WIND ENERGY AND MILITARY AIRSPACE IN TEXAS: A BRIEFING

2010

TEXAS A&M | Institute of Renewable Natural Resources

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Acknowledgements

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Executive Summary

The Issue. – With the nation's largest existing wind generation capacity, Texas leads the nation in wind energy development. Soon to have almost 100 "wind farms", each having an average just over 70 turbines, Texas will soon meet its 2025 target of 10,000 Megawatts (MW) of capacity. As the wind energy industry continues to expand, issues of compatibility with other national priorities are likely to arise. Among those compatibility issues is military training, specifically the potential for radar interference to military flight training and operations. Given the recent growth of the wind energy industry in Texas, along with the prevalence of military training facilities in the state, this issue is a growing concern to decision-makers.

Report Purpose. – The purpose of this report is to provide briefing materials as input for decision-makers. If the development of wind energy is to be compatible with existing and future military training needs, then the information presented in this report represents a starting point for assessing present status and analysis of future compatibility. Compatible siting is project dependent, depending on a wide variety of variables including topography, population density, prevailing weather, equipment type and operational patterns.

Summary Statistics

Military Use

- Texas has 25 U.S. military installations totaling about 735 square miles.
- Military flight training is conducted across 73,000 square miles of special use air space and approximately 22,000 miles of military training routes.
- Each military installation with aviation capacity has a minimum radar vectoring area of 20 nautical miles.

Wind

- Including existing and planned wind generation facilities, Texas has approximately 98 wind farms with a total of 7,140 turbines.
- Texas has over 32,000 square miles of Competitive Renewable Energy Zones (CREZ) in 5 areas, accounting for 11% of the state's land area.
- Over 60% of the state's existing and planned wind generation facilities are in a CREZ. Those facilities contain 72% of the state's wind turbines.

Overlap

- Eight installations with flight training requirements are in areas of the state where wind speeds are optimal for wind energy.
- Over 3,500 square miles of existing military Special Use Airspace overlaps with a CREZ .
- Over 2,500 miles of military traning routes pass through a CREZ.
- Approximately 22% of the state's existing wind turbines are in the radar vectoring areas of some of the state's major flight training installations – including Dyess AFB, Goodfellow AFB, NAS Kingsville, and NAS Corpus Christi.

Military Installations

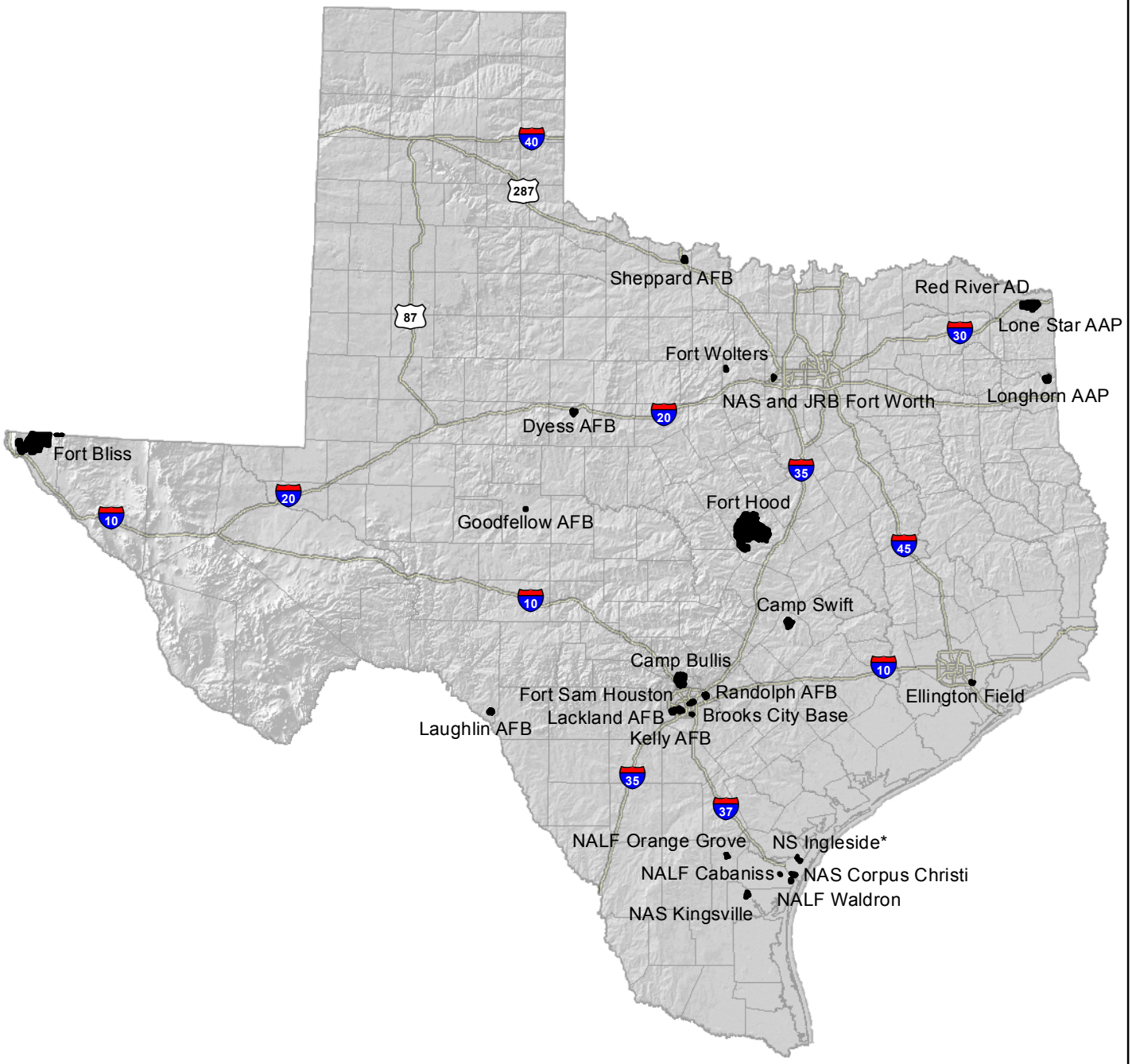
Military installations in Texas encompass over 735 sq. miles with boundary perimeter totaling more than 650 miles. These installations are comprised of Army, Navy, Air Force, and National Guard facilities.

Base	Area (Square Miles)	Perimeter (Miles)
Brooks City Base	2	6
Camp Bullis	50	34
Camp Swift	18	21
Dyess AFB	8	15
Ellington Field	3	9
Fort Bliss	195	111
Fort Hood	332	196
Fort Sam Houston	5	19
Fort Wolters	2	7
Goodfellow AFB	2	6
Kelly AFB	6	17
Lackland AFB	10	24
Laughlin AFB	6	12
Lone Star AAP	24	20
Longhorn AAP	13	18
NALF Cabaniss	1	8
NALF Orange Grove	2	11
NALF Waldron	1	11
NAS and JRB Fort Worth	3	10
NAS Corpus Christi	4	16
NAS Kingsville	5	13
NS Ingleside*	1	10
Randolph AFB	5	18
Red River AD	30	33
Sheppard AFB	7	14
TOTAL	**735**	**661**

* Note: NS Ingleside has been recommended for closure by 2005 Base Realignment and Closure (BRAC).

Abbreviations:
AFB—Air Force Base
AAP—Army Ammunition Plant
NALF—Navy Landing Airfield
NAS—Naval Air Station
JRB—Joint Reserve Base
NS—Naval Station
AD—Army Depot

Military Installations



*NS Ingleside is recommended to close according to 2005 Base Realignment and Closure (BRAC).

Wind Energy

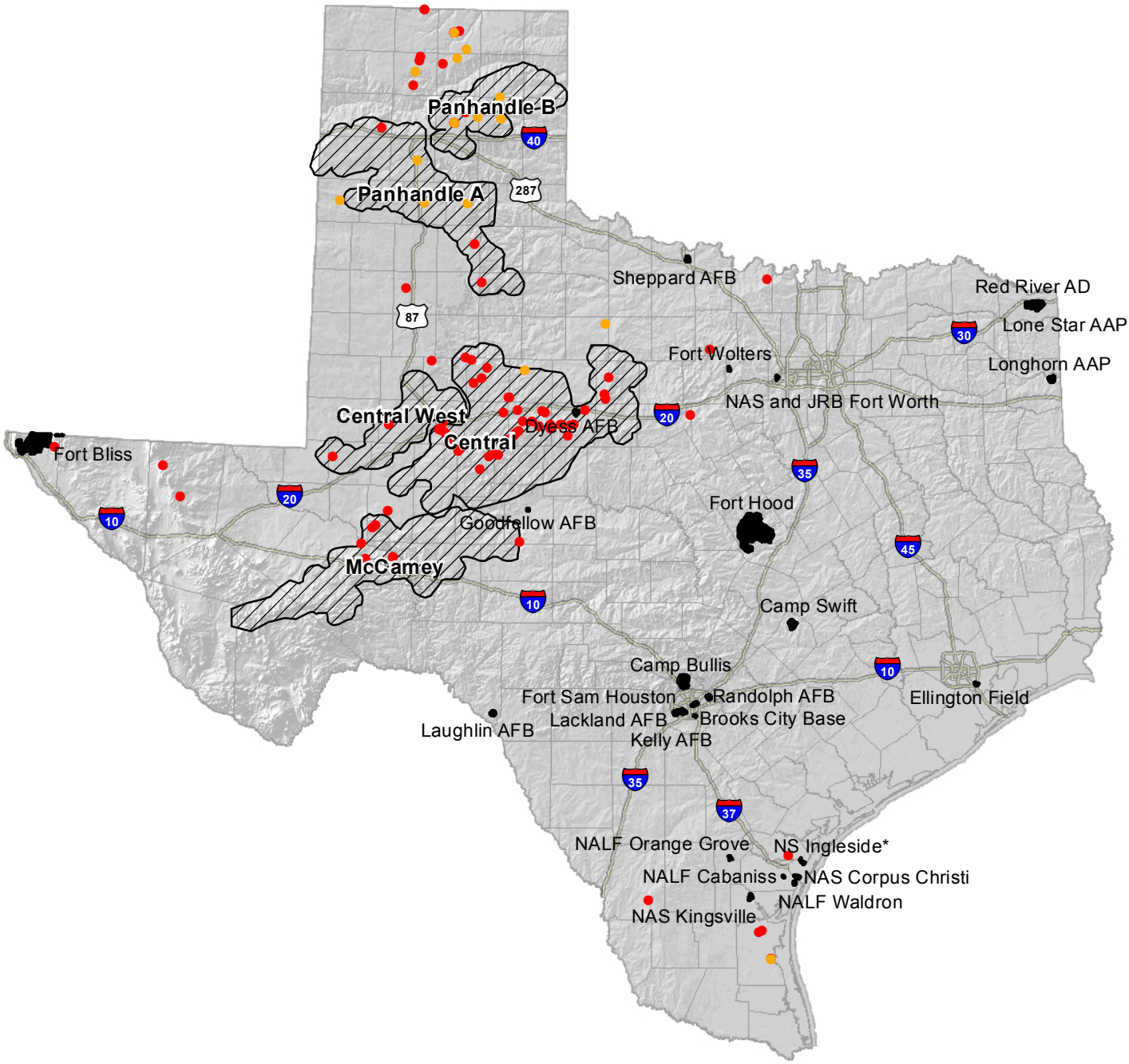
Wind energy is among the world's fastest growing sources of energy. Texas leads the nation in wind generating capacity and in 2006 accounted for almost one-third of newly installed wind capacity in the U.S. The Renewable Portfolio Standard (RPS) for Texas mandates a target of 10,000 MW renewable energy capacity by 2025—most of which will be achieved through wind. RPS is a regulation set by the Texas Legislature (Senate Bill 20) that requires the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal. Texas is on track to attain this goal much earlier than expected with 9,708 MW of capacity already online. In all, including existing and planned wind generation facilities, Texas has approximately 98 wind farms with a total of 7,140 turbines. Over 60% of wind farms are in a CREZ. Those wind farms contain 72% of the state's wind turbines.

			# Turbines	kW	MW
Wind Farms in Texas	**All (98)**	**Total**	**7,140**	**159,755**	**22,375**
		Avg.	73	1,700	228
		Max.	242	3,000	5,000
	Existing (81)	**Total**	**6,252**	**134,155**	**9,472**
		Avg.	77	1,656	117
		Max.	242	3,000	299
	Proposed (17)	**Total**	**888**	**25,600**	**12,904**
		Avg.	52	1,969	759
		Max.	200	3,000	5,000
Wind Farms in Texas CREZ	**All (63)**	**Total**	**5,183**	**103,280**	**14,198**
		Avg.	82	1,721	225
		Max.	242	3,000	3,000
	Existing (55)	**Total**	**4,751**	**93,180**	**7,170**
		Avg.	86	1,694	130
		Max.	242	3,000	299
	Proposed (8)	**Total**	**432**	**10,100**	**7,028**
		Avg.	54	2,020	879
		Max.	200	3,000	3,000

Competitive Renewable Energy Zones (CREZ) are a state legislative mandate (Senate Bill 20) meant to foster the development of transmission infrastructure to prime wind energy areas prior to development of wind farms. CREZ are areas where wind generation facilities will be constructed throughout West Texas and the Panhandle. Transmission facilities from the CREZ will be built to other areas of the state to deliver renewable power to end-use consumers. There are five CREZ in Texas encompassing approximately 11% of the state's land.

CREZ		
Name	**Sq. Miles**	**Perimeter (Miles)**
Panhandle A	7,039	555
Panhandle B	3,320	320
McCamey	7,266	566
Central	11,471	659
Central West	2,950	312
TOTAL	**32,045**	**2,411**

Wind Energy



Wind Farms

- Existing
- Proposed
- CREZ
- Installations

*NS Ingleside is recommended to close according to 2005 Base Realignment and Closure (BRAC).

0 50 100 200 Miles

Wind Speed

With present technology, wind energy development requires average wind speeds > 6 meters per second (m/s) and operates optimally in areas where average winds speeds are greater than 7 m/s. Wind turbines are mounted on towers ranging from 30 to 90 meters tall.

Approximately 90% of Texas has average wind speeds exceeding 6 m/s and 60% of the state has wind speeds in the optimal range (>7 m/s). All current wind energy infrastructure in Texas exists in these areas. They are concentrated in the western one-third of the state and along the South Texas coast.

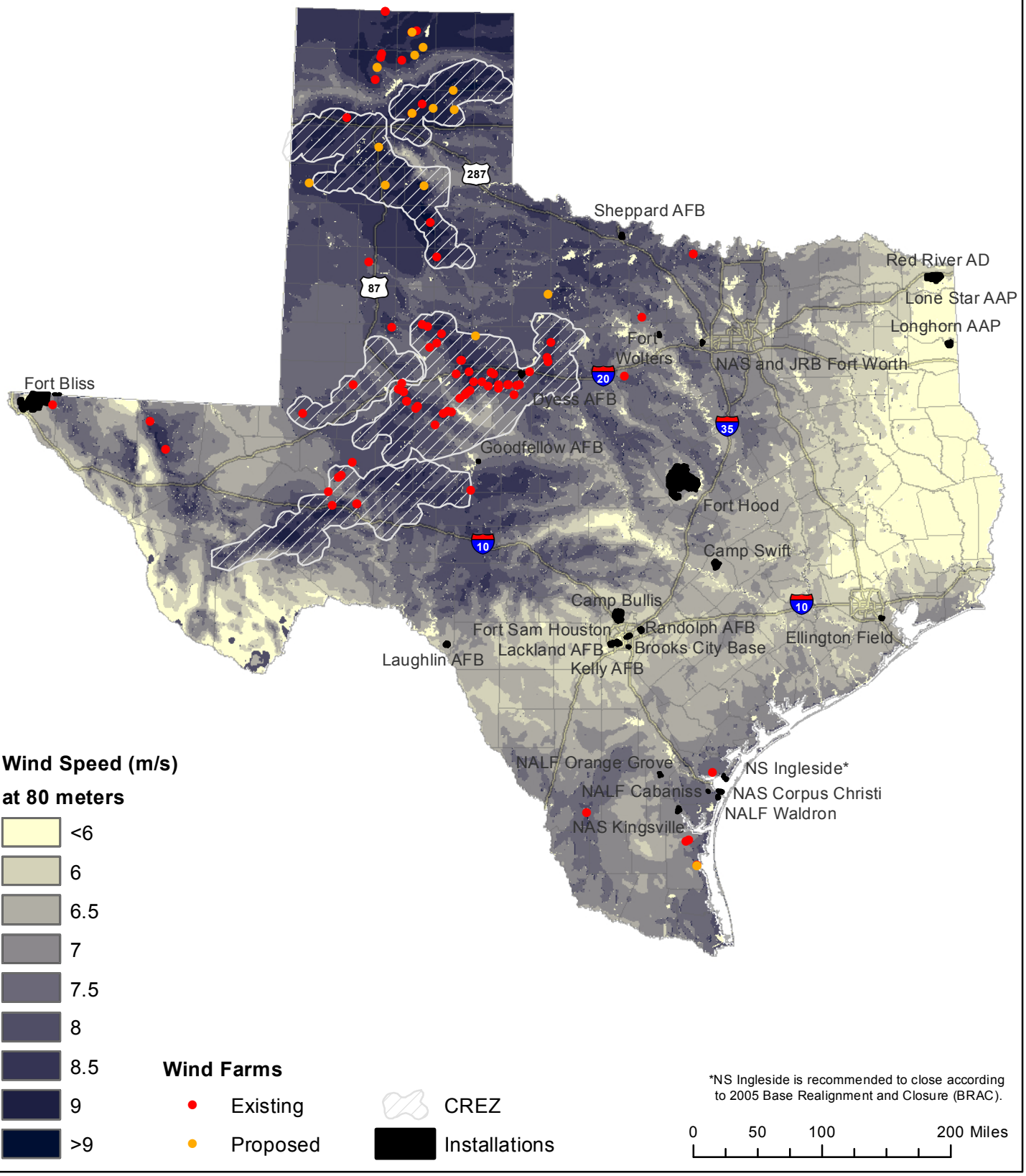
CREZ	Avg. Wind Speed (m/s)
Central	7.88
Central West	7.75
McCamey	7.98
Panhandle A	8.57
Panhandle B	8.74

Eight installations are in areas where average wind speeds exceed 7 m/s. They are Dyess AFB, Sheppard AFB, Goodfellow AFB, and the Naval Air Stations and Navy Landing Airfields in South Texas (5) surrounding Corpus Christi.

Installation	Avg. Wind Speed (m/s)
Brooks City Base	6.00
Camp Bullis	6.34
Camp Swift	6.50
Dyess AFB	8.01
Ellington Field	6.50
Fort Bliss	6.27
Fort Hood	6.79
Fort Sam Houston	5.98
Fort Wolters	6.75
Goodfellow AFB	7.00
Kelly AFB	5.86
Lackland AFB	6.00
Laughlin AFB	6.50
Lone Star AAP	5.81
Longhorn AAP	5.50
NALF Cabaniss	7.04
NALF Orange Grove	7.00
NALF Waldron	7.62
NAS and JRB Fort Worth	6.76
NAS Corpus Christi	5.60
NAS Kingsville	7.00
NS Ingleside	7.36
Randolph AFB	6.43
Red River AD	5.79
Sheppard AFB	7.76

*Note: Installations highlighted in blue meet the min. avg. wind speeds required for wind energy (>6 m/s).
Red denotes wind speeds ≥7 m/s.

Wind Speed


287
87
20
35
10
10
Sheppard AFB
Red River AD
Lone Star AAP
Longhorn AAP
Fort Wolters
NAS and JRB Fort Worth
Fort Bliss
Dyess AFB
Goodfellow AFB
Fort Hood
Camp Swift
Camp Bullis
Fort Sam Houston
Randolph AFB
Ellington Field
Lackland AFB
Brooks City Base
Laughlin AFB
Kelly AFB
NALF Orange Grove
NS Ingleside*
NALF Cabaniss
NAS Corpus Christi
NALF Waldron
NAS Kingsville
Wind Speed (m/s)
at 80 meters
<6
6
6.5
7
7.5
8
8.5
9
>9
Wind Farms
Existing
Proposed
CREZ
Installations
*NS Ingleside is recommended to close according to 2005 Base Realignment and Closure (BRAC).
0
50
100
200 Miles

Wind Energy and Special Use Airspace (SUA)

With the large number of installations in Texas, there is an equally large area of special use airspace (SUA) set aside for military training activities. SUA when evaluated spatially with Texas' wind energy footprint, inevitably shows a significant overlap. For example, approximately 16% of the Central CREZ and 17% of the McCamey CREZ are also designated as SUA. There are ~3,500 square miles of CREZ in SUAs. Overall, 5% of military SUA overlap with wind energy CREZ.

CREZ name	Total SUA (sq. miles)	Total CREZ (sq. miles)
Central	1,904	11,471
Central West	424	2,950
McCamey	1,237	7,266
Panhandle A	2	7,039
Panhandle B	15	3,320
TOTAL	**3,582**	**32,045**

SUA Definitions

An **Alert** area is an airspace wherein a high volume of pilot training activities or an unusual type of aerial activity is conducted, neither of which is hazardous to aircraft.

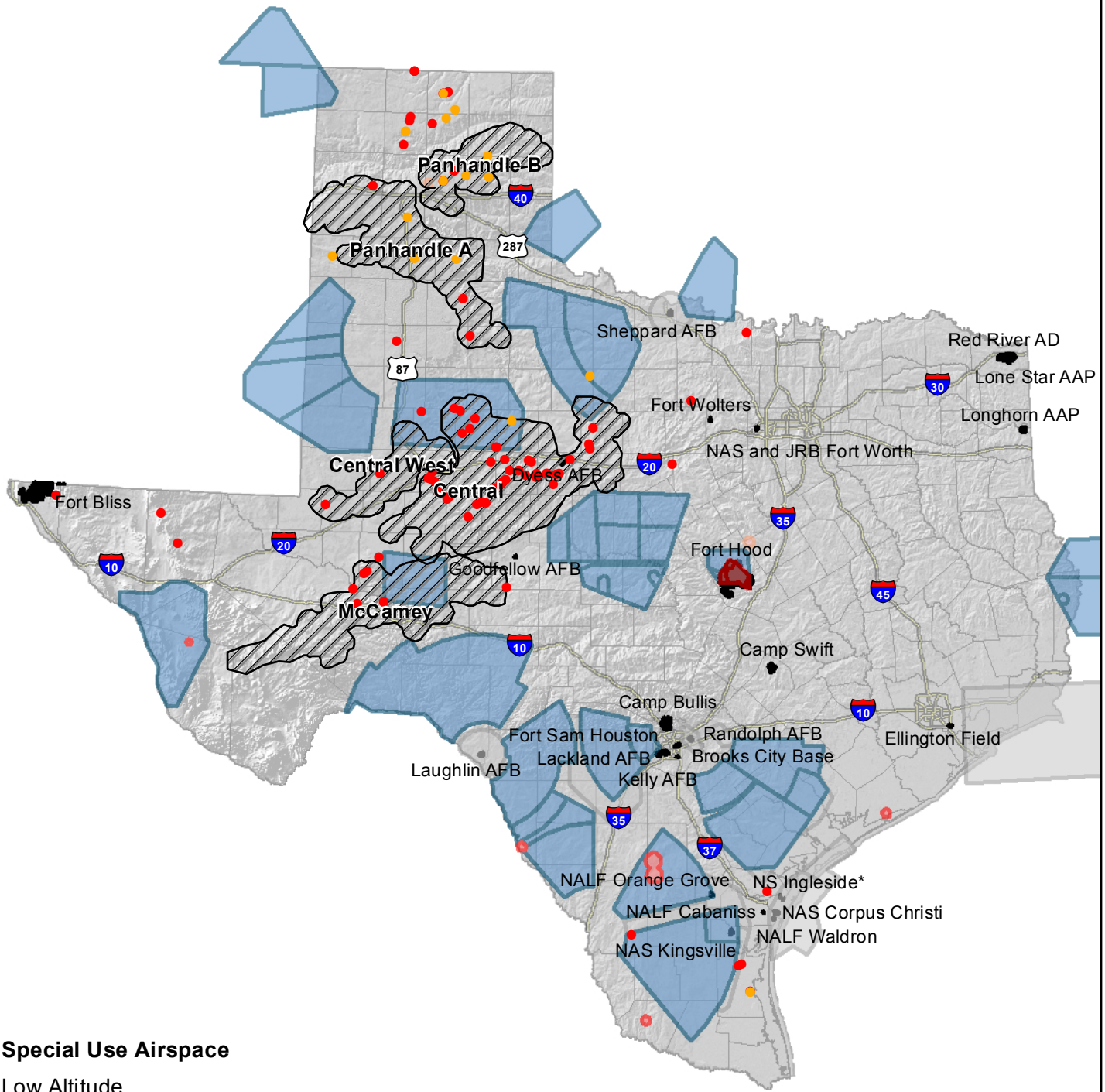
Military Operations Area (MOA) is airspace established outside of Class A airspace (18,000 to 60,000 feet) to separate or segregate certain non-hazardous military activities from IFR (Instrument Flight Rules) traffic and to identify for VFR (Visual Flight Rules) traffic where these activities are conducted. Examples of activities conducted in MOAs include, but are not limited to: air combat tactics, air intercepts, aerobatics, formation training, and low-altitude tactics.

A **Prohibited** area is airspace established under 14 CFR (Code of Federal Regulations) part 73 provisions, within which no person may operate an aircraft without permission of the using agency. Prohibited areas are established when necessary to prohibit flight over an area on the surface in the interest of national security and welfare. They normally extend from the surface upward to a specified altitude, with a "continuous" time of designation.

Restricted area is airspace established under 14 CFR part 73 provisions, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and IFR/VFR operations in the area may be authorized by the controlling ATC facility when it is not being utilized by the using agency.

A **Warning** area is airspace extending from 3 nautical miles outward from the coast of the United States, designated to contain activity that may be hazardous to nonparticipating aircraft.

Wind Energy and Special Use Airspace (SUA)



Wind Energy and Military Training Routes (MTR)

Military Training Routes (MTR) are another designation of military training airspace. MTRs include Slow, Visual, and Instrument routes and occur at elevations up to 10,000 feet. Like special use airspace, MTRs overlap with wind energy areas—~20% of total CREZ area overlaps with training routes. Slow routes, which exist between 250 and 1,500 feet, overlap with approximately 41% of the Central CREZ which encompasses Dyess Air Force base. There are approximately 22,000 miles of MTRs in Texas—10% of those are within the CREZ.

Visual Routes by CREZ			
CREZ Name	**Sq. Miles**	**CREZ (%)**	**Length (miles)**
Central	2,758	24	303
Central West	119	4	15
McCamey	2,845	39	214
Panhandle A	1,014	14	25
Panhandle B	513	15	38
Subtotal	**7,249**	**22**	**595**
Slow Routes by CREZ			
CREZ Name	**Sq. Miles**	**CREZ (%)**	**Length (miles)**
Central	4,728	41	975
Central West	122	4	12
McCamey	400	5	49
Panhandle A	867	12	111
Panhandle B	-	-	-
Subtotal	**6,117**	**19**	**1147**
Instrument Routes by CREZ			
CREZ Name	**Sq. Miles**	**CREZ (%)**	**Length (miles)**
Central	1,807	16	205
Central West	263	9	37
McCamey	3,497	48	313
Panhandle A	926	13	144
Panhandle B	628	19	95
Subtotal	**7,121**	**22**	**794**

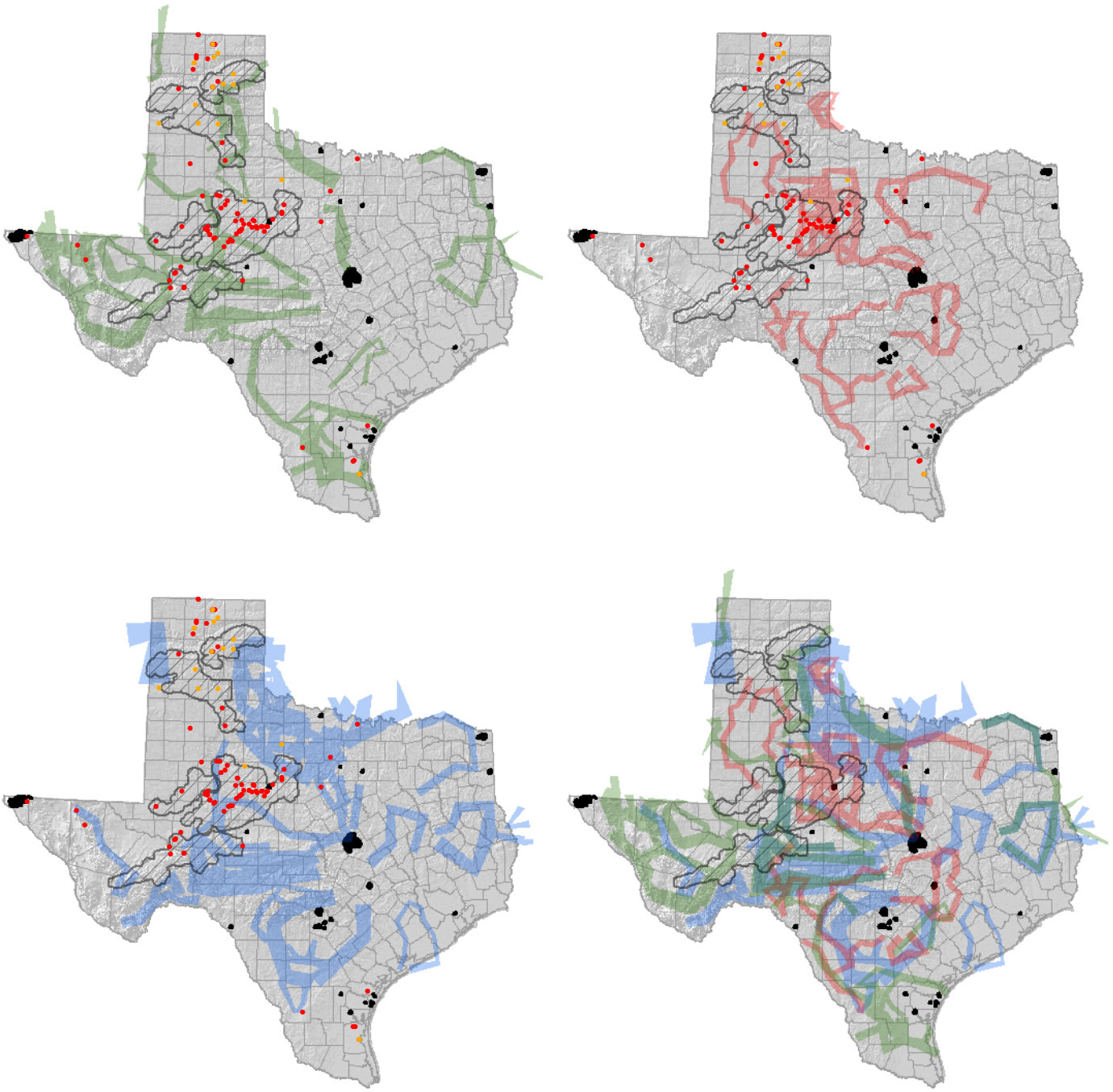
MTR Definitions

A **Slow Route** is airspace for aircraft operating below 250 knots and between 250 and 1,500 feet above ground level (AGL).

Visual Route is airspace at 10,000 feet mean sea level (MSL) and below that is generally developed to be flown under visual conditions or VFR. Visual routes are used for the purpose of conducting low altitude navigation and tactical training under VFR below 10,000 feet MSL at airspeeds in excess of 250 knots indicated air speeds (IAS).

An **Instrument Route** is airspace below 10,000 feet MSL developed to be flown, to the maximum extent possible, under IFR or instrument mode. Instrument routes are used for the purpose of conducting low altitude navigation and tactical training in both IFR and VFR weather conditions below 10,000 feet MSL at airspeeds in excess of 250 knots IAS.

Wind Energy and Military Training Routes (MTR)



Military Training Routes

- Instrument Routes
- Slow Routes
- Visual Routes

Wind Farms

- Existing
- Proposed

CREZ

Installations

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0 100 200 400 Miles

Wind Turbines and Radar Vectoring Areas

Radar Vectoring Areas (RVAs) are areas where navigational guidance is provided to aircraft using airport surveillance radar systems. Electromagnetic Interference (EMI) from industrial scale wind turbine arrays can adversely impact these radars and associated navigation systems. Incompatibility sited wind farms can cause clutter, false targets, lost targets, legitimate target disappearance, and legitimate target seduction. All these effects negatively impact RVA flight safety, effectiveness, and efficiency. They can temporarily erase aircraft from radar screens, and in some cases, mislead meteorologists into thinking a wind farm is a thunderstorm. Blades on wind turbines can rotate at speeds of up to 200 miles per hour, causing problems for radar systems to exactly locate specific objects such as aircraft.

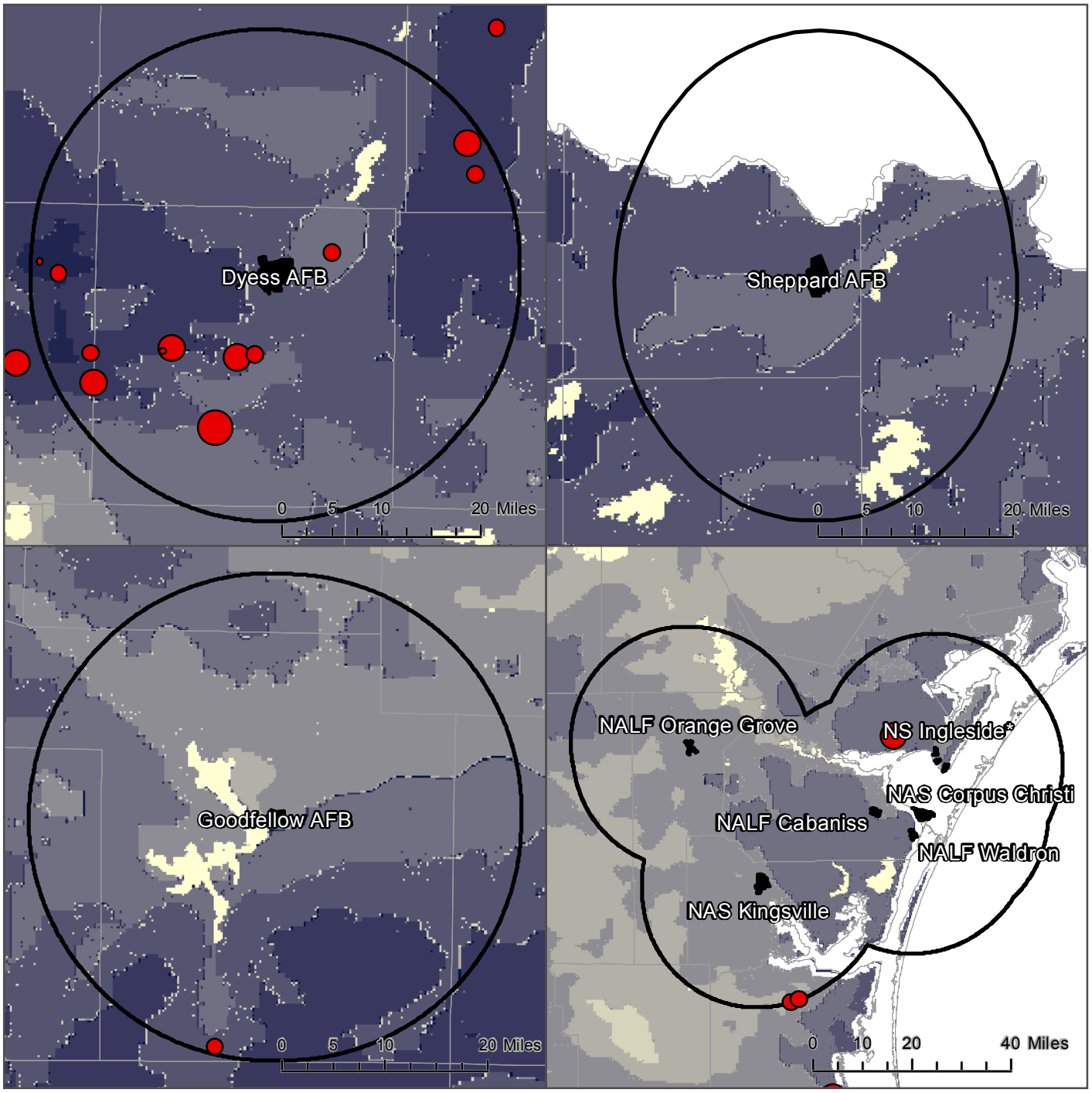
An installation's RVA is encompassed by a radius of 20 nautical miles around the installation. There are approximately 1,137 wind turbines within the RVA of Dyess AFB. Over 25% of the wind turbines along the coast in South Texas near the Naval Air Stations and Navy Landing Airfields surrounding Corpus Christi are within the RVAs of those installations.

The installations with the highest potential for further wind development (Dyess, Sheppard, Goodfellow and the Naval Air Stations and Navy Landing Airfields in South Texas surrounding Corpus Christi) have a total of 1,346 turbines—this comprises approximately 20% of the state's current turbine count. Fort Bliss is the only other installation to currently have turbines within its RVA.

Installations	# of Turbines within RVA
Dyess AFB	1,137
Sheppard AFB	-
Coastal Installations	109
Goodfellow AFB	100
Fort Bliss	2

	# Turbines	# Wind Farms
Existing	6,252	81
Proposed	888	17
Total	7,140	98

Wind Farms and Radar Vectoring Areas



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Sources

Layer	Source
Major Highways	Federal Highway Administration
Wind Speed	Adapted from a map of wind resource estimates developed by AWS Truewind and the National Renewable Energy Laboratory. (http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=tx)
Competitive Renewable Energy Zones (CREZ)	http://www.seco.cpa.state.tx.us/re_wind-transmission.htm) The Electric Reliability Council of Texas (ERCOT)
Special Use Air Space	National Geospatial-Intelligence Agency
Military Installations	Office of the Secretary of Defense Installation Visualization Tool (OSD IVT) Office
Military Training Routes	National Geospatial-Intelligence Agency
Developed Areas	Digitized by IRNR staff from 1995 Digital Ortho Quarter Quads (DOQQs) and 2008 National Agriculture Imagery Program (NAIP) imagery
Wind Farms	Georeferenced by IRNR staff based on locations given from: West Texas A&M University Alternative Energy Institute (www.windenergy.org) *(spreadsheet)* Multiple websites from attribute table with additional location info: Global Energy Observatory (http://openmodel.newmexicoconsortium.org/geo/form.php?pid=6061) Open Energy Info (http://en.openei.org/wiki/Map_of_Wind_Farms) Higher Power Energy, LLC (http://www.hpnrg.com/projects.html) Renewable Energy Systems Ltd. (http://www.res-americas.com/wind-farms/operational.html) The Wind Power Wind Turbines and Wind farms Database (http://www.thewindpower.net/wind-farm-3203.php) NRG Energy, Inc. (http://www.nrgenergy.com/index.htm) Open Access Technology International, Inc. (http://www.oatioasis.com/FPL/FPLdocs/CompanyEnergyAffiliate.pdf)

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