TEXAS A&M NRI
NATURAL RESOURCES INSTITUTE

OFFICE OF LOCAL DEFENSE COMMUNITY COOPERATION
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Texas Military Airspace & Land Use Projections

Protecting Military Readiness in Texas: Phase II

Texas A&M Natural Resources Institute

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Report Contact

TEXAS A&M NRI NATURAL RESOURCES INSTITUTE

Alison Lund
alison.lund@ag.tamu.edu

ACRONYMS & ABBREVIATIONS

AAA	Airport Airspace Analysis
DoD	Department of Defense
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
ICLUS	Integrated Climate and Land Use Scenarios
MOA	military operating area
m	meter
MTRs	military training route
MW	megawatts
NLCD	National Land Cover Database
NRI	Texas A&M Natural Resources Institute
OA	Obstruction Analysis
OLDCC	Office of Local Defense Community Cooperation
PAD-US	Protected Areas Database of the United States
SUA	Special Use Airspace
TENT	Texas Early Notification Tool
TMPC	Texas Military Preparedness Commission
TPWD	Texas Parks and Wildlife Department
USGS	U.S. Geological Survey

Image: Spangler, Thomas. United States Air Force.

INTRODUCTION

The U.S. military maintains a significant and critical presence throughout the state of Texas, spanning a combined footprint of over 1.5 million acres across 15 active-duty Army, Navy, and Air Force installations and the headquarters of Army Futures Command. With over $123 billion in economic impact to the state economy, military operations rivals many of the leading industries in Texas.[1] The military mission, while imperative to national defense and the Texas economy, is under mounting pressure from various encroachment threats. Proactive land use planning is imperative to ensure the future functionality and capabilities of these installations. Military stakeholders recognize this need and are increasing efforts to engage in partnerships with surrounding communities, neighboring landowners, and local industries in forging innovative solutions for incompatible land use issues. The success of these efforts, however, requires an understanding of issues important to all stakeholders involved and, in many cases, a preemptive, collaborative approach.

In 2019, the Texas A&M Natural Resources Institute (NRI), in partnership with the Texas Military Preparedness Commission (TMPC), and with a grant from the U.S. Department of Defense (DoD) Office of Local Defense Community Cooperation (OLDCC; formerly the Office of Economic Adjustment), completed the Texas Early Notification Tool (TENT). This web mapping application facilitates early engagement between developers (mainly wind industry) and the military. Expanding on this work, NRI obtained another grant from OLDCC to address land use compatibility around military assets — through facilitating communication between military, industry, and defense communities, and by developing meaningful products that assist planners in developing statewide strategies and solutions to combat potential land use conflicts. The project, titled **Protecting Military Readiness in Texas: Phase II**, includes four tasks:

1 | Annual military/wind energy stakeholder meeting

2 | Maintenance and update of the Texas Early Notification Tool

3 | Issue reports covering:
- Land use compatibility and legislative considerations
- Land use change projections
- Candidate species review

4 | Additional web tool(s) associated with issue reports

This report addresses land use change projections, which may have adverse implications for military test and training spaces. Specifically, the intent of this report is to describe the data that feeds into an associated web tool, which provides information for assisting Texas installations in proactive, long-term planning.

MILITARY AIRSPACE AND ASSETS

Military airspace falls into two primary categories: Special Use Airspace (SUA) and Military Training Routes (MTRs). The military also operates on or above other designated areas (Military Operating Area; MOA) and has instrumentation located off installation footprints. These areas are important because they represent the only airspace where many types of critical military training and testing can be conducted. Specifically, training spaces designated for low-altitude and night flights are essential for providing pilots with real world environments to enhance skillsets and maintain required flight hours. Appendix A provides illustrations of these spaces.

Threats

Encroachment is a term used by the DoD to refer to incompatible uses of land, air, water, and other resources. It is any outside activity, law, or pressure that affects the ability of military forces to train to doctrinal standards or to perform the mission assigned to the installation. For example, urban growth surrounding installations often leads to noise ordinances and additional safety precautions. Similarly, environmental concerns and protective legislative mandates, such as concerning endangered species habitat protections, increase the difficulty of maintaining military mission. This report addresses two primary threats of encroachment to military assets in Texas: 1) land use change resulting from development (i.e., industrial, commercial, and residential development) and 2) wind energy development.

Land Use Change/Development:

Military assets encompass a large portion of the state, primarily rural areas to avoid unnecessary human interference. Civilian job opportunities on installations and the need for businesses off-base to support the installation's personnel and families has significantly contributed to the expansion of commercial and residential development into undeveloped, rural areas adjacent to installations as well as areas under the airspace they manage. In addition, the Texas population has increased by approximately 15 percent (from 25 million to 29 million residents) since 2010, and is expected to increase by more than 70 percent (from 30 million to 51 million residents) from 2020 to 2070, thus furthering the demand for rural lands for supporting development.[2, 3]

Wind Energy Development

Wind energy is among the world's fastest growing sources of energy. Texas leads the nation in wind generating capacity with 33,133 MW of installed capacity and 7,619 MW of capacity under construction.[4] During 2020, wind energy provided nearly 20% of all in-state electricity production.[4] Many of the areas in the state that are most suitable for wind turbines coincide with airspace routes.

Potential Impacts

Incompatible development near military assets can stop or impair the use of those spaces and reduce the efficiency of test and training activities, thus compromising the overall mission. Listed below are some key impacts posed on aviation assets, by incompatible land use.

Sensitive Developments

Sensitive land uses may include residential housing, schools, nursing homes, retirement communities, health care facilities, state and federal parks, among others. The most common sensitivities relative to military activities are concerns about noise and safety near installations, ranges, airfields, and airspace. As such, Title 14 of the Code of Federal Regulations set perimeters that include avoidance areas, minimum flight altitudes, and maximum airspeeds that influence the use of airspace.[5]

Noise

The operation of military aircraft results in varying levels of noise depending on the type of airframe, the height of the aircraft above ground, and airspeed. Training exercises near communities can lead to noise complaints, often resulting in restrictions (independent from those restrictions identified in Title 14 of the Code of Federal Regulations) on flight altitudes, airspeeds, and timing. This leads to suspensions or delays in conducting testing or training events.

Vertical Obstructions

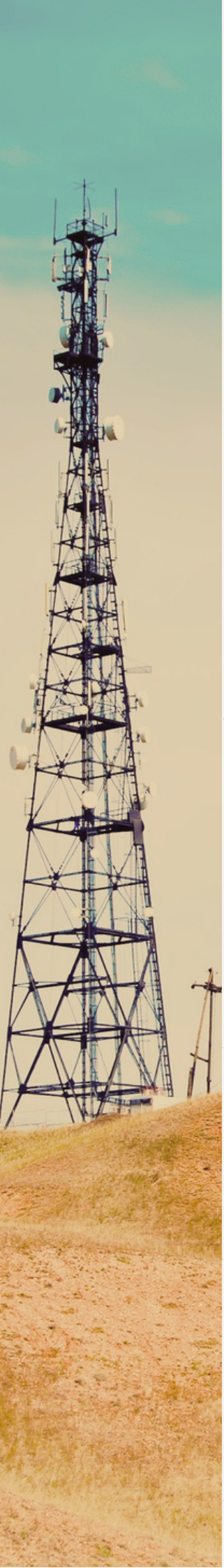
Designated airspaces defined by SUA and MTRs, in addition to helicopter turf routes and other non-published training airspace, are intended to give pilots safe, navigable airspace to conduct training while limiting potential harm to themselves or those on the ground. Tall buildings and other structures may encroach vertically into the navigable airspace used by military operations, creating avoidance areas that could require units to work around them or abandon the low altitude training altogether.

Nighttime Illumination, Glint, and Glare

With the use of night vision equipment, a significant portion of military training is now conducted at night. These exercises simulate combat situations to help troops develop situational awareness and ultimately minimize casualties. Under low light conditions, light sources from developed areas can cause glare and excessive illumination, which jeopardizes military training capabilities by eliminating realistic conditions and negatively impacting the use of night vision devices. Solar energy can also create glint and glare issues during daytime hours, which could temporarily blind pilots.

Frequency Spectrum Impedance and Interference

The military relies on a range of frequencies for communications and support systems. Public uses also rely on a range of frequencies to support daily life. As the use of the frequency spectrum increases (such as the rapid advances in cellular phone technology) and as development expands near military installations, operating areas, and off-site radar systems, the issue of frequency spectrum impedance, interference, and competition increases. Wind turbines also impact airborne radar by causing false returns (via Doppler shift), which could cause issues during training missions.



INTERACTIVE WEB TOOL

Formal DoD flight information publications, AP/1A and AP/1B, contain listings of current prohibited, restricted, danger, warning, and alert areas, in addition to operating instructions for all MTRs, SUA, and Parachute Jumping Areas. These documents are published primarily for preflight planning and have proven critical for aviation safety. Supplemental planning tools that identify areas where land use change is likely to occur, however, may provide missing information needed by operations planners and airspace managers to engage in early planning, outreach, and mitigation measures to protect airspace from encroachment of incompatible land use development. The following section describes the data used to develop the ***Texas Airspace Planning and Forecasting Tool*** ***(TAPFT.NRI.TAMU.EDU)*** —a publicly available web tool, designed to allow users the ability to explore projected development across Texas in conjunction with military assets. A complementary electronic user guide and web tool overview video are included on the web tool to help users get started.

Wind Turbines and Other Tall Structures

Current Development

Current wind turbine and other tall structures (vertical obstacles) data were derived from the Federal Aviation Administration's (FAA) Digital Obstacle File dataset. This data includes human made structures that obstruct aviation due to their height above ground level such as radio and cell phone towers, wind turbines, and power lines. This data is updated every 56 days by the FAA. This web tool will launch utilizing data published in July 2021, and will be updated every 6 months during the next three years of web tool maintenance.

Data source:

https://www.faa.gov/air_traffic/flight_info/aeronav/Digital_Products/dof/

Modifications made:

Obstacles displayed on the web tool only include those that are taller than 150 feet above ground level. Horizontal buffers of 2,000 feet were added to wind turbines and other tall structures to account for FAA Code of Federal Regulation 91.119 b, which outlines minimum safe altitudes and horizontal radius requirements for aircrafts traveling over congested areas (to include tall obstacles).

Data limitation:

The Digital Obstacle File contains only obstruction data for those man-made objects that affect domestic aeronautical charting products and does not purport to indicate the presence of all obstructions which may be encountered.

Wind Turbines and Other Tall Structures cont.

Projected Development

Projected, or proposed, wind turbine development was derived from the U.S. Fish and Wildlife Service's Ecological Services Wind Energy data, which is developed through the FAA's Obstruction Analysis /Airport Airspace Analysis (FAA OA/AAA) Wind Turbine Location Data dataset. Currently, a database which describes other proposed vertical structures, such as radio towers and tall buildings, does not exist or is not publicly available. The FAA OA/AAA Wind Turbine Location Data has three classifications that describe proposed wind turbine development: *Determined without Build Date*, *Determined as Hazard*, and *Not Yet Determined*. This dataset is updated monthly by FAA OA/AAA. This tool will launch utilizing data published in July 2021, and will be updated every 6 months during the next three years of web tool maintenance.

Data source:

https://www.fws.gov/southwest/es/Energy_Wind_FAA.html

Modification made:

Horizontal buffers of 2,000 feet were added to projected wind turbines to account for FAA Code of Federal Regulation 91.119 b, which outlines minimum safe altitudes and horizontal radius requirements for aircrafts traveling over congested areas (to include tall obstacles).

Data limitation:

It is unknown when, or if, wind turbine records under the proposed classifications will be constructed.

Land Use

Current Development - Man-made

Existing land development (i.e., impervious surface) was derived from the U.S. Geological Survey's (USGS) National Land Cover Database (NLCD). The NLCD provides nationwide data on land cover and land cover change at a 30 m resolution with a 16-class legend based on a modified Anderson Level II classification system. This dataset is infrequently updated by the USGS, and the latest version (2016) was utilized for this web tool. This data will be updated on the web tool, if applicable, during the next three years of web tool maintenance.

Data source:

https://www.mrlc.gov/data

Modification made:

Select NLCD land cover categories were reclassified into one *Existing Development* category to be displayed in the web tool. Appendix B describes the NLCD categories that were grouped for the purposes of this web tool.

Data limitation:

The existing land cover classification represents ground features as they were in 2016. Any development since 2016 will not be captured in the existing development layer.

Current Development - State and Federal Parks

Existing state and federal parks were derived from the Texas Parks and Wildlife Department's (TPWD) State Parks dataset and the USGS's Protected Areas Database (PAD-US version 2.1). PAD-US is America's official national inventory of U.S. terrestrial and marine protected areas and includes historic or cultural areas, national lakeshore or seashore, national monuments, national parks, national recreational areas, national wildlife refuges, recreation management areas, state historic or cultural areas, state parks, and state recreation areas. This dataset is updated irregularly by the USGS, and this web tool utilizes the most current version (PAD-US 2.1; released on September 15, 2020). The TPWD State Parks dataset (last modified by TPWD in August 2016) contains state parks that are not included in the PAD-US data. State and federal park data will be updated on the web tool, if available, during the next three years of web tool maintenance.

Data sources:

Federal parks: https://www.usgs.gov/core-science-systems/science-analytics-and-synthesis/gap/science/protected-areas
State parks: https://tpwd.texas.gov/gis/

Data Limitation:

The datasets that represent current state and federal parks only include currently protected areas and do not contain information about future parks.

Land Use cont.

Projected Development

Projected land use change, in the form of expanding development, was derived from the U.S. Environmental Protection Agency's (EPA) Integrated Climate and Land Use Scenarios (ICLUS) version 2.1, SSP2 scenario dataset. ICLUS SSP2 is a "middle-of-the-road" projection, where social, economic and technological trends do not shift markedly from historical patterns, resulting in a U.S. population of 455 million people by year 2100. Domestic migration trends remain consistent with the recent past. This version of the ICLUS model does not include climate change projections that may dynamically update location-specific amenities when calculating migration. State and federal park projections are not included in this dataset, as this data does not exist or is not publicly available. The ICLUS data is updated irregularly by the EPA, and this web tool utilizes the most current version (released in May 2020). This data will be updated on the web tool, if available, during the next three years of web tool maintenance.

Data source:

https://www.epa.gov/gcx/about-iclus

Modifications made:

Projected development was calculated for the years 2030 and 2050. Select ICLUS land use categories were reclassified into three different land use types to be displayed in the web tool: *Urban*, *Suburban*, and *Industrial*. Appendix B describes how ICLUS categories were grouped for purposes of this web tool.

Data limitation:

Land use classifications used in this analysis are projections based on historical development patterns, and future development may not occur exactly where projected by this dataset.

APPENDIX A.

Literature Cited

1 Texas Military Preparedness Commission Office of the Governor. 2020. Military installations across Texas 2020. https://gov.texas.gov/uploads/files/organization/military/2020-ALL.pdf

2 Huang P., H. You, L. Valencia, and L. B. Potter. 2019. 2018 Estimated population of Texas, its counties, and places. Texas Demographic Center at The University of Texas at San Antonio. https://demographics.texas.gov/Resources/publications/2019/20191205_PopEstimatesBrief.pdf

3 Texas Water Development Board. 2016. Water for Texas: 2017 State water plan. Austin, TX, USA. http://www.twdb.texas.gov/waterplanning/swp/2017/

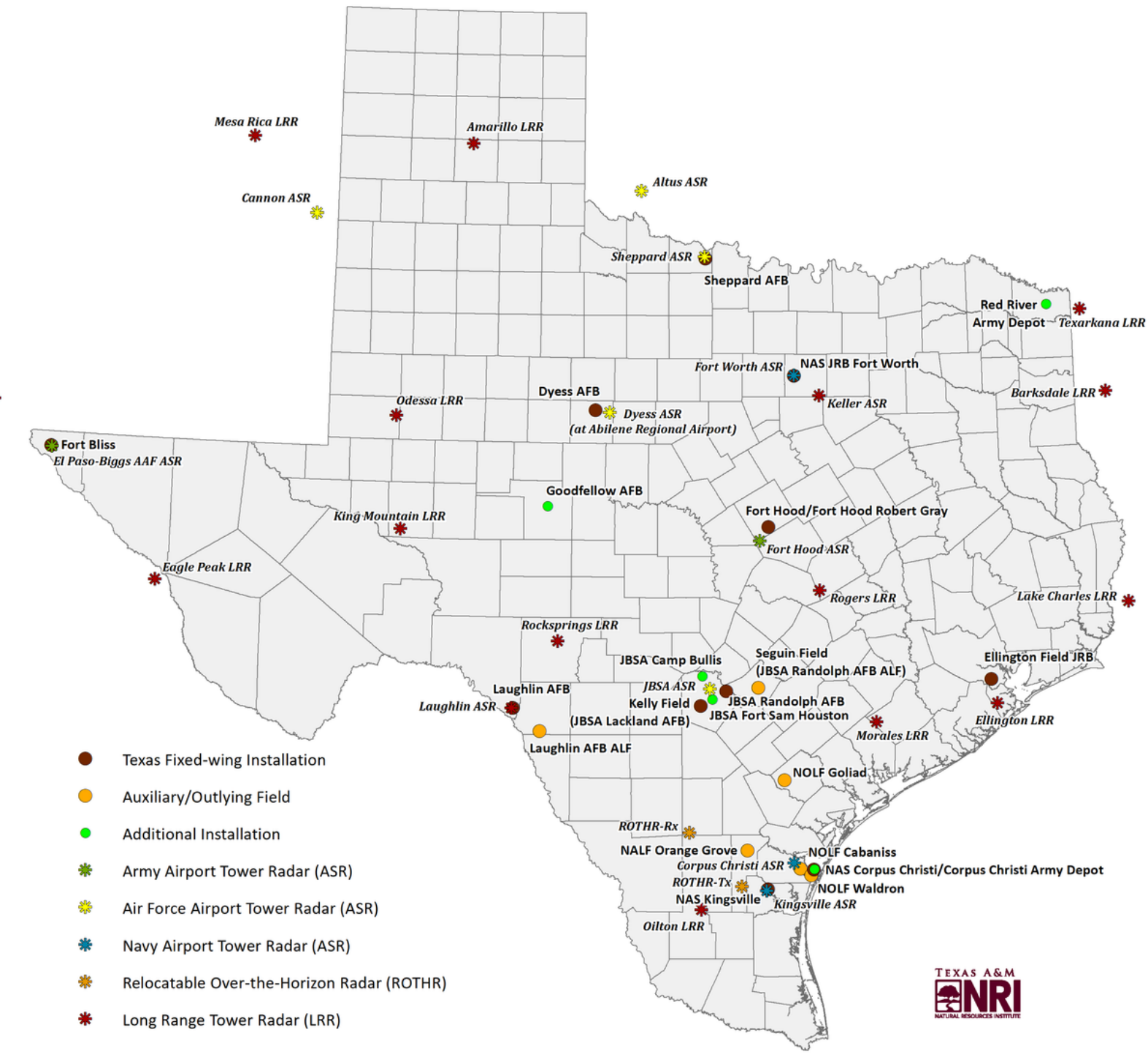
4 U.S. Energy Administration's Open Data API, Electricity Net Generation. 2020. https://windexchange.energy.gov/states/tx

5 For more information on Title 14 of the Code of Federal Regulations, please see the following website: https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=3efaad1b0a259d4e48f1150a34d1aa77&rgn=div5&view=text&node=14:2.0.1.3.10&idno=14#se14.2.91_1119

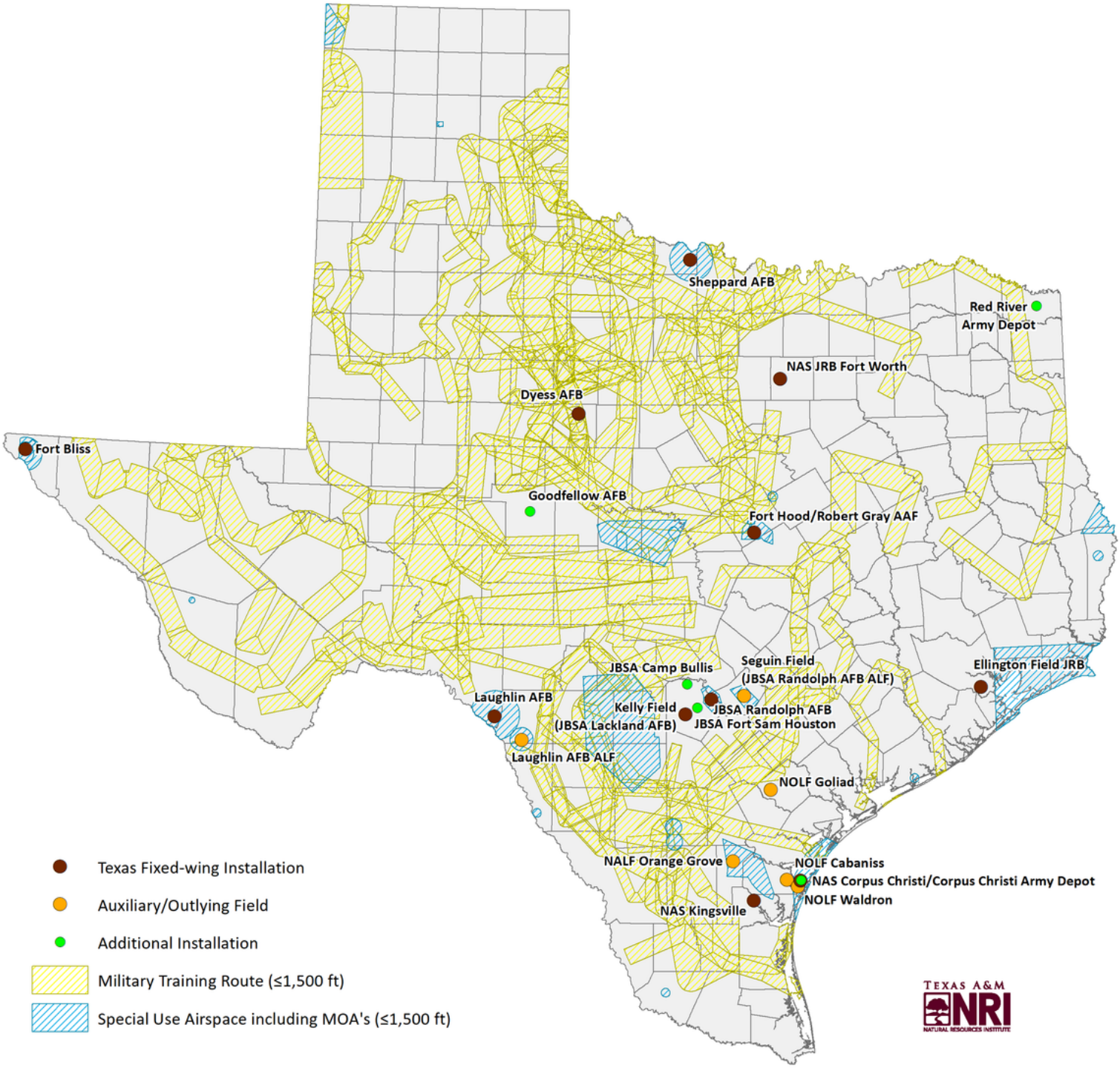
APPENDIX B.

Maps of Military Airspace and Assets

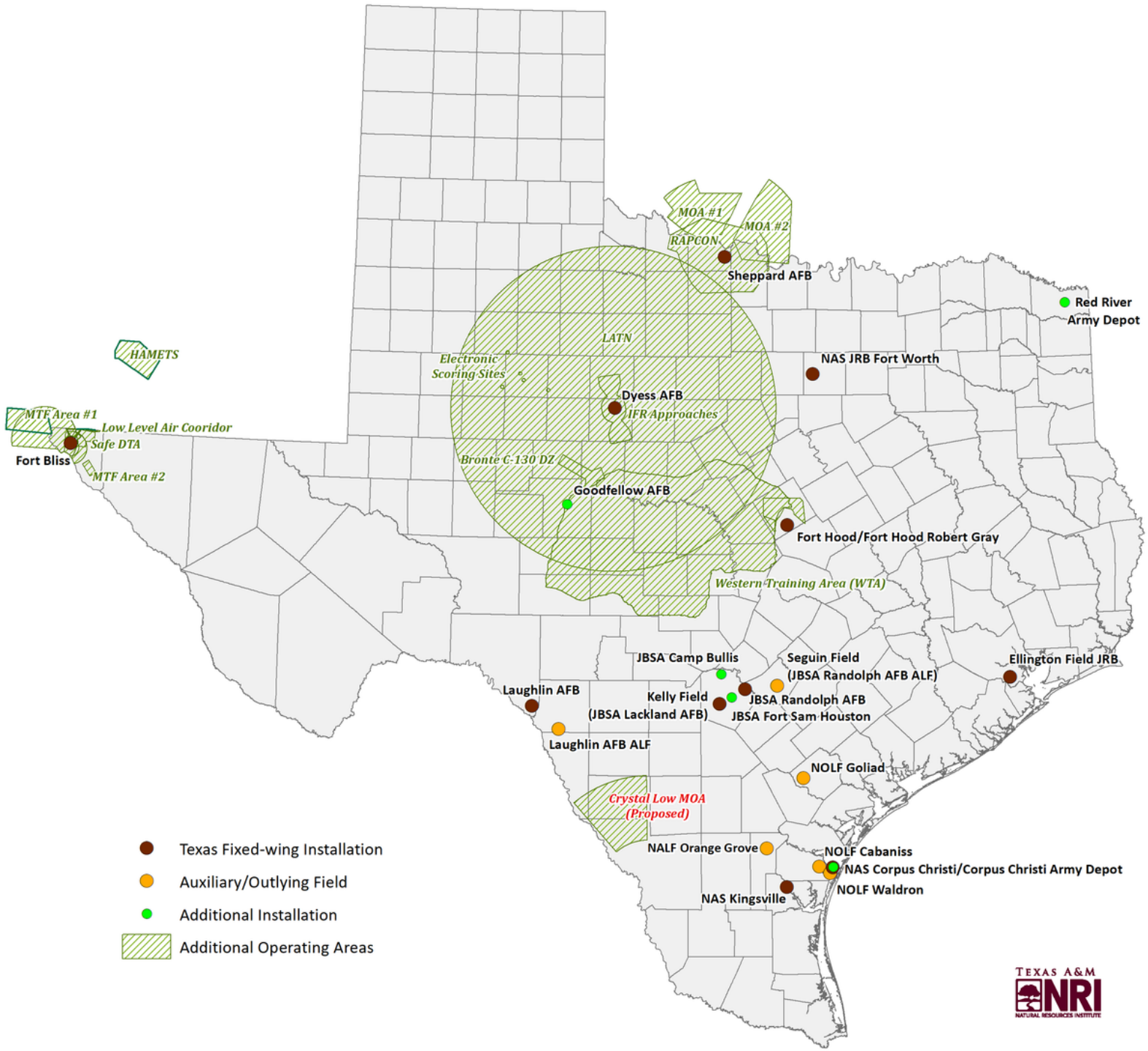
Texas military installations, air traffic control radars and long range radars, 2019.



Special Use Airspace (includes restricted airspace and Military Operations Areas) and Military Training Routes in Texas, 2019.



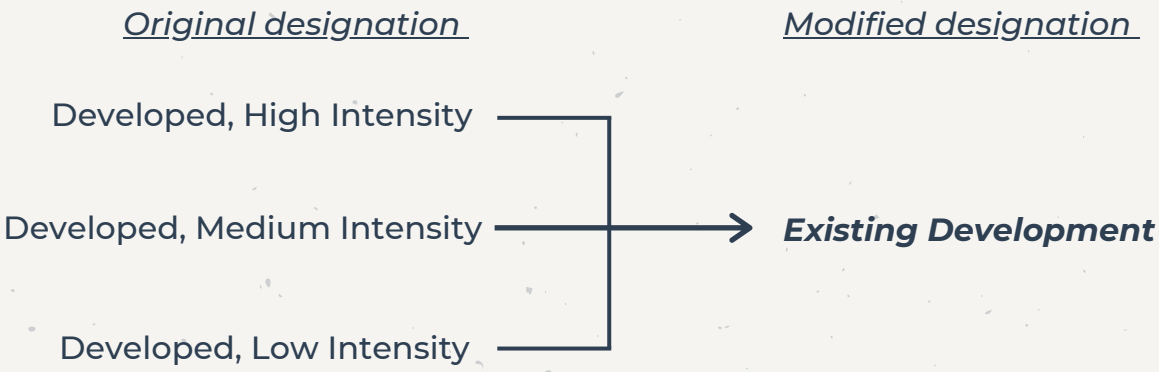
Additional Military Operating Areas in Texas, 2019.



APPENDIX C.

Data Groupings

National Land Cover Database



Integrated Climate Land Use Scenarios