TO: All Interested Parties JS

FROM: Jessica Schultz, Deputy Director, Weather Surveillance Radar - Model 1988 Doppler (WSR-88D) Radar Operations Center (ROC)

SUBJECT: Lowering the Minimum Scan Angle of the KMOB WSR-88D serving the Mobile, AL, area

DATE: September 13 2023

In accordance with provisions of the National Environmental Policy Act of 1969, the WSR-88D ROC prepared a Draft Environmental Assessment (EA) analyzing the potential environmental effects of lowering the minimum scan angle of the KMOB WSR-88D serving the Mobile AL, area. The Draft Environmental Assessment is available for public review and comment. The Draft EA may be obtained at:

https://www.roc.noaa.gov/WSR88D/SafetyandEnv/EAReports.aspx

The KMOB WSR-88D is an existing radar facility located at Mobile Regional Airport about 12 miles west of downtown Mobile in Mobile County, AL. The KMOB WSR-88D, commissioned in 1994, is one of 159 WSR-88Ds in the nationwide network. The KMOB WSR-88D antenna transmits a narrow focused main beam with a width of 1 degree. In normal operation, the radar antenna rotates horizontally to cover all directions (i.e., azimuths). The radar antenna also varies the scan angle at which it points with respect to the horizon. Currently, the WSR-88D operates at a minimum of scan angle of +0.5 degrees (deg) above the horizon. The ROC proposes to reduce the minimum scan angle of the KMOB WSR-88D from the current minimum of +0.5 deg to +0.2 deg (i.e., 0.3 deg lower than existing) to provide enhanced coverage of the lower portions of the atmosphere. No construction activities or physical modification of the KMOB WSR-88D would be required to implement the proposed action; the only change would be to the radar's operating software.

The ROC will accept written comments on the Draft EA until October 23, 2023. Please submit comments via either email or regular mail to:

James Manitakos
Sensor Environmental LLC
296 West Arbor Avenue
Sunnyvale, CA 94085-3602

Email: jmanitakos@sensorenvirollc.com

Comments sent by regular mail must be postmarked October 23, 2023. After the end of the Draft EA review period, the ROC will prepare a Final EA containing responses to all comments. The government will not make any decision on implementing the proposed action until completion of the environmental review. Thank you for your interest in this important project.

SENSOR ENVIRONMENTAL LLC
www.sensorenvirollc.com

Draft Environmental Assessment Report • September 2023

ENVIRONMENTAL ASSESSMENT (EA)

LOWERING THE MINIMUM SCAN ANGLE OF THE WEATHER SURVEILLANCE RADAR - MODEL 1988, DOPPLER (WSR-88D) SERVING THE MOBILE, ALABAMA, AREA

Prepared by

James Manitakos, Project Manager
Sensor Environmental LLC
296 West Arbor Avenue
Sunnyvale, CA 94085

Andre Tarpinian, Radio Frequency Engineer
Huntington Ingalls Industries Mission Technologies / Alion Science and Technology
8350 Broad Street, Suite 1400
McLean, VA 22102

Prepared for

Ryan Groce
Centuria Corporation
11800 Sunrise Valley Drive, Suite 420
Reston, VA, 20191

This page intentionally left blank.

Executive Summary

The Weather Surveillance Radar, Model 1988 Doppler (WSR-88D) Radar Operations Center (ROC) is composed of representatives from the National Weather Service (NWS) of the Department of Commerce, the Air Force Weather Agency (AFWA) of the Department of Defense, and the Federal Aviation Administration (FAA) of the Department of Transportation. The ROC operates the existing WSR-88D serving the Mobile, AL, area. The International Civil Aviation Organization designator for the radar is KMOB and the radar is located at Mobile Regional Airport about 12 miles west (W) of downtown Mobile, Mobile County, AL. The KMOB WSR-88D was commissioned in September 1994 and has been in continuous operation since 1994. It is one of 159 WSR-88Ds in the nationwide network.

The KMOB WSR-88D is an S-band Doppler, dual polarized weather radar, which ROC uses to collect meteorological data to support weather forecasts and severe weather warnings for the Mobile, AL, area. The KMOB WSR-88D antenna transmits a narrow focused main beam with a width of 1 degree. In normal operation, the WSR-88D antenna rotates horizontally to cover all directions (i.e., azimuths). The radar antenna also varies the scan angle at which it points with respect to the horizon. The scan angle is measured along the axis of the main beam and can be changed in 0.1 deg increments. Currently, the KMOB WSR-88D operates at a minimum of scan angle of +0.5 degrees (deg) above the horizon. ROC proposes to reduce the minimum scan angle of the KMOB WSR-88D from the current minimum of +0.5 deg to +0.2 deg (the proposed action). Lowering the minimum scan angle would provide enhanced coverage of the lower portions of the atmosphere. No construction activities or physical modification of the KMOB WSR-88D would be required to implement the proposed action; the only change would be to the radar's operating software.

In April 1993, ROC prepared a National Environmental Policy Act (NEPA) document titled, *Supplemental Environmental Assessment (SEA) of the Effects of Electromagnetic Radiation from the WSR-88D Radar*. That document analyzed operating the WSR-88D at a minimum scan angle of +0.5 degree (deg). This Draft EA builds on that prior study by examining the possible effects of operating the KMOB WSR-88D at a minimum scan angle of +0.2 (i.e., 0.3 deg lower than the minimum scan angle examined in the April 1993 SEA). Operating this radar at a lower scan angle would increase the area of radar coverage, providing additional data on atmospheric conditions to ROC forecasters and other data users. The area covered at 2,000 ft above site level (ASL) would increase by 74.8%. The range of 2,000 ft coverage over the Gulf of Mexico would increase by about 23 miles and the radar coverage over Biloxi, MS, would decrease in altitude from about 1,240 to 220 ft above ground elevation. This radar coverage improvement would be very beneficial to weather forecasters and others parties (e.g., public safety agencies and emergency responders) using the radar information.

A minimum scan angle of +0.2 deg would not result in the main bean impinging on any terrain or structures within the safe setback distances for human exposure, implantable medical devices, safe electro-explosive devises (EEDs), or fuel handling. The Mobile Regional Airport ATCT and three communications within safe setback distances for Hazard of unsafe/unreliable EEDs would be illuminated by the WSR-88D main beam, but this it is improbable that unsafe/unreliable EEDs would be in use at those structures. No astronomical observatories are located within 150 miles of the KMOB WSR-88D; the proposed action would not result in adverse effects to astronomical observatories. Radiofrequency (RF) exposure levels in the vicinity would slightly increase. As shown in Table S-1, during normal operation of the radar with rotating antenna, RF exposure would comply with the safety standards developed by the Institute of Electrical and Electronic Engineers (IEEE) and adopted by the American National Standards Institute (ANSI) for the general public and workers. Federal Communications Commission (FCC) and Occupational safety and Health Administration (OSHA) safety levels would also be met at all locations.

Table S-1: RF Power Density within Main Beam of KMOB WSR-88D at Minimum Scan Angle of +0.2 deg Compared to ANSI/IEEE Safety Standards

Location / Distance from Radar	Time-Averaged Power Density (mW/cm^2)	ANSI/IEEE General Public RF Safety Standard		ANSI/IEEE Occupational RF Safety Standard	
		Safety Standard (mW/cm^2)	Factor Below Std	Safety Standard (mW/cm^2)	Factor Below Std
Surface of Radome	0.602	1.0	1.66	5.0	8.3
Closest Structure: ATCT, 3,900 ft NNW	0.00038	1.0	2,600	5.0	13,100
Closest Terrain: 6,400 ft ESE	0.00020	1.0	5,000	5.0	25,000

During infrequent stationary antenna operation, RF exposure levels within the WSR-88D main beam would exceed ANSI/IEEE and FCC safety levels for exposure of the general public within 1,740 ft of the WSR-88D antenna. FCC and ANSI/IEEE occupational safety levels would be exceeded within 777 ft. The KMOB WSR-88D operating at +0.2 deg would not impinge on the ground surface or any structures within those distance and risks to human health would not result.

Because the KMOB WSR-88D operates in a frequency band dedicated to government radiolocation services and the main beam would not impinge on the ground surface in the radar vicinity, the proposed action would not cause radio interference with television, radio, cellular telephone, personal communications devices (PCDs), electro-explosive devices, fuel handling, or active implantable medical devices.

Lowering the minimum scan angle of the KMOB WSR-88D would not require physical changes to the radar, vegetation removal, or ground disturbance. The proposed action would not result in significant effects in the following subject areas:

- Land Use and Coastal Zone Management
- Geology, Soils, and Seismic Hazards
- Drainage and Water Quality
- Transportation
- Air Quality
- Flood Hazards
- Wetlands
- Biological Resources / Protected Species
- Cultural and Historic Resources
- Environmental Justice / Socioeconomic Impacts
- Farmlands
- Energy Consumption
- Visual Quality/ Light Emissions
- Solid and Hazardous Waste
- Wild and Scenic Rivers

ROC evaluated the benefits and potential impacts of lowering the minimum center of beam scan angle of the KMOB WSR-88D to each angle between +0.4 and +0.0 deg in 0.1 degree increments. Operating the KMOB WSR-88D at alternative minimum scan angle of +0.4 or +0.3 deg would result in similar environmental effects as the proposed action. Like the proposed action, environmental impacts would not be significant. A minimum scan angle of +0.4 or +0.3 deg would increase the radar's coverage area, but by less than the proposed action (i.e., minimum scan angle of +0.2) deg. Minimum scan angles lower than +0.2 deg would not increase coverage area and would result in increased ground clutter returns. Thus, a minimum scan angle of +0.2 deg is the most beneficial among those considered by the ROC.

The no action alternative would result in continued operation of the KMOB WSR-88D at the existing minimum scan angle of +0.5 deg. The improvements in radar coverage resulting from the proposed project would not be achieved. The no-action alternative would not change RF exposure levels from existing. Under both the proposed action and the no action alternative, RF exposure during normal WSR-88D operations would conform to safety standards established by ANSI/IEEE, OSHA, and FCC. Similar to the proposed action, the no-action alternative would not cause significant effects to the natural or man-made environment.

The ROC will distribute the Draft EA to interested members of the public and government agencies for review and comment. Comments on the Draft EA will be accepted by ROC during a minimum 30-day comment period which will end on October 23, 2023. The ROC will provide official responses to all pertinent comments received during the Draft EA comment period in a

Final EA report. The ROC will make a decision whether to implement the proposed lowering of the KMOB WSR-88D minimum scan angle after the Final EA report is completed.

CONTENTS

FIGURES

TABLES

ABBREVIATIONS

AAMI	Association for Advancement of Medical Instrumentation
AFB	Air Force Base
AFWA	Air Force Weather Agency
AGL	above ground level
AL	Alabama
ANSI	American National Standards Institute
ASL	above site level
ATCT	Airport Traffic control Tower
Deg	degree(s)
CMP	Coastal Management Program
DoA	Department of Agriculture
E	east
EA	Environmental Assessment
E.O.	Executive Order
EED	electro-explosive device
EMI	electromagnetic interference
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
ft	foot, feet
HERO	Hazards of Electromagnetic Radiation to Ordnance
IEEE	Institute of Electrical and Electronics Engineers
JSPO	Joint System Program Office
KMOB	WSR-88D serving the Mobile, AL, area
m	meter(s)
MBTA	Migratory Bird Treaty Act (of 1918)
MHz	megahertz
mi	mile(s)
MPE	maximum permissible exposure
MSL	mean sea level
mW/cm^2	milliwatts per square centimeter
NAO	NOAA Administrative Order
N	north
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar (also known as WSR-88D)
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NTIA	National Telecommunications and Information Agency
NE	northeast
NW	northwest
NWS	National Weather Service
PEIS	Programmatic Environmental Impact Statement
RF	radiofrequency

ROC	Radar Operations center
S	south
SE	southeast
SW	southwest
SEA	Supplemental Environmental Assessment
SHPO	State Historic Preservation Office
sq mi	square mile(s)
std	standard
U.S.	United States
USAF	U.S. Air Force
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
W	west
WSR-88D	Weather Surveillance Radar – 1988, Doppler

1 BACKGROUND AND SCOPE OF REPORT

1.1 BACKGROUND

The Weather Surveillance Radar, Model 1988 Doppler (WSR-88D) Radar Operations Center (ROC) is composed of representatives from the National Weather Service (NWS) of the National Oceanic and Atmospheric Administration within the Department of Commerce, the Air Force Weather Agency (AFWA) of the Department of Defense, and the Federal Aviation Administration (FAA) of the Department of Transportation. The ROC operates a nationwide network of 159 weather radars that provide critical real-time information on atmospheric conditions to weather forecasters.

The network radars operated by ROC are named Weather Surveillance Radar-Model 1988 Doppler (WSR-88D) after the year they were first put into service and their capabilities to use Doppler shift measurements to determine wind velocities. They are also known as Next Generation Weather Radars (NEXRADs). Like all active radars, the WSR-88D transmits a radio signal, which reflects off targets and returns to the radar. The radar measures the strength of the return signal, its direction of return, and the time between transmission and return, which allows determination of the target characteristics. Because the WSR-88D has the potential to cause electromagnetic effects on the environment, ROC carefully considered these effects and strives to prevent effects, or when effects cannot be avoided, mitigate the significance of those effects. To that end, the NEXRAD Joint System Program Office (JSPO) prepared environmental reports evaluating potential electromagnetic effects of the WSR-88D during planning and implementation of the WSR-88D network. In 1984, the JSPO issued the first environmental document which considered electromagnetic effects (among other effects). That report is titled: *Next Generation Weather Radar Programmatic Environmental Impact Statement (PEIS), Report R400-PE201* [ROC, 1984]. In 1993, JSPO issued a supplemental report updating the analysis contained in the 1984 PEIS to account for changes since 1984 in electromagnetic standards and guidelines and developments in radar design and operational modes. The supplemental report is titled *Final Supplemental Environmental Assessment (SEA) of the Effects of Electromagnetic Radiation from the WSR-88D Radar* [NEXRAD JSPO, 1993]. The 1993 SEA analyzed the potential electromagnetic effects of operating the WSR-88D at a minimum scan angle of +0.5 degree (deg) above horizontal, measured at the center of the WSR-88D main beam. The minimum scan angle of +0.5 deg represented the lowest scan angle used by WSR-88Ds at that time.

The ROC operates the WSR-88D serving the Mobile, AL, area. The radar identifier is KMOB and the radar is located at Mobile Regional Airport about 12 miles west (W) of downtown Mobile, AL. The KMOB WSR-88D is part of the nationwide WSR-88D network. The ROC proposes to operate the KMOB WSR-88D at a minimum scan angle of +0.2 deg above the horizon which is lower than the current minimum scan angle of +0.5 deg above the horizon. Operating the KMOB WSR-88D at this lower scan angle was not analyzed in the 1993 SEA.

The ROC follows procedures established by National Oceanic and Atmospheric Administration (NOAA), the parent agency of NWS, for evaluation of the potential environmental consequences to comply with the National Environmental Policy Act (NEPA). Procedures to be followed are set forth in NOAA Administrative Order (NAO) 216-6A (NOAA, 2016). Because ROC's proposed action of operating the KMOB WSR-88D at a minimum scan angle below +0.5 deg has the potential to cause environmental effects, there is a need to analyze potential environmental consequences, determine their significance, and develop measures to mitigate adverse impacts if necessary.

1.2 SCOPE OF REPORT

This Draft EA report analyzes the potential effects on persons and activities in the vicinity that could result from implementing the proposed action (i.e., lowering the KMOB WSR-88D minimum scan angle to +0.2 deg). Potential environmental effects of alternative minimum scan angles and the no-action alternative (i.e., continued operation of the KMOB WSR-88D at the current minimum scan angle of +0.5 deg) are also considered for comparison purposes. As part of that analysis, the findings of the 1993 SEA have been updated to account for changes in safety standards and guidelines that have been occurred since 1993 and site -specific conditions at the KMOB WSR-88D site and vicinity. The scope of this EA is limited to analyzing potential effects from lowering the minimum scan angle of the KMOB WSR-88D. Because the types of electromagnetic effects that may result and their significance depends on local conditions, uses and topography, the analysis and findings in this EA are specific to the KMOB WSR-88D, and do not apply to other WSR-88Ds or the WSR-88D network as a whole.

2 PURPOSE AND NEED

NWS is the nation's premiere meteorological forecasting organization. The agency's official mission is as follows:

> "The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community [NWS, 2009]".

The ROC supports NWS mission by operating a nationwide network of 159 WSR-88Ds. Data from the WSR-88Ds is used to improve the accuracy of meteorological forecasts, watches, and warnings. As an example, the WSR-88D generates precipitation estimates allowing prediction of river flooding in hydrological basins of the area. NWS disseminates advance flood warnings to local and state public safety, emergency managers, and the public, allowing them to take appropriate actions to minimize hazards to life and property. Because the meteorological phenomena of greatest interest occur with a few thousand feet (ft) of the ground surface, radar coverage of lower portions of the atmosphere is of great value to forecasters.

The elevation above the ground at which the WSR-88D can collect atmospheric data increases with distance from the radar due to earth curvature and the upward tilt of the radar beam, which is currently +0.5 deg or greater. Lowering the KMOB WSR-88D minimum scan angle to +0.2 deg (the proposed action) would expand the geographic area with radar coverage below 10,000 ft AGL, a substantial benefit to forecasters and other users of WSR-88D data. This EA report describes the improvements in radar coverage that would result if the ROC operates the KMOB WSR-88D serving the Mobile, AL, area at a minimum scan angle of +0.2 deg and the environmental effects that may result.

The National Oceanic and Atmospheric Administration (NOAA) is the parent agency of the NWS and the ROC follows NOAA requirements for complying with the National Environmental Policy Act (NEPA) are contained in NOAA Administrative Order (NAO) 216-6A, *Compliance with the National Environmental Policy Act, Executive Orders 12114, Environmental Effects Abroad of Major Federal Actions; 11988 and 13690, Floodplain Management; and 11990 Protection of Wetlands* (NOAA, 2016)], and the Companion Manual for NOAA Administrative Order 216-6A; Policies and Procedures for Compliance with the National Environmental Policy Act and Related Authorities (NOAA, 2017). ROC is subject to those requirements. Appendix E of the NOAA Companion Manual specifies the proper level of NEPA review for actions proposed by NOAA components and lists types of actions that are categorically excluded from the need to prepare a NEPA analysis document (e.g., an EA or environmental impact statement [EIS]). Categorical Exclusion G6, which addresses NEXRAD Radar Coverage, states that

"Actions that change the NEXRAD radar coverage patterns that do not lower the lowest scan angle and do not result in direct scanning of previously non-scanned terrain by the NEXRAD main beam" are categorically excluded from NEPA (NOAA, 2017). The proposed action would not meet these specifications and does not qualify for categorical exclusion treatment. Therefore, NEPA analysis is required for the proposed lowering of the KMOB WSR-88D minimum scan angle to +0.2 deg; this EA report satisfies that requirement.

3 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

3.1 PROPOSED ACTION

3.1.1 DESCRIPTION OF KMOB WSR-88D

The WSR-88D network collects data on weather conditions and provides critical inputs to forecasters. The network is composed of 159 radars, most of which were installed in the late 1980s and 1990s. Each radar includes a roughly 28-ft diameter dish antenna mounted on a steel lattice tower of varying height (depending on local conditions), and shelters housing electronic equipment, a standby power generator and fuel tank, and a transitional power maintenance system. The dish antenna rotates 360 deg and is covered by a fiberglass radome to protect it from the elements.

Figure 1 is a photograph of the KMOB WSR-88D, which was commissioned in September 1994 and has been in continuous operations since being commissioned. The KMOB WSR-88D serves the Mobile, AL, area and is operated by the ROC. The KMOB WSR-88D is located is located at Mobile Regional Airport, about 12 miles west of downtown Mobile, Mobile County, AL (see Figure 2). The radar antenna, radome, and steel-lattice tower are standard. Table 1 provides information on the KMOB WSR-88D.

Table 1: Information on KMOB WSR-88D serving the Mobile, AL, area

Elevation, ground surface at tower base (mean sea level, MSL)	208 ft
Elevation, center of antenna (MSL)	290 ft
Tower Height (m)	20 m (66 ft)
Latitude (WGS84)	30° 40’ 46” N
Longitude (WGS84)	88˚ 14’ 23” W
Operating Frequency	2,720 megaHertz (MHz)
Spot Blanking or Sector Blanking used	No

3.1.2 Proposed Change in Minimum Scan Angle

The WSR-88D is designed to detect and track weather phenomena within a roughly 230 mi distance of the radar. It accomplishes this task by emitting a narrow main beam from a rotating dish antenna. The antenna rotates continuously around a vertical axis to cover the surrounding area. The main beam scan angle is the number of degrees above or below horizontal at the center of the main beam. The upward tilt of the antenna (and therefore the scan angle of the main beam) can be changed, allowing the radar to scan the sky at angles up to + 60.0 deg and down to -1.0 deg; however, in current operation, the maximum scan angle is +19.5 deg and the minimum scan angle is +0.5 deg.

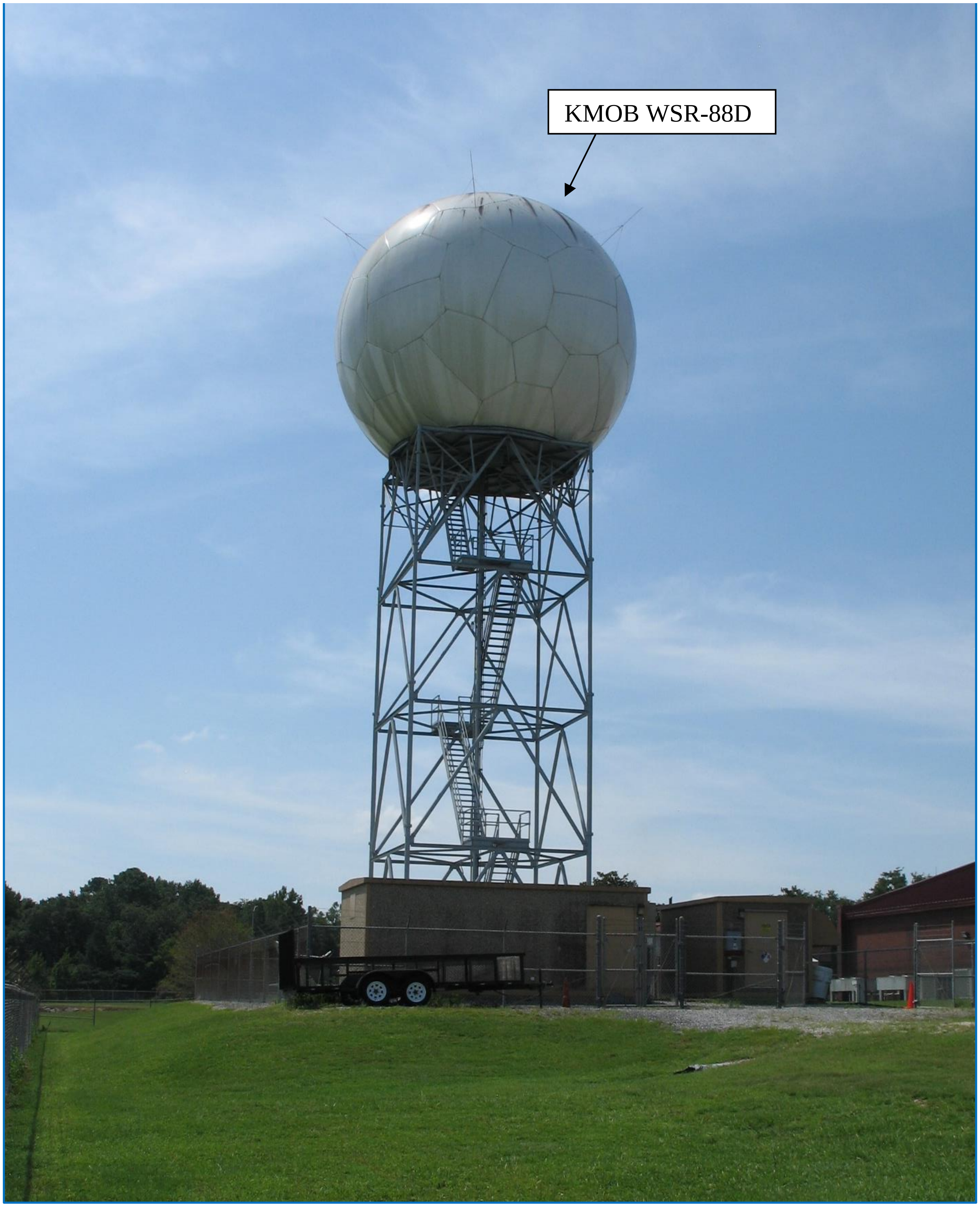


Figure 1: Photograph of KMOB WSR-88D serving Mobile, AL, area

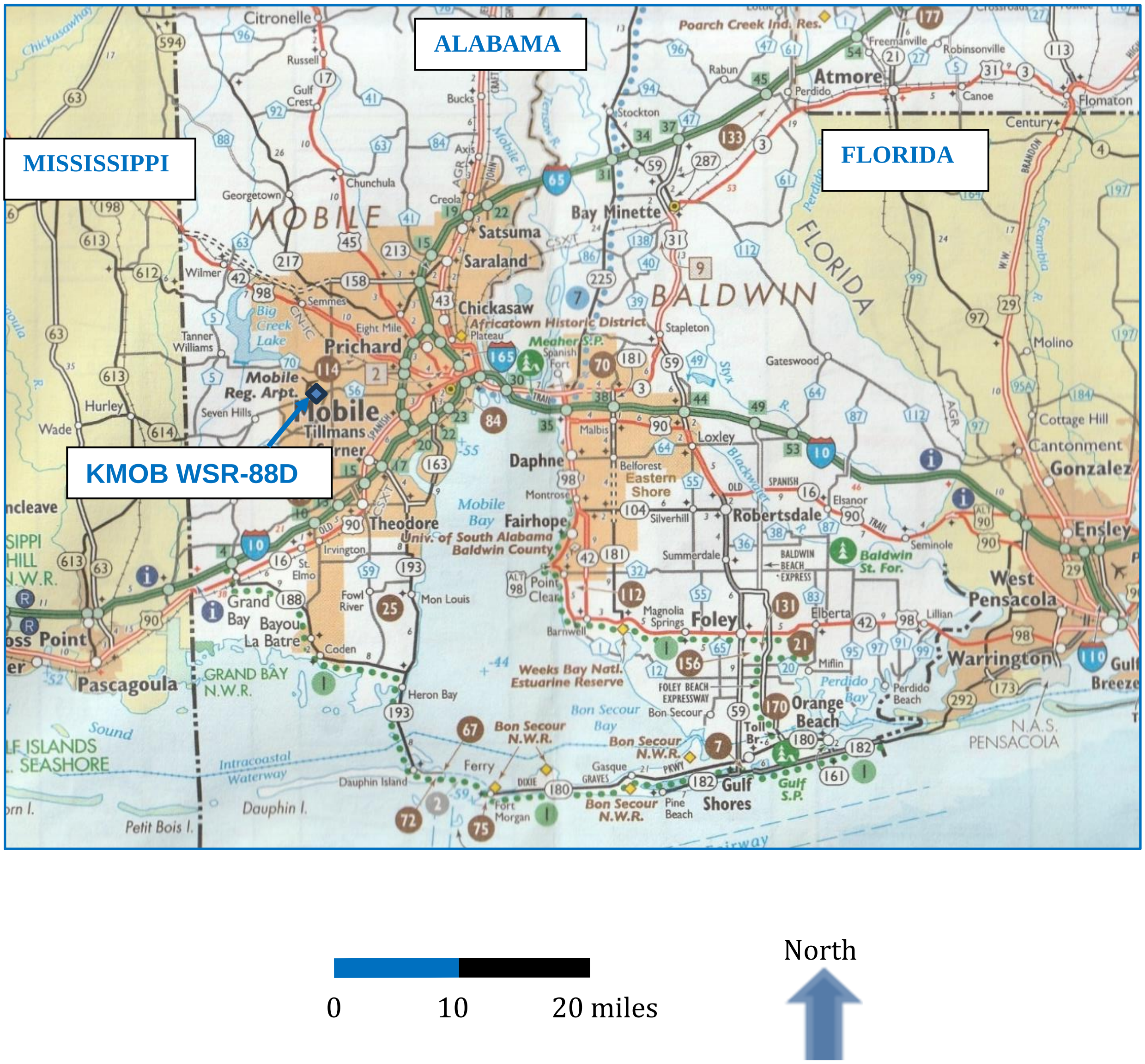


Figure 2: Location of KMOB WSR-88D

The WSR-88D main beam has a total width of 1 deg in the horizontal and vertical directions (i.e., beam edge is ½ deg from the center of the beam), as shown in Figure 3. The power density of the WSR-88D is greatest at the center of the beam and decreases towards the edge of the beam. At the edge of the main beam, the power density is one half of the center of beam power density. In current operation, the minimum scan angle of the main beam is +0.5 deg (i.e., 0.5 deg above horizontal at the center of the main beam) and the lower edge of the main beam (i.e., lower half-power point) is at 0.0 deg or horizontal. ROC proposes to reduce the minimum center of beam scan angle to +0.2 deg, which is 0.3 deg lower than the current minimum scan angle, placing the lower edge of the main beam at -0.3 deg.

Figure 4 is a schematic drawing showing the change in coverage that would result from lowering the KMOB WSR-88D minimum scan angle. The floor of coverage would decrease slightly. Because the lowered radar main beam would not be significantly obstructed by nearby terrain, buildings, or trees, the radar would cover portions of the atmosphere which are currently not covered. Table 2 shows the improvement in radar coverage that would be achieved, which ranges from 74.8% increase in coverage area at 2,000 ft above site level (ASL) to 31.0% increase at 10,000 ft ASL. Coverage at 2,000 ft elevation over the Gulf of Mexico would extend from the current 60 miles south (S) of the Gulf shoreline to about 83 miles. Figures 5, 6, and 7 show the improvement in radar coverage that would be achieved at 2,000 ft, 5,000 ft, and 10,000 ft ASL, respectively. The improvement in WSR-88D coverage would be beneficial to NWS and AFWA forecasters and other users of radar data (e.g., emergency response mangers, water managers, farmers, transportation officials).

Table 2: Existing and Proposed Radar Coverage Areas for KMOB WSR-88D

Minimum Center of Beam Scan Angle (deg)	Coverage Floor (deg)	Area Covered (sq. mi.)		
		2,000 ft ASL	5,000 ft ASL	10,000 ft ASL
+0.5 (existing)	0.0	10,970	27,920	56,740
+0.2 (proposed)	-0.3	19,181 (+74.8%)	40,550 (+45.2%)	74,359 (+31.0%)

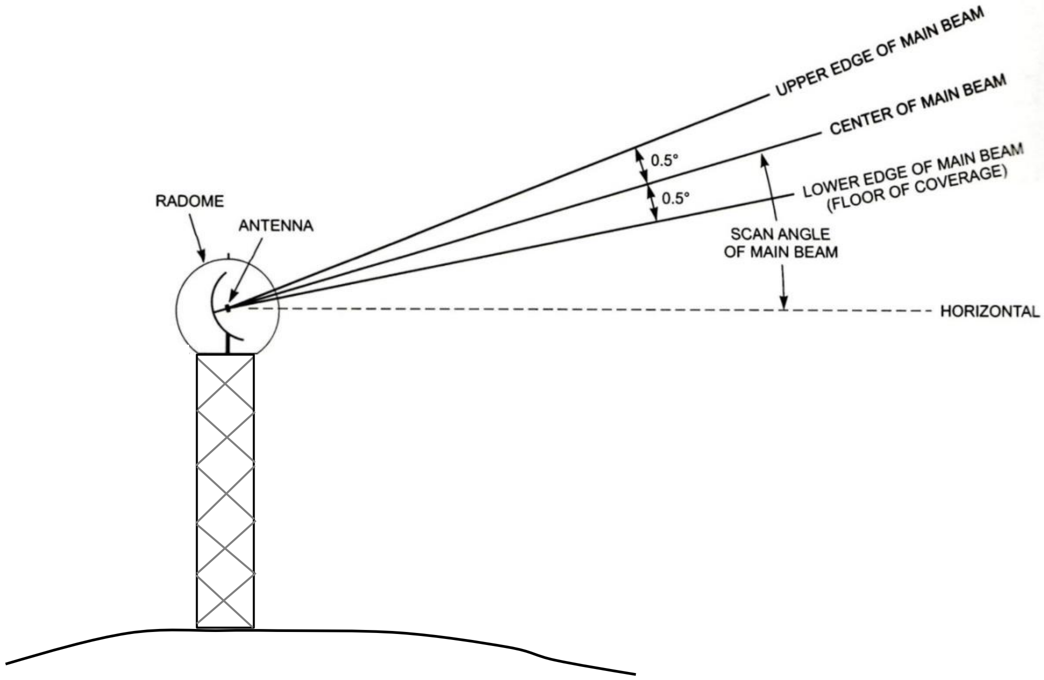


Figure 3: Schematic of WSR-88D Main beam

(Not to scale, width of main beam exaggerated)

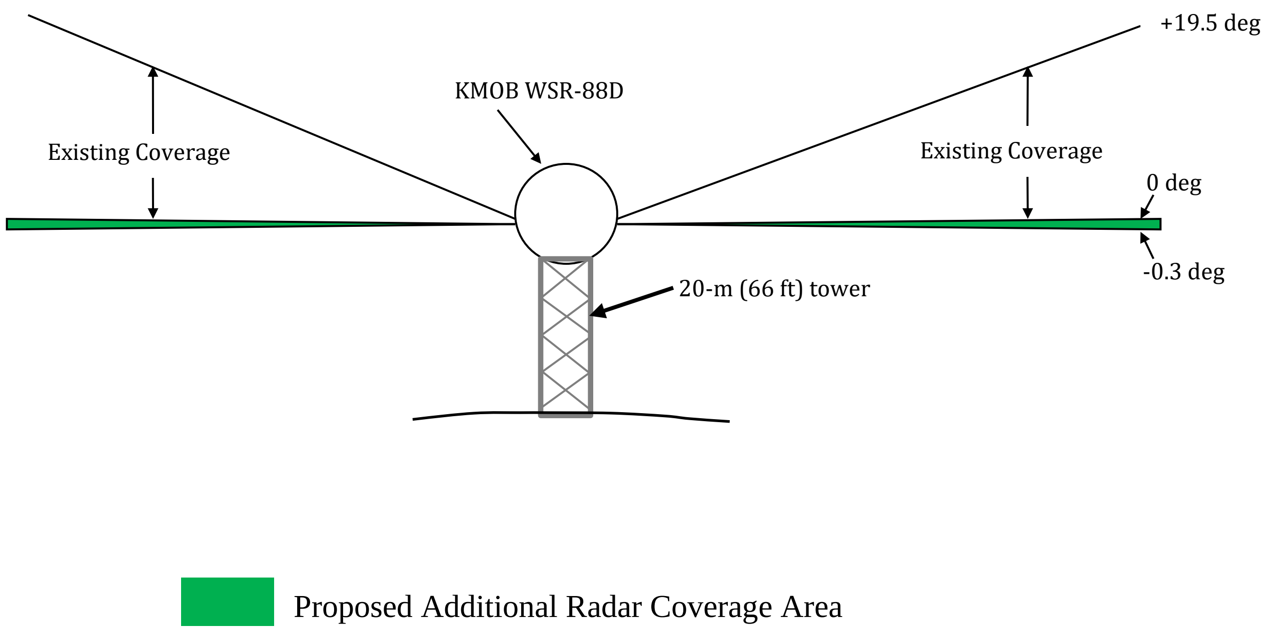


Figure 4: Drawing of Proposed Additional Radar Coverage

Figure 5: Existing and Proposed KMOB WSR-88D Coverage at 2,000 ft ASL

Figure 6: Existing and Proposed KMOB WSR-88D Coverage at 5,000 ft ASL

Figure 7: Existing and Proposed KMOB WSR-88D Coverage at 10,000 ft ASL

The City of Biloxi, MS, located 44 miles WSW of the KMOB WSR-88D, and nearby coastal areas are areas of concern. Currently the floor of radar coverage is at an altitude of about 1,240 ft over Biloxi. Lowering the minimum scan angle of the radar to +0.2 deg would lower the altitude of the radar coverage floor to about 220 ft over Biloxi, MS.

The existing WSR-88D transmitter and antenna are physically equipped to operate at the proposed minimum scan angle. The only change required to implement the proposed change would be modifications to the software that controls radar operations and processes data collected by the radar. No construction activities or ground disturbance would be required to implement the proposed action. The transmit power of the radar would also be unchanged.

3.2 ALTERNATIVES

NAO 216-6A requires analysis of the no-action alternative in EAs. For purposes of this EA report, the no-action alternative is defined as continuing to operate the KMOB WSR-88D serving the Mobile, AL, area with the current minimum center of main beam scan angle of +0.5 deg. This is the same minimum scan angle used by most other WSR-88Ds in the nationwide network. The no-action alternative and alternative minimum scan angles (other than the proposed action of +0.2 deg) between +0.4 and 0.0 deg are analyzed in Section 5 of this EA.

4 ENVIRONMENTAL SETTING, CONSEQUENCES, AND MITIGATION

4.1 EXPOSURE OF PERSONS TO RADIOFREQUENCY RADIATION

4.1.1 SAFETY STANDARDS

The electromagnetic environment at a specific location and time is composed of the all the electromagnetic fields from various sources (natural and manmade) that arrive there. The electromagnetic spectrum in an area is a continuously usable resource whose dimensions are amplitude, time, frequency, and space. In areas large enough to permit adequate spatial separation of users, the electromagnetic spectrum can simultaneously accommodate many users if they are sufficiently separated in frequency. The electromagnetic environment at any point can change nearly instantaneously and will vary spatially, even at locations in proximity; therefore, it is convenient to measure and characterize electromagnetic phenomena using averages over time and space.

Manmade contributions to the electromagnetic environment are both intentional and unintentional. Radio and television broadcasts, cellular telephone transmissions, and radar signals are examples of intentional contributions. Electromagnetic noise generated by power lines, fluorescent lights, and motors of all sorts are examples of unintentional human contributions. The KMOB WSR-88D transmits a radio signal at a frequency of 2,720 MHz, which is within the radiofrequency (RF) or microwave portion of the electromagnetic spectrum. Although microwaves can add heat to objects, they do not contain enough energy to remove electrons from biological tissue, and are a form of non-ionizing radiation. In this regard, microwaves are fundamentally different from ionizing radiations (e.g., X-rays, ultraviolet rays) which occur at higher frequency portions of the electromagnetic spectrum. Ionizing radiation occurs only at frequencies greater than 10^9 MHz. RF or microwave fields are non-ionizing radiation. Due to the fundamental differences between ionizing and non-ionizing radiation, safety standards and guidelines vary greatly for the two types of electromagnetic radiation. In this section only standards for non-ionizing radiation are addressed because KMOB WSR-88D RF emissions are non-ionizing.

The Institute of Electrical and Electronics Engineers (IEEE) developed safety guidelines for human exposure to RFR, and those standards have been adopted by the American National Standards Institute (ANSI) [ANSI/IEEE, 2019 and 2020]. The ANSI/IEEE safety standard is designed to protect all persons (including infants, elderly persons, and pregnant women) from adverse health effects from exposure to radiofrequency (RF), even if exposure should last over an entire lifetime. These guidelines set safety levels for maximum permissible exposure (MPE) to RF signals, which include a 10- to 50-fold safety margin and are intended to protect all members of the population.

MPEs are specified in power density of the radio signal in milliwatts per square centimeter (mW/cm^2) and vary with operating frequency. Separate MPEs have been established for exposure of the general public and workers and for time-averaged exposure and peak exposure. Occupational safety standards are higher than those for the general public because workers are trained in RF safety practices and have greater ability to use that knowledge to protect themselves from potentially harmful RF exposure. The KMOB WSR-88D operating frequency is 2,720 MHz. The IEEE/ANSI safety standards for those frequencies are 1.0 mW/cm^2 for the general public (averaged over 30 minutes) and 5.0 mW/cm^2 for workers (averaged over 6 minutes). Federal Communications Commission (FCC) RF exposure standards for RF exposure of the general public and occupational exposure are the same as the ANSI/IEEE safety standards. The Occupational Health and Safety Administration (OSHA) regulates occupational exposure to RF emissions; the OSHA safety standard is 10.0 mW/cm^2 (averaged over 6 minutes) (OSHA, 2021).

4.1.2 RF Exposure Levels

The KMOB WSR-88D is mounted on a 20 m tall steel-lattice tower. Ground surface elevation is 208 ft MSL. The center of the antenna is at 290 ft MSL and the lower edge of the antenna is at 276 ft MSL or 68 ft above ground level (AGL). When operating at the current minimum scan angle of +0.5 deg, the lower edge of the beam is at 0.0 deg (i.e., horizontal) and the radar's main beam does not impinge on the ground surface within 3 miles of the radar (see Appendix C). Operating at the proposed minimum scan angle of +0.2 deg; the closest terrain illuminated by the main beam would 6,400 feet (1.21 miles) east-southeast (ESE) of the WSR-88D. The closest structure within the main bean would be the airport traffic control tower (ATCT) located 3,900 ft (0.74 miles) north-northwest (NNW). RF power density levels at the nearest illuminated ground and the ATCT are shown in Table 3.

Compared to the existing minimum scan angle of +0.5 deg, lowering the minimum scan angle to +0.2 deg would result in a slight increase in RF exposure levels at air space in the vicinity of the radar. Appendix A includes calculations of the existing time-averaged RF exposure levels in the vicinity of the KMOB WSR-88D, and the RF exposure that would result if ROC lowers the minimum scan angle to +0.2 deg. Table 3 summarizes the results from Appendix A.

Table 3: RF Power Densities of KMOB WSR-88D Main Beam Compared to Safety Levels

Location / Distance from KMOB WSR-88D	Time-Averaged Power Density (mW/cm^2)	ANSI/IEEE General Public RF Safety Standard		ANSI/IEEE and FCC Occupational RF Safety Standard	
		Safety Standard (mW/cm^2)	Factor Below Std	Safety Standard (mW/cm^2)	Factor Below Std
Surface of Radome	0.602	1.0	1.66	5.0	8.3
Closest Structure: ATCT, 3,900 ft NNW	0.00038	1.0	2,600	5.0	13,100
Closest Terrain: 6,400 ft ESE	0.00020	1.0	5,000	5.0	25,000

During normal operation of the WSR-88D with a rotating antenna, RF exposure levels at all locations would comply with safety standards for exposure of both workers (i.e., occupational exposure) and the general public.

During infrequent stationary antenna operation, RF exposure levels within the WSR-88D main beam would exceed ANSI/IEEE and FCC safety levels for exposure of the general public within 1,740 ft of the WSR-88D antenna. FCC occupational safety levels would be exceeded within 777 ft. No structures or terrain are within those distances and no RF safety hazards would result.

4.1.3 RF Electro-stimulation

The ANSI/IEEE safety guidelines also cover possible induction of currents within the bodies of persons and the potential for electro-stimulation of persons who make contact with conductive objects in the RFR field. The result is potentially harmful sensation of shock and/or burn. These effects only occur for RF fields at frequencies below 110 MHz (ANSI/IEEE, 2006). The KMOB WSR-88D would continue to operate at 2,720 MHz, outside the frequency range where induced currents or electro-simulation occur, and would not cause these effects.

4.1.4 Cumulative RF Exposure

As shown in Table 3, the power density of RF transmissions decreases exponentially with distance from the antenna. At all locations in the vicinity, RF emitted by the WSR-88D during normal operation would be at substantially below the safety standard for RF exposure of the general public. It is improbable that radio emissions from an external source would add to the WSR-88D RF emissions during normal operation to cause cumulative RF exposure levels exceeding safety standards.

4.2 RF EXPOSURE OF EQUIPMENT AND ACTIVITIES

4.2.1 Television, Radio, Cellular Telephone, and Personal Communications Devices (PCDs)

High-power radar, such as the WSR-88D, can interfere with operation of radio, television, cellular telephone, and PCDs in close vicinity to the radar antenna. However, these devices operate at different frequencies from the WSR-88D, reducing the potential for radio interference. NTIA regulations reserve the 2,700 to 3,000 MHz band for government radiolocation users (e.g., meteorological and aircraft surveillance radars) [NTIA, 2009]. The WSR-88D operates outside the frequencies used by television and radio broadcasts, cellular telephones, and personal communication devices. Lowering the minimum scan angle to +0.2 deg would not result in the main beam impinging on the ground surface within 1.2 miles of the radar and the potential for radio interference would be low. No mitigation is necessary.

4.2.2 Electro-explosive Devices (EEDs)

Electro-explosive devices are used to detonate explosives, separate missiles from aircraft, and propel ejection seats from aircraft. Under extreme circumstances, electromagnetic radiation can cause unintended firing of EEDs. Calculations based on a U.S. Air Force (USAF) standard indicate that using electric blasting caps at distances beyond approximately 900 ft from the WSR-88D is a safe practice, even in the main beam of the radar, where the power density of the WSR-88D radio signal is greatest [USAF, 1982]. The U.S. Navy Hazards of Electromagnetic Radiation to Ordnance (HERO) regulations classify EEDs as safe, susceptible, or unsafe and unreliable, based on compliance with MIL-STD 664 (series). HERO safe EEDs are considered safe in all RFR environments. HERO susceptible EEDs may be detonated by RF energy under certain circumstances. HERO unsafe or unreliable EEDs have not been evaluated for compliance with MILSTD 664 or is being assembled, dissembled, or subject to unauthorized conditions, which can increase its sensitivity to RF emissions. Safe separation distances vary for susceptible and unsafe or unreliable ordnance [Naval Sea Systems Command, 2008]. For HERO susceptible ordnance, the safe separation distance (D) in ft is calculated as follows:

$$D = (781)\,(f)^{-1}(\text{average power x antenna gain})^{½}$$

Where f is operating frequency in MHz and average power = maximum transmitted power × duty cycle. Inserting these values gives:

$$D = (781)\,(2{,}720)^{-1}\,(475{,}000\text{ W} \times 0.0021 \times 35{,}500)^{½}\text{ ft}$$
$$D = 1{,}709\text{ ft}$$

For HERO unsafe or unreliable EEDs, the safe separation distance (D) in ft is calculated as follows:

$$D = (2{,}873)\,(f)^{-1}(\text{average power x antenna gain})^{½}$$
$$D = (2{,}873)\,(2{,}720)^{-1}\,(475{,}000\text{ W} \times 0.0021 \times 35{,}500)^{½}\text{ ft}$$
$$D = 6{,}285\text{ ft}$$

HERO concerns are only applicable in locations illuminated by the main beam of the radar. When operating at a minimum scan angle of +0.2 deg, the KMOB WSR-88D main beam would not illuminate the ground or structures within the safe setback distance for HERO safe EEDs. The upper portions of the ATCT and three cellular telephone towers would be within the safe setback distance for unsafe/unreliable EEDs, bur it is improbable that those types of EEDs would be in use on those towers.

4.2.4 Fuel Handling

Electromagnetic fields can induce currents in conductive materials and those currents can generate sparks when contacts between conductive materials are made or broken. Sparks can ignite liquid fuels, such as gasoline. This phenomenon is rare, but can result in hazards to human health and property. This potential hazard arises during the transfer of fuel from container to another (e.g., fueling an automobile, boat, or airplane). The U.S. Navy developed a Technical Manual identifying the circumstances where this hazard may occur and providing direction on how to prevent it. The Technical Manual identifies a safe standoff distance based on radar operating characteristics [Naval Sea Systems Command, 2003]. Using formula contained in the Technical Manual, the distance from the WSR-88D at which RFR hazards to fuel may occur is

537 ft. This hazard only exists in areas directly illuminated by the main beam. The WSR-88D main beam operating at a minimum center of antenna scan angle of +0.2 deg would not illuminate the ground or any occupied structures within 537 ft of the radar. The existing fuel tank for the standby generator at the base of the WSR-88D tower would not be illuminated by the WSR-88D main beam and hazards to fuel handling activities would not result. No mitigation is required.

4.2.5 Active Implantable Medical Devices

ANSI and the Association for Advancement of Medical Instrumentation (AAMI) developed the PC69:2007 standard to prevent external electromagnetic sources from causing electromagnetic interference with active implantable medical devices, including cardiac pacemakers and implantable cardiac defibrillators [ANSI/AAMI, 2007]. This standard specifies that cardiac pacemakers and ICDs must be tested by exposing them to a specified magnetic field and that the device must operate without malfunction or harm to the device. The specified field strength varies with frequency. For the WSR-88D operating frequency of 2,720 MHz, the field strength is 3 A/m. This is converted to power density (S) in units of W/m^2 by assuming free air impedance of 377 ohms:

$$S = 377\ |3|^2 \quad W/m^2$$
$$S = 3{,}393\ W/m^2$$

To convert to mW/cm^2, we multiply the numerator by 1,000 mW/W and the divisor by 10,000 $cm^2/\ m^2$ which gives a value of 339.3 mW/cm^2. The peak pulse power of the WSR-88D is given by the following formula (see Appendix A):

$$U_1 = 1.44 \text{ X } 10^9/R^2\ mW/cm^2$$

Inserting R = 2,060 ft gives a value of 339.3 mW/cm^2, which equals the threshold established by PC69:2007 standard. At distances of 2,060 ft or greater, the main beam of the WSR-88D would not adversely affect implantable medical devices. There would also be no hazards to implantable medical devices at locations outside the main beam. Operating at the minimum potential center of beam scan angle of +0.2 deg, the main beam of the KMOB WSR-88D would not illuminate the ground or structures within 2,060 ft of the radar.

Theoretically, persons in aircraft flying within 2,060 ft of the radar could be exposed to RF levels above the device susceptibility threshold set by ANSI/AAMI, but the likelihood of significant harm is extremely low. For persons in aircraft, the airframe would attenuate the RF level and the duration of exposure would be far less than the averaging time (6 to 30 minutes) specified in the RF safety standards, reducing the amount of RF exposure. Additionally, device susceptibility threshold in the PC69:2007 standard is based on coupling of the RFR directly into the device leads (which is the test protocol); the WSR-88D signal would be incident upon the surface of the body and would decrease considerably in strength at the location of the device leads within the body. Third, even in the unlikely event that the WSR-88D RFR couples into the device at levels above the susceptibility threshold, the device would revert to safe mode of operation that would prevent significant harm to the wearer or damage to the device [ANSI/AAMI, 2007].

FCC regulations at 47 CFR Part 95.1221 require that MedRadio medical implant devices and medical body-worn transmitters be able to withstand exposure to RF at the MPEs specified in FCC regulations at 47 CFR 1.1310 (FCC, 2017). As described in Section 4.1 above, RF exposure levels in the vicinity of the KMOB WSR-88D would comply with the FCC safety standards. Exposure of persons wearing implantable medical devices to the KMOB WSR-88D radio emissions would not result in adverse effects.

4.2.6 Astronomical Observatories

The WSR-88D can cause harmful electromagnetic interference (EMI) with charge-couple devices (CCDs) which electronically record data collected by astronomical telescopes (NEXRAD JSPO 1993). The potential for harmful EMI would arise if the WSR-88D's main beam would directly impinge on an astronomical observatory during low angle scanning. No observatories are within 150 miles of the KMOB WSR-88D (see Appendix C). No adverse effects on astronomical observatories would result.

4.2.7 Summary of RF Exposure Effects

Table 5 summarizes impacts to potentially RF-sensitive equipment and activities. The potential for the proposed action to cause radio interference with other radio users would be very low.

Table 4: Potential Effects of KMOB WSR-88D on Equipment and Activities

Equipment / Activity	Applicable Standard	Setback Distance	Would Main Beam Impinge Within Setback Distance?	Potential for Significant Effects
TV, Radio, Cellular Telephone, and Personal Communications Devices (PCDs)	NTIA Frequency Allocations	n/a	n/a	Very low
EEDs	U.S. Navy HERO Safe/Unsafe	1,709 ft / 6,285 ft	No	Very low
Fuel Handling	U.S. Navy Hazards to Personnel, Fuel, and Other Flammable Material	537 ft	No	None
Active Implantable Medical Devices	AAMI PC69:2007, FCC 47 CFR Part 95.1221	2,060 ft	No	Very Low
Astronomical Observatories	Direct Exposure to WSR-88D Main Beam	n/a	n/a	None

4.3 LAND USE AND COASTAL ZONE MANAGEMENT

Alabama is a coastal state and has a Coastal Management Program (CMP) administered by the Alabama Department of Conservation and Natural Resources, State Lands Division, Coastal Section. The coastal management zone extends from the 10-ft elevation contour to three miles seaward from the shoreline. The KDOX WSR-88D is not located in the coastal management zone (Alabama Coastal Area Management Program, 2023). The proposed action would not adversely affect coastal resources or conflict with policies of Alabama's Coastal Area Management Program.

The KMOB WSR-88D is located at Mobile Regional Airport and nearby land uses consist of aviation and airport support facilities The proposed action would not change land uses at the KMOB WSR-88D site or vicinity and would not adversely affect nearby land uses.

4.4 GEOLOGY, SOILS, AND SEISMIC HAZARDS

The WSR-88D site is underlain by Pliocene-age flat-lying marine terrace sedimentary layers of the Citronelle formation., consisting of interlayered conglomerate, siltstone, and shale (American Association of Petroleum Geologists 1975). Soil is Saucier-Urban Land complex on 0 to 8% slope. Saucier-Urban Land complex is deep and moderately well drained. The water table is 18 to 30 inches below the ground surface and this soil is not hydric. The frequency or flooding or ponding is "none." Saucier-Urban Land complex soil is not hydric and not considered prime farmland. Natural Resources Conservation Service, 2023).

U.S. Geological Survey (USGS) considers Walton County to have a low risk of seismic hazards (USGS, 2014). The proposed action would not affect the WSR-88D tower structure or change its seismic risk level.

Lowering the minimum scan angle of the KMOB WSR-88D would not require physical changes to the radar or result in ground disturbance. The proposed action would have no effect on geology, soils, or seismicity. No mitigation measures are required.

4.5 DRAINAGE AND WATER QUALITY

The KMOB WSR-88D site drains via overland flow to a nearby drainage ditch which discharge to Miller Creek, a tributary of the Escatawpa River. The Escatawpa River flows southward and discharges to the Gulf of Mexico near Gautier, Mississippi (USGS, 2020a, b, c, d, and e). Lowering the minimum scan angle of the KMOB WSR-88D would not result in ground disturbance. The proposed action would not affect the amount of impervious surface area at the radar site, the rate of storm runoff flowing from the site during or after precipitation events, or generate water pollutants. The proposed action would have no effect on drainage or water quality. No mitigation measures are required.

4.6 TRANSPORTATION

The KMOB WSR-88D is located at Mobile Regional Airport. Vehicle access is via Airport Boulevard, a divided four-lane paved road and Joseph Drawns Drive, a two-lane paved road. with low traffic volumes. The proposed action requires modification of the software used by the WSR-88D to support scan at angles below +0.5 deg. To implement the change in scan angle, ROC technicians and engineers would travel to the KMOB WSR-88D site to perform initial testing and ensure that the modified software is operating properly. Travel to the site would be minimal and would not result in significant congestion on local roads. Transportation effects would not be significant. No mitigation measures are required.

4.7 AIR QUALITY

The KMOB WSR-88D is equipped with a standby generator that is used if primary power is interrupted and periodically for testing. The proposed action would not change the power consumption of the WSR-88D or affect the hours of operation of the standby generator, and no change in air emissions would result. A Clean Air Act Federal Conformity Determination is not required. No mitigation measures are required.

4.8 FLOOD HAZARDS

Executive Order (E.O.) 11988, *Floodplain Management*, requires the Federal Government to avoid adverse impacts to the 100-year or base floodplain (that is, the area subject to a 1 percent annual chance of flooding), unless there is no practicable alternative [President, 1977a]. The KMOB WSR-88D site outside the 100-year floodplain (FEMA, 2020). The proposed action of lowering the minimum would not affect floodplains or flood hazards. No mitigation measures are required.

4.9 WETLANDS

E.O. 11990, *Protection of Wetlands*, requires the Federal Government avoid funding or implementing projects which would adversely impact wetlands unless there is no practicable alternative [President, 1977b]. Based on National Wetland Inventory maps prepared by the U.S. Fish and Wildlife Service (USFWS), the WSR-88D site does not contain federal jurisdictional wetlands. The nearest wetland is a riverine lower perennial unconsolidated bottom permanently flooded wetland (R2UBH), located about 200 ft 900 NE (USFWS, 2023f). The proposed action would not result in ground disturbance or changes to drainage and would not affect federal jurisdictional wetlands; no mitigation is required.

4.10 BIOLOGICAL RESOURCES / PROTECTED SPECIES

The USFWS administers the Endangered Species Act (ESA) and Migratory Bird Treaty Act. The KMOB WSR-88D is located within the area served by the USFWS Alabama Ecological Services Field Office in Daphne, AL. The EA preparers obtained a protected species list from that office (see Appendix B). Table 5 list threatened, endangered, and candidate species that may occur in the vicinity of the WSR-88D site:

Table 5: Threatened, Endangered, and Candidate Species that may Occur in the Vicinity of the KMOB WSR-88D

Species	Scientific Name	Type	Status	Critical Habitat at Site?
Alligator snapping turtle	*Macrochelys temminckii*	Reptile	Proposed Threatened	None designated for this species
Black pinesnake	*Pituophis melanoleucus lodingi*	Reptile	Threatened	None at site
Eastern indigo snake	*Drymarchon couperi*	Reptile	Threatened	None designated for this species
Gopher tortoise	*Gopheris polyphemus*	Retile	Threatened	None designated for this species
Monarch butterfly	*Danaus plexippus*	Insect	Candidate	None designated for this species

Alligator snapping turtles (*Machrochelys temminckii*) depend on aquatic habitat (USFWS, 2023a). The proposed action would not disturb water bodies or impact water quality and would not impact these species.

Black pinesnakes (*Pituophis melanoleucus lodingi*) occupy open-canopied upland pine forest. They require large tracts of unfragmented to support their large home ranges. Habitat loss and fragmentation and development od high density pine forests have contributed to declining populations (USFWS, 2020b). Suitable habitat is not present at or near the KMOB WSR-88D. The proposed action would not directly affect Eastern indigo snakes. It would also not result in vegetation removal or soil disturbance and would not affect black pinesnake habitat.

Eastern indigo snakes (*Drymarchon couperi)* are large (up to 9 ft in length), thick-bodied glossy black snakes with white to orangish chins and bellies that inhabit longleaf pine forest in the southeastern U.S. The species has declined in population due to habitat destruction overcollection for pet trade, and vehicle strikes (USFWS, 2023c). Suitable habitat is not present at or near the KMOB WSR-88D. The proposed action would not directly affect Eastern indigo snakes. It would also not result in vegetation removal or soil disturbance and would not affect Eastern indigo snake habitat.

Gopher tortoise (*Gopheris polyphemus*) is a large dark brown to grayish black terrestrial tortoise inhabiting deep sand ridges typically vegetated with longleaf pine and scrub oak and herbaceous ground cover. The most significant threats to gopher tortoises are habitat alteration and taking.

(USFWS 2023d). The proposed action would not directly affect gopher tortoises. It would also not result in vegetation removal or soil disturbance and would not affect gopher tortoise habitat.

One candidate species for listing as threatened or endangered could potentially occur in the local area: Monarch Butterfly (*Danaus plexippus*). The KMOB WSR-88D is not located within designated monarch butterfly critical habitat. Monarch butterflies are brightly colored and lay eggs on milkweed host plants, and larvae emerge in two to five days and feed on milkweed. Adults live two to five weeks, except when overwintering when they enter suspended reproduction and may live up to nine months. In temperate climates, monarchs seasonally migrate up to 1,800 miles (USFWS, 2023e). The proposed action would not result in ground disturbance or removal of vegetation and would not impact monarch butterfly habitat.

In addition to threatened, endangered, and candidate species USFWS is responsible for protecting migratory birds under the Migratory Bird Treaty Act and Executive Order 13186 *Responsibilities of Federal Agencies to Protect Migratory Birds* and bald and golden eagles under the *Bald and golden Eagle Protection Act*. Birds of particular concern in vicinity of the proposed action include Chimney swift (*Chaetura pelagica*), Prothonotary warbler (*Protonotaria citrea*), and swallow-tailed kite (*Elanoides forficatus)* (see Appendix B).

Lowering the minimum scan angle to +0.2 deg from the current +0.5 deg would result in a thin sliver of the atmosphere, which is currently below the main beam overage area, being exposed to the main beam of the WSR-88D (see Figure 4). The portion of this atmosphere above the newly exposed sliver of atmosphere is currently within the main beam and RF exposure levels would not change. The sliver of the atmosphere where new main beam coverage would result in increased RF exposure levels would be very small near the WSR-88D - 5 ft thick at 900 ft from the WSR-88D and increasing in thickness with distance from the radar. At 1 mile it would be 28 ft thick and at five miles it would be 138 ft thick. Birds, bats, or insects flying within the newly covered sliver of the atmosphere would be exposed to RF emissions from the WSR-88D. The RF levels in the sliver of airspace would be no greater than in RF levels in the existing covered airspace, which occurs just above the newly exposed air space. At distances of several miles or greater where the volume of newly covered airspace would be substantial, RF levels would be very low. At 900 ft, RF exposure levels would be 100 times less than safety standards for human exposure. Based on the extremely low RF levels at distance from the WSR-88D, RF exposure of birds or insects flying within the newly covered airspace would not be harmful.

Increased RF exposure could result if a bird or butterfly flies in a path that keeps it within the WSR-88D main beam for extended periods of time. However, during normal operation the WSR-88D main beam is continuously moving. At 1,000 ft the WSR-88D main beam is moving at an effective speed of about 89 miles per hour and it is very unlikely that a bird or insect could remain within the WSR-88D main beam for any length of time.

No impacts would result to threatened or endangered species, monarch butterfly, migratory birds, or bald and golden eagles. No mitigation measures are required.

4.11 CULTURAL AND HISTORIC RESOURCES

Section 106 of the National Historic Preservation Act of 1966 (as amended) requires that federal agencies consider the effects of their actions on historic places and, if effects may result, provide the State Historic Preservation Officer (SHPO) with an opportunity to comment on their actions. Section 106 regulations are set forth in 36 CFR Part 800, *Protection of Historic Properties* (Advisory Council on Historic Preservation, 2010).

Because the proposed action would not involve ground disturbance, no impacts to archaeological or paleontological resources would result. The proposed action's area of potential effect (APE) is defined as area within 1,740 ft of the KMOB WSR-88Ds where RF exposure of persons within the WSR-88D main beam could potentially exceed safety levels (see Appendix A). The National Register of Historic Places database was searched to identify places listed or eligible for listing on within the APE. No listings were found (National Park Service, 2023). Structures within the APE include a postal facility, the airport terminal building, a used car sale lot, a construction equipment rental company, and a pre-fabricated shed store. All of these structures are of modern construction and lack historic attributes. No places listed or eligible for listing on NRHP are located within the APE and the proposed action would not affect historic properties. Under Section 106 Regulations 36 CFR Section 800.4 (d)(1), *No Historic Properties Affected*, if the proposed action does not have the potential to affect historic properties, the ROC shall provide notification of this determination to the SHPO. If the SHPO does not object to the determination within 30 days, ROC's section 106 responsibilities are fulfilled. [ecfr, 2023).

4.12 ENVIRONMENTAL JUSTICE AND SOCIOECONOMIC IMPACTS

E.O. 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, requires federal agencies to identify and address, as appropriate, disproportionately high and adverse environmental or human health effects on minority populations and low income populations (President, 1994).

The KMOB WSR-88D is located at Mobile Regional Airport in the city of Mobile, AL. Nearby land uses are airport-related. The proposed action would not generate air or water pollutants or hazardous waste. The project would modify the operation of the KMOB WSR-88D by reducing the minimum scan angle from +0.5 deg to +0.2 deg. The WSR-88D main beam would not impinge on the ground in proximity to the radar and would comply with safety standards for human exposure to RF energy and setbacks for activities (e.g., fuel handling and EED use) that are potentially sensitive to RF exposure. No disproportionately high and adverse effects would result to any persons, including minority or low income populations. No mitigation is required.

4.13 FARMLANDS

The Farmland Protection Policy Act sets forth federal policies to prevent the unnecessary conversion of agricultural land to non-agricultural use. NRCS regulations at 7 CFR Part 658, *Farmland Protection Policy Act*, are designed to implement those policies. Completion of Form

AD-1006 and submission to the U.S. Department of Agriculture (DoA) is required if a federal agency proposes to convert land designated as prime farmland, farmland of statewide importance, or unique farmland to non-agricultural use. Soil at the KMOB WSR-88D site is not classified as prime farmland (NRCS, 2023). Additionally, the WSR-88D site is committed to non-agricultural airport use. The proposed action would not convert farmland to non-farm use. No mitigation is necessary.

4.14 ENERGY CONSUMPTION

The proposed action would not change electric use by the WSR-88D and would have no effect on energy consumption. No mitigation is necessary.

4.15 VISUAL QUALITY/ LIGHT EMISSIONS

The proposed action would not change the appearance of the KMOB WSR-88D or result in new emissions of visible light. The proposed action would have no effect on visual quality. No mitigation is necessary.

4.16 SOLID AND HAZARDOUS WASTE

The proposed action would result in no changes to solid or hazardous waste generation. No mitigation is necessary.

4.17 WILD AND SCENIC RIVERS

The Wild and Scenic Rivers Act of 1968 protects free-flowing rivers of the U.S. These rivers are protected under the Act by prohibiting water resource projects from adversely impacting values of the river: protecting outstanding scenic, geologic, fish and wildlife, historic, cultural, or recreational values; maintaining water quality; and implementing river management plans for these specific rivers. The wild and scenic rivers closest to the KMOB WSR-88D is Black Creek in southern Mississippi, about 51 miles NW of the WSR-88D. (National Park Service, 2023). The proposed action would not affect that wild and scenic river. No mitigation is necessary.

5 ALTERNATIVES TO THE PROPOSED ACTION

5.1 MINIMUM SCAN ANGLES BETWEEN +0.4 AND 0.0 DEG

ROC evaluated the benefits and potential impacts of lowering the minimum center of beam scan angle of the KMOB WSR-88D to each angle between +0.4 and 0.0 deg in 0.1 degree increments (see Appendix C). That analysis found that the proposed action of lowering the minimum scan angle to +0.2 deg would result in the significant improvement in radar coverage.

A minimum scan angle of +0.4 or +0.3 deg would increase the radar's coverage area, but by less than the proposed action (i.e., minimum scan angle of +0.2) deg. A minimum scan angle lower than +0.2 deg would not increase coverage area and would have the drawback of increasing ground clutter returns.

Because a minimum scan angle of +0.2 deg would result in significant improvement in radar coverage area while avoiding significant environmental impacts, ROC selected +0.2 deg as the proposed minimum scan angle for the KMOB WSR-88D.

5.2 NO ACTION

The no action alternative consists of continued operation of the KMOB WSR-88D at the existing minimum scan angle of +0.5 deg. The improvements in radar coverage summarized in Section 3 would not be achieved and the project objectives would not be met.

The proposed action would result in increased RF exposure compared to existing WSR-88D operations as described in section 4.1; the no-action alternative would not change RF exposure levels from existing. Under both the proposed action and the no action alternative, RF exposure during normal WSR-88D operations would conform to safety standards established by ANSI/IEEE, OSHA, and FCC.

Similar to the proposed action, the no-action alternative would not result in adverse effects in the following topic areas:

- Land Use and Coastal Zone Management
- Geology, Soils, and Seismic Hazards
- Drainage and Water Quality
- Transportation
- Air Quality
- Flood Hazards
- Wetlands
- Biological Resources / Protected Species
- Cultural and Historic Resources
- Environmental Justice and Socioeconomic Impacts
- Farmlands

- Energy Consumption
- Visual Quality/ Light Emissions
- Solid and Hazardous Waste
- Wild and Scenic Rivers

6 FINDING

The proposed action of lowering the scan angle of the KMOB WSR-88D from the current minimum of +0.5 deg to +0.2 deg would not result in significant changes in the quality of the human environment. Lowering the minimum scan angle would also not add to the environmental effects of past, present, and reasonably foreseeable future actions to cause cumulatively significant effects

The proposed action would improve the quality of meteorological radar data available to ROC forecasters and others users of the data. This may indirectly benefit the residents and businesses of the Mobile, AL, area, improving the accuracy of forecast and severe weather alerts, which could result in environmental benefits if weather dependent economic or government activities (e.g., agriculture, construction, outdoor recreation, transportation, military operations, water management) become more efficient or safer as a result of improved weather services. The resulting environmental benefits are difficult to quantify, but are unlikely to be significant.

Implementation of the proposed action would not have the potential to cause significant changes in the environmental. A Finding of No Significant Impact is warranted for the proposed action.

7 DOCUMENT PREPARERS

This Draft EA was prepared by Sensor Environmental LLC under contract to Centuria Corporation. Centuria Corporation provides support to the ROC Radar Operations Center (ROC) in Norman, OK.

Mr. James Manitakos, CEO, served as Sensor's Project Manager. Huntington Ingalls Industries (HII)/Alion Science and Technology Corporation prepared radar coverage maps and calculated coverage areas under subcontract to Sensor. Mr. Andre Tarpinian, Radio Frequency Engineer, served as HII Alion's Project Manager. Ms. Jessica Schultz, Deputy Director of the ROC, and Mr. Ryan Groce, Centuria Corporation Program Manager, from the ROC assisted in preparation of this EA.

8 REFERENCES

Alabama Coastal Area Management Program, Alabama Coastal Area Management Program | Outdoor Alabama (accessed September 5, 2023).

American Association of Petroleum Geologists. *Geological Highway Map of Southeastern Region, Alabama, Louisiana, Florida, Mississippi, Georgia* (1975).

ANSI/IEEE. *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 3 kHz to 300 GHz*. IEEE Std C95.1-2019 (February 8, 2019).

ANSI/IEEE. *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 3 kHz to 300 GHz, Corrigenda 2*. IEEE Std C95.1-2019 (September 24, 2020).

Ecfr. https://www.ecfr.gov/current/title-36/chapter-VIII/part-800 (accessed August 21, 2023).

EPA. *National Primary and Secondary Ambient Air Quality Standards*, 40 CFR Part 50 (2011).

FCC. *Radiofrequency Radiation Exposure Limits*. Title 47, Code of Federal Regulations, Part 1.1310(E)(1). 47 CFR § 1.1310 - Radiofrequency radiation exposure limits. | CFR | US Law | LII / Legal Information Institute (cornell.edu) (Accessed November 26, 2021).

FEMA. *Flood Insurance Rate Map Mobile County, Alabama and Incorporated Areas*. Map Number 01097C0536L (June 5, 2020).

National Park Service, National Wild and Scenic Rivers System. https://www.rivers.gov/. (accessed September 6, 2023).

Natural Resources Conservation Service. *Web Soil Survey*. Web Soil Survey (usda.gov) (accessed July 11, 2023).

Naval Sea Systems Command. *Technical Manual, Electromagnetic Radiation Hazards (U), (Hazards to Personnel, Fuel, and Other Flammable Material) (U)*, NAVSEA OP 3565/NAVAIR 16-1-529, Volume 1, Sixth Revision (February 1, 2003).

Naval Sea Systems Command. *Technical Manual, Electromagnetic Radiation Hazards (U), (Hazards to* Ordnance*) (U)*, NAVSEA OP 3565/NAVAIR 16-1-529, Volume 2, Seventeenth Revision, (September 11, 2008).

NEXRAD JSPO. *Final Supplemental Environmental Assessment (SEA) of the Effects of Electromagnetic Radiation from the WSR-88D Radar* (April 1993).

NOAA NAO 216-6A: *Compliance with the National Environmental Policy Act, Executive Orders 12114, Environmental Effects Abroad of Major Federal Actions; 11988 and 13690, Floodplain Management; and 11990 Protection of Wetlands*. (April 22, 2016).

NOAA. *Policies and Procedures for Compliance with the National Environmental Policy Act and Related Authorities*. Companion Manual for NOAA Administrative Order 216-6A (January 13, 2017).

National Park Service. National Register of Historic Places (nps.gov) (accessed August 20, 2023).

NRCS. *Farmland Protection Policy Act*, 9 CFR Part 658 (January 1, 2010).

NTIA. *Manual of Regulations and Procedures for Federal Radio Frequency Management* (revised September 2009).

NWS. *Next Generation Weather Radar Programmatic Environmental Impact Statement (PEIS), Report R400-PE201* (1984).

NWS. *Mission of the NWS*, http://www.wrh.noaa.gov/psr/general/mission/index.php (Accessed October 26, 2009).

OSHA. *Standard Number 1910.97, Non Ionizing Radiation*. 1910.97 - Nonionizing radiation. | Occupational Safety and Health Administration (osha.gov) (accessed November 27, 2021).

President. *Floodplain Management*, Executive Order 11988, 42 *Federal Register* 26951 (May 24, 1977a).

President. *Protection of Wetlands*, Executive Order 11990, 42 *Federal Register* 26961 (May 24, 1977b).

President. *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*, Executive Order 12898, 59 Federal Register 7629 (February 11, 1994).

Schultz, Jessica. Radar Focal Point, ROC Radar Operations Center. email to jmanitakos@sensorenvirollc.com (March 20, 2019).

USFWS. *Environmental Conservation Online System*, Species Profile for Alligator snapping turtle(Macrochelys temminckii) (fws.gov) (Accessed September 6, 2023a).

USFWS. *Environmental Conservation Online System*, Species Profile for Black pinesnake(Pituophis melanoleucus lodingi) (fws.gov) (Accessed September 6, 2023b).

USFWS. *Environmental Conservation Online System*, Species Profile for Eastern indigo snake (Drymarchon couperi) (fws.gov) (Accessed September 6, 2023c).

USFWS. *Environmental Conservation Online System*, Species Profile for Gopher tortoise(Gopherus polyphemus) (fws.gov) (Accessed September 6, 2023d).

USFWS. *Environmental Conservation Online System*, Species Profile for Monarch butterfly(Danaus plexippus) (fws.gov) (Accessed September 6, 2023e).

USFWS. Wetlands Mapper. National Wetlands Inventory (usgs.gov) (accessed August 15, 2023f).

USGS. *Simplified National Seismic Hazards Risk Map* (2014).

USGS. *Big Point Quadrangle, Mississippi - Alabama.* 7.5-minute series (2020a).

USGS. *Kreole Quadrangle, Mississippi - Alabama.* 7.5-minute series (2020b).

USGS. *Saint Elmo Quadrangle, Alabama – Mobile County.* 7.5-minute series (2020c).

USGS. *Spring Hill Quadrangle, Alabama – Mobile County.* 7.5-minute series (2020d).

USGS. *Tanner Williams Quadrangle, Alabama – Mobile County.* 7.5-minute series (2020e).

9 EA DISTRIBUTION

William Deringer
Centuria Corporation
11800 Sunrise Valley Drive, Suite 420
Reston, VA, 20191
William.d.deringer@noaa.gov

Mark S. George
Environmental Engineer
Environmental Compliance Division
NOAA Safety & Environmental Compliance Office
325 Broadway, Bldg. DSRC
Boulder, CO 80305-3328
mark.george@noaa.gov

Ryan Groce
Centuria Corporation
11800 Sunrise Valley Drive, Suite 420
Reston, VA, 20191
Ryan.groce@noaa.gov

Sharon Linton
ROC NEPA Coordinator
1325 East West Hwy, Bldg. SSMC2
Silver Spring, MD 20910-3283
sharon.linton@noaa.gov

Amanda McBride
Alabama Historical Commission
468 Perry Street
Montgomery, AL 36104
Section.106@ahc.alabama.gov

James B. McLaughlin
NOAA ROC Radar Operations Center
1200 Westheimer Drive
Norman, OK 73069
james.b.mclaughlin@noaa.gov

Katherine D. Renshaw
NOAA NEPA Coordinator
Office of General Counsel
1305 East West Highway, Bldg. SSMC4
Silver Spring, MD 20910-3278
katherine.renshaw@noaa.gov

Jessica Schultz, Deputy Director
NOAA ROC Radar Operations Center
1200 Westheimer Drive
Norman, OK 73069
Jessica.A.Schultz@noaa.gov

Gerald Stewart, USAF
NOAA ROC Radar Operations Center
1200 Westheimer Drive
Norman, OK 73069
gerald.stewart.2@us.af.mil

Sallie Ahlert
Branch Chief, Program Branch,
ROC Radar Operations Center
1313 Halley Circle, Bldg. 600
Norman, OK 73069-8480
sallie.m.ahlert@noaa.gov

Andre Tarpinian
Huntington Ingalls Industries Mission Technologies Group
8193 Dorsey Run Road, Suite 250
Annapolis Junction, MD 20701
atarpinian@alionscience.com

USFWS Alabama Ecological Services Field Office
1208 B Main Street
Daphne, AL 36526-4419
alabama@fws.gov

SENSOR ENVIRONMENTAL LLC
www.sensorenvirollc.com

Environmental Assessment Report

ENVIRONMENTAL ASSESSMENT (EA)

LOWERING THE MINIMUM SCAN ANGLE OF THE WEATHER SURVEILLANCE RADAR - MODEL 1988, DOPPLER (WSR-88D) SERVING THE MOBILE, AL, AREA

APPENDICES

APPENDIX A

RADIOFREQUENCY RADIATION POWER DENSITY CALCULATIONS

1. OBJECTIVE

This appendix quantifies the power densities of the radiofrequency radiation (RFR) emitted by the Weather Surveillance Radar, Model 1988 Doppler (WSR-88D) during operations that include minimum scan angles lower than +0.5 degrees (deg). The calculated power densities will be used to analyze the potential for effects to result from exposure of humans, equipment, and activities to the WSR-88D radio signal, and the significance of any identified potential effects.

2. METHODOLOGY

This memorandum builds upon the analysis included in the 1993 *Supplemental Environmental Assessment (SEA) of the Effects of Electromagnetic Radiation from the WSR-88D Radar* [NEXRAD Joint System program Office, 1993]. The 1993 analysis analyzed the potential electromagnetic effects of the WSR-88D signal when the radar operates at a minimum center of beam scan angle of +0.5 deg. This memorandum builds on that analysis by considering operation at a lower minimum scan angle of -0.2 deg. The parameters of the WSR-88D are shown in Table A-1 and are not changed from the 1993 analysis:

TABLE A-1: Operating Characteristics of WSR-88D Serving the Mobile, AL, Area (KMOB)	
Parameter	**Value**
Operating Frequency	2,720 megahertz (MHz)
Wavelength at 2,705 MHz)	0.3615 ft, 11.02 cm
Maximum pulse power	475 kiloWatts (kW)
Maximum duty cycle	0.21%
Antenna diameter	28 ft, 853 cm
Antenna gain	35,500:1, 45.5 dB
Beam width to half-power points	1.0 deg
First sidelobe relative power density, maximum	0.00325, -25 dB
Other sidelobe maximum power density, relative to main beam	0.0004, -34 dB

The ROC proposes to modify the minimum center of beam scan angle used during operation of the KMOB WSR-88D below the +0.5 angle currently used. This would not require changes to the antenna, other hardware which composes the WSR-88D, or the radiated pulse power of the WSR-88D. However, incorporating scans at angles below +0.5 deg could affect the amount of RFR exposure experienced by persons, equipment, and activities at or near ground level in the vicinity of the radar. This memorandum quantifies that change.

3. MODIFIED VOLUME SCAN PATTERN 31

The WSR-88D uses a number of complex volume scan patterns to maximize the quality and usefulness of the meteorological data it collects. The 1993 report analyzed volume scan pattern 31, which results in the highest levels of ground-level RFR exposure. Volume Scan Pattern

(VCP) 31 consists of eight 360 deg rotations of the antenna at various scan angles. ROC proposed to add two additional antenna rotations at a scan angle between +0.5 and 0.0 deg to this scan pattern to increase the range at which the radar can detect and track meteorological phenomena, especially at low elevations within the atmosphere. This memorandum assumes that the two added scans would be at +0.2 deg (i.e., lower half power point of -0.3 deg), the lowest scan angles under consideration by ROC. Adding two +0.2 degree scans would result in the greatest possible increase in ground level RFR exposure. The modified VCP 31 would be as follows:

- Two complete rotations at +0.2 deg
- Two complete rotations at +0.5 deg
- Two complete rotations at +1.5 deg
- Two complete rotations at +2.5 deg
- One complete rotation at +3.5 deg
- One complete rotation at +4.5 deg

The complete pattern would include 10 rotations of the antenna at a speed of 0.8 revolutions per minute (rpm), the pattern would take about 12 minutes and 22 seconds to complete [Turner, 2011].

4. CALCULATION OF RF POWER DENSITIES

Appendix A of the 1993 SEA includes detailed calculations of the RFR power density and exposure levels resulting from volume scan pattern 31. The proposed scan change would not affect the distance of the transition from the near field to the far field, calculated at 640 to 800 ft in section A.3 of the 1993 Appendix A.

4.1 Far Field

For VCP 31 operation of the WSR-88D, the values of U_1, U_2, U_3, U_4 and U_5 are unchanged from the values derived in 1993 Appendix A. The RF human exposure standards are based on time-averaged RF exposure for six minutes (occupational exposure) or 30 minutes (general public exposure) [American National Standards Institute/Institute of Electrical and Electronic Engineers, 2019]and 2020. We use six minutes as the averaging time as a worst-case analysis. The time-averaged power density for VCP 31, considering the contributions from both the main beam and the first five sidelobes is given by U_5, below:

$$U_{5,\ VCP\ 31} = 5{,}804 / R^2 \text{ mW/cm}^2$$

At this point the analysis must consider the proposed modifications to VCP 31, which will change the values of U_4 and U_5. The modified VCP 31 would have two additional +0.3 deg scans. Within our six minute averaging time, these two added scans would replace the RFR contribution from one +1.5 deg and one +2.5 deg scan. As described in the 1993 appendix, U_4 sums the RFR contributions at center of antenna level from each of the scans performed during the six minute period of interest. The coefficients for the +0.3 deg scans are 2.4/6 reflecting the proportion of the 6 minutes and 1.0 because the center of beam will essentially be at antenna level (i.e., +0.2 deg which equates to 2.8 ft, or one-tenth of the beam width at the far field transition distance of 800 ft). The corresponding coefficients for the two +0.5 deg scans within the six minutes are 2.4/6 and 0.5, and for the one +1.5 deg scan within the six minutes are 1.2/6 and 0.012. The modified U_4 calculation is given below

$$U_{4,\ mod} = [(2.4/6)\ (1.0) + (2.4/6)\ (0.5) + (1.2/6)\ (0.012)]\ U_3$$

$$U_{4,\ mod} = (0.602)\ U_3$$

Inserting the U_3 value of 1.35 x $10^4/R^2$ milliwatts/cm^2 (mw/ cm^2), yields:

$$U_{4,\ mod} = 8{,}130\ /\ R^2\ \ mW/cm^2$$

U_4 is the 6-minute time-averaged power density at locations in the far field directly illuminated by the main beam and at the same elevation as the WSR-88D antenna, considering the RFR contributed from the main beam and the first five sidelobes. According to the WSR-88D specification, sidelobes of higher order than the first five will contain less than 5% of the eradiated energy. The 1993 SEA calculated the average power density of these higher order sidelobes at $4/R^2$ mW/cm^2. We add this to U_4 to obtain U_5, the total time-averaged power density at an elevation even with the center of antenna elevation and distances greater than 800 ft from the antenna:

$$U_{5,\ mod} = 8{,}130 \text{ x } 10^3/R^2 + 4/R^2 = 8{,}134/R^2\ \ mW/cm^2$$

4.2 Near Field

Appendix A of the 1993 SEA contains the following formula for power density in the WSR-88D main beam during VCP 31 operation:

$$U_{6,\ VCP\ 31} = 9800/\ (R^2 + 800R)\ mW/cm^2$$

Which is based on calculation of the height Y of the mathematical cylinder illuminated by all scans during the six-minute period using the formula Y = 28 + R Tan (2 deg) + 0.035R. Since the modified scan pattern of interest includes scans of +0.2. +0.5, and +1.5 degs, the angular range is 1.3 deg, and we recalculate Y as follows:

$$Y = 28 + R \text{ x Tan } (1.3 \text{ deg}) = 28 + 0.023R$$

The circumference of the illumination cylinder is $2\pi RY$ and the total area A is

$$A = 2\pi RY = 176R + 0.14R^2$$

The average power radiated is less than or equal to 1 kW, and the average power over the cylindrical surface cannot exceed this value divided by the area. At the mid-height of the cylinder, the local power density will exceed the average value by a factor of 2 (unchanged from the 1993 analysis). We introduce this factor, multiply by 10^6 to convert from kW to mW, and divide by 929 to convert from sq ft to square centimeters (sq cm):

$$U_{6, mod} = 2 \times 10^6 / (929) (176R + 0.14R^2) = 15{,}378 / (R^2 + 1{,}258R) \text{ mW/cm}^2$$

$U_{6, mod}$ is the time-averaged RFR exposure within the area illuminated by the WSR-88D main beam up to distances of 640 ft where the beam begins to spread.

4.3 RF Exposure Levels near KMOB WSR-88D

Table A-2 shows the time-averaged RF power densities that would result at locations directly illuminated by the main beam of the KMOB WSR-88D when operating in modified VCP 31. The near field is within 640 ft of the radar and the U_6 formula is used to calculate these near field values. At greater distances, the far field formula for U_5 is used. For comparison purposes, corresponding values for the original VCP 31 are also shown. As can be seen from Table A-1, use of modified scan pattern 31 would lower the elevation at which the main beam occurs and would also slightly increase the time-averaged power densities in both the near and far fields.

Table A-2: Comparison of RF Power Densities within the WSR-88D Directly Illuminated Area Using VCP 31 and Modified VCP 31

Place	Distance (ft)	Original VCP 31 Lowest Elev (ft MSL)	Original VCP 31 Time-Avg Power Density (mW/cm2)	Modified VCP 31 Lowest Elev (ft MSL)	Modified VCP 31 Time-Avg Power Density (mW/cm^2)
Surface of Radome	20	276*	0.598	n/a	0.602
Airport Traffic Control Tower	3,900 ft NNW	276	0.00038	256	0.00053
Cellular Telephone Towers	4,300 ft E and SW	276	0.00031	253	0.00044
Closest Illuminated Terrain	6,400 ft ESE	276	0.00014	242	0.00020

*****Elevation of bottom edge of KMOB WSR-88D antenna

ROC may infrequently operate the KMOB WSR-88D with a stationary antenna, resulting in the main beam being continuously pointed at the same location for a period of time. The RF exposure level within the main beam can be calculated using equation U_1 multiplied by the radar duty cycle

$$U_7 = (1.44 \times 10^9/R^2)\ 0.0021 = 3.024 \times 10^6/R^2 \qquad (\text{mW/cm}^2)$$

When operating in stationary antenna mode, the KAH WSR-88D would exceed the American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) safety levels within the following distances:

- ANSI/IEEE and FCC General Public Safety Level (1.0 mW/cm^2): 1,740 ft
- Federal communications commission (FCC) and ANSI Occupational Safety Level (5.0 mW/cm^2): 777 ft

5. REFERENCES

ANSI/IEEE. *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 3 kHz to 300 GHz*. IEEE Std C95.1-2019 (February 8, 2019).

ANSI/IEEE. *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 3 kHz to 300 GHz, Corrigenda 2*. IEEE Std C95.1-2019 (September 24, 2020).

Ciardi, Edward, Program Manager, EVP weather Systems, Centuria Corporation. emails to James Manitakos, Sensor Environmental LLC, (February 14, 2018).

FCC. *Radiofrequency Radiation Exposure Limits*. Title 47, Code of Federal Regulations, Part 1.1310(E)(1). 47 CFR § 1.1310 - Radiofrequency radiation exposure limits. | CFR | US Law | LII / Legal Information Institute (cornell.edu) (Accessed November 26, 2021).

Next Generation Weather Radar Joint System Program Office (JSPO), *Final Supplemental Environmental Assessment (SEA) of the Effects of Electromagnetic Radiation from the WSR-88D Radar* (April 1993).

APPENDIX B

PROTECTED SPECIES LIST

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Alabama Ecological Services Field Office
1208 B Main Street
Daphne, AL 36526-4419
Phone: (251) 441-5181 Fax: (251) 441-6222
Email Address: alabama@fws.gov

In Reply Refer To: July 22, 2023
Project Code: 2023-0107806
Project Name: KMOB WSR-88D Lower Scan Angle EA

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Project consultation requests may be submitted by mail or email (Alabama@fws.gov). **Ensure that the Project Code in the header of this letter is clearly referenced in any request for consultation or correspondence submitted to our office.**

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. **Ensure that the Project Code in the header of this letter is clearly referenced with any request for consultation or correspondence about your project that you submit to our office.**

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Alabama Ecological Services Field Office
1208 B Main Street
Daphne, AL 36526-4419
(251) 441-5181

PROJECT SUMMARY

Project Code: 2023-0107806
Project Name: KMOB WSR-88D Lower Scan Angle EA
Project Type: Maintenance/Modification Meteorological Tower
Project Description: Lowering the minimum scan angle of the existing KMOB WSR-88D
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@30.6795459,-88.23982357107107,14z

Counties: Mobile County, Alabama

ENDANGERED SPECIES ACT SPECIES

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

REPTILES

NAME	STATUS
Alligator Snapping Turtle *Macrochelys temminckii* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4658	Proposed Threatened
Black Pinesnake *Pituophis melanoleucus lodingi* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/452	Threatened
Eastern Indigo Snake *Drymarchon couperi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/646	Threatened
Gopher Tortoise *Gopherus polyphemus* Population: Western DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6994	Threatened

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: National Weather Service
Name: James Manitakos
Address: 296 West Arbor Avenue
City: Sunnyvale
State: CA
Zip: 94085
Email jmanitakos@sensorenvirollc.com
Phone: 4084980077

APPENDIX C

TECHNICAL MEMORANDUM AND TRIP REPORT

TECHNICAL MEMORANDUM

TO: Ryan Groce, Program Manager, Centuria Corporation	**FROM:** James Manitakos, CEO, Sensor Environmental LLC
CC: Jessica Schultz, Deputy Director, National Weather Service Radar Operations center Andre Tarpinian, Senior RF Engineer, Huntington Ingalls Industries Mission Technologies Group (formerly Alion Science and Technology Corp.)	**SUBJECT:** Analysis of Lower Scan Angles for Weather Surveillance Radar, Model 1988 Doppler (WSR-88D) Serving Mobile, AL, Area
DATE: August 10, 2023	

1. BACKGROUND AND NEED

The National Weather Service (NWS) proposes to reduce the minimum vertical scan angles used during normal operation of the WSR-88D serving Mobile, AL, area. Information on this radar is shown in Table 1. This WSR-88D was commissioned in September 1994 and has been in operation at its current location since then.

TABLE 1: Information on WSR-88D Serving the Eglin AFB, FL, Area	
Location	Co-located with Weather Forecast Office at Mobile Regional Airport, 12 miles west (W) of downtown Mobile, Mobile County, AL
Commissioning	September 1994
International Civil Aviation Organization Designator	KMOB
Elevation, ground surface at tower base (mean sea level, MSL)	208 feet (ft)
Elevation, center of antenna (MSL)	290 ft
Tower Height (m)	20 m (66 ft)
Latitude (WGS84)	30˚40’46” N
Longitude (WGS84)	88˚14’23” W
Operating Frequency	2,720 megaHertz (MHz)
Spot Blanking or Sector Blanking used	No
Weather Forecast Office	Mobile/Pensacola Weather Forecast Office 8400 Airport Boulevard, Building 11 Mobile, Al 36608

The National weather service (NWS) currently operates the KMOB WSR-88D at a minimum center-of-beam scan angle of + 0.5 degree (deg). The WSR-88D main beam has a width of 1 deg to the half power points. Half of the beam (i.e., 0.5 deg) is below the axis, resulting in an essentially horizontal floor for existing radar coverage. As a result, the WSR-88D cannot provide radar coverage of the atmosphere below the elevation of the WSR-88D antenna. At considerable distance from the radar, earth curvature increases the height above the ground surface of the uncovered area. To increase the amount of radar coverage provided by the KMOB WSR-88D, The WSR-88D Radar Operations Center (ROC) proposes to operate the radar with a lower center-of-beam minimum scan angle and is considering angles between +0.4 and 0.0 deg. This would result in the lower half power point of the main beam at -0.1 to -0.5 deg, depending on the minimum scan angle selected.

2. INVESTIGATIONS PERFORMED

To analyze the benefits and potential impacts of lowering the minimum scan angle of the KMOB WSR-88D, Sensor Environmental LLC and our subcontractor Huntington Ingalls Industries Mission Technologies Group (formerly Alion Science and Technology Corporation) performed the following tasks:

1. Visited the KMOB WSR-88D to ascertain site conditions and activities in the vicinity (see Attachment A, Trip Report).
2. Obtained 360-degree calibrated panoramic photograph taken at 15-m level of the KMOB WSR-88D tower, which is about 30 ft lower than the center of antenna height.
3. Prepared maps showing the extent of WSR-88D coverage at 2,000 ft above site level for each (center of beam) scan angle from the current minimum of +0.5 degree to 0.0 degree (See Attachment B).
4. Identified areas of terrain and activities that are potentially sensitive to radiofrequency (RF) radiation exposure in proximity to the WSR-88D that would be directly illuminated by the main beam at each lower scan angle under consideration (see Attachment C).
5. Identified astronomical observatories within 150 miles and analyzed the potential for a lowered WSR-88D main beam to directly impinge on each observatory.
6. Identified wind turbines within 50 miles and analyzed the potential for a lowered WSR-88D main beam to directly impinge on the turbines.

3. WSR-88D COVERAGE

KMOB WSR-88D is located on level ground at Mobile Regional Airport in the Mobile, Mobile County, AL, about 12 mi west of downtown Mobile. The Project team used Alion Integrated Target Acquisition System (ITAS) terrain-based computer model with GIS-based interface to project the terrain-dependent radar coverage for the KMOB WSR-88D at 2,000 ft above site level (ASL). The radar coverages shown in Attachment B are based on Digital Terrain Elevation

Data (DTED) Level 2 topographic data and 4/3 earth radius to account for atmospheric refraction of the WSR-88D main beam. The lower half-power point of the unobstructed WSR-88D main beam is considered the minimum elevation (i.e., floor) of WSR-88D coverage. Table 2 shows KMOB WSR-88D coverage areas at 2,000 ft above site level (ASL) for the range of minimum scan angles under consideration by NWS.

TABLE 2: KMOB WSR-88D Radar Coverage Areas for Minimum Scan Angles

Coverage Altitude (ft ASL)	Minimum Center of Beam Scan Angle (deg)	Lower Half-power Point (deg)	Area in Lambert Projection (sq. mi.)	Change from Existing Minimum Scan Angle
2,000	+0.5 (existing)	0.0	10,970	n/a
2,000	+0.4	-0.1	14,731	+34.3%
2,000	+0.3	-0.2	18,169	+65.6%
2,000	+0.2, +0.1, 0.0	-0.3, -0.4, -0.5	19,181	+74.8%

When operating at the current minimum center of beam minimum scan angle of +0.5 deg, the KMOB WSR-88D is subject to almost no terrain blockage (see Attachment B). At a lower scan angle of +0.4, radar coverage would improve in all directions. At a lower scan angle of +0.3, additional coverage improvements would be achieved in all directions; however, terrain blockage would limit the improvement in radar coverage to the northwest (NW), north (N), northeast (NE), and east (E). At a lower scan angle of +0.2, additional coverage improvements would be achieved to the southeast (SE), south (S), southwest (SW), and west (W). Negligible additional coverage would result at minimum scan angles below +0.2 deg.

Low altitude radar coverage over the Gulf of Mexico is a concern. Under current operations, 2,000-ft radar coverage extends over the Gulf of Mexico a maximum of 60 miles from the radars. Lowering the WSR-88D minimum scan angle to +0.2 would extend the area of 2,000 ft coverage over the Gulf of Mexico to 83 miles from the radar (see Attachment B).

The City of Biloxi, MS, located 44 miles WSW of the KMOB WSR-88D, and nearby coastal areas are areas of concern. Currently the floor of radar coverage is at an altitude of about 1,240 ft over Biloxi. Lowering the minimum scan angle of the radar to +0.2 deg would lower the altitude of the coverage floor over Biloxi, MS to about 220 ft.

4. HUMAN EXPOSURE AND POTENTIALLY RF-SENSITIVE ACTIVITIES

Exposure to radiofrequency (RF) radiation can potentially be harmful to humans and RF-sensitive activities. Table 3 presents the safe setback distances from the WSR-88D for human exposure, implantable medical devices, fuel handling, and EEDs (Sensor Environmental LLC, 2011). Safety standards for implantable medical devices, fuel handling, and EEDs are based on instantaneous exposure. Safety standards for human exposure are based on time-averaged exposure; therefore, exposure during both rotating antenna and stationary antenna operations are considered.

<table>
<tr><th colspan="4">TABLE 3: Safe Setback Distances for Human Exposure and Potentially RF-Sensitive Activities Directly Illuminated by the WSR-88D Main Beam</th></tr>
<tr><th>Activity</th><th colspan="2">Safe Setback Distance (ft)</th><th>Source</th></tr>
<tr><td rowspan="2">Human Exposure</td><td>Rotating Antenna</td><td>20</td><td rowspan="2">American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)</td></tr>
<tr><td>Stationary Antenna</td><td>1,740</td></tr>
<tr><td>Implantable Medical devices</td><td colspan="2">2,060</td><td>ANSI/Association for the Advancement of Medical Instrumentation (AAMI)</td></tr>
<tr><td>EEDs (Safe/Unsafe)</td><td colspan="2">1,709 / 6,285</td><td>Naval Sea Systems Command</td></tr>
<tr><td>Fuel Handling</td><td colspan="2">537</td><td>Naval Sea Systems Command</td></tr>
<tr><td colspan="4">Sources: ANSI/AAMI, 2007; ANSI/IEEE, 2029 and 2020; Naval Sea Systems Command, 2003 and 2008</td></tr>
</table>

Table 3 shows safe setback distances from the WSR-88D for human exposure, implantable medical devices, fuel handling, and electro-explosive devices (EEDs). The greatest safe setback distance for human exposure or any of these activities is for exposure of EEDs, which include blasting caps, some types of ordnance, and equipment used in aviation systems (e.g., ejection seats and separation systems for air-launched missiles). Hazard of Radiation to Ordnance (HERO) regulations characterize EEDs as either unsafe or safe with differing setback distances. HERO unsafe or unreliable EEDs have not been evaluated for compliance with MILSTD 664 or are being assembled, dissembled, or subject to unauthorized conditions, which can increase its sensitivity to RF emissions. HERO safe EEDs have been evaluated for compliance with MILSTD 664 and are not being assembled or dissembled (Naval Sea Systems command, 2008). Based on the U.S. Navy HERO regulations, the safety setback distances for HERO unsafe and safe EED, respectively are 6,285 ft and 1,709 ft respectively. U.S. Air Force safety regulations consider a 900 ft setback distance from radars such as the WSR-88D safe for all types of blasting caps (U.S. Air Force, 1982).

5. DIRECTLY ILLUMINATED TERRAIN AND STRUCTURES

Photographs 3A through 3D in Attachment A Trip Report are panoramic photographs taken from the 15-m level of the KMOB WSR-88D tower and show a 360 deg view of the horizon. As shown in these figures, no nearby structures rise above WSR-88D antenna elevation except for communications towers registered with the Federal Communications Commission (FCC) and the Airport Traffic Control Tower (ACTC). Those towers are analyzed in the next paragraphs.

A search of the FCC Antenna Structure Registration site identified 23listings within 3 miles of the KMOB WSR-88D. Table 5 provides additional information. Twenty of those towers are located farther from the KMOB WSR-88D than all setback distances in Table 3. Three towers (Registration Numbers 1230005, 1233918, and 1320058, shaded in Table 4) are within the safe setback distance for HERO unreliable/unsafe ordnance, but meet all other safe setback distances. Towers with Registration Numbers 1230005 and 1233918 rise higher in elevation than the WSR-88D feedhorn and are illuminated by the radar's main beam during current operations; lowering the WSR-88D minimum scan angle would not change that situation. It is extremely unlikely that HERO unsafe/unreliable would be in use at the upper portions of a commercial communications tower. Since all other setback distances would be met, no hazards would result at those towers. The tower with Registration Number 1320058 is 4,300 ft southwest of the WSR-88D and has a top elevation of 248 ft, or 42 feet lower than the WSR-88D feedhorn. It is not currently illuminated by the radar main beam and would not be illuminated at a lower scan angle of +0.2 deg. No RF hazards will result to personnel or RF-sensitive activities at any of the towers listed in the FCC database.

TABLE 4: FCC Antenna Structure Registrations within 3 miles of KMOB WSR-88D

Registration Number	Distance and Direction from WSR-88D	Top of Tower Elevation (ft MSL)	Registrant	Status	Closer than safe setback distances?
1035189	2.44 mi (12,9000 ft) west-southwest (WSW)	366	Cellco Partnership	Constructed	No

TABLE 4: FCC Antenna Structure Registrations within 3 miles of KMOB WSR-88D					
Registration Number	**Distance and Direction from WSR-88D**	**Top of Tower Elevation (ft MSL)**	**Registrant**	**Status**	**Closer than safe setback distances?**
1035190	1.8 mi (9,500 ft) north-northeast (NNE)	370	Cellco Partnership	Constructed	No
1035193	2.8 mi (13,500 ft) ENE	356	Cellco Partnership	Constructed	No
1063618	2.5 mi (13,300 ft) NE	367	Mobile County Communications District	Constructed	No
1202824	1.2 mi (6,400 ft) WSW	344	American Towers, LLC	Constructed	No
1202829	1.85 mi (8,800 ft) NE	339	American Towers, LLC	Constructed	No
1206147	1.6 mi (8,400 ft) E	305	Crown Castle South LLC	Constructed	No
1206156	2.4 mi (12,800 ft) WSW	362	Crown Castle South LLC	Constructed	No
1210054	2.6 mi (13,800 ft) NE	330	City of Mobile	Granted not constructed	No
1229302	1.2 mi (6,500 ft) SE	330	Crown Castle South LLC	Constructed	No
12229654	1.9 mi (10,200 ft) N	368	SBA Properties, LLC	Constructed	No

TABLE 4: FCC Antenna Structure Registrations within 3 miles of KMOB WSR-88D					
Registration Number	**Distance and Direction from WSR-88D**	**Top of Tower Elevation (ft MSL)**	**Registrant**	**Status**	**Closer than safe setback distances?**
1230005	0.8 mi (4,300 ft) E	330	SBA Structures, LLC	Constructed	Yes
1230392	3.0 mi (15,700 ft) E	332	Foresite, LLC	Granted not constructed	No
1232532	2.8 mi (14,600 ft) NE	368	SBA Structures, LLC	Constructed	No
1233047	1.6 mi (8,400 ft) ESE	325	SBA Properties, LLC	Constructed	No
1237777	2.4 mi (12,900 ft) NE	380	SBA Properties, LLC	Constructed	No
1233918	1.0 mi (5,400 ft) NE	330	SWI Funds Tower Holdings, LLC	Constructed	Yes
1235204	2.2 mi (11,400 ft) S	343	Pinnacle Tower Acquisition LLC	Constructed	No
1279064	3.0 mi (15,800 ft) E	400	Alabama Power Company	Constructed	No
1302527	2.8 mi (14,600 ft) NW	344	GST Capital Partners LLC, Gulf South towers LLC	Granted not constructed	No
1303118	2.7 mi (14,500 ft) NW	288	Eco-site LLC	Constructed	No

TABLE 4: FCC Antenna Structure Registrations within 3 miles of KMOB WSR-88D					
Registration Number	**Distance and Direction from WSR-88D**	**Top of Tower Elevation (ft MSL)**	**Registrant**	**Status**	**Closer than safe setback distances?**
1320058	0.8 mi (4,300 ft) SW	248	New Cingular Wireless PCS, LLC	Constructed	Yes
1320857	1.9 mi (10,200 ft) NNW	368	Tillman Infrastructure, LLC	Constructed	No

The Mobile Regional Airport ATCT, 3,900 ft NNW of the WSR-88D, has a cab at similar elevation as the WSR-88D feedhorn and antennas mounted on the cab rise above the radar horizon (see Attachment 1, Figure 3D). The cab and roof top antennas are illuminated by the WSR-88D main beam during current operations. Lowering the minimum scan angle of the WSR-88D would continue that situation. The ATCT is within the safe setback distance for HERO unreliable/unsafe EEDs, but meets all other safe setback distances. It is extremely unlikely that HERO unsafe/unreliable (i.e., EEDs being tested or assembled) would be in use at the ATCT cab or rooftop. Since all other setback distances would be met, no hazards would result.

Attachment C contains maps showing terrain directly illuminated by the KMOB WSR-88D main beam at minimum center of beam scan angles of +0.5 seg (current operation) through 0.0 deg. At the current minimum scan angle of +0.5 deg, the main beam does not impinge on the ground within 3 miles. At minimum scan angle of +0.4 deg, the main beam would impinge on small areas of elevated terrain about 2.7 miles (14,300) ft to the N of the radar. At a scan angle of +0.3 deg, the main beam would impinge on elevated ground between 2 and 2.5 miles to NW, N and NE of the radar. At scan angles of +0.2 or +0.1 deg, the main beam would impinge on elevated ground in all directions, with the closest being 1.2 miles (6,500 ft) ESE, which is outside the safe setback distances for human exposure and activities listed in Table 3. A scan angle of +0.0 deg would increase the areas of illuminated terrain, including areas located 0.8 mile (4,400 ft) NE and WSW.

6. ASTRONOMICAL OBSERVATORIES

The WSR-88D can potentially cause adverse electromagnetic interference (EMI) with charge-couple devices (CCDs) which electronically record data collected by astronomical telescopes (NEXRAD JSPO), 1993). Due to the sensitivity of astronomical equipment which is designed to detect very faint signals from space, this equipment is vulnerable to EMI. The potential for harmful EMI would arise if the WSR-88D main beam would directly impinge on an astronomical observatory during low angle scanning. The area of potential impact to observatories is within 150 miles of the WSR-88D. Portions of the states of Alabama, Florida, Georgia, Louisiana, and Mississippi are within 150 miles of the KMOB WSR-88D and were evaluated to identify observatories. No astronomical observatories are located within 150 miles (www.go-astronomy.com, 2023).

7. WIND TURBINES

Wind turbines are a special concern because they produce Doppler radar returns that can mask meteorological returns. The U.S. Wind turbine Database (U.S. geological Survey [USGS], 2023) was searched for wind turbines within 50 miles of the KMOB WSR-88D. The search did not identify any wind turbines within 50 miles.

The U.S. Department of Interior Bureau of Ocean Energy Management (BOEM) is responsible for leasing offshore waters within U.S Exclusive Economic Zone for renewable energy projects, including wind turbines, and environmental review of proposed leases and projects. BOEM's list of existing leases and applications was searched and identified no active proposed wind turbine projects near the Gulf of Mexico coastline of Florida. Alabama, or Mississippi.

8. SUMMARY AND RECOMMENDATION

Compared to the current minimum scan angle of +0.5 deg, lowering the minimum scan angle of the KMOB WSR-88D to +0.2 deg would increase coverage area at 2,000 ft above site level by 74.8%. The range of 2,000 ft coverage over the Gulf of Mexico would increase by about 23 miles and the radar coverage over Biloxi, MS, would decrease in altitude from about 1,240 to 220 ft above ground elevation. Lowering the minimum scan angle below +0.2 deg or lower would result in negligible additional coverage.

A minimum scan angle of +0.2 deg would not result in the main bean impinging on any terrain or structures within the safe setback distances for human exposure, implantable medical devices, safe EEDs, or fuel handling. The Mobile Regional Airport ATCT and three communications within safe setback distances for HERO unsafe/unreliable ordnance would be illuminated by the WSR-88D main beam, but this it is improbable that such ordnance would be in use at those structures. Lowering the WSR-88D minimum scan angle would also not result in adverse effects to astronomical observatories. No wind turbines are present within 50 miles of the WSR-88D and lowering the minimum scan angle would not result in new or more intense doppler returns from wind turbines. Therefore, a minimum center of beam scan angle of +0.2 deg is recommended for the KMOB WSR-88D.

9. MEMORANDUM AUTHORS

This memorandum was prepared by Sensor Environmental LLC under contract to Centuria Corporation, which is a support contractor to the National Weather Radar Operations Center. Mr. James Manitakos, CEO, served as Sensor's Project Manager. Huntington Ingalls Industries Mission Technologies Group prepared radar coverage maps and calculated coverage areas under subcontract to Sensor. Mr. Andre Tarpinian, Radio Frequency Engineer, served as Huntington's Project Manager.

10. REFERENCES

ANSI/IEEE. *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 3 kHz to 300 GHz*. IEEE Std C95.1-2019 (February 8, 2019).

ANSI/IEEE. *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 3 kHz to 300 GHz, Corrigenda 2*. IEEE Std C95.1-2019 (September 24, 2020).

ANSI/AAMI. *American National Standard, Active Implantable Medical Devices – Electromagnetic compatibility – EMC test protocols for cardiac pacemakers and implantable cardioverter defibrillators*, ANSI/AAMI PC69:2007 (2007).

BOEM. Lease and Grant Information. Lease and Grant Information | Bureau of Ocean Energy Management (boem.gov) (accessed July 2, 2023)

FCC. Antenna Structure Registration Web Site. https://wireless2.fcc.gov/, (Accessed July 15, 2023).

Go Astronomy, www.go-astronomy.com/obvservatories.htm, accessed July 15, 2023.

Naval Sea Systems Command. *Technical Manual, Electromagnetic Radiation Hazards (U), (Hazards to Personnel, Fuel, and Other Flammable Material) (U)*, NAVSEA OP 3565/NAVAIR 16-1-529, Volume 1, Sixth Revision (February 1, 2003).

Naval Sea Systems Command. *Technical Manual, Electromagnetic Radiation Hazards (U), (Hazards to* Ordnance*) (U)*, NAVSEA OP 3565/NAVAIR 16-1-529, Volume 2, Seventeenth Revision, (September 11, 2008).

NEXRAD JSPO. *Final Supplemental Environmental Assessment (SEA) of the Effects of Electromagnetic Radiation from the WSR-88D Radar* (April 1993).

NTIA. *Manual of Regulations and Procedures for Federal Radio Frequency Management.* May 2014.

Sensor Environmental LLC, *Supplemental Environmental Assessment (EA) of the Electromagnetic Effects of Operating Weather Service Radar – 1988 Doppler (WSR-88D) to Serve Coastal Washington at Scan Angles Below +0.5 Degree*. Prepared for National Weather Service/Centuria Corporation, September 2011.

U.S. Air Force. *Explosive Safety Standards*. U.S. Air Force Regulation 127-100(c1). July 27, 1982.

USGS. *Spring Hill Quadrangle, Alabama – Mobile County*. 7.5-minute series (2020).

USGS. *Tanner Williams Quadrangle, Alabama – Mobile County*. 7.5-minute series (2020).

USGS. *U.S. Wind Turbine Database*, https://eerscmap.usgs.gov/uswtbdb/viwer (accessed July 15, 2023).

ATTACHMENT A

TRIP REPORT, KMOB WSR-88D

TRIP REPORT

Traveler: James Manitakos, Sensor Environmental LLC

Destination: KMOB Weather Surveillance Radar, Model 1988 Doppler (WSR-88D) serving the Mobile, AL, area

Dates: July 31 - August 2, 2023

Purpose: Field Inspection of radar and vicinity and obtaining 360-degree panoramic photographs from of KMOB WSR-88D tower.

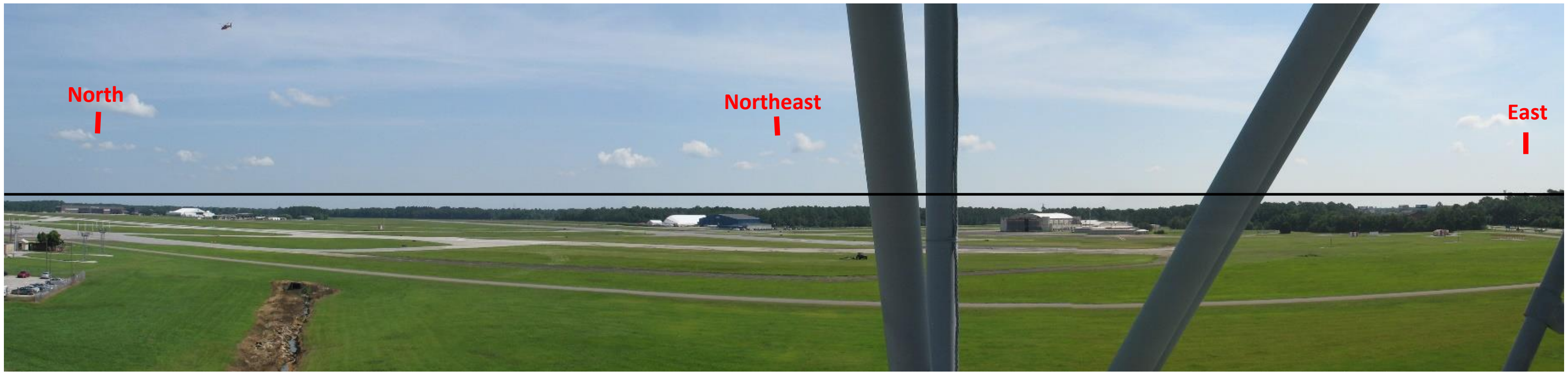
Summary: July 31: Mr. Manitakos flew to Atlanta and drove to Mobile, AL

August 1: Weather: 91° F, sunny. Mr. Manitakos met with Jeremy Menhennett at the Mobile/Pensacola Weather Forecast Office, took pictures of the KMOB WSR-88D (photographs 1 and 2), and investigated land uses in the vicinity of the radar. Mr. Manitakos took panoramic photographs (Photograph 3) from the 15-m level of the KMOB WSR-88D, which is about 30 ft below the center of the WSR-88D antenna.

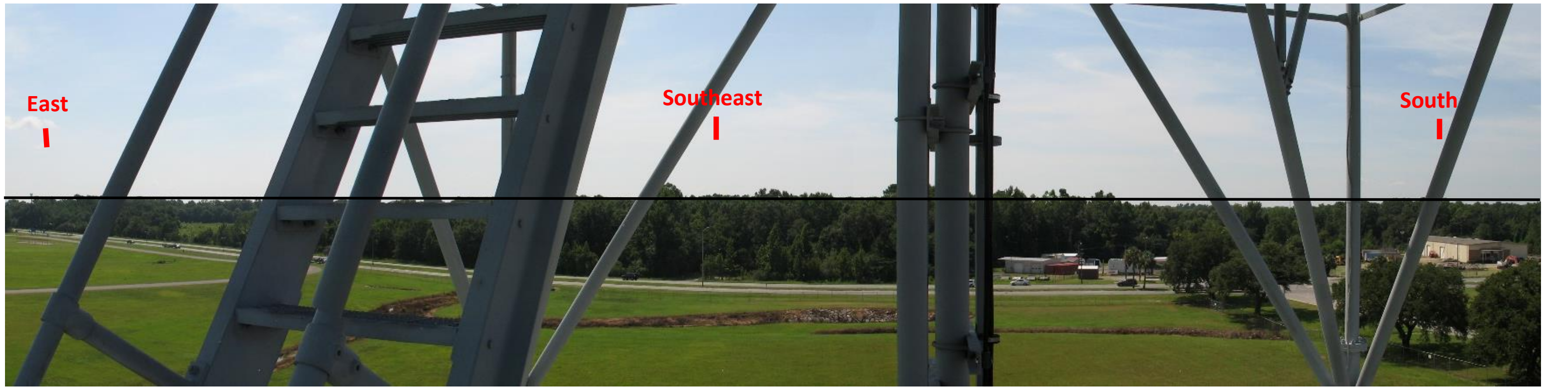
August 2: Mr. Manitakos drove to Calera, AL to conduct field visit to KBMX WSR-88D serving Birmingham, AL, area.

Photograph 1: KMOB WSR-88D serving Mobile, AL, area viewed from NW

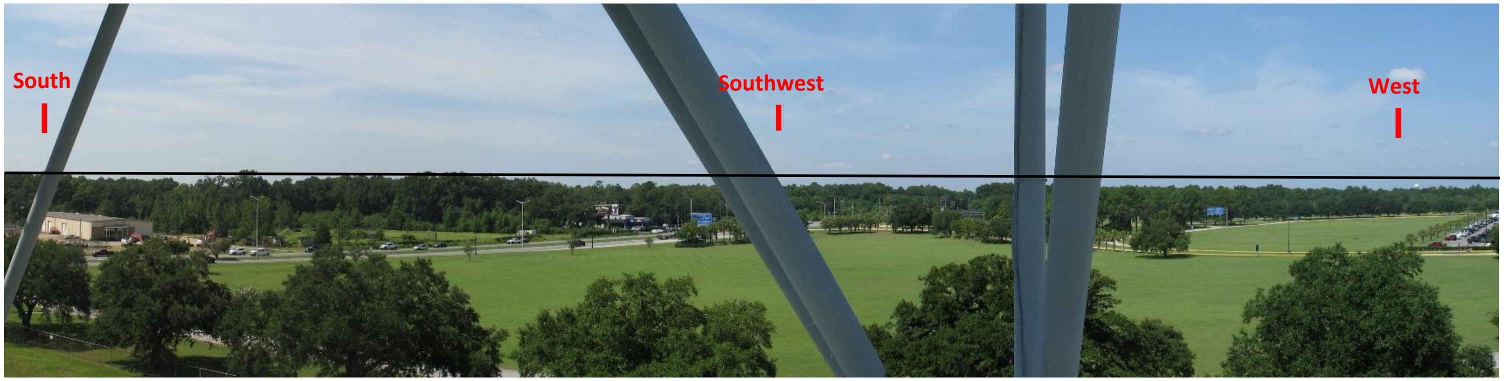
Photograph 2: Sign at Mobile Weather Forecast Office



Photograph 3A: Panoramic photograph from KMOB WSR-88D tower [— 0 deg]



Photograph 3B: Panoramic photograph from KMOB WSR-88D tower [— 0 deg]

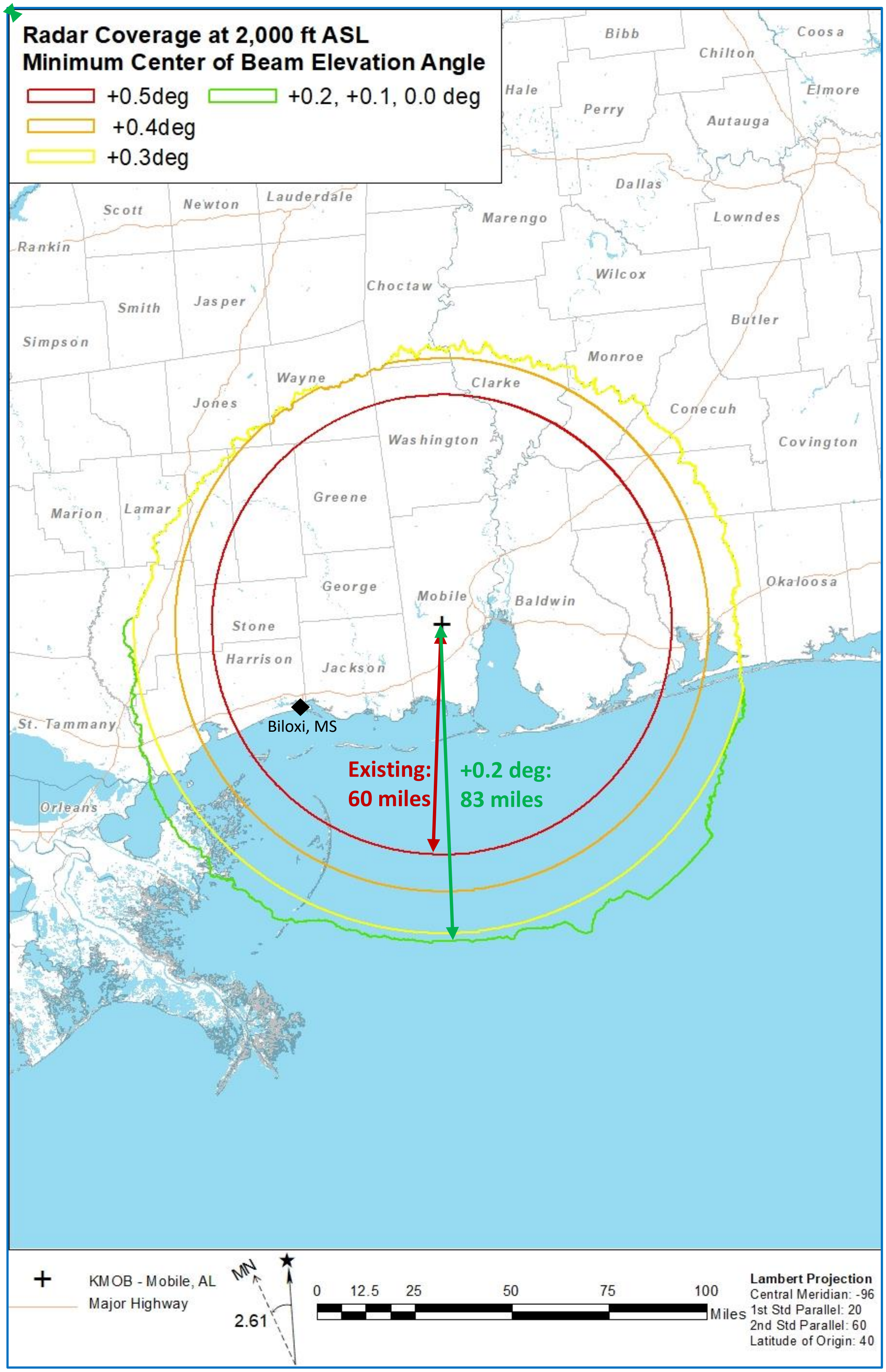


Photograph 3C: Panoramic photograph from KMOB WSR-88D tower [— 0 deg]

Photograph 3D: Panoramic photograph from KMOB WSR-88D tower [— 0 deg]

ATTACHMENT B

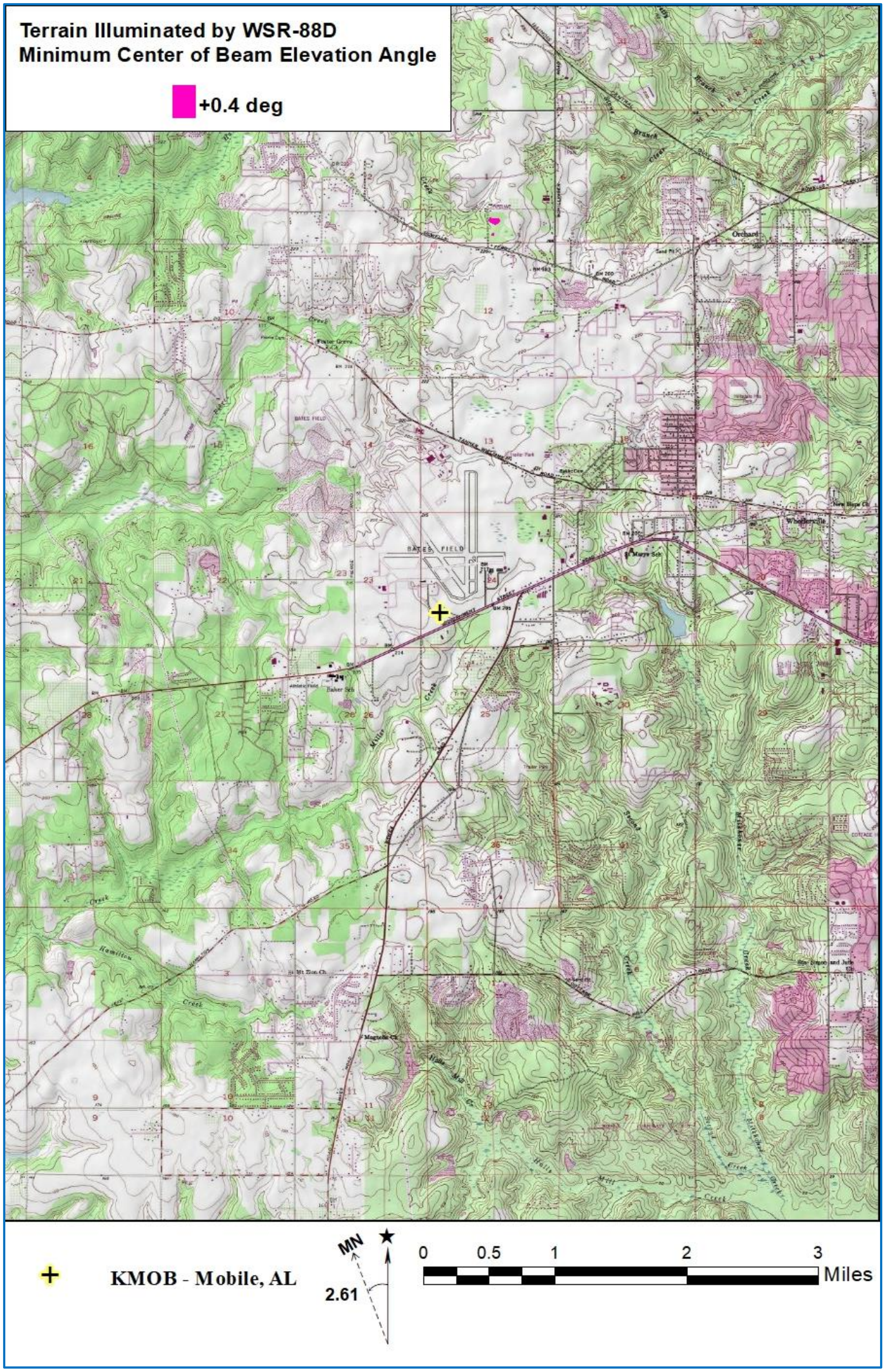
KMOB WSR-88D COVERAGE MAP
MINIMUM SCAN ANGLES +0.5 deg to 0.0 deg

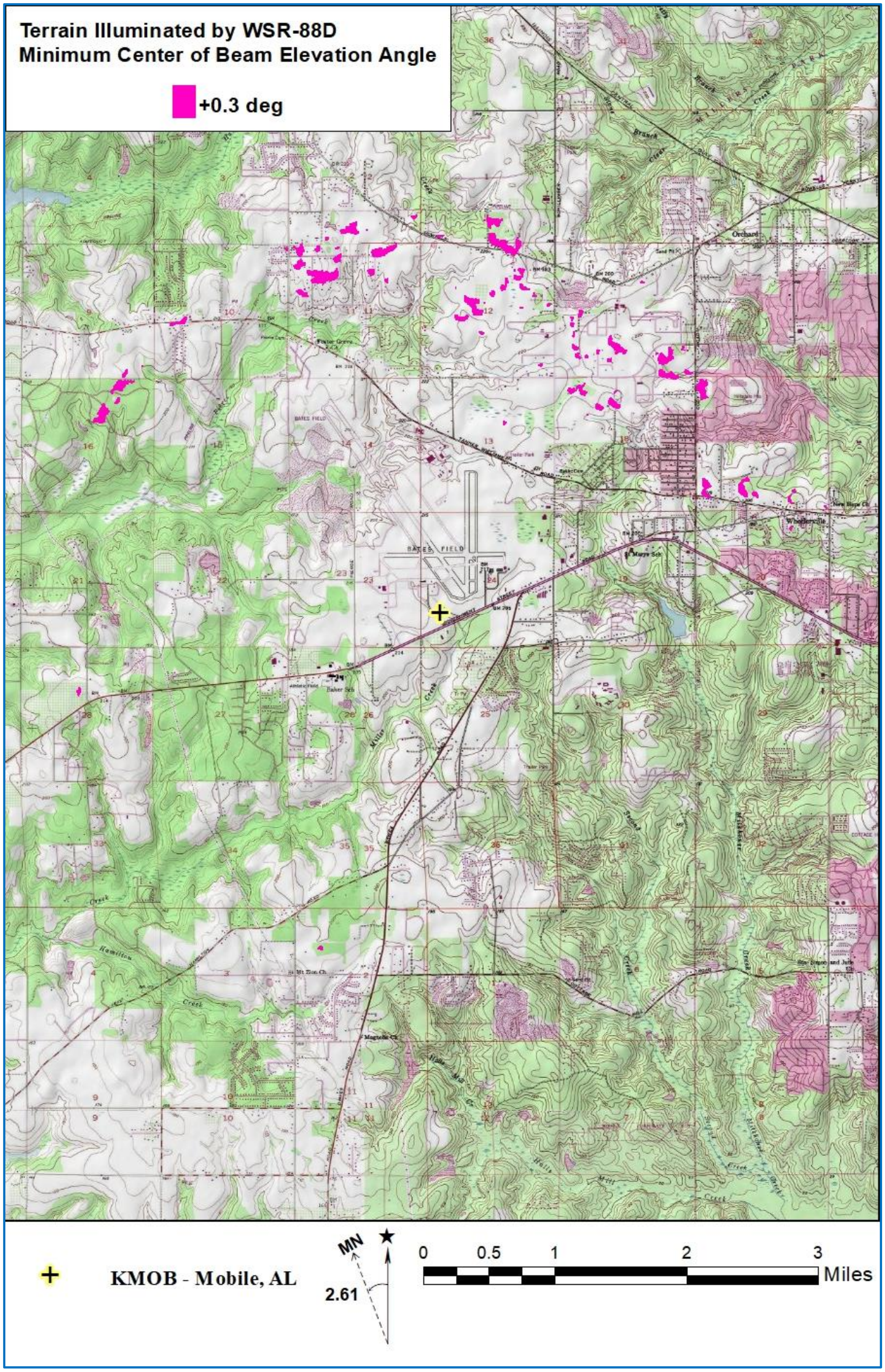

Radar Coverage at 2,000 ft ASL
Minimum Center of Beam Elevation Angle
+0.5deg
+0.2, +0.1, 0.0 deg
+0.4deg
+0.3deg
Biloxi, MS
Existing: 60 miles
+0.2 deg: 83 miles
KMOB - Mobile, AL
Major Highway
MN
2.61
0 12.5 25 50 75 100 Miles
Lambert Projection
Central Meridian: -96
1st Std Parallel: 20
2nd Std Parallel: 60
Latitude of Origin: 40

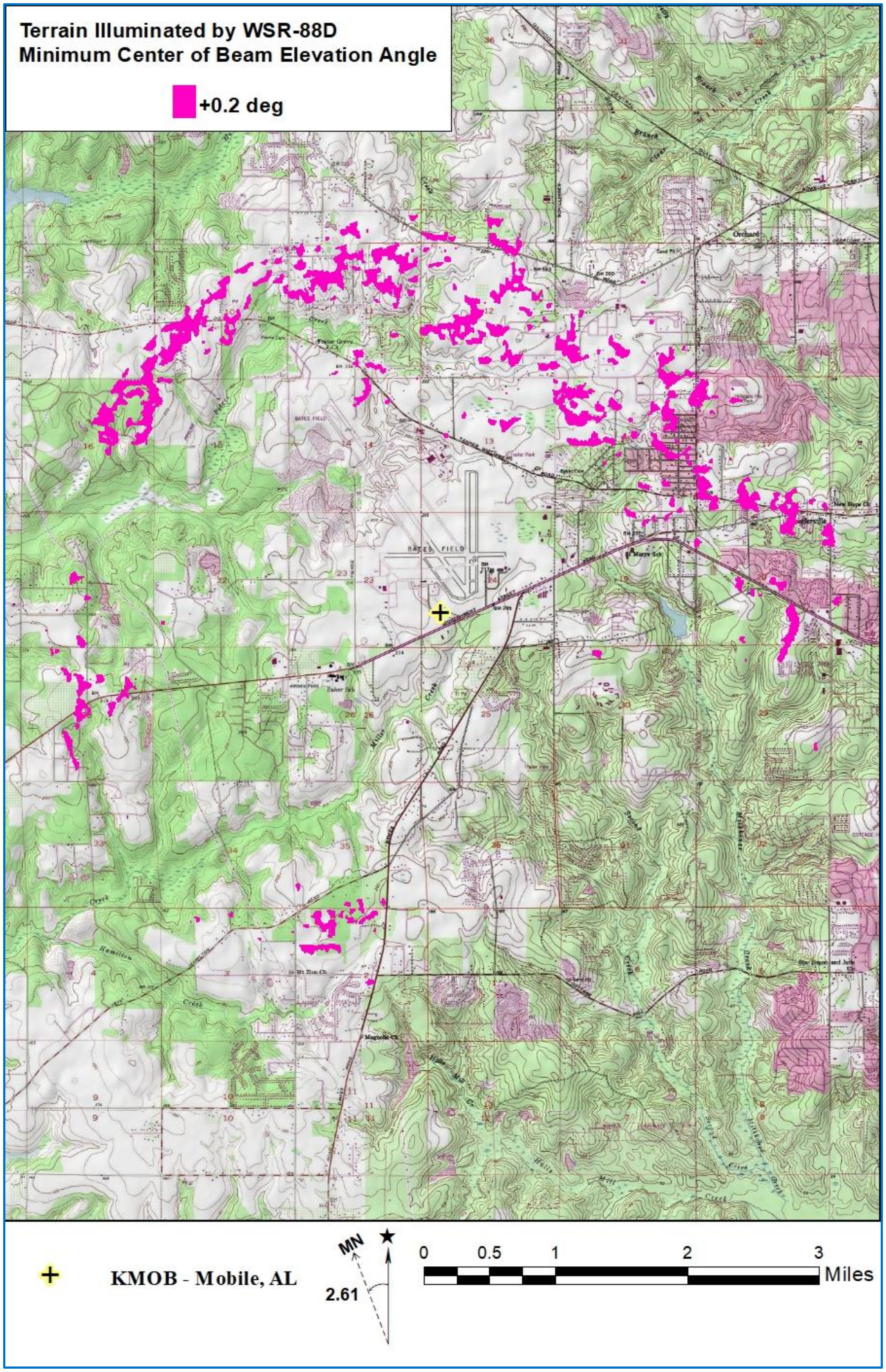
ATTACHMENT C

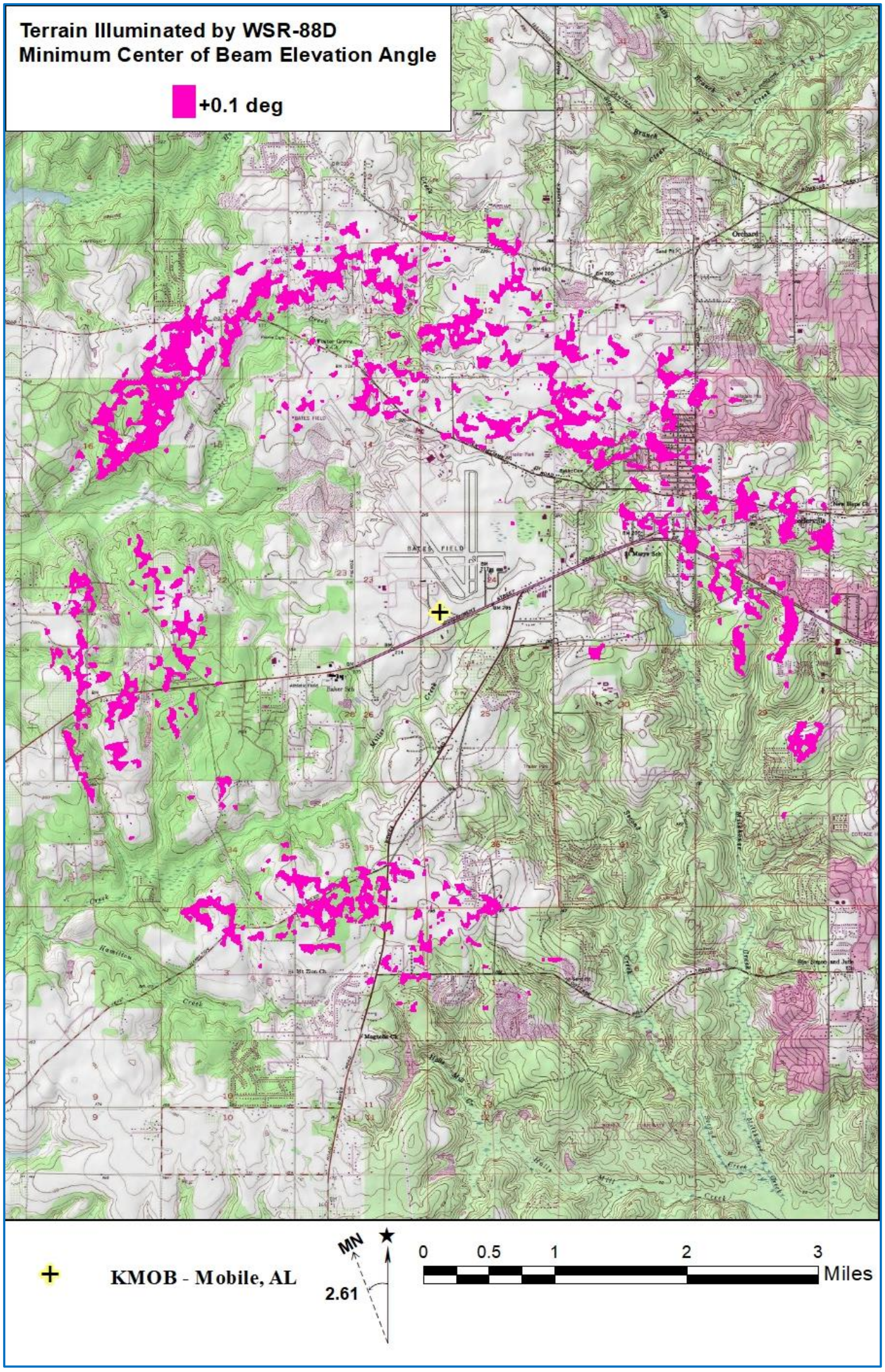
KMOB WSR-88D NEARBY DIRECTLY ILLUMINATED TERRAIN
AT SCAN ANGLES OF +0.4 to 0.-0 deg

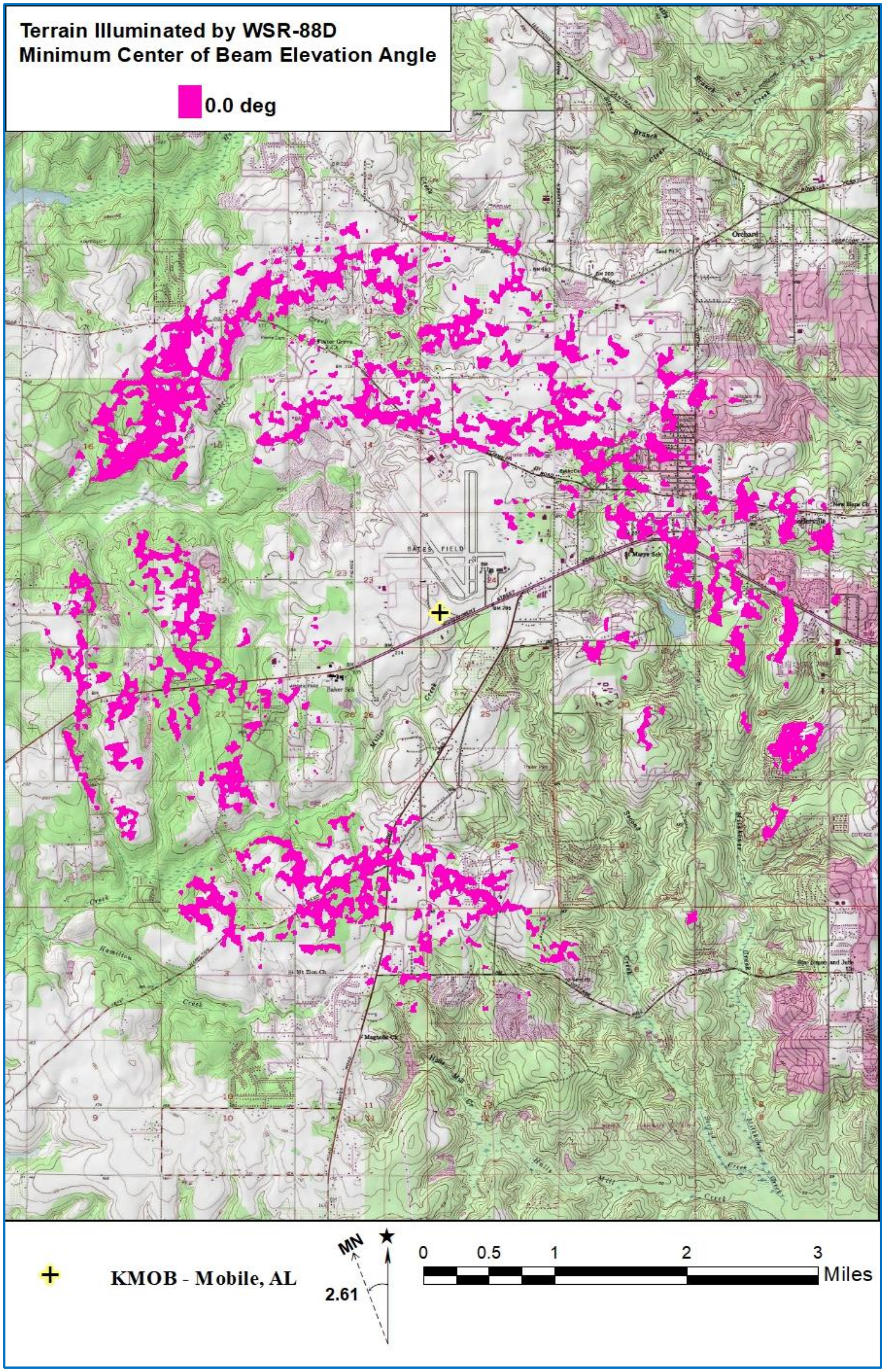
NOTE: No terrain within 3 miles is directly illuminated by the WSR-88D main beam at scan angles of +0.5 deg.


Terrain Illuminated by WSR-88D
Minimum Center of Beam Elevation Angle
+0.4 deg
KMOB - Mobile, AL
MN
2.61
0
0.5
1
2
3
Miles


Terrain Illuminated by WSR-88D
Minimum Center of Beam Elevation Angle
+0.3 deg
KMOB - Mobile, AL
MN
2.61
0
0.5
1
2
3
Miles


Terrain Illuminated by WSR-88D
Minimum Center of Beam Elevation Angle
+0.2 deg
KMOB - Mobile, AL
MN
2.61
0
0.5
1
2
3
Miles


Terrain Illuminated by WSR-88D
Minimum Center of Beam Elevation Angle
+0.1 deg
KMOB - Mobile, AL
MN
2.61
0 0.5 1 2 3
Miles


Terrain Illuminated by WSR-88D
Minimum Center of Beam Elevation Angle
0.0 deg
KMOB - Mobile, AL
MN
2.61
0
0.5
1
2
3
Miles