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Summary of Siting Analyses for the Texas Advanced Nuclear Reactor Working Group

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OAK RIDGE National Laboratory

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SUMMARY OF SITING ANALYSES FOR THE TEXAS PUBLIC UTILITY COMMISSION

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ABSTRACT

The Texas Advanced Nuclear Working Group (TANWG) acting on behalf of the Texas Public Utility Commission (PUC) requested that Oak Ridge National Laboratory (ORNL) staff evaluate a select set of potential advanced reactor sites in Texas using the Oak Ridge – Siting Analysis for power Generation Expansion (OR-SAGE) tool. The US Department of Energy (DOE) Gateway for Accelerated Innovation in Nuclear (GAIN) provided funding for the site reviews. This letter report documents an overview of the analyses results. Individual data packages for each site are provided separately.

1. INTRODUCTION

1.1 BACKGROUND

This work summarizes siting evaluation assistance provided to the TANWG for suitability of advanced nuclear technologies to meet siting criteria from the Nuclear Regulatory Commission (NRC) and associated guidance documents including the Electric Power Research Institute (EPRI) siting guide and other proprietary datasets. Existing and recently retired coal sites in Texas based on a recent DOE coal-to-nuclear study[1] were evaluated for this report.

Through the work of the TANWG, the Texas PUC is interested in reducing the risk of nuclear deployment decisions by creating a portfolio of deployment locations that meet site selection requirements for the future deployment of new nuclear technologies. The unique OR-SAGE tool and existing data is applied to support the desire to evaluate potential brown field sites.

The OR-SAGE tool is designed to use industry-accepted practices in screening sites and then employ the proper array of data sources through the considerable computational capabilities of geographic information system (GIS) technology available at ORNL. The tool was developed to screen potential sites on a national and regional basis. However, because of the tool granularity, it is often focused specifically on user sites of interest.

More than 60 data sets have been collected and processed by ORNL to develop exclusionary, avoidance, and suitability criteria for screening sites for a variety of power generation types, including nuclear power plants. Available site evaluation parameters include population density, slope, seismic activity, proximity to cooling-water sources, proximity to hazard facilities, avoidance of protected lands and floodplains, susceptibility to landslide hazards, and many others. All siting parameters should be considered as flags to inform siting decisions and should not be used to rule in or rule out any site.

The OR-SAGE process is very versatile. Essentially, OR-SAGE is a visual, relational database. The database partitions the contiguous United States, a total of 7.2E8 hectares (~1.8 billion acres), into 100- by 100-m (1 hectare or ~2.5 acre) cells. The database is tracking just under 700 million individual land cells. Successive suitability criterion is applied to each cell in the database. User-specified thresholds can be applied to each siting parameter data layer. In this manner, a variety of scenarios can be quickly and thoroughly evaluated. Data can be added and/or revised within OR-SAGE to address user interests.

[1] J. Hanson, et al., *Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants*, INL/RPT-22-67964, Rev. 1, September 13, 2022.

1.2 METHODOLOGY

OR-SAGE is essentially a dynamic visualization database that has matured with support from EPRI and the DOE Office of Nuclear Energy (NE). Specifically, the DOE-NE Systems Analysis and Integration (SA&I) Campaign enabled additional functionality and supported a broad application of OR-SAGE to the potential for backfit of advanced reactors at aging coal plants.[2] This report demonstrated the versatility of OR-SAGE and serves as a good reference for the OR-SAGE methodology. This report summarizes the application of the OR-SAGE tool to the potential placement of an advanced non–light-water reactor (non-LWR) at industrial sites for power generation.

Power reactor siting in the United States is based on limiting dose to individuals on the site exclusion area boundary and on the boundary of a low-population zone as defined in Title 10 to the Code of Federal Regulations, Part 100 (10 CFR 100). There is also well-defined regulatory guidance[3] for siting a nuclear power plant (NPP) in the US in NRC Regulatory Guide 4.7 (RG 4.7), "General Site Suitability Criteria for Nuclear Power Stations." Furthermore, the EPRI siting guide[4] for Nuclear Energy Generation Facilities, provides siting criteria for consideration and is updated periodically. Approximately 50 potential site selection evaluation criteria (SSEC) are identified in the various sources related to public health and safety, environment, socioeconomic, and engineering factors. The selected advanced non-LWR siting factors for a nominal small NPP provide a high level of discrimination and readily available data. The default advanced non-LWR siting criteria used in this study are as follows:

- Land with a population density greater than 500 people per square mile (including a 4-mile buffer) is excluded. The cap at 4 miles is based on vendors demonstrating small source terms that meet the 10 CFR 100 dose requirements at or near the NPP exclusion area boundary.
- Wetlands and open water are excluded.
- Protected lands (e.g., national parks, historic areas, wildlife refuges) are excluded.
- Land with a moderate or high landslide hazard susceptibility is excluded. This is a flag based on broad-based risk assessments by the US Geological Survey (USGS) and is not a substitute for in-depth geological evaluations at the site.
- Land that lies within a 100-year floodplain is excluded.
- Land with a slope greater than 12% (~7°) is excluded. This is an economic consideration regarding site preparation.
- Land located in proximity to hazardous facilities (airports, military facilities, missile generating or toxic gas generating facilities) is avoided. This is a flag based on a broad consideration for risk and RG 4.7 guidance. Meeting this avoidance criterion is not a substitute for an in-depth risk assessment.
- Land too close to the identified fault lines is excluded; the length of the fault line determines the required standoff distance per 10 CFR 100, Appendix A.
- Land with safe shutdown earthquake (SSE) peak ground acceleration (2% chance in a 50-year return period) greater than 0.3 g is excluded. This can be adjusted based on individual technology design

[2] Ibid.

[3] NRC, *General Site Suitability Criteria for Nuclear Power Stations*, RG 4.7, Revision 3, March 2014.

[4] A. Sowder (Project Manager), *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Energy Generation Facilities (Siting Guide)*, 3002023910, 2022 Revision, EPRI, 2022.

specifications. For example, smaller technology designs with limited piping may be able to demonstrate robustness at higher g-forces.

For comparison, the following large light water reactor parameters are considered in place of or alongside the above parameters:

- Land with a population density greater than 500 people per square mile (including a 20-mile buffer) is excluded. The cap at 20 miles is based on RG 4.7 guidance.

- Land areas that are more than 20 miles from cooling water makeup sources with at least 135,000 gallons per minute are excluded for nominal large LWR plant applications. It is assumed that advanced non-LWRs will not need this resource.

The siting criteria are combined using an algebraic approach. The algebraic approach employed by OR-SAGE is summarized in Appendix A of a report on backfitting nuclear plants at Tennessee Valley Authority (TVA) sites.[5] Based on preliminary design information and expert judgment, it is assumed that a small, advanced reactor, as defined by multiple vendors, can easily be accommodated on a 50-acre footprint. Many proposed advanced reactor NPP technologies have even smaller proposed footprints. Microreactors may require a footprint of only a few acres.

1.1 DATA PACKAGES

Applying these parameters to each Texas site resulted in two analyses for each site including the desired look at a small, advanced technology such as the XE-100 reactor[6] and a comparison for a large LWR. A data package has been prepared for each Texas coal site evaluated in the 2022 DOE study. The data packages will be provided separately from this letter report. Each site data package includes 9 pages of relevant figures. The first figure in each data package is simply a satellite view of the area around the site center followed by a table of the parameters applied for small, advanced reactor technology siting. This is followed by a color-coded composite map like that shown in

Figure 1 demonstrating the algebraic combination of the advanced reactor criteria.

[5] R. Belles, O. Omitaomu, and A. Worrall, *TVA Coal-Fired Plant Potential for Advanced Reactor Siting*, ORNL/TM-2021/2158, September 2021.

[6] XE-100 is an example of a small, advanced reactor technology. The XE-100 reactor is an 80 Mwe pebble-bed, high-temperature, gas-cooled reactor (HTGR) designed by X-Energy. There are numerous small, advanced reactor designs in development. ORNL is not endorsing any specific technology.

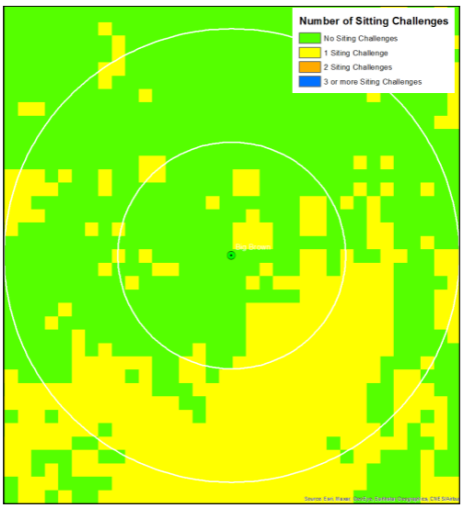

Figure 1. Sample composite map for a site.

The white concentric circles on the composite map in

Figure 1 sweep an area with a 0.5-mile radius and a 1-mile radius, respectively. This equates to areas of about 500 acres and 2,000 acres.

This composite map is followed in each data package by small individual parameter maps for each of the criterion. A subsequent composite map is provided in each data package for a large LWR application. Two additional individual parameter maps for this large LWR evaluation are also provided to round out each data package.

2. SITE EVALUATIONS FOR SELECTED TANWG SITES

2.1 CHEMOURS INGLESIDE PLANT

The site is located adjacent to Corpus Cristi Bay and the Gulf of Mexico in San Patricio County, TX. The site is approximately 2 miles west of Ingleside, TX and 4 miles east of Portland, TX. Corpus Cristi is approximately 10 miles southwest of the site across the bay. The OR-SAGE evaluation process was applied around the provided site center point[7] and the composite results are shown in Figure 2. The evaluation radii are depicted as white circles on the map.

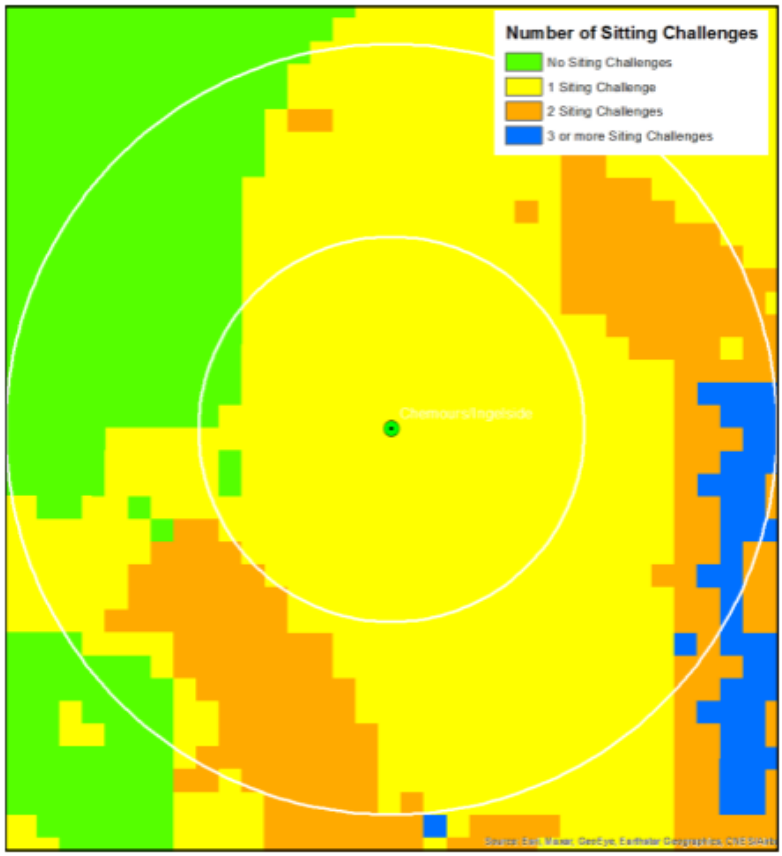

Figure 2. Chermours Ingleside Plant advanced reactor composite map.

Population density within 4 miles is not an issue, except on the outer evaluation radius toward Ingleside. The dredged access area from Corpus Cristi Bay and operating sites ponds are flagged. The largest flagged area is for the hazardous operations at the Chalmers plant itself. This is based on the toxic gas risk posed by refrigerant manufacturing at the site. A significant tract of land northwest of the site center meets all the OR-SAGE screening criteria (shown in green) within the 1.0-mile radius. The large yellow expanse could come into advanced reactor siting consideration with an adequate risk analysis for the selected reactor technology. The large LWR composite map is similar, although population density is a larger factor for the southern and eastern part of the evaluated area.

[7] Center points provided by the TANWG.

2.2 NRG GREGORY GENERATING STATION

The site is located adjacent to Corpus Cristi Bay and the Gulf of Mexico in San Patricio County, TX. The site is approximately 1 mile west of the Chermours Ingleside Plant. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 3. The evaluation radii are depicted as white circles on the map.

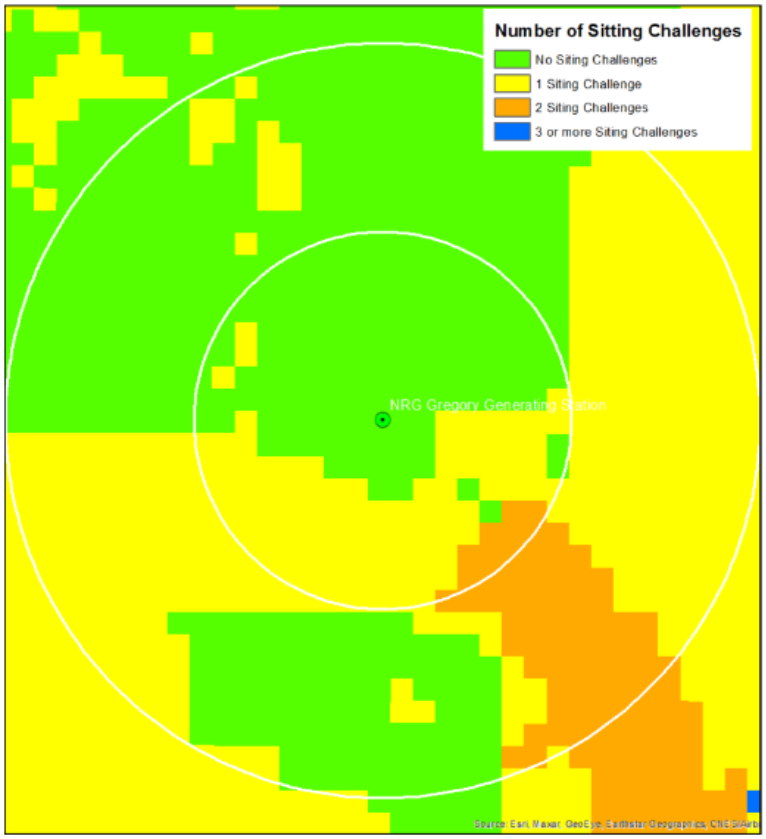

Figure 3. NRG Gregory Generating Station advanced reactor composite map.

Population density within 4 miles is not an issue, except on the outer evaluation radius toward Ingleside. The dredged access area from Corpus Cristi Bay and operating sites ponds are flagged. The flagged area for the hazardous operations at the Chalmers plant slides east, which opens up significant tracts of land that meets all the OR-SAGE screening criteria (shown in green).

The large LWR composite map is similar, although population density is a larger factor for the southeastern evaluation area and the western part of the evaluated area.

2.3 CONROE NORTH INDUSTRIAL PARK

The site center is located 6 miles east of Lake Conroe in Montgomery County, TX. The site is approximately 1 mile north of Conroe, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 4. The evaluation radii are depicted as white circles on the map.

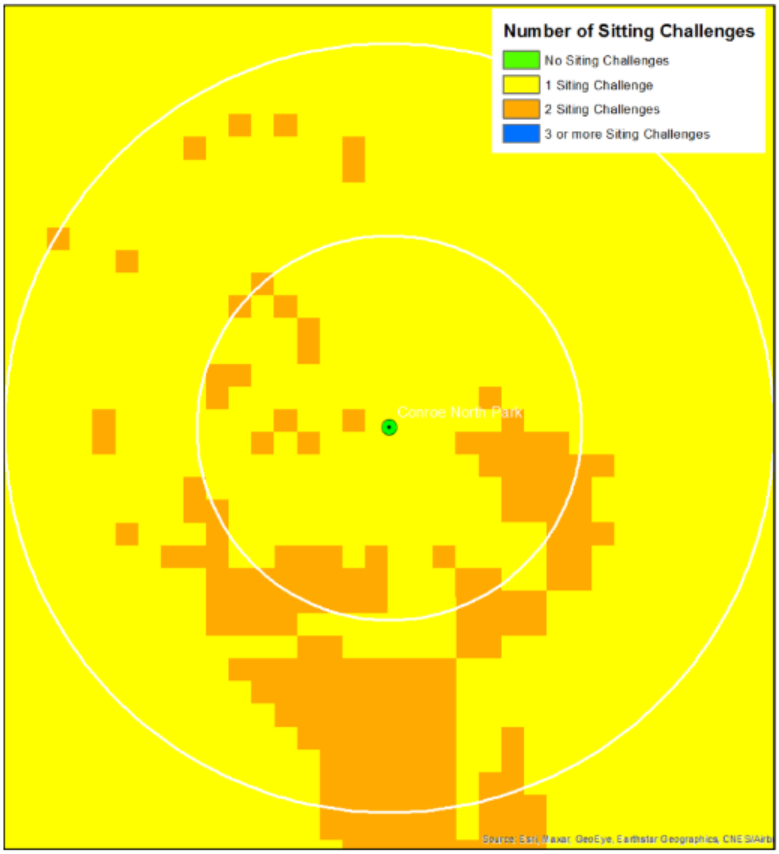

Figure 4. Conroe North Industrial Park advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the large population associated with nearby Conroe, TX. This accounts for the yellow color across the composite map. There is some marshy area associated with Stewart Creek to the south of the site center. This accounts for the orange color in the composite map. An advanced reactor technology with analyzed accident source term completely contained within the site footprint may be possible here. The OR-SAGE technology is flagged population at 4 miles, but a technology with a contained source term could be evaluated at a smaller buffer distance. The Conroe-North Houston Regional Airport (2 miles east of the industrial park) would need to be evaluated for risk to a reactor placement in this area. Visually, land in the northeast quadrant looks the most promising for siting a small, advanced reactor technology. The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.4 DIESON TECHNOLOGY PARK

The site center is located 1 mile east of the Conroe North Industrial Park in Montgomery County, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 5. The evaluation radii are depicted as white circles on the map.

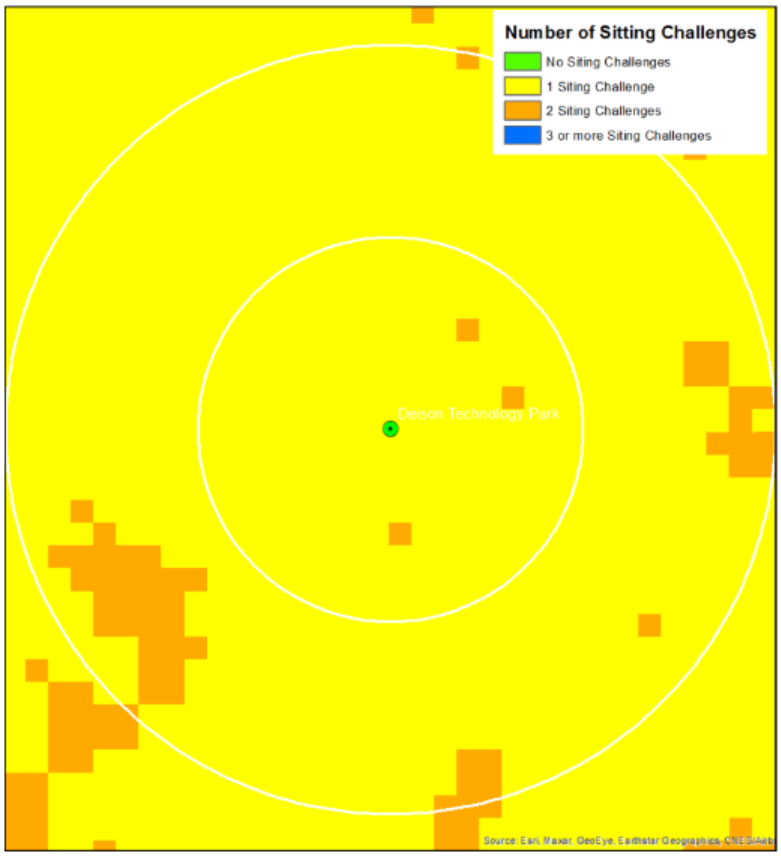

Figure 5. Dieson Technology Park advanced reactor composite map.

The analysis of this site is identical to the Conroe North Industrial Site.

2.5 CYPRESS ENTERGY POWER STATION

The site center is located 3.5 miles west of Village Creek in Hardin County, TX. The site is approximately 2 miles northwest of Lumberton, TX and 4 miles southwest of Silsbee, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 6. The evaluation radii are depicted as white circles on the map.

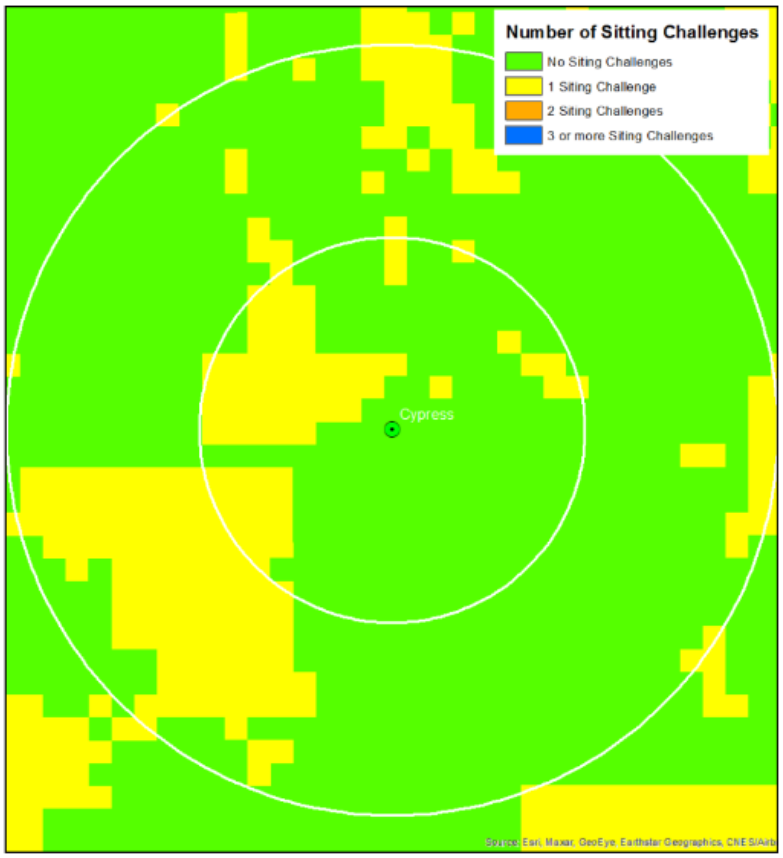

Figure 6. Cypress Entergy Power Station advanced reactor composite map.

Population density within 4 miles is not an issue except for the yellow-colored area in the bottom right corner of the outside the composite map. The only other flag for this site is associated with the former site ponds and wetlands. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.6 DOW TEXAS CITY PLANT

The site is located adjacent to Galveston Bay and the Gulf of Mexico in Harris County, TX. The site is immediately bounded to the north and to the west by population centers. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 7. The evaluation radii are depicted as white circles on the map.

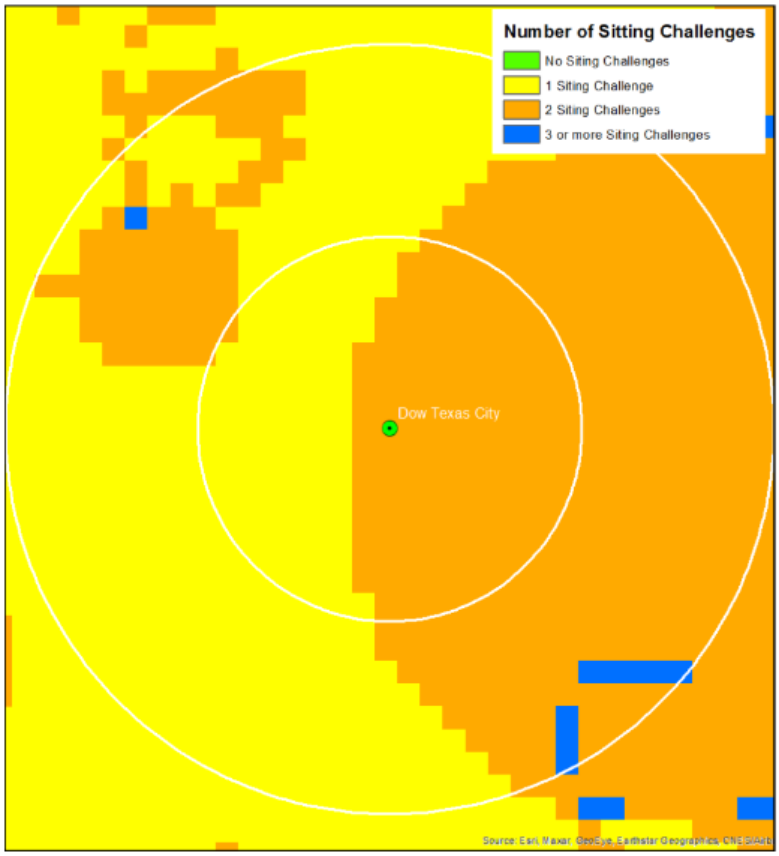

Figure 7. Dow Texas City advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the various immediately adjacent population outside the plant boundary. This accounts for the yellow color across the composite map. There is some marshy area northwest of the site center and a church in the northwest quadrant of the composite map. This accounts for the orange color in that area.

The second largest flagged area is for the hazardous operations at the Dow plant itself. This is based on the fire, missile, and toxic gas risk posed by the site operations. An advanced reactor technology with analyzed accident source term completely contained within the site footprint may be possible here. The OR-SAGE technology is flagged for population at 4 miles, but a technology with a contained source term could be evaluated at a smaller buffer distance.

The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.7 FORT CAVAZOS

The Army Base at Fort Cavazos is approximately 7 miles west of Belton Lake straddling Bell County and Coryell County, TX. The site is immediately north of Killeen, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 8. The evaluation radii are depicted as white circles on the map.

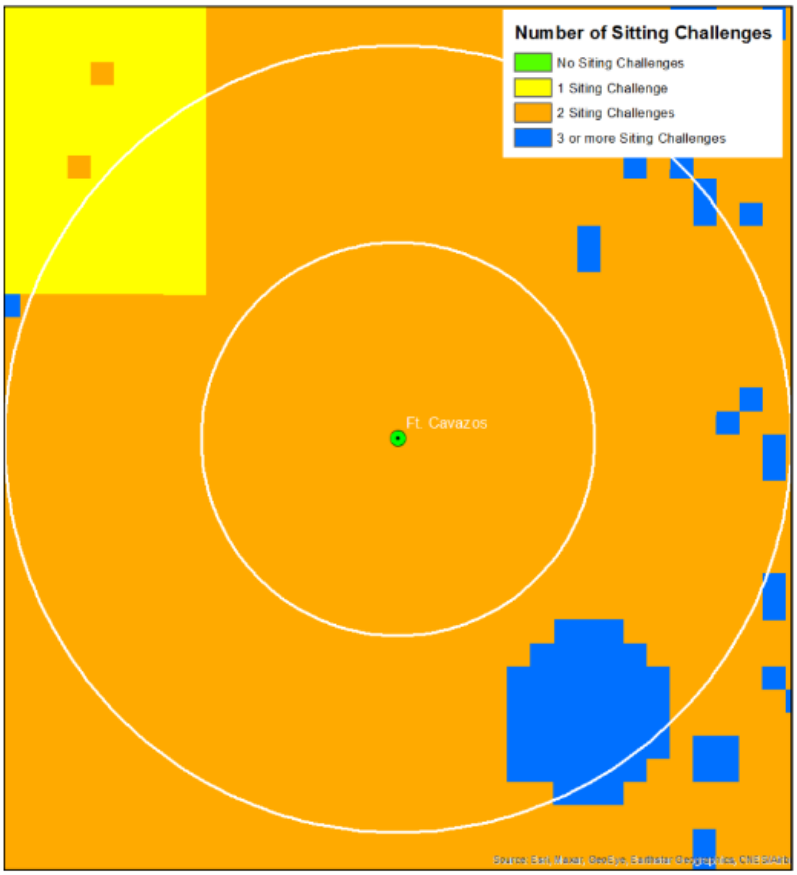

Figure 8. Fort Cavazos advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the large population associated with Killeen, TX. This affects the entire composite map except for the yellow area in the upper left corner.

The second largest flagged area is for the hazardous operations associated with military bases in general. This is based on the fire, missile, and toxic gas risk posed by the base operations. This accounts for much of the composite map colored orange. The blue area on the composite map is associated with a youth center near the site center of the evaluation and some wet areas.

An advanced reactor technology with analyzed accident source term completely contained within the site footprint may be possible here, especially in areas away from the built-up areas of the base. The OR-SAGE technology is flagged for population at 4 miles, but a technology with a contained source term could be evaluated at a smaller buffer distance. A risk assessment of the hazardous operations at the site could also reduce or eliminate the hazardous operations flag.

The large LWR composite map is similar, however, population density would likely preclude consideration of a large reactor in the evaluation area. If there is land available well away from the base center and Killeen, TX, a large LWR may be possible.

2.8 FORT SAM HOUSTON

Salado Creek runs along the edge of the Army Base at Fort Sam in Bexar County, TX. The site is surrounded by the many communities that make up San Antonio, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 9. The evaluation radii are depicted as white circles on the map.

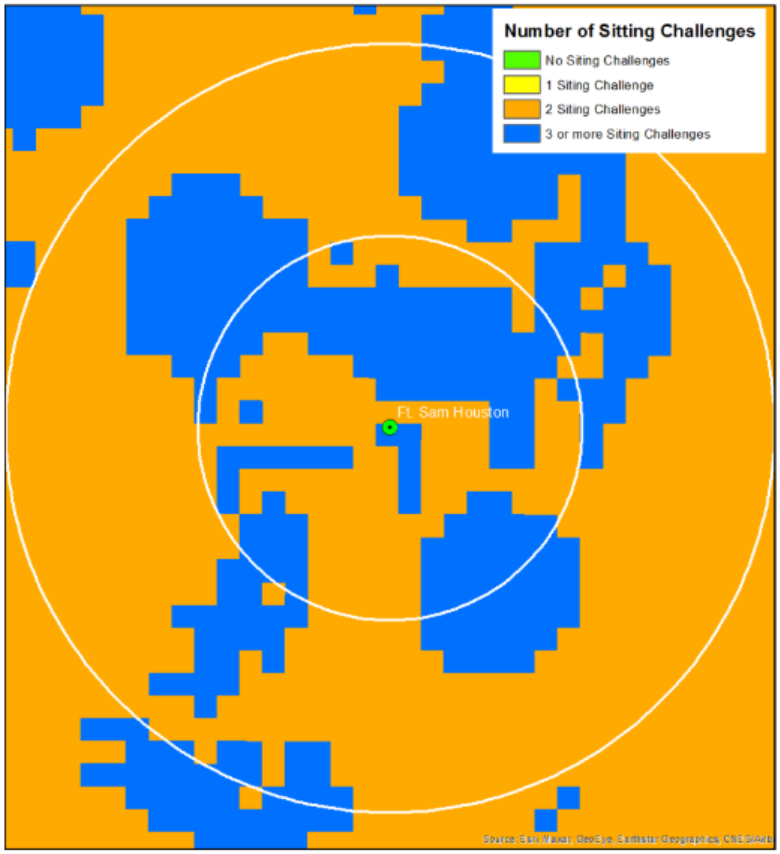

Figure 9. Fort Sam Houston advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the large population associated with San Antonio, TX. This affects the entire composite map. Military bases are automatically flagged within OR-SAGE for their potential fire, missile, and toxic gas hazards. Along with population, this accounts for the underlying color of the entire composite map being rendered orange. A risk assessment of the actual risk associated with siting a reactor on a military base will be necessary.

Wetlands and open water associated with Salado Creek run north-south across the map. This accounts for some of the stray blue cells on the composite map. A cemetery, a school, and a hospital account for the 3 concentrated blue areas on the map.

It is difficult to envision an advanced reactor technology being sited at this location. However, the base does extend southwest of the analyzed site midpoint. There may be areas within that area that would allow for an advanced reactor technology appropriate for a military base with the analyzed accident source term completely contained within a small site footprint.

The large LWR composite map is totally colored blue. Population density is too high and there is insufficient makeup cooling water at this location to support a large LWR site.

2.9 GRIMES

The site includes a cooling pond in Grimes County, TX. The site is approximately 2 miles northwest of the small town of Shiro, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 10. The evaluation radii are depicted as white circles on the map.

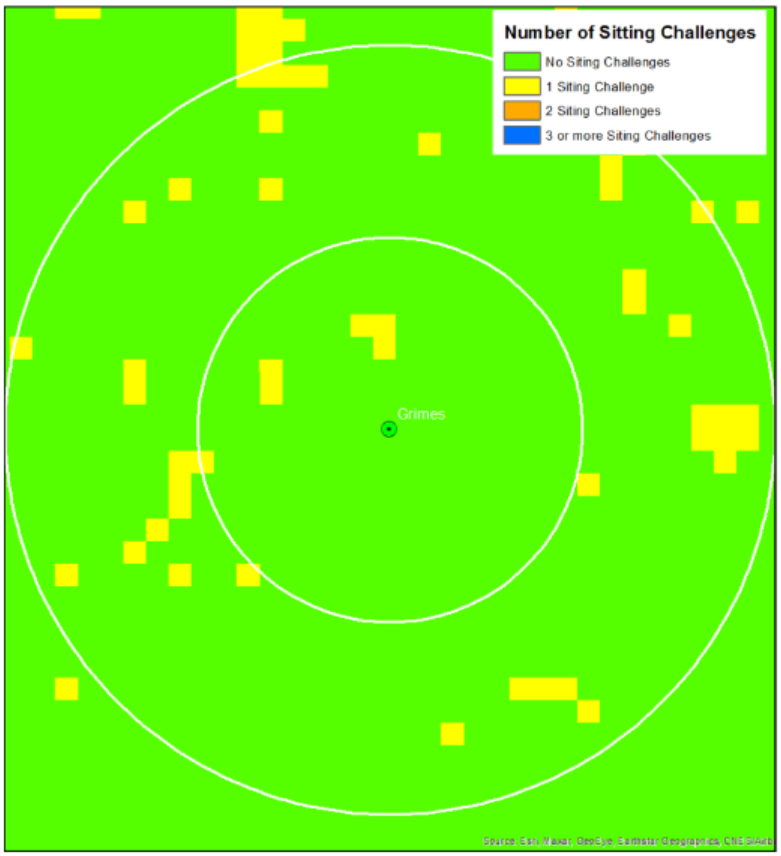

Figure 10. Grimes advanced reactor composite map.

Population density within 4 miles is not an issue. The only flag for this site is associated with small ponds in the area. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.10 GULF INLAND – DAYTON

The site is located 6 miles west of the Trinity River in Liberty County, TX. The site is approximately 2 miles southwest of Dayton, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 11. The evaluation radii are depicted as white circles on the map.

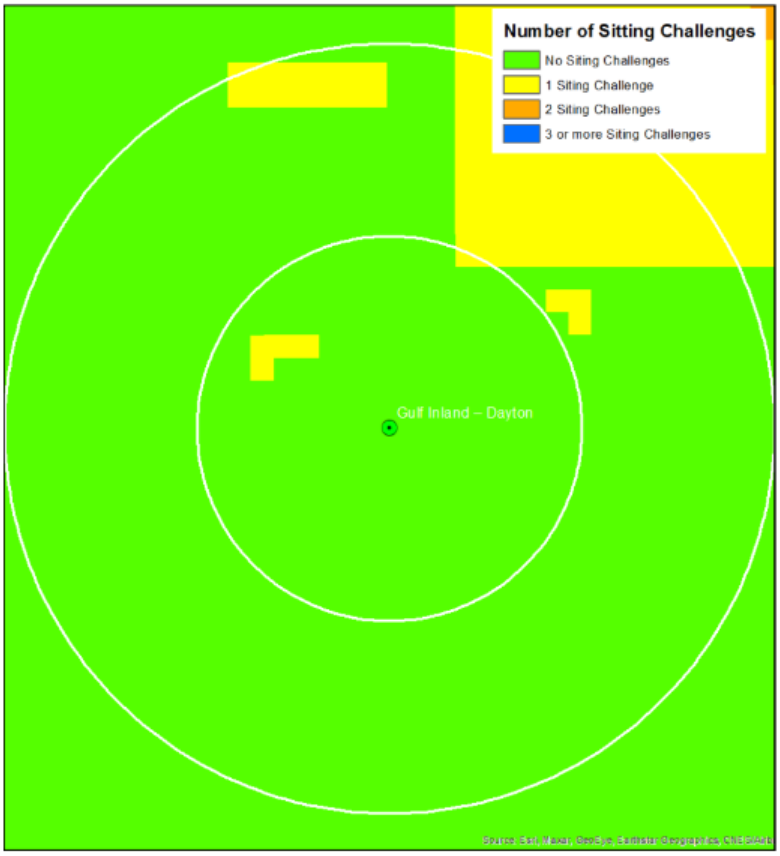

Figure 11. Gulf Inland - Dayton advanced reactor composite map.

Population density within 4 miles is not an issue except for the upper right corner of the evaluation area. The only other flags for this site are associated with small ponds in the area. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.11 HARTBURG ENTERGY POWER STATION

The site is located 1.5 miles west of the Sabine River in Newton County, TX. The site is approximately 2 miles north of Forest Heights, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 12. The evaluation radii are depicted as white circles on the map.

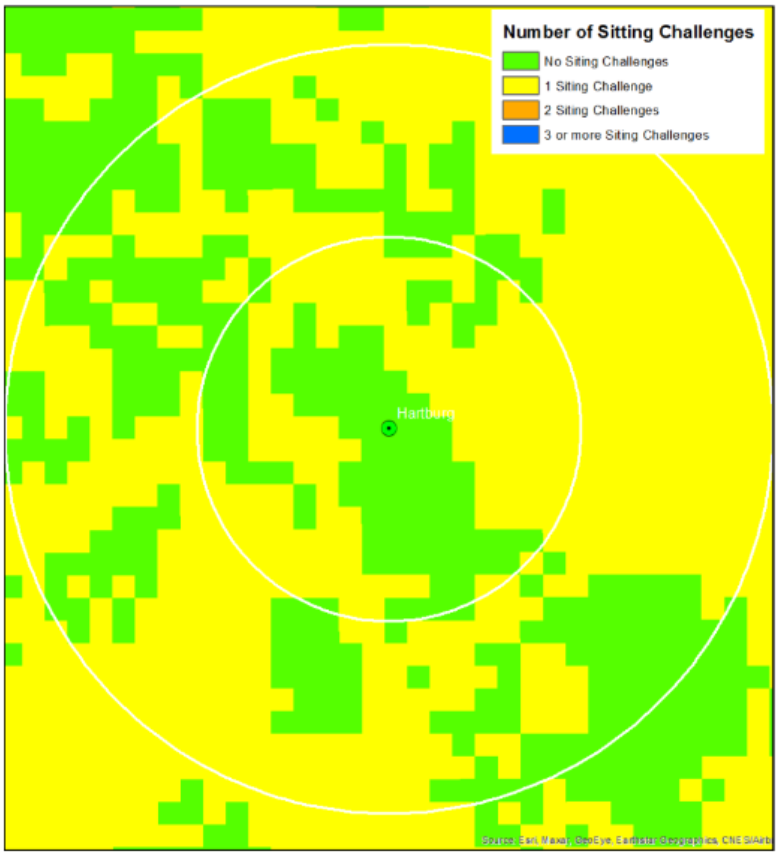

Figure 12. Hartburg Entergy Power Station advanced reactor composite map.

Population density within 4 miles is not an issue. The only flag for this site is associated with wetlands and open water. This accounts for the yellow color on the composite map. However, significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.12 IRONHOURSE TERMINALS – BEAUMONT

The site is located 4 miles southeast of the Pine Island Bayou in Newton County, TX. The site is approximately 2 miles west of the outer boundary of Beaumont, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 13. The evaluation radii are depicted as white circles on the map.

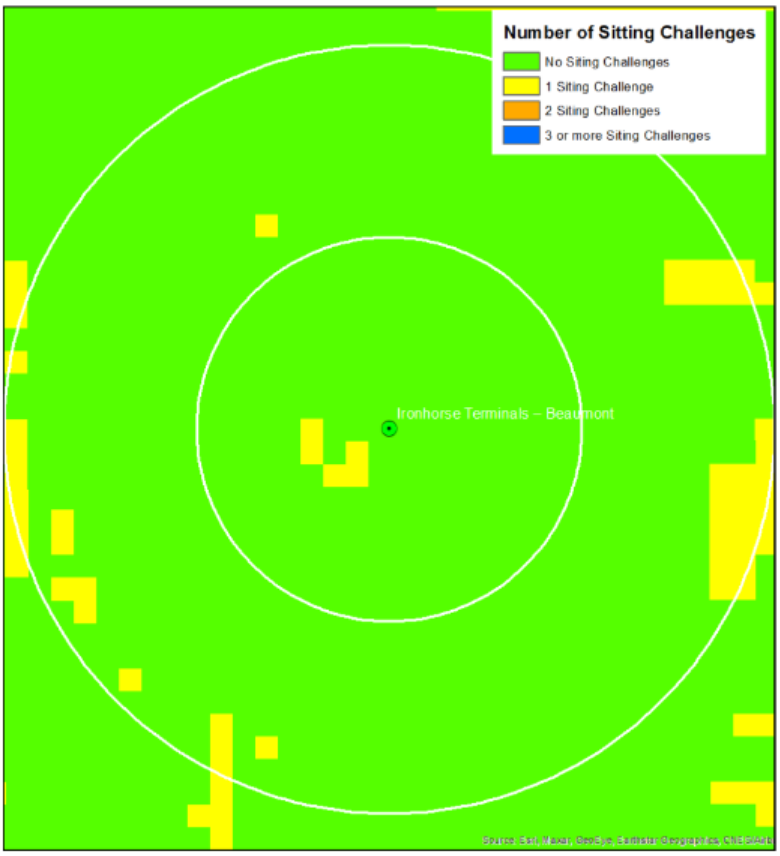

Figure 13. Ironhorse Terminals - Beaumont advanced reactor composite map.

Population density within 4 miles is not an issue. The only flag for this site is associated with limited wetlands and open water. This accounts for the yellow color on the composite map. However, significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.13 JOINT BASE SAN ANTONIO (JBSA) – CHAPMAN ANNEX

The evaluation area is bordered by Leon Creek in Bexar County, TX. The site is surrounded by the many communities that make up San Antonio, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 14. The evaluation radii are depicted as white circles on the map.

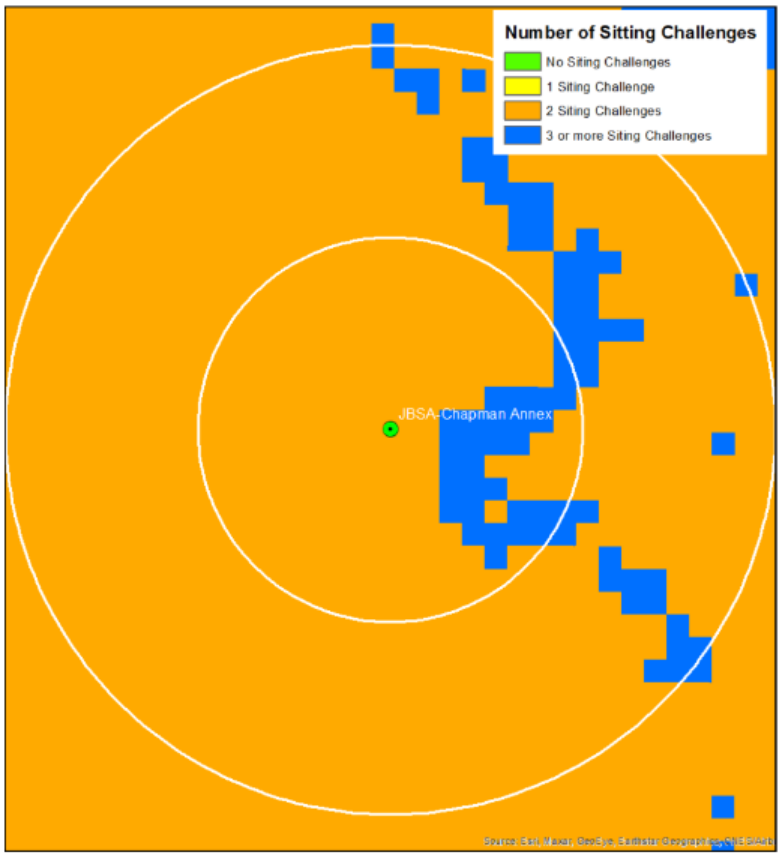

Figure 14. JBSA-Chapman Annex advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the large population associated with San Antonio, TX. This affects the entire composite map. Military bases are automatically flagged within OR-SAGE for their potential fire, missile, and toxic gas hazards. Along with population, this accounts for the underlying color of the entire composite map being rendered orange. A risk assessment of the actual risk associated with siting a reactor on a military base will be necessary.

Wetlands and open water associated with Leon Creek run north-south across the map. This accounts for the blue cells on the composite map.

It is difficult to envision an advanced reactor technology being sited at this location. The OR-SAGE technology is flagged population at 4 miles, but a technology, appropriate for a military base, with a contained source term could be evaluated at a smaller buffer distance.

The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.14 JOINT BASE SAN ANTONIO (JBSA) – LACKLAND 1

The site is surrounded by the many communities that make up San Antonio, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 15. The evaluation radii are depicted as white circles on the map.

Figure 15. JBSA-Lackland 1 advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the large population associated with San Antonio, TX. This affects the entire composite map. Military bases are automatically flagged within OR-SAGE for their potential fire, missile, and toxic gas hazards. Along with population, this accounts for the underlying color of the entire composite map being rendered orange. A risk assessment of the actual risk associated with siting a reactor on a military base will be necessary.

Wetlands and open water associated with Leon Creek appear in the upper right on the map. This accounts for the blue cells on the composite map. A golf course appears as protected land in the upper left on the map and a fitness center is associated with the large blue area to the left inside the 0.5-mile radius circle. Park land is identified south of the site center.

It is difficult to envision an advanced reactor technology being sited at this location. The OR-SAGE technology is flagged population at 4 miles, but a technology, appropriate for a military base, with a contained source term could be evaluated at a smaller buffer distance.

The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.15 JOINT BASE SAN ANTONIO (JBSA) – LACKLAND 2

The evaluation area is just south of JBSA-Lackland 1. The site is surrounded by the many communities that make up San Antonio, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 16. The evaluation radii are depicted as white circles on the map.

Figure 16. JBSA-Lackland 2 advanced reactor composite map.

This site center is just south of the analyzed area for JBSA-Lackland 1. The analysis is the same.

2.16 LAKE HUBBARD POWER PLANT

The site is adjacent to Ray Hubbard Lake in Dallas County, TX. The site is surrounded by the many communities that make up Dallas, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 17. The evaluation radii are depicted as white circles on the map.

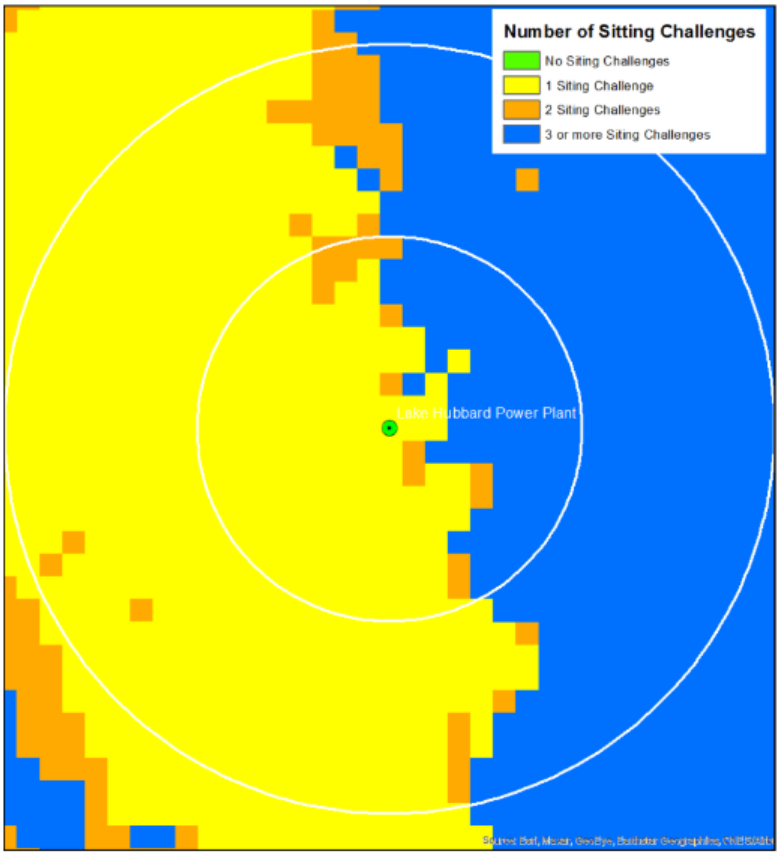

Figure 17. Lake Hubbard Power Plant advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the large population associated with Dallas, TX. This accounts for the underlying yellow color across the composite map. The lake is coded as wetland and floodplain, which accounts for the blue color on the composite map.

Since population is the major factor at this site, an advanced reactor technology with analyzed accident source term completely contained within the site footprint may be possible within the yellow area. The OR-SAGE technology is flagged for population at 4 miles, but a technology with a contained source term could be evaluated at a smaller buffer distance.

The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.17 LEGEND ENTERGY COMBINED CYCLE COMBUSTION TURBINE (CCCT) PLANT

The site is adjacent to Taylor Bayou in Jefferson County, TX. The site is 3 miles west of Port Arthur, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 18. The evaluation radii are depicted as white circles on the map.

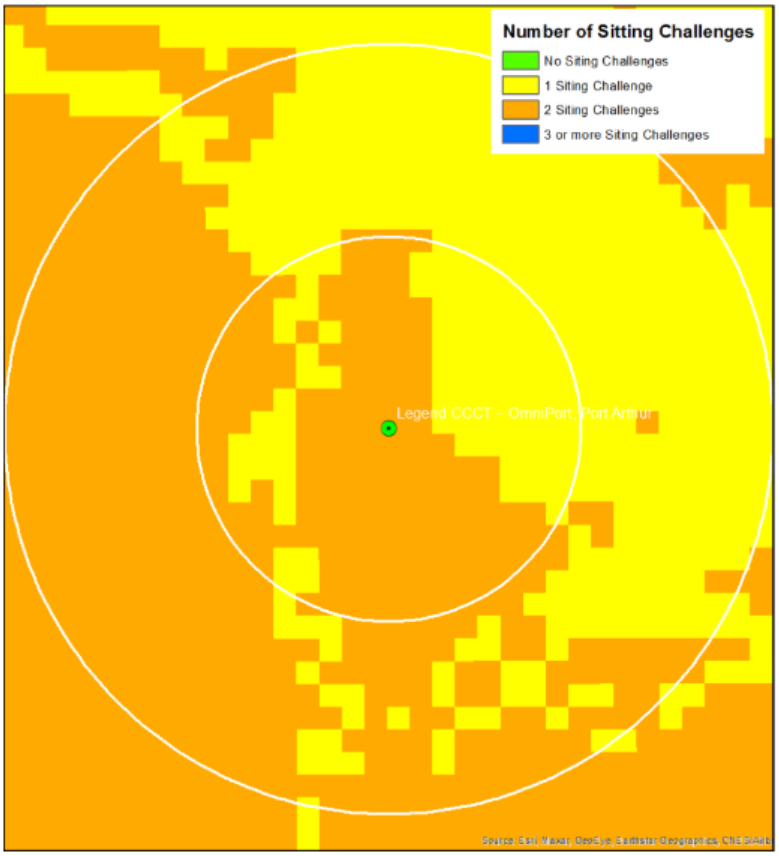

Figure 18. Legend Entergy CCCT Plant advanced reactor composite map.

Population density within 4 miles is not an issue. However, the entire area is flagged for fire, missile, and toxic gas hazard associated with the Port Arthur industrial facilities to the east. A risk assessment of the actual risk associated with siting a reactor near an industrial site will be necessary.

Extensive wetlands and open water are indicated in the area. This accounts for the orange color on the composite map. With appropriate analysis of the hazard risk, an advanced reactor technology with analyzed accident source term completely contained within the site footprint may be possible in the yellow area.

The large LWR composite map is impacted by population density in the upper half of the area.

2.18 MONTGOMERY COUNTY POWER STATION

The site is adjacent to Lewis Creek Reservoir in Montgomery County, TX. The site is 2 miles west of Willis, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 19. The evaluation radii are depicted as white circles on the map.

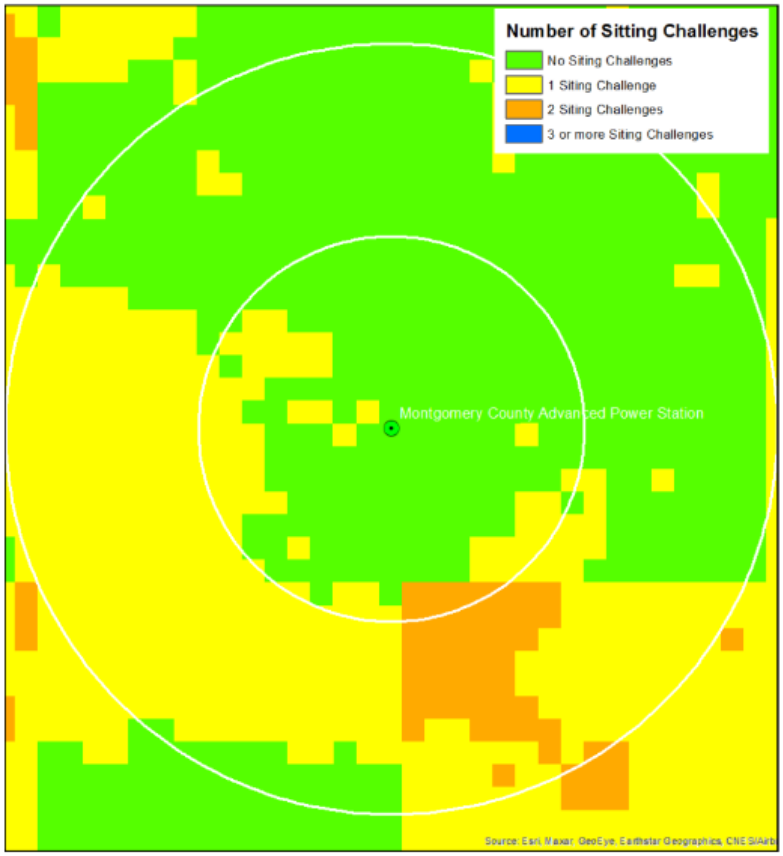

Figure 19. Montgomery County Power Station advanced reactor composite map.

Population density within 4 miles is not an issue except in the lower right corner of the composite map. The major flag for this site is associated with the site ponds and the Lewis Creek Reservoir. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is impacted by population within 20 miles and inadequate makeup cooling water.

2.19 ORANGE COUNTY POWER STATION

The site is located adjacent to Sabine Lake in Orange County, TX. The site is approximately 2 miles west of Bridge City, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 20. The evaluation radii are depicted as white circles on the map.

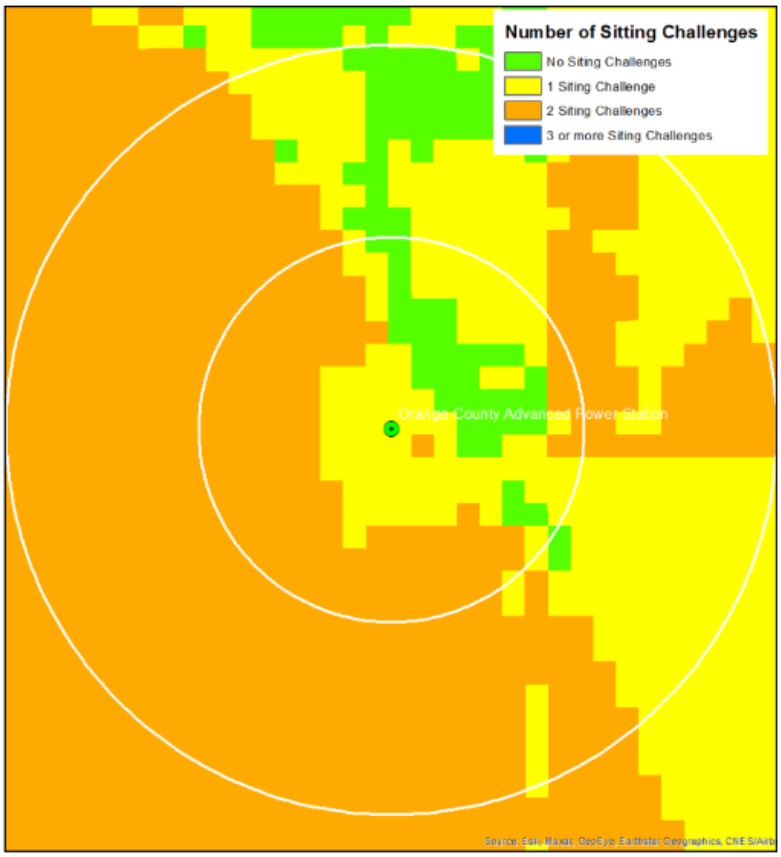

Figure 20. Orange County Power Station advanced reactor composite map.

Population density within 4 miles is not an issue except in the upper right corner of the composite map. The major flag for this site is associated with the wetlands that surround the site. An oil refinery southwest of the site also impacts the site. However, north of the site center, there are tracts of land that meets all the OR-SAGE screening criteria (shown in green) available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.20 ORANGE CROSSING

The site is located adjacent to Cow Bayou in Orange County, TX. The site is approximately 2 miles east of Vidor, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 21. The evaluation radii are depicted as white circles on the map.

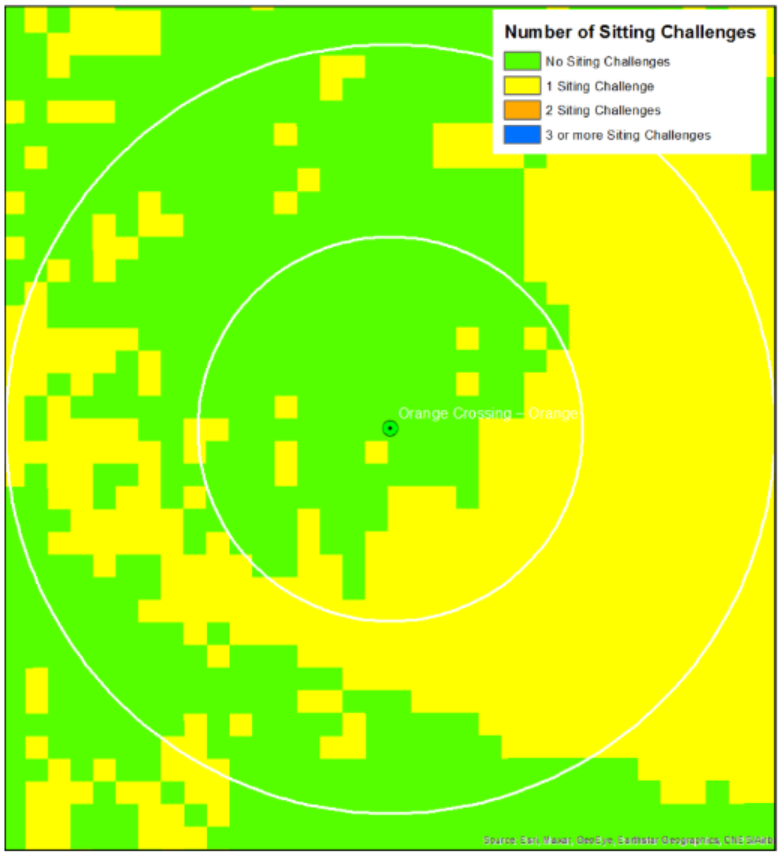

Figure 21. Orange Crossing advanced reactor composite map.

Population density within 4 miles is not an issue. The only flag for this site is associated with the bayou around the site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.21 PORT OF BROWNSVILLE – SITE 1

The site is located near the Gulf of Mexico in Cameron County, TX. The site is in the port area adjacent to Brownsville, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 22. The evaluation radii are depicted as white circles on the map.

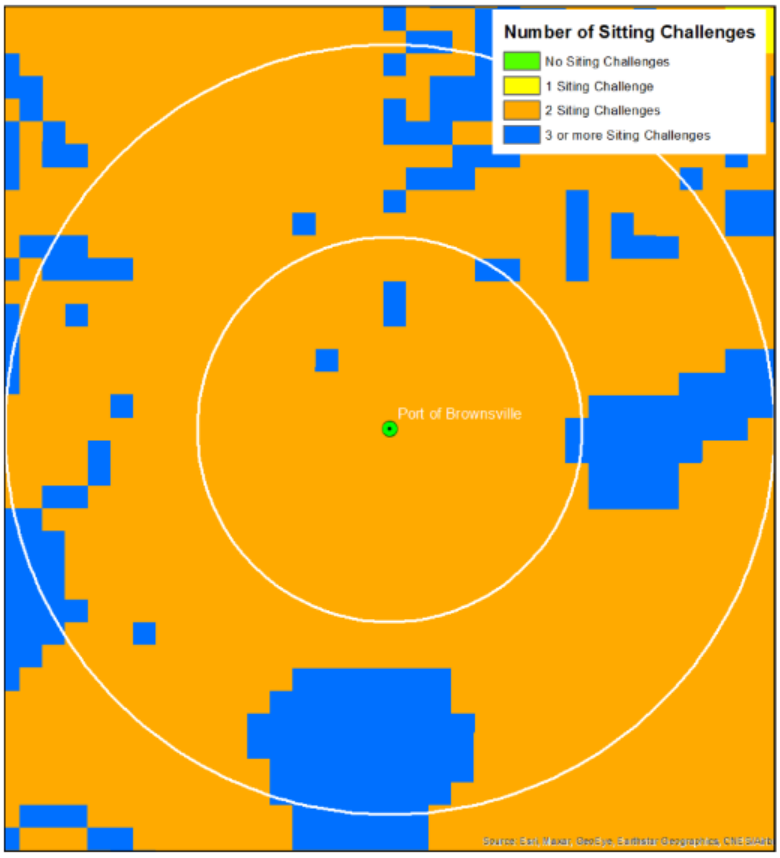

Figure 22. Port of Brownsville-Site 1 advanced reactor composite map.

Population density within 4 miles is the major issue at this location due to the large population associated with San Antonio, TX. This affects the entire composite map. In addition, the site is within a 10-mile radius of the Brownsville South Padre Island International Airport. These two flags are the reason the underlying color for the entire composite map is orange. A risk assessment is required to evaluate the proximity of the airport to the site.

The blue areas in the map are due to the open water and an elementary school near the site. The OR-SAGE technology is flagged for population at 4 miles, but a technology with a contained source term and assessed for the airport risk, could be evaluated at a smaller buffer distance. The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.22 PORT OF BROWNSVILLE – SITE 2

The site is located near the Gulf of Mexico in Cameron County, TX. The site is approximately 9 miles northeast of Brownsville, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 23. The evaluation radii are depicted as white circles on the map.

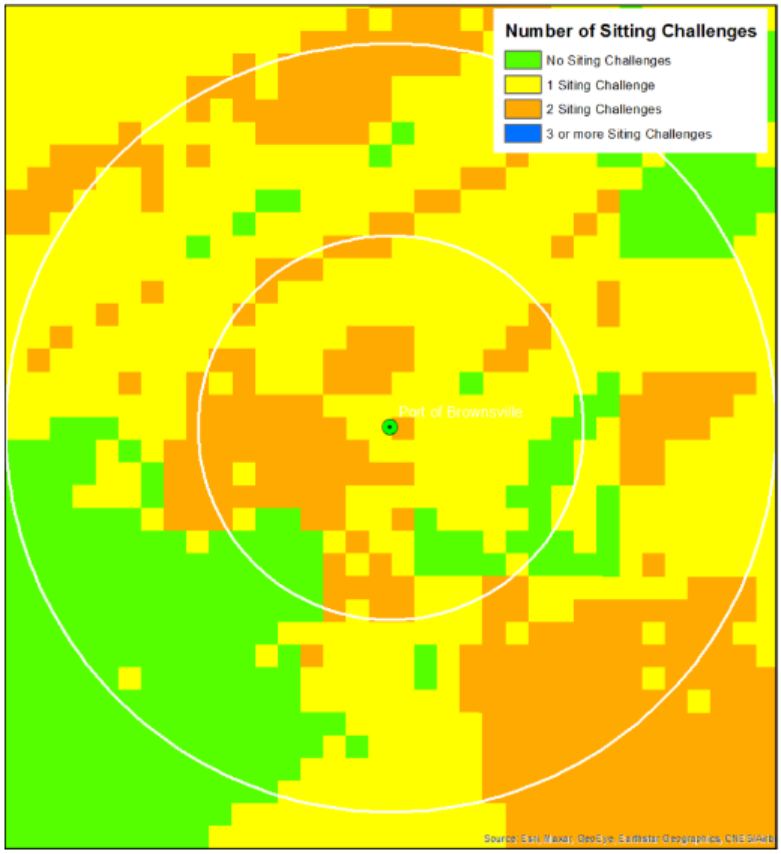

Figure 23. Port of Brownsville-Site 2 advanced reactor composite map.

Population density within 4 miles is not an issue. The two flags for this site are associated with wetlands and open water near the site and a swath of protected land near the site. However, significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.23 PORT OF CORPUS CRISTI

The site is located adjacent to Corpus Cristi Bay near the Gulf of Mexico in San Patricio County, TX. The site is in the town of North Beach, TX, just outside Corpus Cristi, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 24. The evaluation radii are depicted as white circles on the map.

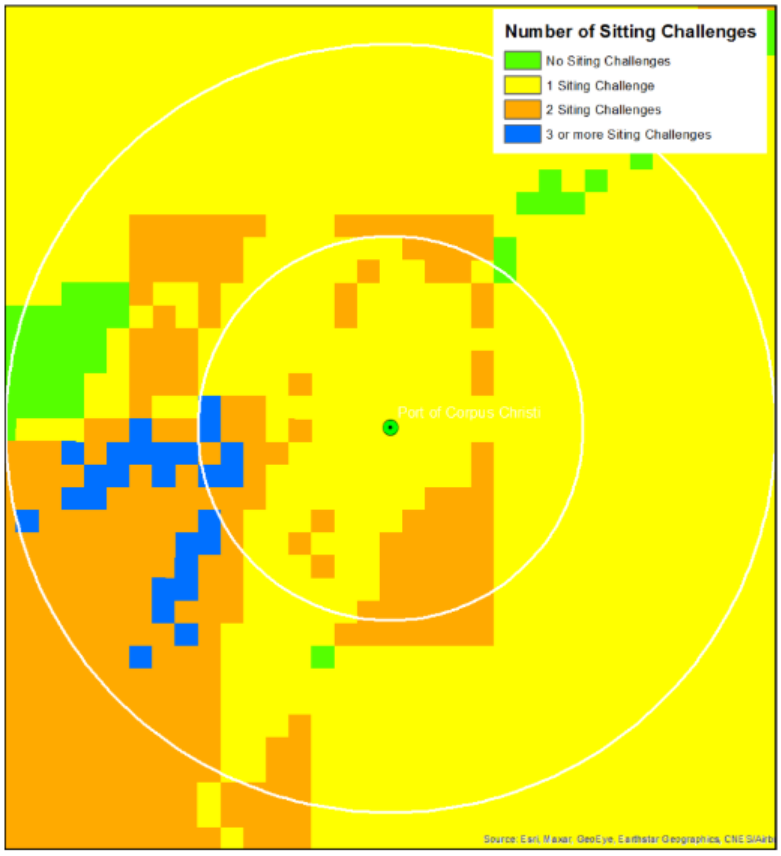

Figure 24. Port of Corpus Cristi advanced reactor composite map.

The site is on a peninsula surrounded by open water. In addition, an oil refinery exists nearby on the land connection to the peninsula. The oil refinery is flagged with a 1-mile buffer by OR-SAGE for its fire, missile, and toxic gas risk. Combined, these siting criteria account for an underlying yellow color on the entire composite map.

Population density within 4 miles is not an issue except in the lower left corner of the composite map signified by the large orange color block. However, there are condos and hotels along the bayfront on the peninsula. While the population associated with these buildings does not exceed the advanced reactor population density criterion near the site center, it could be difficult to site a reactor here based on public use. There is also a public park just inside the 0.5-mile radius.

The OR-SAGE technology is flagged for population at 4 miles, but a technology with a contained source term and assessed for the refinery risk could be evaluated at a smaller buffer distance and sited close to the site center on the map. The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.24 PORT OF FREEPORT

The site is in the port adjacent to the Gulf of Mexico in Brazoria County, TX. The site is in the town of Freeport, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 25. The evaluation radii are depicted as white circles on the map.

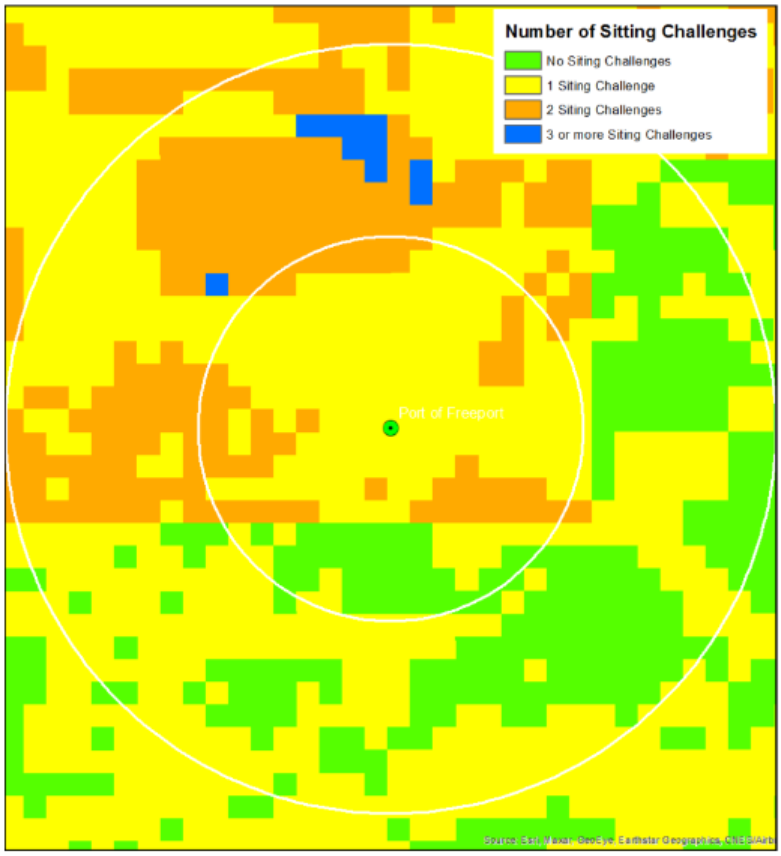

Figure 25. Port of Freeport advanced reactor composite map.

Population density for a small, advanced reactor is a factor north and west of the site center as depicted by the predominantly yellow rectangle in a rectangle image on the composite map. The open water associated with the harbor area is also flagged, as depicted by the random form yellow and orange coloring on the map.

The solid orange block north of the site center is associated with a school. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available south and east of the site center.

The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.25 PORT OF HOUSTON

The site is in the port adjacent to the Buffalo Bayou in Harris County, TX. The site is in an industrial area surrounded by the many communities that make up Houston, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 26. The evaluation radii are depicted as white circles on the map.

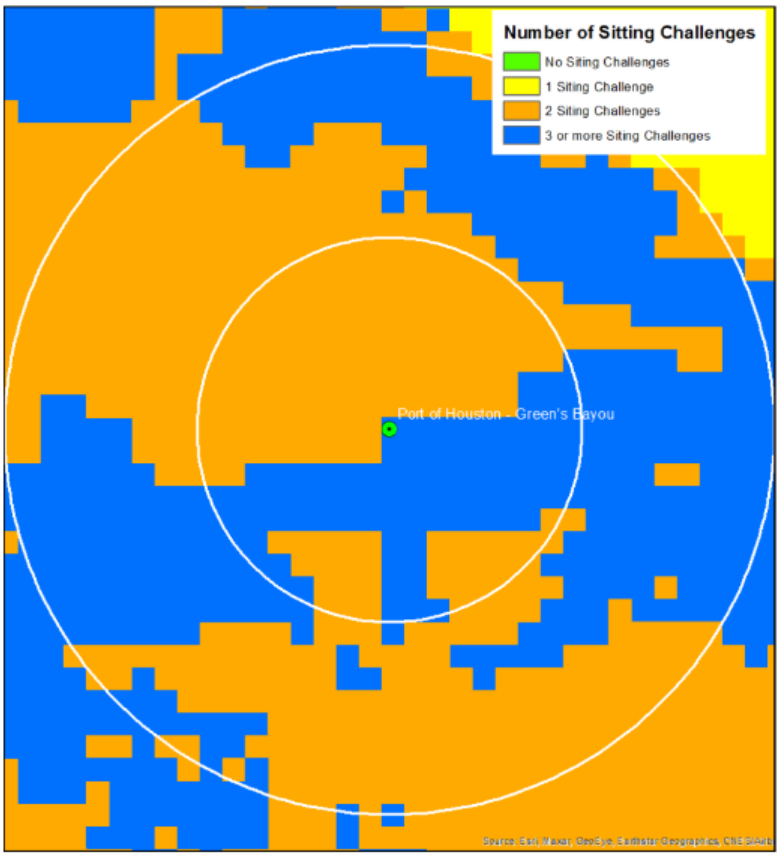

Figure 26. Port of Houston advanced reactor composite map.

Population density for a small, advanced reactor is a factor over the entire composite map. In addition, nearby oil refineries are flagged with a 1-mile buffer by OR-SAGE for their fire, missile, and toxic gas risk. This accounts for the overall orange color of the composite map, except for the upper left corner that is beyond the 1-mile buffer to the oil refineries. The open water associated with the port accounts for the blue color on the composite map.

The OR-SAGE technology is flagged for population at 4 miles, but a technology with a contained source term and assessed for the refinery risk could be evaluated at a smaller buffer distance and sited north of the site center on the map. The large LWR composite map is similar, however, population density would absolutely preclude consideration of a large reactor in the evaluation area.

2.26 PORT OF PORT ARTHUR

The site is adjacent to Sabine Lake in Jefferson County, TX. The site is in an outlying area near West Port Arthur, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 27. The evaluation radii are depicted as white circles on the map.

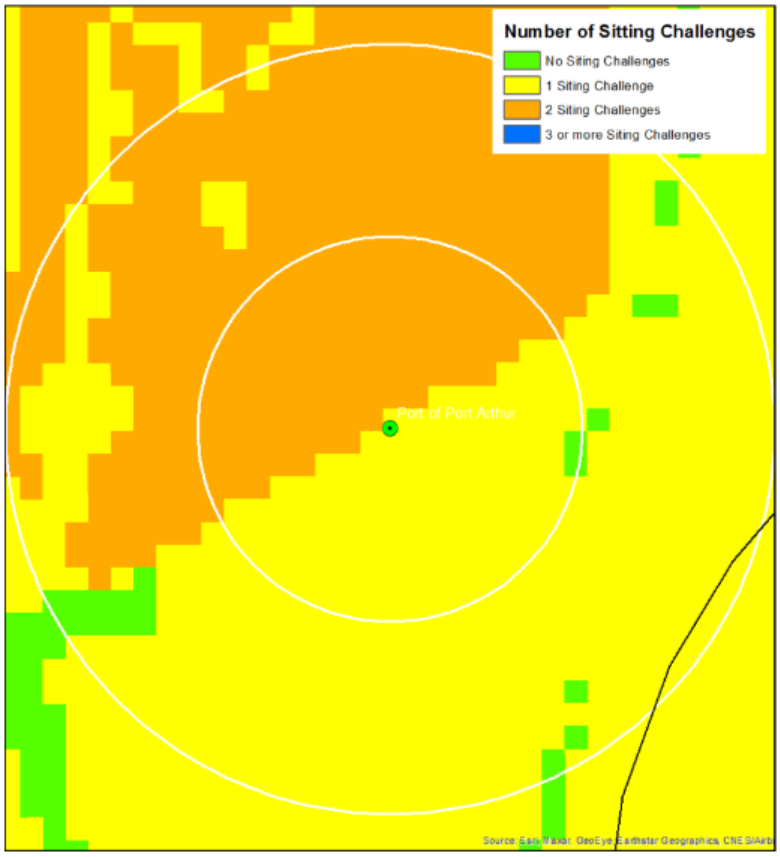

Figure 27. Port of Port Arthur advanced reactor composite map.

Population density for a small, advanced reactor is not a factor for this site. However, wetlands and open water are flagged over most of the analyzed area. This accounts for the underlying yellow color on the composite map. In addition, nearby oil refineries are flagged with a 1-mile buffer by OR-SAGE for their fire, missile, and toxic gas risk. This accounts for the orange color in the upper left on the composite map.

There are very small tracts of land that meets all the OR-SAGE screening criteria (shown in green). In general, the flooding risk associated with the wetlands will need to be addressed to site a reactor here. The large LWR composite map is similar.

2.27 PORT OF VICTORIA

The site center is in a light industrial area just east of Blue Bayou in Victoria County, TX. The site is 4 miles south of Victoria, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 28. The evaluation radii are depicted as white circles on the map.

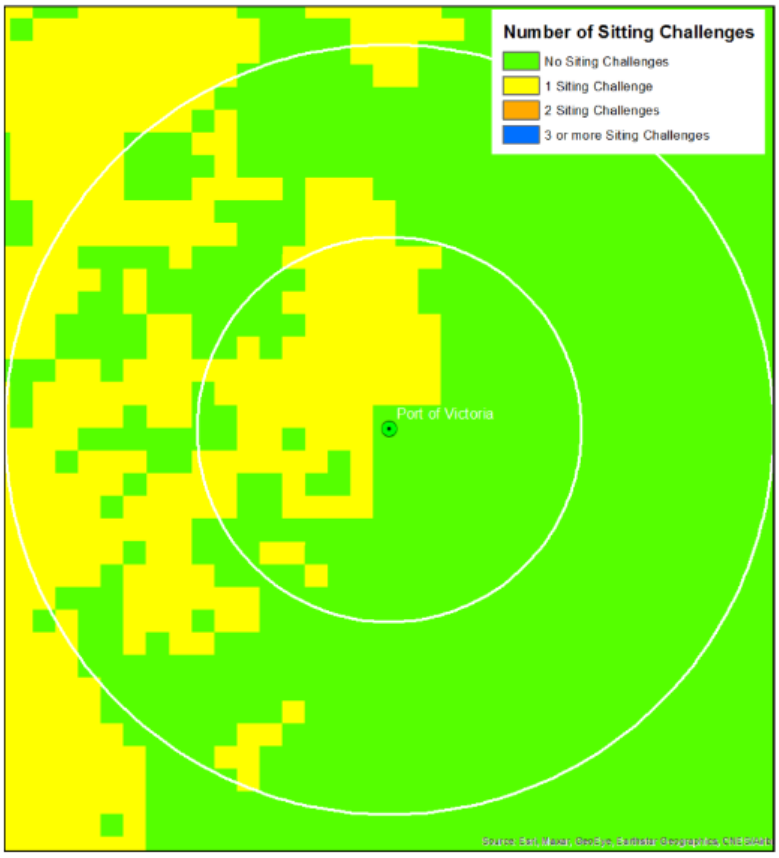

Figure 28. Port of Victoria advanced reactor composite map.

Population density for a small, advanced reactor is not a factor for this site. The only flag for this site is associated with Blue Bayou to the west. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.28 ROCKY CREEK

The site center is in Walker County, TX next to an Entergy substation. The site is approximately 9 miles west of Huntsville, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 29.

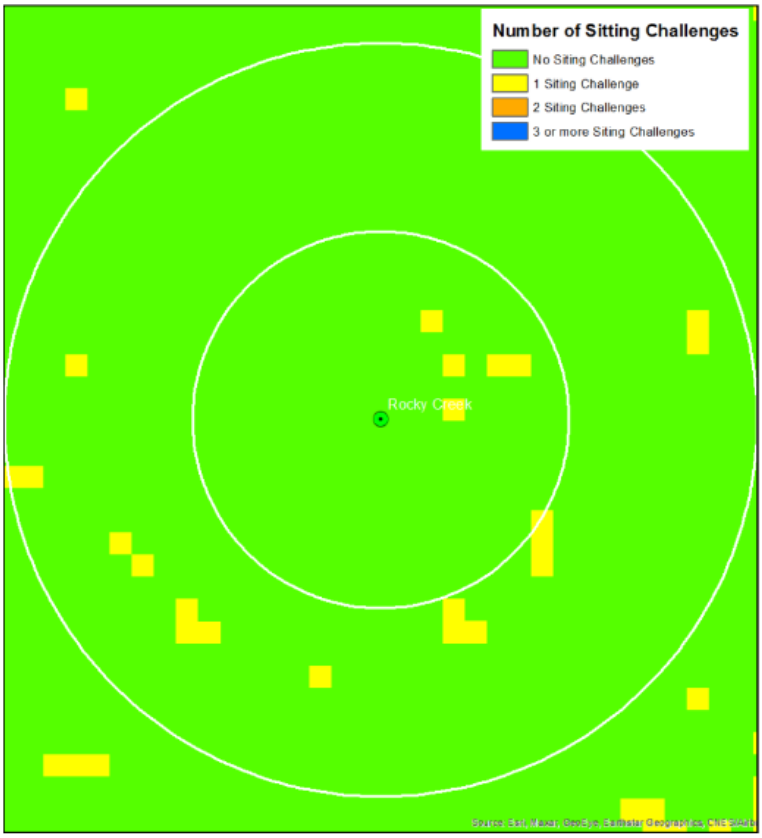

Figure 29. Rocky Creek advanced reactor composite map.

Population density for a small, advanced reactor is not a factor for this site. The only flag for this site is associated with the ponds and wetlands in the area. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is similar.

2.29 TEXAS A&M UNIVERSITY - RELLIS CAMPUS

The site center is located 1.5 miles northeast of the Brazos River in Brazos County, TX. The site is approximately 6 miles west of College Station, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 30.

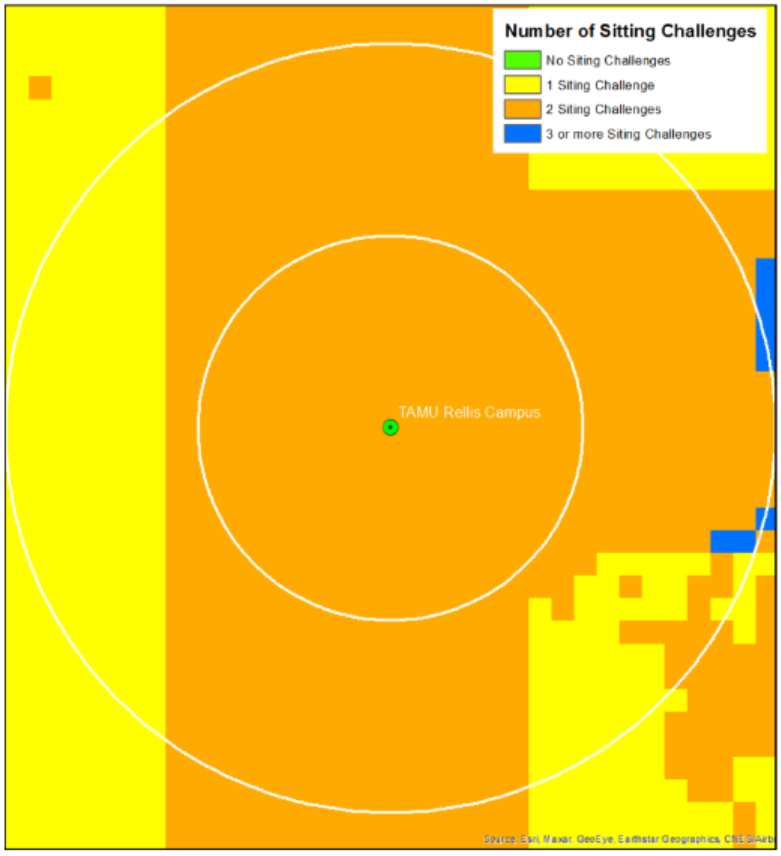

Figure 30. TAMU Rellis Campus advanced reactor composite map.

There are numerous oil derricks and a small airport near the site. This accounts for the underlying yellow color on the composite map. Ambient population density for a small, advanced reactor within 4 miles is an issue through the center of the site. This is reflected by the orange striping on the composite map. Some wetlands are also shown in the lower right corner of the map.

A risk assessment for the oil derricks and the small airport would likely show a minimal risk for this site. The OR-SAGE technology is flagged for population at 4 miles, but a technology with a contained source term and assessed for the other risks could be evaluated at a smaller buffer distance and sited at this location. The large LWR composite map is precluded by population.

2.30 UNIVERSITY LAND SITE 12

The rural site center is in Andrews County approximately 7 miles west of Andrews, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 31.

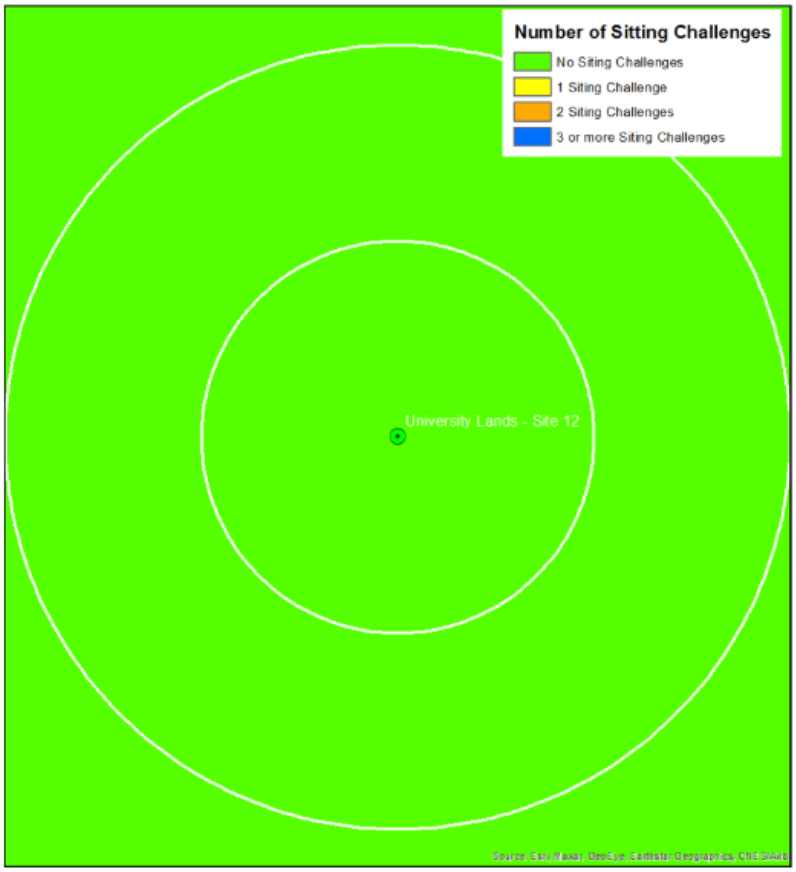

Figure 31. University Land Site 12 advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.31 UNIVERSITY LAND SITE 15

The site center is in Upton County approximately 5 miles southwest of Rankin, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 32.

Figure 32. University Land Site 15 advanced reactor composite map.

There are few flags for this site. There is some land flagged for slope northeast of the site center on the composite map. There is some land flagged for wetlands southeast of the site center on the composite map. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.32 UNIVERSITY LAND SITE 16 – PECOS COUNTY

The site center is in Pecos County south of the Maplewood Solar Plant. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 32.

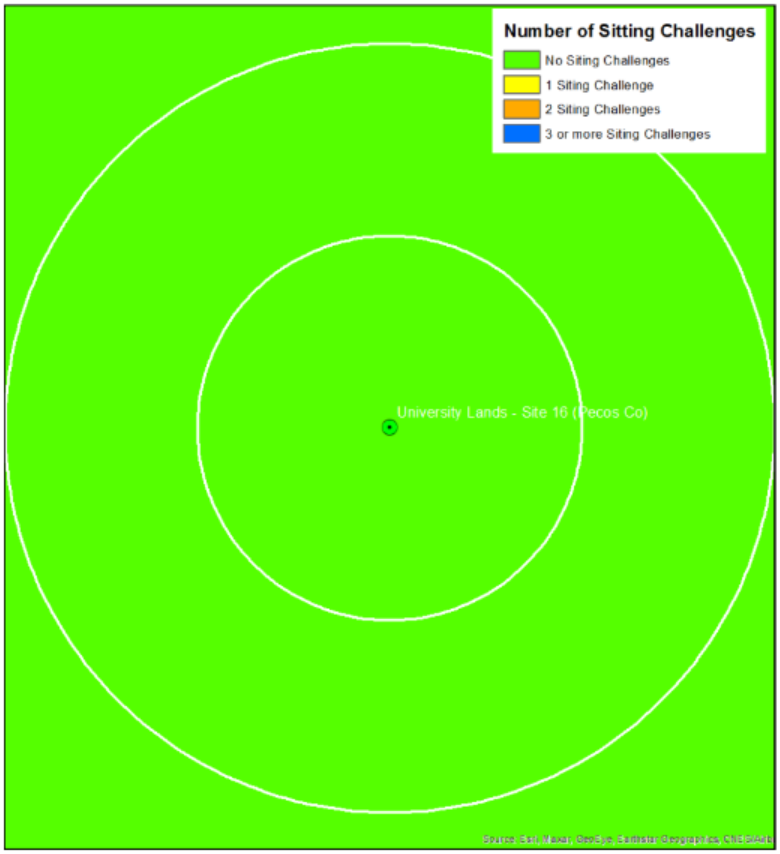

Figure 33. University Land Site 16 (Pecos) advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.33 UNIVERSITY LAND SITE 16 – WARD COUNTY

The site center is in Ward County approximately 1 mile west of Thorntonville, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 34.

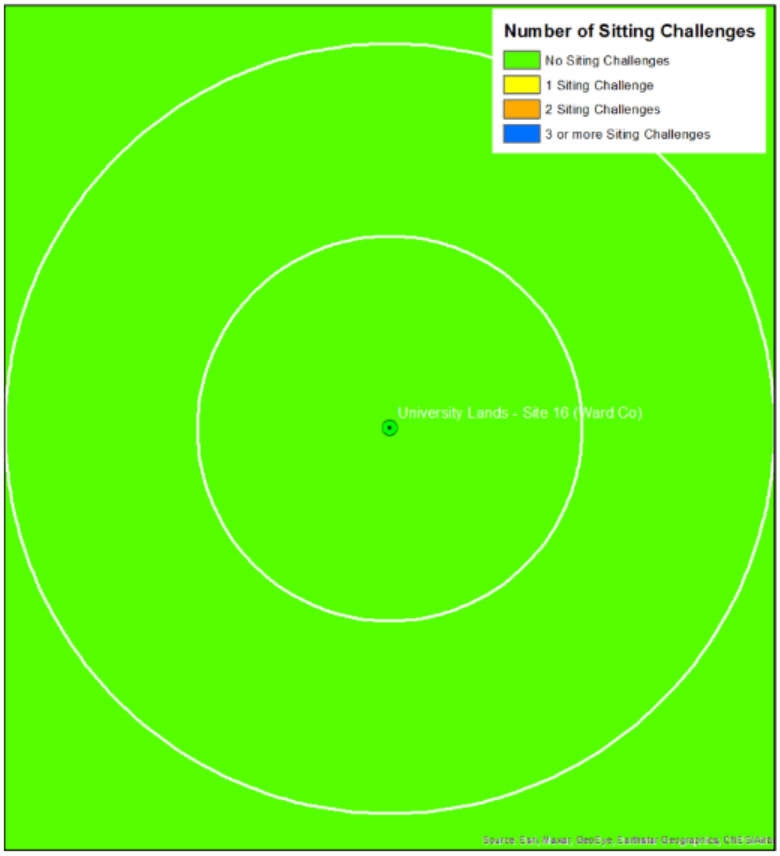

Figure 34. University Land Site 16 (Ward) advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.34 UNIVERSITY LAND SITE 17

The site center is in Winkler County approximately 14 miles south of Kermit, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 35.

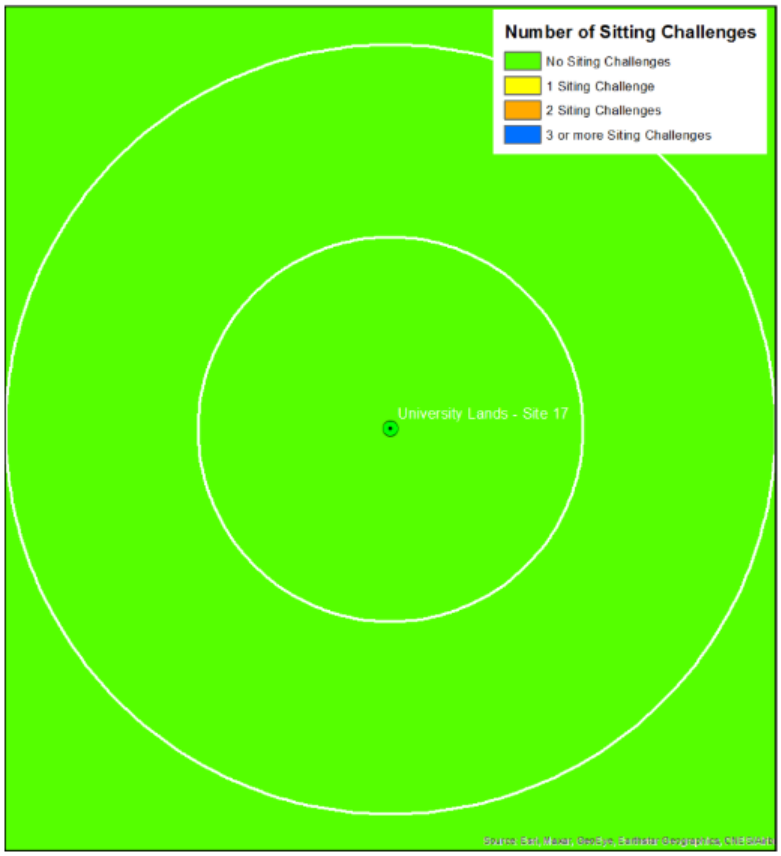

Figure 35. University Land Site 17 advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.35 UNIVERSITY LAND SITE 18

The site center is in Pecos County, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 36.

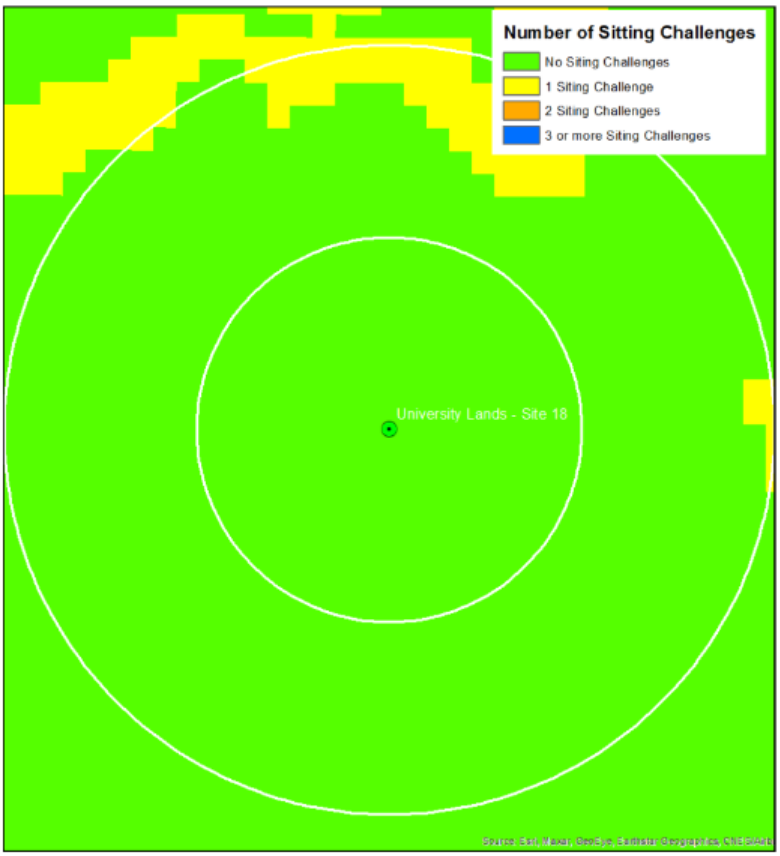

Figure 36. University Land Site 18 advanced reactor composite map.

There are few flags for this site. There is some land flagged for slope north of the site center on the composite map. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.36 UNIVERSITY LAND SITE 26

The site center is in Pecos County, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 37.

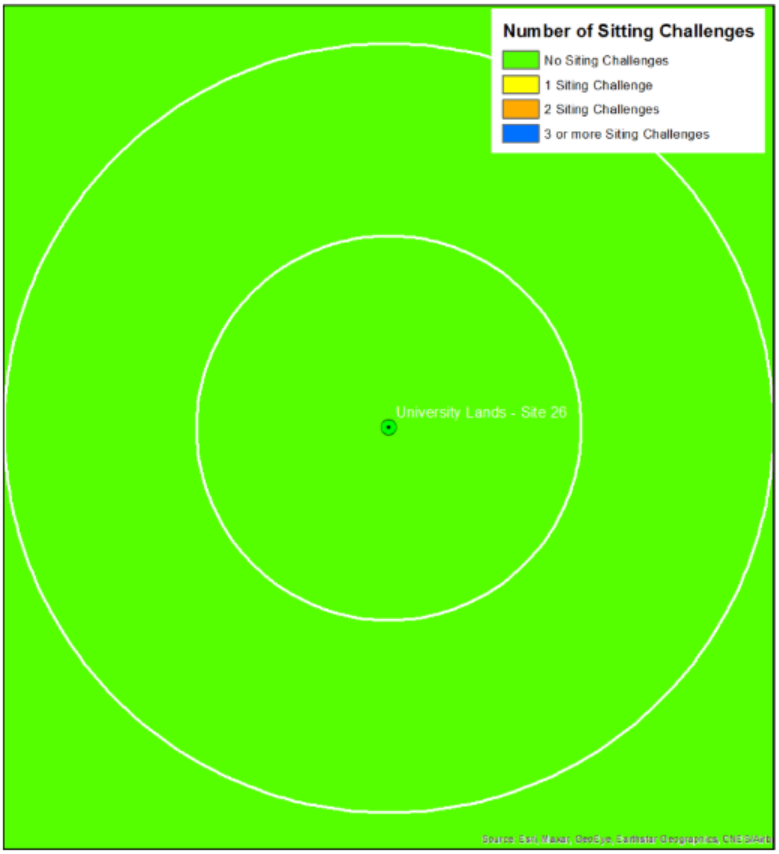

Figure 37. University Land Site 26 advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.37 UNIVERSITY LAND SITE 27

The site center is in Pecos County, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 38.

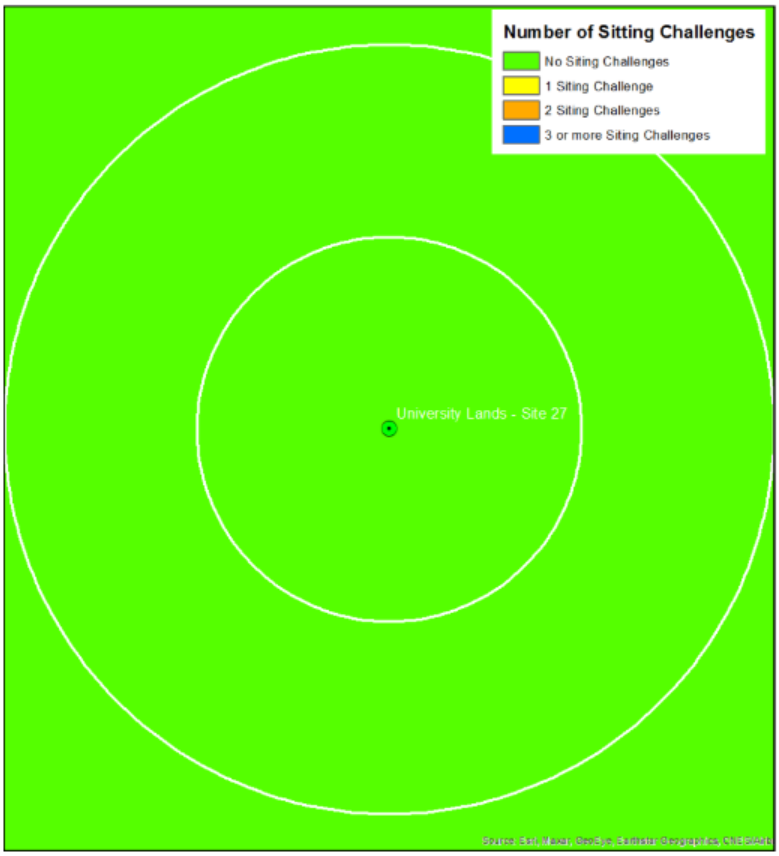

Figure 38. University Land Site 27 advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.38 UNIVERSITY LAND SITE 31

The site center is in Crane County, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 39.

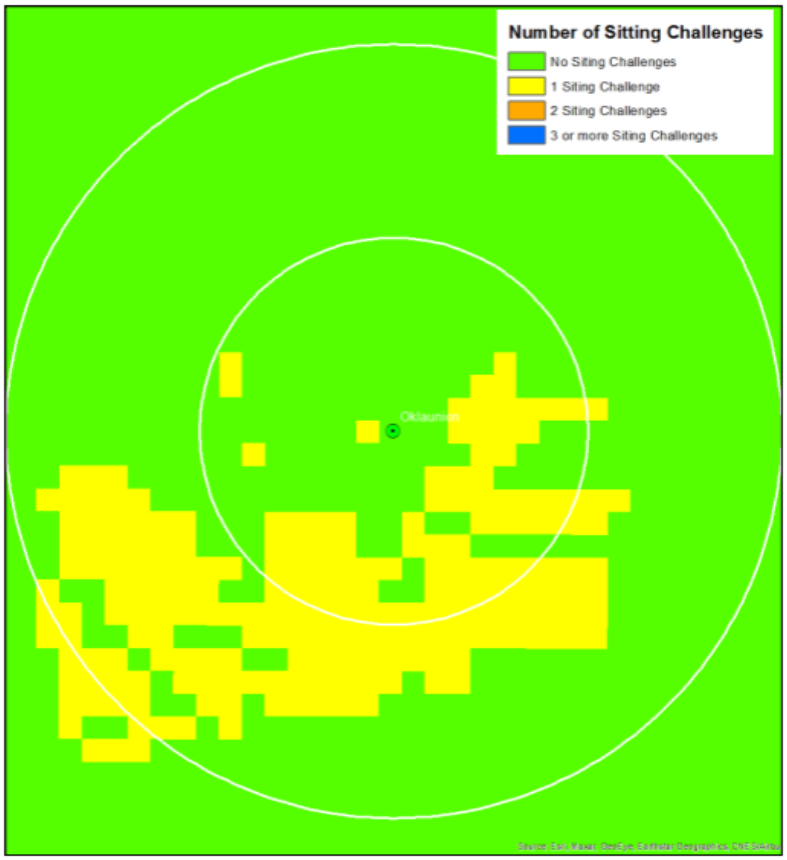

Figure 39. University Land Site 31 advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.39 UNIVERSITY LAND SITE 35

The site center is in Crane County, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 40.

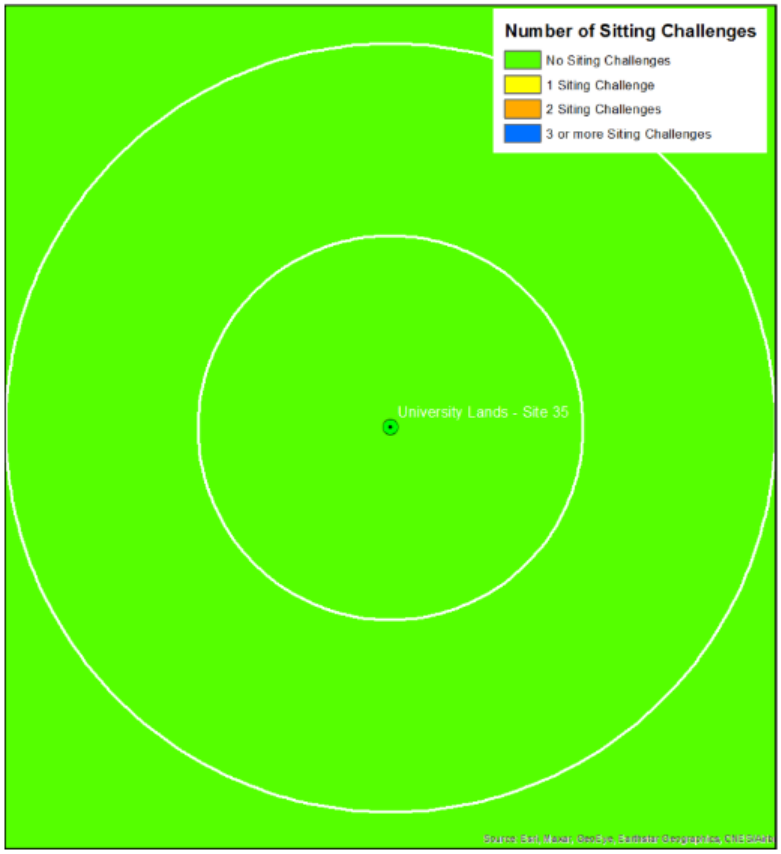

Figure 40. University Land Site 35 advanced reactor composite map.

There are no flags for this site. Significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available within the 0.5-mile and 1.0-mile radii. The large LWR composite map is precluded for lack of make-up cooling water.

2.40 WESTERN COMBUSTION TURBINE

The site center straddles San Jacinto and Liberty Counties about 0.5 miles north of Cleveland, TX. The OR-SAGE evaluation process was applied around the provided site center point and the composite results are shown in Figure 41.

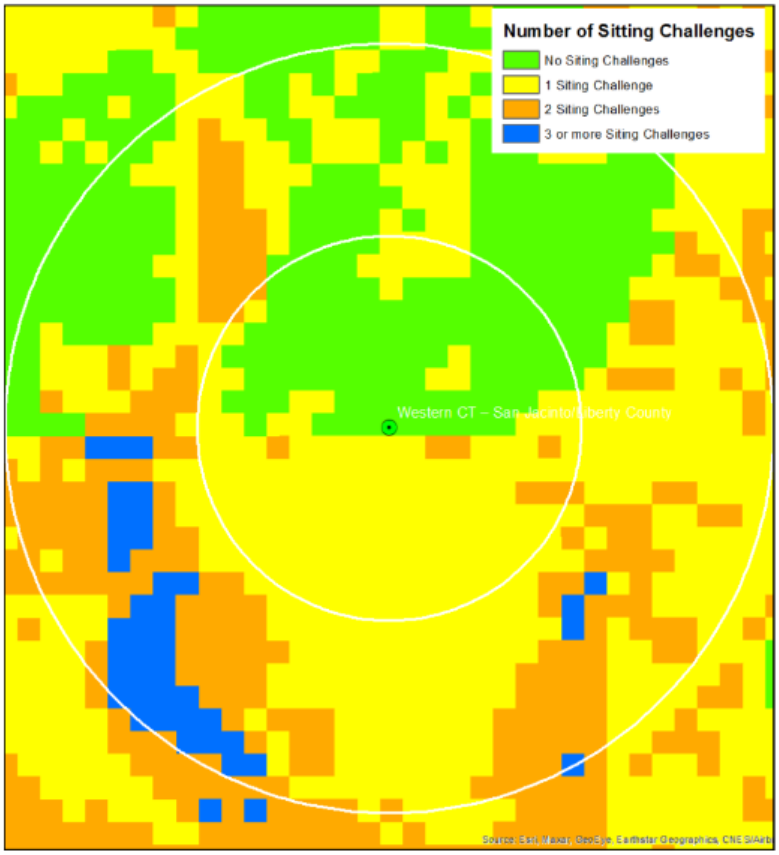

Figure 41. Western CT advanced reactor composite map.

Population density for a small, advanced reactor is a factor south of the site center on the composite map. Significant area is designated as wetlands or within the 100-year floodplain. There is also a school southwest of the site center where the blue color is depicted on the composite map. However, significant tracts of land that meets all the OR-SAGE screening criteria (shown in green) are available north of the site center. The large LWR composite map is similar.

3. SUMMARY

The OR-SAGE analyses do not provide an alternative for the detailed site analyses required by the NRC. However, the siting data visualization provided by OR-SAGE does indicate where siting issues may exist. Most of the 40 sites evaluated should be amenable to consideration for advanced reactor siting. Many sites will require further risk analysis for the fire, missile, or toxic gas hazard that an oil refinery may impose. In the OR-SAGE modeling, all advanced reactor siting assumes little, or no make-up cooling water is required. Therefore, all these results are subject to the selection of a specific reactor technology.

Fifteen of these sites may also be amenable to consideration of a large LWR installation. Large LWRs are more sensitive to population density and sufficient makeup water cooling.