ORNL/TM-2014/433

Evaluation of Potential Locations for Siting Small Modular Reactors near Federal Energy Clusters to Support Federal Clean Energy Goals

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September 2014

OAK RIDGE NATIONAL LABORATORY
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Reactor and Nuclear Systems Division
Computational Sciences and Engineering Division

EVALUATION OF POTENTIAL LOCATIONS FOR SITING SMALL MODULAR REACTORS NEAR FEDERAL ENERGY CLUSTERS TO SUPPORT FEDERAL CLEAN ENERGY GOALS

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ACRONYMS

B&W	Babcock and Wilcox Company
DoD	US Department of Defense
DOE	US Department of Energy
Dominion	Virginia Electric and Power Company
GIS	geographic information system
iPWR	integral pressurized-water reactor
MW(e)	megawatt electrical
NAS	Naval Air Station
NE	(DOE) Office of Nuclear Energy
NRC	US Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
OR-SAGE	Oak Ridge Siting Analysis for power Generation Expansion
PWR	pressurized-water reactor
SSEC	site selection and evaluation criteria
SMR	small modular reactor
STP	South Texas Project
USGS	US Geological Survey
VSEC	Virginia-Hampton Roads Small Modular Reactor Energy Development Council
ZIP	Postal Zone Improvement Plan

ABSTRACT

Geographic information systems (GIS) technology was applied to analyze federal energy demand across the contiguous US. Several federal energy clusters were previously identified, including Hampton Roads, Virginia, which was subsequently studied in detail. This study provides an analysis of three additional diverse federal energy clusters. The analysis shows that there are potential sites in various federal energy clusters that could be evaluated further for placement of an integral pressurized-water reactor (iPWR) to support meeting federal clean energy goals.

1. BACKGROUND, INTRODUCTION, AND METHODOLOGY

1.1 BACKGROUND

The overall objective of this research project is to use the Oak Ridge Siting Analysis for power Generation Expansion (OR-SAGE) tool to support the US Department of Energy (DOE) Office of Nuclear Energy (NE) in evaluating future electrical generation deployment options for small modular reactors (SMRs) in areas with significant energy demand from the federal sector. Deployment of SMRs in zones with high federal energy use can provide a means for meeting federal clean energy goals. SMRs are defined as reactor plant designs with individual reactor modules rated at 300 megawatt electrical (MW[e]) or less.

The Task 1 technical report[1] documented the identification of US locations to possibly site new SMR nuclear power plants in areas where the concentration and electricity use by federal government agencies are high and forecasted to grow in the next 10 years. “Federal agencies” include military and other agencies (Homeland Security, DOE, Federal Bureau of Investigation, Social Security Administration, etc.) with missions of national critical importance. Using publicly available data,[2,3] federal energy usage was catalogued by the first two digits of the Postal Zone Improvement Plan (ZIP) Code and the full ZIP Code. Combined federal energy data sorted by the first two digits of the ZIP Code are shown in Fig. 1.

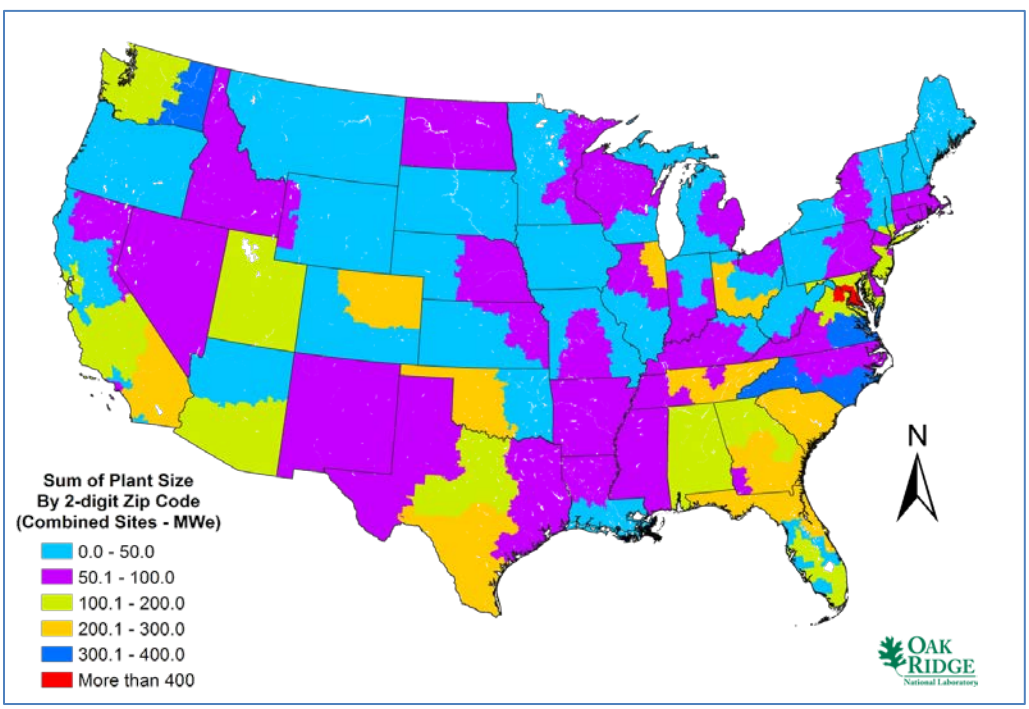

Fig. 1. Combined federal energy consumption by two-digit ZIP Code area.

The orange, dark blue, and red areas in Fig. 1 (around Washington, DC) have higher federal energy consumption. Note that the only dark blue areas are in Virginia, North Carolina, and Washington. Eastern Washington, which is dark blue, shares the same two-digit ZIP Code area (99) as all of Alaska. The dark blue color in eastern Washington is a result of the power demand in Alaska.

Federal sites depicted by the full ZIP Code are represented by a colored dot in Fig. 2. The size and color of each dot indicate the average annual energy consumption within a specific ZIP Code for fiscal years (FYs) 2009–2012. Based on available data, thirteen federal energy clusters were identified, and eight were selected as areas with significant energy consumption to provide favorable opportunities for SMR siting. These clusters are discussed in detail in the Task 1 report. The Hampton Roads, Virginia, area was identified as being among the largest federal energy clusters. These federal power clusters were identified based upon power usage data, geographical concentration (collocation) of federal agencies, and/or operation of large federal data centers.

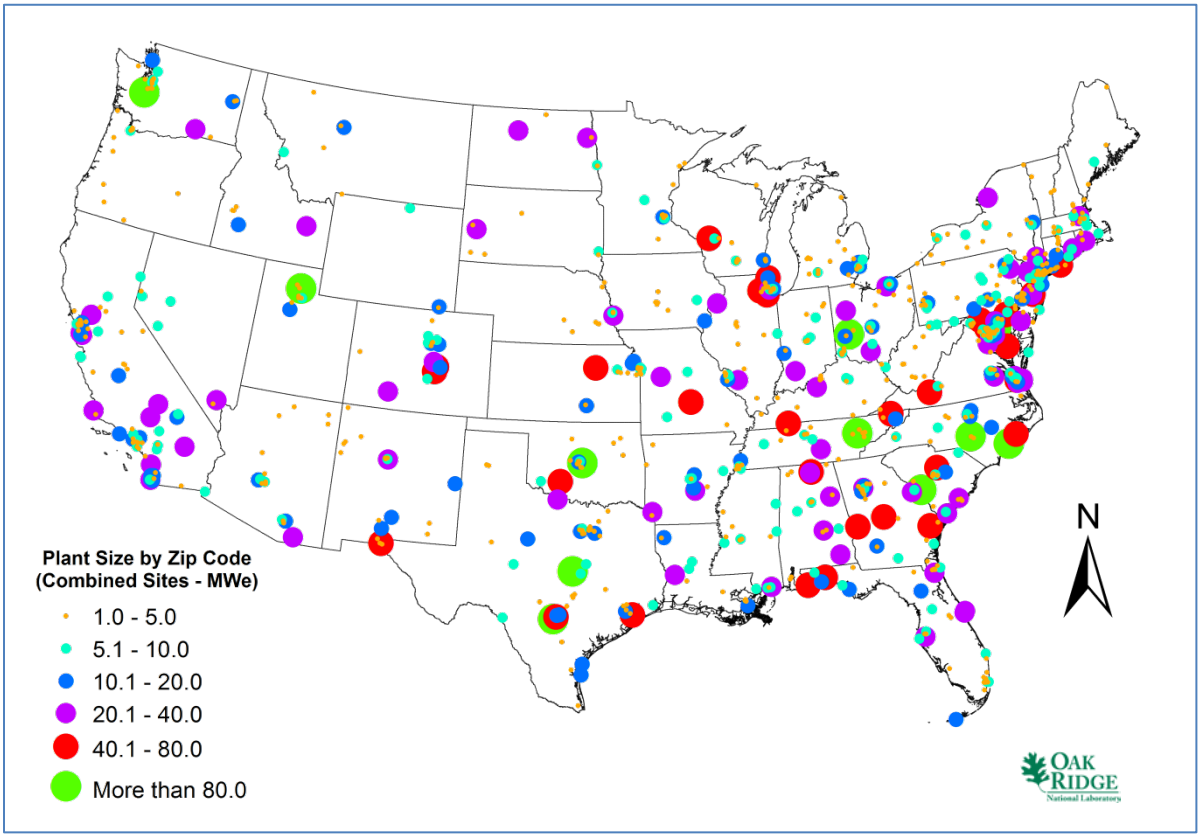

Fig. 2. Energy consumption at reported federal facilities.

Energy consumption data for federal facilities over a multi-year period were analyzed mathematically using spreadsheet manipulations of two-digit ZIP Codes and visually analysis of GIS layers. Energy clusters among these federal facilities were identified using the methods described above. Some facility clusters are relatively compact, while others require a very broad definition for a facility cluster (i.e., covering a significant distance or range to supply power to all facilities in the cluster). Thirteen clusters identified by one or both methodologies were analyzed against SMR siting criteria, without consideration for surrounding population, based on previous studies on SMR siting.[4,5] Eight energy clusters were selected as areas with significant energy consumption based on historical data and providing favorable opportunities for SMR siting to possibly meet federal clean energy goals. The rest of the previously identified clusters were not included in the summary due to a combination of siting criteria deficiencies,

lack of a favorable host facility, anticipated high population density, or the distance between federal facilities.

The top clusters are identified in Table 1, which lists the highest required plant capacity established by mathematical or visual analysis.

Table 1. Summary of top federal energy clusters

Location/facility	Plant capacity to meet energy demand (MW[e])	Percentage of federal energy demand
Virginia Peninsula/Hampton Roads area	368.5	3.7%
Savannah River Site, South Carolina	337.1	3.4%
Florida Panhandle	304.9	3.1%
South-Central Texas	252.0	2.6%
Denver-Colorado Springs, Colorado	237.8	2.4%
East Tennessee/Oak Ridge National Laboratory	234.3	2.4%
Southwest Oklahoma-North Texas	218.8	2.2%
Western Ohio	206.1	2.1%

1.2 INTRODUCTION

Eleven potential sites in the Hampton Roads, Virginia, area were identified for evaluation in Task 2 by the Virginia-Hampton Roads Small modular reactor Energy Development Council (VSEC). The eleven sites, documented by a letter report,[6] were then evaluated using the OR-SAGE tool based on previously developed screening criteria and the application of spatial modeling and GIS. However, the population screening criteria were not applied to the site evaluations.

Task 3 of the project evaluated two of the eleven individual sites in Task 2 for sensitivity to population density. Sensitivity to population density is a significant factor of interest in the potential for siting new SMRs and possibly backfitting SMRs into older coal plant facilities. Initially, VSEC was to select the two sites of interest, but after VSEC withdrew from the project, Oak Ridge National Laboratory (ORNL) staff members selected two sites for further study as documented in the Task 3 technical report.[7] The Yorktown Power Station and Fort Story were selected for further detailed population density evaluation.

Task 4 of the project was anticipated to evaluate two of the best individual Task 2 sites with regard to (1) favorability for siting an SMR and its ability to support meeting the federal clean energy goals, and (2) additional parameters of interest to VSEC. However, after VSEC withdrew from the project, Task 4 was revised to investigate selected sites for three additional federal energy clusters as identified in Task 1 for favorable SMR siting opportunities. This evaluation was conducted in a manner similar to that performed in Task 2 for the Hampton Roads area, but on a more limited basis for the three additional federal energy clusters. Overall, nine additional sites were evaluated. In addition, site detail was leveraged from two previous reports on the potential for SMR replacement of certain coal-fired power plants[8] and SMR support of DOE and US Department of Defense (DoD) facilities.[9]

The three federal energy clusters selected for additional analysis were the Florida Panhandle, South-Central Texas, and Denver-Colorado Springs from Table 1 above. This letter report provides the results of evaluations of nine potential sites over these three potential federal energy clusters. The site evaluations are based on previously developed screening criteria and the application of spatial modeling and GIS. For reference purposes, a generalized SMR plant parameter envelope for the Babcock and Wilcox (B&W)

Generation mPower SMR integral technology is used for all site evaluations.[*] The B&W Company SMR design is based on existing pressurized-water reactor (PWR) technology. A dual-unit mPower installation would nominally provide 360 MW(e) to a utility grid or to a microgrid.

1.3 APPROACH AND METHODOLOGY

DOE-NE has previously tasked ORNL to support identification of candidate sites for new SMR power plants using an ORNL GIS-based tool.[4,5] This effort has led to the development and refinement of OR-SAGE, a tool to support power plant siting evaluations. OR-SAGE is a flexible tool being used to evaluate power plant siting options and considerations for a variety of power sources. The approach for this study is to use the OR-SAGE tool configured to screen for a two unit installation of the B&W Generation mPower iPWR[†]. The screening process is independent of population density. The nine OR-SAGE tool screening criteria applied for the mPower iPWR analysis are as follows:

- Wetlands and open water are excluded.
- Protected lands (e.g., national parks, historic areas, wildlife refuges) are excluded.
- Land with moderate or high landslide hazard susceptibility is avoided.
- Land that lies within a 100 year floodplain is excluded.
- Land with a slope of greater than 18% (~10°) is avoided.
- Land areas that are more than 20 miles from sufficient cooling water makeup sources (at least 30,000 gpm) based on a 360 MW(e) modular iPWR installation are excluded for mPower SMR plant applications.
- Land too close to identified fault lines is avoided (the length of the fault line determines the standoff distance).
- Land located in proximity to hazardous facilities (airports and oil refineries) is avoided.
- Land with safe-shutdown earthquake peak ground acceleration (2% chance in a 50 year return period) greater than 0.5 g is excluded.

These parameters are tracked in the OR-SAGE database on a cell-by-cell basis for the entire contiguous US. A more detailed discussion of each criterion is available in the general SMR siting report[4] provided to DOE-NE in September 2012. Sensitivity to population density will be a factor of interest for any future evaluation of any federal energy cluster.

The DOE Savannah River Site is fairly compact and has been previously evaluated for favorable SMR placement.[9] Therefore, the next three sites in order of electricity demand from Table 1 were selected for analysis in this study. This had the added benefit of providing three diverse cluster locations across the contiguous US. At least three potential sites in each area are evaluated for favorability of siting an mPower iPWR. To the extent possible, the sites selected were diverse in terms of current use, such as coal-fired power plants, nuclear power plants, and DoD facilities.

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[*] Generation mPower was a constituent of VSEC, which led to the mPower iPWR as the technology of interest. For comparison, the report for DOE-NE, ORNL/TM-2012/403[4] includes the NuScale technology as a bounding SMR technology.

[†] The mPower iPWR design is one technology that meets the general definition of an SMR. The acronyms SMR and iPWR are used interchangeably throughout this letter report.

2. EVALUATION OF POSSIBLE SMR SITES NEAR FEDERAL ENERGY CLUSTERS

Task 1 of this project characterized all land in the contiguous US to possibly site new SMR nuclear power plants in areas where the concentration and electricity use by federal government agencies is high and forecasted to grow in the next 10 years. "Federal agencies" include DoD and other agencies (Homeland Security, DOE, Federal Bureau of Investigation, Social Security Administration, etc.) that have missions of national critical importance.

While Task 2 provided an in-depth look at 11 sites in the Hampton Roads federal energy cluster, Task 4 provides a more limited evaluation of sites in three additional federal energy clusters. The federal energy clusters selected for additional analysis are the Florida Panhandle, South-Central Texas, and the Denver-Colorado Springs area. This letter report provides the results of evaluations of nine potential sites spread over these three potential federal energy clusters. The site evaluations are based on previously developed screening criteria and the application of spatial modeling and GIS. Additional potential sites in each of these clusters will be identified, and in some cases, additional sites were the subject of previous analyses that can be leveraged for this evaluation.

A data package and analysis for each site was prepared. These site summaries are available in Appendix A. A description of the nominal site evaluation process is also included in Appendix A. The site evaluation process is identical to that used in Task 2.

US Nuclear Regulatory Commission (NRC) siting guidance[10] recommends calculating the population density within 20 miles of the site and excluding population densities of greater than 500 people per square mile. Using an SMR to assist in meeting federal clean energy goals may require that SMRs be located closer to population centers. SMRs will have a smaller source term than large reactors, and the appropriate evacuation zone is an issue still under discussion with the NRC staff. For the purposes of this study, a 10 mile buffer was deemed appropriate for initial SMR siting evaluations. This buffer zone also corresponds to the plume exposure pathway emergency planning zone. Sensitivity to population density was studied in detail in Task 3.

To meet the population density guidance, each cell in the database is queried for ambient population, which considers the weighted transient population. If a cell population is greater than 500 people per square mile, it is immediately excluded. If a cell population is less than 500 people per square mile, the surrounding area is evaluated by calculating the population density in an expanding set of rings out to a maximum of 10 miles (in simple terms, a buffer zone). If any ring is calculated to have a population density above 500 people per square mile, then the center cell is excluded. If no ring around the central cell exceeds a population density of 500 people per square mile, then the cell remains viable with regard to population. Though population density is not included in the initial site evaluations for each of the federal energy clusters reviewed in this analysis, the analysis of each cluster presents a color coded regional result of a 10 mile population dataset query. This provides some added insight on the viability of the proposed sites, which are represented as blue dots on the regional maps below. The maximum search radii can be set to any value to create alternate buffer distances.

Based on the detail provided in each site summary package, an evaluation of each site is offered in the following sections detailing the results for each federal energy cluster evaluated. Detail about the site owner is provided, and any partial or full siting issues are addressed. Other imagery details are also explained. Based on the analysis, the individual sites are binned into one of three categories based on the review:

1. Exclusive of population, the site meets multiple conventional standards for consideration of siting an SMR at the proposed location. There are no current or near-term foreseeable SMR site selection and evaluation criteria (SSEC) issues that should preclude this site from further SMR siting consideration.

2. Exclusive of population, the site meets multiple conventional standards in the near term for consideration of siting an SMR at the proposed location, but there may be longer term issues that could preclude this site from further SMR siting consideration. For example, the site may be heavily developed with little room for expansion necessary to site an iPWR.
3. The site is not a likely candidate for consideration of siting an SMR. Numerous SSEC are not met, or other parameters exist that could make it difficult to site an iPWR.

2.1 EVALUATION OF THE FLORIDA PANHANDLE

Publicly available energy use data from Task 1 indicated that energy demand at federal facilities in the Florida Panhandle is in excess of 300 MW(e). Demand on this scale can easily be met by a dual-unit mPower iPWR. The selected sites for potential SMR siting evaluations in the Florida Panhandle area are (1) the Herbert Scholz Generating Plant, a coal-fired power plant; (2) Plant Farley, a nuclear power plant; and (3) Naval Air Station (NAS) Pensacola, a DoD facility. Other potential sites in the area include:

- James F. Crist Generating Plant,
- Lansing Smith Generating Plant (previously evaluated[8]),
- Tyndall Air Force Base,
- Maxwell Air Force Base, and
- Eglin Air Force Base (previously evaluated[9]).

The potential sites in the Florida Panhandle are shown on the regional area map in Fig. 3. The map shows the individual population density avoidance SSEC layer for this region when queried at a buffer distance of 10 miles. Population density is not a direct factor in the analysis of the selected sites in the Florida Panhandle, but Fig. 3 adds some insight on the population density in the region.

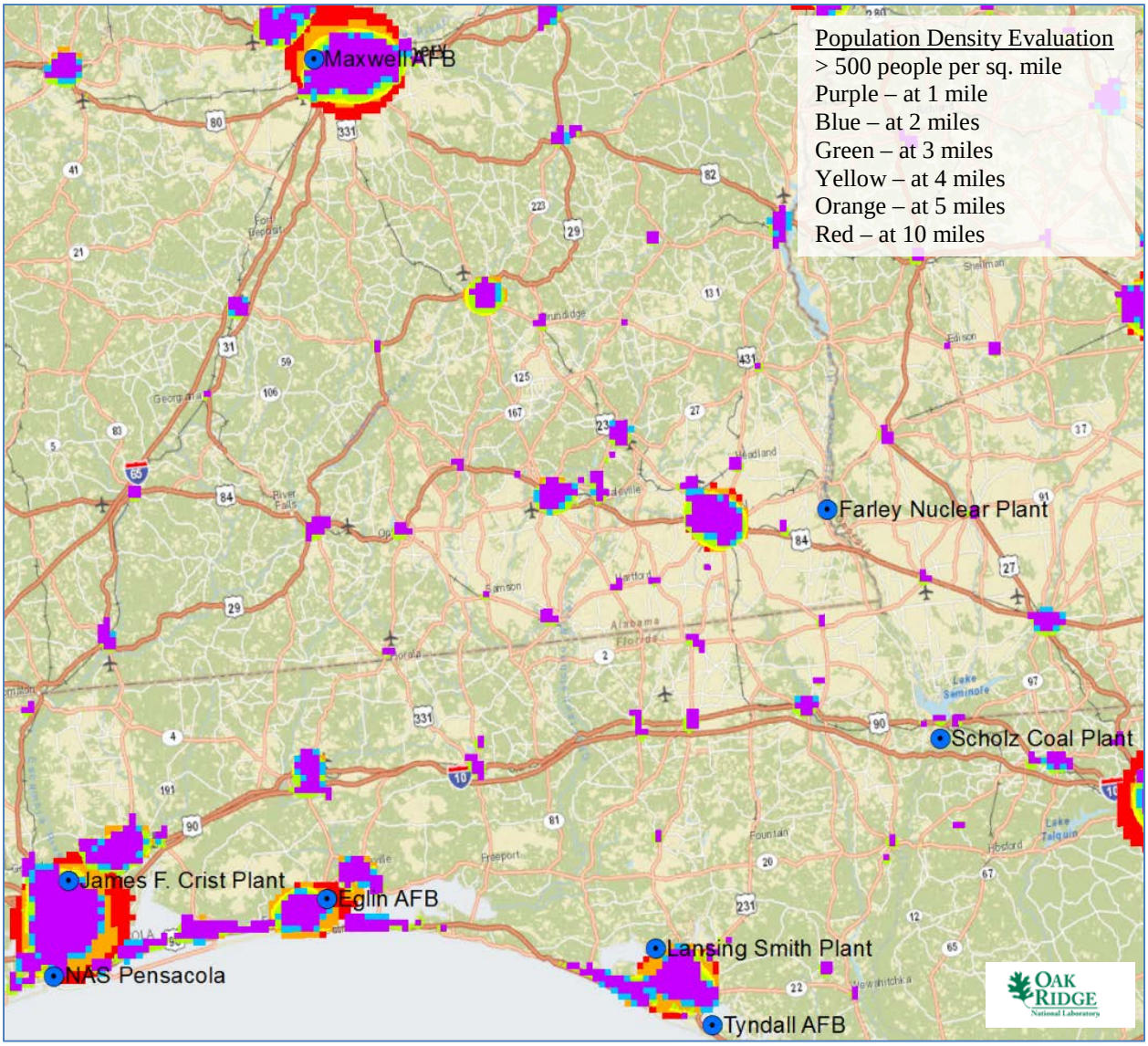


Fig. 3. Florida Panhandle regional map of potential sites on population avoidance layer.

Each site was evaluated visually using Google Earth to estimate available acreage, identify proximity to nearby dwellings and other industrial uses, and identify any potential hazards. Internet searches were conducted to identify more up-to-date plant status and other conditions that may limit the site for SMR placement.

2.1.1 Binning of Site Evaluation Results

Of the three evaluated sites, two are rated as more favorable for siting an iPWR. These sites have significant space that meets all screening criteria, or the issues are well understood and are judged not to impact iPWR siting at that location. These sites are:

- the Herbert Scholz Generating Plant, and
- Plant Farley.

Based on previous analysis, Eglin Air Force Base would also fit into this category.

Not surprisingly, two of these sites are existing power plant sites. Eglin Air Force Base is owned by the DoD. These two power plants stand out based on their existing infrastructure, logistics, available space, and security (Plant Farley). Eglin Air Force base previously stood out based on available space and security.

Based on previous analysis, the Lansing Smith Generating Plant was rated in the second category for siting an iPWR. These sites are generally favorable for siting an iPWR but are identified as having at least one significant issue to overcome. The Lansing Smith Generating Plant site is approximately four miles from the Panama City–Bay County International Airport, though the runway is not aligned with the site. A separate risk assessment regarding the proximity to the airport would be required. In addition, there are wetlands and 100 year floodplain issues near the site.

Naval Air Station (NAS) Pensacola is rated as not a likely candidate for siting an iPWR. This site has airport runway alignment and dense infrastructure issues that would be difficult to overcome.

2.1.2 Evaluation of Regional Population

Regional population density impacts evaluated with a 10 mile buffer on SMR siting in the Florida panhandle are shown in Fig. 3. The color coding in the figure indicates the point at which individual cells exceed the population density setpoint of 500 people per square mile. The densest population is typically in the purple colored cells, where the population density setpoint was exceeded within one mile of a given cell. Plant Farley, the Scholz coal plant, and Tyndall Air Force Base (not analyzed) appear to be well outside densely populated areas evaluated out to 10 miles. The remaining facilities identified in the panhandle region would require further analysis using more refined population density analysis tools as was done in Task 3 of the project for sites in the Hampton Roads area.

2.2 EVALUATION OF SOUTH-CENTRAL TEXAS

Publicly available energy use data from Task 1 indicated that energy demand at federal facilities in South-Central Texas is in excess of 250 MW(e). Demand on this scale can easily be met by a dual-unit mPower iPWR. The selected sites for evaluation in the South-Central Texas area are (1) Lackland Air Force Base, a DoD facility; (2) the South Texas Project, a nuclear power plant; and (3) the Twin Oaks Power Station, a coal-fired power plant. Other potential sites in the area include:

- San Miguel Electric Co-op,
- Spruce/Deely/Sommers (co-located) Plants,
- Fayette Power Project,
- Comanche Peak,
- Randolph Air Force Base,
- Fort Sam Houston, and
- Fort Hood (previously evaluated).

The potential sites in South-Central Texas are shown on the regional area map in Fig. 4. The map shows the individual population density avoidance SSEC layer for this region when queried at a buffer distance of 10 miles. Population density is not a direct factor in the analysis of the selected sites in the South-Central Texas region, but Fig. 4 adds some insight on the population density in the region.

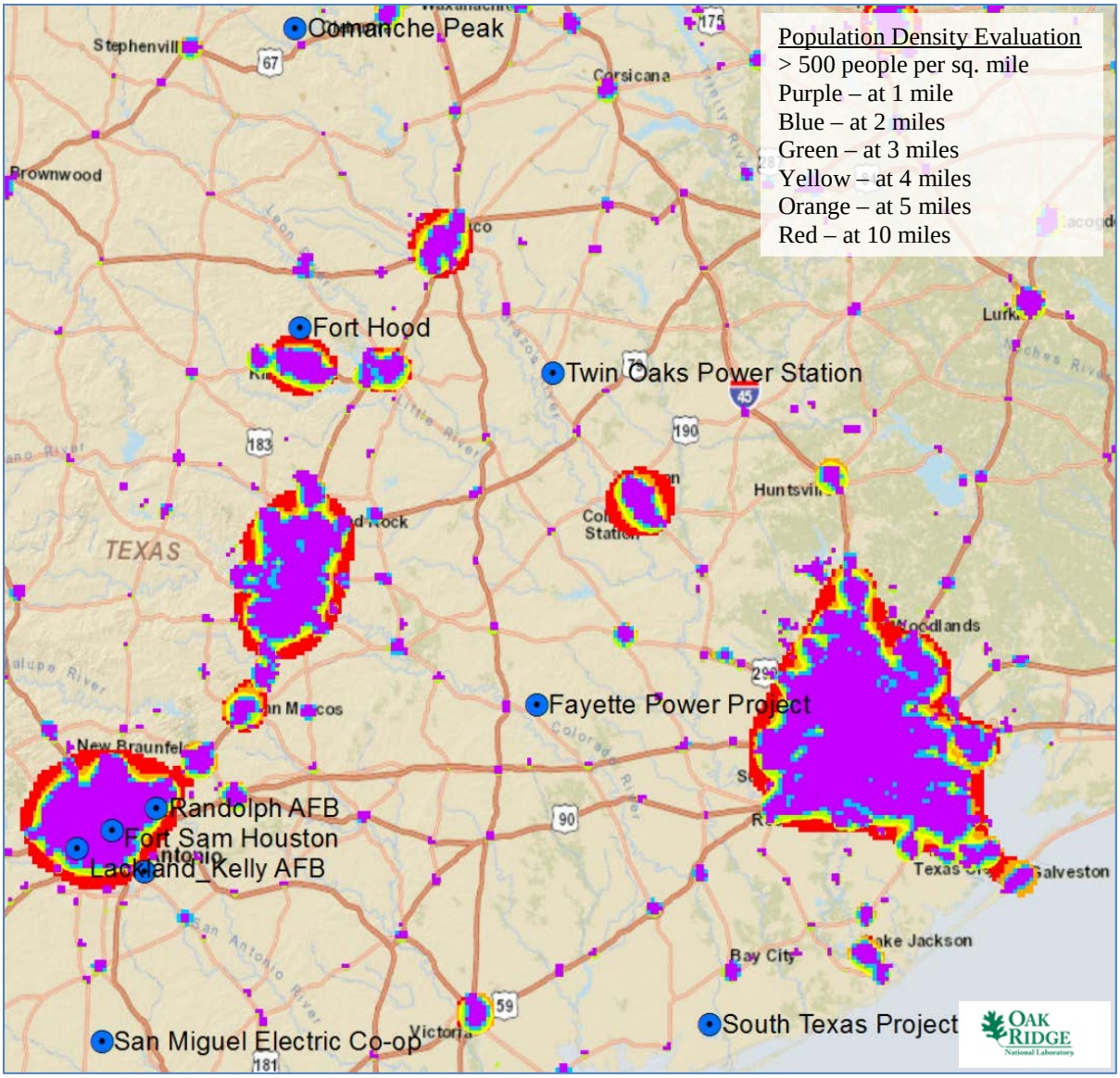


Fig. 4. South-Central Texas regional map of potential sites on population avoidance layer.

Each site was evaluated visually using Google Earth to estimate available acreage, identify proximity to nearby dwellings and other industrial uses, and identify any potential hazards. Internet searches were conducted to identify more up-to-date plant status and other conditions that may limit the site for SMR placement.

2.2.1 Binning of Site Evaluation Results

Of the three evaluated sites, all are rated as more favorable for siting an iPWR. These sites have significant space that meets all screening criteria, or the issues are well understood and are judged not to impact iPWR siting at that location. These sites are:

- Lackland Air Force Base (especially the Medina Training Annex),
- South Texas Project, and

- Twin Oaks Power Station.

Based on previous analysis, the northern portion of the 193,000 acre Fort Hood site would also fit into this category.

Not surprisingly, two of these sites are existing power plant sites. The remaining two, including Fort Hood, are owned by the DoD. The power plant sites stand out based on the existing infrastructure, logistics, available space, and security (South Texas Project). The DoD bases stand out based on available space and security.

None of the evaluated facilities fit into one of the lower category bins.

2.2.2 Evaluation of Regional Population

Regional population density impacts evaluated with a 10 mile buffer on SMR siting in the South-Central region of Texas are shown in Fig. 4. The color coding in the figure indicates the point at which individual cells exceed the population density setpoint of 500 people per square mile. The densest population is typically in the purple colored cells, where the population density setpoint was exceeded within one mile of a given cell. Fort Hood, the Twin Oaks Power Station, the San Miguel Electric Co-op (not analyzed), the Fayette Power Project (not analyzed), and Comanche Peak (not analyzed) appear to be well outside densely populated areas evaluated out to 10 miles. The remaining facilities identified in central Texas would require further analysis using more refined population density analysis tools as was done in Task 3 of the project for sites in the Hampton Roads area.

2.3 EVALUATION OF CENTRAL COLORADO

Publicly available energy use data from Task 1 indicated that energy demand at federal facilities in central Colorado is in excess of 230 MW(e). Demand on this scale can easily be met by a dual-unit mPower iPWR. The selected sites for evaluation in the central Colorado area are (1) Fort Carson, a DoD facility; (2) the Ray Nixon Power Plant, a coal-fired power plant; and (3) the Arapahoe Station, a coal-fired power plant. Other potential sites in the area include:

- Martin Drake Power Plant,
- Cherokee Station,
- Peterson Air Force Base,
- Schriever Air Force Base,
- Buckley Air Force Base, and
- The US Air Force Academy.

The potential sites in central Colorado are shown on the regional area map in Fig. 5. The map shows the individual population density avoidance SSEC layer for this region when queried at a buffer distance of 10 miles. Population density is not a direct factor in the analysis of the selected sites in the central Colorado region, but Fig. 5 adds some insight on the population density in the region.

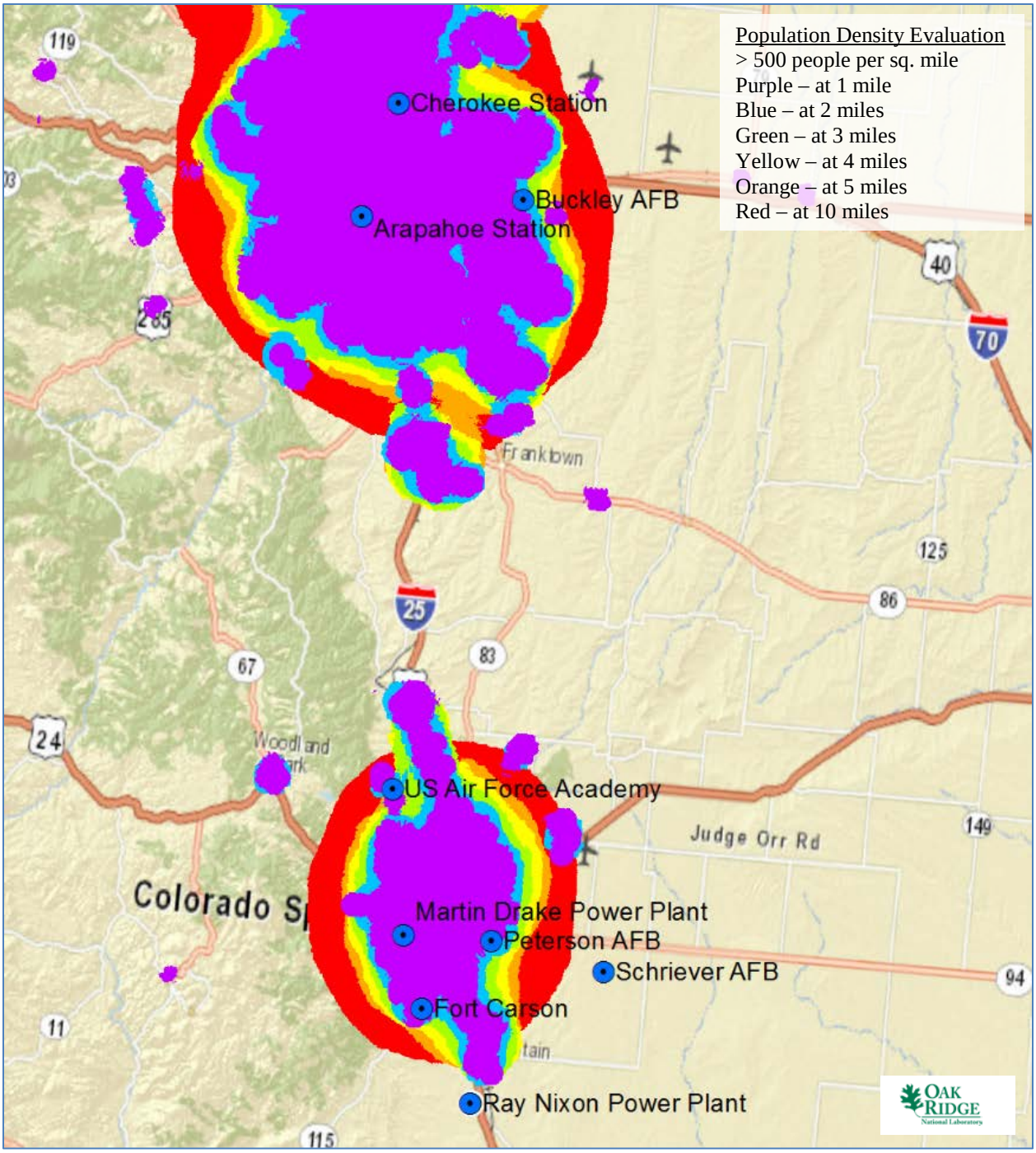


Fig. 5. Central Colorado regional map of potential sites.

Each site was evaluated visually using Google Earth to estimate available acreage, identify proximity to nearby dwellings and other industrial uses, and identify any potential hazards. Internet searches were conducted to identify more up-to-date plant status and other conditions that may limit the site for SMR placement.

2.3.1 Binning of Site Evaluation Results

Of the three sites, two are rated as the more favorable for siting an iPWR. These sites have significant space that meets all screening criteria, or the issues are well understood and are judged not to impact iPWR siting at that location. These sites are:

- Ray Nixon Power Plant, and
- Fort Carson (southern area of the base).

One site is an existing power plant site, and the other is owned by the DoD. The Ray Nixon Power Plant stands out based on the existing infrastructure, logistics, and available space. Fort Carson stands out based on available space and the security infrastructure.

Arapahoe Station is rated in the second category for siting an iPWR. This site has limited space with no expansion potential and has had flooding problems in the past.

No evaluated sites were identified as unlikely candidate locations for siting an iPWR.

2.3.2 Evaluation of Regional Population

Regional population density impacts evaluated with a 10 mile buffer on SMR siting in the central region of Colorado are shown in Fig. 5. The color coding in the figure indicates the point at which individual cells exceed the population density setpoint of 500 people per square mile. The densest population is typically in the purple colored cells, where the population density setpoint was exceeded within one mile of a given cell. Schriever Air Force Base (not analyzed) and the Ray Nixon Power Plant appear to be outside densely populated areas evaluated out to 10 miles. The remaining facilities identified in central Colorado would require further analysis using more refined population density analysis tools as was done in Task 3 of the project for sites in the Hampton Roads area.

3. SUMMARY

Eight of the nine sites evaluated demonstrate reasonable potential for further consideration for placement of an iPWR. Seven of these nine sites were judged to be more favorable. The Arapahoe Station in Colorado was judged to be favorable but limited by the available acreage and nearby community parks. NAS Pensacola in the Florida panhandle was judged to be unfavorable because of site buildings and the runway alignment with respect to the remaining open space. The remaining seven sites stand out based upon the OR-SAGE screening criteria and apparent space available. Dated evaluation of nearby grid capacity is available with each assessment. However, an evaluation of current grid infrastructure, potential for microgrid infrastructure, or other factors of potential interest are not part of the site review process at this point. This task did not consider an exhaustive number of potential sites in each cluster area. Therefore, other sites could be judged as favorable or more favorable based on additional screening parameters.

The list of sites evaluated is provided in Table 2. The sites are listed by region and in the order in which they are discussed in the appendix. Overall, there are four coal-fired plant sites, two nuclear power plant sites, and two DoD sites. The results of the initial OR-SAGE screen for each site are also listed in Table 2 in terms of the number of identified siting issues based on the OR-SAGE SSEC. However, these issues need to be seen in the context of the individual site evaluations in Appendix A, and the list is not intended to score the proposed sites.

Table 2. List of nine proposed sites

Proposed site	Owner	Initial geographic information system evaluation
Florida Panhandle		
Herbert Scholz Generating Plant	Gulf Power Company	2 partial siting issues
Plant Farley	Southern Company	1 partial siting issue
NAS Pensacola	US Navy	1 partial siting issue
South-Central Texas		
Lackland Air Force Base	US Air Force	0 siting issues
South Texas Project	STP Nuclear Operating Company	0 siting issues
Twin Oaks Power Station	Blackstone Group LP.	0 siting issues
Central Colorado		
Fort Carson	US Army	1 full, 1 partial siting issue
Ray Nixon Power Plant	Colorado Springs Utility	1 full, 1 partial siting issue
Arapahoe Station	Xcel Energy	2 partial siting issues

The results show that there are numerous potential sites in various federal energy clusters that could be evaluated further for placement of an iPWR. Siting iPWRs in the vicinity of these federal energy clusters would aid these areas in meeting federal clean energy goals.

4. REFERENCES

1. R. J. Belles, G. T. Mays, O. A. Omitaomu, and W. P. Poore, *Identification of Selected Areas to Support Federal Clean Energy Goals Using Small Modular Reactors*, ORNL/TM-2013/578, December 2013.
2. Office of the Deputy Under Secretary of Defense (Installations and Environment), *Department of Defense Annual Energy Management Report Fiscal Year 2011*, September 2012.
3. DOE Office of Energy Efficiency and Renewable Energy, FEMP EISA 432 Compliance Tracking System, http://ctsedwweb.ee.doe.gov/CTSDataAnalysis/DataAnalysisTool/DataAnalysisTool.aspx, accessed on October 7, 2013.
4. R. J. Belles, G. T. Mays, O. A. Omitaomu, and W. P. Poore, *Updated Application of Spatial Data Modeling and Geographical Information Systems (GIS) for Identification of Potential Siting Options for Small Modular Reactors*, ORNL/TM-2012/403, September 2012.
5. G. T. Mays, R. J. Belles, O. A. Omitaomu et al., *Application of Spatial Data Modeling and Geographical Information Systems (GIS) for Identification of Potential Siting Options for Various Electrical Generation Sources*, ORNL/TM-2011/157/R1, May 2012.
6. R. J. Belles, T. J. Harrison, and O. A. Omitaomu, *Evaluation of Proposed Hampton Roads Area Sites for Using Small Modular Reactors to Support Federal Clean Energy Goals*, ORNL/LTR-2014/155, Oak Ridge National Laboratory, Oak Ridge, TN, April 2014.
7. R. J. Belles and O. A. Omitaomu, *Population Sensitivity Evaluation of Two Proposed Hampton Roads Area Sites for a Possible Small Modular Reactor*, ORNL/TM-2014/300, August 2014.
8. R. J. Belles, G. T. Mays, O. A. Omitaomu, and W. P. Poore, *Evaluation of Suitability of Selected Set of Coal Plant Sites for Repowering with Small Modular Reactors*, ORNL/TM-2013/109, March 2013.
9. W. P. Poore, R. J. Belles, G. T. Mays, and O. A. Omitaomu, *Evaluation of Suitability of Selected Set of Department of Defense Military Bases and Department of Energy Facilities for Siting a Small Modular Reactor*, ORNL/TM-2013/118, March 2013.
10. Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, Nuclear Regulatory Commission, April 1998.

APPENDIX A—EVALUATION OF SELECTED SITES NEAR FEDERAL ENERGY CLUSTERS

The sites included in Appendix A include:

Florida Panhandle
- Herbert Scholz Generating Plant
- Plant Farley
- NAS Pensacola

South-Central Texas
- Lackland Air Force Base
- South Texas Project
- Twin Oaks Power Station

Central Colorado
- Fort Carson
- Ray Nixon Power Plant
- Arapahoe Station

APPENDIX A— EVALUATION OF SELECTED SITES NEAR FEDERAL ENERGY CLUSTERS

A.1 Nominal Site Evaluation Process

Each site summary in Appendix A includes specific detail regarding the site location similar to that shown for the Herbert Scholz Generating Plant in Fig. A.1. Relevant, publicly available detail about each site is summarized, and a table of statistics similar to that shown in Table A.1 is provided to support a description of each site. Each site statistic table includes:

- Population within 0.5, 1, 5, and 10 miles, which allows a population density calculation
- Distance to 400, 800, 1600, and 3200 MW(e) grid capacity[‡]
- Nearest cities with populations greater than 10,000, 50,000, 100,000, and 500,000
  - These results are calculated from the site center to the nearest city center with a population between ranges of values (10,000 to 50,000, 50,000 to 100,000, etc.).
  - If a site resides within a large city, the algorithm will still identify the nearest population centers meeting each set of ranges.
- Distance to cooling water makeup source greater than 50,000, 100,000, 200,000, and 500,000 gpm stream flow
  - Note that a 360 MW(e) modular iPWR installation requires approximately 30,000 gpm stream flow, assuming no more than 10% of the available stream flow is used for power production.
  - Available cooling water makeup is based on current consumption. The cooling water already used by a given coal station may be sufficient for a replacement iPWR SMR.
- Geotechnical information, including
  - Maximum earthquake acceleration
  - Maximum slope
  - Nearest fault line
  - Nearest hazardous site
- Accessibility by road, water, rail, and air

In each site evaluation summary, a satellite aerial view of the site is provided such as that shown in Fig. A.2. This provides a convenient look at the area topography, including nearby major roads, rivers, and population activity (e.g., towns and subdivisions).

Following the satellite view of each site, a screening criteria summary bar, or “dashboard” chart, provides a quick look at what siting issues may exist for each site, similar to that shown in Table A.2. The SMR SSEC that are not met at the screened values are indicated. If an SMR siting criterion box is green, there is no potential siting issue. Hatched purple and green indicates that only a portion of the area does not meet that criterion; this is termed a “partial” siting issue for the site. Solid purple indicates that the particular SMR criterion is an issue for a significant portion of the site. The SMR SSEC are listed, and their respective values appear below the summary bar for reference.

[‡] Grid capacity data are based on 2004 data.

Following the site screening criteria dashboard in each evaluation summary is a localized composite map similar to that shown in Fig. A.3. At the local level, individual 100 × 100 m cells can be identified. The cells are color coded as in Fig. A.3 to clearly illustrate multiple unmet SMR siting criteria. A green square has no siting issues relative to the selected SMR SSEC values; a yellow square has a single siting issue; an orange square has two siting issues; and a blue square has three or more siting issues. This is a powerful feature of the OR-SAGE tool, because it allows areas with a limited number of siting challenges to also be identified. Engineering solutions may be available for areas with just one or two siting challenges. A more detailed discussion of each SMR SSEC is available in the general SMR siting report[2] provided to DOE-NE in September 2012.

Based on preliminary design information and expert judgment, it is assumed that an iPWR base design package can be accommodated on a 50 acre footprint. In general, more than 50 acres are available at each of the evaluated sites.

Following the composite map, nine smaller individual siting criterion maps are provided to identify the locations where the selected individual parameter values may not be met within the proposed site boundary. Any areas shown colored magenta do not meet the individual siting criterion at the value selected for SMR screening. These individual layer maps provide a visual correlation to the data reported in the dashboard chart for each site.

Using all these available data inputs, a summary of each site is prepared regarding the favorability of the site for potentially supporting an mPower iPWR. The impact of any unfavorable layers on each site is evaluated. Any community impacts, such as surrounding schools and known population trends or limitations, are noted.

A.2 Herbert Scholz Generating Plant

A.2.1 Location Detail

The Herbert Scholz Generating Plant is located in Jackson County, Florida. As shown in Fig. A.1, the site is located in the Florida Panhandle, northwest of Tallahassee, Florida. The plant is on the west bank of the Apalachicola River in a rural area just south of the Georgia border. Approximately three miles upstream of the site is the Jim Woodruff Lock and Dam. Lake Seminole is formed behind the dam and, the lock allows barge navigation on the river. Rail access is available onsite via the rail spur for coal delivery. The town of Sneads, Florida, is approximately 3.5 miles northwest of the site, and the town of Chattahoochee, Florida, is approximately 3.5 miles northeast of the site.

- Location: Herbert Scholz Generating Plant
- Owner: Gulf Power Company (subsidiary of Southern Company)
- Coordinates: lat. 30.669377° N, long. 84.886731° W

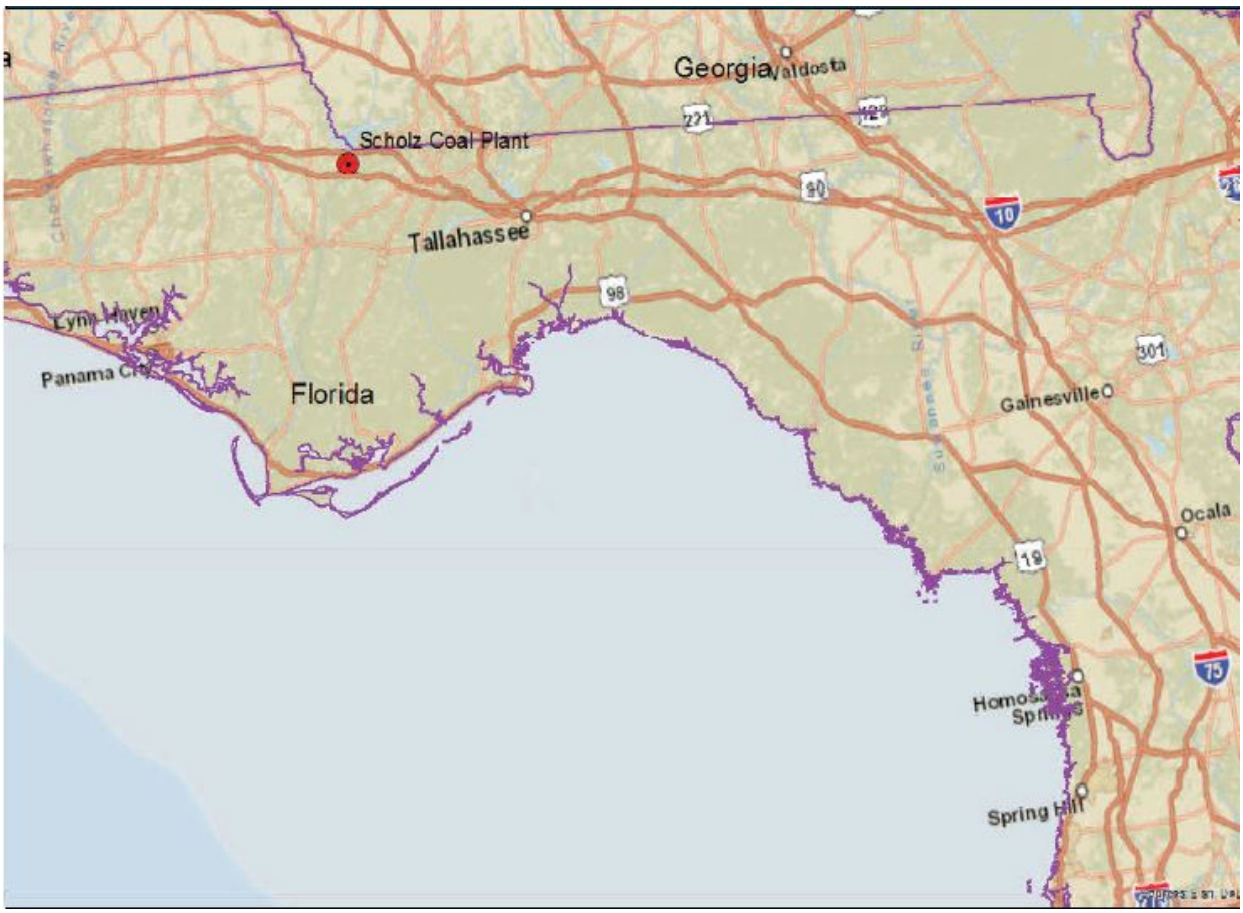


Fig. A.1. Herbert Scholz Generating Plant location map.

A.2.2 Site Description and Status

The Herbert Scholz Generating Plant is a two unit coal power plant. The two units have a nameplate capacity of 80 MW(e) according to a Gulf Power plant factsheet, though other sources list the site capacity as high as 98 MW(e). Both units were commissioned in 1953. Plant heat is rejected using once-through cooling from the adjacent Apalachicola River.

The plant footprint is approximately 500 acres, but the utility may control even more. There is virtually no development in the immediate vicinity of the plant. As noted in Table A.1, there are no fault lines in the immediate vicinity, and maximum earthquake ground acceleration is minimal. Sufficient fresh water makeup is available for an iPWR closed-cycle cooling system. Once-through cooling is currently in use at the site but is based on an 80 MW(e) plant; upscaling the once-through cooling to a 360 MW(e) plant may be problematic with regulators.

Gulf Power has also accumulated approximately 3000 acres in Escambia County, Florida, north of Pensacola, to hold for siting a future generating station. A nuclear power plant is one alternative for the Escambia site based on Gulf Power news releases.

The permanent population within one mile of the plant is approximately 500 people, yielding a population density of approximately 160 people per square mile. The permanent population within 10 miles of the plant is approximately 34,000 people, yielding a population density of about 110 people per square mile.

Table A.1. Herbert Scholz Generating Plant site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 0	> 400 MWe	~ 23 mi
1 mi of Site Centroid	~ 500	> 800 MWe	~ 128 mi
5 mi of Site Centroid	~ 16,000	> 1600 MWe	~ 40 mi
10 mi of Site Centroid	~ 34,000	> 3200 MWe	~ 185 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Bainbridge, GA	> 50,000 gpm	~ 0.3 mi (Apalachicola R)
> 50,000	Dothan, AL	> 100,000 gpm	~ 0.3 mi (Apalachicola R)
> 100,000	Tallahassee, FL	> 200,000 gpm	~ 0.3 mi (Apalachicola R)
> 500,000	Jacksonville, FL	> 500,000 gpm	~ 0.3 mi (Apalachicola R)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 2.2 mi (US-90)
Max Slope	~ 2 %	Distance to Water Transport	~ 0.3 mi (Apalachicola River)
Nearest Fault Line	~ 830 mi	Distance to Rail Transport	~ 0.1 mi (CXST)
Nearest Hazard Site	~ 37 mi (Airport—Tallahassee Regional)	Distance to Airport	~ 37 mi (Tallahassee Rgnl.)

A.2.3 Aerial Imagery

The aerial imagery in Fig. A.2 indicates abundant open space near and within the Scholz coal-fired power plant boundary.

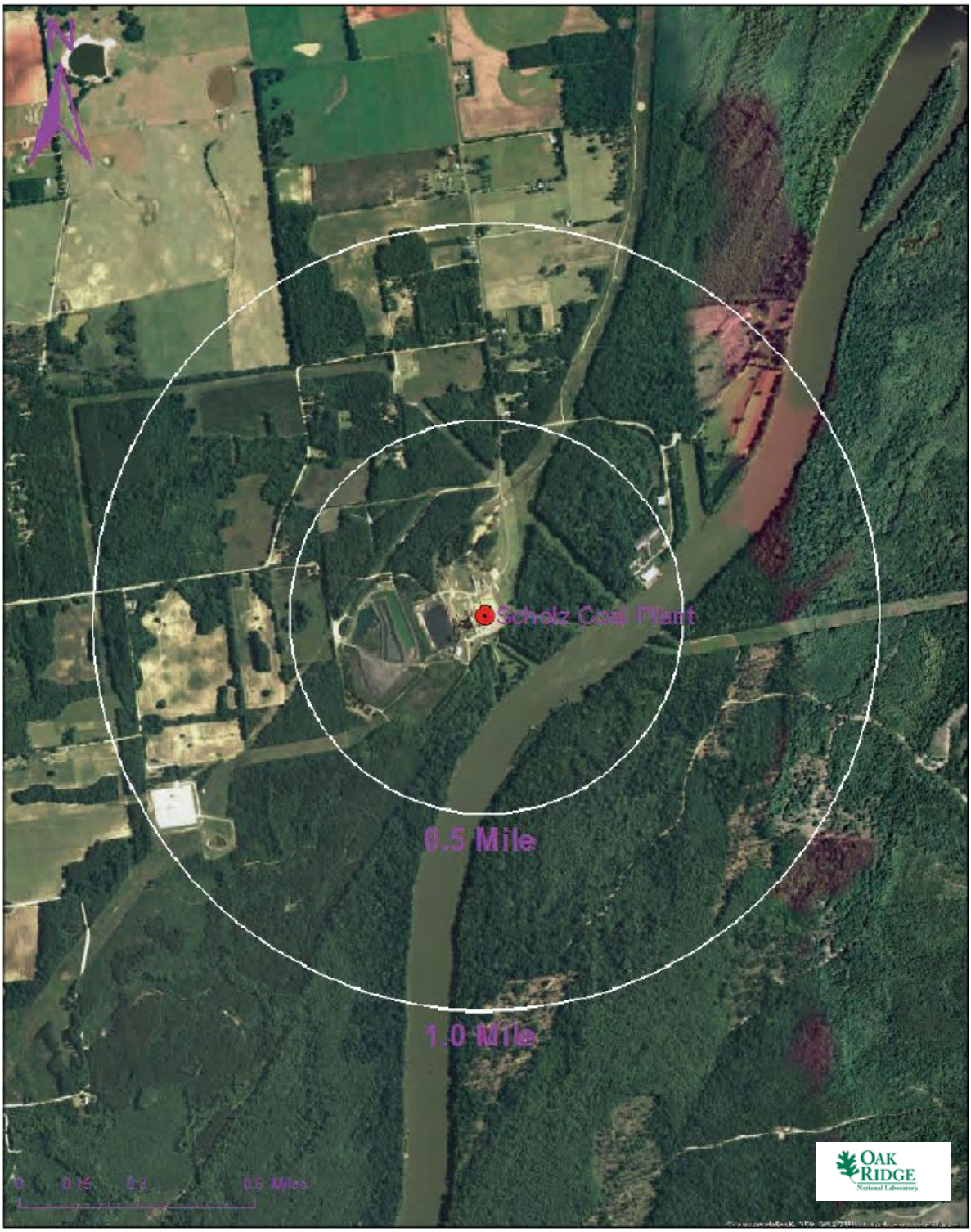
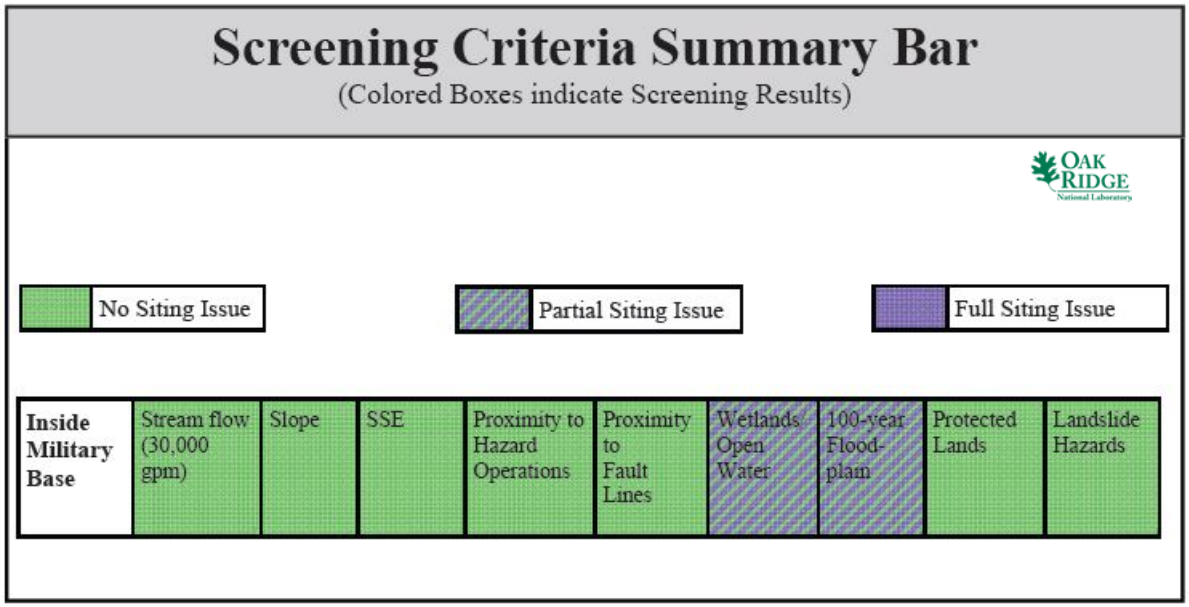


Fig. A.2. Satellite view of Herbert Scholz Generating Plant proximity.

A.2.4 Screening Criteria Overview

Table A.2. Herbert Scholz Generating Plant siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.2.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the Scholz facility is shown in Fig. A.3. As shown (independent of population), much of the property is immediately favorable for siting an iPWR. The orange area is associated with the river, and much of the adjacent yellow area is related to the floodplain. Following this map are maps of the individual SMR siting criteria based on selected input values.

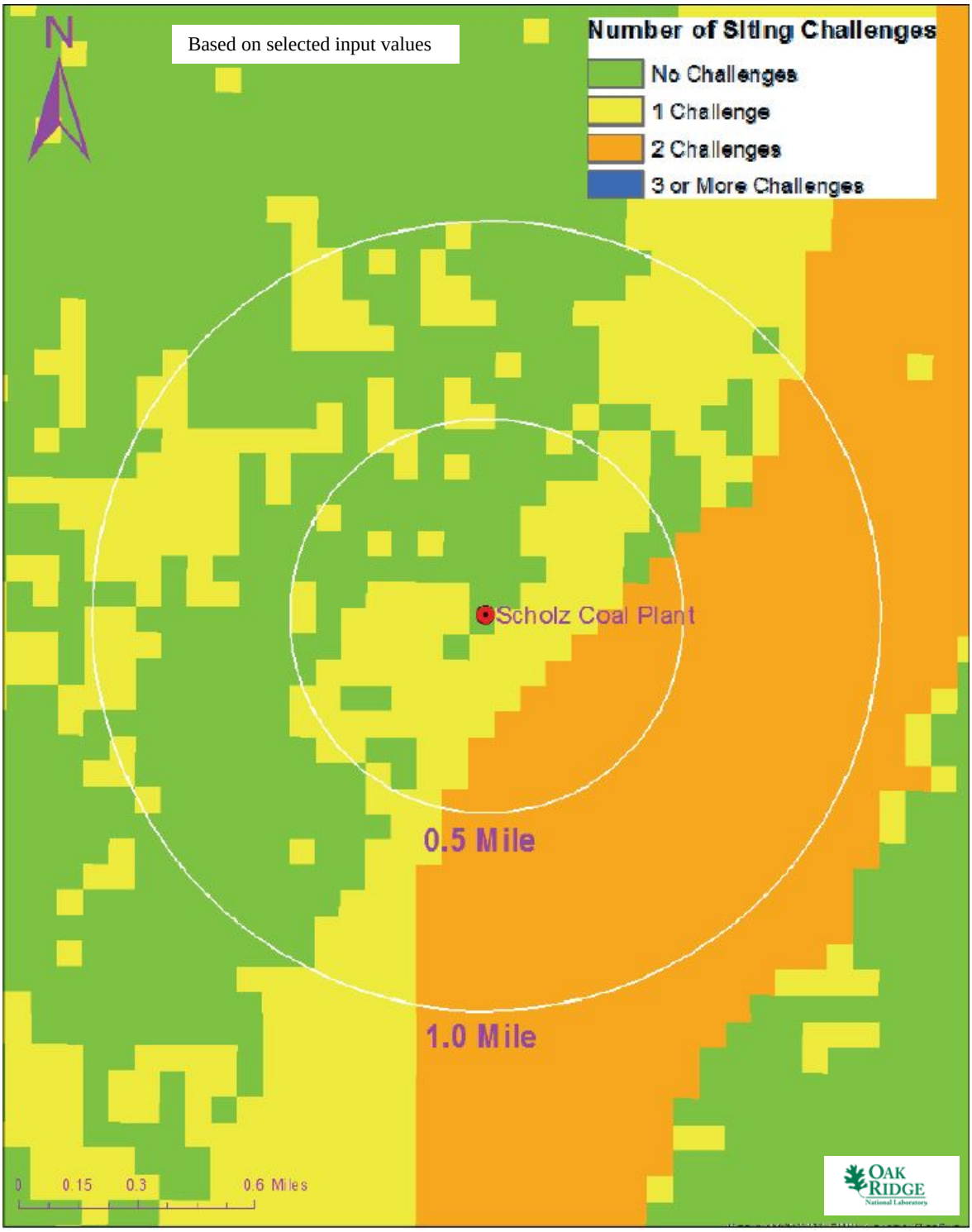
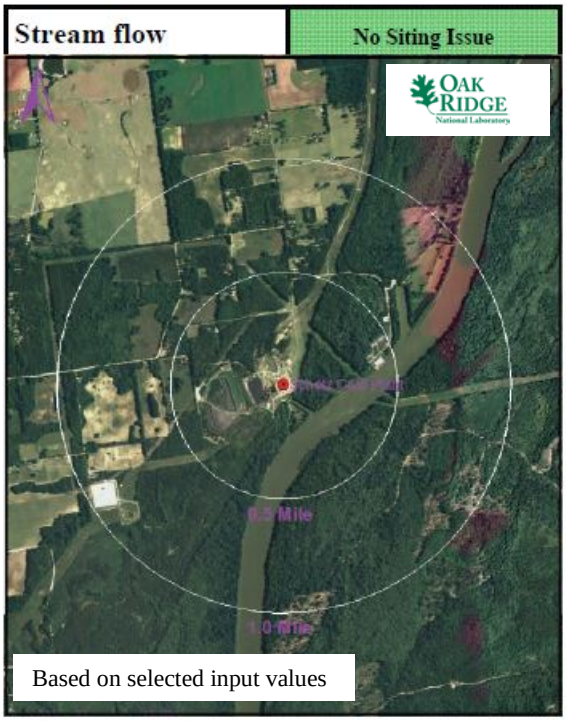
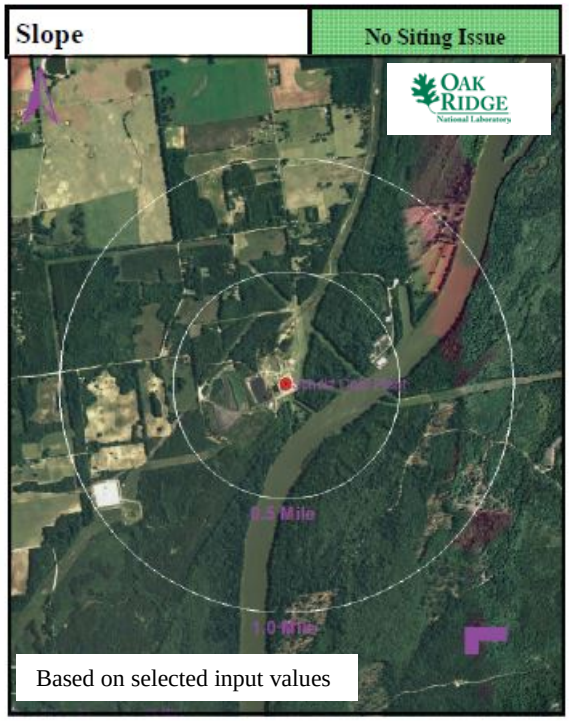
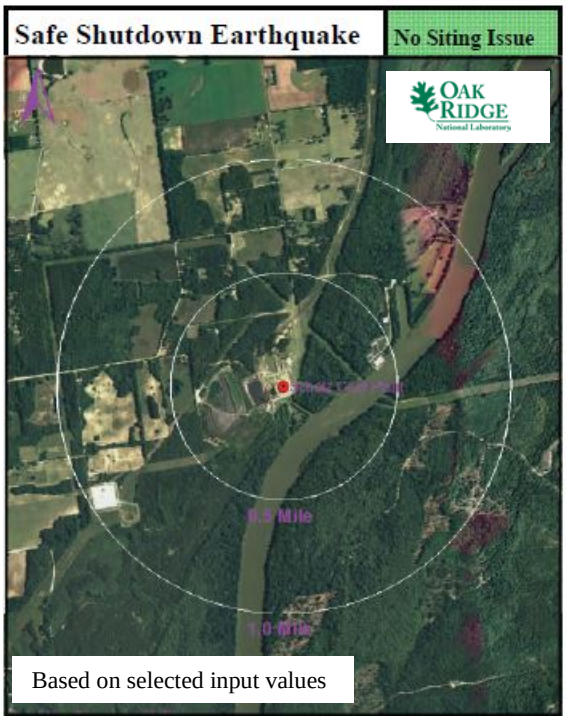


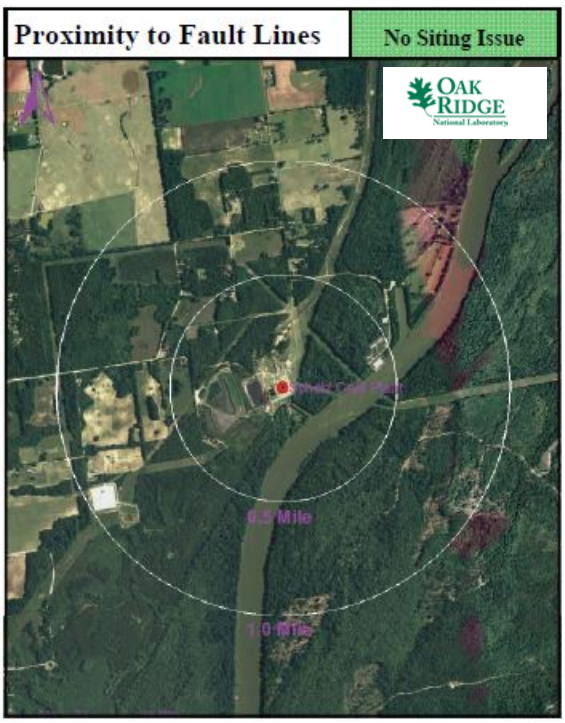
Fig. A.3. Herbert Scholz Generating Plant composite map.

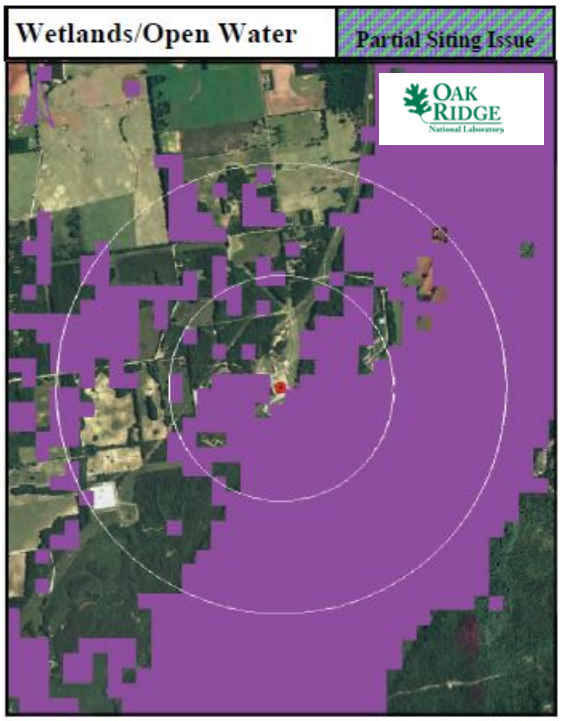


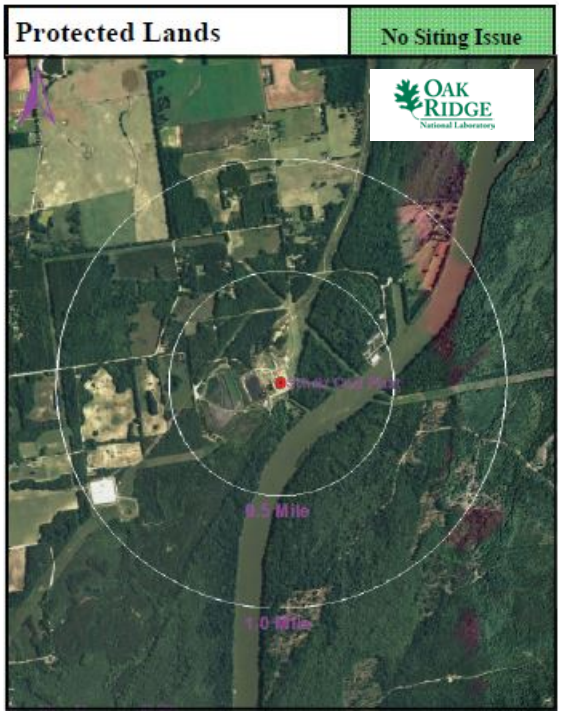




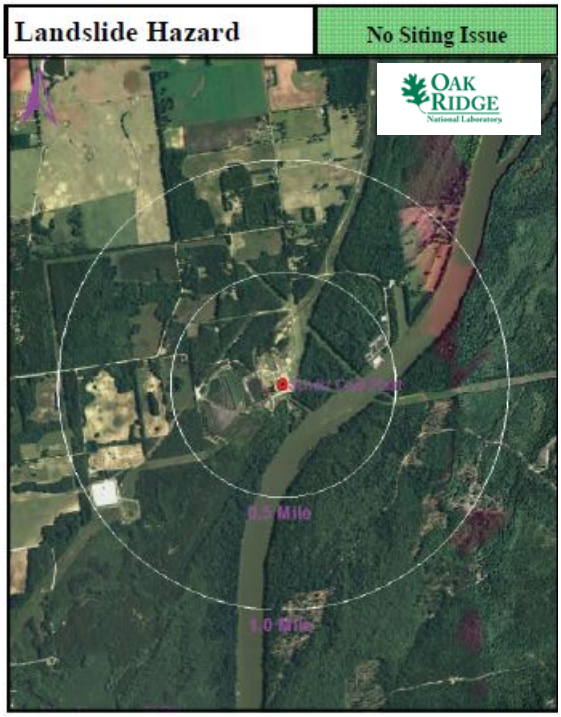
Herbert Scholz Generating Plant







Herbert Scholz Generating Plant



Herbert Scholz Generating Plant

A.2.6 Site Evaluation

As shown in the maps above, area to the north and northeast of the current plant location is predominantly favorable for siting an iPWR. West and southwest of the current site indicates wetlands. Much of this area has manmade canals which could be filled as necessary. Therefore, most of the site positioned away from the river should be favorable for siting an iPWR.

Table A.2 further confirms the partial siting issues for wetlands and open water, as well as the 100 year floodplain. This is indicative of a plant site immediately adjacent to the cooling water supply. Adequate flood barriers can be engineered. As such, these do not appear to create a barrier to siting an iPWR at the site.

There are a few homes in the area related to the farming and rural use of the surrounding land. Table A.1 corroborates the low population density of the area. No strong population growth indicators are present in the area. As shown in Fig. 3 in the main body of the document, the site is well outside an area evaluated at 500 people per square mile within ten miles. No nearby public lands or schools are observed. Therefore, population should not be an issue in the future at this site.

Multiple transportation opportunities are favorable for iPWR construction. There is a concrete pier on the Apalachicola River just north of the plant site. Rail access for coal delivery is available onsite, and highway access is available within three miles.

The site has electrical generation infrastructure available. In addition, Gulf Power Company is already considering nuclear generation at another Florida site, and the parent company already operates several nuclear power stations in addition to ongoing construction at the Vogtle plant site. Overall, the Herbert Scholz Generating Plant meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.

A.3 Plant Farley

A.3.1 Location Detail

Plant Farley is located in Houston County, Alabama. As shown in Fig. A.4, the site is located east of Dothan, Alabama, on the Alabama-Georgia state line and just north (15 miles) of the Florida state line. The plant is on the west bank of the Chattahoochee River in a wooded rural area. Approximately 2.5 miles upstream of the site is the George W. Andrews Lock and Dam. The lock and dam are used for navigational purposes, providing for barge navigation on the river. Rail access is available nearby. The town of Columbia, Alabama, is approximately five miles north of the site, and the town of Ashford, Alabama, is approximately eight miles southwest of the site.

- Location: Plant Farley
- Owner: Alabama Power (subsidiary of Southern Company)
- Coordinates: lat. 31.223056° N, long. 85.111667° W

Fig. A.4. Plant Farley location map.

A.3.2 Site Description and Status

Plant Farley is a two unit nuclear power plant. The two units total 1820 MW(e) and were commissioned in 1977 and 1981. Both units have been approved by the NRC for license renewal. Plant heat is rejected through mechanical draft cooling towers. Makeup water is drawn from the Chattahoochee River.

The plant footprint is approximately 1850 acres, but the utility may have access to even more land. There is virtually no development in the immediate vicinity of the plant. As noted in Table A.3, there are no fault lines in the immediate vicinity, and maximum earthquake ground acceleration is minimal. Sufficient fresh water makeup is available for a closed-cycle cooling system.

The permanent population within one mile of the plant is approximately 500 people, yielding a population density of approximately 160 people per square mile. The permanent population within 10 miles of the plant is approximately 30,000 people, yielding a population density of about 95 people per square mile.

Table A.3. Plant Farley site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Boundary	~ 3,000	> 400 MWe	~ 2 mi
1 mi of Site Boundary	~ 10,000	> 800 MWe	~ 1 mi
5 mi of Site Boundary	~ 350,000	> 1600 MWe	~ 28 mi
10 mi of Site Boundary	~ 1,200,000	> 3200 MWe	~ 182 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Poquoson, VA	> 50,000 gpm	~ 0.1 mi (Big Lost River)
> 50,000	Suffolk, VA	> 100,000 gpm	~ 0.1 mi (Big Lost River)
> 100,000	Chesapeake, VA	> 200,000 gpm	~ 0.1 mi (Big Lost River)
> 500,000	Washington, DC	> 500,000 gpm	~ 0.1 mi (Big Lost River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.05 g	Distance to Major Roadway	~ 0.8 mi (I-64)
Max Slope	~ 4%	Distance to Water Transport	~ 0.2 mi (Elizabeth River)
Nearest Fault Line	~ 1169 mi	Distance to Rail Transport	~ 0.2 mi (NS)
Nearest Hazard Site	~ 9.6 mi (Airport—Norfolk Int'l)	Distance to Airport	~ 9.6 mi (Norfolk Int'l)

A.3.3 Aerial Imagery

The aerial imagery in Fig. A.5 shows the plant sits along a bend of the Chattahoochee River. There is ample open space near and within the Farley site.

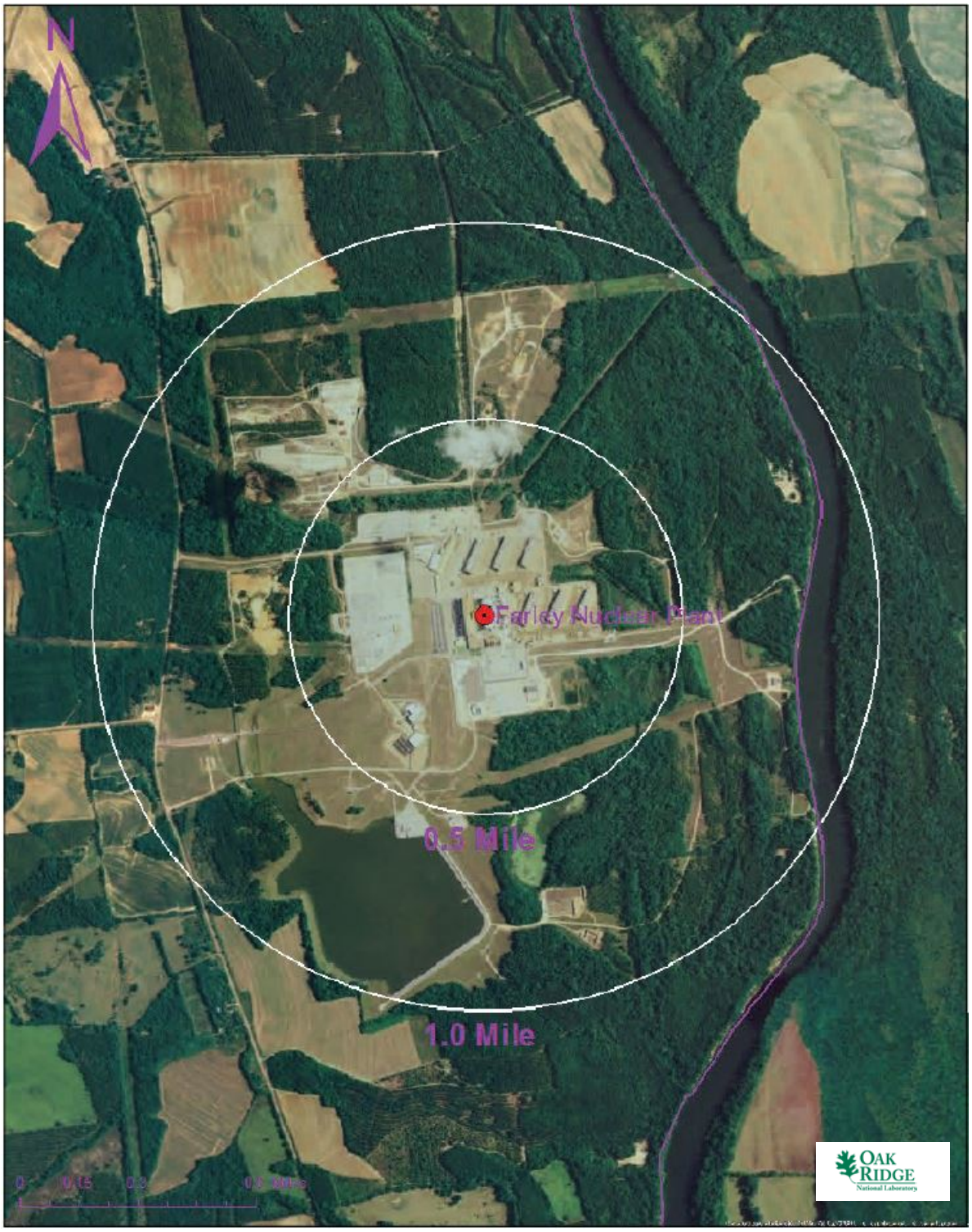
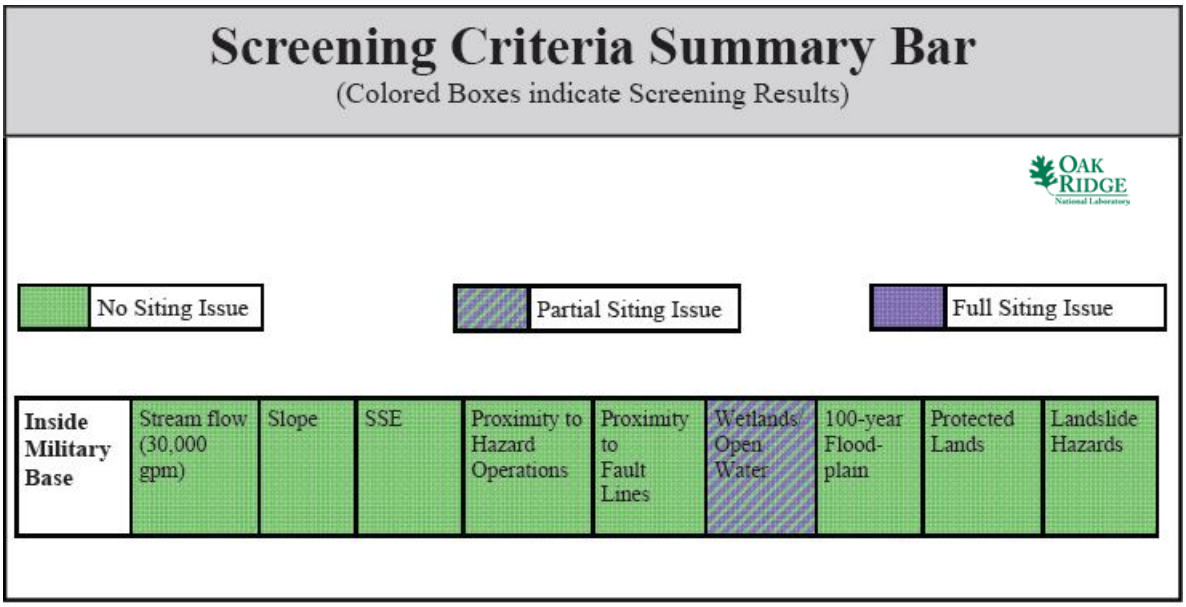


Fig. A.5. Satellite view of Plant Farley proximity.

A.3.4 Screening Criteria Overview

Table A.4. Plant Farley siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.3.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Plant Farley is shown in Fig. A.6. As shown (independent of population), most of the site outlined is favorable for siting an iPWR. The yellow area inside the 0.5 mile circle is a drainage area, and the southern yellow area inside the 1.0 mile circle is a cooling pond. Following this map are maps of the individual SMR siting criteria based on selected input values.

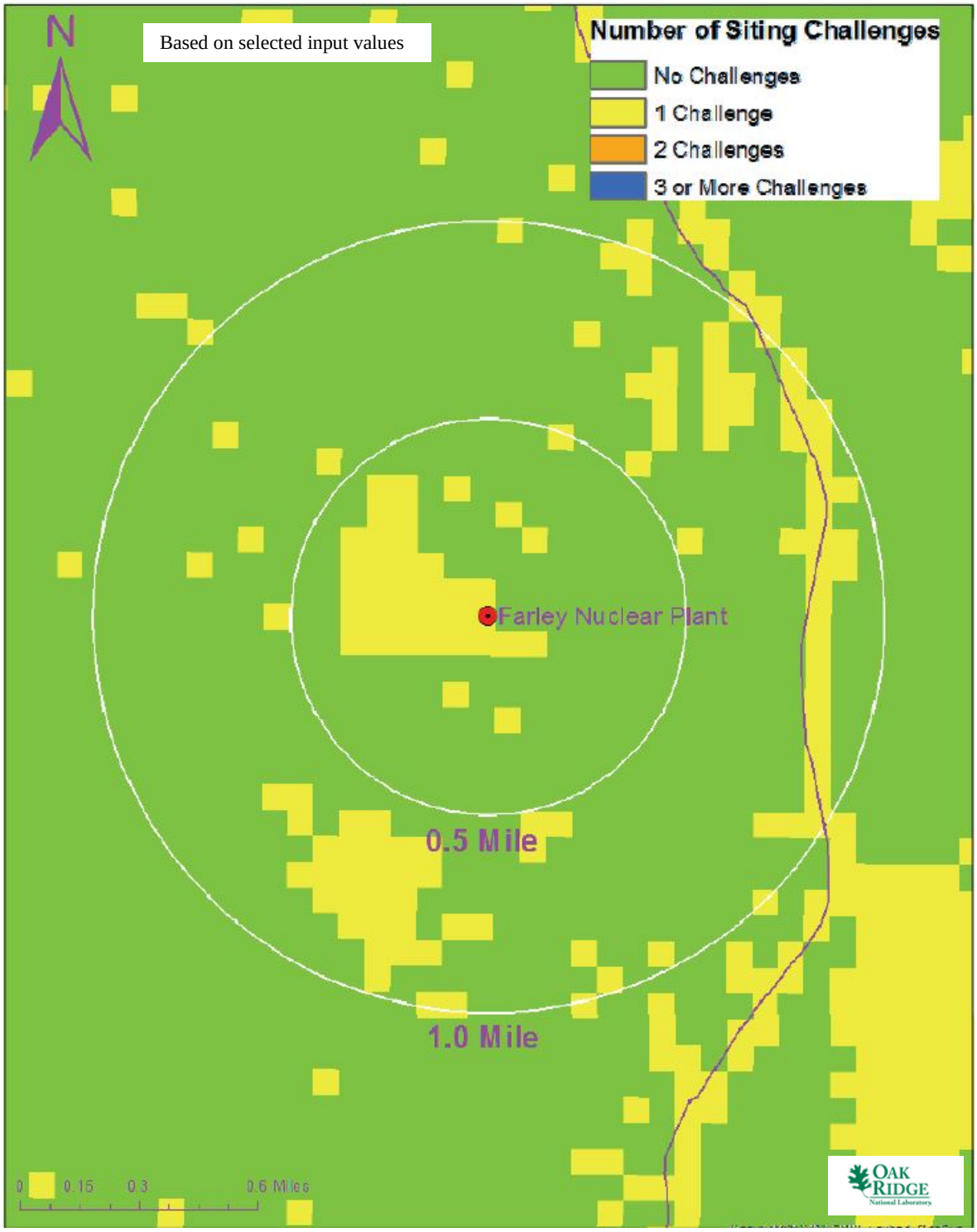
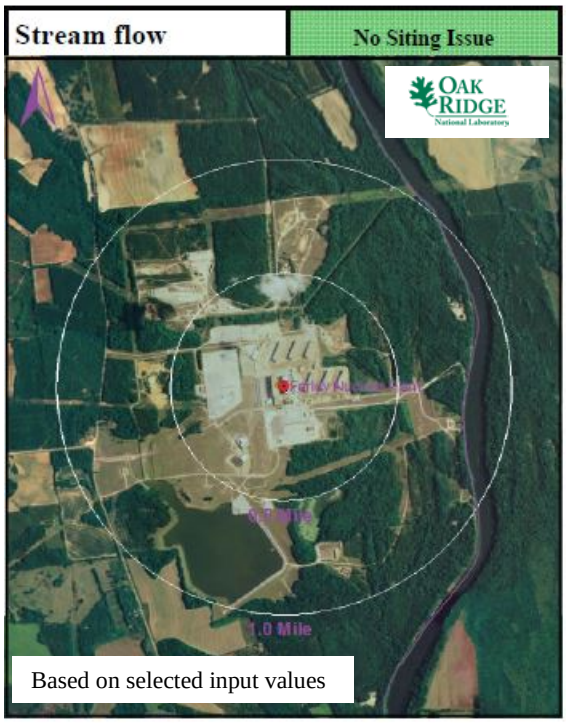
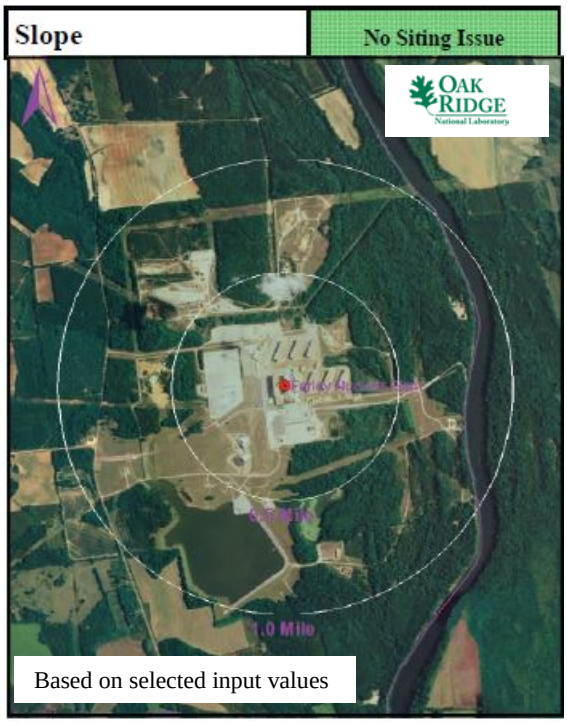
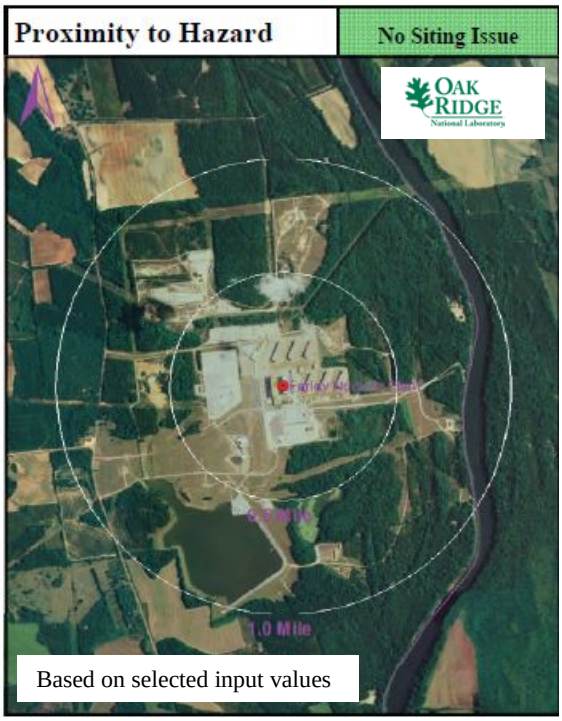


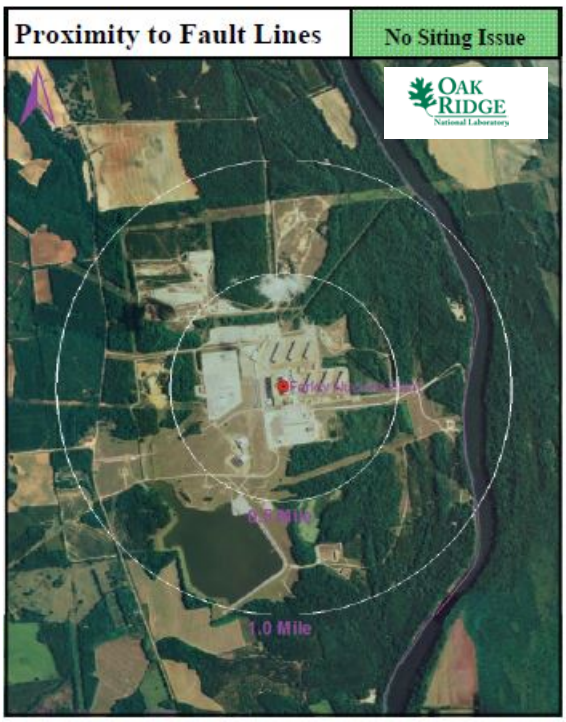
Fig. A.6. Plant Farley composite map.

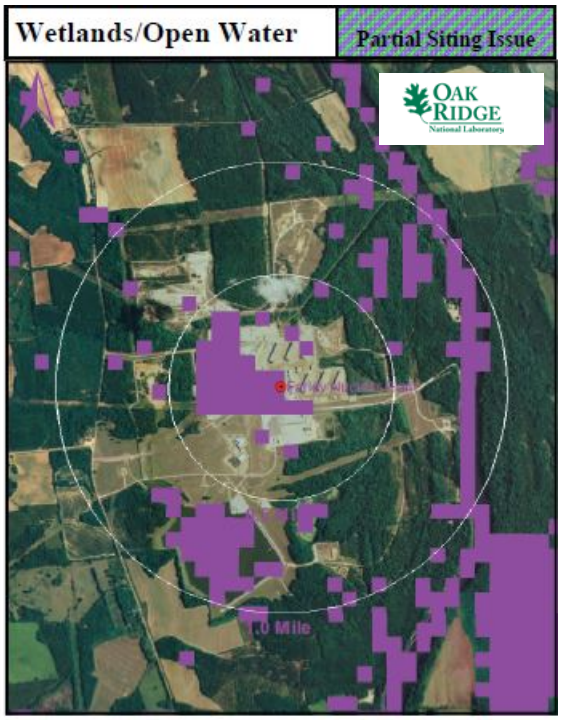


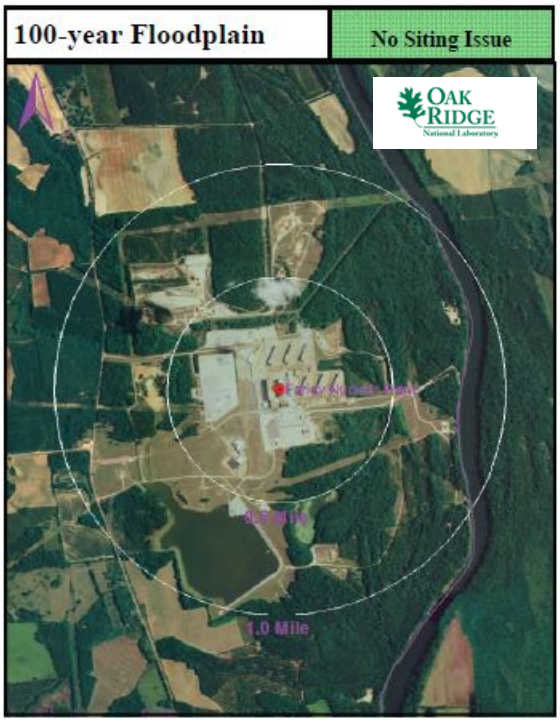




Plant Farley







Plant Farley

Plant Farley

A.3.6 Site Evaluation

As shown in the maps above, the area to the north and southeast of the current plant location is predominantly favorable for siting an iPWR. Other areas around the current site include wetlands. However, most of the land lying west of the Chattahoochee River should be favorable for siting an iPWR.

Table A.4 further confirms the partial siting issues for wetlands and open water. This is indicative of a plant site immediately adjacent to the cooling water supply. Adequate flood barriers can be engineered. As such, these do not appear to create a barrier to siting an iPWR at the site.

There are a few homes in the area related to the farming and rural use of the surrounding land. Table A.3 corroborates the low population density of the area. No strong population growth indicators are present in the area. As shown in Fig. 3 in the main document, the site is well outside an area evaluated at 500 people per square mile within ten miles. No nearby public lands or schools are observed. Therefore, population should not be an issue in the future at this site.

The site has electrical generation infrastructure available. In addition, Alabama Power Company and its parent company operate several nuclear power plants, including Plant Farley. The logistical and security infrastructure necessary to operate a nuclear power facility is already in place at the Plant Farley site. Overall, the Plant Farley site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.

A.4 Naval Air Station Pensacola

A.4.1 Location Detail

Naval Air Station (NAS) Pensacola is located in Escambia County, Florida. As shown in Fig. A.7, the site is located on the western shore of the entrance to Pensacola Bay, south of Pensacola, Florida. Air and barge access are available onsite. Warrenton, Florida, is two miles north of the center of the air station. The city of Pensacola is just north of Warrenton.

- Location: NAS Pensacola
- Owner: US Navy
- Coordinates: lat. 30.350019° N, long. 87.292267° W

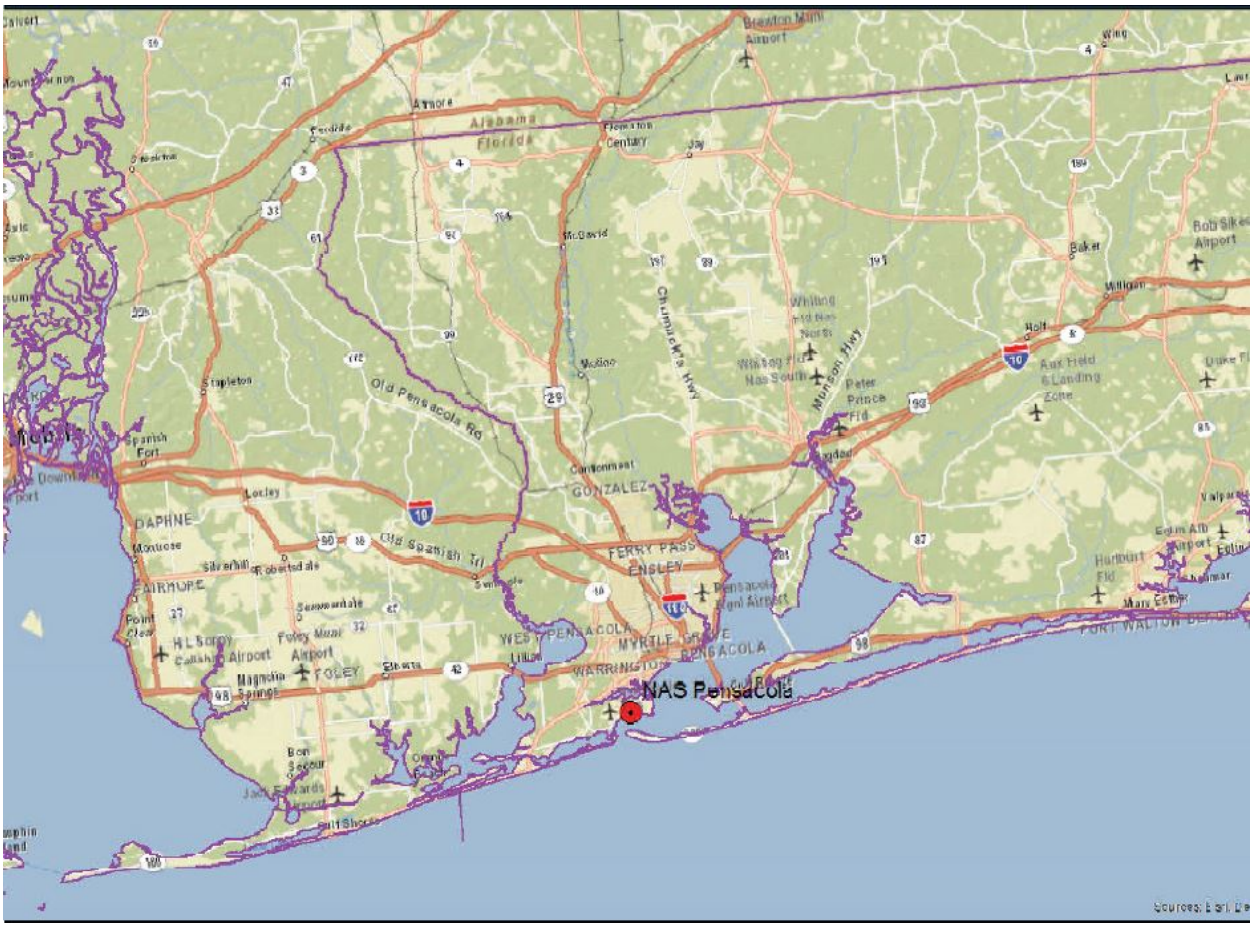


Fig. A.7. NAS Pensacola location map.

A.4.2 Site Description and Status

NAS Pensacola is the home of numerous tenant commands. Over 20,000 military and civilian personnel work on the base. The site consists of almost 6,000 acres at the main base, most of which contain substantial infrastructure. A large portion of the acreage is devoted to the airfield.

As noted in Table A.5, there are no fault lines in the immediate vicinity, and maximum earthquake ground acceleration is less than 0.2g. Adequate utility grid capacity for an iPWR facility is available within 10

miles. Once-through cooling is available from Pensacola Bay, and reprocessed (gray) water cooling may be an option given the proximity to population centers.

The permanent population within one mile of the camp is approximately 7,000 people, yielding a population density of approximately 2,230 people per square mile. The permanent population within 10 miles of the plant is approximately 350,000 people, yielding a population density of about 1,100 people per square mile.

Table A.5. NAS Pensacola site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 3,200	> 400 MWe	~ 8.5 mi
1 mi of Site Centroid	~ 7,000	> 800 MWe	~ 63.0 mi
5 mi of Site Centroid	~ 92,000	> 1600 MWe	~ 135.0 mi
10 mi of Site Centroid	~ 350,000	> 3200 MWe	~ 248.0 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Warrington, FL	> 50,000 gpm	~ 0.9 mi (Pensacola Bay)
> 50,000	Pensacola, FL	> 100,000 gpm	~ 0.9 mi (Pensacola Bay)
> 100,000	Mobile, AL	> 200,000 gpm	~ 0.9 mi (Pensacola Bay)
> 500,000	Memphis, TN	> 500,000 gpm	~ 0.9 mi (Pensacola Bay)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 3.2 mi (US-98)
Max Slope	~ 0 %	Distance to Water Transport	~ 0.9 mi (Pensacola Bay)
Nearest Fault Line	~ 710 mi	Distance to Rail Transport	~ 0.5 mi (AGR)
Nearest Hazard Site	~ 11 mi (Airport—Pensacola Regional)	Distance to Airport	~ 11 mi (Pensacola Rgnl.)

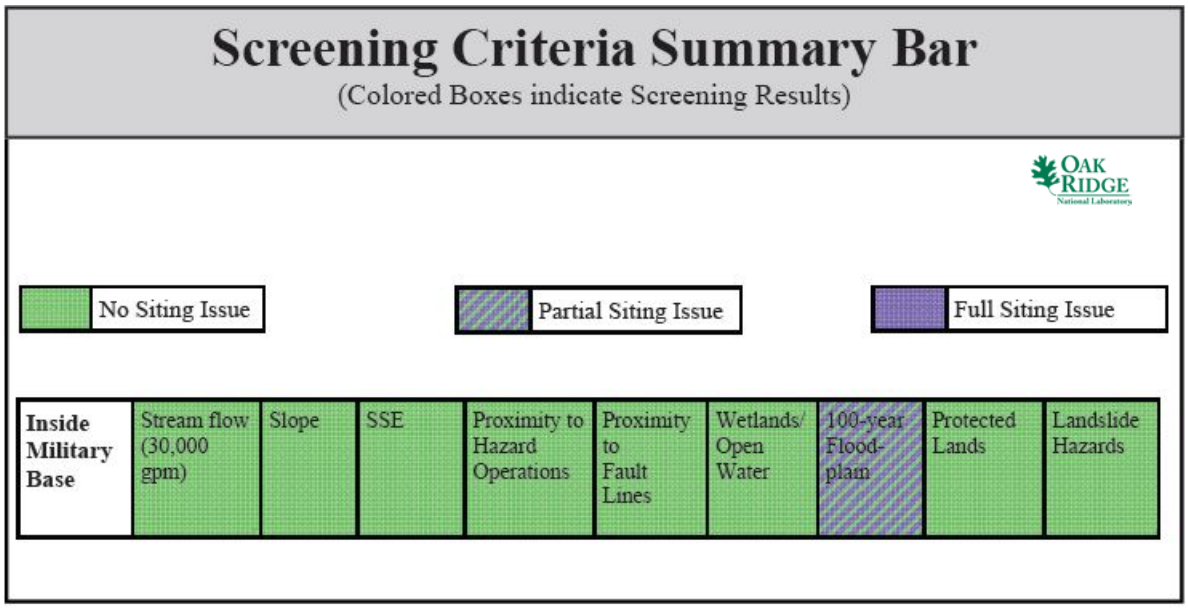
A.4.3 Aerial Imagery

As shown in the aerial imagery in Fig. A.8, there is very little open space available that is not in alignment with existing air station runways.

Fig. A.8. Satellite view of NAS Pensacola proximity.

A.4.4 Screening Criteria Overview

Table A.6. NAS Pensacola siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.4.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to NAS Pensacola is shown in Fig. A.9. As shown (independent of population), the northern area of the base indicates no challenges for siting an iPWR. However, this area is aligned with the base runways and would be unsuitable. Following this map are maps of the individual SMR siting criteria based on selected input values.

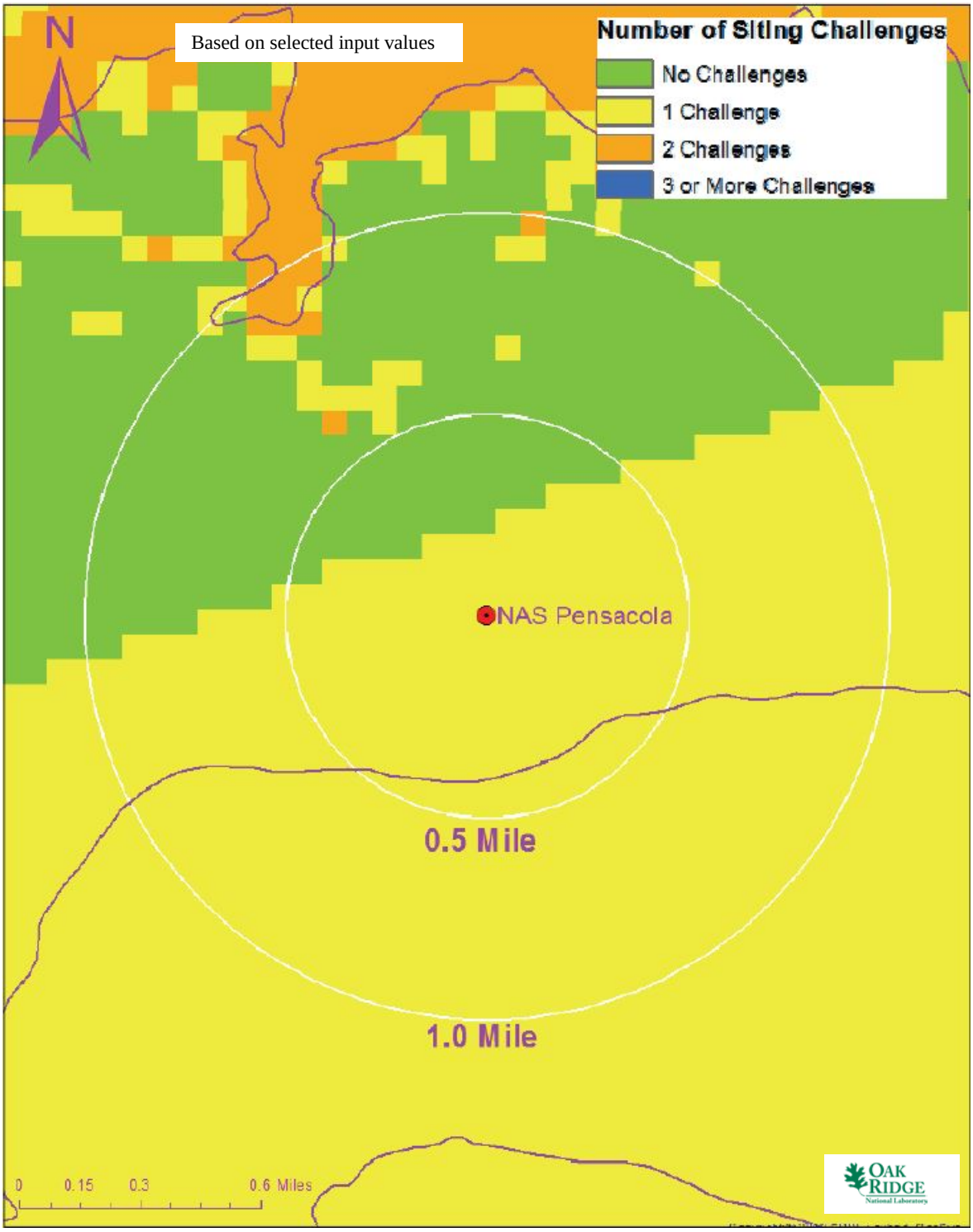
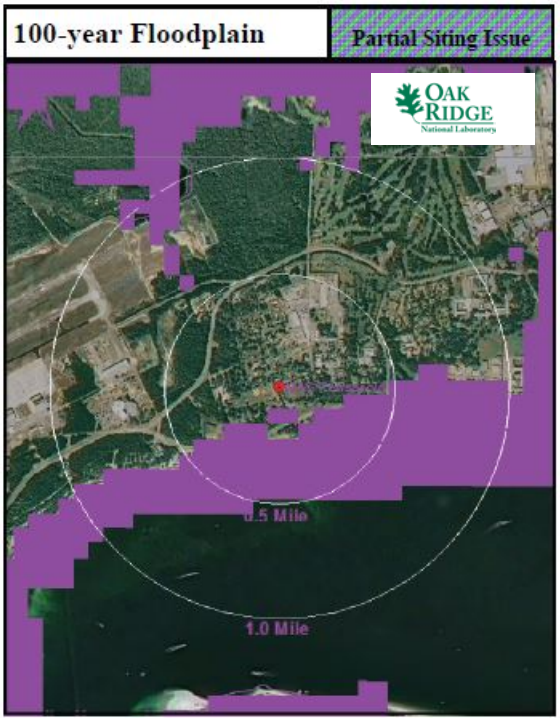


Fig. A.9. NAS Pensacola composite map.

NAS Pensacola



NAS Pensacola

NAS Pensacola

A.4.6 Site Evaluation

As shown in the maps above, area on the north side of the base center is predominantly favorable for siting an iPWR. However, further inspection shows that this land is in direct alignment with one set of runways on the base.

Table A.6 further confirms the partial siting issues for wetlands and open water, as well as the 100 year floodplain. This is indicative of a plant site immediately adjacent to the cooling water supply. Ordinarily, adequate flood barriers could be engineered, which would limit these siting issues as a barrier to siting an iPWR at the site. However, there is considerable infrastructure on the base which limits the opportunity for siting an iPWR.

The location of the base on the gulf coast is a strong future population growth indicator. As shown in Fig. 3 in the main document, the site is well inside an area evaluated at 500 people per square mile within ten miles. Therefore, population will be an issue in the future at this site.

Multiple transportation opportunities are favorable for iPWR construction. There are pier facilities onsite, and airport access is available through the air station.

Because of the dense base infrastructure and the proximity and alignment of the base runways, NAS Pensacola is not a likely candidate for consideration of siting an iPWR.

A.5 Lackland Air Force Base

A.5.1 Location Detail

Lackland Air Force Bases are located in Bexar County, Texas, within the San Antonio city limits, as shown in Fig. A.10. Leon Creek, a small waterway, runs through the site. Medio Creek runs just south and west of the base site on the adjacent Medina Air Force Base. Interstate access is available nearby, and an airfield is available on the site.

- Location: Lackland Air Force Base
- Owner: US Air Force
- Coordinates: lat. 29.382539° N, long. 98.596674° W

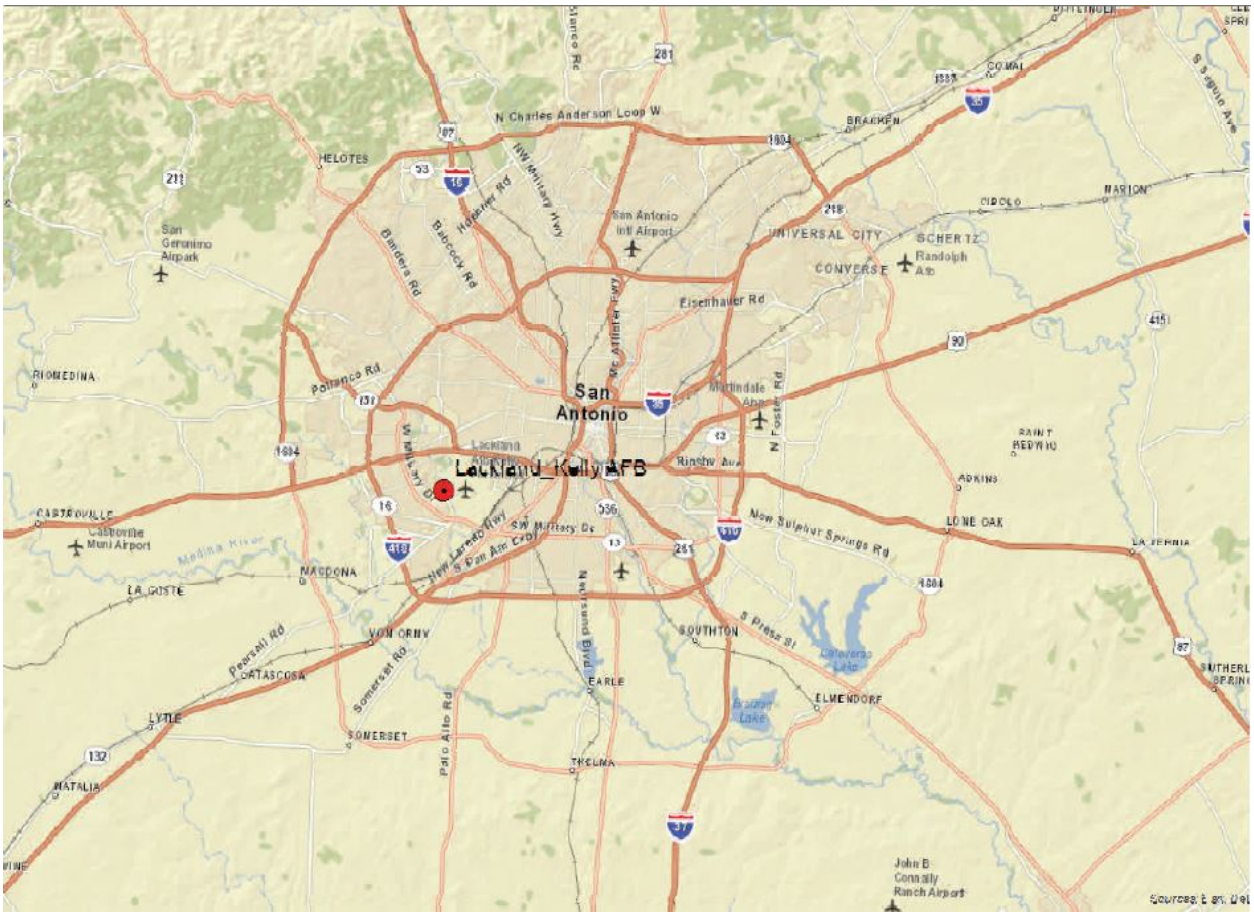


Fig. A.10. Lackland Air Force Base location map.

A.5.2 Site Description and Status

Joint Base San Antonio includes Lackland Air Force Base, Kelly Air Force Base, and the Medina Training Annex, among other local military installations. These three collocated installations encompass 7000 acres. Approximately 40,000 airmen, family members, and civilian employees work or live onsite.

There is considerable undeveloped area available on the Medina Training Annex west of the center of the Lackland base. As noted in Table A.7, there are no fault lines in the immediate vicinity, and maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR facility is available nearby. Sufficient fresh water makeup is available for a closed-cycle cooling

system from the Medina River. Flood control on the river is provided by the Medina Lake Dam west of San Antonio.

The permanent population within one mile of the camp is approximately 12,500 people, yielding a population density of approximately 4,000 people per square mile. The permanent population within 10 miles of the plant is approximately 1,484,000 people, yielding a population density of about 4,700 people per square mile.

Table A.7. Lackland Air Force Base site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 0	> 400 MWe	~ 18.0 mi
1 mi of Site Centroid	~ 12,500	> 800 MWe	~ 0.1 mi
5 mi of Site Centroid	~ 384,000	> 1600 MWe	~ 206.0 mi
10 mi of Site Centroid	~ 1,484,000	> 3200 MWe	~ 851.0 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Helotes, TX	> 50,000 gpm	~ 20 mi (Medina River)
> 50,000	Round Rock, TX	> 100,000 gpm	~ 37 mi (Guadalupe Rv.)
> 100,000	Killeen, TX	> 200,000 gpm	~ 37 mi (Guadalupe Rv.)
> 500,000	San Antonio, TX	> 500,000 gpm	~ 37 mi (Guadalupe Rv.)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 0.9 mi (SR-113)
Max Slope	~ 2 %	Distance to Water Transport	~ 110 mi (Victoria Barge Canal)
Nearest Fault Line	~ 276 mi	Distance to Rail Transport	~ 2.1 mi (UP)
Nearest Hazard Site	~ 9 mi (Refinery—Age Refining & Marketing	Distance to Airport	~ 13 mi (San Antonio Int'l)

A.5.3 Aerial Imagery

The aerial imagery in Fig. A.11 indicates moderate open space southwest of the base center point. The Medina Training Annex lies further west outside the aerial frame and includes significant open space.

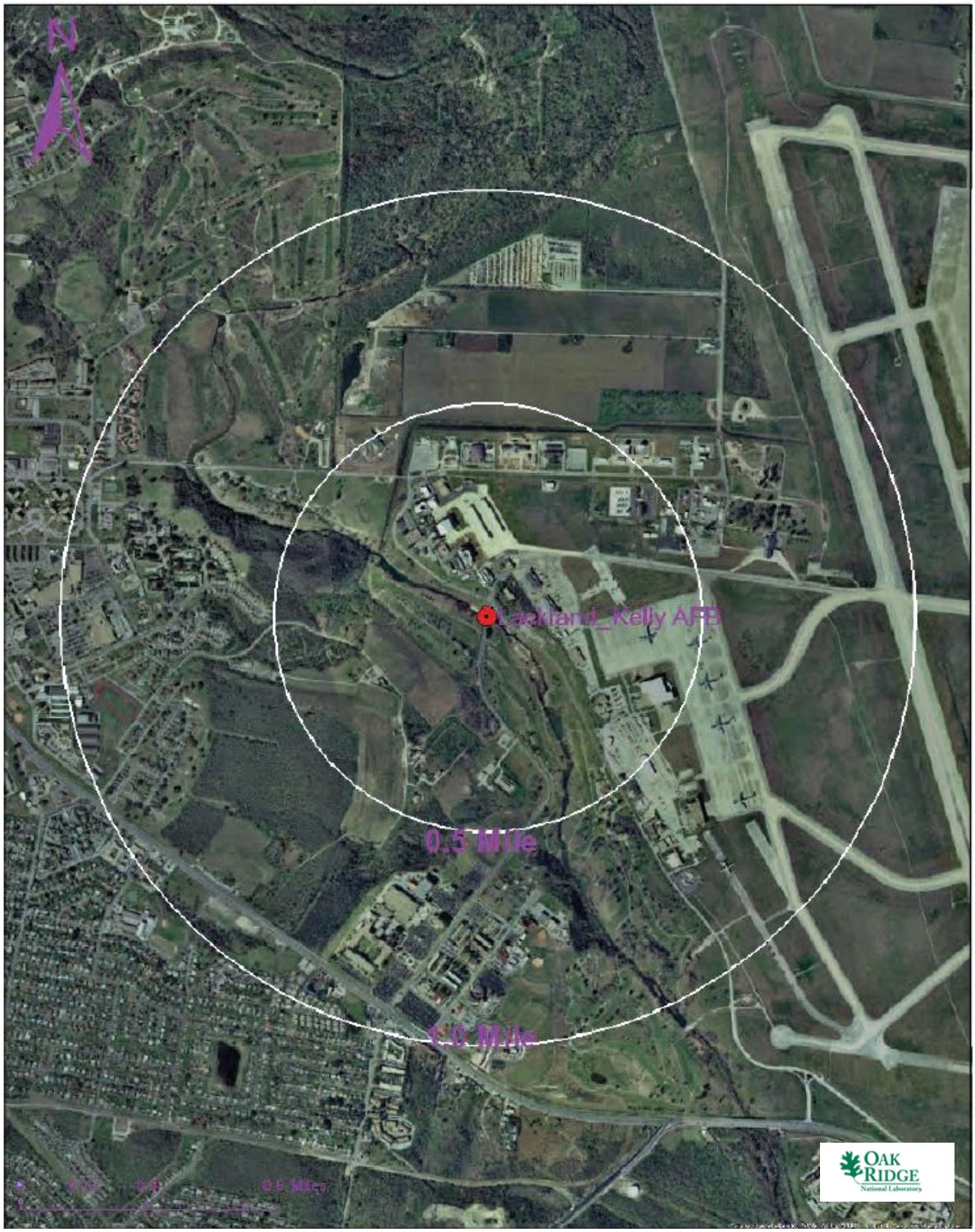
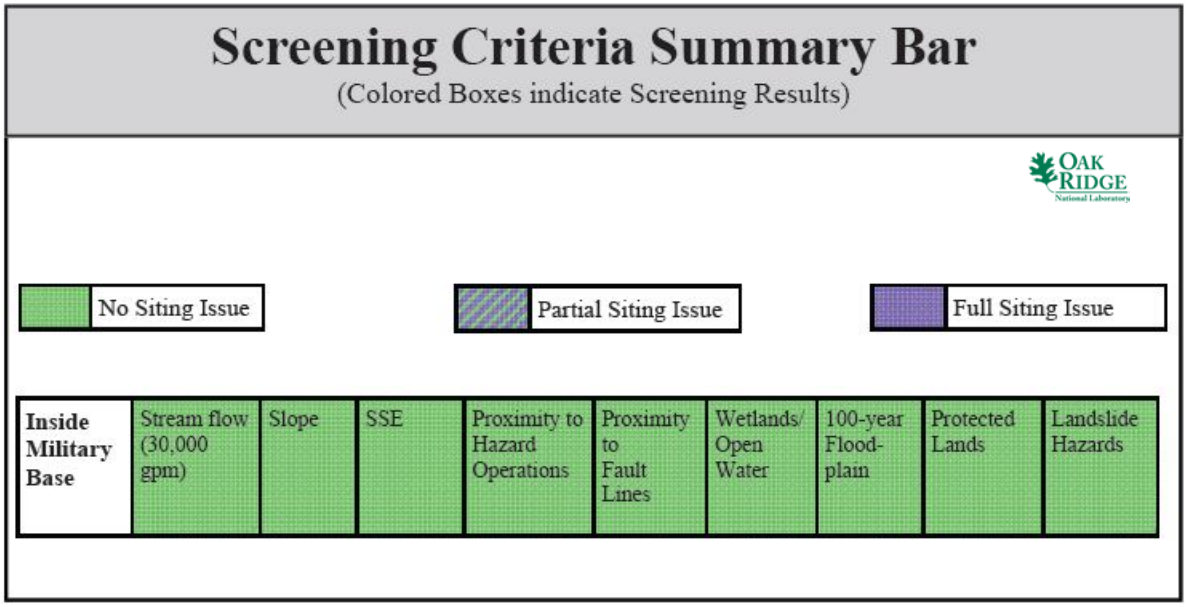


Fig. A.11. Satellite view of Lackland Air Force Base proximity.

A.5.4 Screening Criteria Overview

Table A.8. Lackland Air Force Base siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.5.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Lackland Air Force Base is shown in Fig. A.12. As shown (independent of population), half of the property near the base center is favorable for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

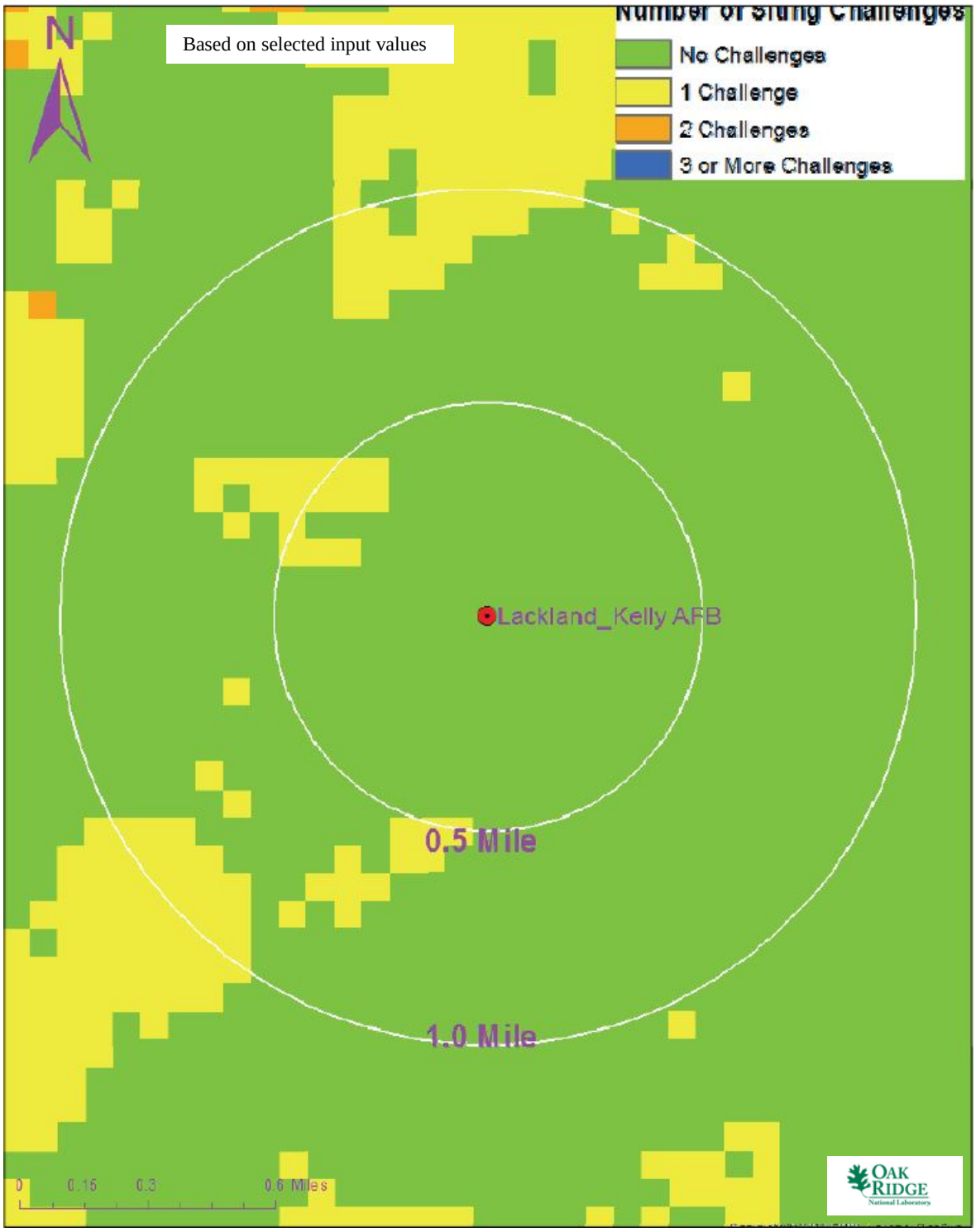
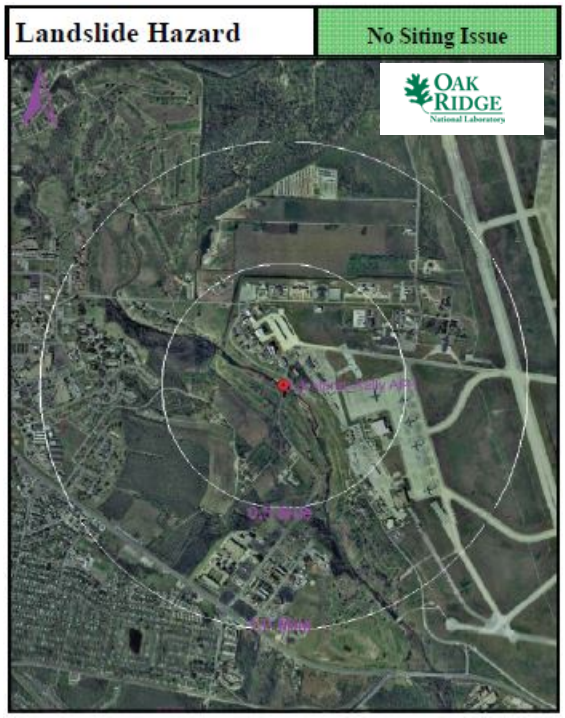


Fig. A.12. Lackland Air Force Base composite map.

Lackland Air Force Base

Lackland Air Force Base



Lackland Air Force Base

A.5.6 Site Evaluation

As shown in the maps above, a significant portion of the base is favorable for siting an iPWR. However, the eastern section of the figure shows the base runways, which would not be favorable for siting an iPWR. Table A.8 does not indicate any siting issues within one mile of the base center point.

As shown in Fig. 4. South-Central Texas regional map of potential sites on population avoidance layer. in the main body of the report, the site is within an area evaluated at 500 people per square mile within ten miles. This would require further analysis using more sophisticated population density tools. However, the Medina Training Annex is west of the base center point and further away from the city center. The open space on this section of the base and the expected reduced population density in that part of the base may make that area the most favorable for further analysis.

Though population will still need to be evaluated based on Fig. 4. South-Central Texas regional map of potential sites on population avoidance layer. in the main report, Lackland Air Force Base does meet multiple conventional standards for consideration of siting an iPWR on the base.

A.6 South Texas Project

A.6.1 Location Detail

The South Texas Project is located in Matagorda County, Texas. As shown in Fig. A.13, the site is located on the gulf coast approximately 75 miles southwest of Houston. Bay City, Texas, is 12 miles to the north. The Colorado River runs just east of the site, though a large cooling water reservoir is available onsite. Highway and barge access are readily available to the site.

- Location: South Texas Project
- Owner: STP Nuclear Operating Company
- Coordinates: lat. 28.795147° N, long. 96.049164° W

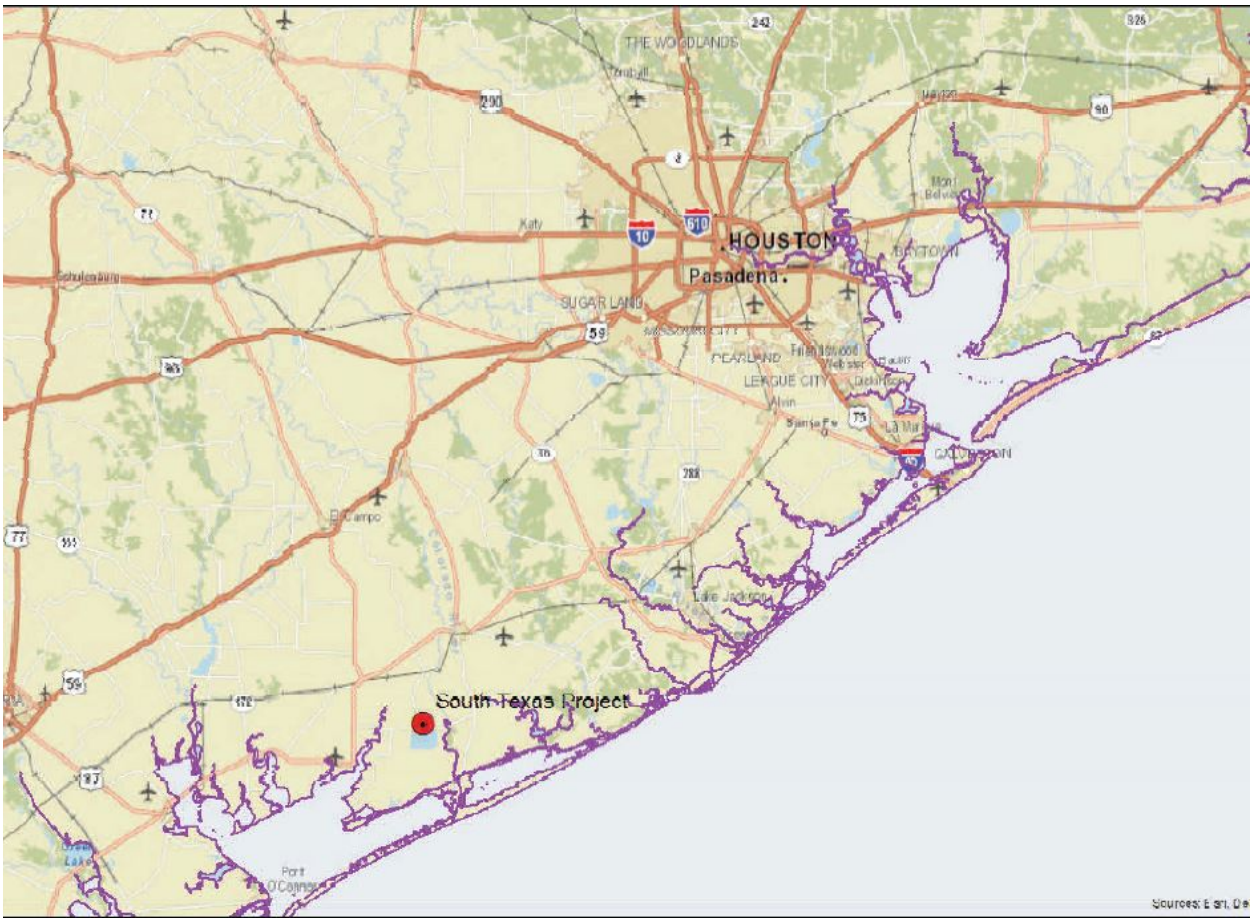


Fig. A.13. South Texas Project location map.

A.6.2 Site Description and Status

The South Texas Project is a two unit nuclear power plant. The two units total 2700 MW(e) and were commissioned in 1988 and 1989. Both units are pending license renewal. Plant heat is rejected to a 7,000 acre reservoir. Makeup water is drawn from the Colorado River. The entire plant resides on 12,200 acres.

There is virtually no development in the immediate vicinity of the plant. As noted in Table A.9, there are no fault lines in the immediate vicinity, and maximum earthquake ground acceleration is minimal. The land is very flat. Adequate utility grid capacity for an iPWR facility is available onsite. Sufficient fresh

water makeup is available for a closed-cycle cooling system from the nearby Colorado River. However, once-through cooling from the existing reservoir may be sufficient to support additional power plants.

The permanent population within one mile of the plant is approximately 2,200 people, yielding a population density of approximately 700 people per square mile. The permanent population within 10 miles of the plant is approximately 24,000 people, yielding a population density of about 75 people per square mile.

Table A.9. South Texas Project site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 800	> 400 MWe	~ 0.1 mi
1 mi of Site Centroid	~ 2,200	> 800 MWe	~ 0.1 mi
5 mi of Site Centroid	~ 9,000	> 1600 MWe	~ 82.0 mi
10 mi of Site Centroid	~ 24,000	> 3200 MWe	~ 730 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Bay City, TX	> 50,000 gpm	~ 3 mi (Colorado River)
> 50,000	Sugar Land, TX	> 100,000 gpm	~ 3 mi (Colorado River)
> 100,000	Pasadena, TX	> 200,000 gpm	~ 3 mi (Colorado River)
> 500,000	Houston, TX	> 500,000 gpm	~ 3 mi (Colorado River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 9.3 mi (SR-35)
Max Slope	~ 0 %	Distance to Water Transport	~ 3 mi (Colorado River)
Nearest Fault Line	~ 430 mi	Distance to Rail Transport	~ 0.2 mi (UP)
Nearest Hazard Site	~ 27 mi (Refinery—Conoco Phillips Company)	Distance to Airport	~ 76 mi (William P. Hobby)

A.6.3 Aerial Imagery

The aerial imagery in Fig. A.14 indicates moderate open space within the South Texas Project boundary.

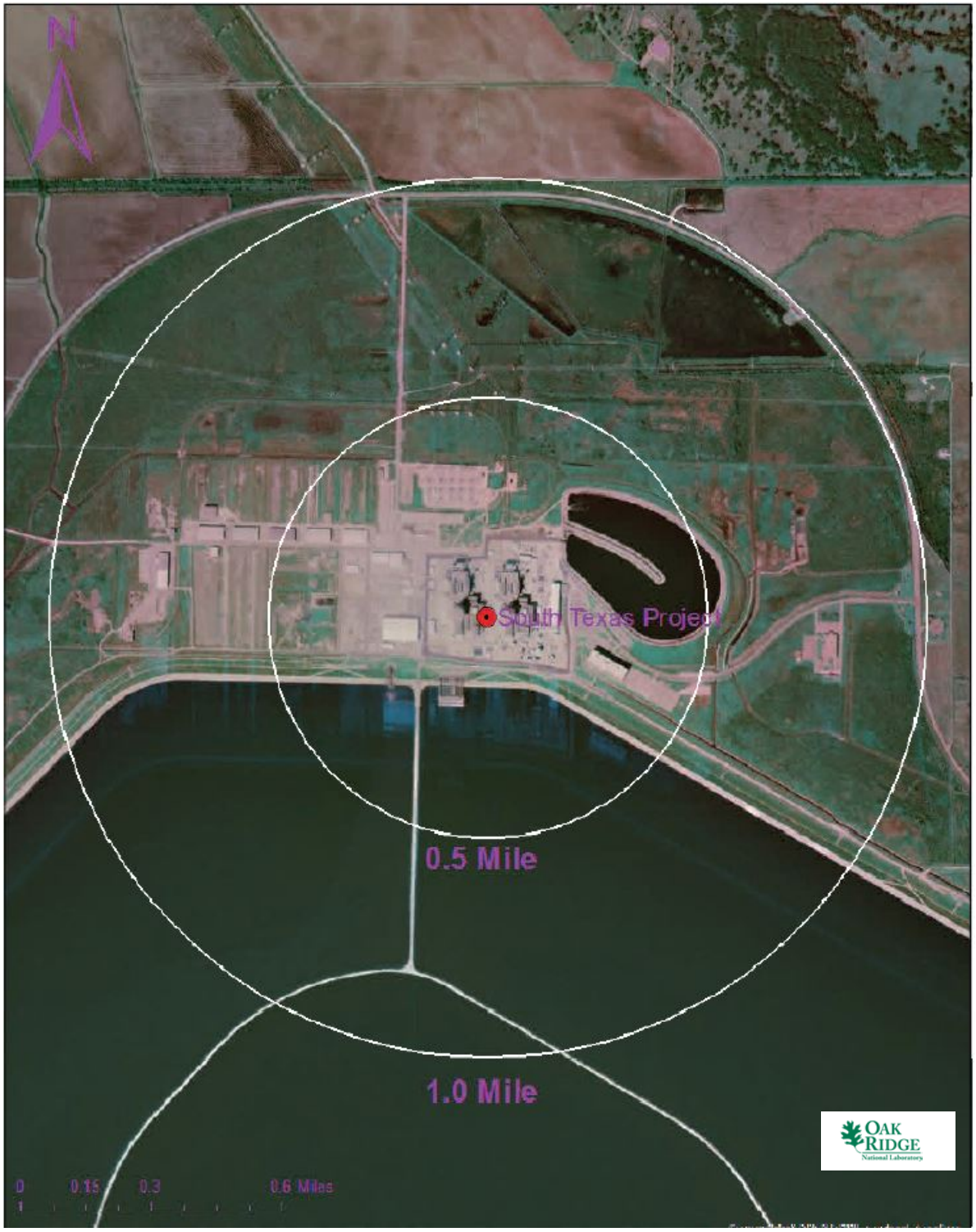
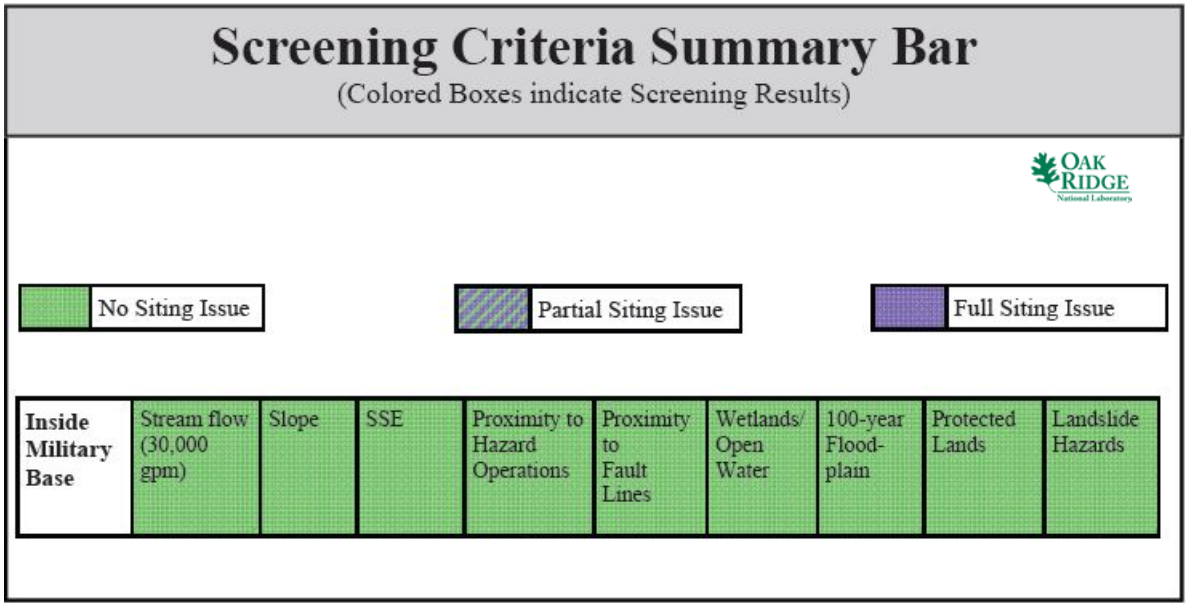


Fig. A.14. Satellite view of South Texas Project proximity.

A.6.4 Screening Criteria Overview

Table A.10. South Texas Project siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.6.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the South Texas Project is shown in Fig. A.15. As shown, (independent of population), only the cooling water reservoir shows up as a screening issue for siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

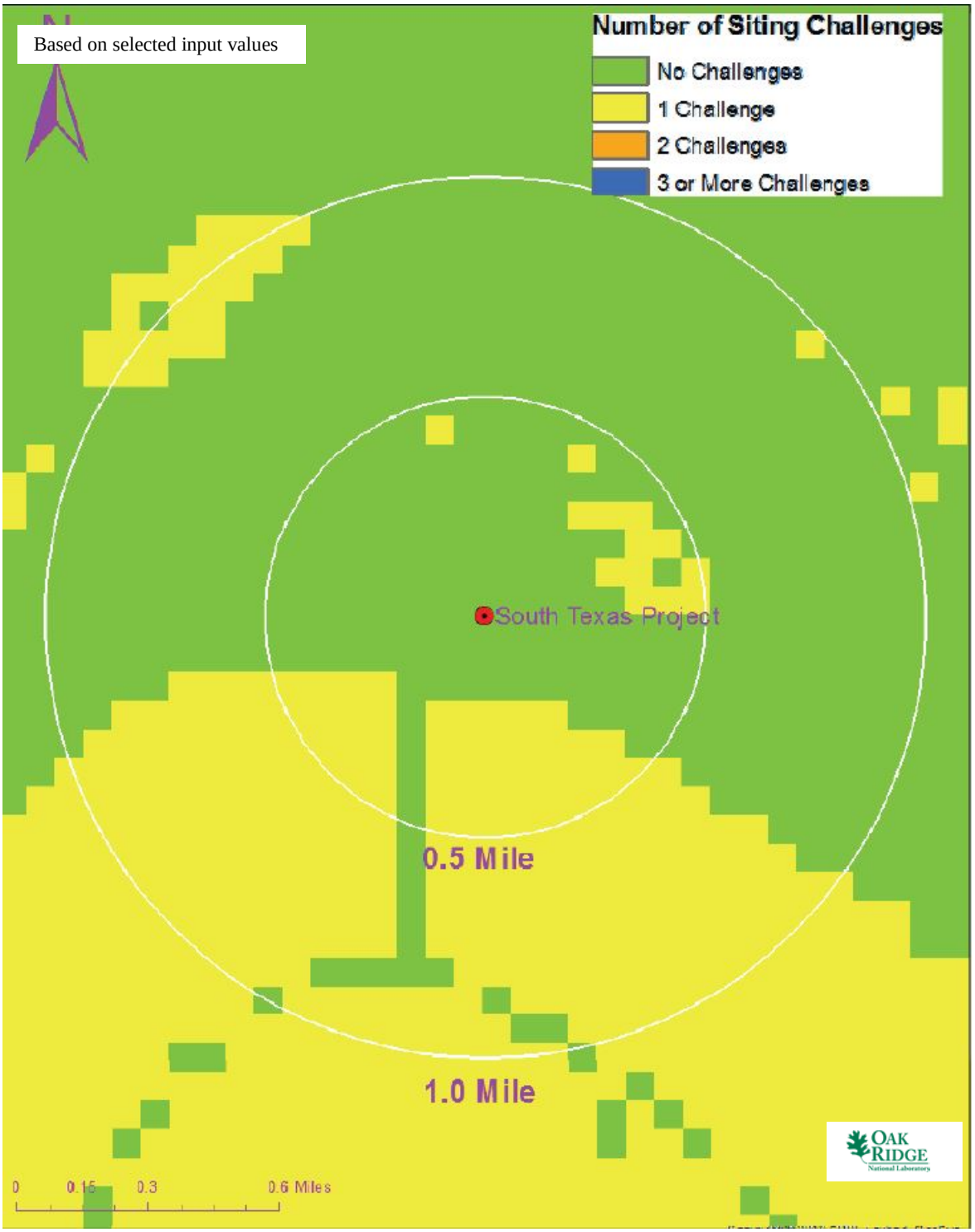
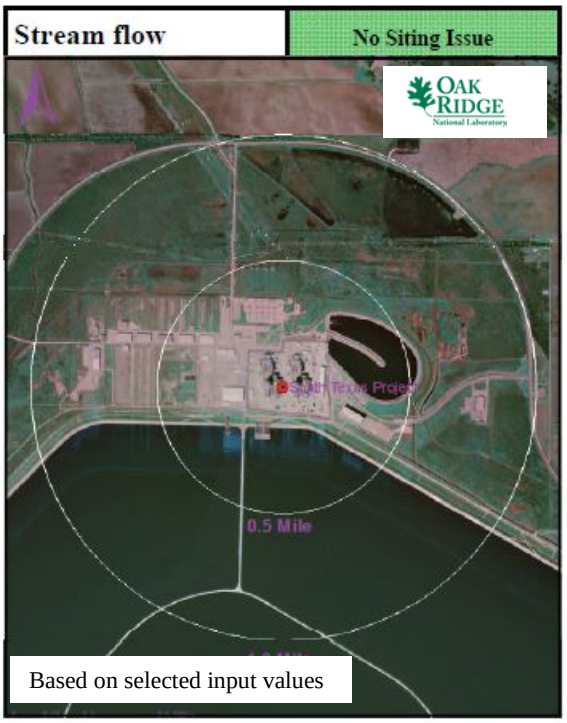
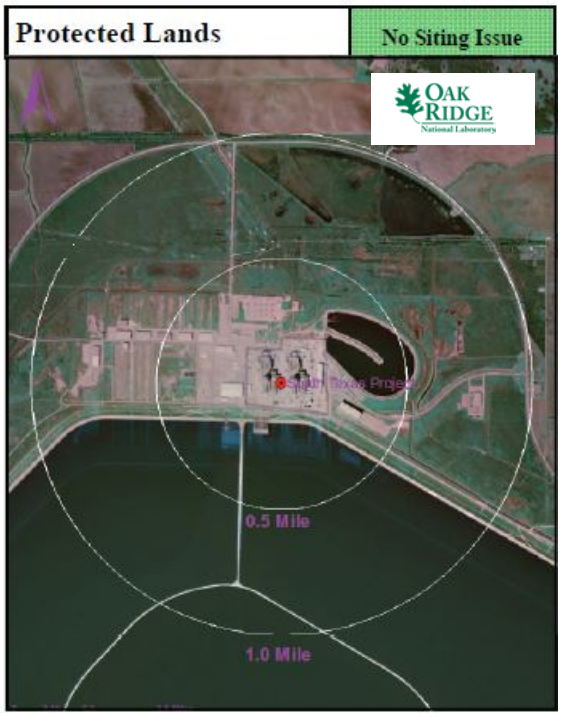


Fig. A.15. South Texas Project composite map.



South Texas Project



South Texas Project

South Texas Project

A.6.6 Site Evaluation

As shown in the maps above, the only screening issue at the South Texas Project is related to the onsite cooling reservoirs. Otherwise, the land around the site is largely rural and favorable for siting an iPWR.

Multiple transportation opportunities are favorable for iPWR construction. Barge access is available from the gulf, and major roadways exist within 10 miles of the plant. A former rail spur was available onsite but is no longer maintained in operable condition. However, numerous rail heads exist at other industrial plants in the area.

There are a few homes in the area related to the farming and rural use of the surrounding land. Table A.9 corroborates the low population density of the area. No strong population growth indicators are present in the area. As shown in Fig. 4 in the main report, the site is well outside an area evaluated at 500 people per square mile within ten miles. No nearby public lands or schools are observed. Therefore, population should not be an issue in the future at this site.

The site has electrical generation infrastructure available. The logistical and security infrastructure necessary to operate a nuclear power facility is already in place at the South Texas Project site. STP Nuclear Operating Company has previously considered expanding the nuclear capacity at this site. Overall, the South Texas Project site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.

A.7 Twin Oaks Power Station

A.7.1 Location Detail

Twin Oaks Power Station is located in Robertson County, Texas. As shown in Fig. A.16, the site is in a rural area approximately 40 miles southeast of Waco, Texas, and 40 miles northwest of College Station, Texas. The Brazos River runs west of the plant. Rail and heavy-haul road access are readily available to the site.

- Location: Twin Oaks Power Station
- Owner: Blackstone Group LP
- Coordinates: lat. 31.092008° N, long. 96.695088° W

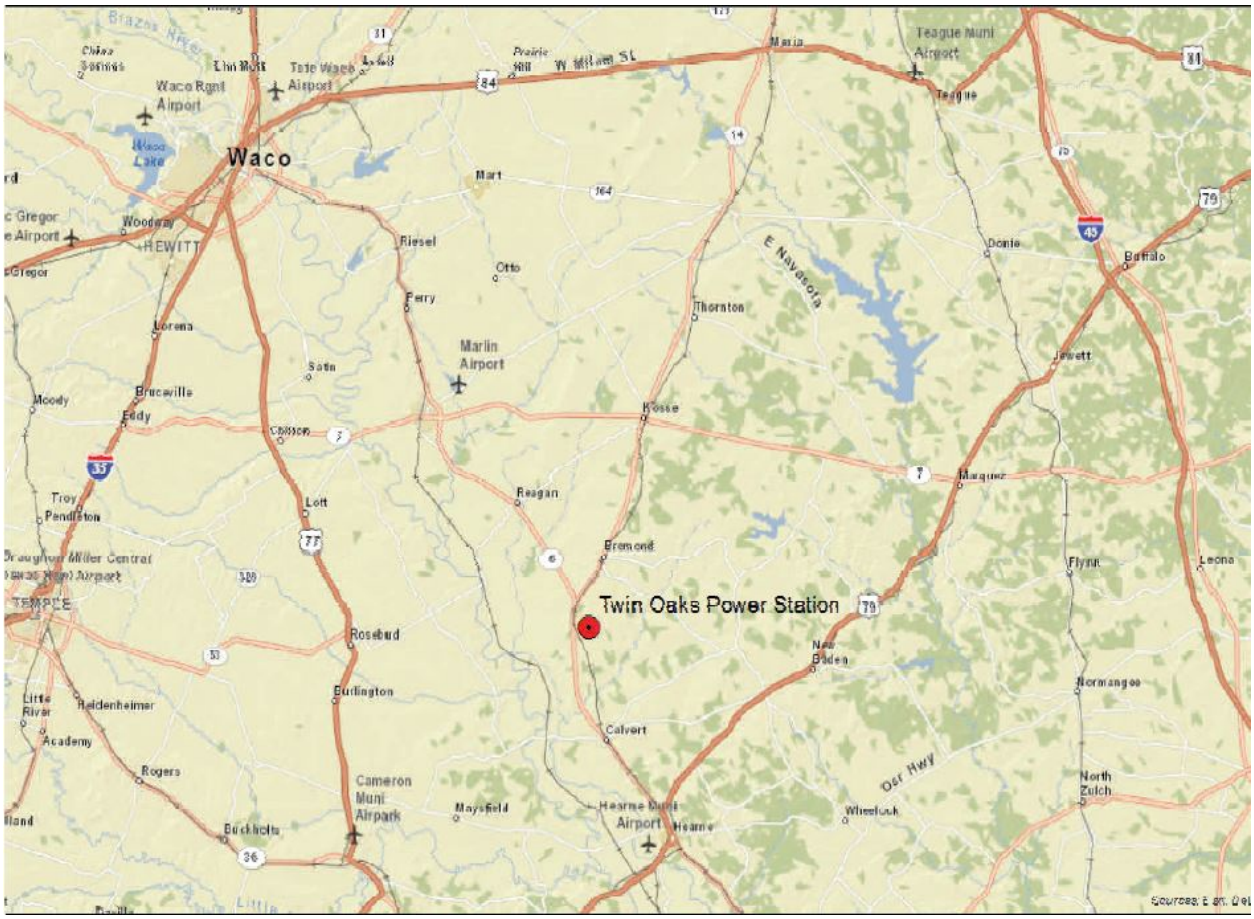


Fig. A.16. Twin Oaks Power Station location map.

A.7.2 Site Description and Status

The Twin Oaks Power Station is a two unit coal power plant. The two units have a nameplate capacity of 305 MW(e) according to a plant factsheet, though other sources list the site capacity as high as 349 MW(e). The units were commissioned in 1990 and 1991. The plant uses cleaner-burning fluidized bed combustion technology. Plant heat is rejected using mechanical draft cooling towers. Coal is provided by road from the nearby Walnut Creek Mining Company.

The plant footprint is approximately 1,000 acres, but the utility may control even more. There is virtually no development in the immediate vicinity of the plant. As noted in Table A.11, there are no fault lines in the immediate vicinity, and maximum earthquake ground acceleration is minimal. The land is very flat. Adequate utility grid capacity for an iPWR facility is available at the plant.

The permanent population within one mile of the plant is approximately 400 people, yielding a population density of approximately 125 people per square mile. The permanent population within 10 miles of the plant is approximately 12,500 people, yielding a population density of about 40 people per square mile.

Table A.11. Twin Oaks Power Station site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 0	> 400 MWe	~ 24 mi
1 mi of Site Centroid	~ 400	> 800 MWe	~ 31 mi
5 mi of Site Centroid	~ 3,100	> 1600 MWe	~ 96 mi
10 mi of Site Centroid	~ 12,500	> 3200 MWe	~ 702 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Hewitt, TX	> 50,000 gpm	~ 17 mi (Brazos River)
> 50,000	Bryan, TX	> 100,000 gpm	~ 17 mi (Brazos River)
> 100,000	Waco, TX	> 200,000 gpm	~ 17 mi (Brazos River)
> 500,000	Austin, TX	> 500,000 gpm	~ 17 mi (Brazos River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 1.1 mi (SR-6)
Max Slope	~ 2 %	Distance to Water Transport	~ 123 mi (Buffalo Bayou)
Nearest Fault Line	~ 266 mi	Distance to Rail Transport	~ 0.9 mi (UP)
Nearest Hazard Site	~ 40 mi (Airport—Eastwood Field)	Distance to Airport	~ 40 mi (Eastwood Field)

A.7.3 Aerial Imagery

The aerial imagery in Fig. A.17 indicates abundant open space near and within the Twin Oaks coal-fired power plant boundary.

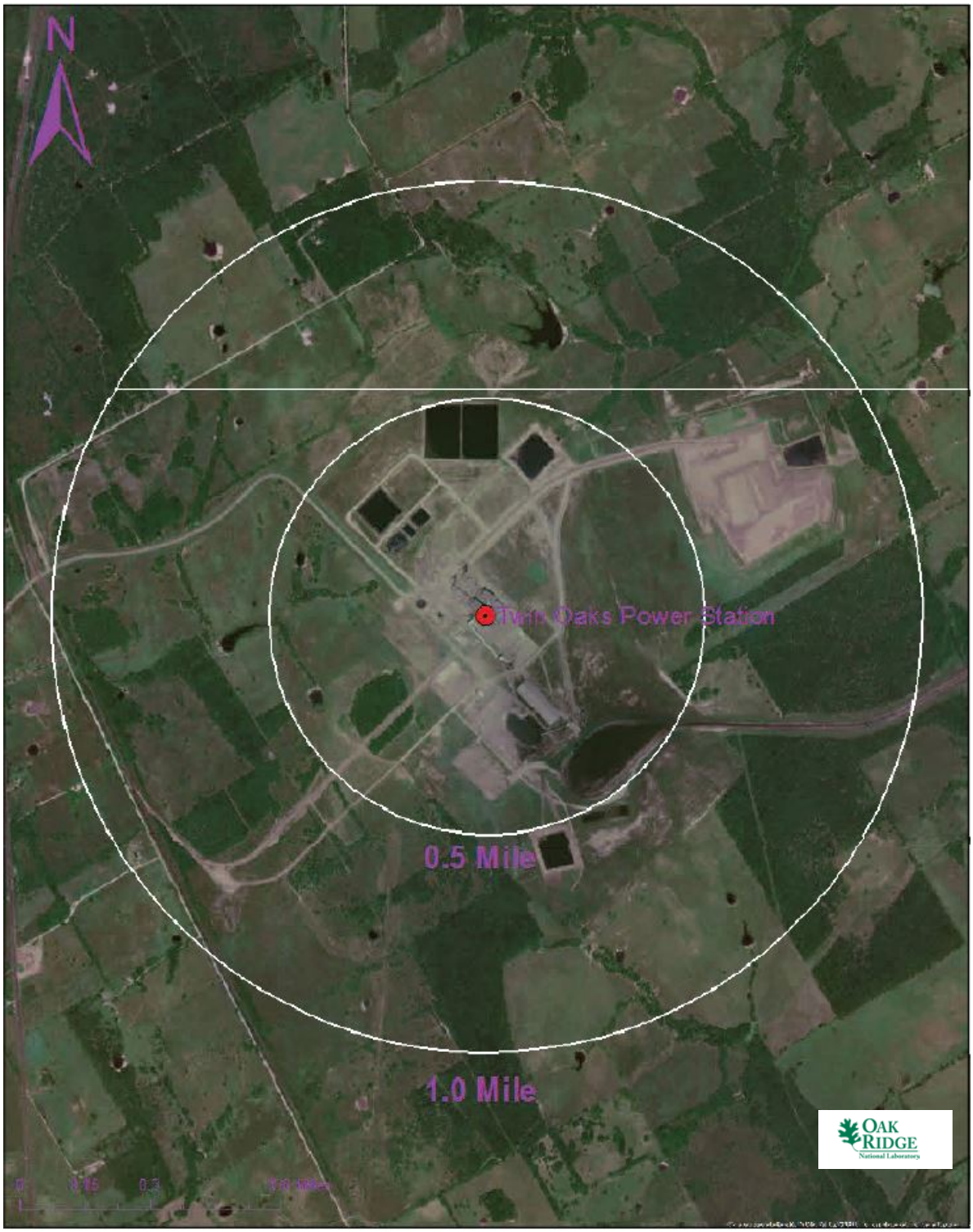
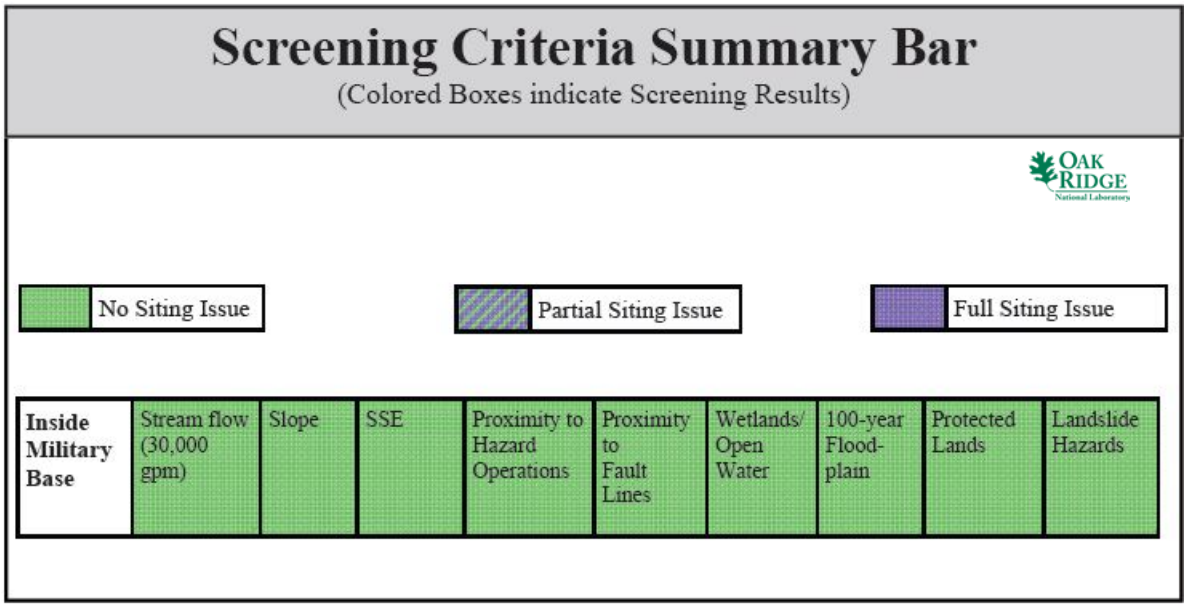


Fig. A.17. Satellite view of Twin Oaks Power Station proximity.

A.7.4 Screening Criteria Overview

Table A.12. Twin Oaks Power Station siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.7.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to Twin Oaks Power Station is shown in Fig. A.18. As shown (independent of population), most of the property has no screening issues relative to siting an iPWR. Following this map are maps of the individual SMR siting criteria based on selected input values.

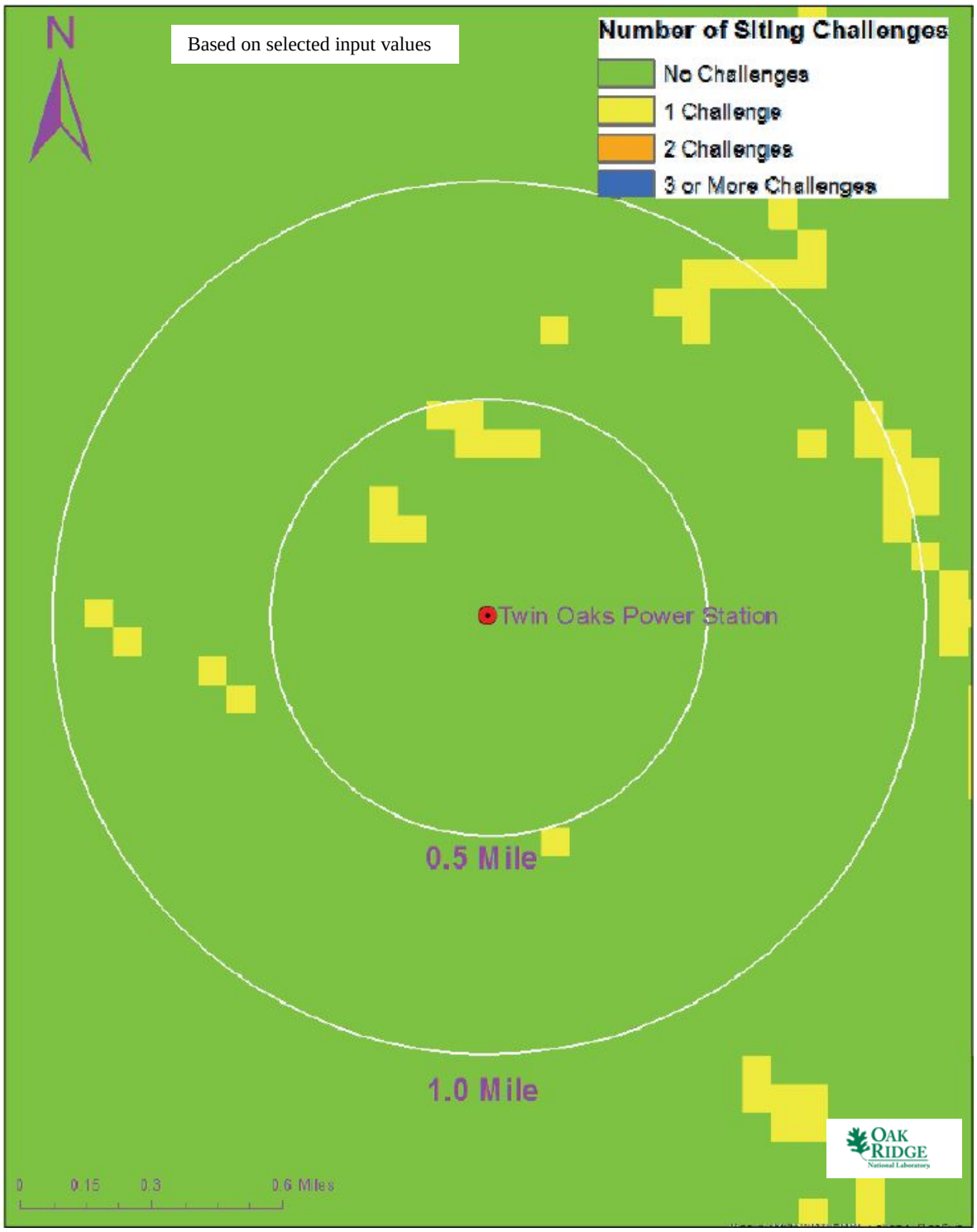
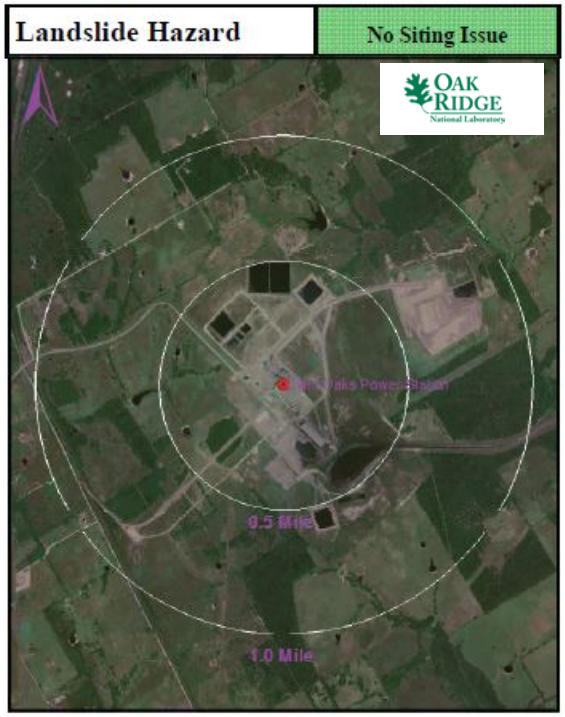


Fig. A.18. Twin Oaks Power Station composite map.

Twin Oaks Power Station

Twin Oaks Power Station



Twin Oaks Power Station

A.7.6 Site Evaluation

As shown in the maps above, the Twin Oaks Power Station site has no screening issues. Only the cooling ponds and ash ponds are noted in the composite map. The land around the site is largely rural and favorable for siting an iPWR.

Multiple transportation opportunities are favorable for iPWR construction. A rail siding is available onsite. Heavy-haul roads are also available.

There are a few homes in the area related to the farming and rural use of the surrounding land. Table A.11 corroborates the extremely low population density of the area. No strong population growth indicators are present in the area. As shown in Fig. 4 in the main report, the site is well outside an area evaluated at 500 people per square mile within ten miles. No nearby public lands or schools are observed. Therefore, population should not be an issue in the future at this site.

The site has electrical generation infrastructure available. The logistical infrastructure necessary to operate a nuclear power facility is already in place at the Twin Oaks Power Station site. An appropriate security infrastructure would have to be established. Overall, the Twin Oaks Power Station site meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.

A.8 Fort Carson

A.8.1 Location Detail

Fort Carson is located just south of Colorado Springs, Colorado, in El Paso County. As shown in Fig. A.19, the post is located to the west of Interstate 25. The southern portion of the post is within 20 miles of the Arkansas River. Interstate, rail, and air transport are readily available to the site.

- Location: Fort Carson
- Owner: US Army
- Coordinates: lat. 38.739879° N, long. 104.794203° W

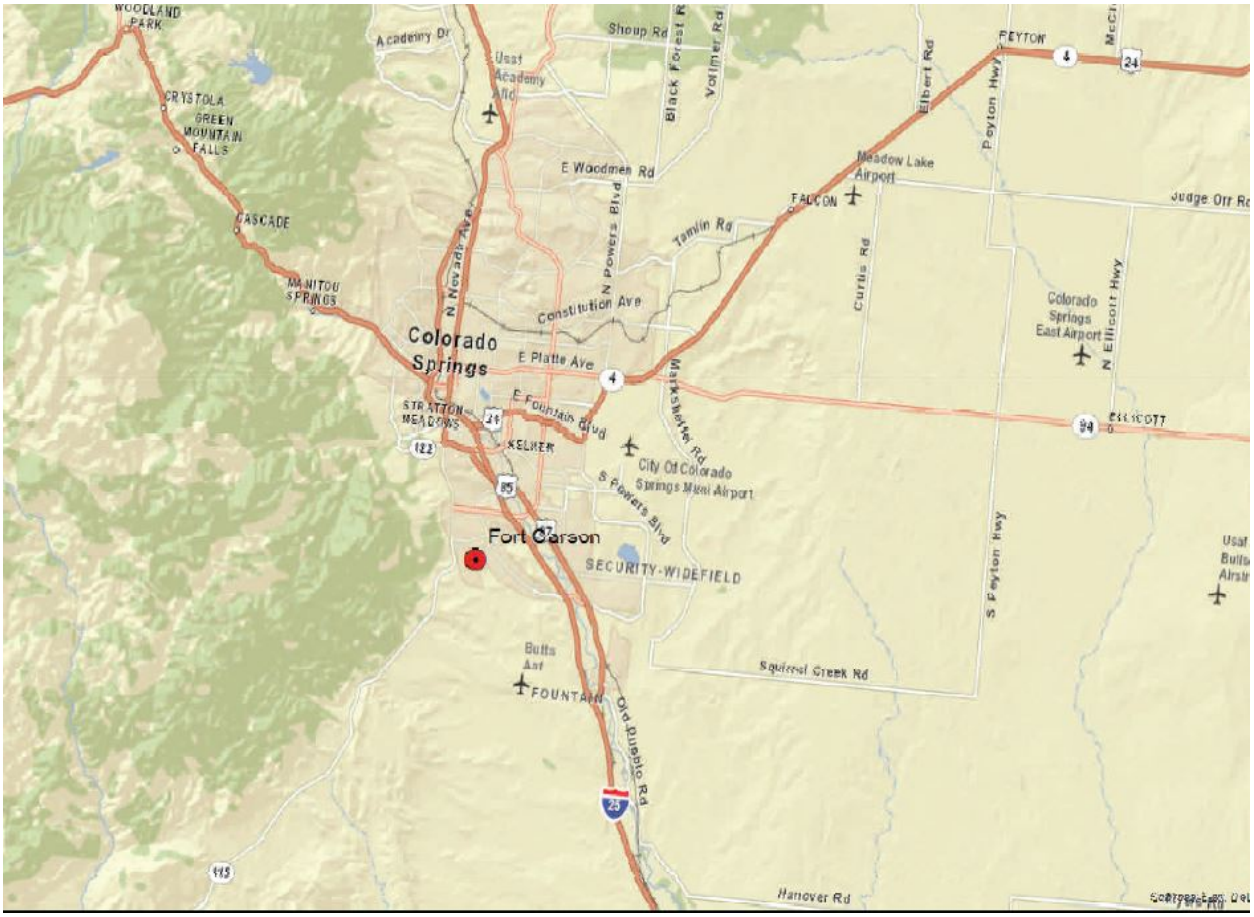


Fig. A.19. Fort Carson location map.

A.8.2 Site Description and Status

Fort Carson is the home of numerous tenant commands. Over 70,000 military and civilian personnel live and/or work on the base. The site consists of almost 122,000 acres at the main base. An airfield is included onsite. The northern portion of the post contains substantial infrastructure, while the southern half of the base is rural.

As noted in Table A.13, the nearest major fault line based on US Geological Survey (USGS) data is nearby at the northwest tip of the base. The maximum safe shutdown earthquake for the site is below 0.3 g peak ground acceleration. The maximum reported slope on the site is steep at approximately 41%

grade, though the northern section of the post is flat. Adequate cooling water makeup is available to the southern portion of the base from the Arkansas River to the southwest. Major highways and rail transport are nearby. Water transport is not available.

The permanent population within one mile of the camp is approximately 9,600 people, yielding a population density of approximately 3,000 people per square mile. The permanent population within 10 miles of the plant is approximately 615,000 people, yielding a population density of about 2,000 people per square mile. The southern portion of the base is further away from Colorado Springs and the base housing, which yields a lower local population density.

Table A.13. Fort Carson site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 0	> 400 MWe	~ 2 mi
1 mi of Site Centroid	~ 9,600	> 800 MWe	~ 87 mi
5 mi of Site Centroid	~ 177,000	> 1600 MWe	~ 380 mi
10 mi of Site Centroid	~ 615,000	> 3200 MWe	~ 560 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Fort Carson, CO	> 50,000 gpm	~ 27 mi (Arkansas River
> 50,000	Highlands Ranch, CO	> 100,000 gpm	~ 27 mi (Arkansas River
> 100,000	Colorado Springs, CO	> 200,000 gpm	~ 27 mi (Arkansas River
> 500,000	Denver, CO	> 500,000 gpm	~ 27 mi (Arkansas River
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 0.7 mi (SR-115)
Max Slope	~ 1 %	Distance to Water Transport	~ 480 mi (Missouri River)
Nearest Fault Line	~ 3 mi	Distance to Rail Transport	~ 1.8 mi (USG)
Nearest Hazard Site	~ 7 mi (Airport—City of Colorado Springs Municipal)	Distance to Airport	~ 7 mi (City of Colorado Springs Municipal)

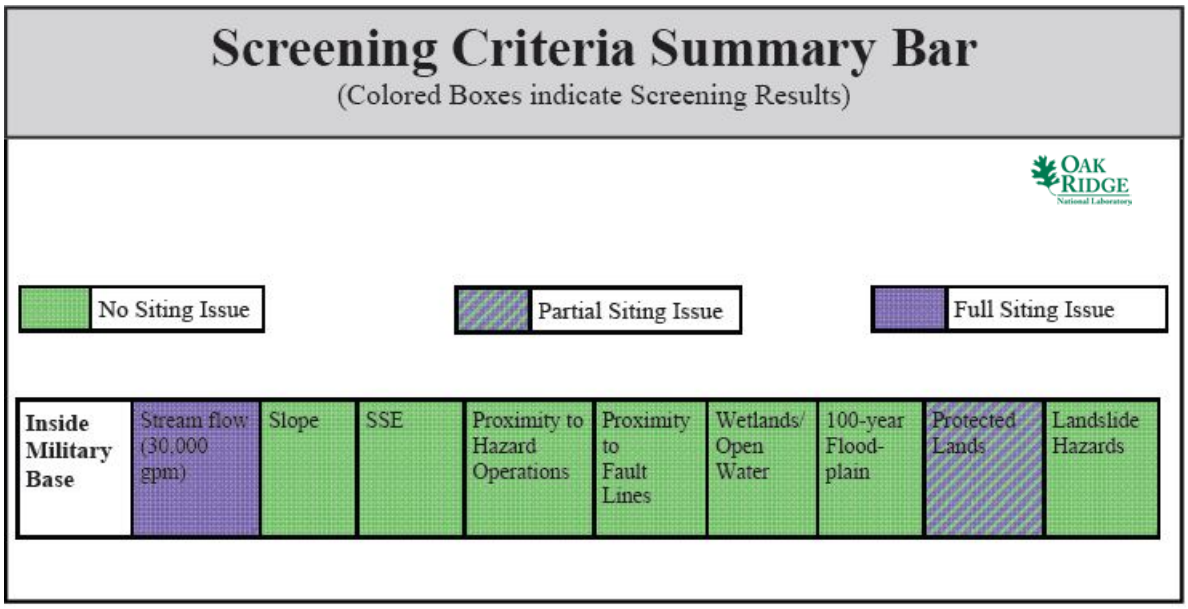
A.8.3 Aerial Imagery

The aerial imagery in Fig. A.20 indicates significant infrastructure near the site. This is associated with the northern section of the post. Base property to the south is unoccupied.

Fig. A.20. Satellite view of Fort Carson proximity.

A.8.4 Screening Criteria Overview

Table A.14. Fort Carson siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.8.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the northern portion of Fort Carson is shown in Fig. A.21. As shown (independent of population), the northern property has two siting issues: the lack of available cooling water makeup and the presence of local schools. Following this map are maps of the individual SMR siting criteria based on selected input values. Significant area in the southern portion of the fort has no SMR siting issues.[9]

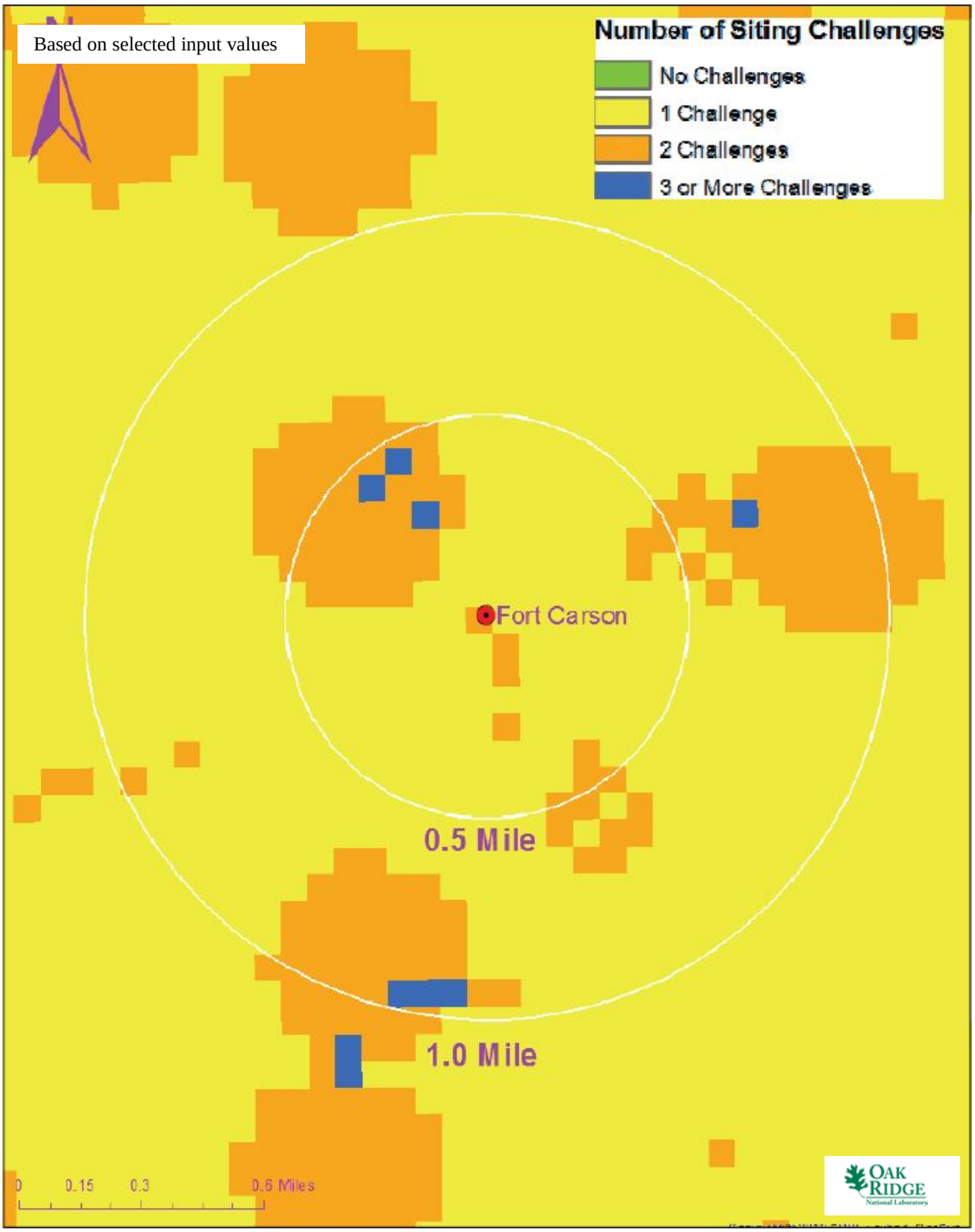
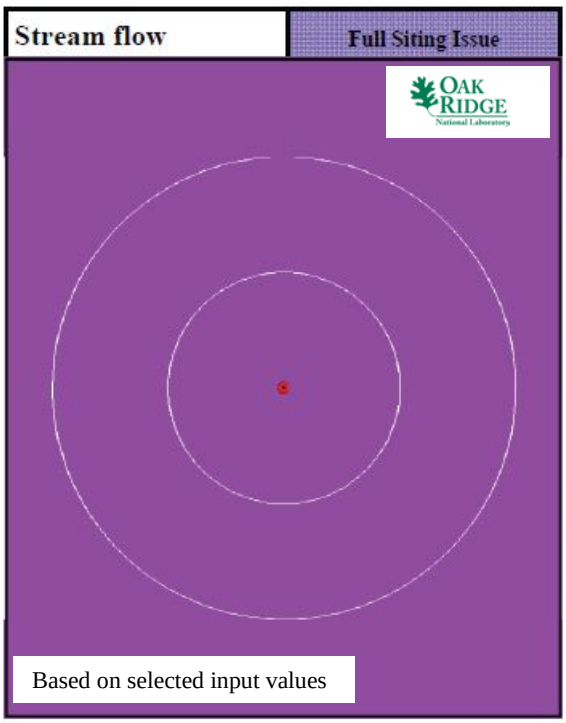


Fig. A.21. Fort Carson composite map.


Stream flow
Full Siting Issue
OAK RIDGE National Laboratory
Based on selected input values

Slope
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values

Safe Shutdown Earthquake
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values

Proximity to Hazard
No Siting Issue
OAK RIDGE National Laboratory
Based on selected input values

Fort Carson

Proximity to Fault Lines
No Siting Issue
OAK RIDGE
National Laboratory

Wetlands/Open Water
No Siting Issue
OAK RIDGE
National Laboratory

100-year Floodplain
No Siting Issue
OAK RIDGE
National Laboratory

Protected Lands
Partial Siting Issue
OAK RIDGE
National Laboratory

Fort Carson

Fort Carson

A.8.6 Site Evaluation

As shown in the maps above, the northern portion of Fort Carson has siting issues that include inadequate cooling water makeup within 20 miles, and several onsite schools (protected land). This is confirmed in Table A.14.

As shown in Fig. 5 in the main body of the report, the site is within an area evaluated at 500 people per square mile within ten miles. This would require further analysis using more sophisticated population density tools. However, the southern portion of the base center point, which is further away from the city center and base housing, is outside of this dense population zone. The open space on this section of the base and the expected reduced population density in that part of the base make that area the most favorable for further analysis.

Multiple transportation opportunities are favorable for iPWR construction. Interstate and air access are immediately available. Rail access is nearby.

The site has electrical generation infrastructure available. Adequate space to the south and site security are favorable. Overall, Fort Carson meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.

A.9 Ray Nixon Power Station

A.9.1 Location Detail

The Ray Nixon Power Station is located in El Paso County, Colorado. As shown in Fig. A.22, the site is located in a rural area just west of Interstate 25 near Colorado Springs, Colorado. The area to the west of the power plant is part of Fort Carson. The town of Fountain, Colorado, is approximately three miles north of the plant. Rail access is available onsite via the rail spur for coal delivery. Heavy-haul road access is available from the adjacent interstate.

- Location: Ray Nixon Power Station
- Owner: Colorado Springs Utility
- Coordinates: lat. 38.633379° N, long. 104.706698° W

Fig. A.22. Ray Nixon Power Station location map.

A.9.2 Site Description and Status

The Ray Nixon Power Station is a single unit coal power plant. The unit has a nameplate capacity of 207 MW(e) according to a plant factsheet, though other sources list the site capacity as high as 227 MW(e). The unit was commissioned in 1980. Plant heat is rejected using a forced draft mechanical cooling tower.

The plant footprint is approximately 220 acres, but the utility may control even more. Land to the south of the plant is used for industrial purposes. There is virtually no development in the immediate vicinity of the plant. As noted in Table A.15, the nearest major fault line based on USGS data is nearby at the northern tip of the adjacent Fort Carson. The maximum safe shutdown earthquake for the site is below 0.2 g peak ground acceleration. Adequate utility grid capacity for an iPWR facility is available at the site. Adequate cooling water makeup is available from the Arkansas River to the southwest (just beyond the typical pump distance considered at 20 miles) and from the adjacent water treatment plant south of the plant site. Major highways and rail transport are nearby. Water transport is not available.

The permanent population within one mile of the camp is approximately 1,400 people, yielding a population density of approximately 450 people per square mile. The permanent population within 10 miles of the plant is approximately 183,000 people, yielding a population density of about 600 people per square mile. Land to the south and west of the site is further from the identified population center.

Table A.15. Ray Nixon Power Station site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 350	> 400 MWe	~ 0.2 mi
1 mi of Site Centroid	~ 1,400	> 800 MWe	~ 94 mi
5 mi of Site Centroid	~ 45,000	> 1600 MWe	~ 383 mi
10 mi of Site Centroid	~ 183,000	> 3200 MWe	~ 628 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Fountain, CO	> 50,000 gpm	~ 24 mi (Arkansas River)
> 50,000	Highlands Ranch, CO	> 100,000 gpm	~ 24 mi (Arkansas River)
> 100,000	Colorado Springs, CO	> 200,000 gpm	~ 24 mi (Arkansas River)
> 500,000	Denver, CO	> 500,000 gpm	~ 24 mi (Arkansas River)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 0.8 mi (I-25)
Max Slope	~ 4 %	Distance to Water Transport	~ 24 mi (Arkansas River)
Nearest Fault Line	~ 8 mi	Distance to Rail Transport	~ 0.1 mi (USG)
Nearest Hazard Site	~ 12 mi (Airport—City of Colorado Springs Municipal)	Distance to Airport	~ 12 mi (City of Colorado Springs Municipal)

A.9.3 Aerial Imagery

The aerial imagery in Fig. A.23 indicates abundant open space near and within the Ray Nixon Power Station boundary. The city of Fountain, Colorado, is immediately north of the boundary of the image.

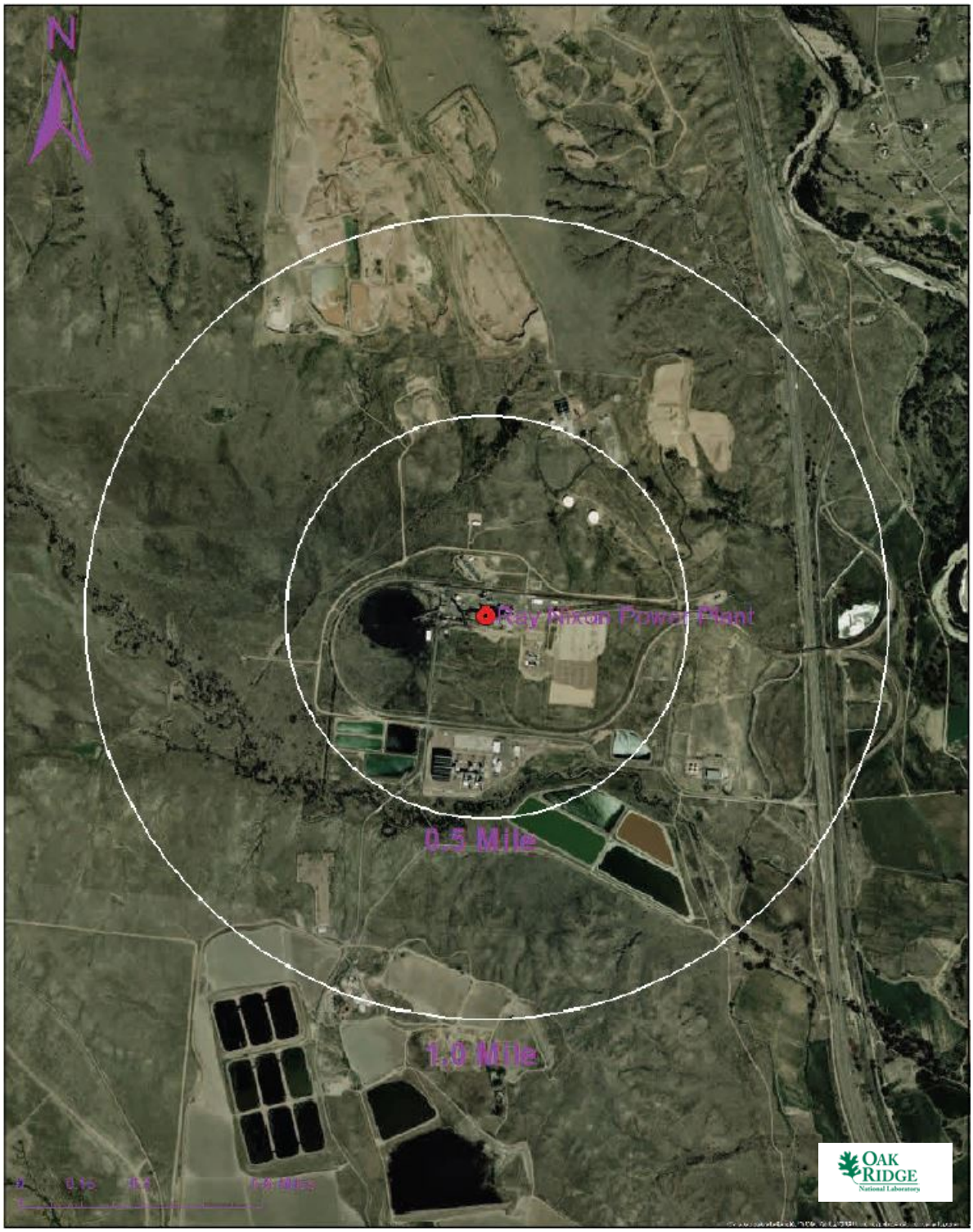
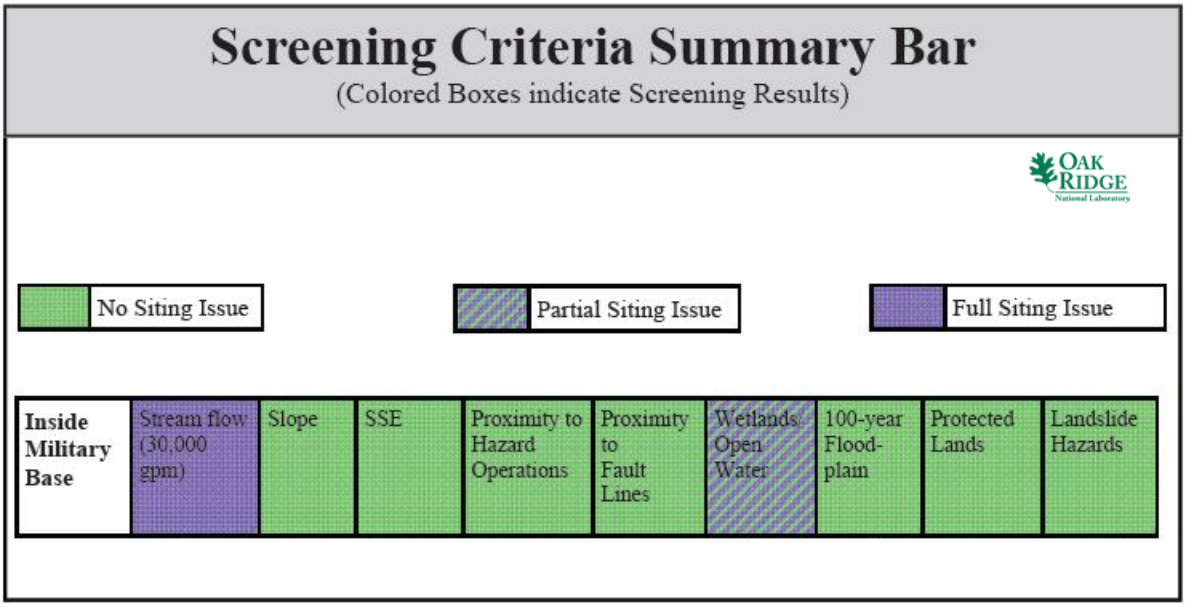


Fig. A.23. Satellite view of Ray Nixon Power Station proximity.

A.9.4 Screening Criteria Overview

Table A.16. Ray Nixon Power Station siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.9.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the Ray Nixon Power Station is shown in Fig. A.24. As shown (independent of population), all of the property has an issue with adequate stream flow within 20 miles. Following this map are maps of the individual SMR siting criteria based on selected input values.

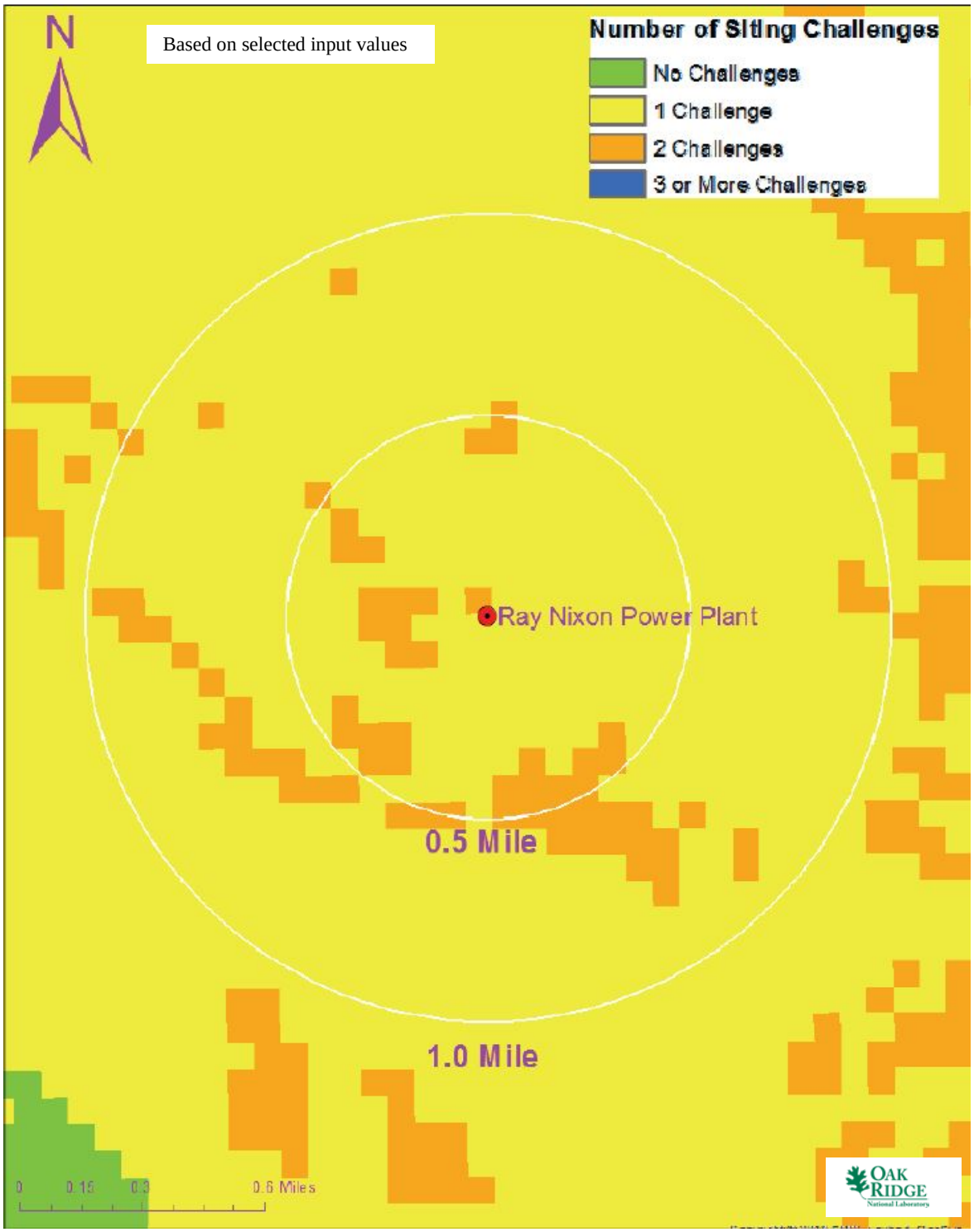
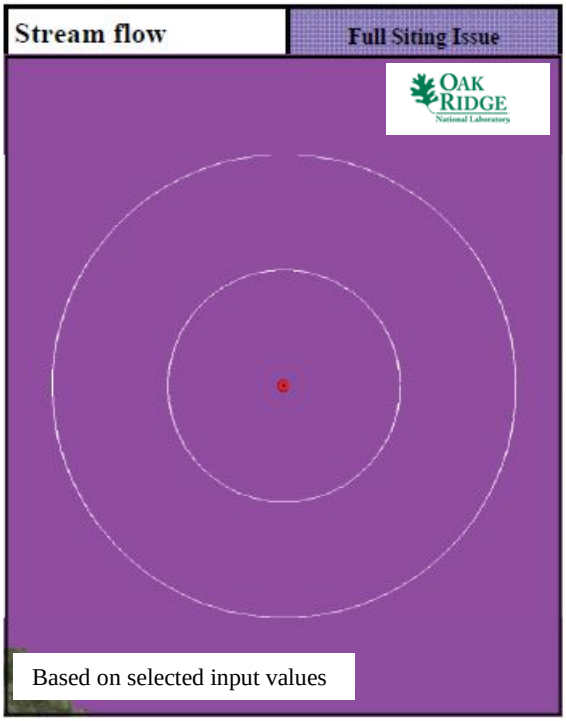
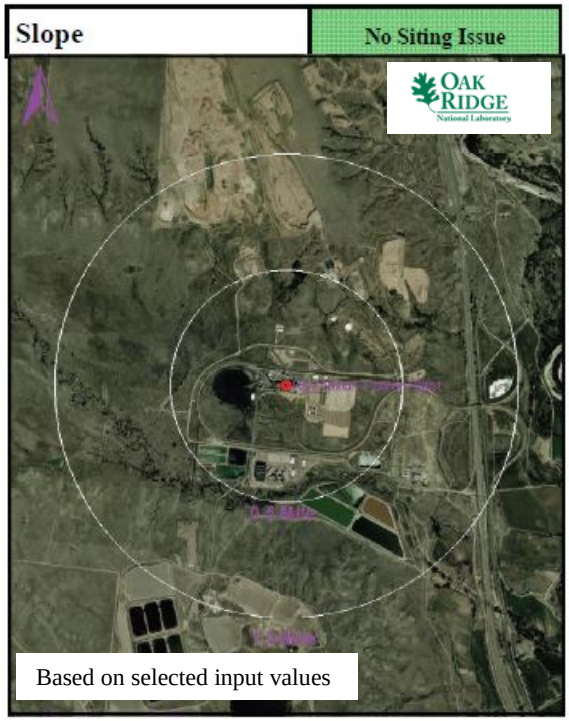
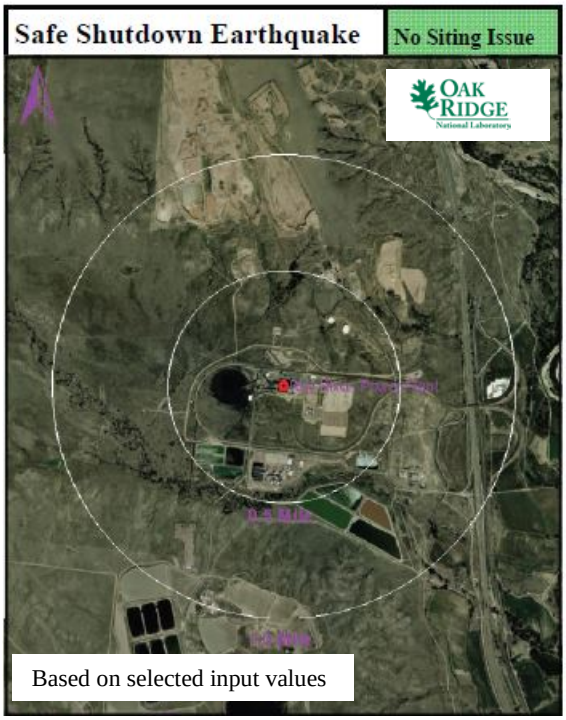
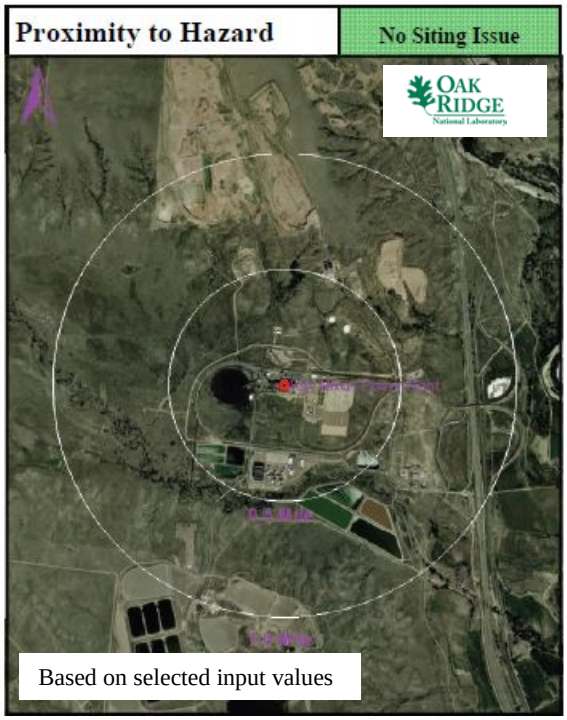


Fig. A.24. Ray Nixon Power Station composite map.

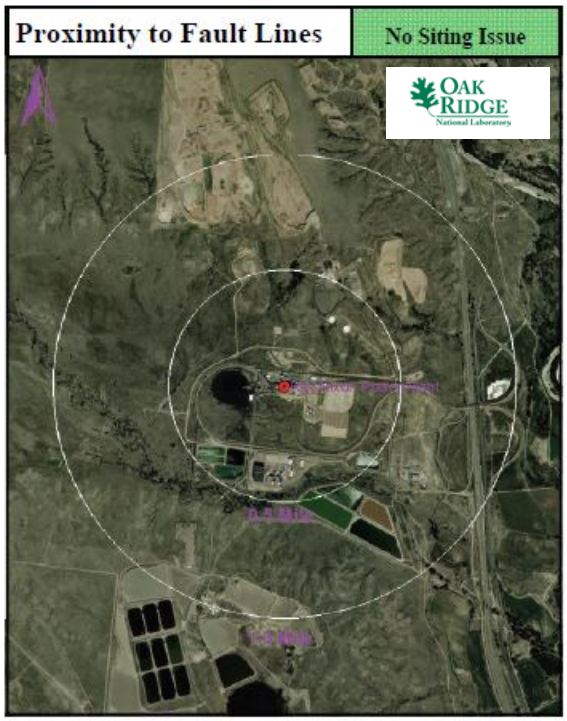


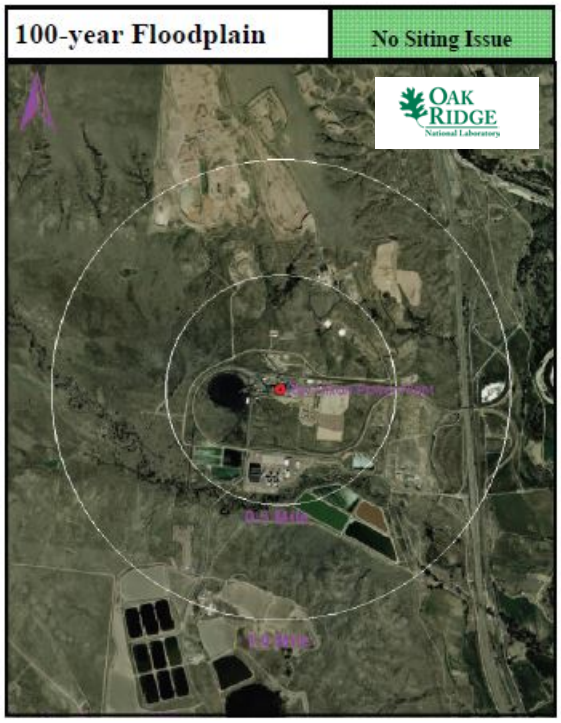


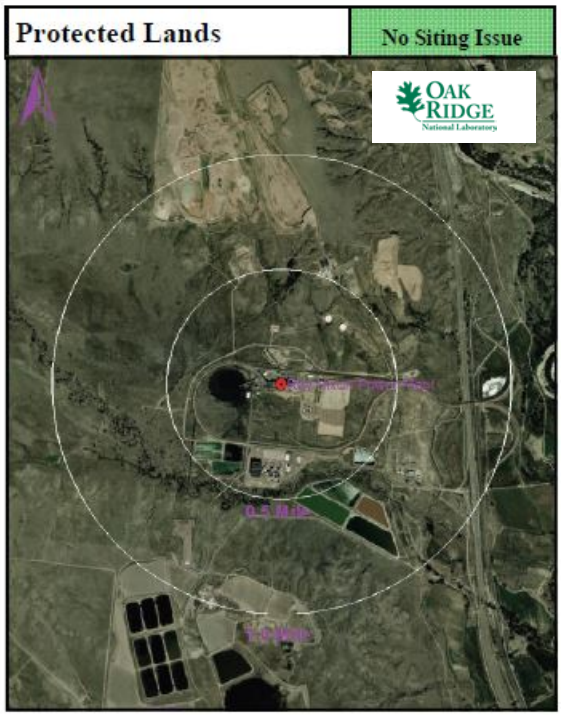




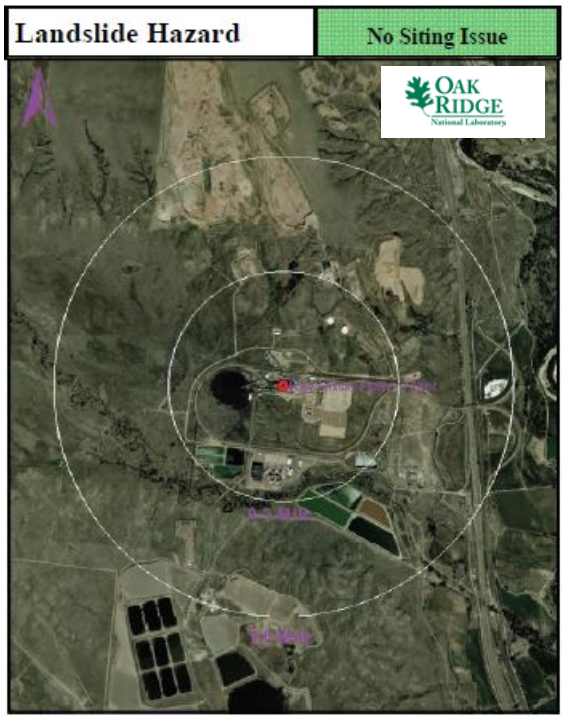
Ray Nixon Power Station







Ray Nixon Power Station



Ray Nixon Power Station

A.9.6 Site Evaluation

As shown in the maps above, the plant site has an issue with inadequate stream flow to provide for cooling water makeup to a closed cycle cooling system. The Arkansas River is 24 miles southwest of the site with adequate stream flow to provide for makeup cooling water. This is just beyond the typical cutoff for pumping cooling water at 20 miles and may not be a significant issue. In addition, the area water treatment plant is just south of the site, which could provide gray-water cooling. Therefore, cooling water does not seem to be an issue for the site. In addition, a partial site issue relative to wetlands and open water is noted in Table A.16. This is due to a small creek flowing just south of the site and the existing onsite reservoirs. As such, these two issues do not appear to create a barrier to siting an iPWR at the site.

South of Fountain, Colorado, the area is more rural in nature. There is a sparse subdivision of homes about 3.5 miles south of the plant site, and the Pikes Peak International Raceway is located in this area. As shown in Fig. 5 in the main report, the site is outside an area evaluated at 500 people per square mile within ten miles. Therefore, population should not be an issue in the future at this site.

Multiple transportation opportunities are favorable for iPWR construction. Rail access for coal delivery is available onsite, and interstate access is available adjacent to the site.

The site has electrical generation infrastructure available. Overall, the Ray Nixon Power Station meets multiple conventional standards for consideration of siting an iPWR at the proposed location. There are no current or near-term foreseeable SMR SSEC siting issues that should preclude this site from further SMR siting consideration.

A.10 Arapahoe Station

A.10.1 Location Detail

The Arapahoe Station is located in Denver County, Colorado. As shown in Fig. A.25, the site is located on the western bank of the South Platte River south of Denver, Colorado. The station is approximately five miles south of the center of Denver. Barge access is readily available to the site. Rail access is available onsite via the rail spur for coal delivery. Heavy-haul road access is available from the nearby interstate system.

- Location: Arapahoe Station
- Owner: Xcel Energy
- Coordinates: lat. 39.670109° N, long. 105.003319° W

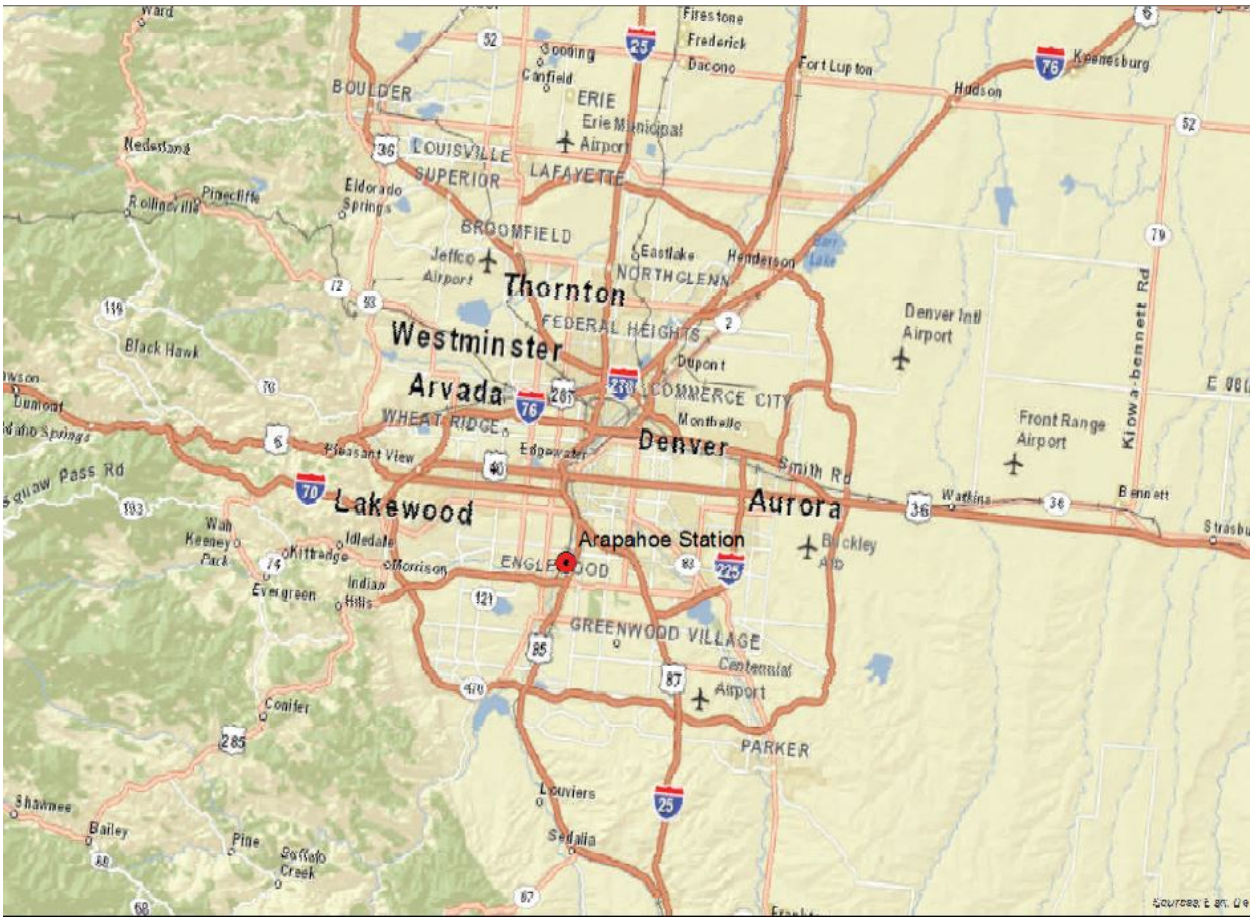


Fig. A.25. Arapahoe Station location map.

A.10.2 Site Description and Status

At its peak, the Arapahoe Generating Station was a four unit coal power plant. The four units had a nameplate capacity of 250 MW(e) according to an Xcel Energy factsheet. The units were commissioned between 1950 and 1955. The last two remaining operating units providing 160 MW(e) closed their operations in December 2013. Plant heat was rejected using a forced draft mechanical cooling tower. Xcel Energy plans to replace the energy that had been provided by the coal plant and to meet increased energy demand in the area using added gas-fired, solar, and wind energy.

The plant footprint is approximately 70 acres. As noted in Table A.17, there is a fault line in the immediate vicinity, though the maximum earthquake ground acceleration is minimal. The land is reasonably flat. Adequate utility grid capacity for an iPWR facility is available onsite. Sufficient fresh water makeup from the South Platte River is available for a closed-cycle cooling system. In addition, a water treatment plant is situated just south of the plant site and could possibly provide gray water cooling to the site.

The permanent population within one mile of the camp is approximately 28,000 people, yielding a population density of approximately 8,900 people per square mile. The permanent population within 10 miles of the plant is approximately 2,200,000 people, yielding a population density of about 7,000 people per square mile.

Table A.17. Arapahoe Station site statistics

Population **Population Within**		**Utility** **Distance to Grid Capacity**	
0.5 mi of Site Centroid	~ 7,000	> 400 MWe	~ 0.1 mi
1 mi of Site Centroid	~ 28,000	> 800 MWe	~ 74 mi
5 mi of Site Centroid	~ 640,000	> 1600 MWe	~ 366 mi
10 mi of Site Centroid	~ 2,200,000	> 3200 MWe	~ 560 mi
Nearest City with Population		**Distance to Cooling Water**	
> 10,000	Englewood, CO	> 50,000 gpm	~ 8 mi (South Platte Rvr.)
> 50,000	Highlands Ranch. CO	> 100,000 gpm	~ 8 mi (South Platte Rvr.)
> 100,000	Lakewood, CO	> 200,000 gpm	~ 8 mi (South Platte Rvr.)
> 500,000	Denver, CO	> 500,000 gpm	~ 8 mi (South Platte Rvr.)
Geotechnical		**Accessibility**	
Max Earthquake Acceleration	< 0.2 g	Distance to Major Roadway	~ 0.4 mi (US-85)
Max Slope	~ 1 %	Distance to Water Transport	~ 451 mi (Missouri River)
Nearest Fault Line	~ 7 mi	Distance to Rail Transport	~ 0.1 mi (BNSF)
Nearest Hazard Site	~ 10 mi (Refinery—Suncor Energy)	Distance to Airport	~ 22 mi (Denver Int'l

A.10.3 Aerial Imagery

The aerial imagery in Fig. A.26 indicates limited open space near the plant boundary, though the immediate area is largely dedicated to industrial use.

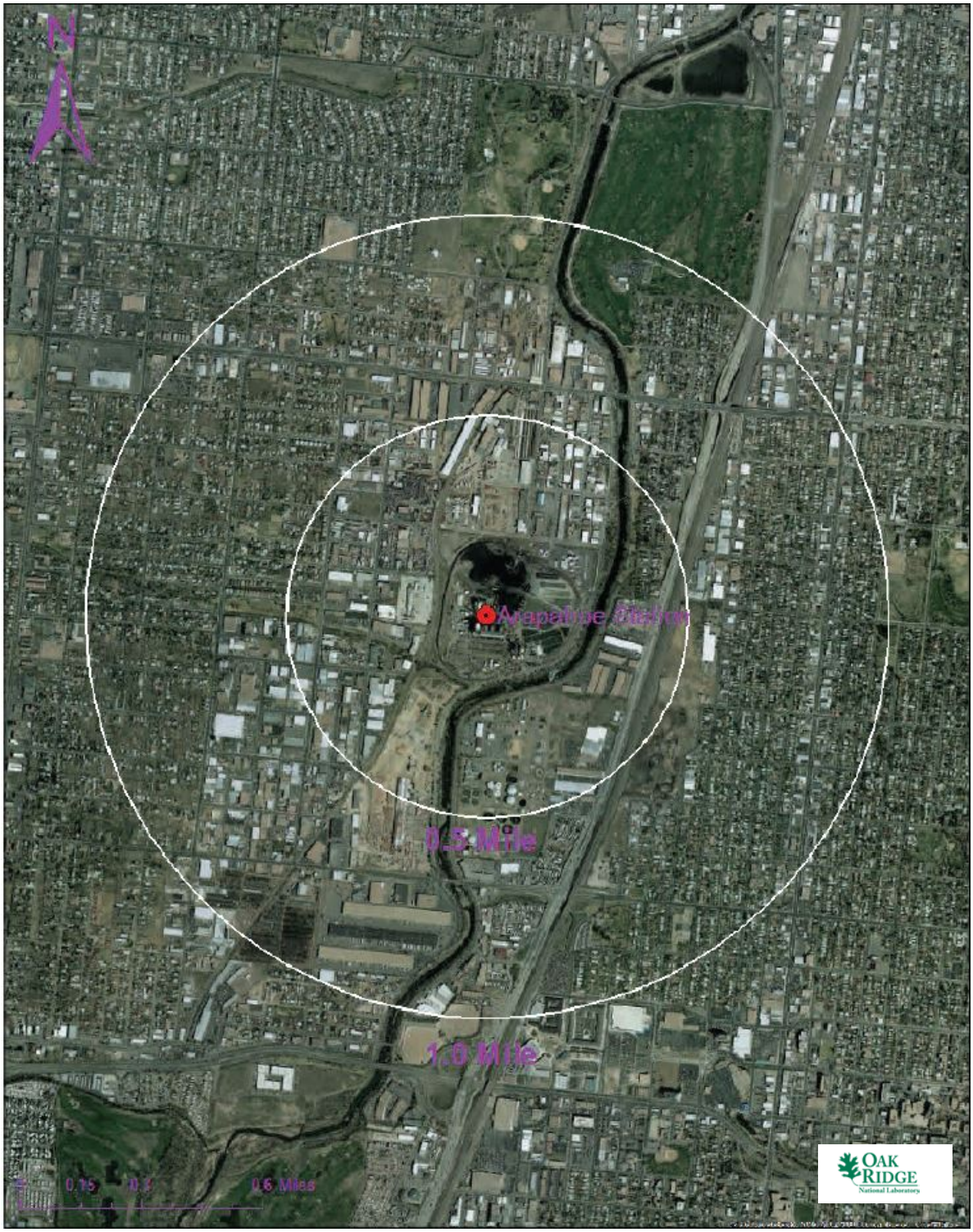
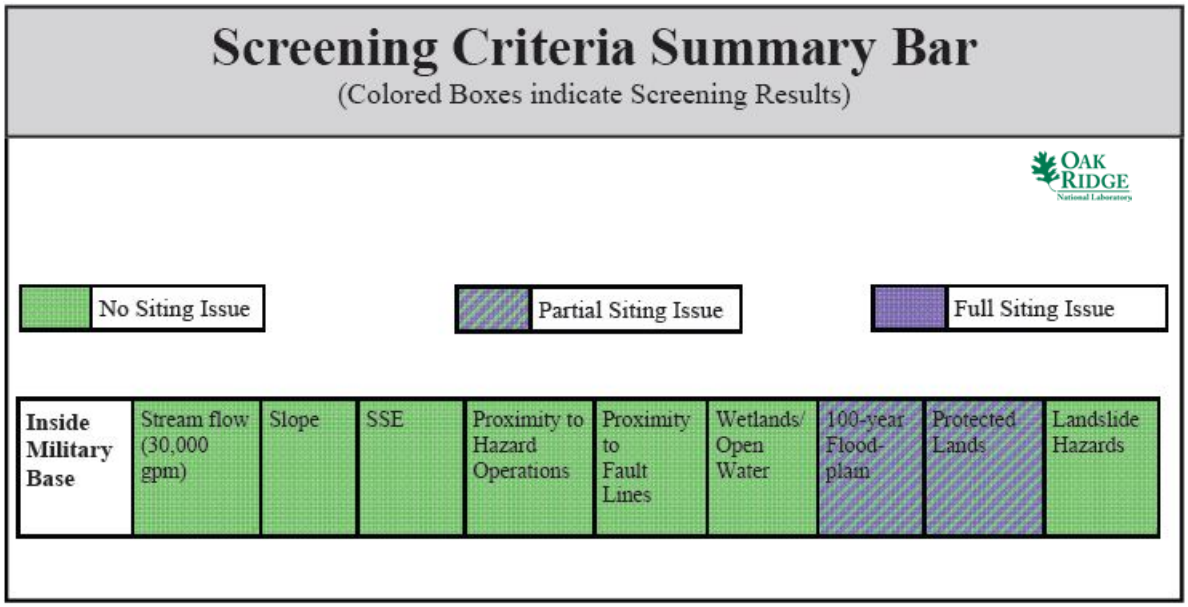


Fig. A.26. Satellite view of Arapahoe Station proximity.

A.10.4 Screening Criteria Overview

Table A.18. Arapahoe Station siting criteria summary



Screening Criteria Table

Criteria	Value
Streamflow/cooling water make-up (gpm)	< 30,000
Slope	> 18%
Safe shutdown earthquake (ground acceleration)	> 0.5
Proximity to hazardous operations - buffer (mile)	Depends on hazardous operation[1]
Proximity to fault lines - buffer (mile)	Depends on length of fault
Wetlands/Open Water	—
100-year floodplain	—
Protected lands	—
Landslide hazard (moderate and high)	—

[1]Hazardous facilities (airports, 5 miles; oil refineries, 1 mile)

A.10.5 Composite Map and Individual Siting Issue Maps

A composite map of SMR siting challenges to the Arapahoe Generating Station is shown in Fig. A.27. As shown (independent of population), most of the property is favorable for siting an iPWR. There are some issues with wetlands and the 100 year floodplain associated with the proximity to the South Platte River. Following this map are maps of the individual SMR siting criteria based on selected input values.

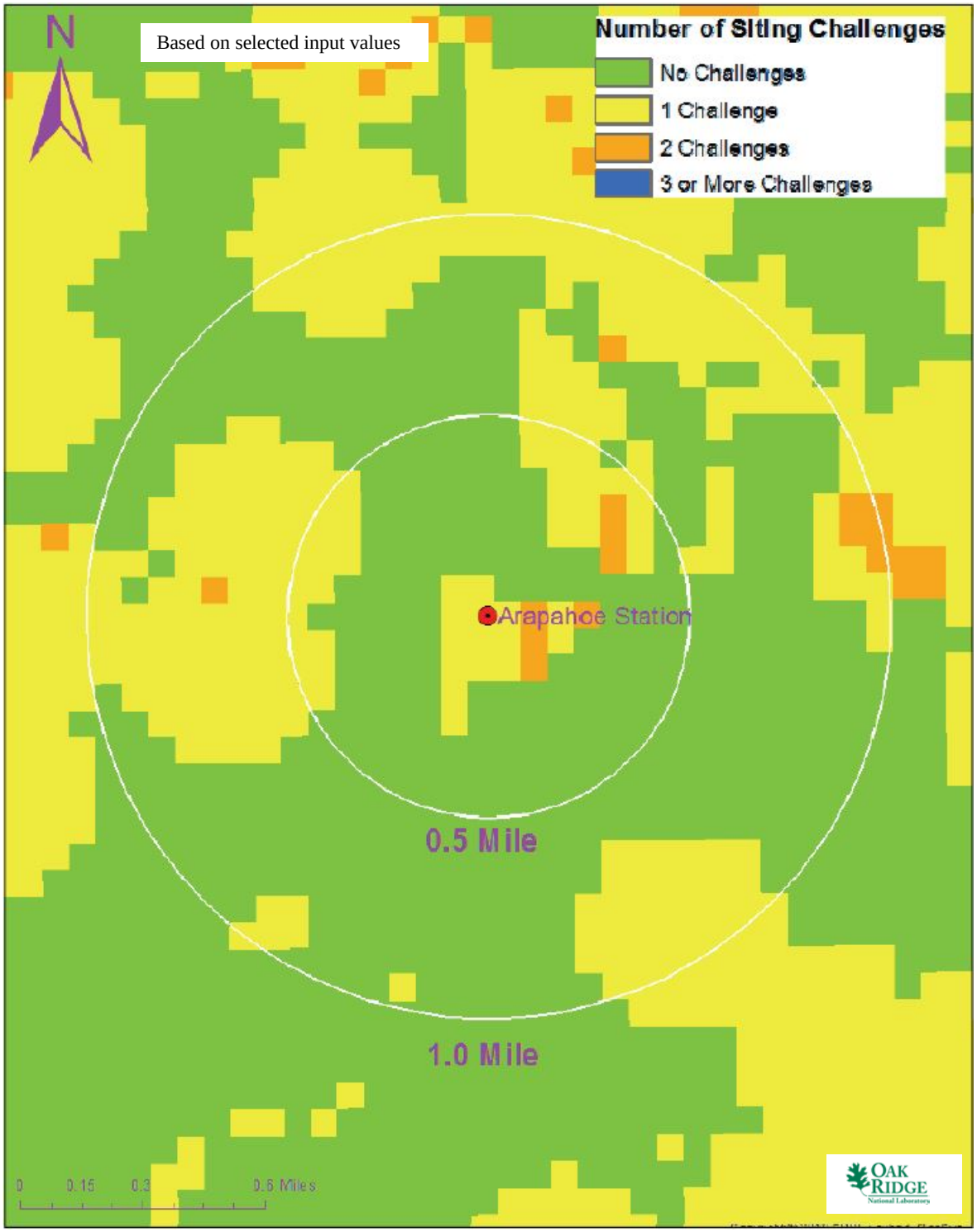
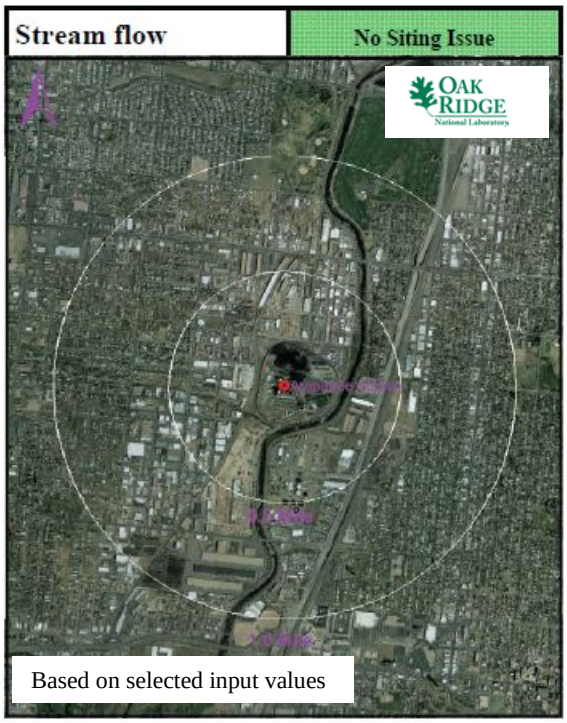
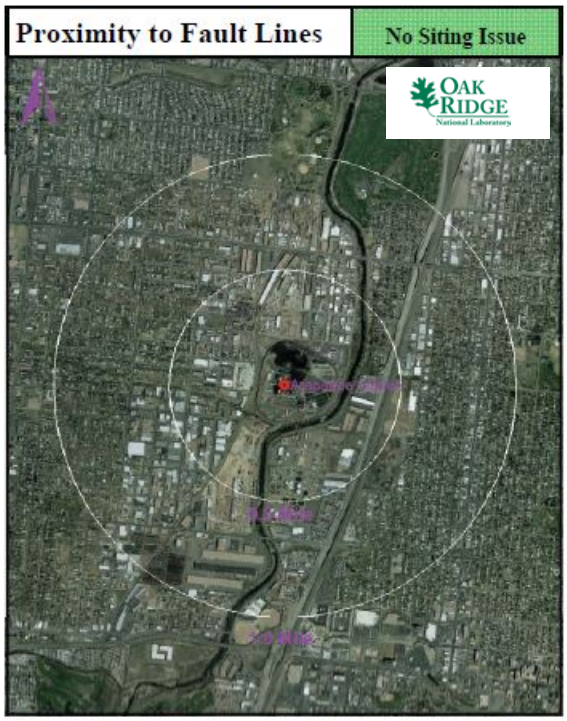


Fig. A.27. Arapahoe Station composite map.



Arapahoe Station



Arapahoe Station

Arapahoe Station

A.10.6 Site Evaluation

As shown in the maps above, most of the land in the immediate vicinity of the current plant location is predominantly favorable for siting an iPWR. The 100 year floodplain is an issue along the South Platte River, and the plant has experienced flooding in the past. In addition, there are numerous small parks located nearby that show up as protected land between the 0.5 mile and one mile radius circles around the plant site.

Table A.18 further confirms the partial siting issues for wetlands and open water, as well as the 100 year floodplain. This is indicative of a plant site immediately adjacent to a river. Improved flood barriers can be engineered. As such, these issues do not appear to create a barrier to siting an iPWR at the site.

The site is totally blocked by development and infrastructure. Roughly 70 acres is available to the utility to site an iPWR at the Arapahoe Station location. Though this is adequate for an mPower plant, the overall size of the location could be problematic.

Multiple transportation opportunities are favorable for iPWR construction. Rail access for coal delivery is available onsite, and interstate access is available adjacent to the site.

The site has electrical generation infrastructure available. Exclusive of population, the Arapahoe Station site meets multiple conventional standards in the near term for consideration of siting an SMR at the proposed location, but the limited land available at the site and the proximity to numerous area parks could preclude this site from further SMR siting consideration. In addition, as shown in Fig. 5 in the main body of the report, the site is in the heart of the densest population associated with the Denver urban area.