound critical movement that currently operates at Level of Service (LOS) "C" during the morning peak hours would lessen to LOS "D" in 2014. [Note: LOS ratings range from "A" (best rating; lowest delay) to "F" (worst rating; highest delay)].

The northbound critical movement currently operates at LOS "F" during the nighttime peak hour. The eastbound critical movement currently operates at LOS "F" during both the morning and nighttime peak hours. After the construction of the South Milledge Avenue NBAF, the northbound movement would operate at LOS "E" in 2014. The eastbound movement would remain at LOS "F."

The critical movements at South Milledge Avenue and the South Milledge Avenue NBAF entrance occur in the westbound left turn from South Milledge Avenue into the South Milledge Avenue NBAF and the northbound left turn from the South Milledge Avenue NBAF onto South Milledge Avenue. The northbound movement would operate at LOS "F" for both the morning and nighttime peaks hours in 2009 and 2014. The westbound movement would operate at LOS "B" for the morning peak in 2009 and 2014 and the westbound movement would operate at LOS "B" in the nighttime peak for 2009 and LOS "C" in the nighttime peak for 2014.

The Department of Transportation and Public Works recommends that the intersection at Whitehall Road and South Milledge Avenue be redesigned as a standard intersection with signals and separate left and right turn lanes on South Milledge Avenue, as well as left and right turn lanes on Whitehall Road.

The LOS for the South Milledge Avenue NBAF drive access at South Milledge Avenue is "F." The Department of Transportation and Public Works recommends that there be two points of access to the South Milledge Avenue NBAF, with a minimum 300 feet separation. The Department of Transportation and Public Works also recommends a dedicated left turn lane on westbound South Milledge Avenue into the facility (ACC 2007a).

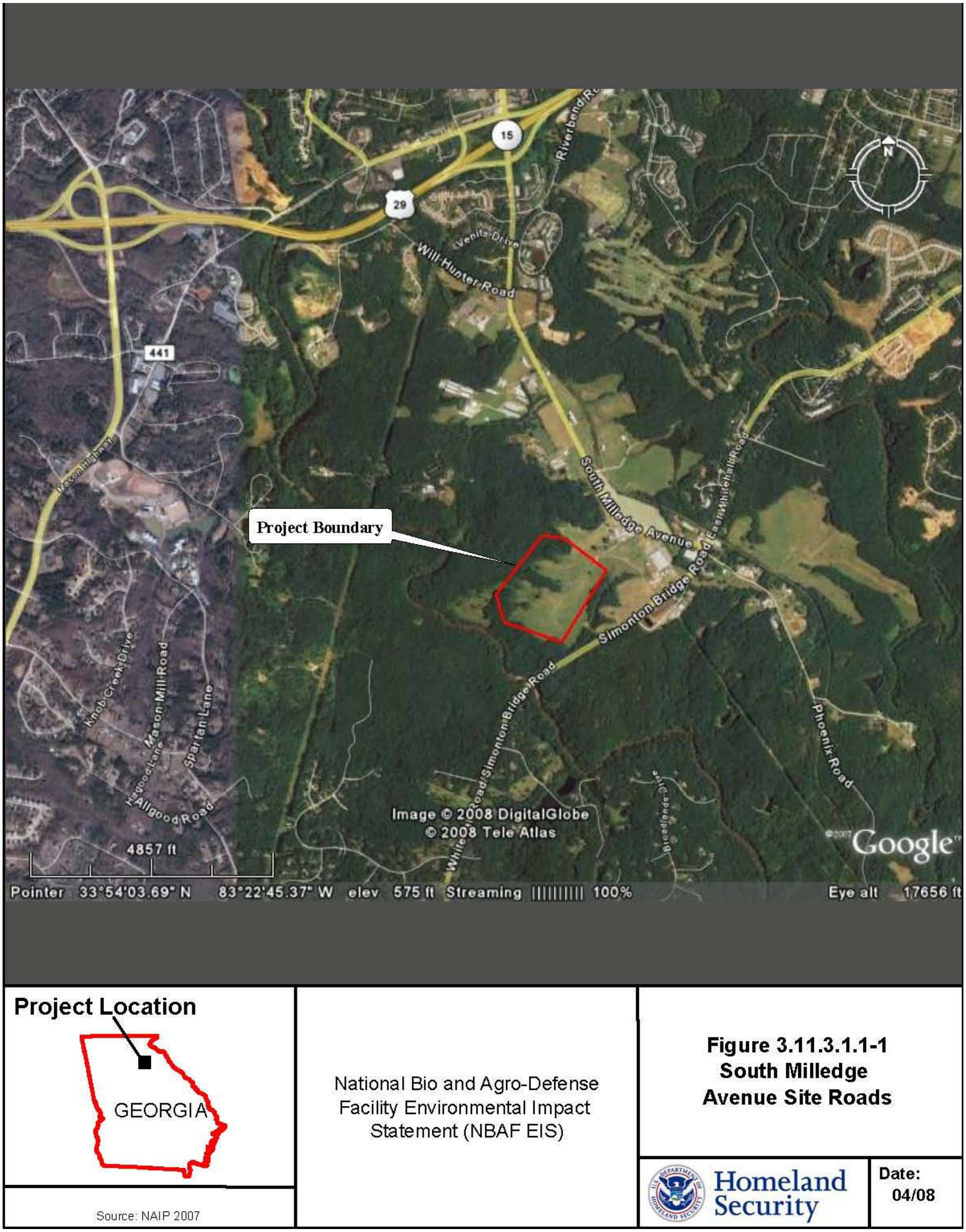


Figure 3.11.3.1.1-1 — South Milledge Avenue Site Roads

The additional vehicles from approximately 350 new employees represent a small fraction of the total vehicles in the City of Athens. South Milledge Avenue has an average daily traffic volume of 10,860 vehicles (ACC 2007a). The Department of Transportation and Public Works estimated that the 350 employees could make a total of 1,000 trips per day. This would increase daily traffic volume on South Milledge Avenue by approximately 9%.

The Athens-Clarke County Fire and Emergency Services would provide fire and emergency services to the South Milledge Avenue NBAF. Response time is currently estimated at slightly more than 5 min. South Milledge Avenue NBAF security measures on-property would also be incorporated.

Cumulative Impacts

According to the University of Georgia Office of the University Architects for Facilities Planning (Kevin Kirsche, UGA, January 25, 2008), UGA has no immediate projects of significant consequence planned for areas surrounding the proposed South Milledge Avenue Site. Five significant development projects anticipated by the University over the next 5 years and submitted to the University System of Georgia Board of Regents are to be located on main campus and are not within reasonable distance of the South Milledge Avenue Site to contribute to cumulative impacts. In addition, there are no proposed regional development projects within a 2-mile radius of the site (Brad Griffin, Athens-Clark County Planning Director, January 24, 2008). However, it is anticipated that the rapid population growth of Clarke County would continue with associated increase of traffic on highways and roadways in the area.

The ROI for traffic was determined to be the 2-mile radius around the South Milledge Avenue Site. It is not likely that future foreseeable actions beyond this area would have a cumulative effect on traffic. Although the NBAF would result in an increase in traffic within this radius, there would be not be substantial cumulative impacts since there are no identified future actions within the ROI.

3.11.4. Manhattan Campus Site

3.11.4.1 Affected Environment

3.11.4.1.1 Highways and Roads

The Manhattan Campus Site is located in north-central Manhattan, Kansas, at the southeast corner of Denison and Kimball Avenues (Figure 3.11.4.1.1-1). The major highway in the vicinity of the Manhattan Campus Site is I-70, which runs east-west approximately 12 miles (19.3 kilometers) south of the Manhattan Campus Site.

3.11.4.2 Construction Consequences

3.11.4.2.1 Highways and Roads

Vehicles (such as light trucks) and heavy machinery (bulldozers, dump trucks, cranes, and cement mixer trucks) would be used onsite during construction of the Manhattan Campus NBAF. Construction vehicles would operate primarily during the daylight hours and be parked onsite over night. Parking for site or construction workers during hours of construction activities would be on or adjacent to the Manhattan Campus construction site. During construction activities, some vehicular and pedestrian traffic may be rerouted to avoid the construction areas. Any roadway or pedestrian walkway closures and associated rerouting would be limited to the immediate area of construction and would not include general area traffic within the immediate vicinity or effect regional traffic patterns. The construction phase would be temporary and in some cases may be intermittent, occurring only during certain construction stages or times of day.

Mobilization and demobilization would result in trips of heavy equipment and light- and medium-weight vehicles for the entire 4-yr construction period. Deliveries of soil, backfill, and building materials are expected to occur an average of twice daily for a 6-month window of time (NDP 2007a).

3.11.4.3 Operation Consequences

3.11.4.3.1 Highways and Roads

According to a 2005 traffic analysis performed by the National Transportation Board, the traffic flow critical to the Manhattan Campus Site is Denison Avenue from Anderson Avenue to Kimball Avenue. This portion of Denison Avenue is classified as a Collector road by the City of Manhattan, Kansas. It is currently one lane in each direction. A range of intersection controls exist throughout the study corridor from signals to stop control. Because the corridor borders the west side of the KSU campus, there is heavy pedestrian and bicycle traffic in conjunction with vehicular traffic. Recommended improvements to the Denison Avenue corridor include modifying Denison Avenue to a three-lane section (one lane in each direction with a center turn lane) for the length of the corridor, the complete reconstruction of pavement from Claflin Road to Kimball Avenue, and intersection improvements at Anderson Avenue, Claflin Road, Jardine Road, and Kimball Avenue (HNTB 2005).

The 2005 average daily traffic (ADT) for the Denison Avenue corridor segment from Jardine Road to Kimball Avenue (adjacent to the Manhattan Campus Site) was reported as 10,031 vehicles per day. Using the projected traffic growth rate of 4.6 per annum, the 2008 ADT for the Denison Avenue corridor segment from Jardine Road to Kimball Avenue. is estimated at 11,480 vehicles per day (HNTB 2005). The Manhattan Campus Site will impact traffic in the Denison Avenue corridor by the addition of 350 new employees making approximately 1,000 trips per day. This impact would increase the daily traffic volume within the Denison Avenue corridor by approximately 8.7%. The additional vehicles from approximately 350 new employees represent 0.9% of the total vehicles in Riley County (41,160) (City Data 2007).

The City of Manhattan would provide fire and emergency services to the Manhattan Campus Site. A manned fire station is located directly north of the proposed site on Kimball Avenue. As a result fire response time is expected to be less than 1 min.

<u>Cumulative Impacts</u>

According to KSU (Ron Trewyn, KSU, January 28, 2008), there are two major projects planned within a 2-mile radius of the Manhattan Campus Site. These projects, the Kansas State Equine Education Center and the Flint Hills Horse and Park Events Center, are related and would be located at the same site north of Kimball Avenue and east of Denison Avenue, encompassing 85 to100 acres and include both the educational and competitive event components. These projects would result in 150 to 180 full-time and part-time jobs. The increase in traffic is estimated to be 500 to 700 vehicles per week, primarily on weekends. The projects are in the preliminary planning stages, so any increase in public service demands and environmental impacts are not known.

There are additional projects planned on the KSU campus. One noteworthy project is the Jardine Complex Phase II, which includes 544 new bedrooms. Phase I added 608 bedrooms and over 2,000 daily trips, while Phase II is adding 347 apartments and another 2,000 daily trips. Another project is the Equestrian Center Phase I for the College of Agriculture, Department of Animal Sciences at Kansas State Athletic Department. There are 80 equestrian team members/coaches, a 40-seat classroom, and scheduled 400-person stadium events. This project would result in over 1,000 daily trips.

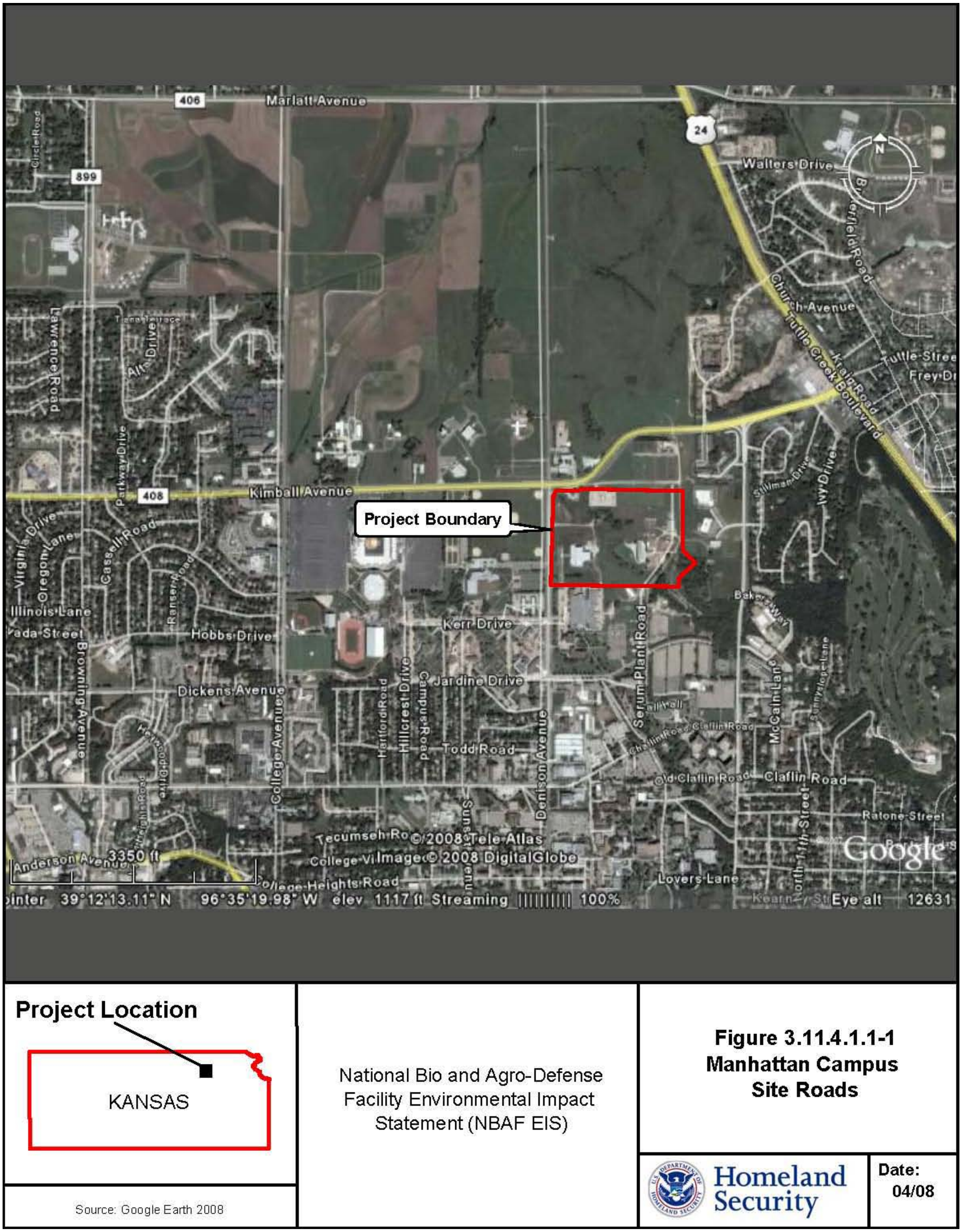


Figure 3.11.4.1.1-1 — Manhattan Campus Site Roads

The ROI for traffic is a 2-mile radius around the proposed NBAF site. The NBAF would result in an increase in traffic as described in Section 3.11.4, and the additional future projects would contribute to the increase in traffic as well. The addition of 150 to 180 full- or part-time jobs with the Kansas State Equine Education Center and the Flint Hills Horse and Park Events Center to the 250-350 jobs with the proposed NBAF represents a small percentage of related traffic on the KSU campus and Riley County.

The total overall cumulative traffic impacts would be 23,580 daily trips for the ROI. This includes the current traffic, the proposed NBAF site, the new KSU project traffic, the increase of commercial/industrial employment traffic, and additional freight traffic.

3.11.5 Flora Industrial Park Site

3.11.5.1 Affected Environment

3.11.5.1.1 Highways and Roads

The Flora Industrial Park Site is located in the northern part of Flora, Mississippi (Figure 3.11.5.1.1-1). U.S. Highway 49 borders the western edge of the Flora Industrial Park Site and runs southeast from the Town of Flora to Jackson, Mississippi. U.S. 49 and State Highways 22 and 463 provide access to Interstates 55 and 20, which are both less than 20 miles from the proposed site. The site would be accessed from the northbound lane of U.S. 49 near the intersection with Middle Road.

3.11.5.2 Construction Consequences

3.11.5.2.1 Highways and Roads

Vehicles (such as light trucks) and heavy machinery (bulldozers, dump trucks, cranes, and cement mixer trucks) would be used onsite during construction of the NBAF. Construction vehicles would operate primarily during the daylight hours and be parked onsite over night. Parking for site or construction workers during hours of construction activities would be on or adjacent to the Flora Industrial Park construction site. During construction activities, some vehicular and pedestrian traffic may be rerouted to avoid the construction areas. Any roadway or pedestrian walkway closures and associated rerouting would be limited to the immediate area of construction and would not include general area traffic within the immediate vicinity or effect regional traffic patterns. The construction phase would be temporary and in some cases may be intermittent, occurring only during certain construction stages or times of day.

Mobilization and demobilization would result in trips of heavy equipment and light- and medium-weight vehicles for the entire 4-yr construction period. Deliveries of soil, backfill, and building materials are expected to occur an average of twice daily for a 6-month window of time (NDP 2007a).

3.11.5.3 Operation Consequences

3.11.5.3.1 Highways and Roads

The transportation corridor critical to the Flora Industrial Park Site is U.S. Highway 49 in Flora, Mississippi, north of the intersections with Cox Ferry Road and First Street North. The Flora Industrial Park Site fronts U.S. Highway 49, which is a four-lane divided highway, and the proposed entrance aligns with an existing median break. Improvements to U.S. Highway 49 resulting from the installation of the NBAF would include a left turn lane (south bound Highway 49), as well as typical acceleration and deceleration lanes at the entrance drive. There appears to be sufficient room within the median and the right-of-way to construct these improvements (NDP 2008b).

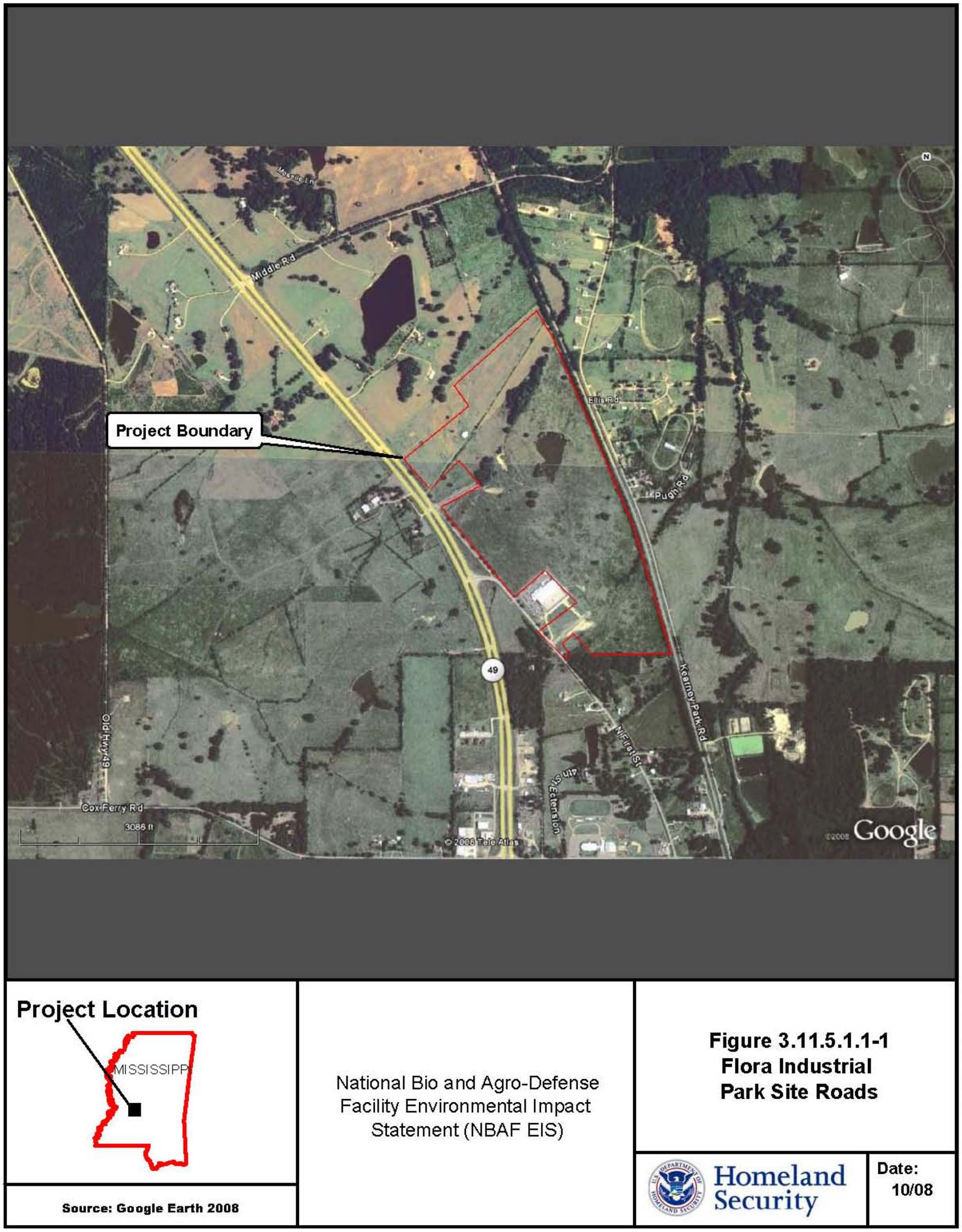


Figure 3.11.5.1.1-1 — Flora Industrial Park Site Roads

The 2002 ADT for U.S. Highway 49 in Flora, Mississippi north of the intersection with First Street North was reported by the Mississippi Department of Transportation (MDOT) as 11,000 vehicles per day. The projected 2010 ADT for this segment of U.S. Highway 49 is estimated at 14,828 vehicles per day (MDOT 2002). The NBAF is projected to impact traffic in the identified Highway 49 corridor by the addition of 350 new employees making approximately 1,000 trips per day. This impact would increase the daily traffic volume within the Highway 49 corridor by approximately 6.7%.

The Town of Flora would provide fire and emergency services to the Flora Industrial Park Site (MCEDA 2007). The response time for fire and emergency services to the Flora Research Park Site is anticipated to range from 3 to 5 min based a response distance of 2.0 miles at an average response speed of 40 mph.

Cumulative Impacts

According to the Metro Jackson Chamber of Commerce, there are several new residential projects being planned in the Town of Flora or in Madison County. Terra Subdivision is located within the town limits of Flora with 19 lots available and 60 acres being developed. Depending on the density allowed for the subdivision, there is a potential of up to 240 additional lots. Another future development project is Andover Subdivision, which is located off State Highway 22 within 5 miles of the proposed site in an unincorporated area. Phase I of the subdivision has approximately 73 lots. Numerous phases are predicted for this development over the next 5 years, but data were not available to state the additional number of lots to be developed. The Highlands Subdivision is another future planned project located off Mount Leopard and would be accessed from Highway 22. It is within 5 miles of the proposed NBAF site. The data provided did not state the number of lots predicted for this development, but all of the lots would be greater than 5 acres. Other noted subdivisions that have not announced their density allocations are Magnolia Heights and Woodlands of Flora.

The Metro Jackson Chamber of Commerce stated that there are no non-residential economic development projects scheduled for Flora within the next 5 years. Therefore, from a private sector commercial and industrial perspective, there are no anticipated cumulative effects that would impact the Flora area.

There is a proposed major development (Galeria-Madison) approximately 15-20 miles from the proposed NBAF and includes a mix of single-family homes, condominiums, an office park, and a shopping center. The acreage, square footages, and density numbers were not available for this development. There are other developments occurring but they are not of major regional significance.

The ROI for traffic is the Town of Flora. The NBAF would result in an increase in traffic as is described in Section 3.11.5, and the additional future projects would contribute to the increase in traffic, as well. The volume of traffic from the NBAF is projected to be 1,000 daily trips. New road construction or improvements to existing roadways may be required to increase residual roadway capacity to accommodate the additional traffic load.

For the ROI, 2030 projections state that there will be 9,589 people and 3,516 total housing units. Assuming a rate of 10 daily trips per household unit, there would be a total of 35,160 daily trips by 2030 for residential traffic. However, this would not account for commercial- and industrial-based traffic activity. Based on these projections, approximately 4,800 people and 1,750 total housing units would be accounted for year 2015. Based on the same daily trip rates for traffic in 2030, there would be total of 17,580 daily traffic trips for the residential component of Flora in 2015. It is assumed that there would be 20% to 30% increase over the projected 2015 and 2030 figures to calculate commercial- and industrial-based traffic activity and a 5% increase for freight traffic. Based on that assumption, the daily traffic cumulative trip total would increase to approximately 23,000 daily trips in 2015 and 45,000 daily trips in 2030.

3.11.6 Plum Island Site

3.11.6.1 Affected Environment

A description of the existing highways, roads, and marine transportation associated with the restricted ferry access to Plum Island from Long Island, New York, and Connecticut is located in Section 3.11.2.1

3.11.6.2 Construction Consequences

3.11.6.2.1 Highways, Roads, and Marine Transportation

Vehicles (such as light trucks) and heavy machinery (bulldozers, dump trucks, cranes, and cement mixer trucks) would be used on-site during construction of the Plum Island NBAF. Mobilization and demobilization of heavy equipment and light- and medium-weight vehicles will occur during the entire 4-yr construction period. Deliveries of soil, backfill, and building materials to Plum Island would be expected to occur an average of once daily for a 6-month window of time (NDP 2007a). Construction vehicles would operate primarily during the daylight hours and would remain on the island as required by construction scheduling.

For reasons of time and transportation costs, the logistical transport of construction equipment and materials will likely originate from the Orient Point Ferry Terminal on Long Island, New York or from some adjacent public ferry terminal by special arrangement. This preference would contribute to the increased use of the primary collector roads in the Long Island North Fork area, NYS Route 25, and CR 48. The staging of equipment and the daily commute by construction personnel in the early morning and late afternoon hours would have a noticeable, but short-term, impact on the traffic patterns for Route 25. The added traffic pressures would, however, be transient and would dissipate as construction schedules are completed. No parking issues are anticipated from increased construction personnel traffic due to the expansive parking facilities available at the Orient Point Ferry terminal.

Although the infrastructure at the Old Saybrook ferry station precludes its use for the staging and transport of construction equipment and materials to Plum Island, the ferry service could serve to transport construction personnel to and from the construction site on Plum Island. The availability of multiple transportation routes to the Old Saybrook ferry station would minimize the impact of construction personnel’s daily commutes. These routes are largely limited to two-way light-commercial streets. Concentrated peak flows of workers coming to/from the Old Saybrook ferry station on a daily basis would result in localized congestion in the dock area. This condition would soon dissipate as vehicles disperse from the marina area. Conversely, parking at the Old Saybrook ferry station offers a different set of challenges. Because the Old Saybrook ferry station is not owned/controlled by DHS, off-street parking is only available in the paved lot controlled by the station’s private owners. Large numbers of commuting vehicles cannot be accommodated in this lot during the active marina season, from May 1 to October 31. During off-season periods, adequate parking would be available for construction workers.

3.11.6.3 Operation Consequences

3.11.6.3.1 Highways, Roads, and Marine Transportation

No substantial impact is anticipated on highways and roads with regard to the post-construction phase of the NBAF at the Plum Island Site. The number of employees on Plum Island would be increased from 200 at PIADC to approximately 550 people with the building of the new facility. Of the current PIADC employees, approximately 50% commute from New York and 50% from Connecticut. It is anticipated that the additional staff would commute to the island in the same ratios as the existing employees resulting in an additional 175 employees at each ferry terminal. The NBAF is projected to impact traffic in the Route 25, West Fork Long Island corridor and the Highway 95, Old Saybrook, Connecticut, corridor from the addition of 175 new employees making approximately 350 trips per day for each identified corridor. This impact would marginally increase the daily traffic volume within the both the Route 25, West Fork Long Island corridor and the Highway 95, Old Saybrook, Connecticut, corridor.

The existing PIADC facility has two fire trucks and an ambulance. A second ambulance is planned for purchase to provide emergency services to the NBAF. A fire brigade and a mutual aid agreement with the local community are also in place for the existing facility. The mutual aid agreement would need to be updated or revised for the NBAF. NBAF security measures on property would also be incorporated.

Cumulative Impacts

The ROI for traffic is Suffolk County. The evaluation of the effects of the NBAF on traffic is included in Sections 3.11.6.2 and 3.11.6.3. As previously stated, population growth in Suffolk County has increased only modestly in recent years. However, traffic congestion is a problem in the county due to an increase in the number of registered vehicles and licensed drivers. Construction and operation of the NBAF would result in only a negligible cumulative effect to traffic.

3.11.7 Umstead Research Farm Site

3.11.7.1 Affected Environment

3.11.7.1.1 Highways and Roads

The Umstead Research Farm Site is located in a mostly rural area outside the city boundaries of Butner, North Carolina, and is serviced by no primary or alternate means of public transportation. All property surrounding the Umstead Research Park Site is owned by the State of North Carolina and managed by agencies within the state.

The Umstead Research Farm Site is a 249-acre parcel located within the southwest portion of the 4,035-acre North Carolina Department of Agriculture and Consumer Services Umstead Research Farm. It shares a partial northern border with the North Carolina State University Beef Cattle Field Laboratory property; shares a partial southern border with the North Carolina Department of Juvenile Justice and Delinquency Prevention, C.A. Dillon School; and is adjacent to the Butner Federal Prison property to the southwest. The Umstead Research Farm Site is located approximately 4 miles northwest of the intersection of Interstate Highway I-85 and SR 1103, and approximately 2,208 feet due north from the intersection of Old Route 75 and SR 1120 (Veazey Road) (NDP 2007b). Figure 3.11.7.1.1- 1 provides a graphic of roads near the Umstead Research Farm Site.

3.11.7.2 Construction Consequences

3.11.7.2.1 Highways and Roads

Vehicles (such as light trucks) and heavy machinery (bulldozers, dump trucks, cranes, and cement mixer trucks) would be used onsite during construction of the NBAF. Construction vehicles would operate primarily during the daylight hours and be parked onsite over night. Parking for site or construction workers during hours of construction activities would be on or adjacent to the NBAF construction site. During construction activities, some vehicular and pedestrian traffic may be rerouted to avoid the construction areas. Any roadway or pedestrian walkway closures and associated rerouting would be limited to the immediate area of construction and would not include general area traffic within the immediate vicinity or effect regional traffic patterns. The construction phase would be temporary and in some cases may be intermittent, occurring only during certain construction stages or times of day. Mobilization and demobilization would result in trips of heavy equipment and light- and medium-weight vehicles for the entire 4-yr construction period. Deliveries of soil, backfill, and building materials are expected to occur an average of twice daily for a 6-month window of time (NDP 2007a).

Figure 3.11.7.1.1-1 — Umstead Research Farm Site Roads

3.11.7.3 Operation Consequences

3.11.7.3.1 Highways and Roads

According to a 2007 comprehensive transportation plan prepared by the County of Granville, North Carolina, the transportation corridors critical to the Umstead Research Farm Site include SR 1121 (Range Road) and Old Route 75 (Granville County 2007). The Umstead Research Farm Site would be accessed primarily from Range Road. Currently, a dirt road intersecting Range Road leads to the site. Approximately 4,100 feet of new road would replace the dirt road to connect the Umstead Research Farm Site to Range Road. Access to Range Road is from Old Route 75. Both routes have been designated as boulevards needing improvement by the County of Granville, Comprehensive Transportation Plan of 2007. Planned improvements to Range Road include (from Old Route 75 to Little Mountain Road) constructing new four-lane divided highway with raised median facility, curb, gutter, and 110 foot right-of-way (ROW). There would also be a need for a deceleration lane and a left turn lane on Range Road at the Umstead Research Farm Site driveway entrance to facilitate traffic flow (NDP 2007a). Planned improvements to Old Route 75 include (from Julian Daniel to Range Road) widening of Old Route 75 to a four-lane divided highway with raised median facility, curb, gutter, and 110 foor ROW (Granville County 2007).

The 2006 ADT for Range Road (SR 1121) was reported by the North Carolina Department of Transportation (NCDOT) as 381 vehicles per day and Old Route 75 was reported as 5,500 vehicles per day (NCDOT 2006). The Umstead Research Farm Site is projected to impact the transportation infrastructure in the identified transportation corridors by the addition of 350 new employees making approximately 1,000 trips per day. This impact would increase the average daily traffic volume on Range Road and Old Route 75 by an average of 140%. However, these roads are capable of providing service to these traffic loads without a substantial loss of service.

The Town of Butner would provide fire and emergency services to the NBAF (NCDCCPS 2007). Butner's fire fighting equipment includes two class-A pump trucks, one 95-foot ladder truck, one 2,000-gallon tanker, and one skid unit brush truck. The response time for fire and emergency services to the NBAF would range from 7 to 10 min based on a response distance of approximately 5.0 miles at an average response speed of 40 mph.

Cumulative Impacts

The ROI for traffic was determined to be the 2-mile radius around the Umstead Research Farm Site. The NBAF would result in an increase in traffic in the immediate area. However, no future traffic impacts have been identified since there are no future planned projects proposed for the area. Recent population growth trends for Granville County are located either in Oxford or the southern portion of the county. Therefore, it is not likely that the area surrounding the proposed NBAF site would experience any cumulative increase in traffic.

3.11.8 Texas Research Park Site

3.11.8.1 Affected Environment

3.11.8.1.1 Highways and Roads

The Texas Research Park Site is located in a mostly rural area far outside the city boundaries of San Antonio and is serviced by no primary or alternate means of public transportation. The Texas Research Park Site is a 100.1-acre parcel located within the northwest portion of the 1,236-acre Texas Research Park. The Texas Research Park is located approximately 4 miles west of Interstate Loop 1604 West, on State Highway 211 (Texas Research Parkway), between U.S. Highway 90 West and State Highway 1957 (Potranco Road) (Figure 3.11.8.1.1- 1) (BSA 2007).

The Texas Research Park Site is accessed from State Highway 1957 (Potranco Road) by boulevard-type streets that include Zeta Drive, Theta Drive, Lambda Drive, and Omicron Drive. The Texas Research Park NBAF site is also accessed from State Highway 211 (Texas Research Parkway) at Lambda Drive, a boulevard-type street (BSA 2007).

3.11.8.2 Construction Consequences

3.11.8.2.1 Highways and Roads

Vehicles (such as light trucks) and heavy machinery (bulldozers, dump trucks, cranes, and cement mixer trucks) would be used onsite during construction of the NBAF. Construction vehicles would operate primarily during the daylight hours and be parked onsite over night. Parking for site or construction workers during hours of construction activities would be on or adjacent to the construction site. During construction activities, some vehicular and pedestrian traffic may be rerouted to avoid the construction areas. Any roadway or pedestrian walkway closures and associated rerouting would be limited to the immediate area of construction and would not include general area traffic within the immediate vicinity or effect regional traffic patterns. The construction phase would be temporary and in some cases may be intermittent, occurring only during certain construction stages or times of day.

Mobilization and demobilization would result in trips of heavy equipment and light- and medium-weight vehicles for the entire 4-yr construction period. Deliveries of soil, backfill, and building materials are expected to occur an average of twice daily for a 6-month window of time (NDP 2007a).

3.11.8.3 Operation Consequences

3.11.8.3.1 Highways and Roads

According to a 2007 traffic analysis of FM 1957 (Potranco Road) prepared by Rodriguez Transportation Group for the Texas Department of Transportation (TXDOT), the transportation corridors critical to the Texas Research Park Site include State Highway 211 (Texas Research Parkway) and State Highway 1957 (Potranco Road) (TXDOT 2007a). Both transportation corridors would provide access to the NBAF. The first phase of the TXDOT SH 211 improvement project to install a two-lane highway with wide shoulders (between US 90 to SH 1957) was completed in 1991. The second phase of the improvement project, scheduled for completion by 2010, is to expand the roadway into a four-lane highway (TXDOT 2007b). With regards to SH 1957, planned improvements include the upgrade of the current two-lane, 6- to 8-foot shoulders with a 4-lane highway from SH 471 in Medina County to County Road 381 (approximately 2 miles west of the SH 1957/SH 211 intersection) and six lanes from County Road 381 to Loop 1604. The planned roadway cross-section would consist of raised medium, bike lanes, and side walks. The projected completion schedule for these improvements to SH 1957 are scheduled for completion by 2010 (TXDOT 2007c).

The projected 2010 ADT for State Highway 211 from US 90 to FM 1957 (Potranco Road) is estimated at 16,100 vehicles per day (TXDOT 2007a). The TXDOT traffic analysis also identified the anticipated 2010 peak hourly traffic volumes for intersections along the SH 1957 corridor. The peak hourly traffic volume in 2010 for the intersection of SH 1957 and SH 211 was estimated at 1,000 vehicles per hour (TXDOT 2007a). The Texas Research Park Site is projected to impact the transportation infrastructure in the identified transportation corridors by the addition of 350 new employees making approximately 1,000 trips per day. This impact would increase the average daily traffic volume on SH 211 by approximately 6.2%.

San Antonio would provide fire and emergency services to the Texas Research Park Site. Response time is currently 12 to 14 min. Bexar and Media County assets respond in emergency situations as well. Security for the Texas Research Park is currently provided by the University of Texas Health Sciences Center San Antonio Police force. The Texas Research Park also has an Entry Control Station that is manned 24-hours per day by security personnel, with periodic roving patrols.

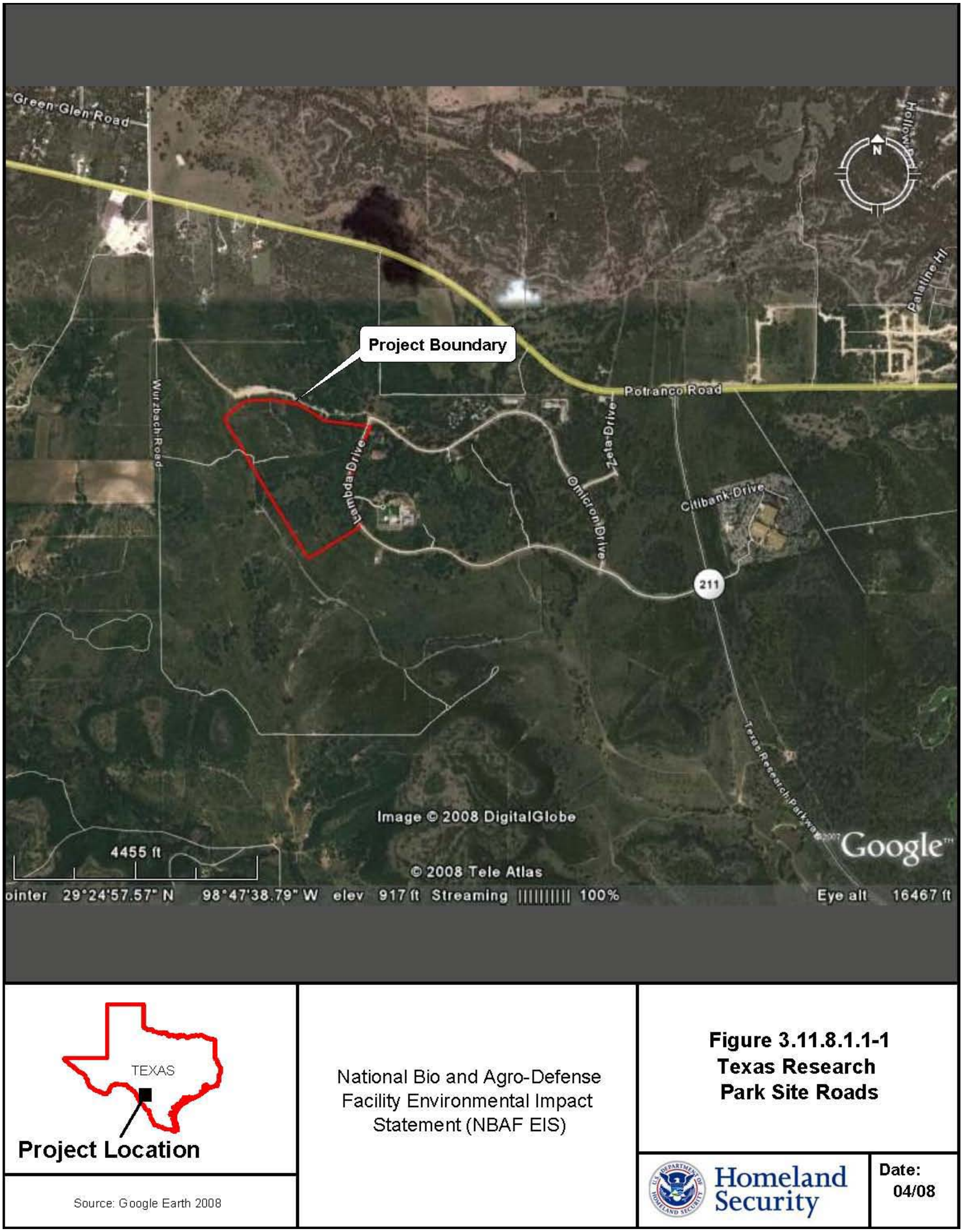


Figure 3.11.8.1.1-1 — Texas Research Park Site Roads

Cumulative Impacts

In Bexar County, there are several other public and private activities proposed or ongoing that would have potential to impact area highways and roads. Future planned projects in the vicinity of the Texas Research Park Site include a number of new residential development projects that would result in over 13,000 new residential units in the region. The estimated population generated from these planned developments would be 31,200 people for just residential, not including commercial, office, or industrial population from employment in the area.

The ROI for traffic is the area within a 2-mile radius of the Texas Research Park Site. The NBAF would result in an increase to local traffic. However, the amount of traffic generated by the NBAF would be minor when compared to the traffic potentially generated by the planned new residential units in the ROI. The residential traffic generated would total an estimated 135,320 daily trips and 13,532 peak hour trips. An increase in associated commercial/industrial activity would produce an additional estimated 40,000 daily trips.

3.11.9 Transportation Shipments of Infectious Materials

Regulations concerning transportation of packages of biological or other agents are intended to ensure that the public and workers in the transportation chain are protected from exposure to any agent in the package. Transportation of biological agents is regulated by the Public Health Service, USDOT, U.S. Postal Service, the International Air Transport Association, and the Occupational Safety and Health Administration. Statistical data show that these regulations are effective in protecting both the contents of packages and the persons who handle the packages. As of November 2005, no cases of illness due to the release of a diagnostic specimen or infectious substance during transport were reported. In addition, only 106 (0.002%) of the 4,920,000 primary containers shipped in 2003 to worldwide laboratories and other destinations were reported broken during transit. In each of the 106 reported breakages, absorbent in appropriately prepared packages contained the leaking material, and none of the secondary or outer containers were damaged (ASM 2005).

The USDOT defines an “infectious substance” as a material known or reasonably expected to contain a pathogen. A pathogen is a microorganism (including bacteria, viruses, rickettsiae, parasites, or fungi) or other agent, such as a proteinaceous infectious particle (prion) that can cause disease in humans or animals.

Infectious substances in transit on U.S. transportation infrastructure are governed by USDOT regulations (49 Code of Federal Regulations [CFR] 171, 172, 173, and 178). Accidents and incidents involving infectious substances and materials are tracked and reported by USDOT. Based on USDOT data, the general population risk from 1999 to 2003 from all hazardous materials transportation was 1 in 23,350,000 or 4.2 fatalities per 100 million shipments (USDOT 2005).

An annualized listing of infectious substance incidents compared to total incidents from all hazardous substance classes is provided below as Table 3.11.9-1. The number of infectious substance incidents varied from 0.2% to 5.2% of the total incidents for all hazardous material classes.

In Georgia, hazardous material incidents (546) accounted for only 2.9% of the national hazardous material incidents total (19,125) for 2007 (USDOT 2007). By comparison, the general population risk per year for motor vehicle accidents is 1 in 7,700. In Kansas, hazardous material incidents (397) accounted for only 2.1% of the national hazardous material incidents total (19,125) for 2007 (USDOT 2007). In Mississippi, hazardous material incidents (148) accounted for only 0.8% of the national hazardous material incidents total (19,125) for 2007 (USDOT 2007). In New York, hazardous material incidents (530) accounted for 2.8% of the national hazardous material incidents total (19,125) for 2007 (USDOT 2007). In North Carolina, hazardous material incidents (492) accounted for 2.6% of the national hazardous material incidents total (19,125) for 2007 (USDOT 2007). In Texas, hazardous material incidents (1,556) accounted for 8.1% of the national hazardous material incidents total (19,125) for 2007 (USDOT 2007).

Operations of the NBAF would require between 2,600 and 4,160 shipments per year of infectious materials. Nationally, a range of 1,460,000 to 29,200,000 shipments of infectious materials are transported within the United States on a yearly basis (USDOT 1998). The number of infectious materials shipments projected for the NBAF operations represents less than one-half of 1% of the annual infectious materials shipments in the United States. In addition, strict adherence to state and federal transportation and packaging requirements provides reasonable expectation that a transportation accident would not release an infectious organism resulting in exposure to humans or animals. An increase in infectious material traffic from theNBAF would not materially increase the risks associated with the shipment of infectious substances.

Table 3.11.9-1 — Infectious Substance Incidents in the United States

Hazardous Material Class	Year	Incidents	Percent of Total	Hospitalized	Non-Hospitalized	Fatalities	Damages
		No.		No.	No.	No.	$
All	2007	19,063	100.0%	35	175	10	87,331,467
Infectious (Etiologic)		292	1.5%	0	1	0	79,000
All	2006	20,433	100.0%	30	203	6	70,895,432
Infectious (Etiologic)		1,067	5.2%	0	0	0	12,583
All	2005	16,006	100.0%	173	780	36	59,368,001
Infectious (Etiologic)		256	1.6%	0	0	0	0
All	2004	14,982	100.0%	44	245	13	52,586,831
Infectious (Etiologic)		292	1.9%	0	4	0	36,519
All	2003	15,462	100.0%	17	102	15	53,602,375
Infectious (Etiologic)		34	0.2%	0	4	0	4,390

Note: USDOT 2007 data.

3.12 EXISTING HAZARDOUS, TOXIC, OR RADIOLOGICAL WASTE CONTAMINATION

3.12.1 Methodology

This section describes the baseline environmental conditions at each of the proposed NBAF locations that relate to the possible presence of environmental contamination. (Waste generation and management activities associated with the construction and operation of the proposed NBAF are discussed in Section 3.13.) Existing contamination may be the result of former or current operations at the proposed site locations or at adjacent and nearby properties if hydrogeologic conditions suggest that possible contamination at these properties could have migrated to the proposed location. Baseline environmental conditions relating to possible contamination must be taken into account during the construction phase of the project to protect the health and safety of workers at the construction site. If environmental contamination is suspected at or near the NBAF during the operational phase of the project, characterization and remediation may be required. In severe cases, environmental contamination has the potential to disrupt the operation.

Assessing baseline environmental conditions is also performed as part of the "due diligence" process associated with acquiring commercial property. This process entails evaluating the potential liabilities associated with the remediation of contamination arising from former activities at the property or originating from neighboring locations.

Most of the information presented on each of the proposed locations derives from Phase I Environmental Site Assessments (ESAs) performed in accordance with the requirements of American Society for Testing and Materials (ASTM) E-1527-05 or previous versions of this standard that were in effect at the time the assessments were performed. The primary goal of these studies is to determine whether there is a "recognized environmental condition," commonly called a "REC" indicating:

> the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. (ASTM E-1527-05)

The presence of a REC generally indicates that further studies must be performed to dismiss the REC or to characterize and manage the risks to the project posed by the environmental conditions that are present. If further studies (e.g., a Phase II ESA or a specialized study) are required, they may be performed before or after an NBAF site is chosen assuming a decision is made to proceed with the action alternative.

The authors of Phase I ESAs evaluate the potential for contamination by researching the

- Current and prior uses of the land proposed for the NBAF location; and
- Current and prior uses of adjacent properties and locations.

The following types of data are used to inform their evaluations:

- Visual assessments;
- Land records relating to past uses;
- Aerial photographs;
- Data from regulatory databases suggesting that contamination could be present, or that operations with the potential to cause contamination are present, or were present in the past;
- Data from other sources, such as interviews with key site personnel familiar with the history of use of the proposed location and adjacent locations; and
- Monitoring data for environmental media, to the extent it is readily available.

Environmental sampling is not required as part of Phase I ESAs performed in accordance with ASTM E-1527-05. Phase I ESAs are preliminary studies designed to reduce, but not eliminate, uncertainties related to existing contamination. In addition, all Phase I ESAs have limitations (e.g., related to scope, time frame, etc.), data gaps, or deviations from ASTM E-1527-05. Understanding these assessment-specific limitations, data gaps, and deviations is necessary to place ESA findings, recommendations, and RECs in their proper context.

None of the data from the Phase I ESAs and other sources presented below would rule out any of the sites being considered for the NBAF location, assuming a build alternative is implemented. In some cases, however, additional data gathering must be performed to mitigate the possible impacts of existing contamination.

3.12.2 No Action Alternative

Under the No Action Alternative, the existing PIADC would continue to operate. Because this alternative involves no new construction or operations beyond ongoing infrastructure upgrades, baseline environmental conditions would have no new impacts on continued operations.

3.12.3 South Milledge Avenue Site

3.12.3.1 Affected Environment

Geo-Hydro Engineers conducted a Phase I ESA at the South Milledge Avenue Site in January 2007 (Geo-Hydro Engineers 2007). The purpose of the assessment was to perform due diligence on behalf of UGA, the site owner, before the sale of the property and to determine if there is a REC as defined under ASTM E-1527-05.

The scope of the assessment included

- Reviewing site history using aerial photographs, maps and data, and historical use information;
- Performing site reconnaissance to identify present use and improvements, topography, hydrology, presence of hazardous chemicals and polychlorinated biphenyls (PCBs), wells, pits, sumps, storage tanks, water sources, and utilities;
- Performing a windshield tour of adjoining properties;
- Taking photographs to document site conditions;
- Conducting interviews with persons knowledgeable about the property; and
- Reviewing records related to regulatory listings [National Priorities List (NPL); Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS); Underground Storage Tanks (USTs)], subsurface soil conditions, geology, and former solid waste disposal.

No environmental sampling was performed (Geo-Hydro Engineers 2007).

The assessment found that the property encompasses 67 acres of pastureland that is located on the UGA Whitehall Farm and is currently used by UGA Equestrian Team. Adjoining property to the north, west, and south is wooded and pasture. There are some residences adjoining the northeast portion of the parcel that are located off a private road. The UGA Animal Science Arena is located to the southeast. The property also serves as a land buffer to the Middle Oconee River (Geo-Hydro Engineers 2007).

According to the property owners (the UGA Board of Regents), the property has historically been used for agricultural purposes. It has been owned by UGA since 1936. Historical records and aerial photographs dating back to 1938 indicate that the properties surrounding the South Milledge Avenue Site have been used for agricultural purposes since the 1940s. However, deed records indicate that a yarn mill (Whitehall Mills) was located on South Milledge Avenue (one of the roads bounding the South Milledge Avenue Site) in the 1920s and 1930s (Geo-Hydro Engineers 2007).

Based on a search of regulatory databases for records that could indicate potential contamination on properties in the vicinity of the proposed South Milledge Avenue Site, Geo-Hydro Engineers determined that three properties needed additional review. Their findings with respect to these properties are summarized below.

- The Georgia Forestry Commission (GA FC), Clarke-Oconee Unit reported a suspected leaking underground storage tank in 1997 to the Georgia Environmental Protection Division (EPD). Records from the Georgia EPD indicate that this site was closed in 2001 with a “No Further Action” status. The GA FC site is approximately 0.5 miles east of the South Milledge Avenue Site and is at a higher elevation. However, because it “appears to be in different drainage basin than the South Milledge Avenue Site,” Geo-Hydro Engineers does not consider it to be a REC under ASTM E-1527-05 (Geo-Hydro Engineers 2007, p. 9).
- The UGA Hazardous Materials Treatment Facility (UGA HMTF) is a large quantity generator of hazardous waste and is listed in databases pertaining to *Resource Conservation and Recovery Act* (RCRA) corrective action (CORRACTS); the *Comprehensive Environmental Response,*

Compensation and Liability Act (CERCLA) [it is a "No Further Remedial Action Planned" (NFRAP) site in the CERCLIS]; and spills in the state of Georgia (due to a sewage spill into the Oconee River). The Will Hunter Road location of this site is approximately 1 mile northwest of the South Milledge Avenue Site. The data indicated that the UGA HMTF had a total of 80 RCRA violations but that all had been brought into compliance by July 2005. According to the CORRACTS database, there are four RCRA Facility Investigations (RFIs) and the latest RFI Workplan, approved December 19, 2005, determined that migration of contaminated groundwater was under control and groundwater monitoring will continue to confirm containment of contaminated groundwater. Because the UGA HMTF location "does not appear to be upgradient from the subject property," Geo-Hydro Engineers does not believe it constitutes a REC with respect to the South Milledge Avenue Site (Geo-Hydro Engineers 2007, p. 9).

- The University of Georgia Milledge Avenue Site at the former UGA Botanical Gardens landfill is referenced as a solid and hazardous waste site in regulatory listings. A release of lead in groundwater was reported, and cleanup was being conducted for source materials, soil, and groundwater. Although this site is "at a higher elevation and may be upgradient" to the South Milledge Avenue Site, Geo-Hydro Engineers concludes that it is unlikely that past or present releases have resulted in contamination of the soil or groundwater there because of it is more than 1 mile north of the site, and it is in a separate drainage basin (Geo-Hydro Engineers 2007).[17]

The Geo-Hydro Engineers report discusses another property, the Whitehall Mills facility, which was not referenced in the regulatory databases. The facility operated in the 1920s and 1930s. Because former industrial facilities have the potential to contaminate soil or groundwater and the former Whitehall Mills facility location "is at a higher elevation than and may be upgradient to" the South Milledge Avenue Site, it is an exception to the Geo-Hydro Engineers conclusion that there is no evidence of a REC in connection with the site. The Geo-Hydro Engineers report concludes, however, that the potential for a release of hazardous substances or petroleum from the former Whitehall Mills facility to the South Milledge Avenue Site is low because of "the lack of local, state, or federal records for the Whitehall Mill facility and the amount of time elapsed since operations have ceased" (Geo-Hydro Engineers 2007, p. 15).

Overall, the conclusion from the Geo-Hydro Engineers Phase I ESA is that "the potential for a past or present release of hazardous or petroleum substances leading to contamination of soil or groundwater at the subject property [the South Milledge Avenue Site] is low" (Geo-Hydro Engineers 2007, p. 15).

Terracon Consultants conducted an updated Phase I ESA for this property in the fall of 2007. Their regulatory database search turned up the GA FC, Clark Oconee Unit, and the UGA HMTF discussed above and assessed by Geo-Hydro Engineers. However, because these facilities are more than 3,000 feet from the proposed NBAF site, Terracon determined that they were not of environmental concern in relation to the South Milledge Avenue Site (Terracon 2007f).

Terracon's updated investigation on the Whitehall Mills facility determined that the former yarn mill was located approximately 2,500 feet and cross-gradient from the South Milledge Avenue Site and therefore was not of environmental concern. Terracon's conclusion with respect to the Whitehall Mills facility is as follows, "Based on distance and topographic gradient, the former yarn mill is not considered a REC to the site" (p. 18). Terracon's overall recommendation is that there are no RECs associated with the South Milledge Avenue Site that warrant further testing or investigations at this time (Terracon 2007f, pp. 18-19).

[17] Newspaper stories from the late 1990s/early 2000s provide additional information about the contamination that occurred at the UGA Botanical Gardens landfill and the subsequent cleanup that occurred. These stories report that UGA buried radioactive and chemical waste from its science labs at the Milledge Avenue Site until 1979. Several other area agencies also used the landfill, including the U.S. Forest Service and the EPA's Athens research lab. Solvents from the site leaked into the groundwater for the City of Athens, and soils at the site contained relatively small amounts of chloroform, benzene, and methylene chloride. The cleanup involved a water treatment system downstream of the landfill, construction of a clay cap and subterranean cut-off wall, and phytoremediation to clean up the soil (Kiser 1998, McLaughlin 2002, and Melancon 2001).

3.12.3.2 Environmental Consequences

Because there are no RECs at the proposed South Milledge Avenue Site or at adjoining properties, no construction or operational impacts are anticipated due to existing hazardous, toxic, or radiological waste contamination.

3.12.4 Manhattan Campus Site

3.12.4.1 Affected Environment

Allied Environmental Consultants conducted a Phase I ESA of the Manhattan Campus Site KSU in April 2007. The work included:

- A visual inspection of the site,
- A review of available historical documents and sources,
- A review of previous ownership and site usage, and
- A review of reasonably ascertainable environmental records for the site (AEC 2007).

The ESA also included an inspection of the adjoining properties and surrounding area to determine if businesses or other parties engage in activities that may affect environmental conditions at the site. Allied Environmental Consultants contacted federal, state, and local agencies to determine if potential environmental problems exist related to the site or adjoining properties, and they interviewed utility and property representatives about environmental conditions on or around the property (AEC 2007).

The principal current land use of the Manhattan Campus Site is agricultural. It includes pasture, animal husbandry structures (e.g., animal enclosures, barns, feed mills), and woods. An electrical substation owned by Westar Energy and the BRI occupy small portions of the property. Land uses for adjoining properties include other KSU facilities (teaching, research, and agricultural storage facilities; a public safety/fire department building; and athletic fields), residential housing, and a product research and development company. Past uses of the site appear to have been primarily agricultural (animal husbandry and feed milling), associated with the educational mission of the university. The site development apparently dates to the late 1800s when the facility was established as a land-grant institution (AEC 2007).

Allied Environmental Consultants reviewed federal and state environmental records (relating to RCRA, CERCLA, and other environmental programs) obtained from Environmental Data Resources, Inc., and the Kansas Geological Society to identify possible sources of existing contamination. Using these records, Allied Environmental Consultants identified and discussed the following sites that are within a 0.5 miles of the Manhattan Campus Site:

- KSU is a RCRA large-quantity generator of hazardous waste. Medical, hazardous, and universal waste is stored in a building less than 0.125 miles north-northeast of the Manhattan Campus Site and shipped off-site for treatment and disposal at least every 90 days. A closed landfill [known as the Old Chemical Waste Landfill (OCWLF)] between 0.25 and 0.5 miles west-northwest of the Manhattan Campus Site is responsible for a number of regulatory database listings found including a CERCLIS NFRAP site listing, inclusion on the CORRACTS list, and groundwater monitoring wells included on the Kansas Registry of Water Wells. (These database listings indicated the potential for environmental contamination.) The OCWLF is currently in a monitored natural attenuation program that is overseen by the KDHE. Contaminants of concern include VOCs and radiochemicals in the groundwater. Because groundwater flow from the OCWLF site is toward the northeast and away from the Manhattan Campus Site, the contaminated groundwater would have no adverse impact on the facility.[18] RCRA enforcement records show 42 KSU violations associated with the storage facility and the OCWLF; 41 of these violations have been resolved (AEC 2007).

- The KSU Agronomy Research Farm on Kimball Avenue, which is less than 0.125 miles north-northeast of the Manhattan Campus Site, has a compost landfill registered with the KDHE. No records indicate contamination. It also has an aboveground storage tank (AST) for used oil storage. A leaking underground storage tank associated with the facility was discovered in 1991 and later closed. Levels of contamination at the site did not exceed state cleanup levels (AEC 2007).
- The fire department is a small-quantity generator (SQG) of hazardous waste with no reported violations. It also has an active diesel UST with no reported problems. The fire department is between 0.125 and 0.25 miles northwest of the Manhattan Campus Site.

Other items noted in the Allied Environmental Consultants Phase I ESA involving properties that are just beyond 0.5 miles from the Manhattan Campus Site are summarized below.

- Formerly leaking USTs that were closed in compliance with state cleanup levels were identified at the KSU Manhattan Transmitter Site and the KSU Denison/Marlotte site. Both sites are just over 0.5 miles west of the Manhattan Campus Site (AEC 2007).
- Besides the groundwater monitoring wells associated with the OCWLF, wells were also found associated with the following landowners all located between 0.5 and 1 mile from the Manhattan Campus Site: Samarrai, Leiszier Oil Co. and Amoco Remediation (AEC 2007).

The overall conclusion of the Phase I ESA performed by Allied Environmental Consultants for KSU is that the assessment "revealed no evidence of RECs in connection with the property" (AEC 2007, p. iii).

Terracon performed a subsequent Phase I ESA in the fall of 2007. Their findings were similar to those of Allied Environmental Consultants, except that

- They identified a leach field adjacent to the east of the site that represents a REC warranting further investigation, and
- They recommended that an on-site septic system associated with an inactive recycle storage building be investigated for proper closure in accordance with applicable regulations (Terracon 2007c, p. iii.).

Both of these environmental conditions were identified based on interviews with KSU personnel during a site visit. Terracon's presentation of the information that led to these findings is quoted below.

> East of the site is the current location for the KSU Swine Research facility. During a site visit, Terracon noted the footprint of the former serum (molasses) making facility. West of this facility is a leach field associated with former serum plant operations. According to information provided by KSU professor Dr. Emeritus McKee, KSU operated this building to develop a serum to prevent "Blackleg" for animals. Operation of this plant stopped prior to 1979 and the plant was demolished in 2001. Dr. McKee also indicated that wastes discharged to the leach field would have been sanitary wastes and wash down from the serum equipment (Terracon 2007c, p. 25).
>
> Mr. Carlson [KSU Facilities Planning Office] reported to Terracon that a septic system which has been inactive for more than 30 years was present at the recycle storage building (#12). This facility was previously called the "herdsman's house" and was previously used as a residence. Mr. Carlson did not know if the septic system was properly abandoned according to local and/or state regulations. The system is reported to be located southwest of this

[18] A restrictive covenant circumscribes future uses of the OCWLF site, which is between 0.25 and 0.5 miles west-northwest of the proposed Manhattan Campus Site. It requires preservation of the waste containment system; protection of permanent survey markers and benchmarks; consultation with the KDHE before commencement of any on-site excavation, construction, etc. (except for the installation of monitoring wells or other monitoring devices); and continued maintenance of waste containment and monitoring systems if title to this property is transferred (State of Kansas 1989).

building. Stressed vegetation or noxious odors was not observed in the vicinity of Building #12. According to Mr. Carlson, the remaining site facilities are connected to the City of Manhattan sanitary sewer system (Terracon 2007c, p. 21).

3.12.4.2 Environmental Consequences

A leach field adjacent to the site represents a REC warranting a subsurface investigation. This type of investigation could determine if the presence of hazardous constituents associated with former serum plant operations could have construction impacts or require remediation before construction occurs. In addition, an on-site septic system should be closed in accordance with applicable regulations if there is no evidence that this has not already occurred. Assuming a build alternative is implemented and the Manhattan Campus Site is the chosen location, DHS would pursue a Phase II ESA and any other necessary studies before construction begins.

3.12.5 Flora Industrial Park Site

3.12.5.1 Affected Environment

David Holman, PE, conducted a Phase I ESA for the Flora Industrial Park Site in 1993 for the Town of Flora and the Madison County Development Authority. The objective of the assessment was to assist the Town of Flora and Madison County in assessing the risk associated with acquiring the property for the purpose of developing it into an industrial park (Holman 1993).

The study involved

- Examining the chain of title for the previous 50 years;
- Reviewing current and past zoning and land use;
- Interviewing past owners;
- Reviewing information in the files of state regulatory agencies including listings for the NPL, CERCLIS, RCRA sites, and leaking USTs; and
- Performing a site inspection.

The state file review encompassed looking for sites within a 1-mile radius of the property. No sampling was performed (Holman 1993).

The study found that the property had been used exclusively for agricultural purposes for at least 50 years. No evidence of environmental problems was found within a 1-mile radius of the site in the files of state regulatory agencies. Because there was no evidence of environmental contamination, the risk of environmental liabilities was determined to be low. The Holman assessment noted the presence of three old, abandoned water cisterns that appeared to be free of contamination (but they have not been tested) (Holman 1993).

Mendrop~Wages performed an updated Phase I ESA in April 2007 for the MCEDA. The assessment involved records review and gathering information from site reconnaissance and interviews. The primary changes that occurred in the intervening 14 years (between 1993 and 2007) with respect to the Flora Industrial Park Site are as follows:

- The Primos manufacturing facility was built to the west of the Flora Industrial Park Site.
- While the Flora Industrial Park Site and its immediate environs remain for the most part undeveloped, Madison County, experienced “exponential growth” since the early 1990s with its population almost doubling.
- Property improvements including access points and an overhead electrical line were noted in the updated assessment (Mendrop Wages 2007).

The Mendrop~Wages assessment did not reveal the presence of any adverse environmental conditions on the Flora Industrial Park Site that would negatively affect any proposed site development activities. The presence of the abandoned water cisterns (mentioned in the 1993 Holman report) were noted as evidence of former residential structures once located on the property but not as sources of potential contamination (Mendrop Wages 2007).

Terracon performed a third Phase I ESA for this property in the fall of 2007. The information and conclusions presented in the Terracon report are similar to the previous reports, except that the presence of regulatory database listings referring to a Hurricane Katrina debris disposal site and two facilities with USTs are noted. According to Terracon, these listings do not present environmental concerns for the following reasons:

- The debris disposal site was apparently never used.
- One UST listing refers to a gasoline UST installed in 1978 and removed in 1994. No listings suggest environmental contamination, and the UST's former location is more than 1,500 feet southwest and topographically separated from the Flora Industrial Park Site.
- There is apparently a 12,000-gallon diesel UST at a facility 3 miles south of the Flora Industrial Park Site. It does not represent an environmental concern based on its distance from this location (Terracon 2007b).

An interview conducted by Terracon with the Executive Director of the MCEDA established that the water cisterns associated with former tenant houses on the property had been filled in by the Town of Flora. The Terracon report concludes that there are no environmental conditions associated with the Flora Industrial Park Site that warrant additional investigation (Terracon 2007b).

The protective covenants imposed by the MCEDA on Flora Industrial Park tenants are included as Appendix C.7.4 in the State of Mississippi's February 2007 submission of additional information to their expression of interest for potential sites for the NBAF. The objective of these covenants is to ensure that the park remains a desirable site for the location of industry, manufacturing, processing, and related operations. These covenants will remain in effect until January 1, 2020, or until they changed, altered, or amended by the legally constituted zoning authority or by the owners of the majority of the acreage in the Flora Industrial Park. Paragraph 109.01-07 of these covenants specifically prohibits the "processing, incineration, or storage of dead animal materials, including offal reduction; curing, tanning, and storage of hides; distillation of bones; and rendering of fat" (MS 2007, Appendix C.7.5).

3.12.5.2 Environmental Consequences

Because there are no RECs at the Flora Industrial Park Site or at adjoining properties, no construction or operational impacts are anticipated due to existing hazardous, toxic, or radiological waste contamination. However, protective covenants prohibiting the processing, incineration, or storage of dead animal materials may need to be changed or clarified. As the owner of the Flora Industrial Park, the MCEDA is authorized to change this covenant if this is necessary or prudent to clarify that it does not apply to a scientific research facility, such as the NBAF (personal communication between Chuck Pergler, Tetra Tech, Inc., Duane O'Neill, MCEDA, January 22, 2008). Assuming a build alternative is implemented and the Flora Industrial Park Site is the chosen location, DHS would work with the Madison County Economic Development Authority to determine if a clarification or change to the Flora Industrial Park protective covenants is necessary.

3.12.6 Plum Island Site

3.12.6.1 Affected Environment

Plum Island is a self-contained island in the Long Island Sound located approximately 12 miles southwest of New London, Connecticut, and 1.5 miles from the northeast tip of Long Island, New York. It began operation as a Department of the Army fort in 1879 (Fort Terry) and operated in that capacity until it was declared surplus in 1948. It served as a U.S. Army Chemical Corps facility until 1954 when ownership was transferred to the U.S. Department of Agriculture's Agricultural Research Service (ARS) to develop and maintain a diagnostic capability for exotic animal diseases foreign to the United States and to conduct research on the prevention and control of these diseases. Many of the former military fortifications found on Plum Island were used in the initial decades of PIADC's operation as animal holding facilities. Later, various chemicals and other surplus materials were stored and abandoned in the military batteries. PIADC remained under ARS control until June 2003 when it was transferred to the DHS (Terracon 2007a; BMT Entech 2006).

The proposed Plum Island Site is adjacent to the current PIADC laboratories; these existing laboratories are west of the proposed Plum Island Site. The Long Island Sound is to the north; the wastewater treatment plant, undeveloped land, and wetlands are to the south; and undeveloped land and a quarry pit are to the east (Terracon 2007a).

A management-imposed "nothing leaves the island" policy that was instituted at the outset of PIADC's establishment meant that all waste streams and their residuals generated on the island remained there; they could not be transported off the island for further treatment and/or disposal. The purpose of the policy was to ensure that waste removal processes would not be responsible for allowing biological agents under study to escape the confines of the island. This policy encompassed all materials and objects used, consumed, and discarded at PIADC including wastes generated by diagnostic and research activities. Items that could be burned were incinerated in one of several incineration units. Non-burnable materials (metal, glass, and ceramics) and items too large to be incinerated were chemically and/or thermally decontaminated and disposed in or on the land (BMT Entech 2006; Terracon 2007a).

In 1991, ARS approved a new biological safety plan that modified safety procedures pertaining to waste handling and disposal practices. This plan permitted the removal of most solid waste streams after appropriate decontamination protocols were observed. Some waste streams were subsequently transferred from the island to permitted treatment, storage, and disposal facilities on the mainland (BMT Entech 2006).

In recent years, clean up and removal actions have occurred at multiple sites where wastes were historically disposed. These actions were coordinated with appropriate federal, state, and local authorities responsible for ensuring compliance with applicable environmental and public health regulations including RCRA and CERCLA (Terracon 2007a; BMT Entech 2002, 2004, 2006, 2007a, 2007b, 2007c, and 2007d).

Pursuant to a 1994 Compliance Order issued by the U.S. Environmental Protection Agency (EPA) Region 2 under RCRA, PIADC was required to assess 87 sites (buildings) to determine if their operational and hazardous waste compliance history suggested they had been used for hazardous waste treatment, storage, or disposal. PIADC was further required to develop and implement a Closure Plan in accordance with RCRA Interim Status regulations at sites where hazardous waste had been managed. After the initial site investigations and assessments, regulatory oversight was transferred to state (NYSDEC) and county (Suffolk County Department of Health Services) regulators (BMT Entech 2006).

The first phase of the assessment found that 53 of the 87 sites had not been associated with hazardous waste management. Thirteen of the 34 remaining sites were eligible for "administrative closure," that is no further actions or investigations were required for them to be considered closed in accordance with RCRA. The 21 remaining sites requiring further action (i.e., screening, contamination removal, and remediation) were comprised of individual buildings and structures having a broad range of historical use at Plum Island. Extensive media sampling in and around each of the 21 buildings/structures was performed. As a result, no further action was required at 3 of the 21 sites. Remedial and removal actions were taken to achieve RCRA closure at the remaining 18 sites (BMT Entech 2006), 3 of which (Buildings 101, 103, and 115) are located in close proximity to the Plum Island Site.

Under CERCLA, investigations were undertaken at PIADC to evaluate the nature and extent of waste disposal activities that had historically occurred on the island and to determine if Plum Island was eligible for placement on the NPL.[19] A September 2002 BMT Entech report describes the results of initial CERCLA investigations undertaken at PIADC. These investigations of potential waste disposal areas encompassed 49 sites: 21 Waste Management Areas (WMAs), 15 additional Areas of Potential Concern (AOPCs) (identified from historical aerial photography), 10 historical Army batteries, and 3 Army support structures. Regulator-approved work plans were developed in support of the site investigation and were implemented during a field program conducted in 1999. Findings from the site investigations resulted in specific recommendations for the 49 individual sites that were investigated. Regulatory and PIADC personnel agreed to these recommendations at a meeting in May 2001. A small number of sites required post-meeting investigations; the first phase of these investigations occurred in 2002 (BMT Entech 2002).

The investigatory phase of the field program involved the collection of more that 1,000 media and quality assurance/quality control samples that were analyzed for volatile and semi-volatile compounds, pesticides, PCBs, and metals. Screening of the risks posed by Plum Island contamination to possible targets and receptors suggested that the site should not be placed on the NPL. Investigation by excavation (IBE) followed by removal was performed at 10 sites that contained large quantities of laboratory wastes, including glassware, bottles, and small quantities of hypodermic syringes and needles. These laboratory wastes had been autoclaved prior to disposal to render them biologically inactive. Because of the presence of sharps in these materials, they were considered treated regulated medical waste by the State of New York and they could not be reburied. The IBE project also encompassed a limited surface removal action at two sites to recover scrap metal (BMT Entech 2002).

Of the original 49 CERCLA investigation sites, 3 are partially within the footprint of the Plum Island Site (Terracon 2007a). At the site known as WMA 4/AOPC11, IBE and removals were performed. According to BMT Entech, initial sampling results showed a small number of polycyclic aromatic hydrocarbon and numerous metal exceedances of screening benchmarks in soils data. These same analytes were observed in the confirmation data in roughly the same frequency and concentrations as that encountered in the 1999 data. The elevated concentrations of some metals were attributed to the construction debris and metallic materials encountered and recovered. The benzo(a)pyrene exceedance may be attributable to the past disposal of ash in this landfill. There were numerous PCB exceedances but not at particularly high levels. Groundwater samples collected in 1999 revealed several dissolved metals in excess of state drinking water standards, and some of them (calcium, potassium, sodium, and magnesium) were present at levels in excess of the same analytes in overlying soils. BMT Entech attributes this result to salt water encroachment from the nearby Long Island Sound. BMT Entech does not consider groundwater contamination of potable island water supplies to be a realistic threat from WMA 4/AOPC 11 because all potable wells on the island are located a considerable distance upgradient (BMT Entech 2007d).

At the site known as WMA 6, IBE and removals were performed. Sampling results in soil before IBE showed metal exceedances of screening benchmarks and one VOC exceedance. Confirmation sampling results showed no VOC exceedances but broader and more numerous metal detections. BMT Entech attributes the elevated metals concentrations to construction debris and metallic materials encountered and recovered at this site. No groundwater exceedances were detected in initial samples, and no additional samples were collected. Because PIADC potable well fields are located a considerable distance upgradient of WMA 6 and would not be impacted by remaining contaminants, BMT Entech recommends no further action under CERCLA (BMT Entech 2007d).

At the site known as AOPC 6, IBE and removals were performed. Post-remediation in 1999 sampling results showed exceedances for some metals and benzo(a)pyrene. Post-removal sampling also contained a PCB detection of 21,000 parts per billion (which is more than two times New York State's 10,000 parts per billion

[19] The NPL lists sites where the extent of known or threatened releases of hazardous substances, pollutants, or contaminants makes clean up of the site a "national priority."

subsurface benchmark for this substance). The elevated concentrations of some metals are likely attributed to construction debris and metallic materials encountered and recovered at this site, and the benzo(a)pyrene may be attributable to the past disposal of ash in this landfill. Because the PCB detection was in a sample taken at 6-8 feet below ground surface, BMT Entech did not believe a removal/remedial response was warranted to address this exceedance. Because PIADC's existing potable well fields are located a considerable distance upgradient from AOPC 6 and would not be impacted by residual contamination, BMT Entech recommends no further action under CERCLA (BMT Entech 2007d).

Terracon performed a Phase I ESA at the proposed NBAF location on Plum Island between October and December 2007. It included a regulatory database review, historical and physical records review, interviews, user-provided information, and a visual reconnaissance of the site and adjoining properties. No environmental sampling was performed (Terracon 2007a). This ESA was completed before the BMT Entech confirmation sampling and recommendations discussed in the previous paragraphs were available for the three CERCLA investigation sites that are partially within the footprint of the Plum Island Site. The Terracon ESA was subsequently revised in March 2008 to incorporate the results of the BMT Entech confirmation sampling.

Terracon's review of state and federal environmental databases found entries for the PIADC and its support facilities (e.g., Plum Island Ferry Terminal) (Terracon 2007a). The primary environmental concerns raised by these sources involve the possible environmental impacts of PIADC's former waste management practices and the potential for contamination arising from the island's extensive fuel storage and distribution system.

Terracon's review of BMT Entech's report found that slight exceedances of PAHs, metals, and PCBs exist within the proposed development area. If the proposed NBAF is constructed at the Plum Island Site, Terracon recommends that a detailed Health and Safety Plan and Soil Management Plan be developed prior to the commencement of construction activities. The Health and Safety Plan should identify the risks associated with working at the site and establish proper procedures and protocols for workers at the site during construction. In addition, because of the potential to generate contaminated soil during excavation, a Soil Management Plan would be required to properly identify and dispose of contaminated material (Terracon 2008).

The Terracon Phase I ESA also presents information relating to PIADC's fuel storage and distribution system and secondary containment systems. PIADC uses No. 2 fuel oil for heating, hot water, emergency power, and incineration. It also uses gasoline for vehicles, diesel for heavy machinery and ferries, and used oil for heating.[20] In total, the island stores approximately 650,000 gallons of petroleum products. The majority of this total is fuel oil that is stored in three 210,000 gallon aboveground storage tanks (ASTs) that are fueled by a tanker from the harbor area through a designated aboveground pipeline. These ASTs, six USTs, as well as tractor-trailer-mounted generators and boilers are located to the west of the existing laboratory, approximately 1,000 feet from the Plum Island Site and cross-gradient (Terracon 2007a).

With regard to spills, Terracon notes that an underground pipe leak from a No. 2 fuel oil UST was discovered in 1995 near a building that is approximately 1,000 feet west and cross-gradient from the Plum Island Site. An automated recovery system was installed in the area of contamination in 2000. The combined recovery of fuel oil from vacuum enhanced fuel recovery and the automated recovery system is 9,228 gallons of fuel oil as of June 2008. However, Terracon concludes that this spill and other spills documented in environmental databases do not pose a threat to the environmental integrity of the site (Terracon 2007a).

3.12.6.2 Environmental Consequences

To mitigate construction impacts associated with the previous burial of hazardous and toxic wastes in the vicinity of the Plum Island Site, an assessment of construction worker risk, a Health and Safety Plan (which

[20] Used oil from PIADC ferries, vehicles, and from the cafeteria is collected in a 500-gallon tank and used to heat one building (E-mail from Thomas Dwyer, DHS to Judith Weintraub, TetraTech, on April 14, 2008).

would include a strategy to manage the risks to construction workers), and a Soil Management Plan would have to be completed before the NBAF could be built at the Plum Island Site, assuming a build alternative is implemented.

3.12.7 Umstead Research Farm Site

3.12.7.1 Affected Environment

Withers & Ravenel conducted a Phase I ESA at the Umstead Research Farm Site in October 2007. The assessment included a site inspection, historical research, municipal research, and a search of national and state environmental databases. No environmental sampling was performed (Withers & Ravenel 2007b).

At the time of the site inspection, the property was vacant and consisted of undeveloped woodlands with some cleared former logging trails and logging decks. Large portions of the property were impassible due to dense vegetation. There were no indications of structures, utilities, or other man-made improvements. Water supply wells, groundwater monitoring wells, pits, lagoons, etc., were absent. The site is bordered to the north by undeveloped woodlands and agricultural fields belonging to the North Carolina State University Beef Cattle Field Laboratory; to the south by undeveloped woodlands and the Dillon School, a state juvenile correction facility; and to the east and west by undeveloped woodlands. Other facilities located in close proximity to the property include the Umstead Research Farm (1,500 feet southeast), a federal corrections facility (3,000 feet southwest), and a state hospital (John Umstead Hospital) (5,000 feet southwest) (Withers & Ravenel 2007b).

Based on available records, interviews, and aerial photographs, the Withers & Ravenel ESA describes the ownership history and past uses of the Umstead Research Farm. Prior to 1942, the Umstead Research Farm Site and surrounding areas were privately owned and used for residential and agricultural purposes. In 1942, the U.S. government purchased approximately 43,000 acres of land, including the proposed Umstead Research Farm Site, to establish the Camp Butner Training Facility.[21] It was heavily used throughout World War II but was considered excess by 1947. In 1950, 9,800 acres of that former camp, including the Umstead Research Farm Site, were transferred to the State of North Carolina by the U.S. government. It was administered by the Hospitals Board of Control until the early 1990s when it was transferred to the North Carolina Department of Agriculture. This property is now utilized by the Department of Agriculture and NCSU. Other portions of the former Camp Butner property were transferred to private individuals, the National Guard, and the Federal Corrections System (Withers & Ravenel 2007b).

Based on information in local, state, and federal environmental databases, Withers & Ravenel present the following analyses of potential environmental threats posed by surrounding and nearby properties:

- The Hazardous Substance Disposal Sites list contains locations of uncontrolled or unregulated hazardous waste sites. The Range Road Burn Site was identified on this list; it is approximately 2,600 feet (almost 0.5 miles) northeast of the Umstead Research Farm Site. In 1970, an EPA Region IV team concluded that the Athol Manufacturing Company, a former manufacturer of polyvinyl chloride film and laminates, burned their hazardous waste by-products at this site. The site was investigated by a North Carolina CERCLA team in 1986. One soil sample collected from zero to 6 inches below the land surface was analyzed for various parameters. Total lead levels in the sample were 44,000 parts per million (ppm), and extractable lead levels were 9.5 ppm. Total cadmium levels were 1,500 ppm, and extractable cadmium levels were 3.0 ppm. No other soil or groundwater assessment data were available in available files and Withers & Ravenel “suspect” that no additional assessment activities were completed. In addition, they point out that the extent of contamination in the burn site area has not been determined, the burn site area is open and readily accessible to the surrounding population, and the site is “topographically isolated from the subject property by an

[21] The Camp Butner Training Facility is also referred to as the Fort Butner Training Camp, Camp Butner, and Former Camp Butner in the sources used to prepare this section.

unnamed, southerly flowing tributary of Knap of Reeds Creek, which extends in a north-south orientation between the subject property and the Range Road Burn Site." Based on available information, Withers & Ravenel "does not consider the Range Road Burn Site to be a REC relative to the subject property" (Withers & Ravenel 2007, p. 10).

- Withers & Ravenel evaluated a hazardous incident spill record and a leaking underground storage tank record applicable to the John Umstead Hospital. Because the hospital is located almost 1 mile from the Umstead Research Farm Site, they do not consider it to be an environmental concern (Withers & Ravenel 2007b).
- Withers & Ravenel evaluated data associated with the Fort Butner Training Camp, which is identified as a Formerly Used Defense Site where the USACE is taking necessary cleanup actions. They reviewed the Engineering Evaluation/Cost Analysis (EE/CA) on the Camp Butner site (Parsons 2004) and interviewed a representative of the USACE Wilmington District Office.[22] Withers & Ravenel found that the former Camp Butner site was divided into six areas for evaluation purposes. The Umstead Research Farm Site falls into Area 5. One area that is currently used by the U.S. Army National Guard (Area 6) as a training facility was not evaluated in the EE/CA. Digital geographic mapping using EM-61 and EM-61 MK 2 metal detectors was conducted to identify and locate surface and subsurface geophysical anomalies for intrusive sampling. A total of 7,087 anomalies were intrusively investigated in the five areas studied; 2,029 of these anomalies were in Area 5, and 2,028 of them were identified as non-ordnance and explosives (OE) scrap. The OE scrap item found in Area 5 was inert and identified as a single "spider" plate (pressure plate) from an M1 anti-tank practice mine. It was recovered from the ground surface approximately 365 feet north of the Umstead Research Farm Site. One area (A5G00019) on the Umstead Research Farm Site was assessed and no unexploded ordnance (UXO) was discovered. The USACE Wilmington representative explained that the Umstead Research Farm Site was not part of any firing ranges, it was not used to store munitions, and no UXO or ordnance scraps were found on the property. Based on the recommendations presented in the EE/CA, the USACE and Granville County implemented institutional controls on all five areas evaluated, including Area 5 where the Umstead Research Farm Site is located.[23] The USACE Wilmington District Office representative also explained that there is a local belief in Butner that the 78th Infantry Division (the division that formerly utilized the former camp) dumped ammunition into Lake Lightning, which is now a portion of Lake Holt Reservoir. This reservoir is located northeast of the Umstead Research Farm Site. USACE installed groundwater monitoring wells around the lake to assess groundwater samples for munitions contamination. No contamination has been found to date, and the NCDENR has issued a "Notice of No Further Action" (Withers & Ravenel 2007b).

Withers & Ravenel conclude that "no RECs were identified in connection with the subject property." However, they believe that the following finding should be considered during development of the property:

> The location of off-site sources of potential groundwater contamination, i.e., the former Camp Butner facility, the existing agricultural research facilities, and the existing National Guard Training facility, has the potential to create regional groundwater contamination. Therefore, use of groundwater on the subject property for any purpose is not recommended without additional research or assessment of groundwater quality. (Withers & Ravenel 2007b, p. 25)

Terracon conducted an updated Phase I ESA for this property in the fall of 2007. In particular, they reviewed the information relating to the former Fort Butner Training Camp described by Withers & Ravenel. As discussed below, additional information regarding the possible risks posed by this facility was derived from an additional interview and their review of a USACE report describing drinking well sampling that was performed to determine if groundwater quality had been impacted by former DoD activities.

[22] The Wilmington District Office oversaw the assessment and remediation activities associated with the former Camp Butner facility.
[23] Institutional controls are legal or other non-engineered controls on access. Examples include zoning, permitting, deed notifications, deed restrictions, sign-posting requirements, and restrictive easements or covenants.

Terracon interviewed a Research Station Division Forester with the North Carolina Department of Agriculture (the previous owner) regarding environmental concerns associated with the site. She indicated that "all of the military training operations that were previously conducted at the larger Camp Butner property did not occur at or near the site and that she is unaware of any unexploded ordinance (UXO) have been discovered at the site" (Terracon 2007e, p. 8).

Recent and continuing USACE investigation and cleanup activities (i.e., from Fiscal Year 2006 through the end of Fiscal Year 2008) associated with former Camp Butner operations involve Area 1, Area 4, and the Lakeview subdivision, which is a residential subdivision formerly included in Area 4. These activities are described in meeting minutes of the former Camp Butner Restoration Advisory Board, which are posted on a USACE Web site devoted to Camp Butner (http://www.saw.usace.army.mil/campbutner/index.htm). No activities are currently planned for Area 5, where the Umstead Research Farm site is located.

The Terracon report describes the results of the USACE report entitled *Final Sampling Report: Drinking Well Sampling Event – Former Camp Butner NC.* According to Terracon,

> Samples were collected at or near known firing ranges previously used during artillery and training operations. The closest range is located approximately 1.5 mile northeast of the northern boundary of the site. According to results, nine substances were collected above the project screening levels which included: chloroform; bis(2-ethylexyl)phthalate; alpha-chlordane; gamma-chlordane; heptachlor epoxide; perchlorate, iron, lead, and manganese. Evaluation of these substances indicates only perchlorate and lead may be present [above project screening levels] in the areas where artillery training activities occurred at Camp Butner" (Terracon 2007e, p. 21)

Because the closest former firing range is more than 1.5 miles northeast of the Umstead Research Farm Site, Terracon concludes that the former Camp Butner operations do not constitute a REC relative to the Umstead Research Farm Site. Further, Terracon concludes that there are no RECs that warrant further investigation at this time (Terracon 2007e).

3.12.7.2 Environmental Consequences

Because there are no RECs at the Umstead Research Farm Site or at adjoining properties, no construction or operational impacts are anticipated due to existing hazardous, toxic, or radiological waste contamination.

Although the UXO risk associated with the Umstead Research Farm Site appears to be low, institutional controls still remain in effect at the property. Adherence to these controls may require that site construction workers be properly trained before they begin their employment at the worksite.

3.12.8 Texas Research Park Site

3.12.8.1 Affected Environment

Raba-Kistner consultants conducted a Phase I ESA for the Texas Research Park Site in 2003 for the Texas Research Park Foundation. The foundation was established in 1986 when land was donated to create the park.

The Raba-Kistner Phase I ESA was performed to provide documentation that the landowner had no reason to suspect that hazardous substances had previously been disposed on, or near, the property. The assessment was based on

- Research and evaluation of readily available and practically reviewable federal and state documents and databases (e.g., NPL, CERCLIS, RCRIS, and USTs);

- Interviews with persons knowledgeable about the site; and
- Site reconnaissance by an environmental professional.

No environmental sampling was performed (Raba-Kistner 2003).

Raba-Kistner reported that the property is located in an area that is rural but developing with nearby educational and research facilities. It had no physical improvements and had previously been used as agricultural pasture. Aerial photographs dating back to 1938 show the site and adjacent properties as undeveloped and vacant land in a native wooded state. Research Plaza, located northeast of the site, first appeared in photographs in 1997. Other Texas Research Park tenants in 2003 included the University of Texas Health Science Center, San Antonio (UTHSCSA); the Cancer Therapy and Research Center; the Southwest Oncology Group; and Genzyme Corporation (Raba-Kistner 2003).

The TRP was established in 1986, when land was donated to create the park. It is owned and operated by the Texas Research and Technology Foundation.

Based on the information reviewed, Raba-Kistner found no evidence to suggest that the site or adjacent properties were contaminated with hazardous substances. Four nearby properties were generators of hazardous waste, and two nearby properties owned regulated petroleum storage tanks. No evidence was found linking these properties to corrective action or environmental enforcement actions (Raba-Kistner 2003).

An environmental attributes and utility capacity summary was prepared for the Texas Bio and Agro-Defense Consortium by BSA Environmental Services in February 2007. The findings are similar to those of Raba-Kistner. There were no listings for the Texas Research Park Site or surrounding properties within a 1-mile radius on any federal, state, local, or tribal database (BSA 2007).

Terracon prepared a Phase I ESA for this property in October to December of 2007. Their findings are similar to those presented in the Raba-Kistner and BSA Environmental Services reports. While other Texas Research Park tenants (UTHSCSA, Cancer Therapy and Research Center; University of Texas Institute of Biotechnology) are found in environmental databases, these listings are not associated with environmental contamination or enforcement actions. These properties are in these databases because they generate hazardous waste or own USTs. Consequently, Terracon concludes that there are no environmental conditions associated with the Texas Research Park location that warrant additional investigation (Terracon 2007d).

3.12.8.2 Environmental Consequences

Because there are no RECs at the Texas Research Park Site or at adjoining properties, no construction or operational impacts are anticipated due to existing hazardous, toxic, or radiological waste contamination.

3.13 WASTE MANAGEMENT

3.13.1 Methodology

This section describes the existing waste management infrastructure at each of the proposed NBAF sites and the impacts of the construction and operation of the NBAF. Most of the waste management construction and operation impacts would be the same at all of the proposed NBAF locations. These common impacts are described in Section 3.13.2. The affected environment and the waste management impacts that would vary by site are described in Sections 3.13.3 – 3.13.9 for the No Action Alternative and the six proposed NBAF locations, respectively.

General information on the waste streams that would be generated by the construction and operation of the facility and on the disposition of these waste streams (Section 3.13.2) was derived based on

- NBAF Design Partnership engineering, and feasibility studies (NDP 2007a; NDP 2007b; NDP unpublished information 2007; NDP 2008a);
- Widely available scientific studies and articles (NABCC 2004; Etherington 2008; NSWMA 2004; HERC 2007; CDC and NIH 2007); and
- Experience with and knowledge of wastewater and solid, hazardous, and infectious waste management practices.

Information on the affected environment and waste management impacts that would vary by site (Sections 3.13.3 – 3.13.9) was primarily derived from:

- Information submitted to DHS in Expressions of Interest and supplemental data,
- Site visits and other information gathered by the EIS preparation team, and
- Publicly available information from municipal, state, and federal regulatory and environmental Web sites and databases.

3.13.2 Waste Management Impacts Common to All Alternative Sites

If a build alternative is implemented, there would be waste impacts associated with the construction and operation of the facility regardless of location. This section describes the wastes that are likely to be generated by the construction and operation of the facility and explains how they would be managed.

3.13.2.1 Construction Consequences

Construction of the NBAF would generate construction debris, sanitary solid waste, and wastewater. Hazardous wastes could also be generated. The disposition of these construction waste materials is discussed below.

Construction Debris

All of the states where the NBAF may be located have landfills that accept construction debris. To the extent that local capacity is an issue, the construction debris may be transported to neighboring localities and states. The construction contract may require that some construction materials (e.g., metals) be salvaged when economically feasible to decrease the amount of construction debris to be disposed.

Municipal Solid Waste

Municipal solid waste that may be generated over the course of NBAF construction could include waste generated by construction workers, such as disposable food containers and paper. Municipal solid waste is routinely imported or exported by all of the states where the NBAF may be located (Table 3.13.2.1-1). The ability of municipal solid waste to cross state lines for treatment and disposal suggests that disposal capacity would not be an issue at any of the proposed locations.

Wastewater

During construction, equipment would be washed down as necessary in a designated area with appropriate controls for collecting and managing the wash water. This wastewater stream would then be disposed of in accordance with applicable permits and regulations.

Table 3.13.2.1-1 — Municipal Solid Waste (MSW) Imports and Exports by State

State	MSW Generated (10^6 tons/yr)	MSW Imports (10^6 tons)	Percent Imports of Generation	MSW Exports (10^6 tons)	Percent Exports of Generation	Net Imports (+)/ Exports (-)
GA	10.7	1.445	13.5	0.600	5.6	+0.845
KS	2.8	0.698	24.9	0.371	13.3	+0.327
MS	2.5	0.580	20.0	0.113	3.9	+0.467
NY	36.3	0.311	0.9	8.248	22.7	-7.936
NC	12	0.133	1.1	0.971	8.1	-0.838
TX	43.7	0.251	0.6	0.511	1.2	-0.260

Source: Repa 2005.

Hazardous Waste

For any hazardous waste that is generated during construction, the general contractor would be responsible for disposing of the waste in accordance with all applicable regulations.[24] Hazardous waste is routinely imported or exported by all of the states where the NBAF may be located (Table 3.13.2.1-2). The ability of hazardous waste to cross state lines for treatment and disposal suggests that disposal capacity is not an issue at any of the proposed locations.

Table 3.13.2.1-2 — Interstate Hazardous Waste Shipments (Tons) for 2001

State	Hazardous Waste Generated	Imported	Largest Quantity Imported From	Exported	Largest Quantity Exported to	Net Imports (+)/ Exports (-)
GA	760,043	12,663	FL (33%)	106,512	AL (30%)	-93,849
KS	1,571,587	19,846	AR (27%)	42,643	OK (59%)	-22,797
MS	2,165,734	67,090	AL (47%)	35,905	TX (26%)	+31,085
NY	3,534,261	113,706	NJ (28%)	118,471	NJ (45%)	-4,765
NC	327,721	14,611	SC (44%)	79,607	SC (39%)	-64,996
TX	7,555,402	220,000	LA (30%)	200,953	LA (35%)	+19,047

Source: NSWMA, May 2004.

3.13.2.2 Operation Consequences

Operation of the proposed NBAF could generate sanitary solid, medical, hazardous, and radiological wastes, as well as sanitary and industrial wastewater. These wastes would either leave the facility by being discharged through the sanitary sewer system to a publicly owned treatment works (POTW) near the proposed facility location, if appropriate, or they would be collected and disposed at regulated, permitted solid, hazardous, or radiological waste management facilities. All of the potentially infectious waste generated at the facility would undergo pretreatment before it is discharged to the sanitary sewer system or packaged and transported to an appropriate off-site management facility. Liquid biowaste from BSL-3E, BSL-3Ag, and BSL-4 areas would undergo redundant on-site treatment before being discharged to the sanitary sewer. Generation, treatment, and disposition information for the following specific waste categories are as follows: wastewater; waste solids; animal carcasses/pathological waste; radiological waste; and medical, hazardous, and industrial solid waste.

[24] The generation of hazardous waste is not expected during the construction of the NBAF, but it is possible at Plum Island. At Plum Island, the excavation of former landfills could result in the generation of known or suspected hazardous items (e.g., lead acid batteries, compressed gas cylinders, intact or damaged chemical items) requiring different types of regulated disposal, including hazardous waste disposal.

Wastewater

Wastewater generated by the NBAF would be discharged to the sanitary sewer. The wastewater stream would consist of treated biological and infectious waste (i.e., wastewater that is sterilized in biowaste cookers), other laboratory waste liquids (e.g., waste from BSL-2 laboratories), liquid effluents from carcass disposal, conventional sanitary sewer waste (discharges from sinks, toilets, and showers in non-BSL-3 and BSL-4 areas), and cooling tower blowdown (NDP 2007a; NDP 2007b; NDP 2008b). Wastewater generation rates may be impacted by the carcass disposal methodology chosen for the facility with alkaline hydrolysis (a form of tissue digestion) generating the most wastewater (NABCC 2004). Table 3.13.2.2-1 presents estimated average and maximum daily wastewater generation rates for the NBAF in all locations.

Table 3.13.2.2-1 — Estimated NBAF Average and Maximum Daily Wastewater Generation Rates (Gallons Per Day)

State	Sterilized Wastewater	Non-Sterilized Wastewater	Cooling Tower Blowdown	Estimated Daily Average	Estimated Daily Maximum
GA	35,000	16,100	21,200	72,300	150,000
KS	35,000	16,100	16,400	67,500	140,000
MS	35,000	16,100	26,000	77,100	150,000
NY	35,000	16,100	11,600	62,700	125,000
NC	35,000	16,100	18,500	69,600	150,000
TX	35,000	16,100	28,800	79,900	150,000

Sources: NDP 2007a; NDP 2008b.

While the amount of sterilized and non-sterilized wastewater generated by the NBAF remains constant at all of the proposed locations, the amount of cooling tower blowdown[25] entering the wastewater stream is higher in areas located in warmer climates because more cooling water would be used in the facility. The estimated daily average is the sum of sterilized, non-sterilized, and cooling tower blowdown values.

Table 3.13.2.2-2 summarizes the types of waste that may be discharged to the sanitary sewer system from the proposed NBAF (excluding cooling tower blowdown) and the pretreatment processes that would be applied to each type of waste before entering the sanitary sewer system. The pretreatment requirements applicable to the biological and infectious wastes that would be discharged to the sanitary sewer are derived from Biosafety in Microbiological and Biomedical Laboratories (BMBL) (CDC and NIH 2007). These requirements involve taking appropriate precautions that are based on risk assessment, and they become more stringent as biosafety levels increase. The BMBL also requires documentation of the decontamination of liquid wastes generated in BSL-4 areas, and the decontamination process must be validated physically and biologically. Biological validation must be performed at least annually (CDC and NIH 2007). Additional requirements may need to be met to conform to the acceptance criteria of the individual POTWs handling NBAF wastewater discharges.

Biowaste from the BSL-3E, BSL-3Ag, and BSL-4 areas would enter a dedicated treatment system that involves thermal treatment (sterilization) followed by subsequent decontamination. Various technologies are being considered for the liquid effluent decontamination system, including steam sterilization technologies, reverse polymerization systems, chemical systems, heat and chemical systems, irradiation systems, etc. Steam sterilization is recommended by the NBAF design team because it is a proven methodology offered by multiple vendors. Decontamination system tanks would be located in a dedicated space below the floors of the BSL-3E, BSL-3Ag, and BSL-4 areas. Biowaste would be gravity drained to the liquid waste decontamination system. Biowaste piping would be double walled in areas that are not accessible for inspection (NDP 2007a; NDP 2008b). Some liquid waste streams from these areas that are comprised of chemical disinfectants, such as liquids from dunk tanks or chemical showers, may enter the decontamination system without first undergoing sterilization.

[25] Blowdown is the portion of the circulating water in the cooling system that is removed to maintain the amount of dissolved solids and other impurities at an acceptable level.

pH adjustment may be necessary for liquid wastes originating in BSL-2 areas (to raise the pH) and for liquid wastes generated by the alkaline hydrolysis process (to lower the pH), if this process is chosen for carcass disposal (NDP 2007a; NDP 2008b; NABCC 2004). pH adjustment for corrosivity is required by national pretreatment standards promulgated under the *Clean Water Act* (U.S.C., Title 33, Chapter 26). These national pretreatment standards prohibit the discharge of wastes from all non-domestic sources that are corrosive, including any discharge with a pH of less than 5.0 (unless the POTW is specifically designed to handle corrosive wastes). If a build alternative is implemented, other minimum pretreatment standards that would apply to liquid wastes involve prohibitions related to ignitability; solids or viscous pollutants; oxygen demanding pollutants; temperature; oils; or pollutants that produce toxic gases, vapors, or fumes sufficient to cause health and safety problems (see 40 CFR 403.5(b)).

Waste Solids

As shown in Table 3.13.2.2-3, all waste solids from BSL-3E, BSL-3Ag, and BSL-4 areas and from Class III Biosafety Cabinets (BSCs) located in BSL-2 areas would leave these areas after either

- Passing through an autoclave, or
- Undergoing gas decontamination or chemical disinfection.

Materials that are not heat sensitive and not very large would be autoclaved, while gas and chemical disinfection would be used on heat-sensitive materials and objects too large to be autoclaved. Waste that has been treated by autoclaving, gas decontamination, or chemical disinfection may be discarded as sanitary solid waste unless laboratory procedures dictate that particular waste material cannot be disposed of in the sanitary solid waste stream or if the waste material is hazardous by EPA definitions. The BMBL requires that disposable materials from BSL-3E and BSL-3 Ag areas be incinerated following on-site decontamination through autoclaving or other methods (CDC and NIH 2007). Because no on-site incinerator is planned for non-pathological wastes, they would be transported to an off-site licensed, permitted municipal solid, medical, or hazardous waste incinerator as appropriate, depending on constituents[26].

It is estimated that the NBAF could generate 15,000 cubic yards per year of municipal (i.e., sanitary) solid waste and 592.6 cubic yards per year of special medical waste. These estimates were made by extrapolating actual generation rates from a similar facility in proportion to total floor space in the facilities. Using these estimates, the combined annual total volume of municipal solid waste and special medical waste that could be generated per year at the NBAF would be approximately 15,592 cubic yards (13,134 tons[27]) (BSA 2007).

[26] Pathological wastes include animal carcasses, organs, and tissues. An on-site incinerator is being considered for these wastes but not for the treatment of other types of waste solids.
[27] Assumes specific gravity of 1.

Table 3.13.2.2-2 — Summary of Sanitary Sewer Wastes [a]

Type of Waste	Origins	Pretreatment	Comments
Biological liquid waste from BSL-4 [b] areas	Animal suites and laboratory areas, emergency decontamination showers, liquids from dunk tanks, effluent from autoclaves, chemical showers	Dedicated biowaste gathering and treatment system that includes batch sterilization (as necessary) followed by liquid effluent decontamination in biowaste cookers	Biowaste from these areas would be gravity drained to the liquid effluent decontamination system. The piping would be double walled in areas that are not accessible for inspection. Various liquid disinfectants would be used as surface disinfectants, and these would subsequently be sent to the biowaste cookers.
Biological liquid waste from BSL-3E containment areas	Pathology, analytical chemistry, virus isolation, immunology, vaccine testing, and reagent production research and support laboratories; cage wash for smaller animals; insect holding and experiments; effluent from autoclaves; effluent from toilets and shower out facilities serving BSL-3 and BSL-4 areas	Dedicated biowaste gathering and treatment system that includes batch sterilization (as necessary) followed by liquid effluent decontamination in biowaste cookers	Biowaste from these areas would be gravity drained to the liquid effluent decontamination system. The piping would be double walled in areas that are not accessible for inspection. Various liquid disinfectants would be used as surface disinfectants, and these would subsequently be sent to the biowaste cookers.
Biological liquid waste from BSL-3 Ag [c] areas	Animal housing and research studies; decontamination of corridors; washdown of animal holding rooms; equipment washing; liquids from dunk tanks; effluent from autoclaves; effluent from toilets and shower out facilities serving BSL-3 and BSL-4 areas	Dedicated biowaste gathering and treatment system that includes batch sterilization (as necessary) followed by liquid effluent decontamination in biowaste cookers	Biowaste from these areas would be gravity drained to the liquid effluent decontamination system. The piping would be double walled in areas that are not accessible for inspection. High-pressure washing systems for the cleaning of animal facilities would include hot high-pressure washing and localized addition of chemicals, although low-pressure, flooding systems may be investigated. The volume of this waste stream would be impacted by the type of system used for room decontamination. For example, the use of gas for room decontamination would result in a lower volume sanitary sewer waste stream.

Table 3.13.2.2-2 — Summary of Sanitary Sewer Wastes1 (Continued)

Type of Waste	Origins	Pretreatment	Comments
Liquid effluent from carcass disposal	Rendering and alkaline hydrolysis would both result in animal tissue being reduced to liquid	The effluent from alkaline hydrolysis may need pH adjustment	Alkaline hydrolysis would produce more liquid than rendering.
Liquid wastes from BSL-2 areas (except the insectary) and the cGMP [d] module	Cell culture, media production, reagent development, test development, microbiology, molecular biology, glassware/metal wash, autoclaves associated with Class III BSC [e] material, sinks for hand washing	Treatment system that includes pH monitoring, reagent injection capability, and a sample port to allow for monitoring of the waste stream leaving the treatment system	The treatment system would treat effluent from the BSL-2 areas to within discharge limitations of 5 to 9 pH units.
BSL-2 insectary wastes	The BSL-2 insectary is used for the breeding, rearing, manipulating, and pre-test and post-test holding of insects – they are not infected with pathogens	Lab wastes from these areas would be sterilized before they enter the sanitary sewer to ensure that all larvae are destroyed	Treatment (sterilization) would be in the containment area.
Conventional sanitary waste	Washing of equipment from non-BSL-3 and BSL-4 areas, effluent from toilets and showers in non-BSL-3 and BSL-4 areas	All clothing and towels from BSL-3 and BSL-4 biocontainment areas would be sterilized before washed	None

[a] Excludes cooling tower blowdown.
[b] BSL = Biosafety Level.
[c] Ag = Agricultural.
[d] cGMP=current Good Manufacturing Practice.
[e] BSC=Biosafety Cabinet.
Sources: NDP 2007a; NDP 2007b; NDP 2008b; HHS 2007; NABCC 2004.

Table 3.13.2.2-3 — Summary of Waste Solids

Type of Waste	Origin	Pretreatment	Disposition
Waste solids from BSL-3E [a], BSL-3Ag, and BSL-4 functions (laboratories, procedure rooms, animal rooms, and storage/centrifuge rooms) that are not heat sensitive; waste solids from Class III BSCs [b] in BSL-2 laboratories	Waste bedding, packaging, sharps, PPE [c], medical supplies, pathological waste (samples), waste tissues and organs harvested from animals; empty feed packaging; waste resulting from the processing of samples	All wastes from these areas that are not heat sensitive would be autoclaved. Some of these wastes (e.g., animal bedding) would be surface disinfected first.	Solid waste management facility (off-site incinerator or landfill)
Heat-sensitive solids and some large pieces of equipment from BSL-3E, BSL-3Ag, and BSL-4 functions (laboratories, procedure rooms, animal rooms, and storage/centrifuge rooms)	Some PPE, plastics, paper goods, equipment wastes	Gas decontamination (e.g., vaporized hydrogen peroxide, chlorine dioxide, formaldehyde burn, or ethylene oxide) or disinfection in dunk tanks	Solid waste management facility (off-site incinerator or landfill)
Animal carcasses	Necropsy suites	Incineration, rendering, and alkaline hydrolysis are being considered.	Solid residuals would be tested and sent to solid or hazardous waste management facilities; as appropriate
Radiological waste	Research and clinical operations	All waste with radiological constituents would be containerized and sent off-site for treatment and/or disposal. Operational protocols would preclude discharge of radioactive waste through the plumbing system.	Low-level radioactive waste management facility
Chemical waste (RCRA [d] hazardous)	Solvents and chemical wastes from laboratory operations	Some chemical waste may be neutralized in containers before they are transported off-site.	Hazardous waste management facility
Conventional solid waste	Non-hazardous wastes from BSL-2 laboratories and the administrative areas of the facility	Not required	Solid waste management facility

[a] BSL = Biosafety Level.
[b] BSC = Biosafety Cabinet.
[c] PPE = Personal Protective Equipment.
[d] RCRA = *Resource Conservation and Recovery Act.*
Sources: NDP 2007a; NDP 2007b; NDP 2008b; CDC and NIH 2007; NABCC 2004.

Treatment of Animal Carcasses/Pathological Waste

A number of different technologies are being considered for the on-site treatment of the estimated 375 to 1,200 euthanized animal carcasses that could be generated annually at the facility. Table 3.13.2.2-4 provides a brief comparison of three of these technologies: incineration, alkaline hydrolysis, and rendering. There are different options available for all of these technologies; Table 3.13.2.2-4 consequently focuses on generic advantages and disadvantages.

Incineration was formerly the most common method of treating infectious medical waste. Between 1997 and 2004, however, the number of hospital/medical/infectious waste incinerators (HMIWIs) is estimated to have dropped from 2,400 to 111 (a 95% reduction). This reduction has been attributed to the costs of complying with 1997 *Clean Air Act* (CAA) regulations, which set strict emissions limits based on the size of the HMIWI, monitoring and testing requirements to demonstrate compliance, siting requirements, the requirement to develop a waste management plan, and training/qualifications requirements for HMIWI operators; the increased costs associated with equipment upkeep, labor, and energy; and the emergence of alternative technologies (HERC 2007).

Alkaline hydrolysis a relatively new and versatile process for the treatment of a variety of biologic, biohazardous, and hazardous wastes in a manner that is relatively nonpolluting and potentially more efficient and economical than incineration. At present, lack of experience with the process and uncertainty as to its availability are its primary disadvantages (NABCC 2004; Etherington 2008). Alkaline hydrolysis may produce an effluent waste stream with the following characteristics:

- Biological Oxygen Demand (BOD) – 10,250 mg/l
- Chemical Oxygen Demand (COD) – 19,600 mg/l
- Suspended Solids – 1,400 mg/l;
- pH – 9.48 (NDP 2008b)[28]

If an alkaline hydrolysis process is used at the NBAF, its effluent is estimated to comprise approximately only 2% of the total wastewater effluent stream. Consequently, when combined with the rest of the wastewater stream, the BOD, COD, and Suspended Solids levels of the total wastewater effluent stream are expected to be orders of magnitude lower. Wastewater effluent streams would be mixed in a blending tank before they are discharged to the sanitary sewer (NDP 2008b).

[28] BOD and COD are a measure of the relative oxygen-depletion effect of a waste contaminant. BOD and the amount of suspended solids in wastewater indicate how much secondary treatment is likely to be required before it is discharged to the environment.

Table 3.13.2.2-4 — Comparison of Technologies Being Considered for Carcass/Pathological Waste Disposal

Technology	Brief Description	Advantages	Disadvantages
Incineration	Modern, fixed-facility incinerators burn animal carcasses to destroy them. An NBAF incinerator would be fueled by natural gas. Afterburner chambers would be used to reduce emissions by burning the gas and particulate matter exiting from the primary chamber. The incineration process produces ash residuals that can be disposed in hazardous or non-hazardous waste landfills, depending on the ash constituents.	Mature technology that is extensively regulated for environmental emissions Biosecure	Low public acceptance Achieving low emissions requires operational expertise Most carcasses are not considered good burning material; fuel and dry burning materials would have to be added
Alkaline hydrolysis	Alkaline hydrolysis uses sodium hydroxide or potassium hydroxide to catalyze the hydrolysis of biological material into a sterile aqueous solution. Steam pressure and heat are applied to accelerate the process. It is carried out in a tissue digester that consists of an insulated, steam-jacketed, pressure vessel operated up to 70 psi. The pH of the liquid effluent (hydrolyzate) would generally have to be lowered to meet the requirements of most sanitary sewers of between 5 and 9. This can be done using bubbling carbon dioxide.	Can be used to eliminate radioactively contaminated tissues The solid residuals of the process are low volume (solids reduction is 97%) and sterile; liquid residuals are sterile, too Well suited to batch operations and has low manpower requirements No emissions, and odors can be controlled with appropriate technology	Relatively new technology with a limited number of technology providers Produces a large amount of liquid effluent that must be monitored and tested before it is released to the sanitary sewer Besides treatment for pH (see column 1), treatment may also be required to lower total suspended solids and biological oxygen demand Requires secondary support services such as a steam boiler
Rendering	The rendering process being considered involves conversion of carcasses into carcass meal (solids), melted fat, and water using a steam-jacked pressure vessel with an internal (steam) heat exchange-rotating shaft with spokes and paddles. Appropriate emissions and odor control technologies can be added to the rendering process, if needed.	Proper operation of rendering processes should result in non-infectious residuals that can be safely disposed Consists of mature technologies	Produces a large quantity of solid and liquid residuals requiring disposal Requires secondary support services such as a steam boiler

Source: NDP 2007a; NDP 2007b; NDP 2008b; NABCC 2004.

The rendering process uses high temperature and pressure to convert whole animal and poultry carcasses or their by-products to fat, protein materials, and water. It is a combination of mixing, cooking, pressurizing, fat melting, water evaporation, and microbial and enzyme inactivation. There are many different types of rendering processes (NABCC 2004). While the primary purpose of the technology is to manufacture products of commercial value, this would not be the case if rendering were used at the NBAF. All of the process residuals would be disposed, including liquids in the sanitary sewer system and solids and fat in regulated and permitted solid or hazardous waste management facilities (as appropriate based on constituents). If a rendering process is used at the NBAF, it may be modeled after the process available at the U.S. Department of Agriculture National Veterinary Laboratories in Ames, Iowa (NDP 2007a).

The final design for the NBAF will probably include more than one technology for the treatment of animal carcasses/pathological waste. Among the factors that may be considered in making this decision are individual site requirements and restrictions, air emissions, liquid and solid waste stream by-products, and operation and maintenance requirements (NDP 2008b).

Radiological Waste

Experiments/procedures that would generate radiological waste are not currently part of the planned mission of the NBAF. If radiological waste is generated at the NBAF in the future, operational protocols would preclude its discharge into the building plumbing systems because the NBAF would not have a piped radioactive waste collection or storage system (NDP 2007a). Radiological waste would be collected, packaged, and transported in accordance with applicable state, Nuclear Regulatory Commission (NRC), and Department of Transportation requirements and it would be disposed in NRC-licensed disposal facilities.

Medical, Hazardous, and Industrial Solid Waste

Disposal of medical, hazardous, and industrial solid waste is governed by federal and state regulations promulgated under the RCRA. In addition, treatment of industrial solid waste in non-hazardous waste incinerators (i.e., municipal waste combustors) is governed by federal and state regulations promulgated under the CAA. As discussed above, incinerators used to treat hazardous, medical, and infectious waste are also governed by CAA regulations.

Off-Site Disposal Capacity for Waste Solids

The vast majority of wastes, other than sanitary sewer wastes, generated at the NBAF requiring off-site disposal would be industrial solid waste, which would be disposed at municipal solid waste landfills. Waste acceptance criteria for municipal solid waste landfills are developed by facility owners and operators based on federal, state, and local regulations and ordinances; facility permits; and technical criteria related to the characteristics of the facilities themselves. (For example, packaged waste may be subject to container size, weight, or volume restrictions that are related to optimum stacking efficiency in disposal cells.) All municipal solid waste landfills will have waste acceptance criteria related to waste characterization (e.g., to show that the waste is not hazardous and that liquids are not present), and many will have criteria related to preventing void spaces in the landfill.

Almost all states import and export municipal solid waste to other states and the amount of municipal solid waste making interstate movements is increasing. On average, approximately 10% of the municipal solid waste generated in the United States was exported to another state for disposal in 2003. The majority of shipments tend to occur between neighboring states. Federal courts have repeatedly ruled that restrictions on interstate waste shipments are unconstitutional (NSWMA 2004). Because of the ability of the NBAF to ship industrial solid waste to out-of-county and even out-of-state facilities, local capacity for industrial solid waste disposal is not an issue. Disposal costs would, however, be impacted by transportation costs. Table 3.13.2.1-1 shows municipal solid waste imports and exports by state for the six states being considered as NBAF locations.

The interstate movement of hazardous waste shows similar trends. All states import and/or export RCRA hazardous wastes. Of the 40.82 million tons of hazardous waste generated in the United States in 2001, 4.15 million tons (10.2%) was transported to another state (or jurisdiction) for treatment and disposal (NSWMA 2004). Because of the ability of the NBAF to ship hazardous waste to out-of-county and even out-of-state facilities, local capacity for hazardous waste disposal is not an issue. Disposal costs would, however, be impacted by transportation costs. Table 3.13.2.1-2 shows hazardous waste imports and exports by state for the six states being considered as NBAF locations.

3.13.3 No Action Alternative

3.13.3.1 Affected Environment

At the existing PIADC, wastewaters generated by research activities would continue to be treated/decontaminated and then sent to Plum Island's central wastewater treatment plant. This plant also receives sink, drain, and sewage wastes from the non-research support facilities on the island. The wastewater treatment plant is a tertiary treatment facility that includes chemical treatment and irradiation (with ultraviolet light) to enhance disinfection of the effluent. Treated wastewater passes through reed beds specifically designed to "polish" the effluent prior to its discharge from an outfall into Plum Gut Harbor. The wastewater treatment plant is currently permitted to treat 80,000 gpd.

Waste solids generated by PIADC activities undergo onsite treatment or they are transported to appropriately permitted offsite facilities. PIADC currently operates three incinerators. Waste generated as a result of operations that cannot be treated in one of the PIADC incinerators is packaged, manifested, and transported to an appropriately permitted receiving facility. Many materials are recycled. Table 3.13.3.1-1 shows the weight of materials handled by the PIADC recycling program in 2006.

Table 3.13.3.1-1 — Materials Handled by the PIADC Recycling Program in 2006

Material	Weight (lb)
Cardboard	14,350
Paper	5,450
Plastic Bottles	860
Aluminum Cans	810
Glass	350
Books/Magazines	31,425

Source: PIADC Environmental Notes 2007.

3.13.3.2 Environmental Consequences

Under the No Action Alternative, the existing waste management procedures for PIADC would continue. Because the NBAF would not be constructed, no construction impacts beyond ongoing infrastructure upgrades or new operational waste impacts would occur.

3.13.4 South Milledge Avenue Site

3.13.4.1 Affected Environment

The Athens-Clarke County Middle Oconee Wastewater Treatment Facility is located on Will Hunter Road, approximately 2 miles from the site. This facility has a permitted treatment capacity of 6 million gpd and currently utilizes approximately 75% of this capacity (4.5 million gpd). The wastewater treatment process includes a bar screen, grit separator, activated sludge process, clarifiers, digesters for biosolids removal, and chlorine disinfection (ACC 2008). A planned facility upgrade would increase its capacity to 10 million gpd. This upgrade is expected to be completed by 2012.

Approximately 10.7 million tons of municipal solid waste and just over 760,000 tons of hazardous waste are generated annually in the State of Georgia (Tables 3.13.2.1-1 and 3.13.2.1-2). Georgia is a net importer of municipal solid waste and a net exporter of hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2).

3.13.4.2 Construction Consequences

Construction of the proposed NBAF at the South Milledge Avenue Site would generate construction debris, sanitary solid waste, and wastewater. The generation of hazardous waste is possible but not expected. Waste-related impacts from construction are similar under all action alternatives and are described in Section 3.13.2.1.

3.13.4.3. Operation Consequences

Operation of the proposed NBAF would generate wastewater; waste solids; and medical, hazardous, and industrial solid wastes. Impacts related to these wastes from operation of the proposed NBAF are similar under all action alternatives and are described in Section 3.13.2.2, along with the proposed treatment methods for animal carcasses/pathological wastes. However, the following information regarding sanitary wastewater and disposal of waste solids is specific to the South Milledge Avenue Site.

The proposed NBAF would discharge sanitary wastewater into the Athens-Clarke County sewer system. NBAF project engineers anticipate collecting sanitary sewer wastewater outside the basement level of the proposed facility. It would have to be pumped 9,500 feet to a gravity line (the closest sewer line) through a force main that would be installed along South Milledge Avenue (NDP 2008a). From there, the waste would be piped to the Middle Oconee Wastewater Treatment Facility. However, planned improvements include a 12-inch sewer line from the NBAF to the Middle Oconee Wastewater Treatment Facility. Once the planned upgrade of this facility to 10 million gpd is completed in 2012, the estimated impact of an additional wastewater discharge of 72,300 gpd average, or 150,000 gpd maximum, that could be contributed by the NBAF would be to use less than 2% of capacity on a maximum discharge day. The treatment of liquid wastes, prior to entry into the sewer line, is discussed in Section 3.13.2.2.

Sewage acceptance criteria may apply to the wastewater discharged from the NBAF. The proposed NBAF would comply with these requirements to not negatively impact regional sewage treatment capability due to flow rate or potentially harmful wastewater constituents.

Georgia is a net exporter of hazardous waste (Table 3.13.2.1-2). Because of the ability of Georgia to ship hazardous waste to other jurisdictions, disposal capacity for hazardous waste would not be an issue.

Cumulative Impacts

According to the University of Georgia Office of the University Architects for Facilities Planning (Kevin Kirsche, UGA, January 25, 2008), UGA has no immediate projects of significant consequence planned for areas surrounding the proposed South Milledge Avenue Site. Five significant development projects anticipated by the University over the next 5 years and submitted to the University System of Georgia Board of Regents are to be located on main campus and are not within reasonable distance of the South Milledge Avenue Site to contribute to cumulative impacts. In addition, there are no proposed regional development projects within a 2-mile radius of the site (Brad Griffin, Athens-Clark County Planning Director, January 24, 2008).

It is unknown at this time the potential impacts of future projects on the Middle Oconee Wastewater Treatment Facility's capacity. However, it is anticipated that the rapid population growth of Clarke County would continue, and use of this facility would increase accordingly.

The wastewater effluent for the proposed NBAF is estimated at 72,300 gpd. This represents less than 2% of the Middle Oconee Wastewater Treatment Facility's current capacity of 6 mgd. Based on the available information, the NBAF would not have a significant cumulative effect on wastewater treatment capability. As the population continues to grow in the region, it is likely that additional wastewater treatment facilities would be constructed as is currently the case. This would occur with or without the NBAF.

3.13.5 Manhattan Campus Site

3.13.5.1 Affected Environment

Wastewater is collected and treated by the City of Manhattan in their wastewater treatment plant. The plant's capacity is 8.7 million gpd and peak flow is 6.95 million gpd, or almost 80% of capacity. The City of Manhattan is currently planning a major wastewater treatment plant expansion and upgrade to address general growth needs and anticipated environmental regulations that are expected to be more stringent than current requirements. The projected capacity of the city's wastewater treatment plant once it is upgraded is 10.7 million gpd, which is an increase of almost 23%. Project design is planned for 2008, with construction occurring in 2009 and 2010.

Approximately 2.8 million tons of municipal solid waste and 1.5 million tons of hazardous waste are generated in the State of Kansas annually. Kansas is a net importer of solid waste and a net exporter of hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2).

3.13.5.2 Construction Consequences

Construction of the proposed NBAF at the Manhattan Campus Site would generate construction debris, sanitary solid waste, and wastewater. The generation of hazardous waste is possible but not expected. Waste-related impacts from construction are similar under all action alternatives and are described in Section 3.13.2.1.

3.13.5.3 Operation Consequences

Operation of the proposed NBAF would generate wastewater; waste solids; and medical, hazardous, and industrial solid wastes. Impacts related to these wastes from operation of the proposed NBAF are similar under all action alternatives and are described in Section 3.13.2.2, along with the proposed treatment methods for animal carcasses/pathological wastes. However, the following information regarding sanitary wastewater and disposal of waste solids is specific to the Manhattan Campus Site.

The proposed NBAF would discharge sanitary wastewater into the City of Manhattan sewer system. Engineering studies propose having the sanitary sewer line from the proposed NBAF exit at the basement level of the facility and rerouted along the southeastern portion of the site to an existing 8-inch gravity sewer line along Denison Avenue. A lift-station system would be necessary to tie the NBAF in with the current sewer system (NDP 2008a). If the NBAF adds an average discharge of approximately 67,500 gpd or a maximum discharge of 140,000 gpd, this would use up less than 2% of the expanded wastewater treatment plant capacity on a maximum discharge day.

Kansas is a net importer of solid waste and a net exporter of hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2). The ability of Kansas to import solid waste from and export hazardous waste to other jurisdictions suggests that disposal capacity for solid and hazardous waste is not an issue.

<u>Cumulative Impacts</u>

According to KSU (Ron Trewyn, KSU, January 28, 2008), it has two major projects planned within a 2-mile radius of the Manhattan Campus Site. These projects, the Kansas State Equine Education Center and the Flint

Hills Horse and Park Events Center, are related and would be located at the same site north of Kimball Avenue and east of Denison Avenue, encompassing 85 to 100 acres and include both the educational and competitive event components. These projects would result in 150 to 180 full-time and part-time jobs. The projects are in the preliminary planning stages, so any increase in public service demands and environmental impacts are not known.

There are additional projects planned on the KSU campus. One noteworthy project is the Jardine Complex Phase II, which includes 544 new bedrooms. Phase I added 608 bedrooms and over 2,000 daily trips, while Phase II is adding 347 apartments and another 2,000 daily trips. Another project is the Equestrian Center Phase I for the College of Agriculture, Department of Animal Sciences at Kansas State Athletic Department. There are 80 equestrian team members/coaches, a 40-seat classroom, and scheduled 400-person stadium events. This project would result in over 1,000 daily trips.

The ROI for wastewater capacity is the City of Manhattan, which provides wastewater treatment for the area including the Manhattan Campus Site. The NBAF would utilize less than 2% of the City of Manhattan's wastewater treatment facility's capacity and is not anticipated to be substantial; however, the effluent would represent an increase in the ROI cumulative wastewater load. Wastewater treatment capacity of the future projects in the ROI is not known but would contribute to the cumulative effects to the resource.

3.13.6 Flora Industrial Park Site

3.13.6.1 Affected Environment

Wastewater is collected and treated by the Town of Flora. There is currently a 10-inch gravity line on the proposed NBAF site, which discharges into a 350 gpm lift station (NDP 2008a). This sewer line currently has no flow, so it has 100% excess flow capacity. A 6-inch force main transports the waste to the Town of Flora treatment facility. The 6-inch force main currently has 52% excess flow rate capacity. Current lagoon capacity is 300,000 gpd, with 100,000 gpd being used. State funding is being sought for more than a two-fold increase in capacity. Wastewater is treated in an aeration lagoon, passed through a sand filter, and then discharged into a tributary of the Big Black River.

Approximately 2.5 million tons of municipal solid waste and just over 2 million tons of hazardous waste are generated in the State of Mississippi annually. Mississippi is a net importer of both solid and hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2).

3.13.6.2 Construction Consequences

Construction of the proposed NBAF at the Flora Industrial Park Site would generate construction debris, sanitary solid waste, and wastewater. Generation of hazardous waste is possible but not expected. Waste-related impacts from construction are similar under all action alternatives and are described in Section 3.13.2.1.

3.13.6.3 Operation Consequences

Operation of the proposed NBAF would generate wastewater; waste solids; and medical, hazardous, and industrial solid wastes. Impacts related to these wastes from operation of the proposed NBAF are similar under all action alternatives and are described in Section 3.13.2.2 along with the proposed treatment methods for animal carcasses/pathological wastes. However, the following information regarding sanitary wastewater and solid waste disposal is specific to the Flora Industrial Park Site.

The proposed NBAF would discharge sanitary wastewater to the Town of Flora sewer system. NBAF project engineers anticipate collecting sanitary wastewater outside the basement level of the facility and connecting it via a gravity line to the existing 10-inch gravity line on the proposed site (NDP 2008a). If the NBAF adds a discharge between 77,100 (average) and 150,000 (maximum) gpd to the Flora sanitary sewer system, between 40% and 75% of the current remaining lagoon capacity would be used. However, state funding is being sought for expansion of the discharge of this current lagoon. The peak and average flow rates into the lift station are not known at this time; therefore, the need for lift station upgrades cannot yet be determined.

Sewage acceptance criteria may apply to the Flora Industrial Park Site. The proposed NBAF would comply with these requirements and would not negatively impact regional sewage treatment capability due to flow rate or potentially harmful wastewater constituents. Industrial pretreatment criteria are dictated by the State of Mississippi Department of Environmental Quality (David Holman, Town of Flora, March 19, 2008, e-mail to Clarissa Hageman, Tetra Tech, Inc.).

Mississippi is a net importer of both solid and hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2). The ability of Mississippi to import solid waste and hazardous waste from other jurisdictions suggests that disposal capacity for solid and hazardous waste is not an issue.

<u>Cumulative Impacts</u>

According to the Metro Jackson Chamber of Commerce, there are several new residential projects being planned in the Town of Flora or in Madison County. Terra Subdivision is located within the town limits of Flora with 19 lots available and 60 acres being developed. Depending on the density allowed for the subdivision, there is a potential of up to 240 additional lots. Another future development project is Andover Subdivision, which is located off State Highway 22 within 5 miles of the proposed site in an unincorporated area. Phase I of the subdivision has approximately 73 lots. Numerous phases are predicted for this development over the next 5 years, but data were not available regarding the additional number of lots to be developed. The Highlands Subdivision is another future planned project located off Mount Leopard and would be accessed from Highway 22. It is within 5 miles of the proposed NBAF site. The data provided did not state the number of lots predicted for this development, but all of the lots would be greater than 5 acres. Other noted subdivisions that have not announced their density allocations are Magnolia Heights and Woodlands of Flora.

The Metro Jackson Chamber of Commerce stated there are no non-residential economic development projects scheduled for Flora within the next 5 years.

There is a proposed major development (Galeria-Madison) approximately 15-20 miles from the proposed NBAF and includes a mix of single-family homes, condominiums, an office park, and a shopping center. The acreage, square footages, and density numbers were not available for this development. There are other developments occurring, but they are not of major regional significance.

The demand for wastewater treatment capacity from the NBAF is not anticipated to be substantial; however, the effluent volume and constituents would represent an increase in the ROI cumulative wastewater record. The addition of 15,000 people by the year 2015 would occur with or without the NBAF and would result in additional use of the wastewater treatment capacity. It is likely that additional wastewater treatment capability would be needed in the future.

3.13.7 Plum Island Site

3.13.7.1 Affected Environment

The proposed location of the NBAF at the Plum Island Site is adjacent to the current PIADC laboratories. The existing waste management facilities and procedures at PIADC are described in Section 3.13.3.1. PIADC is an existing large-quantity generator of sanitary, medical/infectious, hazardous, and universal waste.

Approximately 36.3 million tons of municipal solid waste and just over 3.5 million tons of hazardous waste are generated annually in New York. New York is a net exporter of municipal solid waste and hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2).

3.13.7.2 Construction Consequences

Construction of the proposed NBAF at the Plum Island Site would generate construction debris, sanitary solid waste, and wastewater. Hazardous wastes could also be generated. Waste-related impacts from construction are similar under all action alternatives and are described in Section 3.13.2.1.

3.13.7.3 Operation Consequences

Operation of the proposed NBAF would generate wastewater; waste solids; and medical, hazardous, and industrial solid wastes. Impacts related to these wastes from operation of the proposed NBAF are similar under all action alternatives and are described in Section 3.13.2.2 along with the proposed treatment methods for animal carcasses/pathological wastes. However, the following information regarding sanitary wastewater and solid waste disposal is specific to the Plum Island Site.

The NBAF would discharge sanitary wastewater into the PIADC wastewater treatment plant in Building 102. NBAF project engineers anticipate collecting sanitary sewer wastewater outside the basement level of the proposed facility. It would have to be pumped 1,000 feet from a new pump station to the existing plant. While the plant's current permitted capacity (80,000 gpd) could handle an estimated 62,700 gpd average from the NBAF, it is not sufficient to handle estimated peak loads of up to 125,000 gpd. Options being considered to address this shortfall include

- Constructing and permitting a new wastewater treatment plant,
- Expanding the existing plant to handle peak NBAF loads, and
- Adding pretreatment holding tanks allowing peak loads to be averaged and fall within current permitted capacity (NDP 2008a).

As a generator of solid and hazardous wastes, PIADC is familiar with properly permitted outlets for the receipt, treatment, and disposal of these wastes. For example, approximately 965 tons of TRMW generated by PIADC investigation by excavation projects (see Section 3.12.6) were disposed in appropriately permitted landfills in Pennsylvania. In addition, some of the policies and procedures applicable to the on-site management of solid and hazardous wastes would generally be applicable to the same and similar waste streams generated at the proposed Plum Island Site (see Section 3.13.3.1).

New York is a net exporter of municipal solid waste and hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2). The ability of New York to export solid and hazardous waste to other jurisdictions suggests that disposal capacity for solid and hazardous waste is not an issue.

3.13.8 Umstead Research Farm Site

3.13.8.1 Affected Environment

Wastewater collection, treatment, and disposal services for the Butner area are provided by the SGWASA. The SGWASA treatment plant has a capacity of more than 5 million gpd, and it is currently operating at less than 50% of capacity.

Approximately 12 million tons of municipal solid waste and almost 328,000 tons of hazardous waste are generated in the State of North Carolina annually. North Carolina is a net exporter of both municipal solid and hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2).

3.13.8.2 Construction Consequences

Construction of the proposed NBAF at the Umstead Research Farm Site would generate construction debris, sanitary solid waste, and wastewater. Generation of hazardous waste is possible but not expected. Waste-related impacts from construction are similar under all action alternatives and are described in Section 3.13.2.1.

3.13.8.3 Operation Consequences

Operation of the proposed NBAF would generate wastewater; waste solids; and medical, hazardous, and industrial solid wastes. Impacts related to these wastes from operation of the proposed NBAF are similar under all action alternatives and are described in Section 3.13.2.2 along with the proposed treatment methods for animal carcasses/pathological wastes. However, the following information regarding sanitary wastewater and solid waste disposal is specific to the Umstead Research Farm Site.

The proposed NBAF would discharge sanitary wastewater to the SGWASA sewer system. NBAF project engineers anticipate collecting sanitary sewer wastewater outside the basement level of the facility and routing it approximately 2,500 feet from the facility to an existing gravity line south of the property running along Highway 75 (NDP 2008a). Because the SGWASA treatment plant is currently operating at less than 50% of capacity, the addition of an estimated wastewater discharge from the NBAF of 69,600 gpd average, or 150,000 gpd maximum, would use less than 6% of available operating capacity on a maximum discharge day

Sanitary wastewater from the NBAF would have to meet SGWASA acceptance criteria. Discharge of medical waste (defined as infectious agents, human blood and blood products, pathological wastes, sharps, body parts, contaminated bedding, surgical wastes, potentially contaminated laboratory wastes, and dialysis wastes), for example, must be specifically authorized by the SGWASA Director in a wastewater discharge permit.

North Carolina is a net exporter of both municipal solid and hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2). The ability of North Carolina to export solid waste and hazardous waste to other jurisdictions suggests that disposal capacity for solid and hazardous waste is not an issue.

<u>Cumulative Impacts</u>

According to the Granville County Economic Development Commission (Leon Turner, EDC, February 20, 2008), there are currently no major new projects being planned in Granville County. Development Services has permitted around 3,000 new homes, but it is uncertain how many will be built with the current housing slow down. It is unknown when the housing market will return to its level of previous years.

Although the majority of the 5 mgd wastewater capacity of the SGWASA sewage treatment plant has been allocated for residential use at this time, there is substantial wastewater capacity reserved for commercial and industrial uses. Over the next year, some of the capacity that has been allocated for residential use may return to SGWASA if the homes are not constructed within the time period allowed (Leon Turner, EDC, February 20, 2008). Wastewater capacity of 69,000 gpd for the NBAF represents approximately 1.3% of the total capacity of the plant and has been reserved with much more becoming available due to the housing slow down. There is also currently a plan to upgrade and expand the SGWASA wastewater treatment plant in Butner.

As previously discussed, the Knap of Reeds Creek is the receiving waters from the City of Butner's wastewater treatment, and Knap of Reeds Creek is currently not meeting all NCDENR, DWQ designated uses. The NBAF's contribution to the wastewater treatment facility's capacity is not anticipated to be substantial; however, the effluent volume and constituents would represent an increase in the ROI cumulative wastewater effluents entering the Knap of Reeds Creek.

3.13.9 Texas Research Park Site

3.13.9.1 Affected Environment

Wastewater from the Texas Research Park Site flows through SAWS Far West area lines and eventually into the SAWS Medio Creek WRC. A SAWS project currently in the bidding phase will expand the Medio Creek WRC capacity to 16 million gpd from the current capacity of 8.5 million gpd.

Approximately 43.7 million tons of municipal solid waste and 7.5 million tons of hazardous waste are generated in Texas annually. Texas is a net exporter of solid waste and a net importer of hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2).

3.13.9.2 Construction Consequences

Construction of the proposed NBAF at the Texas Research Park Site would generate construction debris, sanitary solid waste, and wastewater. Generation of hazardous waste is possible but not expected. Waste-related impacts from construction are similar under all action alternatives and are described in Section 3.13.2.1.

3.13.9.3 Operation Consequences

Operation of the proposed NBAF would generate wastewater; waste solids; and medical, hazardous, and industrial solid wastes. Impacts related to these wastes from operation of the proposed NBAF are similar under all action alternatives and are described in Section 3.13.2.2, along with the proposed treatment methods for animal carcasses/radiological wastes. However, the following information regarding sanitary wastewater and solid waste disposal is specific to the Texas Research Park Site.

Wastewater collection, treatment, and disposal services for the proposed NBAF site at Texas Research Park would be provided by the SAWS through an existing 8-inch diameter sewer line to the east of the 100.1-acre tract. NBAF project engineers anticipate collecting sanitary sewer wastewater outside the basement level via a gravity line to the 8-inch sewer line (NDP 2008a). A new sewer line would be extended to serve the proposed NBAF site, and this line would provide additional capacity sufficient for the projected NBAF demand. The tie-in to the SAWS water collection system would have to conform to SAWS Utility Service Regulations. With the Medio Creek WRC capacity expansion, SAWS would have sufficient capacity for the projected 79,000 gpd average and 150,000 gpd maximum NBAF demand. The NBAF wastewater discharge would use less than 1% of expanded SAWS capacity on a maximum discharge day. NBAF wastewater discharged to the sanitary sewer would have to comply with the City of San Antonio's Pretreatment Ordinance for wastewater.

Texas is a net exporter of solid waste and a net importer of hazardous waste (Tables 3.13.2.1-1 and 3.13.2.1-2). The ability of Texas to export solid waste and import hazardous waste from other jurisdictions suggests that disposal capacity for solid and hazardous waste is not an issue.

<u>Cumulative Impacts</u>

In Bexar County, there are several other public and private activities proposed or ongoing that would have potential to impact the wastewater treatment capacity. Future planned projects in the vicinity of the Texas Research Park Site include a number of new residential development projects that would result in over 13,000 new residential units in the region. The estimated population generated from these planned developments would be 31,200 people for just residential, not including commercial, office, or industrial population from employment in the area.

The ROI for wastewater treatment capacity is the western portion of Bexar County in the area served by the SAWS Medio Creek Wastewater Reclamation Center. The contribution of wastewater effluent from the NBAF is projected to be approximately 26.5 million gpy. This represents less than 1% of the capacity of SAWS Medio Creek Wastewater Reclamation Center (8.5 million gpd) and is not anticipated to be substantial; however, the effluent volume and constituents would represent an increase in the ROI cumulative wastewater generation.

3.14 HEALTH AND SAFETY

This section presents the overall objectives, methodology, results, and conclusions related to the identification of potential hazards; the analysis of potential postulated accidents; and the evaluation of consequences associated with normal and abnormal operations of the DHS NBAF. The identification of hazards includes operations with pathogens and other identified risks related to operation of a large high-biocontainment biosafety laboratory. The analysis includes specific evaluation of accidents with potential adverse consequences and intentional acts (perpetrated by adversaries such as terrorists, criminals, employees, extremists, etc.).

The National Academy of Sciences (NAS), Committee on Technical Input on Any Additional Studies to Assess Risk Associated with Operation of the National Emerging Infectious Diseases Laboratory, Boston University, National Research Council, prepared a letter report that provides a discussion of important considerations when developing a risk assessment. Much of that discussion was adopted for presenting the approach taken in the evaluation of potential health and safety impacts from operation of the proposed NBAF (NAS 2008).

The specific objective of this hazard identification, accident analysis, and risk assessment is to identify the likelihood and consequences from accidents or intentional subversive acts. In addition to identifying the potential for or likelihood of the scenarios leading to adverse consequences, this analysis provides support for the identification of specific engineering and administrative controls to either prevent a pathogen release or mitigate the consequences of such a release. The consequence analysis is related specifically to the accidental or intentional release of a pathogen and was developed and presented in a qualitative and or semiquantitative manner. The overall process for the accident and threat analysis as applied to the evaluation of potential impacts related to operation of the proposed NBAF is described in the following illustration.

The fundamental questions addressed in this analysis are (NAS 2008)

- What could go wrong (the sequence of events that could cause an infectious pathogen to escape the laboratory, set up a chain of transmission, and cause infectious disease in the surrounding community)?
- What are the probabilities (likelihood for each type of release) of such a sequence of events?
- What would be the consequences of such a sequence of events (e.g., the impacts of a release including transmission of disease, morbidity, and mortality)?

<u>Scenarios of Release of an Infectious Pathogen</u>

The NBAF analysis was prepared such that both a wide range of realistic hazard scenarios were considered, as well as the identification and detailed evaluation of a select number of high-consequence accidents. This is consistent with what the NAS indicated should be in the first phase of a risk assessment. This approach provided a realistic assessment of risks associated with the NBAF in general and illustrated the comparative risks across the six proposed sites. The hazards analysis of the NBAF operations concentrated on the identification of potential releases that required additional safety controls and determined those accidents that required additional evaluation.

As described by NAS, a second phase of a risk assessment evaluates those potential release scenarios that are highly unlikely but still provide credible high consequences. This method of approach was used for the NBAF where the selected accidents focused on the potential pathogen release from many diverse initiators such as procedural or work practice failures, including those which lead to worker exposures and infections, biocontainment system and equipment failures, and an appropriate array of intentional acts (addressed separately in the Threat Risk Assessment [TRA] in discussed in Section 3.14.3.4).

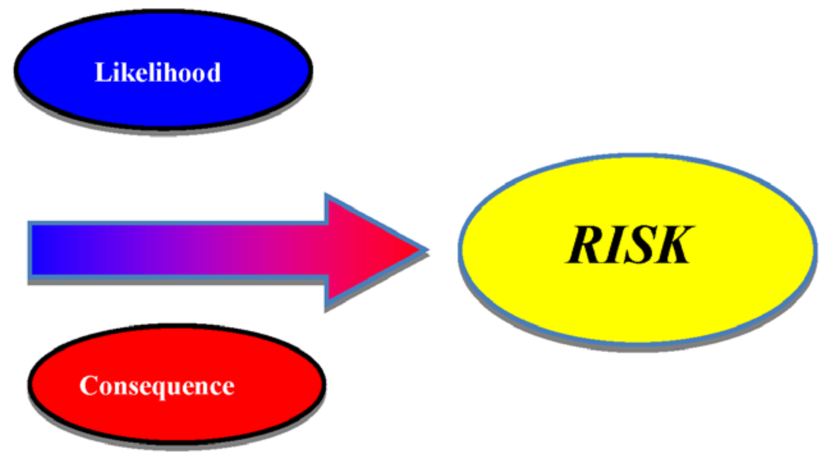
NBAF Biological Hazard/Accident/Threat/Risk Model

<u>Likelihood</u> *is defined as the probability of a defined adverse consequence (accident results in release of pathogens or an adversary acquires, produces, and disseminates a Biological Weapon)*

- *Estimated based on qualitative frequency categories*
- *Event trees identify importance of controls*
- *Event trees developed for unmitigated and mitigated conditions*

<u>Consequence</u> *is defined as the magnitude of the impact to the workers, public, and environment from the accident or intentional act*

- *Consequences calculated using deterministic values*
- *Estimated based on a bounding parameter values*
- *Consequences developed for accidents and intentional acts for both unmitigated and mitigated conditions*



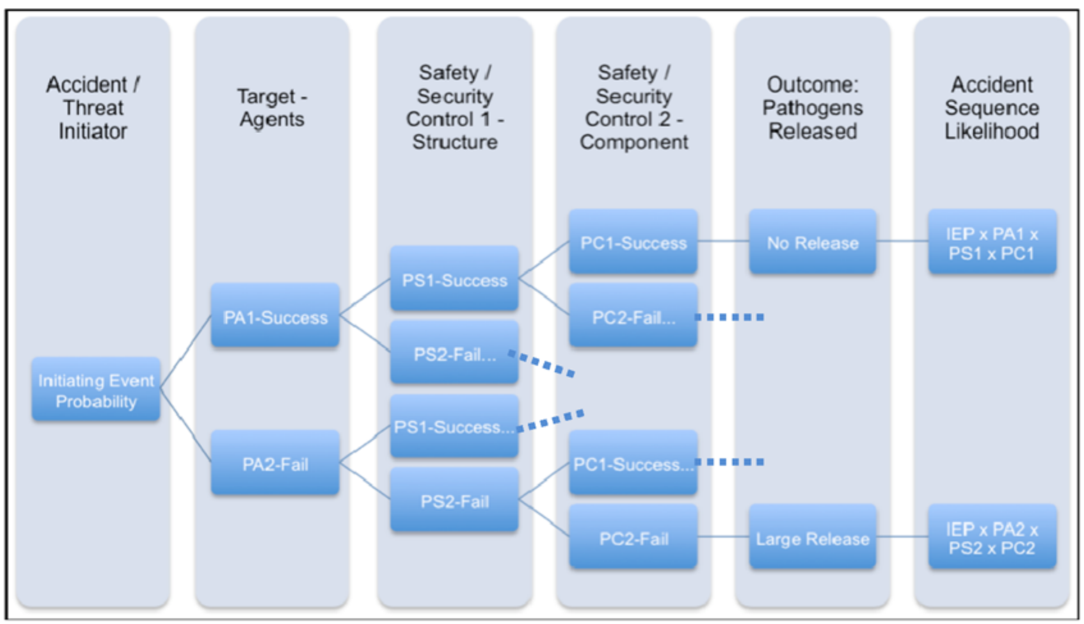
Phase I: Hazards/Threats/Vulnerability Evaluation

- Identify hazards/threats/vulnerabilities
- Develop & evaluate credible scenarios
- Determine qualitative likelihood/consequences
- Identify controls
- Identify potential candidates for detailed analysis

Phase II: Detailed Analysis of Selected Accidents/Threats for Consequence & Likelihood

- Accidents Address: Operations, Natural Phenomena, and External Events
- Threats Address: Terrorists, Disgruntled Employees, Criminals, and Psychotics

Phase II: Accident/Threat Analysis Likelihood Estimation Event Tree



The hazards evaluation, used for the NBAF analysis, identified and evaluated a wide range of realistic scenarios that were postulated to result in an adverse consequence, along with a qualitative evaluation of the protective features in place to prevent or mitigate the hazards and their adverse consequences. Safety controls include engineered safety systems (passive and active) and administrative controls (e.g., training and standard operating procedures, maintenance, and quality assurance).

The overall accident and risk analysis that examined possible sequences and post-release events focused attention on the magnitude of the possible consequences of a release by considering mechanisms of transmission, susceptibility, virulence, and other aspects that influence the growth and spread of disease. The number of accident scenarios analyzed in detail was determined from the wide array of hazard scenarios that lead to high likelihood and consequences to the workers, public, and/or the environment.

Even with the improved engineering and design of high-biocontainment biological laboratories, accidents due to human error or maintenance failures that could cause releases can occur. Recent events include 1) the infection of workers with *Brucella sp.* at one of Texas A&M University's BSL-3 laboratories in 2006; 2) a 1-hr power outage in 2007 at the new BSL-4 facility of the CDC in Atlanta, before work with pathogens begun, wherein the main and back-up power systems both failed and the negative air-pressure system—a key element of pathogen biocontainment—shut down; and 3) in 2007, a release of FMDV to livestock on farms near the Pirbright high-biocontainment laboratory in the United Kingdom due to a damaged and leaking drainage system at the facility (GAO 2007). Scenarios for evaluating the risks posed by the NBAF included potential realistic means of biological pathogen release and describe the various safety controls and barriers relied on to protect laboratory workers, the public, and the environment.

Potential pathogen release included procedural and/or operational and procedural failures, including those that led to worker exposures and infections, spills, loss of biocontainment or control, and even large facility fires. In addition, consider the contamination of the waste streams from the laboratory, intentional infection of laboratory workers, and unintentional release of laboratory animals or pests (such as mosquitoes, which are vectors for RVFV). Development of scenarios to address the numerous and varied situations that can lead to an adverse consequence provides insights into the consideration of additional measures that will enhance laboratory safety.

The NBAF risk assessment and accident analysis assumed, for purposes of providing an initial case for modeling, that a release occurred. Scenarios that include probabilistic evaluation of how a biological pathogen could be released lead to enhanced preventive measures. For example, the assessment of the spill accident highlighted the importance of laboratory worker training in reducing the likelihood of the event. In addition to laboratory-related interventions to *minimize the occurrence* of such events (that is, prevention measures), the risk assessment addressed, as an important safety control, the response capabilities to *respond* to untoward events (that is, mitigating measures).

Without the discussion of preventive and mitigating measures, scenarios would not reflect necessary management and operational aspects of the NBAF, resulting in the loss or unavailability of vital risk information for decision making. Basing scenarios on as much factual information as possible provides relevance and ensures that the various accident scenarios more accurately portray the hazards associated with work in high-biocontainment laboratories.

<u>Pathogens Considered in the NBAF Analysis</u>

The NBAF risk assessment was based on the selection of a variety of representative pathogens with appropriately diverse transmission characteristics (blood borne, transmitted on fomites, spread by aerosol, and/or requiring vectors, as well as the potential for maintenance in existing reservoir species). In addition, such aspects of transmission as high- or low-reproduction, latency, and incubation periods were considered in the assessment of risk at each of the six proposed NBAF sites. The pathogens considered in the NBAF risk assessment were FMDV, RVFV, and Nipah virus.

The characteristics of the particular infectious pathogens considered in the NBAF risk assessment make it more likely that the pathogen could lend itself to the establishment of a chain of transmission that leads to the spread of infection in livestock and endemic species (Section 3.14.4). Infectious pathogens chosen for consideration in the NBAF risk assessment require BSL-3Ag (FMDV and RVFV) or BSL-4 (Nipah virus) biocontainment precautions. These were chosen such that pathogens from both biocontainment levels are represented, and such that the greatest potential for disease spread is represented.

Biosafety biocontainment levels 3E, 3Ag, and 4 include various factors for consideration. These factors include, for example, risk to laboratory workers (and uninfected animals) and whether the pathogen is endemic (neither FMDV, RVFV, nor Nipah virus are endemic viruses in the United States). BSL-3 laboratories are used to study biological pathogens that are potentially lethal and that are transmissible by the aerosol route (CDC 2007; NAS 2008). Consideration of the specific transmissibility, morbidity, and mortality, whether they are handled at the BSL-3 or BSL-4, is also important in evaluating risk. While engineered controls are typically more stringent [e.g., air line respirators in lieu of working in a BSC in BSL-4 facilities, risks of human error may be greater in BSL-3 laboratories.

<u>Estimating the Probability of Release</u>

The potential pathogen releases considered in the NBAF analysis included estimates of likelihood (probability) that were calculated using standard yet simple models with bounding values for the specific parameters. An infectious pathogen release could have a variety of consequences, including (NAS 2008) the following:

- No subsequent transmission, following a small initial pool of infection;
- Little or no subsequent transmission, following multiple exposures;
- Limited transmission that is contained by public health measures; and
- Amplified transmission.

Based on the selected pathogens, the potential for amplified transmission was the primary focus of the NBAF risk assessment. The qualitative analysis of potential outcomes considered the impact of the local characteristics (population density, livestock availability, wildlife, and vector availability) for each of the six proposed sites as discussed in Section 3.14.4.

Risk assessment addresses both the probability and the consequences of adverse events. The scenarios and pathogens discussed were used in the risk assessment to analyze and present the likelihood of adverse events for both mitigated and unmitigated conditions. The qualitative evaluation of the likelihood of the impacts after a release was based on information available from the chemical, nuclear, and biological communities.

The amplified transmission outcome (consequence) is particularly important for the FMDV and RVFV, since these pathogens could establish a successful chain of transmission in both livestock and wildlife species in the United States. Examples of FMD outbreaks in England and RVF and Nipah outbreaks around the world illustrate the magnitude of the adverse consequences from a potential release. Drastic measures to control FMD outbreaks in cattle can and often do lead to great economic loss.

The consequences of a release of an infectious pathogen from a high-biocontainment laboratory depend on numerous factors, such as the characteristics of the pathogen, the pathway by which it is spread, and the size and characteristics of the population that is exposed to it. The major concern for the NBAF analysis is the potential for outbreaks of disease in livestock, wildlife, and, to a lesser degree, the human population.

Modeling is another way of assessing how disease caused by a pathogen may be spread. Modeling may also be an important tool in devising appropriate mitigating strategies. Calculating the subsequent outcome of a potential release of a biological pathogen with models is difficult and uncertain. The process of *transmission*, which has a high degree of uncertainty, is a major parameter in determining the results of a release. It is also difficult and uncertain to estimate the number of contacts between animals, between people, or between animals and people (NAS 2008). In addition, since RVFV is predominantly a vector borne disease, the potential for widespread transmission is amplified by mosquitoes.

The accuracy and precision of a single model to simulate both the transmission of an aerosol-transmissible pathogen and that of a fomite-transmitted pathogen is uncertain and requires great effort to verify or validate the results (NAS 2008). Simple descriptions and qualitative discussions have distinct advantages over the use of controversial and complex models. First, the behavior of simple models are relatively well understood because the mathematics are well-established. The effect of changing inputs in simple models is relatively transparent as in the case of distinguishing between the mitigated and unmitigated accidents. More complexity and detail do not often add to confidence or accuracy of the results. Accuracy is most often determined by the data used to develop input. These data are often either not available or in a form that includes many uncertainties (NAS 2008). This is illustrated by the data available for livestock in the vicinity of each proposed NBAF site. The data were provided in terms of livestock per county without a differentiation as to the species of animal.

The focus of risk assessment performed on the NBAF was on potential bounding consequences, as well as the identification of safety controls to prevent the release or mitigate the consequences, including the need for a robust and comprehensive emergency response program. A robust emergency response program and detailed implementation plans are essential safety controls and are identified as practical aspects of managing an incident (Greenberg 1991).

The detailed analysis of potential consequences associated with operation of a NBAF was developed specifically for each of the six potential sites where the NBAF could be located. In the No Action Alternative, the risks and consequences specifically associated with the NBAF would not occur. However, since PIADC currently operates a BSL-3Ag facility, the risks and consequences presented in this analysis would be applicable to the No Action Alternative, as well. The results and conclusions are presented to inform a decision whether to construct and operate the NBAF and also to provide support for a final determination on which of the six sites is best suited to accommodate the facility, if the decision is made to construct and operate the NBAF. To support this critical decision, the analysis was developed around the specific hazards associated with the operation of a large high-biocontainment biosafety laboratory. The hazards and the subsequent accident analyses focus on the potential for a release of the three representative viral pathogens and the types of safety controls that are to be incorporated into the design and operation of the NBAF that would be relied upon to prevent a release or to mitigate the consequences of a release. As stated in Chapter 1, DHS anticipates that the NBAF would initially focus on African swine fever virus, classical swine fever virus, contagious bovine pleuropneumonia bacteria, FMDV, Japanese encephalitis virus, and RVFV research under BSL-3Ag biocontainment and protocols, as well as Hendra virus and Nipah virus research under BSL-4 biocontainment and protocols. FMDV, RVF, and Nipah virus present the most significant and unique challenges compared to any of the other pathogens currently proposed for study at the NBAF. Therefore, the accidental or intentional (criminal or terrorist activity) act that results in the release of one or more of these three pathogens is used in the following consequence analysis. In conveying the critical information necessary for the decision makers and stakeholders to fully appreciate the overall potential impacts from operations of the NBAF, specific risk ranking strategies were applied to the evaluation of the hazards and accidents. Risk ranking is first based on the likelihood of an accident or intentional release occurring and, second, the subsequent consequences for both mitigated and unmitigated events. The differentiation between the "unmitigated" and "mitigated" events provides the decision makers and stakeholders the essential information to understand and appreciate the reduction in risk to the workers, public, and environment between the unmitigated and mitigated events (DOE 2006).

3.14.1 Introduction

The consequence analysis addresses adverse events as a result of both accident(s) and intentional acts related to all hazards associated with the NBAF operation, yet focuses on the specific hazards posed by the use and handling of biological pathogens. Other hazards considered include those associated with chemicals and radioactive materials (based on references presented in the NBAF Feasibility Study). In addition, common or standard industrial hazards related to energy sources, mechanical systems, and other system or sources were reviewed to determine whether these hazards could act as an initiator in the release of a pathogen (Ericson 2005).

The approach to evaluating the consequences associated with normal and abnormal operations considered a wide array of potential adverse events ranging from the simple loss of biocontainment of a pathogen in a laboratory setting to the extreme significant events related to a facility biocontainment failure and a large-quantity release of a specific pathogen material external to the NBAF. In addition, the analysis considered adverse events, impacts, and consequences associated with the intentional release of pathogens, disruption of operations to the NBAF, and the theft or loss of sensitive information and pathogen materials.

Large quantity releases of a pathogen are considered to be those associated with a loss of biocontainment through either an unfiltered or uncontrolled release of contaminated facility air or wastewater; the loss of infected animals or insects to the environment; or the release to the environment by an infected worker. Less significant releases are considered loss of biocontainment accidents where small quantities of pathogen are released internal to the facility through packaging or sample transport failure, some equipment failure, low-level BSC failure, etc. These smaller "loss of biocontainment" accidents differ from loss of biocontainment accidents in that the final facility biocontainment has not been breached, or has not failed, and is still available for protecting the public and environment from pathogen contamination.

The loss of biocontainment results in a number of specific accident scenarios with the most serious consequences associated with the release of viral particles (virions) to the environment through a variety of pathways. The potential transport of uncontained viable virions as aerosols is a function of the virus species and its sustained viability in the presence or absence of ultraviolet radiation, humidity, ambient temperature, and other factors. It is suspected from past events that the transport of viable FMD, RVF, or Nipah virions via an atmospheric pathway can occur and could potentially result in infections at significant distances from the release point. A wide array of accidental and intentional consequence scenarios were developed to assess the potential impacts from operations of the NBAF. The intermediate steps in developing a detailed accident, consequence, and risk analysis require a knowledge and understanding of the following elements.

- Identification of the Biological Hazard
- Presence of a pathogen of sufficient virulence;
- Existence of the pathogen in sufficient quantity (infectious dose);
- Host susceptibility to infection with the pathogen;
- Ability of the pathogen to cause great impact to livestock and wildlife;
- Ability of the pathogen to become geographically disseminated; and
- Ability of the pathogen to be transmitted.

The assessment of risks for zoonotic and non-zoonotic pathogens and the identification of appropriate safety controls are also dependent on factors such as (Heckert 2007)

- Whether the agent is endemic or foreign to the region;
- The pathogen's ability to cause morbidity and mortality;
- Shedding patterns of the agent in relevant species;
- Whether active control or eradication programs exist for the disease;
- Environmental stability, quantity, and concentration of the agent;
- Use of the agents in animals and laboratories; and
- Host range of the agent and existence of surveillance programs.

For the purposes of evaluating the potential consequences associated with the operation of the NBAF, only pathogens required to be at either the biocontainment level of BSL-3, BSL-3E, BSL-3Ag, and BSL-4 were considered, since these agents represent the greatest potential for large adverse consequences, ease of dissemination, and animal-to-person, animal-to-animal, or other vector-borne transmissions. To fully evaluate the potential for the identified biological agents to pose a threat to workers, public, and the environment, it was necessary to evaluate the material forms and energy sources that might be present, which could lead to a release and subsequent transport of biological agents (Richmond 2001). Generally, the biological agents would be in the form of tissue culture fluids and media or frozen stocks and suspensions (e.g., tissue culture broth) to maintain their viability for research (Furr 2000). On occasion, some biological materials could be in the form of an aerosol, a lyophilized powder, a gel (e.g., agar media petri plates), or a solution. Specific procedures and protocols would be expected for these different physical forms of the biological agent. Depending on the form, the amount of material present and the manner in which it would be prepared or handled would be conducted in accordance with specific design and safety considerations delineated in the NBAF Institutional Biosafety Committee (IBC)-approved protocols and Agency guidelines and protocols.

Developing consequence and frequency estimates for hazard scenarios generally involves adopting numerical assumptions for the following factors:

- Failure of personnel to follow procedures, inadequate training, and other personnel failures;
- Failure of laboratory process equipment;
- Failure of the primary, secondary, and/or tertiary biocontainment of biological material (e.g., sample containers, transportation packaging, equipment, process vessels, etc.);
- Loss of facility biocontainment (e.g., sealed equipment, some BSCs, ventilation and filtration system, facility structure, etc.);
- Other intermediate events in the hazard sequence; and
- Failure of the biosafety program for incident response and emergency communications to the potential release of pathogen.

The evaluation of hazard scenarios relies on determining estimates of two interrelated elements: 1) the probability of a postulated accident scenario occurring and 2) the ultimate consequence of the postulated accident scenario. The methods used to evaluate the hazards from normal and abnormal operations of the NBAF are qualitative in nature and were adopted from standard practices in the biological, chemical, and nuclear industries (DOE 2006; CCPS-1; CDC 2007).

- Accidents leading to release and exposure include
  - Transportation accidents;
  - Loss of biocontainment of animals or insects;
  - Aircraft crash into the NBAF and other catastrophic failures in the structure;
  - Loss of primary and/or secondary biocontainment barrier failures (BSC and NBAF HEPA filters);
  - Inadvertent discharge of biological materials into air handling or liquid and solid waste pathways;
  - Operational upsets (e.g., spills, ejected containers, equipment failures);
  - Natural phenomena, such as seismic events, high winds, floods, and wild fires; and
  - Inadvertent worker exposure (e.g., LAI, needle sticks, inhalation, etc.).

- Types of intentional acts
  - Intentional release of infected animals or vectors;
  - Theft and release of a pathogen;
  - Sabotage and/or facility destruction; and
  - Theft of sensitive information and technology.

The goals and objectives of the consequence analysis are to identify hazards, develop and analyze potential credible accidents, and identify the appropriate type, level, and number of controls to insure the safe operation of the NBAF. The issues surrounding operations of the NBAF are identified and evaluated in relation to the normal and abnormal operations of the NBAF. The accidents and intentional acts are evaluated in detail to define the *bounding* credible event(s) to inform a decision to construct and operate the NBAF. Bounding accidents are those accidents where the consequences are estimated using values for the critical parameters that are at the upper end of the possible range. Constructing the accident release estimates in this manner provides high confidence that the potential accident consequences would not be exceeded. While this approach may tend to overestimate the overall risk, there is benefit in identifying the appropriate safety controls for risk reduction.

NBAF Biological Hazard

The hazard screening process was based on a thorough knowledge of the biological hazards that have been designated as research candidates for the NBAF. These animal pathogens and zoonotic agents are identified for detailed analysis under operational, accidental, and intentional release scenarios.

As presented in Chapter 1 of this EIS, DHS foresees multiple uses and goals for the NBAF. These include

- Serving as a unique BSL-3Ag and BSL-4 livestock laboratory capable of developing countermeasures for Foreign Animal Diseases (FAD), and
- Providing advanced test and evaluation capability for FAD threat detection, vulnerability assessment, and countermeasure assessment for animal and zoonotic diseases.

DHS anticipates that the facility would focus on FMDV, classical swine fever virus, African swine fever virus, RVFV, Nipah virus, Hendra virus, contagious bovine pleuropneumonia bacteria, and Japanese encephalitis virus. Of these, FMDV, RVFV, and Nipah virus currently present the most demanding and bounding challenges regarding

- Animal health impacts
- Biocontainment
- Ecologic impacts
- Economic impacts
- Emergency response
- Human health impacts
- Infectious potential
- Transmissibility and contagion

DHS plans to perform research at the NBAF to study how these pathogens enter the animal, what types of cell the pathogen affects, what effects the pathogen has on cells and animals, how newly developed countermeasures help protect the animal against the pathogen and prevent disease, and new detection methodologies (CRS 2007). To evaluate the hazards posed by these potential research areas at the NBAF, representative pathogens that bound the range of potential consequences were identified. The representative pathogens selected for the detailed hazards and accident analysis are FMDV, RVFV, and Nipah virus. The basis for the selection of these pathogens is presented below.

FMDV

FMDV, a serious animal pathogen that requires BSL-3Ag biocontainment, deserves specific discussion in the NBAF EIS. FMDV causes debilitating vesicular disease and death in all cloven-hoofed livestock and wildlife. Seven serotypes of FMDV, each of which causes FMD, spreads quickly through herds and flocks of susceptible animals. The disease causes high morbidity, which results in dramatic loss of condition and productivity, from which, most infected stock never fully recovers. The economic consequences of an outbreak are huge, and the potential loss of international markets can be devastating. Equines, poultry and fowl, and humans cannot be infected. Though humans are not considered susceptible to infection, FMDV can persist in the human upper respiratory tract for up to 48 hr, making humans potential vectors if they are exposed (CFIA 2005c).

FMDVs are highly infectious and can be transmitted by aerosols and simple contact with fomites (e.g., contaminated materials, inanimate objects, clothing, veterinary equipment, vehicles, foodstuffs, manure, soil, and vegetation). Viruses are excreted from and present in blood and body fluids, including respired air, saliva, vesicular fluids and tissues of the vesicles—which are a hallmark of the infection—semen, vaginal fluids, urine, feces, meats, and milk. Infected animals can excrete high concentrations of virus in respired air, secretions, and fluids.

RVFV

RVFV, a serious animal pathogen that requires BSL-3 biocontainment, deserves specific discussion in the NBAF EIS for several reasons, as presented below. RVFV is a BSL-3E and BSL-3Ag pathogen. RVFV causes disease and death in cattle, sheep, and goats. Abortion rates in pregnant sheep are nearly 100%, and about 90% of infected lambs die. Cattle and calves also suffer but at less dramatic clinical rates (CFIA 2005a).

The virus is transmitted to animals and humans by infected mosquitoes and possibly other biting flies. Other biting insects such as ticks and black flies appear able to harbor and transmit the virus during epidemic outbreaks. It has been shown through experiments that several North American mosquito species can be infected and are capable of transmitting the virus. Certain *Aedes* mosquitoes in Africa are known to transmit virus through their eggs, indicating that there is potential that RVFV could establish a continuous ecological cycle in the United States if it escaped from a research laboratory. One to three percent of infected humans develop severe hemorrhagic fever and/or encephalitis, which may be fatal. These patients often have sufficient virus in their blood to permit mosquito infection and transmission to other humans and animals. Contact with, or consumption of meat from, infected domestic animals is also a source of infection. RVFV is present in blood and body fluids that are highly infectious for at-risk humans, such as veterinarians and abattoir workers, and livestock via aerosols (respiratory route of transmission). RVFV from blood, body fluids, and tissues is a significant hazard because the virus can be aerosolized from animal activity and room, laboratory, or cage wash down operations.

Nipah Virus

Nipah virus, a serious zoonotic agent that requires BSL-4 biocontainment, deserves specific discussion in the NBAF EIS for several reasons. Nipah viruses are recently described zoonotic viruses causing highly fatal encephalitis in humans and can be contagious among humans under particular limited circumstances. In Malaysia, 265 cases of encephalitis with a 40% death rate were reported primarily among pig farmers. In this outbreak, it was shown that close contact with pigs, especially sick pigs, was the major risk factor for human infection. Respiratory infection of humans by aerosols from infected pigs is suspected (CFIA 2005b).

Nipah viruses exhibit an extended host range, with natural infections including swine, humans, and, to a minor extent, cats and dogs. Serologic studies imply that infection can occur in horses and bats. The viruses are carried by fruit-eating bats (absent from the Western hemisphere), and infections in humans and animals can be contracted from bats via fruit or other fomites contaminated by infected bats. Nipah viruses have been detected in respiratory secretions and urine of infected patients in Malaysia, suggesting that person-to-person transmission might be possible in some situations. None of the patients showed obvious pulmonary symptoms. Secondary human-to-human transmission of Nipah virus was not shown for outbreaks in Malaysia or Singapore, but findings from outbreaks in Bangladesh from 2001 to 2007 suggested that close family contact could result in transmission.

As part of the bounding analysis, DHS concluded that the remaining NBAF candidate pathogens, as discussed below, do not exceed those risks posed by FMDV, RVFV, and Nipah virus.

African Swine Fever Virus (ASFV) and *Classical Swine Fever Virus (CSFV)*: These diseases are viral in nature and pose many of the same concerns presented by FMDV. However, all concerns about ASFV and

CSFV are equaled or exceeded by FMDV. FMDV is one of the most contagious infectious diseases known and poses the additional problems of having a broader range of hosts, being transmissible by aerosol over significant distances, and being very resistant to inactivation. ASFV and CSFV raise no concerns that are not present for FMDV.

Hendra Virus (HV): HV has significant similarities to Nipah virus. Both require BSL-4 biocontainment precautions. Both are zoonotic agents, meaning humans as well as animals can become infected. Both are carried by fruit-eating bats (i.e., these bats are reservoirs). Only three cases of human infection from HV have been reported to date, and these appear to have been acquired from body fluids or excretions of infected horses. There are no reports of HV infections in other animals. HV raises no concerns that are not present for Nipah virus.

Japanese Encephalitis Virus (JEV): JEV has significant similarities to RVFV. JEV is a zoonotic agent that is transmitted by mosquito bite, causing infection in birds, pigs, and humans; 0.3% of infections in humans are symptomatic, and fatal encephalitis is possible. Vaccines for use in humans are available for JEV. There is no vaccine for RVFV. JEV raises no concerns that are not present for RVFV.

Contagious Bovine Pleuropneumonia (CBPP): CBPP is the only proposed agent that is bacterial in nature. It is caused by *Mycoplasma mycoides* and is very infectious among cattle. Infectious aerosols are spread via the pulmonary route and, as such, close contact between animals is needed. The bacterium does not survive well outside of its host and, when exposed to normal external environmental conditions, is inactivated within hours or a few days at most. The organism does not survive in meat or meat products. Antibiotic treatment is not very effective and is recommended only in endemic areas where elimination of the organism may not be possible and sub-clinical carriers may develop. As soon as an outbreak is suspected, slaughter of suspect animals is advised. Vaccination of cattle is possible and can be helpful in eradication of disease. All of the problems posed by CBPP are posed by FMDV as well, and comparison of FMDV to CBPP shows FMDV to be a much more serious challenge in all regards. CBPP raises no concerns that are not present for FMDV.

3.14.2 NBAF Hazard and Accident Analysis Methodology

The primary hazard of the NBAF operations is the specific pathogens of FMDV, RVFV, and Nipah virus. The primary accident of interest in evaluating operation consequences is a pathogen release. The types of pathogens described previously are of the type being considered for use in the NBAF. This section presents the results of identifying potential release scenarios and accident initiators that could result in a pathogen release. In addition, hazards from normal and off-normal operations and intentional acts at the NBAF are considered for their role in a pathogen release accident. These hazards are evaluated and analyzed to develop accident scenarios and to estimate conservative consequences of these accidents to the public, workers, and environment and also to develop controls to prevent the accident or to mitigate the consequences of the accident. A detailed hazard and accident methodology used to develop those consequence and risk results is presented in Appendix E.

3.14.2.1 Hazard Evaluation Results

This hazard assessment is developed utilizing information from the NBAF initial feasibility study (NBAF-1) and identifies potential hazards inherent in the anticipated NBAF processes or activities. This hazards listing consists of broad categories of factors that are associated with accident initiation or magnitude and include pathogenic, toxicological, energetic, mechanical, or human error and others.

The methodology used for the hazard evaluation is based primarily on the method referred to as "*what if?/checklist*" analysis technique (CCPS-1). This technique is first applied in brainstorming the identification of various types of failures and scenarios that could conceivably occur in a process or facility. Once the failures and scenarios have been identified in a particular area or step of the process or activity, all pertinent aspects of the operation are considered for potential accident initiators and failure modes. After developing and listing potential failures and accident scenarios, each scenario is qualitatively evaluated to determine the potential consequences of the scenario. Safeguards that prevent, mitigate, or contain the effects of the potential accident are detailed, and each accident scenario is evaluated to determine whether additional improvements or controls should be recommended. All scenarios from the table that have adverse consequences of interest (potential for release of larger quantities of viable pathogens or are imitators to a potential release) are identified. From this list, the safeguards for each selected hazard scenario are categorized as primary and secondary biocontainment barriers and procedural controls. Procedural controls, by their design, are administrative in nature. The following Table presents the safeguards and their associated description in accordance with the expectations outlined in the BMBL (CDC and NIH 2007).

Description of Safety Controls from the 5th Edition of the Biosafety in Microbiological and Biomedical Laboratories (BMBL)	
Safeguard	Description
Primary Biocontainment Barrier (Protective Feature)	Specific or intrinsic to the process or design element equipment (BSC, special process equipment, personnel safety suits, etc.)
Secondary Biocontainment Barrier (Protective System)	Provided by the facility and not the system and is intrinsic to the process or design element (structure, ventilation, fire suppression, etc.)
Procedural Control (Administrative)	Procedural in nature; may be a protective safety management program, a procedure, or a specific procedural step (directive language)

Each hazard scenario is analyzed in an unmitigated fashion where the effects of any primary or secondary biocontainment barriers and/or procedural controls are discounted to determine the uncontrolled impact of the accident scenario on the worker, the public, and the environment. Based on the consequence of severity definitions for the public, the worker, and the environment, which are listed in Tables 3.14.2.1-1 and 3.14.2.1-2, the hazard scenario is assigned a consequence category (DOE 2006; Bahr 1997).

The difference in the descriptions of consequences between workers and the public or environment are intended to convey the fact that the workers are provided personal protection (PPE) and are trained, whereas the public is not afforded this level of protection. Another significant difference in the assignment of consequence categories is that the worker will, in nearly all instances, be in closer proximity to the hazard than a member of the public.

Protection of the public from adverse consequences is primarily driven by engineered controls such as HEPA filtration and pressure controls that prevent large quantities of pathogens from escaping the facility in the event of an operational upset condition. Protection of the worker, because of the close proximity to the hazard, is primarily driven by administrative controls, such as protocols, procedures, and PPE.

Administrative controls such as emergency management and response, on the other hand, provided greater protection for the public than the workers. In a similar fashion, engineered controls such as BSCs and negative pressure boundaries are essential for protecting the involved and non-involved workers within the laboratories. From this discussion, it is apparent that the overall protection to the workers, the public, and the environment is provided by the integration and layering of multiple safety barriers (CCPS 1992).

The consequence categories presented in Table 3.14.2.1-1 include consequence potential from biological hazards, as well as hazardous chemicals and radioactive materials. While the principal hazard at the NBAF is biological materials, the analysis performed was comprehensive and considered both chemicals and radionuclides.

Table 3.14.2.1-1 — Public Consequence Categories and Definitions

Category	Definition
A	**Substantial Off-Site Consequences** • *Biological hazard*: high probability or likelihood for human life-threatening health effects (RVFV and Nipah virus) and spread of animal pathogens (FMDV, RVFV, and Nipah virus) • *Chemical hazard*: off-site concentration Emergency Response Planning Guideline (ERPG) and/or Temporary Emergency Exposure Limit (TEEL) of ≥ EPRG/TEEL-3 • *Radiological hazard:* total effective dose equivalent (TEDE) ≥ 25 rem based on 10CFR830
B	**Moderate Off-Site Consequences** • *Biological hazard*: low probability or likelihood for human life-threatening health effects (RVFV and Nipah virus) and spread of animal pathogens (FMDV, RVFV, and Nipah virus) • *Chemical hazard*: EPRG/TEEL-3 > off-site concentration ≥ EPRG/TEEL-2 • *Radiological hazard:* 25 rem > TEDE ≥ 5 rem
C	**Minimal Off-Site Consequences** • *Biological hazard*: contamination occurs with no or minimal human life-threatening health effects (RVFV and Nipah virus) and spread of animal pathogens (FMDV, RVFV, and Nipah virus) • *Chemical hazard*: EPRG/TEEL-2 > off-site concentration ≥ EPRG/TEEL-1 • *Radiological hazard:* 5 rem > TEDE ≥ 0.1 rem
D	**Negligible Off-Site Consequences** • *Biological hazard*: little contamination with little or no potential for transient human life-threatening health effects (RVFV and Nipah virus) and spread of animal pathogens (FMDV, RVFV, and Nipah virus) • *Chemical hazard*: EPRG/TEEL-1 > off-site concentration ≥ EPRG/TEEL-0 • *Radiological hazard:* 0.1 rem > TEDE ≥ 0.01 rem
E	**No Measurable Off-Site Consequences** • *Biological hazard*: none • *Chemical hazard*: off-site concentration < TEEL-0 • *Radiological hazard:* TEDE < 0.01 rem

Table 3.14.2.1-2 — Worker Consequence Categories and Definitions

Category	Definition
A	Immediate high probability of health effects leading to loss of life
B	Long-term health effects, disability, or severe injury (possibly life threatening)
C	Lost time injury but no disability (work restriction, not life-threatening)
D	Minor injury with no disability and no work restriction
E	No measurable consequences

The expected frequency of an occurrence for each scenario including such factors as the number of operations conducted each year, complexity of the operation, failure-rate data for any equipment involved, operator-error rates, operational experience, and expert judgment is qualitatively assessed (Gertman 1994). A frequency estimate is determined for each scenario using the likelihood categories from Table 3.14.2.1-3. The overall risk for that particular accident scenario to both the public and the worker is then determined from the qualitative estimates of consequence (Tables 3.14.2.1-1 and 3.14.2.1-2) and the frequency of occurrence (Table 3.14.2.1-3). These risk-ranking values are given in Table 3.14.2.1-4 showing the values of both public and worker in the form public/worker. To support unmitigated accident analyses, the accident scenarios are evaluated without primary or secondary biocontainment barriers or procedural controls in place. That is, the consequence of each unmitigated accident scenario is based on the assumption that none of the controls are effective in mitigating or preventing the accidents. The hazards and accident analyses are developed for both unmitigated and mitigated scenarios to assess the value of various protective systems or features and to determine if additional controls that are necessary to reduce risks. For those accidents that have a low consequence and relatively low likelihood then the basic defense, in depth protection features are considered to provide reasonable assurance of adequate protection given the nature of the work. In these situations, no additional analysis is needed. Hazard and accident scenarios that result in high unmitigated risks are selected for detailed analysis, and additional controls are identified.

Table 3.14.2.1-3 — Frequency Categories and Definitions

Frequency Category	Approximate Range	Label	Description
I	$\geq 10^{0}$/yr	Frequent	**Likely to occur often during the life of the facility** Incidents that occur during normal operations
II	$<10^{0}$/yr to $\geq 10^{-2}$/yr	Occasional	**Likely to occur several times during the life of the facility** Incidents that may occur during the lifetime of the facility; these are incidents with a mean expected likelihood of occurring several times (≤50) in 50 operating years
III	$<10^{-2}$/yr to $\geq 10^{-4}$/yr	Probable	**Unlikely but possible to occur during the life of the facility** Incidents that are not anticipated to occur during the lifetime of the facility but could; these are incidents having a likelihood of occurring between 1 time in 100 operating years to 1 time in 10,000 operating years
IV	$<10^{-4}$/yr to $\geq 10^{-6}$/yr	Improbable	**Unlikely to occur during the life of the facility** Incidents that will probably not occur during the lifetime of the facility; these are incidents having a likelihood of occurring 1 time in 10,000 years to between 1 time in 1 million operating years
V	$<10^{-6}$/yr	Remote	**Should not occur during the life of the facility** These remaining incidents have a likelihood of occurring with a frequency of less than 1 time in 1 million operating years

All of the hazard and accident scenarios are evaluated based on the criteria presented in Tables 3.14.2.1-1 – 3.14.2.1-3 for assignment of qualitative likelihood and consequences values. Table 3.14.2.1-4 is then used to assign an appropriate risk rank to the specific hazard or accident scenario. The high risks are taken to those with large consequences and high frequency over the life of the facility. Similarly, low risk hazard and accident scenarios are those characterized by low frequency and low consequences. The risk ranking provides a simple method for distinguishing between accidents to determine the effectiveness of identified controls.

Table 3.14.2.1-4 — Public/Worker Risk Ranking

Matrix of Risk Rank Values Public/Worker					
Consequence Severity	Likelihood Category I	Likelihood Category II	Likelihood Category III	Likelihood Category IV	Likelihood Category V
A	1/1	1/1	2/2	2/2	3/3
B	1/1	2/1	2/2	3/3	3/4
C	1/1	2/2	3/3	3/4	4/4
D	3/2	3/3	3/4	4/4	4/4
E	4/4	4/4	4/4	4/4	4/4

Consequences are taken from Table 3.14.2.1-1 for Public and Table 3.14.2.1-2 for Workers.
Likelihood Category are taken from Table 3.14.2.1-3.
1 = High Risk, 4 = Low Risk.

This risk ranking process is applied to the hazards analysis for selecting accidents that need additional analysis. The risk ranking is also applied to the accident analysis, for both the unmitigated and mitigated scenarios, to either identify the need for additional safety controls or to determine the overall effectiveness of the safety controls to prevent or mitigate the accident. For the purposes of the hazards and accident analysis for the proposed NBAF, the interpretation of Table 3.14.2.1-4 is that risk ranks of 1 or 2 indicate that the consequences and frequency are such that mitigation or prevention measures are necessary. Risk rank 3 is considered borderline in both frequency and consequence and is regarded as the range where additional analysis is needed. Risk rank 4 represents either a very low frequency or a low consequence and can be considered as requiring no additional analysis. In the case of an unmitigated risk rank of 4, no additional analysis is performed. For a mitigated risk rank of 4, the identified safety controls are considered reasonable and adequate to either prevent the accident or to mitigate the consequences.

3.14.2.2 Hazard Screening Analysis

Initially, hazard screening is the process of identifying the scenarios producing the highest pathogenic consequence impact to the worker, the public, and the environment. Characterization of these scenarios is necessary to bound all hazard operations in the NBAF. Once this has been accomplished and the desired operational envelope has been defined, the selection process will identify design-basis accidents representative of the high-consequence scenarios. These accidents are analyzed in detail to evaluate and determine the controls required to protect the public, the worker, and the environment in the event of an accident. The selection and evaluation process is used to define and evaluate bounding design-basis accidents and to select specific controls to prevent the accident or to mitigate the accident consequence significantly. Once complete, lower-tier accidents within the same accident family will be adequately and sufficiently prevented or mitigated.

Standard industrial hazards (slips, trips, falls, wounds, electrical hazards, chemical toxicity, fire hazards, and traumatic injuries) are not included in the hazard identification and evaluation process unless the hazard directly contributes to a pathogen release (DOE 2006). Figure 3.14.2.2-1 illustrates the types of accident scenarios considered while developing the consequence analysis from an inadvertent release of biological agents (see Appendix E, Table E.3-5 for the entire set of NBAF hazard and accident scenarios). A few examples of how specified controls reduce risk include the identified control referred to as "Procedural compliance and 2-person rule," which reduces the risk associated with the LAI-1 scenario by ensuring attention is focused on handling of sharps and by ensuring equipment is maintained and is used properly. The control is an administrative control and acts to reduce the likelihood of the accident thereby reducing risk. Incident response is an administrative control and acts to reduce the risk by mitigating the consequences by ensuring appropriate medical attention, disinfection, etc. PPE in this scenario is an engineered control and can reduce risk by ensuring that exposure is mitigated in the event of equipment failure. In each of the scenarios the role of the controls is to either reduce the likelihood of the event or mitigate the consequences thereby reducing the risk.

The selection of accidents for more detailed evaluation is taken from the set of hazard scenarios. From the identification of hazards and the listing of potential accident initiating events (Table 3.14.2.2-1), accident scenarios are postulated. For the NBAF, the scenarios producing the consequence of an uncontrolled pathogen release are presented in the hazards analysis Table E.3-5 in Appendix E. From this listing, a unique set of accidents to be considered bounding is selected from the hazard analysis summary. The categories of various accidents postulated in the hazards analysis and from which the set of accidents selected for more detailed evaluation is found in Table 3.14.2.2-2. The rationale for selecting a bounding accident is based semiquantitatively on the unmitigated frequency and consequences of the accident and consideration for existing controls relied on for mitigation or prevention. Table 3.14.2.2-2 presents the accident type along with examples and a description of the bounding candidates.

Once this rationale is complete for a given set of operational hazards or accident initiating events, the bounding accidents can be selected by sorting the table based on hazard or accident type or consequence, etc. For the NBAF, the proposed scenarios were evaluated based on accident type and integrating unmitigated public and environment (P/E) consequences with the existing control set to determine the effect on risk (consequence and probability). Generally, one or two accidents are selected from each accident family for further semiquantitative analysis, as well as any unique accidents that might stand out from the others based on requiring specific controls or caused by specific phenomena. For the NBAF, the specific set of accident types considered for detailed analysis is listed above in Table 3.14.2.2-2.

3.14.2.3 Accident Analysis Methodology

After bounding and unique accidents have been selected, they are subjected to quantitative consequence analysis to determine if the control set used to prevent or mitigate the consequences contains

- The correct type of control (engineered or procedural),
- A sufficient number of controls, and
- The appropriate safety designation for the particular accident under consideration.

The accident analysis methodology used in this section consists of the following steps, consistent with Nuclear and Chemical Industry standards for format and content and consistent with the provisions set forth for assessing biological hazards and risks:

- Accident scenario description and development;
- Semiquantitative scenario probability description using appropriate techniques;
- Source term analysis, specification of the pathogens involved;
- Consequence analysis from both accident events and intentional acts; and
- Comparison of the quantity of pathogens released, through exposure pathways, to an infectious dose to support identification of suitable engineered or procedural controls.

Examples of Hazard Scenarios from Appendix E, Table E.3-5

Accident Number	Hazard	Accident Type	What-if (initiating event)	Outcome (accident progression)	Freq	Unmitigated (uncontrolled)			Existing Controls	Freq	Mitigated (controlled)				Recommended Additional Controls
						Consequence		Qualitative Risk			Consequence		Qualitative Risk		
						P/E	W	highest of P/E or W			P/E	W	P/E	W	
LAI-1	Uncontrolled *known or unknown* exposure to pathogen	Laboratory acquired infections (LAI)	**procedural violation** creates sharps (scissors, scalpels, sharp lab surfaces, other glass items including reagent bottles, vials, blood tubes, capillary tubes, microscope slides)	personnel infection (autoinoculation)	Frequent (≥ 1.0 / yr)	B	A	1	procedures and training for sharps handling and control; PPE; incident reporting requirements; incident response; security protocol; human reliability program (HRP)	Occasional (1.0 / yr to E-2 / yr)	E	C	4	2	2-person rule for procedure compliance and equipment use; need for monitoring or detection capability to control contamination spread (fluorescence?)
LAI-4	Uncontrolled *known or unknown* exposure to pathogen	Laboratory acquired infections (LAI)	**procedural violation** results in ingestion from inadvertent contact between mucous membranes and contaminated surfaces or hands	personnel infection	Frequent (≥ 1.0 / yr)	B	A	1	procedures and training for contamination recognition and control; procedures against eating, drinking, cosmetics application, gum, tobacco, eye drops, open wounds, etc in facility; PPE; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	E	C	4	3	2-person rule for procedure compliance and equipment use; need for monitoring or detection capability to control contamination spread (fluorescence?)
LAI-5	Uncontrolled *known or unknown* exposure to pathogen	Laboratory acquired infections (LAI)	**equipment malfunction** results in ingestion from inadvertent contact between mucous membranes and contaminated surfaces or hands	personnel infection	Frequent (≥ 1.0 / yr)	B	A	1	procedures and training for contamination recognition and control; equipment maintenance and use procedures prevent misuse and proper equipment replacement protocol; procedures against eating, drinking, cosmetics application, gum, tobacco, eye drops, open wounds, etc in facility; PPE; BSC, laboratory, facility containment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	E	C	4	3	2-person rule for procedure compliance and equipment use; configuration management governs maintenance type and frequency or equipment replacement; need for monitoring or detection capability to control contamination spread (fluorescence?)
LAI-7	Uncontrolled *known or unknown* exposure to pathogen	Laboratory acquired infections (LAI)	**equipment malfunction** results in aerosol production and inhalation (centrifuge, grinding, homogenizing, blending, vigorous shaking or mixing, sonic disruption, cell separator, etc)	personnel infection	Frequent (≥ 1.0 / yr)	A	A	1	procedures and training for recognizing and controlling aerosol production in routine lab operations (culture prep and handling, pipette use, sampling, etc) in addition to lab equipment use (centrifuge, blending, grinding, mixing, shaking, etc); equipment maintenance and use procedures prevent misuse and proper equipment replacement protocol; PPE; BSC, laboratory, facility containment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	E	B	4	2	2-person rule for procedure compliance and equipment use; configuration management governs maintenance type and frequency or equipment replacement; BSC enclosures for aerosol-generating operations and equipment; need for monitoring or detection capability to control contamination spread (fluorescence?)
LAI-11	Uncontrolled *known or unknown* exposure to pathogen	Laboratory acquired infections (LAI)	**animal handling equipment malfunction** results in bites, scratches	personnel infection	Frequent (≥ 1.0 / yr)	B	A	1	procedures and training for animal handling equipment use; procedures and training for equipment maintenance; PPE; BSC, laboratory, facility containment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Occasional (1.0 / yr to E-2 / yr)	E	C	4	2	2-person rule for procedure compliance and equipment use; configuration management governs maintenance type and frequency or equipment replacement; need for monitoring or detection capability to control contamination spread (fluorescence?)
CONT-2	Uncontrolled *known or unknown* exposure to pathogen	Loss of containment	**animal handling or insectary equipment malfunction** results in escaped animal or insect	environmental contamination	Frequent (≥ 1.0 / yr)	A	A	1	procedures and training for animal handling and husbandry as well as for insectary operations; appropriate animal and insect facilities are provided and personnel are trained on procedures for their use and maintenance to procedures prevent misuse and proper equipment replacement protocol; PPE; BSC, laboratory, facility containment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4 / yr to E-6 / yr)	D	E	4	4	2-person rule for procedure compliance and facility use, especially the insectary; configuration management governs maintenance type and frequency or equipment replacement; BSC enclosures for animal and insectary operations and equipment; need for monitoring or detection capability to control contamination spread (fluorescence?)
CONT-3	Uncontrolled *known or unknown* exposure to pathogen	contaminated solid waste (including animal)	**procedure violation** results in incomplete sterilization/disinfection of solid waste	contamination, possible personnel infection, possible environmental contamination	Frequent (≥ 1.0 / yr)	A	A	1	procedures and training exist for pre- and post-treatment waste handling; for preparing and transferring the waste for treatment; and for sampling and confirming sterile prior to discharge to environment; treated waste is transferred and retained in a controlled repository; PPE; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	D	D	3	4	2-person rule for procedure compliance and equipment use; if there is no QC on sterilization effectiveness, the mitigated half of this scenario needs updating; need for monitoring or detection capability to control contamination spread (fluorescence?)
SUIT-1	Uncontrolled *known or unknown* exposure to pathogen	suit-specific hazards	**suit breach** from crush, pinch, puncture (air-lock doors, quick disconnects, movement of equipment, suit puncture or tear)	personnel contamination	Frequent (≥ 1.0 / yr)	C	A	1	procedures and training for suit use and for recognizing and controlling pinch points; procedures and training for minimizing and recognizing aerosol production in routine lab operations (culture prep and handling, pipette use, sampling, etc) in addition to lab equipment use (centrifuge, blending, grinding, mixing, shaking, etc); suit maintenance and use procedures prevent misuse and proper equipment replacement protocol; redundant PPE; BSC, laboratory, facility containment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	E	B	4	2	2-person rule for procedure compliance, equipment use, and for suit damage hazard control; configuration management governs maintenance type and frequency or equipment replacement; BSC enclosures for aerosol-generating operations and equipment; need for monitoring or detection capability to control contamination spread (fluorescence?)

Examples of Hazard Scenarios from Appendix E, Table E.3-5 (continued)

Accident Number	Hazard	Accident Type	What-if (initiating event)	Outcome (accident progression)	Unmitigated (uncontrolled) Freq	Unmitigated Consequence P/E	Unmitigated Consequence W	Unmitigated Qualitative Risk highest of P/E or W	Existing Controls	Mitigated (controlled) Freq	Mitigated Consequence P/E	Mitigated Consequence W	Mitigated Qualitative Risk P/E	Mitigated Qualitative Risk W	Recommended Additional Controls
NECR-1	Uncontrolled *known or unknown* exposure to pathogen	necropsy safety	**procedure violation during necropsy** results in LAI due to cut/puncture, ingestion, or inhalation	contamination and possible personnel infection	Frequent (≥ 1.0 / yr)	B	A	1	procedures and training in use for sharps use and handling/disposal, for contamination control to prevent inadvertent ingestion (no eating, drinking, cosmetics, tobacco, etc.), and for recognizing and controlling aerosol production in routine lab operations (culture prep and handling, pipette use, sampling, etc) in addition to lab equipment use (centrifuge, blending, grinding, mixing, shaking, etc); PPE; incident reporting requirements; incident response; security protocol; HRP	Occasional (1.0 / yr to E-2 / yr)	E	C	4	2	2-person rule for procedure compliance and equipment use; if there is no QC on sterilization effectiveness, the mitigated half of this scenario needs updating; need for monitoring or detection capability to control contamination spread (fluorescence?)
ENER-1	Uncontrolled *known or unknown* exposure to pathogen	energetic event causing release	**deflagration of natural gas or other flammable process gas leak** causing BSC failure, laboratory, or main structure failure; personnel contamination, room contamination, ventilation system leakage around, through HEPA filters	contamination, personnel infection, laboratory contamination, possible environmental contamination	Occasional (1.0 / yr to E-2 / yr)	A	A	1	procedures and training for equipment use, open flame and spark control; equipment maintenance and use procedures prevent facility gas leak and accumulation; BSC, laboratory, facility containment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	A	A	2	2	currently, natural gas is available to the central utility plant and should be precluded from the NBAF; flammable gas cylinders should contain limited volume if required at all for processes
ENER-5	Uncontrolled *known or unknown* exposure to pathogen	energetic event causing release	**deflagration/explosion of external (to the facility) supply of diesel, fuel oil, gasoline** leading to facility breach, personnel contamination, room contamination, possible environmental contamination	contamination, personnel infection, laboratory contamination, possible environmental contamination	Probable (E-2 / yr to E-4 / yr)	A	A	1	training and maintenance procedures developed and used; combustible control program developed and implemented; ventilation in central utility plant; recognition and control of flammable gases and ignition sources; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4 / yr to E-6 / yr)	A	A	2	2	Central utility plant to store 500,000 gal of diesel (feasibility study, section 4.10, pg 2); proximity of diesel storage to main laboratories needs to be increased
FIRE-1	Uncontrolled *known or unknown* exposure to pathogen	fire (inside BSC or outside BSC but inside laboratory)	**fire from deflagration of natural gas or other flammable process gas leak** causing BSC failure, personnel contamination, room contamination, ventilation system leakage around, through HEPA filters	contamination, personnel infection, laboratory contamination, possible environmental contamination	Probable (E-2 / yr to E-4 / yr)	A	A	1	training and maintenance procedures developed and used; combustible loading controls; flammable gas controls in place including recognition and control of flammable gases and ignition sources, gas detection, BSC ventilation used to prevent accumulation and catastrophic consequences; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4 / yr to E-6 / yr)	E	C	4	4	reliance on operating and maintenance procedures, stored energy control, and combustible loading controls to prevent and mitigate fires; frequent inspections; trained and experienced operators and maintenance personnel
LEAK-1	Uncontrolled *known or unknown* exposure to pathogen	process leak, handling error, or poor housekeeping	**unknown process piping leak or other source of contamination (equipment malfunction)** leads to contamination spread	contamination, personnel infection, laboratory contamination, possible environmental contamination	Frequent (≥ 1.0 / yr)	B	A	1	procedures and training for equipment use; equipment maintenance and use procedures prevent misuse and proper equipment replacement protocol; PPE and sharps containers; BSC, laboratory, facility containment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	E	B	4	2	2-person rule for procedure compliance and equipment use; immediate decontamination available; configuration management governs maintenance type and frequency or equipment replacement; need for monitoring or detection capability to control contamination spread (fluorescence?)
LEAK-2	Uncontrolled *known or unknown* exposure to pathogen	process leak, handling error, or poor housekeeping	**procedure violation during material or waste handling or transfer** leads to contamination spread	contamination, personnel infection, laboratory contamination, possible environmental contamination	Frequent (≥ 1.0 / yr)	B	A	1	procedures and training exist for waste handling prior to treatment; for preparing and transferring the waste for treatment; PPE; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2 / yr to E-4 / yr)	E	B	4	2	2-person rule for procedure compliance and equipment use; need for monitoring or detection capability to control contamination spread (fluorescence?)
NPH-2	Uncontrolled *known or unknown* exposure to pathogen	external events and natural phenomena	**seismic event challenges or exceeds facility design criteria** and structure fails, **subsequent fire(s) start** from ignition sources in laboratories; significant environmental and public contamination	personnel and environmental contamination	Probable (E-2 / yr to E-4 / yr)	A	A	1	no seismic controls; feasibility study indicates spectral acceleration of 0.06g to 0.19g – equivalent of light-laboratory seismic resistance; with no seismic controls, ignition sources in laboratories and outside (500,000-gal diesel storage) assumed to result in fires	Probable (E-2 / yr to E-4 / yr)	A	A	1	1	increase structural design, ventilation fans, filter plenums, filter housings, etc., to accept higher accelerations (~0.5g); facility to maintain integrity and negative pressure during and after seismic event; seismic controls mesh with combustible loading controls and program to prevent or significantly mitigate attendant fires
NPH-3	Uncontrolled *known or unknown* exposure to pathogen	external events and natural phenomena	**high winds (tornado) challenge or exceed facility design criteria** and structure fails; significant environmental and public contamination	personnel and environmental contamination	Probable (E-2 / yr to E-4 / yr)	A	A	1	facility wind resistance (90-mph), no tornado considered in feasibility study	Probable (E-2 / yr to E-4 / yr)	A	A	1	1	increase structural design to withstand credible winds for the site; facility to maintain integrity and negative pressure during and after high-wind exposure

Table 3.14.2.2-1 presents a summary of the hazards identification (Ericson, 2005).

Table 3.14.2.2-1 — Results of Hazard Identification

Hazard	BSL Material/Energy Source	Controls and Safety Features
Acceleration/Deceleration • Inadvertent motion • Sloshing of liquids • Translation of objects • Impacts (sudden stops) • Failing of brakes, wheels, tires, etc. • Falling objects • Fragments or missiles	Surfaces, obstructions (slipping, tripping, bumping, dropping) can lead to an inadvertent release	- Signs and markings - Ergonomics - Secondary containers - Use of break-resistant containers
Biological Agents • Viruses • Others as appropriate	BSL-1 through 4 biocontainment strategies apply to the NBAF	- Small volumes - Standard Operating Procedures - IBC review and approval - BSCs, HEPA, autoclave
Chemical Reaction (non-fire) • Disassociation, product reverts to separate components • Corrosion, rust, etc. • Combination, new product formed from mixture	Laboratory-scale corrosives, acids, bases (household bleach, acetic acid, hydrochloric acid), bases (NaOH), and solvents – improper use can lead to an inadvertent release of biological agents	- Hazardous chemical PPE - Spill clean-up kits - Chemical Hygiene Plan - Standard Operating Procedures
Electrical • Shock • Burns • Overheating • Ignition of combustibles • Inadvertent activation • Explosion, electrical • Static, electrostatic electricity	Transformers, batteries (UPS), cable runs, operating voltages (<120 V to <600 V), high voltages (>600 V), diesel units (back-up generator), motors, pumps, switchgear, service outlets, concealed wiring – can be initiator for a facility fire.	- Electrical Safety Training - ESO inspections - Externally located electrical room.
Flammability and Fires • Presence of fuel – solid, liquid, gas • Presence of strong oxidizer – oxygen, peroxide, etc. • Presence of strong ignition force – welding torch, heaters	Electrical equipment Flammable/combustible/volatile lab-scale chemicals (alcohols, phenol, chloroform)	- Flammables storage cabinet - Flammable-rated cold storage - Limited use of hazardous chemicals
Heat and Temperature • Source of heat, non-electrical • Hot surface burns • Cold surface burns • Increased gas pressure caused by heat • Increased flammability caused by heat • Increased volatility caused by heat	Cryogenics [lab-scale dry ice (CO_2) and liquid nitrogen] Refrigerating units Heaters [thermocyclers/water-baths at >194°F (>90°C)]	- Temperature-related PPE - Non-exposed steam lines

Table 3.14.2.2-1 — Results of Hazard Identification (Continued)

Hazard	BSL Material/Energy Source	Controls and Safety Features
Internal Flooding • Source of water	Sprinkler piping Plumbing	- Design of facility
Mechanical • Sharp edges or points • Rotating equipment • Reciprocating equipment • Pinch points • Weights to be lifted • Stability/toppling frequency • Ejected parts or fragments	Sharps, rotating machinery, motors, pumps, fans, mechanical devices used for pipetting	- Standard Operating Procedures - Use of sharps, etc., required to be minimized per the BMBL (CDC 2007)
Pressure • Compressed gas • Compressed air tool pressure system exhaust • Accidental release • Objects propelled by pressure • Water hammer • Flex hose whipping	Facility pressure (HVAC) controls	- Facility design
	Autoclaves Vacuum pumps Compressed gas cylinders, receivers (carbon dioxide)	- Standard Operating Procedures - Location
External Events • Natural phenomena • Fire • Aircraft • Vehicles	Events such as earthquake, lightning, rain, snow, straight high winds, and wind generated missiles	- Facility design (sufficient to withstand NPH and external events)
	High winds	- Facility design
	Wildland and internal fire	- Facility design - Location - Viability of biological agents
	Aircraft crash	- Facility design
	Transportation and vehicle hazards	- Perimeter fence and vehicle barriers

Table 3.14.2.2-2 — Bounding Accident Categories

Type of Event	Examples	Bounding Accident Candidates
Spill or uncontrolled release of aerosolized pathogens (includes *known and unknown* releases)	• Loss of biocontainment • Over-pressurization • Personnel error leading to LAI • Equipment failure leading to LAI	• LAI – autoinoculation due to personnel error • LAI – aerosol uptake by personnel from centrifuge failure • Small spill resulting in loss of biocontainment, personnel and area contamination, but no environmental contamination • Medium-level spill resulting in loss of biocontainment, personnel and area contamination, but no environmental contamination • Loss of animal/insect control resulting in environmental contamination • Improper sterilization/disinfection of solid waste results in environmental contamination • Improper sterilization/disinfection of liquid waste results in environmental contamination
Chemical release	• Spill • Over-pressurization • Personnel error	• Decontamination or disinfectant failure (e.g., chlorine dioxide generator malfunction) during disinfection process resulting in incomplete sterilization and personnel exposure.
Fire	• Furnace • Mechanical or electrical • Flammable gas • Exothermic chemical reaction	• Large room or facility fire resulting in the loss of facility structure and large environmental releases
Deflagration	• Flammable gas • Exothermic chemical reaction • Flammable liquids • Steam	• Ethylene oxide deflagration in confined space during sterilization operation results in loss of biocontainment • Over-pressure event from steam feeding an autoclave results in loss of biocontainment
Natural phenomena events	• Seismic • High wind • Flood • Snow and ice	• Large, multi-laboratory spill as the result of a seismic event with and without an accompanying fire • Large, multi-laboratory spill as the result of structural damage from high winds (tornado) to a BSL-3E/Ag laboratory
External events	• Airplane crash • Wildfire • Transportation • Adjacent facility accidents	• Aircraft crash into the NBAF with subsequent release of pathogens • Transportation accident resulting when an improperly packaged sample arrives and is handled at a BSL level lower than is required • External fuel storage (diesel, fuel oil) explodes and causes loss of facility biocontainment and environmental contamination

The following methodology is used to address the representative or unique bounding accident scenarios identified in Table 3.14.2-6. As presented in Appendix E, accident scenarios that meet the screening criteria are collected into major accident categories representative of accidents with unique characteristics. Unmitigated consequences from accident scenarios that result in pathogen exposure to the worker or to the public and the environment are presented there. Numerous accident scenarios were identified as potentially having such consequences, and many of these accident scenarios were attributable to a single process or activity (a single process or activity could lead to several accident scenarios that might result in unacceptable consequences).

The essential elements of an accident analysis involves development of credible scenarios for which a hazard, such as viral pathogens including FMDV, RVFV, and Nipah virus, can lead to a release, exposure, and ultimately an adverse effect. Each of these elements is essential to understanding the mechanisms leading to the release and the overall risks associated with the accident scenario. There are basically five separate yet coupled elements in any accident or intentional act analysis. These elements can be described using the following concepts or terms: 1) the source term (ST) or quantity of pathogens potentially released, 2) the mechanisms required for a potential release and transport of the pathogens, 3) the assessment of the exposure pathways for the specific pathogens, 4) the resultant dose estimates to each specific pathogen after release, and 5) estimation of the effects from the dose. The last element is often referred to as simply the consequences.

The accident analysis methodology presented here is specifically tailored to assess the consequences from a potential release of viral pathogens from the proposed NBAF. The processes and methods for the estimation of the source term, specific release and transport mechanisms, the exposure pathways, and the evaluation of the dose are presented in the following sections. The presentation of the final effects or consequences is presented on a site-specific basis in Section 3.14.4.

3.14.2.4 Source Term Analysis

The consequence to the public or environment from an accident involving the release of a pathogen is calculated by defining the level of exposure through inhalation, ingestion, contamination, etc.; the infectivity of the pathogen (its relative ability to produce an infection); pathogenicity (its relative ability for an infection to lead to a fatal disease); and the transmissibility (potential for the disease to spread in the population).

The combination of these factors represents the potential consequences resulting from an exposure to a specified pathogen. The exposure is related to the quantity of a pathogen that is available for release or exposure and is referred to as a source term.

The following five-factor formula represents a method for determining a source term (Q) (DOE 2006).

$$Q = MAR \times DR \times RF \times RF \times LPF$$

Where:

Q = source term to the outdoor atmosphere [number of virions released]
MAR = material at risk [mass, concentration (virions)]
DR = damage ratio [dimensionless]
ARF = airborne release fraction [dimensionless]
RF = respirable fraction [dimensionless]
LPF = leak path factor [dimensionless]

MAR – MAR is defined as the amount of hazardous material available to be acted on by a given physical stress. Facility material operational limits and material inventory information are considered in defining the MAR for each accident scenario to be evaluated. Because the inventory in any individual process, activity, or room is subject to day-to-day fluctuations from routine transfers that are necessary to support operations, conservative upper-bound material inventories are used in consequence estimations. In addition to the pathogen content of the MAR, it is necessary to define its form. For a single process or activity in which various material forms could be present, the MAR was assumed to be composed of the material form that yielded the highest conservative value of ARF×RF. This form of material is typically a viable aerosol for the specified pathogens.

DR – DR represents the fraction of the MAR that is affected by the accident and with which given values of ARF×RF can be associated. DRs are scenario dependent, and their development is described in each accident scenario section. This means that phenomenological characteristics (such as temperatures and pressures) of the accident scenario must be considered. State-of-the-art computer models (e.g., CFAST or FDS for fires) are used to support such analysis when required. Other computer codes are used if the potential for an explosion is assessed as large and the magnitude of the explosion expected to be sufficiently large to cause structural damage to biocontainment or equipment in the vicinity of the explosion. Otherwise, analytical expressions are used to perform calculations necessary to support the evaluation of the DR. For the unmitigated release calculations, a conservative value of DR=1 is used unless otherwise stated and justified.

ARF and RF – ARF is that fraction of MAR × DR that is aerosolized. The RF is the fraction of the airborne material that is respirable (inhalable into the deep lung). This is assumed to include particles with an aerodynamic equivalent diameter (AED) of 10 μm or less. Because of the small sizes of viruses the RF is assumed to be 100% (1.0) in all accidents considered in the NBAF. The values of ARF and RF for each postulated accident were selected based on best available data.

For this accident analysis, ARF values range from a low of $1x10^{-7}$ to a high of $4x10^{-5}$. For spills, impacts, and other mechanical release mechanisms, there is suitable basis to suggest that the ARF for viral pathogens in the most conservative form is not likely to exceed $1x10^{-4}$ except when directly released in the form of an aerosol (the ARF for this case is 1.0). For this accident analysis, RF values range from $1x10^{-5}$ and $1x10^{-4}$ for mechanical stresses, a value of 0.1 for deflagrations and 0.01 for fires. These values were chosen to be the bounding and conservative based on analysis of powders, liquids, fires, etc. from the DOE Handbook 3010-94 and actual data from the anthrax attack on the U.S. Senate in 2001. A detailed discussion surrounding the justification for these ARF and RF selections is presented in Appendix E.

LPF – LPF is the fraction of the locally aerosolized material released to the environment. The LPF is dependent on the nature and location of the accident, as well as the condition (open or closed) of various interior and exterior doors. The LPF is also particularly sensitive to whether a fire is associated with the accident and on external wind conditions because these two aspects provide major motile forces for the source aerosol.

In most cases, the LPF values for the accident scenarios developed in this section were qualitatively estimated based on the conceptual design of the NBAF as presented in the Feasibility Study. An *unmitigated* accident is by definition one in which the aerosolized material is assumed to exit to the atmosphere without retention or mitigation (LPF=1). This unmitigated case is of formal significance because the consequence of such a release is the basis for functionally classifying controls needed to ensure that the postulated accidental release to the atmosphere is sufficiently mitigated. For a well-designed facility with a normally operating active ventilation system and high-efficiency particulate air (HEPA) filtration system with redundant filters, the LPF can be estimated to be on the order of (LPF=0.001% or $1{\times}10^{-5}$). This is based on the building being leak tight and HEPA filter efficiencies at a minimum 99.97% (Plog 2002). The Feasibility Study specifies use of standard HEPA with an efficiency of 99.97% [SIC error corrected] at 0.3 μm; however, no specific criteria have yet been established for the NBAF. The purpose of the analysis and the evaluation of the risks are to evaluate the effect of mitigation and to support potential future design considerations.

3.14.2.5 Transport, Transmission, and Exposure Estimates

Exposure to viral pathogens can result from both direct and indirect mechanisms. Types of direct mechanisms include breathing or ingesting the virus, thereby directly bringing the pathogen into the body. Another direct method is by skin contact with the pathogen. Contact often provides a mechanism for the pathogen to enter the body through cuts, abrasions, or mucus membranes. Indirect mechanisms often refer to transmission through an intermediate step such as in the case of being bitten by an infected mosquito (the transmission mode for RVFV) or a bat. This mechanism is referred to as vector-borne transmission. In this case, the receptor can be an individual or an entire population once the vector carrying the pathogen enters the ecosystem (e.g., West Nile virus). Various forms of transmission of a virus considered in the hazards and accident analyses are discussed below.

Direct Transmission

Facility operations are designed to minimize opportunities for direct transmission. Direct transmission would first require a worker to be exposed to a communicable infectious agent (autoinoculation accident scenario was modeled). Under proper laboratory procedures, the likelihood of a worker inhaling or otherwise becoming exposed (e.g., through cuts in the skin or ingestion) to an infectious agent should be low. The potential to acquire a laboratory-caused disease is further reduced through the use of effective vaccines or therapeutic measures (CDC & NIH 2007). Every NBAF worker would be required to be entered into the Human Pathogen Medical Surveillance Program. This medical program, compliant with the immunoprophylaxis policy per the guidance in the BMBL (CDC & NIH 2007), is administered as a control for safety. Workers would receive annual physical examinations and consultation about biological work hazards, and recommended vaccines would be administered by the medical staff. Additionally, an occupational medicine or similar program would be available to workers for injuries or illnesses received during the course of work activities associated with the NBAF.

Vector-Borne Transmission

Vector-borne transmission is an indirect transmission mechanism of an infectious agent that occurs when a vector bites or touches a receptor or in which the infectious agent is transferred to the receptor by a fomite. Given this discussion, vectors can be separated into two different types of vector transmission: biological and mechanical. Biological vectors can involve an arthropod (insects such as mosquitoes and arachnids including ticks or spiders) vector in whose body the infecting organism persists before becoming infective to the receptor. Mechanical vectors can involve an arthropod vector, which transmits an infective organism from one host to another but which is not essential to the lifecycle of the parasite.

FMDV and Nipah virus are not considered as having a biological vector transmission, while RVFV is transmitted via biological vectors. RVFV is predominantly a vector-borne disease, and mosquitoes are the predominant species for a biological vector. The *Aedes lineatopinnis* mosquito acts as viral reservoir (continuous source) and is depicted in Figure 3.14.2.5-1. The virus is dormant in the eggs of the mosquito *Aedes lineatopennis* in dry soil of grassland depressions. With adequate rainfall, the infected mosquitoes develop and infect ruminants. The virus can be spread by many mosquito species. In North America, *Aedes*, *Culex*, and *Anopheles* mosquitoes have been found to be capable vectors. Mechanical vectors such as midges and biting flies play a significant role during major epidemics (uncontrolled release and spread of the disease). The host range is primarily ruminants, with sheep (lambs) being highly susceptible, followed by goats, cattle, camels, several species of rodents, buffaloes, antelope, wildebeest, horses, donkeys, cats, dogs, monkeys, horses, and birds also being affected. In addition, humans are very susceptible to the disease with the minimum infectious dose being unknown.

Figure 3.14.2.5-1 illustrates the mechanisms involved in vector-borne transmission. The illustration indicates how a viral pathogen once in the environment can become part of the ecosystem and cycle through transmission and infection. The concentration of the viral pathogen is continuously replenished in the reservoir leading to additional uptakes and exposures to other receptors such as cows, pigs, and deer.

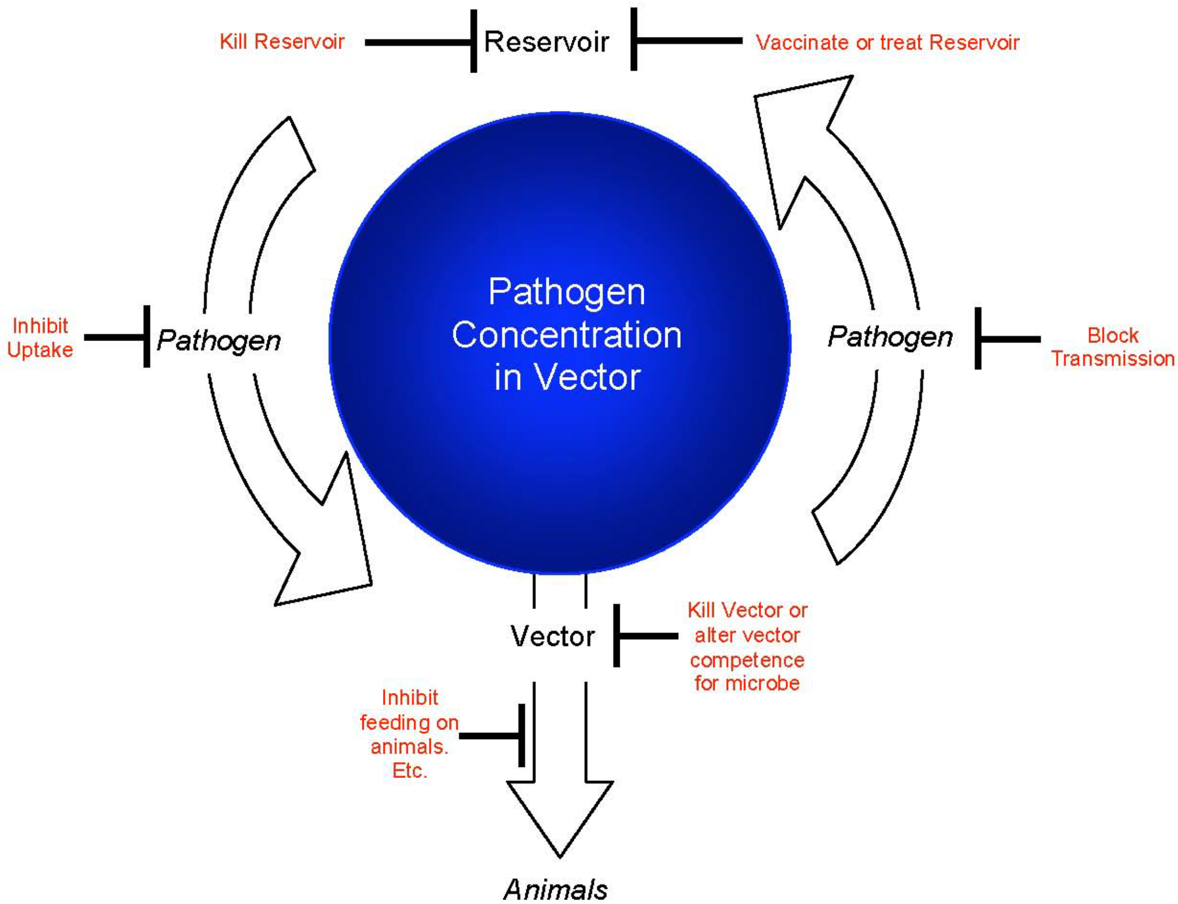


Figure 3.14.2.5-1 — Illustration of the Mechanisms Involved in Vector-Borne Transmission

Because of this potential for continuity in the environment, it is critical that RVFV not be released into the environment. Once in the environment, the virus could become established in a mosquito population and remain prevalent as a significant reservoir that can continuously cause re-infection. The figure above illustrates methods or techniques for interdicting the viral infection cycle, including vaccines, pest controls (pesticides), inhibiting the uptake of the virus, blocking transmission, and stopping the vectors.

The NBAF would be designed to severely limit the potential for possible vector-borne transmission through insects, rodents, and other mechanisms. It is anticipated that the use of pest control, vaccination, and other advanced programs would limit the potential for transmission of infectious agents from animals to humans, humans to humans, or from infected animals to insects or rodents and then to humans or animals (Fleming 2006).

Vehicle-Borne Transmission

Mechanical vectors that do not involve the insects or arachnids are often referred to as vehicles and are termed as vehicle-borne transmission. Vehicle-borne transmission refers to a situation in which a person or material (a "vehicle") becomes surface contaminated with an infectious agent. The primary concern for vehicle-borne transmission would be via the workers' clothing, skin, nares, or hair, as all other materials leaving the NBAF must go through a sterilizing autoclave. The BMBL guidelines established by the CDC and

NIH, which would be followed by the NBAF, are designed to reduce this potential method of transmission. This would substantially reduce any potential for a worker to unknowingly transport biohazardous materials from the NBAF. This is a significant hazard at the NBAF and was addressed in both the hazards analysis and the accident analysis to provide estimates of potential consequences.

The FMDV and Nipah virus can be transmitted via vehicles such as fomites and other contaminated materials. RVFV is predominantly a vector-borne disease and is considered to be much less likely to be transmitted via typically considered vehicles.

Airborne Transmission

All air leaving the BSL-3, BSL-3E, BSL-3Ag, and BSL-4 laboratories is directed via the active ventilation system to flow through ductwork that is HEPA filtered and exit the NBAF through stacks on the building roof. All open cultures of the infectious agents in the BSL-2, BSL-3E, and BSL-4 laboratories would be handled in a BSC. Each BSC has a ventilation system, and all air emissions from operations in a BSC would pass through a HEPA filter in the BSC and, in the case of the BSL-3 and BSL-4 laboratories, two additional HEPA filters, at a minimum, in the NBAF heating, ventilation, and air conditioning (HVAC) system before exiting to the outside air. HEPA filters, at a minimum, remove 99.97% of particulates with a diameter of 0.3 μm (NSC 1996).

The U.S. Environmental Protection Agency, DOE, and NRC have specified in various handbooks, guidance, and standards the use of Gaussian Plume models for the modeling of down-wind concentrations of hazardous constituents resulting from an accidental release. In addition, the Defense Threat Reduction Agency also uses a basic Gaussian Plume model to provide estimates of potential down-wind concentrations of biological materials resulting from a release. Atmospheric transport modeling using a standard Gaussian Plume approach was used to address the potential impacts from the inadvertent release of specified biological agents from the NBAF. The potential impacts from the release of chemicals, radionuclides, and biological agents have been successfully modeled using this approach (Sorensen 1996; Donaldson 1999). The methodology, the appropriateness of the application of the atmospheric transport models employed, and the results of the estimated down-wind concentrations of a hypothetical biological agent are provided in detail in Appendix E (Panofsky 1984; Pasquill 1983).

This approach has been adopted for performing the atmospheric dispersion calculations supporting the NBAF EIS. Similar evaluations of the transport of viral pathogens have been made using the Gaussian Plume model (M.G. Garner, Bureau of Resource Sciences, Commonwealth of Australia 1995, “Potential for wind-borne spread of foot-and-mouth disease virus in Australia;” J.H. Sorensen, December 1999, “An integrated model to predict the atmospheric spread of foot-and-mouth disease virus,” *Epidemiol Infect* 124:577-590, 2000; T. Mikkelsen, European Geosciences Union, 2003, “Investigation of airborne foot-and-mouth disease virus transmission during low-wind conditions in the early phase of the UK 2001 epidemic,” *Atmos Chem Phys Discuss* 3:677-703, 2003). The MACCS2 code uses the ATMOS module to perform all the calculations pertaining to atmospheric transport, dispersion, and deposition (MACCS-1). The output from the ATMOS module used in the analysis of exposure to specified biological agents is referred to χ/Q, which is the concentration term in normalized units. The χ/Q value obtained from the model is multiplied by the total amount of material containing the biological agents that is estimated to have been released from the hypothetical accident. This quantity of material is referred to as the source term. The product of the source term (ST) and the χ/Q produces the total number of elements (e.g., virions, spores, molecules, cells, etc.) toward which a representative receptor is exposed.

Assuming a pathogen release from the NBAF, atmospheric dispersion is estimated using the MACCS2 computer code, which employs a simple straight-line Gaussian model. MACCS2 is a DOE/NRC-sponsored code that has been widely used in support of probabilistic risk assessments for the nuclear power industry and for consequence analyses for safety documentation throughout the DOE complex. A plume centerline, source-normalized concentration ($\tilde{c}$Q), is calculated for each hourly averaged meteorological data set. A single year of site-specific meteorological data were obtained for each of the six proposed NBAF locations. The data were obtained from the nearest measurement location recorded by the National Oceanic and Atmospheric Administration. These statistics represent the 95th percentile of the set of calculated χ/Q values, regardless of location on or beyond the public boundary, and is taken as representative of public exposure. Therefore, these data are used to represent public exposure from an airborne release and are not expected to be exceeded more than 5% of the time for a randomly initiated accident. Further discussion on the dispersion calculations is presented in Appendix E.

Example normalized concentrations from the Gaussian Plume model using the MACCS2 code are presented in Table 3.14.2.5-1.

Table 3.14.2.5-1 — Example Summary Results

Receptor Location (distance from source) in meters	95th Percentile χ/Q (s/m^3) Base Case #1	95th Percentile χ/Q (s/m^3) Case #2 same as base case #1 with 5 MW fire	95th Percentile χ/Q (s/m^3) Case #3 same as base case #1 with 100 MW fire	95th Percentile χ/Q (s/m^3) Case #4 same as base case #1 with Karlsruhe-Julich coefficients
50	9.34E-02	5.21E-4	4.33E-6	1.89E-2
200	9.00E-03	4.46E-5	1.06E-6	1.78E-3
400	3.08E-03	2.01E-5	7.07E-7	6.03E-4
600	1.66E-03	1.36E-5	6.94E-7	3.25E-4
800	1.08E-03	1.17E-5	8.55E-7	2.10E-4
1,000	7.69E-04	1.38E-5	7.64E-7	1.50E-4
2,000	9.75E-05	2.09E-5	6.83E-7	2.11E-5
4,000	3.65E-05	1.40E-5	1.28E-6	5.96E-6
6,000	1.43E-05	9.66E-6	2.27E-6	3.58E-6
8,000	1.19E-05	7.33E-6	2.43E-6	2.32E-6
10,000	7.56E-06	5.44E-6	2.27E-6	1.41E-6

These results show that the base case, which is a ground-level release over fairly flat terrain, provides the bounding estimates for evaluating the potential results from an intentional or accidental release. In addition, it is apparent that the concentration falls off significantly with distance from the source.

Water-Borne Transmission

The NBAF design features, such as backflow preventers, and uniform plumbing code requirements would minimize the potential for microbes within the NBAF from migrating back through the water supply piping to the public. Also, none of the effluent water from the wastewater plant will contribute directly to any potable water source. Potable water supply wells for each proposed NBAF site are discussed in the specific affected environment section.

Water exiting through the sink drains would be combined and diluted by sanitary waste in the sewer system and would undergo a series of treatment steps at the wastewater facility. These treatment steps consist of aeration, secondary clarification, disinfection, dechlorination (for environmental discharges), water reuse system, effluent holding ponds, and sludge drying beds. It is anticipated that there would be minimal effects from water-borne transmission. Because of the potential hazards associated with this pathway, this scenario was specifically evaluated in the hazards and accident analysis.

Safety controls specifically relied upon to mitigate or prevent the inadvertent release of viable pathogens to the environment include the following:

- BSL-3 and BSL-4 laboratory floor drains and piping are segregated and isolated from sanitary waste streams;
- Vents for the drains are segregated and isolated and are provided separate HEPA filtration;
- Autoclave(s), chemical, and gas disinfection methods;
- Secondary biocontainment; and
- Facility structure, which is a safety feature designed to current conceptual design requirements.

In addition to equipment and facility systems that serve as primary and secondary barriers to the release of infectious biological materials, administrative controls serve an important support function. Multiple administrative controls and quality assurance measures are also implemented to minimize the potential for degradation of physical barriers and/or to minimize the amounts of infectious biohazardous materials that become involved in an accident with potential exposure to the workers or release to the environment and the public through the water transmission route. Administrative controls include, but are not limited to, the following programs: Quality Assurance, Qualification and Training, Fire Protection, Engineering and Maintenance, Biological Safety, and Conduct of Operations (DOE 2006; CCPS 1992; Bahr 1997; Greenberg 1991).

Potential release through drains/spills was considered in terms of the specific design and operational characteristics of the NBAF. The autoclave condensate would be directed to the waste treatment system. Dedicated biowaste gathering and treatment systems will be provided for BSL-3(E), BSL-3Ag and BSL-4 functions. Each of the laboratories and associated, procedure rooms, animal rooms and storage/centrifuge rooms are to be provided with a biological liquid waste collection and treatment system. Liquid waste would be treated by a sterilization process (with a method such as an autoclave). The biowaste system would likely employ gravity drainage to the liquid effluent decontamination system. Sanitary connections are also provided to fixtures such as floor or trench drains, lavatories, sinks, and showers. The sanitary and containment areas are segregated as appropriate to maintain the ability to control wastes that require sterilization. The emergency showers/eyewashes are not connected to the wastewater system within the biocontainment areas. There are floor drains associated with the autoclaves, which are tied into the wastewater systems for the biocontainment areas. The piping and connections provide opportunities for release that were evaluated in the accident analyses.

Three scenarios were assessed that could result in the contamination of the NBAF in the plumbing and wastewater system: 1) a flood initiates, or is associated with, a spill of infectious material that results in infectious liquid entering a floor drain; 2) a viable culture of infectious agent is discharged into a sink without adequate decontamination; and 3) a spill of infectious material enters a facility floor or sink drain. Each of these scenarios results in the same circumstance: infectious material discharged to the plumbing that has the potential to contaminate the wastewater system.

Infectious biohazardous material in the NBAF plumbing would be rendered inert through addition of chemical decontamination agents using standard operating procedures for decontamination of laboratory effluent. Proper safety controls would be used before any plumbing work would to be conducted. Workers entering the BSL-3 or BSL-4 laboratory areas would be required to wear appropriate PPE and would be briefed on potential hazards. Potentially contaminated plumbing would represent one of many scenarios where craft workers would be required to conduct work on potentially contaminated systems. Workers that access sewer lines external to the NBAF are accustomed to treating sewer effluent as potentially infectious just as any wastewater from any building. If infectious material from the NBAF were to reach the wastewater system, it would present a potential risk to laboratory workers or the operation of the treatment plant system and also poses a risk to potential release to the environment. However, chemical disinfectants are used in drain lines and all waste originating in the BSL-4, BSL-3(E), and BSL-3Ag areas of the facility will undergo thermal treatment before it is discharged to the sanitary sewer. A lab-scale volume of infectious material, even the amount postulated in the unmitigated release scenario, is a very small fraction of the thousands of gallons of fluid that flows through the plant and resides in treatment plant basins.

3.14.2.6 Evaluating Consequences

Once the source term is evaluated from the five-factor formula discussed earlier, an estimate of the potential consequences of an accident scenario can be made based on atmospheric transport. This estimate should be considered an acute exposure and would not consider long-term effects from secondary transport through water sources, biota, other vector transport, or enhanced viability in the ecosphere through other means.

To determine the airborne exposure potential, the down-wind normalized concentration term χ/Q is multiplied by the source term (ST) to obtain an estimate of the potential exposure in airborne contaminants. In the case of exposure via the inhalation pathway, the expression for determining the total quantity inhaled by an animal or human is related as follows:

$$\text{Total Exposure} = ST \times \chi/Q \times BR$$

Where:

ST = source term [units of MAR; mass, concentration, etc.]
χ/Q = normalized, time-integrated source concentration [s/m^3]
BR = breathing rate of the receptor [m^3/s]

Because the Gaussian Plume model is a time-integrated estimate of the down-wind concentration, it is independent of time. The source term released is assumed to be over the same period as the receptor is exposed, thereby removing the time of exposure and release from the calculation.

The expressions for exposure and source term are used in each of the detailed accident analyses to provide a measure of significance and as a means of comparison. The total inhaled quantity (exposure) is compared to an infectious dose. In the case of FMD, an infection is considered to result from a very small number of virions (10 infectious particles). For RVFV and Nipah virus, the minimum infectious dose is not known but is also considered to require very small numbers of virions depending on the host. The relation used to evaluate non-inhalation routes vary somewhat but are still dependent on a concentration for the source material—a mechanism for getting the pathogens onto or into the body of the animal or human—and a means of estimating the likelihood of a resulting infection.

As was the evaluation method applied to the array of hazard scenarios, the detailed accidents are also evaluated in both a mitigated and unmitigated manner. The unmitigated case does not consider the controls or barriers to be fully effective. The evaluation of unmitigated consequences is based on using bounding values for the factors addressed above (MAR×DR×ARF×RF×LPF). The evaluation of mitigated consequences then relies on the adjustment, with an appropriate basis or rationale, to be reflective of effectively engineered controls. For example, the LPF or DR is considered to be unity in the unmitigated case, leading to very large source terms and consequently large consequences. The mitigated analysis then replaces a LPF of 1.0 with a value of 1×10^{-5} to account for the effectiveness of the "leak tightness" of the facility and the efficiency of the HEPA filtration. Even this "mitigated" value for the LPF is an upper-bound estimate considering that two HEPAs at 99.97% efficient in series could stop more than 99.999991% of the virions from escaping. The value of 1×10^{-5} was specifically used to account for potential ventilation bypass in an active ventilation system.

Determining the likelihood (probability) of the selected accidents is based on using a separate calculation (e.g., event trees) from that used in the consequence, which was the five-factor formula. Breaking the individual accident scenarios into their component parts, where an individual accident sequence has a calculated probability, provides an estimate of the accident probability. Similar to the consequence analysis, the accident probability also has "unmitigated and mitigated" conditions. The "unmitigated" likelihood or accident probability is based on assigning an upper-bound failure probability for event of the tree. The "mitigated" similarly would have event failure probabilities that are reduced based on the effectiveness of the specific controls (e.g., improved training, QA, two-person rule, and formality of operations for administrative controls and improved equipment reliability because of proper selection of equipment, maintenance, and redundancies, etc.). Details of these methods are provided in Operational Accident 1 and in Appendix E for all of the accidents.

3.14.2.7 Accidents for Further Analysis

Having completed the hazard analysis and the accident selection methodology, the accidents considered bounding or unique for representing NBAF operations are presented in Table 3.14.2.7-1. All accidents produce a similar outcome that is the uncontrolled release or exposure of pathogens to the environment.

From Table 3.14.2.7-1, the following summary of bounding and unique accident scenarios is carried forward into accident analysis for quantitative evaluation of controls suitable for mitigating or preventing the consequences described in the hazard analysis:

- 2 – LAIs
- 6 – loss of biocontainment, including spills, contaminated discharges, flooding
- 3 – energetic releases, including deflagration and over-pressure events
- 2 – fire from flammable sources and routine combustible materials
- 1 – transportation scenario
- 4 – external or natural phenomena events including seismic, high winds, small airplane crash

Many of the accidents in Table 3.14.2.7-1 result from procedural violations instead of equipment failure. Examining the Hazard Analysis Table E.3-5 will discover that machine or equipment failure exists in similar scenarios and with similar frequencies of occurrence and consequences to the public, the environment, and the worker. Human error as the initiating event, however, is known to occur at a higher frequency than for equipment failure (Gertman 1994). This is the reason that procedural failures are presented in Table 3.14.2.7 1. As the accident analysis progresses, controls to prevent the accident or further mitigate the consequences will be considered; although desired, prevention of accidents is realistically not attainable, and the objective is to provide reasonable assurance of adequate protection of the workers, the public, and the environment from the hazards posed by the NBAF operations. Thus, the control set for many of the accidents will include reliance on robust conduct of engineering programs, configuration of management programs, training programs, and other programs to enhance formality of operations at all levels to reduce the frequency of human and machine errors in the occurrence of accidents.

It should be noted that with the exception of natural phenomena events and events external to BSL laboratory space (six scenarios including fuel deflagration, fuel fire, seismic, seismic with fire, tornado, and small airplane crash), the existing set of combined engineered and procedural controls appear capable of mitigating bounding accident consequences to Risk levels D and E for public and environmental receptors (Table 3.14.2.7-1). Formal quantitative accident analysis will further evaluate controls with the potential to mitigate or prevent consequences to the worker and the public and the environment.

Table 3.14.2.7-1 — Accidents from Hazard Analysis and Accident Selection Methodology

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
LAI	**Procedural violation** creates sharps (scissors, scalpels, sharp lab surfaces, other glass items including reagent bottles, vials, blood tubes, capillary tubes, microscope slides)	Personal infection (autoinoculation)	Frequent (≥ 1.0/yr)	B/A	1	Procedures and training for sharps handling and control; PPE; incident reporting requirements; incident response; security protocol; human reliability program (HRP)	Occasional (1.0/yr to E-2/yr)	E/C	4/2
LAI	**Procedural violation** results in aerosol production and inhalation (centrifuge, grinding, homogenizing, blending, vigorous shaking or mixing, sonic disruption, cell separator, etc.)	Personal infection	Frequent (≥ 1.0/yr)	A/A	1	Procedures and training for recognizing and controlling aerosol production in routine lab operations (culture prep and handling, pipette use, sampling, etc.) in addition to lab equipment use (centrifuge, blending, grinding, mixing, shaking, etc.); PPE; BSC, laboratory, facility biocontainment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2/yr to E-4/yr)	E/B	4/2
Loss of biocontainment	**Animal handling or insectary procedural violation** results in escaped animal or insect	Environmental contamination	Frequent (≥ 1.0/yr)	A/A	1	Procedures and training for animal handling and husbandry as well as for insectary operations; appropriate animal and insect facilities are provided and personnel are trained on procedures for their use and maintenance; PPE; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2/yr to E-4/yr)	D/E	3/4

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
Contaminated liquid waste (including shower effluent, disinfectant wash down, animal)	**Procedure violation** results in incomplete sterilization/disinfection of liquid waste	Contamination, possible personnel infection, possible environmental contamination	Frequent (≥ 1.0/yr)	A/A	1	Procedures and training exist for pre- and post-treatment waste handling; for preparing and transferring the waste for treatment; and for sampling and (assumed) confirming sterile prior to discharge to environment; treated waste is transferred and (assumed) treated again in a commercial liquid waste treatment facility; PPE; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4/yr to E-6/yr)	D/D	4/4
Contaminated solid waste (including animal)	**Procedure violation** results in incomplete sterilization/disinfection of solid waste	Contamination, possible personnel infection, possible environmental contamination	Frequent (≥ 1.0/yr)	A/A	1	Procedures and training exist for pre- and post-treatment waste handling; for preparing and transferring the waste for treatment; and for sampling and (assumed) confirming sterile prior to discharge to environment; treated waste is transferred and retained in a controlled repository; PPE; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2/yr to E-4/yr)	D/D	3/4

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
Spill, small sample	**Procedural violation during specimen transport** results in spill (slip, trip, fall, drop, jostle, jar, impact)	Contamination, aerosol generation, and possible personnel infection	Frequent (≥ 1.0/yr)	B/A	1	Procedures and training for packaging and transporting or transferring small samples intra-site and inter-laboratory; procedures and training for recognizing and controlling aerosol generation; packaging materials and equipment available and used; PPE; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2/yr to E-4/yr)	E/B	4/2
Spill, small to medium volume	**Procedural violation during specimen transport** results in spill (slip, trip, fall, drop, jostle, jar, impact)	Contamination, aerosol generation, and possible personnel infection	Frequent (≥ 1.0/yr)	B/A	1	Procedures and training for packaging and transporting or transferring medium-volume samples intra-site and inter-laboratory; procedures and training for recognizing and controlling aerosol generation; packaging materials and equipment available and used; PPE; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2/yr to E-4/yr)	E/B	4/2

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
Release from internal flooding	**Internal flooding from failure** of process piping, fire suppression piping, or similar system (see CONT-4)	Contamination of laboratory water or solution accumulation; improper collection and treatment leads to worker contamination or possible environmental release	Probable (E-2/yr to E-4/yr)	A/A	1	Procedures and training exist for liquid waste handling; for preparing and transferring the waste for treatment; and for sampling and (assumed) confirming sterile prior to discharge to environment; treated waste is transferred and treated again in a commercial liquid waste treatment facility (true?); PPE; incident reporting requirements; incident response; security protocol; HRP	Remote (<E-6/yr)	D/D	4/4
Energetic event causing release	**Over-pressure from blockage in steam line** leading to autoclave failure or process steam line failure, personnel contamination, room contamination, ventilation system leakage around, through HEPA filters, environmental contamination	Contamination, personnel infection, laboratory contamination, possible environmental contamination	Probable (E-2/yr to E-4/yr)	A/A	1	Modern autoclave and process steam piping instrumentation and control prevent catastrophic failure if procedures and maintenance protocol exist and personnel are trained and follow procedures; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4/yr to E-6/yr)	E/C	4/4

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
Energetic event causing release	**Deflagration of formaldehyde, ethylene oxide, or other flammable agent during laboratory disinfection or sanitization**, personnel contamination, room contamination, structural failure, loss of biocontainment, ventilation system leakage around, through HEPA filters	Contamination, personnel infection, laboratory contamination, loss of biocontainment, environmental contamination	Probable (E-2/yr to E-4/yr)	A/A	1	Modern disinfection/ sanitization procedures, equipment, process instrumentation and control are available; training and maintenance procedures developed and used; flammable gas controls in place including detection, humidification, ventilation, recognition and control of ignition source used to prevent catastrophic consequences; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4/yr to E-6/yr)	E/C	4/4
Energetic event causing release	**Deflagration/explosion /fire external (to the facility) of the supply of diesel, fuel oil, gasoline** leading to facility breach, personnel contamination, room contamination, possible environmental contamination	Contamination, personnel infection, laboratory contamination, possible environmental contamination	Probable (E-2/yr to E-4/yr)	A/A	1	Training and maintenance procedures developed and used; combustible control program developed and implemented; ventilation in central utility plant; recognition and control of flammable gases and ignition sources; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4/yr to E-6/yr)	A/A	2/2

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
Fire (inside BSC or outside BSC but inside laboratory)	**Fire from buildup of combustibles (poor combustible control in laboratories)** causing BSC failure, personnel contamination, room contamination, possible ventilation system leakage around, through HEPA filters	Contamination, personnel infection, laboratory contamination, possible environmental contamination	Occasional (1.0/yr to E-2/yr)	A/A	1	Combustible loading controls developed and implemented; training and maintenance procedures developed and used for equipment and process use; volume/mass control of chemicals to minimize stored energy; flammable gas controls in place including recognition and control of flammable gases and ignition sources, gas detection, BSC ventilation used to prevent accumulation and catastrophic consequences; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4/yr to E-6/yr)	E/C	4/4

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
Fire (external event)	**Fire from fuel accumulation external to the facility; supply of diesel, fuel oil, gasoline burns** leading to facility breach, personnel contamination, room contamination, possible environmental contamination	Contamination, personnel infection, laboratory contamination, possible environmental contamination	Occasional (1.0/yr to E-2/yr)	A/A	1	Training and maintenance procedures developed and used; combustible control program developed and implemented; ventilation in central utility plant; recognition and control of flammable gases and ignition sources; incident reporting requirements; incident response; security protocol; HRP	Probable (E-2/yr to E-4/yr)	A/A	2/2
External events and natural phenomena	**Small airplane crash into facility (DOE-STD-3014 scenario)** causes structure failure; significant environmental and public contamination	Personnel and environmental contamination	Improbable (E-4/yr to E-6/yr)	A/A	1	No different than for seismic with fire, wind, missile, or other NPH	Improbable (E-4/yr to E-6/yr)	A/A	1/1

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
Transportation	**Mis-identification and site contamination** (failure to meet Federal biomaterial transportation requirements) results in inadequate handling and personnel contamination (high-level pathogen in low-level biocontainment with inadequate PPE)	Contamination, personnel infection, equipment contamination, environmental contamination	Occasional (1.0/yr to E-2/yr)	A/A	1	Procedures and training for packaging, identifying (manifest), and transporting or transferring samples inter-laboratory; procedures and training for recognizing and controlling aerosol generation; packaging materials and equipment available and used; transport system and storage equipment maintenance and use procedures prevent misuse and proper equipment replacement protocol; PPE; BSC, laboratory, facility biocontainment; HEPA-filtered negative-pressure ventilation; incident reporting requirements; incident response; security protocol; HRP	Improbable (E-4/yr to E-6/yr)	E/B	4/3
External events and natural phenomena	**Seismic event exceeds facility design criteria** and structure fails; significant environmental and public contamination	Personnel and environmental contamination	Probable (E-2/yr to E-4/yr)	A/A	1	No seismic controls; feasibility study indicates spectral acceleration of 0.06 g to 0.19 g—equivalent of light-laboratory seismic resistance	Probable (E-2/yr to E-4/yr)	A/A	1/1

Table 3.14.2.7-1 — Accidents From Hazard Analysis and Accident Selection Methodology (Continued)

Accident Type	Initiating Event	Outcome	Unmitigated Frequency	Unmitigated Consequence (P/E over W)	Unmitigated Risk (higher of P/E or W)	Existing Control Set	Mitigated Frequency	Mitigated Consequence (P/E over W)	Mitigated Risk (P/E over W)
External events and natural phenomena	**Seismic event challenges or exceeds facility design criteria** and structure fails, **subsequent fire(s) start** from ignition sources in laboratories; significant environmental and public contamination	Personnel and environmental contamination	Probable (E-2/yr to E-4/yr)	A/A	1	No seismic controls; feasibility study indicates spectral acceleration of 0.06 g to 0.19 g—equivalent of light-laboratory seismic resistance; with no seismic controls, ignition sources in laboratories and outside (500,000-gal diesel storage) assumed to result in fires	Probable (E-2/yr to E-4/yr)	A/A	1/1
External events and natural phenomena	**High winds (tornado) challenge or exceed facility design criteria** and structure fails; significant environmental and public contamination	Personnel and environmental contamination	Probable (E-2/yr to E-4/yr)	A/A	1	Facility wind resistance (90-mph), no tornado (readily apparent) considered in feasibility study	Probable (E-2/yr to E-4/yr)	A/A	1/1

3.14.3 Accident Analysis

Table 3.14.2.7-1 lists the accident scenarios that were developed based on an evaluation of the hazards analysis and for selecting potential accidents that produce bounding consequences. This selection process considered accidents from the more common hazard categorizations (spills, contaminations, laboratory equipment failure, procedure failures, LAI incidents, transport, process upsets, etc.) in addition to unique accidents with low frequencies but with unacceptably high consequences (deflagrations, natural phenomena accidents, external accidents, etc.). Nonetheless, all of the results come from scenarios proposed in the hazards analysis. These accidents include an evaluation of the sequence of events leading to the overall consequences, as well as a description of the models or other risk evaluations relied upon to produce site-specific consequences. A detailed presentation of the spill accident is provided in this section. The remaining accidents are summarized, and the details are available in Appendix E. Table 3.14.3-1 presents an overall summary of all of the accidents considered for the NBAF. Details of the accident consequences are presented on a site-specific basis in Section 3.14.4.

3.14.3.1 Operational Accidents

Operational accidents include those associated with planned and normal unplanned activities related to the NBAF. These accidents are differentiated from natural phenomena or external accidents and intentional acts because the scenarios are developed around the typical operations that are expected to occur in the NBAF. The following presentation of the spill accident is provided to illustrate the accident analysis methodology and represents a wide range of potential scenarios that could lead to a release of pathogens resulting from spills. Operational accidents brought forward from the hazards analysis for detailed evaluation includes 1) drops and spills, 2) LAIs, 3) loss of biocontainment involving infected animals, 4) improper sterilization resulting in release of contaminated liquid or solid wastes to the environment, 5) large room or facility fire resulting in a release of pathogens, and 6) an over-pressure event from a deflagration (inside or outside of the facility).

Operational Accident 1 – Spill/Uncontrolled Release of Pathogens

The presentation of this accident scenario includes additional details to illustrate the methodology. The essential details of the other accidents are provided in Appendix E. This scenario considers the release of pathogens from a small to medium spill. For the purposes of developing a reasonably credible scenario, this accident is considered to be caused by a storage container handling accident, specifically a dropped container or a type of equipment failure that results in spilled or sprayed contents and aerosol production. This scenario effectively bounds the small- and medium-level spill accidents. This accident was selected for analysis because of the potential hazard associated with aerosol production as evaluated in the hazards analysis and accident selection. In addition, this type of spill event was evaluated to potentially occur with a relatively high frequency and can be used to bound the consequence of aerosol release outside of qualified BSC or other engineered enclosures.

Spills and releases can occur from degraded containers; improper packaging of containers or materials; mechanical impact; dropped containers; equipment malfunction due to improper use or inadequate maintenance; procedure violation from packaging, handling, operation, etc.; or a combination of the set. Because pathogens are packaged or processed in various configurations, the configuration most susceptible to becoming an aerosol is examined as a bounding scenario.

Table 3.14.3-1 — Accident Scenario Summary

Accident	MAR*	Unmitigated Release	Risk Rank	Mitigated Release	Risk Rank	Safety Barriers and Procedural Controls
#1. Spill or uncontrolled release of aerosol pathogens – includes dropped containers and equipment failures resulting in aerosol production, worker inhalation exposure, internal facility contamination, and facility release	10^{10} virions (considers a maximum volume of 100 milliliters of material)	10^6 virions; ARF = 1×10^{-4}	**1** **FC II** **Cnsq A/B**	10 virions; due to LPF = $1\ \text{x}10^{-5}$ (biocontainment)	**4** **FC IV** **Cnsq D/C**	**Secondary Barrier – Facility Design and Construction** Active ventilation, which maintains a pressure drop across critical areas and rooms. Passive ventilation system, which includes the leak-tight facility structure, effective efficiency of HEPA filters and plenum to trap the pathogen materials resulting from a spill. **Primary Barrier – Safety Equipment and Personal Protective Equipment** Engineered systems within laboratories to provide biocontainment during process operations (BSCs, etc.) Specialized process equipment for biomaterial processing, packaging, handling, movement, storage, etc. Properly maintained equipment Appropriate PPE available Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc.
#2. Laboratory Acquired Infection (LAI) – produces a worker exposure from autoinoculation, ingestion, or contamination due to personnel error	Variable ≥ 10 virions available (sufficient to cause infection)	Single worker exposure that if not controlled, will expose the public and environment	**1** **FC I** **Cnsq B**	Single worker exposure that is readily recognized and treated; no collateral impact to the public or environment	**4** **FC III** **Cnsq E**	**Primary Barrier – Safety Equipment and Personal Protective Equipment** Specialized process equipment for biomaterial processing, packaging, handling, movement, storage, etc. Properly maintained equipment Appropriate PPE available Sharps procedures developed and implemented Training against procedures Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc.

Table 3.14.3-1 — Accident Scenario Summary (Continued)

Accident	MAR*	Unmitigated Release	Risk Rank	Mitigated Release	Risk Rank	Safety Barriers and Procedural Controls
#3. Loss of animal/insect control - resulting in environmental contamination (scenario also includes the potential for a loss of biocontainment of an animal while remaining inside the NBAF)	10^{10} virions (one infected animal capable of respiring 4×10^4 virions per hour with greater quantities in blood and tissue. Similar quantity as a spill.)	10^{10} virions; the infected animal escapes	**1** **FC II** **Cnsq A**	None; The infected animal does not escape	**3** **FC III** **Cnsq D**	**Secondary Barrier – Facility Design and Construction** Active ventilation, which maintains a pressure drop across critical areas and rooms. Passive and Active Ventilation Systems, redundant HEPA filtration, and other safety barriers to confine material during normal operations Detection systems, alarms, door interlocks, redundant doors, etc. **Primary Barrier – Safety Equipment and Personal Protective Equipment** Animal locator systems to minimize time in the environment in the event of escape Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc.
#4. Improper sterilization/disinfection of solid or liquid waste -results in environmental contamination	10^9 virions (considers a minimum of 10 ml released)	$\leq 10^5$ virions; ARF = 1×10^{-4}	**1** **FC II** **Cnsq A**	None; Sterilization occurs	**3** **FC III** **Cnsq D**	**Primary Barrier – Safety Equipment and Personal Protective Equipment** Disinfection and sterilization equipment; possibly redundant processing protocol Biocontainment systems for liquid and solid waste used as surge awaiting QA approval prior to discharge to the environment Active and passive ventilation system which includes the leak tight facility and the efficiency of the HEPA filters to trap the biological material resulting from a release inside the NBAF Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc. Waste sterilization quality assurance and testing to ensure complete sterilization of infectious waste prior to discharge from facility.

Table 3.14.3-1 — Accident Scenario Summary (Continued)

Accident	MAR*	Unmitigated Release	Risk Rank	Mitigated Release	Risk Rank	Safety Barriers and Procedural Controls
#5. Large room or facility fire - resulting in the loss of facility structure and large environmental release	$>10^{13}$ virions (considers multiple laboratory areas with maximum volumes of viable pathogens. The single maximum volume considered is the 30 L cGMP which contributes 3×10^{12} virons itself.)	$\leq 10^9$; 1 % survive heat and gases, and ARF = 1×10^{-2}	**2** **FC III** **Cnsq A/A**	$< 10^4$ virions; LPF = 1×10^{-5}	**4** **FC IV** **Cnsq D/C**	**Secondary Barrier – Facility Design and Construction** The NBAF biocontainment system, including the NBAF structure, intake and exhaust HEPA filters, and ductwork between the plenums and the structure, provides a barrier against pathogen release to the environment Fire detection and protection systems **Primary Barrier – Safety Equipment and Personal Protective Equipment** Additional safety barriers to provide redundant biocontainment in the event of a large release accident to include BSC, MAR containers, compartmentalization philosophies Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc. Operational MAR limit (Use of small quantities of pathogen in the BSCs).
#6. Over-pressure event - results from a deflagration and loss of biocontainment	3×10^{12} virions (considers single laboratory area with maximum volumes of viable pathogens. The single maximum volume considered is the 30 L cGMP.)	3×10^{10} virions; 10 % survive heat and gases, and ARF = 1×10^{-1}	**2** **FC III** **Cnsq A/A**	3×10^5 virions; reduced by biocontainment LPF = 1×10^{-5}	**4** **FC IV** **Cnsq D/C**	**Secondary Barrier – Facility Design and Construction** The NBAF biocontainment system, including the NBAF structure, intake and exhaust HEPA filters, and ductwork between the plenums and the structure, provides a barrier against pathogen release to the environment **Primary Barrier – Safety Equipment and Personal Protective Equipment** Additional safety barriers to provide redundant biocontainment in the event of a large release accident to include BSC, MAR containers, compartmentalization philosophies Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc. Operational MAR limit (Use of small quantities of pathogen in the BSCs).

Table 3.14.3-1 — Accident Scenario Summary (Continued)

Accident	MAR*	Unmitigated Release	Risk Rank	Mitigated Release	Risk Rank	Safety Barriers and Procedural Controls
#7. Large, multi-laboratory spill as the result of a seismic (or high-wind) event - without an accompanying fire	10^{15} virions (considers multiple laboratory areas and numerous animals with maximum volumes of viable pathogens. The single maximum volume considered is the 30 L cGMP.)	10^{11} virions; ARF = 1×10^{-4}	**2** **FC IV** **Cnsq A/A**	10^{11} virions; LPF = 1.0 (facility containment failure due to NPH) Mitigation can be provided by NPH design and HEPA filtration (multiple HEPA filters in series at 99.97%) reducing the release to < 100 virions	**4** **FC V** **Cnsq E/D**	**Secondary Barrier – Facility Design and Construction** The NBAF biocontainment system, including the NBAF structure, intake and exhaust HEPA filters, and ductwork between the plenums and the structure, provides a barrier against pathogen release to the environment **Primary Barrier – Safety Equipment and Personal Protective Equipment** Additional safety barriers to provide redundant biocontainment in the event of a large release accident to include BSC, MAR containers, compartmentalization philosophies Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc. Operational MAR limit (Use of small quantities of pathogen in all operations).
#8. Aircraft crash into the NBAF or external fuel storage (diesel, fuel oil, gasoline) explosion and fire - causes loss of facility biocontainment with a subsequent release of pathogen into the environment	3×10^{12} virions (considers single laboratory area with maximum volumes of viable pathogens. The single maximum volume considered is the 30 L cGMP.)	3×10^{8}; ARF = 1×10^{-4} or viral pathogens destroyed in heat and gases	**2** **FC IV** **Cnsq A/A**	3×10^{8} virions; LPF = 1.0 (facility is breached by aircraft exposure) Mitigation can be provided by NPH design and HEPA filtration (multiple HEPA filters in series at 99.97%) reducing the release to < 100 virions	**4** **FC V** **Cnsq E/D**	**Secondary Barrier – Facility Design and Construction** The NBAF biocontainment system, including the NBAF structure, intake and exhaust HEPA filters, and ductwork between the plenums and the structure, provides a barrier against pathogen release to the environment **Primary Barrier – Safety Equipment and Personal Protective Equipment** Additional safety barriers to provide redundant biocontainment in the event of a large release accident to include BSC, MAR containers, compartmentalization philosophies Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, etc. Operational MAR limit (Use of small quantities of pathogen in all operations).

* MAR – also referred to as the Material Available for Release. The MAR was estimated specifically for each Bounding Accident based on maximum quantities of pathogens potentially existing in the NBAF at any time. Appendix E provides the details related to calculating the MAR for various configurations and animals.

Several types of aerosol-producing scenarios can be envisioned to occur to packages containing pathogens as they are handled prior to transport or during actual process operations outside of BSC or other engineered enclosures, including the following:

- Drops during container packaging activities prior to or during transport;
- Spills or drops during handling and movement;
- Equipment malfunction from procedural error; and
- Equipment malfunction from inadequate maintenance.

The bounding scenario is taken to be a spill from the fall and breaking of a package from the top shelf of a storage unit or the failure of equipment (centrifuge, blender, grinder, etc.) causing the contents of the package or equipment to be released and aerosolized. In all of these postulated accident scenarios, significant aerosol production is realized causing personnel exposure, laboratory and facility contamination, and a potential release from the facility.

Accident Sequence

A storage package is dropped and breaks, or process equipment (centrifuge, blender, grinder, etc.) fails, releasing pathogen-containing contents in the form of an aerosol. The formation of the aerosol is considered to occur as a result of the energy applied to the contents either as a result of a drop of from an equipment failure. The total amount of energy applied to the contents depends on the equipment (e.g., a centrifuge) failure or the height from which a container is dropped. In either case, the accident is postulated to result in a sequence composed of a number of independent events in series that have a qualitatively determined failure rates derived from hazard rates and demand failure probabilities (McCormick 1981; Fullwood 1988; Gertman 1994). A hazard rate can be interpreted as the number of times that a particular component, system, or piece of equipment fails in some specified time frame. The units of hazard rates are typically in units of time. For equipment that is needed on a continuous basis, the hazard rate is often determined in units of number of failures per hour. When a system needs to respond only in certain situations, the hazard rate is presented in number of failures per demand. These events are shown on event trees, an example of which appears in Figure 3.14.3.1-1.

The following preventive and mitigative features form the basis of this accident to determine the accident probabilities.

Preventive Features

- Packaging intact and appropriate for the material
- Container handled properly and not dropped or impacted
- PPE appropriate and used appropriately
- Proper handling and use of equipment
- Equipment is properly maintained
- Procedures in effect and followed

Mitigative Features

- Active exhaust ventilation system operates
- Passive biocontainment intact and functional
- Other biosafety systems or barriers in place and maintained

Accidents leading to the release of biological material are considered to occur if all the protective features in the prescribed sequence are compromised or fail. Should any *one* event succeed, the accident is prevented or mitigated to varying degrees, depending on precisely which features fail and which continue to function (the effectiveness of the control is also evaluated in terms of mitigated and unmitigated accident frequencies as previously described).

Accidents leading to the release of biological material are considered to occur if all the protective features in the prescribed sequence are compromised or fail. Should any *one* event succeed, the accident is prevented or mitigated to varying degrees, depending on precisely which features fail and which continue to function as intended. The accident sequence for spills is illustrated in Figure 3.14.3.1-1 as an event tree. The overall accident frequency was identified in the hazards analysis as a frequency category (FC) II, indicating that a small to medium spill could occur occasionally over the life of the facility. The event tree is used to illustrate the specific probability of an accident based on the specified initiating event. In addition, based on the number of opportunities for the initiating event and the individual accident sequence events, the overall accident frequency is estimated for the life of the facility, which is assumed to be on the order of 50 years. Each accident is assigned to a qualitative frequency category based on the estimated frequency of the initiating event and the conditional probability of the accident per individual demand for each event in the accident sequence. Weighting or averaging over the individual events determines the overall accident frequency. The estimates of the overall accident frequencies are based on the specific failure rates (probability of failure per demand or unit time) for both unmitigated and mitigated sequences.

The basis for these assignments of frequency and probability is discussed in Appendix E. They are derived from historical experience of failures in similar facilities and generic industrial data sources for equipment failure, together with well-established estimates of human error probabilities. A review of mechanical systems such as pumps, motors, and fans shows that failures can be represented in terms of failure to start and/or failure to run. For other types of mechanical systems, the overall failure can be represented by the failure to operate as expected or failure to perform to a specific level. In these cases, the failure probability could be represented as a failure per demand, for pumps or motors, or even as a failure probability per unit time, for fans or pumps, that are required to run continuously. In the case of HEPA filters, failures can result of being plugged (consequence is high pressure drop across filter), bypassing (characterized by a drop in pressure across the filter housing), or degraded efficiency (higher than expected particulates emerging through the filter). The failure probability for these situations may be represented as a single probability per demand.

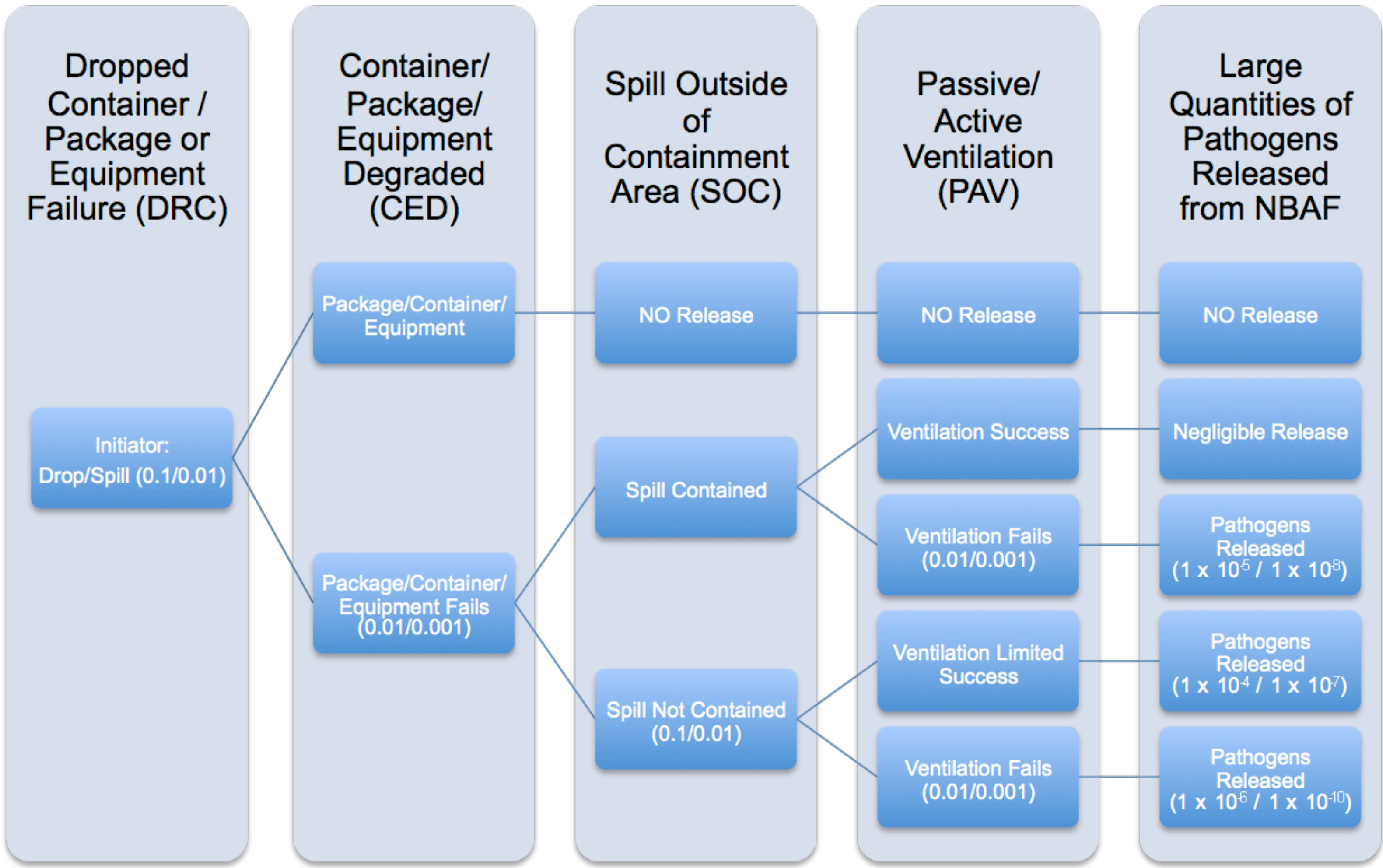
Modeling system behavior of individual components within the various safety systems was found to be unnecessary for providing upper-bound estimates on the probability of failure for mechanical systems. Data for air handling units, as might be found in a typical HVAC system, show that failure probabilities range from a lo of 4×10^{-5} to a high of 2×10^{-2} depending on the application and demand (NRC 2007). Other components including pump valves, water filters, and fans were found to exhibit failure probabilities that range from as low as 4×10^{-9} to as high as 2×10^{-2} again depending on the demand and application. Because failure of an entire system, as envisioned in the event tree depicted in Figure 3.14.3.1-1, is dependent on a variety of individual component interactions that each have small failure probabilities, it is credible and bounding to assign the failure probabilities to the events in the tree as follows. For this analysis, failure probabilities for mechanical systems and human error (reliability) were derived from generic data for various mechanical systems and different types of human activity. The failure probabilities for human error are assigned the values of 0.1 for unmitigated and 0.01 for mitigated accidents scenarios. Failure probabilities for mechanical systems are assigned the values of 0.01 for unmitigated and 0.001 for mitigated accident scenarios. Failure probability data for components of systems that would be expected in the NBAF were estimated from values related to the nuclear and chemical industries. The range of failure probability for critical safety systems was collected over a long period of time from numerous sources, providing a defensible basis for the assigned values used in this analysis (Gertman 1994; McCormick 1981; Fullwood 1988).

The basic events in the overall sequence include the initiating event, which is either a dropped container (package) or equipment failure. The second event in the sequence is that the contents leak from the container or equipment because of container degradation or improper maintenance. The third event is to evaluate the location of the event as inside or outside of biocontainment area. The fourth is evaluating the ability for the released materials to be contained by equipment or location within the facility in order to mitigate or prevent the release from the facility. This last event is referred to as active/passive ventilation. This event addresses the leak tightness of the facility by maintaining proper filtration and pressure gradients (negative pressure in the location of the release directing airflow to the HEPA filters prior to exhausting through the vents). Should all of these protective features fail, then a release of pathogens to the environment would result. Each of these events is discussed and evaluated in detail in the following sections. The analysis of the accident in some detail provides insight into the likelihood (probability) that there is a release given the initiating event. The overall frequency of the accident (unmitigated/mitigated) in a given year, and over the life of the facility, is dependent on the number of demands made for specific event. The accident frequency over the life of the facility, along with the supporting analysis, is used to designate the unmitigated and mitigated risk rank.

The spill accident sequence is represented in the form of an event tree (Figure 3.14.3.1-1) depicting several protective features. Failure of all of these protective features will produce a release of pathogens. The individual events in the accident sequence are related to safety barriers that are modeled as either administrative or engineered controls. The representation of the overall accident frequency in terms of operational years or facility life is determined by the product of the individual event demand probabilities and the total number of demands (or opportunities) for the accident to occur in a year or over the life of the facility. For this accident, the initiating event is presented in terms of a single human error without specific regard to the total number of opportunities. For this reason, the resulting accident probability is in terms of a single demand from the initiating event. To convert this initiating probability to a frequency requires knowledge of the number of handling events per year, which can be determined from knowledge of the expected operations in the NBAF. The initiating event frequency is then the product of the initiating event probability and the number of handling operations per year. The number of handling operations in any given period of time is dependent on the operating characteristics of the NBAF. These characteristics include the number of technicians or animals, the number of containers or unit operations in a given period of time, the number of days or hours per year that the safety systems are expected to be in service, and even the type and amount of specific mission research work that is ongoing. Research facilities have tendencies to fluctuate in types and amount of operations depending on mission objectives.

The event tree with the sequence of events leading to a release of pathogens as a result of a spill is presented in Figure 3.14.3.1-1. The event tree focuses on those events that have a potential to result in a release of pathogens from the NBAF. Each of the discussions that follow provides the rationale for assigning the branch event failure probabilities.

Container/Package Dropped – Equipment Failure – This is considered the initiating event, labeled Dropped - Container (DRC), and is assumed to be the result of a human error. Given the size of the NBAF, the number of laboratories (BSL-3 and BSL-4), animal holding areas, and the expected number of laboratory workers, a dropped container/package or equipment malfunction leading to a spill is considered both reasonable and credible. This accident scenario was developed because a dropped container does not automatically result in a release of pathogens. This initiating event is assigned a demand failure probability, associated with a human error, of 0.1 per demand. Since it is likely that many such opportunities for a container drop are expected to occur in a given year of operation, the overall frequency of this initiating event is much greater than 1 per year. The total number of drops or equipment failures expected in a year is qualitatively estimated based on facility operations.



The three-letter code in the event title represents the event in the sequence. The branch failure probability value is provided in parentheses for each event. For example '(0.1/0.01)' for the initiating event represents the unmitigated/mitigated failure probability for that event. The unmitigated event tree represents the situation where there are minimal procedures, training, maintenance, and reliability of systems and personnel. The mitigate event tree represents a robust management, formality of operations, well-maintained and effective equipment, and rigorous implementation of procedures and controls. The final likelihood (probability) estimates for the sequence are calculated by multiplying each branch (e.g., the largest release is sequence DRC-CED-SOC-PAV), which is an unmitigated likelihood of $1 \times 10^{-6} = 0.1 \times 0.01 \times 0.1 \times 0.01$ per drop event.

Figure 3.14.3.1-1 — Small to Medium Spill and Aerosol Release Accident Scenario

Container/Package/Equipment Degraded Leading to a Spill of Contents – This is the first event in the accident sequence after the initiating event and is labeled Container-Equipment-Degradation (CED) in Figure 3.14.3.1-1. It is assumed that a storage container is dropped or some piece of process equipment fails. The event tree quantification, and the subsequent representation of the risk, based on the accident probability (per year of over the life of the facility) and the potential consequences, does not explicitly take into account that there is a wide range of potential outcomes resulting from a degraded container or package. These outcomes vary from small leaks to complete, instantaneous release of the contents. Conservatively, this accident is considered to result in the release of the entire contents of the package. In addition, it is reasonable to consider that the spilled material could be aerosolized as a result of the impact (see below for a discussion of the fraction aerosolized). The failure probability for this event is primarily based on mechanical failure or wear and tear leading to degradation is assigned a value of 0.01 per demand (per package or container or equipment being called on into service) for the unmitigated case conditional on the occurrence of the drop, as is explained in Appendix E, and a value of 0.001 for the mitigated case. While human error is also an element, because of the potential for improper maintenance of equipment or improper packaging, the failure probability is assumed to be entirely the result of mechanical failure.

Because the NBAF is a new facility, it is assumed that the packages and equipment in use would be new and degradation would not initially be a significant contributor to the failure probability. Procedures and training would be current and attention to detail is expected to be high. The likelihood of encountering degraded transport packages or process equipment may increase with operating history and could be further enhanced by personnel complacency. A robust management system with attention to formality of operations, configuration management, quality assurance, and training in place is expected to significantly reduce the likelihood of human error and mechanical failure.

Spill Outside of Biocontainment Areas – This is the second event in the accident sequence after the initiating event and is labeled Spill-Outside-Biocontainment (SOC) in Figure 3.14.3.1-1. The evaluation of whether a spill is inside or outside biocontainment areas alters the manner in which the spill can be contained. In addition, this event allows consideration of the fact that laboratory rooms where pathogens are present are separated from the non-biocontainment areas or areas with less stringent safety controls (e.g., BSL-2 laboratories, offices, and maintenance areas as opposed to BSL-3 or BSL-4 areas). The plumbing and ventilation are also separated based on the types of work and hazards that are expected. The unmitigated probability of failure for the dropped container (and subsequently the spill) to occur outside of biocontainment was assigned a value of 0.1 for the unmitigated case and a value of 0.01 for the mitigated case because this event, dropping of a package containing pathogens, outside of the appropriate biocontainment area is primarily dependent on human error as opposed to mechanical failure. The procedures for the handling of packages or equipment differ based on the types of hazardous materials contained in the package. The effectiveness of safety controls in preventing the handling of packages in areas where it is not appropriate provides a means for reducing the likelihood of the release. The overall frequency of package handling in an area where the biocontainment protection is less than what is needed for the package contents is determined based on the operational practices (demands) of the various laboratory activities.

Passive/Active Ventilation Operates – This is the last event depicted in the accident sequence. This event is labeled Passive-Active-Ventilation (PAV) in Figure 3.14.3.1-1. Once material has escaped from the breached container or failed equipment, it becomes airborne in a specific area of the facility. Taking into consideration that ventilation is expected to be operating at the time of the release, the aerosol is carried to HEPA filters where it becomes trapped with a specified efficiency of 99.97% per filter (potentially multiple filters in series). The likelihood that ventilation is operating in the critical period after a container drop is based qualitatively on an unanticipated electrical outage or a random mechanical failure. Unanticipated electrical outages are infrequent, and normal operations in the facility are suspended during planned outages. Historically, outages at similar types of biological facilities have occurred approximately four times per year and have lasted less than 2 hours. Considering the number of 2-hour periods in a year, the implication is that power could be interrupted in a given 2-hour period at the rate of $1{\times}10^{-3}$. Assuming the critical period for dispersal after the release is less than 2 hours, the probability that ventilation would shut off during the critical period of the event is on the order of 1×10^{-3} (this failure probability estimate conservatively neglects the capability of onsite back-up power to make up for the loss of off-site power during this critical time). In addition, there are other features of the active/passive ventilation system that would have to fail in order for pathogens to escape the facility in large quantities. These include the HEPA filter failure, leak tightness of the facility is compromised, or there is airflow from biocontainment areas to non-biocontainment areas. Each of these features needs to be factored into the determination of the failure probability for the PAV event; however, because this event is essentially a mechanical system, the failure probability assigned is 0.01 for unmitigated and 0.001 for the mitigated case.

Evaluation of the various accident sequences illustrated in this tree shows that three discrete accident sequences (combined event failures) can result in a potential release of a large number of virions. These sequences are

- DRC-CED-SOC-PAV
- DRC-CED-PAV
- DRC-CED-SOC

The first sequence represents the accident scenario where all of the safety controls fail (each branch in the event tree fails). This sequence is the least likely to occur and has a per demand probability (per handling operation) of 1×10^{-6} for the unmitigated case and 1×10^{-10} demand failure probability for the mitigated case. The second sequence represents the situation where the spill occurs in the appropriate area of the facility, but the passive/active ventilation controls fails resulting in a release of pathogens with a per demand probability of 1×10^{-5} for the unmitigated case and 1×10^{-8} for the mitigated case. The essential difference between these two sequences is that the human error associated with the handling of the package has been removed (event success where the location of the spill is either inside or outside a contained area). The third sequence involves the situation where the package is not in the appropriate area of the facility but the passive/active ventilation control operates. This sequence still leads to a release because the filtration and leak tightness of the facility is less stringent in these areas for the pathogens involved. The individual per demand failure probability is estimated at 1×10^{-4} for the unmitigated and 1×10^{-7} for the mitigated case. This last sequence has the highest failure probability because the entire accident is dependent on two human error events and a single mechanical failure. The evaluation of these sequences indicates the value of the engineered safety controls in contrast to those dependent on operator actions. In addition, the likelihood of the release is reduced when there are a greater number of barriers or controls that must fail before a release is possible.

The accident sequence DRC-CED is one in which the drop and spill occurs, in an appropriate area of the facility, with all subsequent protective features working. Because this accident sequence is in an area where the pressure differential is towards the region of higher biocontainment and the HEPA filtration is more stringent, there is a negligible release.

For purposes of evaluating this accident in the context of all of the remaining accidents to arrive at an overall risk ranking for the facility, it is necessary to convert these individual accident sequences into an overall spill accident frequency. This is accomplished in a qualitative fashion by considering the operational characteristics of the NBAF. Information obtained from the Feasibility Study for the NBAF included details of the mission, numbers and types of animals expected, laboratory space, and projected staff, including maintenance (DHS 2007). From these data, qualitative assessment was made to estimate the total number of potential opportunities (e.g., handling operations) there are for the initiating event to occur. The assessment also included consideration of the operating time and an expected total operating life of the facility on the order of 50 years (the operational life of the facility is based on the fact that many of the missions that the NBAF will replace are currently or have been performed in facilities that are approximately 40 to 50 years old).

Taking these factors into consideration, this accident is assigned a qualitative frequency of $\geq 1 \times 10^{-1}$ (less than 1 accident, resulting in a release, per year) for the unmitigated case, corresponding to a FC II, and 1×10^{-5} per year for the mitigated case, corresponding to a FC IV. Since the range of the accident sequence probabilities (individual demand) was 1×10^{-4} to 1×10^{-10}, the impact of mission objectives, facility operating time, and the total number of workers and packages were sufficient to increase the frequency of a spill accident resulting in a release of pathogens to be less than 1 accident in more than 10,000 operating years of the facility for the mitigated case.

As shown in the above discussion, a completely unmitigated (assumes marginal functioning of the safety controls and high human error rates) release of material is therefore assigned to FC II occasional. Taking into account the engineered and administrative controls that can reduce the frequency of the accident, the mitigated accident frequency is assigned FC IV indicating that a spill leading to a release from the NBAF is improbable (unlikely to occur during the life of the facility) when the protective safety features have a high reliability.

To determine the unmitigated risk rank for this accident scenario the source term is calculated.

Source Term Analysis

The source term is the product of the MAR, ARF, RF, DR, and LPF as discussed in Section 3.14.2. In this accident scenario, the unmitigated source term was calculated using conservative values. The specific values for each of these five factors are discussed below and presented in Table 3.14.3.1-1.

MAR – Based on mission objectives and regulatory requirements, a particular package of biological material could contain approximately 100 milliliters (mL) of culture containing viable pathogens. While there are differences between pathogens in relation to the number of particles in a solution or gel media, it is reasonable to assume that approximately 1×10^{8} viable virions could be present in a single milliliter of culture media. This would yield a total inventory of approximately 1×10^{10} viable virions in a single package containing 100 mL of culture. The biological materials consist of various forms, but the most sensitive are those able to be easily aerosolized upon impact, such as solutions or powders. The MAR for this scenario is then taken to be 1×10^{10} virions of a specific pathogen. For purposes of evaluating the consequences, the MAR represents each of the viruses, FMDV, RVFV, and Nipah virus.

DR – For the unmitigated analysis, the DR is conservatively set at unity (1.0). In even the worst-case spill, however, it is unlikely that all of the biological material would escape the container and the DR would more likely to be much less than 1. Therefore, using a value of DR=1.0 for this consequence estimate is extremely conservative.

ARF and RF – Results of studies with powdered materials, liquids splashing, and solids being crushed on impact provide bounds on the total quantity of inventory that can become airborne as a result of a drop or a spill. As discussed in Section 3.14.2.4, the ARF is assigned a value of 1×10^{-4} and the RF is conservatively taken to be 1.0 (meaning all of the aerosol is at the respirable size).

LPF – For the unmitigated analysis in which the aerosolized material escapes the facility without being filtered or otherwise mitigated by the building biocontainment system, the LPF is set to 1.0. For the mitigated analysis, the LPF is determined by taking into account the biocontainment system (ventilation, HEPA filtration, facility structure). The LPF for the active and passive HEPA filtered system is conservatively estimated to be 1×10^{-5} for the mitigated accident scenario.

Table 3.14.3.1-1 — Small to Medium Aerosol Release Source Term Parameters

Scenario	MAR	DR	ARF	RF	LPF
Unmitigated (No credit for HEPAs, Maintenance, or Procedures)	1×10^{10} virions	1	1×10^{-4}	1	1
Mitigated (Active/Passive Ventilation, Procedures, Maintenance, etc.)	1×10^{10} virions	1	1×10^{-4}	1	1×10^{-5}

Unmitigated Source Term

The unmitigated source term (only considers the physical properties of the pathogens and the culture media, no credit is taken for safety systems) for the small- to medium-spill accident is given by:

$Q=1\times10^{10}$ virions $\times1\times1\times10^{-4}\times1\times1=1\times10^{6}$ virions

Where:

Q = Quantity of viable pathogens released from the NBAF following the spill.

Mitigated Source Term

The LPF for the NBAF, as presented in Section 3.14.2 and Table 3.14.3.1-1 above, is used to calculate the mitigated source term (considers the efficiency of the HEPA filtration and the leakage of the facility, no credit is afforded the container as a conservative estimate) is given by:

$Q=1\times10^{10}$ virions $\times1\times1\times10^{-4}\times1\times1\times10^{-5}=1\times10^{1}$ or 10 virions for the active/passive ventilated safety system, proper maintenance, and high HEPA efficiency.

Consequence Analysis

The dose to the receptor outside of the NBAF (animal or human) is represented by the exposure due to inhalation, ingestion, contact, and vector pathways. For the inhalation pathway, the results of the air transport model provide time-integrated normalized air concentrations; therefore, the estimate of the exposure to pathogens in the air is simply the source term (Q) multiplied by the time-integrated normalized air concentration and the breathing rate in units of cubic meters per second.

The inhalation exposure to air containing transported viral particles is calculated by:

$\text{Exposure} = Q\times BR\times\chi/Q$

Where:

Q = the source term (mitigated or unmitigated [virons])
BR = is the breathing rate [m^3/s]
χ/Q = the 95th percentile normalized distribution of pathogen in the air at the receptor location [s/m^3]

The typical breathing rate for humans is taken to be 3×10^{-4} m^3/s, while the breathing rate for a cow is approximately 6 m^3/hr or 1.6×10^{-3} m^3/s, and a pig is assumed to be approximately the same as a human.

For determining animal exposure from ingestion, both the total time spent grazing and the total quantity of food consumed in a specific time period are important. The estimate of the amount of grass or feed an animal consumes is approximately 100 pounds per day for a cow. The amount is expected to vary greatly depending on the species of animal such as pigs, deer, elk, etc. Because the data obtained for the livestock in the vicinity of each proposed site are taken to be cattle, the estimate of 100 pounds per day is sufficiently representative for purposes of estimating risk. The results of the atmospheric modeling also provide estimates of the quantity of virions deposited on the ground as a function of distance from the site. Therefore, to assess the potential risk to cattle grazing on grass where viral pathogens have been deposited, an estimate of the total area covered by the animal grazing is necessary. Knowing the total amount of food consumed by an animal in a given period of time and the quantity of food produced per area will provide the basis for estimating the total exposure to pathogens while grazing. Estimates of grass production per unit are of ground vary somewhat depending on the species of grass, the type of soil, and available moisture, etc. A conservative estimate for the yield for typical pasture grass is on the order of 3.5 pounds per square meter (lb/m^2). As an example, if one were to assume that a cow eats nearly 100 pounds of feed per day (8 lb/hr assuming that cows eat 12 out of 24 hours) and that there is approximately 3.5 lb/m^2, then a cow would need to cover nearly 30 m^2 per day at a average rate of 2.5 m^2 per hour to ingest 100 pounds of food.

The calculation of unmitigated and mitigated consequences uses these same relationships to provide estimates of exposure. The difference is in the magnitude of the source term (how many virions are available) for inhalation and ingestion.

Unmitigated Off-Site Consequences – Calculation of site-specific exposure values are provided in Section 3.14.4. The calculated χ/Q is site specific and varies with distance from the point of release. A typical χ /Q value at a distance of 250 m (approximate NBAF fence line) is on the order of 1×10^{-2} s/m^3 (see Table 3.14.2.5-1). This value is used to determine the unmitigated exposure results in an inhalation dose of approximately 10,000 virions or about 1,000 times the minimum infectious dose (MID) for FMDV. Because 10 virions are also taken to be the MID for both RVFV and Nipah virus, these results are applicable to all three representative viruses for the inhalation pathway. Similarly, the exposure due to ingestion at the site boundary, for which the typical ground concentrations is approximately 20 virions/ m^2 resulting in a total dose nearly 60 times the MID, is also greater than the minimum necessary to cause infection. Given that the unmitigated consequences at the site boundary are significantly higher than the MID, the identification of robust safety controls to prevent the accident or mitigate the consequences is necessary.

Mitigated Off-Site Consequences – Mitigated accident consequences, in a similar manner as the mitigated accident frequency, are estimated by evaluating the reduction in material released in an accident through the improvement of effectiveness of various controls. In the mitigated consequence analysis, as discussed above, the passive and active ventilation system is credited for reducing the LPF (amount of material that escapes from the facility through leaks and filters) to a fraction of that considered for the unmitigated case. Because the mitigated release is much smaller than the unmitigated case, there is little chance for significant down-wind transport of the pathogens in a concentration that would result in an exposure. Because of the active/passive LPF mitigation effects, the mitigated exposure levels would be 100,000 times smaller than those described for the unmitigated release. The resultant dose at the site boundary would be 1×10^{-1} or 0.1 virions (less than the MID of 10 virions). These results illustrate that focusing resources and attention on the ability for the NBAF to contain pathogens in the event of an accident (in this case a small- to medium-size spill) provides a large reduction in the risk.

Risk Ranking

Based on the evaluation of the likelihood of a specific accident (as described in the evaluation of the event tree) and the consequences (as described by estimating exposure through inhalation and ingestion) associated with this accident, specific risk ranks can be assigned for the unmitigated and mitigated spill accident.

Unmitigated Risk Rank

The unmitigated risk rank is the combination of the accident likelihood (probability) and the bounding consequences through all pathways.

The spill accident has a per drop probability, from the event tree analysis for all three large release sequences, in the range of a 1×10^{-4} to 1×10^{-6}. Considering the total opportunities for a drop to occur during the life of the facility, the unmitigated frequency for this spill accident has a range of 1×10^{-2} to 1×10^{0} or FC II (occasional) from Table 3.14.2.1-3.

The spill accident consequences were shown to be greater than the MID at the site boundary, indicating an unmitigated consequence severity category of B for the worker (long-term health effects) and A for the public/environment (exceeds the MID by more than a factor of 10 at the site boundary).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC II and consequence severity of A/B (public/worker) and the assigned risk rank is 1, which indicates that robust safety controls are required to prevent or mitigate the accident and reduce the risk. Given that the unmitigated consequences at the site boundary are significantly higher than the MID, the identification of safety controls to prevent an accident or to mitigate the consequences is essential. The following table presents the safety controls or barriers relied upon to reduce or prevent a release. The safety controls considered appropriate for reducing the risk for this accident are summarized below.

Summary of Safety Barriers and Procedural Controls

Control	Description
Safety Barriers	Active ventilation, which maintains a pressure drop across critical areas and rooms.
	Passive ventilation system, which includes the leak-tight facility structure, the efficiency of HEPA filters (in series at 99.97% efficient or better), and plenum to trap the spilled pathogen materials.
	Engineered biocontainment systems within laboratories to provide biocontainment during process operations.
	Robust containers and packaging that meet DOT requirements.
	Specialized process equipment for biomaterial processing, packaging, handling, movement, storage, etc.
	Properly maintained equipment.
	PPE available and used appropriately.
Procedural Controls	Conduct of engineering and operations consider maintenance, contamination control, PPE use, training, specialized operational procedures, monitoring and inspections, quality assurance, etc.

After taking into consideration the safety controls in the context of the spill accident, the mitigated risk rank is assigned. Determining the mitigated consequences depends on whether the accident is prevented or not. If the accident is totally prevented, for example, by robust packaging (as well as procedures, maintenance, etc.), then the spill and subsequent release is prevented or mitigated. In the case where the accident is prevented, there is no release and therefore no consequences to the public or worker. Should the accident occur, but with lower frequency, and the safety systems function as expected, then the consequences are significantly reduced as presented above. In either case, the risk is significantly reduced.

Mitigated Risk Rank

The mitigated risk rank, like the unmitigated evaluation above, is the combination of the accident likelihood (probability) and the bounding consequences through all pathways for the mitigated accident.

Through improvements in procedures, training, and quality assurance, the mitigated spill accident has a per drop probability, from the event tree analysis for all three large release sequences, in the range of a 1×10^{-7} to 1×10^{-10}. In the same manner as for the unmitigated accident frequency taking into account the total opportunities for a drop to occur during the life of the facility, the mitigated frequency for this spill accident has a range of 1×10^{-4} to 1×10^{-6} or FC IV (improbable) from Table 3.14.2.1-3.

The spill mitigated accident consequences were shown to be much less than the MID at all distances from the point of release, indicating a mitigated consequence severity category of C for the worker (lost time injury or exposure—no health effects due to proper PPE use) and D for the public/environment (negligible off-site consequences much less than infectious dose).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC IV and consequence severity of D/C (public/worker) and the assigned risk rank is 4, which indicates that the robust safety controls considered are sufficient to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table (Table 3.14.3.1-3).

Table 3.14.3.1-3 — Risk Rank Summary – Spill Accident

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for HEPAs, maintenance, or procedures)	1	FC II (1×10^{-2} to 1×10^{0}) Occasional	A/B (Public/Worker) Exceeds the MID
Mitigated (Active/Passive ventilation, procedures, maintenance)	4	FC IV (1×10^{-4} to 1×10^{-6}) Improbable	D/C (Public/Worker) Negligible off-site consequences

The remaining operational accidents are briefly discussed below.

Operational Accident 2 – LAI

This scenario considers a type of release that is only a local accident where a laboratory worker through a variety of personnel errors results in an autoinoculation, ingestion, or contamination event. This scenario specifically addresses the potential for and the consequences associated with an LAI. In spite of the programs that are expected to be in place to identify and mitigate the effects and consequences of LAI, these do not explicitly prevent accident occurrence.

Several types of errors can lead to a LAI and include use of equipment that was not properly disinfected and failure to follow essential procedures for the use of equipment and disinfecting equipment. In addition, there is the potential for human error that leads to a cut or puncture, the splashing of pathogen-containing solutions into mucous membranes, or the inadvertent contamination incident. The failure to wear proper PPE is also a significant contributor to the occurrence of a LAI. The bounding scenario is taken to be an LAI as a result of personnel error as the initiating event. Mechanical failures can also lead to LAIs; however, the spill accident scenario bounds these events.

Based on mission of the NBAF, it is considered a given that laboratory workers will be in contact with sufficient numbers of viable pathogens (virions of RVFV) that an infection could result from an exposure. For this particular accident scenario, the form of the pathogen is less significant than the exposure pathway and the occurrence of the LAI itself. This accident scenario is essentially only applicable to RVFV and Nipah virus. FMDV is not considered to be available as a LAI, and humans are not considered susceptible to the disease. While humans can be infected with the Nipah virus, there are no documented cases of acquiring the disease through a LAI.

Unmitigated Off-Site Consequences – The exposure to the laboratory worker results in an infection or an LAI with the potential for subsequent infections resulting from vehicles and vectors. This accident scenario is essentially only applicable to RVFV. FMDV is not considered to be available as a LAI, and humans are not considered susceptible to the disease. While humans can be infected with the Nipah virus, there are no documented cases of acquiring the disease through a LAI.

Mitigated Consequences – There are no off-site consequences (no public exposure) associated with this mitigated accident scenario. The potential subsequent infections are also considered to be negligible, unless the mitigation controls fail or are ignored (another procedural violation by the worker). The mitigation controls that need to work include recognizing and reporting the event, followed by prompt medical attention to prevent infection and subsequent public contact. In addition, proper procedures, PPE, and attention to disinfection and decontamination of equipment provide a significant barrier against this accident.

Risk Ranking

Based on the evaluation of the likelihood and the consequences associated with this accident, the following risk ranks were assigned for the unmitigated and mitigated accident scenarios.

Unmitigated Risk Rank

FC I (frequent)
Worker Consequence Category of B (long-term health effects)
Risk Rank=1 (safety controls are required to prevent or mitigate the accident)

After considering the safety controls in the context of the LAI accident, the mitigated risk rank is assigned. Determining the mitigated consequences depends on whether the accident is prevented or not. If the accident is prevented through the proper use of PPE and other systems, then the LAI does not occur and there are no consequences. Should the accident occur, but with lower frequency, the consequences are essentially unchanged and the LAI occurs.

Mitigated Risk Rank

FC III (probable) is unlikely but possible to occur during the life of the facility
Worker Consequence Category of E (no measurable consequences; LAI is prevented)
Risk Rank=4 (no additional safety controls are required to prevent or mitigate the accident)

Using Table 3.14.2.1-4, the combination of the accident likelihood and consequence severity and the assigned risk rank is 4, which indicates that the robust safety controls considered are sufficient to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table (Table 3.14.3.1-4).

Table 3.14.3.1-4 — Risk Rank Summary – LAI Accident

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for PPE, maintenance, or procedures)	1	FC I ($\geq 1\times10^{0}$) Frequent	B (Worker) LAI long-term health effects
Mitigated (PPE, procedures, maintenance)	4	FC III (1×10^{-2} to 1×10^{-4}) Probable	E (Worker) No Measurable consequences

Operational Accident 3 – Loss of Infected Animal/Insect

This scenario considers the release of pathogens resulting from a loss of biocontainment any of the BSL-3 or BSL-4 facilities or an insectary. This includes potential hosts from the outside environment accessing the BSL-3 or BSL-4 facilities, becoming infected, and returning to the outside environment. This accident was selected for analysis because of the hazard associated with loss of biocontainment as evaluated in the hazards analysis. In addition, this type of loss of biocontainment can have a unique impact on the surrounding ecosystem. The potential for viral pathogens such as RVFV and FMDV to become established in the environment has far reaching consequences. The release of a pathogen as a result of loss of biocontainment of a vector is a credible scenario and appropriate for detailed analysis.

A loss of biocontainment or biocontainment of an animal can occur as a result of inattentive laboratory workers coupled with a series of mechanical failures including isolation doors, interlocks, alarms, and detection devices. In this accident scenario, it is assumed that an infected animal contains sufficient viable pathogens to be considered as a source of infection in the environment. The bounding scenario is taken to be a loss of biocontainment of an infected animal and subsequent release of this animal to the environment outside of the NBAF.

The infected animal can contain an inventory of approximately 1×10^{10} viable virions (e.g., viable FMDV pathogens are found in blood, saliva, and respired air of an infected cow, in large quantities). Should an infected animal get out of the NBAF undetected, the animal could act as a reservoir for a specific pathogen for a long period of time. The animal would in effect be a source for an atmospheric transport pathway. This mechanism would not necessarily be credible for all pathogens. Because the source of pathogens is inside the infected animal, the unmitigated respirable source term from this accident is related to animal respiration rate and other factors (external contamination, breathing, perspiration, sneezing, drooling, waste excretion, etc.). The ability for the released animal to act as a source is related to the time the animal is in the environment.

Unmitigated Risk Rank

For the unmitigated accident conditions, it is assumed that more than sufficient viral pathogens could be released for transport down-wind as an aerosol. Accident consequences are described on a site-specific basis in Section 3.14.4. Based on the overall accident scenario and the various sequences, the unmitigated frequency for this accident is assigned a FC II. Public/Environment Consequence Category A (high likelihood for environmental life-threatening effects) off-site consequences are much greater than minimum infectious dose. Risk rank=1 (additional safety controls required to prevent or mitigate the accident).

Mitigated Risk Rank

FC III (probable) is unlikely but possible to occur during the life of the facility. Public/Environment Consequence Category D (negligible off-site consequences much less than infectious dose). Risk rank=3 (consider additional safety controls to prevent or mitigate the accident).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC III and consequence severity of D (public) and the assigned risk rank is 3, which indicates that the risk is borderline and additional considerations of safety controls considered is recommended to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table (Table 3.14.3.1-5).

Table 3.14.3.1-5 — Risk Rank Summary – Animal Release Accident

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for biocontainment, monitoring, or procedures)	1	FC II ($1{\times}10^{-2}$ to $1{\times}10^{0}$) Occasional	A (Public) Exceeds the MID potential to spread disease
Mitigated (Biocontainment, procedures, monitoring, response)	3	FC III ($1{\times}10^{-2}$ to $1{\times}10^{-4}$) Probable	D (Public) Negligible off-site consequences

Operational Accident 4 – Release of Contaminated Wastes

This scenario considers the release of pathogens caused by improper sterilization or disinfection of solid or liquid waste with the end result of pathogens released to the environment. The pathways of concern are for vehicle-borne and water-borne transmission of viable biological agents. Because the viral agents considered in this hazard and accident analyses include those pathogens, which are resistant to environmental factors for extended periods of time, these two pathways are particularly significant. The hazards evaluation identified a number of scenarios for which incomplete or inadequate sterilization could result in high consequences to receptors outside of the NBAF.

The release of biological materials that are incompletely sterilized can occur for a variety of reasons. The equipment used to perform disinfections or sterilization fail to function properly and monitors and testing are not performed, or are not adequate, prior to release to sanitary or other waste handling units. The time period for sterilization is too short as a result of human error or equipment malfunction. There could also be leaks in systems designed to contain the infectious materials. Degraded containers, mechanical systems, and facility structures (piping and drains, etc.) or any combination could all lead to a release of infectious biological materials.

Several different types of accidents involving liquid or solid waste materials containing viable pathogens could occur as they are handled or processed that include the following:

- Inappropriate disposal of biological materials;
- Failure to completely sterilize the biological materials prior to disposition; and
- Systems designed to handle infectious wastes malfunction.

Several decontamination and sterilization technologies were initially reviewed in the NBAF Feasibility Study including chemical, incineration, rendering, autoclave, and digestion. The bounding scenario is taken to be a release of post-sterilized solid or liquid waste containing significant quantities of viable pathogens into either the commercial solid or liquid waste handling systems.

The biological material (MAR) considered in this accident scenario was on the order of $1{\times}10^{9}$ virions with a release fraction of $1{\times}10^{-4}$ for an unmitigated source term of $1{\times}10^{5}$ virions released from the facility.

Unmitigated Risk Rank

For the unmitigated accident conditions, it is assumed that more than sufficient viral pathogens could be released for transport in the environment, even though the release would be localized, as was the recent case in England with FMDV in 2007. Accident consequences are described on a site-specific basis in Section 3.14.4.

Based on the overall accident scenario and the various sequences, the unmitigated frequency for this accident is assigned a FC II.

Public/Environment Consequence Category A (high likelihood for environmental life-threatening effects) off-site consequences are much greater than minimum infectious dose. Risk rank=1 (additional safety controls required to prevent or mitigate the accident).

Mitigated Risk Rank

FC III (probable) is unlikely but possible to occur during the life of the facility. Public/Environment Consequence Category D (negligible off-site consequences much less than infectious dose). Risk rank=3 (consider additional safety controls to prevent or mitigate the accident).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC III and consequence severity of D (public) and the assigned risk rank is 3, which indicates that the risk is borderline and additional considerations of safety controls considered is recommended to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table (Table 3.14.3.1-6).

Table 3.14.3.1-6 — Risk Rank Summary – Waste Release Accident

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for HEPAs, maintenance, or procedures)	1	FC II (1×10^{-2} to 1×10^{0}) Occasional	A (Public) Exceeds the MID potential to spread disease
Mitigated (Active/Passive ventilation, procedures, maintenance)	3	FC III (1×10^{-4} to 1×10^{-6}) Probable	D (Public) Negligible off-site consequences

Operational Accident 5 – Large Room or Facility Fire

Fires in the NBAF were evaluated in the hazards analysis and were found to result in significant consequences to both the laboratory workers (involved and non-involved) and the public. In addition, a subsequent release of pathogens would also pose a significant risk to the environment.

Facility-wide or room fires can result from mechanical failures, flammable materials, and as a result of exothermic reactions. Because the initial hazards identification identified one or more specific fire initiators, this fire accident analysis was developed to reasonably bound the potential consequences associated with this hazard. The accident scenario involves a series of individual and separate events that ultimately lead to the potential for release of one or more pathogens. The events include both human error (e.g., failure to follow procedures, mixing incompatible chemicals, etc.) and mechanical failures (e.g., fire detection and alarm system failure, failure of fire protection system, etc.) that could ultimately lead to the release of pathogens. It is noted that in areas where the heat is significant (increased temperatures can result in destroying significant quantities pathogens), there is a potential for reducing the total source term that is released.

Operations and processes that may be encountered in the NBAF could include the use of volatile or flammable chemicals, as well as energy sources, along with sufficient combustible materials being co-located such that a resulting fire is not precluded from consideration. The assumed accident progression begins when a laboratory worker engaged in cleaning, processing, or other types of activities is found in a situation where there is a combination of fuel, heat, ignition source, and oxygen. This situation can occur inside a BSC, in a laboratory room, or any location in the NBAF. Once a fire is initiated in a location within the NBAF, a number of events must occur for the fire to become sufficiently large that spreading to other areas is possible.

The biological material (MAR) considered in this accident scenario was estimated to be on the order of 1×10^{13} virions considering multiple laboratory areas with maximum volumes of viable pathogens. The single maximum volume considered is the 30 L cGMP. Assuming that 99% of the pathogens are destroyed in the fire and a release fraction of 1×10^{-2} is used, the unmitigated source term is estimated at 1×10^{9} virions released from the facility.

Unmitigated Risk Rank

For the unmitigated accident conditions, it is assumed that more than sufficient viral pathogens could be released for transport in the environment. Based on the overall accident scenario and the various sequences, the unmitigated frequency for this accident is assigned a FC III (probable). Public/Environment and Worker Consequence Category A (high likelihood for life-threatening effects) off-site consequences are much greater than minimum infectious dose. Risk rank=2 (additional safety controls required to prevent or mitigate the accident).

Mitigated Risk Rank

FC IV (improbable) is unlikely to occur during the life of the facility. Worker Consequences Category C (lost time injury or exposure – no health effects due to proper PPE use). Public/Environment Consequence Category D (negligible off-site consequences much less than infectious dose). Risk rank=4 (no additional safety controls to prevent or mitigate the accident).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC IV and consequence severity of D/C (public/worker) and the assigned risk rank is 4, which indicates that the robust safety controls considered are sufficient to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table, Table 3.14.3.1-7).

Table 3.14.3.1-7 — Risk Rank Summary – Large Fire Accident

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for fire suppression, ventilation, HEPAs, maintenance, or procedures)	2	FC III (1×10^{-2} to 1×10^{-4}) Probable	A/A (Public/Worker) Exceeds the MID
Mitigated (Active/passive ventilation, fire suppression)	4	FC IV (1×10^{-4} to 1×10^{-6}) Improbable	D/C (Public/Worker) Negligible off-site consequences

Operational Accident 6 – Over-Pressure Event from a Deflagration

Operations and processes that may be encountered in the NBAF could include the use of chemicals (gas or liquid) that are volatile or flammable. The NBAF feasibility study indicates that natural gas is supplied to the facility for use in laboratory rooms. In addition, the disinfectant gases formaldehyde and ethylene oxide are also flammable and are potential agents for use in large-volume disinfection operations in the NBAF. Because of the potential for flammable or combustible chemicals and natural gas to be routinely used in the facility, an accident scenario involving a deflagration was postulated.

The assumed accident progression begins when a laboratory worker is engaged in cleaning, processing, or another type of activity that requires natural gas or a flammable chemical. A situation develops where there is a buildup of gas inside a BSC or another enclosed area that reaches the lower flammable limit (LFL). During normal operations, this is considered an improbable event but is evaluated here for completeness.

The free volume of a BSC is approximately 4,700 L, thereby providing a sufficiently small confined space to support reaching the LFL. This means a flammable mixture in the BSC is possible and must be controlled. For purposes of scenario development, the existence of a heat or ignition source is also assumed. For purposes of evaluating the worst-case potential release that could affect the public, it is further assumed that a deflagration occurs. Because the specific chemicals are not identified, the deflagration is the result of the buildup of natural gas (recognizing that natural gas is not piped to the BSCs).

The most significant aspect of the deflagration is the resultant pressure wave, which could provide sufficient energy to breach the BSC and release biological materials in aerosol form. This scenario also assumes that approximately 10% of the viable pathogens survive the deflagration and are released.

The biological material (MAR) considered in this accident scenario was on the order of 3×10^{12} virions considering a single laboratory area with maximum volumes of viable pathogens. The single maximum volume considered is the 30 L cGMP. Assuming many of the pathogens are destroyed in the fire and a release fraction of 1×10^{-1} is used, the unmitigated source term is estimated at 3×10^{10} virions released from the facility.

Unmitigated Risk Rank

For the unmitigated accident conditions, it is assumed that more than sufficient viral pathogens could be released for transport in the environment. Based on the overall accident scenario and the various sequences, the unmitigated frequency for this accident is assigned a FC III (probable). Public/Environment and Worker Consequence Category A (high likelihood for life-threatening effects) off-site consequences are much greater than minimum infectious dose. Risk rank=2 (additional safety controls required to prevent or mitigate the accident).

Mitigated Risk Rank

FC IV (improbable) is unlikely to occur during the life of the facility. Worker Consequences Category C (lost time injury or exposure – no health effects due to proper PPE use). Public/Environment Consequence Category D (negligible off-site consequences much less than infectious dose). Risk rank=4 (no additional safety controls to prevent or mitigate the accident).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC IV and consequence severity of D/C (public/worker) and the assigned risk rank is 4, which indicates that the robust safety controls considered are sufficient to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table (Table 3.14.3.1-8).

Table 3.14.3.1-8 — Risk Rank Summary – Large Fire Accident

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for fire suppression, ventilation, HEPAs, maintenance, or procedures)	2	FC III (1×10^{-2} to 1×10^{-4}) Probable	A/A (Public/Worker) Exceeds the MID
Mitigated (Active/passive ventilation, fire suppression)	4	FC IV (1×10^{-4} to 1×10^{-6}) Improbable	D/C (Public/Worker) Negligible off-site consequences

3.14.3.2 Operational Accident 7 – Natural Phenomena Accidents (Seismic or High Wind with No Fire)

This section addresses accident scenarios associated with weather-related initiating events such as floods, high winds, lightning, earthquakes, tornadoes, and hurricanes. The NBAF would be designed and built to withstand the normal meteorological conditions that are present within the geographic area of the proposed sites. Given the nature of the facility, more stringent building codes are applied to the NBAF than are used for homes and most businesses. For the purposes of this accident analysis, the effects from natural phenomena events (e.g., tornados, and earthquakes.) are combined into a single bounding analysis. The current design of the NBAF defines the seismic capacity of the facility to meet a 0.19-g seismic event and a 90-mph wind. The Basic Wind Speed denoted in the Structural Basis of Design is a code-specified reference wind speed index. It is based on 3-second wind gusts measured at a height of 33 feet above grade as recorded at airports. While wind speeds are expected to vary over time, larger magnitude wind speeds occur much less often than lesser wind speeds. The Basic Wind Speed as noted in the NDP reports is expected to occur on the average of only once over a fifty-year period. However, because of code specified building importance modification factors and normal factors of safety incorporated into the structural design, the facility will withstand wind pressures of 170% of the code specified 50-year wind pressures. The building's structural system will actually be capable of resisting a wind speed that is expected to occur only once over a 500 year period. Incorporation of the importance modification factors, for containment of the pathogens, the design basis wind speed for the NBAF would be increased from 90 mph to 119 mph for all sites except Plum Island where the design basis wind speed would increase from 120 mph to 156 mph thereby reducing the likelihood as well as the consequences associated with a severe wind event. The proposed NBAF sites show a relatively low probability of a significant seismic event with a return period on the order of 50 years based on the 2008 USGS National Seismic Hazard Maps. These maps illustrate the seismic hazards consistent with commercial building codes. Executive Order 12699, "Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction" January 5, 1990, required all new federal facilities to be designed to ensure safety of the public (DOE 1996; DOE 2000; Executive Order 12699).

> "…Section 1. Requirements for Earthquake Safety of New Federal Buildings.
> The purposes of these requirements are to reduce risks to the lives of occupants of buildings owned by the Federal Government and to persons who would be affected by the failures of Federal buildings in earthquakes, to improve the capability of essential Federal buildings to function during or after an earthquake, and to reduce earthquake losses of public buildings, all in a cost-effective manner. A building means any structure, fully or partially enclosed, used or intended for sheltering persons or property.
>
> Each Federal agency responsible for the design and construction of each new Federal building shall ensure that the building is designed and constructed in accord with appropriate seismic design and construction standards. This requirement pertains to all building projects for which development of detailed plans and specifications initiated subsequent to the issuance of the order. Seismic design and construction standards shall be adopted for agency use in accord with sections 3(a) and 4(a) of this order…"

Design and evaluation criteria for of essential facilities (e.g., hospitals, fire and police stations, centers for emergency operations) are considered as Seismic Use Group III of IBC 2000. Critical safety controls or barriers are those for which failure to perform their intended safety function poses a significant potential hazard to public health, safety, and the environment because biological materials are present and could be released from the facility as a result of that failure. In the case of the NBAF, the critical safety equipment is required to prevent or mitigate events with the potential to release significant quantities of viral pathogens outside the facility. Design considerations for these critical safety barriers are to limit facility damage as a result of design basis natural phenomena events so that hazardous materials can be controlled and confined, occupants are protected, and the functioning of the facility is not interrupted. Because the safety analyses determined that high-biocontainment biological materials are required for worker safety, a higher design requirement designation is appropriate for the safety equipment necessary to prevent a release. Given the risks posed by the potential seismic and other natural phenomena, accident provisions for design consideration of the facility structure and critical safety equipment should be consistent with those used for facilities designed to standards above that for the model building code requirements for essential facilities (DOE 2000; DOE 1996).

In addition, all of the proposed NBAF sites are located within regions that experience severe weather where wind speeds could exceed the 90-mph criteria specified in the Feasibility Study for the NBAF. Tornado and hurricane events are a significant potential at the proposed sites and can occur with wind speeds in excess of 150 mph (Pasquill 1983; Panofsky 1984). In the unlikely event that a 500-year wind storm strikes the facility, the interior BSL-3Ag and BSL-4 spaces would be expected to withstand a 200 mph wind load (commonly determined to be an F3 tornado). If the NBAF took a direct hit from an F3 tornado, the exterior walls and roofing of the building would likely fail first. This breach in the exterior skin would cause a dramatic increase in internal pressures leading to further failure of the building's interior and exterior walls. However, the loss of these architectural wall components should actually decrease the overall wind loading applied to the building, and diminish the possibility of damage to the building's primary structural system. Since the walls of the BSL-3Ag and BSL-4 spaces would be reinforced cast-in-place concrete, those inner walls would be expected to withstand the tornado. Section 3.14 includes an analysis of the potential consequences of high winds including an F5 tornado event.

In addition, other natural phenomena events have a significant potential for adversely impacting the NBAF and operations. These include lightning strikes that can result in facility fires (previously analyzed) or widespread equipment failures including loss of the active biocontainment systems. Floods also have the potential to adversely impact the operations of the NBAF. A significant flood could produce a loss of power and result in floodwater infiltration of waste biocontainment systems, subsequently releasing pathogens to the environment.

For the purposes of this accident analysis, the seismic event was considered as the potentially bounding natural phenomena accident because the dispersion and dilution of pathogens would be much greater in a high-wind event, and floods, while a potential threat, would likely result in localized consequences. Additional details for all of the NPH accidents are provided in Appendix E.

The high-wind and seismic event accident analysis was developed without considering a subsequent fire in the NBAF. Facility fire was previously evaluated both in the hazards analysis and as an accident and was determined to result in significant consequences to the laboratory workers (involved and non-involved), as well as the public and the environment.

The central difference between the natural phenomena events and other accidents is that the natural phenomena events have a greater potential to impact the entire facility. Internally initiated fires require time and combustible materials to grow to a facility-wide event. A storm (tornado, hurricane, or high straight line winds) and a seismic event will act on the entire facility simultaneously. Because of the extent of the impact, the amount of infectious biological material (and chemicals or radioactive substances) available for release is greater.

The assumed accident progression begins when the NBAF experiences a significant natural phenomena event. In the situation of a major storm, there is the potential that actions can be taken in advance to containerize infectious materials prior to the storm occurring. This is not possible with a seismic event where there is no warning system available. For purposes of estimating potential consequences, either event is conservatively assumed to occur when the facility is in normal operational mode.

The biological material (MAR) considered in this accident scenario was on the order of 1×10^{15} virions considering the entire NBAF is at risk with maximum volumes of viable pathogens in all available areas. The single maximum volume considered is the 30 l cGMP. The release fraction is taken to be 1×10^{-4} and the unmitigated source term estimated at 1×10^{11} virions released from the facility.

Unmitigated Risk Rank

For the unmitigated accident conditions, it is assumed that more than sufficient viral pathogens could be released for transport in the environment. Based on the overall accident scenario and the various sequences, the unmitigated frequency for this accident is assigned a FC IV (improbable). Public/Environment Consequence Category A (high likelihood for environmental life-threatening effects) off-site consequences are much greater than minimum infectious dose. Risk rank=2 (additional safety controls required to prevent or mitigate the accident).

Mitigated Risk Rank

FC V (remote) should not occur during the life of the facility. Worker Consequences Category D (lost time injury or exposure – no health effects due to proper PPE use). Public/Environment Consequence Category E (negligible off-site consequences much less than infectious dose). Risk rank=4 (no additional safety controls to prevent or mitigate the accident).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC IV and consequence severity of D/C (public/worker) and the assigned risk rank is 4, which indicates that the robust safety controls considered are sufficient to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table (Table 3.14.3.2-1).

Table 3.14.3.2-1 — Risk Rank Summary – NPH Accident

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for NBAF structure, ventilation HEPAs)	2	FC IV (1×10^{-4} to 1×10^{-6}) Improbable	A/A (Public/Worker) Exceeds the MID
Mitigated (NBAF structure, ventilation HEPAs)	4	FC V ($\leq 1\times10^{-6}$) Remote	E/D (Public/Worker) Negligible off-site consequences

3.14.3.3 Operational Accident 8 – External Events (Aircraft Crash)

This section addresses all man-made external events such as aircraft crash, transportation events (affecting the facility), loss of power, etc. The aircraft crash into the NBAF or the external fuel storage (diesel, fuel oil, or gasoline) resulting in an explosion and fire is considered the bounding external event. This accident is expected to cause loss of facility biocontainment with a subsequent release of viral pathogens into the environment.

The details of the aircraft crash accident including an estimate of the likelihood are provided in Appendix E. Even though it is unlikely that an aircraft crash in the external fuel storage (diesel, fuel or oil) will explode, the unmitigated consequences and risks were postulated to evaluate the potential for a large quantity of virions to be released. The more likely scenario is an aircraft crash into the structure resulting in a large amount of energy being imparted to equipment or storage inside of the facility. The consequence analysis considered in this scenario was formulated to evaluate the largest potential release to evaluate the value of the NBAF structure as a barrier to a release of pathogens.

The likelihood of an accidental aircraft crash into the facility is dependent on the size of the aircraft, whether it is fixed-wing or rotary, the proximity to an airport (commercial or general aviation), and the design of the facility. The design of the facility is important with respect to area and height. In general, the probability of impact from a small, general aviation aircraft is greater than that of commercial airliner; however, the damage potential is greater for the commercial aircraft. The highest probability of accidental aircraft crashes occurs on take-off and landing when the aircraft are moving slower and are at lower altitudes. The proximity of the proposed NBAF to airports was evaluated for each of the proposed locations based on the available site-specific data and on the conceptual design of the NBAF (DOE 2006a). These results are to be provided in Appendix E.

A penetration of the NBAF with sufficient force to result in a release of pathogens was considered the most credible unmitigated accident scenario. Based on the preliminary wind-load design specification for the NBAF, a simple energy balance was derived between a wind speed greater than 90 mph and a small aircraft engine and drive shaft assembly traveling with a velocity of 100 knots. Based on the energy balance, it is credible that the aircraft would penetrate the facility, likely resulting in a release of pathogens to the environment.

For the situation where the proposed external fuel storage (diesel, fuel oil, or gasoline) explodes or is involved in a large fire and causes the loss of facility biocontainment with a subsequent release of pathogens to the environment, the critical determination was whether there was sufficient energy available to fail the NBAF structure. Based on the proposed proximity of the fuel storage facility to the NBAF and the quantity of fuel expected to be available, there is reason to suspect that a fire (and less likely an explosion), whether accidental or intentional, could catastrophically fail the NBAF biocontainment capabilities and result in a release of pathogens to the environment.

The biological material (MAR) considered in this accident scenario was on the order of 3×10^{12} virions considering the entire NBAF is at risk with maximum volumes of viable pathogens in the area struck by the aircraft. The single maximum volume considered is the 30 L cGMP. The release fraction is taken to be approximately 1×10^{-4} to account for pathogen survival and release fraction. The unmitigated source term is estimated at 3×10^{8} virions released from the facility.

Unmitigated Risk Rank

For the unmitigated accident conditions, it is assumed that more than sufficient viral pathogens could be released for transport in the environment. Based on the overall accident scenario and the various sequences, the unmitigated frequency for this accident is assigned a FC IV (improbable). Public/Environment Consequence Category A (high likelihood for environmental life-threatening effects) off-site consequences are much greater than minimum infectious dose. Risk rank=2 (additional safety controls required to prevent or mitigate the accident).

Mitigated Risk Rank

FC V (remote) should not occur during the life of the facility. Worker Consequences Category D (lost time injury or exposure—no health effects due to proper PPE use). Public/Environment Consequence Category E (negligible off-site consequences much less than infectious dose). Risk rank=4 (no additional safety controls to prevent or mitigate the accident).

Using Table 3.14.2.1-4, the combination of the accident likelihood of FC IV and consequence severity of D/C (public/worker) and the assigned risk rank is 4, which indicates that the robust safety controls considered are sufficient to prevent or mitigate the accident and greatly reduce the risk. The overall risk summary is presented in the following table (Table 3.14.3.3-1).

Table 3.14.3.3-1 — Risk Rank Summary – Aircraft Crash

Scenario	Risk Rank	Accident Frequency	Consequence Severity
Unmitigated (No credit for NBAF structure, ventilation HEPAs)	2	FC IV (1×10^{-4} to 1×10^{-6}) *Improbable*	A/A (Public/Worker) Exceeds the MID
Mitigated (NBAF structure, ventilation HEPAs)	4	FC V ($\leq1\times10^{-6}$) Remote	E/D (Public/Worker) Negligible off-site consequences

3.14.3.4 Intentional Acts and the Threat Risk Assessment (TRA)

The Threat and Risk Assessment (TRA) was developed outside of the EIS process in accordance with the requirements stipulated in federal regulations. The purpose of the TRA was to identify potential vulnerabilities and weaknesses associated with the NBAF and are used to recommend the most prudent measures to establish a reasonable level of risk for the security of operations of the NBAF and public safety. Because of the importance of the NBAF mission and the associated work with potential high-biocontainment biological pathogens, critical information related to the potential for adverse consequences as a result of intentional acts was also necessary to be incorporated into the NEPA process.

TRA was developed in accordance with federal regulations as specified in Title 9—Animals and Animal Products, Chapter I – Animal and Plant Health Inspection Service, Department of Agriculture, Part 121 – Possession, Use, and Transfer of Select Agents and Toxins, §121.11 Security—which states

> "…(a) An individual or entity required to register under this part must develop and implement a written security plan. The security plan must be sufficient to safeguard the select agent or toxin against unauthorized access, theft, loss, or release.
>
> (b) The security plan must be designed according to a site-specific risk assessment and must provide graded protection in accordance with the risk of the select agent or toxin, given its intended use. The security plan must be submitted upon request…
>
> …(e) In developing a security plan, an individual or entity should consider the document entitled, ''Laboratory Security and Emergency Response Guidance for Laboratories Working with Select Agents,' in Morbidity and Mortality Weekly Report (December 6, 2002); 51 (No. RR–19):1–6.

The referenced section of *Morbidity and Mortality Weekly Report* (December 6, 2002) 51 (No. RR–19):1–6, "Laboratory Security and Emergency Response Guidance for Laboratories Working with Select Agents," provides additional guidance for performing the risk assessment. While the TRA cannot be specifically incorporated for obvious security reasons, the essential results are provided in this section to address the risk associated with intentional acts. Specifically, security considerations for microbiological and biomedical facilities guidance and analysis were performed as part of the Threat Assessment, which is comprised of three major types or groupings of threats to a biotech or biomedical facility.

- Criminal activity by animal/environmental rights activists;
- Intellectual property compromise by competitive intelligence agents; and
- Bioterrorists or criminals attempting to obtain biological pathogens for inappropriate use.

The threat assessment combines information from the analysis of assets, threats, and vulnerabilities to determine the level of risk posed by operating the NBAF.

Because the NBAF could ultimately be located at any of the six sites, the TRA focused on the major types of threats, their credibility, and likelihood to a high-consequence biotech/biomedical facility or institute. In addition, the TRA evaluated specifically those elements that are essential in developing a robust security plan. The applicable federal regulations established those elements as

1. The sufficiency to safeguard the select agent or toxin against unauthorized access, theft, loss, or release; and
2. A site-specific risk assessment to provide graded protection in accordance with the risk of the select agent or toxin, given its intended use.

The adversaries identified in the TRA included the following:

- Criminal activity by animal/environmental rights activists and referred to as extremists or psychopaths;
- Intellectual property compromise by competitive intelligence agents and referred to as terrorists, which includes foreign intelligence services, corporate espionage, and terrorist organizations;
- Bioterrorists or criminals attempting to obtain biological pathogens for inappropriate use; and
- Employees who are compromised or disgruntled and are known to pose a potential risk to the facility through disruption to the operations and mission or personnel injury and death.

Each of these threats (or adversaries) was evaluated in detail in the TRA. In addition to the types of threats, the scope of the TRA also included analysis of the physical and operational vulnerability of the NBAF to these threats. Recommendations were evaluated and provided to effectively mitigate the resultant risks from the identified threats. The scope of the TRA for the NBAF therefore included evaluation of the threats, analysis of the vulnerabilities (both on the conceptual NBAF and for each proposed site), and the identification and evaluation of mitigation measures necessary to reduce the risks to acceptable levels.

The TRA specifically analyzed and presented the risks and effective mitigation strategies for ensuring secure operation of the NBAF. The following objectives were addressed in detail as part of the TRA:

- Identification and evaluation of threats;
- Determining their likelihood in relation to the NBAF;
- Identification of the critical assets associated with the NBAF;
- Assessing the potential consequences associated with the impact or loss of identified NBAF assets;
- Quantifying the vulnerability of the physical and operational security of the proposed NBAF;
- Calculating the cumulative risks associated with the threats and consequences with respect to each proposed NBAF site; and
- Providing effective mitigation measures to ensure secure operations against the identified threats.

A discussion of the threat and risk assessment methodology is presented in terms of the critical components including

- Vulnerability Assessments
- Operational Risk Assessments
- Targeting Evaluations

An essential element of identifying and evaluating the potential threats is a thorough knowledge of potential adversaries, including their motivations, capabilities, and activities. As part of the TRA analysis, critical adversary data were obtained from three separate threat intelligence-gathering tasks. The collection of information necessary to identify credible threats and assess their activities was based on different threat levels and intelligence. Information was obtained from 1) statistics related to crimes against persons and property; 2) regional, national, and international intelligence gathering related to a wide variety of threats; and 3) information gained from site-specific security perspectives.

Threats, which are also commonly referred to as adversaries, were separated into specific categories (i.e., insiders and outsiders) based on the federal regulations and associated guidance. Each of the threat categories also includes analysis of the adversaries' tactics, skills, and capabilities. The objectives associated with each threat category from simple theft to potential for total destruction of the NBAF and contamination or infection of nearby animal populations.

The methodology used to analyze the targets of the identified threats and the results of this analysis was the CARVER method, which focuses on six key factors (Criticality, Accessibility, Recoverability, Vulnerability, Effect, and Recognizability) that are necessary to quantify a specific targets' likelihood of being attacked by a specific adversary. The CARVER method provided the means for calculating the probability of attack, which is a fundamental part of the risk equation.

The physical and operational security aspects of a baseline case were evaluated for the purpose of identifying vulnerabilities of the NBAF. The analysis specifically addressed security elements such as sensing, assessment, and response (referred to as SAR, comparable to the terms deterrence, detection, delay, and response used in other vulnerability assessment methodologies) and other aspects of a particular adversary attack.

Numerous threat and consequence scenarios were developed and analyzed to assess the vulnerabilities of the proposed NBAF against the range of adversaries identified as potentially credible threats. The results of the analysis of the threat and consequences scenarios were factored into a series of recommended mitigation measures to the NBAF physical and operational security elements to effectively mitigate the risks. Specific aspects addressed the evaluation of controls including security design elements, building and perimeter security measures, and operational security aspects necessary to respond to the identified threats.

Risk Evaluations and Analysis

Risk evaluation and analysis is dependent on the collection of information necessary to quantify the basic components of the generalized risk equation. Because each of the terms in the risk equation are in part dependent on the identification of specific assets and their assigned value, it is imperative that the assets and priorities are clearly defined. In addition, the risk equation is dependent on a wide array of potential threats or adversaries. Collection of detailed information was necessary to identify various adversaries and assess their specific capabilities necessary to compromise security systems in a particular attack. The modeling of the security system in terms of operational and physical elements was used to simulate the vulnerability for a specified threat, target, and effect. The security system model provides for the quantification of vulnerability in terms that can be coupled to the "Threat" and "Target" functions.

Assets and Priorities

Assets and priorities were identified based on the types of consequences or on the overall impact from their loss. For the purposes of the NBAF and the identified regulatory framework for developing the TRA, the critical assets identified include

- Select agents or pathogens;
- Animals;
- Sensitive or critical research conducted in the NBAF;
- Personnel, laboratory workers, and researchers;

- Technology and related foundation of the NBAF mission; and
- The structures, systems, and components relied upon to maintain biocontainment of biological materials or sensitive information.

The effect or impact associated with the loss of each of these assets differs somewhat depending on a specific adversary's motives or intent. For example, the effect or impact associated with the theft of a select agent or pathogen by a terrorist could be to cause widespread harm to people or the environment, while the effect resulting from a criminal theft may be the loss of mission or the subsequent impact from a release of the pathogen. In a separate example, the loss of sensitive information or technology could have immediate and direct impacts on the safety and health of the public resulting from transfer of the technology by terrorists, or the impact could be the loss of mission and compromise of national security. Each of these impacts or consequences is associated with different motives and different threats. The TRA comprised a wide array of threat-consequence scenarios to address the different threats, assets, and consequences.

Types of Risks

Because of the differences among the various threats, assets, and consequences, the types of risks are inherently different. TRA recognized three different categories of risk.

1. Health, Safety, and Environmental – These are risks associated with the impacts or effects related to the direct and indirect health and safety of workers, the public, and the environment resultant from the intentional release of select agents or pathogens from the NBAF;
2. Loss of Mission – These are risks associated with the impacts from the direct and indirect disruption or loss of mission of the NBAF; and
3. Loss of Sensitive Information and Technology – These are the impacts or effects related to the loss of sensitive information or technology developed or retained in the NBAF.

The threat-consequence scenarios were developed to address each of these types of risks. The quantification of the risks was based on methods and techniques that allowed for direct comparison across different risks. The calculation of the risks could then be ranked to determine those security measures that achieved the most effective mitigation or prevention.

The quantification of the threat variable in the risk equation provides a measure of the significance of a specified adversary and the value of the asset being targeted. Using this method for quantifying the risks affords decision makers the opportunity to discriminate across adversaries and assets in determining what level of security is necessary to reduce the risks.

The threats were separated into two potential adversary groups: insiders and outsiders. Risk estimation was then be used to develop mitigation controls to address both of these groups. Preventative measures address the frequency component of risk (i.e., how often will an undesirable event occur), while mitigation controls affect the potential consequences (i.e., how bad will it be if it occurs).

Internal threats are addressed through mitigation measures that involve administrative controls such as

- Preemployment screening or Personnel Security Programs;
- Contractor screening and monitoring;
- Perimeter security procedures;
- Behavior observation programs;
- Inventory reduction; and
- Emergency response planning.

External threats most often involve mitigation measures that rely on engineered controls such as

- Inventory isolation and control;
- Relocation of storage;
- Obscuring storage;
- Improvements to physical perimeter systems (e.g., double fence line, lighting, motion sensor alarms, video cameras, Jersey barriers, etc.); and
- Preplanning/coordination with local emergency response agencies.

Security systems developed using the concept of "Rings of Protection" provide multiple barriers against intrusion. This is comparable to the Layers of Protection concept used in process safety management referred to as "defense in depth." An example of a Ring of Protection structure would likely include

Ring 1: Internal policies and practices;
Ring 2: Perimeter security systems and procedures;
Ring 3: Storage inventory management; and
Ring 4: Policing by on-site security and local authorities.

Vulnerability Assessments

To evaluate the vulnerability of a particular security system, it was necessary to characterize the features of the system in terms of barriers to the adversary coupled with the ability and timeliness of a potential response to interdict the adversary before an asset is compromised or lost. The description of the security system in these terms provides the framework for developing a threat-consequence scenario in separate components or event sequences.

A variety of deductive and inductive methods were employed to identify and evaluate specific vulnerabilities in the security systems represented by the baseline and upgraded NBAF models. These methods included classical "What-If?" analysis, failure modes and effects analysis, and a comprehensive hazards analysis. The deductive method chosen to estimate the overall vulnerability estimates included the use of event and fault trees. These techniques have been used successfully in the nuclear and chemical industry for both safety and security risk estimation for many years. These methods are described in detail in a variety of documents including: *Probabilistic Safety Assessment in the Chemical and Nuclear Industries*, the *NRC's NUREG-0492 Fault Tree Handbook*, and *Risk Analysis and the Security Survey*. Each of the documents presents variants of this approach used for calculating the risk associated with safety or security applications.

This technique used in this TRA for the quantification of the security system vulnerability relied upon a combination of event and fault trees, which are considered to be effective deductive tools for obtaining critical information about a system. The fault tree technique is a systematic method for acquiring information about a system, which is used in making critical decisions related to consequence mitigation and prevention. For the NBAF, risks are directly related to the vulnerability of the security systems to specific threats.

The vulnerability of the systems was evaluated based on a wide array of potential threat-consequence scenarios. In much the same way the hazard scenarios were developed for the accidents, these threat-consequence scenarios were screened to identify a select number of scenarios that were evaluated in detail to estimate the likelihood and the consequences for the baseline case and the upgraded NBAF conditions. This is similar in process to the unmitigated and mitigated analyses previously discussed. The specific scenarios evaluated would clearly identify specific vulnerabilities in the systems and are therefore not included in what can be presented as the following consequence categories:

- Agent Theft
- Intentional Release

- Information Security/Cyber Attack
- Sabotage/Physical Destruction
- Technology Transfer of Pathogen Information

For each of the consequence categories, the evaluation of risks and the associated identification of critical security features to mitigate the consequences or prevent the attack were incorporated into the TRA. The analysis, like that for the accidents, was comprehensive and bounding. The evaluation demonstrated that the risks from intentional acts could be reduced to very low levels with the identified security features.

Overall Summary of Risk Results

The results of the TRA provided threat/consequence information valuable in ranking of each of the six sites relative to one another. The details of what constituted vulnerability or the specific nature of an adversarial attack are not included in these results. A qualitative discussion of site differentiators is provided in the following paragraphs.

Taking into account the various attack vectors and security features that are specific to a specific region or area, a relative ranking system was developed. Because of factors such as proximity to transportation, demographics and transient populations, waterways, and access to roads, trains, and airports, differences in risk estimates arose when applied to a specific proposed NBAF site. The overall risks associated with intentional acts for any proposed NBAF site could be reduced by incorporating system recommendations. There is about a factor of 1.5 risk differential that separates any one NBAF site from another. This means that the highest risk site is only 50% greater risk than the lowest risk site. For purposes of comparison, the difference is the baseline risk and the NBAF risk incorporating security features was approximately a factor of 100 for the most sever threat/consequence scenarios. Taking into consideration the risk reduction against the facility-specific aspects, the differences in the proposed NBAF sites are relatively small.

3.14.4 Site-Specific Consequences

This section provides the summary of consequences from operations, accidents, and intentional acts for each of the proposed sites. Site-specific consequences are based on the estimates of pathogens released from the bounding accidents and the estimation of exposure as described in Section 3.14.3. The exposure to pathogens is based on the results of the transport of viral pathogens as aerosols after release and are calculated using the Gaussian Plume model. Tables 3.14.4-1 and 3.14.4-2 present summary results for several down-wind distances of the normalized air and ground concentrations. These results are multiplied by the estimated quantity of pathogens released in a specific accident to arrive at the estimated concentrations for each accident and site.

For each site, the normalized time-integrated air and ground concentrations are presented for both near- and far-field perspectives. The near-field presentation focuses on distances up to 1 kilometer (km) from the release. The results of the Gaussian Plume model for the 95% estimates of the air concentrations—for ground-level releases—tend to be greatest at distances close to the point of release. In addition, the ground deposition typically is greatest close to the release point. By focusing on distances less than 1 km from the release, an opportunity to discern subtle differences in the air and ground concentrations is provided. For small accidents (and mitigated large accidents), the majority of pathogens that would be released will be within this area. The initial response to an accident will also focus on the magnitude of the problem close to the source. The far-field perspective is provided for distances out to 10 km to illustrate the potential down-wind transport of pathogens in the unmitigated accidents.

The consideration of the use of flat terrain, no building wake, the same boundary layer height, a ground level release, and a single year of site-specific meteorological data for each of the sites resulted in the Kansas, Mississippi, Texas, and New York sites having the same 95% χ/Q values up to 10 km distances from the release. These results illustrate that there is little differentiation between any of the sites based purely on the meteorology. Site-specific consequences, however, consider the exposed populations of humans, animals, and the environment.

Table 3.14.4-1 — Unmitigated Site-Specific χ/Q Normalized Air Concentration Estimates

Radial Distance From Release Point (meters)	GA	KS	MS	NY	NC	TX
	χ/Q Normalized Air Concentration (s/m^3)					
50	9.34×10^{-2}	1.61×10^{-1}	1.61×10^{-1}	1.61×10^{-1}	8.11×10^{-2}	1.61×10^{-1}
200	9.00×10^{-3}	1.57×10^{-2}	1.57×10^{-2}	1.57×10^{-2}	7.80×10^{-3}	1.57×10^{-2}
600	1.66×10^{-3}	2.91×10^{-3}	2.91×10^{-3}	2.91×10^{-3}	1.44×10^{-3}	2.91×10^{-3}
1,000	7.69×10^{-4}	1.35×10^{-3}	1.35×10^{-3}	1.35×10^{-3}	6.66×10^{-4}	1.35×10^{-3}
6,000	1.43×10^{-5}	2.54×10^{-5}	9.08×10^{-5}	9.08×10^{-5}	1.46×10^{-5}	4.02×10^{-5}
10,000	7.56×10^{-6}	1.18×10^{-5}	1.55×10^{-5}	3.01×10^{-5}	5.44×10^{-6}	1.36×10^{-5}

Table 3.14.4-2 — Unmitigated Site-Specific Normalized Ground Concentration Estimates

Radial Distance From Release Point (meters)	GA	KS	MS	NY	NC	TX
	Normalized Ground Concentration ($1/m^2$)					
50	1.54×10^{-4}	1.59×10^{-4}	2.12×10^{-4}	2.38×10^{-4}	9.97×10^{-5}	1.64×10^{-4}
200	2.76×10^{-5}	1.92×10^{-5}	3.03×10^{-5}	3.19×10^{-5}	1.73×10^{-5}	1.98×10^{-5}
600	5.95×10^{-6}	3.16×10^{-6}	6.08×10^{-6}	6.95×10^{-6}	4.49×10^{-6}	3.86×10^{-6}
1,000	2.73×10^{-6}	1.93×10^{-6}	2.89×10^{-6}	3.00×10^{-6}	2.33×10^{-6}	2.05×10^{-6}
6,000	1.29×10^{-8}	1.66×10^{-8}	2.73×10^{-8}	3.14×10^{-8}	1.30×10^{-8}	2.27×10^{-8}
10,000	5.92×10^{-9}	8.22×10^{-9}	1.16×10^{-8}	1.91×10^{-8}	5.73×10^{-9}	1.01×10^{-8}

The resultant ground concentrations differ between each of the sites due to the different rainfall estimates, which influence the wet deposition rates.

A summary of the accidents is provided in Table 3.14.3-1 to present the scenario, the available biological material considered in the event for both the unmitigated and mitigated cases, along with a brief summary of the safety barriers and procedural controls relied upon to either mitigate or prevent a release.

For each of the accidents considered in this analysis, specific concentration terms were developed based on site-specific meteorological data obtained from the nearest measurement location. From these data, normalized concentration terms for the air and ground deposition were determined on a site-specific basis. Tables 3.14.4-3 and 3.14.4-4 present the air and ground concentrations for each site for the spill accident to illustrate the potential for infections to result down-wind of the NBAF. Since Nipah virus and RVFV are not considered to be any more infectious than FMDV, the minimum infectious dose of 10 virions also serves as a reasonably conservative estimate of the infectious dose for these viruses.

For a specific example, since the breathing rate for a cow is estimated to be on the order of 1.6×10^{-3} m^3/s and using the calculated air concentration for the Kansas site at a distance of 50 m for the spill event of 1.6×10^{5} virions s/m^3,then the total exposure to the cow via inhalation is on the order of 2.6×10^{2} (260) virions (50 m is the minimum calculated distance for the Gaussian Plume model). This exposure is approximately 25 times greater than the minimum infectious dose and therefore would represent a relatively high likelihood for the cow to acquire the disease via the inhalation of the virions in the air.

[*Note: The air concentration of 1.6×10^5 virions is the product of the χ/Q value from Table 3.14.4.3-1 for the Kansas site at 50 m (1.6×10^{-1} s/m^3) and the source term for the spill accident 1×10^6 virions released.*]

For calculation of the ground concentration and a resultant exposure, the results are not independent in time as were the χ/Q values. Therefore, to assess the potential risk to cattle grazing on grass where viral pathogens have been deposited, an estimate of the total time that the receptor is exposed is necessary. As a an example, if one were to assume that a cow eats nearly 100 pounds of feed per day (8 lb/hr assuming that cows eat 12 hours out of 24) and that the yield for typical pasture grass in on the order of approximately 3.5 pounds per square meter; then a cow would need to cover nearly 30 m^2 per day at a average rate of 2.5 m^2 per hour to meet the food intake of a 100 pounds.

Consider the unmitigated ground concentration for the Kansas site at a distance of 1 km for the seismic event (source term of 1×10^{11} virions) is 1.9×10^5 virions per m^2, the exposure to a cow for a single day would be on the order of 5.7×10^6 virions or 5.7×10^5 (570,000) times greater than the infectious dose. It is unlikely that a release of this magnitude would go unnoticed or without intervening emergency response. Assuming that the grazing time is limited to a single hour, a reasonable time period before emergency plans could be implemented; the unmitigated exposure would not be reduced significantly.

[*Note: The ground concentration of 1.9×10^5 virions is the product of the "normalized ground concentration" value from Table 3.14.4.3-2 for the Kansas site at 1 km (1.9×10^{-6} 1/m^2) and the source term for the spill accident 1×10^{11} virions released.*]

Site-specific consequences are developed using the source terms provided from the accident analysis of Section 3.14.3 and are summarized in Table 3.14.3-1. The site-specific consequences are presented for both unmitigated, without the benefit of safety controls, and mitigated, taking credit for the safety controls that reduce quantity of pathogens released in an accident, consequences.

The determination of the consequences for all of the accidents is based on the specific hazards posed by FMDV, RVFV, and Nipah virus. FMDV has a known infectious dose, are highly infectious, and are transmitted mainly by aerosols and simple contact with fomites (contaminated materials, inanimate objects, clothing, veterinary equipment, vehicles, foodstuffs, manure, soil, and vegetation). Viruses are excreted from, and present in blood and body fluids, including respired air, saliva, vesicular fluids, and tissues of the vesicles, which are a hallmark of the infection, semen, vaginal fluids, urine, feces, meats, and milk. Infected animals can excrete high concentrations of virus in respired air, secretions, and fluids. For example, cattle may excrete up to 1.26×10^5 or 126,000 virions respired in a 24-hour period. Therefore, there are over 500 infectious doses of the FMDV respired from a single bovine animal per hour. Swine (pigs) have been measured at rates up to 3.9×10^8 virions/24 hours in expired air. Doses as low as 10 to 20 virions could infect a sheep and a steer, respectively (J.H. Sorensen, December 1999, "An integrated model to predict the atmospheric spread of foot-and-mouth disease virus," *Epidemiol Infect* 124:577-590, 2000). The minimum dose of natural aerosol to infect a pig has not been determined, but some observations suggest that it is probably much higher than that for other species (A. Donaldson, August 1999, "Airborne spread of foot-and-mouth disease," *Microbiology Today*, Vol. 26, p. 118-119). The Canadian Food Inspection Agency presents in the Pathogen Safety Data Sheet for Foot and Mouth Disease that as few as 10 infectious particles can produce disease. The minimum infectious dose for the Nipah and RVFV are not readily known and are, for the purposes of evaluating hazards and accidents, conservatively assumed to be the same as that for FMDV (10 infectious particles or virions) (CFIA 2005a; CFIA 2005b; CFIA 2005c; Goh KJ 2000; NEEG 2007).

Furthermore, based on mission objectives and regulatory requirements, an individual package containing biological materials may contain approximately 100 mL. Typical concentrations of viral pathogens are estimated based on a specific volume of culture medium. Culture media is used to grow and maintain cells at an appropriate temperature and gas mixture (typically, 37°C, 5% CO_2) in a cell incubator. Culture conditions vary widely for each cell type, and variation of conditions for a particular cell type can result in different phenotypes being expressed. Aside from temperature and gas mixture, the most commonly varied factor in culture systems is the growth medium. Recipes for growth media can vary in pH, glucose concentration, growth factors, and the presence of other nutrient components. The growth factors used to supplement media are often derived from animal blood, such as calf serum. Nearly all of the culture media are essentially in the form of liquids or gels.

For the purposes of the hazard and accident analysis, the concentration in a milliliter (1/1,000 of a liter or a cubic-centimeter) is taken to be approximately 1×10^8 viable virions. Therefore, there could be a total inventory of approximately 1×10^{11} viable virions per liter of media. The biological materials consist of various forms but are considered to aerosolize upon impact. Using these concentrations of virions in typical media and the numbers of virions respired from a typical infected cow, estimates for the site-specific consequences from the MAR for each accident were developed.

Table 3.14.4-3 — Unmitigated Site-Specific Air Concentration Estimates From a Spill Release of Aerosol Pathogen

Radial Distance From Release Point (meters)	GA	KS	MS	NY	NC	TX
	Air Concentration (virions s/m^3)					
50	9.3×10^4	1.6×10^5	1.6×10^5	1.6×10^5	8.1×10^4	1.6×10^5
200	9.0×10^3	1.6×10^4	1.6×10^4	1.6×10^4	7.8×10^3	1.6×10^4
600	1.7×10^3	2.9×10^3	2.9×10^3	2.9×10^3	1.4×10^3	2.9×10^3
1,000	7.7×10^2	1.4×10^3	1.4×10^3	1.4×10^3	6.7×10^2	1.4×10^3
6,000	1.4×10^1	2.5×10^1	9.1×10^1	9.1×10^1	1.5×10^1	9.1×10^1
10,000	7.6	1.2×10^1	1.6×10^1	3.6×10^1	5.4	1.6×10^1

Note: Source Term = 100 mL of bio material ; MAR = 1×10^{10} virions * ARF = $1\text{x }10^{-4}$ = 1×10^6 virons as source term

Table 3.14.4-4 — Unmitigated Site-Specific Ground Concentration Estimates From a Spill of Aerosol Pathogen

Radial Distance From Release Point (meters)	GA	KS	MS	NY	NC	TX
	Ground Concentration (virions/m^2)					
50	1.5×10^2	1.6×10^2	2.1×10^2	2.4×10^2	1.0×10^2	1.6×10^2
200	2.8×10^1	1.9×10^1	3.0×10^1	3.2×10^1	1.7×10^1	2.0×10^1
600	6.0	3.2	6.0	7.0	4.5	3.9
1,000	2.7	1.9	2.9	3.0	2.3	2.0
6,000	1.3×10^{-2}	1.7×10^{-2}	2.7×10^{-2}	3.1×10^{-2}	1.3×10^{-2}	2.3×10^{-2}
10,000	5.9×10^{-3}	8.2×10^{-3}	1.2×10^{-2}	1.9×10^{-2}	5.7×10^{-3}	1.0×10^{-2}

Note: Source Term = 100 mL of bio material ; MAR = 1×10^{10} virions * ARF = $1\text{x }10^{-4}$ = 1×10^6 virons as source term

The risk ranking assigned for the specific accidents and summarized in Tables 3.14.3-1 and 3.14.4-5.

The unmitigated accident risk ranking resulted in a risk rank of either 1 or 2. These rankings were the result of operational accident frequencies between 1×10^{-2} and 1×10^{0} (NPH and aircraft crash accident frequencies were lower because of the likelihood of the initiating events was much smaller). Likewise the consequences for the unmitigated operational, NPH, and external accidents were all "A" to the public and "A" or "B" to the worker, indicating high potential for large quantities of virions to be released.

The mitigated accident risks were significantly reduced (often by more than one category for both frequency and consequence) by factoring in improvements in safety barriers and controls. Two of the mitigated accidents (loss of an infected animal and release of contaminated wastes) had risk ranks of 3, indicating the need for considering additional controls. This risk rank was assigned because the mitigated accident frequency only dropped by one bin from a FC II to a FC III after factoring in the controls. Overall, however, the risk reduction in the mitigated accidents illustrates the effectiveness of the safety controls.

Table 3.14.4-5 — Accident Risk Rank Summary

Accident	Accident Case	Risk Rank	Frequency Category	Severity Category
Operational Accident 1	Unmitigated Mitigated	1 4	II IV	A/B D/C
Operational Accident 2	Unmitigated Mitigated	1 4	I III	B E
Operational Accident 3	Unmitigated Mitigated	1 3	II III	A E
Operational Accident 4	Unmitigated Mitigated	1 3	II III	A D
Operational Accident 5	Unmitigated Mitigated	2 4	III IV	A/A D/C
Operational Accident 6	Unmitigated Mitigated	2 4	III IV	A/A D/D
NPH	Unmitigated Mitigated	2 4	IV V	A/A E/D
Aircraft	Unmitigated Mitigated	2 4	IV V	A/A E/D

These risk ranks, however, do not provide information that can be used to discriminate between the proposed NBAF sites to assess the site-specific impacts from a postulated release of FMDV, RVFV, or Nipah virus. To evaluate the site-specific risks, a coupling of the risk ranks for the accidents, which are generic in that all of the release scenarios, could occur at any of the proposed NBAF sites, with the site-specific characteristics is necessary.

Since risk is the product of the likelihood and consequence of an accident and the accident frequency is a characteristic of the NBAF structure and operations, then the frequency of the accidents can be assumed to be constant across the proposed sites. In other words, moving from one site to another does not change the accident frequency; therefore, only the change in consequences is needed to assign a site-specific risk.

Therefore, based on the unmitigated air and ground concentrations possible from a release of viral pathogens as a result of the postulated accidents a coupled site-specific risk ranking was developed to compare released inventories to potential infections down-wind from the NBAF (Asante-Duah 2002; Greenberg 1991; Cohrssen 1989). The data presented in the table are based on the 10 virion minimum infectious dose for each of the three pathogens. While other livestock would have a different MID for each of the viruses, the bounding scenario is to consider all of the livestock to be at the same level of susceptibility.

The risk ranking, based on the change in site-specific consequences, ranges from a minimum of “none” to a maximum of “high” based on the MID. A review of the site-specific unmitigated air and ground concentrations shows that a minimum of 1×10^4 (10,000) virions is necessary to be released before there is a credible possibility for multiple infections down-wind of the release. For example, a potential infection is expected to result from a release such that the exposure (inhalation, contact, or ingestion) of at least 10 virions. Taking the air concentration at 50 m of 1.6×10^{-1} for the Mississippi site, the product of the ST, a cow’s breathing rate, and the air concentration (1.6×10^{-1} * 1.6×10^{-3} * 1×10^4) yields nearly 3 virions, which is less than one-third of the MID of 10 virions, indicating that no infection would likely result. The risks presented in the accident analysis section were based on qualitative estimates of exposure based on the magnitude of the unmitigated and mitigated source terms. This phase of the risk ranking takes the site independent consequences calculated in the accident analysis and incorporates the site-specific aspects for population, wildlife, agriculture, and other environmental factors for the purpose of differentiating one proposed site from another. Table 3.14.4-6 presents the site-specific consequence basis for assigning site-specific risk ranks.

Table 3.14.4-6 — Site-Specific Risk Ranking Based on Potential Infections

Site-Specific Risk Category	Label	Description	Viable Pathogens Released
I	High	Likelihood of receptor infection approaches certainty (dose is greater than 10 times the infectious dose)	$VP > 1 \times 10^6$
II	Moderate	Likelihood of receptor infection increases with concentration (dose is equal to or greater than the infectious dose)	$1 \times 10^4 < VP \leq 1 \times 10^6$
III	None or Low	Likelihood of receptor infection approaches zero (dose is less than MID)	$VP \leq 1 \times 10^4$

The interpretation of the site-specific risk ranks includes the unmitigated and mitigated site-independent accident frequencies. Because these frequencies do not change from one site to another, they are not repeated in the following site-specific discussions.

In each of the site-specific cases, the effective mitigation of risk is dependent on the incorporation of robust safety controls into the design, construction, and operation of the NBAF. The need for robust safety controls is emphasized in federal regulations and executive orders to ensure that operation of the facility does not result in adverse consequences to the workers, public, or environment. To meet this objective, it is essential that the identified safety controls, including both the primary and secondary barriers, are able to meet their intended safety function during normal and credible abnormal conditions. Because of the nature of the pathogens anticipated in the operation of the NBAF, the need for the increased assurance on the performance of safety equipment. This specifically means safety controls need to ensure that viral pathogens are contained during all operations, external mishaps, and after credible natural phenomena events.

Table 3.14.4-7 presents a summary of the site-specific risk ranks.

Table 3.14.4-7 — Summary of Site-Specific Risk Ranks

Site		Site-Specific Risk Rank[a]	Site-Independent Accident Risk Range[b]	Accident Frequency Range[c]	Accident Severity Range[d]
Georgia	Unmitigated		1 - 2	I - II	A/A – A/B
	Mitigated	II - Moderate	3 - 4	III - IV	D/C – E/D
Kansas	Unmitigated		1 - 2	I - II	A/A – A/B
	Mitigated	II - Moderate	3 - 4	III - IV	D/C – E/D
Mississippi	Unmitigated		1 - 2	I - II	A/A – A/B
	Mitigated	II - Moderate	3 - 4	III - IV	D/C – E/D
Plum Island	Unmitigated		1 - 2	I - II	A/A – A/B
	Mitigated	III - Low	3 - 4	III - IV	D/C – E/D
North Carolina	Unmitigated		1 - 2	I - II	A/A – A/B
	Mitigated	II - Moderate	3 - 4	III - IV	D/C – E/D
Texas	Unmitigated		1 - 2	I - II	A/A – A/B
	Mitigated	II - Moderate	3 - 4	III - IV	D/C – E/D

[a] The primary differentiator among sites is the ability for FMDV, RVFV, and Nipah virus to become established and spread considering the hosts, vectors, and vehicles.
[b] Site-independent accident frequencies do not vary across sites.
[c] NPH and Aircraft Crash accidents have unmitigated frequency IV and mitigated frequency V.
[d] Accident Severity Categories were assigned based on the NBAF operations and structure not on location.

The evaluation of site-specific consequences in Section 3.14.4.1 – 3.14.4.6 illustrates that with the exception of Plum Island, each of the proposed sites resides in an area where the wildlife, vegetation, agriculture, and human populations provide ample opportunity for each of the viruses (FMDV, RVFV, and Nipah virus) to become established and spread once released from the NBAF. For this reason, the focus of the hazards, accident, and risk analysis was on the biocontainment of the viruses within the NBAF and the importance of both the engineered and administrative controls to prevent or mitigate accidents.

3.14.4.1 South Milledge Avenue Site

Site-specific consequences for the proposed South Milledge Avenue Site, are depicted in terms of the accidents postulated in Section 3.14.3. Each of the accidents has the potential to release pathogens to the environment. Because of the differences in topography, weather, and agricultural, uses near each site the consequences are presented individually for each proposed site. In the case of the South Milledge Avenue Site, the site-specific atmospheric data were used to provide estimates of time-integrated down-wind air and ground concentrations that could result in the event of a release as postulated in the accidents.

To assess the site-specific consequences from the postulated bounding accidents, it is first necessary to evaluate the results of the transport modeling and the development of specific air and ground concentrations of viral pathogens estimated to have been released in each accident. Figure 3.14.4.1-1 illustrates the near-field effects of a potential release and the subsequent down-wind transport in air along with the deposition onto the ground as a result of settling or washout (NUREG 3332). The radial symmetry in figure 3.14.4.1-1 and 3.14.4.1-2 are for illustration purposes only. This shows the chosen boundary location as an estimate of down-wind normalized 95th percentile air-concentrations; this figure does not reflect an actual down-wind plume result. Tables 3.14.4.1-1 and 3.14.4.1-2 present the resultant air and ground concentrations for each unmitigated accident at specific radial distances. The combination of these concentration tables and the figures representing the near- and far-field results provides the basis for evaluating the impacts to the population and environment after a hypothetical release at the proposed Georgia NBAF Site.

The normalized air concentrations for the Georgia site range from 9×10^{-2} at distances of 200 m to 7.7×10^{-4} at a distance of 1,000 m (1 km) from a release. The ground concentrations for these same radial distances range from a high of 2.8×10^{-5} to a low of 2.7×10^{-6}. Taking into consideration the source terms for each of the specific accidents, the normalized air and ground concentration values represent the potential for significant concentrations in the air and on the ground for the more significant accidents such as over-pressure, seismic, and fire events.

As with the previous discussion, the majority of the NBAF would be within the 200-m radial distance. Significant releases of pathogens from the NBAF as a result of accidents could be expected to occur only from the higher biocontainment areas. The site boundary would be located at approximately 250 m from the center of the NBAF. For the purposes of the analysis, it is assumed that distances past 200 m essentially represents an off-site release. Section 3.8.3.1.1 presents the discussion of the vegetation in the vicinity of the proposed NBAF site. The area is predominantly wooded forestland with small streams, lakes, and wetlands at distances greater than 10 km from the site. Within the immediate area of the site is mainly pastureland currently used for grazing livestock.

Section 3.8.3.1.4 presents the terrestrial wildlife in the vicinity of the proposed South Milledge Avenue Site. Numerous species of mammals, birds, reptiles, and insects (mosquitoes and ticks) inhabit the area around the proposed site. Mammals include both white tail deer and wild boar. The wildlife and livestock in the vicinity of the site are prime candidates for acquiring or transmitting the FMDV and RVFV and to some extent the Nipah virus in pigs. While the FMDV, RVFV, and Nipah virus each have different characteristics related to transmission and viability, however, the unmitigated concentrations near the facility are potentially significant.

The location of the proposed NBAF South Milledge Avenue Site provides a significant opportunity for the spread of viruses via vectors and infected wildlife. In addition, the atmospheric modeling indicates that down-wind transport is a credible scenario given a sufficiently large release of pathogens.
For this site, as with all of the sites except the Plum Island Site there is a potential for viral pathogens to be transported significant distances by the wind. The results of the modeling indicate that this transport pathway is not limited (Figure 3.14.4.1-2), as was the case for Plum Island. It is considered likely that deer or wild boar could act to spread disease over long distances. In addition, common vectors such as mosquitoes can be transported long distances.

The potential for acquiring and spreading diseases from the FMDV, RVFV, and Nipah virus is also illustrated by consideration of the livestock in the vicinity of the proposed site. The counties surrounding the proposed South Milledge Avenue Site contain significant numbers of livestock potentially exposed in the event of a release. Data related to the distribution of livestock in the vicinity of the NBAF were obtained from a DHS tasking response dated August 6, 2007. The specific task was to collect information about livestock in the areas of the proposed NBAF sites to support the determination as to whether accidental laboratory release at these locations could have the potential to affect nearby livestock (DHS 2007). The normalized concentrations presented in Figure 3.14.4.1-2 up to distances of 10 km from the proposed NBAF site includes Clarke and Oconee counties. Data provided on livestock density indicate that there is on the order of 20 to 30 livestock, mostly cattle, per square kilometer in the vicinity of the proposed NBAF.

The area within a 5-km radius of the proposed NBAF would be approximately 78.5 km^2 containing as many as 2,300 cattle. For the unmitigated accidents, concentrations on the order of 1×10^4 or greater occur at distances greater than 5 km for the high source term accidents. At relatively close proximity to the site (less than 1 km), the unmitigated concentrations in the air and on the ground show the potential for a large number of infections from any of the three viruses. The number of livestock outside of the 5-km radius increases significantly (>100,000 animals) and are at risk from the postulated unmitigated releases.

The far-field distribution of viral pathogens via air transport, in terms of normalized time-integrated air and ground concentrations, falls off sharply with distance. The normalized air concentration falls to less than 1×10^{-4} s/m^3 at distances greater than 2 km. At these distances, the quantity of material released would need to be much greater than 1×10^4 (10,000 virions) before there is a significant potential for an infection to result. The normalized air concentration falls off by more than an order of magnitude at distance of 10 km.

Tables 3.14.4.1-3 and 3.14.4.1-4 present the accident-specific air and ground concentrations for the mitigated scenarios. It is evident from the mitigated air concentration results and a cow's breathing rate of 1.6×10^{-3} m^3/s that only the significant accidents of a large facility fire or an over-pressure event (deflagration) are considered to have a potential for resulting in an infection after a release. In the event that either of these accidents occurs, the mitigated results show that the elevated air concentrations are limited to distances less than 400 m, indicating that the viral pathogens will not be transported in significant quantities far from the site. This result illustrates the localized effects of the mitigated accidents. In a similar manner, the ground concentrations are limited to short distances from the release point. Taking into consideration that a cow would cover a 30-m^2 area in a single day, the resultant dose would be less than the MID (10 virions) at distances greater than 2 km. Emergency planning and rapid response to a possible release will afford an opportunity to mitigate the consequences of the postulated accidents.

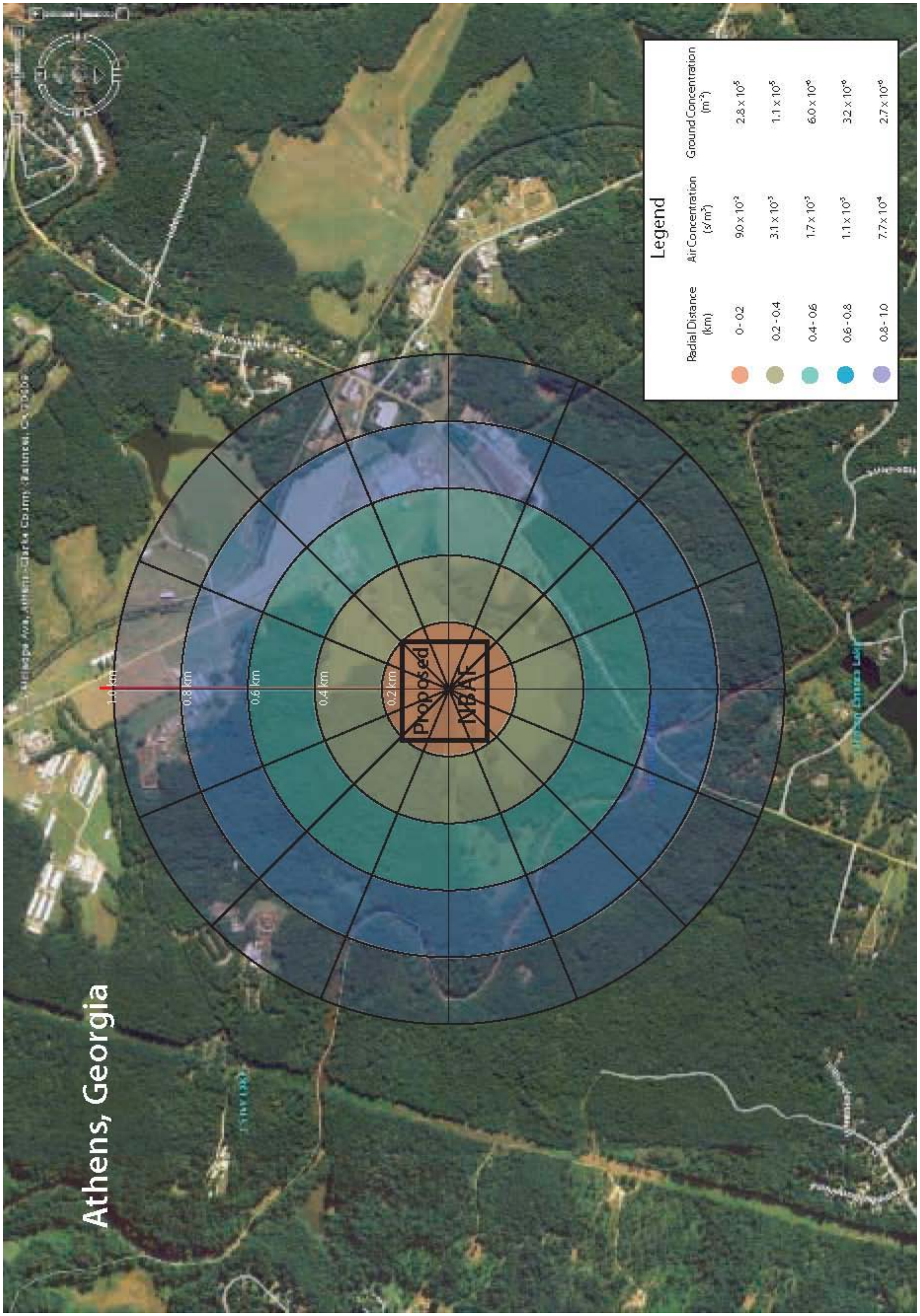


Figure 3.14.4.1-1 — Near Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

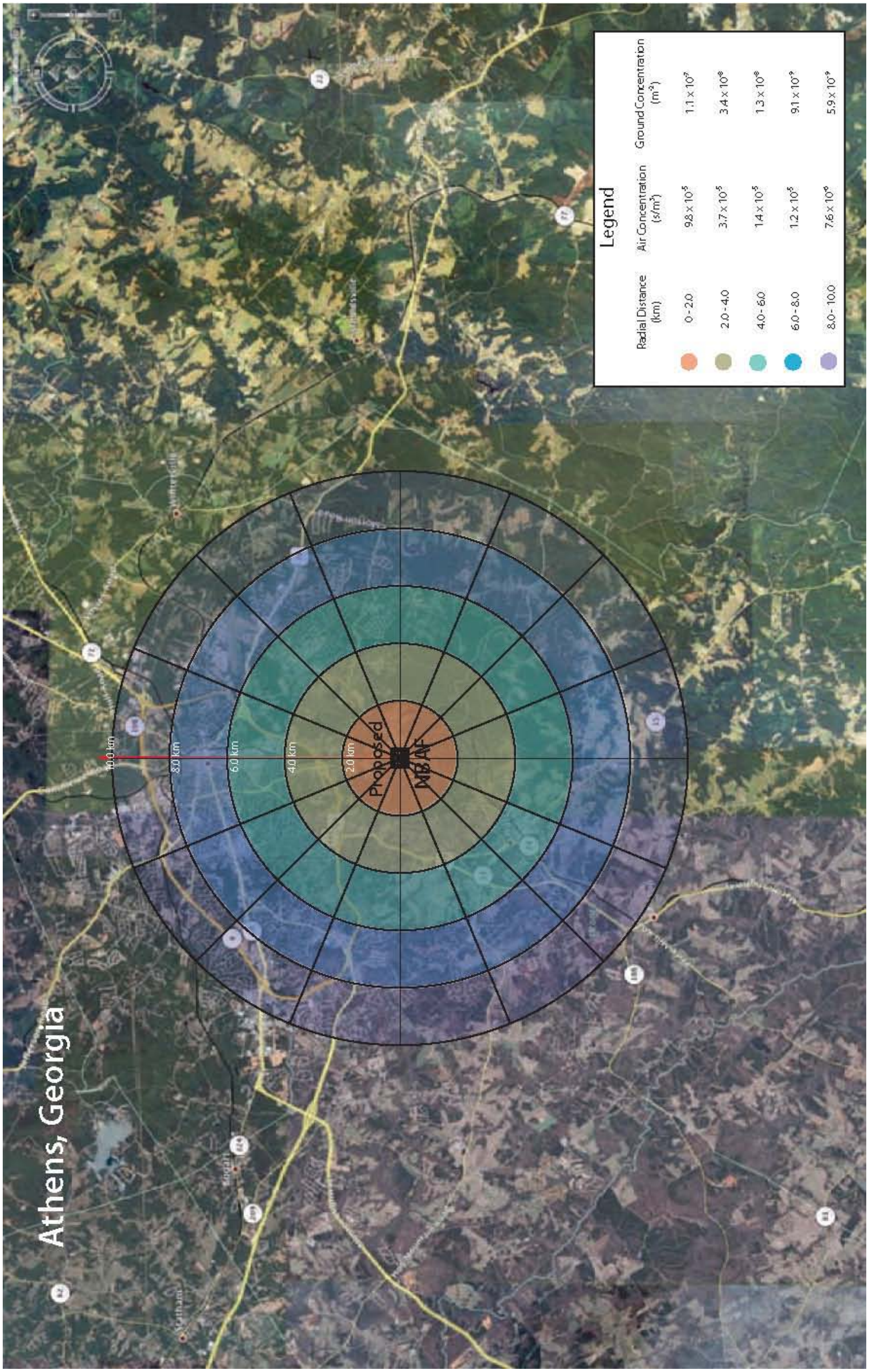


Figure 3.14.4.1-2 — Far Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

Table 3.14.4.1-1 — Unmitigated Accident Specific Air Concentration (virions/m^3) South Milledge Avenue Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	9.3E-02	9.3E+04	9.3E+08	9.3E+03	9.3E+07	2.8E+09	9.3E+09	2.8E+07
200	9.0E-03	9.0E+03	9.0E+07	9.0E+02	9.0E+06	2.7E+08	9.0E+08	2.7E+06
400	3.1E-03	3.1E+03	3.1E+07	3.1E+02	3.1E+06	9.2E+07	3.1E+08	9.2E+05
600	1.7E-03	1.7E+03	1.7E+07	1.7E+02	1.7E+06	5.0E+07	1.7E+08	5.0E+05
800	1.1E-03	1.1E+03	1.1E+07	1.1E+02	1.1E+06	3.2E+07	1.1E+08	3.2E+05
1,000	7.7E-04	7.7E+02	7.7E+06	7.7E+01	7.7E+05	2.3E+07	7.7E+07	2.3E+05
2,000	9.8E-05	9.8E+01	9.8E+05	9.8E+00	9.8E+04	2.9E+06	9.8E+06	2.9E+04
4,000	3.7E-05	3.7E+01	3.7E+05	3.7E+00	3.7E+04	1.1E+06	3.7E+06	1.1E+04
6,000	1.4E-05	1.4E+01	1.4E+05	1.4E+00	1.4E+04	4.3E+05	1.4E+06	4.3E+03
8,000	1.2E-05	1.2E+01	1.2E+05	1.2E+00	1.2E+04	3.6E+05	1.2E+06	3.6E+03
10,000	7.6E-06	7.6E+00	7.6E+04	7.6E-01	7.6E+03	2.3E+05	7.6E+05	2.3E+03

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Source Term = MAR * ARF * RF * DR * LPF

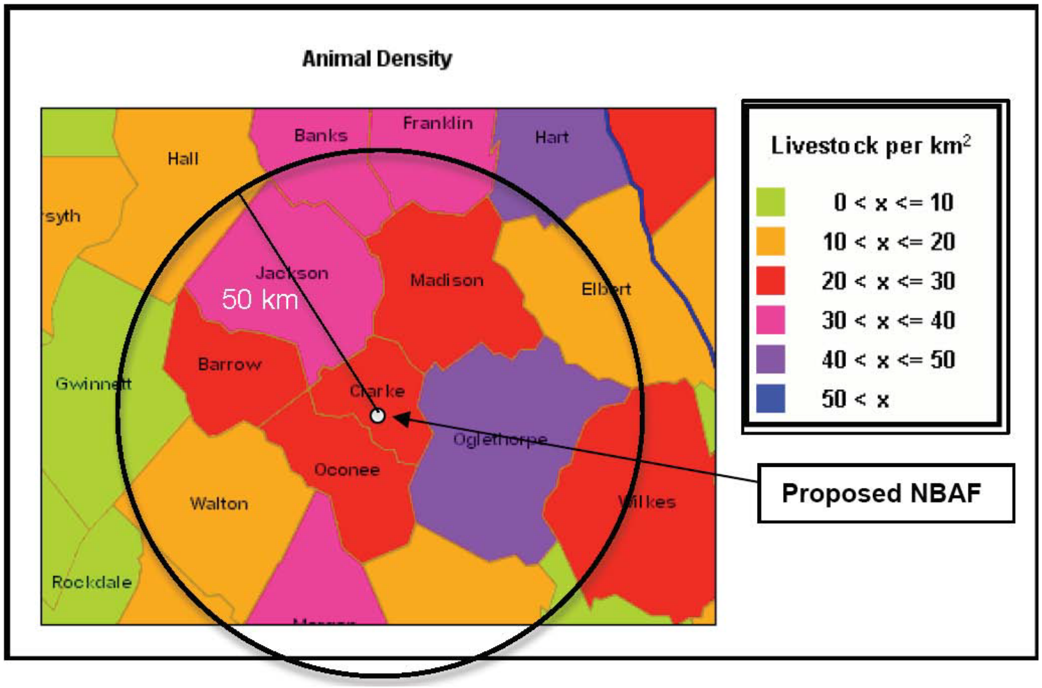
Table 3.14.4.1-2 — Unmitigated Accident Specific Ground Concentration (virions/m²) South Milledge Avenue Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m²)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	1.5E-04	1.5E+02	1.5E+06	1.5E+01	1.5E+05	4.6E+06	1.5E+07	4.6E+04
200	2.8E-05	2.8E+01	2.8E+05	2.8E+00	2.8E+04	8.3E+05	2.8E+06	8.3E+03
400	1.1E-05	1.1E+01	1.1E+05	1.1E+00	1.1E+04	3.4E+05	1.1E+06	3.4E+03
600	5.9E-06	5.9E+00	5.9E+04	5.9E-01	5.9E+03	1.8E+05	5.9E+05	1.8E+03
800	3.2E-06	3.2E+00	3.2E+04	3.2E-01	3.2E+03	9.5E+04	3.2E+05	9.5E+02
1,000	2.7E-06	2.7E+00	2.7E+04	2.7E-01	2.7E+03	8.2E+04	2.7E+05	8.2E+02
2,000	1.1E-07	1.1E-01	1.1E+03	1.1E-02	1.1E+02	3.3E+03	1.1E+04	3.3E+01
4,000	3.4E-08	3.4E-02	3.4E+02	3.4E-03	3.4E+01	1.0E+03	3.4E+03	1.0E+01
6,000	1.3E-08	1.3E-02	1.3E+02	1.3E-03	1.3E+01	3.9E+02	1.3E+03	3.9E+00
8,000	9.1E-09	9.1E-03	9.1E+01	9.1E-04	9.1E+00	2.7E+02	9.1E+02	2.7E+00
10,000	5.9E-09	5.9E-03	5.9E+01	5.9E-04	5.9E+00	1.8E+02	5.9E+02	1.8E+00

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where “E” represents power of 10.

[a]Source Term = MAR * ARF * RF * DR * LPF

County & Surrounding Counties	Number of Herds	Number of Livestock
Clarke	53	7511
Oconee	224	11078
Barrow	302	13356
Oglethorpe	252	52598
Madison	474	22072
Jackson	608	26285
	1913	**132900**



Livestock Proximal to the South Milledge Avenue Site

The accident analysis conservatively estimates a final mitigated source term of 3×10^5 virions for the over-pressure event and 1×10^4 virions for the large fire. The risk values indicated that the higher efficiency HEPAs, NBAF structure, fire suppression system, and other appropriate controls were sufficient to mitigate or prevent the accidents. In addition, the release of contaminated wastes and the loss of an infected animal were assigned site-independent risk ranks of 3, indicating that additional controls should be considered to effectively reduce the likelihood of the accident. The consequences in these two scenarios were assigned public severity category D based on the accident being prevented. The effectiveness of the sterilization of wastes and the biocontainment of the animals were the primary controls. In the event this accident occurs, there is a good chance that the viruses will not be contained without timely emergency response.

Site-Specific Consequences for FMDV

FMDV spreads quickly through herds and flocks of susceptible animals. With an incubation period of as little as 12 hours, the disease can spread quite rapidly. Cattle are often considered to act as indicators because of the low infectious dose, sheep act as maintenance hosts, and swine act as amplifiers of FMDV. The livestock and wildlife (deer and boar) in the vicinity of the Georgia site provides ample opportunity for FMDV to establish in the environment upon a release. FMDV can persist in the human upper respiratory tract for up to 48 hours, making humans potential vectors if they are exposed. In addition, the ability for FMDV to be spread by fomites and with the large human population in the area, the ability for the FMDV to spread over large areas also exists. The consequences of a large release of FMD virions would be as severe as that of RVFV or Nipah virus in this area.

Site-Specific Consequences for RVFV

RVFV is an acute mosquito-borne (vector-based) viral disease affecting mainly ruminants (e.g., cattle, sheep, deer) and humans. In animals, RVF causes abortions and high mortality in young. In humans, RVF causes severe influenza-like syndrome. The area around the Georgia site would provide an environment for RVFV to be easily transmitted once released. The inhalation pathway to humans and wind-borne dispersal of infected vectors can transmit RVFV, and infected livestock and people movement are a means of spreading RVFV. Mosquitoes are a reservoir for RVFV, and the virus can remain dormant in the eggs of the mosquito in dry soil of grassland depressions. With adequate rainfall, the infected mosquitoes could develop and infect ruminants. The virus can be spread by many mosquito species. The consequences of a large release of RVF virions would be as severe as that of FMDV or Nipah virus in this area.

Site-Specific Consequences for Nipah Virus

In pigs, the Nipah virus appears to cause a high rate of febrile illness but a low rate of sickness and death, yet it can appear as sudden death syndrome in mature swine. In humans, Nipah virus is characterized by severe febrile encephalitis, fever, headache, dizziness, and vomiting with a high mortality rate. The host range of Nipah virus is in pigs, cats, dogs, and possible in horses and goats. Because Nipah virus is transmitted by direct contact with bodily fluids, mechanical transmission, and aerosol transmission, there is substantial opportunity for the Nipah virus to spread in the area. The consequences of a large release of Nipah virions would be as severe as that of RVFV or FMDV in this area.

The final risk rank for the mitigated accident scenarios for the proposed NBAF South Milledge Avenue Site is III (none) for all accidents except over-pressure and fire, which are designated as risk rank II (moderate) for distances close to the release. Because of the potential for easy spread of FMDV, RVFV, and Nipah virus diseases via infected livestock, wildlife, and vectors, the overall risk for the South Milledge Avenue Site is designated as risk rank II (moderate).

Table 3.14.4.1-3 — Mitigated Accident Specific Air Concentration (virions/m^3) South Milledge Avenue Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	9.3E-02	9.3E-01	0.0	0.0	9.3E+02	2.8E+04	9.3E+00	0.0
200	9.0E-03	9.0E-02	0.0	0.0	9.0E+01	2.7E+03	9.0E-01	0.0
400	3.1E-03	3.1E-02	0.0	0.0	3.1E+01	9.2E+02	3.1E-01	0.0
600	1.7E-03	1.7E-02	0.0	0.0	1.7E+01	5.0E+02	1.7E-01	0.0
800	1.1E-03	1.1E-02	0.0	0.0	1.1E+01	3.2E+02	1.1E-01	0.0
1,000	7.7E-04	7.7E-03	0.0	0.0	7.7E+00	2.3E+02	7.7E-02	0.0
2,000	9.8E-05	9.8E-04	0.0	0.0	9.8E-01	2.9E+01	9.8E-03	0.0
4,000	3.7E-05	3.7E-04	0.0	0.0	3.7E-01	1.1E+01	3.7E-03	0.0
6,000	1.4E-05	1.4E-04	0.0	0.0	1.4E-01	4.3E+00	1.4E-03	0.0
8,000	1.2E-05	1.2E-04	0.0	0.0	1.2E-01	3.6E+00	1.2E-03	0.0
10,000	7.6E-06	7.6E-05	0.0	0.0	7.6E-02	2.3E+00	7.6E-04	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

Table 3.14.4.1-4 — Mitigated Accident Specific Ground Concentration (virions/m^2) South Milledge Avenue Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.5E-04	1.5E-03	0.0	0.0	1.5E+00	4.6E+01	1.5E-02	0.0
200	2.8E-05	2.8E-04	0.0	0.0	2.8E-01	8.3E+00	2.8E-03	0.0
400	1.1E-05	1.1E-04	0.0	0.0	1.1E-01	3.4E+00	1.1E-03	0.0
600	5.9E-06	5.9E-05	0.0	0.0	5.9E-02	1.8E+00	5.9E-04	0.0
800	3.2E-06	3.2E-05	0.0	0.0	3.2E-02	9.5E-01	3.2E-04	0.0
1,000	2.7E-06	2.7E-05	0.0	0.0	2.7E-02	8.2E-01	2.7E-04	0.0
2,000	1.1E-07	1.1E-06	0.0	0.0	1.1E-03	3.3E-02	1.1E-05	0.0
4,000	3.4E-08	3.4E-07	0.0	0.0	3.4E-04	1.0E-02	3.4E-06	0.0
6,000	1.3E-08	1.3E-07	0.0	0.0	1.3E-04	3.9E-03	1.3E-06	0.0
8,000	9.1E-09	9.1E-08	0.0	0.0	9.1E-05	2.7E-03	9.1E-07	0.0
10,000	5.9E-09	5.9E-08	0.0	0.0	5.9E-05	1.8E-03	5.9E-07	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

3.14.4.2 Manhattan Campus Site

Site-specific consequences for the proposed Manhattan Campus Site, are depicted in terms of the accidents postulated in Section 3.14.3. Each of the accidents has the potential to release pathogens to the environment. Because of the differences in topography, weather, and agricultural uses near each site, the consequences are presented individually for each proposed site. In the case of the Kansas site, the site-specific atmospheric data were used to provide estimates of time-integrated down-wind air and ground concentrations that could be produced as a result of a postulated release.

To assess the site-specific consequences from the postulated bounding accidents, it is first necessary to evaluate the results of the transport modeling and the development of specific air and ground concentrations of viral pathogens estimated to have been released in each accident. Figure 3.14.4.2-1 illustrates the near field effects of a potential release and the subsequent down-wind transport in air along with the deposition onto the ground as a result of settling or washout (NUREG 3332). The radial symmetry in figure 3.14.4.2-1 and 3.14.4.2-2 are for illustration purposes only. This shows the chosen boundary location as an estimate of down-wind normalized 95th percentile air-concentrations; this figure does not reflect an actual down-wind plume result. Tables 3.14.4.2-1 and 3.14.4.2-2 present the resultant air and ground concentrations for each unmitigated accident at specific radial distances. The combination of these concentration tables and the figures representing the near- and far-field results provides the basis for evaluating the impacts to the population and environment after a hypothetical release at the proposed Kansas NBAF site.

The normalized air concentrations for the Manhattan Campus Site range from 1.6×10^{-2} at distances of 200 m to 1.4×10^{-3} at a distance of 1,000 m (1 km) from a release. The ground concentrations for these same radial distances range from a high of 1.9×10^{-5} to a low of 1.9×10^{-6}. Taking into consideration the source terms for each of the specific accidents, the normalized air and ground concentration values represent the potential for significant concentrations in the air and on the ground for the larger accidents such as over-pressure, seismic, and fire events.

As with the previous discussion, the majority of the NBAF would be within the 200-m radial distance. Significant releases of pathogens from the NBAF as a result of accidents could be expected to occur only from the higher biocontainment areas. The site boundary would be located at approximately 250 m from the center of the NBAF. For the purposes of the analysis, it is assumed that distances past 200 m essentially represents an off-site release. Section 3.8.4.1.1 presents the discussion of the vegetation in the vicinity of the proposed NBAF site. The area outside of the 4-km distance from the site is predominantly prairie grassland with streams or rivers, as well as a few intermittent wetlands. Within the immediate area of the site is mainly disturbed pastureland, currently used for grazing livestock, and a significant presence of industrial and residential areas.

Section 3.8.4.1.4 presents the terrestrial wildlife in the vicinity of the proposed Manhattan Campus Site. Numerous species of mammals, birds, reptiles, and insects (mosquitoes and ticks) inhabit the area around the proposed site. Major mammals include white tail deer, mule deer, elk, bison, and wild boar. The wildlife and livestock in the vicinity of the site are prime candidates for acquiring or transmitting the FMD and RVFV and to some extent the Nipah virus in pigs. While the FMDV, RVFV, and Nipah virus each have different characteristics related to transmission and viability, the unmitigated concentrations near the facility are potentially significant.

The location of the Manhattan Campus Site provides a significant opportunity for the spread of viruses via vectors and infected wildlife. In addition, the atmospheric modeling indicates that down-wind transport is a credible scenario given a sufficiently large release of pathogens.

For this site, as with all of the sites except the Plum Island Site, there is a potential for viral pathogens to be transported significant distances by the wind. The results of the modeling indicate that this transport pathway is not limited (Figure 3.14.4.2-2), as was the case for Plum Island. It is considered likely that deer, elk, bison, and wild boar could act to spread disease over long distances. In addition, common vectors such as mosquitoes can be transported long distances.

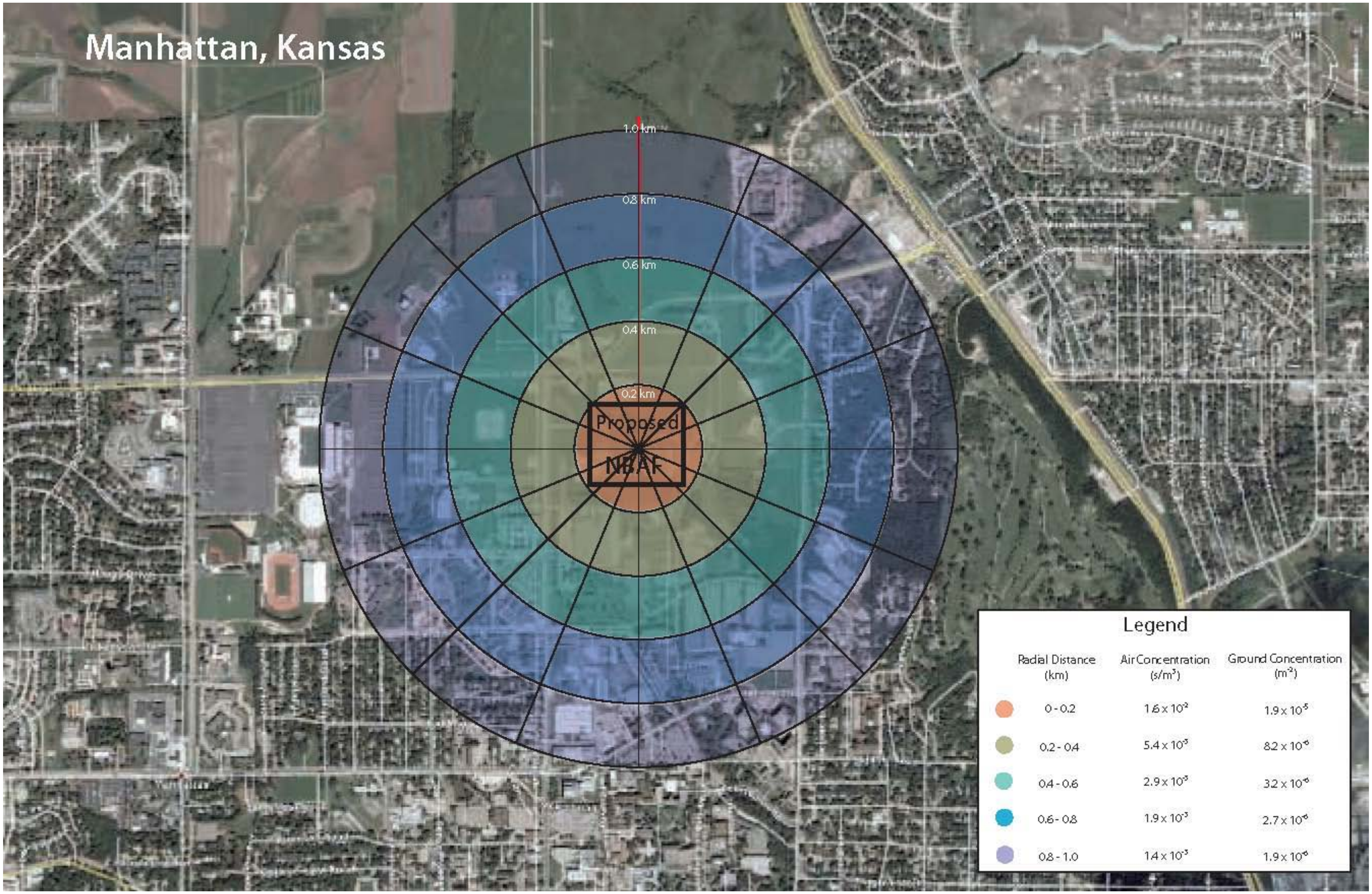


Figure 3.14.4.2-1 — Near Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

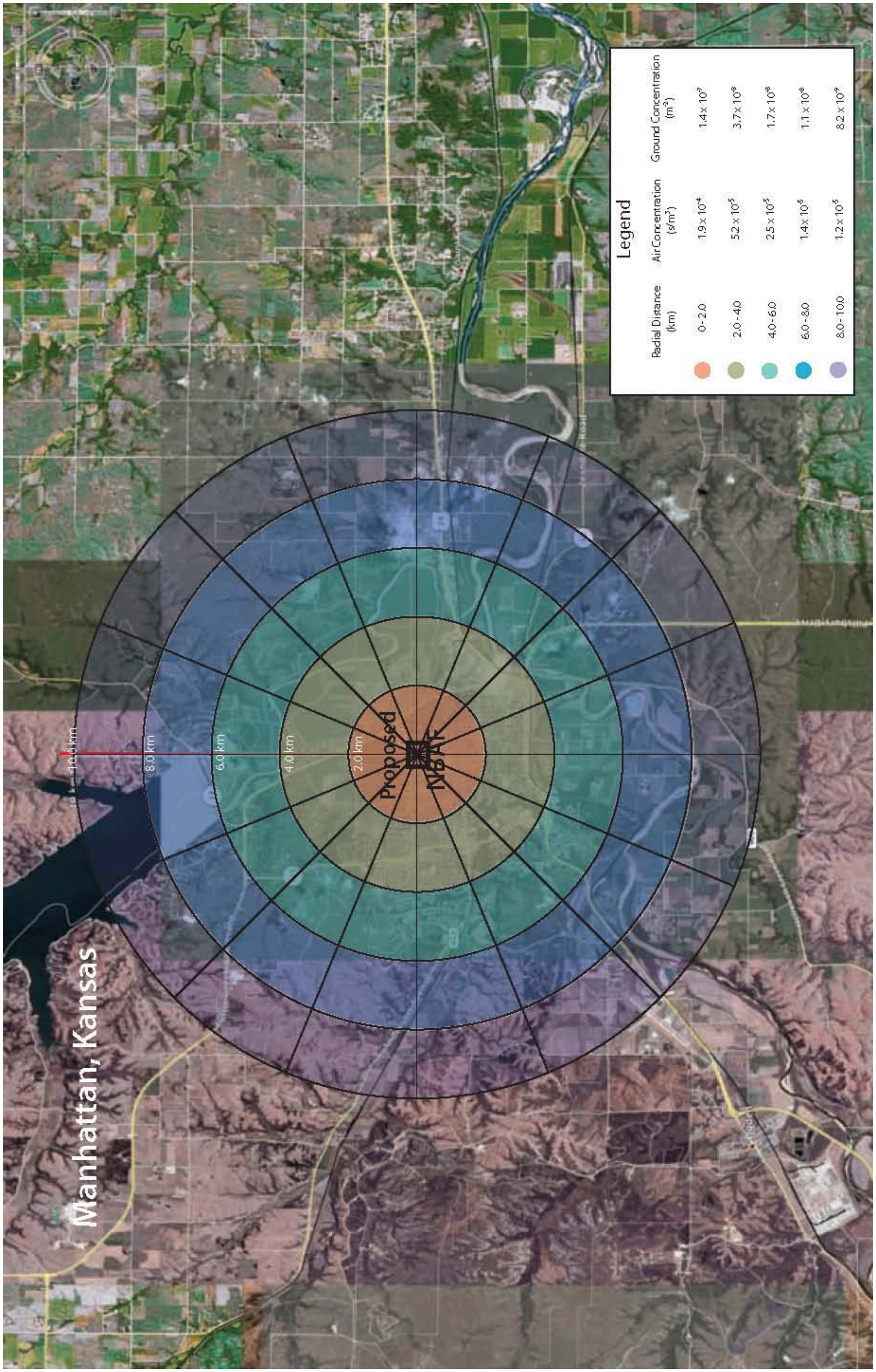


Figure 3.14.4.2-2 — Far Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

Table 3.14.4.2-1 — Unmitigated Accident Specific Air Concentration (virions/m^3) Manhattan Campus Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	1.6E-01	1.6E+05	1.6E+09	1.6E+04	1.6E+08	4.8E+09	1.6E+10	4.8E+07
200	1.6E-02	1.6E+04	1.6E+08	1.6E+03	1.6E+07	4.7E+08	1.6E+09	4.7E+06
400	5.4E-03	5.4E+03	5.4E+07	5.4E+02	5.4E+06	1.6E+08	5.4E+08	1.6E+06
600	2.9E-03	2.9E+03	2.9E+07	2.9E+02	2.9E+06	8.7E+07	2.9E+08	8.7E+05
800	1.9E-03	1.9E+03	1.9E+07	1.9E+02	1.9E+06	5.6E+07	1.9E+08	5.6E+05
1,000	1.4E-03	1.4E+03	1.4E+07	1.4E+02	1.4E+06	4.1E+07	1.4E+08	4.1E+05
2,000	1.9E-04	1.9E+02	1.9E+06	1.9E+01	1.9E+05	5.7E+06	1.9E+07	5.7E+04
4,000	5.2E-05	5.2E+01	5.2E+05	5.2E+00	5.2E+04	1.6E+06	5.2E+06	1.6E+04
6,000	2.5E-05	2.5E+01	2.5E+05	2.5E+00	2.5E+04	7.6E+05	2.5E+06	7.6E+03
8,000	1.4E-05	1.4E+01	1.4E+05	1.4E+00	1.4E+04	4.3E+05	1.4E+06	4.3E+03
10,000	1.2E-05	1.2E+01	1.2E+05	1.2E+00	1.2E+04	3.5E+05	1.2E+06	3.5E+03

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.
[a]Source Term = MAR * ARF * RF * DR * LPF

Table 3.14.4.2-2 — Unmitigated Accident Specific Ground Concentration (virions/m²) Manhattan Campus Site

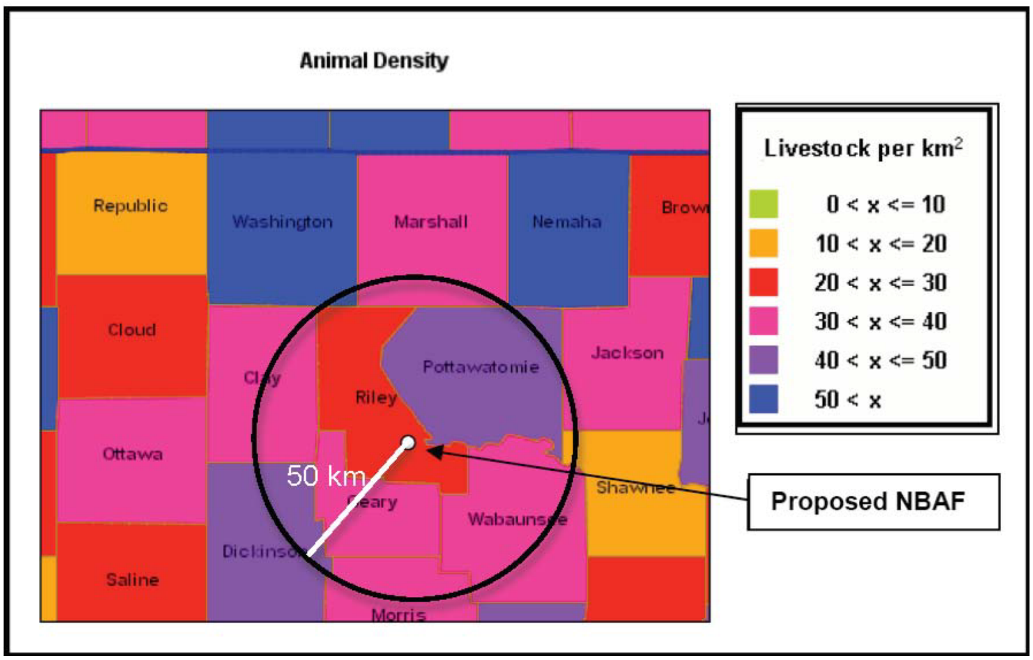
		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m²)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	1.6E-04	1.6E+02	1.6E+06	1.6E+01	1.6E+05	4.8E+06	1.6E+07	4.8E+04
200	1.9E-05	1.9E+01	1.9E+05	1.9E+00	1.9E+04	5.7E+05	1.9E+06	5.7E+03
400	8.2E-06	8.2E+00	8.2E+04	8.2E-01	8.2E+03	2.5E+05	8.2E+05	2.5E+03
600	3.2E-06	3.2E+00	3.2E+04	3.2E-01	3.2E+03	9.5E+04	3.2E+05	9.5E+02
800	2.7E-06	2.7E+00	2.7E+04	2.7E-01	2.7E+03	8.2E+04	2.7E+05	8.2E+02
1,000	1.9E-06	1.9E+00	1.9E+04	1.9E-01	1.9E+03	5.8E+04	1.9E+05	5.8E+02
2,000	1.4E-07	1.4E-01	1.4E+03	1.4E-02	1.4E+02	4.3E+03	1.4E+04	4.3E+01
4,000	3.7E-08	3.7E-02	3.7E+02	3.7E-03	3.7E+01	1.1E+03	3.7E+03	1.1E+01
6,000	1.7E-08	1.7E-02	1.7E+02	1.7E-03	1.7E+01	5.0E+02	1.7E+03	5.0E+00
8,000	1.1E-08	1.1E-02	1.1E+02	1.1E-03	1.1E+01	3.4E+02	1.1E+03	3.4E+00
10,000	8.2E-09	8.2E-03	8.2E+01	8.2E-04	8.2E+00	2.5E+02	8.2E+02	2.5E+00

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a] Source Term = MAR * ARF * RF * DR * LPF

The potential for acquiring and spreading diseases from the FMDV, RVFV, and Nipah virus is also illustrated by considering the livestock in the vicinity of the proposed Kansas site. The counties surrounding the proposed Manhattan Campus Site contain significant numbers of livestock potentially exposed to any off-site release. Data related to the distribution of livestock in the vicinity of the NBAF were obtained from a DHS tasking response dated August 6, 2007. Data were collected related to livestock in the areas of the proposed NBAF sites to support the determination as to whether accidental laboratory releases at these locations could have the potential to affect nearby livestock (DHS 2007). The normalized concentrations presented in Figure 3.14.4.2-2 up to distances of 10 km from the proposed NBAF is fully contained by Riley and Pottawatomie counties. Data provided on livestock density indicates that there is on the order of 20 to 50 livestock, mostly cattle, per square kilometer in this area.

County & Surrounding Counties	Number of Herds	Number of Livestock
Riley	262	46431
Washington	523	155747
Clay	333	55616
Geary	139	41601
Wabaunsee	379	75753
Pottawatomie	589	91424
Marshall	562	75935
	2787	**542507**



Livestock Proximal to the Manhattan Campus Site

The area within a 5-km radius of the proposed NBAF would be approximately 78.5 km^2 and could comprise greater than 3,000 cattle. For the unmitigated accidents, concentrations on the order of $1{\times}10^4$ or greater occur at distances greater than 5 km for the high source term accidents. At relatively close proximity to the site (less than 1 km), the unmitigated concentrations in the air and on the ground show the potential for a large number of infections from any of the three viruses. The number of livestock outside of the 5-km radius increases significantly (>500,000 animals) and are at risk from the postulated unmitigated releases.

The far-field distribution of viral pathogens via air transport, in terms of normalized time-integrated air and ground concentrations, falls off sharply with distance. The normalized air concentration falls to less than 5×10^{-4} s/m^3 at distances greater than 2 km. At these distances, the quantity of material released would need to be much greater than 5×10^3 (5,000 virions) before there is a significant potential for an infection to result. The normalized air concentration falls off by more than an order of magnitude at distance of 10 km.

Tables 3.14.4.2-3 and 3.14.4.2-4 present the accident-specific air and ground concentrations for the mitigated scenarios. It is evident from the mitigated air concentration results and a cow's breathing rate of 1.6×10^{-3} m^3/s that only the significant accidents of a large facility fire or an over-pressure event (deflagration) are considered to have a potential for resulting in an infection after a release. In the event that either of these accidents occurs, the mitigated results show that the elevated air concentrations are limited to distances less than 400 m, indicating that the viral pathogens will not be transported in significant quantities far from the site. This result illustrates the localized effects of the mitigated accidents. In a similar manner, the ground concentrations are limited to short distances from the release point. Taking into consideration that a cow would cover a 30-m^2 area in a single day, the resultant dose would be less than the MID (10 virions) at distances greater than 2 km. Emergency planning and rapid response to a possible release will afford an opportunity to mitigate the consequences of the postulated accidents.

The accident analysis conservatively estimates a final mitigated source term of 3×10^5 virions for the over-pressure event and 1×10^4 virions for the large fire. The risk values indicated that the higher efficiency HEPAs, NBAF structure, fire suppression system, and other appropriate controls were sufficient to mitigate or prevent the accidents. In addition, the release of contaminated wastes and the loss of an infected animal were assigned site-independent risk ranks of 3, indicating that additional controls should be considered to effectively reduce the likelihood of the accident. The consequences in these two scenarios were assigned public severity category D based on the accident being prevented. The effectiveness of the sterilization of wastes and the biocontainment of the animals were the primary controls. In the event that this accident occurs, there is a good chance that the viruses will not be contained without timely emergency response.

Site-Specific Consequences for FMDV

FMDV spreads quickly through herds and flocks of susceptible animals. With an incubation period of as little as 12 hours, the disease can spread quite rapidly. Cattle are often considered to act as indicators because of the low infectious dose, sheep act as maintenance hosts, and swine act as amplifiers of FMDV. The livestock and wildlife (deer and boar) in the vicinity of the Kansas site provides ample opportunity for FMDV to establish in the environment upon a release. FMDV can persist in the human upper respiratory tract for up to 48 hours, making humans potential vectors if they are exposed. In addition, the ability for FMDV to be spread by fomites, and with the large human population in the area the ability for the FMDV to spread over large areas also exists. The consequences of a large release of FMD virions would be as severe as that of RVFV or Nipah virus in this area.

Site-Specific Consequences for RVFV

RVFV is an acute mosquito-borne (vector-based) viral disease affecting mainly ruminants (e.g., cattle, sheep, deer) and humans. In animals, RVF causes abortions and high mortality in young. In humans, RVF causes severe influenza-like syndrome. The area around the Kansas site would provide an environment for RVFV to be easily transmitted once released. The inhalation pathway to humans and wind-borne dispersal of infected vectors can transmit RVFV, and infected livestock and people movement are a means of spreading RVFV. Mosquitoes are a reservoir for RVFV, and the virus can remain dormant in the eggs of the mosquito in dry soil of grassland depressions. With adequate rainfall, the infected mosquitoes could develop and infect ruminants. The virus can be spread by many mosquito species. The consequences of a large release of RVF virions would be as severe as that of FMDV or Nipah virus in this area.

Site-Specific Consequences for Nipah Virus

In pigs, the Nipah virus appears to cause a high rate of febrile illness but a low rate of sickness and death, yet it can appear as sudden death syndrome in mature swine. In humans, Nipah virus is characterized by severe febrile encephalitis, fever, headache, dizziness, and vomiting with a high mortality rate. The host range of Nipah virus is in pigs, cats, dogs, and possible in horses and goats. Because Nipah virus is transmitted by direct contact with bodily fluids, mechanical transmission, and aerosol transmission, there is substantial opportunity for the Nipah virus to spread in the area. The consequences of a large release of Nipah virions would be as severe as that of RVFV or FMDV in this area.

The final risk rank for the mitigated accident scenarios for the proposed Manhattan Campus Site is III (none) for all accidents except over-pressure and fire, which are designated as risk rank II (moderate) for distances close to the release. Because of the potential for easy spread of FMDV, RVFV, and Nipah virus diseases via infected livestock, wildlife, and vectors, the overall risk for the Kansas site is designated as risk rank II (moderate).

Table 3.14.4.2-3 — Mitigated Accident Specific Air Concentration (virions/m^3) Manhattan Campus Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.6E-01	1.6E+00	0.0	0.0	1.6E+03	4.8E+04	1.6E+01	0.0
200	1.6E-02	1.6E-01	0.0	0.0	1.6E+02	4.7E+03	1.6E+00	0.0
400	5.4E-03	5.4E-02	0.0	0.0	5.4E+01	1.6E+03	5.4E-01	0.0
600	2.9E-03	2.9E-02	0.0	0.0	2.9E+01	8.7E+02	2.9E-01	0.0
800	1.9E-03	1.9E-02	0.0	0.0	1.9E+01	5.6E+02	1.9E-01	0.0
1,000	1.4E-03	1.4E-02	0.0	0.0	1.4E+01	4.1E+02	1.4E-01	0.0
2,000	1.9E-04	1.9E-03	0.0	0.0	1.9E+00	5.7E+01	1.9E-02	0.0
4,000	5.2E-05	5.2E-04	0.0	0.0	5.2E-01	1.6E+01	5.2E-03	0.0
6,000	2.5E-05	2.5E-04	0.0	0.0	2.5E-01	7.6E+00	2.5E-03	0.0
8,000	1.4E-05	1.4E-04	0.0	0.0	1.4E-01	4.3E+00	1.4E-03	0.0
10,000	1.2E-05	1.2E-04	0.0	0.0	1.2E-01	3.5E+00	1.2E-03	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.
[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

Table 3.14.4.2-4 — Mitigated Accident Specific Ground Concentration (virions/m^2) Manhattan Campus Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.6E-04	1.6E-03	0.0	0.0	1.6E+00	4.8E+01	1.6E-02	0.0
200	1.9E-05	1.9E-04	0.0	0.0	1.9E-01	5.7E+00	1.9E-03	0.0
400	8.2E-06	8.2E-05	0.0	0.0	8.2E-02	2.5E+00	8.2E-04	0.0
600	3.2E-06	3.2E-05	0.0	0.0	3.2E-02	9.5E-01	3.2E-04	0.0
800	2.7E-06	2.7E-05	0.0	0.0	2.7E-02	8.2E-01	2.7E-04	0.0
1,000	1.9E-06	1.9E-05	0.0	0.0	1.9E-02	5.8E-01	1.9E-04	0.0
2,000	1.4E-07	1.4E-06	0.0	0.0	1.4E-03	4.3E-02	1.4E-05	0.0
4,000	3.7E-08	3.7E-07	0.0	0.0	3.7E-04	1.1E-02	3.7E-06	0.0
6,000	1.7E-08	1.7E-07	0.0	0.0	1.7E-04	5.0E-03	1.7E-06	0.0
8,000	1.1E-08	1.1E-07	0.0	0.0	1.1E-04	3.4E-03	1.1E-06	0.0
10,000	8.2E-09	8.2E-08	0.0	0.0	8.2E-05	2.5E-03	8.2E-07	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

3.14.4.3 Flora Industrial Park Site

Site-specific consequences for the proposed Flora Industrial Park Site are depicted in terms of the accidents postulated in Section 3.14.3. Each of the accidents has the potential to release pathogens to the environment. Because of the differences in topography, weather, and agricultural uses near each site, the consequences are presented individually for each proposed site. In the case of the Flora Industrial Park Site, the site-specific atmospheric data were used to provide estimates of time-integrated down-wind air and ground concentrations that could result in the event of a release as postulated in the accidents.

To assess the site-specific consequences from the postulated bounding accidents, it is first necessary to evaluate the results of the transport modeling and the development of specific air and ground concentrations of viral pathogens estimated to have been released in each accident. Figure 3.14.4.3-1 illustrates the near-field effects of a potential release and the subsequent down-wind transport in air along with the deposition onto the ground as a result of settling or washout (NUREG 3332). The radial symmetry in figure 3.14.4.3-1 and 3.14.4.3-2 are for illustration purposes only. This shows the chosen boundary location as an estimate of down-wind normalized 95th percentile air-concentrations; this figure does not reflect an actual down-wind plume result. Tables 3.14.4.3-1 and 3.14.4.3-2 present the resultant air and ground concentrations for each unmitigated accident at specific radial distances. The combination of these concentrations tables and the figures representing the near- and far-field results provides the basis for evaluating the impacts to the population and environment after a hypothetical release at the proposed Flora Industrial Park Site.

The normalized air concentrations for the Flora, Mississippi, site range from 1.6×10^{-2} at distances of 200 m to 1.4×10^{-3} at a distance of 1,000 m (1 km) from a release. The ground concentrations for these same radial distances range from a high of 3×10^{-5} to a low of 2.9×10^{-6}. Taking into consideration the source terms for each of the specific accidents, the normalized air and ground concentration values represent the potential for significant concentrations in the air and on the ground for the larger accidents such as over-pressure, seismic, and fire events.

As with the previous discussion, the majority of the NBAF would be within the 200-m radial distance. Significant releases of pathogens from the NBAF as a result of accidents could be expected to occur only from the higher biocontainment areas. The site boundary would be located at approximately 250 m from the center of the NBAF. For the purposes of the analysis it is assumed that distances past 200 m essentially represents an off-site release. Section 3.8.5.1.1 presents the discussion of the vegetation in the vicinity of the proposed NBAF site. The area outside of the 4-km distance from the site is predominantly wooded forestland with streams or rivers, as well as wetlands. Within the immediate area of the site is mainly pastureland currently used for grazing livestock.

Section 3.8.5.1.4 presents the terrestrial wildlife in the vicinity of the proposed Mississippi NBAF site. Numerous species of mammals, birds, reptiles, and insects (mosquitoes and ticks) inhabit the area around the proposed site. Mammals include both white tail deer and wild boar. The wildlife and livestock in the vicinity of the site are prime candidates for acquiring or transmitting the FMD and RVFV and to some extent the Nipah virus in pigs. While the FMDV, RVFV, and Nipah virus each have different characteristics related to transmission and viability, however, the unmitigated concentrations near the facility are potentially significant.

The location of the proposed Flora Industrial Park Site provides a significant opportunity for the spread of viruses via vectors and infected wildlife. In addition, the atmospheric modeling indicates that down-wind transport is a credible scenario given a sufficiently large release of pathogens.

For this site, as with all of the sites except the Plum Island Site there is a potential for viral pathogens to be transported significant distances by the wind. The results of the modeling indicate that this transport pathway is not limited (Figure 3.14.4.3-2) as was the case for Plum Island. It is considered likely that deer or wild boar could act to spread disease over long distances. In addition, common vectors such as mosquitoes can be transported long distances.

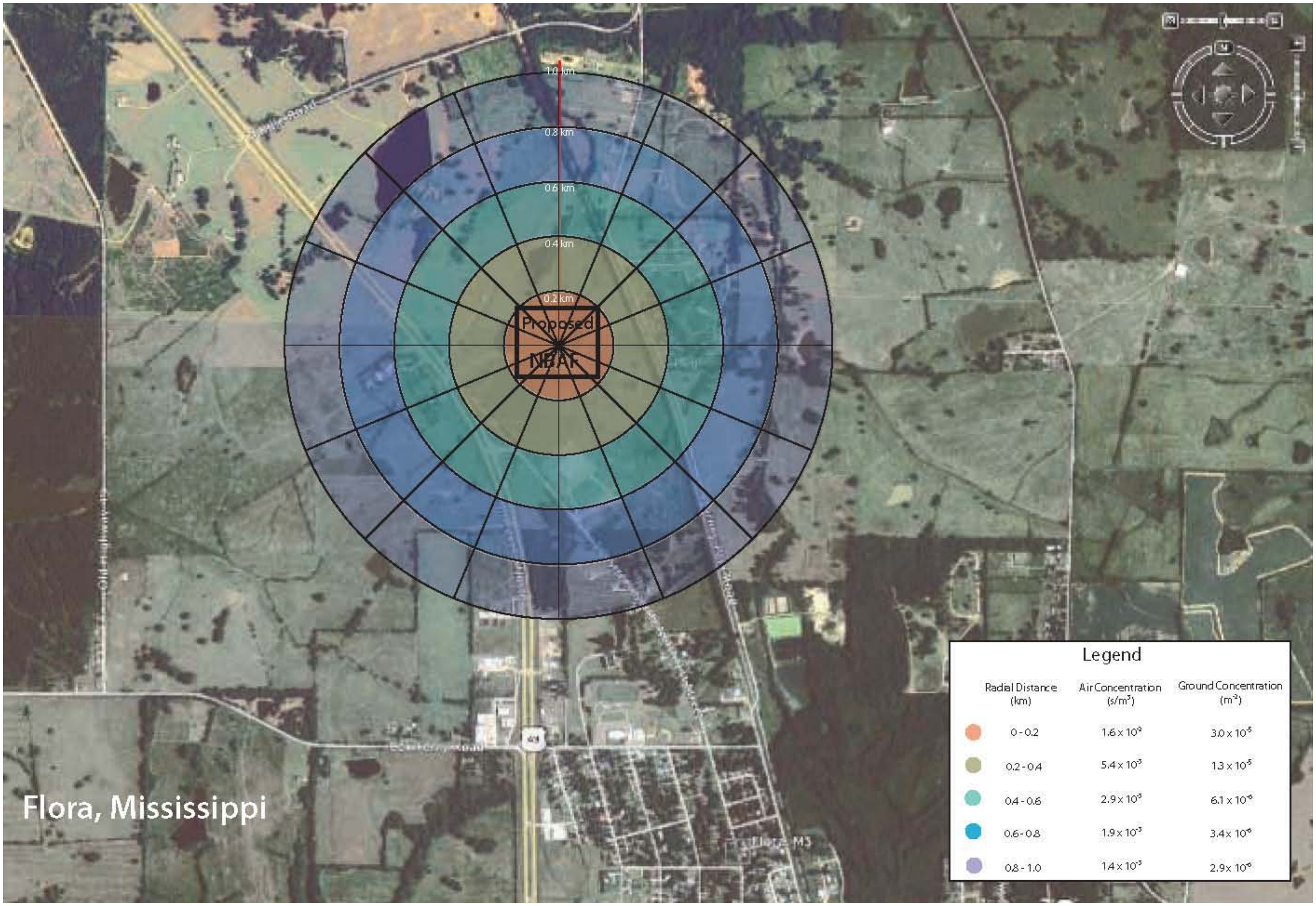


Figure 3.14.4.3-1 — Near Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

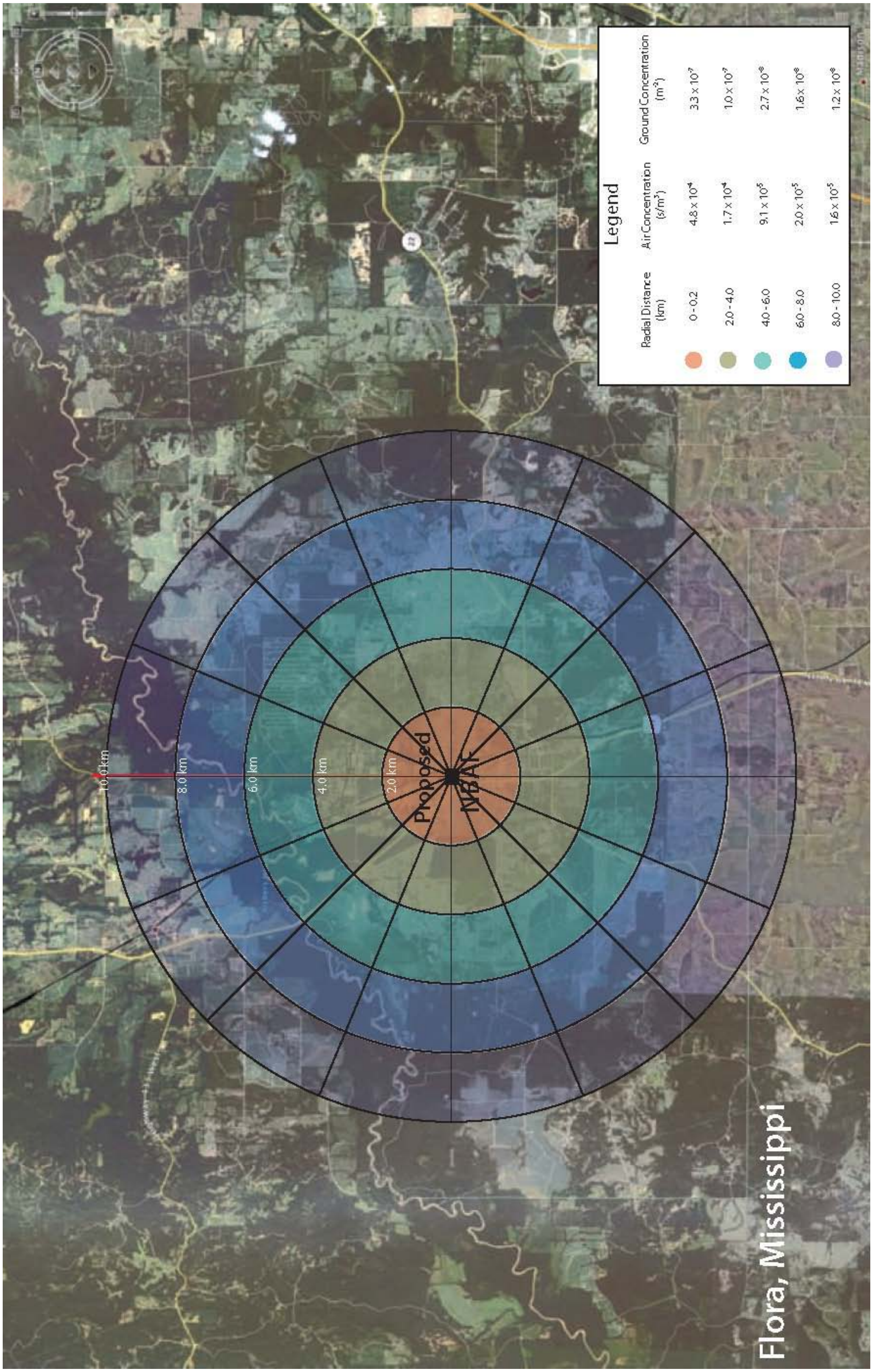


Figure 3.14.4.3-2 — Far Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

Table 3.14.4.3-1 — Unmitigated Accident Specific Air Concentration (virions/m^3) Flora Industrial Park Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	1.6E-01	1.6E+05	1.6E+09	1.6E+04	1.6E+08	4.8E+09	1.6E+10	4.8E+07
200	1.6E-02	1.6E+04	1.6E+08	1.6E+03	1.6E+07	4.7E+08	1.6E+09	4.7E+06
400	5.4E-03	5.4E+03	5.4E+07	5.4E+02	5.4E+06	1.6E+08	5.4E+08	1.6E+06
600	2.9E-03	2.9E+03	2.9E+07	2.9E+02	2.9E+06	8.7E+07	2.9E+08	8.7E+05
800	1.9E-03	1.9E+03	1.9E+07	1.9E+02	1.9E+06	5.6E+07	1.9E+08	5.6E+05
1,000	1.4E-03	1.4E+03	1.4E+07	1.4E+02	1.4E+06	4.1E+07	1.4E+08	4.1E+05
2,000	4.8E-04	4.8E+02	4.8E+06	4.8E+01	4.8E+05	1.4E+07	4.8E+07	1.4E+05
4,000	1.7E-04	1.7E+02	1.7E+06	1.7E+01	1.7E+05	5.0E+06	1.7E+07	5.0E+04
6,000	9.1E-05	9.1E+01	9.1E+05	9.1E+00	9.1E+04	2.7E+06	9.1E+06	2.7E+04
8,000	2.0E-05	2.0E+01	2.0E+05	2.0E+00	2.0E+04	5.9E+05	2.0E+06	5.9E+03
10,000	1.6E-05	1.6E+01	1.6E+05	1.6E+00	1.6E+04	4.7E+05	1.6E+06	4.7E+03

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Source Term = MAR * ARF * RF * DR * LPF

Table 3.14.4.3-2 — Unmitigated Accident Specific Ground Concentration (virions/m^2) Flora Industrial Park Site

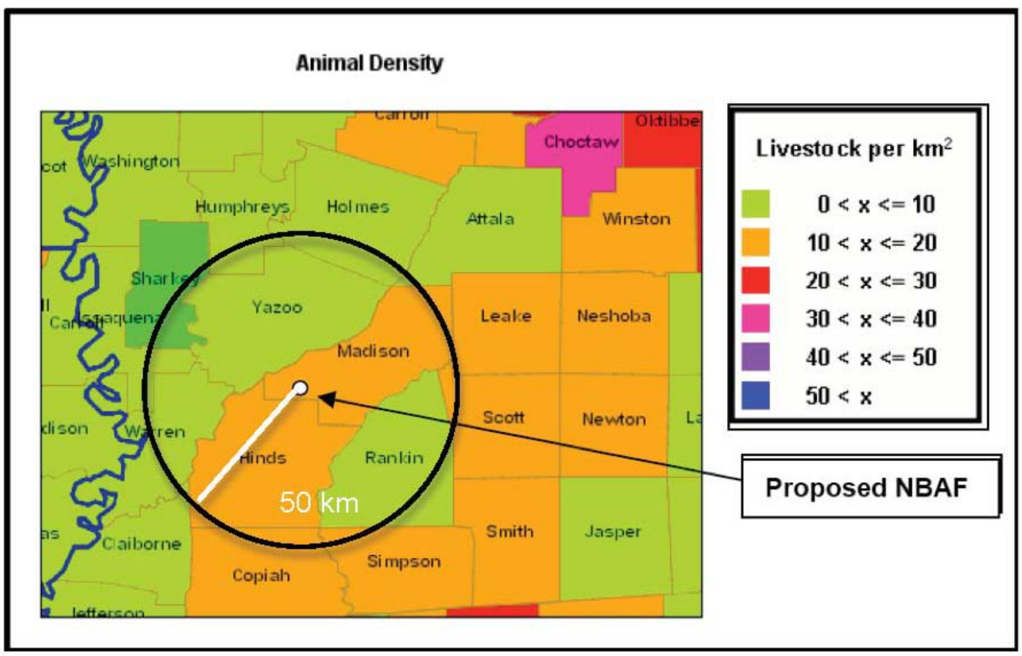
		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	2.1E-04	2.1E+02	2.1E+06	2.1E+01	2.1E+05	6.4E+06	2.1E+07	6.4E+04
200	3.0E-05	3.0E+01	3.0E+05	3.0E+00	3.0E+04	9.1E+05	3.0E+06	9.1E+03
400	1.3E-05	1.3E+01	1.3E+05	1.3E+00	1.3E+04	3.8E+05	1.3E+06	3.8E+03
600	6.1E-06	6.1E+00	6.1E+04	6.1E-01	6.1E+03	1.8E+05	6.1E+05	1.8E+03
800	3.4E-06	3.4E+00	3.4E+04	3.4E-01	3.4E+03	1.0E+05	3.4E+05	1.0E+03
1,000	2.9E-06	2.9E+00	2.9E+04	2.9E-01	2.9E+03	8.7E+04	2.9E+05	8.7E+02
2,000	3.3E-07	3.3E-01	3.3E+03	3.3E-02	3.3E+02	9.8E+03	3.3E+04	9.8E+01
4,000	1.0E-07	1.0E-01	1.0E+03	1.0E-02	1.0E+02	3.0E+03	1.0E+04	3.0E+01
6,000	2.7E-08	2.7E-02	2.7E+02	2.7E-03	2.7E+01	8.2E+02	2.7E+03	8.2E+00
8,000	1.6E-08	1.6E-02	1.6E+02	1.6E-03	1.6E+01	4.9E+02	1.6E+03	4.9E+00
10,000	1.2E-08	1.2E-02	1.2E+02	1.2E-03	1.2E+01	3.5E+02	1.2E+03	3.5E+00

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Source Term = MAR * ARF * RF * DR * LPF

The potential for acquiring and spreading diseases from the FMDV, RVFV, and Nipah virus is also illustrated by considering the livestock in the vicinity of the proposed Flora Industrial Park Site. The counties surrounding the proposed Flora Industrial Park Site contain significant numbers of livestock potentially exposed to any off-site release. Data related to the distribution of livestock in the vicinity of the NBAF was obtained from a DHS tasking response dated August 6, 2007. The specific task was to collect information about livestock in the areas of the proposed NBAF sites to support the determination as to whether accidental laboratory releases at these locations could have the potential to affect nearby livestock (DHS 2007). The normalized concentrations presented in Figure 3.14.4.3-2 up to distances of 10 km from the proposed NBAF site extends into the Yazoo, Madison, and Hinds counties. Data provided on livestock density indicate that there is on the order of 10 to 20 livestock, mostly cattle, per square kilometer in this area.

Country & Surrounding Countries	Number of Herds	Number of Livestock
Madison	324	19148
Yazoo	231	13370
Attala	268	10533
Hinds	624	35300
Rankin	424	18231
Scott	450	23639
Leake	440	20270
Holmes	238	11765
	2999	**152256**



Livestock Proximal to the Flora Industrial Site

The area within a 5 km radius of the proposed NBAF would be approximately 78.5 km^2 containing fewer than 1,600 cattle. For the unmitigated accidents, concentrations on the order of $1{\times}10^4$ or greater occur at distances greater than 5 km for the high source term accidents. At relatively close proximity to the site (less than 1 km), the unmitigated concentrations in the air and on the ground show the potential for a large number of infections from any of the three viruses. The number of livestock outside of the 5-km radius increases significantly (>300,000 animals) and are at risk from the postulated unmitigated releases.

The far-field distribution of viral pathogens via air transport, in terms of normalized time-integrated air and ground concentrations falls off sharply with distance. The normalized air concentration falls to less than 5×10^{-4} s/m^3 at distances greater than 2 km. At these distances, the quantity of material released would need to be much greater than 5×10^3 (5,000 virions) before there is a significant potential for an infection to result. The normalized air concentration falls off by more than an order of magnitude at distance of 10 km.

Tables 3.14.4.3-3 and 3.14.4.3-4 present the accident-specific air and ground concentrations for the mitigated scenarios. It is evident from the mitigated air concentration results and a cow's breathing rate of 1.6×10^{-3} m^3/s that only the significant accidents of a large facility fire or an over-pressure event (deflagration) are considered to have a potential for resulting in an infection after a release. In the event that either of these accidents occurs, the mitigated results show that the elevated air concentrations are limited to distances less than 400 m, indicating that the viral pathogens will not be transported in significant quantities far from the site. This result illustrates the localized effects of the mitigated accidents. In a similar manner, the ground concentrations are limited to short distances from the release point. Taking into consideration that a cow would cover a 30-m^2 area in a single day, the resultant dose would be less than the MID (10 virions) at distances greater than 2 km. Emergency planning and rapid response to a possible release will afford an opportunity to mitigate the consequences of the postulated accidents.

The accident analysis conservatively estimates a final mitigated source term of 3×10^5 virions for the over-pressure event and 1×10^4 virions for the large fire. The risk values indicated that the higher efficiency HEPAs, NBAF structure, fire suppression system, and other appropriate controls were sufficient to mitigate or prevent the accidents. In addition, the release of contaminated wastes and the loss of an infected animal were assigned site-independent risk ranks of 3, indicating that additional controls should be considered to effectively reduce the likelihood of the accident. The consequences in these two scenarios were assigned public severity category D based on the accident being prevented. The effectiveness of the sterilization of wastes and the biocontainment of the animals were the primary controls. In the event this accident occurs, there is a good chance that the viruses will not be contained without timely emergency response.

Site-Specific Consequences for FMDV

FMDV spreads quickly through herds and flocks of susceptible animals. With an incubation period of as little as 12 hours, the disease can spread quite rapidly. Cattle are often considered to act as indicators because of the low infectious dose, sheep act as maintenance hosts, and swine act as amplifiers of FMDV. The livestock and wildlife (deer and boar) in the vicinity of the Flora Industrial Park Site provide ample opportunity for FMDV to establish in the environment upon a release. FMDV can persist in the human upper respiratory tract for up to 48 hours, making humans potential vectors if they are exposed. In addition, the ability for FMDV to be spread by fomites and with the large human population in the area, the ability for the FMDV to spread over large areas also exists. The consequences of a large release of FMD virions would be as severe as that of RVFV or Nipah virus in this area.

Site-Specific Consequences for RVFV

RVFV is an acute mosquito-borne (vector-based) viral disease affecting mainly ruminants (e.g., cattle, sheep, deer) and humans. In animals, RVF causes abortions and high mortality in young. In humans, RVF causes severe influenza-like syndrome. The area around the Flora Industrial Park Site would provide an environment for RVFV to be easily transmitted once released. The inhalation pathway to humans and wind-borne dispersal of infected vectors can transmit RVFV, and infected livestock and people movement are a means of spreading RVFV. Mosquitoes are a reservoir for RVFV, and the virus can remain dormant in the eggs of the mosquito in dry soil of grassland depressions. With adequate rainfall, the infected mosquitoes could develop and infect ruminants. The virus can be spread by many mosquito species. The consequences of a large release of RVF virions would be as severe as that of FMDV or Nipah virus in this area.

Site-Specific Consequences for Nipah Virus

In pigs, the Nipah virus appears to cause a high rate of febrile illness but a low rate of sickness and death, yet it can appear as sudden death syndrome in mature swine. In humans, Nipah virus is characterized by severe febrile encephalitis, fever, headache, dizziness, and vomiting with a high mortality rate. The host range of Nipah virus is in pigs, cats, dogs, and possible in horses and goats. Because Nipah virus is transmitted by direct contact with bodily fluids, mechanical transmission, and aerosol transmission, there is substantial opportunity for the Nipah virus to spread in the area. The consequences of a large release of Nipah virions would be as severe as that of RVFV or FMDV in this area.

The final risk rank for the mitigated accident scenarios for the proposed NBAF Flora Industrial Park Site is III (none) for all accidents except over-pressure and fire, which are designated as risk rank II (moderate) for distances close to the release. Because of the potential for easy spread of FMDV, RVFV, and Nipah virus diseases via infected livestock, wildlife, and vectors, the overall risk for the Flora Industrial Park Site is designated as risk rank II (moderate).

Table 3.14.4.3-3 — Mitigated Accident Specific Air Concentration (virions/m^3) Flora Industrial Park Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.6E-01	1.6E+00	0.0	0.0	1.6E+03	4.8E+04	1.6E+01	0.0
200	1.6E-02	1.6E-01	0.0	0.0	1.6E+02	4.7E+03	1.6E+00	0.0
400	5.4E-03	5.4E-02	0.0	0.0	5.4E+01	1.6E+03	5.4E-01	0.0
600	2.9E-03	2.9E-02	0.0	0.0	2.9E+01	8.7E+02	2.9E-01	0.0
800	1.9E-03	1.9E-02	0.0	0.0	1.9E+01	5.6E+02	1.9E-01	0.0
1,000	1.4E-03	1.4E-02	0.0	0.0	1.4E+01	4.1E+02	1.4E-01	0.0
2,000	4.8E-04	4.8E-03	0.0	0.0	4.8E+00	1.4E+02	4.8E-02	0.0
4,000	1.7E-04	1.7E-03	0.0	0.0	1.7E+00	5.0E+01	1.7E-02	0.0
6,000	9.1E-05	9.1E-04	0.0	0.0	9.1E-01	2.7E+01	9.1E-03	0.0
8,000	2.0E-05	2.0E-04	0.0	0.0	2.0E-01	5.9E+00	2.0E-03	0.0
10,000	1.6E-05	1.6E-04	0.0	0.0	1.6E-01	4.7E+00	1.6E-03	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

Table 3.14.4.3-4 — Mitigated Accident Specific Ground Concentration (virions/m^2) Flora Industrial Park Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	2.1E-04	2.1E-03	0.0	0.0	2.1E+00	6.4E+01	2.1E-02	0.0
200	3.0E-05	3.0E-04	0.0	0.0	3.0E-01	9.1E+00	3.0E-03	0.0
400	1.3E-05	1.3E-04	0.0	0.0	1.3E-01	3.8E+00	1.3E-03	0.0
600	6.1E-06	6.1E-05	0.0	0.0	6.1E-02	1.8E+00	6.1E-04	0.0
800	3.4E-06	3.4E-05	0.0	0.0	3.4E-02	1.0E+00	3.4E-04	0.0
1,000	2.9E-06	2.9E-05	0.0	0.0	2.9E-02	8.7E-01	2.9E-04	0.0
2,000	3.3E-07	3.3E-06	0.0	0.0	3.3E-03	9.8E-02	3.3E-05	0.0
4,000	1.0E-07	1.0E-06	0.0	0.0	1.0E-03	3.0E-02	1.0E-05	0.0
6,000	2.7E-08	2.7E-07	0.0	0.0	2.7E-04	8.2E-03	2.7E-06	0.0
8,000	1.6E-08	1.6E-07	0.0	0.0	1.6E-04	4.9E-03	1.6E-06	0.0
10,000	1.2E-08	1.2E-07	0.0	0.0	1.2E-04	3.5E-03	1.2E-06	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

3.14.4.4 Plum Island Site

Site-specific consequences for the proposed NBAF Plum Island site are depicted in terms of the accidents postulated in Section 3.14.3. Each of the accidents has the potential to release pathogens to the environment. Because of the differences in topography, weather, and agricultural use near each site, the consequences are presented individually for each proposed site. In the case of the Plum Island Site, the site-specific atmospheric data were used to provide estimates of time-integrated down-wind air and ground concentrations that could result in the event of a release as postulated in the accidents.

To assess the site-specific consequences from the postulated bounding accidents, it is first necessary to evaluate the results of the transport modeling and the development of specific air and ground concentrations of viral pathogens estimated to have been released in each accident. Figure 3.14.4.4-1 illustrates the near-field effects of a potential release and the subsequent down-wind transport in air along with the deposition onto the ground as a result of settling or washout (NUREG 3332). The radial symmetry in figure 3.14.4.4-1 and 3.14.4.4-2 are for illustration purposes only. This shows the chosen boundary location as an estimate of down-wind normalized 95th percentile air-concentrations; this figure does not reflect an actual down-wind plume result. Tables 3.14.4.4-1 and 3.14.4.4-2 present the resultant air and ground concentrations for each unmitigated accident at specific radial distances. The combination of these concentration tables and the figures representing the near- and far-field results provides the basis for evaluating the impacts to the population and environment after a hypothetical release.

The near-field results presented in Figure 3.14.4.4-1 illustrate that significant fraction of the island falls with 1 km of the proposed NBAF. The normalized air concentrations range from 1.6×10^{-2} at distances of 200 m to 1.4×10^{-3} at a distance of 1,000 m (1 km) from a release. The ground concentrations for these same radial distances range from a high of 3.2×10^{-5} to a low of 3×10^{-6}. Taking into consideration the source terms for each of the specific accidents, the normalized air and ground concentration values represent the potential for significant concentrations in the air and on the ground for the larger accidents such as over-pressure, seismic, and fire events.

The majority of the NBAF would be within the 200-m radial distance. Significant releases of pathogens from the NBAF as a result of accidents could be expected to occur only from the higher biocontainment areas (BSL-3 and BSL-4 areas), which are generally located in the interior of the facility. At a distance of approximately 250 m from the center of the NBAF, the site boundary would be located. For the purposes of the analysis, it is assumed that distances past 200 m essentially represents an off-site release. Section 3.8.2.1.4 presents the terrestrial wildlife in the vicinity of Plum Island. The island is predominately populated by numerous species of birds, with many being waterfowl that are migratory in nature. In addition, there are significant populations of white tail deer on the mainland The presence of deer on the island, while not precluded (deer have not been found on the island since 2004 due to an eradication program), are not prevalent to the degree they are on the mainland. The FMDV, RVFV, and Nipah virus each have different characteristics related to transmission and viability; however, the unmitigated concentrations near the facility are potentially significant.

While it is possible for the viral pathogens to be transported significant distances by the wind, the results of the modeling indicates that this transport pathway is limited (Figure 3.14.4.1-2). The location of the Plum Island provides a barrier against the spread of viruses. It is considered unlikely that deer can get on and off of the island, but common vectors such as mosquitoes can be transported long distances.

Mosquito species vary in their breeding habits, biting behavior, host preferences and flight range. Most mosquitoes disperse less than two kilometers; some move only a few meters away from their original breeding place, others can fly some 5 or 10 kilometers, and a few species will disperse up to 50 kilometers downwind from the larval habitats (ICPMR, 2008).

RVFV can remain dormant in mosquito eggs for years and when eggs hatch after rainfall the mosquito harbors the virus.

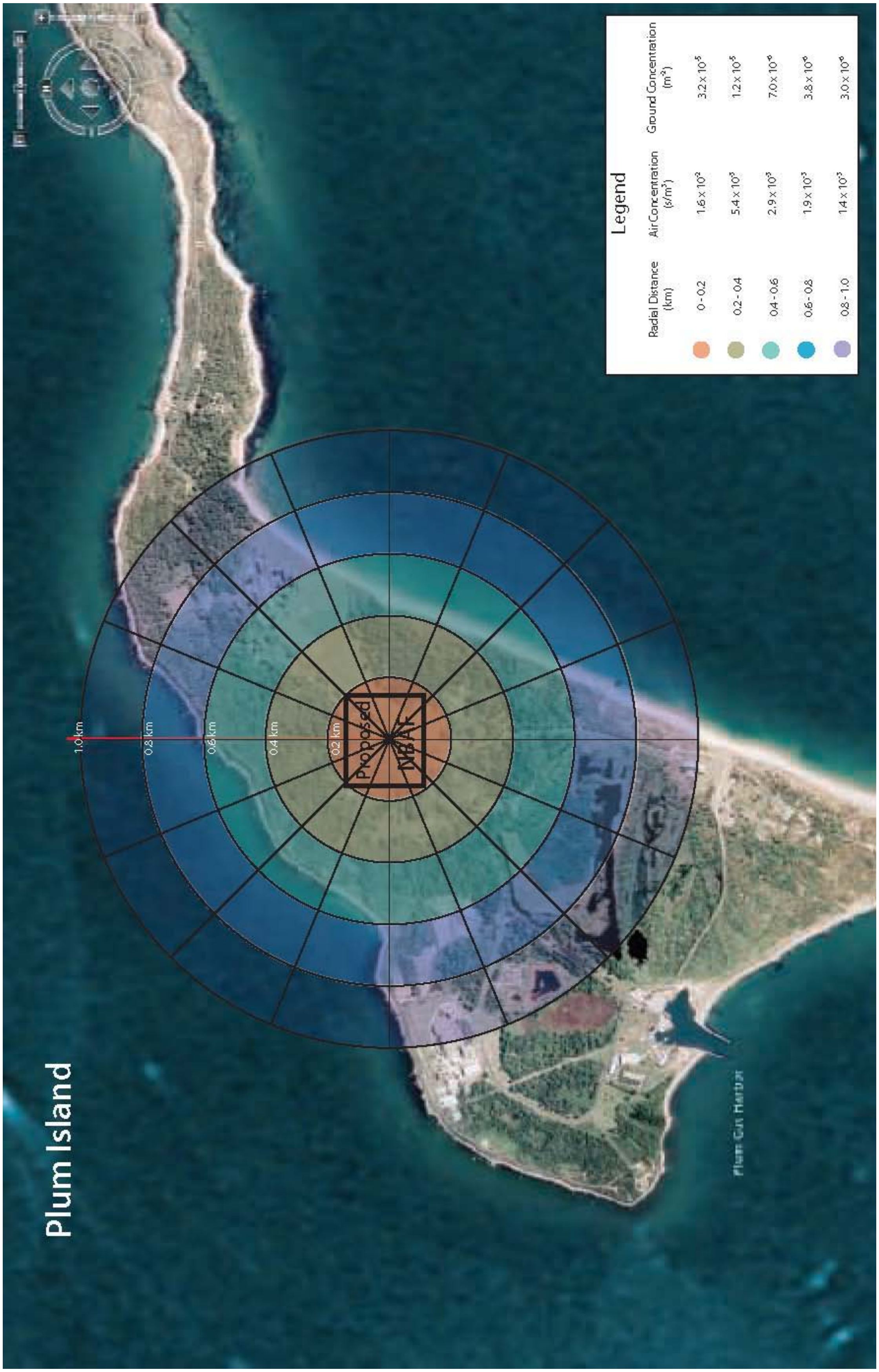


Figure 3.14.4.4-1 — Near Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

Table 3.14.4.4-1 — Unmitigated Accident Specific Air Concentration (virions/m^3) Plum Island Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	1.0E+10	1.0E+11	3.0E+08
50	1.6E-01	1.6E+05	1.6E+09	1.6E+04	1.6E+12	1.6E+11	1.6E+10	4.8E+07
200	1.6E-02	1.6E+04	1.6E+08	1.6E+03	1.6E+11	1.6E+10	1.6E+09	4.7E+06
400	5.4E-03	5.4E+03	5.4E+07	5.4E+02	5.4E+10	5.4E+09	5.4E+08	1.6E+06
600	2.9E-03	2.9E+03	2.9E+07	2.9E+02	2.9E+10	2.9E+09	2.9E+08	8.7E+05
800	1.9E-03	1.9E+03	1.9E+07	1.9E+02	1.9E+10	1.9E+09	1.9E+08	5.6E+05
1,000	1.4E-03	1.4E+03	1.4E+07	1.4E+02	1.4E+10	1.4E+09	1.4E+08	4.1E+05
2,000	4.8E-04	4.8E+02	4.8E+06	4.8E+01	4.8E+09	4.8E+08	4.8E+07	1.4E+05
4,000	1.7E-04	1.7E+02	1.7E+06	1.7E+01	1.7E+09	1.7E+08	1.7E+07	5.0E+04
6,000	9.1E-05	9.1E+01	9.1E+05	9.1E+00	9.1E+08	9.1E+07	9.1E+06	2.7E+04
8,000	5.9E-05	5.9E+01	5.9E+05	5.9E+00	5.9E+08	5.9E+07	5.9E+06	1.8E+04
10,000	3.0E-05	3.0E+01	3.0E+05	3.0E+00	3.0E+08	3.0E+07	3.0E+06	9.0E+03

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.
[a]Source Term = MAR * ARF * RF * DR * LPF

Table 3.14.4.4-2 — Unmitigated Accident Specific Ground Concentration (virions/m^2) Plum Island Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	1.0E+10	1.0E+11	3.0E+08
50	2.4E-04	2.4E+02	2.4E+06	2.4E+01	2.4E+05	7.2E+06	2.4E+07	7.2E+04
200	3.2E-05	3.2E+01	3.2E+05	3.2E+00	3.2E+04	9.6E+05	3.2E+06	9.6E+03
400	1.2E-05	1.2E+01	1.2E+05	1.2E+00	1.2E+04	3.7E+05	1.2E+06	3.7E+03
600	6.9E-06	6.9E+00	6.9E+04	6.9E-01	6.9E+03	2.1E+05	6.9E+05	2.1E+03
800	3.8E-06	3.8E+00	3.8E+04	3.8E-01	3.8E+03	1.1E+05	3.8E+05	1.1E+03
1,000	3.0E-06	3.0E+00	3.0E+04	3.0E-01	3.0E+03	9.0E+04	3.0E+05	9.0E+02
2,000	3.3E-07	3.3E-01	3.3E+03	3.3E-02	3.3E+02	9.8E+03	3.3E+04	9.8E+01
4,000	8.5E-08	8.5E-02	8.5E+02	8.5E-03	8.5E+01	2.5E+03	8.5E+03	2.5E+01
6,000	3.1E-08	3.1E-02	3.1E+02	3.1E-03	3.1E+01	9.4E+02	3.1E+03	9.4E+00
8,000	2.8E-08	2.8E-02	2.8E+02	2.8E-03	2.8E+01	8.5E+02	2.8E+03	8.5E+00
10,000	1.9E-08	1.9E-02	1.9E+02	1.9E-03	1.9E+01	5.7E+02	1.9E+03	5.7E+00

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.
[a]Source Term = MAR * ARF * RF * DR * LPF

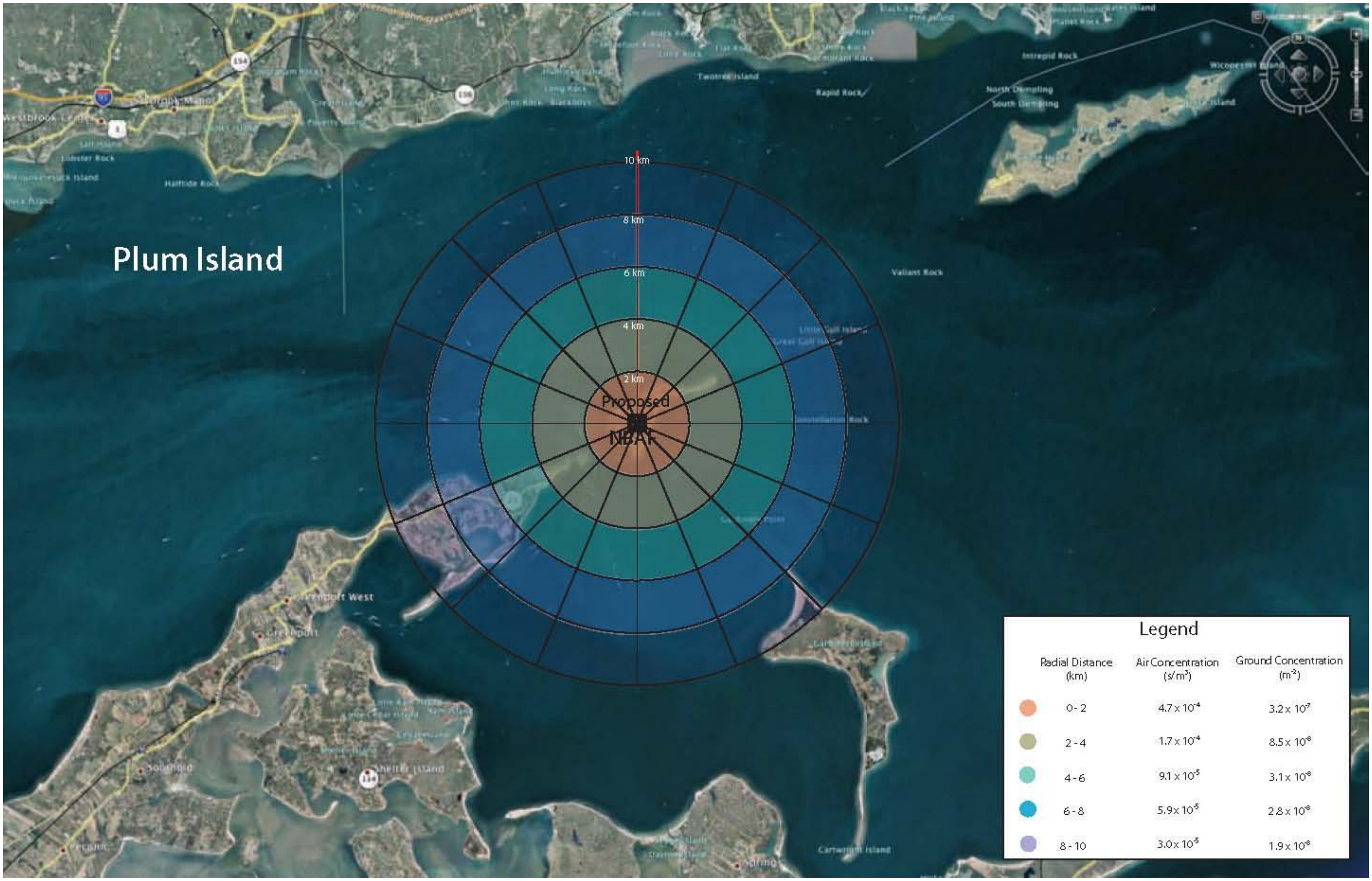


Figure 3.14.4.4-2 — Far Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

The far field distribution of viral pathogens via air transport, in terms of normalized time-integrated air and ground concentrations illustrates the island's protective features against the spread of pathogens. The island is nearly 2 km from the mainland and at this distance the normalized air concentration falls to approximately 5×10^{-4} s/m^3, which indicates that the quantity of material released has to be much greater than 1×10^4 (10,000 virions) before there is a significant potential for an infection to result. The normalized air concentration falls off by an order of magnitude at a distance of 10 km.

Tables 3.14.4.4-3 and 3.14.4.4-4 present the accident-specific air and ground concentrations for the mitigated scenarios. It is evident from the mitigated air concentration results and a cow's breathing rate of 1.6×10^{-3} m^3/s that only the significant accidents of a large facility fire or an over-pressure event (deflagration) are considered to have a potential for resulting in an infection after a release. In the event that either of these accidents occurs, the mitigated results show that the elevated air concentrations are limited to distances less than 600 m, indicating that the viral pathogens will not be transported in significant quantities off of the island. In a similar manner, the ground concentrations are limited to short distances from the release point. Taking into consideration that a cow would cover a 30-m^2 area in a single day, the resultant dose would still be less than the MID (10 virions) at distances greater than 2 km. Since there are no cows roaming free on the island and the presence of deer is minimal, it is reasonable to conclude that the ground concentrations even from the most significant accidents will not result in an infection off of the island.

The accident analysis conservatively estimates a final mitigated source term of 3×10^5 virions for the over-pressure event and 1×10^4 virions for the large fire. The risk values indicated that the higher efficiency HEPAs, NBAF structure, fire suppression system, and other appropriate controls were sufficient to mitigate or prevent the accidents. In addition, the release of contaminated wastes and the loss of an infected animal were assigned site-independent risk ranks of 3, indicating that additional controls should be considered to effectively reduce the likelihood of the accident. The consequences in these two scenarios were assigned public severity category D based on the accident being prevented. The effectiveness of the sterilization of wastes and the biocontainment of the animals were the primary controls. Should this accident occur on Plum Island, the release has a good chance of being contained on the island.

Site-Specific Consequences for FMDV

FMDV spreads quickly through herds and flocks of susceptible animals. With an incubation period of as little as 12 hours, the disease can spread quite rapidly. Cattle are often considered to act as indicators because of the low infectious dose, sheep act as maintenance hosts, and swine act as amplifiers of FMDV. There are no livestock and very limited wildlife (deer) in the vicinity of the Plum Island site. Therefore, there is little opportunity for FMDV to become established in the environment upon a release. FMDV can persist in the human upper respiratory tract for up to 48 hours, making humans potential vectors if they are exposed. In addition, the ability for FMDV to be spread by fomites and with the large human population in the area, the ability for the FMDV to spread over large areas exists if contaminated individuals or animals can get off of the island. The consequences of a large release of FMD virions would be as severe as that of RVFV or Nipah virus in this area but less than that for the other five proposed sites.

Site-Specific Consequences for RVFV

RVFV is an acute mosquito-borne (vector-based) viral disease affecting mainly ruminants (e.g., cattle, sheep, deer) and humans. In animals, RVF causes abortions and high mortality in young. In humans, RVF causes severe influenza-like syndrome. The area around the Plum Island Site could provide an environment for RVFV to be transmitted once released; however, with the limitations afforded by the open water, the chances of spreading the disease are less than for the other five proposed NBAF sites. The inhalation pathway to humans and wind-borne dispersal of infected vectors can transmit RVFV and infected livestock and people movement are a means of spreading RVFV. Mosquitoes are a reservoir for RVFV, and the virus can remain dormant in the eggs of the mosquito in dry soil of grassland depressions. With adequate rainfall, the infected mosquitoes could develop and infect ruminants. The virus can be spread by many mosquito species. The consequences of a large release of RVF virions would be as severe as that of FMDV or Nipah virus in this area but less than that for the other five proposed sites.

Site-Specific Consequences for Nipah Virus

In pigs, the Nipah virus appears to cause a high rate of febrile illness but a low rate of sickness and death, yet it can appear as sudden death syndrome in mature swine. In humans, Nipah virus is characterized by severe febrile encephalitis, fever, headache, dizziness, and vomiting with a high mortality rate. The host range of Nipah virus is in pigs, cats, dogs, and possible in horses and goats. Even though Nipah virus is transmitted by direct contact with bodily fluids, mechanical transmission, and aerosol transmission, there is little opportunity for the Nipah virus to spread off of the island. The consequences of a large release of Nipah virions would be as severe as that of RVFV or FMDV in this area but less than that for the other five proposed sites.

The final risk rank for the mitigated accident scenarios for the proposed NBAF Plum Island Site is III (none) for all accidents except over-pressure and fire, which are designated as II (moderate) for distances close to the release. Given the low likelihood of infected animals or vectors getting off of the island, thereby significantly reducing the potential for the spread of disease, the overall risk for the Plum Island Site is designated as III (low or none).

Table 3.14.4.4-3 — Mitigated Accident Specific Air Concentration (virions/m^3) Plum Island Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.6E-01	1.6E+00	0.0	0.0	1.6E+03	4.8E+04	1.6E+01	0.0
200	1.6E-02	1.6E-01	0.0	0.0	1.6E+02	4.7E+03	1.6E+00	0.0
400	5.4E-03	5.4E-02	0.0	0.0	5.4E+01	1.6E+03	5.4E-01	0.0
600	2.9E-03	2.9E-02	0.0	0.0	2.9E+01	8.7E+02	2.9E-01	0.0
800	1.9E-03	1.9E-02	0.0	0.0	1.9E+01	5.6E+02	1.9E-01	0.0
1,000	1.4E-03	1.4E-02	0.0	0.0	1.4E+01	4.1E+02	1.4E-01	0.0
2,000	4.8E-04	4.8E-03	0.0	0.0	4.8E+00	1.4E+02	4.8E-02	0.0
4,000	1.7E-04	1.7E-03	0.0	0.0	1.7E+00	5.0E+01	1.7E-02	0.0
6,000	9.1E-05	9.1E-04	0.0	0.0	9.1E-01	2.7E+01	9.1E-03	0.0
8,000	5.9E-05	5.9E-04	0.0	0.0	5.9E-01	1.8E+01	5.9E-03	0.0
10,000	3.0E-05	3.0E-04	0.0	0.0	3.0E-01	9.0E+00	3.0E-03	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

Table 3.14.4.4-4 — Mitigated Accident Specific Ground Concentration (virions/m^2) Plum Island Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	2.4E-04	2.4E-03	0.0	0.0	2.4E+00	7.2E+01	2.4E-02	0.0
200	3.2E-05	3.2E-04	0.0	0.0	3.2E-01	9.6E+00	3.2E-03	0.0
400	1.2E-05	1.2E-04	0.0	0.0	1.2E-01	3.7E+00	1.2E-03	0.0
600	6.9E-06	6.9E-05	0.0	0.0	6.9E-02	2.1E+00	6.9E-04	0.0
800	3.8E-06	3.8E-05	0.0	0.0	3.8E-02	1.1E+00	3.8E-04	0.0
1,000	3.0E-06	3.0E-05	0.0	0.0	3.0E-02	9.0E-01	3.0E-04	0.0
2,000	3.3E-07	3.3E-06	0.0	0.0	3.3E-03	9.8E-02	3.3E-05	0.0
4,000	8.5E-08	8.5E-07	0.0	0.0	8.5E-04	2.5E-02	8.5E-06	0.0
6,000	3.1E-08	3.1E-07	0.0	0.0	3.1E-04	9.4E-03	3.1E-06	0.0
8,000	2.8E-08	2.8E-07	0.0	0.0	2.8E-04	8.5E-03	2.8E-06	0.0
10,000	1.9E-08	1.9E-07	0.0	0.0	1.9E-04	5.7E-03	1.9E-06	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

3.14.4.5 Umstead Research Farm Site

Site-specific consequences for the proposed Umstead Research Farm Site are depicted in terms of the accidents postulated in Section 3.14.3. Each of the accidents has the potential to release pathogens to the environment. Because of the differences in topography, weather, and agricultural uses near each site, the consequences are presented individually for each proposed site. In the case of the Umstead Research Farm Site, the site-specific atmospheric data were used to provide estimates of time-integrated down-wind air and ground concentrations that could result in the event of a release as postulated in the accidents.

To assess the site-specific consequences from the postulated bounding accidents, it is first necessary to evaluate the results of the transport modeling and the development of specific air and ground concentrations of viral pathogens estimated to have been released in each accident. Figure 3.14.4.5-1 illustrates the near-field effects of a potential release and the subsequent down-wind transport in air along with the deposition onto the ground as a result of settling or washout (NUREG 3332). The radial symmetry in figure 3.14.5.1-1 and 3.14.5.1-2 are for illustration purposes only. This shows the chosen boundary location as an estimate of down-wind normalized 95th percentile air-concentrations; this figure does not reflect an actual down-wind plume result. Tables 3.14.4.5-1 and 3.14.4.5-2 present the resultant air and ground concentrations for each unmitigated accident at specific radial distances. The combination of these concentration tables and the figures representing the near- and far-field results provides the basis for evaluating the impacts to the population and environment after a hypothetical release at the proposed North Carolina NBAF site.

The normalized air concentrations for the North Carolina site range from 7.8×10^{-3} at distances of 200 m to 6.7×10^{-4} at a distance of 1,000 m (1 km) from a release. The ground concentrations for these same radial distances range from a high of 1.7×10^{-5} to a low of 2.3×10^{-6}. Taking into consideration the source terms for each of the specific accidents, the normalized air and ground concentration values represent the potential for significant concentrations in the air and on the ground for the more significant accidents such as over-pressure, seismic, and fire events.

As with the previous discussion, the majority of the NBAF would be within the 200-m radial distance. Significant releases of pathogens from the NBAF as a result of accidents could be expected to occur only from the higher biocontainment areas. The site boundary would be located at approximately 250 m from the center of the NBAF. For the purposes of the analysis, it is assumed that distances past 200 m essentially represents an off-site release. Section 3.8.7.1.1 presents the discussion of the vegetation in the vicinity of the proposed NBAF site. The area outside of the immediate area of the NBAF site is characterized as recovering clear-cut forest area. At greater distances the vegetation includes wooded forestland with numerous lakes, streams or rivers, and wetlands. In addition, there are large agricultural areas for crops and grazing.

Section 3.8.7.1.4 presents the terrestrial wildlife in the vicinity of the proposed Umstead Research Farm Site. Numerous species of mammals, birds, reptiles, and insects (mosquitoes and ticks) inhabit the area around the proposed site. Mammals include both white tail deer and grey fox. Within 3 km of the proposed site are significant areas of industrial and residential development. Section 3.8.7.1.4 presents the terrestrial wildlife in the vicinity of the proposed Umstead Research Farm Site. Numerous species of mammals, birds, reptiles, and insects (mosquitoes and ticks) inhabit the area around the proposed site. Major mammals include white tail deer and coyote. The wildlife and livestock in the vicinity of the site are prime candidates for acquiring or transmitting the FMD and RVFV and to some extent the Nipah virus when pigs are present. While the FMDV, RVFV, and Nipah virus each have different characteristics related to transmission and viability, the unmitigated concentrations near the facility are potentially significant.

The location of the proposed NBAF Umstead Research Farm Site provides a significant opportunity for the spread of viruses via vectors and infected wildlife. In addition, the atmospheric modeling indicates that down-wind transport is a credible scenario given a sufficiently large release of pathogens.

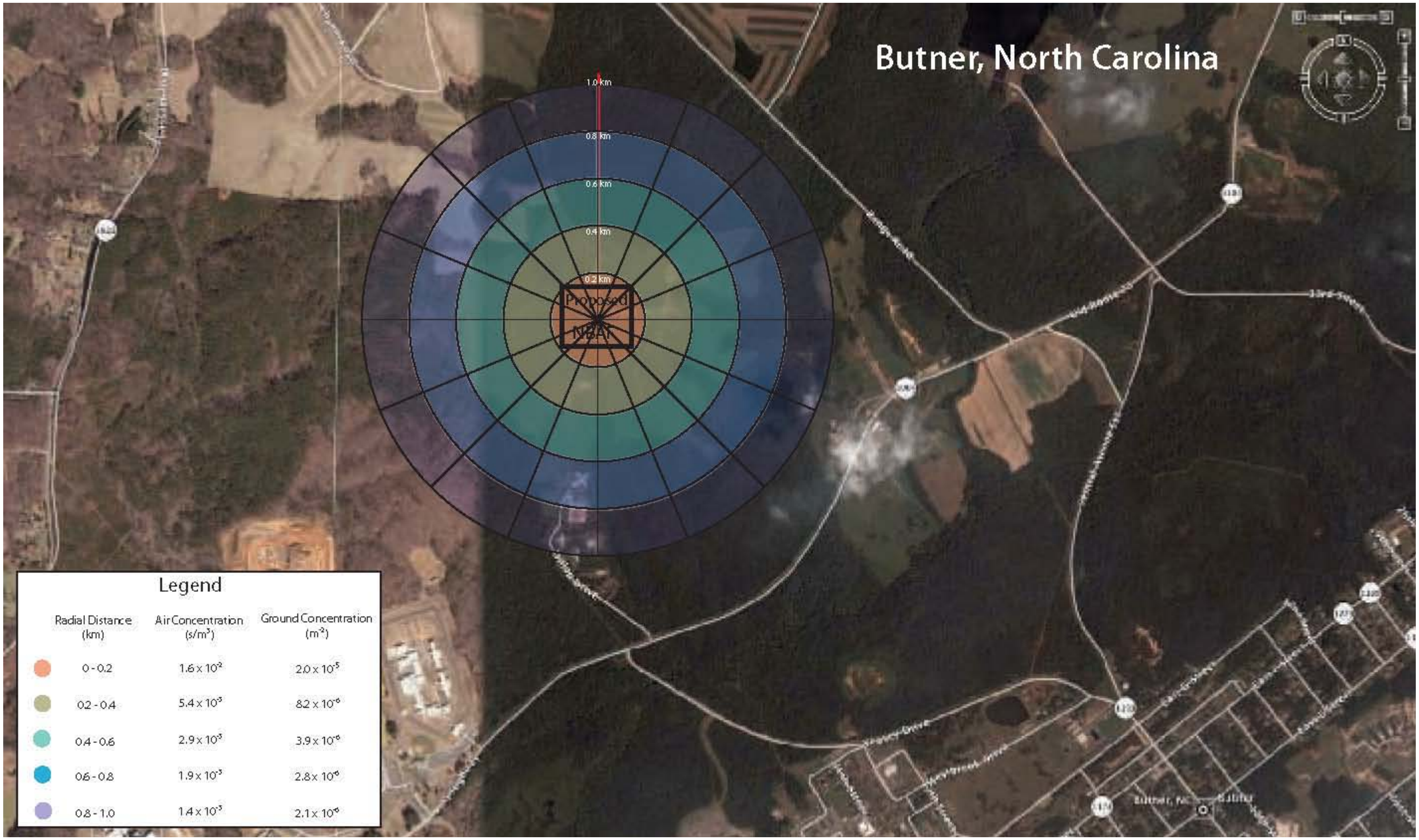
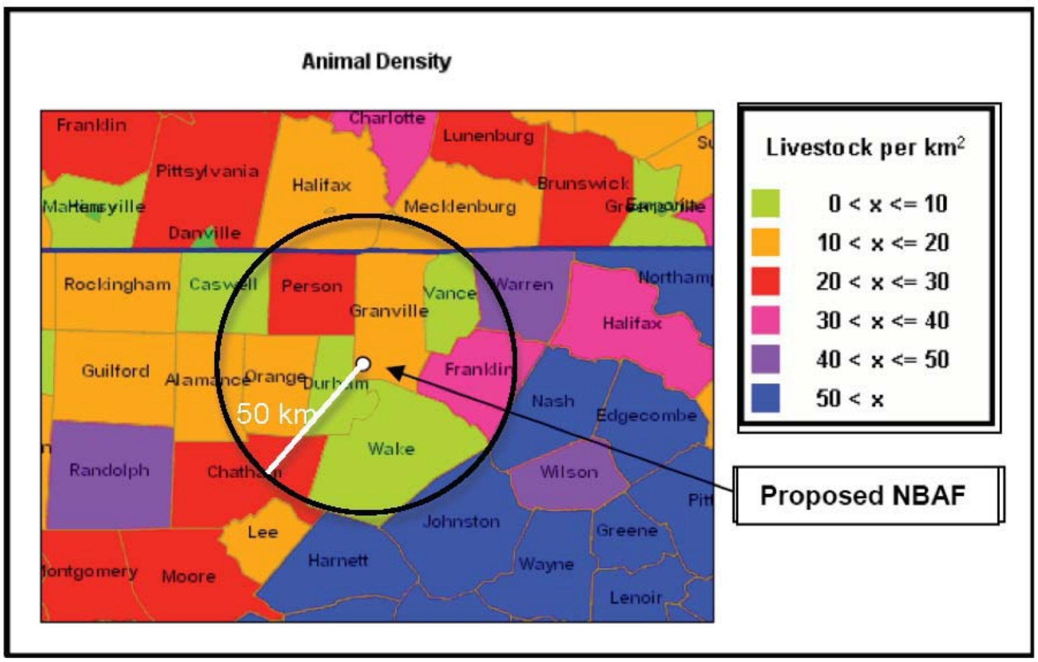


Figure 3.14.4.5-1 — Near Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

For this site, as with all of the sites except the Plum Island Site there is a potential for viral pathogens to be transported significant distances by the wind. The results of the modeling indicate that this transport pathway is not limited (Figure 3.14.4.5-2), as was the case for Plum Island. It is considered likely that deer could act to spread disease over long distances. In addition, common vectors such as mosquitoes can be transported long distances.

The potential for acquiring and spreading diseases from the FMDV, RVFV, and Nipah virus is also illustrated by consideration of the livestock in the vicinity of the proposed Umstead Research Farm Site. The counties surrounding the proposed NBAF Umstead Research Farm Site contain significant numbers of livestock potentially exposed in the event of a release. Data related to the distribution of livestock in the vicinity of the NBAF were obtained from a DHS tasking response dated August 6, 2007. Data were collected related to livestock in the areas of the proposed NBAF sites to support the determination as to whether accidental laboratory release at these locations could have the potential to affect nearby livestock (DHS 2007). The normalized concentrations presented in Figure 3.14.4.3-2 up to distances of 10 km from the proposed NBAF are fully contained by Durham and Granville counties. Data provided on livestock density indicate that there is on the order of 0 to 30 livestock, mostly cattle, per square kilometer in this area.

County & Surrounding Counties	Number of Herds	Number of Livestock
Granville	301	16674
Halifax, VA	460	31693
Mecklenburg, VA	355	24054
Person	197	22583
Durham	101	4611
Wake	270	13835
Franklin	238	40263
Vance	77	2346
	1999	**156059**



Livestock Proximal to the North Carolina Site

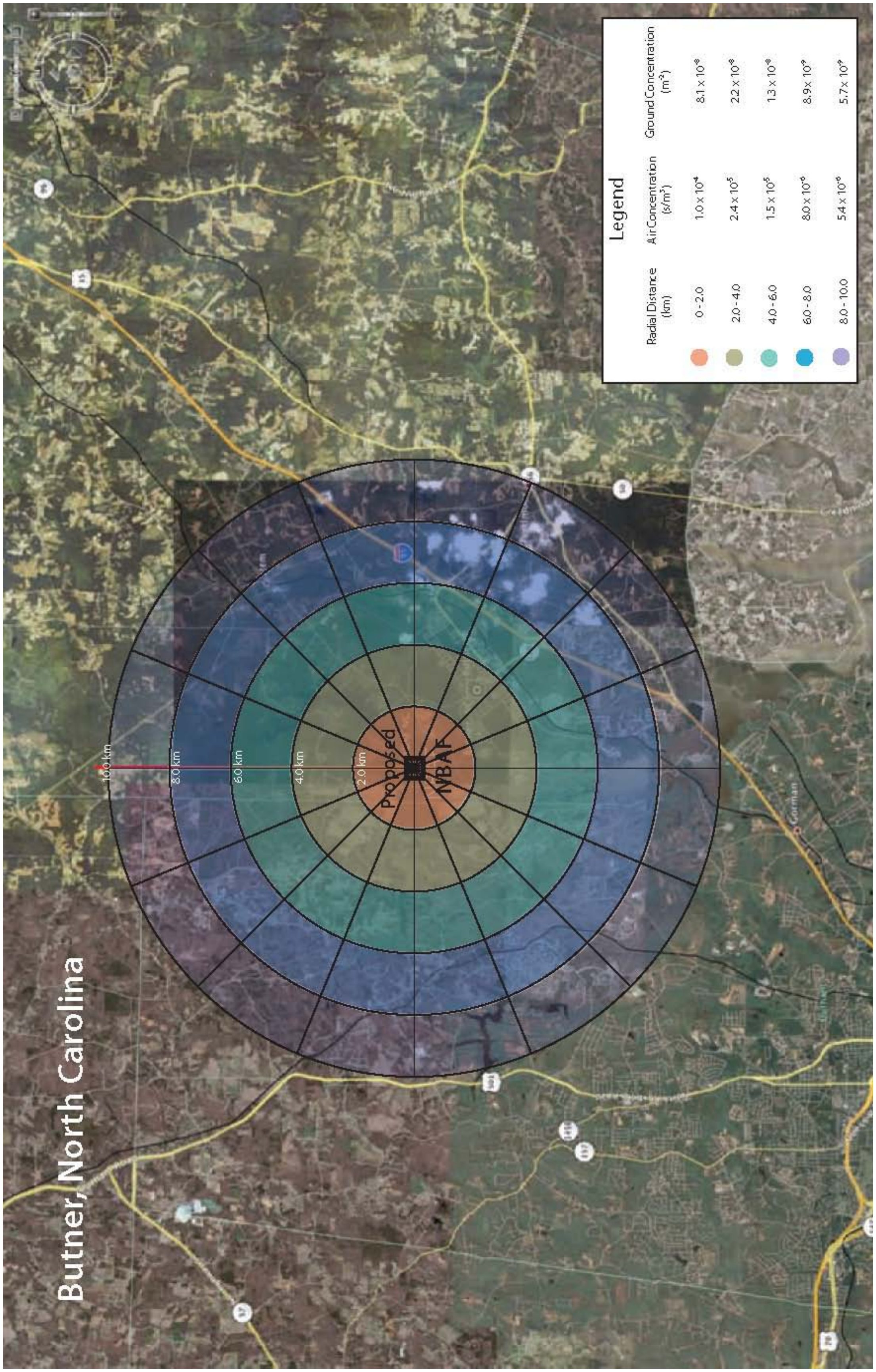


Figure 3.14.4.5-2 — Far Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

Table 3.14.4.5-1 — Unmitigated Accident Specific Air Concentration (virions/m^3) Umstead Research Farm Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	8.1E-02	8.1E+04	8.1E+08	8.1E+03	8.1E+07	2.4E+09	8.1E+09	2.4E+07
200	7.8E-03	7.8E+03	7.8E+07	7.8E+02	7.8E+06	2.3E+08	7.8E+08	2.3E+06
400	2.7E-03	2.7E+03	2.7E+07	2.7E+02	2.7E+06	8.0E+07	2.7E+08	8.0E+05
600	1.4E-03	1.4E+03	1.4E+07	1.4E+02	1.4E+06	4.3E+07	1.4E+08	4.3E+05
800	9.3E-04	9.3E+02	9.3E+06	9.3E+01	9.3E+05	2.8E+07	9.3E+07	2.8E+05
1,000	6.7E-04	6.7E+02	6.7E+06	6.7E+01	6.7E+05	2.0E+07	6.7E+07	2.0E+05
2,000	1.0E-04	1.0E+02	1.0E+06	1.0E+01	1.0E+05	3.0E+06	1.0E+07	3.0E+04
4,000	2.4E-05	2.4E+01	2.4E+05	2.4E+00	2.4E+04	7.3E+05	2.4E+06	7.3E+03
6,000	1.5E-05	1.5E+01	1.5E+05	1.5E+00	1.5E+04	4.4E+05	1.5E+06	4.4E+03
8,000	8.0E-06	8.0E+00	8.0E+04	8.0E-01	8.0E+03	2.4E+05	8.0E+05	2.4E+03
10,000	5.4E-06	5.4E+00	5.4E+04	5.4E-01	5.4E+03	1.6E+05	5.4E+05	1.6E+03

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.
[a]Source Term = MAR * ARF * RF * DR * LPF

Table 3.14.4.5-2 — Unmitigated Accident Specific Ground Concentration (virions/m2) Umstead Research Farm Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% ($1/m^2$)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	1.0E-04	1.0E+02	1.0E+06	1.0E+01	1.0E+05	3.0E+06	1.0E+07	3.0E+04
200	1.7E-05	1.7E+01	1.7E+05	1.7E+00	1.7E+04	5.2E+05	1.7E+06	5.2E+03
400	7.4E-04	7.4E+02	7.4E+06	7.4E+01	7.4E+05	2.2E+07	7.4E+07	2.2E+05
600	4.5E-06	4.5E+00	4.5E+04	4.5E-01	4.5E+03	1.3E+05	4.5E+05	1.3E+03
800	2.9E-06	2.9E+00	2.9E+04	2.9E-01	2.9E+03	8.7E+04	2.9E+05	8.7E+02
1,000	2.3E-06	2.3E+00	2.3E+04	2.3E-01	2.3E+03	7.0E+04	2.3E+05	7.0E+02
2,000	8.1E-08	8.1E-02	8.1E+02	8.1E-03	8.1E+01	2.4E+03	8.1E+03	2.4E+01
4,000	2.2E-08	2.2E-02	2.2E+02	2.2E-03	2.2E+01	6.5E+02	2.2E+03	6.5E+00
6,000	1.3E-08	1.3E-02	1.3E+02	1.3E-03	1.3E+01	3.9E+02	1.3E+03	3.9E+00
8,000	8.9E-09	8.9E-03	8.9E+01	8.9E-04	8.9E+00	2.7E+02	8.9E+02	2.7E+00
10,000	5.7E-09	5.7E-03	5.7E+01	5.7E-04	5.7E+00	1.7E+02	5.7E+02	1.7E+00

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Source Term = MAR * ARF * RF * DR * LPF

The area within a 5-km radius of the proposed NBAF would be approximately 78.5 km^2 and could be fewer than 1,000 cattle. For the unmitigated accidents, concentrations on the order of 1×10^4 or greater occur at distances greater than 5 km for the high source term accidents. At relatively close proximity to the site (less than 1 km), the unmitigated concentrations in the air and on the ground show the potential for a large number of infections from any of the three viruses. The number of livestock outside of the 5-km radius increases to as many as 156,000 animals, which are at risk from the postulated unmitigated releases.

The far-field distribution of viral pathogens via air transport, in terms of normalized time-integrated air and ground concentrations falls off sharply with distance. The normalized air concentration falls to less than 1×10^{-4} s/m^3 at distances greater than 2 km. At these distances, the quantity of material released would need to be much greater than 1×10^3 (1,000 virions) before there is a significant potential for an infection to result. The normalized air concentration falls off by nearly two orders of magnitude at a distance of 10 km.

Tables 3.14.4.5-3 and 3.14.4.5-4 present the accident-specific air and ground concentrations for the mitigated scenarios. It is evident from the mitigated air concentration results and a cow's breathing rate of 1.6×10^{-3} m^3/s that only the significant accidents of a large facility fire or an over-pressure event (deflagration) are considered to have a potential for resulting in an infection after a release. In the event that either of these accidents occurs, the mitigated results show that the elevated air concentrations are limited to distances less than 400 m, indicating that the viral pathogens will not be transported in significant quantities far from the site. This result illustrates the localized effects of the mitigated accidents. In a similar manner, the ground concentrations are limited to short distances from the release point. Taking into consideration that a cow would cover a 30-m^2 area in a single day, the resultant dose would be less than the MID (10 virions) at distances greater than 2 km. Emergency planning and rapid response to a possible release will afford an opportunity to mitigate the consequences of the postulated accidents.

The accident analysis conservatively estimates a final mitigated source term of 3×10^5 virions for the over-pressure event and 1×10^4 virions for the large fire. The risk values indicated that the higher efficiency HEPAs, NBAF structure, fire suppression system, and other appropriate controls were sufficient to mitigate or prevent the accidents. In addition, the release of contaminated wastes and the loss of an infected animal were assigned site-independent risk ranks of 3, indicating that additional controls should be considered to effectively reduce the likelihood of the accident. The consequences in these two scenarios were assigned public severity category D based on the accident being prevented. The effectiveness of the sterilization of wastes and the biocontainment of the animals were the primary controls. In the event this accident occurs, there is a good chance that the viruses will not be contained without timely emergency response.

Site-Specific Consequences for FMDV

FMDV spreads quickly through herds and flocks of susceptible animals. With an incubation period of as little as 12 hours, the disease can spread quite rapidly. Cattle are often considered to act as indicators because of the low infectious dose, sheep act as maintenance hosts, and swine act as amplifiers of FMDV. The livestock and wildlife (deer and boar) in the vicinity of the North Carolina site provides ample opportunity for FMDV to establish in the environment upon a release. FMDV can persist in the human upper respiratory tract for up to 48 hours, making humans potential vectors if they are exposed. In addition, the ability for FMDV to be spread by fomites and with the large human population in the area, the ability for the FMDV to spread over large areas also exists. The consequences of a large release of FMD virions would be as severe as that of RVFV or Nipah virus in this area.

Site-Specific Consequences for RVFV

RVFV is an acute mosquito-borne (vector-based) viral disease affecting mainly ruminants (e.g., cattle, sheep, deer) and humans. In animals, RVF causes abortions and high mortality in young. In humans, RVF causes severe influenza-like syndrome. The area around the Umstead Research Farm Site would provide an environment for RVFV to be easily transmitted once released. The inhalation pathway to humans and wind-borne dispersal of infected vectors can transmit RVFV, and infected livestock and people movement are a means of spreading RVFV. Mosquitoes are a reservoir for RVFV and the virus can remain dormant in the eggs of the mosquito in dry soil of grassland depressions. With adequate rainfall, the infected mosquitoes could develop and infect ruminants. The virus can be spread by many mosquito species. The consequences of a large release of RVF virions would be as severe as that of FMDV or Nipah virus in this area.

Site-Specific Consequences for Nipah Virus

In pigs, the Nipah virus appears to cause a high rate of febrile illness but a low rate of sickness and death, yet it can appear as sudden death syndrome in mature swine. In humans, Nipah virus is characterized by severe febrile encephalitis, fever, headache, dizziness, and vomiting with a high mortality rate. The host range of Nipah virus is in pigs, cats, dogs, and possible in horses and goats. Because Nipah virus is transmitted by direct contact with of bodily fluids, mechanical transmission, and aerosol transmission, there is substantial opportunity for the Nipah virus to spread in the area. The consequences of a large release of Nipah virions would be as severe as that of RVFV or FMDV in this area.

The final risk rank for the mitigated accident scenarios for the proposed NBAF Umstead Research Farm Site is III (none) for all accidents except over-pressure and fire, which are designated as risk rank II (moderate) for distances close to the release. Because of the potential for easy spread of FMDV, RVFV, and Nipah virus diseases via infected livestock, wildlife, and vectors, the overall risk for the Umstead Research Farm Site is designated as risk rank II (moderate).

Table 3.14.4.5-3 — Mitigated Accident Specific Air Concentration (virions/m^3) Umstead Research Farm Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	8.1E-02	8.1E-01	0.0	0.0	8.1E+02	2.4E+04	8.1E+00	0.0
200	7.8E-03	7.8E-02	0.0	0.0	7.8E+01	2.3E+03	7.8E-01	0.0
400	2.7E-03	2.7E-02	0.0	0.0	2.7E+01	8.0E+02	2.7E-01	0.0
600	1.4E-03	1.4E-02	0.0	0.0	1.4E+01	4.3E+02	1.4E-01	0.0
800	9.3E-04	9.3E-03	0.0	0.0	9.3E+00	2.8E+02	9.3E-02	0.0
1,000	6.7E-04	6.7E-03	0.0	0.0	6.7E+00	2.0E+02	6.7E-02	0.0
2,000	1.0E-04	1.0E-03	0.0	0.0	1.0E+00	3.0E+01	1.0E-02	0.0
4,000	2.4E-05	2.4E-04	0.0	0.0	2.4E-01	7.3E+00	2.4E-03	0.0
6,000	1.5E-05	1.5E-04	0.0	0.0	1.5E-01	4.4E+00	1.5E-03	0.0
8,000	8.0E-06	8.0E-05	0.0	0.0	8.0E-02	2.4E+00	8.0E-04	0.0
10,000	5.4E-06	5.4E-05	0.0	0.0	5.4E-02	1.6E+00	5.4E-04	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

Table 3.14.4.5-4 — Mitigated Accident Specific Air Concentration (virions/m^3) Umstead Research Farm Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.0E-04	1.0E-03	0.0	0.0	1.0E+00	3.0E+01	1.0E-02	0.0
200	1.7E-05	1.7E-04	0.0	0.0	1.7E-01	5.2E+00	1.7E-03	0.0
400	7.4E-04	7.4E-03	0.0	0.0	7.4E+00	2.2E+02	7.4E-02	0.0
600	4.5E-06	4.5E-05	0.0	0.0	4.5E-02	1.3E+00	4.5E-04	0.0
800	2.9E-06	2.9E-05	0.0	0.0	2.9E-02	8.7E-01	2.9E-04	0.0
1,000	2.3E-06	2.3E-05	0.0	0.0	2.3E-02	7.0E-01	2.3E-04	0.0
2,000	8.1E-08	8.1E-07	0.0	0.0	8.1E-04	2.4E-02	8.1E-06	0.0
4,000	2.2E-08	2.2E-07	0.0	0.0	2.2E-04	6.5E-03	2.2E-06	0.0
6,000	1.3E-08	1.3E-07	0.0	0.0	1.3E-04	3.9E-03	1.3E-06	0.0
8,000	8.9E-09	8.9E-08	0.0	0.0	8.9E-05	2.7E-03	8.9E-07	0.0
10,000	5.7E-09	5.7E-08	0.0	0.0	5.7E-05	1.7E-03	5.7E-07	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

3.14.4.6 Texas Research Park Site

Site-specific consequences for the proposed Texas Research Park Site, located near the city of San Antonio, are depicted in terms of the accidents postulated in Section 3.14.3. Each of the accidents has the potential to release pathogens to the environment. Because of the differences in topography, weather, and agricultural uses near each site, the consequences are presented individually for each proposed site. In the case of the Texas Research Park Site, the site-specific atmospheric data were used to provide estimates of time-integrated down-wind air and ground concentrations that could result in the event of a release as postulated in the accidents.

To assess the site-specific consequences from the postulated bounding accidents, it is first necessary to evaluate the results of the transport modeling and the development of specific air and ground concentrations of viral pathogens estimated to have been released in each accident. Figure 3.14.4.4-1 illustrates the near-field effects of a potential release and the subsequent down-wind transport in air along with the deposition onto the ground as a result of settling or washout (NUREG 3332). The radial symmetry in figure 3.14.4.6-1 and 3.14.4.6-2 are for illustration purposes only. This shows the chosen boundary location as an estimate of down-wind normalized 95th percentile air-concentrations; this figure does not reflect an actual down-wind plume result. Tables 3.14.4.6-1 and 3.14.4.6-2 present the resultant air and ground concentrations for each unmitigated accident at specific radial distances. The combination of these concentrations tables and the figures representing the near- and far-field results provides the basis for evaluating the impacts to the population and environment after a hypothetical release at the proposed Texas Research Park Site.

The normalized air concentrations for the San Antonio, Texas, site range from 1.6×10^{-2} at distances of 200 m to 1.4×10^{-3} at a distance of 1,000 m (1 km) from a release. The ground concentrations for these same radial distances range from a high of 2.0×10^{-5} to a low of 2.1×10^{-6}. Taking into consideration the source terms for each of the specific accidents, the normalized air and ground concentration values represent the potential for significant concentrations in the air and on the ground for the more significant accidents such as over-pressure, seismic, and fire events.

As with the previous discussion, the majority of the NBAF would be within the 200-m radial distance. Significant releases of pathogens from the NBAF as a result of accidents could be expected to occur only from the higher biocontainment areas. The site boundary would be located at approximately 250 m from the center of the NBAF. For the purposes of the analysis, it is assumed that distances past 200 m essentially represents an off-site release. Section 3.8.8.1.1 presents the discussion of the vegetation in the vicinity of the proposed NBAF site. In the general area in and around the proposed NBAF site, the vegetation is predominantly prairie grassland typical of the southwestern United States with wooded areas that are generally scrubby. The area contains few water sources within 10 km of the site and essentially no wetlands. Within the immediate area of the site is mainly disturbed pastureland, currently used for grazing livestock, and a significant presence of industrial and residential areas.

Section 3.8.4.1.4 presents the terrestrial wildlife in the vicinity of the proposed Texas Research Park Site. Numerous species of mammals, birds, reptiles, and insects (mosquitoes and ticks) inhabit the area around the proposed site. Major mammals include white tail deer and coyote. The wildlife and livestock in the vicinity of the site are prime candidates for acquiring or transmitting the FMD and RVFV and to some extent the Nipah virus when pigs are present. While the FMDV, RVFV, and Nipah virus each have different characteristics related to transmission and viability, the unmitigated concentrations near the facility are potentially significant.

The location of the proposed NBAF Texas Research Park Site provides a significant opportunity for the spread of viruses via vectors and infected wildlife. In addition, the atmospheric modeling indicates that down-wind transport is a credible scenario given a sufficiently large release of pathogens.

For this site, as with all of the sites except the Plum Island Site there is a potential for viral pathogens to be transported significant distances by the wind. The results of the modeling indicate that this transport pathway is not limited (Figure 3.14.4.6-2), as was the case for Plum Island. It is considered likely that deer could act to spread disease over long distances. In addition, common vectors such as mosquitoes can be transported long distances.

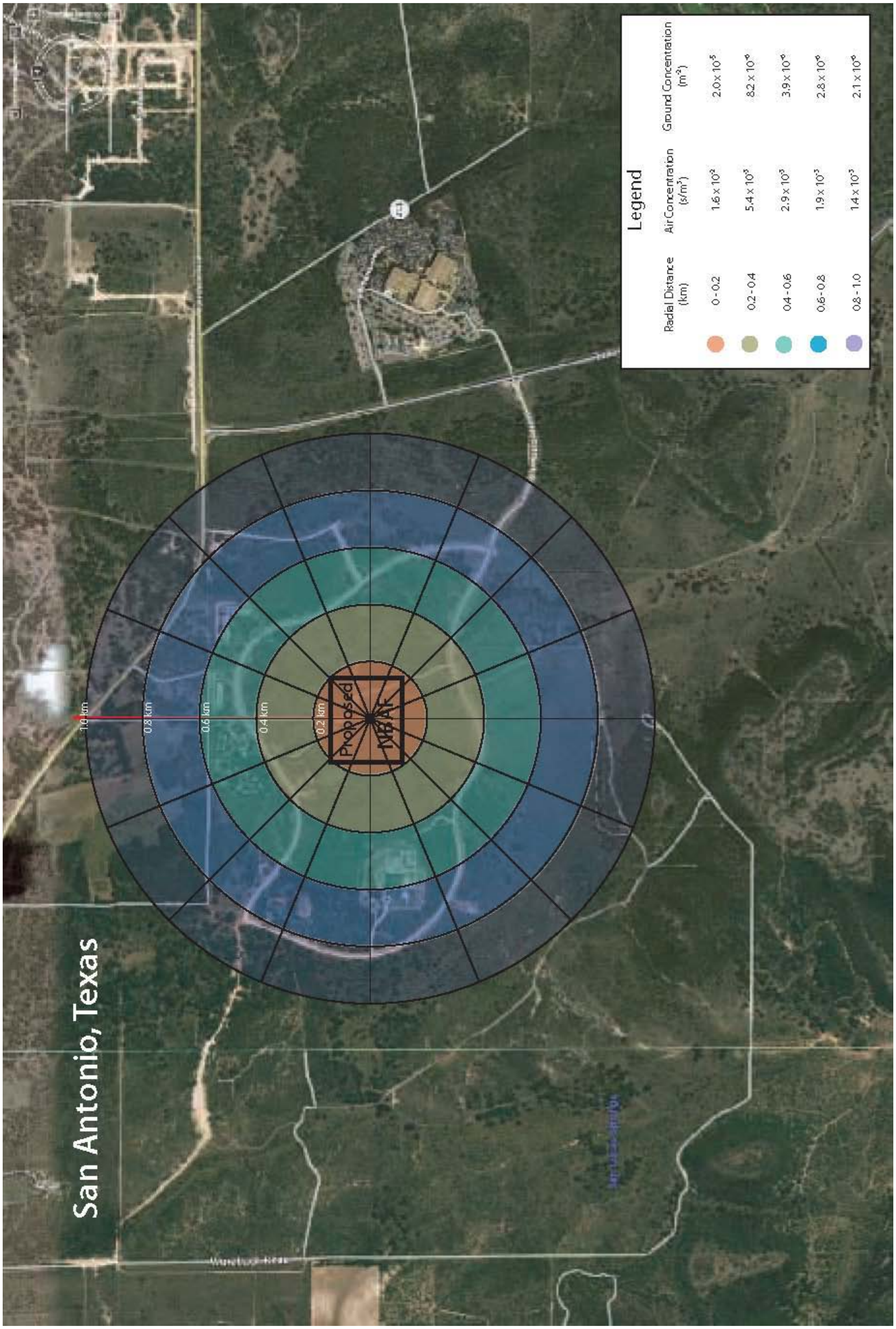


Figure 3.14.4.6-1 — Near Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

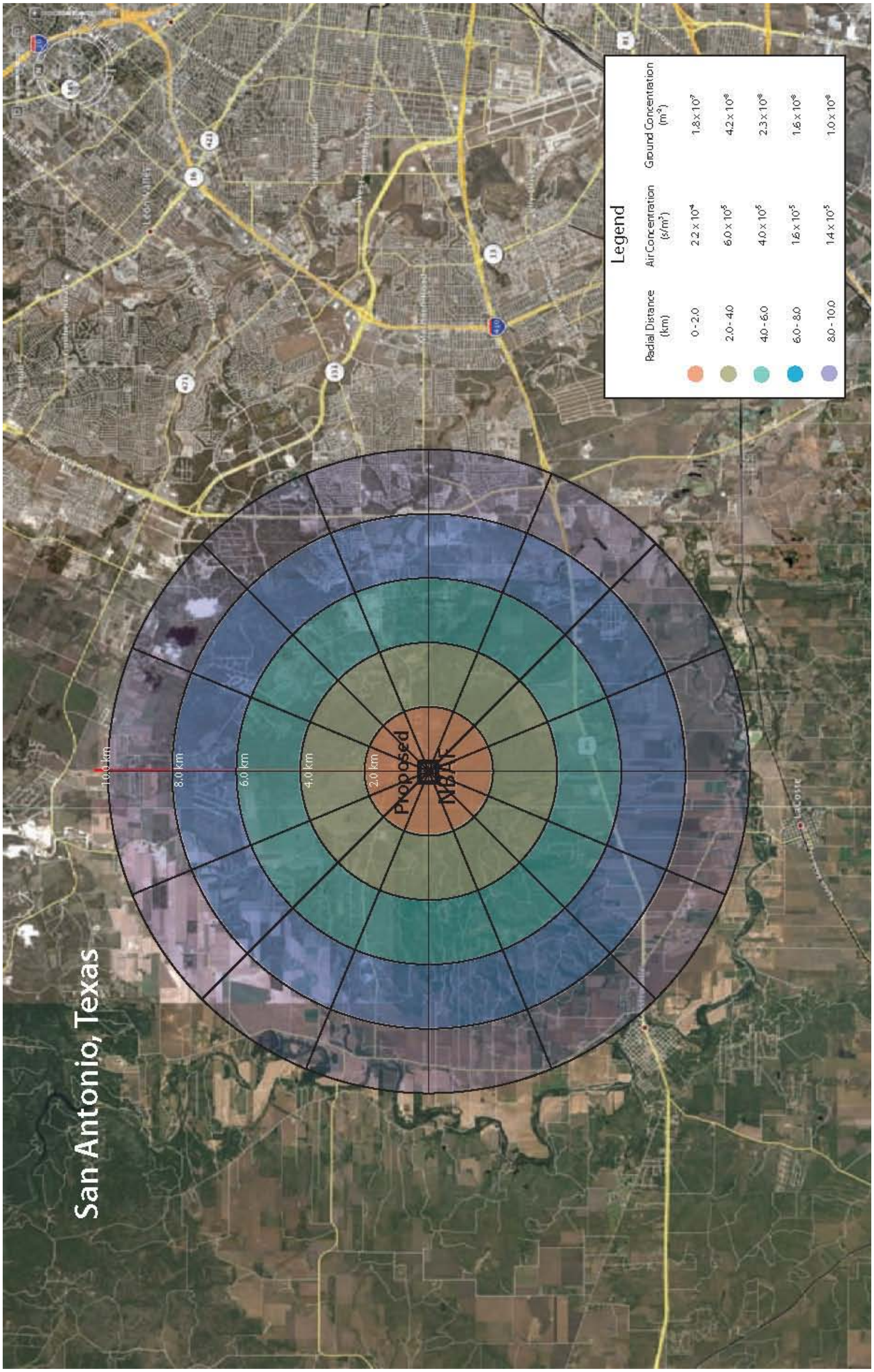


Figure 3.14.4.6-2 — Far Field Distribution of Viral Pathogens Based On Time-Integrated Atmospheric Transport

Table 3.14.4.6-1 — Unmitigated Accident Specific Air Concentration (virions/m^3) Texas Research Park Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	1.6E-01	1.6E+05	1.6E+09	1.6E+04	1.6E+08	4.8E+09	1.6E+10	4.8E+07
200	1.6E-02	1.6E+04	1.6E+08	1.6E+03	1.6E+07	4.7E+08	1.6E+09	4.7E+06
400	5.4E-03	5.4E+03	5.4E+07	5.4E+02	5.4E+06	1.6E+08	5.4E+08	1.6E+06
600	2.9E-03	2.9E+03	2.9E+07	2.9E+02	2.9E+06	8.7E+07	2.9E+08	8.7E+05
800	1.9E-03	1.9E+03	1.9E+07	1.9E+02	1.9E+06	5.6E+07	1.9E+08	5.6E+05
1,000	1.4E-03	1.4E+03	1.4E+07	1.4E+02	1.4E+06	4.1E+07	1.4E+08	4.1E+05
2,000	2.2E-04	2.2E+02	2.2E+06	2.2E+01	2.2E+05	6.7E+06	2.2E+07	6.7E+04
4,000	6.0E-05	6.0E+01	6.0E+05	6.0E+00	6.0E+04	1.8E+06	6.0E+06	1.8E+04
6,000	4.0E-05	4.0E+01	4.0E+05	4.0E+00	4.0E+04	1.2E+06	4.0E+06	1.2E+04
8,000	1.6E-05	1.6E+01	1.6E+05	1.6E+00	1.6E+04	4.9E+05	1.6E+06	4.9E+03
10,000	1.4E-05	1.4E+01	1.4E+05	1.4E+00	1.4E+04	4.1E+05	1.4E+06	4.1E+03

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Source Term = MAR * ARF * RF * DR * LPF

Table 3.14.4.6-2 — Unmitigated Accident Specific Ground Concentration (virions/m^2) Texas Research Park Site

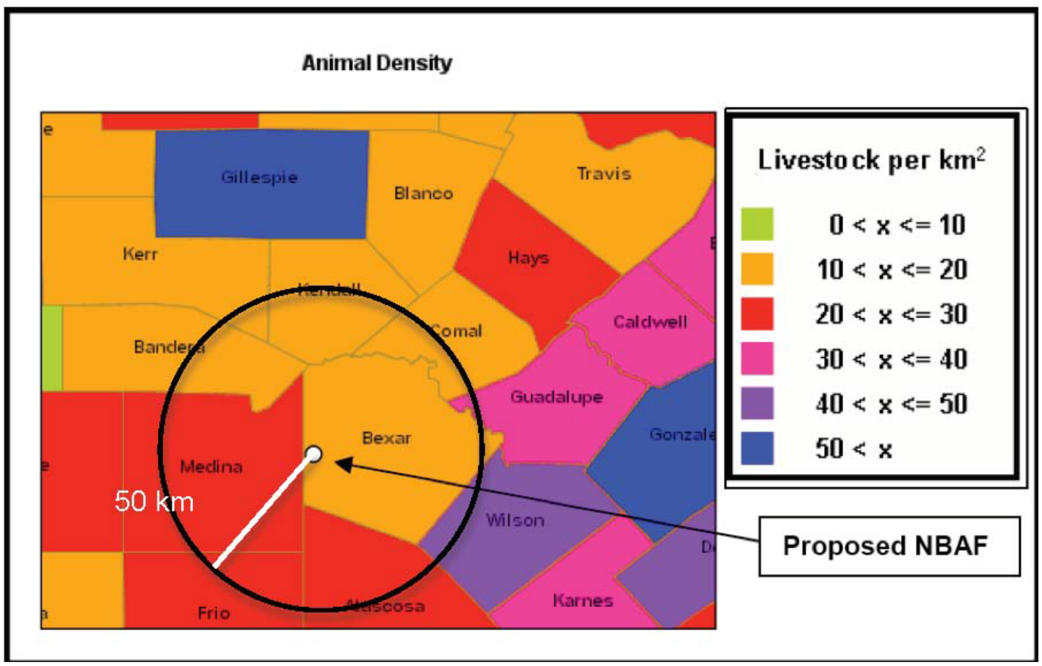
		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Unmitigated Source Term[a]						
		1.0E+06	1.0E+10	1.0E+05	1.0E+09	3.0E+10	1.0E+11	3.0E+08
50	1.6E-04	1.6E+02	1.6E+06	1.6E+01	1.6E+05	4.9E+06	1.6E+07	4.9E+04
200	2.0E-05	2.0E+01	2.0E+05	2.0E+00	2.0E+04	5.9E+05	2.0E+06	5.9E+03
400	8.2E-06	8.2E+00	8.2E+04	8.2E-01	8.2E+03	2.5E+05	8.2E+05	2.5E+03
600	3.9E-06	3.9E+00	3.9E+04	3.9E-01	3.9E+03	1.2E+05	3.9E+05	1.2E+03
800	2.8E-06	2.8E+00	2.8E+04	2.8E-01	2.8E+03	8.5E+04	2.8E+05	8.5E+02
1,000	2.1E-06	2.1E+00	2.1E+04	2.1E-01	2.1E+03	6.2E+04	2.1E+05	6.2E+02
2,000	1.8E-07	1.8E-01	1.8E+03	1.8E-02	1.8E+02	5.3E+03	1.8E+04	5.3E+01
4,000	4.2E-08	4.2E-02	4.2E+02	4.2E-03	4.2E+01	1.2E+03	4.2E+03	1.2E+01
6,000	2.3E-08	2.3E-02	2.3E+02	2.3E-03	2.3E+01	6.8E+02	2.3E+03	6.8E+00
8,000	1.6E-08	1.6E-02	1.6E+02	1.6E-03	1.6E+01	4.7E+02	1.6E+03	4.7E+00
10,000	1.0E-08	1.0E-02	1.0E+02	1.0E-03	1.0E+01	3.0E+02	1.0E+03	3.0E+00

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Source Term = MAR * ARF * RF * DR * LPF

The potential for acquiring and spreading diseases from the FMDV, RVFV, and Nipah virus is also illustrated by consideration of the livestock in the vicinity of the proposed Texas site. The counties surrounding the proposed NBAF Texas Research Park Site contain significant numbers of livestock potentially exposed in the event of a release. Data related to the distribution of livestock in the vicinity of the NBAF were obtained from a DHS tasking response dated August 6, 2007. Data were collected related to livestock in the areas of the proposed NBAF sites to support the determination as to whether accidental laboratory release at these locations could have the potential to affect nearby livestock (DHS 2007). The normalized concentrations presented in Figure 3.14.4.6-2 up to distances of 10 km from the proposed NBAF are fully contained by Bexar and Medina counties. Data provided on livestock density indicate that there is on the order of 10 to 30 livestock, mostly cattle, per square kilometer in this area.

County & Surrounding Counties	Number of Herds	Number of Livestock
Bexar	1823	58410
Kendall	815	33554
Bandera	630	23983
Medina	1529	73909
Atascosa	1344	92413
Wilson	1839	94654
Comal	684	18120
Guadalupe	1896	64846
	10560	**459889**



Livestock Proximal to the Texas Research Park Site

The area within a 5-km radius of the proposed NBAF would be approximately 78.5 km^2 and could comprise nearly 1,600 cattle. For the unmitigated accidents, concentrations on the order of 1×10^4 or greater occur at distances greater than 5 km for the high source term accidents. At relatively close proximity to the site (less than 1 km), the unmitigated concentrations in the air and on the ground show the potential for a large number of infections from any of the three viruses. The number of livestock outside of the 5-km radius increases significantly (>450,000 animals) and are at risk from the postulated unmitigated releases.

The far-field distribution of viral pathogens via air transport, in terms of normalized time-integrated air and ground concentrations, falls off sharply with distance. The normalized air concentration falls to less than 2×10^{-4} s/m^3 at distances greater than 2 km. At these distances, the quantity of material released would need to be much greater than 5×10^3 (5,000 virions) before there is a significant potential for an infection to result. The normalized air concentration falls off by nearly an order of magnitude at distance of 10 km.

Tables 3.14.4.6-3 and 3.14.4.6-4 present the accident-specific air and ground concentrations for the mitigated scenarios. It is evident from the mitigated air concentration results and a cow's breathing rate of 1.6×10^{-3} m^3/s that only the significant accidents of a large facility fire or an over-pressure event (deflagration) are considered to have a potential for resulting in an infection after a release. In the event that either of these accidents occurs, the mitigated results show that the elevated air concentrations are limited to distances less than 400 m, indicating that the viral pathogens will not be transported in significant quantities far from the site. This result illustrates the localized effects of the mitigated accidents. In a similar manner, the ground concentrations are limited to short distances from the release point. Taking into consideration that a cow would cover a 30-m^2 area in a single day, the resultant dose would be less than the MID (10 virions) at distances greater than 2 km. Emergency planning and rapid response to a possible release will afford an opportunity to mitigate the consequences of the postulated accidents.

The accident analysis conservatively estimates a final mitigated source term of 3×10^5 virions for the over-pressure event and 1×10^4 virions for the large fire. The risk values indicated that the higher efficiency HEPAs, NBAF structure, fire suppression system, and other appropriate controls were sufficient to mitigate or prevent the accidents. In addition, the release of contaminated wastes and the loss of an infected animal were assigned site-independent risk ranks of 3, indicating that additional controls should be considered to effectively reduce the likelihood of the accident. The consequences in these two scenarios were assigned public severity category D based on the accident being prevented. The effectiveness of the sterilization of wastes and the biocontainment of the animals were the primary controls. In the event this accident occurs, there is a good chance that the viruses will not be contained without timely emergency response.

Site-Specific Consequences for FMDV

FMDV spreads quickly through herds and flocks of susceptible animals. With an incubation period of as little as 12 hours, the disease can spread quite rapidly. Cattle are often considered to act as indicators because of the low infectious dose, sheep act as maintenance hosts, and swine act as amplifiers of FMDV. The livestock and wildlife (deer and boar) in the vicinity of the Texas site provides ample opportunity for FMDV to establish in the environment upon a release. FMDV can persist in the human upper respiratory tract for up to 48 hours, making humans potential vectors if they are exposed. In addition, the ability for FMDV to be spread by fomites and with the large human population in the area, the ability for the FMDV to spread over large areas also exists. The consequences of a large release of FMD virions would be as severe as that of RVFV or Nipah virus in this area.

Site-Specific Consequences for RVFV

RVFV is an acute mosquito-borne (vector-based) viral disease affecting mainly ruminants (e.g., cattle, sheep, deer) and humans. In animals, RVF causes abortions and high mortality in young. In humans, RVF causes severe influenza-like syndrome. The area around the Texas site would provide an environment for RVFV to be easily transmitted once released. The inhalation pathway to humans and wind-borne dispersal of infected vectors can transmit RVFV, and infected livestock and people movement are a means of spreading RVFV. Mosquitoes are a reservoir for RVFV, and the virus can remain dormant in the eggs of the mosquito in dry soil of grassland depressions. With adequate rainfall, the infected mosquitoes could develop and infect ruminants. The virus can be spread by many mosquito species. The consequences of a large release of RVF virions would be as severe as that of FMDV or Nipah virus in this area.

Site-Specific Consequences for Nipah Virus

In pigs, the Nipah virus appears to cause a high rate of febrile illness but a low rate of sickness and death, yet it can appear as sudden death syndrome in mature swine. In humans, Nipah virus is characterized by severe febrile encephalitis, fever, headache, dizziness, and vomiting with a high mortality rate. The host range of Nipah virus is in pigs, cats, dogs, and possible in horses and goats. Because Nipah virus is transmitted by direct contact with bodily fluids, mechanical transmission, and aerosol transmission, there is substantial opportunity for the Nipah virus to spread in the area. The consequences of a large release of Nipah virions would be as severe as that of RVFV or FMDV in this area.

The final risk rank for the mitigated accident scenarios for the proposed NBAF Texas Research Park Site is III (none) for all accidents except over-pressure and fire, which are designated as risk rank II (moderate) for distances close to the release. Because of the potential for easy spread of FMDV, RVFV, and Nipah virus diseases via infected livestock, wildlife, and vectors, the overall risk for the Texas Research Park Site is designated as risk rank II (moderate).

Table 3.14.4.6-3 — Mitigated Accident Specific Air Concentration (virions/m^3) Texas Research Park Site

		Accident Type						
Radial Distance (meters)	Normalized Air Concentration 95% χ/Q (s/m^3)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.6E-01	1.6E+00	0.0	0.0	1.6E+03	4.8E+04	1.6E+01	0.0
200	1.6E-02	1.6E-01	0.0	0.0	1.6E+02	4.7E+03	1.6E+00	0.0
400	5.4E-03	5.4E-02	0.0	0.0	5.4E+01	1.6E+03	5.4E-01	0.0
600	2.9E-03	2.9E-02	0.0	0.0	2.9E+01	8.7E+02	2.9E-01	0.0
800	1.9E-03	1.9E-02	0.0	0.0	1.9E+01	5.6E+02	1.9E-01	0.0
1,000	1.4E-03	1.4E-02	0.0	0.0	1.4E+01	4.1E+02	1.4E-01	0.0
2,000	2.2E-04	2.2E-03	0.0	0.0	2.2E+00	6.7E+01	2.2E-02	0.0
4,000	6.0E-05	6.0E-04	0.0	0.0	6.0E-01	1.8E+01	6.0E-03	0.0
6,000	4.0E-05	4.0E-04	0.0	0.0	4.0E-01	1.2E+01	4.0E-03	0.0
8,000	1.6E-05	1.6E-04	0.0	0.0	1.6E-01	4.9E+00	1.6E-03	0.0
10,000	1.4E-05	1.4E-04	0.0	0.0	1.4E-01	4.1E+00	1.4E-03	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

Table 3.14.4.6-4 — Mitigated Accident Specific Ground Concentration (virions/m^2) Texas Research Park Site

		Accident Type						
Radial Distance (meters)	Normalized Ground Concentration 95% (1/m^2)	Small-Medium Spill	Loss of Animal	Improper Sterilization	Large Room Fire	Over-Pressure Event	Seismic	Air craft crash
		Mitigated Source Term[a]						
		10	0	0	10,000	300,000	100	0
50	1.6E-04	1.6E-03	0.0	0.0	1.6E+00	4.9E+01	1.6E-02	0.0
200	2.0E-05	2.0E-04	0.0	0.0	2.0E-01	5.9E+00	2.0E-03	0.0
400	8.2E-06	8.2E-05	0.0	0.0	8.2E-02	2.5E+00	8.2E-04	0.0
600	3.9E-06	3.9E-05	0.0	0.0	3.9E-02	1.2E+00	3.9E-04	0.0
800	2.8E-06	2.8E-05	0.0	0.0	2.8E-02	8.5E-01	2.8E-04	0.0
1,000	2.1E-06	2.1E-05	0.0	0.0	2.1E-02	6.2E-01	2.1E-04	0.0
2,000	1.8E-07	1.8E-06	0.0	0.0	1.8E-03	5.3E-02	1.8E-05	0.0
4,000	4.2E-08	4.2E-07	0.0	0.0	4.2E-04	1.2E-02	4.2E-06	0.0
6,000	2.3E-08	2.3E-07	0.0	0.0	2.3E-04	6.8E-03	2.3E-06	0.0
8,000	1.6E-08	1.6E-07	0.0	0.0	1.6E-04	4.7E-03	1.6E-06	0.0
10,000	1.0E-08	1.0E-07	0.0	0.0	1.0E-04	3.0E-03	1.0E-06	0.0

Note: Scientific notation in this table, for example 5.4E+02, is also expressed as 5.4×10^2 where "E" represents power of 10.

[a]Mitigated Source Term = MAR * ARF * RF * DR * LPF reduced by application of safety controls (Primary and Secondary Barriers)

3.15 MITIGATION

This section discusses measures that could be used, or are already integral to the proposed alternatives, to mitigate (i.e., avoid or reduce) environmental impacts resulting from siting, constructing, and operating the proposed NBAF at one of the site alternatives. Mitigation, according to NEPA regulations (40 CFR 1508.20), includes

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- Compensating for the impact by replacing or providing substitute resources or environments.

All practicable means to avoid or minimize environmental harm from the selected alternative have been incorporated into the design of the NBAF. The evaluation for potential health and safety impacts during normal and abnormal operational phase of the proposed NBAF are specifically addressed in Section 3.14.

Under the No Action Alternative, no mitigation measures would be necessary since the NBAF would not be built. If the proposed NBAF is constructed at one of the six alternative sites, measures to mitigate potential environmental, socioeconomic, and health adverse impacts described in Chapter 3 are summarized in Table 3.15.1.

Table 3.15-1 — Summary of Potential Effects, Mitigation Measures, and Mechanisms for Implementation

Resource	Potential Effect	Mitigation Measure	Mechanism
Land Use and Visual Resources	Visual impacts	Fencing and setbacks landscaping	The design of the NBAF includes a perimeter fence and setback of the facility back from the fence for security purposes. Additionally, portions of the facility would be underground, reducing its height. These design features also serve to mitigate visual impacts by minimizing the impact. Further, the design of the NBAF includes landscaping for aesthetic purposes, specifically calling for the use of native plant material. Landscaping would help reduce visual impacts over time. Nighttime lighting could be mitigated with the use of shielded lighting and/or shielded fixtures that direct light downwards and can be used to keep light within the boundaries of the site and use of the minimum intensity of lighting that is necessary to provide adequate security.
Infrastructure and Utilities	Potential for NBAF utility needs to exceed capacity of local providers	Potential and on-going utility improvements	Local utility providers may need to upgrade their public utility. In some cases, upgrades are already planned and would accommodate NBAF requirements; in other cases, the provider would have to upgrade the utility and has agreed to do so, where necessary. Utility upgrades would rectify the impact of potential capacity exceedances of local public utilities.
Air Quality	Dust and particulates during construction	Implementation of approved fugitive dust control measures, good engineering practices, and overall good housekeeping	During construction, contract requirements would be in place that would obligate the contractor to implement measures that would minimize air quality impacts. Such measures would include approved fugitive dust control measures, good engineering practices, and overall good housekeeping.

Table 3.15-1 — Summary of Potential Effects, Mitigation Measures, and Mechanisms for Implementation (Continued)

Resource	Potential Effect	Mitigation Measure	Mechanism
	Pollutant emissions from laboratory operations, boilers, back-up generators, and incineration	Engineering controls State-of-the-art control technologies with redundant fail safe response measures	The design of the NBAF includes several engineering controls to prevent the escape of gaseous and particulate air emissions due to laboratory operations. These engineering controls include: • High efficiency-particulate air (HEPA) filtration for air exhaust and air intake systems • Design of critical zones as a sealed "box-within-a-box" with interlocks at all points of access • Hardened structural systems to mitigate, and progressive collapse that would help withstand seismic and/or other external threats. Boilers, back-up generators, and incinerators (if used) would be designed and constructed using state-of-the-art technologies that would assure compliance with air permit requirements. Additionally, regulatory oversight would assure compliance. Through these measures, air impacts would be minimized.
Noise	Noise increase from the facility's related traffic, heating, cooling, and filtration systems; noise from use of the back-up generators	Noise abatement design features	The design of the NBAF includes several measures that would reduce both internal and external noise levels. Interior partitions within and between offices would have sound attenuating insulation materials. All laboratory doors would be insulated for sound reduction, and mechanical systems would have sound attenuation equipment based on standard design practices. Laboratory fans would have packless-type sound reducing devices on the exhaust mains and outside air by-pass ducts.
Geology and Soils	Structural integrity during seismic event	Building design Non-expansive soil backfill Deep pile foundation system Engineered conditioning of soils	The final design of the NBAF will ensure sufficient stiffness to minimize structural deflection and vibration and will meet or exceed all applicable seismic building codes. Furthermore, depending on site soils, non-expansive soil backfill, a deep pile foundation system, and/or engineered conditioning of soils may be used. These design and construction features would reduce possible impacts due to a seismic event.

Table 3.15-1 — Summary of Potential Effects, Mitigation Measures, and Mechanisms for Implementation (Continued)

Resource	Potential Effect	Mitigation Measure	Mechanism
	Soil erosion	Use of BMPs during construction Landscaping	During construction, erosion control measures would be implemented in accordance with applicable permits and a SWPPP. Such measures would be site specific but are likely to include BMPs such as filter fabric fences, drop inlet protection, natural covered swales, and/or sedimentation ponds. Use of these measures would be required in the construction contract. Post-construction, the NBAF design includes landscaping with functional storm water management uses and the maintenance/retention of a healthy soil structure. These construction and design features would help to reduce the likelihood of project-related soil erosion.
Water Resources	Sedimentation to surface waters	Use of BMPs during construction Buffers	During construction, measures to prevent sedimentation to surface waters would be implemented in accordance with applicable permits and a SWPPP. Such measures would be site specific but are likely to include BMPs such as filter fabric fences, drop inlet protection, natural covered swales, and/or sedimentation ponds. Use of these measures would be required in the construction contract. Post-construction, vegetated buffer strips would be maintained around any surface waters on-site to intercept potential sedimentation.
	Increased storm water runoff due to increase in impervious surface	Storm water management Landscaping	The design of the NBAF includes measures to reduce storm water runoff due to increased impervious surface. For example, design measures include pervious pavement in both parking lots and pedestrian walkways, capturing and using roof runoff for landscape watering, and grading of parking lots to filter storm water through landscaped areas. These design features are consistent with the LID approach. The goal of LID design is to minimize runoff volume and preserve existing flow paths by managing runoff and detaining storm water prior to discharging to a municipal storm water conveyance system.
	Potential groundwater contamination during construction	Use of BMPs during construction	A SPCC plan would be prepared that would describe potential spill sources, locations, volumes, flow directions, and response/mitigation tactics. Response/mitigation tactics would be site specific but are likely to include BMPs and good engineering practices that minimize or prevent either horizontal or vertical pollutant transport. Adherence to this plan would be required in the construction contract.

Table 3.15-1 — Summary of Potential Effects, Mitigation Measures, and Mechanisms for Implementation (Continued)

Resource	Potential Effect	Mitigation Measure	Mechanism
Biological Resources	Impacts to on- or off-site wetlands and aquatic resources and species that may use these resources from spills and runoff during construction or operation	Avoidance Use of BMPs during construction Adherence to SWPPP and SPCC to prevent and contain storm water runoff and spills Landscaping LID	Wetlands, steams, and aquatic habitats would be avoided through design and siting. Depending on the site, however, some project features such as a utility line, access road, or perimeter fence could cross a wetland or aquatic resource that cannot be avoided. In such a case, proper permits would be obtained; compensation for impacts may be required. During construction, BMPs such as filter fabric fences, drop inlet protection, natural covered swales, and/or sedimentation ponds would be employed to minimize the potential for impacts to wetlands or other aquatic resources, both on- and off-site. Use of these measures would be required in the construction contract. Post-construction, vegetated buffer strips would be maintained around any surface waters on-site to intercept potential sedimentation. Additional measures outlined in a SWPPP and SPCC would be followed. Design measures consistent with the LID approach would be used, such as pervious pavement in both parking lots and pedestrian walkways, capturing and using roof runoff for landscape watering, and grading of parking lots to filter storm water through landscaped areas to minimize runoff.

Table 3.15-1 — Summary of Potential Effects, Mitigation Measures, and Mechanisms for Implementation (Continued)

Resource	Potential Effect	Mitigation Measure	Mechanism
Biological Resources (continued)	Potential adverse effects to wildlife due to accidental release	Design measures to reduce release potential Adherence to BMBL guidelines and NBAF operational procedures and protocols including emergency response plan	Nighttime lighting that could affect wildlife including migratory bird populations could be mitigated with the use of shielded lighting and/or shielded fixtures that direct light downwards and can be used to keep light within the boundaries of the site and use of the minimum intensity of lighting that is necessary to provide adequate security. The NBAF includes many features specifically designed to reduce the potential release of pathogens and therefore avoid potential impacts. Such features include perimeter fencing, HEPA filtration for air exhaust and air intake systems, design of critical zones as a sealed “box-within-a-box” with interlocks at all points of access, and hardened structural systems to mitigate progressive collapse that would help withstand seismic and/or other external threats. Additionally, adherence to operational procedures, which could include measures such as use of sterile mosquitos, and BMBL guidelines would further reduce release potential. In the event of a release, plans would be developed that identify mitigation measures to minimize impacts to wildlife and livestock. Based on existing plans developed by the USDA and NPS, such measures could include establishment of various zones of response (e.g., infected zone, buffer zone, control zone, and outer surveillance zone); coordination with federal, state, and local agencies; assessment of the risks posed by wildlife based on density and distribution, social organization, habitat, contact with domestic livestock, and the length of time that wildlife could have been exposed to the virus; determination of the required level of management and control measures, potentially including population reduction or procedures to prevent or limit wildlife and livestock interaction; and implementation of mosquito control measures.
Cultural Resources	Damage to historic or cultural sites during construction	Use of BMPs during construction Adherence to any SHPO requirements	Currently no impacts to cultural resources are expected to occur at any of the sites; however, if unknown sites are discovered during construction, BMPs would be implemented and the SHPO notified.

Table 3.15-1 — Summary of Potential Effects, Mitigation Measures, and Mechanisms for Implementation (Continued)

Resource	Potential Effect	Mitigation Measure	Mechanism
Socioecono mics	Potential adverse effects to agricultural and hunting economy due to accidental release	Design measures to reduce release potential Adherence to BMBL guidelines and NBAF operational procedures and protocols including emergency response plan	The NBAF includes many features specifically designed to reduce the potential release of pathogens that could result in economic impacts. Such measures include perimeter fencing, HEPA filtration for air exhaust and air intake systems, design of critical zones as a sealed “box-within-a-box” with interlocks at all points of access, and hardened structural systems to mitigate progressive collapse that would help withstand seismic and/or other external threats. Additionally, adherence to operational procedures, which could include measures such as use of sterile mosquitos, and BMBL guidelines would further reduce release potential.
Traffic and Transporta-tion	Increased traffic	Vehicular and pedestrian reroutes during construction Potential and ongoing roadway improvements	During construction, it may be necessary at certain times to reroute vehicular and pedestrian traffic near the construction site. Any such reroutes would be coordinated with the appropriate state and/or local agencies. Depending on the site, some roadway improvements, such as turning lanes, may be necessary to accommodate traffic volume increases associated with NBAF.
Existing Hazardous, Toxic, and Radiologic Waste	Exposure of construction workers to existing contaminants	Additional evaluations to determine the extent and nature of existing waste and remediation measures Development of Health and Safety Plan, Soil Management Plan Worker training prior to construction	Depending on the site, additional hazardous, toxic, and radiologic waste evaluations may be undertaken prior to construction. Based on the results of the evaluation, measures would be identified that should be used to mitigate the construction or operational impacts due to former waste management practices. Such measures could include Health and Safety Plan, Soil Management Plan, additional remediation, and specialized worker training.

Table 3.15-1 — Summary of Potential Effects, Mitigation Measures, and Mechanisms for Implementation (Continued)

Resource	Potential Effect	Mitigation Measure	Mechanism
Waste Management	Potential for NBAF liquid waste stream to exceed acceptance criteria at local sewage treatment facility and to exceed capacity of local providers	Pre-treatment Potential and ongoing utility improvements	Pre-treatment of liquid waste streams, such as pH adjustment, may be necessary and would be implemented to meet sewage acceptance criteria, therefore avoiding potential impacts. At some sites, the local sewer system or wastewater treatment facility may need to be upgraded to accommodate the liquid waste stream from the NBAF. In some cases, upgrades are currently planned or are underway. The upgrades could include installation of additional capacity at the wastewater treatment facility, installation of larger pipes from the NBAF to the treatment facility, or installation of connecting pipe from the NBAF to the sewer system. The local utility would make the upgrades. Utility upgrades would rectify the impact of potential capacity exceedances of local public utilities.
Health and Safety	Worker health and safety during operations	Adherence to BMBL and OSHA safety standards, adherence to NBAF safety procedures and protocols	Compliance with CDC/NIH requirements and OSHA standards including procedural controls and use of primary containment barriers (e.g., biosafety cabinets, special process equipment, and safety suits).
	Public safety during operations	Adherence to BMBL and OSHA safety standards, adherence to NBAF safety procedures and protocols	Compliance with CDC/NIH requirements and OSHA standards including procedural controls and use of secondary containment barriers (e.g., robust facility design, HEPA filtration, and fire supression). Development of emergency management protocols and coordination with local emergency management agencies. Offer training for first responders on protocols, hazards, and equipment regarding pathogens and biological agents.

3.16 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are defined as those that meet the following two criteria:

- There are no reasonably practicable mitigation measures to eliminate the impacts; and
- There are no reasonable alternatives to the proposed project that would meet the purpose and need of the action, eliminate the impact, and not cause other or similar significant adverse impacts.

The previous section (Section 3.15 Mitigation) describes potential effects to resources and measures to mitigate those effects. However, many of these effects would not be completely mitigated. The following adverse effects cannot be fully mitigated while still allowing the Proposed Action at one of the alternative sites to proceed and meet the stated purpose and need as described in Chapter 1. Because the No Action Alternative would not result in any additional impacts, unavoidable adverse impacts are not associated with this alternative.

Visual Resources. As described in Section 3.2 (Land Use and Visual Resources), the visual impact from the proposed NBAF, particularly at the South Milledge Avenue Site, the Flora Industrial Park Site, and the Umstead Research Farm Site, would be prominent but would be partially ameliorated by limited screening and setbacks. However, due to the prominence of the facility at the site's topographical high point, visual effects would be sustained. Visual effects from exterior lighting would be an additional sustained effect, particularly at the sites previously mentioned. The proposed NBAF and perimeter fence would be well lit for security purposes.

Air Quality. As described in Section 3.4 (Air Quality), there would be unavoidable effects to air quality during site preparation and construction. Measures to reduce the effects have been described, but not all air pollutants would be eliminated. There would be additional effects to air quality from operation of the proposed NBAF, including effects from a back-up generator system and a boiler system, as well as from operation-related traffic.

Noise. As described in Section 3.5 (Noise), there would be some unavoidable noise impacts during both construction and operation. Noise levels during construction would vary by construction phase and equipment used. The magnitude of impact would also vary by site with some sites having more sensitive noise receptors within close proximity than other sites. Unavoidable impacts during operation would be noise impacts associated with use of the emergency generators and noise from increased traffic associated with NBAF. The generators are a back-up response system and would not be a routine noise source.

Traffic. As described in Section 3.11 (Traffic and Transportation), there would be unavoidable impacts to traffic during both site preparation/construction activities and NBAF operations. Short-term construction activities followed by long-term NBAF operations would impact traffic and roadway infrastructure by increasing the number of vehicles in the immediate and surrounding areas during peak travel times. Measures to mitigate the impacts from increased vehicle utilization of surrounding roadway infrastructure are generally described in the previous Section 3.17, Mitigation.

3.17 THE RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

This section describes whether the benefit from construction and operation of the NBAF would be worth loss of resources at the alternative sites that provide benefits to the environment in comparison to the No Action Alternative. The previous sections in Chapter 3 provide descriptions of the potential adverse effects and benefits from the construction and operation of the NBAF at one of the proposed sites.

Short-term effects would be similar for all sites. For this EIS, short-term refers primarily to the period of construction of the NBAF. A loss of undeveloped land would occur at each site, but no protected species or other prominent natural resource would be directly affected with the exception of the South Milledge Avenue Site, where minimal (<0.5 acres) wetlands would be effected from road crossings. Energy and resource use for construction of the NBAF would not vary to a great degree from site to site.

The long-term effects would also be similar to a great degree for all sites. Long-term refers to the effects to resources due to operation of the NBAF over time. The potential for indirect effects to off-site surface and groundwater features would be minimized through BMPs and appropriate project design features. Energy and resource use for operation of the NBAF would not vary from site to site to a great degree, but those effects include a variation in fuel costs for heating, cooling, and chilled water production.

Long-term benefits of the NBAF would include protection of livestock and wildlife resources as well as protecting the economy from an outbreak of any FAD or zoonotic diseases in the United States by developing diagnostic techniques, vaccines, and other countermeasures.

The No Action Alternative would not result in any additional short- or long-term effects. However, the No Action Alternative would also not result in the scale of long-term benefits to livestock and wildlife resources as would be realized with the NBAF. Although research to improve protection from FAD and zoonotic diseases is currently conducted at PIADC and other facilities in the United States, none have the capabilities that would be available with the NBAF.

3.18 SUMMARY OF SIGNIFICANT EFFECTS

Table 3.18-1 provides a description of the effect categories used in Table 3.18-2. The effects categories provide the basis for comparison of the alternatives and their effects on the resources described in Chapter 3.

Table 3.18-1 — Environmental Effects Categories

Effect Category		Definition
Beneficial Effects	Significant	An action that would greatly improve current conditions
	Moderate	An action that would moderately improve current conditions
	Minor	An action that would slightly improve current conditions
Negligible or No Effect		An action that would neither improve nor degrade current conditions
Adverse Effects	Minor	An action that would slightly degrade current conditions
	Moderate	An action that would moderately degrade current conditions
	Significant	An action that would greatly degrade current conditions

No significant adverse effects to environmental or human resources would be expected from any of the alternatives with normal operation of the NBAF. Moderate effects that would occur would be to the following resources:

- Potable Water – use of 36 million to 52 million gallons of potable water per year.
- Wastewater treatment capacity – generation of 25 million to 30 million gallons of wastewater per year.
- Water Resources – use of 36 million to 52 million gallons of potable water per year could affect surface or groundwater resources.
- Visual Quality – visual prominence of the NBAF at five of the alternative site locations.
- Air Quality – Potential for air emissions to affect local air quality.
- Traffic – Potential adverse traffic flow effects at the South Milledge Avenue Site and the Texas Research Park Site.

Significant beneficial effects to biological resources (wildlife), economics, and health and safety could occur with the development of new vaccines, diagnostic procedures, or rapid responses to potential FAD outbreaks.

Table 3.18-2 — Comparison of Environmental Effects

Resource	No Action	South Milledge Avenue Site	Manhattan Campus Site	Flora Industrial Park Site	Plum Island Site	Umstead Research Farm Site	Texas Research Park Site
Potential Adverse Effects for Normal Operations							
Land Use	None	Minor	Minor	Minor	Minor	Minor	Minor
Visual	None	Moderate	Moderate	Moderate	Minor	Moderate	Moderate
Infrastructure	Minor	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Air Quality	Minor	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Noise	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Geology and Soils	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Water	Minor	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Biology	Negligible	Minor	Negligible	Negligible	Negligible	Minor	Negligible
Cultural	None	None	None	None	None	None	None
Socioeconomics	None	Minor	Minor	Minor	Minor	Minor	Minor
Traffic and Transportation	None	Moderate	Minor	Minor	Negligible	Minor	Moderate
Hazardous Waste	None	Negligible	Negligible	Negligible	Minor	Minor	Negligible
Waste Management	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Health and Safety[1]	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Environmental Justice	None	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Cumulative Effects	None	Minor	Minor	Moderate	Negligible	Minor	Moderate
Potential Beneficial Effects for Normal Operations							
Biology	None	Significant	Significant	Significant	Significant	Significant	Significant
Socioeconomics	None	Significant	Significant	Significant	Significant	Significant	Significant
Health and Safety	None	Significant	Significant	Significant	Significant	Significant	Significant