

IDENTIFYING LAND USE CONFLICT FOR A MORE EQUITABLE FUTURE IN THE COASTAL GEORGIA SENTINEL LANDSCAPE

by

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(Under the Direction of Rosanna Rivero)

ABSTRACT

The purpose of this research is to understand how equity is integrated into the Department of Defense (DOD) climate change policy, create a justification for policy intervention through a land use analysis, and propose strategies for more equitable engagement with communities surrounding military installations. A future land use map was developed using the Land Use Conflict Identification Strategy to create a 2050 baseline scenario for three systems: urban, conservation, and agriculture for coastal areas in the Georgia Sentinel Landscape. This area includes Fort Stewart (FS), Hunter Army Airfield (HAA), the FS/HAA Army Compatible Use Buffer, and Chatham, Bryan, and Liberty Counties. This was compared to disadvantaged areas identified by the White House Justice40 initiative to help justify where DOD resources should be targeted for more climate resilient and equitable future outcomes. Future research could incorporate multiple scales and utilize the data collected for a participatory project, such as geodesign.

INDEX WORDS: Climate Equity, Equity, Georgia Sentinel Landscape, Justice40, Land Use Conflict Identification Strategy

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DEDICATION

To the folks who learned to pivot after the 2020 COVID-19 Pandemic and those who helped us get back on our feet.

And to my husband, Frank, who supported and loved me every single day.

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CHAPTER 1

INTRODUCTION

1.1 Background

Some military installations were initially sited in rural areas to avoid disturbing people through noise and light pollution, training exercises, and other activities. However, installations often spur population growth because they become economic hubs. The Department of Defense (DOD) uses the term “encroachment” to classify “DOD factors and influences that constrain or have the potential to inhibit the full access or operational use of the live training and test domain.”¹ Encroachment threats are two-fold: first, the external threat of urban areas expanding closer and second, the internal threat of endangered species and critical habitat. Other examples include, but are not limited to, unexploded ordnance and munitions, radio frequency spectrum, maritime or airspace restrictions, air quality, airborne noise, physical obstructions, and renewable energy projects.² Therefore, installations have created buffer areas, called Army Compatible Use Buffer (ACUB) zones, which “allow installations to work with partners to encumber off-post land to protect habitat and buffer training without acquiring any new land for Army ownership.”³ These buffer zones are areas where DOD incentivizes partners to conserve the natural landscape both in and out of the installation fence line to enhance climate resilience and prevent the development of open land to achieve the installation’s mission.

¹ Department of Defense, Directive 3200.15, Sustaining Access to the Live Training and Test Domain December 18, 2013, updated July 2, 2020. Accessed from <https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/320015p.pdf>

² Department of Defense, Directive 3200.15

³ US Army Environmental Command, “Army Compatible Use Buffer (ACUB) Program,” Accessed from <https://aec.army.mil/index.php/consERVE/ACUB>

In 2013, DOD partnered with the Department of Interior (DOI) and the Department of Agriculture (USDA) to create the Sentinel Landscape Partnership. Sentinel Landscapes are defined as “areas in which natural and working lands are well suited to protect defense facilities from land use that is incompatible with the military's mission.”⁴ USDA, DOD, and DOI partner with local organizations and private landowners to incorporate compatible land uses and development with military readiness activities through sustainable management practices. The Sentinel Landscape program reported that sustainable management practices on high-value military testing and training areas have increased preserved wildlife habitat, agriculture production, and reduced land-use conflicts.⁵ The landscape and buffer zone have become ripe for climate resiliency projects. While beneficial, these programs do not prioritize or mention equity in stated goals. In this study, equity is defined as,

“Not offering the same investments to everyone, but instead prioritizing the most under-resourced communities and populations to systematically fill investment and service gaps.”⁶

The difference between equality and equity is fundamental to understanding why it is important to prioritize under-resourced communities and populations. Equality focuses on fairness, where everyone gets the same treatment. Equity's goal is justice, where everyone gets what they need to succeed, accounting for the disparities in resources and treatment of groups.⁷ Climate change will disproportionately affect disadvantaged communities, and this should be incorporated into any DOD program focused on climate resiliency.⁸

⁴ Sentinel Landscapes Partnership. “Georgia Sentinel Landscape” Landscapes. Accessed from <https://sentinellandscapes.org/landscapes/georgia/>

⁵ DOD News. “Southern Georgia Named ‘Sentinel Landscape’ for Readiness Enhancement.” December 19, 2017. Accessed from <https://www.defense.gov/News/News-Stories/Article/Article/1399955/southern-georgia-named-sentinel-landscape-for-readiness-enhancement/>

⁶ UCLA Luskin Center for Innovation, “Making Justice40 a Reality for Frontline Communities: Lessons From State Approaches to Climate and Clean Energy Investments.” September 21, 2021, p 31. Accessed from <https://www.thejustice40.com/>

⁷ Project READY, “Module 12: Equity Versus Equality, Diversity versus Inclusion.” Accessed from <https://ready.web.unc.edu/section-1-foundations/module-12/>

⁸ IPCC [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, (eds.)]. *Summary for Policymakers*, Cambridge: Cambridge University Press, 2022 <https://www.ipcc.ch/report/ar6/wg2/>

A solution to this may be a new initiative from the White House called Justice40. The Biden-Harris Administration signed Executive Order 14008 on “Tackling the Climate Crisis at Home and Abroad,” which is a governmentwide approach to invest at least 40% of overall benefits from federal investments in climate and clean infrastructure to disadvantaged communities and tracks performance towards that goal through the Environmental Justice Scorecard.⁹ The order “establishes the National Climate Task Force, assembling leaders from across 21 federal agencies and departments to enable a whole-of-government approach to combatting the climate crisis.”¹⁰ Disadvantaged communities are defined by, “a combination of variables that may include, but are not limited to, the following:

- Low income, high and/or persistent poverty
- High unemployment and underemployment
- Racial and ethnic segregation, particularly where the segregation stems from discrimination by government entities
- Linguistic isolation
- High housing cost burden and substandard housing
- Distressed neighborhoods
- High transportation cost burden and/or low transportation access
- Disproportionate environmental stressor burden and high cumulative impacts
- Limited water and sanitation access and affordability
- High energy cost burden and low energy access
- Jobs lost through the energy transition

⁹ The White House, "Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity across Federal Government," 2021. Accessed from <https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/>

¹⁰ The White House, "Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis"

- Access to healthcare”¹¹

Justice40 lists eight “covered programs” for federal investments: climate change, clean energy and transportation, affordable and sustainable housing, training and workforce development (related to climate, natural disasters, environment, clean energy, clean transportation, housing, water and wastewater infrastructure, and legacy pollution reduction, including in energy communities), remediation and reduction of legacy pollution, and critical clean water and wastewater infrastructure.¹² Both the DOI and USDA are listed as federal agencies with potential covered programs, while DOD is not.¹³ As the Sentinel Landscape encompasses multiple federal agencies and is focused on climate resiliency, it could be a prime target to invest resources and multi-sector equity strategies across federal agencies in disadvantaged communities in Georgia that will disproportionately feel the impacts of climate change.

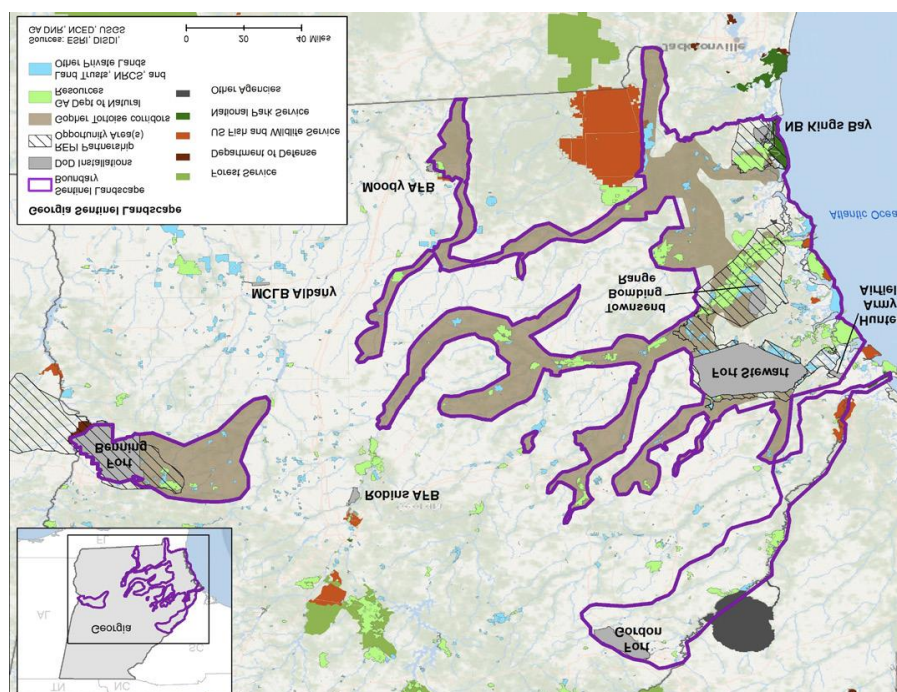


Figure 1. The Georgia Sentinel Landscape¹⁴

¹¹ Shalanda Young et al., “Interim Implementation Guidance for the Justice40 Initiative.” Memorandum. July 20, 2021. Accessed from <https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf>, p 2-3

¹² Young et al., “Interim Implementation Guidance for the Justice40 Initiative,” 3

¹³ Young et al., “Interim Implementation Guidance for the Justice40 Initiative,” 13

¹⁴ Sentinel Landscapes Partnership. “Georgia Sentinel Landscape.”

The Georgia Sentinel Landscape was established in 2018 and spans from Fort Stewart outside of Savannah to Fort Benning near Columbus, covering most of South Georgia (Figure 1). It includes multiple military installations and ranges, prime timberland and agricultural soils, longleaf pine forests, and coastal ecosystems. The military installations and ranges within the landscape boundary consist of: Fort Benning, Fort Stewart, Hunter Army Airfield, Townsend Bombing Range, Fort Gordon, Robins Air Force Base, Marine Corps Logistics Base-Albany, Moody Air Force Base, and Naval Submarine Base (NSB) Kings Bay.⁴

To illustrate where Georgia Sentinel Landscape program managers should leverage Justice40 resources, including funding and tools, the coastal portion was chosen as a case study. The study area includes Fort Stewart/Hunter Army Airfield (FS/HAA) and counties within the Sentinel Landscape and ACUB: Chatham, Bryan, and Liberty. Fort Stewart, combined with the three counties, creates a study area of almost one million acres. This area intends to protect habitat corridors for the gopher tortoise, red-cockaded woodpecker, eastern indigo snake, and other species of concern, along with hundreds of acres of farmlands and the Savannah River watershed. The landscape is considered a coordinated and collaborative strategy for landowners and the military to provide tangible benefits.¹⁵ This area is unique because FS/HAA have the ACUB, which allows installations to partner with local landowners to prevent development and conserve valuable habitat without acquiring any new land under Army ownership.¹⁶

1.2 Purpose of Study and Research Question

This research aims to understand how equity is integrated into DOD climate change policy, create a justification for policy intervention through a land use analysis, and propose strategies for more equitable engagement with communities surrounding military installations. The threats facing these natural and agricultural areas will also impact the people who live on and around military installations. Fort Stewart lies primarily in Bryan and Liberty Counties, and extends to Evans, Long, and Tattnall, and

¹⁵ Sentinel Landscapes Partnership, “Georgia Sentinel Landscape”

¹⁶ U.S. Army Environmental Command, “Army Compatible Use Buffer (ACUB) Program.” Accessed from <https://aec.army.mil/index.php/conserve/ACUB>

Hunter Army Airfield is in Chatham. While the Sentinel Landscape program has many noteworthy goals, equity is not explicitly stated as a focus. The focus is primarily on conservation and agriculture.

The adaptive capacity of both urban and rural areas will be improved with “integrated, inclusive planning and investment in everyday decision-making about urban infrastructure, including social, ecological and grey/physical infrastructures.”¹⁷ Chatham County and the City of Savannah are the only local governments listed as partners within the ACUB.¹⁸ As the metropolitan center of coastal Georgia, Chatham County has many resources for planning through the city, county, and Chatham-Savannah Metropolitan Planning Commission (MPC). However, this study will include Bryan and Liberty Counties to illustrate the need for a coordinated, regional approach to more equitable planning. This study seeks to answer the question, “How can spatial analysis and land use planning be used to justify greater policy intervention for more equitable outcomes to help achieve program goals of the Sentinel Landscape?”

1.3 Study Overview

An overview of the study area and literature review of federal policy sets the foundation for how DOD became involved in climate resiliency projects, describes the interwoven web of local governments and federal agencies involved, and constructs a tripartite equity framework for engagement. Then, a future baseline land-use scenario in the FS/HAA portion of the Georgia Sentinel Landscape and Chatham, Bryan, and Liberty Counties will be developed with the Land Use Conflict Identification Strategy (LUCIS) method in ArcGIS Pro. LUCIS was chosen to visualize future land use because it incorporates three land use systems: urban, conservation, and agriculture; the latter two are fundamental to the Sentinel Landscape program.¹⁹ The scenario will use the goals of the Georgia Sentinel Landscape, Justice40 Initiative, and the local counties to help visualize a 2050 land use scenario. Once a land use scenario is created, the equity framework will be applied to areas where land use conflict was identified and are

¹⁷ IPCC, *Summary for Policymakers*, 33

¹⁸ U.S. Army Environmental Command, “U.S. Army: Fort Stewart: Georgia REPI Program Project Profile.” Accessed from <https://aec.army.mil/application/files/3215/9369/4195/FortStewart.pdf>

¹⁹ Margaret H. Carr, and Paul Dean Zwick. *Smart Land-Use Analysis: The LUCIS Model Land-Use Conflict Identification Strategy*. 1st ed. ESRI Press, 2007.

identified as disadvantaged census tracts by the Justice40 Climate and Economic Justice Screening Tool (CEJST).

This research aims to encourage DOD to have greater engagement with the surrounding communities within the Sentinel Landscape. As the Sentinel Landscape includes many census tracts identified as disadvantaged, program managers should leverage Justice40 resources, including funding and tools. This study will demonstrate that climate resiliency and equity must be integrated to meet Sentinel Landscape program goals. Ultimately, this research can serve as a proof-of-concept with practical advice for professionals to incorporate into their work.

CHAPTER 2

STUDY AREA, LITERATURE REVIEW AND EQUITY FRAMEWORK

This chapter describes the study area, which encompasses FS/HAA, the FS/HAA ACUB, and Chatham, Bryan, and Liberty Counties. The general and land use goals for each county are outlined here and inform the goals for the land use analysis. A literature review on the federal policy illuminates how DOD is now committed to climate resiliency and reveals the need for more equitable engagement strategies. The chapter closes with a tripartite equity framework Sentinel Landscape program managers can implement to work towards more equitable outcomes for people living near military installations.

2.1 Study Area

The United States military presence along coastal Georgia dates to the mid-eighteenth century and evolved to host the largest installation east of the Mississippi River. Fort Stewart is approximately 280,000 acres and Hunter Army Airfield is almost 6,000 acres.²⁰ While some military installations were originally sited in defensively strategic, remote locations, they now need to manage encroachment. FS/HAA spans six counties: Bryan, Chatham, Evans, Liberty, Long, and Tattnall. To navigate this relationship, Fort Stewart created the ACUB area around the installation to encourage compatible development with the military mission and engage in habitat conservation efforts.

Conservation and agriculture are priorities, but urban areas must also be considered, as the Sentinel Landscape encompasses all of Bryan and Liberty Counties and most of Chatham County (Figure 2). This portion of the Sentinel Landscape is extremely vulnerable to the impacts of climate change,

²⁰ Office of the Deputy Assistant Secretary of Defense, “Base Structure Report – Fiscal Year 2018 Baseline- A Summary Of The Real Property Inventory Data.” 2017. Accessed from <https://www.acq.osd.mil/eie/Downloads/BSI/Base%20Structure%20Report%20FY18.pdf>

including sea level rise, flooding, and other natural hazards.²¹ Additionally, it is an area where population growth is expected to increase. The section outlines the counties' land use plans, population growth, and future goals for a more inclusive resilience strategy that will include surrounding communities.

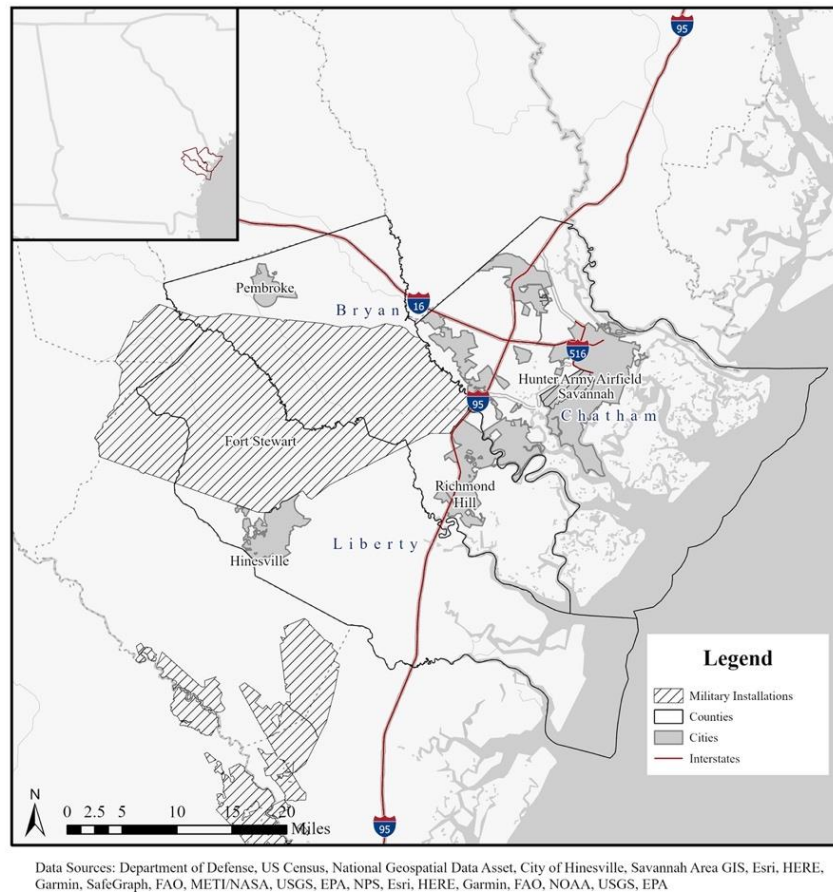


Figure 2. Context Map of the Study Area including Fort Stewart/HAA (military installations), Chatham County, Bryan County, and Liberty County (counties), and larger cities within each county (Savannah, Richmond Hill, Pembroke, and Hinesville).

²¹ Mathew E. Hauer, Jason M. Evans, and Clark R. Alexander, "Sea-level rise and sub-county population projections in coastal Georgia." *Population and Environment* 37 (2015): 44-62.

2.1.1 Fort Stewart

Named for the Revolutionary War hero General Daniel Stewart of Liberty County, Camp Stewart was established in 1940 in response to World War II with the mission to train anti-aircraft artillery troops. The V-shaped camp was sited in a rural area of 5,000 acres near Richmond Hill with the entrance in Hinesville.²² The towns of Clyde, Taylors Creek, and Willie were cleared to establish the camp, and the USDA estimated more than 1,500 families were displaced by the camp. The area was chosen because it was rural, yet still close to the port of Savannah.²³ Fort Stewart currently lies primarily in Bryan and Liberty Counties, but extends out to Evans, Long, and Tattnall, and Hunter Army Airfield is six miles away in Chatham. The front gate and visitor entrance to Fort Stewart is in Hinesville, Liberty County.

Even in its early years, the actions of the military extended beyond camp, where Boomtown and Zoomtown set up outside of the boundaries for soldiers to spend their money. This type of spontaneous town is common throughout planning and dates to the Medieval period, where *faubourgs*, civil trading communities, grew up outside the walls of *burgs*, the military and administrative centers around which many towns developed.²⁴ Soldiers often took advantage of buses going to Savannah.²⁵ Additionally, nearby farmers were warned to protect their livestock from falling shells once firing commenced. Camp Stewart became a permanent fixture as Fort Stewart in 1956 and is now home to the 3rd Infantry Division.²⁶

In fiscal year 2019, FS/HAA supported a population of 121,763 people, including total military, active duty-Army, reserve, students, other services, DOD civilians, contract employees, family members, and retirees. Within the study area, the majority of the FS/HAA population resides within Chatham and Liberty Counties (Table 1). Military presence in coastal Georgia is well established, but as the region

²² James H. Clifford, "Fort Stewart, Georgia." research-article. *On Point* 19, no. 2 (10/01/ 2013): 45-49.

²³ Clifford, "Fort Stewart, Georgia."

²⁴ A. E. J. Morris, *History of Urban Form : Before the Industrial Revolutions*. 3rd ed. Wiley. Longman Scientific & Technical, 1994.

²⁵ John Rieken and Craig Pascoe, "Fort Stewart." New Georgia Encyclopedia, last modified Aug 14, 2020. Accessed from <https://www.georgiaencyclopedia.org/articles/government-politics/fort-stewart/>

²⁶ Fort Stewart-Hunter Army Airfield, "History and Museum." About. Accessed from <https://home.army.mil/stewart/index.php/about/history#qt0:1>

continues to attract a growing population and impacts from climate change push development further inland, encroachment has become a greater concern that can threaten and reduce operations.²⁷

Table 1. Fiscal Year 2019 Population of Fort Stewart/HAA in Study Area Counties²⁸

County	Military Population	Retiree Population	Student Population	Totals
Chatham	7,619	2,246	1,495	11,360
Bryan	2,054	654	1,514	4,222
Liberty	11,239 (on post) + 6,160 (off post)	2,968	3,306	23,673

2.1.1.1 Army Compatible Use Buffer (ACUB)

The ACUB program is authorized by Title 10, Section 2684a, and is part of the Readiness and Environmental Protection Integration (REPI) program. This program allows installations to partner with local landowners to prevent development and conserve valuable habitat without acquiring any new land under Army ownership. It helps to address concerns of encroachment such as urban sprawl and development that may hamper the ability of military training due to complaints of noise, dust, and smoke from weapons, vehicles, and aircraft. The ACUB program works with voluntary landowners and lands under easement are held by an ACUB partner, such as a land trust, and are not used for military purposes.²⁹

The FS/HAA ACUB was established in 2005 with updates in 2011, 2014, and 2019, and protects the airspace for unmanned aerial vehicle operations and integrates close air support such as drop zones for paratrooper training (Figure 3). The buffer zone protects the public from smoke produced by prescribed burning of longleaf pine forests. The fire promotes longleaf forest restoration, which provides valuable habitat for red-cockaded woodpeckers, flatwood salamanders, gopher tortoises, and other species. The ACUB allows for necessary live fire, operational airspace, and maneuver training that requires training

²⁷ Fort Stewart/Hunter Army Airfield, “Army Compatible Use Buffer (ACUB) Program Plan Update.” July 15, 2019.

²⁸ Travis R. Mobley, “Fort Stewart & Hunter Army Airfield, Georgia Economic Impact Analysis and Partner Summary Fiscal Year 2019 (01 Oct 18 –30 Sep 19).” PowerPoint presentation, October 18, 2019.

²⁹ U.S. Army Environmental Command, “Army Compatible Use Buffer (ACUB) Program.”

realism. In return, the community benefits through the preservation of rural, working lands, alleviation of safety concerns, and wildlife protection. As of FY 2019, 39,645 acres are protected.³⁰

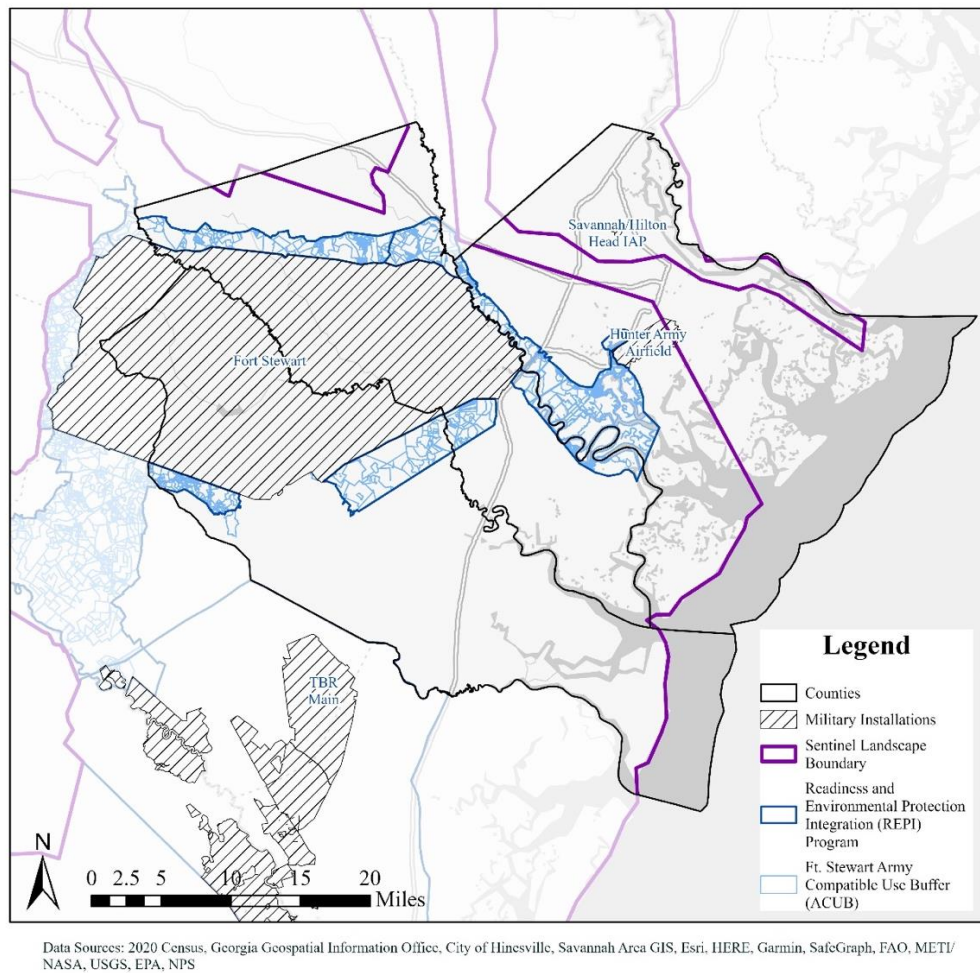


Figure 3. The Sentinel Landscape and ACUB boundaries in the study area

The ACUB coordinates with several key partners that include:

- Chatham County
- City of Savannah
- The Conservation Fund
- Georgia Department of Natural Resources

³⁰ U.S. Army Environmental Command, “U.S. Army: Fort Stewart: Georgia REPI Program Project Profile.”

- Georgia Forestry Commission
- Georgia Land Trust
- Knobloch Foundation
- The Longleaf Alliance
- The Nature Conservancy
- The Trust for Public Land
- U.S. Department of Agriculture-Natural Resources Conservation Service
- U.S. Fish and Wildlife Service
- U.S. Forest Service³¹

These partners can help to achieve the Sentinel Landscape and ACUB goals, which are primarily conservation, preservation, agriculture, and timber-based. A site visit to the FS/HAA ACUB area with the Georgia-Alabama Land Trust (GALT) helped to identify activity within the ACUB and better understand each land use category (Figure 4). As the coastal counties along the ACUB are expected to experience growth, despite the growing threats of climate change, there is an urgency to place conservation easements on parcels of land in the ACUB boundary (Table 2).

Table 2. Expected Residential Population Growth by 2050 in Counties³²

County	2000 Population	2020 Population*	2050 Population	Estimated % increase from 2020 to 2050
Bryan	23,417	40,755	61,388	33.6 %
Chatham	232,048	289,463	352,754	17.9%
Liberty	61,610	63,004	67,198	6.2%

* Georgia Office of Planning and Budget (GOPB) 2020 population estimates are slightly different from the 2020 Census because this is the residential population estimate.

³¹ U.S. Army Environmental Command, “U.S. Army: Fort Stewart: Georgia REPI Program Project Profile.”

³² Georgia Office of Planning and Budget, “Population Projections.” Accessed from <https://opb.georgia.gov/census-data/population-projections>

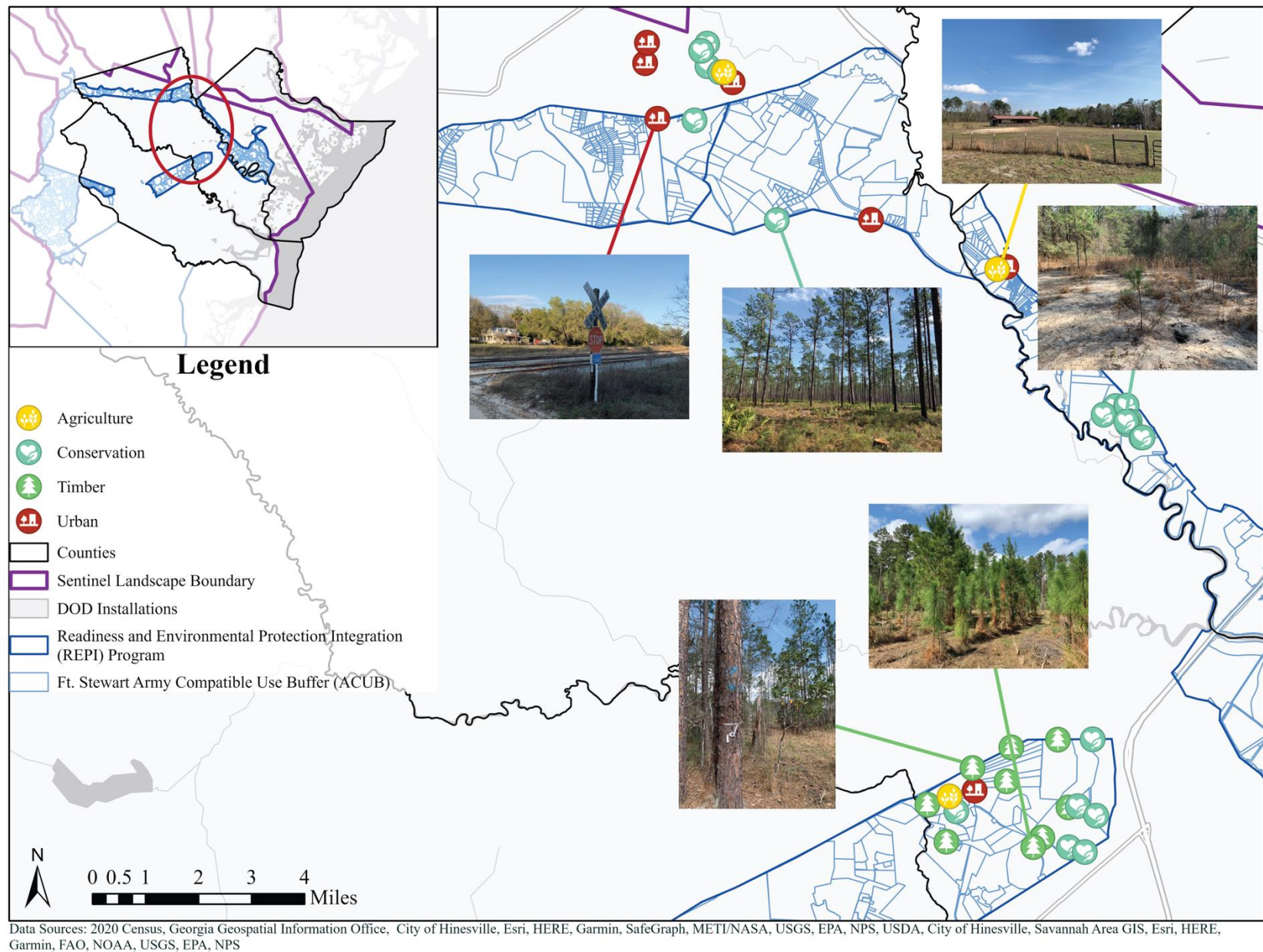


Figure 4. Site visit point locations with corresponding land use category photos

2.1.2 Chatham County

Chatham County is located on the Georgia coast, bounded by Effingham County and South Carolina to the north, the Atlantic Ocean to the east, Bryan County to the south, and Fort Stewart to the west (Figure 5). The county population was estimated at 296,329 people and density at 681.8 people per square mile in the 2020 Census.³³ Chatham County includes several incorporated cities: Bloomingdale, Garden City, Pooler, Port Wentworth, Savannah, Thunderbolt, Tybee Island, and Vernonburg. Savannah is the largest metropolitan area within the county and Georgia coastal region and contains almost half of the county population with 147,088 people.³⁴ Savannah serves as an economic, cultural, governmental, and international trade hub for the six coastal counties and bi-state area.³⁵

The county continues to experience growth and the Georgia Office of Planning and Budget (GOPB) estimated the residential population will increase by 17.9% with 352,754 people in 2050.³⁶ This is due to the attractiveness of the region to retirees and second-home residents and expected economic growth.³⁷ The smaller incorporated areas have absorbed portions of the county's growth and the city of Savannah annexed unincorporated areas to increase the supply of drinking water. Further development is impeded by the ability to expand water and wastewater services into unincorporated areas because much to the land is poorly drained in the natural floodplain.³⁸ To plan for the expected growth and development, Chatham County Savannah Metropolitan Planning Commission (MPC) adopted the most recent comprehensive plan update, Plan 2040, in 2021.

³³U.S. Census Bureau, "Quick Facts: Chatham County, Georgia." Accessed from <https://www.census.gov/quickfacts/chathamcountygeorgia>

³⁴ U.S. Census Bureau, "Quick Facts: Savannah city, Georgia." Accessed from <https://www.census.gov/quickfacts/savannahcitygeorgia>

³⁵ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040." October 14, 2021, 144. Accessed from <https://www.thempc.org/Comprehensive/Compplan>

³⁶ Georgia Office of Planning and Budget, "Population Projections."

³⁷ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 144

³⁸ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 144

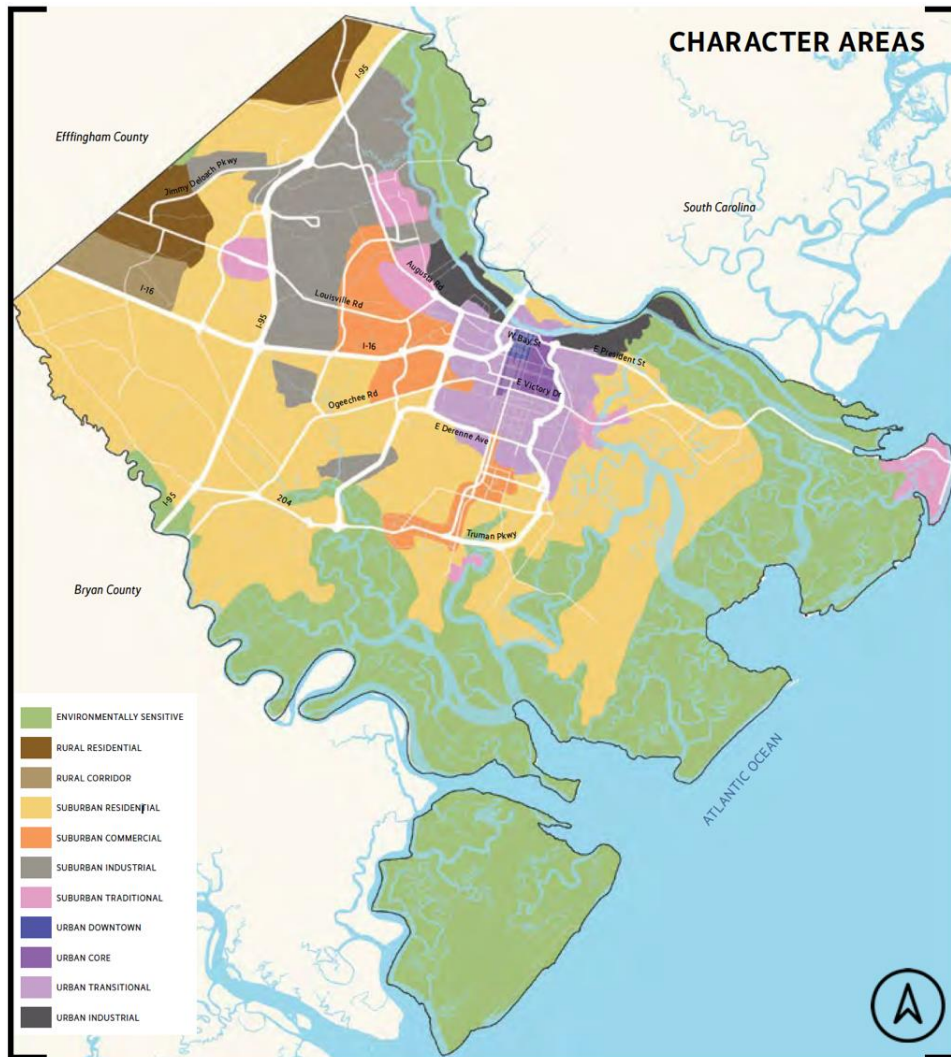


Figure 5. Character Areas in Chatham County³⁹

Plan 2040 contains the community vision and goals for the next twenty years based on community outreach and engagement with county and city staff, the community advisory committee, and members of the public. The following are Chatham County and the City of Savannah’s stated community goals:

- **Economic Development:** Unincorporated Chatham County & Savannah are anchors to a thriving, business-friendly, regional economy in which all workers are prepared for quality jobs, and residents feel empowered to attain a high quality of life.

³⁹ Chatham County - Savannah Metropolitan Planning Commission, “Plan 2040,” 163

- **Land Use:** Unincorporated Chatham County & Savannah are healthy and safe places to live, work, play and raise a family, and have social and economic values that integrate the area's history, natural resources, efficient government, and public mobility system.
- **Transportation:** Unincorporated Chatham County & Savannah prioritize safe mobility for all users; offer efficient mobility options to support economic vitality; provide infrastructure that is sensitive to unique local characteristics; connect neighborhoods to education, employment, and services; and sustain environmental quality with clean mobility modes.
- **Housing:** Unincorporated Chatham County & Savannah achieve affordable, diverse and safe housing for their residents through efficient and effective policies and programs.
- **Natural resources:** Unincorporated Chatham County & Savannah are enhanced by the protection and maintenance of natural resources and ecosystems.
- **Quality of life:** Unincorporated Chatham County & Savannah citizens achieve a superior quality of life within a safe, active, and healthy environment inclusive of the area's history, natural resources, public mobility, and efficient government.
- **Historic Resources:** Unincorporated Chatham County & Savannah as historical and emerging cultural resources provide unique advantages to balance preservation with development and economic growth.
- **Education:** Unincorporated Chatham County & Savannah are innovative and inclusive educational systems, and are a model of academic excellence that enables students to have the knowledge, skills, and ability to succeed at chosen pathways.
- **Community health:** Unincorporated Chatham County & Savannah have a culture of health including equal access to quality and affordable healthcare, chronic disease prevention, health inclusive policies, and healthy environmental design.

- **Public safety:** Unincorporated Chatham County & Savannah provide a community that is a safe place to live, work, and raise a family, and within which protection of residents is considered an integral part of its social and economic values.
- **Broadband & Fiber Optics:** Unincorporated Chatham County & Savannah have closed the digital divide to ensure access to fast affordable, and reliable broadband while acquiring world class broadband network capabilities to accelerate high-tech business development.⁴⁰

The comprehensive plan outlines policy recommendations for each of these goals, however, this research focused on the land use, natural resources, and climate change sections.

2.1.2.1 Land Use

Savannah is the urban nucleus of Chatham County with a historic downtown, high-quality pedestrian environment, international airport, Port of Savannah, rail networks, access to major interstates (I-16 and I-95), and Hunter Army Airfield.⁴¹ Transportation facilities influence the growth patterns of the city, which are leading to expansion west of the city as the urban neighborhoods decline in population.⁴² Plan 2040 embraced the chosen development pattern of “Strong Corridors” that included:

- More managed growth of development
- Focus on urban rehab and infill of existing developed areas
- Priority for mixed-use zoning
- Interest in diversity of housing choices
- Concentrate development at existing transportation nodes
- Prioritize land for parks, trails & natural areas
- Manage land for conservation & preservation

⁴⁰ Chatham County - Savannah Metropolitan Planning Commission, “Plan 2040,” 92-99

⁴¹ Chatham County - Savannah Metropolitan Planning Commission, “Plan 2040,” 144

⁴² Chatham County - Savannah Metropolitan Planning Commission, “Plan 2040,” 150

- Regional cooperation between municipalities
- Preserve undeveloped natural resource areas
- Brownfield redevelopment.⁴³ (Figure 6)

Chatham County and Savannah hope to implement this strategy to ensure consistency in the zoning ordinance, address concerns of gentrification, strategized redevelopment areas, coordinate annexation efforts, and increase regional cooperation.⁴⁴

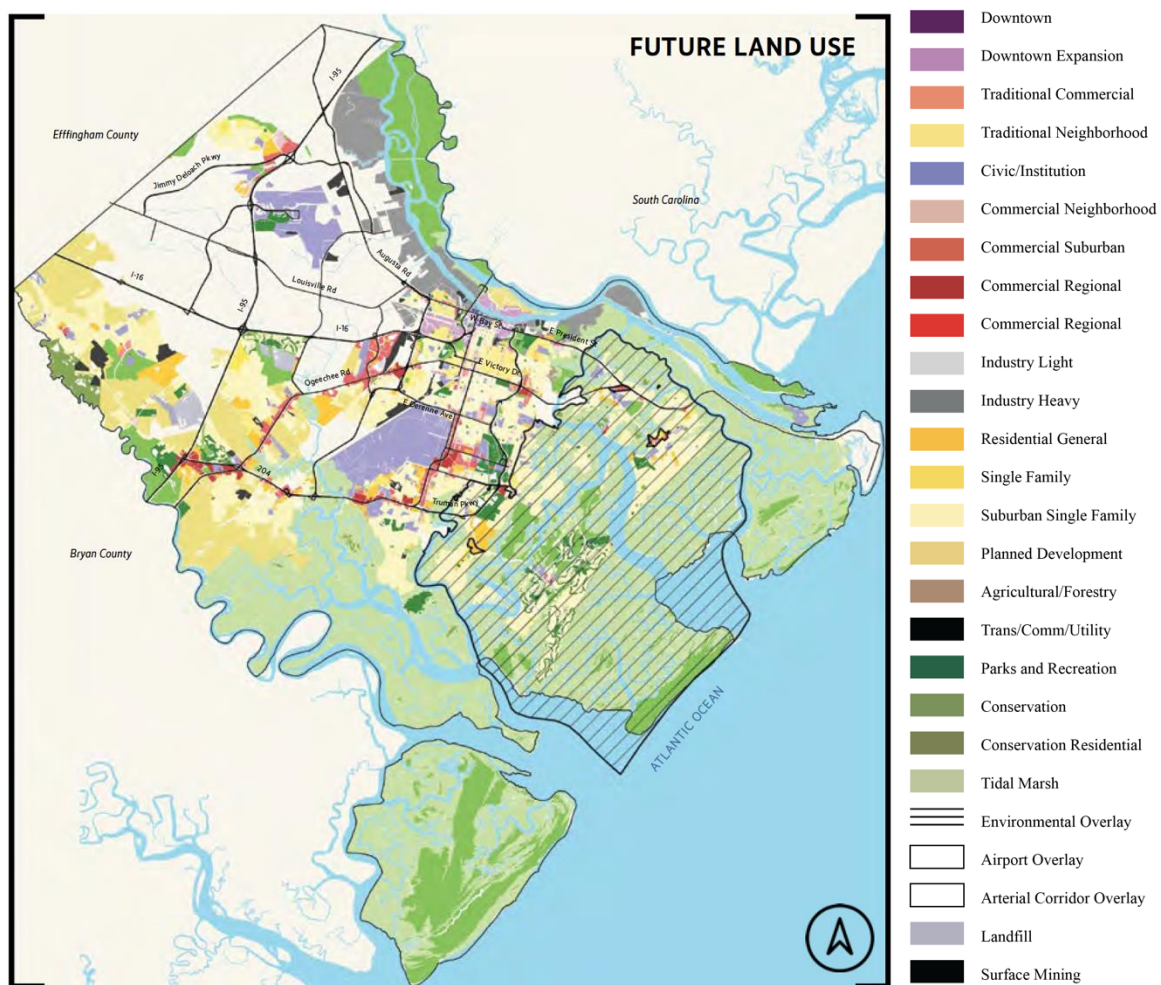


Figure 6. Chatham County Future Land Use Plan⁴⁵

⁴³ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 156.

⁴⁴ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 194-195.

⁴⁵ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 189

2.1.2.2 Natural Resources

The MPC recognized the need for a proactive approach to protect the natural resources in Chatham County from the expected growth and development. The county is concerned about the reduced quality of life and exacerbating environmental hazards such as flooding, polluted waterways, temperature extremes, and extreme weather events.⁴⁶ Plan 2040 outlined a plan to preserve and enhance the public realm by maintaining the green elements in the urbanized areas and protecting coastal resources from development.⁴⁷ Coastal resources listed include marshlands, beaches, and marsh hammocks, which are vulnerable to climate change impacts such as sea level rise, extreme rainfall events, and daily high tide flooding.⁴⁸

Chatham County experienced an increase in the number of farms from 2012 to 2017 from 35 to 67 farms as the result of a growing movement of sourcing local foods such as berries, honey, meat, and eggs from nearby nurseries and small farms.⁴⁹ The loss of agricultural and forest land to the development of residential subdivisions and commercial areas was a concern in the comprehensive plan, as it contributes to environmental degradation. The MPC emphasized the importance of protecting this farmland through land use regulations.

These natural resources can be protected if development is restricted to land that is already developed and conversion of undeveloped land at the periphery of the county is minimized. Public opinion and data both reflected the need for more efficient development that will not consume undeveloped land and prioritize open space for public parks, greenways, and wildlife corridors.⁵⁰

2.1.2.3 Climate Resilience

Climate change was integrated into Plan 2040 and Chatham County created a climate change resiliency program known as Resilient Chatham County in 2022. This is an inter-departmental program

⁴⁶ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 194.

⁴⁷ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 194-195, 293

⁴⁸ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 327

⁴⁹ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 316

⁵⁰ Chatham County - Savannah Metropolitan Planning Commission, "Plan 2040," 339

that works across the county government to reduce vulnerability and risks associated with climate change. This proactive approach intends to build community resilience through four main themes: infrastructure and environment, leadership and strategy, health and wellbeing, and economy and society (Figure 7).⁵¹ These strategies indicate a commitment to a whole-government approach to climate change within the county.

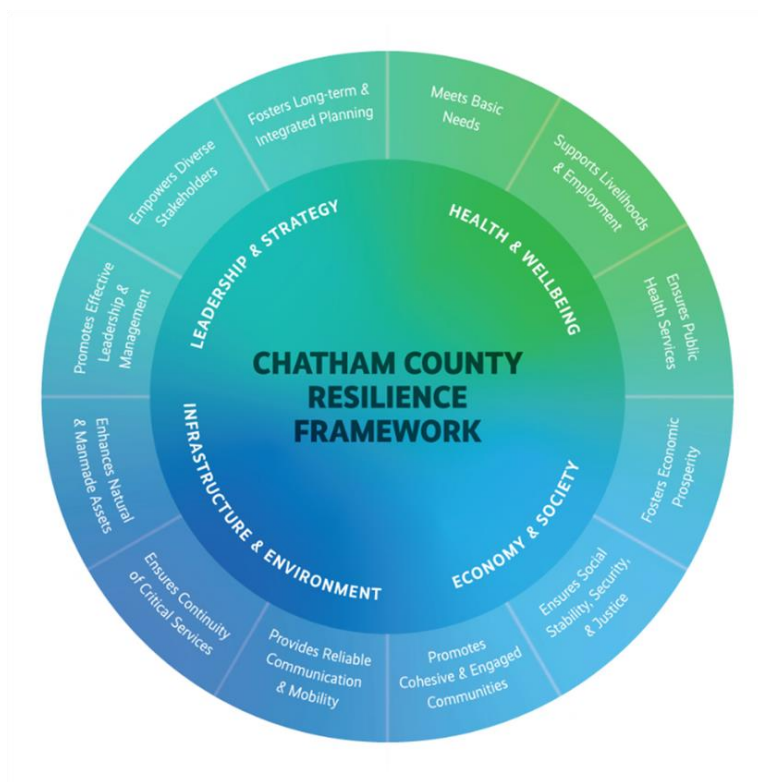


Figure 7. Chatham County Resilience Framework⁵²

2.1.3 Bryan County

Bryan County is south of Chatham County, and bounded by the Atlantic Ocean to the east, Liberty County to the south, and split in half by Fort Stewart, with the northern part of the county touching Bulloch, Evans, and Effingham Counties. The county population was estimated at 46,938 people

⁵¹ Chatham County, "Resilient Chatham County." Accessed from <https://www.chathamcountyga.gov/OurCounty/Resiliency/>

⁵² Chatham County, "Resilient Chatham County."

and the density was 102.2 people per square mile in the 2020 Census.⁵³ Bryan County includes the cities of Pembroke (North Bryan County) and Richmond Hill (South Bryan County). Although Pembroke serves as the county seat, Richmond Hill is the largest city with a population of 17,556.⁵⁴ This is one of the fastest growing areas along the Georgia coast, and the GOPB estimated the residential population to grow to 61,388 in 2050, an increase of 33.6%.⁵⁵ Bryan County's 2018 Comprehensive Plan Update addressed future goals and visions for the county.

Bryan County's community goals will help lay out a road map for the future, generate local buy-in to the plan and ensure that the plan is implemented. These included:

- Encourage the protection and conservation of the rich historic heritage in Bryan County
- Create and maintain a long-term sustainable and diverse economic base
- Maintain the small-town atmosphere of the area as the community grows
- Establish and maintain conservation and protection of natural areas that would be endangered by development. These areas include, but are not limited to, floodplains, wetlands, groundwater recharge areas and protected river corridors
- Develop and maintain adequate public services and facilities to accommodate existing and future development
- Enhance and maintain communication between each local government jurisdiction in Bryan County, State Government, and the surrounding counties in an effort to efficiently and effectively serve the residents of Bryan County⁵⁶

⁵³ U.S. Census Bureau, "Quick Facts: Bryan County, Georgia." Accessed from <https://www.census.gov/quickfacts/fact/table/bryancountygeorgia/PST045222>

⁵⁴ U.S. Census Bureau, "Quick Facts: Richmond Hill city, Georgia." Accessed from <https://www.census.gov/quickfacts/richmondhillcitygeorgia>

⁵⁵ Georgia Office of Planning and Budget, "Population Projections."

⁵⁶ Bryan County, "Bryan County 2018 Comprehensive Plan Update." June 12, 2018, 43. Accessed from <https://www.bryancountyga.org/government/departments-h-z/planning-zoning/comprehensive-plan>

Bryan County identified several needs and opportunities based on discussions with stakeholders and residents and statistical data. These were combined and sorted into nine different elements with needs and opportunities: cultural and historic resources, natural resources, economic development, population, housing community facilities and services, development patterns, transportation, and governmental relations.⁵⁷ This research focused on the population and development patterns, land use, and natural resources sections.

2.1.3.1 Population and Development Patterns

The north-south division of the county considerably affects development patterns. North Bryan is more rural with single-lot development, whereas South Bryan contains master planned communities and marsh front property. The existing infrastructure is not expected to be able to accommodate the expected population growth and will cause many challenges from water and sewer to the public school system. The county hopes to take advantage of the population influx for economic growth and offer a range of urban to rural living environments.⁵⁸

The county is “drastically” impacted by Fort Stewart’s military population, and this will need to be taken into consideration in addition to the expected growth.⁵⁹ Fort Stewart accounts for 30% of the county and significantly impacts the development patterns. Overall, the county would like to increase connectivity between neighborhoods, update the zoning code, and create modern design guidelines for commercial and residential areas. However, there is hesitation by residents due to negative perceptions of how this may impact the current way of life and property values.⁶⁰

2.1.3.2 Land Use Goals

The comprehensive plan was able to summarize the land use goals for both parts of the county, even though each are unique. Future land use goals included:

⁵⁷ Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 31

⁵⁸ Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 36

⁵⁹ Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 36

⁶⁰ Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 38

- Maintain the small town feel of the area while growth continues to happen.
- Address the traffic issues with creative solutions
- Expand the local economy so that the county can become a place to live, work and play.
- Protect the environment of the county
- Expand the park system with trails, passive recreation, public gathering spaces with performance venues, libraries, and facilities for senior centers.
- Grow and maintain the excellent school system.⁶¹

These overarching goals can be applied to both portions of the county, but North Bryan is characterized by timber and agriculture and rural nature, and South Bryan by coastal resources and fast-growing population. The north has not experienced the same growth as the south, which allows for more timber and agriculture production (Figure 8). The FS/HAA ACUB promotes the continuation of the traditional agricultural, timbering, and low-density residential development of North Bryan. In contrast, South Bryan is more concerned with storm water management and flooding, which will restrict development (Figure 9). Wetlands dominate most of the county, even the north portion, and are a major consideration in development.⁶²

⁶¹ Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 77

⁶² Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 87

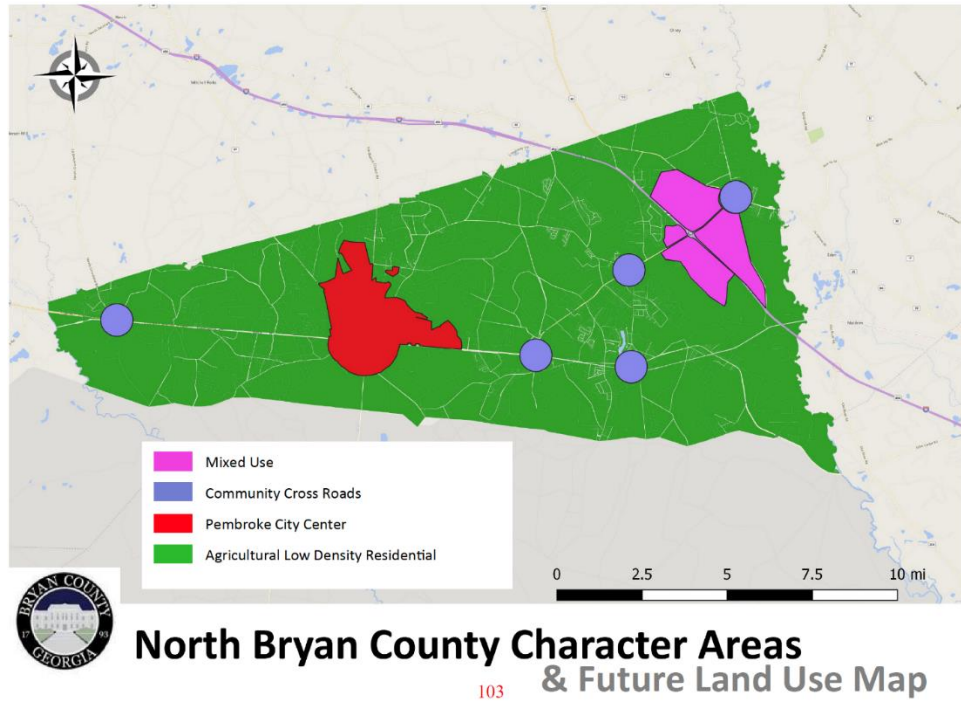


Figure 8. North Bryan County Character Areas and Future Land Use⁶³

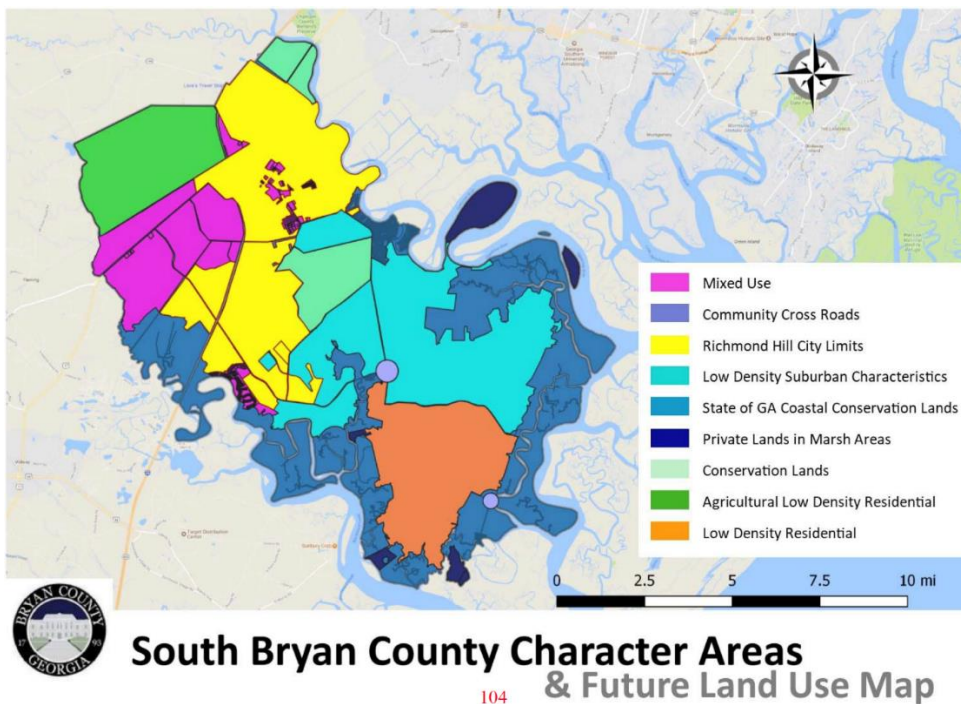


Figure 9. South Bryan County Character Areas and Future Land Use⁶⁴

⁶³ Bryan County, "Bryan County 2018 Comprehensive Plan Update," 103

⁶⁴ Bryan County, "Bryan County 2018 Comprehensive Plan Update," 104

2.1.3.3 Natural Resources

Bryan County has many natural and cultural resources, which current development practices are not preserving or protecting according to the comprehensive plan. The county stated they are attempting to protect these resources, but there are no ordinances that require developers to consider conservation priorities, such as tree species of importance. The county hopes to minimize development and contain it in urbanized areas to preserve open space for public parks, greenbelts, and wildlife corridors. Drinking water is a concern due to the depletion of drinking water from the Floridan aquifer. Bryan County has a mandated cap on how much groundwater they are allowed to draw from the aquifer. This is a challenge for development and expansion in unincorporated areas of the county.⁶⁵

2.1.3.4 Climate Resilience

Bryan County is vulnerable to many of the risks associated with climate change, such as flooding, storm surge, rising sea levels, and drought. The county hopes to build community resilience, which it defined as, “the sustained ability of a community to utilize available resources to anticipate the risk of, respond to, withstand, and recover from adverse situations... [and] minimize any disaster’s disruption to everyday life and their local economies.”⁶⁶ Other than mapping out hazards, there was no specific climate change program such as in Chatham County.

2.1.4 Liberty County

Liberty County is south of Bryan County, bounded by the Atlantic Ocean to the east, McIntosh County to the south, and Long County to the west (Figure 10). Fort Stewart lies in the northern half of the county (185 square miles).⁶⁷ The county population was estimated at 65,711 people and the density at 126.3 people per square mile in the 2020 Census.⁶⁸ The county contains several municipalities:

⁶⁵ Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 33-34

⁶⁶ Bryan County, “Bryan County 2018 Comprehensive Plan Update,” 115

⁶⁷ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future.” June 2020, 22. Accessed from <https://thelcpc.org/comprehensive-planning/>

⁶⁸ U.S. Census Bureau, “Quick Facts: Liberty County, Georgia.” Accessed from <https://www.census.gov/quickfacts/libertycountygeorgia>

Allenhurst, Flemington, Gum Branch, Hinesville, Midway, Riceboro, and Walthourville. Hinesville is the largest city in the county with a population of 35,420, serves as the county seat, and is the main entrance to Fort Stewart.⁶⁹

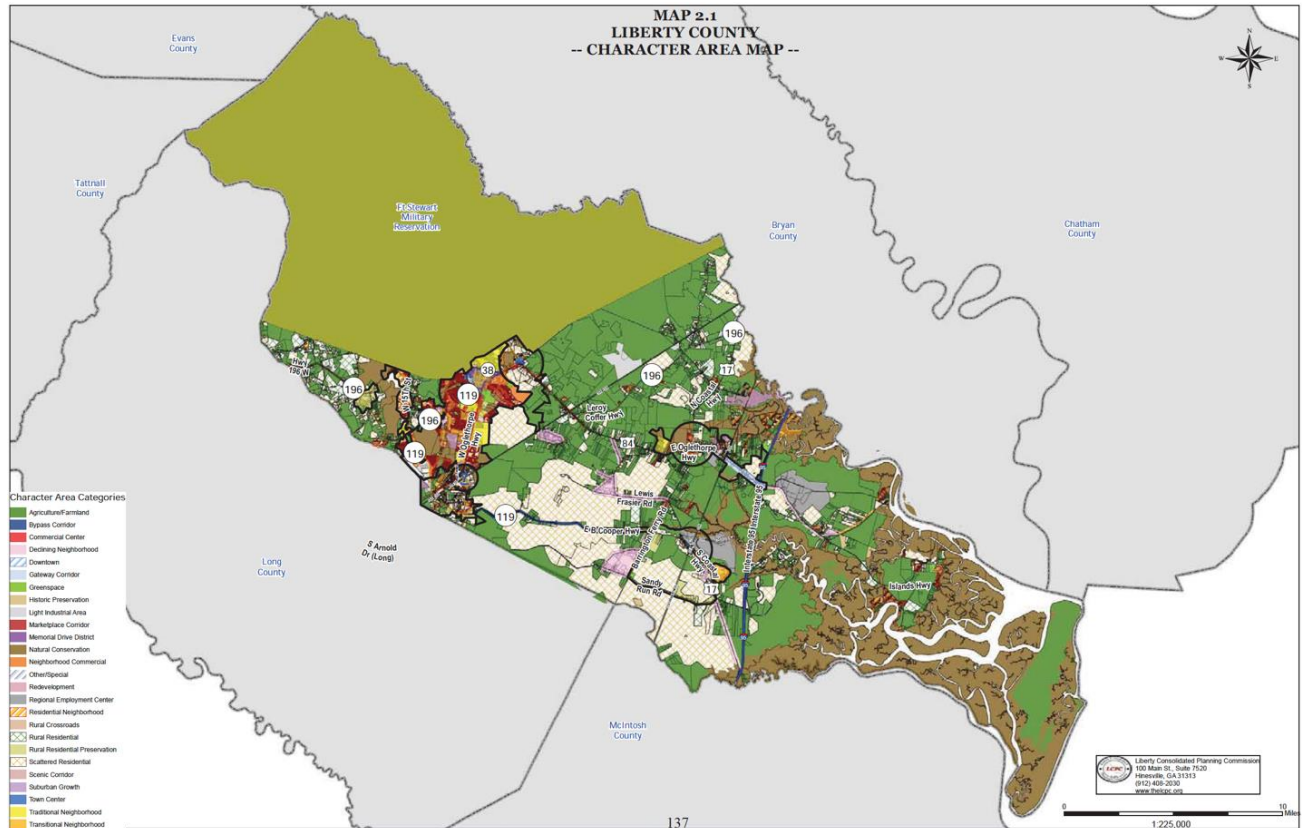


Figure 10. Liberty County character areas⁷⁰

The 2040 Liberty County Joint Comprehensive Plan *Progress in Motion: Using Our Past, to Build Our Future* is a compilation of the collective vision of each municipality in the county. The community goals for the county included:

- We will address transportation needs and challenges to develop opportunities for improvements that are compatible with an enhanced quality of life

⁶⁹ U.S. Census Bureau, “Quick Facts: Hinesville city, Georgia.” Accessed from <https://www.census.gov/quickfacts/hinesvillecitygeorgia>

⁷⁰ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 137

- We will maximize the use of existing infrastructure and encourage growth that is supportive of existing development
- We will encourage and support the development of affordable housing
- We will seek to promote brownfield and greyfield sites for appropriate mixed-used development
- We will enforce ordinances that protect and preserve our community character
- We will promote sustainable and efficient commercial development that re-uses existing buildings and promotes the revitalization of neighborhood commercial centers to serve as community focal points
- We will aim to create a walkable community by encouraging new development near the street front, providing frequent street connections and pedestrian links
- We will enforce regulations to address signage
- We will encourage the preservation of our history and foster civic pride
- We will promote the use of natural and cultural assets for outdoor recreational and leisure activities
- We will preserve the history of Liberty County by pursuing listing on the National Register of Historic Places for eligible buildings, districts, and landmark structures
- We will continue to preserve and promote cultural arts activities and heritage through festivals, exhibits, and reenactments
- We will promote safe, affordable, and sanitary housing
- We will promote cluster development to ensure protection of environmental areas, allowing for open space, and protecting farmland and the character of rural communities⁷¹

⁷¹ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 17-18

This research focused on the needs and opportunities of the natural resources and land use development sections.

2.1.4.1 Land Use

Liberty County is planning to accommodate the projected growth by limiting urban sprawl, distributing growth fairly, and protecting environmentally sensitive areas through overlay districts and design guidelines. Preservation of greenspace for recreational and aesthetic purposes is highly valued by the county. Wildlife and riparian corridors were listed as primary considerations for development. The county will determine future land use by areas deemed most suitable, encourage infill development, and discourage sprawl to preserve greenspace and farmland (Figure 11). To help achieve these goals, the county hopes to review and update outdated zoning regulations for consistency.⁷²

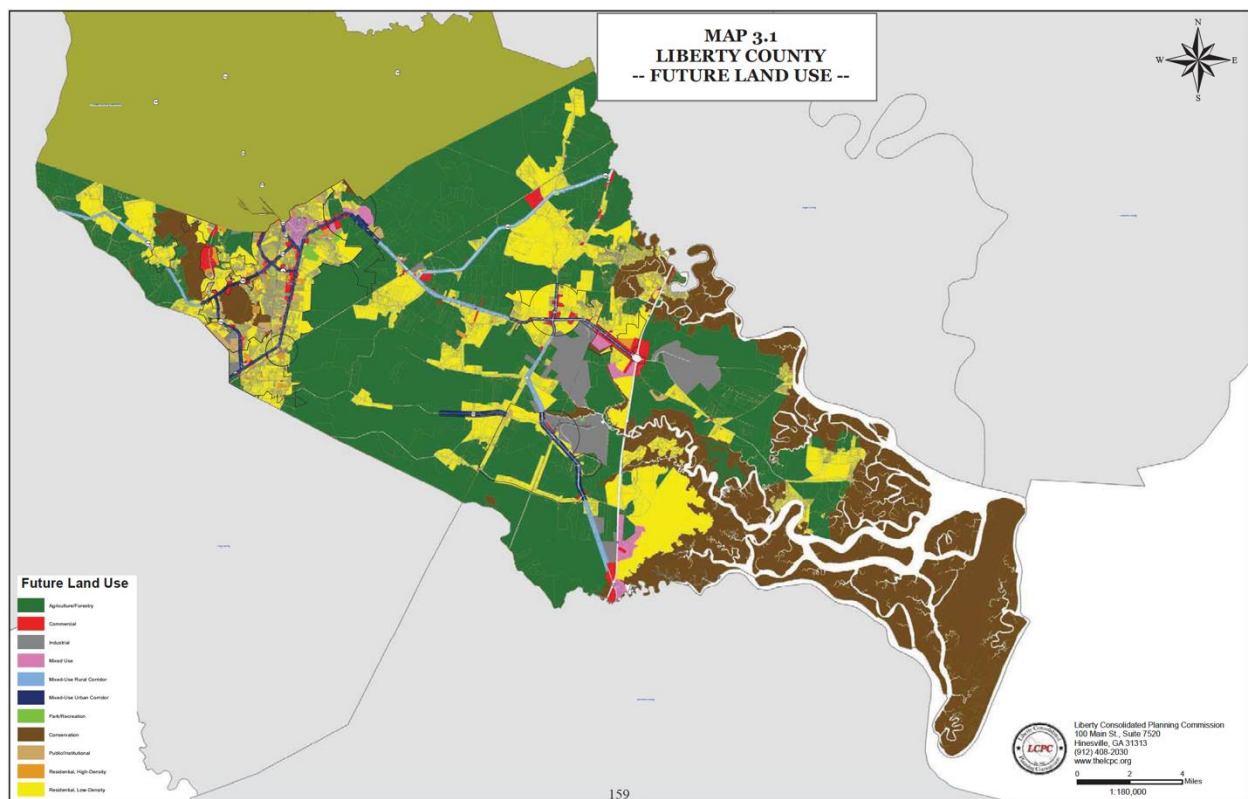


Figure 11. Liberty County future land use map⁷³

⁷² Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 58-63

⁷³ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 157

2.1.4.2 Natural Resources

Most of the county outside of Hinesville is “distinctly” rural containing farmland and woodland.⁷⁴ A priority of the county is to preserve these areas in the unincorporated cities of Gum Branch and Riceboro and limit development to the urbanized areas, as farming and timbering are seen as economic drivers within the county.⁷⁵ Protection of natural resources is critical for flood control and drinking water. Over half of the county not under federal jurisdiction contains wetlands, which provide natural flood mitigation, erosion control, pollutant filtration, and habitat. These areas are also used for recreational purposes. Liberty County uses groundwater from the Miocene aquifer and recharge areas exist throughout the county. This area is also an indirect recharge area for the Floridan aquifer that Bryan and Chatham Counties draw from for groundwater. Liberty County will not be allowed more credits to draw water from the Floridan aquifer per the Coastal Water and Wastewater Permitting Plan for Managing Saltwater Intrusion.⁷⁶

2.1.4.3 Climate Change

Climate change and sea level rise were listed as concerns, especially considering how it will impact cropland and development. The county’s natural resources serve as recreational functions for boating, swimming, sunbathing, picnicking, fishing, and hunting, and educational uses.⁷⁷ The county determined vulnerable areas, but no strategies for combatting climate change were listed other than working to expand reclaimed water use from treated wastewater.⁷⁸

⁷⁴ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 49

⁷⁵ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 49

⁷⁶ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 50-51

⁷⁷ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 52

⁷⁸ Liberty County, “Liberty County Joint Comprehensive Plan: Using Our Past to Build Our Future,” 53

2.1.5 Study Area Goals

The study area includes four entities to coordinate: FS/HAA, Chatham County, Bryan County, and Liberty County. Although each may apply goals differently, there are similar threads that run throughout the area. These include:

- More walkable and pedestrian-friendly places
- Cluster development and connectivity
- Protect historical and natural resources
- Prioritize accessible, efficient, and sustainable transportation
- Affordable housing with a range of options
- Encourage infill development and areas where infrastructure exists
- Maintain desired character areas as indicated in comprehensive plans
- Create climate resilient cities

The character area maps help to understand how the counties view their current state, and the future land use maps show where they would like to go. These goals were incorporated into the land use analysis and compared with the 2050 future land use map created by this study.

2.1.6 Wildlife Corridors

Proposed land use goals and plans should consider wildlife ecology and corridors to build capacity for urban climate resilience.⁷⁹ Planners and program managers can utilize the Southeast Conservation Adaptation Strategy (SECAS) Southeastern Blueprint as a resource. It is a “living spatial plan to achieve the SECAS vision of a connected network of lands and waters across the Southeast and

⁷⁹ Jack Ahern, "Urban landscape sustainability and resilience: the promise and challenges of integrating ecology with urban planning and design." *Landscape ecology* 28 (2013): 1203-1212.

Caribbean,” and identifies conservation targets for terrestrial, freshwater and marine ecosystems based on priority level (e.g., low to high) and corridors to link coastal and inland areas.⁸⁰

The Georgia coastal plain is ecologically diverse, and Fort Stewart is home to the

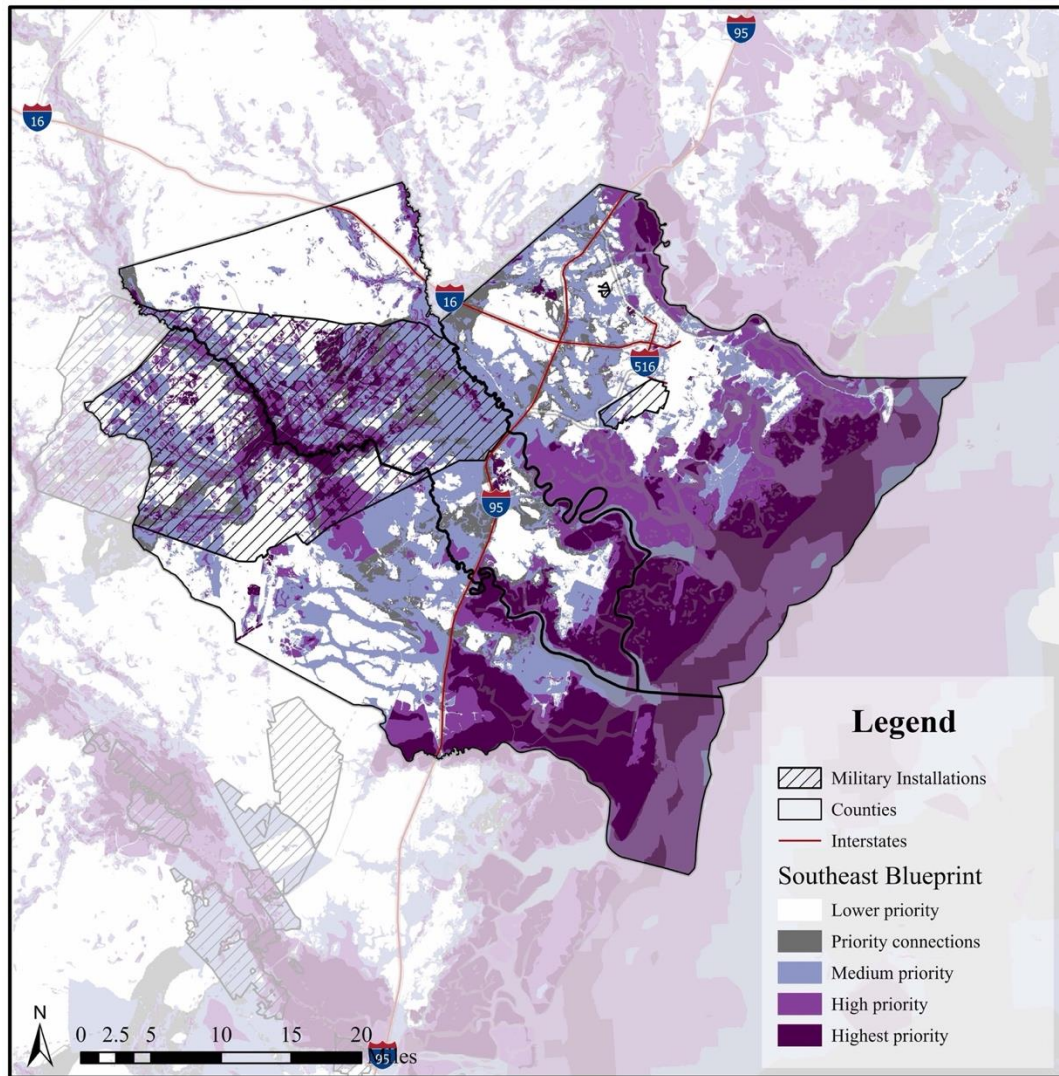
“Largest, contiguous old-growth longleaf pine-dominated ecosystem in the state that harbors the only known extant population of frosted flatwoods salamanders in the state. Many other rare or unique herps thrive here, including gopher tortoises, spotted turtles, eastern diamondback rattlesnakes, pine snakes, southern hognose snakes, gopher frogs, carpenter frogs, tiger salamanders, many-lined salamanders, and striped newts. The most recently documented mimic glass lizard was found at Fort Stewart.”⁸¹

The barrier islands and marshes are home to nesting and/or foraging habitats for green, loggerhead, Kemp’s ridley, and leatherback sea turtles. Marshes and estuaries provide habitat for diamondback terrapins, and glass lizards and diamondback rattlesnakes can be found further upland.⁸² The study area contains highest and high priority conservation areas east of Interstate-95, along the coastline and within Fort Stewart, with medium priority further upland (Figure 12).

⁸⁰ Southeast Conservation Adaptation Strategy, “Southeast Conservation Blueprint.” October 2022. Accessed from <https://secassoutheast.org/blueprint>

⁸¹ Southeast Conservation Adaptation Strategy, “Southeast Conservation Blueprint Summary for Georgia.” April 4, 2023, 25-26. Accessed from <https://secassoutheast.org/resources>

⁸² Southeast Conservation Adaptation Strategy, “Southeast Conservation Blueprint Summary for Georgia,” 26



Data Sources: Department of Defense, US Census, Southeast Conservation Adaptation Strategy (SECAS) Atlas, City of Hinesville, Savannah Area GIS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

Figure 12. Southeast Blueprint Priority Areas in Chatham, Bryan, and Liberty Counties

The Georgia Department of Natural Resources 2015 State Wildlife Action Plan listed the following conservation goals for the southern coastal plain ecoregion:

- Maintain known viable populations of all high priority species and functional examples of all high priority habitats through land protection, incentive-based habitat management programs on private lands, and habitat restoration and management on public lands.

- Increase public awareness of high priority species and habitats by developing educational messages and lesson plans for use in environmental education facilities, local schools, and other facilities.
- Encourage restoration of important wildlife habitats through reintroduction of prescribed fire, hydrologic restoration, and revegetation efforts.
- Combat the spread of invasive/noxious species in high priority natural habitats by identifying problem areas, providing technical and financial assistance, developing specific educational messages, and managing exotic species populations on public lands.
- Minimize impacts from residential and commercial development on high priority species and habitats by providing input on environmental assessments
- Continue efforts to recover federally listed species by implementation of recovery plans⁸³

The Georgia Sentinel Landscape advances these goals and protects priority habitats through non-profit partnerships. The Longleaf Alliance received funding from the Georgia Sentinel Landscape to provide financial assistance to landowners in fifty counties for the Prescribed Fire Initiative, which will prioritize longleaf ecosystems, gopher tortoise habitat, and proximity to military installations.⁸⁴ Other partnerships include The Nature Conservancy to protect viable gopher tortoise populations and the Savannah River Clean Water Fund (SRCWF) to conserve the riverbank buffers within the Savannah River Watershed.⁸⁵ These partnerships are key to protecting the invaluable habitat and wildlife corridors within

⁸³ Georgia Department of Natural Resources, “State Wildlife Action Plan.” September 2015, 169 Accessed from <https://georgiawildlife.com/WildlifeActionPlan>

⁸⁴ The Longleaf Alliance, “Georgia Sentinel Landscape Prescribed Fire Program” Accessed from <https://longleafalliance.org/what-we-do/conserving-diverse-forests/georgia-sentinel-landscape-prescribed-fire-program/>

⁸⁵ The Nature Conservancy, “Southern Georgia Named a Sentinel Landscape.” Accessed from <https://www.nature.org/en-us/about-us/where-we-work/united-states/georgia/stories-in-georgia/southern-georgia-sentinel-landscape/>

the coastal region. Conservation of natural resources is allowed through the Sikes Act and Title 10 of the US Code.

2.2 Legal Basis for Environmental Protection and Resource Management

The federal government owns and manages approximately 640 million acres of land (~28%) of the 2.27 billion acres of land in the United States, of which the DOD administers 8.8 million acres in the US,⁸⁶ and owns almost 590,000 acres of land in Georgia.⁸⁷ Due to their remote locations, large land holdings, and open space, DOD lands have become “islands of biodiversity” in the face of urban sprawl and are disproportionately home to more threatened and endangered species than any other federal landholder.⁸⁸ DOD seeks to work with local and state partners to find compatible uses in the REPI, which includes the Sentinel Landscapes Partnership and ACUB programs, to balance the needs of military readiness and encroachment.

This section reviews statutory laws primarily used for authorization and funding of REPI programs that military installations must follow regarding encroachment and natural resource management. These include the Sikes Act (16 U.S.C. § 670 c-1), Title 10 US Code Armed Forces-Agreements to limit encroachments and other constraints on military training, testing, and operations (10 U.S.C. § 2684a), and Intergovernmental Support Agreements (IGSAs, 10 U.S.C. § 2679). The Sikes Act allows for natural resource management and enforceable Integrated Natural Resources Management Plans (INRMPs). Other important statutes for funding and allowing public and private partnerships fall under Title 10 - Agreements to limit encroachments and other constraints on military training, testing, and operations and Intergovernmental Support Agreements (IGSAs). Together, these lay the groundwork for putting conservation into practice by DOD and the military services.

⁸⁶ Carol H. Vincent and Laura A. Hanson, "Federal land ownership: overview and data." Library Of Congress Washington DC, 2020.

⁸⁷ Office of the Deputy Assistant Secretary of Defense, “Base Structure Report – Fiscal Year 2018 Baseline- A Summary Of The Real Property Inventory Data.” 2017. Accessed from <https://www.acq.osd.mil/eie/Downloads/BSI/Base%20Structure%20Report%20FY18.pdf>

⁸⁸ Catherine M. Vogel, "Military Readiness and Environmental Security-Can They Co-Exist," 317-8.

2.2.1 Sikes Act

Arguably the most important law regarding natural resource management on military installations, the Sikes Act (16 U.S.C. § 670) is the foundation for DOD environmental programs (e.g., REPI). The Sikes Act introduced cooperative agreements with applicable agencies such as the US Fish and Wildlife Service (FSW) and the National Oceanic and Atmospheric Administration (NOAA) for the “conservation, protection, and management of fish and wildlife.”⁸⁹ The Sikes Act of 1960 recognized the potential for fish and wildlife management and recreation on DOD land, and the Sikes Act Improvement Act of 1997 (SAIA) expanded the scope to include Integrated Natural Resources Management Plans (INRMPs) with the purpose of,

“The conservation and rehabilitation of natural resources on such installations; the sustainable multipurpose use of the resources on such installations, which shall include hunting, fishing, trapping, and nonconsumptive uses; and subject to safety requirements and military security, public access to military installations to facilitate the use.”⁹⁰

The INRMPs are required to carry out the following with regards to the installation purpose:

- fish and wildlife management, land management, forest management, and fish- and wildlife-oriented recreation;
- fish and wildlife habitat enhancement or modifications;
- wetland protection, enhancement, and restoration, where necessary for support of fish, wildlife, or plants;
- integration of, and consistency among, the various activities conducted under the plan;
- establishment of specific natural resource management goals and objectives and time frames for proposed action;
- sustainable use by the public of natural resources to the extent that the use is not inconsistent with the needs of fish and wildlife resources;

⁸⁹ The Sikes Act, Pub. L. 86–797, Sept. 15, 1960, 74 Stat. 1052 (Sec. 101)

⁹⁰ The Sikes Act, Pub. L. 86–797, Sept. 15, 1960, 74 Stat. 1052 (Sec. 101a3a)

- public access to the installation that is necessary or appropriate for the use described in subparagraph (F), subject to requirements necessary to ensure safety and military security;
- enforcement of applicable natural resource laws (including regulations);
- no net loss in the capability of installation lands to support the military mission of the installation; and
- such other activities as the Secretary of the military department determines appropriate.⁹¹

INRMPs are required as of the SAIA, must be updated every five years, and address land management activities in support of installation missions with a focus on natural resource protection laws and military compliance.⁹² INRMPs are formal documents with an extensive process and any management activity listed in the plan must be carried out.⁹³ While natural resource management is important, the Sikes Act ensures the primary purpose of military installations is national defense and the management plan should not inhibit the mission.⁹⁴ The INRMPs trigger the National Environmental Policy Act (NEPA) if they will have an impact on the surrounding environment.

2.2.2 Title 10

Title 10 of the US Code is the legal basis for the armed forces and DOD. Two sections are applicable to the REPI program and will be discussed below: 10 U.S. Code § 2684a and 10 U.S. Code § 2679.⁹⁵ In fiscal year (FY) 2003, congress passed 10 USC §2684a- Agreements to limit encroachments and other constraints on military training, testing, and operations. This authorized agreements where

“the Secretary of Defense or the Secretary of a military department may enter into an agreement with an eligible entity or entities described in subsection (b) to address the use or development of real property in the vicinity of, or ecologically related to, a

⁹¹ The Sikes Act, Pub. L. 86–797, Sept. 15, 1960, 74 Stat. 1052 (Sec. 101)

⁹² Jim Omans, "Integrating the sikes act improvement amendments (SAIA) and NEPA on military installations." *Federal Facilities Environmental Journal* 10, no. 2 (1999), 102-103

⁹³ ⁹³ Jim Omans, "Integrating the SAIA and NEPA on military installations," 103

⁹⁴ Vogel, "Military Readiness and Environmental Security-Can They Co-Exist." 338

⁹⁵ “Building Resilience to Climate Change Through Off-Base Natural Infrastructure Solutions.” Readiness and Environmental Protection Integration Program. No date. <https://repiprimers.org/resilience/#figure03-anchor>

*military installation, as well as a State-owned National Guard installation, or military airspace for purposes of: limiting any development or use of the property that would be incompatible with the mission of the installation; preserving habitat on the property in a manner that- is compatible with environmental requirements; and may eliminate or relieve current or anticipated environmental restrictions that would or might otherwise restrict, impede, or otherwise interfere, whether directly or indirectly, with current or anticipated military training, testing, or operations on the installation; maintaining or improving military installation resilience; or protecting Clear Zone Areas from use or encroachment that is incompatible with the mission of the installation.*⁹⁶

Military departments are allowed to partner with state and local governments or conservation non-profits to protect active training and testing areas with buffer zones.⁹⁷ Eligible partners can be a State or political subdivision of a State or a private entity with a stated principal organizational purpose or goal of conservation, restoration, or preservation of land and natural resources, or a similar purpose or goal, as determined by the Secretary concerned.⁹⁸

10 USC §2684a is an expansion of legislative authority of the Private Lands Initiative to address concerns of encroachment.⁹⁹ The Conservation Partnering Program, better known as the Readiness and Environmental Protection Initiative (REPI), was created in 2003 to implement and fund this new authority by the Office of the Secretary of Defense (OSD) to achieve more compatible land uses to protect from encroachment, such as development or loss of natural habitat.¹⁰⁰ REPI can finance natural infrastructure climate adaptation projects through 10 USC §2684a on parcels protected by the program.¹⁰¹ When approved for a project, funds are allocated in one lump sum, but partners may place the funds in interest-bearing accounts and wait to use them if the project is a long-term initiative as opposed to a one-time

⁹⁶ Agreements to limit encroachments and other constraints on military training, testing, and operations, Public Law 107-314, Public Law 109-163, Public Law 109-364 (Sec. 1)(a))

⁹⁷ Beth E. Lachman, Anny Wong, and Susan A. Resetar, *The thin green line: an assessment of dod's readiness and environmental protection initiative to buffer installation encroachment*. Vol. 612. (Rand Corporation), 2007, 1.

⁹⁸ Public Law 107-314, Public Law 109-163, Public Law 109-364 (Sec. 1)(b))

⁹⁹ Lachman et al., *The thin green line*, 1

¹⁰⁰ Lachman et al., *The thin green line*, 1

¹⁰¹ "Building Resilience to Climate Change Through Off-Base Natural Infrastructure Solutions."

investment.¹⁰² REPI was intended to create a framework for management, oversight, and coordination of funding decisions and implementation.¹⁰³

The Secretary of Defense or the Secretary of a military department may, “accept an appraisal or title documents prepared or adopted by a non-Federal entity as satisfying the applicable requirements of section 301 of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. 4651) or section 3111 of title 40 if the Secretary concerned finds that the appraisal or title documents substantially comply with the requirements.”¹⁰⁴ This can be interpreted as the federal government does not need to pay fair market value if the owner accepts a lower amount or offer more than market value. The interpretation of DOD-defined fair market value can cause confusion and issues with effectiveness.¹⁰⁵

Examples of the agreements between local governments and stakeholder groups to limit encroachment and other constraints to military missions include: Army and Marines conservation-based partnerships, Army cooperative agreements with key stakeholders and land holders, Navy implementation of a real estate procedure for individual parcels and required a recordable interest in the acquired land, and the Air Force protection of critical air space with the Air Installation Compatible Use Zone (AICUZ) program.¹⁰⁶ The Army created the Army Compatible Use Buffer (ACUB) program through 10 USC §2684a, to reduce or prevent encroachment.¹⁰⁷

Passed in FY 2003, 10 USC §2684a was amended by the John S. McCain National Defense Authorization FY 2019 (Public Law 115-232) to include climate change as a reason for military installation resilience. The Interagency Cooperation in Conservation and Resilience Programs to Avoid or

¹⁰² “Building Resilience to Climate Change Through Off-Base Natural Infrastructure Solutions.”

¹⁰³ Lachman et al., *The thin green line*, 21

¹⁰⁴ Public Law 107-314, Public Law 109-163, Public Law 109-364 (Sec. 7)

¹⁰⁵ Lachman et al., *The thin green line*, 71

¹⁰⁶ James Davenport, "Encouraging Compatible Land Use between Local Governments and Military Installations: A Best Practices Guide, 11

¹⁰⁷ Lachman et al., *The thin green line* 150.

Reduce Adverse Impacts on Military Installation Resilience and Military Readiness Activities amendment states,

“In order to facilitate interagency cooperation and enhance the effectiveness of actions that will protect the environment, military installation resilience, and military readiness, the recipient of funds provided pursuant to an agreement under this section or under the Sikes Act (16 U.S.C. 670 et seq.) may, with regard to the lands and waters within the scope of the agreement, use such funds to satisfy any matching funds or cost-sharing requirement of any conservation or resilience program of any Federal agency notwithstanding any limitation of such program on the source of matching or cost-sharing funds.”¹⁰⁸

10 USC §2684a is an integral part of the natural resource management legal landscape for DOD and conservation programs targeted at encroachment to improve installation resilience in the face of climate change.

Passed in FY 2013, 10 U.S. Code § 2679- Intergovernmental Support Agreements (IGSAs) are a legal authority used by the REPI program for resilience projects to “participate in and fund public services typically administered by state or local governments that build resilience to climate change in areas with military installations.”¹⁰⁹ An IGSA is defined as a “legal instrument reflecting a relationship between the Secretary concerned and a State or local government that contains such terms and conditions as the Secretary concerned considers appropriate for the purposes of this section and necessary to protect the interests of the United States.”¹¹⁰ As of July 2018, the US Government Accountability Office (GAO) found military services had approved 45 IGSAs at 33 installations.¹¹¹

The agreements “may be for a term not to exceed ten years; and may use for installation-support services provided by a State or local government, wage grades normally paid by that State or local

¹⁰⁸ Public Law 107-314, Public Law 109-163, Public Law 109-364 (Sec. 7(h))

¹⁰⁹ “Building Resilience to Climate Change Through Off-Base Natural Infrastructure Solutions.”

¹¹⁰ Real Property; Related Personal Property; And Lease of Non-Excess Property, Sec. 2679 - Repealed. Pub. L. 108-375, div. B, title XXVIII, §2821(c)(2), Oct. 28, 2004, 118 Stat. 2129 (Section (1)(f)(4)).

¹¹¹ U.S. Government Accountability Office, *DOD installation services: Use of Intergovernmental Support Agreements Has Had Benefits, but Additional Information Would Inform Expansion*. GAO-19-4. (Washington, DC, 2018.) Accessed October 28, 2022. <https://www.gao.gov/products/gao-19-4>, 1

government.”¹¹² It is important to note that services used by the installation must already be provided for state or local government use and contracts are awarded on a competitive basis.¹¹³ These requirements can cause limitations for the use of IGSA’s.¹¹⁴ However, entering a partnership where the service already exists, can create cost avoidance or cost savings.¹¹⁵ These are an integral part of the REPI program.

2.2.3 Sentinel Landscape Partnership: Memorandum of Understanding

In 2013, USDA, DOD, and DOI established the Sentinel Landscapes Partnership through a Memorandum of Understanding (MOU). The official purpose of the MOU was to, “establish a mutually beneficial partnership among the Parties to coordinate the delivery of Federal programs to optimize the benefits of Federal assistance to landowners whose working and natural lands also serve to protect the military mission.”¹¹⁶ National leadership of the USDA, DOD, and DOI created a partnership through the Federal Coordinating Committee (FCC) with representatives from DOD, USDA’s Natural Resource Conservation Service (NRCS), the US Forest Service (USFS), the Farm Service Agency (FSA), the U.S. Fish and Wildlife Service (USFWS), and the Bureau of Land Management (BLM).¹¹⁷

The FCC can designate sentinel landscapes, connect private landowners with federal assistance programs, and maintain sustainable management practices to accomplish goals and spend less.¹¹⁸ The goals of the sentinel landscape program are to

“Plan and execute mutually beneficial programs, projects, activities, and strategies to: preserve, enhance, or protect habitat, working lands, and associated agricultural and forest production in the vicinity of military installations; reduce, prevent, or

¹¹² Public Law 108-375, div. B, title XXVIII, §2821(c)(2), Oct. 28, 2004, 118 Stat. 2129 (Section (1) (a)(2)).

¹¹³ Public Law 108-375, div. B, title XXVIII, §2821(c)(2), Oct. 28, 2004, 118 Stat. 2129 (Section (1)(a)(3-4)).

¹¹⁴ U.S. Government Accountability Office, *DOD installation services*, 5

¹¹⁵ U.S. Government Accountability Office, *DOD installation services*, 2

¹¹⁶ MOU: Agreements & Memorandum of Understanding Mutually Entered into between Department Of Agriculture, Department Of Defense, And Department Of The Interior Establishing A Sentinel Landscapes Coordinating Committee. 2013. Accessed from

https://sentinellandscapes.org/media/3bppnifl/2022_sl_mou_signed_02142022.pdf

¹¹⁷ Sentinel Landscapes Partnership, “Georgia Sentinel Landscape.”

¹¹⁸ Sentinel Landscapes Partnership, “Georgia Sentinel Landscape.”

eliminate restrictions that inhibit military testing and training; and forestall incompatible development in the vicinity of installations.”¹¹⁹

The MOU was authorized until January 1, 2019, and was extended by the 2018 National Defense Authorization Act (NDAA, Public Law 115-91).¹²⁰

Section 317 of the NDAA FY2018 formally established the designation of Sentinel Landscapes Partnership and defined them as

“a landscape-scale area encompassing— (A) one or more military installations or state-owned National Guard installations and associated airspace; and (B) the working or natural lands that serve to protect and support the rural economy, the natural environment, outdoor recreation, and the national defense test and training missions of the military- or State-owned National Guard installation or installations.”¹²¹

Under Section 317, the Secretary of Agriculture and Secretary of the Interior may, “give to any eligible landowner or agricultural producer within a designated sentinel landscape priority consideration for participation in any easement, grant, or assistance programs administered by that Secretary’s department. Participation in any such program pursuant to this section shall be voluntary.”¹²² This statute legally recognized the Sentinel Landscape Partnership and lead to the creation of the Georgia Sentinel Landscape in 2018.

A primary tool of the Sentinel Landscape is to partner with local landowners in the buffer area through conservation easements to protect the installation from encroachment while achieving natural resource management goals.¹²³ Many of these lands contain species listed as threatened or endangered by the Endangered Species Act (ESA). The red-cockaded woodpecker is listed as endangered and the eastern

¹¹⁹ MOU: Agreements & Memorandum of Understanding Mutually Entered into between Department Of Agriculture, Department Of Defense, And Department Of The Interior Establishing A Sentinel Landscapes Coordinating Committee

¹²⁰ Sentinel Landscapes Partnership, “Georgia Sentinel Landscape.”

¹²¹ National Defense Authorization Act, Public Law 115-91, 2018 (Section 317(e)(3)(a))

¹²² National Defense Authorization Act, Public Law 115-91, 2018 (Section 317(d))

¹²³ Sentinel Landscapes Partnership, “Georgia Sentinel Landscape.”

indigo snake is listed as threatened wherever found.¹²⁴ The gopher tortoise was previously listed as threatened in the state of Georgia, but the most recent review found,

*“the gopher tortoise in the eastern portion of its range and the gopher tortoise in the western portion of its range meet the criteria of separate distinct population segments (DPS), as defined by [USFWS] Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act. [USFWS] determined the Eastern DPS of the gopher tortoise is not warranted for listing at this time. Further, [USFWS] confirm[ed] that the Western DPS of the gopher tortoise meets the definition of a threatened species.”*¹²⁵

Although DOD complies with the ESA and actively works to preserve listed species, such as in the REPI program, DOD also has a strong case that military preparedness can outweigh the ESA if a threatened or endangered species is not in danger of extinction.¹²⁶ Understanding the ability of the military to continue its mission and landowner property rights are essential in conjunction with the ESA. A primary tool used for this are conservation easements.

The Uniform Conservation Easement Act (UCEA) was passed in 1981 as a template for states to use as a tool of conservation, and by 2005 all fifty states has statutes authorizing some form of conservation easements.¹²⁷ The Georgia Uniform Conservation Easement Act (GA Code §44-10), defines a conservation easement as,

*“a nonpossessory interest of a holder in real property imposing limitations or affirmative obligations, the purposes of which include retaining or protecting natural, scenic, or open-space values of real property; assuring its availability for agricultural, forest, recreational, or open-space use; protecting natural resources; maintaining or enhancing air or water quality; or preserving the historical, architectural, archeological, or cultural aspects of real property.”*¹²⁸

¹²⁴ Environmental Conservation Online System, “Threatened & Endangered Species.” No date. Accessed from: <https://ecos.fws.gov/ecp/>

¹²⁵ US Fish and Wildlife Service, “Endangered and Threatened Wildlife and Plants; Finding for the Gopher Tortoise Eastern and Western Distinct Population Segments.” 87 FR 61834. October 12, 2022. Accessed from: <https://www.federalregister.gov/documents/2022/10/12/2022-21659/endangered-and-threatened-wildlife-and-plants-finding-for-the-gopher-tortoise-eastern-and-western>

¹²⁶ Curtis Cranston, “The US Military's Environmental Protection Efforts: Unexpected Eco-Friendly Solutions to Land Management Problems,” 1060.

¹²⁷ Jessica Owley et al., “Climate change challenges for land conservation: Rethinking conservation easements, strategies, and tools.” *Denv. L. Rev.* 95 (2017), 743.

¹²⁸ GA Code §44-10-2-1

Military installations can work with private landowners surrounding the installations to enter into a conservation easement with a non-profit conservation agency, such as a land trust. The Georgia-Alabama Land Trust is the partner for FS/HAA.

In conclusion, there are many layers the Sentinel Landscape sits upon to allow for DOD to coordinate natural resource management, such as the Sikes Act and Title 10. While natural resource conservation is not the main objective of DOD, the willingness to enter into IGSA's and work with other agencies and private landowners is critical as the effects of climate change become more apparent. The REPI and ACUB programs are successful examples of these statutes at work. While this is just the surface of environmental legislation DOD needs to consider for natural resource management, it is useful to understand the complex web of agencies DOD coordinates to pursue these projects.

2.3 Equity Framework

To state goals of equity and execute them are two different things. As such, this framework addresses the amorphous nature of environmental justice and equity for resiliency efforts in and around DOD military installations. It provides a roadmap for Sentinel Landscape program managers to navigate these land use conflicts, fulfill the military mission, build a collaborative network, and address climate challenges, all while ensuring equity is a consideration. The tripartite model for an equitable approach includes recognition, procedural, and distributional equity. Key concepts for each are outlined underneath each section and applied in the discussion.

2.3.1 DOD's Engagement with Climate Change, Environmental Justice, and Equity

Climate change became a top priority for DOD over the last two decades. As far back as 2003, DOD was conducting publicly available research to explore the national security implications of climate change and resource scarcity.¹²⁹ In 2012, DOD published its first *Climate Change Adaptation Roadmap* in

¹²⁹ Peter Schwartz and Doug Randall, "An abrupt climate change scenario and its implications for United States national security." California Inst. of Tech. Pasadena jet propulsion lab, 2003.

response to President Obama's Executive Order (EO) # 13514, "Federal Leadership in Environmental, Energy and Economic Performance."¹³⁰ Since 2012, there have been multiple updates to the adaptation roadmap, and a shift of language to include climate change, resilience, and environmental justice.

DOD's defense strategy referred to climate change as a "threat multiplier" in the 2014 *Climate Change Adaptation Roadmap*, where it will "accelerate, exacerbate, or trigger" conflicts of national security.¹³¹ There was a new recognition that the role of the military may expand to provide humanitarian assistance and disaster relief alongside civil authorities in response to new infectious diseases, terrorism, and natural disasters.¹³² Resilience emerged in DOD climate language in 2016 as part of DOD Directive 4715.21: Climate Change Adaptation and Resilience.¹³³ As DOD's defense strategy evolved to recognize the long-ranging impacts of climate change and the need for increased resiliency, intensification of inequities was not incorporated into the larger strategy.

DOD released its *Strategy on Environmental Justice* in March of 1995 in response to President Clinton's EO # 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." DOD's strategy identified the NEPA as the primary mechanism to implement the directives of the EO and listed the Joint Land Use Studies (JLUS) program and Restoration Advisory Boards as model projects and programs.¹³⁴ In 2019, the US Government Accountability Office (GAO) found that DOD had not updated its original 1995 *Strategy on Environmental Justice*. Even more, it was one of two agencies reviewed that did not issue strategic plans after 2011, despite signing an MOU to do so. GAO stated, "DOD officials said that the agency has not prioritized environmental justice efforts,"¹³⁵

¹³⁰ Department of Defense, Office of the Undersecretary of Defense (Acquisition and Sustainment). (2021). *Department of Defense Draft Climate Adaptation Plan*. Report Submitted to National Climate Task Force and Federal Chief Sustainability Officer. 1 September 2021.

¹³¹ Daniel Abrahams, "From discourse to policy: US policy communities' perceptions of and approaches to climate change and security." *Conflict, Security & Development* 19, no. 4 (2019): 323-345.

¹³² J. D. Banusiewicz, "Hagel to address "threat multiplier" of climate change. US Department of Defense news article." (2014).

¹³³ Department of Defense, *Department of Defense Draft Climate Adaptation Plan*.

¹³⁴ Department of Defense, "Environmental Justice Draft Strategic Plan: U.S. Department of Defense." Washington, DC, March 24, 1995.

¹³⁵ J. Gmez, *ENVIRONMENTAL JUSTICE: Federal Efforts Need Better Planning, Coordination, and Methods to Assess Progress*. United States Government Accountability Office, 2019, 15

and found “no clear progress towards achieving environmental justice goals” since signing the MOU in 2011.¹³⁶ DOD was severely lacking in comparison to other federation agencies in their implementation of environmental justice.¹³⁷

Progress was stagnant toward greater incorporation of environmental justice for the last few decades, however, executive orders by President Biden in 2021 prompted DOD to create new plans to address these topics. The relevant EOs are EO # 14008, “Tackling the Climate Crisis at Home and Abroad,” and EO #13985, “Advancing Racial Equity and Support for Underserved Communities Through the Federal Government.” DOD acknowledged environmental justice in the 2021 *Climate Adaptation Plan* (CAP)¹³⁸ and equity in the 2022 *Equity Action Plan* (EAP).¹³⁹

The DOD CAP listed “environmental justice” as one of the four “enablers” to achieve “lines of effort” (also known as actions). The four enablers, continuous monitoring and data analytics, aligning incentives to reward innovation, climate literacy, and environmental justice, integrate the five lines of efforts:

1. Climate-informed decision-making,
2. Train and equip a climate-ready force,
3. Resilient built and natural infrastructure,
4. Supply chain resilience and innovation, and
5. Enhance adaptation and resilience through collaboration.¹⁴⁰

While environmental justice is listed as an enabler to achieve these goals, the pathway to implementation needs to be clarified. Additionally, equity was not mentioned once throughout the CAP. While not synonymous with environmental justice, equitable actions play an important role. It is clear

¹³⁶ Gmez, *Environmental Justice*, 45

¹³⁷ Gmez, *Environmental Justice*.

¹³⁸ Department of Defense, *Department of Defense Draft Climate Adaptation Plan*.

¹³⁹ Department of Defense, *Equity Action Plan*. April 2022.

¹⁴⁰ Department of Defense, *Department of Defense Draft Climate Adaptation Plan*.

DOD has taken significant actions to address the environmental impacts of climate change, but environmental justice and equity were not always a part of the solution. CAPs are notorious for stating goals of justice and equity, yet often lack concrete strategies to implement and measure outcomes. By continuing to omit equity concerns in adaptation planning, it can reinforce existing vulnerabilities and create new sources of inequities.¹⁴¹

The EAP is a “holistic strategy for continuing to cultivate enduring and equitable change”¹⁴² and hopes to extend DOD equity actions to all Americans. This is a transition away from the traditional approach of solely targeting department-wide actions. Actions will fall into five categories: procurement and contracting; military installations; military families; equitable artificial intelligence (AI) research and development; and underserved community investment. The EAP listed barriers to equitable outcomes, actions and intended impacts on the barrier, tracking progress, and accountability for each action. These give a general framework for military installations, but little specific guidance.

In summary, DOD prioritized climate change adaptation in national defense over the past decade but neglected environmental justice and equity within that strategy. These are integral to climate adaptation and resilience efforts, and DOD is required to prioritize climate change for national security and include environmental justice into its mission, “by developing programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts” as part of EO # 14008, “Tackling the Climate Crisis at Home and Abroad.”¹⁴³ The recent 2021 CAP and 2022 EAP commit to making environmental justice and equity part of the greater national defense strategy. Climate adaptation and resilience strategies should seek to address vulnerabilities in meaningful actions.

¹⁴¹ Kayleigh Swanson, "Equity in urban climate change adaptation planning: A review of research." (2021).

¹⁴² Department of Defense, *Equity Action Plan*. April 2022, 1

¹⁴³ Executive Order, "14008. Tackling the Climate Crisis at Home and Abroad." *Federal Register* 86 (2021).

2.3.2 Recognitional Equity

Recognitional equity is foundational to every project yet is typically addressed the least out of the equity tripartite in resiliency plans^{144, 145, 146} Seigerman et al. places recognition as the root system of an “equity tree” because it “acts like a root system, anchoring equity through acknowledgment and respect of diversity, and through humility in relation to the perspectives of others.”¹⁴⁷ The effects of climate change currently are and will negatively impact historically marginalized and disadvantaged groups worse than others, exacerbating vulnerabilities already present.¹⁴⁸ This calls for decision-makers to transform processes by first acknowledging they are not neutral and often perpetuate unbalanced power dynamics. Often these power struggles between communities and decision-makers can play out in framing. For example, narrow framing of a problem can result in the exclusion of already marginalized groups. Therefore, recognitional equity is key for the Sentinel Landscape partners to include within any project. Key concepts for recognitional equity are to acknowledge intersecting identities and value local knowledge.^{149, 150}

2.3.2.1 Acknowledge Intersecting Identities

Marginalized groups are not homogenous and can vary based on aspects such as age, class, citizenship status, gender, physical/mental ability, race, and sexuality. Often, institutionalized patterns, structures, and policies continue to perpetuate the oppression of marginalized groups.¹⁵¹ Moreover, these identities are not siloed, and decision-makers can come to understand the variation in vulnerabilities by

¹⁴⁴ Sara Meerow et al., "Social equity in urban resilience planning." *Local Environment* 24, no. 9 (2019): 793-808.

¹⁴⁵ Gwendoly Blue et al., "Justice as parity of participation: Enhancing Arnstein's ladder through Fraser's justice framework." *Journal of the American Planning Association* 85, no. 3 (2019): 363-376.

¹⁴⁶ Adrian Martin, "Justice and conservation: The need to incorporate recognition." *Biological conservation* 197 (2016): 254-261.

¹⁴⁷ Seigerman et al., "Operationalizing equity for integrated water resources management." *JAWRA Journal of the American Water Resources Association* (2022).

¹⁴⁸ IPCC, *Summary for Policymakers*

¹⁴⁹ Sara Meerow et al., "Social equity in urban resilience planning."

¹⁵⁰ Donald R. Nelson et al., "Challenges to realizing the potential of nature-based solutions." *Current Opinion in Environmental Sustainability* 45 (2020): 49-55.

¹⁵¹ Meerow, "Social equity in urban resilience planning."

recognizing the intersectionality of these facets of a person or group. Recognition of distinct identities and histories is critical because it contributes to perceptions and preferences of environmental services.¹⁵²

2.3.2.2 Value Local Knowledge

Often, conservation work occurs on indigenous land; thus, is intertwined with cultural diversity. Land managers can misrepresent, devalue, and even consider local practices inferior to mainstream strategies associated with the dominant social group.¹⁵³ Not only can this negatively impact conservation work, but it can have psychological effects, where well-being and self-respect are eroded due to the colonization of space and territory intertwined with community traditions.¹⁵⁴ Resilience and conservation efforts are not solely about the environment but encompass the people that inhabit the land and benefit from them. Decision-makers and land managers should acknowledge and uplift any local knowledge and practices to create a space where voices of indigenous peoples and local communities can be combined to democratize conservation efforts and produce a sense of dignity and capability.

2.3.3 Procedural Equity

Procedural equity takes place in decision-making processes where stakeholder and community participation are integral for fair outcomes. The Siegerman et al. equity tree places procedural equity as the trunk of the tree because procedures “provide structure and support for equity and facilitate many of the ways recognition and distribution impact each other. Procedural equity requires the inclusive participation of local stakeholders, transparency in the project planning, and management, and consent from all parties involved.”¹⁵⁵ Although increasing participation and engagement may sound straightforward, equitable procedures require decision-makers to be nuanced in this process. The key concepts for procedural equity are power dynamics and framing.

¹⁵² Donald R. Nelson et al., "Challenges to realizing the potential of nature-based solutions."

¹⁵³ Adrian Martin, Brendan Coolsaet, Esteve Corbera, Neil M. Dawson, James A. Fraser, Ina Lehmann, and Iokiñe Rodríguez. "Justice and conservation: The need to incorporate recognition." *Biological conservation* 197 (2016): 254-261.

¹⁵⁴ Adrian Martin et al., "Justice and conservation: The need to incorporate recognition."

¹⁵⁵ Siegerman, "Operationalizing equity for integrated water resources management."

2.3.3.1 Participation and Power Dynamics

Although participatory processes often focus on consensus or compromise, it is important to understand that what is good for the whole is not necessarily good for marginalized groups, which may increase the burdens these groups already face. Participatory processes are not neutral and reflect the assumptions of the decision-makers that will frame the interactions with the public. Arnstein's Ladder of Participation (1969) is often cited as a visual representation of the spectrum of public participation and consists of eight rungs to illustrate the relationship between citizen participation and power (Figure 13a).¹⁵⁶ The ladder was instrumental in the field of urban planning, and the Journal of the American Planning Association (JAPA) dedicated a special issue to the fiftieth anniversary of the original article in 2019.¹⁵⁷

Each rung falls into three degrees of participation: nonparticipation, tokenism, and citizen power. Nonparticipation is defined as manipulation (rung one) and therapy (rung two), tokenism is defined as informing (rung three), consultation (rung four), and placation (rung five), and citizen power is defined by partnership (rung six), delegated power (rung seven), and citizen control (rung eight). Arnstein recognized the simplicity of the ladder and stated there are more than just eight rungs, but these steps demonstrate the redistribution of power from the "haves" (power-holders) to "have-nots" (powerless) where the citizens are empowered to make their own decisions about their community and benefit from social, political, and economic processes.¹⁵⁸ Although Arnstein's Ladder represented a shift in thinking about participatory practices in government decision-making from the mid-twentieth century, there are criticisms to the linear representation that resulted in reimaginations and additions.

Scholars from a range of disciplines offer additions to the ladder. Hurlbert and Gupta created a split ladder of participation for a range of policy problems (e.g., structured or unstructured) to better

¹⁵⁶ Sherry R Arnstein, "A ladder of citizen participation." *Journal of the American Institute of planners* 35, no. 4 (1969): 216-224.

¹⁵⁷ Carissa Schively Slotterback and Mickey Lauria. "Building a foundation for public engagement in planning: 50 years of impact, interpretation, and inspiration from Arnstein's Ladder." *Journal of the American Planning Association* 85, no. 3 (2019): 183-187.

¹⁵⁸ Arnstein, "A ladder of citizen participation." .

address what level of participation is required under varying conditions of trust and governance.¹⁵⁹ Lyles and White advocated for “planning as caring” with six foundational, emotional components: self-awareness, self-regulation, awareness of others, working with difference, empowering power through relationships, and extending compassion.¹⁶⁰ Rosen and Painter argued for a co-production model, where dynamic and iterative co-constructed processes can lead to more equitable power and resource distributions, as opposed to the sequential and static approaches of Arnstein’s Ladder.¹⁶¹ Laskey and Nicholls asserted the ladder undervalues the constraints of urban growth regimes and planning establishments, and planners should engage in dialogue and partnerships with insurgent planners to achieve community empowerment, rather than consent.¹⁶²

There are other models for participation, such as the International Association for Public Participation (IAP²) Spectrum of Public Participation (Figure 13b). The spectrum defined goals and promises to the public with the level of participation: inform, consult, involve, collaborate, and empower, which are similar to the rungs on Arnstein’s Ladder.¹⁶³ This has been used internationally and adapted to the needs of different agencies (e.g., US Environmental Protection Agency)¹⁶⁴ and non-profits (e.g., Facilitating Power).¹⁶⁵ Ultimately, public participation models are imperfect, but can be updated and modified to help reach goals of empowerment.

¹⁵⁹ Margot Hulbert and Joyeeta Gupta. "The split ladder of participation: A diagnostic, strategic, and evaluation tool to assess when participation is necessary." *Environmental Science & Policy* 50 (2015): 100-113.

¹⁶⁰ Ward Lyles and Stacey Swearingen White. "Who cares? Arnstein’s ladder, the emotional paradox of public engagement, and (re) imagining planning as caring." *Journal of the American Planning Association* 85, no. 3 (2019): 287-300.

¹⁶¹ Jovanna Rosen and Gary Painter. "From citizen control to co-production: Moving beyond a linear conception of citizen participation." *Journal of the American planning association* 85, no. 3 (2019): 335-347.

¹⁶² Allison B. Laskey and Walter Nicholls. "Jumping off the ladder: Participation and insurgency in Detroit’s urban planning." *Journal of the American Planning Association* 85, no. 3 (2019): 348-362.

¹⁶³ International Association for Public Participation, “IAP2 Spectrum of Public Participation.” Core Values, Ethics, Spectrum – The 3 Pillars of Public Participation. Accessed from <https://www.iap2.org/page/pillars>

¹⁶⁴ Environmental Protection Agency. “Spectrum of Public Involvement.” Accessed from <https://www.epa.gov/international-cooperation/spectrum-public-involvement>

¹⁶⁵ Rosa Gonzalez, “The Spectrum of Community Engagement to Ownership.” Accessed from <https://movementstrategy.org/resources/the-spectrum-of-community-engagement-to-ownership/>

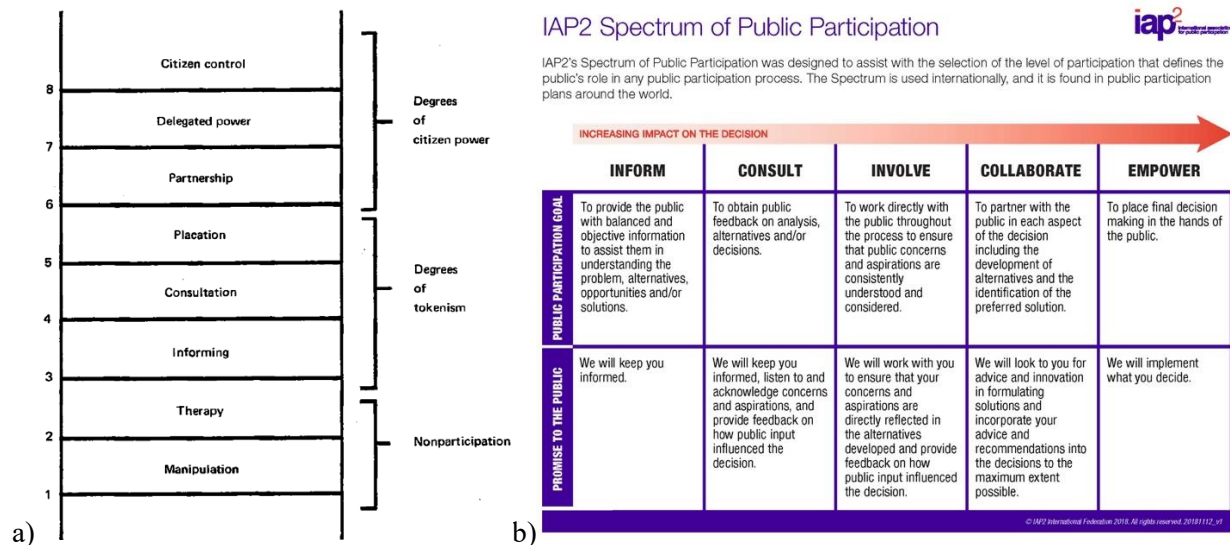


Figure 13. Visualizing participation: a) The Ladder of Citizen Participation¹⁶⁶ and b) IAP² Spectrum of Public Participation¹⁶⁷

2.3.3.2 Framing

Framing of decision-making can substantially impact the outcome of participatory processes and reflect the power dynamic between land managers and marginalized groups. Decision-makers have the power to frame the problem, goals, and interests of a particular issue.¹⁶⁸ For example, when environmental services are framed as a reduction in harm to build infrastructure based on monetary costs and benefits, it may result in less equitable outcomes than if human health, food, water provision, air pollution reduction, and recreational services are prioritized. A wider framing of the goals of environmental services can result in a shift of what priorities are valued. Identifying the values of marginalized communities and understanding the cultural context can result in a more inclusive framing of the problem.¹⁶⁹

¹⁶⁶ Sherry R Arnstein, "A ladder of citizen participation."

¹⁶⁷ International Association for Public Participation, "IAP2 Spectrum of Public Participation."

¹⁶⁸ Blue, "Justice as parity of participation."

¹⁶⁹ Johannes Langemeyer and James JT Connolly. "Weaving notions of justice into urban ecosystem services research and practice." *Environmental science & policy* 109 (2020): 1-14.

Intentional inclusion, meaningful participation, and representation are key to a fairer process. To ensure all relevant stakeholders are included in the process, initiatives must be context-specific and adaptable to those typically left out of the process. This can depend on location, language, and access to digital technologies. Vulnerable communities have knowledge about local conditions that can influence development projects.¹⁷⁰ To increase participation, multiple solutions must be employed such as recruitment, framing, and remedial efforts for a more just process. By framing vulnerability in more dynamic terms, decision-makers can begin to understand the experience of marginalized groups is on a spectrum based on interests, needs, and priorities.¹⁷¹

2.3.4 Distributional Equity

Distributive equity is the result of recognitional and procedural equity and encompasses the allocation of benefits and harms of resources, risks, and opportunities. It recognizes the uneven distribution of environmental burdens and benefits and focuses on improving the welfare of disadvantaged society.¹⁷² Within the Seigerman et al. equity tree, distributional equity is depicted as the crown, as a project's outcome will depend on its context and scope.¹⁷³ On its face, distributional equity can appear as a trade-off of who receives or does not receive the benefits of a project. However, many decisions lead up to the allocation of costs and benefits, such as recognizing groups of people who traditionally have not benefited from funding or resources. This can manifest in exacerbating current threats from lack of investment or displacement.¹⁷⁴ The metrics for quantifying distributional equity are easier to grasp than those of recognitional and procedural but must be thoughtfully implemented and measured to ensure benefits are maximized. Key concepts for distributional equity are building a

¹⁷⁰ Swanson, "Equity in urban climate change adaptation planning: A review of research."

¹⁷¹ Blue, "Justice as parity of participation."

¹⁷² Duran Fiack et al., "Sustainable adaptation: Social equity and local climate adaptation planning in US cities." *Cities* 115 (2021): 103235

¹⁷³ Seigerman, "Operationalizing equity for integrated water resources management."

¹⁷⁴ Joan Fitzgerald, "Transitioning from urban climate action to climate equity." *Journal of the American Planning Association* 88, no. 4 (2022): 508-523.

foundation for thoughtful outcomes through recognitional and procedural equity and ensuring thoughtful outcomes.

2.3.4.1 Building a Foundation through Recognitional and Procedural Equity

Distributional equity requires recognitional equity, an acknowledgment of and understanding of local values, and procedural equity, processes that are informed by a wide range of experiences. A purely distributional approach is limiting because identity and power will affect resource allocation. Distributive concerns are more obvious in climate adaptation plans than efforts at recognitional equity.¹⁷⁵ Cities can address distributional equity through the allocation of climate-related programs, land uses, and infrastructure. This can include fair access to resilience infrastructure and funding focused on prioritizing frontline and historically marginalized communities.¹⁷⁶

Frontline communities should be prioritized across all aspects of a climate plan, and distributional equity calls for the plan to specify the recipients and principles used to make that decision. Three essential steps to integrate equity in climate action plans for authentic participation are antiracism training; a concerted effort to bring underrepresented groups to the table; and ensuring that all feel valued in the planning process, both in terms of the way meetings are structured and literally in paying participants for their time. Metrics of distribution should be monitored before and after implementation.¹⁷⁷ Building a foundation for distributional equity takes place by working to include recognitional and procedural equity.

2.3.4.2 Ensuring Thoughtful Outcomes

Climate adaptation planning focuses more on distributive equity metrics than recognitional and procedural ones because it is well-studied that the effects of climate change will not be uniformly felt. Policymakers and the public tend to focus on the outcomes of planning, demanding redistribution of efforts to help those that least contributed to the effects of climate change (e.g., the Biden-Harris

¹⁷⁵ Fiack, "Sustainable adaptation: Social equity and local climate adaptation planning in US cities."

¹⁷⁶ Swanson, "Equity in urban climate change adaptation planning: A review of research."

¹⁷⁷ Fitzgerald, "Transitioning from urban climate action to climate equity."

administration's Justice40 initiative).¹⁷⁸ While there are many efforts to achieve distributive equity in climate resilience planning, there are few studies that analyze the long-term outcomes of policy and planning implementation at the local level.¹⁷⁹ Even so, decision-makers can learn from current literature and recent efforts to ensure disadvantaged groups of people receive benefits from ongoing and future projects.

For example, green investments in low-income neighborhoods need to be informed by the historical legacy of redlining, housing discrimination, racial segregation. The economic redistribution of wealth and resources can help to correct existing structural inequities.¹⁸⁰ More inclusive outcomes can be achieved by intentional distribution of funds, prioritization of disadvantaged communities, partnership cultivation, and project implementation. Metrics for distributional equity often include an evaluation of who received the benefits of the project, and these should be developed through recognition and procedural equity.¹⁸¹

In conclusion, this section outlined the land use goals and plans for each county, detailed the legal basis for DOD climate resiliency work, and built an equity framework that will be used to inform the land use analysis and give context to the results. The Coastal Georgia Sentinel Landscape is a unique area with a web of policies and actors working towards similar goals. Together, these can come together into an intricate mosaic that contribute to both climate resiliency and climate equity. Future progress towards equity requires recognition of the past and acute awareness of the present. The next chapter will describe the methods for visualizing that future through land use.

¹⁷⁸ Fitzgerald, "Transitioning from urban climate action to climate equity."

¹⁷⁹ Swanson, "Equity in urban climate change adaptation planning: A review of research."

¹⁸⁰ Kate Derickson et al., "Reflections on crafting a policy toolkit for equitable green infrastructure." *Npj urban sustainability* 1, no. 1 (2021): 21.

¹⁸¹ Seigerman, "Operationalizing equity for integrated water resources management."

CHAPTER 3

METHODS

Land use planning relies on geographic information systems (GIS) to visualize and analyze spatial data. GIS was first created by Roger Tomlinson in 1963 for the Canadian government to compile an inventory of natural resources.¹⁸² While the concept of using spatial data to inform design is largely contributed to landscape architect Ian McHarg in his publication *Design with Nature* (1969), he was influenced by the scholarship of Warren Manning and Jaqueline Tyrwhitt, who both used map overlays to inform design.¹⁸³ Since McHarg, GIS evolved from a design-based tool into one for performing spatial analysis.¹⁸⁴

Land suitability analyses can highlight areas that should be prioritized for a specific purpose based on stakeholder input. For example, suitability analyses identified priority areas for conservation¹⁸⁵ and habitat conservation for at-risk herpetofauna species¹⁸⁶ within the southeast region of the US. While conservation may lend itself to suitability analyses, equity can also be analyzed through GIS. Heckert and Rosan created an equity index for siting green infrastructure¹⁸⁷ and Clark et al. created a framework to assess social inequality in urban areas using fine-scale spatial data.¹⁸⁸ Spatial data can help identify target areas for specific goals, and there are various methods to approach a suitability analysis.

¹⁸² Esri, "History of GIS." What is GIS? Accessed from <https://www.esri.com/en-us/what-is-gis/history-of-gis>

¹⁸³ Susan Herrington, "The nature of Ian McHarg's science." *Landscape Journal* 29, no. 1 (2010): 1-20.

¹⁸⁴ Michael F Goodchild, "Towards Geodesign: Repurposing Cartography and GIS?" *Cartographic Perspectives*, no. 66 (Fall 2010): 7–21. doi:10.14714/CP66.93.

¹⁸⁵ Southeast Conservation Adaptation Strategy, "Southeast Conservation Blueprint." October 2022. Accessed from <https://secassoutheast.org/blueprint>

¹⁸⁶ Brian A. Crawford et al., "Expert-Informed Habitat Suitability Analysis for at-Risk Species Assessment and Conservation Planning." Article. *Journal of Fish & Wildlife Management* 11, no. 1 (2020): 130-50.

¹⁸⁷ Megan Heckert and Christina D. Rosan, "Developing a Green Infrastructure Equity Index to Promote Equity Planning." *Urban Forestry & Urban Greening* 19 (September 1, 2016): 263–70. doi:10.1016/j.ufug.2015.12.011.

¹⁸⁸ Lara P. Clark et al., "A data framework for assessing social inequality and equity in multi-sector social, ecological, infrastructural urban systems: Focus on fine-spatial scales." *Journal of Industrial Ecology* 26, no. 1 (2022): 145-163.

This study selected the Land Use Conflict Identification Strategy (LUCIS) to illustrate the varying interests of urban, conservation, and agriculture through a series of suitability analyses that were combined to create one final land use conflict map and allocate future land use for 2050.¹⁸⁹ This study used the Georgia Sentinel Landscape program website, Justice40 policy memorandum, and county comprehensive plans as a proxy for stakeholders. While this study chose to use the original three land use categories, it is a flexible method that can be customized to the goals of stakeholders and use any three land use categories. LUCIS has been used to understand the effects of climate change on transportation systems in Miami-Dade County, FL,¹⁹⁰ sustainable land use scenarios in Glynn County, Georgia,¹⁹¹ and low impact solar siting in Georgia.¹⁹² Additionally, it requires less direct stakeholder participation than other methods. The resulting LUCIS 2050 future land use allocation map can help Sentinel Landscape program managers visualize program goals in terms of land use planning.

3.1 Land Use Conflict Identification Strategy (LUCIS)

Carr and Zwick developed LUCIS to demonstrate the connection between individual land use decisions and long-term spatial consequences.¹⁹³ LUCIS is defined as, “a goal-driven GIS model that produces a spatial representation of probable patterns of future land use” and is divided into the following categories:

- Existing conservation, urban, and agricultural lands,
- Areas preferred for future conservation, urban, and agricultural uses, and
- Areas of probable conflict between conservation, urban, and agricultural land uses.¹⁹⁴

¹⁸⁹ Margaret H. Carr and Paul Dean Zwick. *Smart Land-Use Analysis: The LUCIS Model Land-Use Conflict Identification Strategy*. 1st ed. ESRI Press, 2007.

¹⁹⁰ Yu Han et al., "Evaluating Impacts of Coastal Flooding on the Transportation System Using an Activity-Based Travel Demand Model: A Case Study in Miami-Dade County, FL." *Transportation* 49, no. 1 (2022): 163-84.

¹⁹¹ Zhan Shi, *Visualizing Future Land Use: Facing Climate Hazard in the Coastal Area of Glynn County, Ga.* 2015.

¹⁹² The Nature Conservancy, “Georgia Low Impact Solar Siting Tool User Guide.” 2021. Accessed from <https://secassoutheast.org/2022/09/14/TNC-uses-the-Blueprint-to-help-inform-low-impact-solar-siting-in-GA.html>

¹⁹³ Carr and Zwick, *Smart Land-Use Analysis*, 7

¹⁹⁴ Carr and Zwick, *Smart Land-Use Analysis*, 10

The three land-use classifications of conservation, urban, and agriculture are based on Eugene P. Odum's four general land use types proposed in his article, "The Strategy of Ecosystem Development." By compartmentalizing land use into productive, protective, compromise, and urban/industrial types, Odum created a systems-analysis procedure to help answer the question of "How much is too much of a good thing?"¹⁹⁵ Carr and Zwick reduced the four systems into three land use classifications, combining protective and compromising into conservation (Table 3).¹⁹⁶

Table 3. LUCIS Approach Compared to Odum's Work in "The Strategy of Ecosystem Development" adapted from Carr and Zwick Table 2.1

Odum's Classifications	Odum's Classifications Definitions	LUCIS Classifications	Private/Public Ownership
Productive	Succession is continually retarded by human controls to maintain high levels of productivity	Agriculture: Lands that produce food, fuel, and fiber	Mostly private lands
Protective	Natural areas, where succession is allowed or encouraged to proceed into the mature, and thus stable, if not highly productive stages	Conservation: Environmentally significant lands	Public ownership for conservation purposes and private lands where future development is constrained by easement or deed restriction
Compromise	Some combination of the first two stages exists		
Urban/Industrial	Biologically non-vital areas	Urban: Lands that support relatively intense human activity like residential, commercial, and industrial uses.	Privately and publicly owned lands for reasons other than conservation

The LUCIS methodology follows five steps that incorporate stakeholder goals and preferences for the three land use categories (Figure 14).¹⁹⁷ These results will help determine areas of conflict.

¹⁹⁵ Carr and Zwick, *Smart Land-Use Analysis*, 10

¹⁹⁶ Carr and Zwick, *Smart Land-Use Analysis*, 11

¹⁹⁷ Carr and Zwick, *Smart Land-Use Analysis*, 12

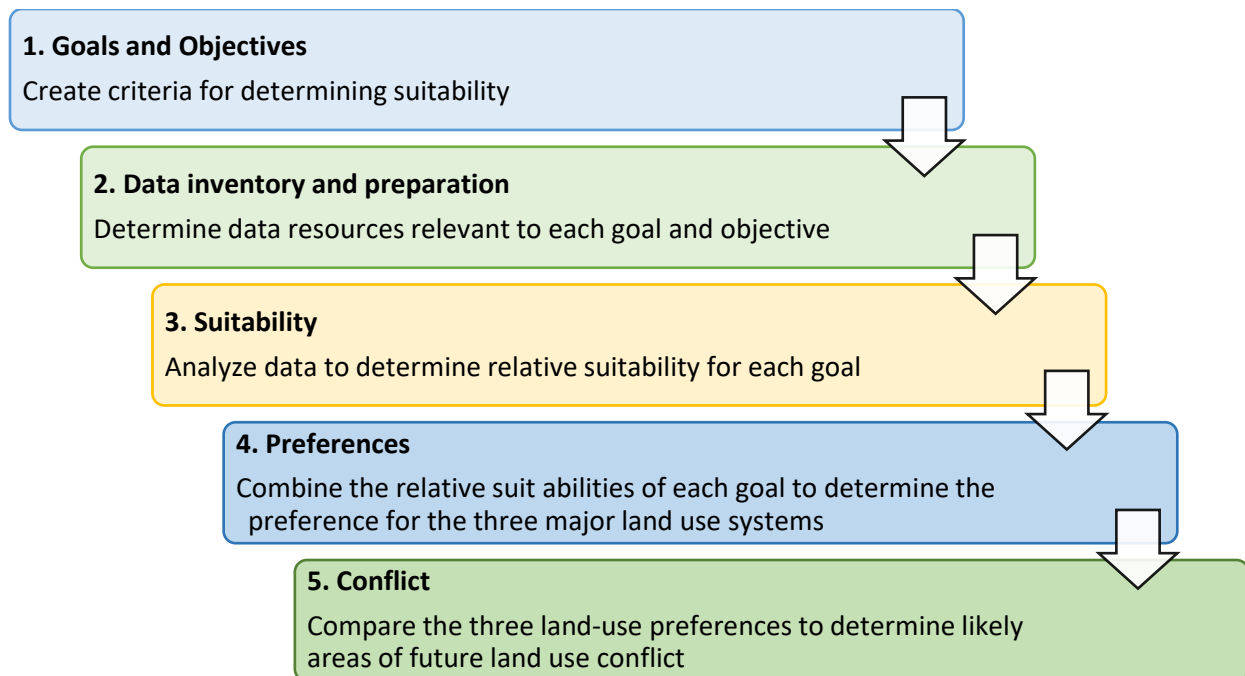


Figure 14. The five steps of the LUCIS model

3.1.1 Goals and Objectives

Land use planning requires forethought and cannot be a “plan-as-you-go” undertaking. This is done by setting hierarchical goals and objectives. Goals are a statement of what is to be accomplished and supporting objectives describe how those goals will be achieved. These are summarized in a concise statement of intent.¹⁹⁸ Goals and objectives are specific, address broad themes, imply action using consistent verbiage, and are subject to change and evolve as needed.¹⁹⁹ The goals and objectives of this project were chosen based on those already identified by the Sentinel Landscape, Justice40 Initiative, and county comprehensive plans. Not all goals were able to be incorporated into the analysis due to a lack of data or concerns of relevancy from a regional scale.

3.1.1.1 Georgia Sentinel Landscape Goals:

- Protect Military Test and Training Missions

¹⁹⁸ Carr and Zwick, *Smart Land-Use Analysis*, 81
Carr and Zwick, *Smart Land-Use Analysis*, 83

- Fort Benning, Fort Stewart, Hunter Army Airfield, Townsend Bombing Range, Fort Gordon, Robins Air Force Base, Marine Corps Logistics Base-Albany, Moody Air Force Base, and Naval Submarine Base Kings Bay
- Conserve Habitat and Natural Resources
 - Coastal resiliency, savannah river watershed, longleaf pine forests, and gopher tortoise habitat, increase access to public outdoor recreation
- Strengthen Economies of Farms, Ranches, and Forests
 - Agriculture and forestry in REPI Boundaries, expand outreach

3.1.1.2 Justice40 Covered Programs:

- Climate Change
- Clean Energy and Energy Efficiency
- Clean Transportation
- Affordable and Sustainable Housing
- Training and Workforce Development
- Remediation and Reduction of Legacy Pollution
- Development of Critical Clean Water Infrastructure

3.1.1.3 Comprehensive Plan Goals:

- More walkable and pedestrian friendly places
- Cluster development and connectivity
- Protect historical and natural resources
- Prioritize accessible, efficient, and sustainable transportation
- Affordable housing and range of options
- Encourage infill development and areas where infrastructure exists
- Maintain desired character areas as indicated in comprehensive plans
- Create climate resilient cities

3.1.2 Data Inventory and Preparation

LUCIS is a GIS-driven methodology and requires spatial data for analysis. After identifying goals and objectives, datasets were chosen to represent each based on availability, scale, and accuracy. Data were collected during a month-long period and various organizations were contacted for data permissions or in search of local data. Conservation and agriculture data were primarily from regional or national datasets and were more straightforward to obtain. Urban data at the local level proved more difficult. Chatham County provided a large range of publicly available data through the Savannah Area Geographic Information System (SAGIS), but Bryan and Liberty Counties did not have the same resources. The Georgia Coastal Regional Commission was contacted to help provide spatial data in the more rural counties.

All data were reprojected into Georgia East State Plane Coordinate System (NAD 1983, 2011) and resampled or reprojected to a cell size of 98.425 feet (30m) if necessary. This cell size was chosen to keep distortion to a minimum as most raster data used originally had a 30m cell size. Data was manipulated to represent the study area through clip, dissolve, reproject, vector to raster, and symbology functions. Metadata was collected for each data source including the dataset name, organization, year, description, and original raster cell value (Appendix A).

3.1.3 Suitability

LUCIS is based on the premise that land use conflict is unavoidable due to the range of stakeholder values and motivations.²⁰⁰ Therefore, the initial suitability analyses attempted to capture biases and represent stakeholder interests in each system. Single utility assignment (SUA) was determined by the utility values for individual features in a single layer of spatial data. This analysis used a range of 1-5 values, where one represented low priority, three represented medium priority, and five represented high priority. No data was assigned to areas where data spatial data was not available. After determining the SUA, a multiple utility assignment (MUA) was applied to goals where data could be more easily

²⁰⁰ Carr and Zwick, *Smart Land-Use Analysis*, 102

combined (e.g., roads and rail, species habitat, and priority conservation areas). Values were assigned using the suitability modeler in ArcGIS Pro (Appendix B).

3.1.4 Preferences

Carr and Zwick differentiate between suitability and preference by asking, “Which of the contributing suitability criteria are most important?”²⁰¹ Preference can be used to capture community values. The suitability rasters were combined in Suitability Modeler using weighted values determined by stakeholders to create one land-use preference raster for each category. A survey was sent out to five stakeholders familiar with the Sentinel Landscape, ACUB, and county comprehensive plans (Appendix C). Stakeholders were asked to rank the criteria relative to each other on a scale of 1-10 and identify the stakeholder group they identified with most: urban, conservation, agriculture, military readiness, or other. Stakeholders were identified through a snowball method and recommended by Defense Resilience Specialists at the University of Georgia Carl Vinson Institute of Government. The results from the survey were averaged to determine the weight of each SUA or MUA in the suitability modeler (Appendix B). The weight represented the relative importance of each to determine suitability. The sum of the weights equaled 1.0 (100%).

3.1.5 Conflict

Once suitability models were created for the urban, conservation, and agriculture land use categories, they were combined to identify areas of conflict. Conflict is defined as any time:

- Three cells sharing the same spatial location have equal collapsed preference values (major conflict)
- Two cells have equal collapsed preference values, and the third cell has a lower collapsed preference (moderate conflict)²⁰²

²⁰¹ Carr and Zwick, *Smart Land-Use Analysis*, 128

²⁰² Carr and Zwick, *Smart Land-Use Analysis*, 147

The conflict analysis followed a three-step process. (Figure 15).²⁰³

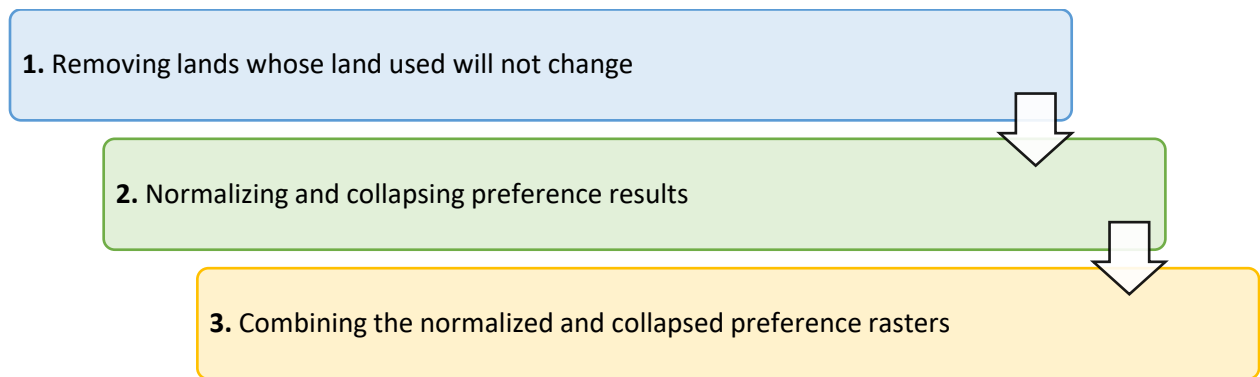


Figure 15. Conflict analysis steps

Lands in the suitability analysis were removed if the land use was deemed to not change. These included protected areas from the Protected Areas Database (PAD), existing populated places from the 2020 Census, and open water from the National Hydrology Database (NHD). These vector layers were each projected, clipped, and combined to create a mosaic raster layer. This layer became the development mask. The mask removed land from the suitability models that was unavailable for future land use development considerations. This was used to limit conflict analysis to areas where additional development has the potential to occur.

The relative suitability for conservation, urban, and agriculture land uses was normalized before comparing preferences using the divide tool. Values for each suitability model were divided by five to create a scale of 0 to 1. Suitability models needed to be normalized to create a more consistent scale for the conflict model. The normalized suitability models were then collapsed into high, medium, and low preferences to illustrate the differences more clearly between each land use using the geometric classification method. Although Carr and Zwick recommended the standard deviation method, the data were not normally distributed, and this method relies on a normal distribution of values.

²⁰³ Carr and Zwick, *Smart Land-Use Analysis*, 137

Therefore, the geometric classification method was chosen to collapse preference values. The geometric interval classification,

“Creates class breaks based on class intervals that have a geometric series. The geometric coefficient in this classifier can change once (to its inverse) to optimize the class ranges. The algorithm creates geometric intervals by minimizing the sum of squares of the number of elements in each class. This ensures that each class range has approximately the same number of values in each class and that the change between intervals is fairly consistent. This algorithm was specifically designed to accommodate continuous data. It is a compromise between the equal interval, natural breaks (Jenks), and quantile methods. It creates a balance between highlighting changes in the middle values and the extreme values, thereby producing a result that is visually appealing and cartographically comprehensive.”²⁰⁴

The normalized and collapsed land use preferences for each system were then reclassified for the conflict model. Values for each went from a classification of one, low priority, 2, medium priority, and 3, high priority to values that could be combined using the raster calculator:

- **Agriculture:** 100 (low), 200 (medium), and 300 (high)
- **Conservation:** 10 (low), 20 (medium), and 30 (high)
- **Urban:** 1 (low), 2 (medium), and 3 (high)

These values created the conflict model, one raster to represent potential land use conflict with values ranging from 111 to 333. The numbers should be interpreted as values of 1, 2, and 3 for each system (Table 4). This created five essential conflict categories:

1. Agriculture/Urban Conflict
2. Urban/Conservation Conflict
3. Agriculture/Conservation Conflict
4. Equal Preference among all three land-use types (major conflict)

²⁰⁴ Esri. "Data Classification Methods." ArcGIS Pro Help. Accessed from <https://pro.arcgis.com/en/pro-app/latest/help/mapping/layer-properties/data-classification-methods.htm>

5. No conflict: urban, agriculture, or conservation preference

Table 4. Conflict Code and Description

Code	Conflict/Preference Description
111	major conflict
112	urban
113	urban
121	conservation
122	moderate conflict (moderate conservation/ moderate urban)
123	urban
131	conservation
132	conservation
133	moderate conflict (high conservation/high urban)
211	agriculture
212	moderate conflict (moderate agriculture/ moderate urban)
213	urban
221	moderate conflict (moderate agriculture/ moderate conservation)
222	major conflict
223	urban
231	conservation
232	conservation
233	moderate (high conservation/high urban)
311	agriculture
312	agriculture
313	moderate (high agriculture/high urban)
321	agriculture
322	agriculture
323	moderate conflict (high agriculture/high urban)
331	moderate conflict (high agriculture/high conservation)
332	moderate conflict (high agriculture/high conservation)
333	major conflict

3.1.6 Future Land Use Allocation

Areas of conflict were used to help determine future land use allocation.²⁰⁵ This study created a baseline future land-use allocation to demonstrate a scenario where land use policies and existing urban density remain at the status quo. Four inputs are required to determine the baseline allocation:

1. Projected population increase
2. Gross urban density
3. Total number of urban acres required to support the projected population
4. LUCIS conflict raster

The fundamental regional land-use equation was used to determine how many acres will be required for human use in the future based on the projected population for a target year.²⁰⁶

$$\text{Population} \div \text{gross urban density} = \text{acres of land needed to support human settlement}$$

The year 2050 was used to estimate the projected population increase using residential population growth estimates from GOPB (Table 2). Gross urban density was calculated by using the area and population from the 2020 Census Populated Places and averaged for the three counties. Future land use was visualized using an adapted version of Carr and Zwick's method (Figure 16).²⁰⁷

²⁰⁵ Carr and Zwick, *Smart Land-Use Analysis*, 165

²⁰⁶ Carr and Zwick, *Smart Land-Use Analysis*, 166

²⁰⁷ Carr and Zwick, *Smart Land-Use Analysis*, 167

1. Allocate cells to future urban use where LUCIS results indicated there was no conflict between collapsed preference values and urban preference dominates.

2. Allocate additional cells to future urban use where LUCIS results showed urban collapsed preference values are in conflict with agriculture and conservation collapsed preference values.

3. Allocate remaining cells to future agricultural and conservation use where agriculture and conservation were in conflict

Figure 16. The three steps for land use allocation

3.2 Equity Framework and Identifying Disadvantaged Populations

Land use planning and future allocation can follow status quo policies or new policy interventions can be introduced to achieve stakeholder goals. This study considered how land use planning can incorporate the goals of CEJST and follow a tripartite equity framework to guide the future land use allocation decision-making process. This framework can help to achieve more equitable outcomes and balance conservation and development around Fort Stewart.

3.2.1 Framework

The equity framework was created based on a literature review of a mix of primary and secondary sources, including academic journal articles, guidebooks, and government resources. The framework is divided into three parts: recognition, procedural, and distributional equity. This was developed within Chapter 2 and applied to the results of the LUCIS analysis.

3.2.2 Disadvantaged Populations

The Justice40 policy initiatives and criteria identified in the CEJST were used to evaluate areas where disadvantaged groups currently exist and may be disproportionately harmed if not considered. CEJST was

developed by the Council on Environmental Quality and U.S. Digital Service, and the Environmental Protection Agency's (EPA) EJSCREEN serves as a precedent. CEJST defines and identifies disadvantaged communities with interactive maps to support equitable decision-making for sectors across the federal government.

CEJST defines eight types of burdens: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development (Table 5). Census tracts were identified as disadvantaged or not, and in what way, then overlaid on the future land use allocation map.

Table 5. Descriptions of the CEJST eight burden categories²⁰⁸

Burden	Communities are identified as disadvantaged if they are in census tracts that:
Climate Change	ARE at or above the 90th percentile for expected agriculture loss rate OR expected building loss rate OR expected population loss rate OR projected flood risk OR projected wildfire risk AND are at or above the 65th percentile for low income
Energy	ARE at or above the 90th percentile for energy cost OR PM2.5 in the air AND are at or above the 65th percentile for low income
Health	ARE at or above the 90th percentile for asthma OR diabetes OR heart disease OR low life expectancy AND are at or above the 65th percentile for low income
Housing	Experienced historic underinvestment OR are at or above the 90th percentile for housing cost OR lack of green space OR lack of indoor plumbing OR lead paint AND are at or above the 65th percentile for low income
Legacy Pollution	Have at least one abandoned mine land OR Formerly Used Defense Sites OR are at or above the 90th percentile for proximity to hazardous waste facilities OR proximity to Superfund sites (National Priorities List (NPL)) OR proximity to Risk Management Plan (RMP) facilities AND are at or above the 65th percentile for low income
Transportation	ARE at or above the 90th percentile for diesel particulate matter exposure OR transportation barriers OR traffic proximity and volume AND are at or above the 65th percentile for low income
Water and Wastewater	ARE at or above the 90th percentile for underground storage tanks and releases OR wastewater discharge AND are at or above the 65th percentile for low income
Workforce Development	ARE at or above the 90th percentile for linguistic isolation OR low median income OR poverty OR unemployment AND fewer than 10% of people ages 25 or older have a high school education (i.e. graduated with a high school diploma)

²⁰⁸ Council on Environmental Quality. “Methodology.” Climate and Economic Justice Screening Tool 1.0. 2022. Accessed from <https://screeningtool.geoplatform.gov/en/methodology>

CHAPTER 4

RESULTS

The LUCIS method is broken into three sections: existing land use, preferred areas for land use, and potential conflict between land uses. This study used the National Land Cover Database (NLCD) 2019 to describe existing land use, suitability analyses for preferred land use, and the conflict analysis to create a future land use scenario for 2050.²⁰⁹ The Justice40 CEJST data was then mapped out by each burden within the study area to demonstrate the threats disadvantaged communities currently face. The CEJST census tracts were finally overlaid over the 2050 land use allocation map to better understand areas that may face increasing pressures with population growth and urban development.

4.1 Existing Land Use

The first part of the LUCIS method is to identify existing urban, conservation, and agricultural lands. This was done using the most recent version of the National Land Cover Database (NLCD, 2019). Three-quarters (75.4%) of the existing land cover of the county is forested (29.7%) or covered by wetlands (45.7%, Figure 17, Table 6). Prominent land use patterns observed included (Figure 18):

- Most developed areas are in Savannah and Hinesville
- North Bryan County features the most cropland and pasture area
- Fort Stewart is primarily forested

²⁰⁹ J. Dewitz and U.S. Geological Survey, 2021, National Land Cover Database (NLCD) 2019 Products (ver. 2.0, June 2021); U.S. Geological Survey data release, <https://doi.org/10.5066/P9KZCM54>

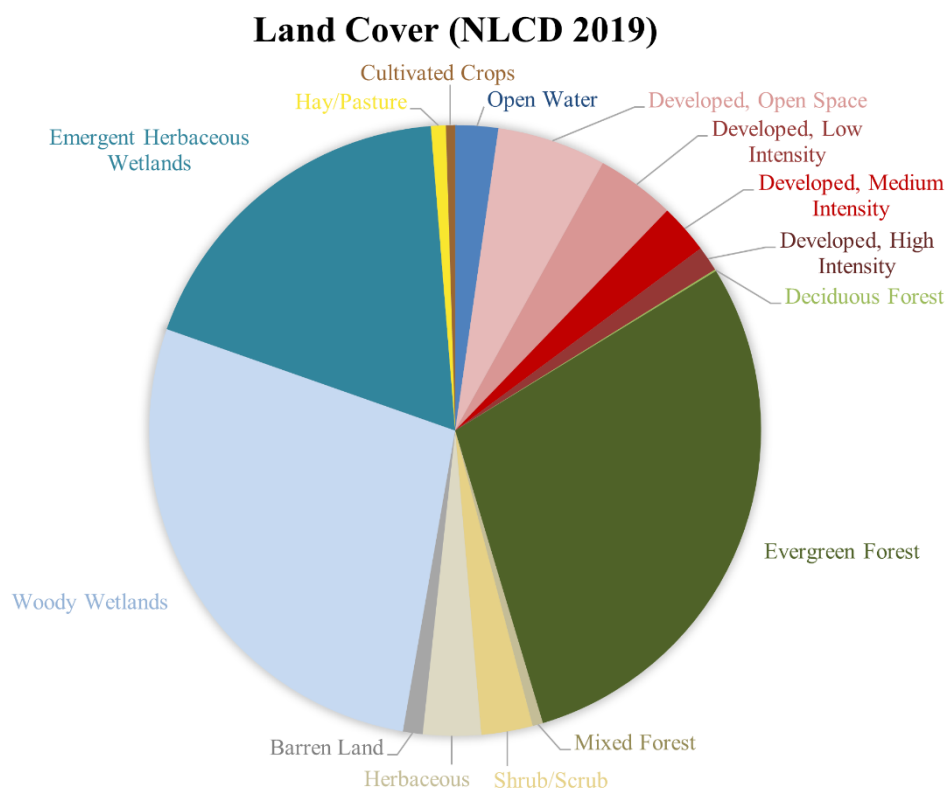


Figure 17. Distribution of land cover in the study area

Table 6. Percentage of land cover in the study area

Land Cover Category	Percentage %
Open Water	2.3
Developed, Open Space	5.8
Developed, Low Intensity	4.2
Developed, Medium Intensity	2.6
Developed, High Intensity	1.3
Deciduous Forest	0.1
Evergreen Forest	29.1
Mixed Forest	0.5
Shrub/Scrub	2.7
Herbaceous	3.1
Barren Land	1.0
Woody Wetlands	27.6
Emergent Herbaceous Wetlands	18.3
Hay/Pasture	0.8
Cultivated Crops	0.5

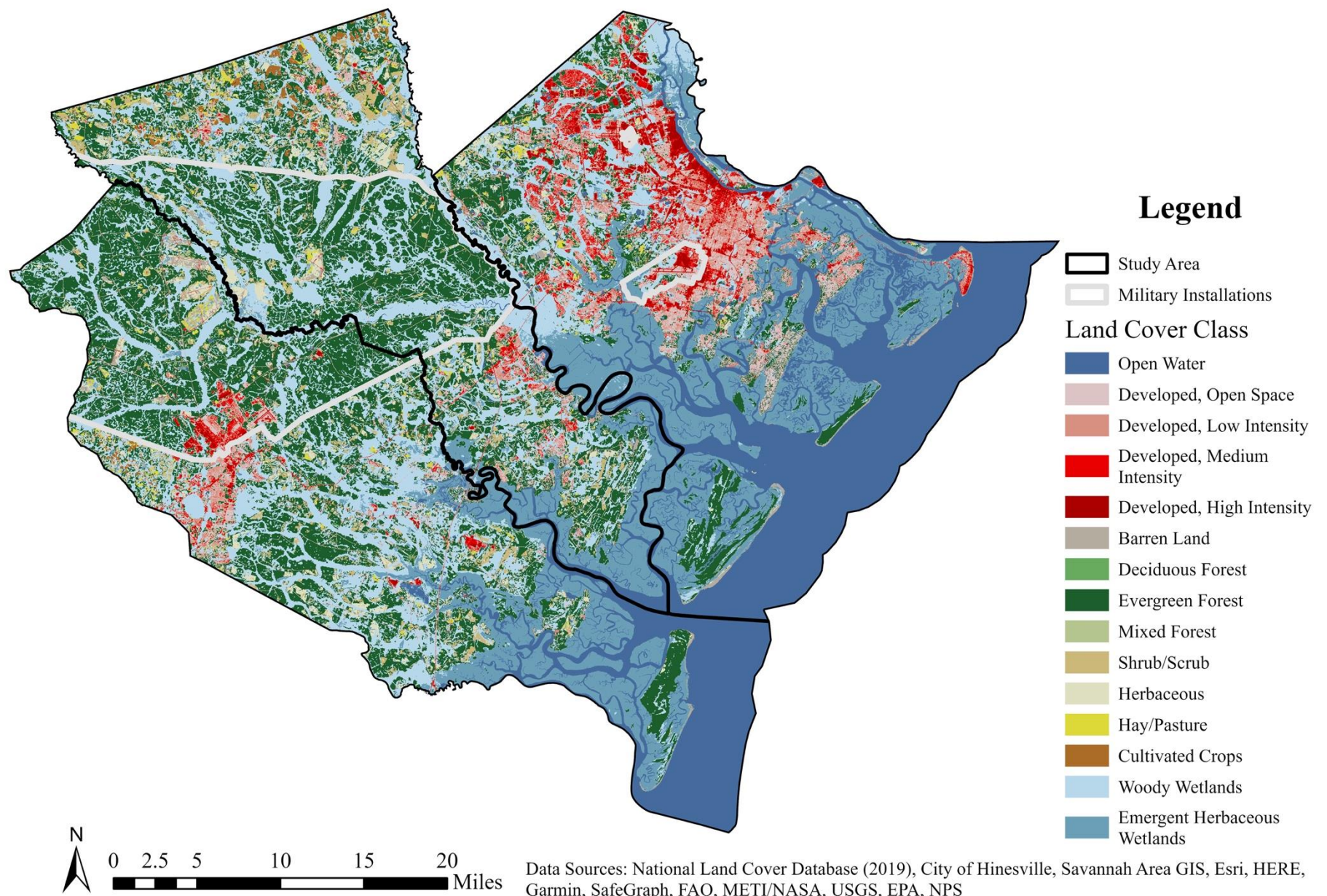


Figure 18. Study area land cover from the National Land Cover Database

4.2 Suitability Models

Setting goals and objectives was a critical component to guide the suitability and conflict analysis. Goals were based on Sentinel Landscape goals, Justice40 objectives, and county comprehensive plans. These were combined into a statement of intent for each land use category (Table 7). The urban category was the most comprehensive and consisted of three goals, six objectives, and thirteen sub-objectives. The conservation category consisted of two goals, four objectives, and eleven sub-objectives. The agriculture category was the smallest and consisted of one goal, two objectives, and five sub-objectives. These goals will be referenced throughout the results section.

Table 7. Statement of intent, goals, objectives, and sub-objectives for each land use category

URBAN
Statement of Intent: Identify lands most suitable for compatible and climate resilient urban development around military installations.
Goal 1: Protect Military Test and Training Missions
Objective 1.1: Development outside of noise and safety buffers
Subobjective: 1.1.1: Identify lands outside of noise zones
Subobjective: 1.1.2: Identify lands outside of the installations, noise zones, and REPI/ACUB boundaries
Objective 1.2: Protect training routes and special use airspace
Subobjective: 1.2.1: Identify roads part of the Strategic Highway Network (STRAHNET)
Subobjective: 1.2.2: Identify railroads used for transportation
Goal 2: Green Urban Infrastructure
Objective 2.1: Increased urban heat island effect mitigation benefits
Subobjective 2.1.1: Retain existing tree canopy
Subobjective 2.1.2: Retain land already designated as an urban park
Subobjective 2.2.3: Identify areas with better walkability
Objective 2.2: Clean and Renewable Energy
Subobjective 2.2.1: Identify lands best suited for low impact solar
Subobjective 2.2.2 Identify areas with existing electric vehicle chargers
Goal 3: Prioritize developed areas with existing resources and maintain character
Objective 3.1: Cluster development and connectivity, encourage infill development
Subobjective 3.1.1: Identify lands that are already developed
Subobjective 3.1.2: Identify areas with high population density
Subobjective 3.1.3: Identify lands predicted to be developed in 2050
Objective 3.2: Maintain character areas determined by counties

Subobjective 3.2.1: Identify areas zoned for commercial, residential, and industrial use

CONSERVATION

Statement of Intent: Identify lands most suitable for conservation of natural resources and threatened/endangered species that can also act as a buffer to the installation.

Goal 1: Conserve Habitat and Natural Resources

Objective 1.1: Preserve open space and wildlands

Subobjective 1.1.1: Identify areas already protected

Subobjective 1.1.2: Identify existing forest, wetland, and open ocean land cover

Subobjective 1.1.3: Identify lands predicted to be forested and wetlands in 2050

Objective 1.2: Improve water quality and forest health

Subobjective 1.2.1: Identify priority areas in the Savannah River Watershed

Subobjective 1.2.2: Identify priority areas for the longleaf pine

Subobjective 1.2.3: Identify impaired streams and create protective buffers

Objective 1.3: Strengthen populations and create wildlife corridors

Subobjective 1.3.1: Identify threatened/endangered and keystone species habitat

Subobjective 1.3.2: Prioritize habitat corridors identified by the Southeast Conservation Blueprint

Goal 2: Enhance coastal resilience and protect vulnerable areas

Objective 2.1: Increased flood mitigation Benefits

Subobjective 2.1.1: Identify areas with wetlands

Subobjective 2.1.2: Identify areas within FEMA flood hazard zones

Subobjective 2.1.3: Identify areas where sea level rise is predicted at 2ft by NOAA

AGRICULTURE

Statement of Intent: Identify lands most suitable for farming and ranching that can also act as a buffer to military installations in cooperation with private landowners.

Goal 1: Strengthen and protect economies of farms, ranches, and forests

Objective 1.1: Protect suitable land areas for farming, ranching, and timbering

Subobjective 1.1.1: Identify areas with prime farmland soil

Subobjective 1.1.2: Identify areas within the REPI/ACUB boundaries

Objective 1.2: Prioritize areas with existing agriculture

Subobjective 1.2.1: Identify areas zoned for agriculture and low density residential

Subobjective 1.2.2: Identify areas with cropland/hay/pasture as the existing land use

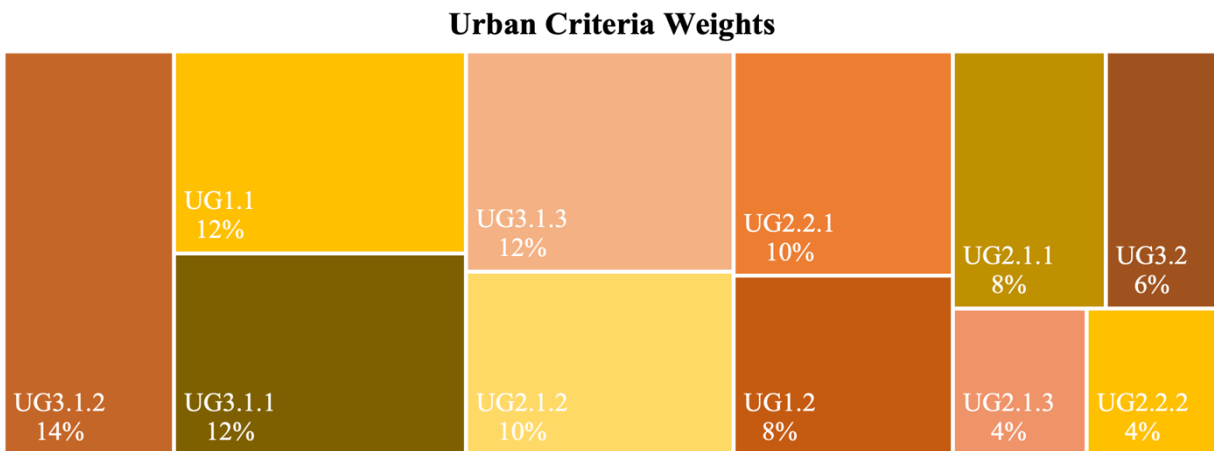
Subobjective 1.2.3: Identify areas predicted to have cropland as the land use in 2050

To determine suitability, spatial data was identified for each sub-objective (Appendix B) and ranked from low priority to high priority on a scale of one to five, where one was the lowest priority and five the highest. Sub-objectives were binary (e.g., present or not), categorical (e.g., land use category), and continuous (e.g., tree canopy). Once spatial data was determined and each sub-objective was ranked,

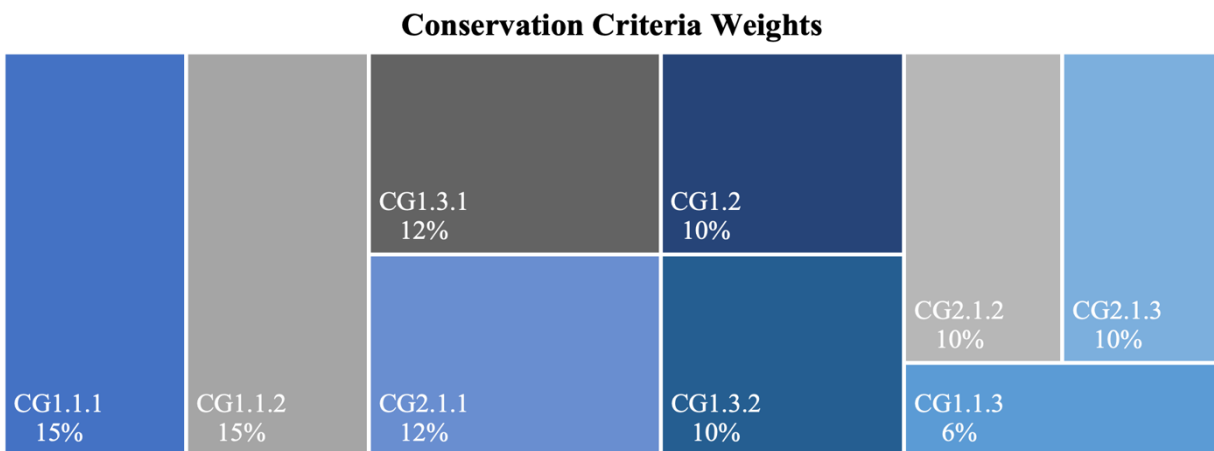
a survey was sent to five stakeholders familiar with the Sentinel Landscape. Survey respondents were asked to identify with a stakeholder group (e.g., urban, conservation, agriculture, military readiness, or other) and rank each sub-objective on a scale of 1-10, where one was least important and ten was most important (Appendix C).

Sixty percent of respondents (three stakeholders) identified most with conservation, 20% (one stakeholder) identified most with military readiness/DOD, and 20% (one stakeholder) as other, installation and defense community partner. Stakeholders were then asked to identify with a second group, and sixty percent of respondents (three stakeholders) identified with military readiness/DOD, 20% (one stakeholder) identified with conservation, and 20% (one stakeholder) as urban. Because the stakeholders primarily identified as conservation and military readiness/DOD, all responses were given equal weight when averaging. These rankings were averaged to create the weighted percent for each sub-objective in the suitability model (Figure 19).

a



b



c

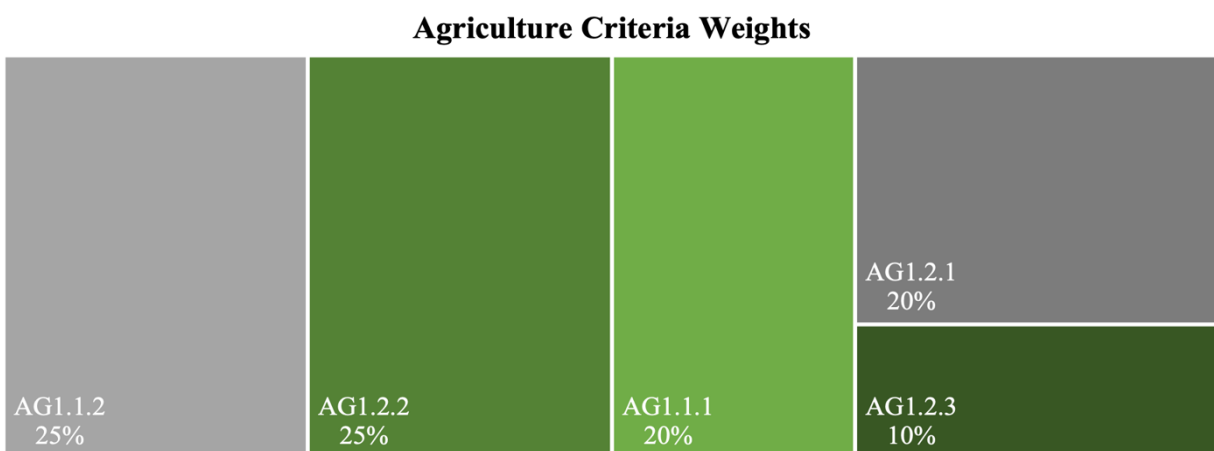


Figure 19. Percent assigned to each land use category goal based on stakeholder survey results (a. urban, b. conservation, and c. agriculture)

The suitability models were created in ArcGIS Pro 3.0 using the Suitability Modeler. The modeler transformed each sub-objective into five classes, where one was the lowest priority and five was the highest. Each sub-objective was weighted based on the stakeholder survey. More important sub-objectives were weighted higher. The Suitability Modeler then overlaid each transformed and weighted sub-objective to create one final suitability model for the three land use categories. The most suitable areas for urban development are in existing urban areas of Savannah/Chatham County, Richmond Hill, Pembroke, and Hinesville, with the least suitable as Fort Stewart and areas covered by wetlands (Figure 20). The most suitable areas for conservation are the inverse of urban (Figure 21), and agriculture is most suitable within the ACUB boundary and North Bryan County (Figure 22).

The final suitability model was reclassified using the geometric interval method. Each suitability model was then normalized using the divide tool, collapsed into three categories using the geometric interval classification, and ranked by low, medium, and high priority (Figure 23). To create the final conflict model, land that was already determined to have a future land use was removed using the development mask (Figure 24). The total study area is 952,961.3 acres, and the development mask consisted of 624,040.9 acres, leaving 328,920.4 acres available for future land use.

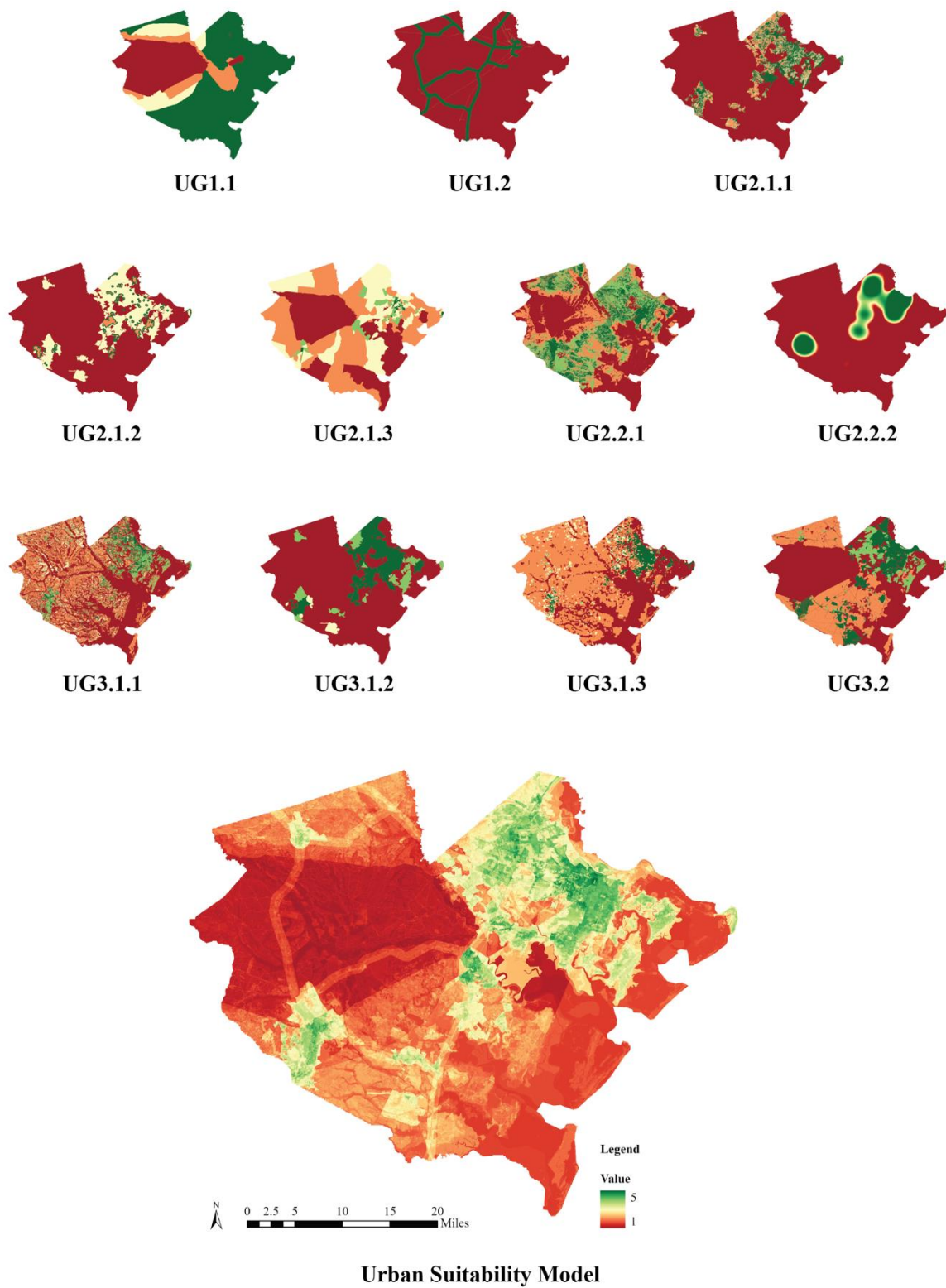


Figure 20. Urban transformed criteria and suitability model

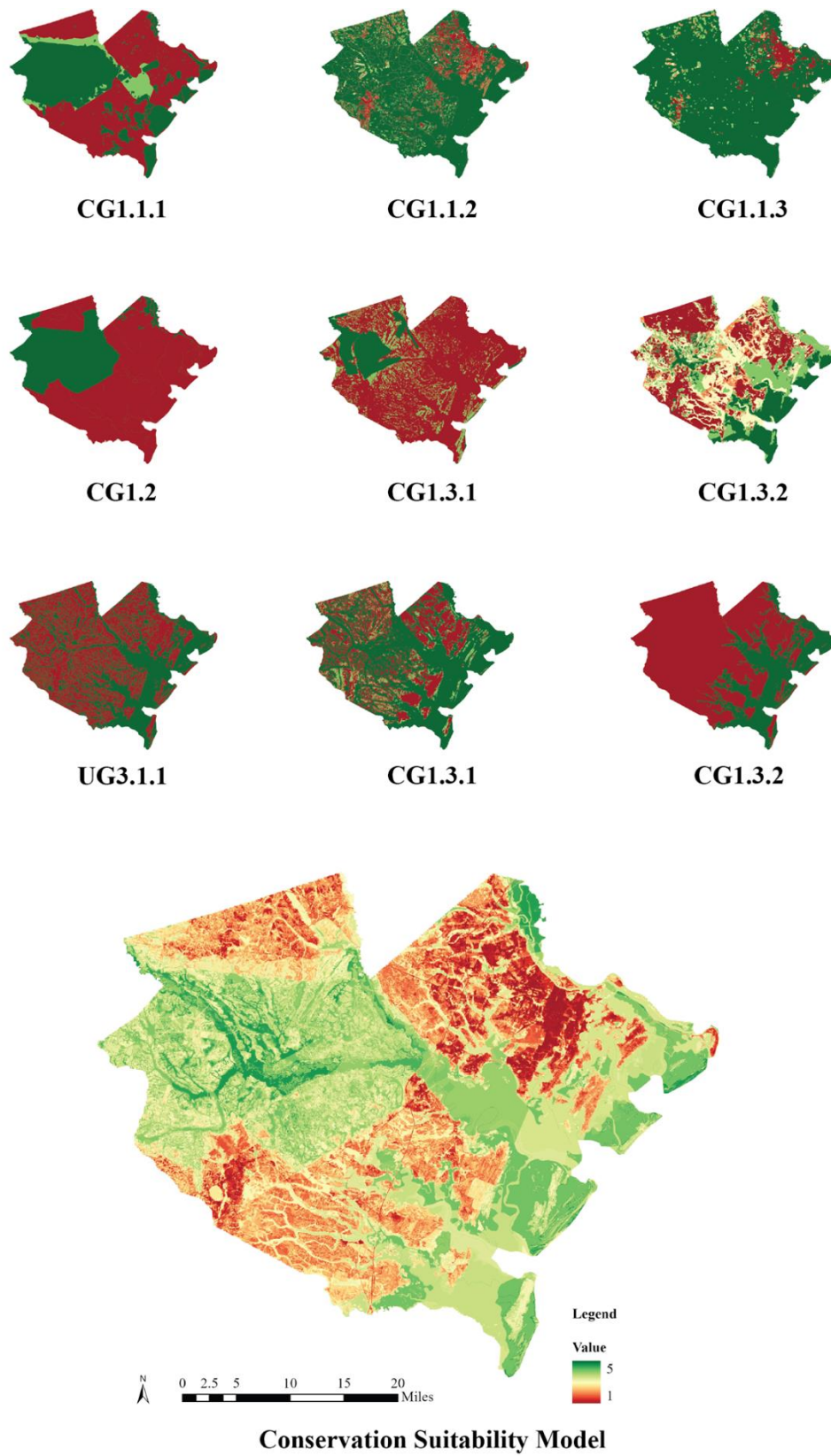
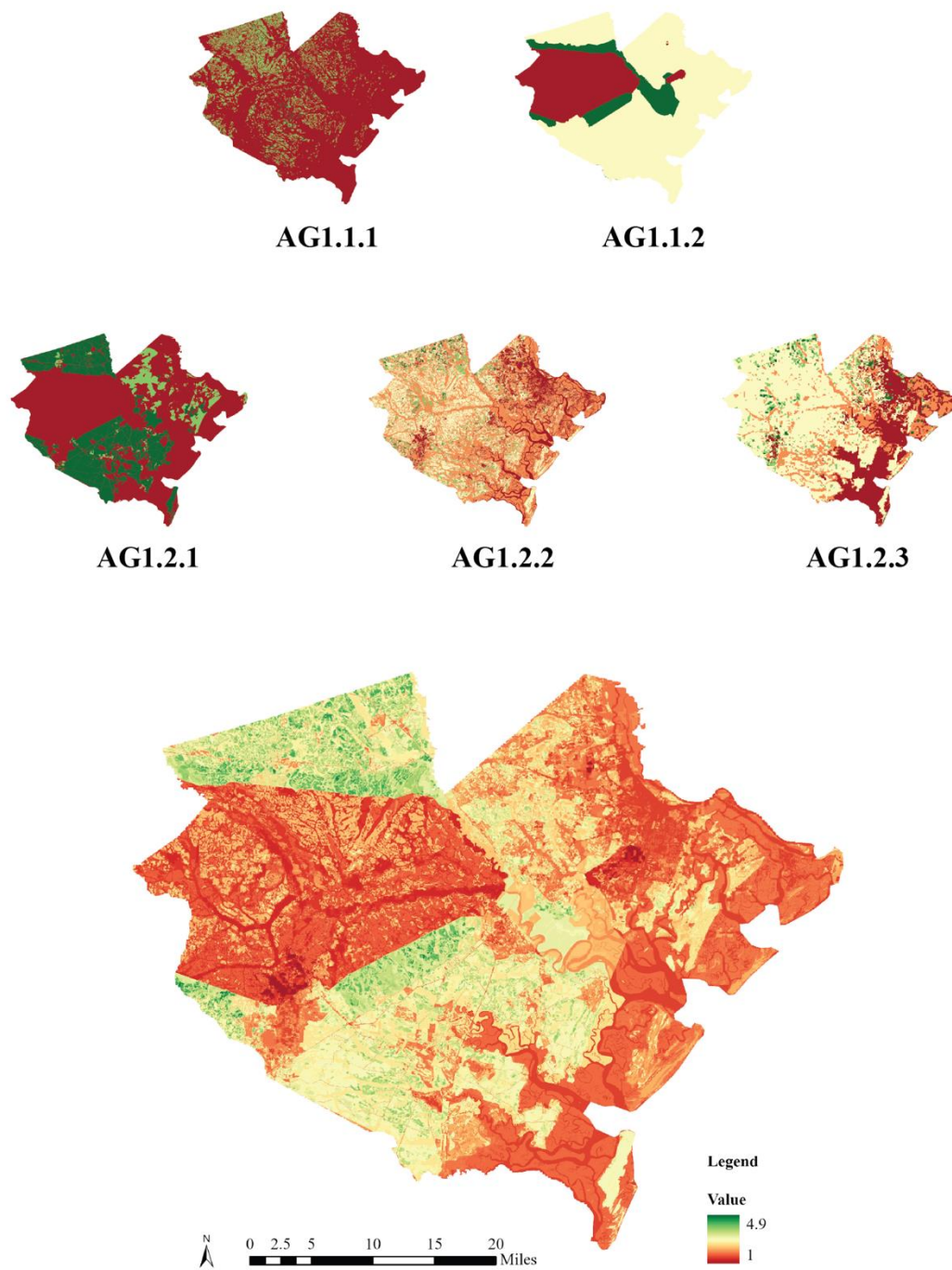
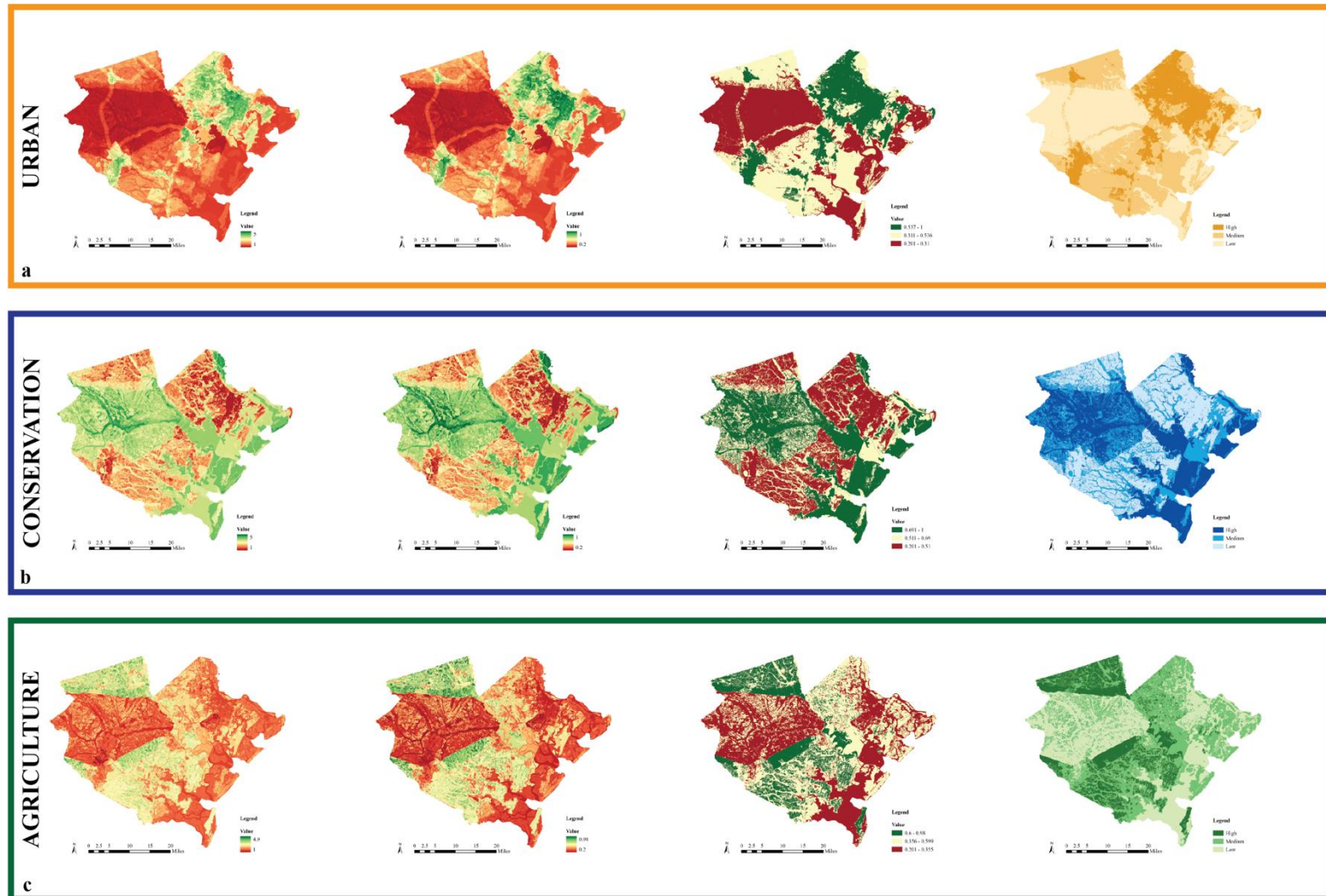


Figure 21. Conservation transformed criteria and suitability model



Agriculture Suitability Model

Figure 22. Agriculture transformed criteria and suitability model



Suitability Model
(Continuous)

Normalize
(Divide Tool)

Collapse
(Geometric Classification)

Rank by Priority
(High, Medium, Low)

Figure 23. Preparing the individual land use suitability models for the conflict model

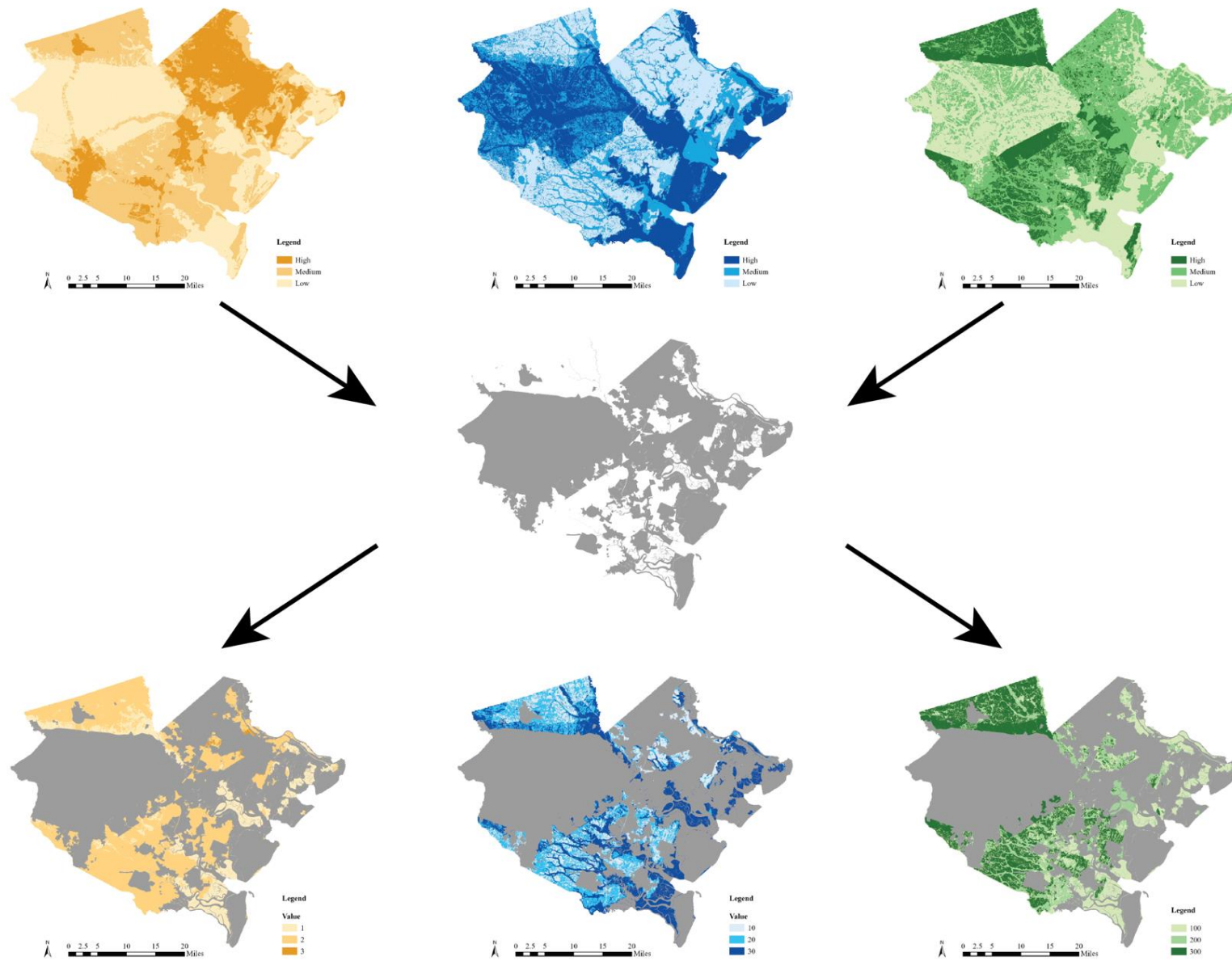


Figure 24. Development mask removed lands unavailable future land use

4.3 Conflict Model

The suitability models were reclassified to new values for the conflict model. Once added together, one raster was produced with values ranging from 111 to 333. There were 101,494.6 acres in conflict (30.9%) and 227,425.8 acres not in conflict (69.1%, Figure 25b). Out of the conflict areas, 56565.7 acres were in moderate conflict (17.2 %, conflict between two land uses) and 44928.9 acres were in major conflict (13.7%, conflict between all three land uses, Figure 25c). Urban preference accounted for 13855.1 acres (4.2%), conservation preference for 109,106.9 acres (33.2%), and agriculture for 104463.7 (31.8%, Table 8, Figure 25a).

Table 8. Description of conflict and preference areas by acres and percent

Description	Acres	Percent
major conflict	44928.9	13.7
urban	13855.1	4.2
conservation	109106.9	33.2
agriculture	104463.8	31.8
Agriculture/Conservation Conflict	26475.8	8.0
Agriculture/Urban Conflict	21334.7	6.5
Conservation/Urban Conflict	8755.2	2.7
Total	328920.4	100.0

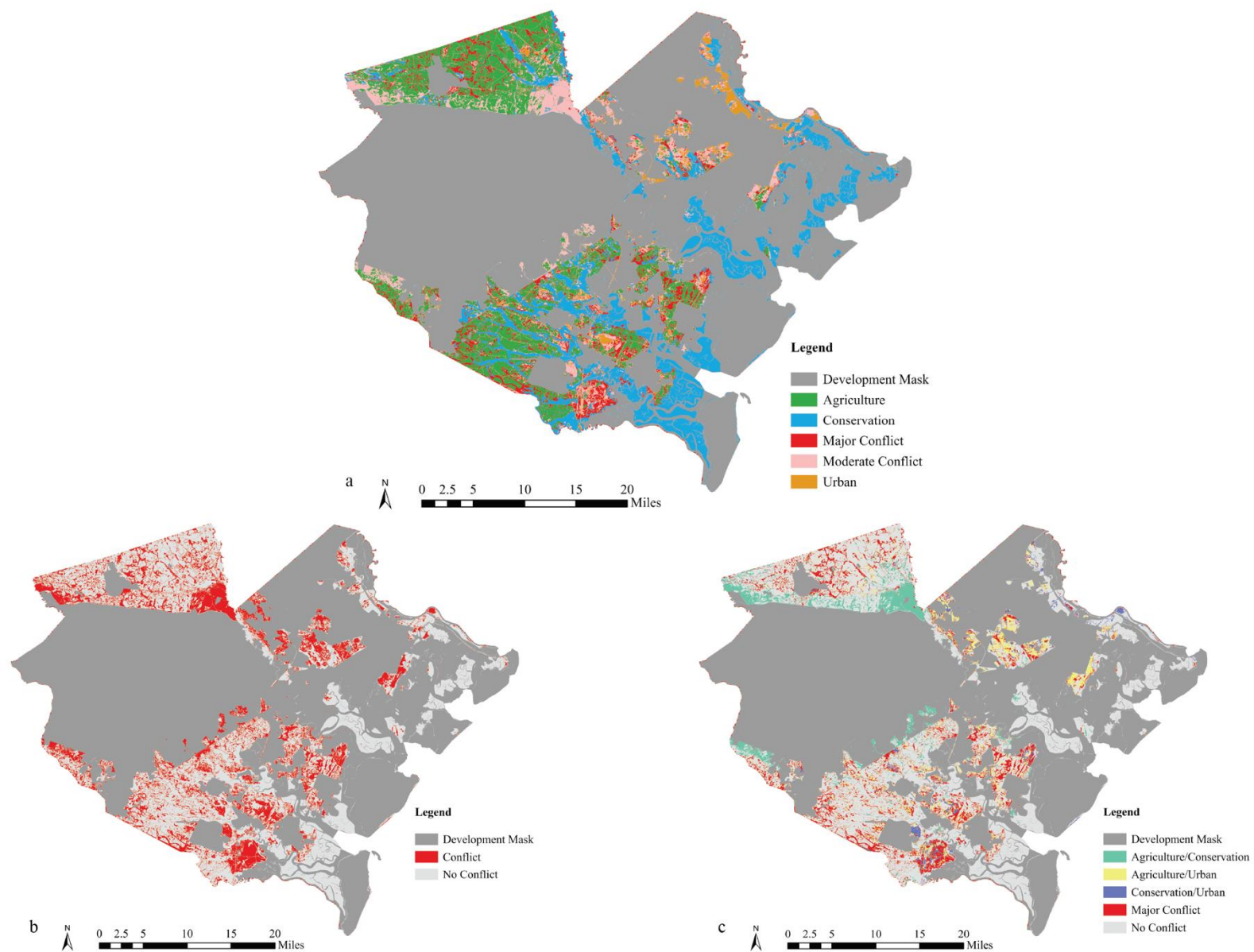


Figure 25. Conflict model with areas of conflict and preference. The top left map a) shows area in conflict or not, the top right map; b) shows the type of conflict between land uses, and the bottom map; and c) shows areas of preference and conflict

4.4 Future Land Use Allocation

The fundamental regional land use equation was used to determine how many acres will be required for human use in the future for 2050. As a baseline, this scenario assumes the same density pattern and other scenarios could be created by changing the density.

$$\text{Population} \div \text{gross urban density} = \text{acres of land needed to support human settlement}$$

The total residential population growth in the three counties was 88,118 people (Table 2). Typically, gross urban density would be calculated using only the residential areas of the urban areas, however, due to the availability of data, the gross density will be calculated using the area of the 2020 Census populated places. The average population density was calculated for each county, with Chatham being the densest and Bryan the least dense. The extra urban area needed for each county was calculated individually and then added together to create a regional estimate. A total of 59,587 acres was needed to accommodate the expected population growth if the population density remains the same in 2050 (Table 9).

Table 9. Variables for the fundamental land use equation by county

Equation Variable	Chatham	Bryan	Liberty
Estimated 2050 Population Growth	63,291	20,633	4,194
Average Population Density (pop/acre)	1.7	1.1	1.4
Extra Urban Area Needed (acres)	37131.8	19471.5	2983.7

To create the baseline future land use scenario, the conflict model was reclassified into future urban (no conflict), future urban (in conflict), future conservation (no conflict), future agriculture (no conflict), future conservation or agriculture (in conflict), and null (Figure 26). The null area consisted of cells along the edge of the study area with a 111 code (major conflict, all low priority). A total of 43,945 acres were available for urban development when future urban areas not in conflict and in conflict were combined

(Table 10). This left 15,642 acres still needed for urban development if the population density remains at 2020 levels. Land will need to be allocated from conservation and agriculture areas in conflict (68,883.6 acres) or current urban areas will need to densify to accommodate expected population growth.

Table 10. Future land use baseline allocation descriptions with acres

Description	Acres	Percent%
Null	2521.1	0.8
Future Urban (no conflict)	13855.1	4.2
Future Urban (in conflict)	30089.9	9.1
Future Conservation (no conflict)	109106.9	33.2
Future Agriculture (no conflict)	104463.8	31.8
Future Conservation or Agriculture (in conflict)	68883.6	20.9
Total	328920.4	100.0

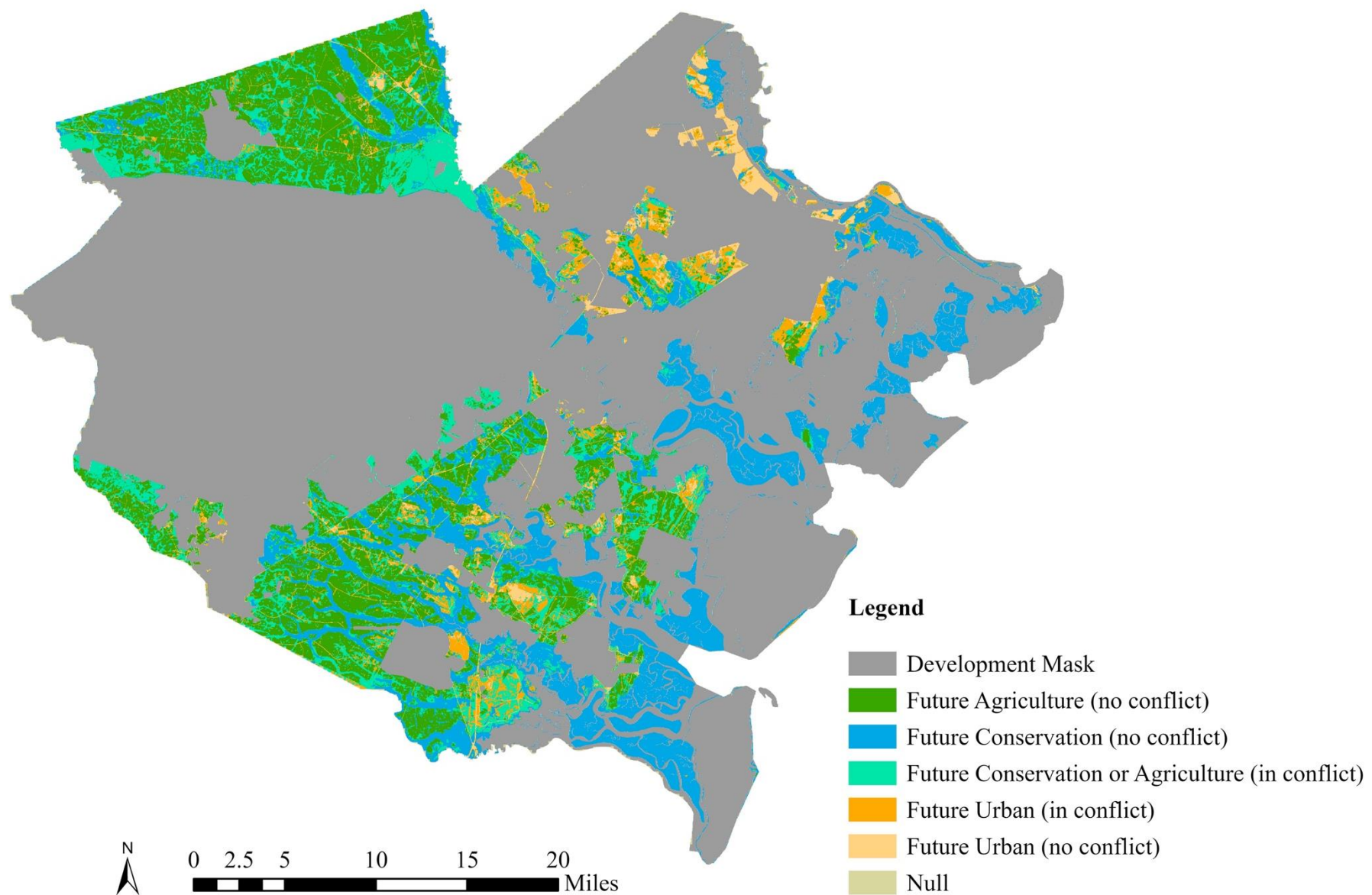


Figure 26. 2050 Future land use allocation baseline scenario

Most of the future urban land was located within Chatham County, along the Savannah River, north of Hunter Army Airfield, and along the edges of Savannah. While these areas may be suitable for urban development, it does not necessarily equate to residential development. The remaining land for future development was most suitable for conservation and agriculture uses (85.9%). Unless population density increases in existing urban areas, urban development will occur in these areas without any protections for agriculture and conservation. Conservation areas were more concentrated closer to the coast, while agriculture was further inland and primarily in North Bryan County. Future conservation and agriculture land in conflict were combined because these are both primary goals of the Sentinel Landscape and concentrated in the REPI/ACUB boundary.

4.5 CEJST Disadvantaged Areas

The study area contained a total of 38 census tracts CEJST identified as disadvantaged. These were concentrated in the downtown core of Savannah, North Bryan County, Hinesville, and almost all of Liberty County (Figure 27). Many census tracts within the study area met the threshold for one of the eight climate or economic burdens of climate change (Figure 28a), energy (Figure 28b), health (Figure 28c), housing (Figure 28d), legacy pollution (Figure 29e), transportation (Figure 29f), water and wastewater (Figure 29g), and workforce development (Figure 29h). However, they must meet the burden threshold and be at or above the 65th percentile for low income or have fewer than 10% of people ages 25 or older have a high school education (Table 5).

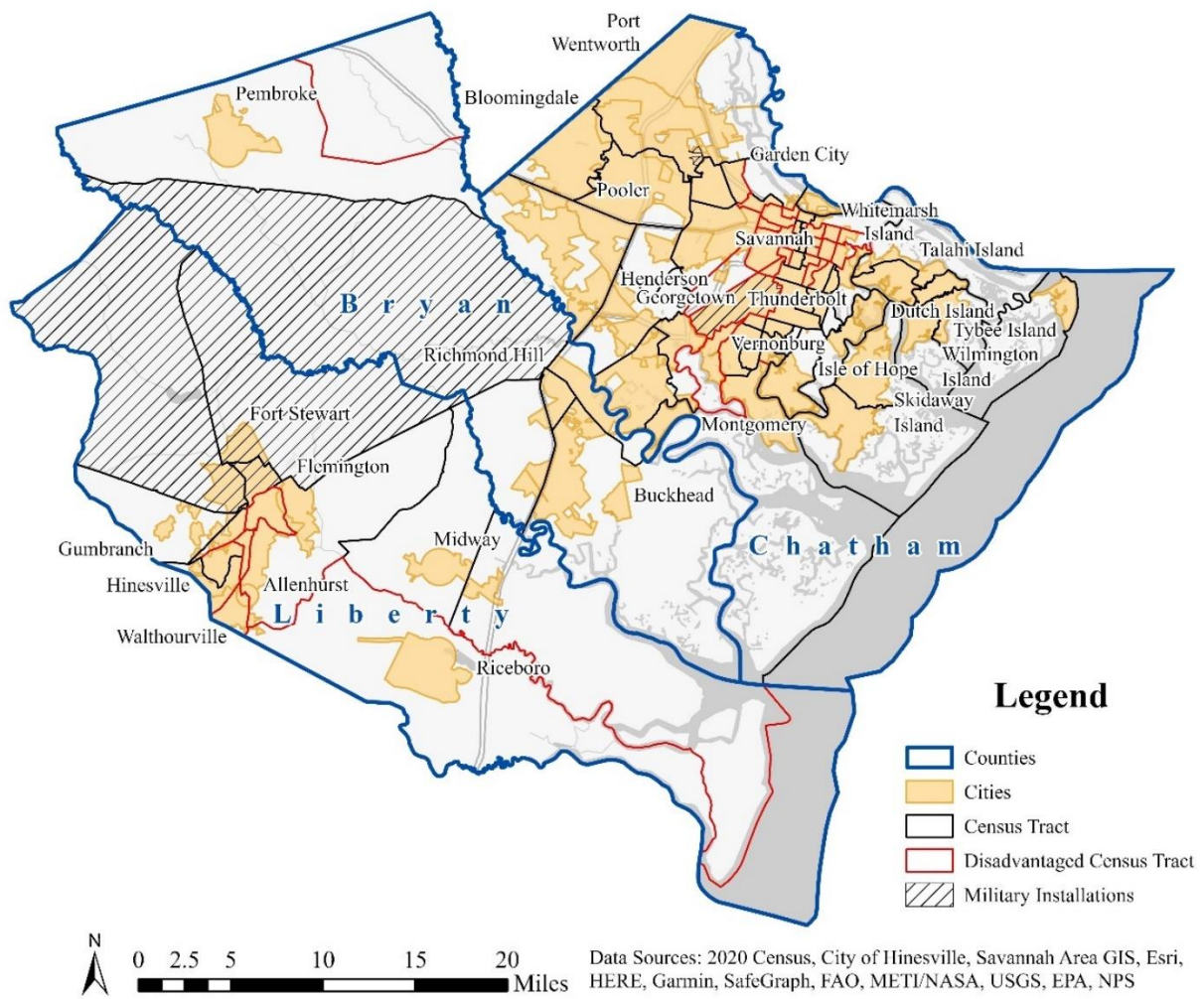


Figure 27. Disadvantaged census tracts in the study area

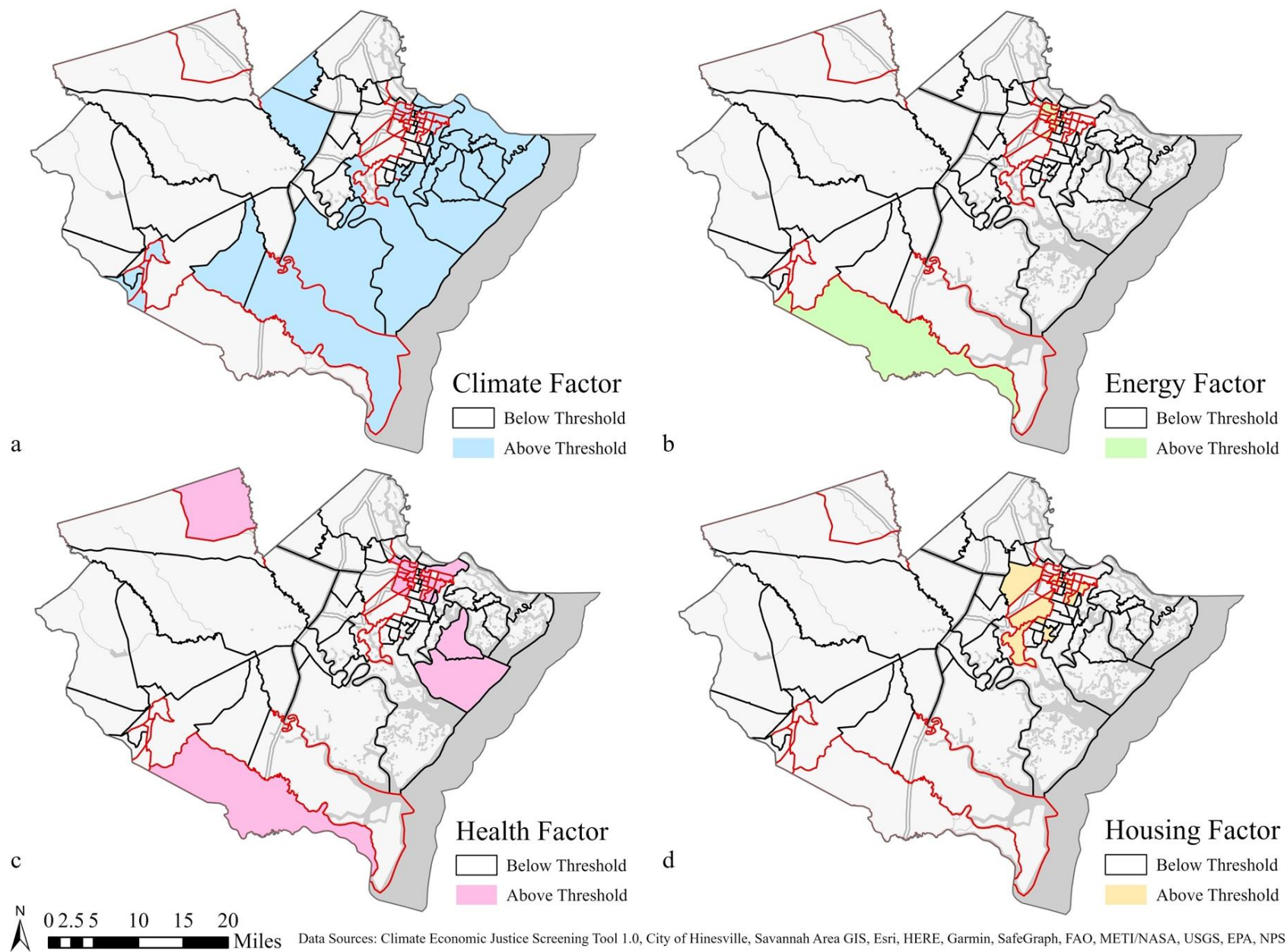


Figure 28. Climate and economic burdens: a) climate, b) energy, c) health, and d) housing

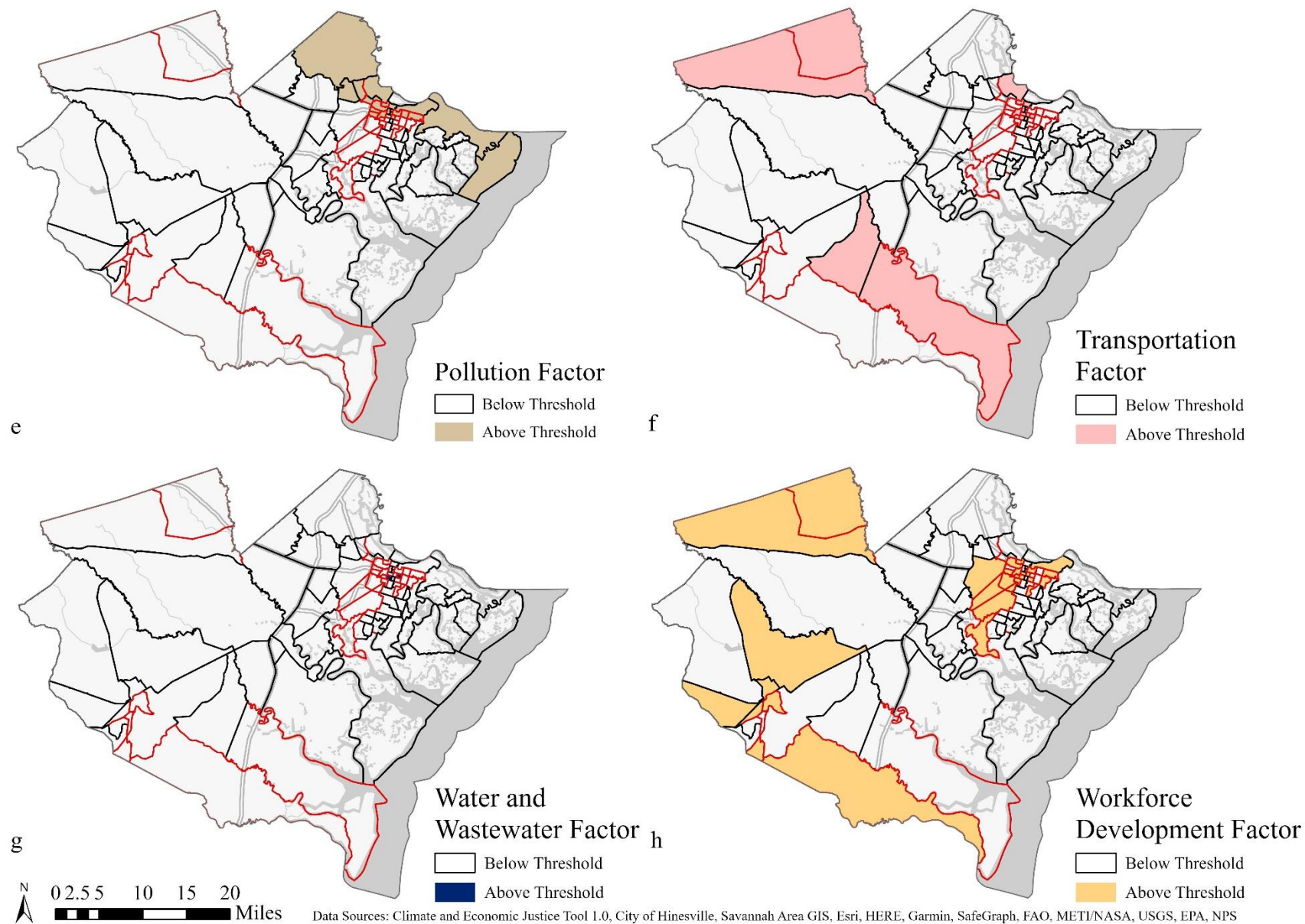


Figure 29. Climate and economic burdens: e) legacy pollution, f) transportation, g) water and wastewater, and h) workforce development

Within the study area, census tracts faced the highest burdens under CEJST categories of workforce development (low median income, poverty, and unemployment), health (asthma, diabetes, heart disease, and low life expectancy), and climate change (projected wildfire and flood risk, Figure 30). A full description of the types of burdens experienced within each census tract can be found in Appendix D.

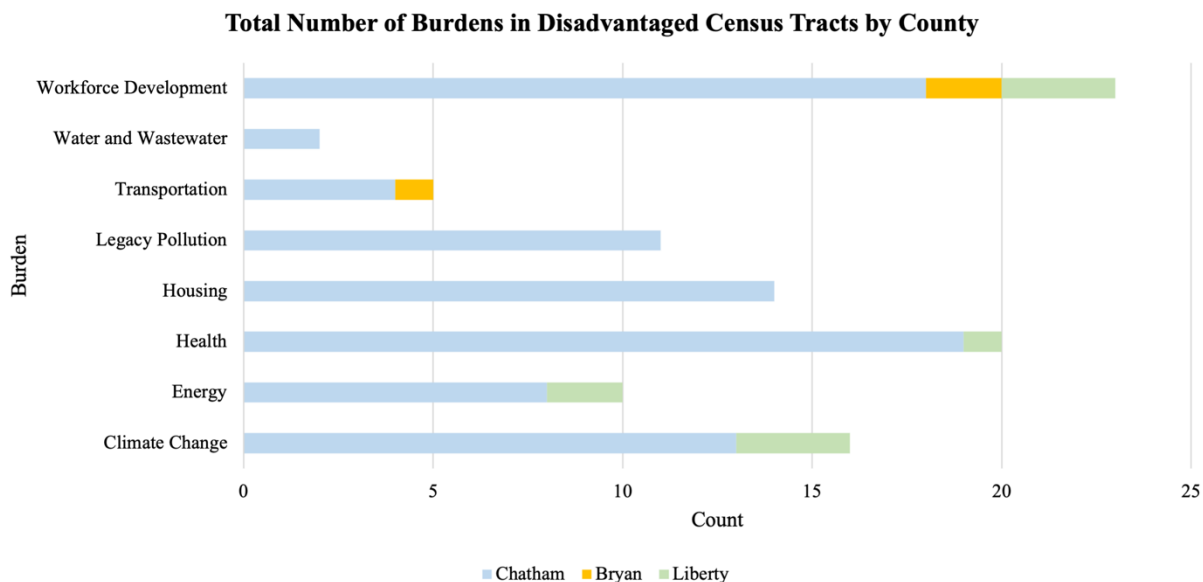


Figure 30. Total number of CEJST burdens within census tracts by county

The CEJST census tracts were overlaid on the future land use allocation map, where disadvantaged tracts are hatched (Figure 31). There was a total of 38 census tracts with a population of 116,803 identified as disadvantaged within the study area and 9 tracts (33,952 people) were outside of the development mask. There were 86,150 people currently classified as disadvantaged in Chatham County, 10,379 in Bryan County, and 20,274 in Liberty County. If the urban areas were to densify and expand, greater care should be taken within these census tracts. The tracts in the downtown core of Savannah are technically not part of the Sentinel Landscape, but still relevant when considering the area due to the proximity of FS/HAA.

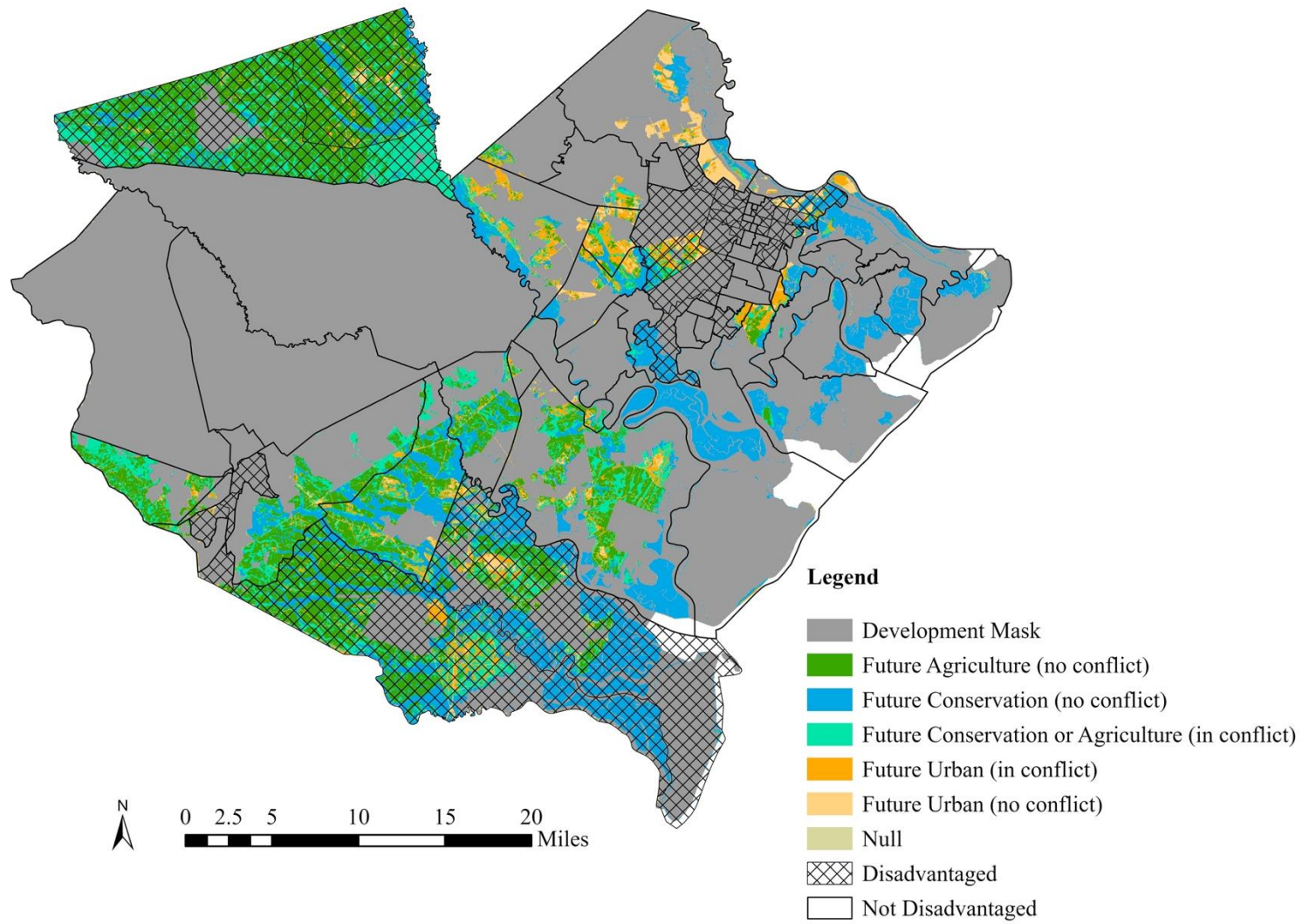


Figure 31. Future land use map with CEJST census tract overlaid, where disadvantaged tracts are hatched

Together, the suitability analyses, conflict maps, future land use allocation, and CEJST census tracts identified where land uses and resources should be targeted based on stakeholder goals. The scenario assumes the population density will remain the same in 2050, and the outcome would be different if the scenario were to be created using different criteria and weighted differently. While imperfect, the maps provide a compelling visual for decision-makers to utilize and produce regional strategies.

CHAPTER 5

DISCUSSION

There were four main takeaways from this research: visualizing a collective future with land use planning can help to achieve stakeholder goals; DOD has policies in place to incorporate equity into climate resiliency projects; CEJST is a tool to help identify agencies DOD can collaborate with and areas where resources should be targeted; equity goes beyond policy and must become part of a larger local engagement strategy to truly build a more climate resilient landscape. The following section describes each takeaway in detail.

5.1 Land Use Planning to Achieve Stakeholder Goals

The 2050 future land use map represented a scenario biased towards the stakeholder goals and an extremely optimistic outcome, where 86% of the land within the study area is used for agriculture or conservation. It is important to note that this scenario assumed the population density will remain the same in 2050, and the outcome would be different if the scenario were to be created using different criteria and weighted differently. This map demonstrated the need for policy intervention to restrict development to future urban areas. After creating the development mask, the available land for future land use allocation was extremely limited in Bryan and Liberty Counties as compared to Chatham County. Therefore, stakeholders should consider increasing population density, the resources needed to do so, and the impacts of these decisions.

For example, in this analysis, Chatham County featured the most future urban land, but Bryan County is expected to have the most population growth through 2050 (Table 2). The most available land for future land use allocation was in North Bryan County, which was highly suitable for agriculture. To retain the agricultural and low-density character of North Bryan, urban development will need to be

considered elsewhere, such as northern Chatham County and potentially Effingham County, which borders Chatham and Bryan. New challenges are emerging for the Sentinel Landscape with the development of the Hyundai Motor Group (HMG) Megaplant.

HMG broke ground in October 2022 on the new Megaplant America, its first electric vehicle and battery plant in the US. The site is approximately 3,000 acres and is located near Ellabell off Interstate-16, in the northern corner of Bryan County. It is expected to open in 2025 and employ 8,100 people, not including indirect jobs.²¹⁰ The Megaplant site is just outside of the ACUB boundary, where the Georgia-Alabama Land Trust is racing to ensure parcels are protected from development by easement. The two North Bryan County census tracts are both listed as disadvantaged in the workforce development burden category for high levels of unemployment and low income. The state and development authorities are welcoming this new plant with open arms, which will help provide jobs. However, this may interfere with Sentinel Landscape goals for less development near installations. This is a good example of why DOD should work to engage with local communities to balance conservation goals and needed development in disadvantaged areas (Figure 32).

²¹⁰ Latrice Williams, “‘This project is monumental’: Hyundai breaks ground on EV battery plant in Bryan County.” Savannah Now. October 25, 2022. Accessed from <https://www.savannahnow.com/story/news/local/2022/10/25/hyundai-motor-breaks-ground-ev-plant-bryan-county-georgia/10595069002/>

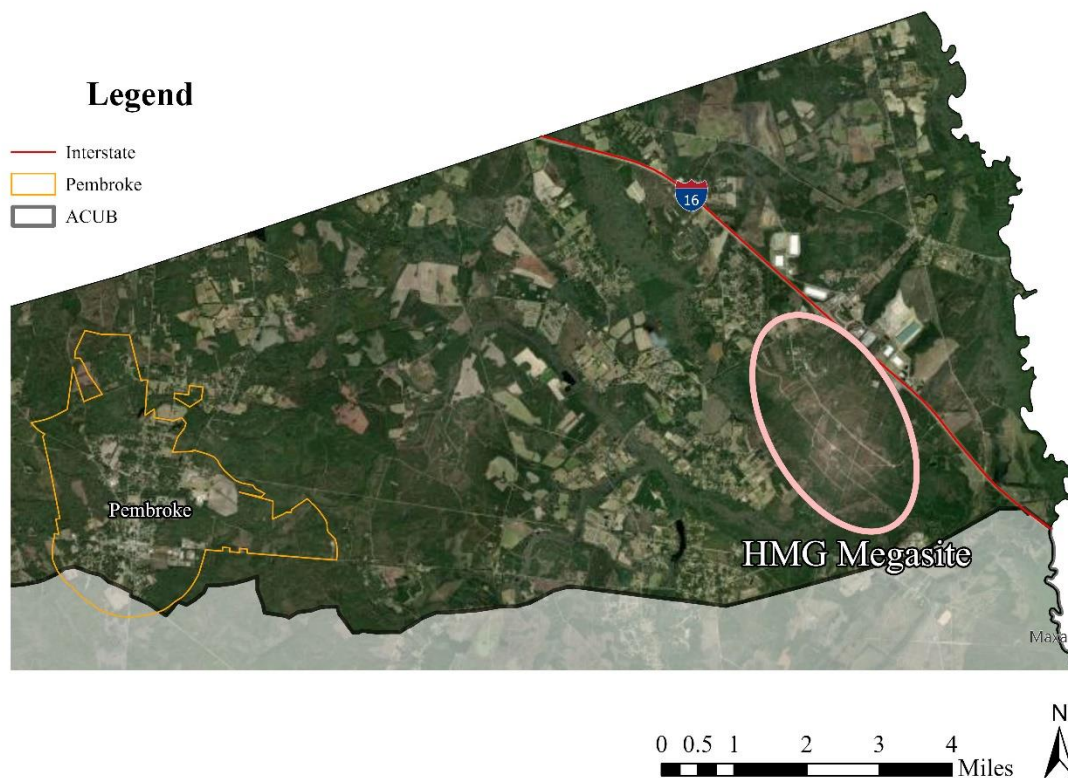
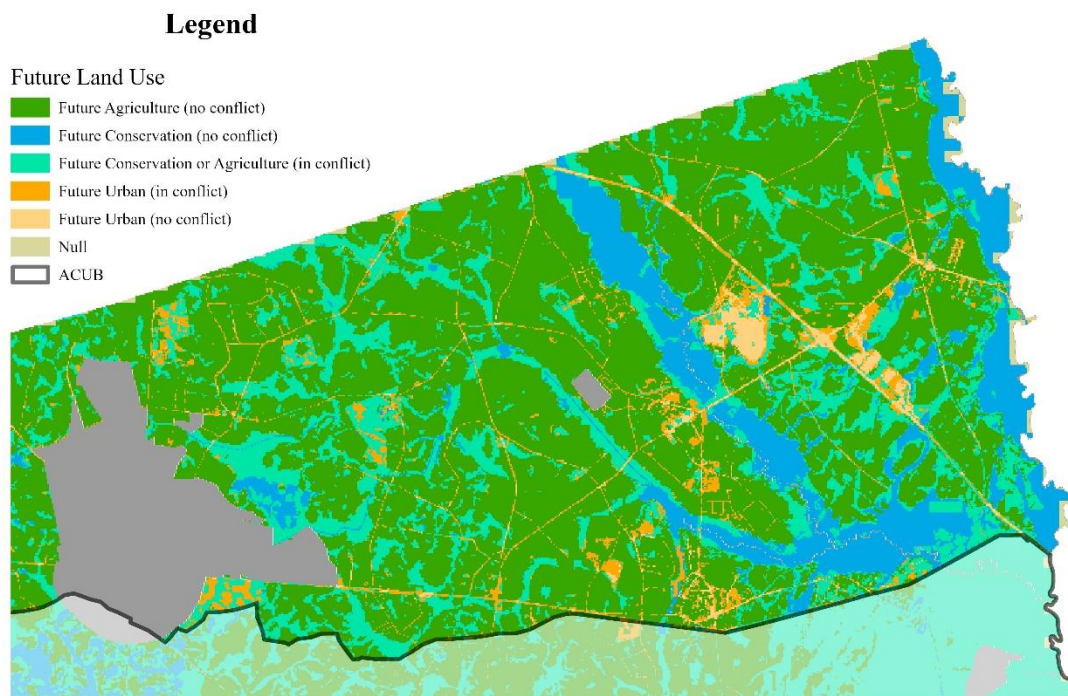


Figure 32. Location of the HMG Megaplant site in comparison to the 2050 Future Land Use Map

While the focus of this study is to implement equity within the Sentinel Landscape, it is important to state who was not included due to a lack of time, resources, and ability to follow up. Most obvious, are the residents, especially those who live within disadvantaged communities. Although flawed, this scenario illustrated desired outcomes that can help inform future decision-making and help prioritize resources to specific areas within the Coastal Georgia Sentinel Landscape. Future studies, or an expansion of this one, could include more stakeholder experiences, which will be discussed in detail later in the section. Ultimately, the goal of this research was to encourage DOD to have greater engagement with the surrounding communities within the Sentinel Landscape. The Sentinel Landscape includes many census tracts identified as disadvantaged, and program managers should leverage existing policies and Justice40 resources to help achieve goals.

5.2 Investment in Climate Resilience and Equity

Within the last four years, DOD gained the ability to appropriate funds for climate change and wrote plans to incorporate environmental justice and equity into the larger DOD strategy. These policies allow for climate change to be used as a reason for military installation resiliency (e.g., 10 USC §2684a) and equity initiatives to be incorporated into climate resiliency projects (e.g., Executive Order 14008). The challenge of implementing stated principles of environmental justice and equity as part of climate resilience planning is not unique to DOD, as plans to implement and evaluate equitable strategies are often unclear.²¹¹ Conservation and restoration are part of climate solutions but cannot be the only solutions employed to address environmental injustices and inequities.

Currently, DOD seeks out individual landowners within the REPI/ACUB area to preserve land through a conservation or agriculture easement through their partner organization, the Georgia-Alabama Land Trust. Landowners are paid through DOD for the easement, as opposed to the usual process where land is donated. This is a collaborative process but on a parcel-by-parcel basis. Conservation easements in

²¹¹ Greg Schrock et al., "Pursuing equity and justice in a changing climate: Assessing equity in local climate and sustainability plans in US cities." *Journal of Planning Education and Research* 35, no. 3 (2015): 282-295.

Georgia may be modified or terminated in “accordance with the principles of law and equity” under GA Code §44-10-4 but are essentially permanent under the Georgia Land Conservation Act (GLCA).²¹² The GLCA is intended “to promote partnerships for the conservation of land resources that are identified by cities or counties as locally valuable or identified by the department as having state-wide significance” and requires a project to “promote the permanent protection of conservation land” as part of the criteria for approval.”²¹³ There are many benefits to a permanent conservation easement, but also unintended consequences.

In the face of climate change, Georgia’s landscape could change, along with the critical habitat designations of ESA threatened or endangered species. Additionally, the climate could affect land use typically protected by conservation easements such as agriculture, timber, and open space. In this case, other tools can be considered that provide greater flexibility in time and space, such as fee ownership, option agreements, contractual payments, term conservation easements, moving conservation easements, tradable conservation easements, and flexible reserves.²¹⁴ Further, payments for ecosystem services by using legal contracts could increase compensation for landowners and create an incentive to continue to properly manage the natural resources.²¹⁵ Although conservation easements are one of REPI’s primary tools to protect land, there are other options the Sentinel Landscape program managers can advocate for in addition to the easements. When considering the area on a regional scale, greater engagement with the county and city governments will be required for more equitable climate resiliency initiatives.

5.3 Applications of CEJST in the Sentinel Landscape

The REPI program uses IGSA as the legal authority to fund public services for resilience (e.g., conservation easements), but IGSA could be an option to help address climate and economic burdens

²¹² Meghan Ryan and Michelle Godfrey, "The Durability of Conservation Easements in Georgia." (2008), 2

²¹³ GA Code §12-6a-1 & 5(f)

²¹⁴ Jessica Owley et al., "Climate change challenges for land conservation: Rethinking conservation easements, strategies, and tools." *Denv. L. Rev.* 95 (2017): 733

²¹⁵ Kelly Kay, "Breaking the bundle of rights: Conservation easements and the legal geographies of individuating nature." *Environment and Planning A: Economy and Space* 48, no. 3 (2016), 516

identified by Justice40. DOD is not listed as an agency with any covered programs that fit the description to make investments in climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure.²¹⁶ However, DOI and USDA are both listed as agencies with covered programs and are partners in the Sentinel Landscape. Initially, the Natural Resources Conservation Service (NRCS) or National Park Service (NPS) will need to be the primary agency to utilize Justice40 resources because it is the only federal agency that is listed as a Justice40 covered program and a partner in the landscape. (Table 11).

DOD could pursue IGSA to address burdens with agencies who currently have covered programs: US Army Corps of Engineers (USACE), AmeriCorps, Department of Energy (DOE), Department of Health and Human Services (HHS), Department of Homeland Security (DHS), Department of Housing and Urban Development (HUD), Department of Labor (DOL), Department of State (State), Department of Transportation (DOT), Department of Veterans Affairs (VA), and Environmental Protection Agency (EPA).

²¹⁶ The White House. “Justice40 Initiative Covered Programs List Version 1.3.” August 18, 2022. Accessed from https://www.whitehouse.gov/wp-content/uploads/2022/07/Justice40-Covered-Programs-List_v1.1_07-15-2022.pdf

Table 11. Justice40 Covered Programs within the Georgia Sentinel Landscape

Department	Agency	Sentinel Landscape Program	Covered (Y/N)	GA SL Federal Partner (Y/N)
DOD	Office of Local Defense Community Cooperation	Compatible Use Plans	N	N
DOD	Office of Local Defense Community Cooperation	Military Installation Resilience Reviews	N	N
DOD	Natural Resources Program	Legacy Program	N	N
DOD	DOD	Readiness and Environmental Protection Program (REPI)	N	Y
DOI	US Fish and Wildlife Service (USFWS)	North American Wetlands	N	Y
DOI	US Fish and Wildlife Service (USFWS)	Conservation Act Grants	N	Y
DOI	US Fish and Wildlife Service (USFWS)	Migratory Bird Conservation Fund	N	Y
DOI	National Park Service (NPS)	Land and Water Conservation Fund	Y	Y
DOI	Bureau of Land Management (BLM)	National Conservation Areas	N	N
DOI	National Atmospheric and Oceanic Administration (NOAA)	Coastal Estuarine Land Conservation Program	N	N
USDA	Natural Resources Conservation Service (NRCS)	Agricultural Conservation Easement Program	Y	Y
USDA	Natural Resources Conservation Service (NRCS)	Conservation Stewardship Program	Y	Y
USDA	Natural Resources Conservation Service (NRCS)	Environmental Quality Incentives Program	Y	Y
USDA	Natural Resources Conservation Service (NRCS)	Regional Conservation Partnership Program	Y	Y
USDA	Farm Service Agency (FSA)	Conservation Reserve Program	Y	N
USDA	US Forestry Service (USFS) State and Private Forestry	Forest Legacy Program	N	N
USDA	US Forestry Service (USFS) State and Private Forestry	Forest Stewardship Program	N	N
USDA	US Forestry Service (USFS) State and Private Forestry	Land and Water Conservation Fund	Y	N
USDA	US Forestry Service (USFS) State and Private Forestry	Community Forest Program	N	N

5.4 Equitable Engagement Framework

Implementing policies and IGSAAs will promote equity, but day-to-day engagement is equally important. The equity framework developed in chapter two was applied to the future land use and CEJST results.

5.4.1 Recognitional Equity

In order to have a holistic, equitable resiliency strategy, decision-makers should approach land use in the Georgia Sentinel Landscape by recognizing past and present inequities perpetuated by social, political, and environmental laws and policies. There are many facets to recognitional equity, ranging from recognizing whom a project or environmental threat will harm to laws and policies that intentionally and unintentionally discriminate against a group of people.²¹⁷

Recognitional equity begins by identifying disadvantaged areas, as indicated by CEJST, that are more vulnerable to the impacts of climate change. Fort Stewart personnel were found to mostly live in Liberty and Chatham County, which include Hinesville, the main entrance to Fort Stewart, and Hunter Army Airfield, located in Savannah. Most census tracts in the core of Savannah and Hinesville are all identified as disadvantaged. Therefore, DOD has an imperative to contribute resources to these disadvantaged areas where their soldiers primarily reside.

Sentinel Landscape program managers should consider how vulnerability to shocks and stressors, access to resources, and capacity to participate in decision-making processes will be impacted by those identities. Certain groups are typically excluded from participating in the decision-making process due to the influence of social and cultural values.²¹⁸ By recognizing marginalized groups may have a different set of preferences and values, the process for assessing environmental services can expand to become more inclusive. Lastly, program managers should recognize the importance of fostering respect for those

²¹⁷ Swanson, "Equity in urban climate change adaptation planning: A review of research."

²¹⁸ Langemeyer and Connolly, "Weaving notions of justice into urban ecosystem services research and practice."

Recognition equity requires an acknowledgment of intersecting identities, valuing perspectives of groups historically disadvantaged and silenced, and redirecting resources to achieve a more just outcome. It is a recognition that the environment is inhabited by humans with complex histories, and the two cannot be separated. Those who will feel the most impacts of climate change are least likely to receive the benefits of resilience work or be involved in the process of creating solutions. Decision-makers and program managers need to go out of their way to listen, serve, and uplift these groups.

It is important to recognize DOD's past, current, and future role in land use planning. People were forced to leave the land where Fort Stewart was established through government purchasing or condemning of land,²²³ and Black soldiers were notoriously mistreated. Command Major Sergeant James Clifford wrote:

*"One unfortunate product of the times was the treatment of black soldiers. The Army struggled with the dilemma of stationing them in the South. Locals, while not exactly accepting, generally tolerated black enlisted soldiers, but their feelings towards black officers were often entirely different. The idea of black leaders, with the authority to give orders to white troops, was beyond the pale. To avoid serious problems, the Georgia Congressional delegation petitioned the War Department to refrain from assigning African American officers to Camp Stewart. Toleration did not equate to hospitality at Savannah establishments. Black soldiers found that in black churches, homes, and on-post facilities."*²²⁴

Engagement work is not a clean slate, and there may be mistrust within disadvantaged communities due to past mistreatment. However, commitment to finding better solutions can help to create the foundation of trust and build partnerships in surrounding areas. The University of California Luskin Center for Innovation advocated for the implementation of Justice40 to be justice-driven, community-powered, and accountable to change.²²⁵ Regarding a justice-driven approach, "Justice40 should help correct a long history of uneven resources and benefits of federal funding in communities of

²²³ Fort Stewart-Hunter Army Airfield, "History and Museum." About. from <https://home.army.mil/stewart/index.php/about/history#qt0:1>

²²⁴ Clifford, "Fort Stewart, Georgia," 46

²²⁵ UCLA Luskin Center for Innovation, "Making Justice40 a Reality for Frontline Communities," 7

color and low-income areas. Rooting out inequality will require eliminating racial biases and disparities in funding so that race no longer predicts the distribution of resources.”²²⁶ Justice40 may be an opportunity to begin a discussion of reparations to those harmed by the federal government, as the racial wealth disparity “is the single best indicator of the cumulative impact of white racism overtime.”²²⁷ Reparation scholars Darity and Mullen asserted the federal government is responsible for paying reparations based on culpability and financial ability.²²⁸ While compensation may be unlikely, descendants of Black soldiers can attest to the harms their families have faced from the racism of the US government.²²⁹ Taking responsibility for these actions may be a first step forward to building trust with communities.

5.4.2 Procedural Equity

There are many engagement strategies Sentinel Landscape program managers can employ for procedural equity. Sentinel Landscape partners will hold the power to decide who, how, and why certain groups are included and valued in resilience projects. Citizen participation is not a new concept, but decision-makers must go beyond the status quo to establish procedures that seek to empower marginalized groups and redistribute power in the decision-making processes. Program managers can seek to collaborate with existing environmental justice groups, such as the Harambee House/Citizens for Environmental Justice (HH/CFEJ). HH/CFEJ is a local environmental justice group and, “was born out of a tremendous need for African Americans to develop collective strategies for the effective engagement of citizens in local decision-making.”²³⁰ Outreach efforts may differ for each county and city within the Sentinel Landscape, or some may overlap.

²²⁶ UCLA, “Making Justice40 a Reality for Frontline Communities,” 7

²²⁷ William A. Darity Jr. and A. Kirsten Mullen, *From here to equality: Reparations for Black Americans in the twenty-first century*. UNC Press Books, 2022, xi

²²⁸ Darity and Mullen, *From here to equality*, xiii

²²⁹ Katherine Tate, “Will America Ever Pay? Racial Justice and Reparations.” In *The Forum*, vol. 2, no. 3. De Gruyter, 2004.

²³⁰ Harambee House/Citizens for Environmental Justice, “About.” Accessed from <https://www.theharambeehouse.net/about/>

One way to engage the public in land use planning is geodesign. Geodesign is contributed to Carl Steinitz and the latest development in GIS.²³¹ Geodesign is considered a framework that emphasizes systems thinking and utilizes negotiation as a tool with metrics, as opposed to traditional planning and design techniques. The systems approach allows planners to place systems into categories of vulnerable to change and attractive to change.²³² Including more stakeholders through participatory approaches, as opposed to simply technical ones, is a fundamental component of modern land use planning. This approach can lead to an increase in conflict as more stakeholders are involved, however, that may contribute to the goals of equity. Therefore, planners need to account for competing interests when performing spatial analysis.²³³

This approach allows planners to place systems into categories of vulnerable and attractive to change and have participants engage with the systems to create land use plans. Once all participants understand the process, singular concepts can be combined into comprehensive designs that encompass the complexity of the problem.²³⁴ Steinitz suggested regional and landscape planning concentrate on allocation decisions due to the larger size of the design study, in contrast to organization and expression decisions more common in smaller designs.²³⁵ Geodesign has challenges; the process relies on real-time changes to scenarios to allow participants to consider variations on pre-developed criteria.

There is no established framework or precedent to evaluate the impact of geodesign practices on resilience. Gu et al. evaluated 35 geodesign projects to determine connections between and claims made about geodesign processes and resilience due to the failure of most projects to address process relationships, which result in the loss of diversity and dynamics of design outcomes.²³⁶ Gu et al. found projects with more robust and comprehensive designs were overall more resilient in author criteria of

²³¹ William R. Miller, "Introducing Geodesign: The Concept." Accessed from <https://www.esri.com/library/whitepapers/pdfs/introducing-geodesign.pdf>

²³² Carl Steinitz, *A Framework for Geodesign: Changing Geography by Design*. First edition. Esri, 2012.

²³³ Emad Dawwas, "The evolution of GIS as a land use planning conflict resolution tool: A chronological approach." *American Journal of Geographic Information System* 3, no. 1 (2014): 38-44.

²³⁴ Steinitz, *A Framework for Geodesign: Changing Geography by Design*.

²³⁵ Carl Steinitz, "On change and geodesign." *Landscape and Urban Planning* 100, no. 156 (2016): 23-25.

²³⁶ Gu Yexuan et al., "Evaluating practical implementation of geodesign and its impacts on resilience." *Journal of Digital Landscape Architecture* 5 (2020): 467-475.

diversity, dynamics, connectivity, uncertainty, redundancy, and multi-functionality. All principles of geodesign were found to have statistically significant positive effects on some attributes of resilience, although they may not be predictive, and geodesign improved resilience in landscape design.

Rivero et al. utilized geodesign for a planning workshop in Chatham County, Georgia to “evaluate its capacity to promote a unified, collaborative, and mutually agreed design, as a result of a multidisciplinary environment, with a two-scale study area.”²³⁷ The study concluded the process was able to increase participation in the planning process and more collaboration is needed as the county considers options to densify and protect environmental resources in response to the impacts of climate change, population growth, and expansion of city boundaries.²³⁸

Geodesign was also used in Community-Based Tribal Planning and evaluated on the ability to improve the quality of local plans and be inclusionary for citizen participation.¹⁸ Citizen participation was evaluated through Arnstein’s ladder of citizen participation. Davis et al. found that geodesign empowered Indigenous communities to create community-based land use plans that incorporated local knowledge and values.²³⁹ Geodesign was justified as a tool for community-based planning because it engaged local knowledge, and the community could take ownership of the process and resulting plan. Including citizen participation incorporates public opinion on proposed policies that may not typically be available to planners. Additionally, the community may propose solutions planners would not think about due to local expertise. Geodesign offered a bridge to build trust between planners and the Navajo Nation communities for land use decision-making.

²³⁷ Rosanna Rivero, Alison Smith, Hrishikesh Ballal, and Carl Steinitz, "Promoting collaborative Geodesign in a multidisciplinary and multiscale environment: Coastal Georgia 2050, USA." *Proceedings of Digital Landscape Architecture*(2015): 1-20, 44

²³⁸ Rivero et al., "Promoting collaborative Geodesign in a multidisciplinary and multiscale environment"

²³⁹ Jonathan Davis et al., "Evaluating geodesign for community-based tribal planning: the role of planners in marginalized communities." *Journal of the American Planning Association* 87, no. 4 (2021): 527-541.

5.4.3 Distributional Equity

Distributive equity is typically outcomes-oriented and measured in terms of the location and amount of investment. Every project and plan should be designed to include some analysis of distributional metrics before and after implementation. The range of metrics used will vary depending on the project, and applying a wide scope can help to capture elements not traditionally used to measure equitable outcomes.²⁴⁰ A project should consider the long-term impacts and who is able to benefit from them, and if those benefits could be extended to a greater number of people through design from the start. Metrics typically include the distribution of costs and benefits and comparison of alternatives based on monetary value, but this ignores that there may be inequalities in a project area due to demographic and socioeconomic status.²⁴¹

Work within the Sentinel Landscape will likely focus on green infrastructure (GI) to become more climate resilient. Infrastructure and planning efforts can be skewed toward more urban elite groups due to availability of time, access to transportation, and childcare options. White or affluent people also have more access to urban green space, parks, or recreational programs than racial/ethnic minorities and low-income people.²⁴² Even urban park and recreation programs that are public and nonprofit funded follow this pattern, where low-income communities of color have less funding and resources. Urban areas call for more intensive engagement with the public for equitable outcomes. Metrics of equity can become more complex in these social, ecological, and infrastructural systems.²⁴³

The siting component of green infrastructure is an issue of distributional environmental justice as impacts are often localized. And yet, when environmental projects are targeted towards low-income

²⁴⁰ Noelia Zafra-Calvo, et al., "Towards an indicator system to assess equitable management in protected areas." *Biological Conservation* 211 (2017): 134-141.

²⁴¹ Seigerman, "Operationalizing equity for integrated water resources management."

²⁴² Isabelle Anguelovski et al., "Equity impacts of urban land use planning for climate adaptation: Critical perspectives from the global north and south." *Journal of Planning Education and Research* 36, no. 3 (2016): 333-348.

²⁴³ Clark et al., "A data framework for assessing social inequality and equity in multi-sector social, ecological, infrastructural urban systems: Focus on fine-spatial scales." *Journal of Industrial Ecology* 26, no. 1 (2022): 145-163.

communities, the influx of new amenities can lead to displacement due to rising property values.

Greening interventions such as parks and urban gardens can lead to the gentrification process and shifting of boundaries of rural agricultural areas and urban cities.²⁴⁴ Hoover et al. recommended cities prioritize green infrastructure in communities that either want, need or support GI; have stated justice goals and the methods and criteria to match; and implement GI alongside policies or regulations that address systemic racism in planning.²⁴⁵

Rigolon and Christensen recommend the following “Parks-Related Anti-Displacement Strategies” for developers, non-profits, and public agencies:

- Single-room occupancy preservation
- Condominium conversion ordinance
- Inclusionary zoning
- Production incentives (e.g. density bonus ordinance)
- Community benefits agreement
- Commercial and housing linkage fees
- Housing trust fund
- Community land trust and other nonprofit- or city-owned affordable housing
- Value capture (e.g. tax increment financing)
- Competitive funding for parks requiring or incentivizing anti-displacement strategies²⁴⁶

When considering urban areas, each is unique and will require a tailored approach and can utilize a prioritization framework.

²⁴⁴ Jennifer R. Wolch et al., "Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'." *Landscape and urban planning* 125 (2014): 234-244.

²⁴⁵ Fushcia-Ann Hoover et al., "Environmental justice implications of siting criteria in urban green infrastructure planning." *Journal of Environmental Policy & Planning* 23, no. 5 (2021): 665-682.

²⁴⁶ Alessandro Rigolon and Jon Christensen, "Greening without Gentrification: Learning from Parks-Related Anti-Displacement Strategies Nationwide." Accessed from <https://www.ioes.ucla.edu/project/prads/>

CHAPTER 6

CONCLUSION

This study sought to answer the question of how Sentinel Landscapes can address program goals so that climate resilience and adaptation strategies lead to equitable outcomes as outlined in the Justice40 initiative through land use planning. The LUCIS method was employed to create a future land use allocation baseline scenario for 2050. This scenario was used as an example of outcomes according to Sentinel Landscape goals, and 86% of the land was allocated to conservation or agriculture. This scenario is unlikely, as the counties in the study area are expecting population growth in addition to heightened threats from climate change. Therefore, the results were discussed in terms of creating more equitable outcomes using existing policies and a tripartite equity framework.

There are four main takeaways from this research: visualizing a collective future with land use planning can help to achieve stakeholder goals; DOD has policies in place to incorporate equity into climate resiliency projects; CEJST is a tool to help identify agencies DOD can collaborate with and areas where resources should be targeted, equity goes beyond policy and must become part of a larger local engagement strategy to truly build a more climate resilient landscape. This research serves as a proof-of-concept with practical advice for professionals to incorporate into their work for land planning in the Coastal Georgia Sentinel Landscape.

Future research could incorporate multiple scales, ranging from a city to a larger regional area. A focus on population distribution specific to each county would prove useful, especially in Bryan County, where the new HMG Megaplant is under construction and population growth is expected to increase by 20% by 2050. Effingham County would also prove an interesting study as well, due to the need for new developable urban land in Chatham County and the expected growth from the Megaplant. Multiple future

scenarios can be calculated using lower and higher population density estimates to demonstrate the change in the urban area needed.

An expansion of this project could seek to utilize the data collected from the LUCIS portion of this analysis and use it for a participatory project, such as geodesign. The equity framework could be applied to ensure a more equitable process and outcome. Further research into specific Justice40 climate and economic burdens could provide a more robust understanding of potential partnerships within the Sentinel Landscape. And finally, a comprehensive zoning analysis could be performed for Georgia's coastal counties. At present, some places do not have any digital zoning data (e.g., Pembroke), while others have over 100 zoning categories (e.g., Savannah).

This study had several limitations. Time was the ultimate issue, which restricted how many stakeholders could be contacted and the number of land use scenarios that could be created. Greater input from stakeholders and community members is highly valued in these analyses, especially when considering equity. Availability of data for all three counties proved tricky, and most datasets needed to come from sources at a state or national level. Zoning data proved the most difficult, and zoning was pieced together from a 2016 study and city boundaries. Complete and recent zoning data could inform the population density in residential areas. Lastly, future population growth for Fort Stewart could help inform the needed urban area but was unavailable.

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APPENDIX A: DATA DESCRIPTIONS

Goal	Dataset	Description	Raster Resolution	Year	Source
UG1.1.2	Military Installation Zoning Overlay District (MIZOD)	Military Installation Zoning Overlay District (MIZOD) Fort Stewart, GA	n/a	2017	Jay Johnson, Liberty County Assessors' Office
UG1.1.2	Georgia Sentinel Landscape	Fort Stewart/HAA and REPI Boundaries	n/a	2021	Georgia Geospatial Information Office (GIO)
UG1.2.1	Georgia Strategic Highway Network	Roadway sections that are important to the United States' strategic defense policy and which provide defense access, continuity and emergency capabilities for defense purposes.	n/a	2021	Georgia Department of Transportation (GDOT)
UG1.2.2	National Geospatial Data Asset (NGDA)	North America's railway system	n/a	2023	Bureau of Transportation Statistics via Esri
UG2.1.1	Tree Canopy Cover	Single percent tree canopy cover layer containing values ranging from 0 to 100 percent, with each individual value representing the area or proportion of that 30 m cell covered by tree canopy.	30m	2016	Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD)
UG2.1.2	Urban Park Size (Southeast Blueprint)	Size of parks larger than 5 acres in the urban environment.	30m	2022	Southeast Conservation Adaptation Strategy (SECAS)
UG2.2.3	Walkability	The Walkability Index dataset characterizes every Census 2019 block group in the U.S. based on its relative walkability. Walkability depends upon characteristics of the built environment that influence the likelihood of walking being used as a mode of travel.	n/a	2021	EPA Walkability Index

UG2.2.1	Georgia Low Impact Solar Siting Tool (LISST)	The tool compares the sensitivity of lands to impacts from large-scale solar projects and their suitability for solar development. Solar suitability and environmental sensitivity criteria were determined from industry feedback, natural resource agencies, environmental organizations, and published literature.	30m	2021	The Nature Conservancy
UG2.2.2	Electric Vehicle Charging Station Locations	Level 2 and DC Fast electric vehicle charging stations. Each point on the map is counted as one station.	n/a	2023	DOE Alternative Fuels Data Center
UG3.1.1	Land Cover	Data on land cover and land cover change at a 30m resolution with a 16-class legend based on a modified Anderson Level II classification system.	30m	2019	Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD)
UG3.1.2	Populated Places	Areas that include census designated places, consolidated cities, and incorporated places identified by the U.S. Bureau of the Census.	n/a	2020	US Census via Esri
UG3.1.3	Land Cover 2050-Country	Predicted land cover for each country for year 2050, generated by Clark Labs.	300m	2021	Clark Labs
UG3.2.1	Coastal Georgia Geodesign Workshop Zoning	Combined and consolidated zoning for counties in the Georgia Coastal Regional Commission created for a 2016 geodesign workshop.	n/a	2016	Rosanna Rivero and Allison Smith
CG1.1.1	Protected Areas Database (PAD-US 3.0)	PAD-US is America's official national inventory of U.S. terrestrial and marine protected areas that are dedicated to the preservation of biological diversity and to other natural, recreation and cultural uses, managed for these purposes through legal or other effective means.	n/a	2022	U.S. Geological Survey (USGS) Gap Analysis Project (GAP)
CG1.1.2	Land Cover	Data on land cover and land cover change at a 30m resolution with a 16-class legend based on a modified Anderson Level II classification system.	30m	2019	Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD)
CG1.1.3	Land Cover 2050-Country	Predicted land cover for each country for year 2050, generated by Clark Labs.	300m	2021	Clark Labs
CG1.2.1	Georgia Sentinel Landscape	Areas in the GA Sentinel Landscape designated as priority areas for the Savannah River Clean Water Fund.	n/a	2021	Georgia Geospatial Information Office (GIO)

CG1.2.2	Longleaf Local Implementation Team Priorities	Priority areas designated by the Longleaf Alliance Fort Stewart/Altamaha Local Implementation Team (LIT).	n/a	2018	Longleaf Alliance
CG1.2.3	Georgia Biota Impaired Waters with One Mile Buffer	This mapping application shows biota impaired streams, a one-mile buffer around biota impaired streams, and any stream that has a TMDL Implementation Plan is also displayed. GIS Data Set for the 2020 GA 305(b)/303(d) Integrated Report prepared by GAEPD.	n/a	2020	Georgia Environmental Protection Division (GAEPD)
CG1.3.1	Threatened & Endangered Species Critical Habitat	Critical habitat polygon features for threatened and endangered species (loggerhead turtle and piping plover)	n/a	2023	US Fish and Wildlife Service
CG1.3.1	Gopher Tortoise Population Survey	Areas with known populations of the gopher tortoise	30m	2020	GA Department of Natural Resources via The Nature Conservancy
CG1.3.2	Southeast Blueprint	The Blueprint identifies priority areas based on a suite of natural and cultural resource indicators representing terrestrial, freshwater, and marine ecosystems. Across most of the region, a connectivity analysis identifies corridors that link coastal and inland areas and span climate gradients.	30m	2022	Southeast Conservation Adaptation Strategy (SECAS)
CG2.1.1	USA Wetlands	This feature layer displays wetlands of the United States from the National Wetlands Inventory.	n/a	2021	USFWS National Wetland Inventory via Esri
CG2.1.2	FEMA Flood Zone Hazard Areas	This feature layer displays Flood Hazard Areas from the Flood Insurance Rate Map.	n/a	2022	Federal Emergency Management Agency via Esri
CG2.1.3	Georgia 2 Foot Sea Level Rise	The purpose of this dataset is to show potential sea level rise inundation of 2 ft above current Mean Higher High Water (MHHW) for the area. 2050 Projections for High (1.71 ft) and Intermediate High (1.48ft) influenced the decision to use 2ft.	n/a	2022	National Oceanic and Atmospheric Administration (NOAA)
AG1.1.1	USA SSURGO Farmland Class	This layer displays prime, locally important, and unique farmlands for use in implementation of the Farmland Protection Policy Act. As part of the implementation of this law, the Natural Resources Conservation Service identifies high quality agricultural soils as prime farmland, unique farmland, and land of statewide or local importance.	30m	2021	Soil Survey Geographic Database (SSURGO) via Esri

AG1.1.2	Georgia Sentinel Landscape	Fort Stewart/HAA REPI Boundary	n/a	2021	Georgia Geospatial Information Office (GIO)
AG1.2.1	Coastal Georgia Geodesign Workshop Zoning	Combined and consolidated zoning for counties in the Georgia Coastal Regional Commission created for a 2016 geodesign workshop.	n/a	2016	Rosanna Rivero and Allison Smith
AG1.2.2	Land Cover	Data on land cover and land cover change at a 30m resolution with a 16-class legend based on a modified Anderson Level II classification system.	30m	2019	Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD)
AG1.2.3	Land Cover 2050-Country	Predicted land cover for each country for year 2050, generated by Clark Labs.	300m	2021	Clark Labs

APPENDIX B: RANKING AND WEIGHTING OF LAND USE CRITERIA

Goal	Lowest Priority (1)	Low-Medium Priority (2)	Medium Priority (3)	Medium-High Priority (4)	High Priority (5)	Weight
UG1.1	Within Installation Boundary	Within REPI Boundary	Within Noise Zones		Outside of installation, REPI/ACUB and Noise Boundaries	12%
UG1.2	Not STRAHNET or rail	n/a	n/a	Rail 50ft buffer	STRAHNET .5-mile buffer	8%
UG2.1.1	Outside of Populated Places	75-100%	50-75%	25-50%	0-25%	8%
UG2.1.2	Null	Urban Park	Populated Places	n/a	Urban Park buffer 0.25 miles	10%
UG2.1.3	1-2.875	2.876-5.75	5.76-8.125	8.126-10.5	10.5-13.3	4%
UG2.2.1	avoidance recommended, Null (Tybee Island)	not preferred		less preferred	preferred for low impact	10%
UG2.2.2	outside of kernel density	within four standard deviations	within three standard deviations	within two standard deviations	within one standard deviation	4%
UG3.1.1	Open water, woody wetlands, emergent herbaceous wetlands	Deciduous Forest, Evergreen Forest, mixed forest, cultivated crops, hay/pasture	shrub/scrub, barren land, herbaceous	Urban development low and open space	Urban development medium, high	12%
UG3.1.2	Not a populated area	n/a	Population Classes 1-3	Population Classes 4-5	Population Classes 6-8	14%

UG3.1.3	surface water, swampy or often flooded vegetation	mostly deciduous forest, mostly needleleaf/evergreen forest, cropland	grassland, scrub, or shrub	bare area	Artificial surface or urban area	6%
UG3.2	No label, Null, Fort Stewart, Water	Low Density Residential-AR	n/a	Low Density Residential	Industrial, Commercial, No Label, PUD-LDR-HDR-Commercial, Higher Density Residential, MU-LDR-Commercial, MU-LDR-HDR-Commercial, Hinesville, Richmond Hill	12%
CG1.1.1	Not a Protected Area	n/a	n/a	REPI Boundary	Protected Area	15%
CG1.1.2	Developed Low Medium and High	Cropland, hay/pasture, Developed Open Space	Barren Land	Herbaceous, Shrub/scrub	Deciduous Forest, Evergreen Forest, Mixed Forest, Woody wetlands, Emergent Herbaceous Wetlands	15%
CG1.1.3	Artificial Surface or Urban Area	Mostly Cropland	Bare Area	Grassland, Scrub, or shrub	Surface Water, Swampy or Often Flooded Vegetation, Mostly Deciduous Forest, Mostly Needleleaf/Evergreen Forest	6%

CG1.2	Outside of Priority Areas, outside of buffer	n/a	n/a	n/a	Priority Areas, inside 50ft buffer	10%
CG1.3.1	Not gopher tortoise habitat or critical habitat	n/a	Gopher tortoise habitat (medium priority-sandhill survey)	Gopher tortoise habitat (high priority-suitable habitat)	Gopher tortoise habitat (highest priority-population survey) or critical habitat present	12%
CG1.3.2	Lower Priority	Priority Connections	Medium Priority	High Priority	Highest Priority	10%
CG2.1.1	Not a wetland	n/a		n/a	Lake, Pond, Freshwater Emergent Wetland, Freshwater Forested/Shrub Wetland, Estuarine and Marine Deepwater	12%
CG2.1.2	Outside of flood zones	n/a	n/a	0.2% Annual Chance	Regulatory Floodway, 1% Annual Chance	10%
CG2.1.3	Not in SLR zone	n/a	n/a	n/a	In SLR Zone	10%
AG1.1.1	Not Prime Farmland		n/a	Farmland of State Importance	Prime Farmland	20%
AG1.1.2	Military Installations	n/a	Outside of REPI Boundary	n/a	Inside REPI Boundary	25%

AG1.2.1	Industrial, Commercial, No Label, PUD-LDR-HDR-Commercial, Higher Density Residential, MU-LDR-Commercial, MU-LDR-HDR-Commercial, Fort Stewart/Open Water, Hinesville, Richmond Hill	n/a	n/a	Low Density Residential	Low Density Residential-AR	20%
AG1.2.2	Developed Low Medium and High, Open Water	Developed Open Space, Barren Land, Woody wetlands, Emergent Herbaceous Wetlands	Deciduous Forest, Evergreen Forest, Mixed Forest	Herbaceous, Shrub/scrub	Cropland, hay/pasture	25%
AG1.2.3	Surface Water, Artificial Surface or Urban Area	Swampy or often Flooded Vegetation	Mostly Deciduous Forest, Mostly Needleleaf/Evergreen Forest	Grassland, scrub, or shrub, bare area	Mostly Cropland	10%

APPENDIX C: STAKEHOLDER SURVEY RESULTS

	Stakeholder Ranking (1 lowest, 10 highest)				
Criteria	Installation & Defense Community Partner	Military Readiness/DOD	Conservation	Conservation	Conservation
Development outside of the Ft Stewart/HAA Army Compatible Use Buffer (ACUB) area	10	10	10	9	10
Development outside of Ft Stewart Noise Zones	10	10	10	4	7
Prioritizing roads part of the Strategic Highway Network (STRAHNET) when considering urban development.	8	10	9	8	10
Prioritizing existing rail lines when considering urban development.	3	10	5	8	3
Development in urban areas of low-medium (0-50%) tree canopy. This does not include tree canopy outside of urban areas.	10	5	7	5	7
Avoiding development in existing parks in urban areas.	6	10	10	10	8
Siting Low Impact Solar in areas determined as preferable by The Nature Conservancy to increase renewable energy.	7	10	8	9	7
Development in areas where there are electric vehicle (EV) chargers.	8	5	2	6	1
Development in areas with existing sidewalks.	3	5	8	8	1
Development in existing urban areas with higher population density.	9	10	10	10	9
Census tracts with low social vulnerability as indicated by the CDC/ATSDR Social Vulnerability Index (SVI)	1	4		4	6
Development in areas with commercial, industrial, and residential zoning.	10	7	10	10	8
Development in areas that are already developed according to the National Land Cover Database (2019).	9	10	10	7	9
Areas projected to be an urban area or artificial surface in 2050 by Clark Labs.	5	10		6	1

Areas already conserved by local, state, federal, and non-profit organizations as found in the Protected Areas Database.	10	10	10	10	10
Savannah River Clean Water Coalition High Priority Protection Areas	9	10	10	9	9
Impaired streams and buffer areas around them (25-50 feet)	2	5	10	9	10
Gopher tortoise habitat	10	10	10	8	9
Critical habitat for threatened and endangered species (loggerhead sea turtle and piping plover)	10	10	10	8	1
Areas indicated as a priority for a connected network of lands and waters in the Southeast Blueprint from the Southeast Conservation Adaptation Strategy (SECAS)	7	10	8	8	9
Areas where sea level is projected to rise by 2 feet in 2060 by NOAA.	7	10	5	10	8
Areas where wetlands are present	7	10	10	10	10
Areas in a FEMA Flood Hazard Zone	10	10	7	10	7
Habitat Cores from Esri's green infrastructure package	3	5		8	8
Priority areas for longleaf pine as indicated by the Longleaf Alliance Fort Stewart/Altamaha Local Implementation Team	6	10	10	8	9
Areas projected to be forested and flooded in 2050 by Clark Labs.	7	10		8	1
Areas of Prime Farmland	7	7	8	8	9
Areas within the ACUB and REPI boundary	10	10	5	10	8
Areas that are zoned for agriculture or low density/agriculture	5	7	10	10	6
Areas of where the existing land use is cropland and pasture/grassland	5	7	10	10	10
Areas projected to be mostly cropland or grassland in 2050 by Clark Labs.	5	7		8	1

APPENDIX D: DESCRIPTION OF CEJST BURDENS BY CENSUS TRACT

County	Census Tract	Climate Change	Energy	Health	Housing	Legacy Pollution	Transportation	Water and Wastewater	Workforce Development
Chatham	13051000100								low median income and poverty and unemployment
Chatham	13051000601	Projected wildfire risk	Energy cost	Asthma and diabetes		Proximity to Risk Management Plan facilities			low median income and poverty and unemployment
Chatham	13051001100	Projected flood risk		Low life expectancy		Proximity to Risk Management Plan facilities			
Chatham	13051001200	Projected wildfire risk	Energy cost	Asthma and diabetes and low life expectancy	Housing cost	Proximity to Risk Management Plan facilities	Traffic proximity and volume		Low median income and poverty and unemployment
Chatham	13051001500								Low median income and poverty and unemployment
Chatham	13051002000		Energy cost	Asthma and diabetes and low life expectancy	Housing cost	Proximity to Risk Management Plan facilities	Traffic proximity and volume		Low median income and poverty
Chatham	13051002100	Projected flood risk		Diabetes	Lack of indoor plumbing		Traffic proximity and volume	Underground storage tanks and releases	
Chatham	13051002200			Diabetes and low life expectancy					
Chatham	13051002300	Projected wildfire risk	Energy cost	Asthma and diabetes and low life expectancy					Low median income and unemployment
Chatham	13051002700	Projected flood risk		Diabetes and low life expectancy	Lead paint				Low median income

Chatham	13051002800		Energy cost	Asthma and diabetes and low life expectancy					Low median income and poverty and unemployment
Chatham	13051003301	Projected wildfire risk	Energy cost	Diabetes and heart disease and low life expectancy		Proximity to Risk Management Plan facilities			
Chatham	13051003302	Projected wildfire risk		Diabetes and heart disease		Proximity to Risk Management Plan facilities			Unemployment
Chatham	13051003501			Asthma and diabetes	Housing cost				Low median income and poverty and unemployment
Chatham	13051003502			Diabetes	Lack of indoor plumbing				
Chatham	13051003601	Projected flood risk and Projected wildfire risk		Asthma and diabetes		Proximity to Risk Management Plan facilities			Low median income
Chatham	13051003602	Projected wildfire risk		Diabetes and low life expectancy	Housing cost				Poverty and unemployment
Chatham	13051003700	Projected wildfire risk				Proximity to Risk Management Plan facilities			
Chatham	13051004207				Lack of indoor plumbing				
Chatham	13051004209	Projected flood risk			Housing cost				
Chatham	13051004300				Housing cost				

Chatham	13051004400		Energy cost	Asthma and diabetes and low life expectancy	Housing cost				Low median income and poverty and unemployment
Chatham	13051004500			Asthma and diabetes and heart disease					Low median income and unemployment
Chatham	13051010101	Projected flood risk		Asthma and diabetes and heart disease		Proximity to Risk Management Plan facilities			
Chatham	13051010501				Lack of indoor plumbing				Poverty
Chatham	13051010502								Unemployment
Chatham	13051010601					Proximity to Risk Management Plan facilities			
Chatham	13051010901				Lack of indoor plumbing				Low median income and poverty
Chatham	13051011400		Energy cost		Housing cost and lead paint		Traffic proximity and volume	Underground storage tanks and releases	Low median income and poverty
Chatham	13051011600			Diabetes and low life expectancy		Proximity to Risk Management Plan facilities			
Bryan	13029920101								Unemployment
Bryan	13029920102						Transportation barriers		Unemployment
Liberty	13179010501	Expected building loss rate and projected flood risk					Transportation barriers		

Liberty	13179010600		Energy cost	Asthma and diabetes and heart disease					Unemployment
Liberty	13179010204	Projected wildfire risk	Energy cost						Unemployment
Liberty	13179010207	Projected wildfire risk							