Final
Environmental Assessment
Combat Air Forces Adversary Air
Shaw Air Force Base, South Carolina

January 2024

United States Air Force
20th Fighter Wing

Shaw Air Force Base, South Carolina

Privacy Advisory

This Environmental Assessment (EA) is provided for public comment in accordance with the National Environmental Policy Act of 1969 (NEPA), the President's Council on Environmental Quality NEPA Regulations (40 Code of Federal Regulations [CFR] Parts 1500 - 1508), and 32 CFR Part 989, *Environmental Impact Analysis Process (EIAP)*. For this EA, the updated September 2020 CEQ NEPA rules (85 Federal Register 43304 through 43376) are being followed, as modified by the CEQ NEPA Implementing Regulations Revisions Final Rule, effective 20 May 2022. The EIAP provides an opportunity for public input on Department of the Air Force (DAF) decision-making, allows the public to offer input on alternative ways for the DAF to accomplish what it is proposing, and solicits comments on the DAF's analysis of environmental effects.

Public commenting allows the DAF to make better informed decisions. Letters or other written or oral comments provided may be published in the EA. As required by law, comments provided will be addressed in the EA and made available to the public. Providing personal information is voluntary. Any personal information provided will be used only to identify your desire to make a statement during the public comment portion of this process. Private addresses will be compiled to develop a stakeholders list; however, only the names of the individuals making comments and specific comments will be disclosed. Personal home addresses and phone numbers will not be published in the EA.

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This document has been verified that it does not exceed 75 pages, not including appendices, as defined in 40 CFR § 1501.5(f). As defined in 40 CFR § 1508.1(v) a "page" means 500 words and does not include maps, diagrams, graphs, tables, and other means of graphically displaying quantitation or geospatial information.

COVER SHEET
ENVIRONMENTAL ASSESSMENT (EA) FOR COMBAT AIR FORCES ADVERSARY AIR, SHAW AIR FORCE BASE, SOUTH CAROLINA

a. *Responsible Agency*: Department of the Air Force (DAF)

b. *Cooperating Agency*: None

c. *Proposals and Actions:* The environmental assessment (EA) analyzes a Proposed Action to provide dedicated contract adversary air (ADAIR) sorties to support Combat Air Forces training for Shaw Air Force Base (AFB), South Carolina. The Proposed Action would include the addition of 78 contracted maintainers and 15 contracted pilots and approximately 3,500 annual contracted sorties. These contracted sorties would occur within existing special use airspace (SUA) consisting of overland Military Operations Areas (MOAs) and offshore Warning Areas.

d. *For Additional Information*: Mr. Bryan Jobe, 20 CES/CEIEA, Shaw AFB, (803) 895-9985, bryan.jobe@us.af.mil

e. *Designation:* Final EA

f. *Abstract:* This EA has been prepared pursuant to provisions of the National Environmental Policy Act (NEPA) (Title 42 United States Code §§ 4321-4347), Council on Environmental Quality regulations implementing NEPA (Title 40 Code of Federal Regulations [CFR] Parts 1500 - 1508), and the DAF Environmental Impact Analysis Process (32 CFR Part 989).

The purpose of the Proposed Action is to provide dedicated contract ADAIR sorties at Shaw AFB to improve the quality of training and readiness of fighter aircrew of the 20th Fighter Wing and other units supported by Shaw AFB. The Proposed Action is needed to provide better and more realistic training for the flight training program in support of units at Shaw AFB.

Contract ADAIR training would include the use of combat tactics and procedures that differ from Combat Air Forces tactics to simulate an opposing force. Elements affecting Shaw AFB would include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. Elements affecting the airspace would include airspace use and use of defensive countermeasures. The Proposed Action would include the establishment of an estimated 78 contracted maintainers and 15 contracted pilots who would operate an estimated 12 aircraft. The DAF has identified six aircraft types (MiG-29, F-5, Dassault Mirage, F-16, Eurofighter Typhoon, and JAS-39 Gripen) that based on performance capabilities, meet the needs for DAF contract ADAIR selection and Shaw AFB mission training requirements. Contract ADAIR service providers may ultimately choose another type of aircraft to support ADAIR needs for Shaw AFB; however, any aircraft selected would need to operate within the parameters and impact levels evaluated within this EA or supplemental NEPA analysis would be required. On Shaw AFB, the contractor would use Buildings 106, 712, and/or existing space in the facilities of the fighter squadron they are flying with on the particular training day, and aircraft parking on N Row.

Based on the analysis of the affected environment and potential environmental consequences presented in the EA, the Proposed Action would have significant long-term impacts from noise at Shaw AFB under the High Noise Scenario and less than significant impacts under the High, Medium, and Low Noise Scenarios on all other resources at Shaw AFB and in the SUA.

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FINDING OF NO SIGNIFICANT IMPACT

**COMBAT AIR FORCES ADVERSARY AIR
SHAW AIR FORCE BASE, SOUTH CAROLINA**

Pursuant to provisions of the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] §§ 4321 - 4370h); Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500 - 1508); and the Department of the Air Force (DAF) Environmental Impact Analysis Process (EIAP) (32 CFR Part 989), the DAF has prepared the attached Environmental Assessment (EA) to address the potential environmental consequences associated with the Proposed Action to provide contract adversary air (ADAIR) sorties for improving training and readiness of pilots at Shaw Air Force Base (AFB), South Carolina. The attached EA is incorporated by reference in this Finding of No Significant Impact (FONSI).

Purpose and Need

The purpose of the Proposed Action is to provide dedicated contract ADAIR sorties at Shaw AFB to improve the quality of training and readiness of fighter aircrew of the 20th Fighter Wing (20 FW) and other units supported by Shaw AFB. The Proposed Action is needed to provide better and more realistic training for the flight training program in support of units at Shaw AFB. Dedicated contract ADAIR would enable the 20 FW to make existing in-house ADAIR resources available for other missions and use those available flying hours more effectively.

Description of Proposed Action and Alternatives

The Proposed Action would establish an estimated 78 contracted maintainers and 15 contracted pilots who would operate an estimated 12 aircraft and conduct approximately 3,500 annual sorties. Six aircraft types (MiG-29, F-5, Dassault Mirage, F-16, Eurofighter Typhoon, and JAS-39 Gripen) have been identified as capable of providing contract ADAIR support to pilots stationed at Shaw AFB based on performance capabilities of the aircraft and how those capabilities best meet mission training requirements. One or a combination of these aircraft types may be operated by a contractor in support of ADAIR training. All contract aircraft, maintainers, and pilots would operate from existing facilities on Shaw AFB; the use of off-base facilities to support contract ADAIR operations is not considered in the EA.

Approximately 3,500 annual sorties would support training activities within existing special use airspace (SUA) currently used by Shaw AFB pilots. This SUA consists of the overland Bulldog and Gamecock Military Operations Areas (MOAs) and associated Air Traffic Control Assigned Airspace (ATCAA), the RobRoy Airspace (which is a subdivision of the Gamecock MOA), and offshore Warning Areas W-161 and W-177. Contract ADAIR flight operations would occur in this SUA concurrent with aircraft assigned to the 20 FW or other transient DAF aircraft operating from Shaw AFB, as needed. Approximately 1 to 2 percent of the proposed annual sorties (i.e., approximately 35 to 70 sorties) would occur during environmental night hours (10:00 p.m. to 7:00 a.m. local time).

Contract ADAIR aircraft would operate with advanced radar and electronic targeting systems during engagements and employ defensive countermeasures (e.g., RR-188 chaff and M206 flares or similar) during training sortie operations in SUA where authorized. No other live or inert munitions would be used under the Proposed Action.

No changes to the lateral or horizontal extents of existing SUA or the minimum or maximum permitted altitudes of aircraft operating in this SUA are included in the Proposed Action. The Proposed Action does not involve any physical or operational changes to military ground operating areas used, owned, operated, maintained by, or otherwise associated with the Department of Defense. Therefore, such areas are not addressed in the EA.

Alternative 1: Establish Contract ADAIR Capabilities in Building 106 and Building 712 at Shaw AFB

Alternative 1 would implement the Proposed Action by establishing contract ADAIR capabilities with an estimated 12 aircraft providing 3,500 annual sorties at Shaw AFB. Contract ADAIR operations and maintenance activities would occupy space in Building 106 and Building 712 at Shaw AFB, respectively, including available hangar space for aircraft maintenance. Contract ADAIR aircraft parking would be on the November Row of the aircraft parking apron, immediately east of Building 712 and other nearby facilities. Contract ADAIR operations personnel would attend crew briefs and debriefs in Building 106 or other existing facilities at Shaw AFB.

Alternative 2: Establish Contract ADAIR Capabilities in Building 106 and Shared Space with Each Fighter Squadron

Alternative 2 would consist of the same activities and facilities described for Alternative 1 except Building 712 would not be used; rather, contract ADAIR operations and administrative functions would occupy existing space on Shaw AFB in the facilities of the fighter squadron they are flying with on the particular training day.

No Action Alternative

Under the No Action Alternative, contract ADAIR would not be established at Shaw AFB and existing conditions would continue. The No Action Alternative does not meet the purpose and need but is evaluated in this EA in accordance with CEQ NEPA regulations to provide a benchmark for the comparison of potential impacts from Alternatives 1 and 2.

Summary of Findings

Potential effects on the following environmental resources are analyzed in the attached EA: airspace management and usage; noise; safety; air quality; biological resources; land use; socioeconomics; environmental justice and protection of children; cultural resources; hazardous materials and wastes, Environmental Restoration Program (ERP) sites, and toxic substances; and cumulative impacts. These resources were identified based on the nature of the Proposed Action as well as through communications with state and federal agencies and review of past environmental documentation. Potential effects on these resources are summarized below; these summaries are drawn from the detailed analysis presented in the attached EA. Contract ADAIR aircraft operations included in the Proposed Action would be the same under Alternative 1 and Alternative 2; therefore, unless otherwise noted, potential effects from Alternative 1 and Alternative 2 would be the same for all resources evaluated in the EA.

<u>Airspace Management and Usage</u>

The Proposed Action would have negligible long-term impacts on airspace management and usage at Shaw AFB and in the SUA proposed for use. The Proposed Action would not impact airspace operational capacity or necessitate changes to airspace locations or dimensions. The SUA proposed for use are in compatible locations and have sufficient capacity and dimensions to support the proposed contract ADAIR sorites. The Proposed Action would not require modifications to existing airspace or the establishment of new airspace to accommodate the proposed contract ADAIR sorties.

<u>Noise</u>

Under the Proposed Action High Noise Scenario, noise levels generated by contract ADAIR aircraft would increase the overall noise environment in the vicinity of Shaw AFB. The total on-base and off-base land area within day-night average sound level (DNL) contours associated with Shaw AFB would increase by approximately 6,300 acres. Increased DNL would be significant at three representative points of interest (POIs) and surrounding areas where the DNL would increase between 3 and 9 A-weighted decibels (dBA); long-term and likely noticeable at five locations where noise would increase by 3 dBA or more but remain outside the greater than 65 dBA DNL noise contour; and likely unnoticeable at the remaining 12 POIs. The three POIs where significant noise increases would occur are places of worship with primary operating hours in the evening and weekends when the proposed contract ADAIR sorties would occur less frequently.

Under the Medium and Low Noise Scenarios, the land area within Shaw AFB DNL contours would increase by 869 acres and 1,101 acres, respectively. Although increased noise levels under the Low Noise Scenario would be slightly higher than those under the Medium Noise Scenario, increases under either scenario would be marginal relative to the existing noise environment at Shaw AFB. One- to 2-dBA increases in DNL would occur at 13 of the 20 POIs under the Medium Noise Scenario and at 17 of the 20 POIs under the Low Noise Scenario. One POI would also experience a 5-dBA DNL increase under the Low Noise Scenario; however, it would remain outside the greater than 65 dBA DNL contour. Therefore, increases in DNL at these POIs and surrounding areas under the Medium and Low Noise Scenarios would be long-term, likely unnoticeable, and not significant.

Noise levels in the overland and offshore SUA would increase by no more than 1 dBA under the High, Medium, and Low Noise Scenarios. No supersonic operations or corresponding sonic booms would occur in overland SUA proposed for use. Although sonic booms in offshore SUA would likely increase under the Proposed Action, they would occur over open waters of the Atlantic Ocean where no permanent human-occupied structures are present. Therefore, the Proposed Action would have no or negligible effects from noise in the overland and offshore SUA proposed for use.

<u>Safety</u>

The Proposed Action would have no significant impacts on or from occupational safety, emergency response, safety zones, arresting gear capacity, explosives safety, flight safety, and bird-aircraft strike hazards (BASH) provided all applicable requirements and procedures are adhered to. The Proposed Action does not involve changes to Clear Zones, Accident Potential Zones, or Sumter County-designated Density Dispersion Zones associated with Shaw AFB. The Proposed Action would not require the establishment of new quantity-distance (Q-D) arcs or modifications to existing Q-D arcs at Shaw AFB. Defensive countermeasure chaff and flares for proposed contract ADAIR operations would be maintained and delivered by personnel of the 20th Equipment Maintenance Squadron and loaded and unloaded from contract ADAIR aircraft by trained and qualified contract ADAIR personnel. Loading and unloading of defensive countermeasures from contract ADAIR aircraft would occur on the aircraft parking ramp. The removal, maintenance, and/or storage of egress Cartridge Actuated Devices/Propellant Actuated Devices would occur in authorized areas of the installation in accordance with the Wing Safety Office and requirements of the installation's Wing Safety Plan.

Proposed contract ADAIR operations would adhere to a BASH plan developed by the selected contract ADAIR provider. This BASH plan would be based on, and could be an exact copy of, the host Wing's BASH plan. The contract ADAIR BASH plan would voluntarily comply with the Federal Aviation Administration's Wildlife Hazard Mitigation Program.

<u>Air Quality</u>

The Proposed Action would have no or negligible impacts on air quality, greenhouse gases (GHGs), and climate change. The Camden-Sumter Intrastate Air Quality Control Region (AQCR) that includes Shaw AFB and the overland SUA is designated by the US Environmental Protection Agency as unclassifiable/attainment for all criteria pollutants regulated by the National Ambient Air Quality Standards; therefore, requirements of the General Conformity Rule are not applicable to the Proposed Action. Emissions of criteria pollutants from proposed aircraft operations under the High, Medium, and Low Emission Scenarios would be well below applicable significance thresholds and would have no potential to affect the unclassified/attainment status of the AQCR. Estimated GHG emissions under the High Emission Scenario would be at least 3.5 times higher than potential GHG emissions under the Low Emission Scenario but GHG emissions under all three emission scenarios would remain less than 0.1 percent of total estimated 2020 statewide GHG emissions in South Carolina.

Biological Resources

The Proposed Action would have no impacts on vegetation and no potential to introduce or contribute to the spread of invasive species at Shaw AFB or in areas underlying the SUA. Proposed contract ADAIR operations would increase the potential for aircraft strikes with migratory birds at Shaw AFB and in the SUA, and with bats at Shaw AFB. Risks to migratory birds in the SUA would be minimized because many bird species migrate at night when proposed aircraft operations would occur less often, and risks to bats would be minimized because aircraft operations would primarily occur during daytime hours when bats are less active.

The Proposed Action would also increase the risk of aircraft strikes with the federal candidate monarch butterfly (*Danaus plexippus*) and federally proposed endangered tricolored bat (*Perimyotis subflavus*). Adverse effects on the monarch butterfly would be prevented or minimized because suitable habitat for the species at Shaw AFB is limited, making it less likely to be present on the installation and struck during aircraft takeoffs and landings; and because aircraft in the overland SUA would operate at altitudes far higher than the species' migratory altitude of approximately 1,000 feet. As described above for other bat species, the tricolored bat would primarily be active at night when fewer aircraft operations would occur at Shaw AFB, which would help to prevent or minimize adverse effects on that species.

Aircraft noise and movements occurring in the overland and offshore SUA would be unlikely to elicit startle responses that could adversely affect federally listed threatened and endangered species occurring in areas underlying the SUA. Aircraft strikes with federally listed birds and bats in the SUA would also be unlikely because aircraft would operate at higher altitudes than those at which those species typically forage; conduct of the proposed training activities primarily during daytime hours, when listed bird species are less likely to be migrating at high altitudes, would further prevent or minimize potential adverse effects on birds.

The ingestion of small plastic or metal components from expended chaff and flares could adversely affect federally listed threatened and endangered species in areas underlying the overland and offshore SUA. However, given the composition and small size of these components (i.e., 1.3-inch diameter and 0.13-inch thick) and relatively large areas encompassed by the SUA (i.e., thousands of square miles), it is unlikely that federally listed species of birds, sea turtles, terrestrial and marine mammals, and fish would encounter or ingest them during foraging or mistake them for food if they were encountered. These components would eventually sink to the ocean floor rather than persist on the surface or in the water column, further minimizing the potential for accidental ingestion. In the event they are ingested, their small size would aid in passing through the animal's digestive tract.

The DAF has determined that the Proposed Action may affect, but is not likely to adversely affect the following federally listed species:

- Roseate tern (*Sterna dougallii dougallii*)
- West Indian manatee (*Trichechus manatus*)
- Blue whale (*Balaenoptera musculus*)
- Fin whale (*Balaenoptera physalus*)
- North Atlantic right whale (*Eubalaena glacialis*)
- Sei whale (*Balaenoptera borealis*)
- Sperm whale (*Physeter macrocephalus*)
- Green sea turtle (*Chelonia mydas*)
- Kemp's ridley sea turtle (*Lepidochelys kempii*)
- Leatherback sea turtle (*Dermochelys coriacea*)
- Loggerhead sea turtle (*Caretta caretta*)
- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)
- Giant manta ray (*Manta birostris*)
- Oceanic white tip shark (*Carcharhinus longimanus*)

Further, the Proposed Action would not jeopardize the continued existence of the monarch butterfly or the tricolored bat. In accordance with Section 7 of the Endangered Species Act, the DAF has initiated informal consultation with the US Fish and Wildlife Service (USFWS). The USFWS concurred with the DAF's effects determinations on 29 November 2023. DAF notified the National Marine Fisheries Service of the Proposed Action.

Land Use

Adverse impacts on land use from increased noise levels resulting from the High, Medium, and Low Noise Scenarios under the Proposed Action would be minor to moderate and not significant. The area of off-base lands classified as residential land uses within Shaw AFB DNL contours would increase under all three noise scenarios, with corresponding increases in residential population and occupied housing units. Under any of the noise scenarios, the largest increases in residential lands would occur in the greater than 65 and greater than 70 dBA DNL contours; no residential lands would be within the greater than 80 and greater than 85 dBA DNL contours. Under any Proposed Action noise scenario, increases in DNL at residential POIs outside the existing greater than 65 dBA DNL contour would not cause those POIs to fall within the 65 dBA DNL contour under proposed future conditions, nor would DNL increases at residential POIs within the existing 65 dBA DNL contour exceed 2 dBA under proposed future conditions. Residential lands within the High, Medium, and Low Noise Scenario DNL contours would represent less than 7 percent of all lands within the DNL contours, while lands classified as Agricultural Conservation District and Heavy Industrial District would continue to represent 51 percent or more of all land uses within the DNL contours under all noise scenarios.

Although these impacts would be adverse, it is anticipated that the primary human response to noise increases associated with the Proposed Action would be annoyance and that such noise would have no potential to preclude the viability of existing land uses or the continued occupation of those areas, threaten public health or safety, or conflict with planning criteria that ensure the safety and protection of human life and property. The actual noise level perceived or experienced by a listener on or outside Shaw AFB would likely vary for each noise-generating event depending on the type and configuration of aircraft, the operation being performed, aircraft altitude and distance to the listener, weather conditions, topography, other noise sources in the ambient environment, and other factors. Increased noise levels from the Proposed Action would not conflict with noise regulations in Sumter County's Code of Ordinances because airport and airplane noise, and sounds emanating from governmental activities, are exempt from those regulations.

Socioeconomics

The Proposed Action would have no impacts on income and employment at Shaw AFB or in Sumter County because the 93 proposed contract ADAIR personnel would represent a small increase in total employment in the context of population and employment at Shaw AFB, in Sumter County, and in the nearby Columbia-Orangeburg-Newberry metropolitan statistical area. Expenditures for fuel, equipment, and materials to support the Proposed Action and associated payroll tax revenue would provide a long-term, potentially minor, beneficial impact on the local economy. Increased noise levels at POIs under the High, Medium, and Low Noise Scenarios would have no significant impacts on socioeconomics because potentially significant noise increases would occur at places of worship primarily during weekday and daytime hours when large gatherings of people are less likely to be present at these facilities.

Environmental Justice and Protection of Children

Noise increases of 3 dBA or more at three places of worship and their location within the greater than 65 dBA DNL contour under the Proposed Action High Noise Scenario would have the potential to disproportionately impact minority and/or low-income populations that could be present at or near these POIs. Noise increases at the POIs under the Medium and Low Noise Scenarios would be less than 3 dBA and would not disproportionately impact any minority or low-income populations at the identified POIs. The Proposed Action would have no disproportionately adverse effects on children or the elderly at and around Shaw AFB under any of the three modeled noise scenarios. Although Sumter County contains a minority population exceeding 50 percent and meaningfully greater percentage of the population living in poverty, it is unlikely that the presence of the additional proposed contract ADAIR personnel and their dependents would result in disproportionate impacts on those populations because adequate housing, community resources, and community services are available in Sumter County and the surrounding area to support these proposed increases. Further, the increased economic expenditures associated with the Proposed Action would benefit all people and businesses in the region regardless of race or age. None of the modeled residential areas, schools, or childcare facilities would experience an increase in noise greater than a 3 dBA

DNL and higher than 65 dBA DNL under any of the three noise scenarios (no elderly care facilities were identified as POIs in the Region of Influence).

Cultural Resources

Alternative 1 would have no adverse effects on cultural resources and historic properties at Shaw AFB or in areas underlying the overland and offshore SUA. Neither Building 106 nor Building 712 are eligible for listing in the National Register of Historic Places (NRHP). No historic districts or individual historic structures eligible for inclusion are present within the Shaw AFB Area of Potential Effect. Proposed aircraft operations and associated noise would have no potential to affect historic properties in areas underlying the SUA, including submerged archaeological resources underlying the offshore SUA. The Proposed Action would have no effect on archaeological resources or traditional cultural resources or sacred sites because no ground disturbance would occur.

Potential effects on historic resources from Alternative 2 would be the same as those described for Alternative 1, with the exception that Alternative 2 would not involve the use of Building 712.

Per 36 CFR § 800.5, the DAF determined that the Proposed Action would have no adverse effect on historic properties, including significant architectural resources archaeological sites, or traditional cultural properties/sacred sites. In accordance with Section 106 of the National Historic Preservation Act, the DAF initiated consultation with the South Carolina and Georgia State Historic Preservation Offices (SHPOs) and Native American tribes. In a letter dated 27 July 2023 the South Carolina SHPO stated that no properties listed or eligible for listing in the NRHP would be affected by the Proposed Action and concurred that Buildings 106 and 712 are not eligible for listing in the NRHP. In a letter dated 5 September 2023, the Georgia SHPO stated that the Proposed Action would have no adverse effect on historic properties, as defined in 36 CFR § 800.5(d)(1).

Hazardous Materials and Wastes, Environmental Restoration Program Sites, and Toxic Substances

The Proposed Action would have minor impacts from the increased use of hazardous materials during proposed contract ADAIR maintenance activities and management and disposal of associated hazardous waste; no effects on ERP sites at Shaw AFB; no effects from asbestos-containing materials (ACM), lead-based paint (LBP), and polychlorinated biphenyls (PCBs); and no effects from radon. The use of hazardous materials and generation of hazardous waste during proposed contract ADAIR activities would not exceed the capacity of Shaw AFB to manage, handle, store, and dispose of these substances. ACM and LBP are unlikely to be present in Building 106 based on its year of construction; however, ACM and LBP could be present in Building 712, which was built in 1941. No activities that would disturb ACM and LBP potentially present in Building 712 are included in the Proposed Action. If identified in that facility, ACM and LBP would either be managed in place or removed and disposed of in accordance with applicable regulations and procedures. Although unlikely to be present, any PCBs identified in those facilities would be removed and disposed of in accordance with applicable requirements.

The proposed contract ADAIR activities would have no potential to impede or prevent the continued remediation of existing ERP sites on Shaw AFB or the achievement of applicable cleanup objectives. Contamination from those sites would have no potential to affect contract ADAIR personnel because the sites are actively undergoing remediation. Radon poses a low potential for health hazards at Shaw AFB and no new or increased risks from radon would be anticipated.

Cumulative Impacts

When considered with other reasonably foreseeable future actions occurring on and around Shaw AFB and in the SUA proposed for use, the Proposed Action would not contribute to significant cumulative impacts on resources analyzed in the attached EA.

Mitigation

No project-specific best management practices (BMPs) or environmental commitments are identified in the EA; however, the use of standard BMPs is assumed, when applicable, in the Environmental Consequences section of the EA for each resource.

Public Involvement

A Notice of Availability for the Draft EA and proposed FONSI was published in the *Augusta Chronicle*, *Sumter Item*, and *Community Times* inviting the public to review and comment on the Draft EA during the 30-day public review period. Copies of the Draft EA and proposed FONSI were made available for review at the Sumter County Library, Augusta County Library - Headquarters, Florence County Public Library, and electronically on the Shaw AFB website at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. Individuals who were unable to access these documents online were directed to call the Shaw AFB Public Affairs Office to arrange alternate access. No public comments on the Draft EA and Proposed FONSI were received. Government to government correspondence was received and is included in the Final EA.

Conclusion

Finding of No Significant Impact. After review of the attached EA, which was prepared in accordance with the requirements of the NEPA, CEQ regulations, and the DAF EIAP, and is incorporated by reference, I have determined that the Proposed Action under the Medium and Low Noise Scenarios to provide dedicated contract ADAIR sorties to improve the quality of training and readiness of pilots of the 20 FW and other units supported by Shaw AFB, South Carolina, would not have a significant impact on the quality of the human or natural environment. While airport and airplane noise and sounds emanating from governmental activities are exempt from noise regulations under Sumter County's Code of Ordinances, the DAF would not implement the High Noise Scenario due to the potential for significant impacts from increased noise on sensitive receptors (i.e., POIs) proximate to Shaw AFB, and potential significant impacts on land use and environmental justice from increased noise. Accordingly, an Environmental Impact Statement will not be prepared. This decision has been made after considering all submitted information, including a review of any public and agency comments received during the 30-day public comment period, and considering a full range of reasonable alternatives that meet project requirements and are within the legal authority of the DAF.

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ANDREW E. DEROSA, Colonel, USAF
Chief, Civil Engineer Division
HQ ACC/A4C, Directorate of Logistics,
Engineering and Force Protection

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DATE

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TABLE OF CONTENTS

Page

LIST OF FIGURES .... **iv**

LIST OF TABLES .... **iv**

LIST OF ACRONYMS AND ABBREVIATIONS .... **vii**

CHAPTER 1 PURPOSE OF AND NEED FOR ACTION **1-1**

1.1 Introduction 1-1
1.2 Background 1-1
1.3 Location 1-3
1.4 Purpose of the Proposed Action 1-3
1.5 Need for the Proposed Action 1-3
1.6 Interagency and Intergovernmental Coordination and Consultations 1-6
1.7 Applicable Laws and Environmental Regulations 1-6
1.7.1 National Environmental Policy Act 1-6
1.7.2 The Environmental Impact Analysis Process 1-6
1.8 Scope of the Environmental Analysis 1-6

CHAPTER 2 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVE **2-1**

2.1 Proposed Action 2-1
2.1.1 Contract Adversary Air Aircraft 2-1
2.1.2 Facilities 2-1
2.1.3 Maintenance 2-2
2.1.4 Personnel 2-2
2.1.5 Sorties 2-2
2.1.6 Airspace Use 2-3
2.1.7 Defensive Countermeasures and Other Munitions 2-5
2.2 Alternatives Development 2-6
2.2.1 Selection Standards 2-6
2.2.2 Alternatives Screening 2-7
2.2.3 Alternatives Eliminated from Further Consideration 2-7
2.3 Alternatives Retained for Detailed Analysis in the EA 2-8
2.3.1 Alternative 1: Establish Contract ADAIR Capabilities in Building 106 and Building 712 at Shaw AFB 2-8
2.3.2 Alternative 2: Establish Contract ADAIR Capabilities in Building 106 and Shared Space with Each Fighter Squadron at Shaw AFB 2-9
2.3.3 No Action Alternative 2-9
2.4 Mitigation and Best Management Practices 2-9
2.5 Summary of Potential Environmental Consequences 2-11

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES **3-1**

3.1 Analyzed Resources and Evaluation Criteria 3-1
3.2 Resources Eliminated from Further Analysis 3-2
3.2.1 Socioeconomics (Housing, Population, and Schools) 3-2
3.2.2 Visual Resources 3-2
3.2.3 Water Resources 3-3
3.2.4 Soil Resources 3-3
3.2.5 Utilities, Infrastructure, and Transportation 3-3

3.3 Airspace Management and Usage 3-3
3.3.1 Definition of the Resource 3-3
3.3.2 Existing Conditions – Shaw Air Force Base 3-4
3.3.3 Existing Conditions – Special Use Airspace 3-4
3.3.4 Environmental Consequences Evaluation Criteria 3-4
3.3.5 Environmental Consequences – Alternative 1 3-4
3.3.6 Environmental Consequences – Alternative 2 3-5
3.3.7 Environmental Consequences – No Action Alternative 3-5
3.3.8 Cumulative Impacts 3-5
3.4 Noise 3-5
3.4.1 Definition of the Resource 3-5
3.4.2 Existing Conditions – Shaw Air Force Base 3-6
3.4.3 Existing Conditions – Special Use Airspace 3-7
3.4.4 Environmental Consequences Evaluation Criteria 3-11
3.4.5 Environmental Consequences – Alternative 1 3-12
3.4.6 Environmental Consequences – Alternative 2 3-27
3.4.7 Environmental Consequences – No Action Alternative 3-27
3.4.8 Cumulative Impacts 3-28
3.5 Safety 3-28
3.5.1 Definition of the Resource 3-28
3.5.2 Existing Conditions – Shaw Air Force Base 3-28
3.5.3 Existing Conditions – Special Use Airspace 3-32
3.5.4 Environmental Consequences Evaluation Criteria 3-32
3.5.5 Environmental Consequences – Alternative 1 3-33
3.5.6 Environmental Consequences – Alternative 2 3-35
3.5.7 Environmental Consequences – No Action Alternative 3-35
3.5.8 Cumulative Impacts 3-36
3.6 Air Quality 3-36
3.6.1 Definition of the Resource 3-36
3.6.2 Existing Conditions – Shaw Air Force Base 3-37
3.6.3 Existing Conditions – Special Use Airspace 3-37
3.6.4 Environmental Consequences Evaluation Criteria 3-38
3.6.5 Environmental Consequences – Alternative 1 3-38
3.6.6 Environmental Consequences – Alternative 2 3-42
3.6.7 Environmental Consequences – No Action Alternative 3-42
3.6.8 Cumulative Impacts 3-42
3.7 Biological Resources 3-42
3.7.1 Definition of the Resource 3-42
3.7.2 Existing Conditions – Shaw Air Force Base 3-42
3.7.3 Existing Conditions – Special Use Airspace 3-45
3.7.4 Environmental Consequences Evaluation Criteria 3-54
3.7.5 Environmental Consequences – Alternative 1 3-55
3.7.6 Environmental Consequences – Alternative 2 3-60
3.7.7 Environmental Consequences – No Action Alternative 3-60
3.7.8 Cumulative Impacts 3-60
3.8 Land Use 3-60
3.8.1 Definition of the Resource 3-60
3.8.2 Existing Conditions 3-61
3.8.3 Environmental Consequences Evaluation Criteria 3-64

3.8.4 Environmental Consequences – Alternative 1 ... 3-65
3.8.5 Environmental Consequences – Alternative 2 ... 3-74
3.8.6 Environmental Consequences – No Action Alternative ... 3-74
3.8.7 Cumulative Impacts ... 3-74
3.9 Socioeconomics – Income and Employment ... 3-75
3.9.1 Definition of the Resource ... 3-75
3.9.2 Existing Conditions – Shaw Air Force Base ... 3-75
3.9.3 Environmental Consequences Evaluation Criteria ... 3-76
3.9.4 Environmental Consequences – Alternative 1 ... 3-76
3.9.5 Environmental Consequences – Alternative 2 ... 3-76
3.9.6 Environmental Consequences – No Action Alternative ... 3-77
3.9.7 Cumulative Impacts ... 3-77
3.10 Environmental Justice and Protection of Children ... 3-77
3.10.1 Definition of the Resource ... 3-77
3.10.2 Existing Conditions – Shaw Air Force Base ... 3-77
3.10.3 Environmental Consequences Evaluation Criteria ... 3-78
3.10.4 Environmental Consequences – Alternative 1 ... 3-78
3.10.5 Environmental Consequences – Alternative 2 ... 3-79
3.10.6 Environmental Consequences – No Action Alternative ... 3-79
3.10.7 Cumulative Impacts ... 3-79
3.11 Cultural Resources ... 3-80
3.11.1 Definition of the Resource ... 3-80
3.11.2 Existing Conditions – Shaw Air Force Base ... 3-81
3.11.3 Existing Conditions – Special Use Airspace ... 3-81
3.11.4 Environmental Consequences Evaluation Criteria ... 3-84
3.11.5 Environmental Consequences – Alternative 1 ... 3-84
3.11.6 Environmental Consequences – Alternative 2 ... 3-85
3.11.7 Environmental Consequences – No Action Alternative ... 3-85
3.11.8 Cumulative Impacts ... 3-86
3.12 Hazardous Materials and Wastes, Environmental Restoration Program Sites, and Toxic Substances ... 3-86
3.12.1 Definition of the Resource ... 3-86
3.12.2 Existing Conditions – Shaw Air Force Base ... 3-87
3.12.3 Environmental Consequences Evaluation Criteria ... 3-90
3.12.4 Environmental Consequences – Alternative 1 ... 3-91
3.12.5 Environmental Restoration Program Sites ... 3-91
3.12.6 Environmental Consequences – Alternative 2 ... 3-92
3.12.7 Environmental Consequences – No Action Alternative ... 3-92
3.12.8 Cumulative Impacts ... 3-92

CHAPTER 4 REFERENCES ... 4-1

Appendix A Interagency and Intergovernmental Coordination and Consultations

Appendix B Reasonably Foreseeable Future Actions

Appendix C Further Definitions of Resource Areas Analyzed, Methodologies, and Modeling

Appendix D List of Preparers and Contributors

Appendix E Glossary of Terms

LIST OF FIGURES

Page

Figure 1-1 Current and Proposed Adversary Air Enterprise 1-2
Figure 1-2 Shaw Air Force Base Regional Map 1-4
Figure 1-3 Shaw Air Force Base Special Use Airspace 1-5
Figure 2-1 Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur 2-4
Figure 2-2 Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations 2-10
Figure 3-1 Existing Day-Night Average Sound Level Contours at Shaw Air Force Base 3-8
Figure 3-2 High Noise Scenario Day-Night Average Sound Level Contours at Shaw Air Force Base 3-14
Figure 3-3 Comparison of High Noise Scenario and Existing Day-Night Average Sound Level Contours at Shaw Air Force Base 3-15
Figure 3-4 Medium Noise Scenario Day-Night Average Sound Level Contours at Shaw Air Force Base 3-17
Figure 3-5 Comparison of Medium Noise Scenario and Existing Day-Night Average Sound Level Contours at Shaw Air Force Base 3-20
Figure 3-6 Low Noise Scenario Day-Night Average Sound Level Contours at Shaw Air Force Base 3-21
Figure 3-7 Comparison of Low Noise Scenario and Existing Day-Night Average Sound Level Contours at Shaw Air Force Base 3-22
Figure 3-8 Safety Zones and Quantity-Distance Arcs at Shaw Air Force Base 3-30
Figure 3-9 Existing On-Base and Off-Base Land Use Within Existing Day-Night Average Sound Level Contours at Shaw Air Force Base 3-62
Figure 3-10 Existing On-Base and Off-Base Land Use Within Alternative 1 High Noise Scenario Contours at Shaw Air Force Base 3-68
Figure 3-11 Existing On-Base and Off-Base Land Use Within Alternative 1 Medium Noise Scenario Contours at Shaw Air Force Base 3-71
Figure 3-12 Existing On-Base and Off-Base Land Use Within Alternative 1 Low Noise Scenario Contours at Shaw Air Force Base 3-73
Figure 3-13 Environmental Restoration Program Sites at Shaw Air Force Base Proximate to Facilities Proposed for Use by Contract Adversary Air 3-89

LIST OF TABLES

Table 2-1 Contract Adversary Air Potential Aircraft Specifications 2-1
Table 2-2 Shaw Air Force Base Facilities Requirements 2-2
Table 2-3 Current and Proposed Annual Training Activities by Shaw Air Force Base 2-3
Table 2-4 Shaw Air Force Base Special Use Airspace Attributes 2-5
Table 2-5 Existing and Proposed Defensive Countermeasure Use in Shaw Air Force Base Special Use Airspace 2-6
Table 2-6 Comparison of Alternatives 2-8
Table 2-7 Comparison of Potential Environmental Consequences of the Proposed Action 2-11

Table 3-1	Region of Influence for the Proposed Action by Resource	3-1
Table 3-2	Annual Operations at Shaw Air Force Base	3-4
Table 3-3	Existing Annual Aircraft Operations Summary at Shaw Air Force Base	3-6
Table 3-4	Existing Day-Night Average Sound Level Area Affected at Shaw Air Force Base	3-7
Table 3-5	Existing Day-Night Average Sound Level at Points of Interest On and Around Shaw Air Force Base	3-9
Table 3-6	Existing Shaw Air Force Base Annual Aircraft Operations in Special Use Airspace	3-9
Table 3-7	Existing Noise Levels in Special Use Airspace	3-10
Table 3-8	Existing Sonic Boom Levels for Based Aircraft in Special Use Airspace	3-11
Table 3-9	Summary of Noise Impacts	3-11
Table 3-10	Contract Adversary Air Noise Scenarios	3-12
Table 3-11	Summary of Proposed High Noise Scenario Annual Aircraft Operations at Shaw Air Force Base	3-13
Table 3-12	Land Area On and Around Shaw Air Force Base Within Day-Night Average Sound Level Noise Contours Associated With the High Noise Scenario	3-13
Table 3-13	Change in Day-Night Average Sound Level at Representative Points of Interest On and Near Shaw Air Force Base Under the High Noise Scenario	3-16
Table 3-14	Land Area On and Around Shaw Air Force Base Within Day-Night Average Sound Level Noise Contours Associated With the Medium Noise Scenario	3-18
Table 3-15	Change in Day-Night Average Sound Level at Representative Points of Interest On and Near Shaw Air Force Base Under the Medium Noise Scenario	3-18
Table 3-16	Land Area On and Around Shaw Air Force Base Within Day-Night Average Sound Level Noise Contours Associated With the Low Noise Scenario	3-19
Table 3-17	Change in Day-Night Average Sound Level at Representative Points of Interest On and Near Shaw Air Force Base Under the Low Noise Scenario	3-23
Table 3-18	Proposed Shaw Air Force Base Annual Aircraft Operations in Special Use Airspace	3-24
Table 3-19	Proposed ADAIR High Noise Scenario Noise Levels in Special Use Airspace	3-25
Table 3-20	Proposed ADAIR Medium Noise Scenario Noise Levels in Special Use Airspace	3-25
Table 3-21	Proposed ADAIR Low Noise Scenario Noise Levels in Special Use Airspace	3-26
Table 3-22	Special Use Airspace Sonic Boom Levels Undertrack for Based and Adversary Air Aircraft in Level Flight at Mach 1.2	3-27
Table 3-23	Basis of Air Emissions Calculations	3-38
Table 3-24	Contract Adversary Air Emissions – Shaw Air Force Base Airfield Operations	3-39
Table 3-25	Contract Adversary Air Emissions – Special Use Airspace Operations (Bulldog and Gamecock Military Operations Areas)	3-41
Table 3-26	Federal and State Listed Species of Concern at Shaw Air Force Base	3-44
Table 3-27	Federal and State Listed Species Potentially Present In or Under Special Use Airspace	3-47
Table 3-28	Marine Mammals Protected Under the Marine Mammal Protection Act with Potential to Occur in the Warning Areas	3-52
Table 3-29	On-Base Land Use Within Existing Day-Night Average Sound Level Contours at Shaw Air Force Base	3-61
Table 3-30	Residential Population and Occupied Housing Units in Shaw Air Force Base US Census Blocks Under Existing Day-Night Average Sound Level Contours	3-63

Table 3-31 Off-Base Land Use Within Existing Day-Night Average Sound Level Contours at Shaw Air Force Base 3-63
Table 3-32 Residential Population and Occupied Housing Units in Sumter County US Census Blocks Under Existing Day-Night Average Sound Level Contours........ 3-64
Table 3-33 Change in Area Within Day-Night Average Sound Level Contours On and Around Shaw Air Force Base Under the High, Medium, and Low Noise Scenarios of Alternative 1 3-65
Table 3-34 Change in Off-Base Residential Area within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1 3-66
Table 3-35 Percentage of On-Base and Off-Base Lands Within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1 3-67
Table 3-36 Change in Off-Base Residential Population within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1 3-69
Table 3-37 Change in Off-Base Occupied Housing Units within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1 3-69
Table 3-38 National Register of Historic Places-Listed Architectural Resources Within the Special Use Airspace Area of Potential Effect 3-82

LIST OF ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
20 CES/CEIE	20th Civil Engineer Squadron/Environmental Branch
20 EMS	20th Equipment Maintenance Squadron
20 FW	20th Fighter Wing
20 LRS	20th Logistics Readiness Squadron
ACAM	Air Conformity Applicability Model
ACM	asbestos-containing materials
ADAIR	adversary air
AFB	Air Force Base
AFMAN	Air Force Manual
AFOSH	Air Force Occupational Safety and Health
AGE	aerospace ground equipment
AGL	above ground level
AGRS	aggressor squadron
AOC	Area of Concern
APE	Area of Potential Effects
APZ	Accident Potential Zone
AQCR	Air Quality Control Regions
AST	aboveground storage tank
ATC	Air Traffic Control
ATCAA	Air Traffic Control Assigned Airspace
BASH	bird/wildlife-aircraft strike hazard
BDU	bomb dummy units
CAA	Clean Air Act
CAD/PAD	Cartridge Actuated Devices/Propellant Actuated Devices
CAF	Combat Air Forces
CDDAR	Crash Damaged or Disabled Aircraft Recovery
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMA	controlled movement area
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CSEL	C-Weighted Sound Exposure Level
CZ	Clear Zone
DAF	Department of Air Force
DAFI	Department of the Air Force Instruction
DAFMAN	Department of Air Force Manual
dBA	A-weighted decibel
DCMA	Defense Contract Management Agency
DESR	Defense Explosives Safety Regulation
DNL	Day-Night Average Sound Level
DNR	Department of Natural Resources

DoD	Department of Defense
EA	Environmental Assessment
EESOH-MIS	Enterprise Environmental, Safety, and Occupational Health - Management Information System
EFH	essential fish habitat
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EO	Executive Order
ERP	Environmental Restoration Program
ESA	Endangered Species Act
ESOHC	Environmental Safety and Occupational Health Council
FAA	Federal Aviation Administration
FL	flight level
FOD	Foreign Object Damage
ft	foot or feet
FY	fiscal year
GHG	greenhouse gases
GWP	Global Warming Potential
HAZMAT	hazardous materials
HD	Hazard Division
IFR	instrument flight rules
INRMP	Integrated Natural Resources Management Plan
JBLE	Joint Base Langley-Eustis
km	kilometer
LBP	lead-based paint
Ldn	Day-Night Average Sound Level
Ldnmr	Onset-Rate Adjusted Monthly Day-Night Average Sound Level
MMPA	Marine Mammal Protection Act
MOA	Military Operations Area
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NM	nautical mile
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NPS	National Park Service
NRHP	National Register of Historic Places
NTSB	National Transportation Safety Board
O_3	ozone
OSHA	Occupational Safety and Health Administration
Pb	lead
PCB	polychlorinated biphenyl
PFAS	polyfluoroalkyl substances

PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PM_{10}	particulate matter equal to or less than 10 microns
$PM_{2.5}$	particulate matter equal to or less than 2.5 microns
POI	point of interest
POL	petroleum, oils, and lubricants
PSD	Prevention of Significant Deterioration
psf	pounds per square foot
PWS	Performance Work Statement
Q-D	quantity-distance
RCRA	Resource Conservation and Recovery Act
ROAA	Record of Air Analysis
ROI	Region of Influence
SARA	Superfund Amendments and Reauthorization Act
SC	South Carolina
SCDHEC	South Carolina Department of Health and Environmental Control
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SUA	special use airspace
SWMU	Solid Waste Management Unit
tpy	tons per year
TSCA	Toxic Substances Control Act
UFC	Unified Facilities Criteria
U.S.C.	United States Code
US	United States
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Services
UST	underground storage tank

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CHAPTER 1 PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

The Department of the Air Force (DAF) is tasked with the defense of the United States and fulfillment of its responsibilities set forth in 10 United States Code (U.S.C.) §§ 9011 - 9842, *Air Force and Space Force*. The DAF's mission is "to fly, fight, and win…airpower anytime, anywhere." To accomplish this mission, it is critical that combat pilots and the Airmen supporting them receive adequate training to attain proficiency on tasks they must execute during times of war, and further sustain this proficiency as they continue to serve in the DAF. Increasingly, fighter pilots of the Combat Air Forces (CAF) have been operating at degraded levels of proficiency and training readiness due to diminishing fiscal resources. In the context of this Environmental Assessment (EA), the CAF includes all active duty, Air National Guard, and Air Force Reserve units in both formal training units and operational units.

Ideally, CAF fighter pilots would maintain their proficiency by flying 200 or more hours per year practicing training syllabus tasks, tactics, and procedures. However, for much of the last decade, pilots of advanced weapons platforms have been falling 25 to 40 percent short of the flying hours recommended to build and sustain their proficiency on required training tasks (C-SPAN, 2016). At the same time, increasingly complex aircraft and technologies require more time to master the full range of skills required to become proficient combat-ready pilots.

Along with insufficient budgets to support the flying hours and training requirements needed by CAF pilots, they have also had to support adversary air (ADAIR) flying missions that have minimal training value to the pilots themselves. ADAIR missions simulate an opposing force that provides a necessary and realistic combat environment during CAF training missions. Flying these ADAIR missions requires the use of potential adversaries' tactics and procedures that may differ significantly from CAF tactics and procedures. Therefore, ADAIR missions provide minimal CAF training while taking up valuable flying hours that could otherwise be spent on core training tasks. In many cases, no or minimal ADAIR missions have been available to support pilot training and have resulted in degraded readiness for CAF pilots who are expected to operate some of the most sophisticated weapons platforms in the world.

During his confirmation hearing, former Chief of Staff of the Air Force, General David Goldfein, identified a growing crisis in the readiness of CAF pilots by indicating that "as our Air Force shrinks, a combination of relentless operational tempo and misguided reductions in defense spending continues to deplete readiness. The Air Force does not expect a return to full-spectrum readiness for more than a decade" (C-SPAN, 2016). The readiness need retired General Goldfein identified continues to exist across the CAF today.

1.2 BACKGROUND

DAF readiness is currently affected by several factors, including training, weapon system sustainment, and facilities. Training, in particular, has become an increasing concern as worldwide commitments, high operations tempo, and fiscal and personnel limitations detract from available training resources. As an example, the Budget Control Act of 2011, as implemented in 2013, reduced flying hours by 18 percent and temporarily stood down 17 of 40 combat-coded squadrons (The Heritage Foundation, 2015). The DAF prioritized readiness in 2014, but shortfalls in readiness were not eliminated and have persisted through the present day, as indicated by the Air Force Chief of Staff's acknowledgment of the lack of readiness in more than half of the service's combat units.

In the training arena, readiness issues are manifested in multiple ways, such as:

- an inability to internally support ADAIR without a corresponding sacrifice in scarce flying hours and normal training objectives;
- a lack of advanced-threat aircraft to provide representative ADAIR for realistic training;
- a fighter pilot manning crisis, necessitating increased pilot production beyond sustainable levels; and

- granting excessive syllabus waivers to graduates of the Air Force Weapons School due to inadequate ADAIR support during final training phases.

Lack of available ADAIR is degrading pilot readiness and contributing to the overall decline in CAF pilot proficiency.

The arrangement in which CAF ADAIR missions are currently organized is depicted in **Figure 1-1**. The current approach meets less than 50 percent of the total ADAIR requirement across the DAF.

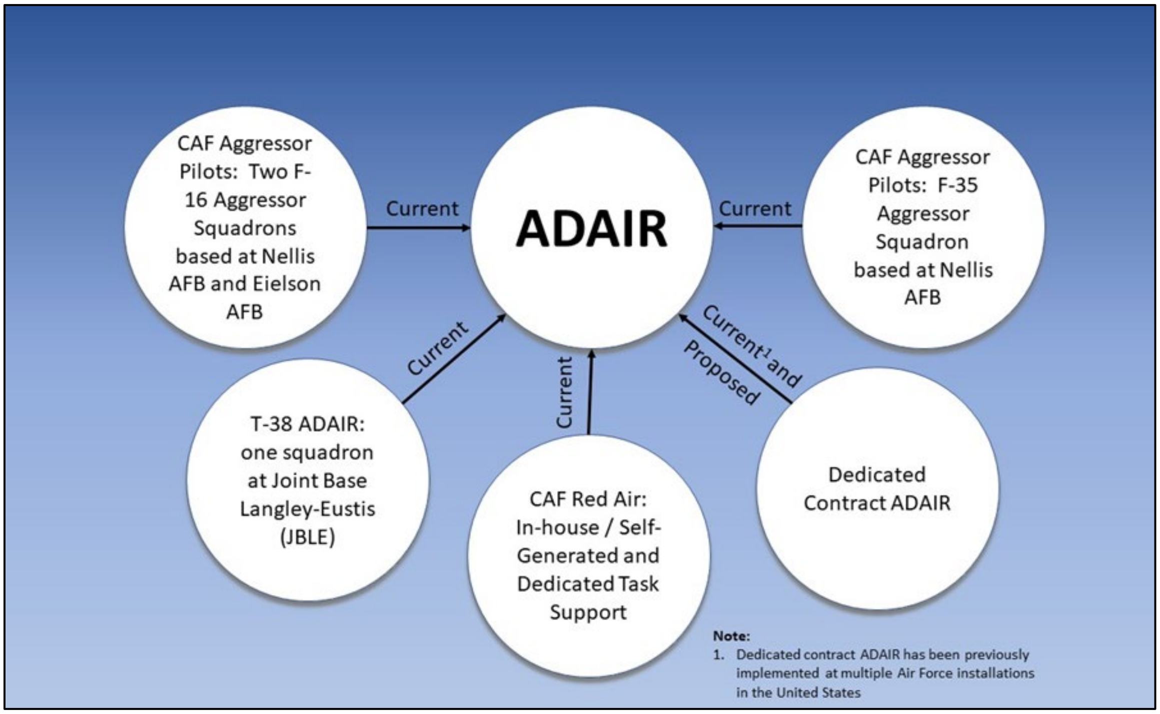

Figure 1-1 Current and Proposed Adversary Air Enterprise

ADAIR training using internal DAF pilots and aircraft (i.e., “self-generated ADAIR”) can either be “in-house” (i.e., aircraft within a unit performing ADAIR functions against aircraft of the same unit in support of daily flying schedules) or via dedicated tasking to support an external unit. Both of these options are referred to as “Red Air.” In both options, performing self-generated ADAIR is at the expense of the tasked units’ standard DAF training objectives. These two options still result in an ADAIR capacity of less than 50 percent of the DAF-wide requirement and reduce the availability and proficiency of combat-qualified pilots when the DAF is experiencing a pilot shortfall.

As shown in **Figure 1-1**, current dedicated ADAIR units in the DAF consist of two F-16 Aggressor Squadrons (AGRSs) based at Nellis Air Force Base (AFB) in Nevada and Eielson AFB in Alaska, and one T-38 ADAIR squadron based at Joint Base Langley-Eustis (JBLE) in Virginia. The F-16 aircraft used for AGRS missions is an advanced weapons platform, but there are not enough to meet the ADAIR training requirements to maintain proficiency of CAF pilots. The T-38 is a basic platform with no advanced electronics (i.e., radar and avionics) or weapons capabilities and does not adequately replicate realistic threat capabilities. The DAF has also established an F-35 AGRS at Nellis AFB to provide ADAIR capability using advanced 5th generation aircraft. However, even with the F-16 AGRS, T-38 ADAIR, and F-35 AGRS capabilities described above, the number of available aircraft and pilots is still insufficient to meet DAF ADAIR training requirements.

The contract ADAIR requirement consists of approximately 30,000 annual sorties (a sortie is a single military aircraft flight from initial takeoff through final landing). The DAF would implement contract ADAIR to support installations that host specific critical air-to-air training missions, such as Shaw AFB. Installations requiring contract ADAIR support include those bases hosting DAF 5th generation fighter units (e.g., F-22 or F-35 aircraft), formal fighter-training units, or those supporting advanced fighter training. DAF requirements for contract ADAIR exist currently at multiple installations within the continental United States and Joint Base Pearl Harbor-Hickam, Hawaii. Dedicated contract ADAIR would provide a fifth avenue to fulfill essential ADAIR sorties, improve the quality of training and readiness of CAF pilots, and allow the DAF to recapitalize other valuable assets and training time.

As further discussed in **Chapter 2**, this EA will evaluate the DAF's Proposed Action to establish contract ADAIR flight and maintenance operations at existing facilities on Shaw AFB, South Carolina, to support ADAIR training requirements for CAF pilots assigned to that installation.

1.3 LOCATION

Shaw AFB is in east-central South Carolina, approximately 30 miles east of Columbia (**Figure 1-2**). Headquarters 9th Air Force is the major tenant at Shaw AFB. The 20th Fighter Wing (20 FW) is the host wing at the installation and operates the 55th, 77th, and 79th Fighter Squadrons. Other major tenants at Shaw AFB include US Army Central and the 15th Air Force. Shaw AFB supports a workforce of approximately 8,700 personnel, including approximately 7,200 active-duty military personnel and more than 1,400 civilians and contractors (Shaw AFB, 2022a).

Proposed contract ADAIR training activities would occur in special use airspace (SUA) currently used by Shaw AFB pilots. This SUA is shown on **Figure 1-3** and consists of the overland Bulldog and Gamecock Military Operations Areas (MOAs) and associated Air Traffic Control Assigned Airspace (ATCAA), the RobRoy Airspace (which is a subdivision of the Gamecock MOAs), and offshore Warning Areas W-161 and W-177. Detailed descriptions of this SUA are provided in **Chapter 2**.

1.4 PURPOSE OF THE PROPOSED ACTION

The purpose of the Proposed Action is to provide dedicated contract ADAIR sorties at Shaw AFB to improve the quality of training and readiness of fighter aircrew of the 20 FW and other units supported by Shaw AFB. Dedicated contract ADAIR would enable the 20 FW to make existing in-house ADAIR resources available for other missions and use those available flying hours more effectively. The Proposed Action would increase the quality of training for fighter aircrew by filling the "near-peer" capacity and capability gap currently present in the ADAIR training program. Additionally, other DAF units that may have been tasked to provide ADAIR training support for Shaw AFB could recapitalize valuable flying hours to focus on increasing their own levels of proficiency and readiness.

1.5 NEED FOR THE PROPOSED ACTION

The Proposed Action is needed to provide better and more realistic training for the flight training program in support of units at Shaw AFB. Dedicated contract ADAIR is critical to improving pilot readiness as it provides realistic training opportunities to employ CAF tactics and procedures that optimize the training value of every mission and does not displace or interfere with on-base activities. Contract ADAIR can be used in basic building block syllabus sorties, or the very advanced and fluid environment of multi-aircraft air combat required by the training plan and pilot upgrade syllabi.

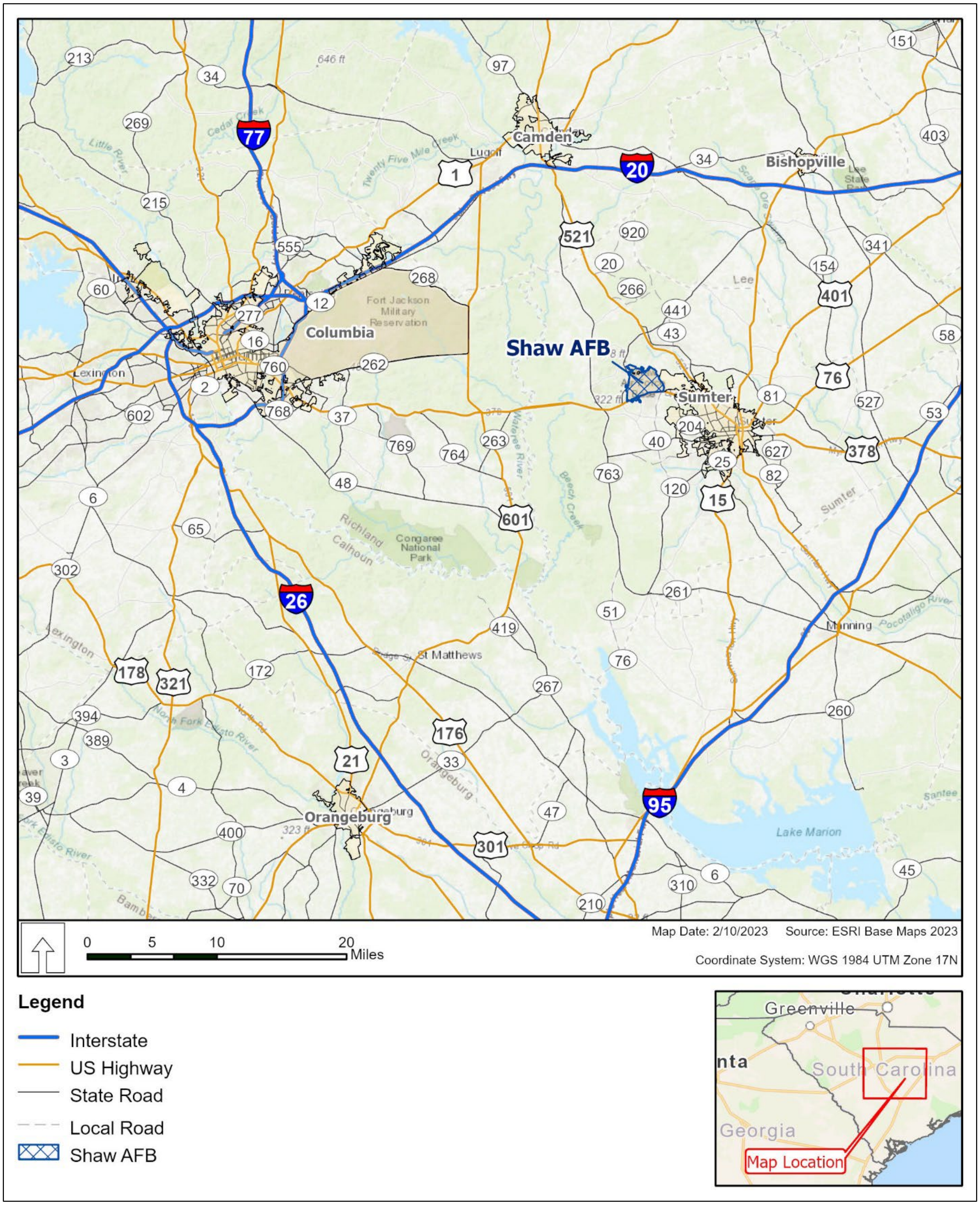

Figure 1-2   Shaw Air Force Base Regional Map

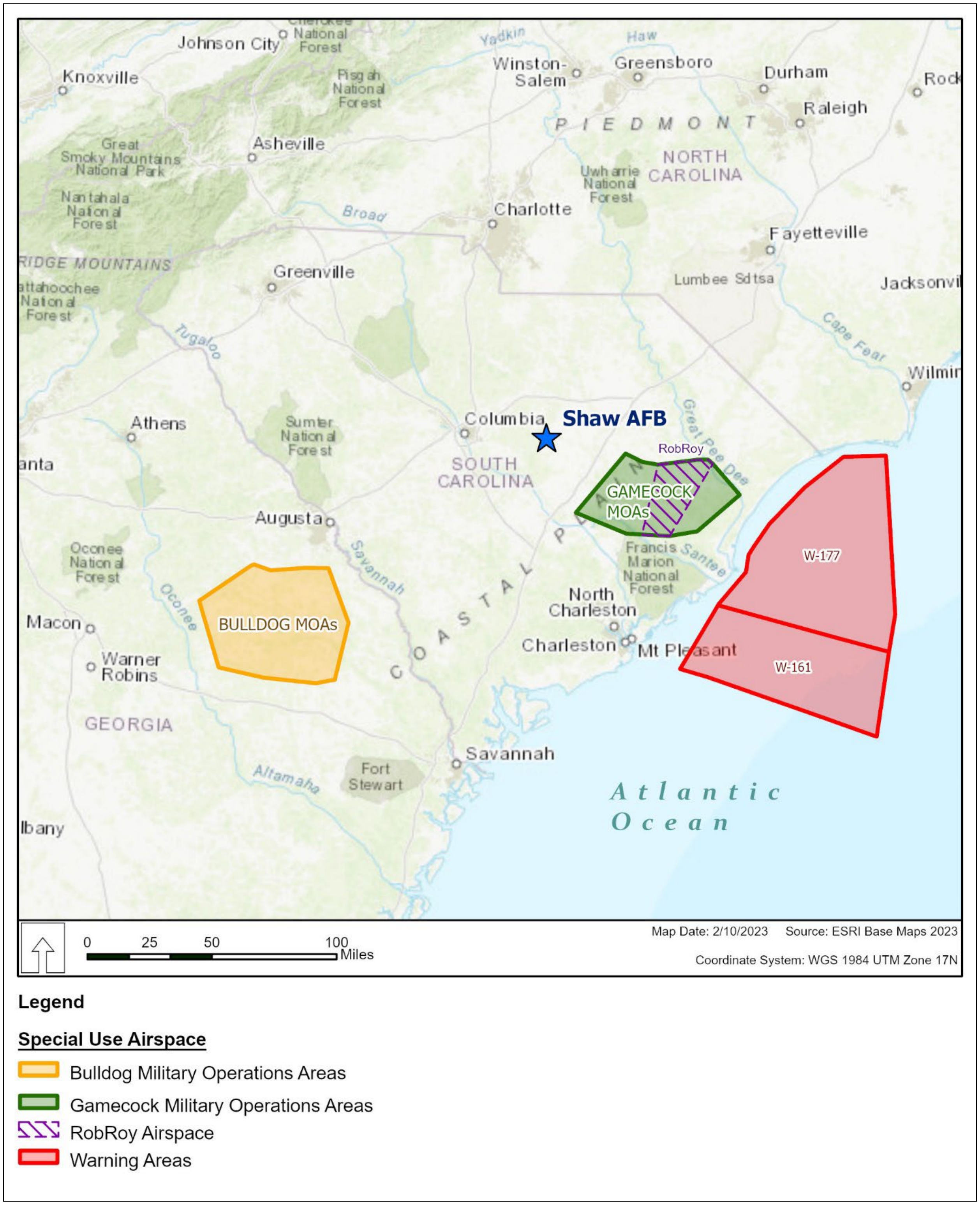

Figure 1-3 Shaw Air Force Base Special Use Airspace

1.6 Interagency and Intergovernmental Coordination and Consultations

The environmental analysis process, in compliance with National Environmental Policy Act (NEPA) guidance, includes public and agency review of information pertinent to the Proposed Action and alternatives. NEPA also requires federal agencies to consider the effects of their proposed actions in accordance with Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA). Consultation with the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) is required, as applicable, to comply with Section 7 of the ESA. Compliance with Section 106 of the NHPA requires consultation with the designated State Historic Preservation Office (SHPO) as well as Native American tribes with historic or cultural ties to the area(s) where the Proposed Action would be implemented. Information regarding public, agency, and tribal stakeholder consultation and coordination conducted during preparation of this EA, including copies of relevant correspondence, is provided in **Appendix A**.

1.7 Applicable Laws and Environmental Regulations

This EA has been prepared in accordance with NEPA and the Air Force Environmental Impact Analysis Process (EIAP) in 32 Code of Federal Regulations (CFR) Part 989. These requirements are briefly described below. The requirements of other laws, regulations, best management practices, and permits relevant to resources evaluated in the EA are discussed in **Chapter 3**.

1.7.1 National Environmental Policy Act

NEPA requires federal agencies to consider the potential environmental consequences of their proposed actions. The law's intent is to protect, restore, or enhance the environment through well-informed federal decisions. NEPA also established the Council on Environmental Quality (CEQ) to implement and oversee federal policies related to this process. Updated CEQ regulations implementing NEPA (40 CFR Parts 1500 - 1508), subject to congressional review (87 Federal Register 23453 through 23470), specify that an EA be prepared to:

- briefly provide sufficient analysis and evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact;
- aid in an agency's compliance with NEPA when no EIS is necessary; and
- facilitate preparation of an EIS when one is necessary.

Adherence to the NEPA process ensures that federal agencies consider the potential environmental effects of their proposed actions, provide opportunities for public and agency input, and comply with the requirements of relevant laws and regulations such as the ESA and NHPA.

1.7.2 The Environmental Impact Analysis Process

The EIAP is the process by which the DAF facilitates compliance with environmental regulations (32 CFR Part 989), including NEPA, which is the primary legislation affecting the agency's decision-making process.

1.8 Scope of the Environmental Analysis

This EA analyzes the potential environmental consequences associated with the DAF's Proposed Action to establish dedicated contract ADAIR support for Shaw AFB. This EA has been prepared in accordance with the NEPA (42 U.S.C. §§ 4321 - 4347), CEQ regulations implementing NEPA (40 CFR Parts 1500 - 1508), and the Air Force EIAP (32 CFR Part 989). NEPA ensures that environmental information, including the anticipated environmental consequences of a proposed action, is available to the public, federal and state agencies, and the decision maker before decisions are made and before actions are taken.

CHAPTER 2 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVE

2.1 PROPOSED ACTION

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training at Shaw AFB, South Carolina. These sorties are necessary to address shortfalls in F-16 pilot proficiency and combat mission readiness. These sorties would also provide the necessary capability and capacity to employ adversary tactics across the training spectrum from basic fighter maneuvers to higher-end, advanced combat training missions. Training scenarios would include using combat tactics and procedures that differ from CAF tactics to simulate an opposing force. The Proposed Action would provide quality and realistic training opportunities that cannot be replaced by simulators to maintain and enhance DAF readiness.

The Proposed Action includes elements that would potentially affect resources and conditions at Shaw AFB and military training SUA currently used by Shaw AFB pilots. Elements potentially affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. Elements potentially affecting this SUA include training operations in the SUA and the deployment of defensive countermeasures. These elements are described in further detail in the following sections.

No changes to the lateral or horizontal extents of this SUA or the minimum or maximum permitted altitudes of aircraft operating in this SUA are included in the Proposed Action. The Proposed Action does not involve any physical or operational changes to military ground operating areas used, owned, operated, maintained by, or otherwise associated with the Department of Defense (DoD). Therefore, such areas are not addressed further in this EA.

2.1.1 Contract Adversary Air Aircraft

Contract ADAIR would provide multiple aircraft with acceptable capabilities to support training requirements. Specifications for proposed contract ADAIR aircraft are shown in **Table 2-1**; these aircraft would be capable of providing contract ADAIR support to aircrew at Shaw AFB. One, or a combination of these aircraft types, may be operated by a contractor in support of ADAIR training.

Table 2-1 Contract Adversary Air Potential Aircraft Specifications

Aircraft	Wingspan (feet)	Length (feet)	Height (feet)	Number of Engines
MiG-29	38	57	16	2
F-5	27	48	14	2
Dassault Mirage	27	51	15	1
F-16	33	50	17	1
Eurofighter Typhoon	35	48	13	2
JAS-39 Gripen	27	47	16	1

2.1.2 Facilities

The Proposed Action would require the use of existing facilities at Shaw AFB by the selected ADAIR contractor for office space, briefing areas for pilots and aircraft maintenance personnel, aircraft maintenance hangar space, tool and equipment storage, aerospace ground equipment (AGE) storage, vehicle parking, and aircraft parking ramp space. These requirements are summarized in **Table 2-2**. The selected ADAIR contractor would coordinate specific requirements with Shaw AFB following contract award. Extensive renovation of existing Shaw AFB facilities to accommodate contract ADAIR personnel and operations is not anticipated.

Following training sorties, contract ADAIR aircraft would land and park at Shaw AFB. Contract ADAIR pilots would then participate in debriefs with DAF aircrew and other personnel at Shaw AFB as needed.

Contract ADAIR aircraft would require Jet A aircraft fuel that would be delivered in fuel trucks owned and operated by the 20th Logistics Readiness Squadron (20 LRS). Contract ADAIR personnel would be responsible for all aircraft fuel and defuel operations. It is anticipated that no additional military or contractor personnel assigned to Shaw AFB would be needed to support the additional deliveries.

Table 2-2 Shaw Air Force Base Facilities Requirements

Aircraft Parking Ramp Area (yd^2)	Maintenance Personnel [1]	Contractor Pilots [1]	Aircraft Maintenance Unit Space (ft^2)	Stand-Alone Operations Space (ft^2)	Integrated Operations Space (ft^2)
8,400	78	15	3,100	1,800	1,200

Notes:

[1] The number of personnel is approximate, and the final number may be slightly higher or lower depending on operational need.

ft^2 = square feet; yd^2 = square yards

2.1.3 Maintenance

Contract ADAIR aircraft maintenance operations would use existing hangar space and Aircraft Maintenance Unit (AMU) facilities provided by the 20 FW at Shaw AFB to perform limited maintenance operations on contract ADAIR aircraft. Contract ADAIR aircraft maintenance would include routine inspections and minor unscheduled repairs on the flightline. Major scheduled maintenance (i.e., depot-level) and unscheduled aircraft maintenance may also be performed at Shaw AFB, or the aircraft may be flown back to the contractor's main operating location.

Contractor maintenance personnel would also be responsible for inspecting and maintaining all external stores (e.g., captive air training missiles, electronic countermeasure pods, or external fuel tanks). All required AGE would be owned or leased and maintained by the contract ADAIR service provider. Fuel for AGE would be obtained by contract ADAIR personnel from the base Defense Logistics Agency fuel station through an account established with the 20 LRS.

2.1.4 Personnel

Contract ADAIR services supporting Shaw AFB would be staffed by approximately 78 contracted maintenance personnel and an estimated 15 contracted pilots. The exact number of contracted maintenance personnel and pilots deployed to Shaw AFB may ultimately be slightly higher or lower depending on operational need. It is anticipated that these personnel would arrive at Shaw AFB in 2024 following contract award.

2.1.5 Sorties

Under the Proposed Action, an estimated 12 contract ADAIR aircraft would fly approximately 3,500 annual sorties to support the 20 FW and other units assigned to Shaw AFB. It is anticipated that contract ADAIR aircraft would fly approximately 16 sorties per day on days when ADAIR training occurs (ADAIR training would not necessarily occur every day). **Table 2-3** summarizes the number and type of current and proposed annual ADAIR sorties at Shaw AFB.

Proposed contract ADAIR sorties would generally consist of five steps: depart from Shaw AFB, transit to the training airspace, perform ADAIR training, transit back to Shaw AFB, and land. Approximately 1 to 2 percent of the proposed annual sorties (i.e., approximately 35 to 70 sorties) would occur during environmental night hours (10:00 p.m. to 7:00 a.m. local time) as defined in Air Force Handbook 32-7084, *AICUZ Program Manager's Guide* (DAF, 2017a). Contract ADAIR pilots would also fly additional patterns at Shaw AFB to maintain their currency and proficiency as required. It is anticipated that these additional patterns would represent no more than 5 percent of the proposed annual sortie total (i.e., approximately 175 patterns).

As shown in **Table 2-3**, the Proposed Action would increase the number of annual sorties currently occurring in SUA used by Shaw AFB pilots by approximately 29 percent. The total number of proposed sorties (3,500 annually) does not include contract ADAIR aircraft taking off from or landing at Shaw AFB for maintenance or other deployments.

Table 2-3 Current and Proposed Annual Training Activities by Shaw Air Force Base

Airspace Proposed for Use [1]	Current Training Sorties	Projected Contract ADAIR Sorties [2, 3, 4]	Total Projected Sorties
Bulldog MOAs / ATCAA	3,608	350	3,958
Gamecock MOAs / ATCAA [5]	4,160	350	4,510
W-161 / W-177	4,217	2,800	7,017 [6]
Total Current and Proposed Training Sorties	11,985	3,500	15,485

Notes:

[1] See **Section 2.1.6** and **Table 2-4** for additional information on current airspace characteristics.

[2] Approximately 5 percent of the total proposed contract ADAIR sorties (i.e., approximately 175 sorties) would consist of flights needed for contract ADAIR pilots to maintain their currency and proficiency.

[3] Approximately 1 to 2 percent of the proposed annual sorties (i.e., approximately 35 to 70 sorties) would occur during environmental night hours (10:00 P.M. to 7:00 A.M. local time) as defined in Air Force Handbook 32-7084, *AICUZ Program Manager's Guide*.

[4] Total proposed sorties do not include contract ADAIR aircraft taking off from or landing at Shaw AFB for maintenance or other deployments.

[5] Includes the RobRoy Airspace (see **Section 2.1.6** for additional discussion).

[6] To provide a conservative analysis of potential effects, the number of total projected sorties for W-161 and W-177 is based on the number of training sorties currently occurring in W-177 (4,217), which is slightly higher than those occurring in W-161 (4,165).

ADAIR = adversary air; ATCAA = Air Traffic Control Assigned Space; MOA = Military Operations Area

2.1.6 Airspace Use

Under the Proposed Action, contract ADAIR flight operations would occur in existing airspace currently used by Shaw AFB pilots. This SUA consists of the Bulldog and Gamecock MOAs and associated ATCAA, the RobRoy Airspace (which is a subdivision of the Gamecock MOA), and Warning Areas W-161 and W-177. This SUA is depicted on **Figure 2-1**. Attributes of this SUA are summarized in **Table 2-4**. Contract ADAIR flight operations would occur in this SUA concurrently with aircraft assigned to the 20 FW or other transient DAF aircraft operating from Shaw AFB, as needed.

Flight time spent within SUA under the Proposed Action would depend upon the specific training mission performed but would typically last 45 to 60 minutes. None of the flight operations included in the Proposed Action would require changes or modifications to the existing attributes of the SUA (including the types of defensive countermeasures and other munitions used in these areas; refer to **Section 2.1.7** for additional information), nor would they require the creation or establishment of new SUA.

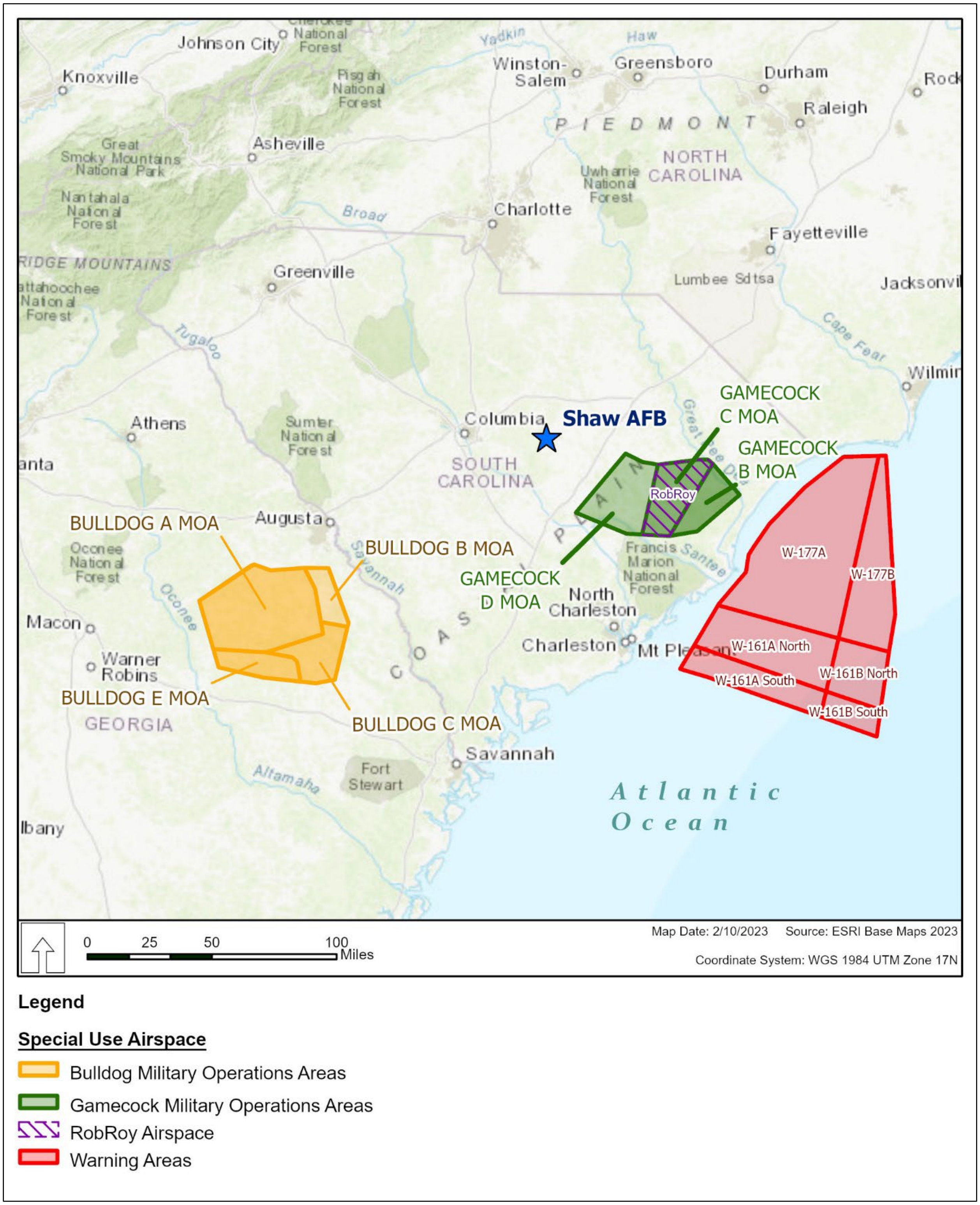

Figure 2-1 Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur

Table 2-4 Shaw Air Force Base Special Use Airspace Attributes

SUA Designation	Altitude [1]
Bulldog MOAs/ATCAA	
Bulldog A MOA	500 ft AGL to, but not including, 10,000 ft MSL
Bulldog B MOA	10,000 ft MSL up to but not including FL 180
Bulldog C MOA	500 ft AGL to, but not including, 10,000 ft MSL
Bulldog E MOA	5,000 ft MSL to, but not including, 10,000 ft MSL
Bulldog ATCAA	Up to FL 270
Gamecock MOAs/ATCAA	
Gamecock B MOA [2]	10,000 ft MSL to but not including FL 180
Gamecock C MOA	100 ft AGL to 10,000 ft MSL (excluding the airspace 1,500 ft AGL and below within a 3 NM radius of Robert F. Swinnie Airport, Andrews, SC)
Gamecock D MOA [3]	10,000 ft MSL to but not including FL 180
Gamecock ATCAA	Up to FL 220
RobRoy Airspace [4]	100 ft AGL to FL 220
Warning Areas [5]	
W-177A	Surface to FL 500
W-177B	Surface to FL 300
W-161A North / W-161A South	Surface to FL 620
W-161B North / W-161B South	Surface to FL 300

Notes:

[1] No changes to current minimum or maximum flight altitudes are included in the Proposed Action.

[2] Gamecock B MOA is designated as “Exercise Only” airspace and is typically not available.

[3] Aircraft operations in Gamecock D MOA are prohibited when the RobRoy Airspace is active (also see Note 4).

[4] The RobRoy Airspace overlaps the eastern half of Gamecock D MOA and the western half of Gamecock C MOA. The RobRoy Airspace may be used by itself or in combination with Gamecock C MOA. Flight operations in Gamecock D MOA are prohibited when the RobRoy Airspace is active.

[5] Aircraft are authorized to perform supersonic operations in all areas of W-161 and W-177 above 10,000 ft MSL and 15 NM (approximately 17.3 statute miles) or more from land.

AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; FL = flight level (vertical altitude expressed in increments of 100 ft [e.g., FL 220 = 22,000 ft, FL 270 = 27,000 ft]); ft = feet; MOA = Military Operations Area; MSL = mean sea level; NM = nautical mile; SC = South Carolina; SUA = special use airspace

2.1.7 Defensive Countermeasures and Other Munitions

Contract ADAIR aircraft would operate with advanced radar and electronic targeting systems during engagements and employ chaff and flares (e.g., RR-188 chaff and M206 flares or similar) during training sortie operations in SUA authorized for their use. Frequent training in the use of chaff and flares by aircrew to master the timing of deployment and the capabilities of these devices is a critical component of ADAIR training. Self-protection flares (i.e., decoy flares) are authorized for use in all Warning Areas at any altitude and above 5,000 feet (ft) above ground level (AGL) within all MOAs and ATCAA. No other live or inert munitions would be used under the Proposed Action.

The ADAIR contractor would receive an allocation for chaff and flares through the 20th Maintenance Group, Munitions Flight. Munitions personnel of the 20th Maintenance Group would store, account for, inspect, maintain, assemble, and deliver chaff and flares to contract ADAIR aircraft; contract personnel would be responsible for loading, unloading, and accountability of chaff and flares provided to their aircraft. The ADAIR contractor would provide all support for Egress System munitions (i.e., cartridge-actuated devices and propellant-actuated devices [CAD/PAD]) and ejector cartridges associated with chaff and flare use and deployment.

Current and proposed quantities of chaff and flare deployments within SUA used by Shaw AFB pilots are summarized in **Table 2-5**. The total quantities of chaff and flares allocated and expended during the Proposed Action may be less than those shown in **Table 2-5**; however, these proposed quantities are used in this EA to provide a conservative analysis of potential impacts from their use.

Table 2-5 Existing and Proposed Defensive Countermeasure Use in Shaw Air Force Base Special Use Airspace

Airspace	Countermeasure Type	Existing Use [1]	Proposed Contract ADAIR Use	Total Estimated Future Use [2]
Bulldog MOAs / ATCAA [3]	Chaff	16,353	11,932	24,197
	Flares	5,887	4,296	8,711
Gamecock MOAs / ATCAA [3]	Chaff	12,443	9,079	18,411
	Flares	4,479	3,628	6,628
W-161 / W-177 [4]	Chaff	6,755	4,929	9,994
	Flares	2,432	1,774	3,598

Notes:

[1] Baseline countermeasure use is based on calendar year 2023 allocations for assigned Shaw Air Force Base fighter aircraft.

[2] This amount is not additive and reflects a 25 percent savings in the amount of chaff and flares used by CAF due to no longer being tasked to fly CAF self-generated Red Air support.

[3] Chaff is authorized for use in the Bulldog and Gamecock MOAs. Flares are authorized for use above 5,000 feet AGL in the Bulldog and Gamecock MOAs and ATCAA.

[4] Chaff is authorized for use in W-161 and W-177 but is limited to less than 400 bundles per scheduled period. Flares are authorized for use in W-161 and W-177.

ADAIR = adversary air; AGL = above ground level; CAF = Combat Air Forces; MOA = Military Operations Area

2.2 ALTERNATIVES DEVELOPMENT

2.2.1 Selection Standards

The following selection standards were applied to assess viable alternatives for implementing the Proposed Action. Alternatives meeting the selection standards would fulfill the purpose and need.

1. **Mission:** Contract ADAIR alternatives must not displace, interfere with, detract from, or reduce other DAF missions or combat operations at Shaw AFB, domestically, or worldwide.
2. **Airspace Capacity:** Alternatives must have the airspace capacity to support force-on-force training engagements and must be able to safely support the contract ADAIR sorties in the airspace. Airspace must be large enough to effectively support realistic air-to-air training. Viable alternatives should not require establishing new military airspace but should occur within existing surrounding military airspace.
3. **Available Facilities:** Alternatives must leverage existing facilities that support the contract ADAIR requirements with minimal short duration, and low-cost renovations, if any are needed. Alternatives must have existing:
   a. operations work/office space;
   b. aircraft parking and hangar space;
   c. maintenance work/office space;
   d. munitions storage space;
   e. fuel storage capacity and delivery capability; and

   f. a runway of sufficient length for takeoff and landing of applicable aircraft, with appropriate safety features, infrastructure, and clear zones to ensure safe operations.

4. **Cost and Time:** CAF fighter aircrew readiness is currently an urgent need; therefore, viable ADAIR alternatives must be capable of supporting contract ADAIR activities in the near term. Solutions that cannot be implemented within the next 2 years, at the latest, would not meet the purpose and need. It is the DAF's preference to implement the Proposed Action as soon as possible.

2.2.2 Alternatives Screening

Alternatives initially considered by the DAF for implementing the Proposed Action are summarized below.

- **Alternative 1:** Establish contract ADAIR capabilities (an estimated 12 aircraft) providing 3,500 annual sorties operating at Shaw AFB. The proposed training activities would occur in SUA currently used by Shaw AFB pilots (refer to **Section 2.1.5** and **Section 2.1.6**). Contract ADAIR administrative functions and aircraft maintenance operations would occupy existing operations and maintenance facilities/space in Building 106 and Building 712 on Shaw AFB. Contract ADAIR aircraft parking would be along the N Row on the existing Shaw AFB aircraft parking apron.
- **Alternative 2:** Establish contract ADAIR capabilities (an estimated 12 aircraft) providing 3,500 annual sorties operating at Shaw AFB. The proposed training activities would occur in SUA currently used by Shaw AFB pilots (refer to **Section 2.1.5** and **Section 2.1.6**). Contract ADAIR operations and administrative functions would occupy existing space on Shaw AFB in the facilities of the fighter squadron they are flying with on the particular training day. Contract ADAIR aircraft maintenance operations would occupy existing space in Building 106 on Shaw AFB. Contract ADAIR aircraft parking would be along the N Row on the existing Shaw AFB aircraft parking apron.
- **Alternative 3:** Establish an additional DAF AGRS of military pilots to fly CAF ADAIR aircraft (an estimated 12 aircraft) providing 3,500 annual training sorties at Shaw AFB. The proposed training activities would occur in SUA currently used by Shaw AFB pilots (refer to **Section 2.1.5** and **Section 2.1.6**).
- **Alternative 4:** Construct new operations and maintenance facilities at Shaw AFB for contract ADAIR capabilities (an estimated 12 aircraft) providing 3,500 annual training sorties. The proposed training activities would occur in SUA currently used by Shaw AFB pilots (refer to **Section 2.1.5** and **Section 2.1.6**).
- **Alternative 5:** Establish dedicated CAF ADAIR by tasking organic CAF units to provide the capability.

2.2.3 Alternatives Eliminated from Further Consideration

The alternatives listed in **Section 2.2.2** were screened against the selection standards presented in **Section 2.2.1**. Alternatives 1 and 2 met all selection standards and would fulfill the purpose and need; therefore, Alternatives 1 and 2 are retained for detailed analysis in this EA. As shown in **Table 2-6**, Alternatives 3, 4, and 5 failed to meet one or more of the selection standards and would not meet the purpose and need; therefore, these alternatives were dismissed from detailed analysis in this EA.

Alternatives 3 through 5 are briefly described below:

- **Alternative 3:** Establish an additional DAF AGRS of military pilots to fly CAF ADAIR aircraft (an estimated 12 aircraft) providing 3,500 annual training sorties at Shaw AFB: Establishing a new DAF AGRS of 4th generation aircraft would meet many of the selection standards; however, it would take longer than 2 years to implement. Training DAF pilots takes more than a decade. Establishing another organic AGRS would require intensive planning, budgeting, and training of DAF pilots before they would be ready to execute their mission. Rapid stand-up and manning of additional AGRSs would be possible but not without reducing both the number of personnel and combat platforms available to support combat operations. Due to the timeframe and/or reductions in combat mission capacity involved, this alternative fails to meet selection standards 1 and 4 and does not meet the purpose and need.

- **Alternative 4:** Construct new operations and maintenance facilities at Shaw AFB to establish contract ADAIR capabilities (an estimated 12 aircraft) providing 3,500 annual training sorties: Establishing the contract ADAIR mission with new facilities construction was considered but not carried forward, as the alternative requires the construction of new facilities and does not provide support in the timely manner needed to address the pilot readiness crisis. Planning, programming, budgeting, appropriating, designing, and constructing new facilities would take 4 to 5 years and as such, would not meet selection standards 3 and 4. Therefore, this alternative would not meet the purpose and need and was eliminated from further consideration.
- **Alternative 5:** Establish dedicated CAF ADAIR by tasking organic CAF units to provide the capability: Tasking organic 4th generation assets to provide dedicated ADAIR support to Shaw AFB would result in both a reduction of combat power applied worldwide and continued degradation of the unit's own readiness. The units employing 4th generation aircraft, such as the F-16, are heavily engaged in deployments and overseas missions. Under this alternative, these units would continue to struggle with providing for their own proficiency while maintaining support for both combat operations and CAF ADAIR. Such an alternative does not meet selection standard 1. Therefore, this alternative does not meet the purpose and need and was dismissed from further consideration.

Table 2-6 Comparison of Alternatives

Alternatives	Selection Standard				
	1. Mission	2. Airspace Capacity	3. Available Facilities	4. Cost and Time	Meets Purpose and Need?
Alternative 1	Yes	Yes	Yes	Yes	**YES**
Alternative 2	Yes	Yes	Yes	Yes	**YES**
Alternative 3	No	Yes	Yes	No	**NO**
Alternative 4	Yes	Yes	No	No	**NO**
Alternative 5	No	Yes	Yes	Yes	**NO**

2.3 Alternatives Retained for Detailed Analysis in the EA

NEPA and the CEQ regulations mandate the consideration of reasonable alternatives for the Proposed Action. "Reasonable alternatives" are those that meet the purpose and need. Alternatives 1 and 2 satisfy the selection standards described in **Section 2.2.1** and meet the purpose and need. Therefore, they are carried forward for detailed analysis in this EA. Although the No Action alternative would not satisfy the selection standards or meet the purpose and need, it is analyzed in the EA in accordance with CEQ NEPA regulations to provide a benchmark for the comparison of impacts from Alternatives 1 and 2.

2.3.1 Alternative 1: Establish Contract ADAIR Capabilities in Building 106 and Building 712 at Shaw AFB

Under Alternative 1, the DAF would establish contract ADAIR capabilities at Shaw AFB as described in **Section 2.1**. Approximately 12 contract ADAIR aircraft would provide 3,500 annual sorties at Shaw AFB. Contract ADAIR operations and maintenance activities would occupy space in Building 106 and Building 712 at Shaw AFB, respectively, including available hangar space for aircraft maintenance. Operations would be integrated into Building 106, while maintenance would be located in Building 712 (**Figure 2-2**). Contract ADAIR aircraft parking would be on the N Row of the aircraft parking apron, immediately east of Building

712 and other nearby facilities. Contract ADAIR operations personnel would attend crew briefs and debriefs in Building 106 or other existing facilities on Shaw AFB.

2.3.2 Alternative 2: Establish Contract ADAIR Capabilities in Building 106 and Shared Space with Each Fighter Squadron at Shaw AFB

Under Alternative 2, the DAF would establish contract ADAIR capabilities at Shaw AFB as described in **Section 2.1**. Approximately 12 contract ADAIR aircraft would provide 3,500 annual sorties at Shaw AFB. Contract ADAIR operations and administrative functions would occupy existing space on Shaw AFB in the facilities of the fighter squadron they are flying with on the particular training day. Contract ADAIR aircraft maintenance operations would occupy existing space in Building 106 on Shaw AFB (**Figure 2-2**). Contract ADAIR operations personnel would attend crew briefs and debriefs in Building 106 or other existing facilities on Shaw AFB. Contract ADAIR aircraft parking would be on the N Row of the aircraft parking apron.

2.3.3 No Action Alternative

Under the No Action Alternative, contract ADAIR would not be established at Shaw AFB and existing conditions would continue. The 20 FW would continue to operate three F-16 squadrons and would provide its own ADAIR support as it currently does. In-house ADAIR support at Shaw AFB would result in further declines in fielded fighter aircrew proficiency or combat operations. The continued use of Shaw AFB resources for ADAIR support is causing declining quality of fighter aircrew production, resulting in unsustainable operations posing a threat to national security. Pilots tasked to support ADAIR missions organically from within CAF would continue to experience their own readiness and proficiency challenges due to the lost training time they are experiencing.

The No Action Alternative does not meet the purpose and need but is evaluated in this EA in accordance with CEQ NEPA regulations to provide a benchmark for the comparison of potential impacts from Alternatives 1 and 2.

2.4 MITIGATION AND BEST MANAGEMENT PRACTICES

Agencies are required to identify and include all relevant and reasonable mitigation measures that could reduce potential significant impacts. CEQ NEPA regulations define mitigation as “avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and compensating for the impact by replacing or providing substitute resources or environments” (40 CFR § 1508.1(s)).

Mitigation measures are not addressed in this EA; however, environmental commitments and best management practices to prevent or minimize non-significant effects from the Proposed Action are described for environmental resources evaluated in **Chapter 3** of this EA, as applicable.

Figure 2-2 Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations

2.5 SUMMARY OF POTENTIAL ENVIRONMENTAL CONSEQUENCES

Potential impacts from the Proposed Action are summarized in **Table 2-7**. This summary is derived from the detailed discussion of potential impacts on each resource presented in **Chapter 3** of this EA.

Table 2-7 Comparison of Potential Environmental Consequences of the Proposed Action

Resource	Proposed Action (Alternative 1 and Alternative 2) [1]	No Action Alternative
Airspace Management and Usage	Negligible long-term impacts on Shaw AFB airspace and SUA.	No change.
Noise	Under the High Noise Scenario, significant noise increases at 3 POIs; long-term and likely noticeable noise increases at 5 POIs; and unnoticeable increases of 1 to 2 dBA at 12 POIs. Negligible long-term impacts from noise under the Medium Noise Scenario, with long-term, likely unnoticeable increases at all POIs. Negligible or minor long-term impacts from noise under the Low Noise Scenario, with long-term, likely unnoticeable increases at all but one POI. No or negligible impacts from noise and sonic booms in onshore and offshore SUA and negligible impacts from sonic booms in offshore SUA under the High, Medium, and Low Noise Scenarios.	No change.
Safety	No or negligible impacts on occupational safety, emergency response, safety zones, arresting gear capacity, explosives safety, flight safety, and bird-aircraft strike hazards provided all applicable procedures and requirements are adhered to.	No change.
Air Quality	No or negligible impacts on air quality or GHGs and climate change at Shaw AFB and in SUA. Emissions of criteria pollutants under the High, Medium, and Low Emission Scenarios would not affect the unclassified / attainment status of the air quality control region that includes Shaw AFB and SUA. Estimated GHG emissions under the High Emission Scenario would be at least 3.5 times higher than potential GHG emissions under the Low Emission Scenario but GHG emissions under all three emission scenarios would remain less than 0.1 percent of total estimated 2020 statewide GHG emissions in South Carolina.	No change.

Table 2-7 Comparison of Potential Environmental Consequences of the Proposed Action

Resource	Proposed Action (Alternative 1 and Alternative 2) [1]	No Action Alternative
Biological Resources	No, negligible, or minor impacts on common species of wildlife at Shaw AFB and in SUA from increased aircraft operations. No impacts on vegetation or from invasive species at Shaw AFB and in areas underlying overland SUA. May affect but not likely to adversely affect 14 federally listed threatened and endangered species present or potentially occurring at Shaw AFB and in areas underlying overland and offshore SUA. Not likely to jeopardize the continued existence of one federal candidate species or one federal proposed endangered species, which could occur at Shaw AFB and in areas underlying overland SUA.	No change.
Land Use	Minor to moderate impacts on land use from increased noise levels under the High, Medium, and Low Noise Scenarios. Increased noise levels under all three noise scenarios would have no potential to preclude the viability of existing land uses or the continued occupation of those areas, threaten public health or safety, or conflict with planning criteria that ensure the safety and protection of human life and property. No DNL increases at residential POIs outside the existing 65 dBA DNL contour that would cause those POIs to fall within the 65 dBA DNL contour under proposed future conditions, and no DNL increases at residential POIs within the existing 65 dBA DNL contour that would exceed 2 dBA under proposed future conditions.	No change.
Socioeconomics	Long-term, potentially minor, beneficial impact on the local economy near Shaw AFB under Alternative 1 resulting from increased expenditures and associated payroll tax revenue. No, negligible, or minor impacts on populations at POIs (places of worship only) where noise increases would potentially occur because such increases would primarily occur during weekday daytime hours when those facilities are less frequently in use.	No change.
Environmental Justice and Protection of Children	Under the High Noise Scenario, potential disproportionately adverse impacts on minority and/or low-income populations potentially present at three POIs where DNL would increase by 3 dBA or more within the 65 dBA DNL contour. No disproportionately adverse effects on potential minority and low-income populations in Sumter County from additional contract ADAIR personnel, and minor beneficial effects from increased economic expenditures associated with the proposed contract ADAIR activities which would benefit all people and businesses in the region regardless of race or age.	No change.

Table 2-7 Comparison of Potential Environmental Consequences of the Proposed Action

Resource	Proposed Action (Alternative 1 and Alternative 2) [1]	No Action Alternative
Environmental Justice and Protection of Children *(continued)*	🟢 No disproportionate adverse effects on minority, low-income, or youth populations at residential, school, or childcare POIs under any Proposed Action noise scenario.	
Cultural Resources	🟢 Under Alternative 1, no adverse effects on historic properties at Shaw AFB and in areas underlying the SUA that are listed or eligible for listing in the NRHP, including architectural resources archaeological sites, and traditional cultural properties/sacred sites. Impacts from Alternative 2 would be the same as Alternative 1 except that Alternative 2 would not involve the use of Building 712, which was built in 1941 but is not eligible for listing in the NRHP.	🟢 No change.
Hazardous Materials and Wastes, Environmental Restoration Program Sites, and Toxic Substances	🟡 Minor impact from the increased procurement and use of hazardous materials and the increased storage and disposal of hazardous waste. 🟢 No adverse impacts on or from active ERP sites at Shaw AFB. No adverse impacts from ACM and LBP; if present in Buildings 106 and 712, these substances would be managed in place or removed and disposed of in accordance with all applicable regulations and procedures. No impacts from radon, as it poses a low potential for health hazards at Shaw AFB. No impacts from PCBs, as Alternative 1 does not involve the use of PCBs or the disturbance of existing PCBs at Shaw AFB, if present. PCBs identified during the proposed contract ADAIR program would be handled and disposed of in accordance with applicable requirements of the Shaw AFB Hazardous Waste Management Plan.	🟢 No change.

Notes:

🟢 No, minor, or negligible impact 🟡 Moderate impact but not significant 🔴 Major, significant impact

[1] Impacts from Alternative 1 and Alternative 2 would be the same for all resources.

ACM = asbestos containing material; ADAIR = adversary air; AFB = Air Force Base; dBA = A-weighted decibel; DNL = Day-Night Average Sound Level; ERP = Environmental Restoration Program; GHG = greenhouse gas; LBP = lead-based paint; NRHP = National Register of Historic Places; PCB = polychlorinated biphenyl; POI = point of interest; SUA = special use airspace

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CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This EA analyzes potential impacts on existing environmental conditions associated with dedicated contract ADAIR sorties for Shaw AFB. The analysis considers the current, baseline conditions of the affected environment and compares those to conditions that might occur should the DAF implement the Proposed Action (Alternative 1 or Alternative 2) or the No Action Alternative.

3.1 ANALYZED RESOURCES AND EVALUATION CRITERIA

In this chapter, each resource is defined, analyzed, and the geographic scope is identified, followed by a description of the existing conditions for that resource. The expected geographic scope of potential environmental consequences is referred to as the region of influence (ROI). The ROI boundaries vary depending on the nature of each resource (**Table 3-1**). For example, the ROI for some resources, such as air quality, extends over a larger jurisdiction unique to the resource. The specific criteria for evaluating impacts and assumptions for the analyses are presented under each resource area. Evaluation criteria for most potential impacts were obtained from standard criteria; federal, state, or local agency guidelines and requirements; and/or legislative criteria.

Table 3-1 Region of Influence for the Proposed Action by Resource

Resource	Region of Influence	
	Shaw Air Force Base	Special Use Airspace
Airspace Management and Use	Shaw AFB and its environs	All Special Use Airspace (see **Figure 1-3**)
Noise	Shaw AFB and its environs	All Special Use Airspace
Safety	Shaw AFB runway(s), taxiways, aircraft parking areas, associated airspace, and adjacent off-base properties	All Special Use Airspace
Air Quality [1]	Shaw AFB and its environs; Camden-Sumter Air Quality Control Region (40 CFR § 81.110)	All Special Use Airspace
Biological Resources	Shaw AFB and its environs including areas adjacent to runways and taxiways; areas within associated safety zones; and on-base and off-base lands within existing and proposed noise contours.	All Special Use Airspace
Land Use	Shaw AFB and off-base lands within existing and proposed noise contours	Not analyzed
Socioeconomics (Income and Employment)	Sumter County, South Carolina	Not analyzed
Environmental Justice	Sumter County, South Carolina	Not analyzed
Cultural Resources	Buildings, facilities, structures, sites, and other areas of Shaw AFB where proposed activities would occur.	All Special Use Airspace
Hazardous Materials, Hazardous Waste, ERP Sites, and Toxic Substances	Buildings, facilities, structures, sites, and other areas of Shaw AFB where proposed activities would occur.	Not analyzed

Notes:
[1] The volume of air extending up to the mixing height (3,000 feet above ground level) and coinciding with the spatial distribution of the Region of Influence is considered in the evaluation of air quality impacts.
AFB = Air Force Base; CFR = Code of Regulations; ERP = Environmental Restoration Program

Impacts and their significance are discussed for each resource. Impacts are defined in general terms and are qualified as adverse or beneficial, and as short- or long-term. For the purposes of this EA, short-term impacts are generally considered those impacts that would have temporary effects. Long-term impacts are generally considered those impacts that would result in persistent effects.

Impacts are defined as

- negligible, the impact is localized and not measurable or at the lowest level of detection;
- minor, the impact is localized and slight but detectable;
- moderate, the impact is readily apparent and appreciable;
- major, the impact is adverse or highly noticeable and considered to be significant.

Major impacts are considered significant and receive the greatest attention in the decision-making process. The significance of an impact is assessed based on the potentially affected environment and degree of the effects of the action (40 CFR § 1501.3[b]). Major impacts require application of a mitigation measure to achieve a less than significant impact. Moderate impacts may not meet the criteria to be classified as significant, but the degree of change is noticeable (audible) and has the potential to become significant if not effectively mitigated. Minor impacts have little to no effect on the environment and are not easily detected; impacts defined as negligible are the lowest level of detection and generally are not measurable. Beneficial impacts provide desirable situations or outcomes.

Reasonably foreseeable future actions that could result in an increased effect to environmental resources in conjunction with the Proposed Action are summarized in **Appendix B**.

3.2 Resources Eliminated from Further Analysis

In compliance with NEPA, CEQ guidelines, and DAF guidance in 32 CFR Part 989, as amended, the description of the affected environment focuses on those resources that may be affected by the Proposed Action. Through a preliminary screening process, the DAF determined that the Proposed Action would have no potential to affect the resources described below; therefore, these resources are not carried forward for detailed analysis in this EA.

3.2.1 Socioeconomics (Housing, Population, and Schools)

As of 2022, Sumter County had a total population of 104,012 individuals. The potential relocation of an estimated 93 contract personnel (i.e., 78 maintenance personnel and 15 pilots) and their families to Sumter County and/or its surrounding area in support of the Proposed Action would represent a negligible increase in local populations and thus, would have no impacts. Adequate housing, public schools, and other community services are available to support the 93 contract personnel and their families; therefore, the Proposed Action would have no impact on the region’s housing, schools, and community services. Therefore, these socioeconomic resources are not carried forward for detailed analysis in this EA (socioeconomic resources consisting of income and employment are addressed in **Section 3.9**).

3.2.2 Visual Resources

The Proposed Action does not involve the construction of new facilities or structures at Shaw AFB or in SUA that would be used for the proposed contract ADAIR training activities. Contract ADAIR aircraft operating on existing runways, taxiways, and aircraft parking aprons at Shaw AFB would be similar to military aircraft operations currently occurring at the installation. Proposed aircraft operations within existing SUA would be similar to those currently occurring there. Overall, the Proposed Action would have no effect on the visual character or visual setting of Shaw AFB, SUA, and adjacent or nearby areas. Therefore, this resource was not retained for detailed analysis in this EA.

3.2.3 Water Resources

The Proposed Action does not involve ground-disturbing activities that could result in the degradation of water quality from the runoff of sediments and pollutants. The potential increase of 93 contract ADAIR personnel and their family members, as well as operational and maintenance activities associated with the Proposed Action, would not affect available surface or groundwater water supplies or water quality at Shaw AFB or surrounding localities. Residual materials from non-toxic chaff and flares dispensed by aircraft during training exercises would be dispersed across wide areas underlying overland SUA and offshore Warning Areas and would have no potential to accumulate in quantities that could contribute to the degradation of water quality in underlying surface water bodies. Adherence to applicable precautions and safety procedures would prevent or minimize potentially adverse impacts on water resources from aircraft fuel dumps. Therefore, water resources are not carried forward for detailed analysis in this EA.

3.2.4 Soil Resources

The Proposed Action does not involve ground-disturbing activities that would have the potential to alter soil composition, structure, or function. Residual materials from non-toxic chaff and flares dispensed by aircraft during training exercises would be dispersed across wide areas underlying overland SUA and would have no potential to accumulate in quantities that could affect underlying soils. Therefore, impacts on soils would be insignificant and are not retained for detailed analysis in this EA.

3.2.5 Utilities, Infrastructure, and Transportation

Existing utilities, infrastructure, and transportation networks on and around Shaw AFB have sufficient capacity to support the Proposed Action and would not require extensions, expansions, upgrades, improvements, or other modifications. Proposed increases in operations, maintenance activities, and personnel at Shaw AFB under the Proposed Action would be marginal relative to the installation’s existing operations and assigned workforce of approximately 8,700 military and civilian personnel (Shaw AFB, 2022a) and would not noticeably increase the demand for electrical, data, or water/sewage services on the installation or in surrounding communities. The Proposed Action would utilize existing facilities on the installation and would not require the construction or substantial renovation of facilities or associated infrastructure. An increase of approximately 93 contract ADAIR personnel commuting to and from the installation each day would not contribute to noticeable increases in traffic congestion in the local transportation network. Therefore, utilities, infrastructure, and transportation are not carried forward for detailed analysis in the EA.

3.3 AIRSPACE MANAGEMENT AND USAGE

3.3.1 Definition of the Resource

Airspace management involves the direction, control, and handling of flight operations in the airspace that overlies the borders of the United States and its territories. The Federal Aviation Administration (FAA) is responsible for planning, managing, and controlling the structure and use of all airspace over the United States. FAA rules govern the national airspace system and FAA regulations establish how and where aircraft may fly. Collectively, the FAA uses these rules and regulations to make airspace use as safe, effective, and compatible as possible for all types of civilian, military, and commercial aircraft. Aircraft use airspace in accordance with FAA rules and procedures applicable to each type of airspace.

Airspace addressed in this section includes airspace around Shaw AFB and overland and offshore SUA used for training by Shaw AFB pilots. Additional information about airspace management and usage is provided in **Appendix C-1**.

3.3.2 Existing Conditions – Shaw Air Force Base

Shaw AFB has dual runways: Runway 04L/22R, which is 10,021 ft long and 200 ft wide, and Runway 04R/22L, which is 8,014 ft long and 200 ft wide. One control tower, located at the eastern side of the dual runways, manages aircraft operations supporting the training and readiness of pilots of the 20 FW and other units supported by Shaw AFB including the National Airborne Operations Center, transient aircraft, and distinguished visitor aircraft flying missions. The control tower manages aircraft flying within a range of 5 miles of the base; when aircraft fly beyond this range, control is transferred to Shaw radar approach control. Additional personnel are typically scheduled to support wing flying exercises or airfield operations outside of published hours.

A variety of factors can influence the annual level of operational activity at an airfield, including economics, national emergencies, and maintenance requirements. Operations consist of take-offs, landings, closed patterns, and static run-ups primarily by based military aircraft with a smaller amount of transient and civilian aircraft operations. Based F-16C aircraft operations make up about 97 percent of the airfield use, with the remaining amount used by other transient and civilian aircraft (3 percent) as shown in **Table 3-2**.

Table 3-2 Annual Operations at Shaw Air Force Base

Use	Annual Operations	Percentage of Use
Based Military		
F-16C	49,613	97
Transients		
Transient and Civilian	1,395	3
Total	**51,008**	**100**

3.3.3 Existing Conditions – Special Use Airspace

SUA addressed in this analysis consists of the overland Bulldog and Gamecock MOAs and associated ATCAA, the RobRoy Airspace (which is a subdivision of the Gamecock MOAs), and offshore Warning Areas W-161 and W-177. Current operations performed in these SUA by Shaw AFB aircraft are summarized in **Table 2-3**, and their locations are shown on **Figure 2-1**. Other attributes of these SUA are described in **Section 2.1.6**.

3.3.4 Environmental Consequences Evaluation Criteria

Adverse impacts on SUA could include modifications to airspace or substantial increases in the number of flight operations occurring in the SUA. For the purposes of this EA, an impact is considered significant if it modifies SUA location, dimensions, or aircraft operational capacity.

3.3.5 Environmental Consequences – Alternative 1

3.3.5.1 Shaw Air Force Base

The Proposed Action would not impact the operational capacity or necessitate changes to, locations, or dimensions of any of the airspace around Shaw AFB. In addition to the proposed 3,500 sorties, contract ADAIR pilots may fly very few additional traffic patterns at Shaw AFB to maintain their currency and proficiency as required. Additional traffic patterns would be anticipated for less than 1 percent of the annual sortie total or approximately 175 sorties. Potential impacts on the Shaw AFB airspace are expected to be negligible and long-term.

3.3.5.2 Special Use Airspace

Under Alternative 1, an additional 3,500 annual training sorties would occur within the Bulldog and Gamecock MOAs and associated ATCAA, the RobRoy Airspace, and W-161 and W-177. This would represent a 29.2 percent increase in aircraft operations in the SUA over existing conditions (see **Table 2-3**). Approximately 2 percent of contract ADAIR sorties would be expected to fly in the SUA during environmental night hours, which is consistent with existing operations conducted within the SUA by Shaw AFB pilots (see **Section 3.2.3**). This would be consistent with existing procedures at Shaw AFB, which conducts approximately 2 percent of training operations during nighttime hours (i.e., 10:00 p.m. to 7:00 a.m. local time).

Time spent within the SUA would depend upon the specific training mission performed but would typically last 30 to 60 minutes. Contractor aircraft and 20 FW aircraft would operate concurrently in the SUA. The SUA proposed for use are in compatible locations and have sufficient capacity and dimensions to support the proposed ADAIR sorties. No airspace modifications would be required to accommodate the additional sorties as part of the Proposed Action. Therefore, the Proposed Action would have negligible long-term impacts on SUA.

3.3.6 Environmental Consequences – Alternative 2

3.3.6.1 Shaw Air Force Base

Proposed aircraft operations under Alternative 2 would be the same as those described for Alternative 1. Therefore, impacts on the airspace environment at Shaw AFB under Alternative 2 would be the same as those described for Alternative 1. Impacts would be negligible and long-term.

3.3.6.2 Special Use Airspace

Proposed aircraft operations under Alternative 2 would be the same as those described for Alternative 1. Therefore, impacts on SUA under Alternative 2 would be the same as those described for Alternative 1. Impacts on SUA would be negligible and long-term.

3.3.7 Environmental Consequences – No Action Alternative

Under the No Action Alternative, contract ADAIR operations would not occur at Shaw AFB or in the Bulldog and Gamecock MOAs or ATCAA, the RobRoy Airspace, or W-161 and W-177. Therefore, the No Action Alternative would have no effect on Shaw AFB airspace or SUA.

3.3.8 Cumulative Impacts

The Proposed Action would result in potential long-term minor increases in flight training operations in the airspace environment in the vicinity of Shaw AFB. The addition of contract ADAIR aircraft and other reasonably foreseeable future actions is anticipated to increase the number of flight operations in the vicinity of the airfield and in the SUA; however, this increase in flight operations would be expected to be minor compared to the flight operations that currently occur. The SUA proposed for use are in compatible locations and have sufficient capacity and dimensions to support other reasonably foreseeable future actions in addition to the Proposed Action. Therefore, the Proposed Action would have negligible impacts on airspace in conjunction with foreseeable future actions.

3.4 NOISE

3.4.1 Definition of the Resource

Military aircraft generate two types of sound (or noise): subsonic noise and supersonic noise. Aircraft subsonic noise consists of two major types of sound events: flight events (including takeoffs, landings, and flyovers) and stationary events, such as engine maintenance run-ups. Aircraft in supersonic flight (exceeding the speed of sound [Mach 1]) cause sonic booms. A sonic boom is characterized by a rapid increase in pressure, followed by a decrease before a second rapid return to normal atmospheric levels. This change occurs very quickly, typically within a few tenths of a second, and is usually perceived as a "bang-bang" sound. Noise characteristics, noise metrics, and other acoustic principles are described in greater detail in **Appendix C.2**.

Noise metrics quantify subsonic and supersonic noise in a standard way. Several metrics can be used to describe a range of situations, from a particular individual event to the cumulative effect of all noise events over a prolonged period. For this analysis, noise is expressed using several metrics including: A-weighted decibels (dBA), day-night average sound level (DNL or L_{dn}), onset-rate adjusted monthly day-night average sound level (L_{dnmr}), C-weighted sound exposure level (CSEL), and overpressure (pounds per square foot [psf]). These noise metrics are calculated using the following software programs: NOISEMAP, MR_NMAP, PCBoom, and BooMap. Additional information regarding noise models and modeling inputs is provided in **Appendix C.2**.

3.4.2 Existing Conditions – Shaw Air Force Base

Aircraft operations are the primary source of noise at Shaw AFB. In addition to aviation noise, some additional noise results from the general operations and functions associated with the installation. These noise sources include the operations of ground-support equipment and transportation noise from vehicular traffic. However, noise resulting from aircraft operations remains the dominant noise source and is the only noise source analyzed in the document.

Aircraft operations at Shaw AFB consist of a variety of aircraft, most with jet engines. Typical aircraft operations include take-offs, landings, closed patterns, and static run-ups. More than 51,000 aircraft operations occur annually at Shaw AFB (**Table 3-3**). The pattern numbers shown in the table are operation counts, not pattern circuit counts. Shaw AFB's dual runways (04L/22R and 04R/22L) are used for all aircraft operations. Additional information regarding existing annual aircraft operations at Shaw AFB is provided in **Appendix C.2**.

Table 3-3 Existing Annual Aircraft Operations Summary at Shaw Air Force Base

Aircraft	Departures		Arrivals		Closed Patterns and Interfacility [1]		Total Operations		
	Day	Night	Day	Night	Day	Night	Day	Night	Total
F-16C	16,230	0	15,323	907	17,153	0	48,706	907	49,613
Transient and Civilian	270	17	265	22	821	0	1,356	39	1,395
Total	**16,500**	**17**	**15,588**	**929**	**17,974**	**0**	**50,062**	**946**	**51,008**

Notes:
[1] F-16C operations include 15,274 closed pattern operations and 1,879 interfacility operations.

Noise contours between 65 to 85 dBA DNL associated with existing daily flight operations at Shaw AFB are shown on **Figure 3-1**. The land area within the noise contours shown on **Figure 3-1** is listed in **Table 3-4**.

Table 3-4 Existing Day-Night Average Sound Level Area Affected at Shaw Air Force Base

Noise Level (DNL, dBA)	Area within Noise Contour (acres)
>65	8,599
>70	4,493
>75	2,481
>80	1,279
>85	665

Notes:

Area (on- and off-airfield property) was based off the NOISEMAP-modeled noise contours and used to calculate the amount of land within each noise contour. The amounts shown are cumulative (i.e., the acreage within the >85 dBA DNL contour is also within all the lower noise level contours).

dBA = A-weighted decibel; DNL = day-night average sound level

In accordance with Air Force Handbook 32-7084, the 65 dBA DNL is the noise level below which generally all land uses are compatible with noise from aircraft operations. These noise levels, which are often shown graphically as contours on maps, are not discrete lines that sharply divide louder areas from land largely unaffected by noise. Instead, they are part of a planning tool that depicts the general noise environment around the airfield based on typical aviation activities. Areas beyond the 65 dBA DNL can also experience levels of appreciable noise depending upon flight activity or weather conditions. In addition, DNL contours may vary from year to year due to fluctuations in operations, funding levels, and other factors. Static run-up operations, such as maintenance and pre/postflight run-ups, are also included in the noise modeling. Additional information regarding static operations at Shaw AFB is provided in **Appendix C.2**.

Twenty representative points of interest (POIs) were identified in the vicinity of Shaw AFB (**Figure 3-1**). These POIs include noise-sensitive receptors such as homes, schools, hospitals, and places of worship. The DNL associated with existing Shaw AFB aircraft operations at each of these POIs is listed in **Table 3-5**.

3.4.3 Existing Conditions – Special Use Airspace

Table 3-6 summarizes Shaw AFB's annual airspace operations. The existing DNLs (L_{dn}) and onset-rate adjusted monthly DNLs (L_{dnmr}), calculated using MR_NMAP, from subsonic aircraft operations in the SUA are listed in **Table 3-7**. The L_{dn} (and L_{dnmr}) were estimated to be below 45 dBA in Bulldog Alpha MOA, Bulldog Bravo MOA, Gamecock Delta MOA, W-161A/B and W-177A/B. The L_{dn} (and L_{dnmr}) do not exceed 65 dBA in any of the SUA. Existing subsonic aircraft noise levels are negligible; however, the L_{dn} (and L_{dnmr}) may vary from year to year due to fluctuations in operations, funding levels, and other factors.

Supersonic operations are authorized in all areas of W-161 and W-177 above 10,000 ft MSL and 15 NM (approximately 17.3 statute miles) or more from land (**Figure 2-1**). Airspace sorties require aircraft to fly at supersonic speeds (above Mach 1.0) for brief periods of time for approximately 10 percent of total flight time. This is equivalent to less than 5 minutes of supersonic flight activity per sortie.

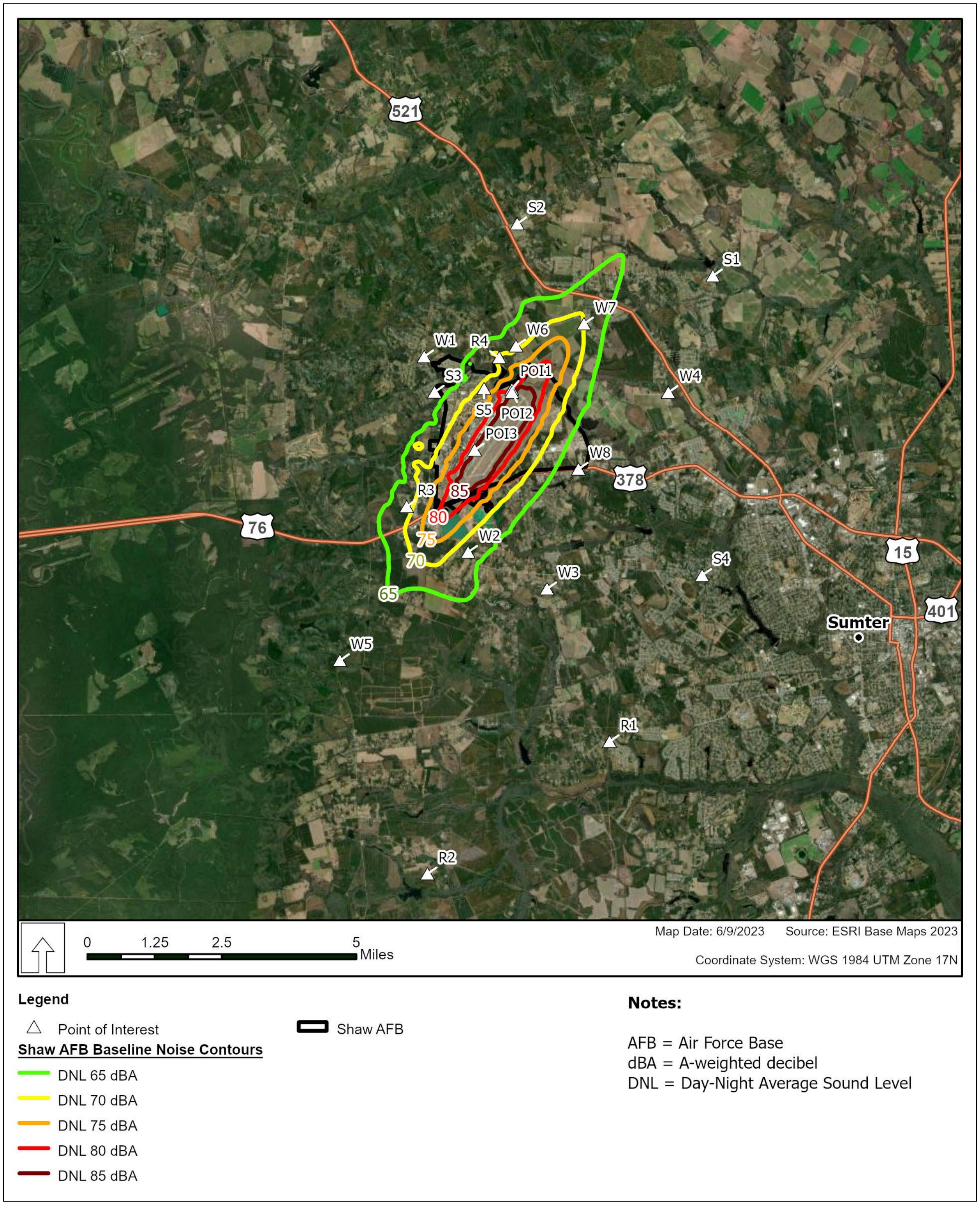

Figure 3-1 Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

Table 3-5 Existing Day-Night Average Sound Level at Points of Interest On and Around Shaw Air Force Base

Points of Interest		DNL (dBA)
ID	Description	
POI1	Building Near 1601 Patrol Road	82
POI2	Building Near 1601 Patrol Road	84
POI3	Near Shaw AFB Fire Department	84
R1	Residential on Willcroft Court	53
R2	Residential on Belles Mill Road (Wedgefield)	38
R3	Residential on Lost Creek Drive	68
R4	Residential on Solstice Drive (Dalzell)	70
S1	Ebenezer Middle School - 3440 Ebenezer Road	54
S2	Hillcrest Middle School - 4355 Peach Orchard Road (Dalzell)	53
S3	Oakland Primary School - 5415 Oakland Drive	63
S4	Wilson Hall - 520 Wilson Hall Road	50
S5	High Hills Elementary School - 4971 Frierson Road	72
W1	Long Branch Baptist Church - 2535 Peach Orchard Road (Dalzell)	59
W2	Victory Church - 5155 Patriot Parkway	67
W3	Lighthouse Baptist Church - 1130 North St. Pauls Church Road	58
W4	St. Mark Four Bridges Church - 2280 4 Bridges Road	54
W5	Lost Sheep Cavalry Ministries International - 1315 Highway 261 South (Wedgefield)	60
W6	Cross Bridge Chrisitian Church - 2490 Sargent Road (Dalzell)	69
W7	Covenant Bible Church - 2805 Frierson Road (Dalzell)	70
W8	St. Luke AMI Church - 2355 North St. Pauls Church Road	61

Notes:
Points of Interest levels based on the NOISEMAP-modeled noise exposures.
dBA = A-weighted decibel; DNL = day-night average sound level; ID = identification

Table 3-6 Existing Shaw Air Force Base Annual Aircraft Operations in Special Use Airspace

Airspace	Altitude Range (feet)	Aircraft	Airspace Operations	
			Daytime (0700-2200 hours)	Nighttime (2200-0700 hours)
Bulldog Alpha MOA	500 AGL to 9,999 MSL	F-16C	3,536	72
Bulldog Bravo MOA	11,000 MSL to 18,000 MSL	F-16C	3,536	72
Bulldog Bravo ATCAA	18,000 MSL to FL 270	F-16C	3,536	72
Bulldog Charlie MOA	500 AGL to 9,999 MSL	F-16C	3,536	72
Bulldog Delta MOA	500 AGL to 17,000 MSL	F-16C	3,536	72
Bulldog Echo MOA	5,000 MSL to 9,999 MSL	F-16C	3,536	72
Gamecock Bravo MOA	10,000 MSL to FL 180	F-16C	0	0
Gamecock Charlie MOA	100 AGL to 10,000 MSL	F-16C	4,077	83
Gamecock Delta MOA	12,000 MSL to FL 180	F-16C	4,077	83
Gamecock Delta ATCAA	FL 180 to FL220	F-16C	4,077	83
RobRoy	100 AGL to 22,000 MSL	F-16C	4,077	83
W-161A	Surface to 50,000 MSL	F-16C	4,082	83

Table 3-6 Existing Shaw Air Force Base Annual Aircraft Operations in Special Use Airspace

Airspace	Altitude Range (feet)	Aircraft	Airspace Operations	
			Daytime (0700-2200 hours)	Nighttime (2200-0700 hours)
W-161B	Surface to 50,000 MSL	F-16C	4,082	83
W-177A	Surface to 50,000 MSL	F-16C	4,133	84
W-177B	Surface to 50,000 MSL	F-16C	4,133	84

Notes:
Sorties may fly on multiple special use airspace such that total airspace operations are greater than total sorties.
AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; FL = flight level; MOA = Military Operations Area; MSL = mean sea level

Table 3-7 Existing Noise Levels in Special Use Airspace

Airspace	Floor	Ceiling	Baseline	
	feet MSL (unless otherwise noted)		L_{dnmr} (dBA)	L_{dn} (dBA)
Bulldog Alpha MOA	500 AGL	9,999	< 45	< 45
Bulldog Bravo MOA	11,000	18,000	< 45	< 45
Bulldog Bravo ATCAA	18,000	FL 270	45	45
Bulldog Charlie MOA	500 AGL	9,999	49	49
Bulldog Delta MOA	500 AGL	17,000	50	50
Bulldog Echo MOA	5,000	9,999	50	50
Gamecock Bravo MOA	10,000	FL 180	45	45
Gamecock Charlie MOA	100 AGL	10,000	50	50
Gamecock Delta MOA	100 AGL	28,000	< 45	< 45
Gamecock Delta ATCAA	12,000	FL 180	< 45	< 45
RobRoy	100 AGL	22,000	53	53
W-161A	Surface	50,000	< 45	< 45
W-161B	Surface	50,000	< 45	< 45
W-177A	Surface	50,000	< 45	< 45
W-177B	Surface	50,000	< 45	< 45

Notes:
AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; dBA = A-weighted decibels; FL = flight level; L_{dn} = day-night average sound level; L_{dnmr} = onset-rate adjusted day-night average sound level; MOA = Military Operations Area; MSL = mean sea level

Under the existing operating conditions (**Table 3-6**), the cumulative sonic boom C-weighted DNL exposure do not exceed 57-decibel C-weighted DNL under W-161A or W-177A.

Single event sonic boom levels estimated for existing supersonic flights in W-161A and W-177A are shown in **Table 3-8**. Overpressure (psf) and C-weighted sound exposure level (decibels) were estimated directly under the flight path for the F-16C at Mach 1.2 at various altitudes. Overpressure levels estimated for W-161A and W-177A range from 1.8 to 0.9 psf depending on flight conditions.

Table 3-8 Existing Sonic Boom Levels for Based Aircraft in Special Use Airspace

Aircraft	Altitude (feet above mean sea level)			
	25,000	30,000	40,000	50,000
Mach 1.2				
Overpressure (pounds per square foot)				
F-16C	1.8	1.5	1.1	0.9
CSEL (decibels)				
F-16C	106.6	105.0	102.7	100.9

Notes:
CSEL = C-weighted sound exposure level – sound exposure level with frequency weighting that places more emphasis on low frequencies below 1,000 hertz

3.4.4 Environmental Consequences Evaluation Criteria

Noise analysis typically evaluates potential changes to existing noise environments that would result from implementation of the Proposed Action. In accordance with Air Force Handbook 32-7084, 65 dBA DNL is the noise level below which generally all land uses are compatible with noise from aircraft operations. Areas below 65 dBA DNL can also experience levels of appreciable noise depending upon training intensity or weather conditions. A DNL increase of greater than 3 dBA would be clearly noticeable and may increase human annoyance. In addition, DNL noise contours may vary from year to year due to fluctuations in operational tempo because of unit deployments, funding levels, and other factors.

Potential changes in the noise environment can be beneficial (i.e., if they reduce the number of sensitive receptors exposed to unacceptable noise levels), negligible (i.e., if the total area exposed to unacceptable noise levels is essentially unchanged), or adverse (i.e., if they result in increased noise exposure to unacceptable noise levels). Projected noise impacts were evaluated for the Proposed Action. Noise impacts from the Proposed Action are summarized in **Table 3-9** and described in additional detail in the following sections.

Noise impacts on land use are discussed in **Section 3.8**.

Table 3-9 Summary of Noise Impacts

Alternative	Change in Noise
Alternative 1	**High Noise Scenario:** **Shaw AFB** – Significant noise increases at 3 POIs (W2, W5, and W7) where the DNL would increase by 3 dBA or more and result in a DNL above 65 dBA; long-term, likely noticeable, but minor and less than significant increases at 5 POIs where the DNL would increase by 3 dBA or more but would remain below 65 dBA (R1, R2, S1, S4, and W3); and likely unnoticeable, negligible, and less than significant increases of 1 to 2 dBA at the remaining 12 POIs. **SUA** – Long-term, likely unnoticeable noise increases of up to 1 dBA (L_{dnmr} and L_{dn}) from additional contract ADAIR subsonic flight operations including all Shaw SUA. Negligible increase in supersonic flight operations.
	Medium Noise Scenario: **Shaw AFB** – DNL would marginally increase (by 1 to 2 dBA) at 13 of the 20 POIs; no or less than 0.5-dBA change [1] in DNL at the remaining 7 POIs. All increases at POIs and the areas surrounding the airfield would be long-term, likely unnoticeable, and less than significant under the Medium Noise Scenario. **SUA** – Long-term, likely unnoticeable noise increase of up to 1 dBA (L_{dnmr} and L_{dn}) from additional contract ADAIR subsonic flight operations in RobRoy; otherwise, noise levels would be identical to existing conditions for all other Shaw SUA. Minor increase in supersonic flight operations.

Table 3-9 Summary of Noise Impacts

Alternative	Change in Noise
	Low Noise Scenario: **Shaw AFB** – DNL would increase at one POI (R2) by 5 dBA; while this increase would be long-term and likely noticeable, the DNL at this POI would remain well below 65 dBA and would therefore be minor and less than significant. DNL at 17 of the 20 POIs would marginally increase by 1 to 2 dBA; while long-term, these increases would likely be unnoticeable and therefore, negligible and less than significant. No or minor increases less than .05 dBA would occur at two POIs (POI2 and W1) [1] and would have no impacts. **SUA** – No change to subsonic operation noise levels compared with existing conditions (with the exception of an increase of 1 dBA (L_{dnmr} and L_{dn}) in RobRoy. Same result for supersonic operations as noted for the Alternative 1 Medium Noise Scenario.
No Action Alternative	None

Notes:
[1] Minor increases in DNL of less than 0.5 dBA are reported as no change.
ADAIR = adversary air; AFB = Air Force Base; dBA = A-weighted decibel(s); DNL = day-night average sound level; POI = point of interest; SUA = special use airspace

3.4.5 Environmental Consequences – Alternative 1

The types of aircraft that would be used by contract ADAIR are not currently known. Therefore, three aircraft noise scenarios were evaluated (High, Medium, and Low) to represent the range of aircraft types that could be selected. The aircraft proposed for use by contract ADAIR and the surrogate aircraft modeled for the High, Medium, and Low Noise Scenarios are listed in **Table 3-10**.

To model changes in noise relative to the baseline conditions, all modeled contract ADAIR flight and engine run-up operations were set to the ADAIR aircraft listed in **Table 3-10** for the appropriate scenario. For example, when looking at the High Noise Scenario, all contract ADAIR operations are modeled as Eurofighter Typhoon operations; however, the NOISEMAP database does not contain noise data for the Eurofighter Typhoon, so an appropriate noise modeling surrogate was selected, the F-18E/F in this case. The noise modeling surrogates for various aircraft listed in **Table 3-10** have been approved for use by the Air Force Civil Engineer Center NEPA Division and Noise and Air Installation Compatible Use Zone Division. Flight profiles for contract ADAIR (i.e., schedules of altitude, power setting, and airspeed along each flight track) were reviewed and approved by the operators at Shaw AFB and Air Combat Command. Representative flight profiles for the various contract ADAIR scenarios are provided in **Appendix C.2**. All contract ADAIR departure profiles were modeled using afterburner or the maximum possible power on all takeoffs. The modeling represents the loudest noise levels for this class of surrogate aircraft and engine types that would be experienced as a result of the Proposed Action.

Table 3-10 Contract Adversary Air Noise Scenarios

Scenario	Adversary Air Aircraft	Surrogate Aircraft
High Noise Scenario	Eurofighter Typhoon	F-18E/F
Medium Noise Scenario	Dassault Mirage	F-16C
Low Noise Scenario	JAS 39 Gripen	F-16A

3.4.5.1 Shaw Air Force Base

High Noise Scenario

Implementation of the Proposed Action High Noise Scenario would result in an approximately 14 percent increase in the number of aircraft operations at Shaw AFB. Contract ADAIR would fly approximately 2 percent of the estimated 3,500 sorties during environmental night hours of 10:00 pm to 7:00 am local time, when the effects of aircraft noise are accentuated. Contractor night sorties would be flown during the Shaw AFB approved flying window. Runway utilization, flight tracks, and flight track utilization for contract ADAIR aircraft would be similar to the existing F-16C aircraft operations at Shaw AFB. Proposed annual departure, arrival, and closed pattern aircraft operations at Shaw AFB with the addition of contract ADAIR are listed in **Table 3-11**. Contract ADAIR would also perform static run-up operations, such as pre- and postflight run-ups.

Table 3-11 Summary of Proposed High Noise Scenario Annual Aircraft Operations at Shaw Air Force Base

Aircraft	Departures		Arrivals		Closed Patterns and Interfacility [1]		Total Operations		
	Day	Night	Day	Night	Day	Night	Day	Night	Total
F-16C	16,230	0	15,323	907	17,153	0	48,706	907	49,613
Transient and Civilian	270	17	265	22	821	0	1,356	39	1,395
Contract Adversary Air	3,500	0	3,304	196	350	0	7,154	196	7,350
Total	**20,000**	**17**	**18,892**	**1,125**	**18,324**	**0**	**57,216**	**1,142**	**58,358**

Notes:
[1] F-16C operations include 15,274 closed patterns and 1,879 interfacility operations

DNL contours between 65 and 85 dBA for flight operations associated with the High Noise Scenario of Alternative 1 and representative POIs are shown on **Figure 3-2**.

The noise levels generated by contract ADAIR aircraft under the High Noise Scenario would increase the overall noise environment in the vicinity of Shaw AFB. A comparison of the High Noise Scenario DNL noise contours to those associated with existing conditions is depicted on **Figure 3-3**. The change in land area within High Noise Scenario noise contours from existing conditions is shown in **Table 3-12**.

Table 3-12 Land Area On and Around Shaw Air Force Base Within Day-Night Average Sound Level Noise Contours Associated With the High Noise Scenario

Noise Level (dBA DNL)	Area within Noise Contour (acres)		
	Existing	High Noise Scenario	Increase
> 65	8,599	14,915	6,316
> 70	4,493	6,914	2,421
> 75	2,481	3,274	793
> 80	1,279	1,665	386
> 85	665	784	119

Notes:
Area (on- and off-airfield property) was based off the NOISEMAP-modeled noise contours and used to calculate the amount of land within each noise contour. The amounts shown are cumulative (i.e., the acreage within the >85 dBA DNL contour is also within all the lower noise level contours).
dBA = A-weighted decibel; DNL = day-night average sound level

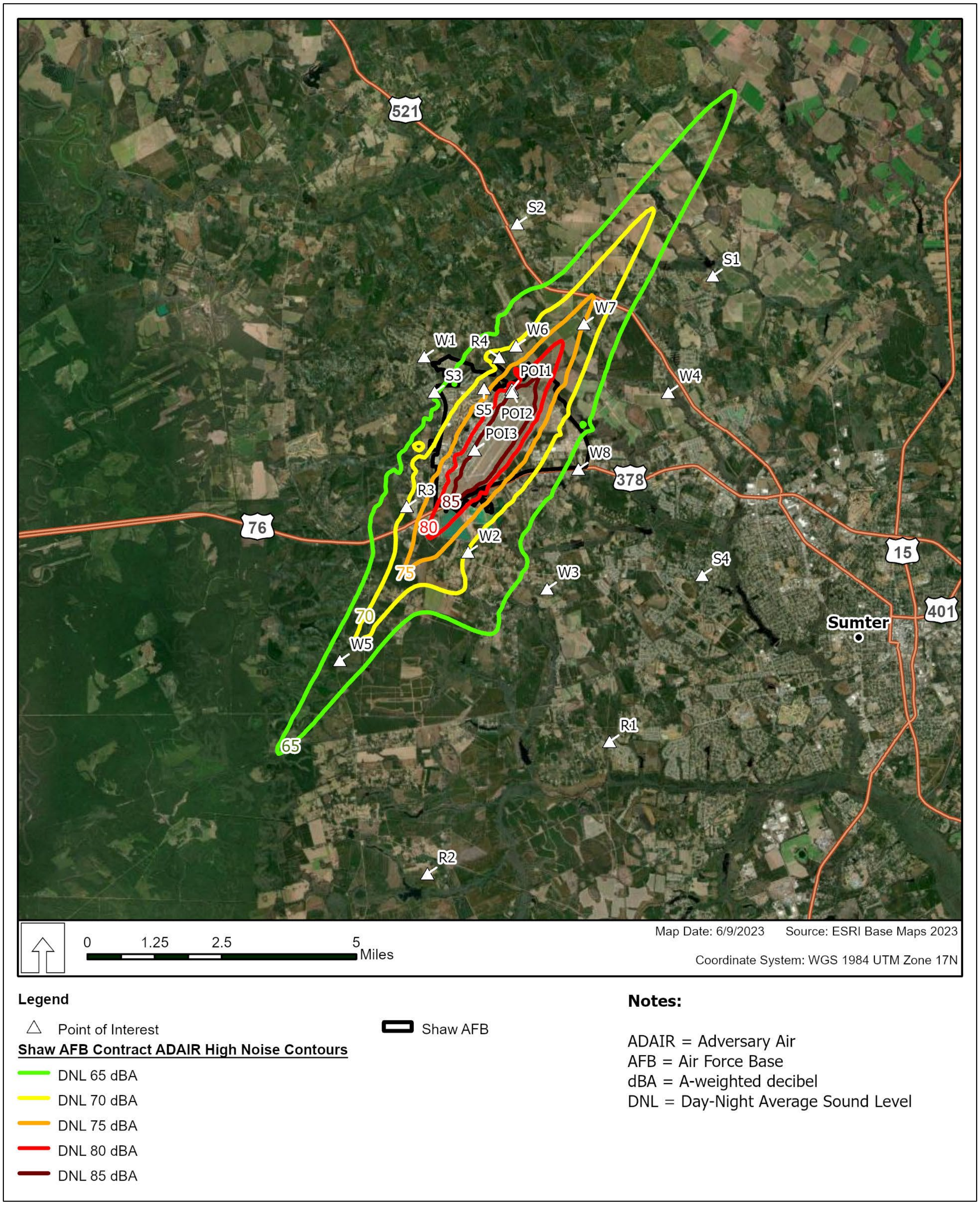

Figure 3-2 High Noise Scenario Day-Night Average Sound Level Contours at Shaw Air Force Base

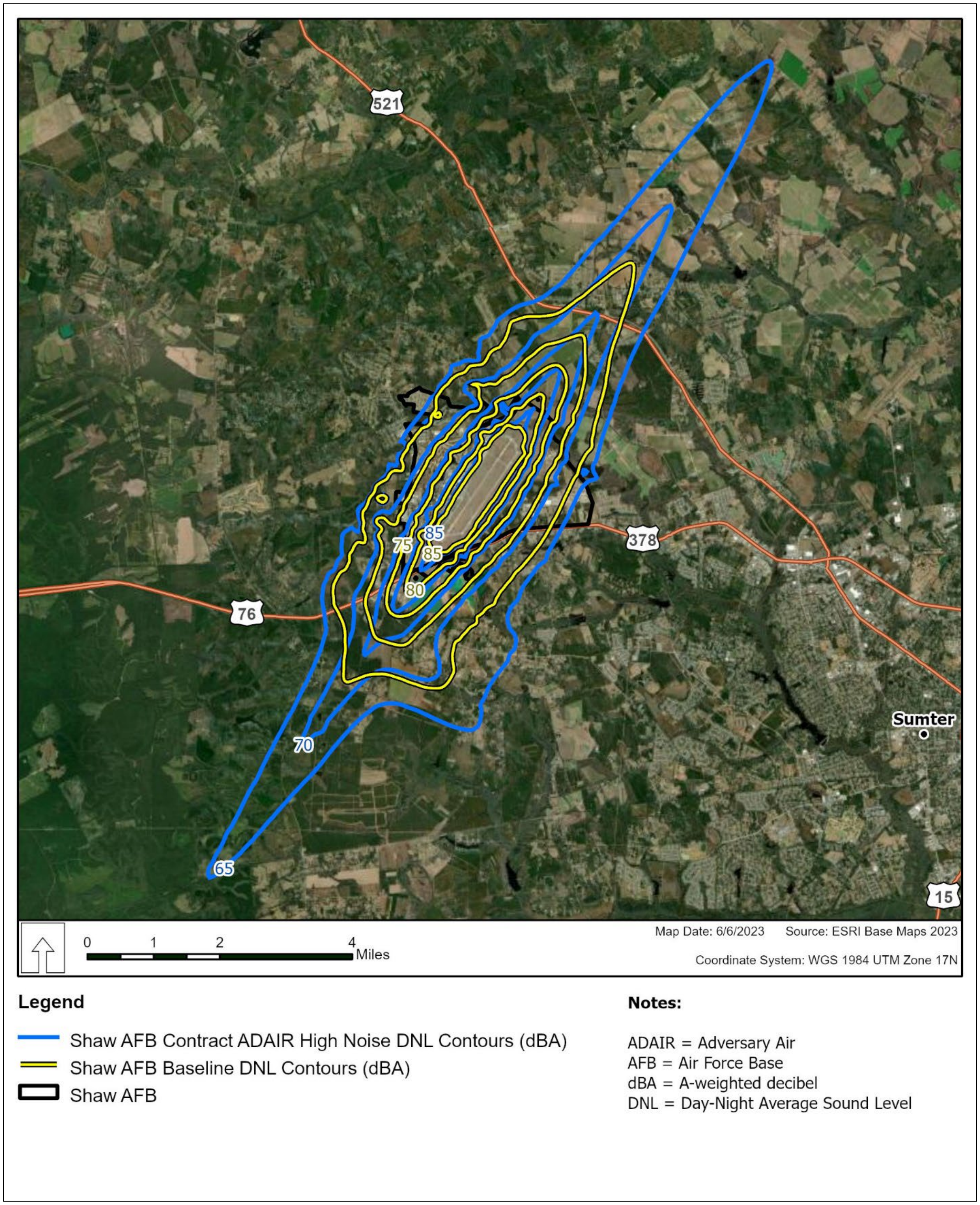

Figure 3-3 Comparison of High Noise Scenario and Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

Under the High Noise Scenario, the DNL would increase by 1 to 9 dBA at representative POIs on and around Shaw AFB (**Table 3-13**). These increases would be significant at three POIs within the existing 65 dBA DNL contour where the DNL would increase by 3 to 9 dBA (W2, W5, and W7). Although increases of 3 dBA or more at five POIs (R1, R2, S1, S4, and W3) would be long-term and likely noticeable, these POIs, would remain outside the 65 dBA DNL. Increases of 1 to 2 dBA at the other POIs (POI1, POI2, POI3, R3, R4, S2, S3, S5, W1, W4, W6, and W8) would be unnoticeable.

Table 3-13 Change in Day-Night Average Sound Level at Representative Points of Interest On and Near Shaw Air Force Base Under the High Noise Scenario

Points of Interest		DNL (dBA) [1]		
ID [2]	Description	Existing Conditions	High Noise Scenario	Increase in DNL
POI1	Building Near 1601 Patrol Road	82	83	1
POI2	Building Near 1601 Patrol Road	84	85	1
POI3	Near Shaw AFB Fire Department	84	86	2
R1	Residential on Willcroft Court	53	58	5
R2	Residential on Belles Mill Road (Wedgefield)	38	44	6
R3	Residential on Lost Creek Drive	68	70	2
R4	Residential on Solstice Drive (Dalzell)	70	71	1
S1	Ebenezer Middle School - 3440 Ebenezer Road	54	58	4
S2	Hillcrest Middle School - 4355 Peach Orchard Road (Dalzell)	53	55	2
S3	Oakland Primary School - 5415 Oakland Drive	63	64	1
S4	Wilson Hall - 520 Wilson Hall Road	50	53	3
S5	High Hills Elementary School - 4971 Frierson Road	72	74	2
W1	Long Branch Baptist Church - 2535 Peach Orchard Road (Dalzell)	59	60	1
W2	Victory Church - 5155 Patriot Parkway	67	70	3
W3	Lighthouse Baptist Church - 1130 North St. Pauls Church Road	58	62	4
W4	St. Mark Four Bridges Church - 2280 4 Bridges Road	54	56	2
W5	Lost Sheep Cavalry Ministries International - 1315 Highway 261 South (Wedgefield)	60	69	9
W6	Cross Bridge Christian Church - 2490 Sargent Road (Dalzell)	69	71	2
W7	Covenant Bible Church - 2805 Frierson Road (Dalzell)	70	75	5
W8	St. Luke AME Church - 2355 North St. Pauls Church Road	61	63	2

Notes:
[1] Points of Interest levels based on the NOISEMAP-modeled noise exposures.
[2] ID numbers correspond to numbers shown on **Figure 3-4**.
dBA = A-weighted decibel; DNL = day-night average sound level

Medium Noise Scenario

The operation numbers, day/night distribution, and runway utilization for the Medium Noise Scenario would be the same as those described above for the High Noise Scenario (see **Table 3-11**). DNL contours between 65 and 85 dBA for flight operations associated with the Medium Noise Scenario of Alternative 1 and representative POIs are shown on **Figure 3-4**.

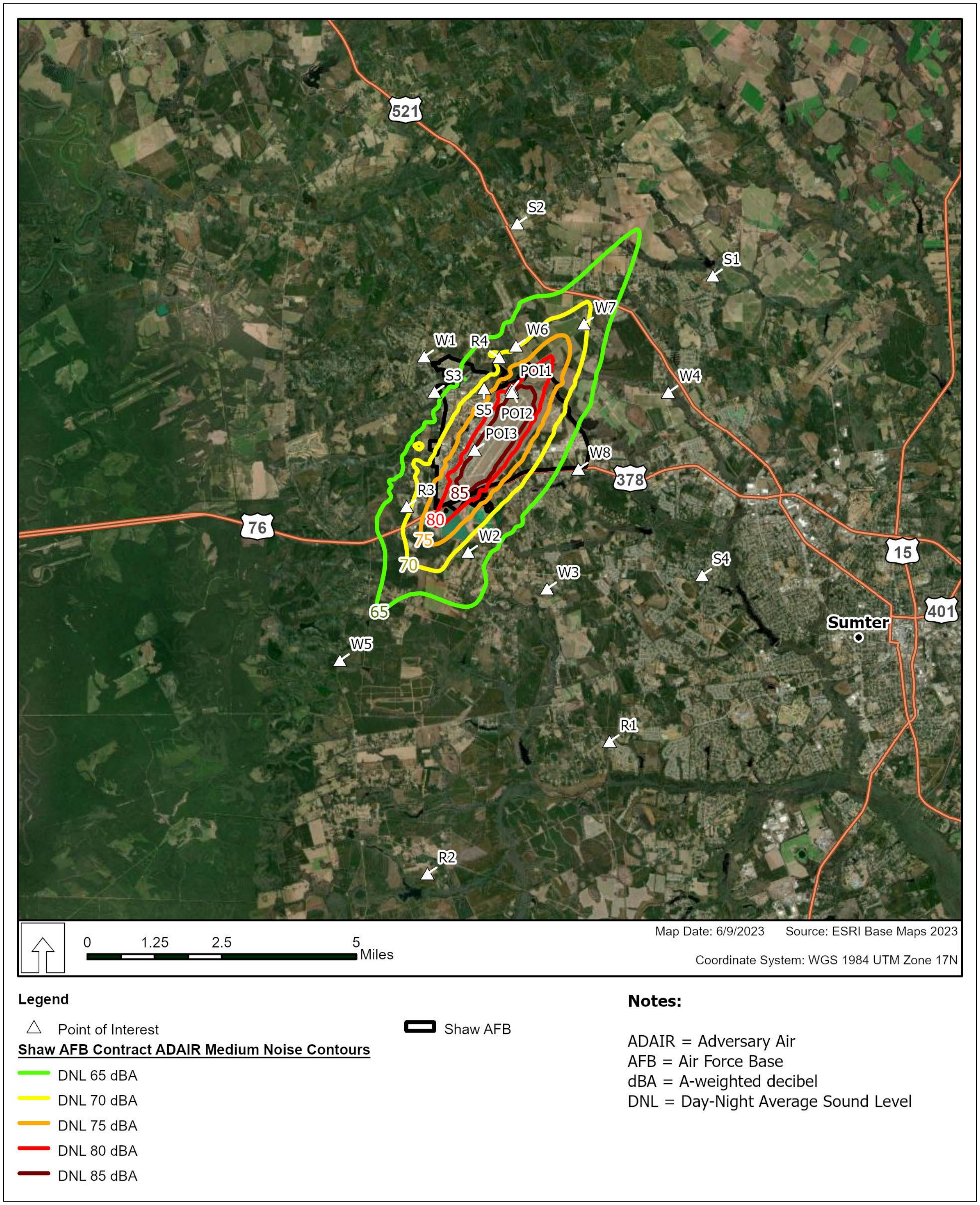

Figure 3-4 Medium Noise Scenario Day-Night Average Sound Level Contours at Shaw Air Force Base

Noise levels generated by contract ADAIR aircraft under the Medium Noise Scenario would marginally increase the overall noise environment in the vicinity of Shaw AFB. A comparison of the Medium Noise Scenario DNL noise contours to those of existing conditions is shown on **Figure 3-5**. The change in land area within the Medium Noise Scenario noise contours from existing conditions is shown in **Table 3-14**.

Table 3-14 Land Area On and Around Shaw Air Force Base Within Day-Night Average Sound Level Noise Contours Associated With the Medium Noise Scenario

Noise Level (DNL, dBA)	Area within Noise Contour (acres) [1]		
	Existing	Medium Noise Scenario	Increase
> 65	8,599	9,468	869
> 70	4,493	4,846	353
> 75	2,481	2,634	153
> 80	1,279	1,378	99
> 85	665	694	29

Notes:
[1] Area (on- and off-airfield property) was based off the NOISEMAP-modeled noise contours and used to calculate the amount of land within each noise contour. The amounts shown are cumulative (i.e., the acreage within the >85 dBA DNL contour is also within all the lower noise level contours).
dBA = A-weighted decibel; DNL = day-night average sound level

Under the Medium Noise Scenario, noise levels would marginally increase (by 1 to 2 dBA) at 13 of the 20 representative POIs (**Table 3-15**) (minor increases of less than 0.5 dBA are reported as no change). All increases in DNL at these POIs and surrounding areas would be long-term, likely unnoticeable, and less than significant under the Medium Noise Scenario.

Table 3-15 Change in Day-Night Average Sound Level at Representative Points of Interest On and Near Shaw Air Force Base Under the Medium Noise Scenario

Points of Interest		DNL (dBA) [1]		
ID [2]	Description	Existing Conditions	Medium Noise Scenario	Increase in DNL
POI1	Building Near 1601 Patrol Road	82	83	1
POI2	Building Near 1601 Patrol Road	84	84	0
POI3	Near Shaw AFB Fire Department	84	85	1
R1	Residential on Willcroft Court	53	55	2
R2	Residential on Belles Mill Road (Wedgefield)	38	39	1
R3	Residential on Lost Creek Drive	68	69	1
R4	Residential on Solstice Drive (Dalzell)	70	70	0
S1	Ebenezer Middle School - 3440 Ebenezer Road	54	55	1
S2	Hillcrest Middle School - 4355 Peach Orchard Road (Dalzell)	53	53	0
S3	Oakland Primary School - 5415 Oakland Drive	63	63	0
S4	Wilson Hall - 520 Wilson Hall Road	50	51	1
S5	High Hills Elementary School - 4971 Frierson Road	72	73	1
W1	Long Branch Baptist Church - 2535 Peach Orchard Road (Dalzell)	59	59	0
W2	Victory Church - 5155 Patriot Parkway	67	68	1
W3	Lighthouse Baptist Church - 1130 North St. Pauls Church Road	58	59	1

Table 3-15 Change in Day-Night Average Sound Level at Representative Points of Interest On and Near Shaw Air Force Base Under the Medium Noise Scenario

Points of Interest		DNL (dBA) [1]		
ID [2]	Description	Existing Conditions	Medium Noise Scenario	Increase in DNL
W4	St. Mark Four Bridges Church - 2280 4 Bridges Road	54	54	0
W5	Lost Sheep Cavalry Ministries International - 1315 Highway 261 South (Wedgefield)	60	62	2
W6	Cross Bridge Christian Church - 2490 Sargent Road (Dalzell)	69	70	1
W7	Covenant Bible Church - 2805 Frierson Road (Dalzell)	70	71	1
W8	St. Luke AME Church - 2355 North St. Pauls Church Road	61	62	1

Notes:

[1] Points of Interest levels based on the NOISEMAP-modeled noise exposures.
[2] ID numbers correspond to numbers shown on **Figure 3-6**.

dBA = A-weighted decibel; DNL = day-night average sound level; ID = identification

__Low Noise Scenario__

The operation numbers, day/night distribution, and runway utilization for the Low Noise Scenario would be the same as those described above for the High Noise Scenario (see **Table 3-11**). DNL contours between 65 and 85 dBA for flight operations associated with the Low Noise Scenario of Alternative 1 and representative POIs are shown on **Figure 3-6**.

Noise levels generated by contract ADAIR aircraft under the Low Noise Scenario would marginally increase the overall noise environment in the vicinity of Shaw AFB. A comparison of the Low Noise Scenario DNL contours to those of existing conditions is depicted on **Figure 3-7**. The change in land area within the Medium Noise Scenario DNL contours from existing conditions is shown in **Table 3-16**.

Table 3-16 Land Area On and Around Shaw Air Force Base Within Day-Night Average Sound Level Noise Contours Associated With the Low Noise Scenario

Noise Level (DNL, dBA)	Area within Noise Contour (acres)		
	Existing	Low Noise Scenario	Increase
> 65	8,599	9,700	1,101
> 70	4,493	4,990	497
> 75	2,481	2,711	230
> 80	1,279	1,427	148
> 85	665	708	43

Notes:

Area (on- and off-installation property) was based on the NOISEMAP-modeled noise contours and used to calculate the amount of land within each noise contour. The amounts shown are cumulative (i.e., the acreage within the >85 dBA DNL contour is also within all the lower noise level contours).

dBA = A-weighted decibel; DNL = day-night average sound level

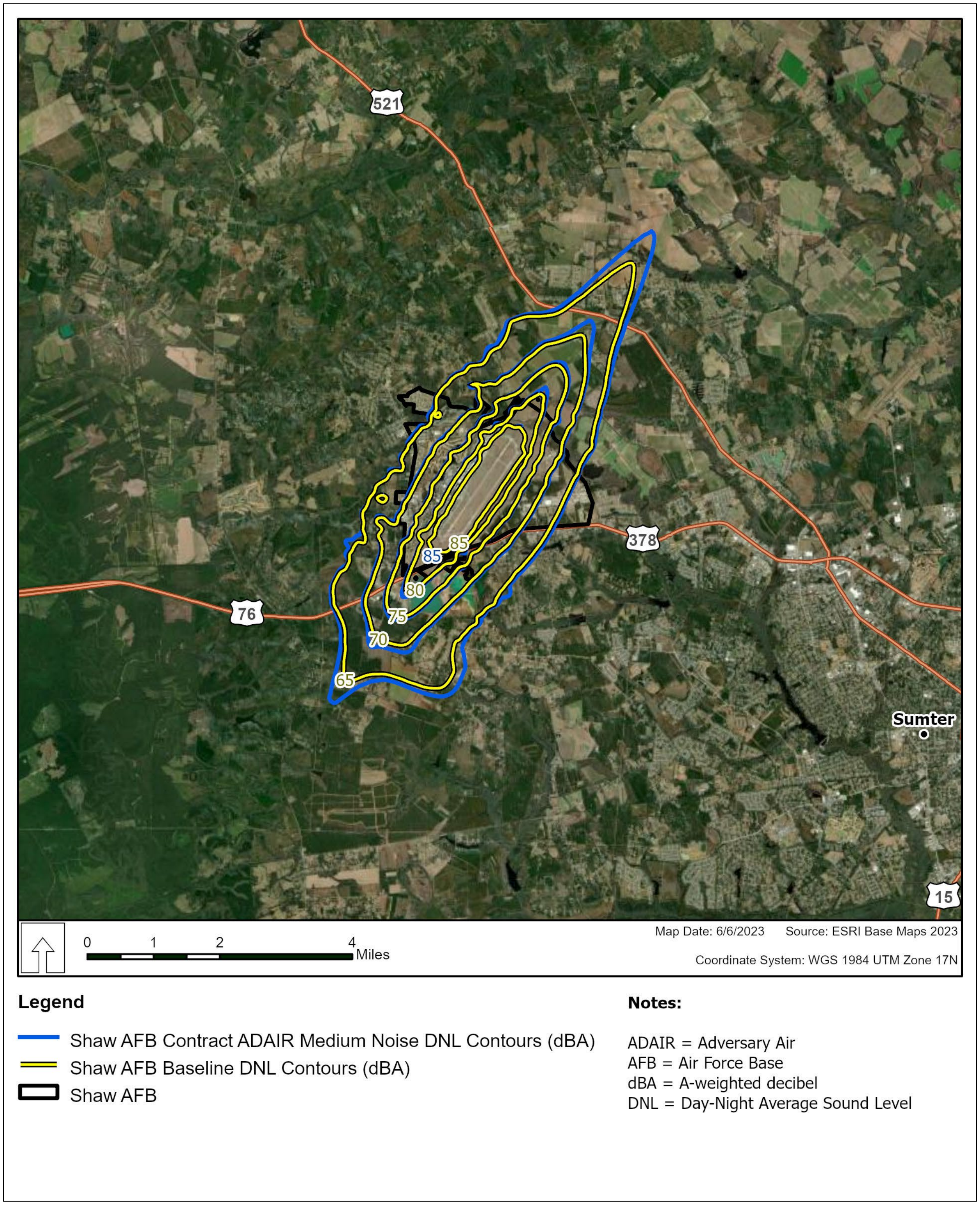

Figure 3-5 Comparison of Medium Noise Scenario and Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

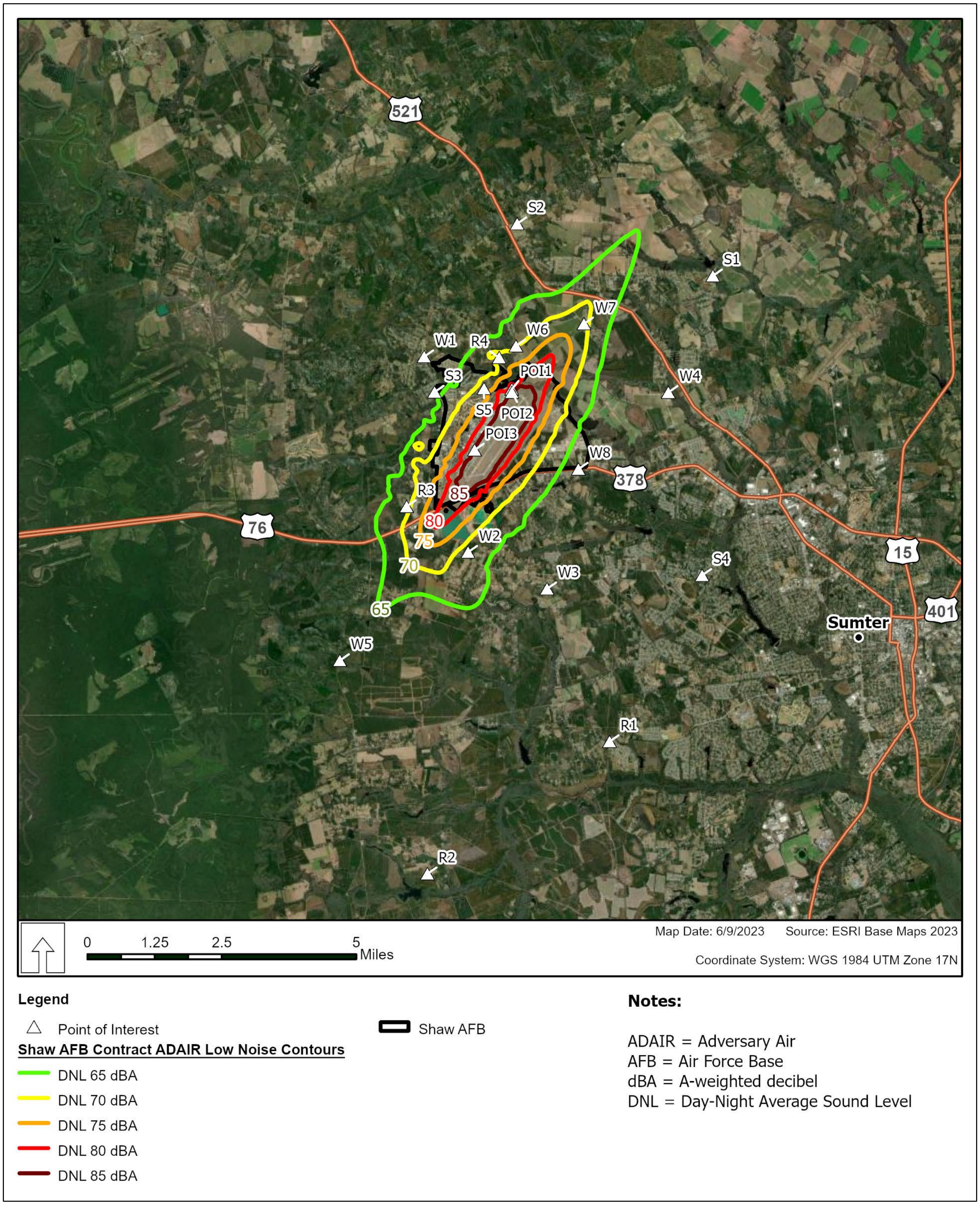

Figure 3-6 Low Noise Scenario Day-Night Average Sound Level Contours at Shaw Air Force Base

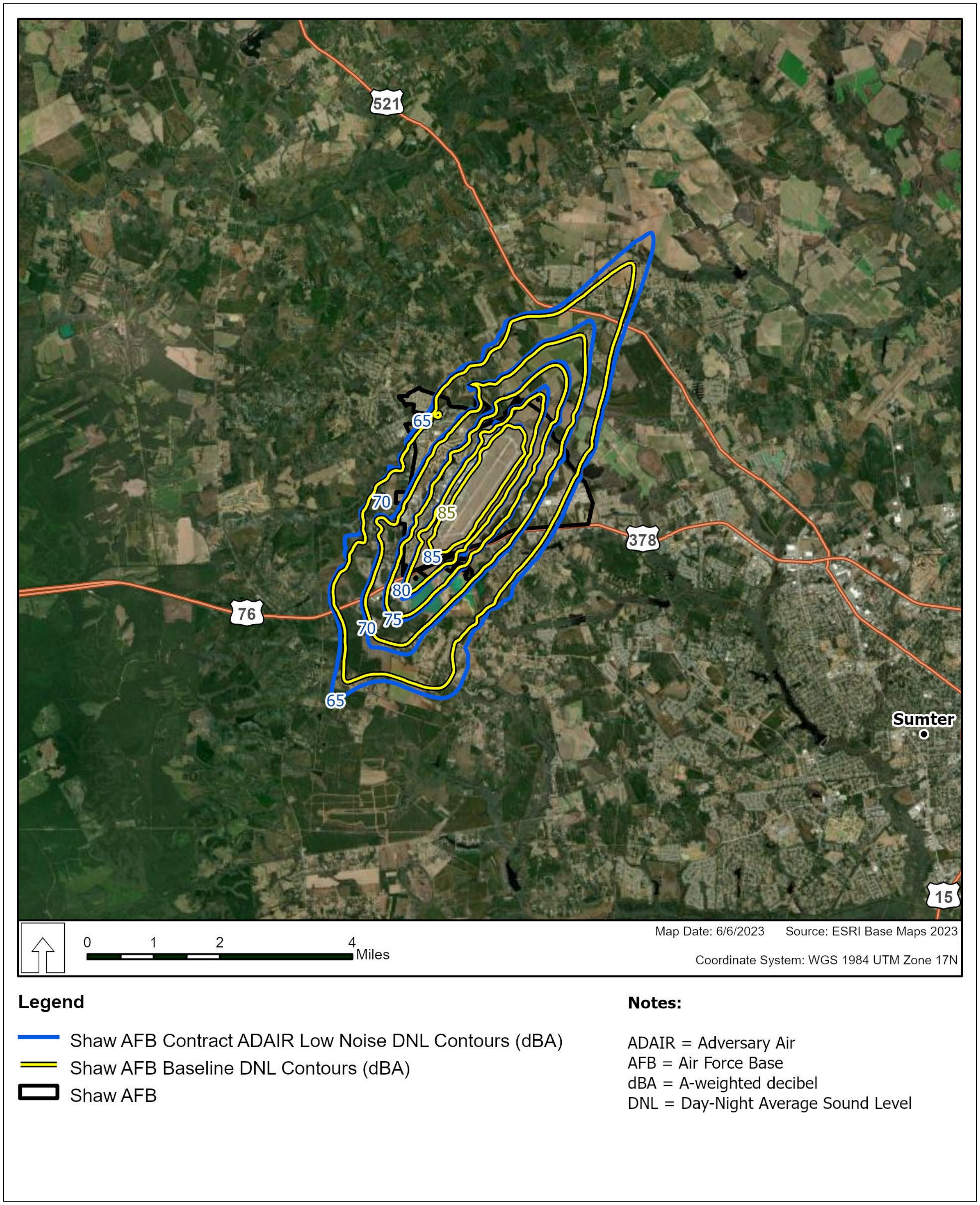

Figure 3-7 Comparison of Low Noise Scenario and Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

Under the Low Noise Scenario, noise levels would marginally increase (by 1 to 2 dBA) at 17 of the 20 representative POIs and increase by 5 dBA at 1 POI (R2) (**Table 3-17**). No or minor increases less than .05 dBA would occur at two POIs (POI2 and W1) (minor increases of less than 0.5 dBA are reported as no change). Although the 5-dBA increase at R2 would likely be noticeable, the DNL at this POI under the Low Noise Scenario would remain well below 65 dBA. While 1- to 2-dBA increases at 17 POIs would be long-term, they would likely be unnoticeable. Therefore, increases in DNL at the representative POIs and surrounding areas under the Low Noise Scenario would be negligible or minor and less than significant.

Table 3-17 Change in Day-Night Average Sound Level at Representative Points of Interest On and Near Shaw Air Force Base Under the Low Noise Scenario

Points of Interest		DNL (dBA)		
ID	Description	Existing Conditions	Low Noise Scenario	Increase in DNL
POI1	Building Near 1601 Patrol Road	82	83	1
POI2	Building Near 1601 Patrol Road	84	84	0
POI3	Near Shaw AFB Fire Department	84	85	1
R1	Residential on Willcroft Court	53	55	2
R2	Residential on Belles Mill Road (Wedgefield)	38	43	5
R3	Residential on Lost Creek Drive	68	69	1
R4	Residential on Solstice Drive (Dalzell)	70	71	1
S1	Ebenezer Middle School - 3440 Ebenezer Road	54	55	1
S2	Hillcrest Middle School - 4355 Peach Orchard Road (Dalzell)	53	54	1
S3	Oakland Primary School - 5415 Oakland Drive	63	64	1
S4	Wilson Hall - 520 Wilson Hall Road	50	51	1
S5	High Hills Elementary School - 4971 Frierson Road	72	73	1
W1	Long Branch Baptist Church - 2535 Peach Orchard Road (Dalzell)	59	59	0
W2	Victory Church - 5155 Patriot Parkway	67	68	1
W3	Lighthouse Baptist Church - 1130 North St. Pauls Church Road	58	59	1
W4	St. Mark Four Bridges Church - 2280 4 Bridges Road	54	55	1
W5	Lost Sheep Cavalry Ministries International - 1315 Highway 261 South (Wedgefield)	60	62	2
W6	Cross Bridge Christian Church - 2490 Sargent Road (Dalzell)	69	70	1
W7	Covenant Bible Church - 2805 Frierson Road (Dalzell)	70	71	1
W8	St. Luke AME Church - 2355 North St. Pauls Church Road	61	62	1

Notes:
Points of interest levels based on the combined AEDT- and NOISEMAP-modeled noise exposures.
dBA = A-weighted decibel; DNL = day-night average sound level; ID = identification

Note that the noise levels associated with the contract ADAIR Low Noise scenario would be slightly higher than those associated with the contract ADAIR Medium Noise scenario. Comparing the contract ADAIR Medium Noise surrogate (F-16C) with the contract ADAIR Low Noise surrogate (F-16A), the F-16C would generate more noise on approach and military power takeoffs than the F-16A, however the F-16A would generate more noise than the F-16C on afterburner takeoffs. Because the based aircraft and all contract ADAIR surrogates were modeled using afterburner takeoffs, the contract ADAIR Low Noise scenario noise levels would be slightly higher than the contract ADAIR Medium Noise scenario noise levels. Both cases show either no change or marginally higher noise levels than existing noise levels at Shaw AFB and would have less than significant impacts compared with existing conditions.

3.4.5.2 Special Use Airspace

Under the High, Medium, or Low Noise Scenarios, an estimated 3,500 annual contract ADAIR operations would occur in the Bulldog and Gamecock MOAs and associated ATCAA, RobRoy Airspace, W-161 and W-177, which are currently used by aircraft based at Shaw AFB. Proposed annual airspace operations by Shaw AFB F-16C aircraft and proposed contract ADAIR aircraft (see **Table 3-10**) under Alternative 1 are presented in **Table 3-18**.

Table 3-18 Proposed Shaw Air Force Base Annual Aircraft Operations in Special Use Airspace

Airspace	Altitude Range (feet)	Aircraft	Airspace Operations	
			Daytime (0700-2200 hours)	Nighttime (2200-0700 hours)
Bulldog Alpha MOA Bulldog Bravo MOA Bulldog Bravo ATCAA Bulldog Charlie MOA Bulldog Delta MOA Bulldog Echo MOA	500 AGL to 9,999 MSL 11,000 MSL to 18,000 MSL 18,000 MSL to FL 270 500 AGL to 9,999 MSL 500 AGL to 17,000 MSL 5,000 MSL to 9,999 MSL	F-16C	3,536	72
		Contract ADAIR	343	7
		Total	**3,879**	**79**
Gamecock Bravo MOA	10,000 MSL to FL 180	F-16C	0	0
		Contract ADAIR	0	0
		Total	**0**	**0**
Gamecock Charlie MOA Gamecock Delta MOA Gamecock Delta ATCAA RobRoy Airspace	100 AGL to 10,000 MSL 12,000 MSL to FL 180 FL 180 to FL220 100 AGL to 22,000 MSL	F-16C	4,077	83
		Contract ADAIR	343	7
		Total	**4,420**	**90**
W-161A W-161B	Surface to 50,000 MSL	F-16C	4,082	83
		Contract ADAIR	2744	56
		Total	**6,826**	**139**
W-177A W-177B	Surface to 50,000 MSL	F-16C	4,133	84
		Contract ADAIR	2744	56
		Total	**6,877**	**140**

Notes:
Sorties may fly in multiple special use airspace such that total airspace operations are greater than total sorties.
ADAIR = adversary air; AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; FL = flight level; MOA = Military Operations Area; MSL = mean sea level

Noise analysis of the High, Medium, and Low Noise Scenarios was conducted to analyze changes to noise levels in the SUA from the proposed aircraft operations listed in **Table 3-18**. **Table 3-19** shows that under the High Noise Scenario, the SUA noise levels would be no more than 1 dBA higher than existing conditions. **Table 3-20** and **Table 3-21** show that under the Medium and Low Noise Scenarios, respectively, noise levels would be identical to existing noise levels (one exception being a 1 dBA increase in the RobRoy Airspace for the Medium Noise Scenario). As a result, there would be no significant impacts under the High, Medium, or Low Noise Scenarios of the Proposed Action.

Table 3-19 Proposed ADAIR High Noise Scenario Noise Levels in Special Use Airspace

Airspace	Floor	Ceiling	Existing Noise Levels		Proposed Action Noise Levels (High Noise Scenario)		Change
	feet MSL (unless otherwise noted)		L_{dnmr} (dBA)	L_{dn} (dBA)	L_{dnmr} (dBA)	L_{dn} (dBA)	(dBA)
Bulldog Alpha MOA	500 AGL	9,999	< 45	< 45	< 45	< 45	0
Bulldog Bravo MOA	11,000	18,000	< 45	< 45	< 45	< 45	0
Bulldog Bravo ATCAA	18,000	FL 270	45	45	45	45	0
Bulldog Charlie MOA	500 AGL	9,999	49	49	50	50	1
Bulldog Delta MOA	500 AGL	17,000	50	50	51	51	1
Bulldog Echo MOA	5,000	9,999	50	50	51	51	1
Gamecock Bravo MOA	10,000	FL 180	45	45	45	45	0
Gamecock Charlie MOA	100 AGL	10,000	50	50	51	51	1
Gamecock Delta MOA	100 AGL	28,000	< 45	< 45	< 45	< 45	0
Gamecock Delta ATCAA	12,000	FL 180	< 45	< 45	< 45	< 45	0
RobRoy	100 AGL	22,000	53	53	54	54	1
W-161A	Surface	50,000	< 45	< 45	< 45	< 45	0
W-161B	Surface	50,000	< 45	< 45	< 45	< 45	0
W-177A	Surface	50,000	< 45	< 45	< 45	< 45	0
W-177B	Surface	50,000	< 45	< 45	< 45	< 45	0

Notes:

AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; dBA = A-weighted decibels; FL = flight level; L_{dn} = day-night average sound level; L_{dnmr} = onset-rate adjusted day-night average sound level; MOA = Military Operations Area; MSL = mean sea level

Table 3-20 Proposed ADAIR Medium Noise Scenario Noise Levels in Special Use Airspace

Airspace	Floor	Ceiling	Existing Noise Levels		Proposed Action Noise Levels (Medium Noise Scenario)		Change
	feet MSL (unless otherwise noted)		L_{dnmr} (dBA)	L_{dn} (dBA)	L_{dnmr} (dBA)	L_{dn} (dBA)	(dBA)
Bulldog Alpha MOA	500 AGL	9,999	< 45	< 45	< 45	< 45	0
Bulldog Bravo MOA	11,000	18,000	< 45	< 45	< 45	< 45	0
Bulldog Bravo ATCAA	18,000	FL 270	45	45	45	45	0
Bulldog Charlie MOA	500 AGL	9,999	49	49	49	49	0
Bulldog Delta MOA	500 AGL	17,000	50	50	50	50	0
Bulldog Echo MOA	5,000	9,999	50	50	50	50	0
Gamecock Bravo MOA	10,000	FL 180	45	45	45	45	0
Gamecock Charlie MOA	100 AGL	10,000	50	50	50	50	0
Gamecock Delta MOA	100 AGL	28,000	< 45	< 45	< 45	< 45	0
Gamecock Delta ATCAA	12,000	FL 180	< 45	< 45	< 45	< 45	0
RobRoy	100 AGL	22,000	53	53	54	54	1

Table 3-20 Proposed ADAIR Medium Noise Scenario Noise Levels in Special Use Airspace

Airspace	Floor	Ceiling	Existing Noise Levels		Proposed Action Noise Levels (Medium Noise Scenario)		Change
	feet MSL (unless otherwise noted)		L_{dnmr} (dBA)	L_{dn} (dBA)	L_{dnmr} (dBA)	L_{dn} (dBA)	(dBA)
W-161A	Surface	50,000	< 45	< 45	< 45	< 45	0
W-161B	Surface	50,000	< 45	< 45	< 45	< 45	0
W-177A	Surface	50,000	< 45	< 45	< 45	< 45	0
W-177B	Surface	50,000	< 45	< 45	< 45	< 45	0

Notes:

AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; dBA = A-weighted decibels; FL = flight level; L_{dn} = day-night average sound level; L_{dnmr} = onset-rate adjusted day-night average sound level; MOA = Military Operations Area; MSL = mean sea level

Table 3-21 Proposed ADAIR Low Noise Scenario Noise Levels in Special Use Airspace

Airspace	Floor	Ceiling	Existing Noise Levels		Proposed Action Noise Levels (Low Noise Scenario)		Change
	feet MSL (unless otherwise noted)		L_{dnmr} (dBA)	L_{dn} (dBA)	L_{dnmr} (dBA)	L_{dn} (dBA)	(dBA)
Bulldog Alpha MOA	500 AGL	9,999	< 45	< 45	< 45	< 45	0
Bulldog Bravo MOA	11,000	18,000	< 45	< 45	< 45	< 45	0
Bulldog Bravo ATCAA	18,000	FL 270	45	45	45	45	0
Bulldog Charlie MOA	500 AGL	9,999	49	49	49	49	0
Bulldog Delta MOA	500 AGL	17,000	50	50	50	50	0
Bulldog Echo MOA	5,000	9,999	50	50	50	50	0
Gamecock Bravo MOA	10,000	FL 180	45	45	45	45	0
Gamecock Charlie MOA	100 AGL	10,000	50	50	50	50	0
Gamecock Delta MOA	100 AGL	28,000	< 45	< 45	< 45	< 45	0
Gamecock Delta ATCAA	12,000	FL 180	< 45	< 45	< 45	< 45	0
RobRoy	100 AGL	22,000	53	53	53	53	0
W-161A	Surface	50,000	< 45	< 45	< 45	< 45	0
W-161B	Surface	50,000	< 45	< 45	< 45	< 45	0
W-177A	Surface	50,000	< 45	< 45	< 45	< 45	0
W-177B	Surface	50,000	< 45	< 45	< 45	< 45	0

Notes:

AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; dBA = A-weighted decibels; FL = flight level; L_{dn} = day-night average sound level; L_{dnmr} = onset-rate adjusted day-night average sound level; MOA = Military Operations Area; MSL = mean sea level

Single event sonic boom levels were estimated, using the PCBoom program, directly undertrack for contract ADAIR supersonic flights in W-161A and W-177A (**Table 3-22**). Overpressure and C-weighted sound exposure levels for the proposed contract ADAIR supersonic aircraft are shown for comparison with the F-16C at Mach 1.2 at various altitudes.

The sonic boom levels listed in **Table 3-22** are the loudest levels computed at the center of the footprint for level flight conditions at Mach 1.2 and the altitudes indicated. Supersonic flights are authorized in all areas of W-161 and W-177 above 10,000 ft MSL and 15 NM (approximately 17.3 statute miles) or more from land (see **Figure 2-1**). Airspace sorties require aircraft to exceed Mach 1.0 (supersonic) for brief periods of time for approximately 10 percent of total flight time. This is equivalent to less than 5 minutes of supersonic flight activity per sortie. The location of these sonic booms would vary with changing flight paths and weather conditions, so it would be unlikely that any given location would experience these undertrack levels more than once over multiple events.

Table 3-22 Special Use Airspace Sonic Boom Levels Undertrack for Based and Adversary Air Aircraft in Level Flight at Mach 1.2

Aircraft	Altitude (feet above mean sea level)			
	25,000	30,000	40,000	50,000
Mach 1.2				
Overpressure (pounds per square foot)				
F-16C	1.8	1.5	1.1	0.9
Eurofighter Typhoon	2.2	1.8	1.4	1.2
Dassault Mirage	1.8	1.5	1.1	0.9
JAS 39 Gripen	1.8	1.5	1.1	0.9
CSEL (decibels)				
F-16C	106.6	105.0	102.7	100.9
Eurofighter Typhoon	108.4	106.8	104.7	103.3
Dassault Mirage	106.6	105.0	102.7	100.9
JAS 39 Gripen	106.6	105.0	102.7	100.9

Notes:
CSEL = C-weighted sound exposure level – sound exposure level with frequency weighting that places more emphasis on low frequencies below 1,000 hertz

Overpressure levels, directly under the flight path, estimated for W-161A and W-177A would range from 2.2 to 0.9 psf depending on flight conditions. Public reaction may occur with overpressures above 1 psf, and in rare instances, damage to structures have occurred at overpressures between 2 and 5 psf (National Aeronautics and Space Administration [NASA], 2017). All supersonic flight paths in W-161A and W-177A would occur over open waters of the Atlantic Ocean where no permanent human-occupied structures are present. Therefore, while the number of sonic booms would likely increase from proposed contract ADAIR aircraft operating in the Warning Areas under the Proposed Action, it is anticipated that potential impacts associated with these additional sonic booms would be negligible.

3.4.6 Environmental Consequences – Alternative 2

Proposed aircraft operations under Alternative 2 would be the same as those described for Alternative 1. Therefore, impacts from noise under the Alternative 2 High, Medium, and Low noise scenarios would be the same as those that would occur under Alternative 1.

3.4.7 Environmental Consequences – No Action Alternative

Under the No Action Alternative, contract ADAIR operations would not occur at Shaw AFB or in the Bulldog and Gamecock MOAs and associated ATCAA, the RobRoy Airspace, or W-161 and W-177. The No Action Alternative would have no effect on the noise environment at Shaw AFB or in those SUA.

3.4.8 Cumulative Impacts

The Proposed Action, in addition to reasonably foreseeable future actions at Shaw AFB, would not result in cumulative impacts greater than those described for Alternative 1.

3.5 SAFETY

3.5.1 Definition of the Resource

This section addresses safety with respect to aircraft ground support and maintenance activities; the handling, use, and storage of explosives, munitions, and ordnance; and flight operations. Occupational safety includes safety considerations associated with ground operations and maintenance activities that support military flight operations including jet blast/maintenance testing and also considers the safety of personnel and facilities on the ground that may be placed at risk from flight operations in the vicinity of the airfield and in the airspace. Safety zones on the installation, which include Clear Zones and Quantity-Distance (Q-D) arcs, restrict the public's exposure to areas where there is a higher potential for aircraft accidents and inadvertent detonations of ordnance or other explosive materials, respectively. Although ground and flight safety are addressed separately, risks associated with safety-of-flight issues and occupational safety concerns are interrelated in the immediate vicinity of the airfield's runways.

Explosives safety relates to the management and safe use of ordnance and munitions. Flight safety considers aircraft flight risks such as midair collision, bird/wildlife-aircraft strike hazard (BASH), and in-flight emergencies. Basic airmanship procedures for handling deviations to Air Traffic Control (ATC) procedures due to an in-flight emergency are defined in Air Force Manual (AFMAN) 11- 202, V3, *Flight Operations*, and established aircraft flight manuals.

3.5.2 Existing Conditions – Shaw Air Force Base

3.5.2.1 Occupational Safety

Occupational safety includes safety considerations associated with ground and industrial operations, operational activities, and motor vehicle use. Ground accidents can occur from the use of equipment or materials and maintenance functions. Day-to-day operations and maintenance activities conducted by the 20 FW are performed in accordance with applicable DAF safety regulations, published Air Force Technical Orders, and Air Force Occupational Safety and Health (AFOSH) requirements set forth in Department of Air Force Instruction (DAFI) 91-202, *The US Air Force Mishap Prevention Program*, and Department of Air Force Manual (DAFMAN) 91-203, *Air Force Occupational Safety, Fire and Health Standards*.

Emergency Response

Emergency response procedures for Shaw AFB mirror those of most other DAF installations and are similar to the procedures used in local civilian communities. The DAF provides emergency responders who are trained for specific types of accidents and incidents. For aircraft crash response, the DoD provides on-field Aircraft Crash Damaged or Disabled Aircraft Recovery (CDDAR) services. Civilian authorities and emergency responders are typically first on-scene at accidents involving DAF personnel and equipment occurring outside the installation boundary; once on-scene, the DAF provides an Incident Commander and command staff for site management, security, and safety investigation.

Safety Zones

Safety zones associated with Shaw AFB are shown on **Figure 3-8**. These zones are established in accordance with Unified Facilities Criteria (UFC) 3-260-01, *Airfield and Heliport Planning and Design* to restrict or minimize the development of incompatible land uses and reduce exposure to aircraft safety hazards. Safety zones associated with Shaw AFB include the Clear Zone (CZ), which covers a 3,000 ft-by-

3,000 ft area adjacent to each end of the installation's dual runways, and Accident Potential Zones (APZs) I and II, which linearly extend 5,000 ft and 7,000 ft, respectively, beyond the CZs.

The CZs are areas having the highest potential for aircraft accidents. Undeveloped open space and agricultural uses, excluding raising of livestock, are the only uses deemed compatible in a CZ. APZ I is an area of reduced accident potential, while APZ II is an area having the lowest accident potential of the three safety zones. Land uses such as residential development, educational facilities, and medical facilities are considered incompatible and are strongly discouraged within APZ I and APZ II.

Sumter County has designated Density Dispersion Zones on county-administered lands outside of Shaw AFB's boundaries. These zones linearly extend beyond APZ II at either end of Shaw AFB's runways (**Figure 3-8**) and are intended to regulate development density and address concerns regarding potential accidents involving aircraft operating at Shaw AFB. These zones are a planning and development tool implemented by Sumter County and are not official DoD airfield safety zones established by UFC 3-260-01.

The controlled movement area (CMA) is any portion of the airfield requiring aircraft, vehicles, and pedestrians to obtain specific ATC tower approval for access. The Shaw AFB CMA includes the runway, overrun areas, instrument landing system critical area (when active), and those portions of the airfield within 100 ft of the runway edge lights. All personnel must request permission from the airfield control tower to enter the CMA in accordance with applicable procedures. Any violations or movement in the CMA without permission poses a considerable risk to departing/arrival aircraft.

All personnel who, in the performance of their assigned duties, work in or travel through maintenance areas and flightline areas on Shaw AFB undergo Foreign Object Damage (FOD) awareness and prevention training. Tire-rollover inspections are conducted on all tires before entering the runway, taxiway, flightline, and parking ramps and at all designated FOD checkpoints. All vehicles transiting the flightline are cleaned of all loose debris before operation and are equipped with a foreign object removal tool. Maintenance personnel inspect aircraft cockpits and flight decks prior to flight and adhere to the "clean-as-you-go" discipline to ensure work areas are clear of FOD.

Arresting Gear Capability

Shaw AFB is equipped with approach and departure end Barrier Arresting Kit (BAK)-12A(B) (45 ft overrun) and BAK-12B(B) (1,457 ft overrun) systems on Runway 04L/22R. Similarly, Hook MB100(B) (75 ft overrun) and BAK-12B(B) (1,210 ft overrun) systems are in place on Runway 04R and BAK-12B(B) (1,221 ft overrun) and Hook MB100(B) (65 ft overrun) systems are in place on Runway 22L. Cable configuration varies based on the runways in use. Aircraft arresting systems at Shaw AFB are sited and maintained in accordance with requirements set forth in AFMAN 32-1040, *Civil Engineer Airfield Infrastructure Systems*.

3.5.2.2 Explosives Safety

The 20th Equipment Maintenance Squadron (20 EMS) provides munitions support to the 20 FW at Shaw AFB, including delivery and pickup, storage, inspection, maintenance, and accountability. In addition to defensive chaff and flares, aircraft munitions include ammunition, solid and liquid propellants, pyrotechnics, warheads, explosive devices, chemical agent substances, and associated components that present real or potential hazards to life, property, or the environment. Munitions at Shaw AFB are used, handled, stored, and managed in accordance with Defense Explosives Safety Regulation (DESR) 6055.09_AFMAN 91-201 (DAFGM2023-01), *Explosives Safety Standards*.

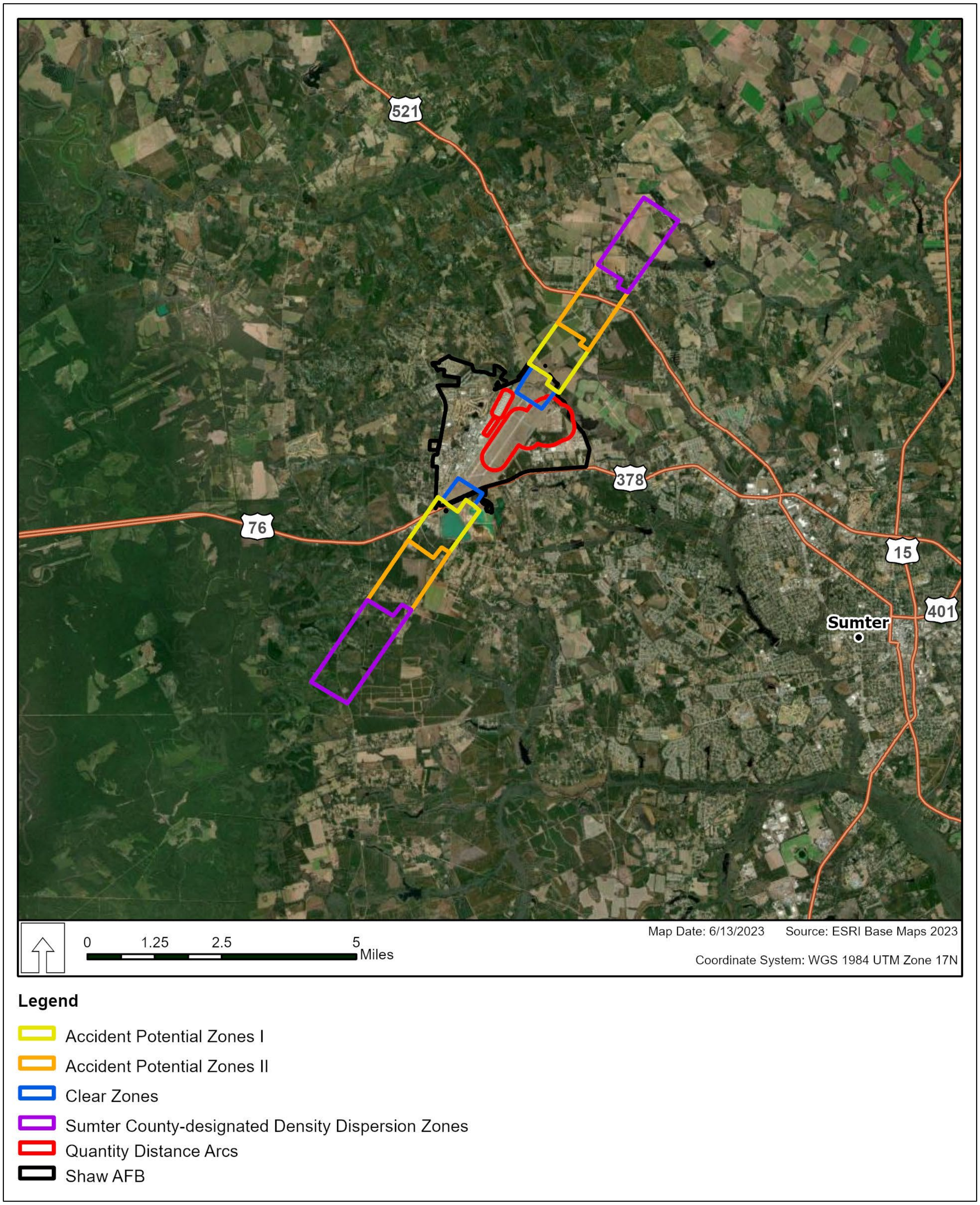

Figure 3-8 Safety Zones and Quantity-Distance Arcs at Shaw Air Force Base

The loading and unloading of aircraft munitions, including defensive chaff and flares, is authorized on the N Row at Shaw AFB in accordance with DESR 6055.09_AFMAN 91-201, provided that the quantity of munitions being loaded or unloaded is limited to a single aircraft load. The installation and removal of explosives necessary for safe flight operations, such as ejector seat propellants and emergency cockpit release explosives, is authorized in any aircraft parking spot on the airfield.

Q-D arcs are defined distances that are maintained between munitions storage areas and of other types of facilities on the installation to prevent or minimize risks to human life and property. These distances are determined by the type and quantity of explosive material being stored. Development within Q-D arcs is either prohibited altogether or limited to facilities and uses that are compatible with nearby explosives storage areas. Q-D arcs on Shaw AFB are shown on **Figure 3-8**.

3.5.2.3 Flight Safety

Shaw AFB has dual runways; Runway 04L/22R which is 10,021 ft long and 200 ft wide and Runway 04R/22L which is 8,014 ft long and 200 ft wide. One control tower, located east of the dual runways, manages aircraft flying within 5 miles of the base; when aircraft fly beyond this range, control is transferred to Shaw radar approach control. Additional personnel are typically scheduled to support wing flying exercises or airfield operations outside of published hours.

Aircraft mishaps and their prevention represent a paramount concern for the DAF. Five major categories of reportable mishaps (Class A, B, C, D, and E) are defined in DoD Instruction 6055.07 and DAFI 91-204, *Safety Investigations and Reports*, based on total cost of property damage or the degree of injury. Mishap types range from loss of life or destruction of an aircraft (Class A) to a minor, reportable injury or property damage less than $25,000 (Class E). Mishaps may result from mid-air collisions, collisions with man-made structures or terrain, mechanical failure, weather-related accidents, pilot error, BASH, FOD, CMA violations, or strikes from defensive countermeasures used during training.

Seven flight mishaps were recorded for Shaw AFB in fiscal year (FY) 2022. This equates to a Flight Mishap Rate of 60.94 per 100,000 flight hours (Shaw AFB, 2022b). One reportable mishap was recorded in FY 2021 and six mishaps were reported in FY 2020.

<u>Midair Collision</u>

Midair collision accidents involve two or more aircraft coming in contact with each other during flight. Factors such as navigation errors, miscommunications, deviations from flight plans, and lack of collision avoidance systems increase the potential for midair collisions. Midair collisions are reported and investigated in accordance with DAFI 91-204 and DAFMAN 91-223, *Safety: Aviation Safety Investigations and Reports*. Pilots and controllers are encouraged to file a Hazardous Air Traffic Report for hazardous or near-miss incidents that occur during flight.

<u>In-Flight Emergency</u>

Each aircraft type has specific emergency procedures based on the aircraft design; these procedures are provided by the aircraft manufacturer. Basic airmanship procedures defined in AFMAN 11-202 (Volume 3) and established aircraft flight manuals also address potential deviations to ATC procedures due to an in-flight emergency. Aircraft experiencing in-flight emergencies are given landing priority and met by emergency response services upon arrival.

<u>Bird/Wildlife-Aircraft Strike Hazards</u>

BASH events present safety concerns for aircraft operations because of the potential for damage to aircraft or injury to aircrews or local populations. Aircraft can encounter birds at nearly all altitudes up to 30,000 ft MSL; however, most birds fly close to the ground. Approximately 52 percent of bird-aircraft strikes at known altitudes occur with birds flying below 400 ft and 88 percent occur at less than 2,000 ft AGL (Air Force Safety Center, 2018).

The DAF BASH program was established to minimize the risk for collisions of birds/wildlife with aircraft and the subsequent loss of life and property. In accordance with DAFI 91-202, each DAF flying unit is required to develop a BASH Plan to reduce hazardous bird/wildlife activity relative to airfield flight operations. The intent of each plan is to reduce BASH issues at the airfield by creating an integrated hazard abatement program through monitoring, avoidance, and actively controlling bird and animal population movements.

Shaw AFB has developed and implemented a BASH Plan in accordance with DAFI 91-202. An assigned US Department of Agriculture (USDA) representative provides support to Shaw AFB to further lower the risk of potential BASH events at the airfield. In addition, Airfield Management and Flight Safety personnel continuously monitor the surrounding area for possible BASH concerns and wildlife harassment.

In the event of a wildlife strike, after receiving notification from Maintenance Operation Control or Airfield Management, Air Force Form 853, Air Force Wildlife Strike Report, is generated, and a sample is collected and mailed to the Smithsonian's Feather Identification Lab for identification. Shaw AFB aircraft experienced nine BASH events in FY 2022, of which three were damaging. In FY 2021, Shaw AFB aircraft experienced four BASH events, of which one was damaging. Wildlife management activities on the airfield in calendar year 2021, including wildlife hazards and recommendations for countering each hazard, are summarized in the Shaw AFB BASH Report (DAF, 2021).

3.5.3 Existing Conditions – Special Use Airspace

Safe, effective, and disciplined flying training operations are a critical priority for aircraft operating in the SUA used by Shaw AFB. Safety concerns associated with SUA flight activities include hazards associated with aircraft mishaps and accidents, bird/wildlife-aircraft strikes, munitions use, and obstructions to flight. Potential accidents could include midair collisions, collisions with terrain or manmade structures, BASH, weather-related accidents, mechanical failure, or pilot error. Hazards potentially present or occurring in the SUA used by Shaw AFB aircraft, and procedures to prevent or minimize their occurrence or severity, are similar to those occurring at Shaw AFB as described in **Section 3.5.2**.

3.5.4 Environmental Consequences Evaluation Criteria

Impacts from implementation of the Proposed Action are assessed according to the potential to increase or decrease safety risks to personnel, the public, property, or the environment. Adverse impacts on safety could include implementing contractor flight procedures that result in greater safety risk or constructing new buildings within established Q-D safety arcs. For the purposes of this EA, an impact is considered significant for the Proposed Action if the proposed safety measures are not consistent with AFOSH and Occupational Safety and Health Administration (OSHA) standards resulting in unacceptable safety risks.

In addition to all applicable DAF safety procedures and aircraft-specific emergency procedures based on the aircraft design, contract ADAIR personnel would adhere to the following DAF guidance throughout the Proposed Action:

- DCMA Instruction 8210-1D, *Contractor's Flight and Ground Operations*, 6 February 2023
- AFMAN 11-2FTV1, *Flying Operations, Flight Test Aircrew Training*, 26 February 2019
- AFMAN 11-2FTV2, *Flying Operations, Flight Test Aircrew Evaluation Criteria*, 21 March 2019
- AFMAN 11-2FTV3, *Flying Operations, Flight Test Operation Procedures*, 29 December 2020
- AFMAN 11-301V1, *Flying Operations, Aircrew Flight Equipment (AFE)*, 31 May 2023
- Air Force Instruction (AFI) 11-401 (ANG Supplement), *Flying Operations, Aviation Management*, 18 April 2017
- AFMAN 11-502, *Flying Operations, Small Unmanned Aircraft Systems*, 29 July 2019, and applicable Air Force Material Command supplements

3.5.5 Environmental Consequences – Alternative 1

Overall, Alternative 1 would have negligible long-term impacts on safety at Shaw AFB and in the Bulldog and Gamecock MOAs and associated ATCAA, RobRoy airspace, and W-161 and W-177. These impacts would not be significant. Potential effects on safety from Alternative 1 are further discussed in the following sections.

3.5.5.1 Shaw Air Force Base

Occupational Safety

Under the Proposed Action, limited contract ADAIR aircraft maintenance and testing would occur on the aircraft parking ramp or in the hangar. These activities would be similar to and consistent with aircraft maintenance activities currently occurring at Shaw AFB. No unique or unusual maintenance activities would be associated with the contract ADAIR aircraft. All scheduled depot-level or other heavy maintenance requirements would occur at off-base contractor facilities.

No significant impacts on occupational safety would be anticipated to occur under the Proposed Action provided the contractor establishes a CDDAR program and all applicable AFOSH and OSHA requirements are implemented.

Emergency Response

In the event of an emergency involving contract ADAIR aircraft at Shaw AFB, DAF emergency responders would provide the initial response. On-field aircraft CDDAR would be provided for crash response. Should an event occur off-base, civilian authorities with the city, county, or state would be first on scene. After the initial response, the contractor would be required to facilitate crash site security and clean-up. The contractor would be responsible to cooperate with the DAF or the National Transportation Safety Board (NTSB) investigation, depending upon circumstances of the incident.

The contractor emergency response would include the following:

- Establish a CDDAR program that is fully integrated into the host operating location's CDDAR program. The contractor would provide technical expertise and facilitate the host operating location's response and recovery capability of contractor-owned aircraft, consistent with the following considerations: (1) urgency to open the runway for operational use; (2) prevention of secondary damage to the aircraft; and (3) preservation of evidence for mishap or accident investigations in accordance with DAFI 91-202 and DAFI 91-204; NTSB guidelines; and any local operating location guidance, as applicable. The contractor would ensure the host operating location's CDDAR personnel receive familiarization training on contract ADAIR aircraft and procedures prior to commencing local flying operations, at permanent and temporary duty operating locations.
- The contractor would develop an egress/cockpit familiarization training program to ensure all host operating location's nonegress personnel (e.g., emergency response personnel, fire department, CDDAR) who may access contractor aircraft cockpits, equipped with egress systems, receive initial and annual refresher training.

No significant impacts on emergency response are anticipated to occur under the Proposed Action provided the contractor establishes a CDDAR program and all applicable AFOSH and OSHA requirements are implemented.

Safety Zones

The Proposed Action does not involve changes to CZs, APZ I, APZ II, or Sumter County-designated Density Dispersion Zones. This would have no effect on safety at Shaw AFB or in surrounding areas of Sumter County.

Arresting Gear Capacity

Contract ADAIR aircraft would be compatible with the existing arresting systems on the airfield or would be capable of operating on the airfield without interference to these existing systems. No changes to or modifications of the existing arresting gear would be needed. Thus, the Proposed Action would have no impacts on the functions or capabilities of existing arresting gear systems at Shaw AFB.

Explosives Safety

Under the Proposed Action, the 20 EMS would support contract ADAIR daily training operations with the maintenance and delivery of defensive countermeasure chaff and flares. This support would be provided by trained and certified personnel following DAF safety guidance and technical orders. Trained and certified contract ADAIR personnel would be responsible for the loading and unloading of defensive countermeasures on contract ADAIR aircraft and would follow approved safety measures outlined in the Performance Work Statement (PWS) (Air Force, 2021). Contract ADAIR personnel would also be responsible for the maintenance of captive air training missiles and any ejector cartridges as contractor-provided equipment.

In rare instances, the removal of egress CAD/PAD from contract ADAIR aircraft may be required for maintenance. In accordance with DESR 6055.09_AFMAN 91-201, paragraph V6.E3.6.1.4.13, when necessary, units may license a limited quantity of in-use egress explosive components of any Hazard Division explosive in the egress shop after removal from aircraft undergoing maintenance. This limit would not exceed the total number of complete sets for the number of aircraft in maintenance and the net explosive weight is limited. Contract ADAIR would work with the Wing Safety Office to obtain a license, if needed, to temporarily store egress CAD/PAD in an appropriate location(s) identified in the Explosive Safety Plan on Shaw AFB. Short-term storage would be limited and only needed in the event of an emergency or unforeseen occurrence such as the issuance of a suspension or restriction on egress equipment or munitions. The need to modify existing Q-D arcs on Shaw AFB to account for temporary storage of CAD/PAD is not anticipated.

The loading and unloading of defensive countermeasure chaff and flares would occur on the aircraft parking ramp. The proposed ramp area for contract ADAIR aircraft is authorized for chaff and flare operations (HC 1.3) in accordance with DESR 6055.09_AFMAN 91-201, paragraph V4.E3.5.2.1.2 and V4.E3.5.2.1.3.

No significant impacts on explosive safety would be anticipated to occur under the Proposed Action provided contract A/DAIR personnel are trained, and all applicable safety guidelines are implemented.

Flight Safety

Under the Proposed Action, contract ADAIR pilots would be required to strictly conform to the flight safety rules directed by the Operations Group Commander. Contract ADAIR would also adhere to the following requirements set forth in the PWS:

- Contract ADAIR flight operations would respond to and follow ATC vectors from approved facilities per FAA and AFI guidelines.
- Contract ADAIR would be conducted under positive tactical control. Pilots would be responsible to respond to tactical vectors and instructions by the applicable controlling authority (Ground Controller Intercept, Baron Controllers, Range Control Officer, Joint Terminal Attack Controller, etc.). If positive control is unavailable, mission flights would remain autonomous and adhere to the briefed presentations and special instructions.
- Contract ADAIR aircraft would :
  - be equipped with applicable communication and navigation capability to operate in the National Airspace Structure under FAA instrument flight rules and aircraft operating limitations, if applicable, and International Civil Aviation Organization equipment prerequisites;

- have at least one type of FAA-approved navigation system such as a Tactical Air Navigation, Automatic Direction Finder Receiver System, with Automatic Direction Finder indicator; Very High Frequency Omni Directional Range; or Global Positioning System/Long Range Navigation;
- have sufficient precision approach instrumentation, compatible with standard DAF instrument landing systems, to permit operations down to 300 ft ceilings and 1-statute-mile visibility; and
- have at least two functional voice radios operating in either the very high frequency/ultra-high frequency bands, and one must be ultra-high frequency.

Bird/Wildlife-Aircraft Strike Hazards

To prevent, minimize, and address potential BASH incidents, the proposed contract ADAIR operations would adhere to a BASH plan developed by the contract ADAIR provider. The contractor-developed BASH plan would be included as part of the Flight Operations Procedures and the Quality Management System set forth in the PWS. The contract ADAIR BASH plan would be based on, and could be an exact copy, of the host Wing's BASH plan. The contract ADAIR BASH plan would also comply with the FAA Wildlife Hazard Mitigation Program, although such compliance is not required.

No significant impacts on airspace/flight safety would be anticipated to occur under the Proposed Action provided that contractor flight safety rules are followed and all applicable AFOSH and OSHA requirements are implemented.

3.5.5.2 Special Use Airspace

Under Alternative 1, the number of training sorties occurring in SUA used by Shaw AFB aircraft would increase (see **Section 2.1.5**). No modifications of the vertical or horizontal extents of the SUA would occur; however, with additional demand for the same airspace resulting from the proposed contract ADAIR operations, the potential for minor impacts on safety can be expected. Adherence to applicable flight safety requirements would prevent or minimize the potential for mishaps to the extent practicable. Additionally, as airspace demand in the region increases, the DAF, in conjunction with other managing agencies, would continue coordination to reduce potential impacts. This would ensure that long-term adverse impacts on safety in SUA would remain negligible or minor and not significant.

3.5.6 Environmental Consequences – Alternative 2

3.5.6.1 Shaw Air Force Base

Proposed aircraft operations under Alternative 2 would be the same as those described for Alternative 1. Therefore, impacts on safety at Shaw AFB from Alternative 2 would be the same as those that would occur under Alternative 1. Impacts on safety under Alternative 2 would be negligible or minor, long-term, and not significant.

3.5.6.2 Special Use Airspace

Proposed aircraft operations under Alternative 2 would be the same as those described for Alternative 1. Therefore, impacts on safety in SUA from Alternative 2 would be the same as those that would occur under Alternative 1. Impacts on safety under Alternative 2 would be negligible or minor, long-term, and not significant.

3.5.7 Environmental Consequences – No Action Alternative

Under the No Action Alternative, contract ADAIR operations would not occur at Shaw AFB or in the Bulldog and Gamecock MOAs and associated ATCAA, the RobRoy Airspace, or W-161 and W-177. The No Action Alternative would have no effect on safety at Shaw AFB or in those SUA.

3.5.8 Cumulative Impacts

The Proposed Action, in addition to reasonably foreseeable future actions at Shaw AFB would follow existing safety procedures and policies for ground and flight operations. Contract ADAIR operations could and would pose an increased risk to flight, ground, and explosive safety; however, through compliance with the FAA and the DoD guidelines specified in DCMA Instruction 8210-1C, Chapter 6; OSHA standards; and the contract ADAIR BASH Plan/FAA Wildlife Hazard Management Plan; potential impacts would be minimized. As airspace demand in the region increases, the DAF, in conjunction with other managing agencies, will continue coordination to reduce potential impacts. Therefore, it is anticipated that the Proposed Action would not contribute to significant cumulative impacts on safety when considered with other reasonably foreseeable actions.

3.6 AIR QUALITY

3.6.1 Definition of the Resource

Air quality in various areas of the country is affected by pollutants emitted by numerous sources, including natural and man-made sources. The US Environmental Protection Agency (USEPA) was mandated under the Clean Air Act (CAA) to set air quality standards for select pollutants that are known to affect human health and the environment to manage pollutant emission levels in ambient air. The USEPA has divided the country into geographical regions known as Air Quality Control Regions (AQCRs) to evaluate compliance with the National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50). The NAAQS are currently established for six criteria air pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (including particulates equal to or less than 10 microns in diameter [PM_{10}] and particulates equal to or less than 2.5 microns in diameter [$PM_{2.5}$]), and lead (Pb). Regulatory areas in each AQCR are designated as an attainment or nonattainment area for each of the criteria pollutants, depending on whether it meets or exceeds the NAAQS. Areas that were reclassified from a previous nonattainment status to attainment are called maintenance areas and are required to prepare a maintenance plan for air quality.

Federal actions in NAAQS nonattainment and maintenance areas are also required to comply with USEPA's General Conformity Rule (40 CFR Part 93). These regulations are designed to ensure that federal actions do not impede local efforts to achieve or maintain attainment with the NAAQS or impede existing State Implementation Plans (SIPs). Federal actions are evaluated to determine if the total indirect and direct net emissions from the action are below *de minimis* levels for each of the pollutants as specified in 40 CFR § 93.153. If the *de minimis* levels are not exceeded for any of the pollutants, no further evaluation is required. However, if net emissions from the action exceed the *de minimis* thresholds for one or more of the specified pollutants, a demonstration of conformity, as prescribed in the General Conformity Regulations (40 CFR Parts 51 and 93), is required.

Under the CAA, special protection for air quality is provided in pristine areas of the country known as Class 1 areas (Class 1 areas include National Parks greater than 6,000 acres or National Wilderness Areas greater than 5,000 acres). Any significant deterioration of air quality is considered significant in Class 1 areas. The USEPA has also established regional haze regulations that require states to make initial improvements in visibility within their Class 1 areas.

Greenhouse gases (GHGs) are gases, occurring from natural processes and human activities, that trap heat in the atmosphere. The accumulation of GHGs in the atmosphere helps regulate the earth's temperature and are believed to contribute to global climate change. The USEPA regulates GHG emissions via permitting and reporting requirements that are applicable mainly to large stationary sources of emissions. Emissions from GHG are expressed in terms of the carbon dioxide equivalent emissions (CO_2e), which is a measure used to compare the emissions from various GHGs based upon their Global Warming Potential (GWP). The GWP is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2). The larger the GWP, the more that a given gas warms the Earth compared to CO_2 over the same time period. Analysts cumulatively compare emission estimates of different gases using standardized GWPs.

See **Appendix C.3** for a detailed discussion on air quality regulations, general conformity, climate change, and GHGs.

3.6.2 Existing Conditions – Shaw Air Force Base

The location and the topography of an area has a significant influence on the climate patterns in the region. Shaw AFB is located in east-central South Carolina. The regional climate where Shaw AFB is located is characterized by relatively high temperatures and evenly distributed precipitation throughout the year. The warmest month at Shaw AFB is July, with an average temperature of 82.2 degrees Fahrenheit (°F). January is the coldest month with an average high temperature of 44.8°F. The wettest month by average precipitation is July with an average of 5.5 inches of rain (Weatherbase, 2023).

Shaw AFB is in the City of Sumter, which is in the Camden-Sumter AQCR (40 CFR § 81.110). Ambient air quality for the Camden-Sumter Intrastate AQCR region is designated as an unclassifiable/attainment area for all NAAQS. Unclassifiable areas are those areas that have not had ambient air monitoring and are assumed to be in attainment with NAAQS. Because the ACQR containing Shaw AFB is considered an unclassifiable/ attainment area for all NAAQS, requirements of the General Conformity Rule are not applicable to the Proposed Action.

No designated Class I areas are within 6.2 miles (10 kilometers [km]) of Shaw AFB.

3.6.3 Existing Conditions – Special Use Airspace

3.6.3.1 Bulldog Military Operations Area and Gamecock Military Operations Area / RobRoy Airspace

The Bulldog and Gamecock MOAs (including associated ATCAA) overlie multiple counties in Georgia and South Carolina, respectively. These counties are designated as unclassifiable/attainment for all criteria pollutants; therefore, General Conformity requirements are not applicable to these areas. No designated Class I areas are within 6.2 miles (10 km) of the Bulldog and Gamecock MOAs.

The Bulldog MOA is located in Georgia and has a similar climate profile as Shaw AFB (i.e., humid subtropical). The Gamecock MOA and RobRoy Airspace are affected by many of the same weather features that affect Shaw AFB. This SUA falls within areas that are classified as humid subtropical climates. Because the Gamecock MOA is located inland and somewhat further northwest, it is subject to slightly colder and snowier conditions in the winter when compared to the Shaw AFB airfield.

3.6.3.2 Offshore Warning Areas

Warning Areas W-177 and W-161 have no known sources of emissions, and state jurisdiction with respect to meeting NAAQS extends to the state seaward boundary (3 miles). The Warning Areas fall outside the 3-mile boundary; therefore, no baseline analysis was prepared for the offshore jurisdictional waters because there are no surface-based operations proposed for that area that would cause project-related emissions.

Under 40 CFR Part 55, permitting and other air quality requirements apply to facilities beyond state seaward boundaries. Within 25 NM of the state seaward boundary, facilities must comply with the air quality regulations of the nearest onshore area. Beyond 25 NM from the state seaward boundary, facilities are subject to federal requirements including the Prevention of Significant Deterioration (PSD) preconstruction permit program and the Title V operating permit program; however, these programs apply only to stationary sources and thus would not be applicable to the proposed contract ADAIR operations in the Warning Areas.

No designated Class I areas are within 6.2 miles (10 km) of the offshore Warning Areas.

3.6.4 Environmental Consequences Evaluation Criteria

Air quality impact analyses from the Proposed Action are based on guidance in Chapter 4 of the *Air Force Air Quality Environmental Impact Analysis Process Guide*, *Volume II – Advanced Assessments*. The ACQR containing Shaw AFB is considered an unclassifiable/attainment area for all NAAQS; therefore, requirements of the General Conformity Rule are not applicable to the Proposed Action. Designated Class I areas are not addressed in the air quality analysis because no such areas are within 6.2 miles (10 km) of Shaw AFB and the overland and offshore SUA proposed for use.

The Air Force Air Conformity Applicability Model (ACAM) (5.0.17b) was used to estimate criteria and precursor pollutant emissions for contract ADAIR airfield operations, maintenance activities, worker commutes, and flight operations in the SUA. In addition, emissions associated with the use of flares within the SUA were estimated, using draft emission factors found in AP-42, Section 15.8 (USEPA, 2009). There are no stationary sources associated with this action, other than for fueling and fuel storage. By default, ACAM only accounts for emissions occurring at or below 3,000 ft within the mixing layer and emissions are evaluated using this default; aircraft emissions released above 3,000 ft were not included in this analysis. Emissions from ACAM were determined separately for the airfield and for the SUA. The basis for the air emissions calculations performed is listed in **Table 3-23**. A detailed description of the methodology, assumptions and input data used are discussed in **Appendix C.3**. The ACAM documentation in the form of a Record of Air Analysis (ROAA) is provided in **Appendix C.3**.

3.6.5 Environmental Consequences – Alternative 1

Emissions from the Proposed Action would result from additional air operations and associated activities by contract ADAIR aircraft. No facility construction, renovation, or demolition activities are included in the Proposed Action and therefore, no emissions associated with such activities would occur.

Similar to the analysis for potential noise impacts, air quality analyses were performed for three different emission scenarios (i.e., High, Medium, and Low; also see **Section 3.4.5**) to evaluate the different types of contract ADAIR aircraft that could be used. Surrogate engine type and reliable criteria emission factors are not available for foreign engine types. The three different emission scenarios, identified as High Emission, Medium Emission, and Low Emission, are listed below with the engine type used for the basis for the emission calculations:

- High Emission Scenario: MiG-29, Engine: F100-PW-100*
- Medium Emission Scenario: Mirage, Engine: F110-GE-100*
- Low Emission Scenario: F-5 A/B, Engine: J85-GE-13

** Surrogate engine type, reliable criteria emission factors not available for foreign engine types.*

Table 3-23 Basis of Air Emissions Calculations

Location	Type of Operation	Estimated Number of Sorties per Year	Ground Operation Emission Sources
Shaw Air Force Base Airfield	LTO Cycles	3,500 [a]	Auxiliary power unit equipment, AGE, personal vehicle use, aircraft maintenance (solvent use), fuel handling and storage, aircraft trim tests (12, one per aircraft)
	TGO Cycles	525 [b]	
Bulldog MOA / ATCAA	Sorties at ≤3,000 ft AGL	350 [c]	Not Applicable

Table 3-23 Basis of Air Emissions Calculations

Location	Type of Operation	Estimated Number of Sorties per Year	Ground Operation Emission Sources
Gamecock MOA / ATCAA (Including RobRoy Airspace)	Sorties at ≤3,000 ft AGL	350 [c]	Not Applicable
Warning Areas (W-161 & W-171)	All Sorties ≥3,000 ft AGL	Not Applicable – No Analysis [d]	Not Applicable

Notes:

[a] Air quality impacts are assessed for the airfield and SUA based on the total annual sorties from the airfield.

[b] Five percent of total sorties flying to the SUA (3,500) would be for contractor proficiency training. Each of these sorties is assumed to include three TGO/low approaches.

[c] Impacts would include flare use at and below 3,000 feet.

[d] Sorties occur above the atmospheric mixing height. No emissions calculated.

AGE = aerospace ground equipment; AGL= above ground level; ATCAA = Air Traffic Control Assigned Airspace; ft = feet; LTO = Landing and Takeoff; MOA = Military Operations Area; TGO = Touch and Go; W = Warning Area.

3.6.5.1 Shaw Air Force Base

Emissions were estimated for each year of the Proposed Action beginning in January 2024 and ending in December 2033. **Table 3-24** presents total increases in annual operational emissions from proposed contract ADAIR operations at Shaw AFB. The methodologies, emission factors, and assumptions used for the emission estimates for each of the emission scenarios and related activities are further described in **Appendix C.3**. The Proposed Action's estimated emissions are compared against the 250 tons per year (tpy) indicator of insignificance for pollutants in attainment areas.

Shaw AFB is in an area that is designated as unclassifiable/attainment for all criteria pollutants. As shown in **Table 3-24**, CO would have the highest annual emission rate of 224.5 tpy under the Low Emission Scenario. Given that the expected CO emissions would be below PSD thresholds, the CO emissions associated with the Low Emission Scenario would not be considered significant. For the remaining pollutants, the annual emission increases are also not considered significant, as they would also be below the respective thresholds.

Table 3-24 Contract Adversary Air Emissions – Shaw Air Force Base Airfield Operations

Scenario	Emissions (tpy) [1, 2, 3]								
	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	CO_2e	Pb	NH_3
High Emission	15.5	74.1	126.7	6.5	11.2	10.2	15,113	0	0.01
Medium Emission	8.0	44.4	62.1	4.3	6.5	4.3	10,364	0	0.01
Low Emission	43.3	21.1	224.5	3.2	1.9	1.8	6,696.4	0	0.01
Insignificance Indicator (tpy)	250	250	250	250	250	250	N/A	25	250

Notes:

Source: Air Conformity Applicability Model Output

[1] The emissions were estimated for each year of the Proposed Action beginning in January 2024 and ending in December 2033. For air quality modeling purposes, these are representative years; the modeling generates air emissions estimates for the life of a representative 10-year contract.

[2] Represents total per year emissions for: 1) flight operations (includes trim tests and auxiliary power unit use), 2) aerospace ground equipment, 3) aircraft maintenance (parts cleaning), and 4) Jet-A storage (fuel for contract adversary air operations and military operations areas for landing and takeoffs, touch and go's, trim tests, airspace use, and travel to the airspace).

[3] Based on 3,500 landing and takeoffs and 525 touch and go's per year.

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; N/A = Not Applicable; NH_3 = ammonia; NO_x = nitrogen oxides; Pb = lead; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; SO_x = sulfur oxides; tpy = tons per year; VOC = volatile organic compound

The results of this analysis demonstrate that the project would not interfere with the region's ability to maintain compliance with all NAAQS. Therefore, the predicted contract ADAIR annual emission increases would not be considered significant in the vicinity of the airfield. These emission findings are documented in the detailed ACAM Report and ROAA documents (**Appendix C.3**).

Emissions of volatile organic compounds from storage tanks used to store jet fuel for contract ADAIR flight operations represent the sole source of stationary emissions associated with the Proposed Action. Shaw AFB is a major source of criteria pollutants and holds a Title V Operating Permit. Contract ADAIR operations would be expected to increase the use of jet fuel at Shaw AFB; however, this would not be expected to affect current Title V terms and conditions. Limits established in the installation's Title V Permit would be reviewed by appropriate personnel at Shaw AFB to ensure that the Proposed Action would have no potential to exceed them.

3.6.5.2 Special Use Airspace

A portion of the proposed contract ADAIR sorties in the Bulldog and Gamecock MOAs would occur at or below 3,000 ft AGL; thus, consistent with the USEPA recommendation regarding mixing height, only those emissions that would occur within the mixing layer (lowest 3,000 ft) were analyzed. Out of the proposed 3,500 sorties, only a small portion would occur at or below 3,000 ft AGL (**Table 3-23**). The proposed use of chaff in the SUA was not considered to have an air quality impact because it has been previously determined that chaff material maintains its integrity after ejection and that the use of explosive charges in impulse cartridges results in minimal PM_{10} emissions (Air Force, 1997)**.** Flare emissions were only determined for areas where flare use would occur at or below 3,000 ft.

The emissions associated with contract ADAIR sorties proposed for the SUA were evaluated using ACAM for the High, Medium, and Low Emission Scenarios. Flare emissions for the SUA were based upon the methodologies in AP-42. Flight time in the mixing layer for the Bulldog MOA was estimated to be approximately 1.11 minutes per sortie and 0.22 minutes per sortie for the Gamecock MOA. In addition, it was assumed the time it would take to fly from the airfield to and from the SUA would occur at an altitude above 3,000 ft AGL; thus, this portion of the sortie is not included in the analysis. The methodologies, emission factors, and assumptions used for the emission estimates for each of the scenarios are outlined in **Appendix C.3**.

Because the SUA are within attainment areas for all criteria pollutants, the general conformity rule does not apply. Estimated emissions in the SUA are compared against the 250 tpy indicator of insignificance for pollutants in attainment areas.

Estimated emissions that would occur in the SUA from proposed contract ADAIR sorties are listed in **Table 3-25**. Emissions for each year of the proposed 10-year period beginning in January 2024 and ending in December 2033 are the same.

As listed in **Table 3-25**, emissions in the SUA for all scenarios would be low when compared to the insignificance indicator threshold of 250 tpy for all criteria pollutants. Of all criteria pollutants, the highest emission rate of 1.35 tpy for NO_x in the Bulldog MOA under the High Emission Scenario would still be well below the insignificance indicator value. Based on this analysis alone, the additional emissions due to contract ADAIR operations in the SUA would not be considered significant with respect to air quality impacts. These emission findings are documented in the ROAA (**Appendix C.3**).

Shaw AFB and associated SUA proposed for use are not located near any Mandatory Class 1 Federal Areas. Thus, potential impacts from the Proposed Action on Class 1 areas in South Carolina and Georgia would not be a concern and are not assessed further.

Table 3-25 Contract Adversary Air Emissions – Special Use Airspace Operations (Bulldog and Gamecock Military Operations Areas)

Airspace Designation	Emission Scenario	Emissions (tpy) [1, 2, 3]								
		VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	CO_2e	Pb	NH_3
Bulldog MOA / ATCAA	High	0.01	1.35	0.04	0.05	0.04	0.03	160.93	0.00	0.00
	Medium	0.00	0.40	0.08	0.03	0.01	0.01	76.77	0.00	0.00
	Low	0.06	0.03	0.62	0.02	0.00	0.00	46.53	0.00	0.00
Gamecock MOA / ATCAA	High	0.00	0.27	0.01	0.01	0.01	0.01	31.90	0.00	0.00
	Medium	0.00	0.08	0.02	0.01	0.00	0.00	15.21	0.00	0.00
	Low	0.01	0.01	0.12	0.00	0.00	0.00	9.22	0.00	0.00
Insignificance Indicator (tpy)		250	250	250	250	250	250	N/A	25	250

Notes:

Source: Air Conformity Applicability Model Output

[1] While contract adversary air targeted performance is estimated to start in January 2024 with a 10-year contract, the emissions were estimated for each year of the Proposed Action beginning in January 2023 and ending in December 2033. For air quality modelling purposes, these are representative years; the modelling generates air emissions estimates for the life of a representative 10-year contract.

[2] Represents total per year emissions.

[3] Emission based on 3,500 sorties.

ATCAA = Air Traffic Control Assigned Airspace; CO = carbon monoxide; CO_2e = carbon dioxide equivalent; LTO = landing and takeoff; MOA = Military Operations Area; N/A = Not Applicable; NH_3 = ammonia; NO_x = nitrogen oxides; Pb = lead; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; SO_x = sulfur oxides; tpy = tons per year; VOC = volatile organic compound

Greenhouse Gases and Climate Change

The combustion of fossil fuels during proposed contract ADAIR aircraft operations and associated activities would contribute directly to GHGs, in terms of CO_2 emissions. For the High Emission Scenario, total GHG emissions, in terms of carbon dioxide equivalent (CO_2e) would be 15,306 tpy from airfield and airspace operations. Similarly, Medium and Low Emission Scenarios, if implemented, would potentially contribute 10,456 tpy and 6,752 tpy of CO_2e, respectively.

Total projected CO_2e emissions from the High Emission Scenario (15,306 tpy of CO_2e) were compared against South Carolina's 2020 GHG emission estimates (USEPA, 2023a). The GHG emissions that would be generated from Medium and Low Emission Scenarios were also similarly compared. This analysis indicates that the CO_2e emissions from the High Emission Scenario would account for approximately 0.022 percent of South Carolina's CO_2e emissions for the energy sector and the Medium and Low Emission Scenarios would account for approximately 0.015 percent and 0.01 percent, respectively.

As described previously, no significance criteria for GHGs have been established. However, based on EIAP guidance, a relative comparison of GHG emissions between the various emissions scenarios is provided. In this case, the potential GHG emissions for the High Emission Scenario would be at least three and a half times more than the potential GHG emissions for the Low Emission Scenario. Compared to the No Action Alternative, in which there would be no additional GHG emissions, the Proposed Action would annually contribute approximately 15,300 tpy (maximum) to existing GHG levels in the region. The GHG emissions from the Proposed Action would result in longer-term GHG emissions increases as they would result primarily from aircraft operations. In the context of statewide GHG emissions, emissions from the Proposed Action would represent less than 0.1 percent of estimated 2020 GHG emissions for the State of South Carolina.

Per the CEQ interim guidance released January of 2023, "Agencies should exercise judgment when considering whether to apply this guidance to the extent practicable to an on-going NEPA process" (CEQ, 2023). The DAF guidance on applying and conducting a Social Cost of GHG Analysis is under development. The DAF guidance will be released shortly and will provide specifics on applying Social Cost of GHG

Analyses and ensure standardization across the DAF. Therefore, a Social Cost of GHG Analysis was not conducted for this EA.

3.6.6 Environmental Consequences – Alternative 2

Under Alternative 2, proposed contract ADAIR operations at Shaw AFB and in SUA would be the same as those described for Alternative 1. Therefore, potential emissions and impacts on air quality and GHG from Alternative 2 would be the same as those described for Alternative 1 (detailed emissions estimates are provided in **Appendix C-3**).

3.6.7 Environmental Consequences – No Action Alternative

The No Action Alternative would not generate any new emissions and would not be expected to change emissions from current baseline levels of operation at Shaw AFB. As a result, there would be no change to regional air quality.

3.6.8 Cumulative Impacts

The Proposed Action, in addition to reasonably foreseeable future actions at Shaw AFB would result in less than significant impacts on air quality. With any addition of ongoing construction projects in the area, PM_{10} emissions could increase; however, these increases would be short in duration and the incremental impact on air quality would be negligible.

Contract ADAIR sorties would occur at times below the mixing height of 3,000 ft AGL in the Bulldog MOA and the Gamecock MOA (see **Section 3.6.5.2**); however, the duration would be short (approximately 1.11 minutes per sortie for the Bulldog MOA and 0.22 minutes per sortie for the Gamecock MOA), and of the 3,500 sorties, only a relatively small portion would occur at or below 3,000 ft AGL; therefore, impacts on air quality would not be significant. Overall, no significant incremental change to air quality would be expected when adding the Proposed Action to reasonably foreseeable future actions; therefore, potential effects on air quality in the SUA would be less than significant.

3.7 BIOLOGICAL RESOURCES

3.7.1 Definition of the Resource

Biological resources include native, nonnative, and invasive plants and animals; sensitive and protected floral and faunal species; and the habitats, such as wetlands, forests, and grasslands, in which they occur. Habitat consists of the resources and conditions in an area that support a particular group of organisms. The primary federal statutes that form the regulatory framework for the evaluation of biological resources are listed below; detailed descriptions of these statutes are provided in **Appendix C.4**.

- Endangered Species Act (ESA) of 1973
- Migratory Bird Treaty Act of 1918
- Bald and Golden Eagle Protection Act of 1940
- Marine Mammal Protection Act (MMPA)
- Magnuson-Stevens Fishery Conservation and Management Act
- EO 1311, Invasive Species

3.7.2 Existing Conditions – Shaw Air Force Base

The following sections describe existing conditions for vegetation, wildlife, invasive species, and threatened and endangered species known or suspected to occur at Shaw AFB. The information presented in this section was gathered from Shaw AFB's *Integrated Natural Resources Management Plan* (INRMP) (Shaw AFB, 2022c), USFWS' Information for Planning and Consultation website, and South Carolina Department of Natural Resources (DNR) listings.

3.7.2.1 Vegetation

Shaw AFB is in the Southeastern Mixed Forest Province, also known as the Middle Atlantic Coastal Province. This region is characterized by numerous marshes, swamps, and lakes, as well as uplands historically forested with evergreen oaks (*Quercus* spp.), laurel (*Laurus* spp.), magnolia (*Magnolia* spp.), and pine (*Pinus* spp.) with an understory of ferns, palms, and shrubs (Bailey, 1995). In addition, there are sandy uplands of pine savannas with understories of grasses and sedges. Shaw AFB is a highly developed, urban installation. Of the 3,569 acres, approximately 84 percent is improved lands and 13 percent is pine plantations (Shaw AFB, 2022c). Several natural and disturbed community types are identified at Shaw AFB (Shaw AFB, 2022c). The Bottomland Hardwoods/Small Stream Forest of Mush Swamp is comprised of native tree species such as red maple (*Acer rubrum*), ash (*Fraxinus* spp.), laurel-leaf oak (*Quercus laurifolia*) and hackberry *(Celtis* spp.). The Oak/Hickory Forest on the north side of Shaw AFB includes loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), and hickory (*Carya* spp.). While the ponds on Shaw AFB are not natural, they do support several native wetland plant species such as naja (*Najas marina*), water-spider orchid (*Habenaria repens*), and meadow beauty (*Rhexia* spp.). The pine plantations on the southeastern corner are planted with loblolly pine that are primarily 30 to 40 years old (Shaw AFB, 2022c).

3.7.2.2 Wildlife

Historically, the Southeastern Mixed Forest Province provided habitat for a wide range of fauna. Currently, the most common large mammal in this region is the whitetail deer (*Odocoileus virginianus*). Wildlife species found at Shaw AFB and associated properties are typical for the region. Common large and small mammals include white-tailed deer, raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and gray fox (*Urocyon cinereoargenteus*); additionally, there are several species of squirrels, mice, and voles. Upland herpetofauna include several species of toads, frogs, snakes, and lizards (Shaw AFB, 2022c). Pond turtle surveys at Shaw AFB in September 2017 found snapping turtle (*Chelydra serpentina*), chicken turtle (*Deirochelys reticularia*), and yellowbelly slider (*Trachemys scripta scripta*), with all but one capture of turtles occurring in Memorial Lake (DAF, 2017b). The most frequently observed fish species in the ponds on Shaw AFB are bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and catfish (*Ictaluridae*). Suitable habitat acreage for birds is very limited on Shaw AFB, habitat is present for some migratory breeding and resident birds. However, between 1997 and 2020 over 140 species of birds were documented at Shaw AFB, Poinsett Electronic Combat Range, and the Wateree Recreation Area (Shaw AFB, 2022c).

A 2017 acoustic bat survey at Shaw AFB detected numerous bat species including the big brown bat (*Eptesicus fuscus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), northern yellow bat (*Lasiurus intermedius*), silver-haired bat (*Lasionycteris noctivagans*), southeastern bat (*Myotis austroriparius*), and tricolored bat (*Perimyotis subflavus*). The tricolored bat was the most frequently documented bat during the acoustic surveys (DAF, 2017c).

3.7.2.3 Invasive Species

The most common invasive plant species at Shaw AFB and the Poinsett Electronic Combat Range include Chinese privet (*Ligustrum sinense*), Chinese wisteria (*Wisteria sinensis*), weeping lovegrass (*Eragrostis curvula*), Chinaberry (*Melia azedarach*), Japanese honeysuckle (*Lonicera japonica*), mimosa (*Albizia julibrissin*), sericea lespedeza (*Lespedeza cuneata*), and Japanese climbing fern (*Lygodium japonicum*) (Shaw AFB, 2017; Shaw AFB, 2022c).

3.7.2.4 Threatened and Endangered Species

No federally endangered or threatened species are known to occur on Shaw AFB and there are no critical habitats present. However, one federal candidate species, the monarch butterfly (*Danaus plexippus*), may occur on base, one species proposed as Endangered under the ESA, the tricolored bat, is documented to be present on base, and several species of concern and state species of special concern are known to occur on base (**Table 3-26**) (DAF, 2017c; Shaw AFB, 2022c; USFWS, 2023). Detailed descriptions of these species are provided in **Appendix C.4**.

Table 3-26 lists the species of concern for Shaw AFB and is derived from the Shaw AFB INRMP (Shaw AFB, 2022c), USFWS' list of birds of conservation concern, and the South Carolina's State Wildlife Action Plan (South Carolina DNR, 2015). Special care, emphasis, and management are applied to these species of concern. Suitable habitat for these species on the Shaw AFB main base is limited; most available habitat for these species is at the Poinsett Electronic Combat Range. However, species listed as potentially present may occur during migration, or infrequently.

Table 3-26 Federal and State Listed Species of Concern at Shaw Air Force Base

Species	State Rank	US Fish and Wildlife Service Status
Birds		
American kestrel (*Falco sparverius paulus*)	State Priority Conservation Species - Highest	Bird of Conservation Concern
Brown-headed nuthatch (*Sitta pusilla*)	State Priority Conservation Species - Highest	Bird of Conservation Concern
Chimney swift (*Chaetura pelagica*)	-	Bird of Conservation Concern
Dark-eyed junco (*Junco hyemalis*)	State Priority Conservation Species – Moderate	-
Eastern meadowlark (*Sturnella magna*)	State Priority Conservation Species - Highest	-
Eastern wood pewee (*Contopus virens*)	State Priority Conservation Species – Highest	-
Golden-crowned kinglet (*Regulus satrapa*)	State Priority Conservation Species – Moderate	-
Great blue heron (*Ardea herodius*)	State Priority Conservation Species – Moderate	-
Green heron (*Butorides viriscens*)	State Priority Conservation Species – Moderate	-
Least tern (*Sternula antillarum*)	State Threatened	-
Loggerhead shrike (*Lanius ludovicianus*)	State Priority Conservation Species – Highest	-
Mallard (*Anas platyrhynchos*)	State Priority Conservation Species – Highest	-
Painted bunting (*Passerina ciris*)	State Priority Conservation Species – Highest	Bird of Conservation Concern
Red-headed woodpecker (*Melanerpes erythrocephalus*)	-	Bird of Conservation Concern
Swallow-tailed kite (*Elanoides forficatus*)	-	Bird of Conservation Concern

Table 3-26 Federal and State Listed Species of Concern at Shaw Air Force Base

Species	State Rank	US Fish and Wildlife Service Status
Mammals		
Tricolored bat (*Perimyotis subflavus*)	-	Proposed Endangered
Fish		
American eel (*Anguilla rostrata*)	State Priority Conservation Species – Highest	-
Insects		
Monarch butterfly (*Danaus plexippus*)	–	Candidate

Source: Shaw AFB, 2022c; USFWS, 2023; South Carolina DNR, 2015

3.7.3 Existing Conditions – Special Use Airspace

There are no biological resources survey data specifically available for the SUA proposed for use to support ADAIR training. Therefore, biological resources existing conditions relies upon existing regional ecoregion information that is applicable to the likely habitats located beneath the SUA. Further, there would be no impacts on reptiles (except potentially on sea turtles), amphibians, aquatic invertebrates, and plants from contract ADAIR operations in the SUA, as these proposed training-support operations would be limited to aircraft movement, noise, and the use of chaff and flares. Therefore, these species are not discussed in detail.

3.7.3.1 Bulldog Military Operations Area

Vegetation

The Bulldog MOA and ATCAA overlies the Southeastern Plains Ecoregion of Georgia. This ecoregion once contained Oak-Hickory-Pine Forest dominated by hickory (*Carya* spp.), longleaf pine (*Pinus palustris*), shortleaf pine (*Pinus echinata*), loblolly pine, white oak (*Quercus alba*), and post oak (*Quercus stellata*). Floodplain communities consisted of oaks, red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), bald cypress (*Taxodium distichum*), and tupelo (*Nyssa* spp.). This region is now covered by a mixture of cropland, pasture, woodland, and forest, and large areas have been planted with pine and agricultural fields (Griffith et al., 2002).

Wildlife

Common mammal species potentially occurring in the Southeastern Plains Ecoregion of Georgia include white-tailed deer, bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), racoon, eastern cottontail rabbit (*Sylvilagus floridanus*), eastern gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), and swamp rabbit (*Sylvilagus aquaticus*). Birds in this ecoregion include wild turkey (*Meleagris gallopavo*), northern bobwhite quail (*Colinus virginianus*), northern cardinal (*Cardinalis cardinalis*), Carolina wren (*Thryothorus ludovicianus*), wood thrush (*Hylocichla mustelina*), tufted titmouse (*Baeolophus bicolor*), field sparrow (*Spizella pusilla*), prairie warbler (*Setophaga discolor*), and herons and egrets. Common reptile species include eastern box turtle (*Terrapene carolina*), common garter snake (*Thamnophis sirtalis*), copperhead (*Agkistrodon contortrix*), and rattlesnake (*Crotalus* spp.), and American alligators (*Alligator mississippiensis*) (Georgia DNR, 2015). Common wildlife species associated with the Southeastern Plains Ecoregion of Georgia would have the potential to occur in areas underlying the Bulldog MOA and ATCAA.

Threatened and Endangered Species

The following federally listed, proposed for listing, and candidate species have the potential to occur in areas underlying the Bulldog MOA and ATCAA:

- Red-cockaded woodpecker (*Picoides borealis*)
- Wood stork (*Mycteria americana*)
- Tricolored bat
- Monarch butterfly
- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)
- Shortnose sturgeon (*Acipenser brevirostrum*)

These species are listed in **Table 3-27** and described in additional detail in **Appendix C.4**.

In addition to the species listed above, federally designated critical habitat for the Atlantic sturgeon is also present in waters underlying the Bulldog MOA and ATCAA.

Invasive Species

Invasive plant species potentially occurring on lands underlying the Bulldog MOA and ATCAA are similar to those described for Shaw AFB (see **Section 3.7.2.3**).

3.7.3.2 Gamecock Military Operations Area / RobRoy Airspace

Vegetation

The Gamecock MOA (including associated ATCAA) and RobRoy Airspace are in the Coastal Plain Ecoregion of South Carolina. Vegetation in this ecoregion includes pine-dominated forests interspersed with agricultural land on better-drained sites, hardwood forests along floodplains and low-gradient streams, and pine forests on less well-drained terraces. Pine forests are generally dominated by loblolly pine or longleaf pine, depending on soil types and forestry activities. The understory of pine forests typically includes shrub thickets dominated by holly species (*Ilex* spp.) and wax myrtle (*Morella cerifera*). Hardwood forests along floodplains are often dominated by American beech (*Fagus grandifolia*) (South Carolina DNR, 2015).

Table 3-27 Federal and State Listed Species Potentially Present In or Under Special Use Airspace

Species	Scientific Name	Federal Status	State Status (GA)	State Status (SC) [1]	Bulldog MOAs / ATCAA	Gamecock MOAs / ATCAA [2]	Warning Areas
Birds							
American kestrel	*Falco sparverius paulus*	BCC	Priority	Highest	X	X	
American oystercatcher	*Haematopus palliatus*	BCC	Priority	Highest		X	
Audubon's shearwater	*Puffinus lherminieri*	BCC	-	-			X
Bachman's sparrow	*Peucaea aestivalis (=Aimophila aestivalis)*	BCC	Priority	SOC, Highest	X	X	
Bald eagle	*Haliaeetus leucocephalus*	BGEPA	Priority	SE, Highest	X	X	
Black skimmer	*Rynchops niger*	BCC	Priority	SOC, Highest		X	
Brown-headed nuthatch	*Sitta pusilla*	BCC	-	Moderate	X	X	
Cerulean warbler	*Dendroica cerulea*	BCC	Priority	Highest		X	
Chimney swift	*Chaetura pelagica*	BCC	-	High	X	X	
Cory's shearwater	*Calonectris diomedea*	BCC	-	-			X
Eastern black rail	*Laterallus jamaicensis* ssp. *jamaicensis*	T	Priority	SOC, Highest		X	X
Eastern whip-poor-will	*Antrostomus vociferus*	BCC	-	High	X	X	
Gull-billed tern	*Gelochelidon nilotica*	BCC	Priority	SOC, Highest		X	
Kentucky warbler	*Oporornis formosus*	BCC	-	High	X	X	
King rail	*Rallus elegans*	BCC	Priority	Highest	X	X	
Lesser yellowlegs	*Tringa flavipes*	BCC	-	High	X	X	
Manx shearwater	*Puffinus puffinus*	BCC	-	-			X
Marbled godwit	*Limosa fedoa*	BCC	-	Highest		X	
Painted bunting	*Passerina ciris*	BCC	Priority	Highest	X	X	
Piping plover	*Charadrius melodus*	T	Priority	Highest		X	X
Prairie warbler	*Dendroica discolor*	BCC	-	High	X	X	
Prothonotary warbler	*Protonotaria citrea*	BCC	Priority	Moderate	X	X	
Red knot	*Calidris canutus rufa*	T	Priority	Highest		X	X
Red-cockaded woodpecker	*Picoides borealis*	E	Priority	SE	X	X	
Red-headed woodpecker	*Melanerpes erythrocephalus*	BCC	-	Moderate	X	X	

Table 3-27 Federal and State Listed Species Potentially Present In or Under Special Use Airspace

Species	Scientific Name	Federal Status	State Status (GA)	State Status (SC) [1]	Bulldog MOAs / ATCAA	Gamecock MOAs / ATCAA [2]	Warning Areas
Roseate tern	*Sterna dougallii dougallii*	E	-	-			X
Ruddy turnstone	*Arenaria interpres morinella*	BCC	-	Highest		X	
Rusty blackbird	*Euphagus carolinus*	BCC	Priority	Highest	X	X	
Short-billed dowitcher	*Limnodromus griseus*	BCC	-	Highest	X	X	
Swallow-tailed kite	*Elanoides forficatus*	BCC	Priority	Highest	X	X	
Willet	*Tringa semipalmata*	BCC	-	High	X	X	
Wilson's plover	*Charadrius wilsonia*	BCC	Priority	-		X	
Wood stork	*Mycteria americana*	T	-	SE, Highest	X	X	
Wood thrush	*Hylocichla mustelina*	BCC	-	High	X	X	
Fish							
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	E	SE, Highest	X [3]	X [3]	X
Giant manta ray	*Manta birostris*	T	-	-			X
Oceanic whitetip shark	*Carcharhinus longimanus*	T	-	-			X
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	SE, Highest	X		X
Mammals							
Blue whale	*Balaenoptera musculus*	E, MMPA	-	SE, High			X
Fin whale	*Balaenoptera physalus*	E, MMPA	-	-			X
Humpback whale	*Megaptera novaeangliae*	MMPA	Priority	SE, High			X
North Atlantic right whale	*Eubalaena glacialis*	E, MMPA	Priority	SE, High			X [3]
Northern long-eared bat	*Myotis septentrionalis*	T	-	Highest		X	
Pygmy sperm whale	*Kogia breviceps*	MMPA	-	SE, High			X
Dwarf sperm whale	*Kogia sima*	MMPA	-	SE, High			X
Sei whale	*Balaenoptera borealis*	E, MMPA	-	-			X
Southeastern pocket gopher	*Geomys pinetis*	-	T	-	X		
Sperm whale	*Physeter macrocephalus*	E, MMPA	-	-			X
Tricolored bat	*Perimyotis subflavus*	PE	-	-		X	

Table 3-27 Federal and State Listed Species Potentially Present In or Under Special Use Airspace

Species	Scientific Name	Federal Status	State Status (GA)	State Status (SC) [1]	Bulldog MOAs / ATCAA	Gamecock MOAs / ATCAA [2]	Warning Areas
West Indian manatee	*Trichechus manatus*	T, MMPA	-	SE, Highest		X	X
Marine Reptiles							
Green sea turtle	*Chelonia mydas*	T	Priority	SE, Highest		X	X
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	-	SE, Highest		X	X
Leatherback sea turtle	*Dermochelys coriacea*	E	Priority	SE, Highest		X	X
Loggerhead sea turtle	*Caretta caretta*	T	Priority	SE, Highest		X	X [3]
Terrestrial Insects							
Monarch butterfly	*Danaus plexippus*	C	Priority	-	X	X	

Notes:

Sources: USFWS, 2023; NMFS, 2023a; South Carolina DNR, 2015; Georgia DNR, 2015

[1] Includes South Carolina Legal Status as well as Priority List Status

[2] Includes the RobRoy special use airspace

[3] Designated Critical Habitat for the listed species is also located within the special use airspace.

ATCAA = Air Traffic Control Assigned Airspace; BCC = Bird of Conservation Concern; BGEPA = Bald and Golden Eagle Protection Act; C=Candidate; E=Endangered; GA = Georgia; MMPA = Marine Mammal Protection Act; MOA = Military Operations Area; PE = Proposed Endangered; SC = South Carolina; SE = State Endangered; SOC = Species of Concern; T = Threatened

Wildlife

South Carolina supports approximately 101 native species of mammals with the largest group of mammals being represented by rodents. Bobcat, coyote, red fox (*Vulpes vulpes*), gray fox, opossum (*Didelphis marsupialis*), raccoon, river otter (*Lontra canadensis*), mink (*Neogale vison*), long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale putorius*), muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*) are all considered furbearers and may be taken by license in the state of South Carolina. There are 427 species of birds documented in South Carolina, 181 are classified as breeding in the state. Additionally, there are 144 species of amphibians and reptiles known to occur in South Carolina. South Carolina has an exceptionally high amphibian diversity, and the Jocassee Gorges area in upstate South Carolina contains the highest number of salamanders found anywhere on earth. There are 146 fish species documented in freshwater habitats of South Carolina or are seasonally dependent on freshwater habitats to complete their life cycle, such as shad and sturgeon. The southeastern US is the most diverse region in the world for freshwater mussels and all the freshwater mussels in South Carolina belong to the family Uniondiae. The total number of named insects in South Carolina is not fully known, but the total insect species reported to occur in South Carolina is 6,511 (South Carolina DNR, 2015). Wildlife species commonly occurring in South Carolina have the potential to be present in areas underlying the Gamecock MOA.

Threatened and Endangered Species

A query of the USFWS Information for Planning and Consultation database identified four species of sea turtles, the piping plover (*Charadrius melodus*), and the red knot (*Calidris canutus*) as federally listed species that could potentially occur in areas underlying the Gamecock MOA (USFWS, 2023). However, these species are associated with marine or nearshore habitats, none of which occur in areas underlying the Gamecock MOA and therefore, are not discussed further for the Gamecock MOA (their potential to occur in or under the offshore Warning Areas is discussed in **Section 3.7.3.3**).

The following federally listed, proposed for listing, and candidate species could occur beneath the Gamecock MOAs:

- Eastern black rail (*Laterallus jamaicensis*)
- Red-cockaded woodpecker
- Wood stork
- Northern long-eared bat *(Myotis septentrionalis*)
- Tricolored bat
- Monarch butterfly
- Atlantic sturgeon
- Shortnose sturgeon
- West Indian manatee (*Tricherchus manatus*)

These species are shown in **Table 3-27** and discussed in additional detail in **Appendix C.4**.

In addition to the species listed above, federally designated critical habitat for the Atlantic sturgeon is present in waters underlying the Gamecock MOA and ATCAA.

Invasive Species

Invasive plant species that could occur in areas underlying the Gamecock MOA and ATCAA are similar to those described for Shaw AFB (see **Section 3.7.2.3**).

3.7.3.3 Offshore Warning Areas

The Warning Areas overlie open waters of the Atlantic Ocean offshore from North Carolina and South Carolina (see **Figure 1-3**). This area of the Atlantic Ocean is part of the South Atlantic Bight where water depths extend to over 13,000 ft. Underwater areas underlying the Warning Areas include the continental shelf, continental slope, and various submarine canyons. The average depth of the continental shelf is 246 ft and has an approximate gradient of 1:1,000. The continental shelf breaks eastward at the continental slope, which has an approximate gradient of 1:10. The water depth along the continental slope averages between 6,500 and 13,000 ft. Various large submarine canyons dissect the continental slope and become deep sea channels along the continental rise (US Navy, 2009).

Vegetation and Wildlife

Marine species potentially occurring in waters of the Atlantic Ocean underlying the Warning Areas are briefly described below.

- **Plankton.** Plankton are organisms that move with the ocean's currents and cannot maintain independent movement against water currents. Plankton include phytoplankton, which are plant-like organisms including algae, zooplankton, which are animals including fish eggs and larvae, and bacterioplankton, which are comprised of bacteria. Phytoplankton are critical to marine food webs. Phytoplankton are most commonly found in surface waters and in nearshore environments where nutrients and sunlight are more plentiful. Phytoplankton concentrations generally decrease with the distance from shore and become less prevalent in the deeper waters of the continental slope.

  The eggs and larvae of fish, which comprise a large portion of zooplankton in the marine environment, are typically found in the upper 650 ft of the ocean water column. As fish larvae mature, their motility increases, and they feed on phytoplankton and smaller zooplankton. The combination of phytoplankton and the smaller zooplankton concentrations are critical to supporting fisheries health and abundance (US Navy, 2018).

- **Benthic Organisms**. Benthic organisms are bottom-dwelling animals that live on and within the marine sediments. These include crustaceans, echinoderms, anthozoans, annelids, mollusks, and ground fish. Some benthic organisms burrow into soft bottoms while other attach themselves to hard structure located on the ocean floor. Most of the ocean floor of the Warning Areas are comprised of soft bottoms and the benthic organisms present in these areas include polychaete and archiannellid worms, bivalves, amphipods, and asteroids (US Navy, 2018). Hard bottom structure in the Warning Areas includes rock outcrops, hard structure from fossil remains, artificial reefs, and shipwrecks that could support benthic invertebrates, such as bryozoans, hard and soft corals, hydroids, anemones, encrusting algae, and sponges. These hard structure areas also support foraging sea turtles and commercial/recreational fishes. Within the Warning Areas, there are isolated patches of temperate soft and hard corals, hydroids, zoanthids, and sponges that colonize rock outcroppings, artificial reefs, and shipwrecks. The southern portion of the Warning Areas has greater concentrations of midshelf and deep-water corals and sponges due to the warmer water temperatures and greater area of hard structure (US Navy, 2009).

- **Fish.** Fish species vary greatly with depth of water, salinity, distance from shore, clarity of the water, availability of structure, and availability of prey. The upper 650 ft of the ocean is the epipelagic zone where there is sufficient sunlight penetration to support phytoplankton while the portion of the ocean's water column between 650 and 3,200 ft is the mesopelagic zone where light penetration is minimal. Sunlight does not penetrate below the mesopelagic zone (Moyle and Cech, 2004). Most fish in the ocean occur in the epipelagic zone and those associated with the nearshore environment are the most commercially valuable. Fish species of greatest interest in the nearshore environment include goby *(Gobiidae)*, drum *(Sciaenidae)*, seabass (*Serranidae*), grouper *(Epinephelidae)*, snapper *(Lutjanidae)*, and sculpin *(Cottidae)* associated with hard bottom habitat and white flounder *(Bothidae and Paralichthyidae)* and stingray (*Dasyatidae*) associated with soft bottom habitat. Tuna *(Scombridae)*, salmon *(Salmonidae)*, billfish and swordfish (*Xiphiidae*), shark *(Carcharhinidae)*, saury

(Scomberesocidae), and ocean sunfish *(Molidae)* are ocean epipelagic fish that could occur beneath the Warning Areas (US Navy, 2018).

- **Essential Fish Habitat (EFH**). The following EFH is present in waters underlying the Warning Areas: snapper grouper fishery; golden crab fishery; coral, coral reefs, and live/hard bottom habitats; coastal migratory pelagics fishery, and spiny lobster fishery. Habitat Areas of Particular Concern for penaeid shrimp and the dolphin and wahoo fishery off the Atlantic states are also present in those waters (NOAA Fisheries, 2023).
- **Marine Mammals**. A total of 33 cetacean species (e.g., whales, dolphins, or porpoises), 3 pinniped species (e.g., seals or sea lions), and 1 manatee species could occur within the Warning Areas (**Table 3-28**). These species are afforded protection under the MMPA. Some cetacean species are resident year-round while others occur seasonally as they migrate through the area. All three pinniped species would be unlikely to occur beneath the Warning Areas but could be rare visitors to the western (shallower) portions of the Warning Areas in winter and spring. The blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus)*, North Atlantic right whale *(Eubalaena glacialis)*, sei whale *(Balaenoptera boreali)*, and sperm whale *(Physeter microcephalus)* are federally listed under the ESA and are described in additional detail in **Appendix C.4**.
- **Sea Turtles**. Four species of sea turtles could potentially occur within the Warning Areas: the green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*). These species are federally listed under the ESA and further discussed below.

Table 3-28 Marine Mammals Protected Under the Marine Mammal Protection Act with Potential to Occur in the Warning Areas

Common Name	Scientific Name	Occurrence in the Warning Areas
Cetaceans		
North Atlantic right whale	*Eubalaena glacialis*	Occurs during fall, winter, and spring, with occasional summer sightings
Humpback whale	*Megaptera novaeangliae*	Occurs during migration in the fall, winter, and spring
Minke whale	*Balaenoptera acutorostrata*	Occurs in waters over the continental shelf year-round
Bryde’s whale	*Balaenoptera brydei*	Occurs year-round
Sei whale	*Balaenoptera boreali*	Occurs in deep waters year-round
Finback whale	*Balaenoptera physalus*	Occurs year-round and is the most commonly sighted large whale in the winter in the Warning Areas
Blue whale	*Balaenoptera musculus*	May occur at any time of the year but less frequent in summer
Sperm whale	*Physeter macrocephalus*	Occurs year-round in deep waters
Pygmy sperm whale	*Kogia breviceps*	Occurs year-round
Dwarf sperm whale	*Kogia sima*	Occurs year-round
Cuvier's beaked whale	*Ziphius cavirostris*	Occurs over the continental slope year-round
True's beaked whale	*Mesoplodon mirus*	Occurs over the continental slope year-round

Table 3-28 Marine Mammals Protected Under the Marine Mammal Protection Act with Potential to Occur in the Warning Areas

Common Name	Scientific Name	Occurrence in the Warning Areas
Gervais' beaked whale	*Mesoplodon europaeus*	Occurs over the continental slope year-round
Sowerby's beaked whale	*Mesoplodon bidens*	Occurs over the continental slope year-round
Blainville's beaked whale	*Mesoplodon densirostris*	Occurs over the continental slope year-round
Rough-toothed dolphin	*Steno bredanensis*	Occurs in waters over the continental slope year-round
Bottlenose dolphin	*Tursiops truncatus*	Occurs in waters over the continental shelf year-round
Pantropical spotted dolphin	*Stenella attenuata*	Occurs in waters over the continental slope year-round
Atlantic spotted dolphin	*Stenella frontalis*	Year-round occurrences
Spinner dolphin	*Stenella longirostris*	Occurs in deep warm waters year-round
Clymene dolphin	*Stenella clymene*	Occurs year-round in the deep warmer waters
Striped dolphin	*Stenella coeruleoalba*	Occurs in waters over the continental slope from the continental break eastward year-round
Common dolphin	*Delphinus delphis*	Occurs in waters over the continental shelf year-round
Fraser's dolphin	*Lagenodelphis hosei*	Likely rare; however, there is the potential to occur year-round
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Primarily in waters over the continental shelf and occurs year-round
Risso's dolphin	*Grampus griseus*	Occurs along the continental shelf break year-round
Melon-headed whale	*Peponocephala electra*	Occurs in deep warm waters over the continental shelf year-round
Pygmy killer whale	*Feresa attenuata*	Occurs in waters over the continental slope year-round
False killer whale	*Pseudorca crassidens*	Occurs in warm waters off the continental shelf year-round
Killer whale	*Orcinus orca*	Occurs year-round
Long-finned pilot whale	*Globicephala melas*	Occurs year-round
Short-finned pilot whale	*Globicephala macrorhynchus*	Occurs year-round
Harbor porpoise	*Phocoena phocoena*	Potential to occur in waters over the continental shelf during fall, winter, and spring
Pinnipeds		
Harbor seal	*Phoca vitulina*	Rare occurrences possible in the waters along the western edge of the Warning Areas
Gray seal	*Halichoerus grypus*	Rare occurrences possible in waters along the western edge of the Warning Areas in winter & spring

Table 3-28 Marine Mammals Protected Under the Marine Mammal Protection Act with Potential to Occur in the Warning Areas

Common Name	Scientific Name	Occurrence in the Warning Areas
Harp seal	*Pagophilus groenlandicus*	Rare occurrences possible in waters along the western edge of the Warning Areas in winter & spring
Manatees		
West Indian Manatee	*Trichechus manatus*	Rare occurrences possible in waters along the western edge of the Warning Areas

Notes:
Source: US Navy, 2009; US Navy, 2018; NMFS, 2023a

Threatened and Endangered Species and/or Species of Concern

Federally listed species potentially occurring in areas underlying the offshore Warning Areas include four birds, four fish, six marine mammals, four sea turtle species, and the West Indian manatee (NMFS, 2023a). These species are listed in **Table 3-27** and listed below; detailed descriptions of these species are provided in **Appendix C.4**. Federally designated critical habitat for the loggerhead sea turtle and North Atlantic right whale is present in waters underlying W-161 (NMFS, 2023b; NOAA, 2023).

- Eastern black rail
- Piping plover
- Red knot
- Roseate tern (*Sterna dougallii*)
- West Indian manatee
- Atlantic sturgeon
- Oceanic whitetip shark (*Carcharhinus longimanus*)
- Giant manta ray (*Manta birostris*)
- Shortnose sturgeon
- Green sea turtle
- Leatherback sea turtle
- Loggerhead sea turtle
- Kemp's ridley sea turtle
- Blue whale
- Fin whale
- North Atlantic right whale
- Sei whale
- Sperm whale

3.7.4 Environmental Consequences Evaluation Criteria

The level of impact on biological resources is based on the

- importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource;
- proportion of the resource that would be affected relative to its occurrence in the region;
- sensitivity of the resource to the proposed activities; and
- duration of potential ecological ramifications.

Impacts on biological resources would be adverse if species or habitats of high concern (i.e., federally and state listed threatened and endangered species and designated critical habitat) would be adversely affected over relatively large areas. Adverse impacts would also include population declines or reductions in the distribution of a species resulting from disturbances associated with the Proposed Action.

As a requirement under the ESA, federal agencies must provide documentation that ensures that agency actions do not adversely affect the existence of any threatened or endangered species. The ESA requires that all federal agencies avoid unauthorized "take" of federally threatened or endangered species or adverse modification of designated critical habitat. The ESA Section 7 consultation process would result in either a concurrence on the DAF's determination of "may affect, not likely to adversely affect" on listed species, or a biological opinion with either an Incidental Take Statement that authorizes a specified amount of "take" (or adverse modification of designated critical habitat) or a jeopardy determination. No ESA Section

7 formal consultation is required if the DAF determines there will be no effect on a threatened or endangered species.

Under the Proposed Action, there would be no ground-disturbing activities and all potential impacts on biological resources would be associated with aircraft operations at Shaw AFB and in the SUA. The aircraft operations associated with the Proposed Action could have impacts on biological resources from aircraft movement, the use of defensive countermeasures in the SUA, noise, or BASH.

3.7.5 Environmental Consequences – Alternative 1

3.7.5.1 Shaw Air Force Base

Overall, Alternative 1 would have no impacts on vegetation; minor impacts on wildlife; no effect on federally listed species and critical habitat; and minor adverse impacts on some South Carolina species of concern and USFWS birds of conservation concern. Potential impacts from Alternative 1 are described in further detail below.

Vegetation

As there would be no ground-disturbing activities, there are no anticipated impacts on vegetation from Alternative 1 on Shaw AFB.

Wildlife

Increased aircraft sorties would have minor adverse impacts on wildlife, especially avian and bat species. Increased aircraft movement would increase the risk of bird and bat strikes, especially for aircraft operating at lower altitudes, such as during takeoffs and landings. Birds of conservation concern, especially raptors, could be at an increased risk of death from aircraft movement. Bat species would be less likely to encounter aircraft because these species are primarily active between dusk and dawn, when far fewer aircraft operations would occur. Increased noise from additional aircraft sorties could result in minor adverse impacts on wildlife species present at and proximate to Shaw AFB; however, species that occur on Shaw AFB are habituated to aircraft presence and noise.

Invasive Species

As there would be no ground-disturbing activities, there would be no impacts on invasive species at Shaw AFB.

Threatened and Endangered Species

As there are no currently listed threatened and endangered species present on Shaw AFB, there would be no impacts on threatened or endangered species. Increased aircraft operations from contract ADAIR at altitudes at or below 1,000 ft could strike migrating monarch butterflies (listed as an ESA candidate species) during soaring flight. However, monarch butterflies would not occur in large numbers on Shaw AFB as most of the base is developed. Therefore, there would be only a slight increase in the likelihood of aircraft strikes on migrating monarchs on Shaw AFB.

Additional aircraft operations at Shaw AFB associated with contract ADAIR under Alternative 1 would increase the potential for aircraft strikes on tricolored bats at and near the Shaw AFB airfield. However, most contract ADAIR operations at Shaw AFB would occur during daytime hours and the tricolored bat is crepuscular/nocturnal. Therefore, the likelihood for the tricolored bat to encounter aircraft more frequently than under existing conditions is very low. As such, aircraft movement and the potential for aircraft strikes proximate to the Shaw AFB airfield would not likely jeopardize the continued existence of the tricolored bat.

Therefore, increased aircraft sorties on Shaw AFB would not likely jeopardize the continued existence of the monarch butterfly and tricolored bat. An ESA Section 7(a)(4) conference was initiated with the USFWS for the monarch butterfly and tricolored bat. USFWS concurred with this *not likely to jeopardize the* *continued existence* determination on 29 November 2023. Copies of relevant Section 7 correspondence are provided in **Appendix A.4**.

3.7.5.2 Special Use Airspace

Vegetation

Proposed contract ADAIR training support within the SUA would not impact vegetation communities or habitat under Alternative 1. Potential impacts on vegetation from countermeasure chaff and flare constituents may include toxicity or accumulation of chemical compounds. However, studies have determined that chaff deposition onto soils does not lead to significant increase of concentrations of chaff or flare chemical constituents in soil and have not been found to be toxic to plants or soil fauna (Air Force, 1997).

Wildlife

Proposed contract ADAIR operations under Alternative 1 would typically occur at altitudes above where most bird species would be migrating or foraging. As such, it is highly unlikely that aircraft movement would adversely impact foraging birds or have a risk of BASH under Alternative 1 in any of the SUA. Migrating birds could have a greater potential of encountering contract ADAIR aircraft during training operations, especially those that migrate at altitudes above 2,000 ft. However, most songbirds migrate at night and that most migratory birds migrate at altitudes less than 2,000 ft. Because ADAIR training would occur in a large area, primarily at high altitudes, and during daytime hours, the likelihood for birds to encounter aircraft during training operations is low. Therefore, adverse impacts on birds from aircraft movement is negligible under Alternative 1. Further, given the altitudes that the proposed operations would occur, aircraft movement in the SUA would have no impacts on terrestrial or marine mammals under Alternative 1.

Noise modeling for the Proposed Action indicates that there would be no substantial increase in noise within the SUA, and that subsonic and/or supersonic noise levels in the airspace would not change substantially from the baseline conditions (see **Section 3.4.5.2**). Therefore, the negligible change in noise levels as a result of the Proposed Action would have no impact on breeding, foraging, or nesting birds (including bald eagles), terrestrial mammals, marine mammals, or sea turtles in the SUA under Alternative 1.

Supersonic flights would not occur in the overland SUA. Sonic booms from supersonic flights within the Warning Areas could cause startle impacts on avian and mammal species on or near sea level; however, sonic boom and post-sonic boom noise that would be experienced by wildlife do not differ substantially from thunder. Further, the sonic boom events would be highly isolated and rare occurrences in the Warning Areas and occur in areas where supersonic flights currently occur with military training activities. As such, sonic booms from supersonic flights would have no impact on wildlife, including marine mammals and sea turtles in Warning Areas under Alternative 1.

Under Alternative 1, the use of chaff and flares would increase by 49 percent within the SUA, including in the Warning Areas. Impacts on terrestrial wildlife would be negligible from the use of chaff and flares, and flare use would account for fire risk, with limitations on flare use in overland MOAs and ATCAA implemented during periods of high fire risk. Impacts on avian species occurring in the Warning Areas from the use of chaff and flares would be limited to a startle effect from chaff and flare deployment and inhalation of chaff fibers or flare combustion products. An evaluation of the potential for chaff to be inhaled by humans and large wildlife found that the fibers are too large to be inhaled into the lungs and chaff material is made of silicon and aluminum that has been shown to have low toxicity (Air Force, 1997). The potential of a bird being struck by debris or a dud flare, given the large areas of the Warning Areas (6,233 square miles), is remote. Startle effects from the release of chaff and flares would be minimal relative to the noise of the aircraft. The potential for birds to be startled from flare deployment at night when flares would be most visible would be minimal due to the short burn time of the flare and limited number of nighttime operations. It is highly unlikely that during active military training with contract ADAIR aircraft that birds would remain in the area where training is occurring to be adversely impacted by chaff and flares deployment. Therefore, chaff and flare deployment would have no impact on avian species under Alternative 1. However, small residual plastic components reaching the ocean surface could have adverse impacts on avian species that forage on the ocean surface and some marine species.

Small residual plastic components of chaff and flares such as end caps and pistons, as well as chaff fibers, would be deposited on the ocean surface during training activities. Some large foraging bird species as well as marine mammals and sea turtles could ingest these constituents if these components remain on the ocean surface or in the water column. It would be unlikely that these debris components would be frequently encountered by foraging marine species, and would also be rare for these species to mistaken the plastic components for food. Therefore, if ingested, residual plastic components from chaff and flare use under Alternative 1 could have minor adverse impacts on avian species, marine mammals, and sea turtles. The effects of chaff and flare components on federally listed bird species, marine mammals, and sea turtles is discussed below in the *Threatened and Endangered Species* sub-section.

Fish

Proposed aircraft operations in the Warning Areas under Alternative 1 would have no impact on marine fish species. The use of additional chaff and flares would increase the potential for the plastic components to fall into the ocean. While the amount of additional plastic material from chaff and flare use is minor, the size of the components is small and most of the material would fall to the ocean floor, the use of chaff and flares within the Warning Areas may have a minor adverse impact on some fish species. Species that are large enough to ingest plastic pieces and inhabit the small portion of the shallower continental shelf waters that overlaps the boundaries of the Warning Areas may be impacted, although the likelihood of any large fish species encountering plastic caps from chaff and flares is extremely low. Therefore, the Proposed Action in the SUA would have no impact on any fishery or EFH.

Threatened and Endangered Species

Under Alternative 1 there would be no ground-disturbing activities within the SUA and potential impacts on threatened and endangered species would be associated with aircraft operations. Because there would be no ground-disturbing activities, there would be no impacts on federally or state listed plant species, reptiles, amphibians, fish, aquatic invertebrates or their habitat in areas underlying the Bulldog and Gamecock MOAs and ATCAA. Designated Critical Habitat for Atlantic sturgeon has been designated in waters underlying the Bulldog and Gamecock MOAs and ATCAA; however, because no ground-disturbing activities are included in the Proposed Action, Alternative 1 would have no effect on Atlantic sturgeon critical habitat. The use of defensive countermeasures and aircraft overflights would not alter the physical or biological features of the Atlantic sturgeon critical habitat in waters underlying the MOAs or the North Atlantic right whale and loggerhead sea turtle designated critical habitats in waters underlying the Warning Areas. Impacts on other listed species could occur from aircraft operations under Alternative 1 from aircraft movement, noise, and bird and animal aircraft strikes and are discussed below.

Alternative 1 would have no impacts on federally and state-listed birds. Bird species occurring within the Bulldog and Gamecock MOAs would primarily be foraging or nesting. Given the large area and high altitude where the majority of contract ADAIR training would occur, and that most ADAIR training would occur during daytime hours, the likelihood for migrating birds (which travel at higher altitudes and often during nighttime hours during migration) to encounter aircraft during training operations is low. Contract ADAIR would only increase the total number of sorties in the overland airspace by 700 sorties annually. As such, these species would likely not be startled or at risk from aircraft strikes from aircraft flying at higher altitudes. Aircraft noise in the MOAs and ATCAA would have no impact on bird species as the noise levels would not exceed 45 dB under Alternative 1.

Listed mammals with the potential to occur in areas underlying the Bulldog and Gamecock MOAs and ATCAA would potentially only be affected by aircraft overflights if the training activities elicited negative behavioral responses, or in the case of bats, were involved with aircraft strikes. It is highly unlikely that either aircraft movement or noise, especially at higher altitudes, would elicit a response from mammals. Noise from contract ADAIR aircraft would not exceed 45 dB and would therefore have no impact on the listed mammal species. Aircraft movement would not be visible to mammals unless an individual was at the exact location at the moment in which an aircraft traveling at high speed at a relatively low altitude passed directly overhead. These occurrences with contract ADAIR aircraft would be so rare as to be negligible and may not even generate a startle response if an interaction occurred. Most of the contract ADAIR training in the Bulldog and Gamecock MOAs and ATCAA would occur during daytime hours when the northern long-eared bat and tricolored bat would not be actively foraging and at altitudes higher than most bats occur. As such, the contract ADAIR training in the overland SUA would have no effect on listed mammals.

Annual migration patterns for the eastern monarch butterfly population include the Bulldog and Gamecock MOAs. Aircraft operations at altitudes at or below 1,000 ft in the MOAs could strike migrating monarch butterflies during soaring flight. However, only 700 additional annual contract ADAIR operations are proposed in the MOAs, and many of these operations would be at altitudes greater than 1,000 ft AGL. Therefore, it would be highly unlikely for aircraft operating in the Bulldog and Gamecock MOAs and ATCAA to strike migrating monarch butterflies under Alternative 1. As such, the contract ADAIR training in the Bulldog and Gamecock MOAs and ATCAA would have no effect on monarch butterflies.

Within the Warning Areas, it is not expected that either aircraft movement or noise emissions, especially at higher altitudes, would elicit a response from marine mammals or sea turtles. Noise from contract ADAIR aircraft would not increase substantially (including from sonic booms) in the Warning Areas and would therefore have no impacts on the listed marine mammal species and sea turtles. Sonic booms from supersonic aircraft movement could cause a startle response by the listed species when they are present on the surface of the ocean; however, sonic booms would be relatively rare events during contract ADAIR training in the action area, and the sonic boom and post-boom rumbling would be similar to what mammal species and sea turtles experience during a thunderstorm; therefore, sonic booms from supersonic aircraft movement is expected to have no impact on listed species. Additionally, for listed bird species such as the piping plover and red knot, given the large area where the majority of contract ADAIR training would occur and that most ADAIR training would occur during daytime hours, the likelihood for migrating or foraging birds to encounter aircraft during training operations is low.

There is the potential for chaff and flare components that remain after use to make their way to the surface of the Atlantic Ocean where they could be ingested by marine mammals, sea turtles, birds, and fish. Chaff and flare components, such as end caps and pistons, would be released into the marine environment, where they would persist for long periods and could be ingested by marine fauna while initially floating on the surface and sinking through the water column. Chaff and flare end caps and pistons would eventually sink to the seafloor (US Navy, 2009), which would reduce the likelihood of ingestion by marine fauna at the surface or in the water column but could still be ingested by some sea turtles such as green turtles and loggerhead turtles that forage on the ocean floor. However, with the relatively small amount of additional chaff and flare use over the very large areas of the Atlantic Ocean in the Warning Areas, there is an extremely low chance that marine fauna would encounter these small plastic chaff and flare components. Due to the large size of the Warning Areas (6,233 square miles) and relatively small amount of chaff and flare used (approximately 6,703 annual total), equates to an annual increase in use of about one chaff or flare per square mile.

Bird species could potentially encounter chaff and flare components on the ocean surface while foraging. Some species of seabirds are known to ingest plastic when it is mistaken for prey (Auman et al., 1997; Yamashita et al., 2011; Provencher et al., 2014). Seabirds consuming plastic does not damage the digestive tract, unless consumed in large quantities (Moser and Lee, 1992). The ingestion of plastic such as chaff and flare compression pads or pistons by birds could cause gastrointestinal obstructions or hormonal changes leading to reproductive issues (Provencher et al., 2014). Unless consumed plastic pieces were regurgitated, the chaff and flare compression pads or pistons could cause digestive tract blockages and eventual starvation and could potentially be lethal to birds foraging on the ocean surface that use or migrate through the Warning Areas and feed at the ocean surface such as the roseate tern. In addition, as previously stated, the majority of these chaff and flare plastic components would fall through the water column to the sea floor and would not remain on the ocean surface where a foraging bird would encounter and consume the plastic pieces. As previously discussed, the additional amount of plastic chaff and flare components that would be deposited into the marine environment is minor, and it is unlikely that foraging birds would encounter chaff and flare components while they were floating on the ocean surface. The potential for ingestion of plastic chaff and flare components as a result of the increased use of chaff and flares may affect but is not likely to adversely affect the roseate tern.

The West Indian manatee, blue whale, fin whale, North Atlantic right whale, sei whale, and sperm whale could encounter the chaff and flare components within the offshore waters under the Warning Areas. In the unlikely event the marine mammals encountered and ingested, the small size of chaff components and flare end caps and pistons (i.e., 1.3-inch diameter and 0.13-inch thick) would aid in passing through the digestive tract of marine mammals (US Navy, 2009); therefore, the use of defensive countermeasures may affect, but is not likely to adversely affect marine mammals.

Sea turtles, including the green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle could also encounter and ingest the end caps of chaff and flares. It is likely that small residual plastic components of chaff and flares would also pass through the digestive tract of mature sea turtles. Small plastic components could however cause digestive problems for sea turtles if ingested. Due to the large size of the Warning Areas proposed for use, it is highly unlikely that a sea turtle would encounter chaff and flare components under Alternative 1; therefore, the increased use of defensive countermeasures within the Warning Areas during contract ADAIR training may affect, but is not likely to adversely affect sea turtles.

Atlantic sturgeon, giant manta ray, and the oceanic white tip shark are found offshore in the marine waters located under the Warning Areas. Due to the dispersion of the chaff and flare components, the chance of Atlantic sturgeon, giant manta ray, and the oceanic white tip shark encountering chaff and flare pistons and caps on the ocean floor while foraging would be highly unlikely. Even if the small chaff and flare plastic components were encountered by these species, there is no evidence that they would be mistaken for a food source and consumed; therefore, the use of defensive countermeasures during contract ADAIR training may affect, but is not likely to adversely affect the Atlantic sturgeon, giant manta ray, and the oceanic white tip shark.

Given the limited range of the shortnose sturgeon in the Atlantic Ocean, the short periods of time that the species spends in saltwater environments, and the distance of the Warning Areas from coastal waters where the shortnose sturgeon is more likely to be found, the shortnose sturgeon would not be present in the Warning Areas; therefore, the shortnose sturgeon would not encounter plastic debris from chaff and flares in the Warning Areas, and the deployment of defensive countermeasures under Alternative 1 would have no effect on the shortnose sturgeon.

The Proposed Action may affect, but is not likely to adversely affect the following:

- Roseate tern
- West Indian manatee
- Blue whale
- Fin whale
- North Atlantic right whale
- Sei whale
- Sperm whale
- Green sea turtle
- Kemp's ridley sea turtle
- Leatherback sea turtle
- Loggerhead sea turtle
- Atlantic sturgeon
- Giant manta ray
- Oceanic white tip shark

The Proposed Action would not jeopardize the continued existence of the monarch butterfly or the tricolored bat. The Proposed Action would have no effect on the remaining listed species with the potential to occur below the SUA (i.e., eastern black rail, red-cockaded woodpecker, northern long-eared bat, wood stork, red knot, piping plover, roseate tern, and shortnose sturgeon). The USFWS concurred with these determinations on 29 November 2023. DAF notified NMFS of the Proposed Action. Copies of relevant correspondence are included in **Appendix A**.

3.7.6 Environmental Consequences – Alternative 2

3.7.6.1 Shaw Air Force Base

Proposed contract ADAIR operations at Shaw AFB under Alternative 2 would be the same as those that would occur under Alternative 1. Therefore, impacts on biological resources at Shaw AFB under Alternative 2 would be the same as those described for Alternative 1.

3.7.6.2 Special Use Airspace

The proposed contract ADAIR operations in SUA under Alternative 2 would be the same as those that would occur under Alternative 1. Therefore, the impacts on biological resources in SUA under Alternative 2 would be the same as those described for Alternative 1.

3.7.7 Environmental Consequences – No Action Alternative

Under the No Action Alternative, proposed contract ADAIR operations would not occur at Shaw AFB and existing conditions would continue. Therefore, the No Action Alternative would have no impacts on biological resources at Shaw AFB and the associated SUA.

3.7.8 Cumulative Impacts

When considered with other reasonably foreseeable future actions, the Proposed Action would not contribute to adverse cumulative impacts on biological resources because no other projects that would increase aircraft operations at Shaw AFB or SUA proposed for use were identified.

3.8 LAND USE

3.8.1 Definition of the Resource

Land use describes the natural or developed condition of a given parcel of land or area, and the type of functions and structures it supports. Examples of land use categories include residential, industrial, commercial, and recreational. Categorizing land uses and identifying land use patterns helps land management organizations characterize, manage, understand, and organize the functions and relationships of land within their jurisdictions.

In the context of this EA, land use is primarily evaluated with respect to existing and projected future noise conditions associated with the Proposed Action at Shaw AFB. The 65 dBA DNL is the noise level outside of which most land uses are compatible with noise from aircraft operations, as defined in Air Force Handbook 32-7084. Noise levels that exceed 65 dBA DNL may result in human annoyance and potential land use incompatibilities. Therefore, the ROI for land use includes on-base and off-base land within noise contours at or above the 65 dBA DNL that are associated with baseline (i.e., existing) conditions and proposed future conditions resulting from the Proposed Action. A detailed discussion of existing and proposed future noise conditions on and around Shaw AFB is provided in **Section 3.4**.

Land use is typically categorized and defined at the local jurisdiction level. As such, the meanings of different land use categories and definitions often vary among jurisdictions. There is no nationally recognized convention or uniform terminology for describing land use. Therefore, to provide a consistent basis for classification and comparison in this EA, land use categories discussed in this section have been generalized from those specifically used by Shaw AFB and surrounding local jurisdictions.

The Proposed Action does not involve the modification of or development within CZs, APZs, and Sumter County-designated Density Dispersion Zones associated with Shaw AFB's main runway, nor would it change the designation of or activities occurring on lands underlying the SUA. Land uses underlying these areas would continue to be defined and administered as they currently are. Therefore, land use underlying the CZs, APZs, Sumter County-designated Density Dispersion Zones, and SUA is not addressed further in this section. Existing conditions and potential effects regarding safety within these areas are discussed in **Section 3.5**.

3.8.2 Existing Conditions

3.8.2.1 On-Base Land Use

Existing DNL contours associated with Shaw AFB encompass approximately 8,126 acres on and off the installation. Existing DNL contours cover approximately 2,971 acres within the boundaries of Shaw AFB, or 37 percent of all land within these contours.

Land uses within existing DNL contours on Shaw AFB are summarized in **Table 3-29** and shown on **Figure 3-9**. Air Operations Maintenance Area/Airfield represents the largest on-base land use category within these contours (1,362.7 acres / 45.9 percent), followed by lands classified as Open Space Buffer Zone (783.5 acres / 26.4 percent). Combined, lands classified within these land use categories comprise 72.3 percent of on-base land within existing noise corridors. All other land use categories listed in **Table 3-29** each represent less than 10 percent of on-base lands within existing DNL contours.

Table 3-29 On-Base Land Use Within Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

Land Use Category	Area (acres) Within Existing DNL Contours					Total Area (acres) [1]	Percent of Total
	>65 dBA DNL	>70 dBA DNL	>75 dBA DNL	>80 dBA DNL	>85 dBA DNL		
Administrative	36.5	7.3	22.2	10.4	0.0	**76.5**	**2.6**
Air Operations Maintenance Area / Airfield	55.0	125.0	193.3	329.7	659.8	**1,362.7**	**45.9**
Community Commercial	4.7	0.7	18.5	1.4	0.0	**25.3**	**0.9**
Community Service Area	7.1	5.7	34.8	2.8	0.0	**50.4**	**1.7**
Housing Accompanied	147.8	49.4	0.0	0.0	0.0	**197.2**	**6.6**
Housing Unaccompanied	0.0	26.2	11.4	0.0	0.0	**37.6**	**1.3**
Industrial	20.7	61.3	26.8	0.1	0.0	**109.0**	**3.7**
Medical / Dental	3.2	21.1	0.0	0.0	0.0	**24.2**	**0.8**
Mixed Urban / Built-up Land	4.9	8.0	5.2	1.5	0.0	**19.6**	**0.7**
Open Space Buffer Zone	177.0	206.8	244.7	155.1	0.0	**783.5**	**26.4**
Outdoor Recreation	81.3	110.4	35.9	7.2	0.0	**234.7**	**7.9**
School	11.6	20.3	0.0	0.0	0.0	**31.9**	**1.1**
Water	0.0	8.1	9.9	0.0	0.0	**18.0**	**0.6**
Total [1]	**549.9**	**650.1**	**602.7**	**508.2**	**659.8**	**2,970.7**	**100.0**

Notes:
Source: Shaw AFB, 2023.
[1] Transportation-related land uses (e.g., roads, railroad tracks, associated rights of way) are not included in the totals shown in this table; therefore, land use acreage totals presented here may be less than those described in **Section 3.3**.
dBA = A-weighted decibel; DNL = day-night average sound level

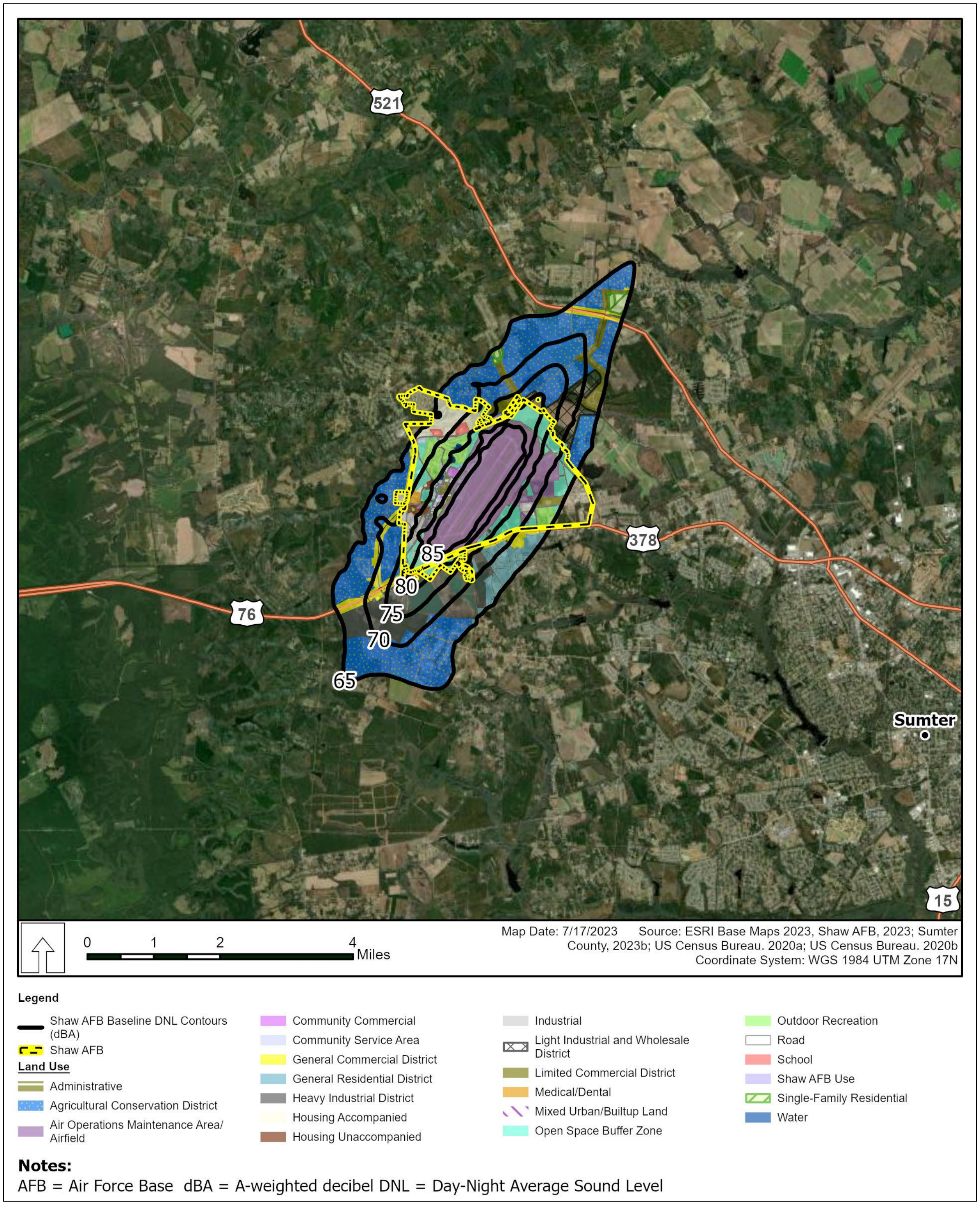

Figure 3-9 Existing On-Base and Off-Base Land Use Within Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

Approximately 5,000 persons live in US Census blocks associated with Shaw AFB that are within or intersected by existing DNL contours (**Table 3-30**). These populations are distributed throughout portions of all five DNL contours overlying the base, although most are within the 65, 70, 75, and 80 dBA DNL. Residents within these blocks occupy just over 1,600 housing units (US Census Bureau, 2020a; US Census Bureau, 2020b). The distribution of housing units within the existing DNL contours is similar to the population distribution.

Table 3-30 Residential Population and Occupied Housing Units in Shaw Air Force Base US Census Blocks Under Existing Day-Night Average Sound Level Contours

dBA DNL	Population	Occupied Housing Units
65	1,896	665
70	1,191	427
75	1,097	340
80	770	207
85	11	4
Total	**4,965**	**1,643**

Notes:
Source: US Census Bureau, 2020a; US Census Bureau, 2020b.
dBA = A-weighted decibel; DNL = day-night average sound level

3.8.2.2 Off-Base Land Use

Existing DNL contours associated with Shaw AFB cover approximately 5,155 acres of off-base land, representing approximately 63.4 percent of all lands within these contours. Off-base land uses within the existing DNL contours are summarized in **Table 3-31** and shown on **Figure 3-9**.

The majority of off-base land within existing DNL contours is classified as Agricultural Conservation District (3,040.6 acres / 59.0 percent), followed by Heavy Industrial District (919.9 acres / 17.8 percent). Lands within these categories represent approximately 76.8 percent of off-base land within existing DNL contours. All other land use categories listed in **Table 3-31** each represent less than 10 percent of off-base lands within existing DNL contours.

Combined, the residential land uses listed in **Table 3-31** total approximately 341.8 acres, or approximately 6.6 percent of all land uses within existing off-base DNL contours. No residential uses are in DNL contours exceeding 75 dBA DNL; the majority of residential land uses are in the 65 dBA DNL contour, with approximately 42.9 acres in the 70 dBA DNL contour.

Airport and aircraft noise, and sounds emanating from governmental activities, are exempt from noise regulations in Sumter County's Code of Ordinances (Sumter County, 2023a).

Table 3-31 Off-Base Land Use Within Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

Land Use Category	Area (acres) Within Existing DNL Contours					Total Area (acres) [1]	Percent of Total
	>65 dBA DNL	>70 dBA DNL	>75 dBA DNL	>80 dBA DNL	>85 dBA DNL		
Agricultural Conservation District	2,280.1	577.6	178.5	4.4	0.0	**3,040.6**	**59.0**
General Commercial District	190.7	83.8	17.3	2.9	0.0	**294.7**	**5.7**
General Residential District	229.3	42.9	0.0	0.0	0.0	**272.2**	**5.3**
Single-Family Residential	69.6	0.0	0.0	0.0	0.0	**69.6**	**1.3**
Heavy Industrial District	294.2	388.3	208.5	29.0	0.0	**919.9**	**17.8**

Table 3-31 Off-Base Land Use Within Existing Day-Night Average Sound Level Contours at Shaw Air Force Base

Land Use Category	Area (acres) Within Existing DNL Contours					Total Area (acres) [1]	Percent of Total
	>65 dBA DNL	>70 dBA DNL	>75 dBA DNL	>80 dBA DNL	>85 dBA DNL		
Light Industrial and Wholesale District	96.9	132.4	49.2	19.8	0.0	**298.4**	**5.8**
Limited Commercial District	163.4	45.5	38.8	0.0	0.0	**247.7**	**4.8**
Shaw AFB Use	0.0	1.5	10.0	0.4	0.0	**11.9**	**0.2**
Total [1]	**3,324.2**	**1,271.9**	**502.4**	**56.5**	**0.0**	**5,155.0**	**100.0**

Notes:
Source: Sumter County, 2023b.
[1] Transportation-related land uses (e.g., roads, railroad tracks, associated rights of way) are not included in the totals shown in this table; therefore, land use acreage totals presented here may be less than those described in **Section 3.3**.
dBA = A-weighted decibel; DNL = day-night average sound level

Approximately 13,000 persons occupy nearly 5,000 housing units in Sumter County Census blocks within or intersected by existing Shaw AFB DNL contours (**Table 3-32**) (US Census Bureau, 2020a; US Census Bureau, 2020b). Most residents and housing units are in Census blocks that are within or intersected by the 65 dBA DNL and 70 dBA DNL contours, which are farther away from the installation's runways; no residents or housing units are in Census blocks that are within or intersected by the 85 dBA DNL contour, which is closer to the runways. More than 2,300 Sumter County residents occupy over 700 housing units in Census blocks within or intersected by the 75 dBA DNL and 80 dBA DNL contours, although no off-base lands designated as General Residential District or Single-Family Residential are within those contours (see **Table 3-31**).

Table 3-32 Residential Population and Occupied Housing Units in Sumter County US Census Blocks Under Existing Day-Night Average Sound Level Contours

dBA DNL	Population	Occupied Housing Units
65	7,528	2,981
70	3,125	1,224
75	1,694	572
80	628	157
85	0	0
Total	**12,975**	**4,934**

Notes:
Source: US Census Bureau, 2020a; US Census Bureau, 2020b.

3.8.3 Environmental Consequences Evaluation Criteria

Potential impacts on land use are based on the level of land use sensitivity in areas potentially affected by the Proposed Action and alternatives as well as compatibility of those actions with existing conditions. In general, a land use impact would be adverse if it met one of the following criteria:

- inconsistency or noncompliance with existing land use plans or policies;
- precluded the viability of existing land use;
- precluded continued use or occupation of an area;
- incompatibility with adjacent land use to the extent that public health or safety is threatened; or
- conflict with planning criteria established to ensure the safety and protection of human life and property.

3.8.4 Environmental Consequences – Alternative 1

Noise increases under each of the High, Medium, and Low Noise Scenarios under the Proposed Action would have the potential to result in corresponding increases in the amount of land within DNL contours associated with Shaw AFB (including land currently outside the existing 65 dBA DNL). Such increases could be perceived by and/or cause annoyance to listeners on and around Shaw AFB.

Generally, it is anticipated that elevated noise levels associated with the Proposed Action would result from multiple discrete events occurring throughout the day (i.e., primarily during aircraft takeoffs) and would be of relatively brief duration, rather than sustained or prolonged noise emissions. Such noise would diminish rapidly as the aircraft climbs to operating altitude and transits to the operational airspace. The actual noise level perceived or experienced by a listener on or outside Shaw AFB would likely vary for each event depending on the type and configuration of aircraft, the operation being performed, aircraft altitude and distance to the listener, weather conditions, topography, other noise sources in the ambient environment, and other factors.

It is anticipated that the primary human response to such noise would be annoyance and that such noise would have no potential to preclude the viability of existing land uses or the continued occupation of those areas, threaten public health or safety, or conflict with planning criteria that ensure the safety and protection of human life and property. Increased noise levels from Alternative 1 would not conflict with noise regulations in Sumter County's Code of Ordinances because airport and airplane noise, and sounds emanating from governmental activities, are exempt from those regulations. Therefore, while adverse, impacts on land use from increased noise levels resulting from the High, Medium, and Low Noise Scenarios under the Proposed Action would be minor to moderate and not significant.

Impacts on land use from each of the High, Medium, and Low Noise Scenarios are further discussed below.

3.8.4.1 High Noise Scenario

Under the High Noise Scenario, the area of on-base and off-base lands within DNL contours associated with the Proposed Action would increase by approximately 6,061.8 acres, or approximately 75 percent over existing conditions (**Table 3-33**). This increase would primarily result from the proposed use of the F-18E/F aircraft under the High Noise Scenario, which generates increased noise during landing operations relative to other aircraft proposed for use (see additional discussion in **Section 3.4**). The largest increase would occur on lands that would fall within the Alternative 1 65 dBA DNL contour (3,770.3 additional acres), which are currently outside of the existing 65 dBA DNL.

Table 3-33 Change in Area Within Day-Night Average Sound Level Contours On and Around Shaw Air Force Base Under the High, Medium, and Low Noise Scenarios of Alternative 1

Noise Level (dBA DNL)	Existing Area (acres)	Change in Area Within DNL Contours (acres)		
		High Noise Scenario	Medium Noise Scenario	Low Noise Scenario
> 65	3,874.1	3,770.3	489.4	573.7
> 70	1,922.1	1,529.6	185.7	245.5
> 75	1,105.0	411.1	56.9	86.4
> 80	564.7	238.0	61.2	91.5
> 85	659.8	112.8	28.1	42.4
Total	**8,125.7**	**6,061.8**	**821.2**	**1,039.5**

Notes:
Source: Sumter County, 2023b.
dBA = A-weighted decibel; DNL = day-night average sound level

Off-base residential land uses within Shaw AFB DNL contours would increase by approximately 556 acres or approximately 163 percent over existing conditions, with the largest increases occurring within the 65 dBA DNL (471.8 acres) and 70 dBA DNL (82.5 acres) (**Table 3-34**). Residential land uses would represent approximately 6.3 percent of off-base lands within Shaw AFB DNL contours under the High Noise Scenario (**Table 3-35**). Lands classified as Agricultural Conservation District (58.0 percent) and Heavy Industrial District (6.9 percent) would continue to represent the largest areas of off-base lands within those contours. On-base and off-base land uses within DNL contours associated with the High Noise Scenario are shown on **Figure 3-10**.

Table 3-34 Change in Off-Base Residential Area within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1

DNL Contour (dBA DNL)	Existing Off-Base Residential Area (acres)	Change (acres)	Total (acres)
High Noise Scenario			
>65	298.9	471.8	770.7
>70	42.9	82.5	125.3
>75	0.0	1.7	1.7
>80	0.0	0.0	0.0
>85	0.0	0.0	0.0
Total – High Noise Scenario	**341.7**	**556.0**	**897.8**
Medium Noise Scenario			
>65	298.9	81.3	380.2
>70	42.9	8.5	51.4
>75	0.0	0.0	0.0
>80	0.0	0.0	0.0
>85	0.0	0.0	0.0
Total – Medium Noise Scenario	**341.7**	**89.9**	**431.6**
Low Noise Scenario			
>65	298.9	120.5	419.4
>70	42.9	13.9	56.7
>75	0.0	0.1	0.1
>80	0.0	0.0	0.0
>85	0.0	0.0	0.0
Total – Low Noise Scenario	**341.7**	**134.5**	**476.2**

Notes:
Source: Sumter County, 2023b.
dBA = A-weighted decibels; DNL = day-night average sound level

Table 3-35 Percentage of On-Base and Off-Base Lands Within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1

Land Use Category	Percent of Total On-Base and Off-Base Area Within Shaw AFB Day-Night Average Sound Level Contours			
	Existing Conditions	High Noise Scenario	Medium Noise Scenario	Low Noise Scenario
All Shaw AFB On-Base Land Uses	**36.6**	**21.8**	**33.6**	**33.1**
Sumter County	**63.4**	**78.2**	**66.4**	**66.9**
Agricultural Conservation District	37.4	58.0	41.2	41.7
General Commercial District	3.6	2.8	3.5	3.4
General Residential District	3.3	4.5	3.7	4.0
Single-Family Residential	0.9	1.8	1.1	1.2
Heavy Industrial District	11.3	6.9	10.4	10.2
Light Industrial and Wholesale District	3.7	2.1	3.3	3.3
Limited Commercial District	3.0	1.9	2.9	2.9
Planned Development	0.0	0.0	0.0	0.0
Shaw AFB Use	0.1	0.1	0.1	0.1

Notes:
Source: Shaw AFB, 2023; Sumter County, 2023b.

As shown in **Table 3-36**, the residential population of Sumter County Census blocks within or intersected by DNL contours associated with the High Noise Scenario would increase by approximately 6,347 persons, or almost 49 percent over existing conditions. The largest change would occur within the 65 dBA and 70 dBA DNL contours (2,845 and 2,168 additional persons, respectively), which are farther away from the installation’s runways. Although off-base residential populations within the 80 dBA DNL and 85 dBA DNL contours would increase by almost 600 persons, these increases would occur on lands with designations other than General Residential District or Single-Family Residential, as no lands with those designations would be located within those contours (see **Table 3-34**).

The number of occupied housing units in Sumter County under High Noise Scenario DNL contours would also increase by 2,431 units or approximately 49 percent (**Table 3-37**). These increases would occur in all contours except the >85 dBA DNL. The distribution of these increases would be similar to those of the residential population. The largest increases in housing units would occur within the 65 dBA and 70 dBA DNL contours (1,172 and 849 occupied housing units, respectively). While housing units within the 80 dBA DNL and 85 dBA DNL contours would increase by approximately 127 units, these increases would occur on lands designated as uses other than General Residential District and Single-Family Residential, as no lands with those designations would be located within those contours (see **Table 3-34**) (Sumter County, 2023b).

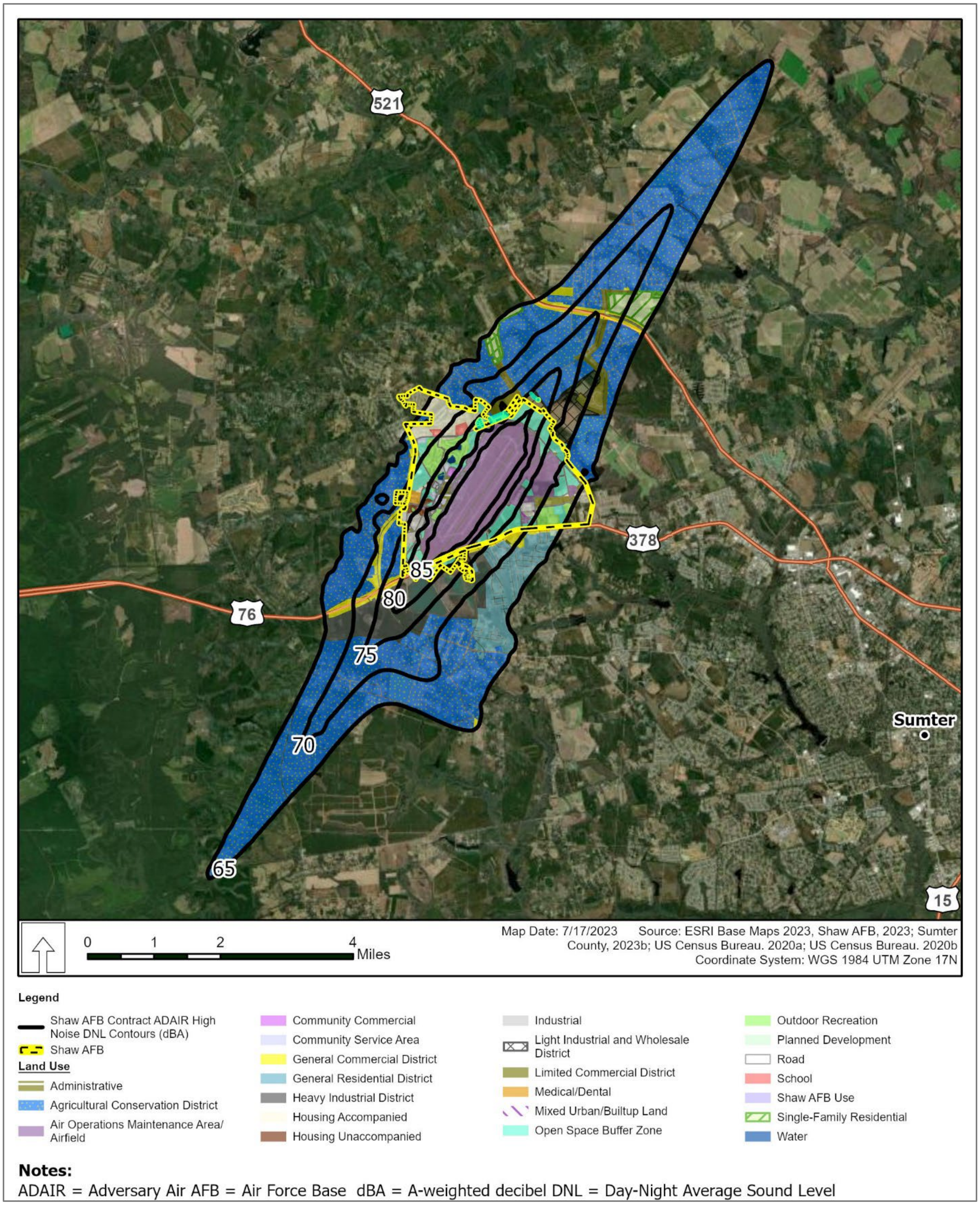

Figure 3-10 Existing On-Base and Off-Base Land Use Within Alternative 1 High Noise Scenario Contours at Shaw Air Force Base

Table 3-36 Change in Off-Base Residential Population within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1

DNL Contour (dBA DNL)	Existing Off-Base Population	Change (Number)	Change (Percent)	Total (Number)
High Noise Scenario				
>65	7,528	2,845	37.8	10,373
>70	3,125	2,168	69.4	5,293
>75	1,694	735	43.4	2,429
>80	628	306	48.7	934
>85	0	293	N/A	293
Total – High Noise Scenario	**12,975**	**6,347**	**48.9**	**19,322**
Medium Noise Scenario				
>65	7,528	716	9.5	8,244
>70	3,125	261	8.4	3,386
>75	1,694	0	0.0	1,694
>80	628	225	35.8	853
>85	0	0	N/A	0
Total – Medium Noise Scenario	**12,975**	**1,202**	**9.3**	**14,177**
Low Noise Scenario				
>65	7,528	709	9.4	8,237
>70	3,125	139	4.4	3,264
>75	1,694	267	15.8	1,961
>80	628	241	38.4	869
>85	0	0	0.0	0
Total – Low Noise Scenario	**12,975**	**1,356**	**10.5**	**14,331**

Notes:
Source: US Census Bureau, 2020a; US Census Bureau, 2020b.
dBA = A-weighted decibels; DNL = day-night average sound level; N/A = not applicable

Table 3-37 Change in Off-Base Occupied Housing Units within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1

DNL Contour (dBA DNL)	Existing Off-Base Occupied Housing Units	Change (Number)	Change (Percent)	Total (Number)
High Noise Scenario				
>65	2,981	1,172	39.3	4,153
>70	1,224	849	69.4	2,073
>75	572	283	49.5	855
>80	157	109	69.4	266
>85	0	18	N/A	18
Total – High Noise Scenario	**4,934**	**2,431**	**49.3**	**7,365**
Medium Noise Scenario				
>65	2,981	279	9.4	3,260
>70	1,224	105	8.6	1,329
>75	572	0	0.0	572
>80	157	80	51.0	237
>85	0	0	N/A	0
Total – Medium Noise Scenario	**4,934**	**464**	**9.4**	**5,398**

Table 3-37 Change in Off-Base Occupied Housing Units within Day-Night Average Sound Level Contours Under the High, Medium, and Low Noise Scenarios of Alternative 1

DNL Contour (dBA DNL)	Existing Off-Base Occupied Housing Units	Change (Number)	Change (Percent)	Total (Number)
Low Noise Scenario				
>65	2,981	276	9.3	3,257
>70	1,224	65	5.3	1,289
>75	572	99	17.3	671
>80	157	86	54.8	243
>85	0	0	0.0	0
Total – Low Noise Scenario	**4,934**	**526**	**10.7**	**5,460**

Notes:
Source: US Census Bureau, 2020a.
dBA = A-weighted decibels; DNL = day-night average sound level; not applicable

Increased noise levels under the High Noise Scenario would have the potential to be perceived by and cause annoyance to some listeners within the expanded DNL contours. However, these increased noise levels would not be anticipated to preclude the viability of existing land uses or preclude continued use or occupation of surrounding areas or threaten public health and safety. DNL increases at residential POIs outside the existing 65 dBA DNL contour would not cause those POIs to fall within the 65 dBA DNL contour under the High Noise Scenario (R1, R2), nor would DNL increases at Residential POIs within the existing 65 dBA DNL contour exceed 2 dBA under the High Noise Scenario (R3, R4) (**Table 3-13**). Additionally, increased noise levels from the High Noise Scenario of Alternative 1 would not conflict with noise regulations in Sumter County's Code of Ordinances because airport and aircraft noise, and sounds emanating from governmental activities, are exempt from those regulations. Therefore, while adverse and long-term, impacts on land use under the High Noise Scenario would be moderate and not significant.

3.8.4.2 Medium Noise Scenario

Land within DNL contours associated with Shaw AFB would increase by approximately 821 acres under the Medium Noise Scenario (**Table 3-33**). The largest increases would occur in the 65 dBA DNL contour (489.4 acres), 70 dBA DNL contour (185.7 acres), and 80 dBA DNL contour (61.2 acres), while increases within the 75 dBA DNL contour and 85 dBA DNL contour would be less than 60 acres and 30 acres, respectively. Land uses within DNL contours associated with the Medium Noise Scenario are shown on **Figure 3-11**.

Residential land uses within the Medium Noise Scenario contours would increase by approximately 90 acres, with the largest increase occurring in the 65 dBA DNL contour (81.3 acres) (**Table 3-34**). Off-base residential land uses would represent approximately 4.8 percent of off-base lands within Shaw AFB DNL contours under the Medium Noise Scenario (**Table 3-35**). Off-base lands classified as Agricultural Conservation District (41.2 percent) and Heavy Industrial District (10.4 percent) would continue to represent the largest areas of off-base lands within those contours.

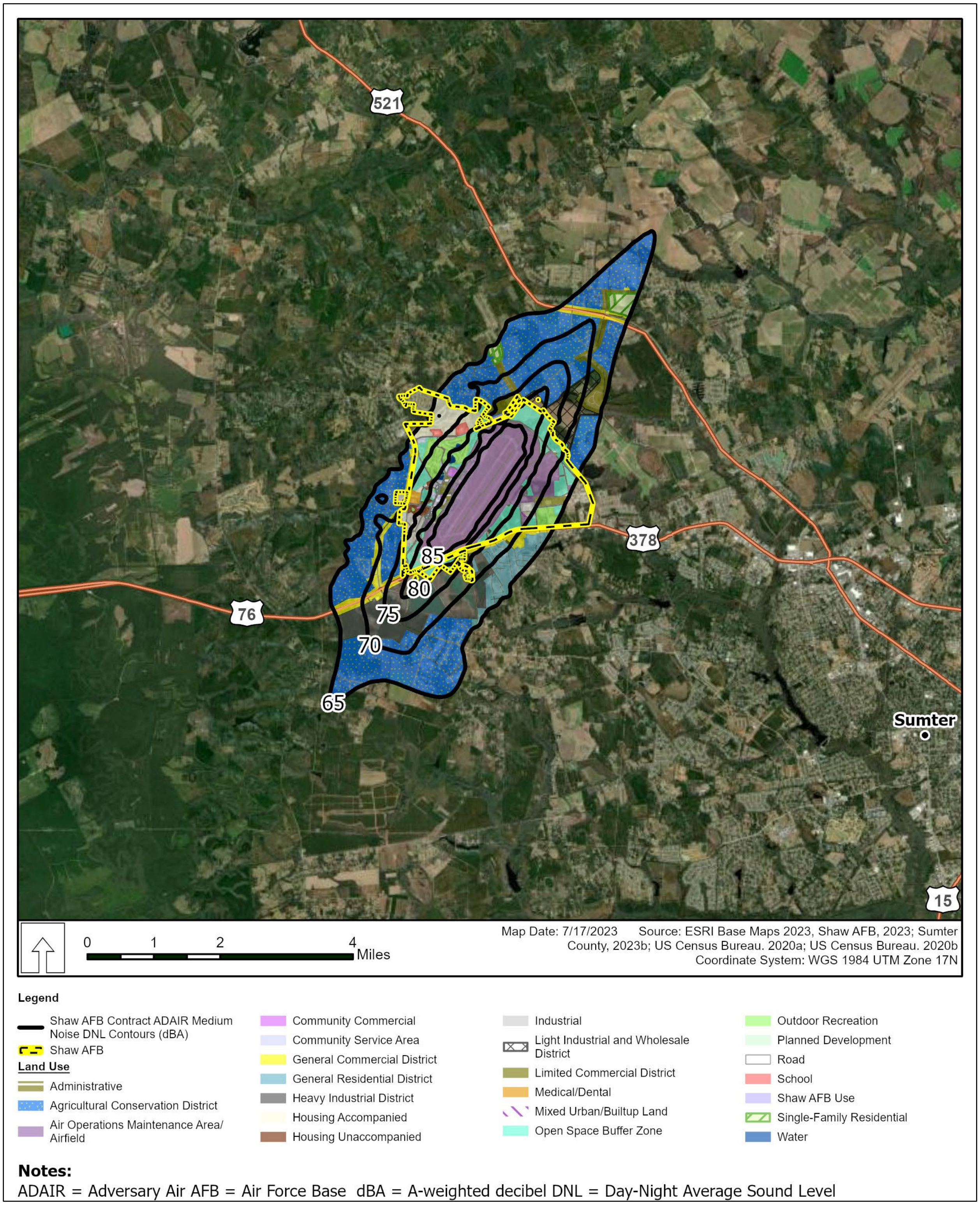

Figure 3-11 Existing On-Base and Off-Base Land Use Within Alternative 1 Medium Noise Scenario Contours at Shaw Air Force Base

The residential population of Sumter County Census blocks within DNL contours associated with the Medium Noise Scenario would increase by approximately 1,202 persons or 9.3 percent over existing conditions (**Table 3-36**). All of the increases would occur in the 65 dBA DNL (716 persons), 70 dBA DNL (261 persons), and 80 dBA DNL (225 persons). Changes in the residential population within the 80 dBA DNL contour would occur on lands designated as uses other than General Residential District and Single-Family Residential, as no lands with those designations would be located within that contour under the Medium Noise Scenario (see **Table 3-34**) (US Census Bureau, 2020a; US Census Bureau 2020b; Sumter County, 2023b). No change in residential population would occur in the 75 and 85 dBA DNL contours; the population within Sumter County census blocks within the 85 dBA DNL contour would continue to be zero.

Increases in the number of occupied housing units within Sumter County census blocks under the Medium Noise Scenario contours would follow a pattern similar to the population changes described above (**Table 3-37**) (US Census Bureau, 2020a; US Census Bureau 2020b; Sumter County, 2023b). The total number of occupied housing units within these contours would increase by 9.4 percent over existing conditions, and no increases would occur in the 75 dBA DNL and 85 dBA DNL contours. Changes in the number of occupied housing units within the 80 dBA DNL contour would occur on lands designated as uses other than General Residential District and Single-Family Residential, as no lands with those designations would be located within that contour under the Medium Noise Scenario (see **Table 3-34**). The number of occupied housing units in Sumter County census blocks under the 85 dBA DLN contour associated with the Medium Noise scenario would continue to be zero.

Overall, while these increased noise levels could be perceived by and cause annoyance to listeners within contours associated within the Medium Noise Scenario, they would not preclude the viability of existing land uses or preclude continued use or occupation of surrounding areas or threaten public health and safety. The DNL at residential POIs would increase by 1 dBA or less under the Medium Noise Scenario and would be likely unnoticeable and less than significant (**Table 3-15**). Increased noise levels from the Medium Noise Scenario of Alternative 1 would not conflict with noise regulations in Sumter County's Code of Ordinances because airport and airplane noise, and sounds emanating from governmental activities, are exempt from those regulations. Therefore, while adverse and long-term, impacts on land use under the Medium Noise Scenario would be minor and not significant.

3.8.4.3 Low Noise Scenario

Under the Low Noise Scenario, the total amount of land within DNL contours associated with Shaw AFB would increase by approximately 1,039.5 acres or approximately 13 percent over existing conditions (**Table 3-33**). This increase would be somewhat more than under the Medium Noise Scenario (821.2 acres) but substantially less than the High Noise Scenario (6,061.8 acres). The largest increases would occur within the 65 dBA DNL and 70 dBA DNL contours (573.7 and 245.5 acres, respectively), while increases within each of the 75 dBA DNL, 80 dBA DNL, and 85 dBA DNL contours would be less than 100 acres. Land uses within DNL contours associated with the Low Noise Scenario are shown on **Figure 3-12**.

Residential lands within the Low Noise Scenario contours would increase by 134.5 acres, with the majority of this increase occurring within the 65 dBA DNL contour (120.5 acres) (**Table 3-34**). No increase in residential lands would occur within the 80 dBA DNL or 85 dBA DNL contours. Residential land uses would represent approximately 5.2 percent of off-base lands within Shaw AFB DNL contours under the High Noise Scenario, while lands classified as Agricultural Conservation District (41.7 percent) and Heavy Industrial District (10.2 percent) would continue to represent the largest areas of off-base lands within those contours (**Table 3-35**).

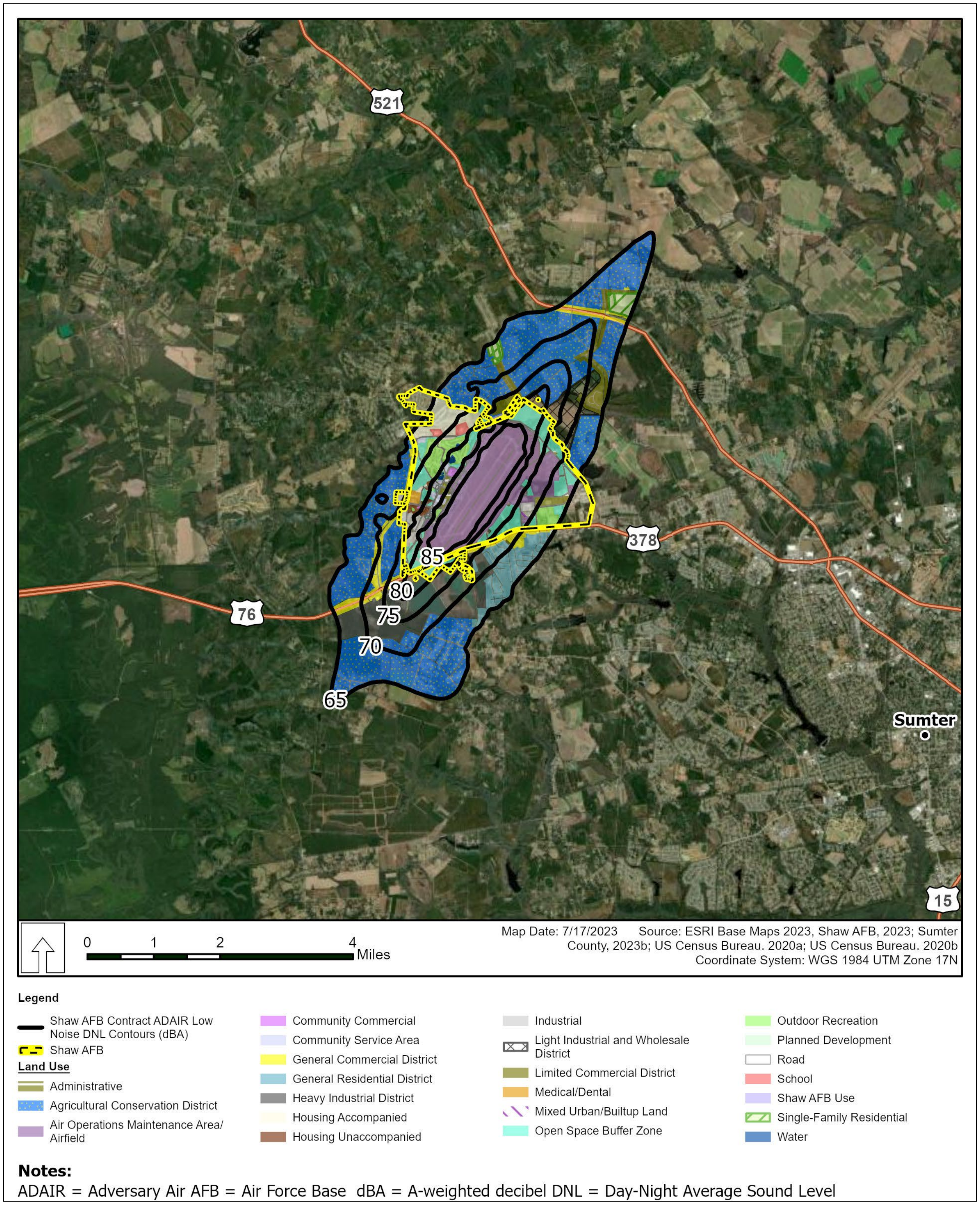

Figure 3-12 Existing On-Base and Off-Base Land Use Within Alternative 1 Low Noise Scenario Contours at Shaw Air Force Base

The residential population of Sumter County Census blocks within Low Noise Scenario DNL contours would increase by approximately 1,356 persons or 10.5 percent over existing conditions (**Table 3-36**). Increases would occur within all DNL contours except the 85 dBA DNL contour, with the largest increases (by percent) occurring in the 75 dBA DNL (15.8 percent) and 80 dBA DNL (38.4 percent) contours. Most increases in the residential population within the 75 dBA DNL contour, and all increases within the 80 dBA DNL and 85 dBA DNL contours, would occur on lands with designations other than General Residential District and Single-Family Residential, as minimal lands with those designations would be located within the 75 dBA DNL contour and none would be located within the 80 dBA DNL and 85 dBA DNL contours of the Low Noise Scenario (see **Table 3-34**). No change would occur within the 85 dBA DNL contour, and the population within that contour would continue to be zero.

Increases in the number of occupied housing units within Sumter County census blocks under the Low Noise Scenario contours would follow a pattern similar to the population changes described above (**Table 3-37**). The total number of occupied housing units within these contours would increase by 10.7 percent over existing conditions, and the largest changes (by percent) would occur in the 75 dBA DNL contour (17.3 percent) and 80 dBA DNL contour (54.8 percent). Most increases in the number of occupied housing units within the 75 dBA DNL contour, and all increases within the 80 dBA DNL and 85 dBA DNL contours, would occur on lands with designations other than General Residential District and Single-Family Residential, as minimal lands with those designations would be located within the 75 dBA DNL contour and none would be located within the 80 dBA DNL and 85 dBA DNL contours of the Low Noise Scenario (see **Table 3-34**) (Sumter County, 2023b; US Census Bureau, 2020a; US Census Bureau, 2020b). No change would occur in the 85 dBA DNL contour, and the number of occupied housing units in Sumter County census blocks within the 85 dBA DNL contour under the Low Noise Scenario would continue to be zero.

Increased noise levels could be perceived by and cause annoyance to listeners within DNL contours associated with the Low Noise Scenario. Although the DNL at one residential POI would increase by 5 dBA under the Low Noise Scenario and would be long-term and likely noticeable, the DNL at this POI would remain well below 65 DBA (**Table 3-17**). DNL increases at other residential POIs between 1 and 2 dBA under the Low Noise Scenario would be long-term but likely unnoticeable. Increases in DNL on Sumter County lands would not be anticipated to preclude the viability of existing land uses or preclude continued use or occupation of surrounding areas or threaten public health and safety. Increased noise levels from the Low Noise Scenario of Alternative 1 would not conflict with noise regulations in Sumter County's Code of Ordinances because airport and airplane noise, and sounds emanating from governmental activities, are exempt from those regulations. Therefore, while adverse and long-term, impacts on land use under the Low Noise Scenario would be minor and not significant.

3.8.5 Environmental Consequences – Alternative 2

Proposed aircraft operations under Alternative 2 would be the same as those that would occur under Alternative 1. Therefore, effects on land use from noise associated with Alternative 2 would be the same as those described in **Section 3.8.4** for the High, Medium, and Low Noise Scenarios under Alternative 1. Effects would not be significant.

3.8.6 Environmental Consequences – No Action Alternative

Under the No Action Alternative, contract ADAIR operations would not occur at Shaw AFB and existing conditions would continue. Therefore, the No Action Alternative would have no effect on land use on and around Shaw AFB.

3.8.7 Cumulative Impacts

Land development and redevelopment activities occur on and outside Shaw AFB on an ongoing basis to accommodate new personnel, tenants, and operations (on Shaw AFB) and new residents, businesses, public facilities, infrastructure, and other local needs and uses (in off-base jurisdictions). A review of the available information of reasonably foreseeable on- and off-base future actions pertaining to land use and development that could be affected by noise conditions indicates there are no large projects near Shaw AFB that when considered in combination with the Proposed Action would have the potential to create cumulative land use impacts.

On Shaw AFB and in local off-base jurisdictions, land development plans will continue to be reviewed by appropriate planning authorities for compatibility with existing natural and human-influenced environmental conditions (including noise at Shaw AFB), base and community needs, and other factors. Based on these reviews, on-base and off-base development would be appropriately planned and sited in areas that are determined to be compatible with existing and anticipated future conditions, including noise generated by Shaw AFB operations. Therefore, when considered with other reasonably foreseeable future land use actions on and around Shaw AFB, the Proposed Action would not contribute to significant adverse effects on land use.

3.9 SOCIOECONOMICS – INCOME AND EMPLOYMENT

3.9.1 Definition of the Resource

Socioeconomics is the relationship between economics and social elements, such as population levels and economic activity. Several factors can be used as indicators of economic conditions for a geographic area, including demographics, median household income, unemployment rates, percentage of families living below the poverty level, employment, and housing data. Data on employment identify gross numbers of employees, employment by industry or trade, and unemployment trends. Data on industrial, commercial, and other sectors of the economy provide baseline information about the economic health of a region. Economic data are typically presented at county, state, and national levels to characterize baseline socioeconomic conditions and provide a basis of comparison to local, statewide, and nationwide trends.

Relevant socioeconomic factors with respect to the Proposed Action primarily include income and employment. The analysis presented in this section primarily focuses on income and employment characteristics of Sumter County and the Columbia-Orangeburg-Newberry metropolitan statistical area. Elements of the Proposed Action occurring in overland SUA (i.e., the Bulldog and Gamecock MOAs and associated ATCAA, and the RobRoy airspace) would be limited to aircraft operations within that airspace and would have no potential to influence socioeconomic conditions in areas of South Carolina and Georgia underlying those SUA; therefore, those areas are not addressed in this analysis. Similarly, proposed activities occurring in SUA overlying the Atlantic Ocean (W-161 and W-177) would have no potential to affect socioeconomic conditions in onshore communities.

3.9.2 Existing Conditions – Shaw Air Force Base

Shaw AFB is within the City of Sumter and bounded to the north, west, and south by Sumter County. In 2021, the unemployment rate for Sumter County was 4.6 percent. The 2021 unemployment rate for Sumter County was higher than that of the state of South Carolina, which was 3.9 percent, but lower than for the United States, which was 5.3 percent (US Bureau of Labor Statistics, 2023a; 2023b). The median household income in 2021 was $49,040 for Sumter County. The median household income of Sumter County was lower than that of the state of South Carolina ($58,234) and the United States ($69,021). The rate of persons in poverty in 2021 was 20.0 percent for Sumter County, which was substantially higher than the rate of persons in poverty in South Carolina (14.6 percent) and the United States (11.6 percent).

In FY 2017, Shaw AFB supported an estimated workforce of 8,723 persons (7,259 military; 764 civilians; and approximately 700 contractors) and approximately 23,300 family members and off-base retirees, with an overall economic impact of $1.8 billion annually (Shaw AFB, 2022a).

3.9.3 Environmental Consequences Evaluation Criteria

Effects on socioeconomic resources were assessed in terms of the economic impact on the local economy that would potentially result from the Proposed Action. The level of impacts associated with the Proposed Action is assessed in terms of direct impacts on the local economy and related impacts on other socioeconomic resources such as employment. The magnitude of potential impacts can vary greatly, depending on the location of an action. For example, implementation of an action that creates 10 employment positions might be unnoticed in an urban area but might have significant impacts in a rural region. In addition, if potential socioeconomic changes resulting from other factors were to result in substantial shifts in population trends or in adverse impacts on regional spending and earning patterns, they may be considered adverse.

All potential impacts on socioeconomics from the Proposed Action would be limited to communities proximate to Shaw AFB in Sumter County, South Carolina.

3.9.4 Environmental Consequences – Alternative 1

3.9.4.1 Shaw Air Force Base

The 78 proposed contract ADAIR maintenance personnel and 15 proposed contract ADAIR pilots would represent a small increase in the total employment in the context of population and employment at Shaw AFB, in Sumter County, and in the nearby Columbia-Orangeburg-Newberry metropolitan statistical area (see **Section 3.8.2**). Therefore, the Proposed Action would have no impacts on income and employment at Shaw AFB or in Sumter County.

It is estimated that the maximum contracted value for ADAIR training would be $30,000 per flight hour (Headquarters ACC Acquisition Management and Integration Center, 2018), though most likely between $8,500 and $15,000 based on the technical solution sought. This would therefore potentially increase annual expenditures in the region of up to approximately $52.5 million to support 12 contract ADAIR aircraft flying 3,500 proposed annual sorties from Shaw AFB. These expenditures would include purchases of fuel, equipment, and materials to support the proposed contract ADAIR sorties as well as the employment of 93 highly skilled contract ADAIR personnel (i.e., aircraft maintainers and pilots). Increased expenditures from the Proposed Action and associated payroll tax revenue would provide a long-term, potentially minor, beneficial impact on the local economy.

As described in **Section 3.4.5**, increased noise levels associated with the Medium and Low Noise Scenarios would not be significant. Under the High Noise Scenario, significant noise increases (3 dBA or higher increase and DNL above 65 dBA) would occur at three POIs (W2, W5, and W7). However, all three of these POIs are places of worship, and no residential or commercial POIs that would potentially experience a significant noise increase were identified. Further, the noise increases at these three places of worship would primarily occur during weekday and daytime hours when large gatherings of people would be less likely to be present. Therefore, increased noise associated with the High, Medium, and Low Noise Scenarios of Alternative 1 would have no significant impacts on socioeconomics.

3.9.5 Environmental Consequences – Alternative 2

3.9.5.1 Shaw Air Force Base

Socioeconomic impacts under Alternative 2 would be the same as those described for Alternative 1. The number of contract ADAIR employees at Shaw AFB under Alternative 2 would be the same as Alternative 1. This would have no adverse impacts and minor beneficial impacts on socioeconomic conditions at Shaw AFB and in Sumter County.

3.9.6 Environmental Consequences – No Action Alternative

Under the No Action Alternative, contract ADAIR operations would not occur at Shaw AFB and existing socioeconomic conditions in Sumter County would continue. Therefore, the No Action Alternative would have no effect on local or regional socioeconomic conditions at or around Shaw AFB.

3.9.7 Cumulative Impacts

The Proposed Action would contribute to potential increases in local employment and economic expenditures, thereby contributing to minor beneficial cumulative impacts on socioeconomics in the region when considered with other past, present, and reasonably foreseeable future actions on and around Shaw AFB.

3.10 ENVIRONMENTAL JUSTICE AND PROTECTION OF CHILDREN

3.10.1 Definition of the Resource

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994) requires that federal agency actions substantially affecting human health or the environment do not exclude persons, deny persons benefits, or subject persons to discrimination because of their race, color, or national origin. Additionally, EO 12898 directs federal agencies to ensure the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Consideration of environmental justice concerns includes race, ethnicity, and the poverty status of populations in the vicinity of a proposed action.

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997) states that each federal agency "(a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks." EO 13045 recognizes that children may suffer disproportionately from environmental health and safety risks.

Minority populations are defined as Alaska Natives and American Indians, Asians, Blacks or African Americans, Native Hawaiians, and Pacific Islanders or persons of Hispanic origin (of any race). Low-income populations include persons living below the poverty threshold as determined by the US Census Bureau. Children are persons under 18 years of age, while elderly populations consist of adults 65 years of age and older.

The analysis presented in this section primarily focuses on the characteristics of human populations in Sumter County. The Proposed Action would have no potential to affect minority and low-income populations or populations of children or the elderly in areas of South Carolina and Georgia underlying the onshore SUA because the Proposed Action would result in no substantial changes in the noise environment of those SUA (see **Section 3.4**). Therefore, populations in those areas are not addressed in this analysis. Similarly, proposed activities occurring in SUA overlying the Atlantic Ocean (W-161 and W-177) would have no potential to affect human populations in onshore communities.

3.10.2 Existing Conditions – Shaw Air Force Base

In 2022, Sumter County had a substantially higher percentage of minorities (55.6 percent) when compared to the state of South Carolina (36.5 percent), and the United States (41.1 percent). A total of 47.9 percent of the Sumter County identified as Black or African American compared to 26.3 percent for the state of South Carolina and 13.6 percent for the United States.

The rate of persons in poverty in 2022 was 20.0 percent for Sumter County, which was higher than the rate of persons in poverty in the state of South Carolina (14.6 percent), and the United States (11.6 percent) (US Census Bureau, 2023).

In 2022, the percentage of the population that were children in Sumter County (23.6 percent), which was slightly higher than the percent of youth population in the state of South Carolina (21.2 percent), and the United States (21.7 percent) (US Census Bureau, 2023).

The percent of the population that were elderly in Sumter County (17.8 percent) was lower than the percent of the elderly population in the state of South Carolina (19.1 percent) in 2022. However, the elderly population of Sumter County was very similar to the percentage of elderly persons in the United States (17.3 percent) (US Census Bureau, 2023).

3.10.3 Environmental Consequences Evaluation Criteria

Environmental justice analysis applies to potential disproportionate effects on minority, low-income, elderly, and youth populations. Environmental justice issues could occur if an adverse environmental or socioeconomic consequence to the human population fell disproportionately upon minority, low-income, elderly, or youth populations. Ethnicity, age, and poverty status were examined and compared to state and national data to determine if these populations could be disproportionately affected by the alternatives.

All potential disproportionate impacts on populations would be limited to the communities surrounding Shaw AFB. As noted above, no substantial changes in the noise environment in the SUA would result from the Proposed Action and thus, there would be no potential for disproportionate impacts on minority and low-income populations or populations of children or the elderly in areas of South Carolina and Georgia underlying the onshore SUA.

3.10.4 Environmental Consequences – Alternative 1

3.10.4.1 Shaw Air Force Base

Under the Proposed Action, the additional personnel and their dependents supporting contract ADAIR at Shaw AFB would represent less than a 0.5 percent increase in the population of Sumter County, assuming all additional personnel and their families choose to reside in that county. Although Sumter County contains a minority population exceeding 50 percent and meaningfully greater percentage of the population living in poverty (see **Section 3.9.2**), the additional proposed contract ADAIR personnel and their dependents are not likely to result in disproportionate impacts on those populations because adequate housing, community resources, and community services are available in Sumter County and the surrounding area to support these proposed increases. Further, the increased economic expenditures associated with the proposed contract ADAIR activities would benefit all people and businesses in the region regardless of race or age. Therefore, the Proposed Action would have no disproportionately adverse effects and minor beneficial economic effects on potential minority and low-income populations in Sumter County.

Except for three POIs (which are identified as places of worship) under the High Noise Scenario, no significant increase in noise would occur at sensitive receptors in the vicinity of Shaw AFB under any of the three noise scenarios (see **Section 3.4.5.1**). None of the POIs identified as residential areas, schools, or childcare facilities (**Table 3-5**) would experience an increase in noise greater than a 3 dBA and higher than 65 dBA DNL under any of the three noise scenarios (no elderly care facilities were identified as POIs in the ROI). Therefore, potential noise increases from the Alternative 1 High Noise Scenario would have no disproportionate adverse effects on minority, low-income, or youth populations at these facilities, or under the Alternative 1 Medium and Low Noise Scenarios at any of the POIs.

Because three POIs (W2, W5, and W7; see **Section 3.4.5.1** and **Table 3-13**) could be significantly impacted by increased noise under the Alternative 1 High Noise Scenario, US Census Bureau Block Group data beneath the High Noise Scenario greater than 65 dBA DNL contours were evaluated to determine if minority or low-income communities are present that could be disproportionately impacted by the increased noise.

A US Census Bureau Block Group is the smallest geographical unit in which the US Census Bureau publishes census data. Within the US Census Bureau Block Groups beneath the greater than 65 dBA DNL noise contours, 52 percent of the population identified as minorities, and 43 percent identified as Black or African American (US Census Bureau, 2023). The percent of the population that identified as minority and as Black or African American within the Census Block Groups beneath the greater than 65 dBA DNL contours under the Alternative 1 High Noise Scenario is similar to that of Sumter County, and substantially higher than either the state of South Carolina or the United States. Further, these three places of worship are churches that likely have a predominant Black or African American congregation, given the large minority population in the surrounding neighborhoods that would likely utilize these facilities as places of worship for the community. Therefore, noise increases of 3 dBA or more at these POIs under the High Noise Scenario and their location within the 65 dBA DNL contour would have the potential to disproportionately impact minority populations present at or near these POIs.

Within the US Census Bureau Block Groups beneath the 65 dBA DNL noise contours, 20 percent of the population is in poverty in the last 12 months (US Census Bureau, 2023). This is the same rate of persons in poverty as Sumter County and is substantially higher than the rates of poverty for the state of South Carolina and the United States. The three places of worship described above where significant noise impacts could occur are located within these low-income communities. Therefore, the congregations of these places of worship could potentially include a higher percentage of the population that is low-income due to the geographic proximity of these POIs to low-income communities. Therefore, noise increases of 3 dBA or more at these POIs under the High Noise Scenario and their location within the 65 dBA DNL contour would have the potential to disproportionately impact low-income communities present at or near these POIs.

3.10.5 Environmental Consequences – Alternative 2

3.10.5.1 Shaw Air Force Base

Proposed contract ADAIR activities under Alternative 2 would be the same as those described for Alternative 1. The increased economic expenditures associated with the proposed contract ADAIR activities would benefit all people and businesses in the region regardless of race or age. Potential noise increases from the Alternative 2 Low and Medium Noise Scenarios would have no disproportionate adverse effects on minority, low-income, or youth populations. However, three POIs (W2, W5, and W7; see **Section 3.4.5.1** and **Table 3-13**) could be significantly impacted by increased noise under the Alternative 2 High Noise Scenario. Therefore, noise increases of 3 dBA or more at these POIs under the Alternative 2 High Noise Scenario and their location within the 65 dBA DNL contour would have the potential to disproportionately impact low-income communities present at or near these POIs.

3.10.6 Environmental Consequences – No Action Alternative

Under the No Action Alternative, the proposed contract ADAIR activities would not occur at Shaw AFB and existing conditions would continue. This would have no disproportionately adverse impacts on minority, low-income, youth, or elderly communities in Sumter County.

3.10.7 Cumulative Impacts

The Proposed Action would have no disproportionately adverse effects and minor beneficial economic effects on minority, low-income, youth, and elderly populations. Therefore, the Proposed Action would not contribute to significant cumulative impacts on these populations when considered with other past, present, and reasonably foreseeable future actions on and around Shaw AFB.

3.11 CULTURAL RESOURCES

3.11.1 Definition of the Resource

Cultural resources are any prehistoric or historic district, site, building, structure, or object considered important to a culture or community for scientific, traditional, religious, or other purposes. These resources are protected and identified under several federal laws and EOs.

Cultural resources include the following subcategories:

- Archaeological (i.e., prehistoric or historic sites where human activity has left physical evidence of that activity, but no structures remain standing);
- Architectural (i.e., buildings or other structures or groups of structures, or designed landscapes that are of historic or aesthetic significance); and
- Traditional cultural properties (resources of traditional, religious, or cultural significance to Native American tribes and other communities).

Significant cultural resources are referred to as historic properties and are either listed or have been determined eligible for listing in the National Register of Historic Places (NRHP). To be eligible for the NRHP, historic properties are generally over 50 years old and have national, state, or local significance in American history, architecture, archaeology, engineering, or culture. They must possess sufficient integrity of location, design, setting, materials, workmanship, feeling, and association to convey their historical significance, and meet at least one of the following criteria (National Park Service [NPS], 1997):

- Criterion A – associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B – associated with the lives of persons significant in our past.
- Criterion C – embody distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D – yielded or likely to yield information important in prehistory or history.

Properties that are less than 50 years old can be considered eligible for the NRHP under Criterion Consideration G if they possess exceptional historical importance. Those properties must also retain historic integrity and meet at least one of the four NRHP Criteria for Evaluation (i.e., Criterion A, B, C, or D). In addition to NRHP-listed and NRHP-eligible cultural resources, historic properties also include National Historic Landmarks.

Federal laws protecting cultural resources include the Archaeological and Historic Preservation Act of 1960 as amended, the American Indian Religious Freedom Act of 1978, the Archaeological Resources Protection Act of 1979, the Native American Graves Protection and Repatriation Act of 1990, and the NHPA, as amended through 2016, and associated regulations (36 CFR Part 800). The NHPA requires federal agencies to consider effects of federal undertakings on historic properties prior to making a decision or taking an action and integrate historic preservation values into their decision-making process. Federal agencies fulfill this requirement by completing the Section 106 consultation process, as set forth in 36 CFR Part 800. Section 106 of the NHPA also requires agencies to consult with federally recognized Native American tribes when undertakings may affect properties of traditional religious and cultural significance.

Section 106 of the NHPA requires all federal agencies to seek to avoid, minimize, or mitigate adverse impacts to historic properties (36 CFR § 800.1[a]). For cultural resource analysis, the Area of Potential Effects (APE) is used as the ROI. The APE is defined as the "geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist," (36 CFR § 800.16[d]) and thereby diminish their historic integrity. The APE for direct and indirect effects includes the facilities at Shaw AFB proposed for use by the contract ADAIR program

(**Section 2.1.2**; **Figure 2-2**), hereafter referred to as the Shaw AFB APE; and the overland and offshore SUA described in **Section 2.1.6** and shown on **Figure 2-1**, hereafter referred to as the SUA APE. The overland portions of the SUA APE include portions of six South Carolina counties (Berkeley, Clarendon, Florence, Georgetown, Horry, and Marion) and portions of 10 Georgia counties (Bulloch, Burke, Candler, Emanuel, Glascock, Jefferson, Jenkins, Johnson, Laurens, and Washington).

3.11.2 Existing Conditions – Shaw Air Force Base

3.11.2.1 Environmental Setting

Shaw AFB covers approximately 3,429 acres in the City of Sumter and is highly developed. The airfield comprises approximately 1,000 acres, base facilities and infrastructure cover 1,400 acres, and remaining areas of the installation consist of forest and wetlands. Located within the coastal plain of South Carolina, Shaw AFB is situated on relatively flat land with little relief in topography; elevation on Shaw AFB varies from 200 ft to 330 ft above MSL (Shaw AFB, 2022c).

3.11.2.2 Architectural Properties

Shaw Army Airfield was officially activated on 30 August 1941 as part of the Army Air Corps. Construction began in the following months. A nearby mansion was initially used a field headquarters. A small prisoner of war camp was operated on the installation in 1945 and early 1946. After World War II, Shaw was selected as a training base and in 1948, redesignated Shaw AFB.

The inventory of existing facilities at Shaw AFB includes buildings and structures that were built during the interwar period (i.e., between World War I and World War II) through the post-Cold War period. Architectural resource studies previously completed at Shaw AFB have identified one NRHP-eligible historic district (the Rosemary Fire Hill Complex) and one individually eligible building (Building 611, aircraft hangar). Neither of these resources is within or adjacent to the Shaw AFB APE (Shaw AFB, 2022d).

Building 106 is modern, built in 1992, and not eligible for inclusion in the NRHP. Building 712 was built in 1941 with modifications that do not include historic treatment. The DAF previously determined that Building 712 was potentially eligible for inclusion in the NRHP; however, the South Carolina SHPO did not concur with this determination (Shaw AFB, 2022d).

3.11.2.3 Archaeological and Traditional Cultural Properties

Nearly 100 percent of Shaw AFB has been surveyed for archaeological resources. These surveys have recorded 14 archaeological sites, of which two are eligible for listing in the NRHP. Neither of these sites are within or adjacent to the Shaw AFB APE (Shaw AFB, 2022d).

Shaw AFB is not in possession of prehistoric human remains, funerary objects, sacred objects, or objects of cultural patrimony and no traditional cultural properties or sacred sites have been identified by tribes on Shaw AFB, including areas within the Shaw AFB APE (Shaw AFB, 2022d). Shaw AFB has identified the Catawba Indian Nation as a federally recognized Tribe with historic ties to the Sumter area of South Carolina and consultation is ongoing. Consultation was also conducted with the Cherokee Nation and the Muscogee (Creek) Nation; copies of relevant tribal consultation correspondence are provided in **Appendix A**.

3.11.3 Existing Conditions – Special Use Airspace

3.11.3.1 Environmental and Cultural Setting

The SUA APE includes the SUA as described in **Section 2.1.6**. Based on the nature of the Proposed Action (i.e., use of existing airspace) and expansive nature of the SUA APE, specific numbers and types of archaeological and architectural resources under the airspace are not described in this EA. NRHP-listed resources, tribal lands, and cultural resources in the marine environment under the SUA proposed for use are described in the following sections.

3.11.3.2 National Register of Historic Places-Listed Resources in the SUA APE

A total of 63 historic architectural resources listed in the NRHP are present on lands within the SUA APE (**Table 3-38**). Sixteen NRHP-listed architectural resources are in the South Carolina portion of the SUA APE and the remaining 47 are in the Georgia portion. Based on the nature of the Proposed Action the expanse of the SUA APE, NRHP-eligible architectural resources within this APE are not individually identified or discussed in detail this EA. A general overview of architectural resource types located within the SUA APE can be extrapolated from the types of NRHP-listed resources shown in **Table 3-38** (NPS, 2023).

Table 3-38 National Register of Historic Places-Listed Architectural Resources Within the Special Use Airspace Area of Potential Effect

NRHP-Listed Architectural Resource	
South Carolina	**County**
Browntown	Florence
Snow's Island	Florence
Pleasant Hill Consolidated School	Georgetown
Rural Hall Plantation House	Georgetown
Clarkson Farm Complex	Williamsburg
Colonel John Gotea Pressley House	Williamsburg
Epps-McGill Farmhouse	Williamsburg
Gamble House	Williamsburg
John Calvin Wilson House	Williamsburg
Kingstree Historic District	Williamsburg
M.F. Heller House	Williamsburg
McCollum-Murray House	Williamsburg
New Market	Williamsburg
Salters Plantation House	Williamsburg
Scott House	Williamsburg
Thorntree	Williamsburg
Georgia	**County**
Burke County Courthouse	Burke
Haven Memorial Methodist Episcopal Church	Burke
Hopeful Baptist Church	Burke
John James Jones House	Burke
Waynesboro Commercial Historic District	Burke
Waynesboro Historic District	Burke
Albert Neal Durden House	Emanuel
Davis-Proctor House	Emanuel
Emanuel County Courthouse and Sheriff Department	Emanuel
James Coleman House	Emanuel
John Rountree Log House	Emanuel
Josiah Davis House	Emanuel
Swainsboro Light and Water Plant	Emanuel
Twin City Historic District	Emanuel
Bartow Historic District	Jefferson

Table 3-38 National Register of Historic Places-Listed Architectural Resources Within the Special Use Airspace Area of Potential Effect

NRHP-Listed Architectural Resource	
Georgia *(continued)*	**County**
Cunningham-Coleman House	Jefferson
Jefferson County Courthouse	Jefferson
Louisville Commercial Historic District	Jefferson
Old Market	Jefferson
#3	Jenkins
#4	Jenkins
Birdsville Plantation	Jenkins
Carswell Grove Baptist Church and Cemetery	Jenkins
Downtown Millen Historic District	Jenkins
Jenkins County Courthouse	Jenkins
Millen High School	Jenkins
Grice Inn	Johnson
Johnson County Courthouse	Johnson
Wrightsville and Tennille Railroad Company Building	Washington
Charles Madden House	Washington
Church-Smith-Harris Street Historic District	Washington
City Cemetery	Washington
Forest Grove	Washington
Francis Plantation	Washington
Holt Brothers Banking Company Building	Washington
James E. Johnson House	Washington
James Kelley House	Washington
North Harris Street Historic District	Washington
Sandersville Commercial and Industrial District	Washington
Sandersville High School	Washington
Tennille Banking Company Building	Washington
Tennille Baptist Church	Washington
Tennille Woman's Clubhouse	Washington
Thomas Jefferson Elder High and Industrial School	Washington
Thomas W. Smith House	Washington
Washington County Courthouse	Washington
Washington Manufacturing Company	Washington

More than 150 NRHP-listed archaeological sites are present in the states of South Carolina and Georgia. These sites represent most of the chronological and cultural contexts associated with the regions, including prehistoric quarries (and other resource extraction sites), settlements, mounds, and historic sites associated with euromerican settlement and industry (e.g., iron forge, plantation farming) (NPS, 2023). Based on the nature of the Proposed Action, the sensitivity surrounding archaeological site locations, and the expanse of the SUA APE, NRHP-eligible and listed archaeological sites within the SUA APE are not individually identified or discussed in detail this EA.

3.11.3.3 Tribal Lands and Traditional Cultural Properties

No Tribal reservation lands are present on lands underlying the Bulldog and Gamecock SUA. However, multiple federally recognized Native American tribes have historic ties to these lands, including the following (US Department of Housing and Urban Development, 2022):

- Absentee-Shawnee Tribe of Indians of Oklahoma
- Alabama-Quassarte Tribal Town
- Catawba Indian Nation
- Cherokee Nation
- Chickasaw Nation
- Eastern Band of Cherokee Indians
- Eastern Shawnee Tribe of Oklahoma
- Kialegee Tribal Town
- Miccosukee Tribe of Indians of Florida
- Muscogee (Creek) Nation
- Seminole Tribe of Florida, Shawnee Tribe
- The Great Seminole Nation of Oklahoma
- Thlopthlocco Tribal Town
- Tuscarora Nation
- United Keetoowah Band of Cherokee Indians in Oklahoma

No traditional cultural properties or sites of religious or cultural significance were identified in the SUA APE during tribal consultation conducted for this EA. Copies of relevant tribal correspondence are provided in **Appendix A**.

3.11.3.4 Cultural Resources in the Marine Environment

Underwater or submerged archaeological resources include shipwrecks, abandoned vessels, prehistoric or historic scatter sites, boat landings, shipyards, and similar features. The eastern seaboard of the United States possesses a high potential for submerged archaeological resources due to the wide range of maritime transportation, trade, and commercial and recreational shipping and boating activities that have occurred along its shorelines since prehistoric times. It is estimated that more than 500 underwater shipwrecks are present along the shores of South Carolina. The continental shelf has the highest potential for containing underwater archaeological resources. The offshore portion of the SUA APE is considered to have a medium to low probability for containing underwater archaeological resources, as it does not include the coast or continental shelf (Holland, 2012). Approximately 20 submerged wrecks and uncharted obstructions have been identified in the open waters below the SUA APE (NOAA, n.d.).

3.11.4 Environmental Consequences Evaluation Criteria

Adverse impacts on cultural resources could include the physical alteration, damage, or destruction of all or part of a resource, or otherwise altering characteristics of the resource that make it eligible for listing in the NRHP. Such effects could include introducing visual or audible elements that are out of character with the property or its setting; neglecting the resource to the extent that it deteriorates or is destroyed; or the sale, transfer, or lease of the property out of agency ownership (or control) without adequate enforceable restrictions or conditions to ensure preservation of the property’s historic significance. For the purposes of this EA, an effect is considered adverse if it alters the integrity of an NRHP-listed or eligible archaeological or architectural resource or if it has the potential to adversely affect traditional cultural properties or sacred sites and the practices associated with the property.

3.11.5 Environmental Consequences – Alternative 1

3.11.5.1 Shaw Air Force Base

No physical modifications or alterations of Buildings 106 and 712 are included in the Proposed Action, and neither facility is considered eligible for listing in the NRHP. The Proposed Action would have no potential to affect NRHP-listed historic districts or individually eligible historic structures because no such districts or structures are present within the Shaw AFB APE. Additionally, no ground disturbance would occur on Shaw AFB under the Proposed Action; as such, the Proposed Action would have no potential to disturb archaeological resources or undocumented traditional cultural properties potentially present on the installation.

In a letter dated 27 July 2023 the South Carolina SHPO stated that no properties listed or eligible for listing in the NRHP would be affected by the Proposed Action and concurred that Buildings 106 and 712 are not eligible for listing in the NRHP. In a letter dated 5 September 2023, the Georgia SHPO stated that the Proposed Action would have no adverse effect on historic properties, as defined in 36 CFR § 800.5(d)(1). Responses received from the Cherokee Nation (27 July 2023), Chickasaw Nation (28 July 2023), and Catawba Indian Nation (15 August 2023) expressed no concerns regarding potential impacts on traditional cultural resources from the Proposed Action. Copies of the South Carolina SHPO, Georgia SHPO, and tribal responses are provided in **Appendix A**.

Therefore, after consultation with the South Carolina and Georgia SHPOs and Native American tribes, the DAF has determined that the Proposed Action would have no adverse effect on historic properties in accordance with 36 CFR § 800.5(b).

3.11.5.2 Special Use Airspace

Noise analysis for the Proposed Action demonstrated that noise levels no more than 1 dBA higher than the current noise environment would result from implementation of the High Noise Scenario. Noise analysis of the in Medium and Low Noise Scenarios for implementing contract ADAIR in the SUA demonstrated that the noise environment would be nearly identical to existing baseline conditions; therefore, Alternative 1 would have no impacts on cultural resources under the High, Medium, or Low Noise Scenarios under the Proposed Action.

The proposed addition of contract ADAIR aircraft operating at supersonic speeds means that the number of sonic booms heard would likely increase; however, the range of associated overpressure produced would not change. Further, overpressure is not anticipated to exceed 2.2 psf, well below the 11 psf threshold under which studies have shown structural damage is rare (NASA, 2017). Sorties within the Warning Areas would be performed at an altitude over the Atlantic Ocean that would not affect potential submerged resources. Noise (under the High, Medium, or Low Scenarios) would not impact cultural resources and would therefore have no effect, and consequently no impact, to historic properties in the Warning Areas.

As noted above, the South Carolina and Georgia SHPOs stated that the Proposed Action would have no adverse effects on historic properties, including properties listed in or eligible for listing in the NRHP. Additionally, the Cherokee Nation, Chickasaw Nation, and Catawba Indian Nation expressed no concerns regarding potential regarding potential impacts on traditional cultural resources from the Proposed Action. Copies of the South Carolina SHPO, Georgia SHPO, and tribal responses are provided in **Appendix A**. Therefore, after consultation with the SHPOs, Native American tribes and other consulting parties, the DAF has determined that the Proposed Action would have no adverse effect on historic properties in accordance with 36 CFR § 800.5(b).

3.11.6 Environmental Consequences – Alternative 2

Proposed contract ADAIR operations under Alternative 2 would be the same as those described for Alternative 1, except that Building 712 would not be used. Effects on cultural resources in the Shaw AFB APE and SUA APE from Alternative 2 would be the same as those described for Alternative 1.

3.11.7 Environmental Consequences – No Action Alternative

Under the No Action Alternative, proposed contract ADAIR operations would not occur at Shaw AFB would not occur and existing conditions would continue. Cultural resources on Shaw AFB would continue to be managed as they currently are. This would have no effect on cultural resources in the Shaw AFB APE and SUA APE.

3.11.8 Cumulative Impacts

The Proposed Action would have no effects on cultural resources. Therefore, when considered with other reasonably foreseeable future actions occurring in and/or adjacent to the Shaw AFB APE and SUA APE, the Proposed Action would not contribute to adverse cumulative effects on cultural resources or historic properties, including significant architectural resources, archaeological resources, or traditional cultural properties/sacred sites.

3.12 HAZARDOUS MATERIALS AND WASTES, ENVIRONMENTAL RESTORATION PROGRAM SITES, AND TOXIC SUBSTANCES

3.12.1 Definition of the Resource

As defined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) and the Toxic Substances Control Act (TSCA), HAZMAT are any substance with physical properties of ignitability, corrosivity, reactivity, or toxicity that might cause an increase in mortality, serious irreversible illness, and incapacitating reversible illness, or that might pose a substantial threat to human health or the environment. HAZWASTE is defined in the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments, defines HAZWASTE as “a solid waste, or combination of solid wastes, which because of its quantity, concentration, physical, chemical, or infectious characteristics, may (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed” (42 U.S.C. § 6903(5)).

Evaluation of HAZMAT and HAZWASTE focuses on aboveground storage tanks (ASTs) and underground storage tanks (USTs) where bulk storage of HAZMAT such as petroleum, oils, and lubricants (POLs) that are used for aircraft operations are often stored, as well as the storage, transport, and use of pesticides, fuels, and other oils and lubricants. The evaluation might also extend to generation, storage, transportation, and disposal of HAZWASTE when such activity occurs at or near the project site of a proposed action. In addition to being a threat to humans, the improper release of HAZMAT and HAZWASTE can threaten the health and well-being of wildlife species, botanical habitats, soil systems, and water resources. The extent of potential contamination from accidental releases of HAZMAT or HAZWASTE varies based on factors such as soil type, pervious or impervious conditions, topography, weather and climate, and presence of surface water and groundwater.

Through the ERP, (formerly the Installation Restoration Program) initiated in 1980, each DoD installation is required to identify, investigate, and clean up HAZWASTE disposal or release sites. Remedial activities for ERP sites follow the Hazardous and Solid Waste Amendment of 1984 under the RCRA Corrective Action Program and CERCLA. The ERP provides a uniform, thorough methodology to evaluate past disposal sites, control the migration of contaminants, minimize potential hazards to human health and the environment, and clean up contamination until it is determined that no further remedial action is warranted. Human development, occupancy, or other uses of ERP lands undergoing remediation may be prohibited or restricted depending on the type and extent of contamination present.

Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic fluorinated chemicals that include perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), two organic chemicals within the PFAS group that were used in industrial and consumer products such as nonstick cookware, stain-resistant fabric and carpet, some food packaging and specialized foam. PFOS and PFOA are the only two compounds of the PFAS group with established USEPA health advisories for drinking water. The DAF is taking a three-step approach to assess and respond to PFOS and PFOA in drinking water: identify, respond, and prevent. The DAF's investigation and response are guided by CERCLA, as well as applicable state laws and the USEPA's Health Advisory for drinking water (DAF, 2022).

Toxic substances might pose a risk to human health but are not regulated as contaminants under the HAZWASTE statutes. Included in this category are asbestos-containing materials (ACM), lead-based paint (LBP), radon, and polychlorinated biphenyls (PCBs). The presence of special hazards or controls over them might affect, or be affected by, a proposed action. These substances are further described below:

- **Asbestos.** Asbestos is regulated by USEPA in accordance with 29 U.S.C. § 669 et seq. Section 112 of the CAA regulates emissions of asbestos fibers to ambient air. It is USEPA policy to leave asbestos in place if disturbance or removal could pose a health threat.
- **Lead-based Paint.** Human exposure to lead has been determined an adverse health risk OSHA and USEPA. Sources of exposure to lead are dust, soils, and paint. The manufacture and use of LBP was banned in the United States in 1978; however, facilities constructed prior to or during 1978 may still contain LBP.
- **Radon.** Radon is an odorless, colorless, naturally-occurring radioactive gas that develops in soils and rocks as uranium decays. Exposure to concentrations of radon has been determined to increase the risk of lung cancer in humans. Radon has a tendency to accumulate in enclosed, below-ground spaces with poor ventilation (e.g., basements and crawlspaces). USEPA recommends mitigation for radon levels at or above 4 picocuries per liter inside residential structures but has not established a threshold for commercial buildings.
- **Polychlorinated Biphenyls**. PCBs were widely manufactured in the United States and used as insulators in electrical equipment such as transformers and fluorescent light ballasts until they were banned in 1979. The disposal of PCBs is regulated under the TSCA (15 U.S.C. § 2601 et seq., as implemented by 40 CFR Part 761), which banned the manufacture and distribution of PCBs, with the exception of PCBs used in enclosed systems. The TSCA regulates and the USEPA enforces the removal and disposal of all sources of PCBs containing 50 parts per million or more; the regulations are more stringent for PCB equipment than for PCB-contaminated equipment.

3.12.2 Existing Conditions – Shaw Air Force Base

The following discussion primarily focuses on HAZMAT, HAZWASTE, and related conditions at Shaw AFB. Proposed contract ADAIR activities occurring in the SUA proposed for use would have no potential to affect the presence or quantities of HAZMAT, HAZWASTE, and similar substances and conditions in or underlying those areas. Therefore, those areas are not addressed further in this section.

HAZMAT and HAZWASTE

The 20th Civil Engineer Squadron/Environmental Branch (20 CES/CEIE) is responsible for the procurement, handling, use, storage, and management of all hazardous and toxic materials, and the management, storage, and disposal of all HAZWASTE at Shaw AFB. HAZMAT used at Shaw AFB for aircraft, motor vehicle, and facilities operations and maintenance include fuels, oils, lubricants, and other petroleum-based products; flammable solvents; paints; corrosives; pesticides; refrigerants; and cleaning products. Generally, the use of HAZMAT at Shaw AFB generates corresponding quantities of HAZWASTE. HAZMAT and HAZWASTE at Shaw AFB are used and managed in accordance with the installation's *Hazardous Materials Management Plan* (Shaw AFB, 2021) and *Hazardous Waste Management Plan* (Shaw AFB, 2022e), respectively. Universal wastes generated at Shaw AFB, such as spent fluorescent light tubes, batteries, thermostats, and lamps, are managed in accordance with universal waste regulations at 40 CFR Part 273.

Shaw AFB operates as a 90-day HAZWASTE facility with a Central Accumulation Area (CAA). The CAA, located at Building 1986, is the only full accumulation area (less than 90 days) for Shaw AFB. Satellite Accumulation Areas are for the collection of HAZWASTE near the point of generation, and in a quantity of up to 55 gallons of HAZWASTE or up to 1 quart of acute HAZWASTE. HAZWASTE are accumulated for up to 90 days, allowing full containers to be turned in to the CAA, reducing disposal costs and limiting disposal shipments. All HAZWASTE in the CAA are shipped off-site to a permitted Treatment, Storage, and Disposal Facility within 90 days of acceptance by a Defense Logistics Agency-qualified contractor and all universal waste containers are shipped off site within 365 days of acceptance (Shaw AFB, 2022e). HAZWASTE are transported to an approved off-base HAZWASTE landfill or incinerator by qualified private contractor.

Petroleum storage tanks at Shaw AFB, including ASTs and mobile fuel trucks, have a total storage capacity of over 2 million gallons. Aviation fuel is received from commercial delivery trucks at the Tanker Truck Unloading Facility (Building 207) and pumped to three large ASTs at the Petroleum, Oils, and Lubricants Yard (Building 113) for storage. Fuel is distributed to individual aircraft via ground refueling trucks (i.e., R-11s), which each have a capacity of 6,000 gallons.

Procedures regarding petroleum storage, spill prevention, and spill response at Shaw AFB are set forth in the installation's *Integrated Contingency Plan* (Shaw AFB, 2022f). Specific procedures have also been established to minimize the potential for spills during loading/unloading and fuel transfers procedures; these include regular periodic inspections, loading/unloading in contained areas, locking valves when not in use, and on-the-job training. All activities involving the loading and unloading of combustible materials are conducted in accordance with requirements set forth in AFI 23-201, *Fuels Management*.

The following reportable spills occurred at Shaw AFB between December 2013 and July 2020 (Shaw AFB, 2022f):

- Motor gasoline spill from a UST in December 2013; was cleaned up within 24 hours.
- JET-A/F24 fuel spill from an aircraft fuel tank in October 2015; cleaned up within 24 hours.
- Spill from a mule reservoir in January 2019; cleaned up within 24 hours
- JET-A/F24 fuel and C6 aqueous film forming foam (3 percent), mixed foam/water solution spill from an aircraft mishap in June 2020.

Five drinking water wells permitted by the South Carolina Department of Health and Environmental Control (SCDHEC) are in operation on Shaw AFB. A source water sanitary survey conducted by SCDHEC for Shaw AFB in December 2019 determined that drinking water wells did not exceed the USEPA's combined PFOS/PFOA lifetime health advisory of 70 parts per trillion (Shaw AFB, 2020). The lifetime health advisory is a non-regulatory concentration of drinking water contaminants at or below which adverse health effects are not anticipated to occur over specific exposure durations.

Environmental Restoration Program Sites

Investigations conducted on Shaw AFB since 1983 have identified more than 100 ERP sites on the installation[1]. The most recent RCRA Part B permit modification in November 2014 lists 123 ERP sites at Shaw AFB; of these, 99 areas of concern (AOC) have received regulatory closure. Cleanup activities at the remaining 24 open sites are ongoing. (Shaw AFB, 2022c).

Figure 3-13 shows the locations of ERP sites undergoing active remediation on Shaw AFB that are near or underlie facilities proposed for use by proposed contract ADAIR personnel and activities (i.e., Buildings 106 and 712, and N Row). These sites are summarized as follows:

[1] This total includes ERP sites at the Poinsett Electronic Combat Range, a 12,500-acre training area managed by Shaw AFB that is approximately 10 miles south of the installation.

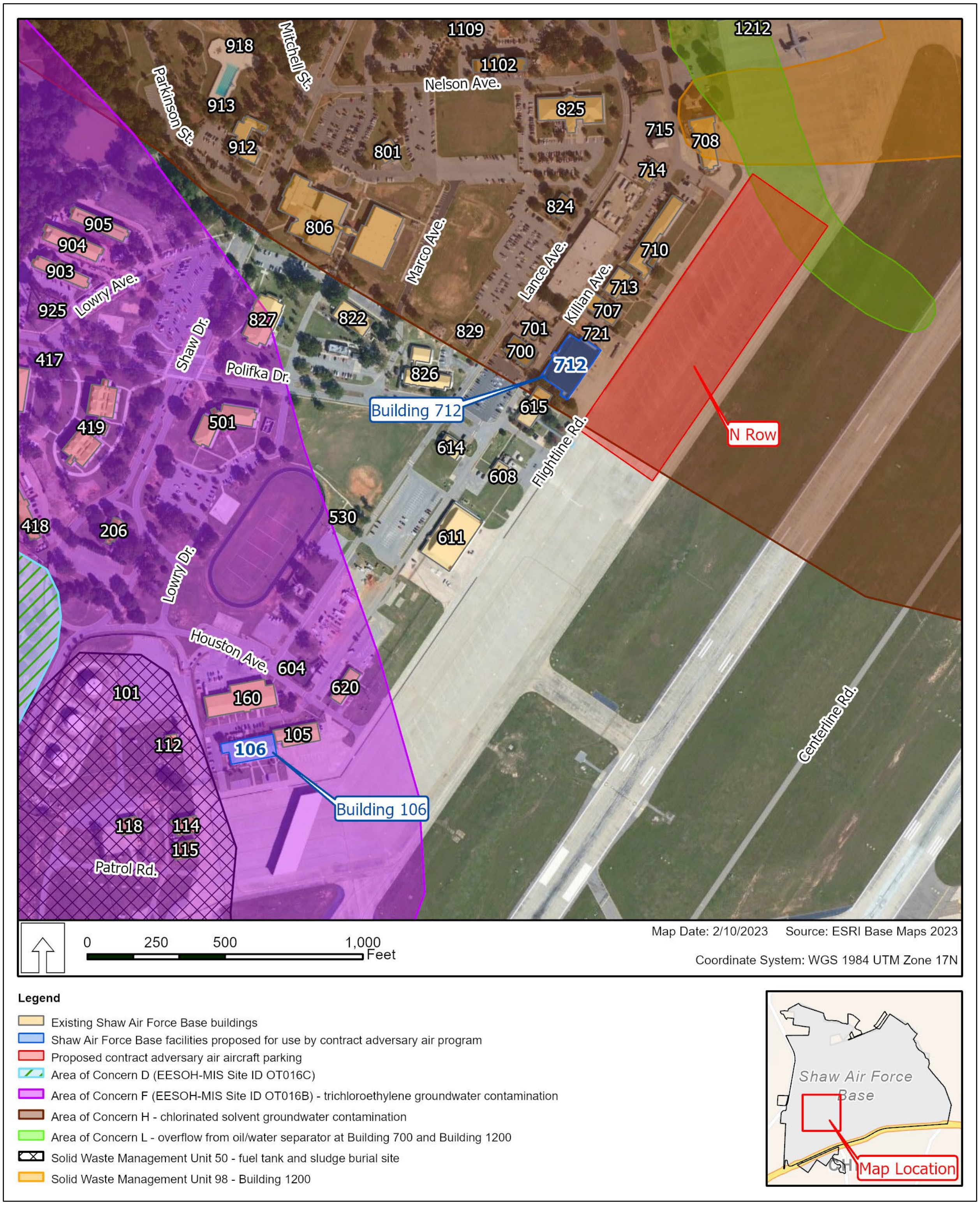

Figure 3-13 Environmental Restoration Program Sites at Shaw Air Force Base Proximate to Facilities Proposed for Use by Contract Adversary Air

- AOC F (EESOH-MIS Site ID-OT016B), an area of trichloroethylene groundwater contamination, underlies the entirety of Building 106.
- AOC H, an area of chlorinated solvent groundwater contamination, underlies the entirety of Building 712 and most of N Row.
- AOC L, an area where overflow from an oil/water separator at Buildings 700 and 1200 occurred, underlies the northeastern end of N Row.
- Solid Waste Management Unit (SWMU) 98, historically associated with Building 1200, is immediately north of N Row.
- SWMU 50, a historic fuel tank and sludge burial site, is immediately west of Building 106.
- AOC D (EESOH-MIS Site ID 0T016C) is adjacent to the western boundary of SWMU 50.

Asbestos Containing Materials and Lead-Based Paint

Demolition, renovation, and repair projects at Shaw AFB that have the potential to disturb or involve the removal of ACM are planned, coordinated, managed, and executed in accordance with applicable requirements of the *Asbestos Management Plan* and *Asbestos Operation Plan* maintained by the 20th Civil Engineer Squadron. The 20 AMDS/SGPB (Aerospace Medicine Squadron/Bioenvironmental Flight) maintains a list of personnel and other facility occupants who may be exposed to ACM and provides recommendations to protect human health. Construction, renovation, and demolition projects involving the disturbance or exposure to lead-based materials are managed and executed in accordance with AFMAN 32-7002, *Environmental Compliance and Pollution Prevention* and other applicable requirements.

Building 106 was built in 1992 and is unlikely to contain ACM or LBP due to its year of construction. However, Building 712 was built in 1941; therefore, there is the potential for Building 712 to contain ACM and LBP. The potential presence of ACM and LBP in Building 712 is currently unknown.

Radon

Sumter County, including Shaw AFB, is located within USEPA radon zone 3, which indicates a low potential for radon to be present inside buildings with average indoor radon levels below 2.0 picocuries per liter (USEPA, 2023b). USEPA and the US Surgeon General have developed radon zone mapping to help local building code officials determine if radon-resistant features are applicable in new building construction. The radon zone designation reflects the average short-term radon measurement that can be expected in a building without the implementation of radon control methods.

Polychlorinated Biphenyls

PCB-containing materials and PCB wastes are managed and disposed of in accordance with procedures set forth in Shaw AFB's *Hazardous Waste Management Plan* (Shaw AFB, 2022e). Although unlikely, PCB-containing materials such as light fixture ballasts could be present at Shaw AFB facilities, including at Buildings 106 and 712.

3.12.3 Environmental Consequences Evaluation Criteria

Impacts on or from HAZMAT, HAZWASTE, and similar substances or conditions would be considered adverse if the Proposed Action resulted in noncompliance with applicable federal, state, and local regulations or increased the amounts generated or procured beyond the capacity of existing waste management procedures at Shaw AFB.

3.12.4 Environmental Consequences – Alternative 1

3.12.4.1 Shaw Air Force Base

Under the Proposed Action, maintenance and operations of 12 contract ADAIR aircraft would contribute to the volume of HAZMAT stored and used at the Shaw AFB and the volume of HAZWASTE generated. This would be a minor adverse effect on HAZMAT and HAZWASTE. An emergency fuel dump could occur in the SUA; however, due to the infrequent nature of emergency fuel dumps, and in-place safety precautions, these emergency procedures are not likely to have adverse effects.

HAZMAT and HAZWASTE

Contract ADAIR aircraft operations and maintenance would contribute to the volume of HAZMAT such as oil, Jet-A fuel, hydrazine, hydraulic fluid, solvents, sealants, and antifreeze at Shaw AFB. All HAZMAT required for the contract ADAIR aircraft and used by contract personnel would adhere to the requirements of the Shaw AFB *Hazardous Materials Management Plan* (Shaw AFB, 2021). This would ensure that only HAZMAT needed for operations and maintenance at the smallest quantities would be used and that all the HAZMAT used for contract ADAIR at Shaw AFB would follow all Shaw AFB *Hazardous Materials Management Plan* (Shaw AFB, 2021) requirements; therefore, while the use and storage of HAZMAT under the Proposed Action would represent a long-term adverse effect, it would remain minor.

HAZWASTE generated by contract ADAIR operations and maintenance at Shaw AFB would be properly handled, stored, and disposed of following the Shaw AFB *Hazardous Waste Management Plan* (Shaw AFB, 2022e). Adherence to these requirements would ensure that HAZWASTE would be managed in accordance with all applicable federal, state, and local laws and regulations. As such, there would be a minor impact from the increased procurement and use of HAZMAT and the increased storage and disposal of HAZWASTE.

Alternative 1 would have no impacts with respect to PFAS because the proposed activities would not involve construction, groundwater-disturbance or withdrawals, or contact with surface water and groundwater.

3.12.5 Environmental Restoration Program Sites

The proposed use of Buildings 106 and 712 to support the proposed contract ADAIR program would be limited to administrative and maintenance activities, and no ground-disturbing activities that could potentially expose workers to subsurface contaminants are included in the Proposed Action. Therefore, the proposed activities occurring in Buildings 106 and 712 would have no potential to delay, prevent the completion of, or otherwise interfere with ongoing remediation activities at active ERP sites near or underlying those facilities (see **Section 3.12.2** and **Figure 3-13**). Similarly, remaining contamination and ongoing remediation activities at these sites would have no potential to adversely affect the health and safety of contract ADAIR personnel within Buildings 106 and 712 because the ERP sites are being actively remediated and contamination is limited to groundwater. Therefore, the Proposed Action would have no adverse impacts on or from active ERP sites at Shaw AFB.

Asbestos-Containing Materials and Lead-Based Paint

No major renovations or construction that could disturb existing ACM and/or LBP, if present in Building 712, and expose workers to these substances is included in the Proposed Action. Typical administrative and maintenance activities that would occur in those facilities under the Proposed Action would be unlikely to disturb those substances, if present. Any of those substances determined to be present during the Proposed Action would either be managed in place or removed in accordance with applicable DAF requirements, including the Shaw AFB *Asbestos Management Plan* and AFMAN 32-7002, to prevent or minimize risks to the health and safety of personnel in those facilities. Therefore, the Proposed Action would have no adverse effects from ACM and LBP.

Radon

Radon poses a low potential for health hazards in buildings at Shaw AFB. No new construction is included in the Proposed Action and no new or increased risks from radon would be anticipated. Therefore, no impacts from radon would occur under the Proposed Action.

Polychlorinated Biphenyls

The implementation of the Proposed Action would not impact PCBs or be impacted by PCBs, as PCBs would not be utilized by the contract ADAIR activities and the disturbance of existing PCBs on Shaw AFB is not anticipated. If PCBs are identified by contract ADAIR personnel, they would be handled and disposed of according to the Shaw AFB *Hazardous Waste Management Plan* requirements (Shaw AFB, 2022e).

3.12.6 Environmental Consequences – Alternative 2

3.12.6.1 Shaw Air Force Base

Proposed contract ADAIR operations and activities under Alternative 2 would be the same as those described for Alternative 1. Therefore, impacts on or from HAZMAT, HAZWASTE, and related substances or conditions resulting from Alternative 2 would be the same as those described for Alternative 1.

3.12.7 Environmental Consequences – No Action Alternative

Under the No Action Alternative, the contract ADAIR operations would not occur at Shaw AFB and existing conditions would continue. This would have no impacts on or from HAZMAT, HAZWASTE, and related substances and conditions.

3.12.8 Cumulative Impacts

The Proposed Action, as well as reasonably foreseeable future actions on and outside Shaw AFB would not be anticipated to result in significant impacts on the management of HAZMAT, HAZWASTE, and related substances and conditions. Quantities of jet fuel, solvents, oil, and other HAZMAT used and stored at Shaw AFB would increase to support contract ADAIR operations, in addition to those used and stored for reasonably foreseeable future projects. However, these increases would not exceed the capacity of Shaw AFB to manage these materials or comply with applicable regulatory requirements, and any potential adverse effects would be minor. No construction or renovation activities would be required to support the Proposed Action; therefore, the Proposed Action would not contribute to significant adverse cumulative effects on or from the disturbance, management, or disposal of ACM, LBP, or PCBs when considered with other reasonably foreseeable future actions.

CHAPTER 4 REFERENCES

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APPENDICES

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TABLE OF CONTENTS

Page

LIST OF FIGURES ..... **iii**

LIST OF TABLES ..... **iii**

APPENDIX A – INTERAGENCY AND INTERGOVERNMENTAL COORDINATION AND CONSULTATIONS **A-2**

A.1 Introduction **A-2**
A.1.1 Agency Consultations A-2
A.1.2 Government-to-Government Consultation A-3
A.2 Public and Agency Review of Environmental Assessment **A-3**
A.3 Intergovernmental and Stakeholder Coordination **A-3**
A.3.1 Sample Scoping Letter A-4
A.4 Draft Environmental Assessment Coordination Letters **A-8**
A.4.1 Sample General Letter A-8
A.4.2 Sample Government-to-Government Letter A-9
A.4.3 USFWS Letter A-11
A.4.4 NOAA Fisheries Letter A-19
A.4.5 SHPO Letters A-23
A.5 Stakeholders List **A-25**
A.6 Agency and Tribal Comment Letters **A-27**
A.7 Draft EA Notice of Availability **A-37**

APPENDIX B – REASONABLY FORESEEABLE FUTURE ACTIONS **B-1**

APPENDIX C – FURTHER DEFINITIONS OF RESOURCE AREAS ANALYZED, METHODOLOGIES, AND MODELING **C-1**

C.1 Airspace Management and Use **C-1**
C.1.1 Definition of the Resource C-1
C.1.2 References C-2
C.2 Noise **C-3**
C.2.1 Sound, Noise, and Potential Effects C-3
C.2.2 Noise Models C-24
C.2.3 Runway and Flight Track Use C-28
C.2.4 Flight Profiles and Aircraft C-30
C.2.5 Ground/Maintenance Run-ups C-193
C.2.6 References C-200
C.3 Air Quality **C-205**
C.3.1 Criteria Pollutants and National Ambient Air Quality Standards C-205
C.3.2 Greenhouse Gases and Climate Change Considerations C-208
C.3.3 Air Conformity Applicability Analysis C-209
C.3.4 Significance Indicators and Evaluation Criteria C-210
C.3.5 Emissions Calculations and Assumptions C-211
C.3.6 References C-212
C.3.7 Detailed ACAM Report and Record of Air Analysis (ROAA) C-214
C.4 Biological Resources **C-258**

C.4.1 Federal Regulatory Statutes C-258
C.4.2 Descriptions of Federal Candidate Species and Species Proposed for Federal Listing Potentially Occurring at Shaw Air Force Base C-259
C.4.3 Descriptions of Federally Listed Threatened and Endangered Species Potentially Occurring in the Bulldog Military Operations Area C-259
C.4.4 Descriptions of Federally Listed Threatened and Endangered Species Potentially Occurring in the Gamecock Military Operations Area C-260
C.4.5 Threatened and Endangered Species and/or Species of Concern Potentially Occurring in Areas Underlying the Offshore Warning Areas C-260
C.4.6 References C-262

APPENDIX D – LIST OF PREPARERS AND CONTRIBUTORS D-1

APPENDIX E – GLOSSARY OF TERMS E-1

LIST OF FIGURES

Figure C-1	Sound Waves from a Vibrating Tuning Fork	C-3
Figure C-2	Frequency Characteristics of A- and C-Weighting	C-5
Figure C-3	Typical A-weighted Sound Levels of Common Sounds	C-6
Figure C-4	Example Time History of Aircraft Noise Flyover	C-7
Figure C-5	Example of Equivalent Sound Level over 24 hours, Day-Night Average Sound Level, and Community Noise Equivalent Level Computed from Hourly Equivalent Sound Levels	C-9
Figure C-6	Typical Day-Night Average Sound Level or Community Noise Equivalent Level Ranges in Various Types of Communities	C-10
Figure C-7	Schultz Curve Relating Noise Annoyance to Day-Night Average Sound Level (Schultz, 1978)	C-12
Figure C-8	Response of Communities to Noise; Comparison of Original Schultz (1978) with Finegold et al. (1994)	C-13
Figure C-9	Percent Highly Annoyed Comparison of International Standard 1996-1 to Federal Interagency Committee on Noise (1992)	C-15
Figure C-10	Speech Intelligibility Curve (digitized from USEPA, 1974)	C-16
Figure C-11	Federal Interagency Committee on Aviation Noise 1997 Recommended Sleep Disturbance Dose-Response Relationship	C-18
Figure C-12	Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) Study Reading Scores Varying with Equivalent Sound Level	C-21
Figure C-13	Departure Flight Tracks at Shaw Air Force Base	C-28
Figure C-14	Arrival Flight Tracks at Shaw Air Force Base	C-29
Figure C-15	Closed Pattern Flight Tracks at Shaw Air Force Base	C-29
Figure C-16	Contract Adversary Air Flight Tracks at Shaw Air Force Base	C-30
Figure C-17	Static Operations Locations	C-194
Figure C-18	Static Operations Locations	C-194
Figure C-19	Static Operations Locations	C-195

LIST OF TABLES

Table B-1	Reasonably Foreseeable Future Actions	B-1
Table C-1	Nonacoustic Variables Influencing Aircraft Noise Annoyance	C-13
Table C-2	Percent Highly Annoyed for Different Transportation Noise Sources	C-14
Table C-3	Indoor Noise Level Criteria Based on Speech Intelligibility	C-17
Table C-4	Probability of Awakening from NA90SEL	C-19
Table C-5	Existing Flight Operations at Shaw Air Force Base	C-26
Table C-6	Alternative 1 Proposed Flight Operations at Shaw Air Force Base	C-27
Table C-7	Runway Usage for Aircraft at Shaw Air Force Base	C-28
Table C-8	Static Pad Locations at Shaw Air Force Base	C-193
Table C-9	Location, Type, and Duration of Ground/Maintenance Run-Up Operations at Shaw Air Force Base	C-196
Table C-10	National Ambient Air Quality Standards	C-205
Table C-11	Metrics for Greenhouse Gas Emission Impacts	C-209
Table C-12	General Conformity Rule De Minimis Emission Thresholds	C-210
Table C-13	Air Conformity Applicability Model Data Inputs for Shaw Air Force Base Contract Adversary Air	C-212

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APPENDIX A
INTERAGENCY AND INTERGOVERNMENTAL COORDINATION AND CONSULTATIONS

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APPENDIX A – INTERAGENCY AND INTERGOVERNMENTAL COORDINATION AND CONSULTATIONS

A.1 INTRODUCTION

Scoping is an early and open process for developing the breadth of issues to be addressed in an Environmental Assessment (EA) and for identifying significant concerns related to an action. Per the requirements of Executive Order (EO) 12372, *Intergovernmental Review of Federal Programs*, as amended by EO 12416, federal, state, and local agencies with jurisdiction that could potentially be affected by the Proposed Action or alternatives were notified during the development of this EA.

The Intergovernmental Coordination Act and EO 12372 require federal agencies to cooperate with and consider state and local views in implementing a federal proposal. Through the coordination process, potentially interested and affected government agencies, government representatives, elected officials, and interested parties that could be affected by the Proposed Action and alternatives were notified during the development of this EA. The recipient mailing list and copies of agency and intergovernmental coordination letters and responses are included in this Appendix.

A.1.1 Agency Consultations

Implementation of the Proposed Action involves coordination with several organizations and agencies. Compliance with Section 7 of the Endangered Species Act (ESA) and implementing regulations (50 Code of Federal Regulations [CFR] Part 402), requires communication with the US Fish and Wildlife Service (USFWS) in cases where a federal action could affect listed threatened or endangered species, species proposed for listing, or candidates for listing. The primary focus of this consultation is to request a determination of whether any of these species occur in the proposal area. If any of these species is present, a determination would be made of any potential adverse impacts on the species. The Shaw Air Force Base (AFB) Natural Resources Office would determine whether any of these species occur in the Proposed Action area. If any of these species are present, the Shaw AFB Natural Resources Office would determine if the Proposed Action would have a potential negative effect on the species and if Section 7 consultation is required. Should no species protected by the ESA be affected by the Proposed Action or alternatives, no additional consultation is required. **Section 3.7** of the EA includes the effects determinations as made by the Shaw AFB Natural Resources Office. The USFWS concurred with DAF's effects determinations on 29 November 2023. The Proposed Action for contract ADAIR support at Shaw AFB is similar to the Proposed Actions for contract ADAIR support analyzed for both Joint Base Langley-Eustis, Langley AFB, and Seymour Johnson AFB. As such, the DAF determined that no new operations are proposed in the Warning Areas W-161 and W-171. Therefore, re-initiation of Section 7 consultation with the National Marine Fisheries Service (NMFS) was not warranted.

The National Historic Preservation Act (NHPA) of 1966 (54 United States Code [U.S.C.] 300101 et seq.) established the National Register of Historic Places (NRHP) and outlined procedures for managing cultural resources on federal property. NHPA requires federal agencies to consider the potential impacts of federal undertakings on historic properties that are: listed, nominated to, or eligible for listing on the NRHP; designated a National Historic Landmark; or valued by modern American Indians for maintaining their traditional culture. Section 106 of the NHPA requires federal agencies to consult with State Historic Preservation Officers (SHPOs), and others, if their undertakings have the potential to impact historic properties and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings.

Compliance with Section 106 and implementing regulations (36 CFR Part 800) was accomplished through consultation between the Department of the Air Force (DAF) and the South Carolina and Georgia SHPOs. In a letter dated July 27, 2023, the South Carolina SHPO stated that no properties listed in or eligible for listing in the NRHP would be affected by the Proposed Action and concurred that Buildings 106 and 712 are not eligible for listing in the NRHP. In a letter dated 5 September 2023, the Georgia SHPO stated that the Proposed Action would have no adverse effect on historic properties, as defined in 36 CFR § 800.5(d)(1).

A.1.2 Government-to-Government Consultation

Consistent with the NHPA's implementing regulations (36 CFR Part 800), DoD Instruction 4710.02, *Interactions with Federally-Recognized Tribes*, Department of the Air Force Instruction 90-2002, *Air Force Interaction with Federally-Recognized Tribes*, and Air Force Manual 32-7003, *Environmental Conservation*, the DAF has a responsibility to consult in good faith with federally recognized tribes who have a documented interest in DAF lands and activities, even though the tribe may not be geographically located near the installation or its airspace, regarding a Proposed Action's potential to affect properties of cultural, historical, or religious significance to the tribes. The tribal coordination process is distinct from National Environmental Policy Act (NEPA) consultation or the intergovernmental coordination processes and requires separate notification of all relevant tribes. The timelines for tribal consultation are also distinct from those of intergovernmental consultations. The installation commander's role in tribal government-to-government consultation is similar to the commander's role with an ambassador. The installation commander may also designate a civilian government employee as the Installation Tribal Liaison Officer (ITLO). The ITLO must be a high-level civilian government employee who is able to interact directly with base leaders and is allowed access to the installation commander without multiple chain of command impediments. At Shaw AFB, the Chief, Environmental Branch has been designated the ITLO.

Copies of tribal correspondence received to date are provided in **Section A.4**.

A.2 Public and Agency Review of Environmental Assessment

A Notice of Availability of the Draft EA and proposed Finding of No Significant Impact (FONSI) was published in the *Augusta Chronicle, Sumter Item,* and *Community Times* inviting the public to review and comment on the Draft EA during the 30-day review period.

Copies of the Draft EA and proposed FONSI were made available for review at the following locations and electronically at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/

- Sumter County Library, 111 North Harvin Street, Sumter, South Carolina 29150
- Augusta County Library - Headquarters, 823 Telfair Street, Augusta, Georgia 30901
- Florence County Public Library, 509 S. Dargan Street, Florence, South Carolina 29506

Individuals who were unable to access these documents online were instructed to call the Shaw AFB Public Affairs Office at (803) 895-2019 or email 20FWpublicaffairs@us.af.mil to arrange alternate access.

A.3 Intergovernmental and Stakeholder Coordination

A.3.1 Sample Scoping Letter

DEPARTMENT OF THE AIR FORCE
20th FIGHTER WING (ACC)
SHAW AIR FORCE BASE SOUTH CAROLINA

19 May 2023

Colonel Kristoffer R. Smith
Commander
517 Lance Avenue
Shaw AFB SC 29152

Mr. Randy S. DeBerry
Manager
West Colombia FSDO (FAA)
125-B Summer Lake Drive
West Columbia SC 29170

Dear Mr. DeBerry

The Department of the Air Force (DAF) and Headquarters Air Combat Command are proposing to provide Combat Air Forces contract adversary air (ADAIR) to improve the quality of training and readiness of fighter aircrew of the 20th Fighter Wing (20 FW) and other units assigned to Shaw Air Force Base (AFB), South Carolina. In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council of Environmental Quality regulations, and the Air Force Environmental Impact Analysis Process (32 Code of Federal Regulations Part 989), the DAF is in the process of preparing an Environmental Assessment and proposed Finding of No Significant Impact, to assess the potential environmental impacts of contract ADAIR support at Shaw AFB. Your organization has been identified as a potential stakeholder and as such, is invited to provide input and participate in the NEPA process.

The Proposed Action includes contracting an estimated 12 contractor aircraft to fly approximately 3,500 annual sorties to support the 20 FW and other units assigned to Shaw AFB. Contract ADAIR services supporting Shaw AFB would be staffed by approximately 78 contracted maintenance personnel and an estimated 15 contracted pilots. Contract ADAIR may use different types of fighter aircraft available with acceptable capabilities to support training requirements.

Training activities would use special use airspace (SUA) near Shaw AFB; no airspace modifications would be required (Figure 1). Contract ADAIR aircraft would operate with advanced radar and electronic targeting systems during engagements and employ chaff and flares (e.g., RR-188 chaff and M206 flares or similar) during training sorties in SUA authorized for their use.

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Shaw AFB has existing facilities including necessary ramp space; maintenance space; operational space; petroleum, oil, and lubricants storage; runway access; and associated parking to support the Proposed Action (Figure 2).

Please forward your questions, comments, or requests for additional information to Bryan Jobe, NEPA Program Manager in the 20 CES/CEIEA, via email at bryan.jobe@us.af.mil, or by telephone at 803-895-9985. We request that we receive your input within 30 days of receipt of this letter to ensure we can address them during the environmental impact analysis process. Thank you for your assistance.

Sincerely

KRISTOFFER R. SMITH, Colonel, USAF
Commander

Attachments:
Figure 1. Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur
Figure 2. Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations

3

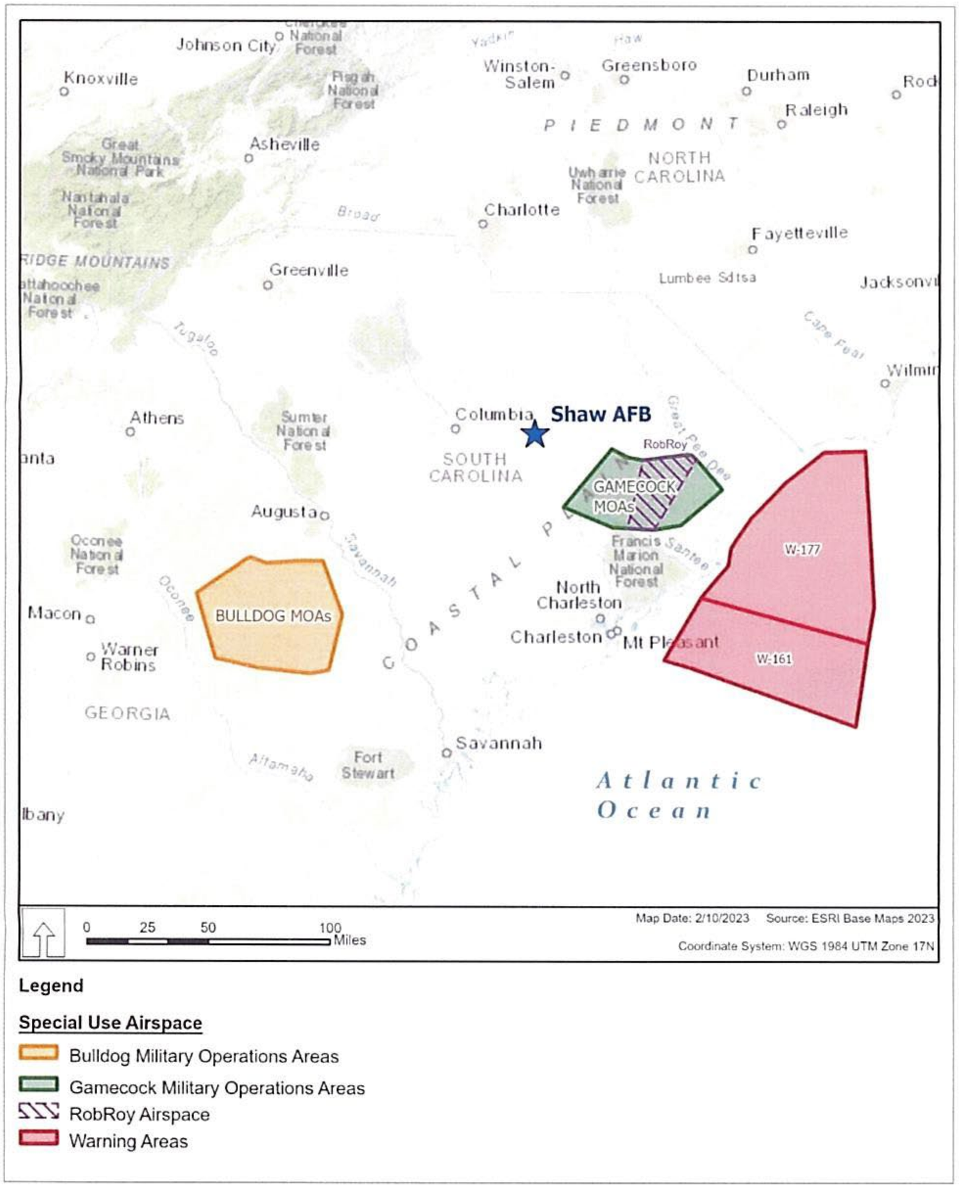

Figure 1. Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur

4

Figure 2. Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations

A.4 Draft Environmental Assessment Coordination Letters

A.4.1 Sample General Letter

DEPARTMENT OF THE AIR FORCE
20th FIGHTER WING (ACC)
SHAW AIR FORCE BASE SOUTH CAROLINA

Colonel Kristoffer R. Smith
Commander, 20th Fighter Wing
517 Lance Avenue
Shaw AFB SC 29152

Randy S. DeBerry
Manager
West Colombia FSDO (FAA)
125-B Summer Lake Drive
West Columbia SC 29170

Dear Randy S. DeBerry

The Department of the Air Force (DAF) and Headquarters Air Combat Command have prepared a Draft Environmental Assessment (EA) and proposed Finding of No Significant Impact (FONSI) evaluating the potential environmental impacts associated with the Proposed Action to provide dedicated Combat Air Forces contract adversary air (ADAIR) training support at Shaw Air Force Base (AFB), South Carolina. The Draft EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality regulations implementing NEPA, and DAF NEPA regulations.

The Proposed Action includes contracting an estimated 12 contractor aircraft to fly approximately 3,500 annual sorties to support the 20th Fighter Wing and other units assigned to Shaw AFB. Contract ADAIR services supporting Shaw AFB would be staffed by approximately 78 contracted maintenance personnel and an estimated 15 contracted pilots. Training activities would use existing special use airspace (SUA) overlying areas of South Carolina and Georgia; this SUA is currently used by Shaw AFB pilots and no airspace modifications would be required. Aircraft would depart from Shaw AFB, transit to the existing SUA, perform ADAIR training, and return to Shaw AFB. Contract ADAIR operations and maintenance activities would be consolidated in existing facilities at Shaw AFB; no facility construction or renovation activities are included in the Proposed Action.

The DAF is requesting your participation in the review and comment process for the Draft EA and proposed FONSI in accordance with Executive Order 12372, *Intergovernmental Review of Federal Programs*. The Draft EA and the proposed FONSI are available for review at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. Please forward your questions, comments, or requests for additional information to Bryan Jobe, NEPA Program Manager in the 20 CES/CEIEA, via email at bryan.jobe@us.af.mil, or by telephone at 803-895-9985 within 30 days of receipt of this letter.

Sincerely

K. Smith

KRISTOFFER R. SMITH, Colonel, USAF
Commander

A.4.2 Sample Government-to-Government Letter

DEPARTMENT OF THE AIR FORCE
20th FIGHTER WING (ACC)
SHAW AIR FORCE BASE SOUTH CAROLINA

Colonel Kristoffer R. Smith
Commander, 20th Fighter Wing
517 Lance Avenue
Shaw AFB SC 29152

Chief
Lewis Johnson
The Great Seminole Nation of Oklahoma
36645 US-270
Wewoka OK 74884

Dear Chief Johnson

In May 2023, I sent you a letter briefly describing the Department of the Air Force's (DAF's) Proposed Action to provide dedicated Combat Air Forces contract adversary air (ADAIR) training support at Shaw Air Force Base (AFB), South Carolina. I would like to follow up by inviting you to engage in government-to-government consultation with Shaw AFB on the proposal.

The DAF and Headquarters Air Combat Command have prepared a Draft Environmental Assessment (EA) and proposed Finding of No Significant Impact (FONSI) evaluating the potential environmental impacts associated with the Proposed Action. The Draft EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality regulations implementing NEPA, and DAF NEPA regulations.

The Proposed Action includes contracting an estimated 12 contractor aircraft to fly approximately 3,500 annual sorties to support the 20th Fighter Wing and other units assigned to Shaw AFB. Contract ADAIR services supporting Shaw AFB would be staffed by approximately 78 contracted maintenance personnel and an estimated 15 contracted pilots. Training activities would use existing special use airspace (SUA) overlying areas of South Carolina, Georgia, and the Atlantic Ocean, and no SUA modification would be required. Proposed aircraft operations in the SUA would be similar to those currently occurring there.

Under the Proposed Action, DAF and contract ADAIR aircraft would depart from Shaw AFB, transit to the existing SUA, perform ADAIR training, and return to Shaw AFB. Contract ADAIR operations and maintenance activities would be consolidated in existing facilities at Shaw AFB; no facility construction or renovation activities are included in the Proposed Action.

Shaw AFB facilities proposed for use are not listed or eligible for listing in the National Register of Historic Places (NRHP), and no ground-disturbing activities are included in the Proposed Action. No traditional cultural properties or sacred sites have been identified beneath

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the Shaw AFB Area of Potential Effects (APE), and the installation is not in possession of prehistoric human remains, funerary objects, sacred objects, or objects of cultural patrimony. Sixty-three NRHP-listed historic architectural resources are present on lands beneath the SUA APE; 16 of these resources are in the South Carolina portion of the SUA APE, and the remaining 47 are in the Georgia portion. Areas of the Atlantic Ocean beneath the SUA APE are considered to have a medium to low probability for containing underwater archaeological resources, as they do not include the coast or continental shelf. At least 15 federally recognized Native American tribes have historic ties to lands within the SUA APE; however, no tribal reservation lands are present beneath the SUA APE, and no traditional cultural properties or sites of religious or cultural significance have been identified beneath the SUA APE.

Based on consideration of responses received to date from the South Carolina and Georgia SHPOs, and the analysis presented in the Draft EA, the DAF has determined per 36 Code of Federal Regulations § 800.5 that the Proposed Action would have no adverse effect on historic properties, including significant architectural resources, archaeological sites, or sites of religious or cultural significance.

The Draft EA and proposed FONSI are available for review at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. Your comments on the Draft EA and proposed FONSI, including your concurrence with the DAF's determination of effects on traditional cultural resources, are requested at your earliest convenience to allow sufficient time for additional consultation if needed. Please provide your comments to Bryan Jobe, NEPA Program Manager in the 20 CES/CEIEA, via email at bryan.jobe@us.af.mil, or by telephone at 803-895-9985. Please inform us if you would prefer to engage in confidential consultation to prevent the inadvertent disclosure of detailed information regarding sensitive sites of traditional or cultural significance.

Sincerely

KRISTOFFER R. SMITH, Colonel, USAF
Commander

A.4.3 USFWS Letter

DEPARTMENT OF THE AIR FORCE
20th FIGHTER WING (ACC)
SHAW AIR FORCE BASE SOUTH CAROLINA

Colonel Kristoffer R. Smith
Commander, 20th Fighter Wing
517 Lance Avenue
Shaw AFB SC 29152

Mr. Thomas D. McCoy
Field Supervisor
USFWS (SC)
176 Croghan Spur Road Suite 200
Charleston SC 29407

Dear Mr. McCoy

The Department of the Air Force (DAF) requests informal Section 7 consultation under the Endangered Species Act (ESA) for the Proposed Action to provide dedicated Combat Air Forces contract adversary air (ADAIR) training support at Shaw Air Force Base (AFB), South Carolina. The Proposed Action would improve the quality of training and readiness of fighter aircrew of the 20th Fighter Wing (20 FW) and other units assigned to Shaw AFB. The DAF has made a *no effect* determination for the northern long-eared bat (*Myotis septentrionalis*), eastern black rail (*Laterallus jamaicensis* ssp. *jamaicensis*), red cockaded woodpecker (*Picoides borealis*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and wood stork (*Mycteria americana*); a *may affect but not likely to adversely affect* determination for the roseate tern (*Sterna dougallii dougallii*) and West Indian manatee (*Trichechus manatus*); and determined that proposed contract ADAIR activities would not jeopardize the continued existence of the monarch butterfly (*Danaus plexippus*) and tricolored bat (*Perimyotis subflavus*).

The Proposed Action includes contracting an estimated 12 contractor aircraft to fly approximately 3,500 annual sorties to support the 20 FW and other units assigned to Shaw AFB. Contract ADAIR services supporting Shaw AFB would be staffed by approximately 78 contracted maintenance personnel and an estimated 15 contracted pilots. Contract ADAIR may use different types of fighter aircraft available with acceptable capabilities to support training requirements.

Training activities would use special use airspace (SUA) near Shaw AFB; no airspace modifications would be required (Figure 1). Overland SUA that would be used by contract ADAIR aircraft includes the Bulldog Military Operations Area (MOA) and Air Traffic Control Assigned Airspace (ATCAA) and the Gamecock MOA and ATCAA. Over the Atlantic Ocean, contract ADAIR would operate in Warning Areas W-161 and W-177. Contract ADAIR aircraft would operate with advanced radar and electronic targeting systems during engagements and employ chaff and flares (e.g., RR-188 chaff and M206 flares) during training sorties in SUA authorized for their use.

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Shaw AFB has existing facilities including necessary ramp space; maintenance space; operational space; petroleum, oil, and lubricants storage; runway access; and associated parking to support the Proposed Action (Figure 2). Therefore, there would be no new construction activities at Shaw AFB under the Proposed Action.

Information for federally listed species potentially occurring at Shaw AFB and in the SUA was gathered from Shaw AFB's Integrated Natural Resources Management Plan (Shaw AFB, 2022) and the US Fish and Wildlife Service Information for Planning and Consultation website (USFWS, 2023).

No federally endangered or threatened species are known to occur on Shaw AFB and no designated critical habitat is present for any listed species. However, one federal candidate species, the monarch butterfly, may occur on base, and one species proposed as Endangered under the ESA, the tricolored bat, is documented to be present on base (DAF, 2017; Shaw AFB, 2022; USFWS, 2023).

Proposed contract ADAIR operations in the overland SUA would have no impacts on federally listed species of reptiles, amphibians, aquatic invertebrates, or plants known or having potential to occur in areas underlying the overland SUA, as these proposed training-support operations would not involve ground disturbance and would be limited to aircraft movement, noise, and the use of chaff and flares. Therefore, these federally listed species, which could occur in the overland SUA but not be impacted by proposed contract ADAIR operations are not evaluated further. The following federally listed, proposed for listing, and candidate avian, mammal, and terrestrial invertebrate species could be affected by proposed aircraft operations in the overland SUA as well as the offshore Warning Areas:

- Eastern black rail – Threatened
- Piping plover – Threatened
- Red knot – Threatened
- Roseate tern – Endangered
- Red-cockaded woodpecker - Endangered
- Wood stork – Threatened
- Northern long-eared bat – Threatened
- Tricolored bat – Proposed Endangered
- Monarch butterfly – Candidate
- West Indian manatee – Threatened

As no listed threatened and endangered species are present on Shaw AFB, the Proposed Action would have no impacts on such species. Increased aircraft operations under the Proposed Action at altitudes at or below 1,000 feet could strike migrating ESA candidate monarch butterflies during soaring flight. However, monarch butterflies would not occur in large numbers on Shaw AFB as most of the base is developed. Therefore, the Proposed Action would only slightly increase the likelihood of aircraft strikes on migrating monarchs at Shaw AFB.

Additional aircraft operations at Shaw AFB associated with the Proposed Action would increase the potential for aircraft strikes on tricolored bats at and near the Shaw AFB airfield.

However, most proposed contract ADAIR operations at Shaw AFB would occur during daytime hours and the tricolored bat is crepuscular/nocturnal. Therefore, the likelihood for the tricolored bat to encounter aircraft more frequently than under existing conditions is very low. As such, aircraft movement and the potential for aircraft strikes proximate to the Shaw AFB airfield would not likely jeopardize the continued existence of the tricolored bat. Therefore, increased aircraft sorties on Shaw AFB would not likely jeopardize the continued existence of the monarch butterfly and tricolored bat.

No ground-disturbing activities would occur within the SUA under the Proposed Action and all potential impacts on threatened and endangered species would be associated with aircraft operations. Because no ground-disturbing activities would occur, the Proposed Action would have no impacts on federally or state-listed plant species, reptiles, amphibians, fish, aquatic invertebrates, or their habitat in areas underlying the Bulldog and Gamecock MOAs and ATCAA. Proposed contract ADAIR operations would have no impacts on federally listed birds in the overland SUA. Bird species occurring within the Bulldog and Gamecock MOAs would primarily be foraging or nesting. Given the large area and high altitude where the majority of contract ADAIR training would occur, and that most ADAIR training would occur during daytime hours, the likelihood for migrating birds (which travel at higher altitudes and often during nighttime hours during migration) to encounter aircraft during training operations would be low. The Proposed Action would increase the total number of sorties in the overland airspace by only 700 sorties annually. As such, these species would likely not be startled or at risk from aircraft strikes from aircraft flying at higher altitudes. Aircraft noise in the Gamecock and Bulldog MOAs and ATCAA from proposed contract ADAIR operations would have no impact on bird species as noise levels would not exceed 45 decibels.

Northern long-eared bats and tricolored bats with potential to occur in areas underlying the Bulldog and Gamecock MOAs and ATCAA would potentially only be affected by aircraft overflights if the training activities elicited negative behavioral responses or were involved with aircraft strikes. It is unlikely that either aircraft movement or noise, especially at higher altitudes, would elicit a response from mammals. Noise from contract ADAIR aircraft would not exceed 45 decibels and would therefore have no impact on listed mammal species. Aircraft movement would not be visible to mammals unless an individual was at the exact location at the moment in which an aircraft traveling at high speed at a relatively low altitude passed directly overhead. These occurrences with contract ADAIR aircraft would be so rare as to be negligible and may not even generate a startle response if an interaction occurred. Most of the contract ADAIR training in the Bulldog and Gamecock MOAs and ATCAA would occur during daytime hours when the northern long-eared bat and tricolored bat would not be actively foraging and at altitudes higher than most bats occur. As such, proposed contract ADAIR operations in the overland SUA would have no effect on the northern long-eared bat or tricolored bat.

Annual migration patterns for the eastern monarch butterfly population include the Bulldog and Gamecock MOAs. Aircraft operations at altitudes at or below 1,000 feet in the MOAs could strike migrating monarch butterflies during soaring flight. However, only 700 additional annual contract ADAIR operations are proposed in the MOAs, and many of these operations would be at altitudes greater than 1,000 feet above ground level. Therefore, it would be highly unlikely for aircraft operating in the Bulldog and Gamecock MOAs and ATCAA to strike migrating monarch butterflies. As such, the contract ADAIR training in the Bulldog and Gamecock MOAs and ATCAA would have no effect on monarch butterflies.

Within the offshore Warning Areas over the Atlantic Ocean, it is not expected that either aircraft movement or noise emissions, especially at higher altitudes, would elicit a response from avian species or the West Indian manatee. Noise from contract ADAIR aircraft would not increase substantially (including from sonic booms) in the Warning Areas. Sonic booms from supersonic aircraft movement could cause a startle response by the listed species when they are present; however, sonic booms would be relatively rare events during proposed contract ADAIR training in the Warning Areas, and sonic booms and post-boom rumbling would be similar to what avian species and the West Indian manatee experience during a thunderstorm; therefore, sonic booms from supersonic aircraft movement is expected to have no impact on listed avian species or the West Indian manatee. Additionally, for listed bird species such as the piping plover and red knot, given the large area where the majority of proposed contract ADAIR training would occur and that most ADAIR training would occur during daytime hours, the likelihood for migrating or foraging birds to encounter aircraft during training operations is extremely low and therefore, would have no effect on these species.

Chaff and flare components, such as end caps and pistons, would be released into the marine environment, where they would persist for long periods and could be ingested by marine fauna and avian species while initially floating on the surface and sinking through the water column. Chaff and flare end caps and pistons would eventually sink to the seafloor (US Navy, 2009), which would reduce the likelihood of ingestion by avian species or the West Indian manatee at the surface or in the water column. However, with the relatively small amount of additional chaff and flare use over the very large areas of the Atlantic Ocean in the Warning Areas, the chance that listed avian species, or the West Indian manatee would encounter these small plastic chaff and flare components is extremely low. The large size of the Warning Areas (6,233 square miles) and relatively small amount of chaff and flare used (approximately 6,703 annual total) equates to an annual increase in use of about one chaff or flare per square mile.

Bird species could potentially encounter chaff and flare components on the ocean surface while foraging. Some species of seabirds are known to ingest plastic when it is mistaken for prey (Auman et al., 1997; Yamashita et al., 2011; Provencher et al., 2014). Seabirds consuming plastic does not damage the digestive tract, unless consumed in large quantities (Moser and Lee, 1992). The ingestion of plastic such as chaff and flare compression pads or pistons by birds could cause gastrointestinal obstructions or hormonal changes leading to reproductive issues (Provencher et al., 2014). Unless consumed plastic pieces were regurgitated, the chaff and flare compression pads or pistons could cause digestive tract blockages and eventual starvation and could potentially be lethal to birds foraging on the ocean surface that use or migrate through the Warning Areas and feed at the ocean surface, such as the roseate tern. In addition, as previously stated, the majority of these chaff and flare plastic components would fall through the water column to the sea floor and would not remain on the ocean surface where a foraging bird could encounter and consume the plastic pieces. As previously discussed, the additional amount of plastic chaff and flare components that would be deposited into the marine environment is minor, and it is unlikely that foraging birds would encounter chaff and flare components floating on the ocean surface. The potential for ingestion of plastic chaff and flare components as a result of the increased use of chaff and flares may affect but is not likely to adversely affect the roseate tern, which could forage on the surface of the Atlantic Ocean in the Warning Areas.

The West Indian manatee could encounter chaff and flare components within offshore waters under the Warning Areas. In the unlikely event that these are encountered and ingested by a manatee, the small size of chaff components and flare end caps and pistons (i.e., 1.3-inch diameter and 0.13-inch thick) would aid in passing through the digestive tract of marine mammals (US Navy, 2009); therefore, the use of defensive countermeasures may affect, but is not likely to adversely affect the West Indian manatee.

The Proposed Action would have *no effect* on the northern long-eared bat, eastern black rail, red cockaded woodpecker, piping plover, red knot, and wood stork. The proposed contract ADAIR operations in the SUA *may affect but are not likely to adversely affect* the roseate tern and West Indian manatee. The proposed contract ADAIR operations from the Shaw AFB airfield and in the overland SUA would not jeopardize the continued existence of the monarch butterfly and tricolored bat. I am requesting your written concurrence with DAF's determinations on these ESA federally listed, proposed for listing, and candidate species. Additionally, the DAF has prepared a Draft Environmental Assessment (EA) in accordance with the National Environmental Policy Act of 1969 and the DAF Environmental Impact Analysis Process (32 Code of Federal Regulations Part 989). The Draft EA and proposed Finding of No Significant Impact are available for viewing or download at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. Please provide your concurrence or comments and additional information concerning the Proposed Action within 30 days of the date of this letter to Bryan Jobe, NEPA Program Manager in the 20 CES/CEIEA, via email at bryan.jobe@us.af.mil or by telephone at 803-895-9985. Thank you for your assistance.

Sincerely

K. Smith

KRISTOFFER R. SMITH, Colonel, USAF
Commander

Attachments:
References
Figure 1. Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur
Figure 2. Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations

References:

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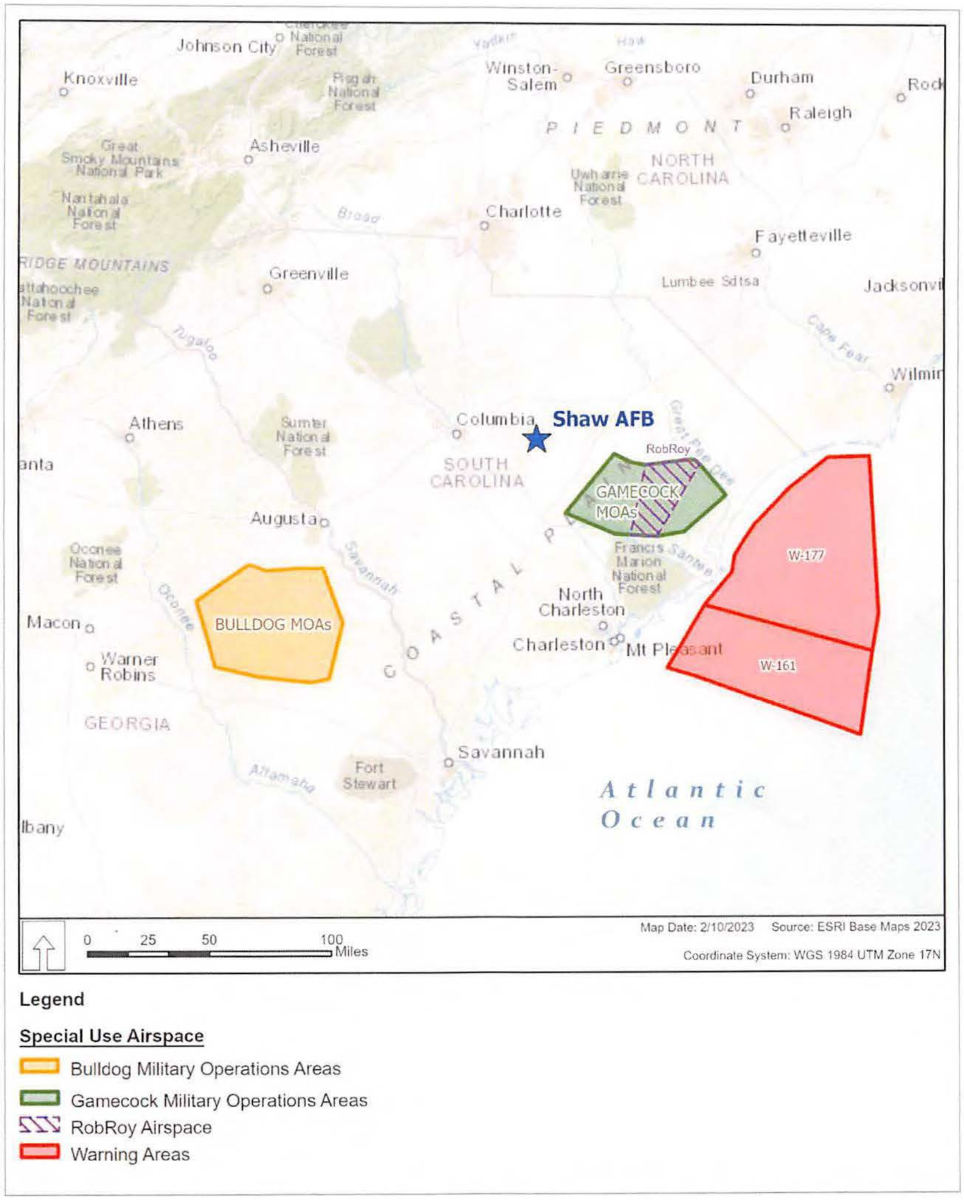

Figure 1. Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur

Figure 2. Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations

A.4.4 NOAA Fisheries Letter

DEPARTMENT OF THE AIR FORCE
20th FIGHTER WING (ACC)
SHAW AIR FORCE BASE SOUTH CAROLINA

Colonel Kristoffer R. Smith
Commander, 20th Fighter Wing
517 Lance Avenue
Shaw AFB SC 29152

Mary Wunderlich
Section 7 Coordinator
National Oceanic and Atmospheric Administration Fisheries
Interagency Cooperation Branch, Protected Resources Division
Southeast Regional Office
263 13th Avenue South
St. Petersburg FL 33701

Dear Mary Wunderlich

The Department of the Air Force (DAF) is proposing to provide dedicated Combat Air Forces contract adversary air (ADAIR) training support at Shaw Air Force Base (AFB), South Carolina (Proposed Action). The Proposed Action would improve the quality of training and readiness of fighter aircrew of the 20th Fighter Wing (20 FW) and other units assigned to Shaw AFB. The Proposed Action includes contracting an estimated 12 contractor aircraft to fly approximately 3,500 annual sorties to support the 20 FW and other units assigned to Shaw AFB. Proposed contract ADAIR services supporting Shaw AFB would be staffed by approximately 78 contracted maintenance personnel and an estimated 15 contracted pilots. Proposed contract ADAIR operations may use different types of fighter aircraft available with acceptable capabilities to support training requirements.

The proposed contract ADAIR training activities would use existing special use airspace (SUA) near Shaw AFB; no airspace modifications would be required (Figure 1). Overland SUA that would be used by contract ADAIR aircraft includes the Bulldog Military Operations Area (MOA) and Air Traffic Control Assigned Airspace (ATCAA) and the Gamecock MOA and ATCAA. Over the Atlantic Ocean, contract ADAIR would operate in Warning Areas W-161 and W-177. Contract ADAIR aircraft would operate with advanced radar and electronic targeting systems during engagements and employ chaff and flares (e.g., RR-188 chaff and M206 flares) during training sorties in SUA authorized for their use.

Shaw AFB has existing facilities including necessary ramp space; maintenance space; operational space; petroleum, oil, and lubricants storage; runway access; and associated parking to support the Proposed Action (Figure 2). Therefore, no new construction activities would occur at Shaw AFB under the Proposed Action.

The DAF previously completed Endangered Species Act (ESA) Section 7 consultation with National Oceanic and Atmospheric Administration (NOAA) Fisheries for proposed contract ADAIR support at Joint Base Langley-Eustis, Langley AFB (JBLE-Langley), Virginia, in 2019 (GARFO-

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2019-02255). Subsequently, the DAF coordinated with NOAA Fisheries in 2020 concerning proposed contract ADAIR support for Seymour Johnson AFB, North Carolina. The DAF determined that re-initiation of Section 7 consultation was not warranted and received concurrence from NOAA Fisheries that proposed contract ADAIR activities at Seymour Johnson AFB (SERO-2020-01452) did not meet re-initiation triggers from the JBLE-Langley Section 7 consultation.

The Proposed Action for contract ADAIR support at Shaw AFB is similar to the Proposed Action analyzed for both JBLE-Langley and Seymour Johnson AFB, including aircraft operations in W-161 and W-177. The only difference between these actions and the Proposed Action at Shaw AFB are the locations from which aircraft would take off and land to support DAF training requirements. The DAF is not aware of any new information that would reveal that the effects of the Proposed Action at Shaw AFB have not been previously considered. The Proposed Action has not been modified in any way that would cause an effect on a listed species or critical habitat beneath W-161 and W-177 in a manner or to an extent not previously considered. Further, no new species has been listed or critical habitat designated in W-161 or W-177 that may be affected by the Proposed Action.

The DAF has determined that no new operations are proposed in W-161 and W-177 that would re-initiate ESA Section 7 consultation with NOAA Fisheries. I am requesting your written concurrence with DAF's determination that re-initiation of ESA Section 7 consultation is not warranted. Additionally, the DAF has prepared a Draft Environmental Assessment (EA) to evaluate potential impacts from the Proposed Action in accordance with the National Environmental Policy Act (NEPA) of 1969 and the DAF Environmental Impact Analysis Process (32 Code of Federal Regulations Part 989). The Draft EA and proposed Finding of No Significant Impact are available for viewing or download at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. Please provide written concurrence with this determination or comments and additional information concerning the Proposed Action within 30 days of the date of receipt of this letter to Bryan Jobe, NEPA Program Manager in the 20 CES/CEIEA, via email at bryan.jobe@us.af.mil or by telephone at 803-895-9985. Thank you for your assistance.

Sincerely

K. Smith

KRISTOFFER R. SMITH, Colonel, USAF
Commander

Attachments:
Figure 1. Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur
Figure 2. Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations

3

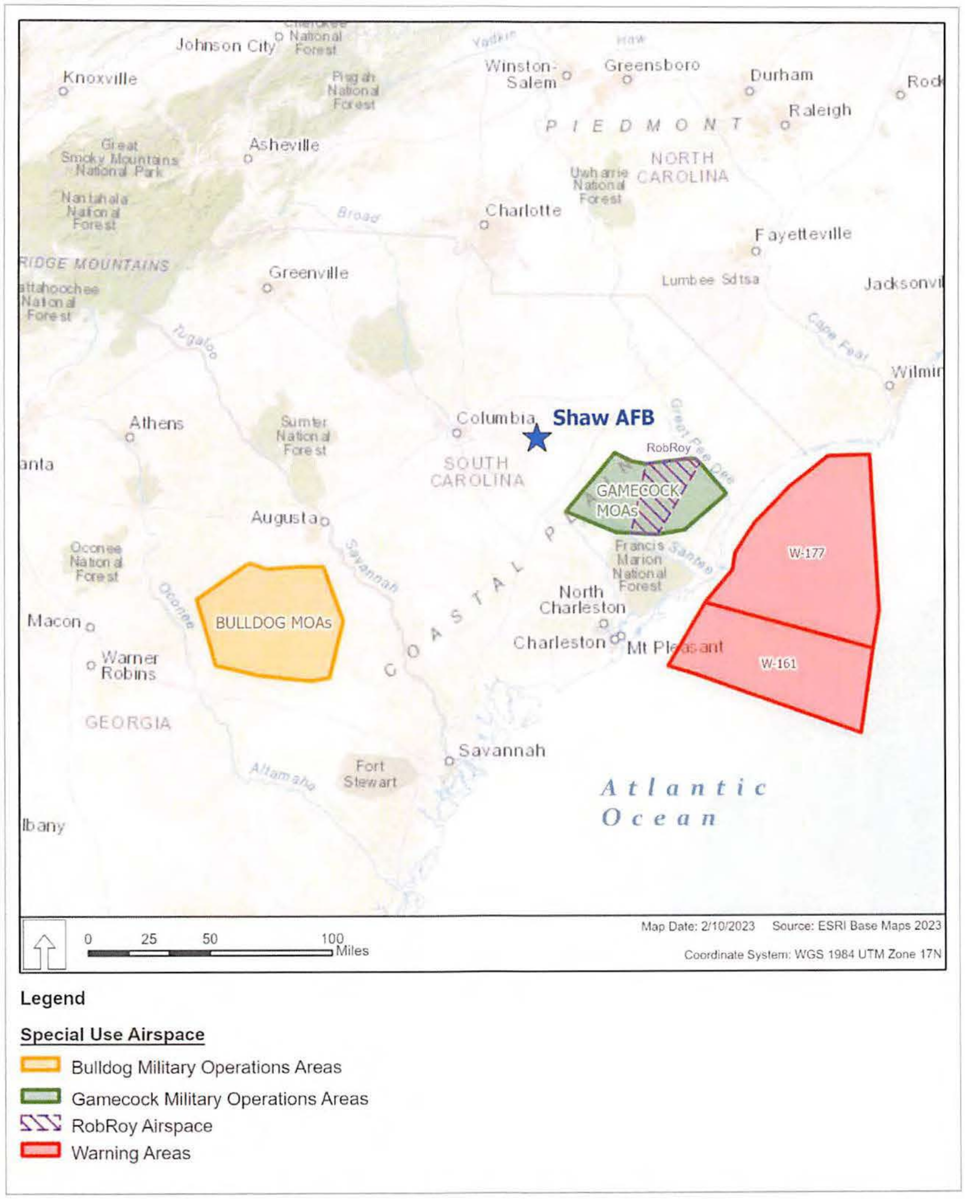

Figure 1. Shaw Air Force Base Special Use Airspace Where Proposed Contract Adversary Air Training Activities Would Occur

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Figure 2. Shaw Air Force Base Facilities Proposed for Use by Contract Adversary Air Personnel and Operations

A.4.5 SHPO Letters

DEPARTMENT OF THE AIR FORCE
20th FIGHTER WING (ACC)
SHAW AIR FORCE BASE SOUTH CAROLINA

Colonel Kristoffer R. Smith
Commander, 20th Fighter Wing
517 Lance Avenue
Shaw AFB SC 29152

Georgia Department of Community Affairs
Christopher Nunn, SHPO
Commissioner, Georgia Department of Community Affairs
60 Executive Park South, NE
Atlanta GA 30329

Dear Mr. Nunn

The Department of the Air Force (DAF) and Headquarters Air Combat Command have prepared a Draft Environmental Assessment (EA) and proposed Finding of No Significant Impact (FONSI) evaluating the potential environmental impacts associated with implementing the Proposed Action. The Draft EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality regulations implementing NEPA, and DAF NEPA regulations.

In May 2023, I sent you a letter briefly describing the DAF's Proposed Action to provide dedicated Combat Air Forces contract adversary air training support at Shaw Air Force Base, South Carolina, and asking for your concurrence with our Area of Potential Effects definition. We responded to your request for clarification regarding the Proposed Action submitted via email by your office in July. The DAF is in receipt of your letter dated 5 September 2023 in which your office determined that the Proposed Action would have no adverse effect to historic properties within the project area, as defined in 36 CFR § 800.5(d)(1).

The Draft EA and proposed FONSI are available for review at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. To ensure the DAF has sufficient time to consider your input, and in compliance with Section 106 of the National Historic Preservation Act, please provide comments or requests for additional information within 30 days of receipt of this letter. Please provide your comments to Bryan Jobe, NEPA Program Manager, 20 CES/CEIEA, via email at bryan.jobe@us.af.mil, or by telephone at 803-895-9985.

Sincerely

K. Smith

KRISTOFFER R. SMITH, Colonel, USAF
Commander

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DEPARTMENT OF THE AIR FORCE
20th FIGHTER WING (ACC)
SHAW AIR FORCE BASE SOUTH CAROLINA

Colonel Kristoffer R. Smith
Commander, 20th Fighter Wing
517 Lance Avenue
Shaw AFB SC 29152

South Carolina Department of Archives and History
Eric W. Emerson
State Historic Preservation Officer
8301 Parklane Road
Columbia SC 29223

Dear Mr. Emerson

The Department of the Air Force (DAF) and Headquarters Air Combat Command have prepared a Draft Environmental Assessment (EA) and proposed Finding of No Significant Impact (FONSI) evaluating the potential environmental impacts associated with the Proposed Action to provide dedicated Combat Air Forces contract adversary air (ADAIR) training support at Shaw Air Force Base (AFB), South Carolina. The Draft EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality regulations implementing NEPA, and DAF NEPA regulations.

In May 2023, I sent you a letter briefly describing DAF's proposal to establish ADAIR at Shaw AFB, South Carolina. At this time, we provided you with preliminary information on historic properties and asked for your concurrence with the Area of Potential Effects (APE) definition. In a letter dated 27 July 2023 your office concurred with the definition of the APE, concurred with the determination that Buildings 106 and 712 are not eligible for listing in the National Register of Historic Places (NRHP), and stated your office believes no properties listed in or eligible for listing in the NRHP have the potential to be affected by this project.

The Draft EA and proposed FONSI are available for your review and awareness at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. Should you have any additional comments, please provide them within 30 days of receipt of this letter to Bryan Jobe, NEPA Program Manager, 20 CES/CEIEA, via email at bryan.jobe@us.af.mil, or by telephone at 803-895-9985.

Sincerely

K. Smith

KRISTOFFER R. SMITH, Colonel, USAF
Commander

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A.5 Stakeholders List

Letters requesting information to support the development of this EA and/or requesting consultation were sent to those listed below.

Federal Agencies

United States Environmental Protection Agency
Region 4
Ntale Kajumba, Manager
NEPA Program Office
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303

Federal Aviation Administration
West Colombia FSDO
Randy S. DeBerry, Manager
125-B Summer Lake Drive
West Columbia, SC 29170

US Fish and Wildlife Service
Southeast Region
Mike Oetker, Regional Director
1875 Century Boulevard
Atlanta, GA 30345

US Fish and Wildlife Service
South Carolina Field Office
Thomas D. McCoy
Field Supervisor
176 Croghan Spur Road, Suite 200
Charleston, SC 29407

US Forest Service
Francis Marion & Sumter National Forests
Richard Lint, Forest Supervisor
4931 Broad River Road
Columbia, SC 29212

Elected Officials

Hon. Henry Dargan McMaster
Governor of South Carolina
1100 Gervais Street
Columbia, SC 29201

Hon. Lindsey Graham
United States Senator
211 Russell Senate Office Building
Washington, DC 20510

Hon. Tim Scott
United States Senator
104 Hart Senate Office Building
Washington, DC 20510

Native American Tribes

Absentee-Shawnee Tribe of Indians of Oklahoma
John Johnson, Governor
2025 S. Gordon Cooper Drive
Shawnee, OK 74801

Alabama-Quassarte Tribal Town
Wilson Yargee, Chief
PO Box 187
Wetumka, OK 74883

Alabama-Quassarte Tribal Town
Ben Yahola, THPO
PO Box 187
Wetumka, OK 74883

Catawba Indian Nation
Bill Harris, Chief
996 Avenue of the Nations
Rock Hill, SC 29730

Catawba Indian Nation
Dr. Wenonah G.Haire
THPO and Catawba Cultural Center Executive Director
1536 Tom Steven Road
Rock Hill, SC 29730

Cherokee Nation
Elizabeth Toombs, THPO
PO Box 948
Tahlequah OK, 74465

Cherokee Nation
Chuck Hoskin, Principal Chief
PO Box 948
Tahlequah, OK 74465

Chickasaw Nation
Bill Anoatubby, Governor
P.O. Box 1548
Ada, OK 74821

Eastern Band of Cherokee Indians
Richard Sneed, Principal Chief
Qualla Boundary
P.O. Box 455
Cherokee, NC 28719

Eastern Band of Cherokee Indians
Russell Townsend, Tribal Historic Preservation Specialist
Qualla Boundary
P.O. Box 455
Cherokee, NC 28719

Eastern Shawnee Tribe of Oklahoma
Glenna Wallace, Chief
PO Box 350
Seneca, MO 64865

Eastern Shawnee Tribe of Oklahoma
Paul Barton
THPO/Director of Culture Preservation Programs/NAGPRA
70500 E. 128 Road
Wyandotte, OK 74370-3148

Kialegee Tribal Town
Mekko Givens, Executive Officer
P.O. Box 332
Wetumka, OK 74883

Miccosukee Tribe of Indians of Florida
Talbert Cypress, Chairman
Tamiami Station
P.O. Box 440021
Miami, FL 33144

Muscogee (Creek) Nation
David Hill, Principal Chief
PO Box 580
Okmulgee, OK 74447

Muscogee (Creek) Nation
Corain Lowe-Zepeda, THPO
PO Box 580
Okmulgee, OK 74447

Seminole Tribe of Florida
Marcellus Osceola, Jr., Chairman
6300 Stirling Road
Hollywood, FL 33024

Shawnee Tribe
Ben Barnes, Chief
29 S Hwy 69A
Miami, OK 74354

The Great Seminole Nation of Oklahoma
Lewis Johnson, Chief
36645 US-270
Wewoka, OK 74884

Thlopthlocco Tribal Town
Ryan Morrow, Town King
P.O. Box 188
Okemah, OK 74859

Tuscarora Nation
Leo Henry, Chief
2006 Mt Hope Rd
Lewiston, NY 14092

Tuscarora Nation
Bryan Printup, Representative
5226 Walmore Rd
Lewiston, NY 14092

United Keetoowah Band of Cherokee Indians in Oklahoma
Joe Bunch, Chief
18300 W. Keetoowah Circle
Tahlequah, OK 74465

State Agencies

South Carolina Dept of Archives and History
Eric W. Emerson
State Historic Preservation Officer
8301 Parklane Road
Columbia, SC 29223

South Carolina Dept of Archives and History
Elizabeth Johnson
Deputy State Historic Preservation Officer
8301 Parklane Road
Columbia, SC 29223

South Carolina Commission of Minority Affairs
Dr. Deloras Dacosta, Executive Director
293 Greystone Blvd
Columbia, SC 29210

Georgia Department of Community Affairs
Christopher Nunn, SHPO Commissioner
60 Executive Park South, NE
Atlanta, GA 30329

Georgia Department of Community Affairs
Historic Preservation Division
Jennifer Dixon, Division Director/DSHPO
60 Executive Park South, NE
Atlanta, GA 30329

A.6 AGENCY AND TRIBAL COMMENT LETTERS

-----Original Message-----
From: JOBE, BRYAN A CIV USAF ACC 20 CES/CEIEA
Sent: Monday, August 7, 2023 1:31 PM
To: Stacy Rieke [redacted]
Subject: RE: Clarification Needed: S106 Review of Training Activities

Hello and good afternoon. I would like to take this time to apologize as I thought I had already sent this response. Two Areas of Potential Effects (APEs) have been proposed to analyze cultural resources for this Proposed Action. The first APE is limited to the facilities proposed for use to accommodate bringing contract ADAIR to Shaw AFB, South Carolina. The second APE includes the special use airspace (SUA) contract ADAIR would fly in. A map illustrating the counties under the Bulldog Military Operations Areas (MOAs) is attached for your reference. Please note that the larger Bulldog MOA shown in the map is further subdivided for training purposes (Bulldog A, Bulldog B, Bulldog C, etc.) which is why we speak to Bulldog MOAs in the plural. Portions of several Georgia counties, including Jefferson, Washington, Burke, Jenkins, Johnson, Emanuel, and Bulloch lie under this airspace.

The Bulldog MOAs are existing airspace, meaning they were previously established by the Federal Aviation Administration on behalf of the Department of the Air Force after potential environmental impacts were analyzed in a previous NEPA document. The Bulldog MOAs are currently used by pilots flying out of Shaw AFB (as well as other DoD pilots) for training. Under this Proposed Action an additional 12 contract aircraft would utilize this airspace along with Shaw AFB pilots to enhance their training. Contract ADAIR aircraft would operate with advanced radar and electronic targeting systems and employ chaff and flares during training in SUA that has been authorized for chaff and flare use.

At this time, we would appreciate your inputs on or concurrence with the APEs as defined. We will reach out to your office again to once the Draft EA is available to notify you and seek concurrence with our determination of effects. Please let me know if you have any further questions or concerns.

-----Original Message-----
From: Stacy Rieke [redacted]
Sent: Wednesday, July 19, 2023 11:09 AM
To: JOBE, BRYAN A CIV USAF ACC 20 CES/CEIEA [redacted]>
Subject: [URL Verdict: Neutral][Non-DoD Source] RE: Clarification Needed: S106 Review of Training Activities

Good morning, Mr. Jobe,
I am circling back to my request below for additional information related to project activities associated with the above-referenced undertaking in Georgia. If this information is not currently available, please let me know.

Thank you,
Stacy Rieke

Stacy Rieke
Environmental Review and Preservation Planning Program Manager
Georgia Department of Community Affairs
Direct [redacted]

<https://twitter.com/GA_DCA> <https://www.facebook.com/Georgia-Department-of-Community-Affairs-863762893697162> <https://www.linkedin.com/company/georgia-department-of-community-affairs> <https://www.youtube.com/user/DCAGeorgia>
<https://www.instagram.com/ga_dca/>

From: Stacy Rieke [redacted]>
Sent: Monday, July 17, 2023 9:05 AM
[redacted]
Subject: Clarification Needed: S106 Review of Training Activities

Mr. Jobe,

The Georgia Historic Preservation Division (GA SHPO) received the attached letter via USPS on July 12th. The undertaking is associated with Shaw Air Force Base in South Carolina, however the map provided indicates a “Special Use” airspace in east Georgia. Would you please provide clarification regarding what project activities will occur in Georgia? Additionally, please provide a map that more clearly shows the location of Georgia activities, specifically the particular counties covered by the “Bulldog MOA” area?

Thank you.
Stacy Rieke

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<https://www.linkedin.com/company/georgia-department-of-community-affairs>
<https://www.youtube.com/user/DCAGeorgia>
<https://www.instagram.com/ga_dca/>

Stacy Rieke
Environmental Review and Preservation Planning Program Manager
Georgia Department of Community Affairs
60 Executive Park South, NE
Atlanta, Georgia 30329
Direct [redacted]

Brian P. Kemp
Governor

Georgia Department of Community Affairs

Christopher Nunn
Commissioner

September 5, 2023

Kristoffer R. Smith
Colonel, USAF Commander
Department of the Air Force
20th Fighter Wing (ACC)
[redacted]
Shaw Air Force Base, South Carolina [redacted]
Attn: Bryan Jobe, NEPA Program Manager

**RE: Shaw AFB (SC): Special Use Airspace Modification/Creation, Bulldog Military Operations Area
Bulloch County, et. al., Georgia
HP-230807-005**

Dear Col. Smith:

The Historic Preservation Division (HPD) has reviewed the information submitted concerning the above referenced project. Our comments are offered to assist the U.S. Department of the Air Force and Shaw Air Force Base (AFB) in complying with the provisions of Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA).

The subject project consists of twelve (12) additional aircraft flying annual training sorties from Shaw AFB in South Carolina within the previously established Bulldog Military Operations Areas (MOA) A, B, and C that encompasses all or a portion of seven (7) counties in east Georgia including Bulloch, Burke, Emanuel, Jefferson, Jenkins, Johnson, and Washington Counties. It is HPD's understanding that the aircraft will operate with advanced radar and electronic targeting systems and employ chaff and flares during trainings in the special use airspace that has been previously authorized for chaff and flare use. Based on the information provided, HPD finds that there are multiple National Register of Historic Places (NRHP)-eligible, listed, and unknown properties within the proposed project area. However, it is HPD's opinion that the subject project, as proposed, will have **no adverse effect** to historic properties within the project area, as defined in 36 CFR Part 800.5(d)(1), due to the nature of the activity.

This letter evidences consultation with our office for compliance with Section 106 of the NHPA. It is important to remember that any changes to this project as it is currently proposed may require additional consultation. HPD encourages federal agencies to discuss such changes with our office to ensure that potential effects to historic resources are adequately considered in project planning.

Please refer to project number **HP-230807-005** in any future correspondence regarding this project. If we may be of further assistance, please contact me at [redacted]

Sincerely,

Stacy Rieke

Stacy Rieke, MHP
Program Manager
Environmental Review & Preservation Planning

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SOUTH CAROLINA DEPARTMENT OF
ARCHIVES & HISTORY

July 27, 2023

Bryan Jobe
NEPA Program Manager
[redacted]

Re: Shaw Air Force Base Contract Adversary Air Personnel and Operations (ADAIR) Use of Bldgs. 106 & 712
Sumter, Sumter County, South Carolina
SHPO Project No23-JS0241

Dear Mr. Jobe:

Thank you for Colonel Kristoffer R. Smith's May 19th, 2023 letter and project review submittal, which we received on July 12th, 2023, regarding the above referenced proposed undertaking. We also received maps as supporting documentation for this undertaking. The State Historic Preservation Office is providing comments to the Air Force (AF) pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR 800. Consultation with the SHPO is not a substitution for consultation with Tribal Historic Preservation Offices, other Native American tribes including those with state recognition, local governments, or the public.

Based on the description of the undertaking's Areas of Potential Effect (APEs) and the identification of no historic properties within the APEs, our office believes that no properties listed in or eligible for listing in the National Register of Historic Places will be affected by this project. We concur that Buildings 106 and 712 are not eligible for listing in the National Register.

Please refer to SHPO Project No. 23-JS0241 in any future correspondence regarding this project. If you have any questions, please contact me at [redacted]

Sincerely,
John D. Sylvest
John D. Sylvest
Supervisor of Survey and Review & Compliance
State Historic Preservation Office

8301 Parklane Road • Columbia, SC 29223 • scdah.sc.gov

July 28, 2023

Mr. Bryan Jobe
NEPA Program Manager
Department of the Air Force
Shaw Air Force Base
[redacted]

Dear Mr. Jobe:

Thank you for the letter of notification regarding the proposed additional special use airspace for training the 20th Fighter Wing assigned to Shaw Air Force Base, Sumter County, South Carolina.

The proposed project is outside of our area; therefore, we do not request government-to-government consultation with the United States Air Force. While the Chickasaw Nation has no objection to the undertaking, we respectfully defer to the federally recognized First American tribe(s) that have identified a connection to the project area.

We appreciate your efforts to preserve and protect significant historic properties. If you have any questions, please contact Ms. Karen Brunso, tribal historic preservation officer, at [redacted] or by email at [redacted]

Sincerely,

Kirk Perry

Kirk Perry, Executive Officer
Division of Historic Preservation

[redacted]

November 17, 2023

Mr. Bryan Jobe, NEPA Program Manager
Department of the Air Force
20th Fighter Wing
[redacted]
Shaw Air Force Base, SC 29152

Dear Mr. Jobe:

Thank you for the letter of notification regarding the Department of the Air Force's Proposed Action to provide dedicated Combat Air Forces contract adversary air training support at Shaw Air Force Base, Sumter County, South Carolina.

The proposed project is outside of our area; therefore, we do not request government-to-government consultation with the Department of the Air Force. While the Chickasaw Nation has no objection to the undertaking, we respectfully defer to the federally recognized First American tribe(s) that have identified a connection to the project area.

We appreciate your efforts to preserve and protect significant historic properties. If you have any questions, please contact Ms. Karen Brunso, tribal historic preservation officer, at ([redacted]) [redacted] or by email at [redacted]

Sincerely,

Kirk Perry

Kirk Perry, Executive Officer
Division of Historic Preservation

[redacted]

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Chuck Hoskin Jr.
Principal Chief
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Bryan Warner
Deputy Principal Chief
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July 27, 2023

Bryan Jobe
Department of the Air Force
20th Fighter Wing
Shaw Air Force Base South Carolina

Re: 20th Fighter Wing, Buildings 106 and 712

Mr. Bryan Jobe:

The Cherokee Nation (Nation) is in receipt of your correspondence about **20th Fighter Wing, Buildings 106 and 712**, and appreciates the opportunity to provide comment upon this project.

The Nation maintains databases and records of cultural, historic, and pre-historic resources in this area. Our Historic Preservation Office (Office) reviewed this project, cross referenced the project's legal description against our information, and found no instances where this project intersects or adjoins such resources. Thus, the Nation does not foresee this project imparting impacts to Cherokee cultural resources at this time.

However, the Nation requests that the Department of the Air Force (DAF) halt all project activities immediately and re-contact our Office for further consultation if items of cultural significance are discovered during the course of this project. Additionally, the Nation requests that DAF conduct appropriate inquiries with other pertinent Historic Preservation Offices regarding historic and prehistoric resources not included in the Nation's databases or records.

If you require additional information or have any questions, please contact me at your convenience. Thank you for your time and attention to this matter.

Wado,

Elizabeth Toombs

Elizabeth Toombs, Tribal Historic Preservation Officer
Cherokee Nation Tribal Historic Preservation Office
[redacted]

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Chuck Hoskin Jr.
Principal Chief
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Bryan Warner
Deputy Principal Chief
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November 27, 2023

Bryan Jobe
Department of the Air Force
20th Fighter Wing
Shaw Air Force Base, South Carolina

Re: Shaw Air Force Base, Combat Air Forces Adversary Air

Mr. Bryan Jobe:

The Cherokee Nation (Nation) is in receipt of your correspondence about **Shaw Air Force Base**, and appreciates the opportunity to provide comment upon this project. This communication is intended for government-to-government consultation with a sovereign federally recognized Tribal Nation. Information received in consultation will be deemed confidential unless explicit consent is provided by the Nation.

The Nation maintains databases and records of cultural, historic, and pre-historic resources in this area. Our Historic Preservation Office (Office) reviewed this project, cross referenced the project's legal description against our information, and found no instances where this project intersects or adjoins such resources. Thus, the Nation does not foresee this project imparting impacts to Cherokee cultural resources at this time.

However, the Nation requests that the Shaw Air Force Base halt all project activities immediately and re-contact our Office for further consultation if items of cultural significance are discovered during the course of this project. Additionally, the Nation requests that the Shaw Air Force Base conduct appropriate inquiries with other pertinent Historic Preservation Offices regarding historic and prehistoric resources not included in the Nation's databases or records.

If you require additional information or have any questions, please contact me at your convenience. Thank you for your time and attention to this matter.

Wado,

Elizabeth Toombs

Elizabeth Toombs, Tribal Historic Preservation Officer
Cherokee Nation Tribal Historic Preservation Office
[redacted]

Catawba Indian Nation
Tribal Historic Preservation Office
[redacted]

[redacted]

August 15, 2023

Attention: Kristoffer Smith
Dept. of the Air Force
20th Fighter Wing (ACC)
Shaw Air Force Base, SC

Re. THPO #	TCNS #	Project Description
2023-702-8		Proposing to provide Combat Air Forces contract adversary air to improve the quality of training and readiness of fighter aircrew of the 20th Fighter wing and other units assigned to Shaw Air Force Base, SC

Dear Mr. Smith,

The Catawba have no immediate concerns with regard to traditional cultural properties, sacred sites or Native American archaeological sites within the boundaries of the proposed project areas. **However, the Catawba are to be notified if Native American artifacts and / or human remains are located during the ground disturbance phase of this project.**

If you have questions please contact Caitlin Rogers at [redacted] e-mail [redacted]

Sincerely,

Caitlin Rogers for

Wenonah G. Haire
Tribal Historic Preservation Officer

United States Department of the Interior
FISH AND WILDLIFE SERVICE
South Carolina Ecological Services Field Office
176 Croghan Spur Road, Suite 200
Charleston, South Carolina 29407

November 29, 2023

Colonel Kristoffer R. Smith
Commander, 20th Fighter Wing
517 Lance Avenue
Shaw AFB SC 29152

Attn: Bryan Jobe

Re: Combat Air Forces Adversary Air, Shaw Air Force Base, South Carolina
FWS Project Code: 2024-0016651

Dear Colonel Smith:

The U.S. Fish and Wildlife Service (Service) has reviewed the above referenced project and offers the following comments pursuant to section 7 of the Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 *et seq*. (ESA). The following comments do not address all Service concerns for fish and wildlife resources and do not preclude separate review and comments by the Service as afforded by other applicable environmental legislation.

Your agency has made a determination of *may affect, but is not likely to adversely affect* for the species listed below.

- Roseate tern (*Sterna dougallii dougallii*)
- West Indian manatee (*Trichechus manatus*)

Based on the justification provided, the Service concurs with your determination that the proposed action *may affect, but is not likely to adversely affect* the species listed above. Consultation is not necessary for *no effect* and *not likely to jeopardize the continued existence* determinations. Please note that obligations under section 7 of the ESA must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is subsequently modified in a manner, which was not considered in this assessment; or (3) a new species is listed or critical habitat is determined that may be affected by the identified action.

The Service recommends that you contact the South Carolina Department of Natural Resources regarding potential impacts to State protected species. If you need further assistance, please contact: Melanie Olds via email at melanie_olds@fws.gov.

Sincerely,

GARY PEEPLES Digitally signed by GARY PEEPLES
Date: 2023.11.29 10:22:20 -05'00'

Gary Peeples
Acting Field Supervisor

A.7 DRAFT EA NOTICE OF AVAILABILITY

NOTICE OF AVAILABILITY

Draft Environmental Assessment for Combat Air Forces Adversary Air at Shaw Air Force Base, South Carolina

A Draft Environmental Assessment (EA) and proposed Finding of No Significant Impact (FONSI) have been prepared by the Department of the Air Force (DAF) to analyze the impacts of providing dedicated contract adversary air (ADAIR) sorties for Combat Air Forces training at Shaw Air Force Base (AFB), South Carolina.

The Proposed Action includes contracting an estimated 12 contractor aircraft to fly approximately 3,500 annual sorties from Shaw AFB to support the 20th Fighter Wing and other units at Shaw AFB. The Proposed Action would require an estimated 78 contracted maintainers and 15 contracted pilots who would maintain and operate the contract ADAIR aircraft. Aircraft would depart from Shaw AFB, transit to existing military special use airspace, perform ADAIR training, transit back, and land at Shaw AFB. Special use airspace includes Military Operations Areas and Air Traffic Control Assigned Airspace overlying portions of South Carolina and Georgia, and offshore Warning Areas over the Atlantic Ocean. Operations and maintenance activities would be consolidated in existing facilities at Shaw AFB; no facility construction, demolition, or renovation activities are included in the Proposed Action.

The Draft EA and proposed FONSI are available electronically on the Shaw AFB website at https://www.shaw.af.mil/Public-Affairs/Community-Engagement/Environmental/. Printed copies are also available at the following public libraries:

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- Florence County Public Library, 509 S. Dargan Street, Florence, South Carolina 29506

Please provide comments on the Draft EA and proposed FONSI by 28 November 2023 to Mr. Bryan Jobe, NEPA Program Manager, 20 CES/CEIEA, 428 Chapin Street, Shaw AFB, South Carolina 29152 or by email to bryan.jobe@us.af.mil. Please note that in accordance with Privacy Act provisions, the DAF will not publish personal information of commenters, such as home addresses, e-mail addresses, or phone numbers.

the Sumter ITEM

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who being duly sworn, says she is a Legal Clerk of the OSTEEN PUBLISHING CO., Publisher of THE ITEM, A Newspaper published in said state and county and that advertisement

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and a copy of advertisement is attached.

Sworn to before me on said date:

October 29, 2023

Jill S. Burrus
Notary Public for South Carolina
Jill S. Burrus

JILL S. BURRUS
Notary Public - State of South Carolina
My Commission Expires
May 31, 2026

THE COMMUNITY TIMES NEWSPAPER NOVEMBER 2 - 8, 2023 PAGE 5

Our Voices Speakin-Up And Sp

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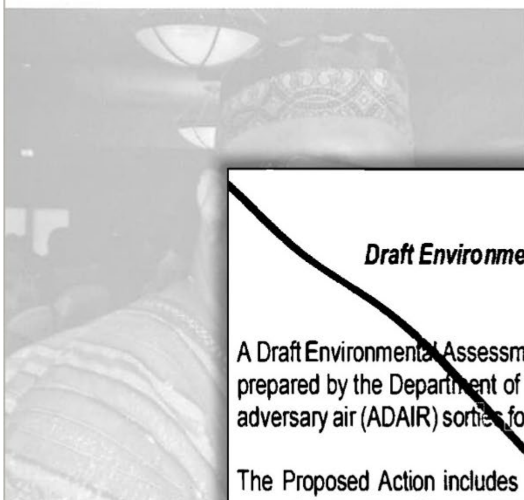

having marital problems and appealed to the Elders in the organization. Seven Elders representing several ethnic groups (including me) gathered to hear the couples' stories. After listening to them

This week we shall call

By Burnett W. "Kwadw Gallman, Jr., M.D.

NOTICE OF AVAILABILITY

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The Community Times

STATE OF SOUTH CAROLINA

COUNTY OF FLORENCE

PRINTERS AFFIDAVIT

Personally appeared before me, Diana B. Smith, who being duly sworn, says he is the Publisher, with DBS Communications, LLC, Publisher of The Community Times, a newspaper published in said State and County, and that advertisement for Notice of Availability:

NOTICE OF AVAILABILITY

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CERTIFICATE OF PUBLICATION

I hereby certify that on November 2-8, 2023
I did publish the Notice of Availability
in The Community Times, a newspaper of general circulation in
Florence County in accordance with state law.

SWORN to berfore me this 3rd,
day of November, 2023

Diana Brunson Smith, Notary

Notary Public for South Carolina
My Commission Expires: April, 2032

Form #370PC (7/87)
SCPC-3-704,3-801,3804

Signature:

Name: Diana B. Smith, Publisher
Address: 3330 Lupine Drive
Florence, SC 29501
Telephone: 843-667-1818

NOTICE OF AVAILABILITY

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AG-37746056

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The Augusta Chronicle
Athens Banner-Herald
Savannah Morning News

PO Box 631697 Cincinnati, OH 45263-1697

PROOF OF PUBLICATION

Eric Webb
Eric Webb
Vernadero Group Incorporated
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New Orleans LA 70119-4361

STATE OF GEORGIA, COUNTY OF RICHMOND

The Augusta Chronicle, a newspaper that is generally circulated in the county of Richmond and in the area adjacent thereto, State of Georgia, printed and published and personal knowledge of the facts herein state and that the notice hereto annexed was Published in said newspapers in the issues dated on:

10/29/2023

and that the fees charged are legal.
Sworn to and subscribed before on 10/29/2023

Legal Clerk

Amy Kokott

Notary, State of WI, County of Brown

6/30/2025

My commision expires

Publication Cost:	$177.48	
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Please do not use this form for payment remittance.

AMY KOKOTT
Notary Public
State of Wisconsin

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APPENDIX B
REASONABLY FORESEEABLE FUTURE ACTIONS

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APPENDIX B – REASONABLY FORESEEABLE FUTURE ACTIONS

Table B-1 Reasonably Foreseeable Future Actions

Scheduled Project	Project Summary	Implementation Date	Relevance to Proposed Action
US 76 / 378 Rural Roads Project	Road construction to include widening and paving directly adjacent to Shaw AFB. The project extends 7.2 miles from the Wateree River and Richland / Sumter County line to a point west of the US 76 / 378 and Patriot Parkway interchange.	2023 – undetermined	Action could occur near Shaw AFB within the same timeframe as the Proposed Action.
S-40 Bridge Replacement over Mush Branch	Replacement of a 50-year-old bridge and widening the bridge to accommodate two lanes and two shoulders.	Spring 2022 – 2028	Action could occur near Shaw AFB within the same timeframe as the Proposed Action.
Resurfacing of Roads: S-344, S-364, S-421, S-422, S-423, S-511, S-752, S-753, S-754, S-755, S-720, S-721, S-904, and S-1093	The Pavement Resurfacing Program encompasses a range of projects: preservation of pavements in good condition, rehabilitation of pavements in fair condition, and reconstruction of pavements in poor condition. Approximately 80 percent of resurfacing projects are rehabilitation projects extending the service life and elevating the condition to a state of good repair.	2021 – undetermined, up to 2031	Action could occur near Shaw AFB within the same timeframe as the Proposed Action.
Road Safety Improvement S-40	South Carolina has a high ‘mileage death rate.’ Road will be assessed for correction to reduce vehicle crashes.	2022 – undetermined	Action could occur near Shaw AFB within the same timeframe as the Proposed Action.

Notes:
AFB = Air Force Base

APPENDIX C
FURTHER DEFINITIONS OF RESOURCE AREAS ANALYZED, METHODOLOGIES, AND MODELING

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APPENDIX C – FURTHER DEFINITIONS OF RESOURCE AREAS ANALYZED, METHODOLOGIES, AND MODELING

C.1 AIRSPACE MANAGEMENT AND USE

C.1.1 Definition of the Resource

Airspace management involves the direction, control, and handling of flight operations in the airspace that overlies the borders of the United States and its territories. Under Title 49, U.S.C. § 40103, *Sovereignty and use of airspace*, and Public Law No. 103-272, the US government has exclusive sovereignty over the nation's airspace. The Federal Aviation Administration (FAA) is responsible for planning, managing, and controlling the structure and use of all airspace over the United States. FAA rules govern the national airspace system, and FAA regulations establish how and where aircraft may fly. Collectively, the FAA uses these rules and regulations to make airspace use as safe, effective, and compatible as possible for all types of aircraft, including civilian, commercial, and military aircraft.

Terminal airspace around civil airports is defined by the terminal airspace area designations for each airport (FAA Order Joint Order 7400.11G, *Airspace Designations and Reporting Points*). These airspace designations include Class A through G, which specify the airspace within which all aircraft operators are subject to operating rules and equipment requirements of Part 91 of the Federal Aviation Regulations (see 14 CFR § 91.130). General descriptions of the airspace classifications common to civil airports, which consist of Class C, D, and E airspace, are described below. More specific rules may apply to Shaw AFB.

Class C. Generally, this is the airspace from the surface to 4,000 feet (ft) above the airport elevation (charted in mean sea level [MSL]) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and have a certain number of Instrument Flight Rules (IFR) operations or passenger enplanements. Although the configuration of each Class C area is individually tailored, the airspace usually consists of a surface area with a 5-nautical mile (NM) radius, an outer circle with a 10-NM radius that extends from 1,200 to 4,000 ft above the airport elevation, and an outer area. Each aircraft must establish two-way radio communications with the Air Traffic Control (ATC) facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while within the airspace.

Class D. Generally, this is the airspace from the surface to 2,500 ft above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures. Arrival extensions for instrument approach procedures may be Class D or Class E airspace. Unless otherwise authorized, each aircraft must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while in the airspace.

Class E. Generally, controlled airspace that is not classified as Class A, B, C, or D is Class E airspace. Class E airspace extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. When designated as a surface area, the airspace will be configured to contain all instrument procedures. Also, in this class are federal airways, airspace beginning at either 700 or 1,200 ft above ground level (AGL) used to transition to and from the terminal or en route environment and en route domestic and offshore airspace areas designated below 18,000 ft MSL. Unless designated at a lower altitude, Class E airspace begins at 14,500 ft MSL over the United States, including that airspace overlying the waters within 12 NM of the coast of the 48 contiguous states and Alaska, up to but not including 18,000 ft MSL, and the airspace above flight level (FL) 600.

Aircraft use different kinds of airspace according to the specific rules and procedures defined by the FAA for each type of airspace. For the Proposed Action, contract adversary air (ADAIR) training activities would utilize special use airspace (SUA) near Shaw AFB. SUA includes Military Operations Areas (MOAs), Restricted Areas, Air Traffic Control Assigned Airspace (ATCAA), and Warning Areas. A MOA is designated airspace outside of Class A airspace used to separate or segregate certain nonhazardous military activities from IFR traffic and to identify for Visual Flight Rules (VFR) traffic where these activities are conducted (14 CFR § 1.1). Activities in MOAs include, but are not limited to, air combat maneuvers, air intercepts, and low-altitude tactics.

The defined vertical and lateral limits vary for each MOA. While MOAs generally extend from 1,200 ft AGL to 18,000 ft above MSL, the floor may extend below 1,200 ft AGL if there is a mission requirement and minimal adverse aeronautical effect. MOAs allow military aircraft to practice maneuvers and tactical flight training at airspeeds in excess of 250 knots indicated airspeed (approximately 285 miles per hour). The FAA requires publication of the hours of operation for any MOA so that all pilots, both military and civilian, are aware of when other aircraft could be in the airspace. Each military organization responsible for a MOA develops a daily use schedule. MOAs exist to notify civil pilots under VFR where heavy volumes of military training exist which increases the chance of conflict and are generally avoided by VFR traffic. MOAs in the vicinity of busy airports may have specific avoidance procedures that also apply to small private and municipal airports. Such avoidance procedures are maintained for each MOA, and both civil and military aircrews build them into daily flight plans.

Restricted Areas are typically used by the military due to safety or security concerns. Hazards include unusual and often invisible threats from artillery use, aerial gunnery, or guided missiles. An ATCAA is an airspace of defined vertical/lateral limits assigned by FAA ATC for the purpose of providing air traffic segregation between the specified activities being conducted within the assigned airspace and other IFR air traffic. Typically, these blocks of airspace start at FL 180 or 18,000 ft MSL and, in some cases, are contoured to the dimensions of the MOAs beneath them. A Warning Area is airspace of defined dimensions that extends from 3 NM outward from the coast of the United States and may be over US waters, international waters, or both. The purpose of Warning Areas is to warn nonparticipating pilots of potentially hazardous activity. Warning Areas may be used for other purposes if released to the FAA during periods when not required for their intended purpose and are within areas in which the FAA has ATC authority.

Each military organization responsible for SUA develops a daily use schedule. Although the FAA designates SUA for military use, other pilots may transit the airspace under VFR. Avoidance procedures are maintained for each SUA, and military aircrews build them into daily flight plans.

The primary operational airspace that would be used by ADAIR aircraft consists of existing SUA currently used by Shaw AFB pilots. This SUA consists of the overland Bulldog and Gamecock MOAs, the RobRoy Airspace (which is a subdivision of the Gamecock MOAs), and offshore Warning Areas W-161 and W-177.

The Radius of Influence for airspace management and use for Shaw AFB include the airfield and its environs as well as the SUA described above.

C.1.2 References

14 CFR § 1.1 – General definitions.

14 CFR § 91.130 – Operations in Class C airspace.

49 U.S.C § 40103. Sovereignty and use of airspace.

Public Law No. 103-272, 1994.

USDOT, FAA. 2022. Order JO 7400.11G, *Airspace Designations and Reporting Points.*

C.2 NOISE

The following sections describe input data used in the noise modeling process. This data was developed in coordination with Shaw AFB personnel.

C.2.1 Sound, Noise, and Potential Effects

C.2.1.1 Introduction

Section C.2.1 discusses sound and noise and their potential effects on the human and natural environment. **Section C.2.1.2** provides an overview of the basics of sound and noise. **Section C.2.1.3** defines and describes the different metrics used to describe noise. The largest section, **Section C.2.1.4**, reviews the potential effects of noise, focusing on effects on humans but also addressing effects on property values, terrain, structures, and animals. **Section C.2.1.5** contains the list of references cited. **Section C.2.2** contains data used in the noise modeling process. A number of noise metrics are defined and described in this appendix. Some metrics are included for the sake of completeness when discussing each metric and to provide a comparison of cumulative noise metrics.

C.2.1.2 Basics of Sound

C.2.1.2.1 Sound Waves and Decibels

Sound consists of minute vibrations in the air that travel through the air and are sensed by the human ear. **Figure C-1** is a sketch of sound waves from a tuning fork. The waves move outward as a series of crests where the air is compressed and troughs where the air is expanded. The height of the crests and the depth of the troughs are the amplitude or sound pressure of the wave. The pressure determines its energy or intensity. The number of crests or troughs that pass a given point each second is called the frequency of the sound wave.

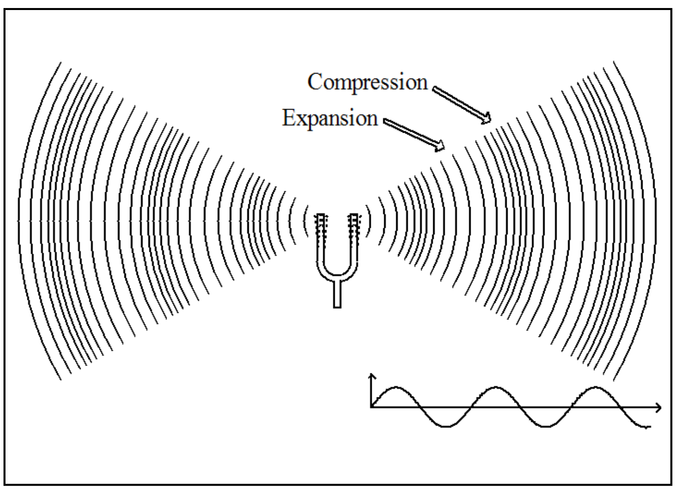


Figure C-1 Sound Waves from a Vibrating Tuning Fork

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration.

- Intensity is a measure of the acoustic energy of the sound and related to sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound.

- Frequency determines how the pitch of the sound is perceived. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.
- Duration or the length of time the sound can be detected.

The loudest sounds that can be comfortably heard by the human ear have intensities a trillion times higher than those of sounds barely heard. Because of this vast range, it is unwieldy to use a linear scale to represent the intensity of sound. As a result, a logarithmic unit known as the decibel (abbreviated dB) is used to represent the intensity of a sound. Such a representation is called a sound level. A sound level of 0 dB is approximately the threshold of human hearing and barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 and 140 dB are felt as pain (Berglund and Lindvall, 1995).

As shown on **Figure C-1**, the sound from a tuning fork spreads out uniformly as it travels from the source. The spreading causes the sound's intensity to decrease with increasing distance from the source. For a source such as an aircraft in flight, the sound level will decrease by about 6 dB for every doubling of the distance. For a busy highway, the sound level will decrease by 3 to 4.5 dB for every doubling of distance.

As sound travels from the source, it also is absorbed by the air. The amount of absorption depends on the frequency composition of the sound, temperature, and humidity conditions. Sound with high frequency content gets absorbed by the air more than sound with low frequency content. More sound is absorbed in colder and drier conditions than in hot and wet conditions. Sound is also affected by wind and temperature gradients, terrain (elevation and ground cover), and structures.

Because of the logarithmic nature of the decibel unit, sound levels cannot simply be added or subtracted and are somewhat cumbersome to handle mathematically; however, some simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example:

60 dB + 60 dB = 63 dB, and
80 dB + 80 dB = 83 dB.

Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels is different than that of ordinary numbers, this process is often referred to as "decibel addition."

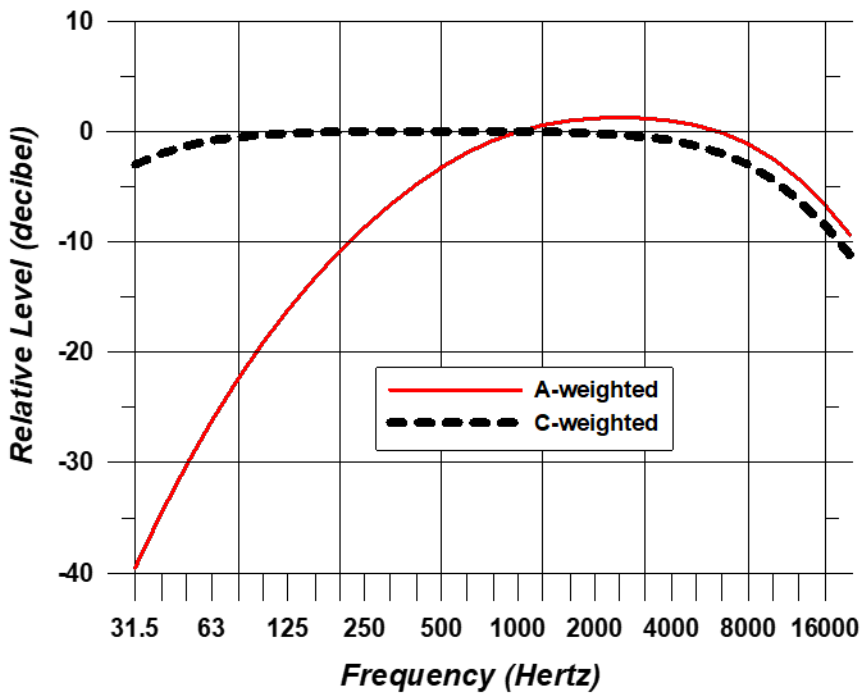
The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness. This relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB actually represents a 90 percent decrease in sound intensity but only a 50 percent decrease in perceived loudness because the human ear does not respond linearly.

Sound frequency is measured in terms of cycles per second or hertz (Hz). The normal ear of a young person can detect sounds that range in frequency from about 20 to 20,000 Hz. As we get older, we lose the ability to hear high frequency sounds. Not all sounds in this wide range of frequencies are heard equally. Human hearing is most sensitive to frequencies in the 1,000 to 4,000 Hz range. The notes on a piano range from just over 27 to 4,186 Hz, with middle C equal to 261.6 Hz. Most sounds (including a single note on a piano) are not simple pure tones like the tuning fork on **Figure C-1** but contain a mix, or spectrum, of many frequencies.

Sounds with different spectra are perceived differently even if the sound levels are the same. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. These two curves, shown on **Figure**

C-2, are adequate to quantify most environmental noises. A-weighting puts emphasis on the 1,000- to 4,000-Hz range where human hearing is most sensitive.

Very loud or impulsive sounds, such as explosions or sonic booms, can sometimes be felt and cause secondary effects, such as shaking of a structure or rattling of windows. These types of sounds can add to annoyance and are best measured by C-weighted sound levels, denoted dBC. C-weighting is nearly flat throughout the audible frequency range and includes low frequencies that may not be heard but cause shaking or rattling. C-weighting approximates the human ear's sensitivity to higher intensity sounds.



Source: ANSI S1.4A -1985 "Specification of Sound Level Meters"

Figure C-2 Frequency Characteristics of A- and C-Weighting

C.2.1.2.2 Sound Levels and Types of Sounds

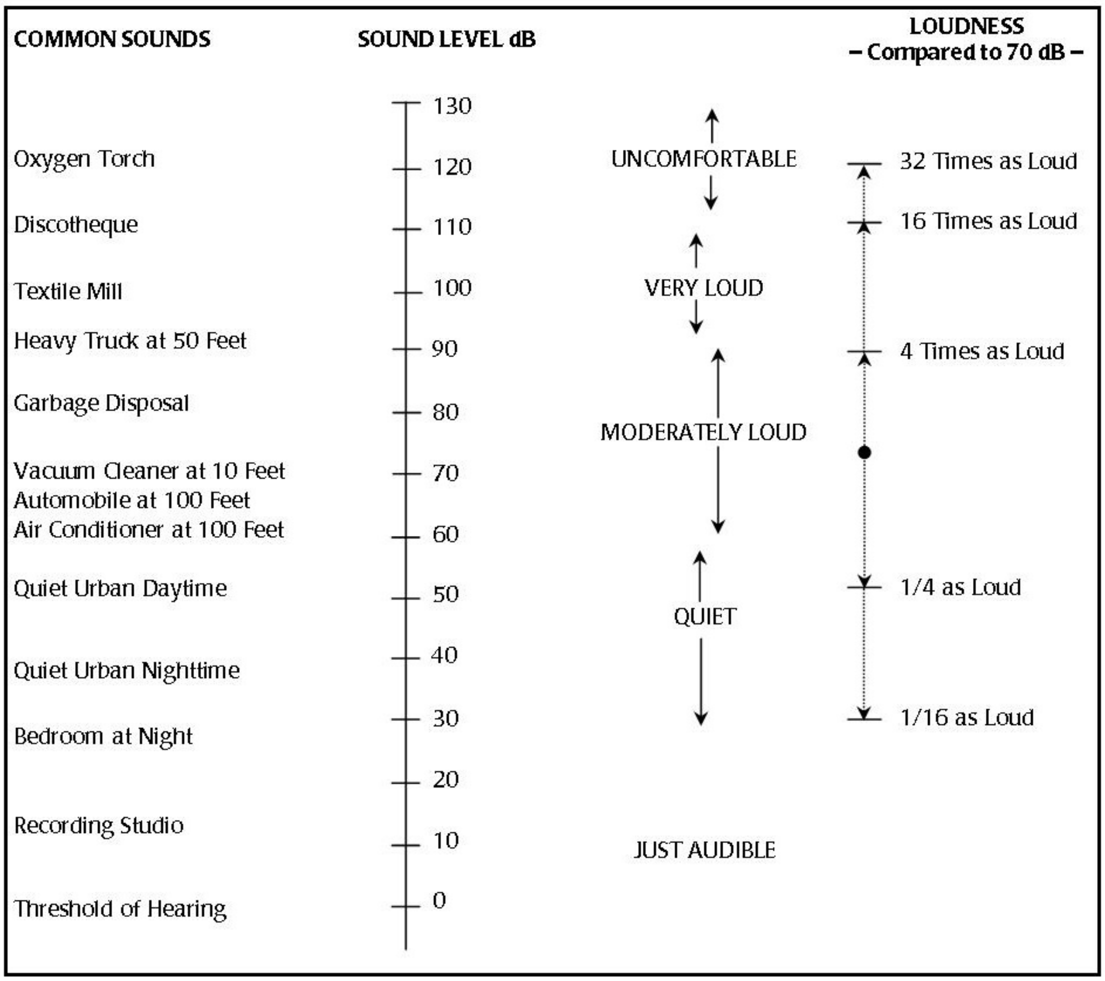
Most environmental sounds are measured using A-weighting. They are called A-weighted sound levels and sometimes use the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the term "A-weighted" is often omitted and the unit dB is used. Unless otherwise stated, dB units refer to A-weighted sound levels.

Sound becomes noise when it is unwelcome and interferes with normal activities, such as sleep or conversation. Noise is unwanted sound. Noise can become an issue when its level exceeds the ambient or background sound level. Ambient noise in urban areas typically varies from 60 to 70 dB but can be as high as 80 dB in the center of a large city. Quiet suburban neighborhoods experience ambient noise levels around 45 to 50 dB (United States Environmental Protection Agency [USEPA], 1978).

Figure C-3 shows A-weighted sound levels from common sources. Some sources, like the air conditioner and vacuum cleaner, are continuous sounds whose levels are constant for some time. Some sources, like the automobile and heavy truck, are the maximum sound during an intermittent event like a vehicle pass-by. Some sources like "urban daytime" and "urban nighttime" are averages over extended periods. A variety of noise metrics have been developed to describe noise over different time periods. These are discussed in detail in **Section C.2.1.3**.

Aircraft noise consists of two major types of sound events: flight (including takeoffs, landings, and flyovers) and stationary, such as engine maintenance run-ups. The former is intermittent and the latter primarily continuous. Noise from aircraft overflights typically occurs beneath main approach and departure paths, in local air traffic patterns around the airfield, and in areas near aircraft parking ramps and staging areas. As aircraft climb, the noise received on the ground drops to lower levels, eventually fading into the background or ambient levels.

Impulsive noises are generally short, loud events. Their single-event duration is usually less than 1 second. Examples of impulsive noises are small-arms gunfire, hammering, pile driving, metal impacts during rail-yard shunting operations, and riveting. Examples of high-energy impulsive sounds are quarry/mining explosions, sonic booms, demolition, and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams (American National Standards Institute [ANSI], 1996).



Source: Harris, 1979

Figure C-3 Typical A-weighted Sound Levels of Common Sounds

C.2.1.3 Noise Metrics

Noise metrics quantify sounds so they can be compared with each other and, with their effects, in a standard way. There are a number of metrics that can be used to describe a range of situations, from a particular individual event to the cumulative effect of all noise events over a long time. This section describes the metrics relevant to environmental noise analysis.

C.2.1.3.1 Single Events

Maximum Sound Level

The highest A-weighted sound level measured during a single event in which the sound changes with time is called the maximum A-weighted sound level or Maximum Sound Level and abbreviated L_{max}. The L_{max} is depicted for a sample event in **Figure C-4**.

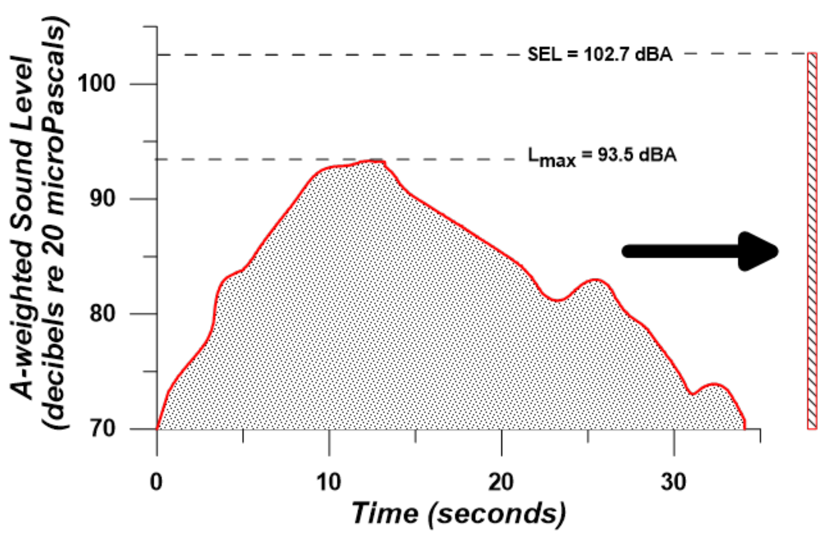
L_{max} is the maximum level that occurs over a fraction of a second. For aircraft noise, the "fraction of a second" is one-eighth of a second, denoted as "fast" response on a sound level measuring meter (ANSI, 1988). Slowly varying or steady sounds are generally measured over 1 second, denoted as "slow" response. L_{max} is important in judging if a noise event will interfere with conversation, television or radio listening, or other common activities. Although it provides some measure of the event, it does not fully describe the noise because it does not account for how long the sound is heard.

Peak Sound Pressure Level

The Peak Sound Pressure Level (L_{pk}) is the highest instantaneous level measured by a sound level measurement meter. L_{pk} is typically measured every 20 microseconds and usually based on unweighted or linear response of the meter. It is used to describe individual impulsive events such as blast noise. Because blast noise varies from shot to shot and varies with meteorological (weather) conditions, the US Department of Defense (DoD) usually characterizes L_{pk} by the metric PK 15(met), which is the L_{pk} exceeded 15 percent of the time. The "met" notation refers to the metric accounting for varied meteorological or weather conditions.

Sound Exposure Level

Sound Exposure Level (SEL) combines both the intensity of a sound and its duration. For an aircraft flyover, SEL includes the maximum and all lower noise levels produced as part of the overflight, together with how long each part lasts. It represents the total sound energy in the event. **Figure C-4** indicates the SEL for an example event, representing it as if all the sound energy were contained within 1 second.



Source: Wyle Laboratories

Figure C-4 Example Time History of Aircraft Noise Flyover

Aircraft noise varies with time. During an aircraft overflight, noise starts at the background level, rises to a maximum level as the aircraft flies close to the observer, then returns to the background as the aircraft recedes into the distance. This is sketched on **Figure C-4**, which also indicates two metrics (L_{max} and SEL) that are described above. Over time there can be a number of events, not all the same. Because aircraft noise events last more than a few seconds, the SEL value is larger than L_{max}. It does not directly represent the sound level heard at any given time but rather the entire event. SEL provides a much better measure of aircraft flyover noise exposure than L_{max} alone.

Overpressure

The single event metrics commonly used to assess supersonic noise from sonic booms are overpressure in pound(s) per square foot (psf) and C-Weighted Sound Exposure Level (CSEL). Overpressure is the peak pressure at any location within the sonic boom footprint. When sonic booms reach the ground, they impact an area that is referred to as a "carpet." The size of the carpet depends on the supersonic flight path and on atmospheric conditions. The width of the boom carpet beneath the aircraft is about 1 mile for each 1,000 ft of altitude (National Aeronautics and Space Administration [NASA], 2017). Sonic booms are loudest near the center of the carpet, under the flight path for steady, level flight conditions, having a sharp "bang-bang" sound. Near the edges, they are weak and have a rumbling sounding like distant thunder. The location of these booms will vary with changing flight paths and weather conditions, so it is unlikely that any given location will experience these undertrack levels more than once over multiple events. Public reaction is expected to occur with overpressures above 1 psf, and in rare instances, damage to structures have occurred at overpressures between 2 and 5 psf (NASA, 2017).

C-Weighted Sound Exposure Level

CSEL is SEL computed with C frequency weighting, which is similar to A-Weighting (discussed in **Section C.2.1.2.2**) except that C-weighting places more emphasis on low frequencies below 1,000 Hz.

C.2.1.3.2 Cumulative Events

Equivalent Sound Level

Equivalent Sound Level (L_{eq}) is a "cumulative" metric that combines a series of noise events over a period of time. L_{eq} is the sound level that represents the decibel average SEL of all sounds in the time period. Just as SEL has proven to be a good measure of a single event, L_{eq} has proven to be a good measure of series of events during a given time period.

The time period of an L_{eq} measurement is usually related to some activity and given along with the value. The time period is often shown in parenthesis (e.g., L_{eq}[24] for 24 hours). The L_{eq} from 7:00 a.m. to 3:00 p.m. may give exposure of noise for a school day.

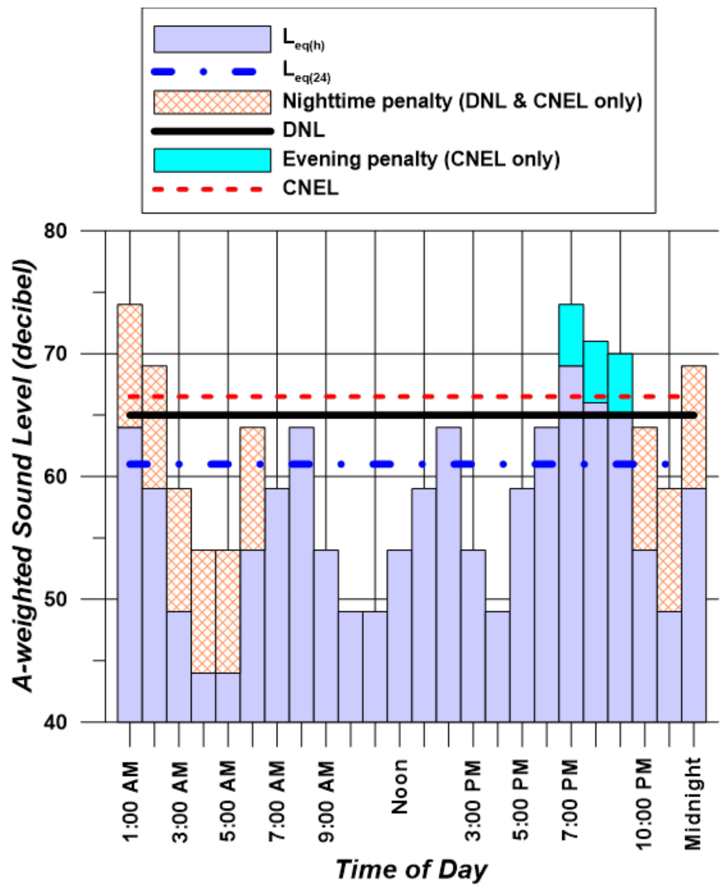
Figure C-5 gives an example of L_{eq}(24) using notional hourly average noise levels (L_{eq}[h]) for each hour of the day as an example. The L_{eq}(24) for this example is 61 dB.

Day-Night Average Sound Level and Community Noise Equivalent Level

Day-Night Average Sound Level (DNL or L_{dn}) is a cumulative metric that accounts for all noise events in a 24-hour period. However, unlike L_{eq}(24), DNL contains a nighttime noise penalty. To account for our increased sensitivity to noise at night, DNL applies a 10-dB penalty to events during the nighttime period, defined as 10:00 p.m. to 7:00 a.m. The notations DNL and L_{dn} are both used for Day-Night Average Sound Level and are equivalent.

Community Noise Equivalent Level (CNEL) is a variation of DNL specified by law in California (California Code of Regulations Title 21, Public Works) (Wyle Laboratories, 1971). CNEL has the 10-dB nighttime penalty for events between 10:00 p.m. and 7:00 a.m. but also includes a 4.8-dB penalty for events during the evening period of 7:00 p.m. to 10:00 p.m. The evening penalty in CNEL accounts for the added intrusiveness of sounds during that period. For airports and military airfields, DNL and CNEL represent the average sound level for annual average daily aircraft events.

Figure C-5 gives an example of DNL and CNEL using notional hourly average noise levels (L_{eq}[h]) for each hour of the day as an example. Note the L_{eq}(h) for the hours between 10:00 p.m. and 7:00 a.m. have a 10-dB penalty assigned. For CNEL, the hours between 7:00 p.m. and 10:00 p.m. have a 4.8-dB penalty assigned. The DNL for this example is 65 dB. The CNEL for this example is 66 dB.



Source: Wyle Laboratories

Figure C-5 Example of Equivalent Sound Level over 24 hours, Day-Night Average Sound Level, and Community Noise Equivalent Level Computed from Hourly Equivalent Sound Levels

Figure C-6 shows the ranges of DNL or CNEL that occur in various types of communities. Under a flight path at a major airport, the DNL may exceed 80 dB while rural areas may experience DNL less than 45 dB. The decibel summation nature of these metrics causes the noise levels of the loudest events to control the 24-hour average. As a simple example, consider a case in which only one aircraft overflight occurs during the daytime over a 24-hour period, creating a sound level of 100 dB for 30 seconds. During the remaining 23 hours, 59 minutes, and 30 seconds of the day, the ambient sound level is 50 dB. The DNL for this 24-hour period is 65.9 dB. Assume, as a second example that 10 such 30-second overflights occur during daytime hours during the next 24-hour period, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes of the day. The DNL for this 24-hour period is 75.5 dB. Clearly, the averaging of noise over a 24-hour period does not ignore the louder single events and tends to emphasize both the sound levels and number of those events.

A feature of the DNL metric is that a given DNL value could result from a very few noisy events or a large number of quieter events. For example, one overflight at 90 dB creates the same DNL as 10 overflights at 80 dB.

DNL or CNEL does not represent a level heard at any given time but represent long-term exposure. Scientific studies have found good correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (Schultz, 1978; USEPA, 1978).

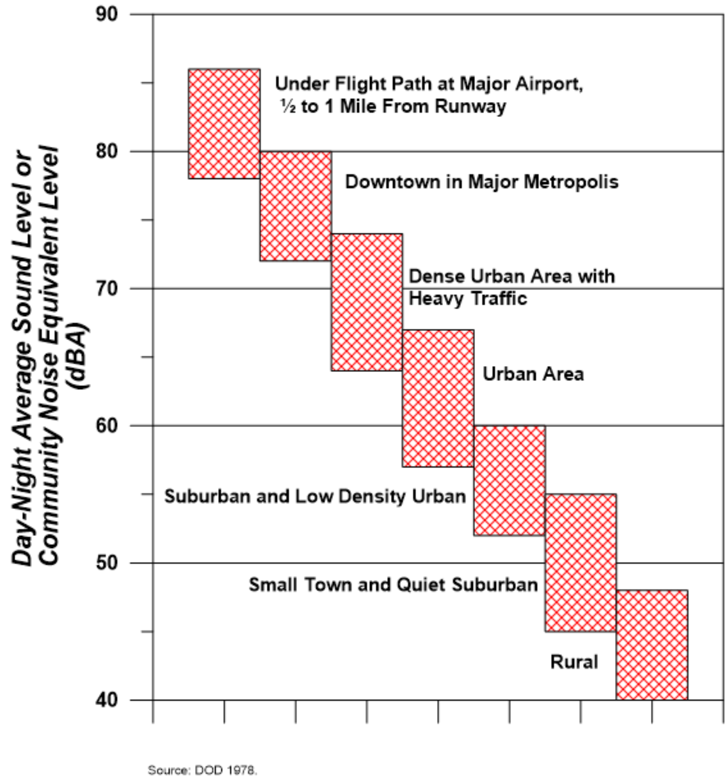


Figure C-6 Typical Day-Night Average Sound Level or Community Noise Equivalent Level Ranges in Various Types of Communities

Onset-Rate Adjusted Monthly Day-Night Average Sound Level and Onset-Rate Adjusted Monthly Community Noise Equivalent Level

Military aircraft utilizing SUA such as military training routes, MOAs, and Restricted Areas generate a noise environment that is somewhat different from that around airfields. Rather than regularly occurring operations such as those at airfields, activity in SUA is highly sporadic. SUA operations are often seasonal, ranging from 10 operations per hour to less than 1 per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset, with rates of up to 150 dB per second.

The cumulative daily noise metric devised to account for the “surprise” effect of the sudden onset of aircraft noise events on humans and the sporadic nature of SUA activity is the Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}). Onset rates between 15 and 150 dB per second require an adjustment of 0 to 11 dB to the event’s SEL while onset rates below 15 dB per second require no adjustment to the event’s SEL (Stusnick et al., 1992). The term ‘monthly’ in L_{dnmr} refers to the noise assessment being conducted for the month with the most operations or sorties -- the so-called busiest month.

In California, a variant of the L_{dnmr} includes a penalty for evening operations (7:00 p.m. to 10:00 p.m.) and is denoted Onset-Rate Adjusted Monthly Community Noise Equivalent Level ($CNEL_{mr}$).

C.2.1.3.3 Supplemental Metrics

Number-of-Events Above a Threshold Level

The Number-of-Events Above (NA) metric gives the total number of events that exceed a noise level threshold (L) during a specified period of time. Combined with the selected threshold, the metric is denoted NAL. The threshold can be either SEL or L_{max}, and it is important that this selection is shown in the nomenclature. When labeling a contour line or point of interest, NAL is followed by the number of events in parentheses. For example, where 10 events exceed an SEL of 90 dB over a given period of time, the nomenclature would be NA90SEL(10). Similarly, for L_{max} it would be NA90L_{max}(10). The period of time can be an average 24-hour day, daytime, nighttime, school day, or any other time period appropriate to the nature and application of the analysis.

NA is a supplemental metric valuable in helping to describe noise to the community. A threshold level and metric are selected that best meet the need for each situation. An L_{max} threshold is normally selected to analyze speech interference, while an SEL threshold is normally selected for analysis of sleep disturbance.

The NA metric is the only supplemental metric that combines single-event noise levels with the number of aircraft operations. In essence, it answers the question of how many aircraft (or range of aircraft) fly over a given location or area at or above a selected threshold noise level.

Time Above a Specified Level

The Time Above (TA) metric is the total time, in minutes, that the A-weighted noise level is at or above a threshold. Combined with the threshold level (L), it is denoted TAL. TA can be calculated over a full 24-hour annual average day, the 15-hour daytime and 9-hour nighttime periods, a school day, or any other time period of interest, provided there is operational data for that time.

TA is a supplemental metric, used to help understand noise exposure. It is useful for describing the noise environment in schools, particularly when assessing classroom or other noise sensitive areas for various scenarios. TA can be shown as contours on a map similar to the way DNL contours are drawn.

TA helps describe the noise exposure of an individual event or many events occurring over a given time period. When computed for a full day, the TA can be compared alongside the DNL in order to determine the sound levels and total duration of events that contribute to the DNL. TA analysis is usually conducted along with NA analysis, so the results show not only how many events occur, but also the total duration of those events above the threshold.

C.2.1.4 Noise Effects

Noise is of concern because of potential adverse effects. The following subsections describe how noise can affect communities and the environment and how those effects are quantified. The specific topics discussed are:

- annoyance;
- speech interference;
- sleep disturbance;
- noise effects on children; and
- noise effects on domestic animals and wildlife.

C.2.1.4.1 Annoyance

With the introduction of jet aircraft in the 1950s, it became clear that aircraft noise annoyed people and was a significant problem around airports. Early studies, such as those of Rosenblith et al. (1953) and Stevens et al. (1953) showed that effects depended on the quality of the sound, its level, and the number of flights. Over the next 20 years considerable research was performed refining this understanding and setting guidelines for noise exposure. In the early 1970s, the USEPA published its “Levels Document” (USEPA, 1974) that reviewed the factors that affected communities. DNL (still known as L_{dn} at the time) was identified as an appropriate noise metric, and threshold criteria were recommended.

Threshold criteria for annoyance were identified from social surveys, where people exposed to noise were asked how noise affects them. Surveys provide direct real-world data on how noise affects actual residents.

Surveys in the early years had a range of designs and formats and needed some interpretation to find common ground. In 1978, Schultz showed that the common ground was the number of people “highly annoyed,” defined as the upper 28 percent range of whatever response scale a survey used (Schultz, 1978). With that definition, he was able to show a remarkable consistency among the majority of the surveys for which data were available. **Figure C-7** shows the result of his study relating DNL to individual annoyance measured by percent highly annoyed (%HA).

Schultz’s original synthesis included 161 data points. **Figure C-8** shows a comparison of the predicted response of the Schultz data set with an expanded set of 400 data points collected through 1989 (Finegold et al., 1994). The new form is the preferred form in the United States, endorsed by the Federal Interagency Committee on Aviation Noise (FICAN, 1997). Other forms have been proposed, such as that of Fidell and Silvati (2004) but have not gained widespread acceptance.

When the goodness of fit of the Schultz curve is examined, the correlation between groups of people is high, in the range of 85 to 90 percent; however, the correlation between individuals is much lower, at 50 percent or less. This is not surprising, given the personal differences between individuals. The surveys underlying the Schultz curve include results that show that annoyance to noise is also affected by non-acoustical factors. Newman and Beattie (1985) divided the non-acoustic factors into the emotional and physical variables shown in **Table C-1**.

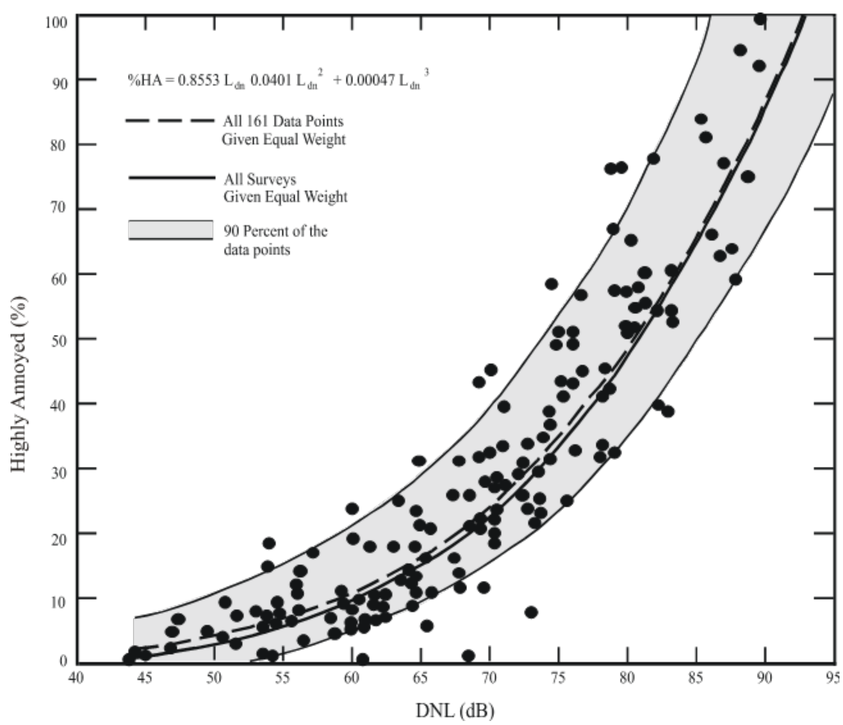


Figure C-7 Schultz Curve Relating Noise Annoyance to Day-Night Average Sound Level (Schultz, 1978)

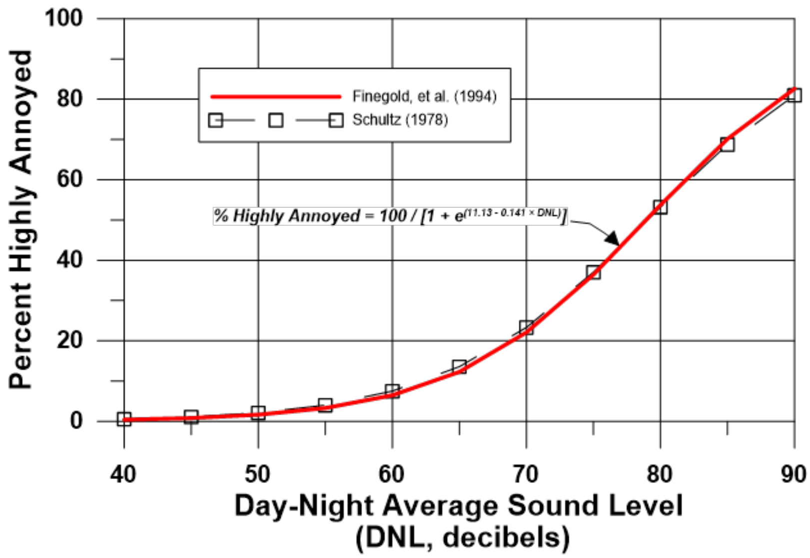


Figure C-8 Response of Communities to Noise; Comparison of Original Schultz (1978) with Finegold et al. (1994)

Table C-1 Nonacoustic Variables Influencing Aircraft Noise Annoyance

Emotional Variables	Physical Variables
• Feeling about the necessity or preventability of the noise • Judgment of the importance and value of the activity that is producing the noise • Activity at the time an individual hears the noise • Attitude about the environment • General sensitivity to noise • Belief about the effect of noise on health • Feeling of fear associated with the noise	• Type of neighborhood • Time of day • Season • Predictability of the noise • Control over the noise source • Length of time individual is exposed to a noise

Schreckenberg and Schuemer (2010) recently examined the importance of some of these factors on short term annoyance. Attitudinal factors were identified as having an effect on annoyance. In formal regression analysis, however, sound level (L_{eq}) was found to be more important than attitude. A series of studies at three European airports showed that less than 20 percent of the variance in annoyance can be explained by noise alone (Márki, 2013).

A recent study by Plotkin et al. (2011) examined updating DNL to account for these factors. It was concluded that the data requirements for a general analysis were much greater than are available from most existing studies. It was noted that the most significant issue with DNL is that it is not readily understood by the public and that supplemental metrics such as TA and NA were valuable in addressing attitude when communicating noise analysis to communities (DoD, 2009a).

A factor that is partially non-acoustical is the source of the noise. Miedema and Vos (1998) presented synthesis curves for the relationship between DNL and percentage “Annoyed” and percentage “Highly Annoyed” for three transportation noise sources. Different curves were found for aircraft, road traffic, and railway noise. **Table C-2** summarizes their results. Comparing the updated Schultz curve suggests that the percentage of people highly annoyed by aircraft noise may be higher than previously thought. Miedema and Oudshoorn (2001) authors supplemented that investigation with further derivation of percent of population highly annoyed as a function of either DNL or DENL along with the corresponding 95 percent confidence intervals with similar results.

Table C-2 Percent Highly Annoyed for Different Transportation Noise Sources

Day-Night Average Sound Level (decibels)	Percent Highly Annoyed (%HA)			
	Miedema and Vos			Schultz Combined
	Air	Road	Rail	
55	12	7	4	3
60	19	12	7	6
65	28	18	11	12
70	37	29	16	22
75	48	40	22	36

Source: Miedema and Vos, 1998

As noted by the World Health Organization (WHO), however, even though aircraft noise seems to produce a stronger annoyance response than road traffic, caution should be exercised when interpreting synthesized data from different studies (WHO, 1999).

Consistent with WHO's recommendations, the Federal Interagency Committee on Noise (FICON, 1992) considered the Schultz curve to be the best source of dose information to predict community response to noise but recommended further research to investigate the differences in perception of noise from different sources.

The International Standard ([ISO] 1996:1-2016) update introduced the concept of Community Tolerance Level (L_{ct}) as the day-night sound level at which 50 percent of the people in a particular community are predicted to be highly annoyed by noise exposure. L_{ct} accounts for differences between sources and/or communities when predicting the percentage highly annoyed by noise exposure. ISO also recommended a change to the adjustment range used when comparing aircraft noise to road noise. The previous edition suggested +3 to +6 dB for aircraft noise relative to road noise while the latest editions recommend an adjustment range of +5 to +8 dB. This adjustment range allows DNL to be correlated to consistent annoyance rates when originating from different noise sources (i.e., road traffic, aircraft, or railroad). This change to the adjustment range would increase the calculated percent highly annoyed at the 65-dB DNL by approximately 2 to 5 percent greater than the previous ISO definition. **Figure C-9** depicts the estimated percentage of people highly annoyed for a given DNL using both the ISO 1996-1 estimation and the older FICON 1992 method. The results suggest that the percentage of people highly annoyed may be greater than previous thought and reliance solely on DNL for impact analysis may be insufficient if utilizing the FICON 1992 method.

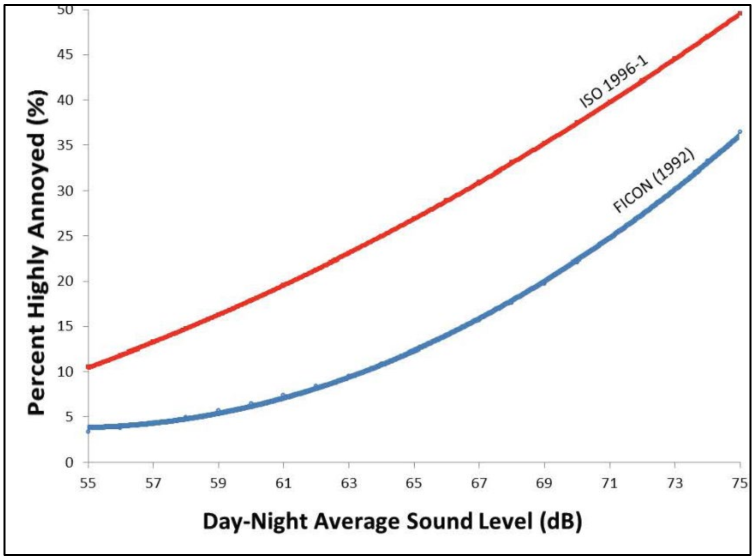


Figure C-9 Percent Highly Annoyed Comparison of International Standard 1996-1 to Federal Interagency Committee on Noise (1992)

C.2.1.4.2 Speech Interference

Speech interference from noise is a primary cause of annoyance for communities. Disruption of routine activities such as radio or television listening, telephone use, or conversation leads to frustration and annoyance. The quality of speech communication is important in classrooms and offices. In the workplace, speech interference from noise can cause fatigue and vocal strain in those who attempt to talk over the noise. In schools it can impair learning.

There are two measures of speech comprehension:

1. Word Intelligibility - the percent of words spoken and understood. This might be important for students in the lower grades who are learning the English language and particularly for students who have English as a Second Language.
2. Sentence Intelligibility – the percent of sentences spoken and understood. This might be important for high-school students and adults who are familiar with the language and who do not necessarily have to understand each word in order to understand sentences.

United States Federal Criteria for Interior Noise

In 1974, the USEPA identified a goal of an indoor $L_{eq}(24)$ of 45 dB to minimize speech interference based on sentence intelligibility and the presence of steady noise (USEPA, 1974). **Figure C-10** shows the effect of steady indoor background sound levels on sentence intelligibility. For an average adult with normal hearing and fluency in the language, steady background indoor sound levels of less than the 45-dB L_{eq} are expected to allow 100 percent sentence intelligibility.

The curve on **Figure C-10** shows 99 percent intelligibility at L_{eq} below 54 dB and less than 10 percent above 73 dB. Recalling that L_{eq} is dominated by louder noise events, the USEPA $L_{eq}(24)$ goal of 45 dB generally ensures that sentence intelligibility will be high most of the time.

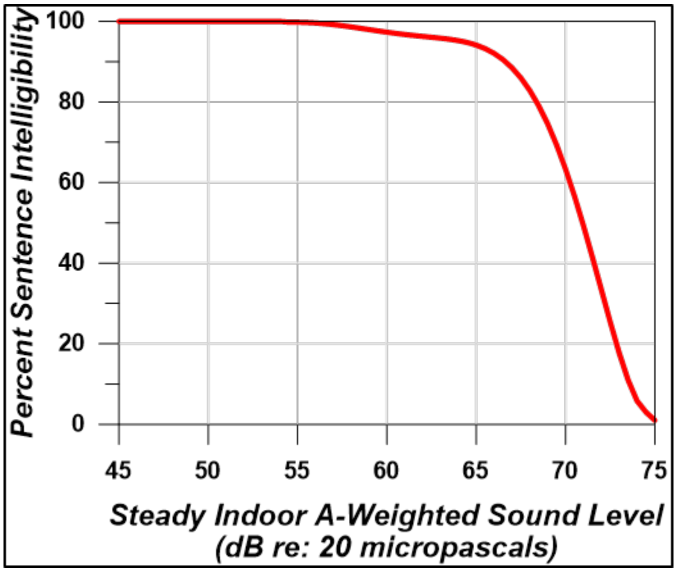


Figure C-10 Speech Intelligibility Curve (digitized from USEPA, 1974)

Classroom Criteria

For teachers to be understood, their regular voice must be clear and uninterrupted. Background noise has to be below the teacher's voice level. Intermittent noise events that momentarily drown out the teacher's voice need to be kept to a minimum. It is therefore important to evaluate the steady background level, level of voice communication, and single-event level due to aircraft overflights that might interfere with speech.

Lazarus (1990) found that for listeners with normal hearing and fluency in the language, complete sentence intelligibility can be achieved when the signal-to-noise ratio (i.e., a comparison of the level of the sound to the level of background noise) is in the range of 15 to 18 dB. The initial ANSI (2002) classroom noise standard and American Speech-Language-Hearing Association (2005) guidelines concur, recommending at least a 15-dB signal-to-noise ratio in classrooms. If the teacher's voice level is at least 50 dB, the background noise level must not exceed an average of 35 dB. The National Research Council of Canada (Bradley, 1993) and WHO (1999) agree with this criterion for background noise.

For eligibility for noise insulation funding, the FAA guidelines state that the design objective for a classroom environment is the 45-dB L_{eq} during normal school hours (FAA, 1985).

Most aircraft noise is not continuous. It consists of individual events like the one sketched on **Figure C-4**. Since speech interference in the presence of aircraft noise is caused by individual aircraft flyover events, a time-averaged metric alone, such as L_{eq}, is not necessarily appropriate. In addition to the background level criteria described above, single-event criteria that account for those noisy events are also needed.

A 1984 study by Wyle for the Port Authority of New York and New Jersey recommended using Speech Interference Level (SIL) for classroom noise criteria (Sharp and Plotkin, 1984). SIL is based on the maximum sound levels in the frequency range that most affects speech communication (500 to 2,000 Hz). The study identified an SIL of 45 dB as the goal. This would provide 90 percent word intelligibility for the short time periods during aircraft overflights. While SIL is technically the best metric for speech interference, it can be approximated by an L_{max} value. An SIL of 45 dB is equivalent to an A-weighted L_{max} of 50 dB for aircraft noise (Wesler, 1986).

Lind et al. (1998) also concluded that an L_{max} criterion of 50 dB would result in 90 percent word intelligibility. Bradley (1985) recommends SEL as a better indicator. His work indicates that 95 percent word intelligibility would be achieved when indoor SEL did not exceed 60 dB. For typical flyover noise, this corresponds to an

L_{max} of 50 dB. While WHO (1999) only specifies a background L_{max} criterion, they also note the SIL frequencies, and that interference can begin at around 50 dB.

The United Kingdom Department for Education and Skills (UKDfES) established in its classroom acoustics guide a 30-minute time-averaged metric of L_{eq}(30min) for background levels and the metric of LA1,30min for intermittent noises, at thresholds of 30 to 35 dB and 55 dB, respectively. LA1,30min represents the A-weighted sound level that is exceeded 1 percent of the time (in this case, during a 30-minute teaching session) and is generally equivalent to the L_{max} metric (UKDfES, 2003).

Table C-3 summarizes the criteria discussed. Other than the FAA (1985) 45 dB L_{max} criterion, they are consistent with a limit on indoor background noise of 35 to 40 dB L_{eq} and a single event limit of 50 dB L_{max}. It should be noted that these limits were set based on students with normal hearing and no special needs. At-risk students may be adversely affected at lower sound levels.

Table C-3 Indoor Noise Level Criteria Based on Speech Intelligibility

Source	Metric/Level (dB)	Effects and Notes
Federal Aviation Administration (1985)	$L_{eq(during\ school\ hours)}$ = 45 dB	Federal assistance criteria for school sound insulation; supplemental single-event criteria may be used.
Lind et al. (1998), Sharp and Plotkin (1984), Wesler (1986)	L_{max} = 50 dB / Speech Interference Level 45	Single event level permissible in the classroom.
World Health Organization (1999)	L_{eq} = 35 dB L_{max} = 50 dB	Assumes average speech level of 50 dB and recommends signal to noise ratio of 15 dB.
American National Standards Institute (2010)	L_{eq} = 35 dB, based on Room Volume (e.g., cubic feet)	Acceptable background level for continuous and intermittent noise.
United Kingdom Department for Education and Skills (2003)	$L_{eq(30min)}$ = 30-35 dB L_{max} = 55 dB	Minimum acceptable in classroom and most other learning environs.

Notes:
dB = decibels; L_{eq} = Equivalent Sound Level; L_{max} = Maximum Sound Level

C.2.1.4.3 Sleep Disturbance

Sleep disturbance is a major concern for communities exposed to aircraft noise at night. A number of studies have attempted to quantify the effects of noise on sleep. This section provides an overview of the major noise-induced sleep disturbance studies. Emphasis is on studies that have influenced US federal noise policy. The studies have been separated into two groups:

1. Initial studies performed in the 1960s and 1970s, where the research was focused on sleep observations performed under laboratory conditions.
2. Later studies performed in the 1990s up to the present, where the research was focused on field observations.

Initial Studies

The relation between noise and sleep disturbance is complex and not fully understood. The disturbance depends not only on the depth of sleep and the noise level but also on the non-acoustic factors cited for annoyance. The easiest effect to measure is the number of arousals or awakenings from noise events. Much of the literature has therefore focused on predicting the percentage of the population that will be awakened at various noise levels.

FICON's 1992 review of airport noise issues (FICON, 1992) included an overview of relevant research conducted through the 1970s. Literature reviews and analyses were conducted from 1978 through 1989 using existing data (Griefahn, 1978; Lukas, 1978; Pearsons et al., 1989). Because of large variability in the data, FICON did not endorse the reliability of those results.

FICON did, however, recommend an interim dose-response curve, awaiting future research. That curve predicted the percent of the population expected to be awakened as a function of the exposure to SEL. This curve was based on research conducted for the US Air Force (Finegold, 1994). The data included most of the research performed up to that point and predicted a 10 percent probability of awakening when exposed to an interior SEL of 58 dB. The data used to derive this curve were primarily from controlled laboratory studies.

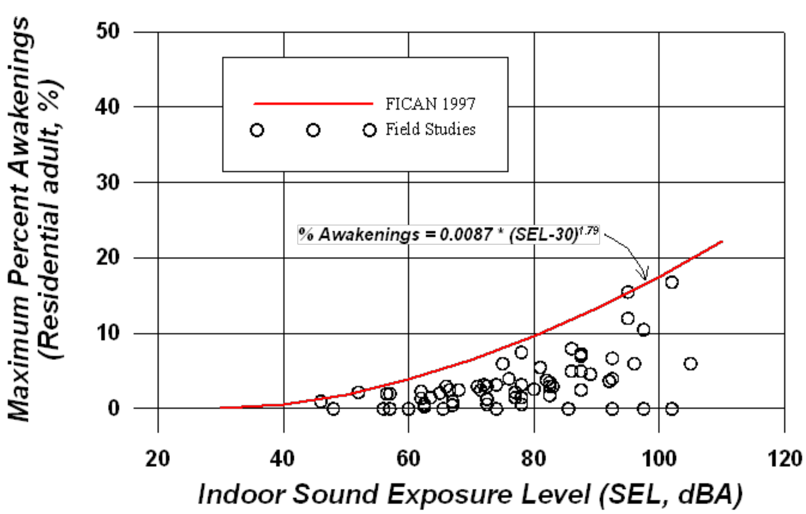
Recent Sleep Disturbance Research ‑ Field and Laboratory Studies

It was noted that early sleep laboratory studies did not account for some important factors. These included habituation to the laboratory, previous exposure to noise, and awakenings from noise other than aircraft. In the early 1990s, field studies in people's homes were conducted to validate the earlier laboratory work conducted in the 1960s and 1970s. The field studies of the 1990s (e.g., Horne, 1994) found that 80 to 90 percent of sleep disturbances were not related to outdoor noise events but rather to indoor noises and non-noise factors. The results showed that, in real-life conditions, there was less of an effect of noise on sleep than had been previously reported from laboratory studies. Laboratory sleep studies tend to show more sleep disturbance than field studies because people who sleep in their own homes are used to their environment and, therefore, do not wake up as easily (FICAN, 1997).

FICAN

Based on this new information, in 1997 FICAN recommended a dose-response curve to use instead of the earlier 1992 FICON curve (FICAN, 1997). **Figure C-11** shows FICAN's curve, the red line, which is based on the results of three field studies shown in the figure (Ollerhead et al., 1992; Fidell et al., 1994, 1995a, 1995b), along with the data from six previous field studies.

The 1997 FICAN curve represents the upper envelope of the latest field data. It predicts the maximum percent awakened for a given residential population. According to this curve, a maximum of 3 percent of people would be awakened at an indoor SEL of 58 dB. An indoor SEL of 58 dB is equivalent to an outdoor SEL of about 83 dB, with the windows closed (73 dB with windows open).



Source: FICAN 1997

Figure C-11 Federal Interagency Committee on Aviation Noise 1997 Recommended Sleep Disturbance Dose-Response Relationship

Number of Events and Awakenings

It is reasonable to expect that sleep disturbance is affected by the number of events. The German Aerospace Center (DLR Laboratory) conducted an extensive study focused on the effects of nighttime aircraft noise on sleep and related factors (Basner et al., 2004). The DLR Laboratory study was one of the largest studies to examine the link between aircraft noise and sleep disturbance. It involved both laboratory and in-home field research phases. The DLR Laboratory investigators developed a dose-response curve that predicts the number of aircraft events at various values of L_{max} expected to produce one additional awakening over the course of a night. The dose-effect curve was based on the relationships found in the field studies.

Later studies by DLR Laboratory conducted in the laboratory comparing the probability of awakenings from different modes of transportation showed that aircraft noise led to significantly lower awakening probabilities than either road or rail noise (Basner et al., 2011). Furthermore, it was noted that the probability of awakening, per noise event, decreased as the number of noise events increased. The authors concluded that by far the majority of awakenings from noise events merely replaced awakenings that would have occurred spontaneously anyway.

A different approach was taken by an ANSI standards committee (ANSI, 2008). The committee used the average of the data shown on **Figure C-10** rather than the upper envelope to predict average awakening from one event. Probability theory is then used to project the awakening from multiple noise events.

Currently, there are no established criteria for evaluating sleep disturbance from aircraft noise although recent studies have suggested a benchmark of an outdoor SEL of 90 dB as an appropriate tentative criterion when comparing the effects of different operational alternatives. The corresponding indoor SEL would be approximately 25 dB lower (at 65 dB) with doors and windows closed and approximately 15 dB lower (at 75 dB) with doors or windows open. According to the ANSI (2008) standard, the probability of awakening from a single aircraft event at this level is between 1 and 2 percent for people habituated to the noise sleeping in bedrooms with windows closed and 2 to 3 percent with windows open. The probability of the exposed population awakening at least once from multiple aircraft events at the 90-dB SEL is shown in **Table C-4**.

Table C-4 Probability of Awakening from NA90SEL

Number of Aircraft Events at the 90-decibel Sound Exposure Level for Average 9-Hour Night	Minimum Probability of Awakening at Least Once	
	Windows Closed	Windows Open
1	1%	2%
3	4%	6%
5	7%	10%
9 (1 per hour)	12%	18%
18 (2 per hour)	22%	33%
27 (3 per hour)	32%	45%

Source: DoD, 2009b

In December 2008, FICAN recommended the use of this new standard. FICAN also recognized that more research is underway by various organizations and that work may result in changes to FICAN's position. Until that time, FICAN recommends the use of the ANSI (2008) standard (FICAN, 2008).

Summary

Sleep disturbance research still lacks the details to accurately estimate the population awakened for a given noise exposure. The procedure described in the ANSI (2008) Standard and endorsed by FICAN is based on probability calculations that have not yet been scientifically validated. While this procedure certainly provides a much better method for evaluating sleep awakenings from multiple aircraft noise events, the estimated probability of awakenings can only be considered approximate.

C.2.1.4.4 Noise Effects on Children

Recent studies on school children indicate a potential link between aircraft noise and both reading comprehension and learning motivation. The effects may be small but may be of particular concern for children who are already scholastically challenged.

Effects on Learning and Cognitive Abilities

Early studies in several countries (Cohen et al., 1973, 1980, 1981; Bronzaft and McCarthy, 1975; Green et al., 1982; Evans et al., 1998; Haines et al., 2002; Lercher et al., 2003) showed lower reading scores for children living or attending school in noisy areas than for children away from those areas. In some studies, noise-exposed children were less likely to solve difficult puzzles or more likely to give up.

A longitudinal study reported by Evans et al. (1998), conducted prior to relocation of the old Munich airport in 1992, reported that high noise exposure was associated with deficits in long-term memory and reading comprehension in children with a mean age of 10.8 years. Two years after the closure of the airport, these deficits disappeared, indicating that noise effects on cognition may be reversible if exposure to the noise ceases. Most convincing was the finding that deficits in memory and reading comprehension developed over the 2-year follow-up for children who became newly noise exposed near the new airport; deficits were also observed in speech perception for the newly noise-exposed children.

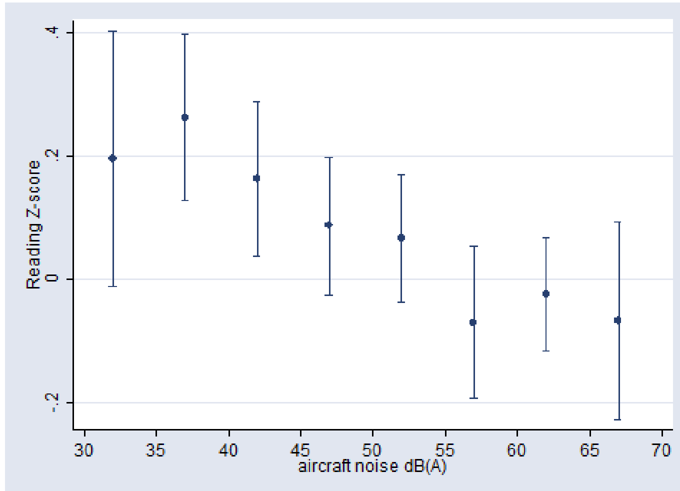
More recently, the Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) study (Stansfeld et al., 2005; Clark et al., 2005) compared the effect of aircraft and road traffic noise on over 2,000 children in three countries. This was the first study to derive exposure-effect associations for a range of cognitive and health effects and was the first to compare effects across countries.

The study found a linear relation between chronic aircraft noise exposure and impaired reading comprehension and recognition memory. No associations were found between chronic road traffic noise exposure and cognition. Conceptual recall and information recall surprisingly showed better performance in high-road traffic noise areas. Neither aircraft noise nor road traffic noise affected attention or working memory (Stansfeld et al., 2005; Clark et al., 2005).

Figure C-12 shows RANCH's result relating noise to reading comprehension. It shows that reading falls below average (a z-score of 0) at L_{eq} greater than 55 dB. Because the relationship is linear, reducing exposure at any level should lead to improvements in reading comprehension.

An observation of the RANCH study was that children may be exposed to aircraft noise for many of their childhood years, and the consequences of long-term noise exposure were unknown. A follow-up study of the children in the RANCH project is being analyzed to examine the long-term effects on children's reading comprehension (Clark et al., 2009). Preliminary analysis indicated a trend for reading comprehension to be poorer at 15 to 16 years of age for children who attended noise-exposed primary schools. An additional study utilizing the same data set (Clark et al., 2012) investigated the effects of traffic-related air pollution and found little evidence that air pollution moderated the association of noise exposure on children's cognition.

There was also a trend for reading comprehension to be poorer in aircraft noise-exposed secondary schools. Significant differences in reading scores were found between primary school children in the two different classrooms at the same school (Bronzaft and McCarthy, 1975). One classroom was exposed to high levels of railway noise while the other classroom was quiet. The mean reading age of the noise-exposed children was 3 to 4 months behind that of the control children. Studies suggest that the evidence of the effects of noise on children's cognition has grown stronger over recent years (Stansfeld and Clark, 2015), but further analysis adjusting for confounding factors is ongoing and is needed to confirm these initial conclusions.



Sources: Stansfeld et al. 2005; Clark et al. 2006

Figure C-12 Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) Study Reading Scores Varying with Equivalent Sound Level

There was also a trend for reading comprehension to be poorer in aircraft noise-exposed secondary schools. Significant differences in reading scores were found between primary school children in the two different classrooms at the same school (Bronzaft and McCarthy, 1975). One classroom was exposed to high levels of railway noise while the other classroom was quiet. The mean reading age of the noise-exposed children was 3 to 4 months behind that of the control children. Studies suggest that the evidence of the effects of noise on children's cognition has grown stronger over recent years (Stansfeld and Clark, 2015), but further analysis adjusting for confounding factors is ongoing and is needed to confirm these initial conclusions.

Studies identified a range of linguistic and cognitive factors to be responsible for children´s unique difficulties with speech perception in noise. Children have lower stored phonological knowledge to reconstruct degraded speech reducing the probability of successfully matching incomplete speech input when compared with adults. Additionally, young children are less able than older children and adults to make use of contextual cues to reconstruct noise-masked words presented in sentential context (Klatte et al., 2013).

FICAN funded a pilot study to assess the relationship between aircraft noise reduction and standardized test scores (Eagan et al., 2004; FICAN, 2007). The study evaluated whether abrupt aircraft noise reduction within classrooms, from either airport closure or sound insulation, was associated with improvements in test scores. Data were collected in 35 public schools near three airports in Illinois and Texas. The study used several noise metrics. These were, however, all computed indoor levels, which makes it hard to compare with the outdoor levels used in most other studies.

The FICAN study found a significant association between noise reduction and a decrease in failure rates for high school students but not middle or elementary school students. There were some weaker associations between noise reduction and an increase in failure rates for middle and elementary schools. Overall, the study found that the associations observed were similar for children with or without learning difficulties and between verbal and math/science tests. As a pilot study, it was not expected to obtain final answers but provided useful indications (FICAN, 2007).

A recent study of the effect of aircraft noise on student learning (Sharp et al., 2014) examined student test scores at a total of 6,198 US elementary schools, 917 of which were exposed to aircraft noise at 46 airports with noise exposures exceeding the 55-dB DNL. The study found small but statistically significant associations between airport noise and student mathematics and reading test scores, after taking demographic and school factors into account. Associations were also observed for ambient noise and total noise on student mathematics and reading test scores, suggesting that noise levels per se, as well as from aircraft, might play a role in student achievement.

As part of the Noise-Related Annoyance, Cognition and Health study conducted at Frankfurt airport, reading tests were conducted on 1,209 school children at 29 primary schools. It was found that there was a small decrease in reading performance that corresponded to a 1-month reading delay; however, a recent study observing children at 11 schools surrounding Los Angeles International Airport found that the majority of distractions to elementary age students were other students followed by themselves, which includes playing with various items and daydreaming. Less than 1 percent of distractions were caused by traffic noise.

While there are many factors that can contribute to learning deficits in school-aged children, there is increasing awareness that chronic exposure to high aircraft noise levels may impair learning. This awareness has led WHO and a North Atlantic Treaty Organization (NATO) working group to conclude that daycare centers and schools should not be located near major sources of noise, such as highways, airports, and industrial sites (NATO, 2000; WHO, 1999). The awareness has also led to the classroom noise standard discussed earlier (ANSI, 2002).

C.2.1.4.5 Noise Effects on Animals and Wildlife

Hearing is critical to an animal's ability to react, compete, reproduce, hunt, forage, and survive in its environment. While the existing literature does include studies on possible effects of jet aircraft noise and sonic booms on wildlife, there appears to have been little concerted effort in developing quantitative comparisons of aircraft noise effects on normal auditory characteristics. Behavioral effects have been relatively well described, but the larger ecological context issues, and the potential for drawing conclusions regarding effects on populations, have not been well developed.

The relationships between potential auditory/physiological effects and species interactions with their environments are not well understood. Manci et al. (1988) assert that the consequences that physiological effects may have on behavioral patterns are vital to understanding the long-term effects of noise on wildlife. Questions regarding the effects (if any) on predator-prey interactions, reproductive success, and intraspecific behavior patterns remain.

The following discussion provides an overview of the existing literature on noise effects (particularly jet aircraft noise) on animal species. The literature reviewed here involves those studies that have focused on the observations of the behavioral effects that jet aircraft and sonic booms have on animals.

A great deal of research was conducted in the 1960s and 1970s on the effects of aircraft noise on the public and the potential for adverse ecological impacts. These studies were largely completed in response to the increase in air travel and as a result of the introduction of supersonic jet aircraft. According to Manci et al. (1988), the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes. The ability to hear sounds and noise and to communicate assist wildlife in maintaining group cohesiveness and survivorship. Social species communicate by transmitting calls of warning, introduction, and other types that are subsequently related to an individual's or group's responsiveness.

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or could interfere with behavioral patterns (Manci et al., 1988). Although the effects are likely temporal, aircraft noise may cause masking of auditory signals within exposed faunal communities. Animals rely on hearing to avoid predators, obtain food, and communicate with, and attract, other members of their species. Aircraft noise may mask or interfere with these functions. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights.

Secondary effects may include nonauditory effects such as stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects and include population decline and habitat loss. Most of the effects of noise are mild enough that they may never be detectable as variables of change in population size or population growth against the background of normal variation (Bowles, 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith et al., 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci et al., 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife “flight” due to noise. Animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed wing versus rotor-wing [helicopter]) and type of flight mission may also produce different levels of disturbance, with varying animal responses (Smith et al., 1988). Consequently, it is difficult to generalize animal responses to noise disturbances across species.

One result of the Manci et al. (1988) literature review was the conclusion that, while behavioral observation studies were relatively limited, a general behavioral reaction in animals from exposure to aircraft noise is the startle response. The intensity and duration of the startle response appears to be dependent on which species is exposed, whether there is a group or an individual, and whether there have been some previous exposures. Responses range from flight, trampling, stampeding, jumping, or running, to movement of the head in the apparent direction of the noise source. Manci et al. (1988) reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals.

Domestic Animals

Although some studies report that the effects of aircraft noise on domestic animals is inconclusive, a majority of the literature reviewed indicates that domestic animals exhibit some behavioral responses to military overflights but generally seem to habituate to the disturbances over a period of time. Mammals in particular appear to react to noise at sound levels higher than 90 dB, with responses including the startle response, freezing (i.e., becoming temporarily stationary), and fleeing from the sound source. Many studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Manci et al., 1988). Some studies have reported such primary and secondary effects as reduced milk production and rate of milk release, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate, and a reduction in thyroid activity. These latter effects appear to represent a small percentage of the findings occurring in the existing literature. Some reviewers have indicated that earlier studies, and claims by farmers linking adverse effects of aircraft noise on livestock, did not necessarily provide clear-cut evidence of cause and effect (Cottereau, 1978). In contrast, many studies conclude that there is no evidence that aircraft overflights affect feed intake, growth, or production rates in domestic animals.

Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service, 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock. This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci et al., 1988).

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects. The relationships between physiological effects and how species interact with their environments have not been thoroughly studied; therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.

Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance, wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese in one study. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the “startle” or “fright” response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation/nesting phase.

C.2.2 Noise Models

This section summarizes the analysis tools used to calculate the noise levels for the EA.

C.2.2.1 NOISEMAP

Analyses of aircraft noise exposure and compatible land uses around DoD airfield-like facilities are normally accomplished using a group of computer-based programs, collectively called NOISEMAP (Czech and Plotkin, 1998; Wasmer and Maunsell, 2022a, 2022b). The core computational program of the NOISEMAP suite is NMAP. In this report NMAP Version 7.3 was used to analyze aircraft operations and to generate noise contours.

C.2.2.2 MR_NMAP

When the aircraft flight tracks are not well defined and are distributed over a wide area, such as in military training routes with wide corridors or MOAs, the Air Force uses the DoD-approved MR_NMAP program (Lucas and Calamia, 1996). In this report, MR_NMAP Version 3.0 was used to model subsonic aircraft noise in SUA. For airspace environments where noise levels are calculated to be less than 45 dB, the noise levels are stated as “<45 dB.”

C.2.2.3 PCBoom

Environmental analysis of supersonic aircraft operations requires calculation of sonic boom amplitudes. For the purposes of this study, the Air Force and DoD-approved PCBoom program was used to assess sonic boom exposure due to military aircraft operations in supersonic airspace. In this report, PCBoom Version 4 was used to calculate sonic boom overpressure footprints and ground signatures from supersonic vehicles performing steady, level flight operations (Plotkin, 2002).

C.2.2.4 BooMap

For cumulative sonic boom exposure under supersonic air combat training arenas, the Air Force and DoD-approved BooMap program was used. In this report, BooMap96 was used to calculate cumulative C weighted DNL (CDNL) exposure based on long-term measurements in a number of airspaces (Plotkin, 1993).

C.2.2.5 Airfield Operations

Table C-5 summarizes the existing operations at Shaw AFB, broken out by aircraft type. **Table C-6** shows the Alternative 1 proposed operations at Shaw AFB. Note that the only difference between the existing conditions and Alternative 1 is the addition of the proposed contract ADAIR operations in **Table C-6**

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Table C-5 Existing Flight Operations at Shaw Air Force Base

Category	Squadron / Unit	Aircraft Type	Departure				Arrival			Closed Pattern			Interfacility			TOTAL		
			Day (0700-2200)	Night (2200-0700)	Total	% of Departures in AB Takeoff Roll	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total
Based		B-737-700	37	1	38	n/a	37	1	38	-	-	-	-	-	-	74	2	76
	55 FS, 77 FS, 79 FS	F-16C	16,230	-	16,230	70	15,323	907	16,230	15,274	-	15,274	1,879	-	1,879	48,706	907	49,613
BASED TOTAL			**16,267**	**1**	**16,268**	**-**	**15,360**	**908**	**16,268**	**15,274**	**-**	**15,274**	**1,879**	**-**	**1,879**	**48,780**	**909**	**49,689**
Transient	twin engine turboprop	C-12	22	1	23	n/a	22	1	23	-	-	-	-	-	-	44	2	46
	transport	C-130E	10	3	13	n/a	9	4	13	54	-	54	-	-	-	73	7	80
	large 4-engine transport jet	C-17	14	3	17	n/a	12	5	17	-	-	-	-	-	-	26	8	34
	transport	C-21A	16	1	17	n/a	16	1	17	-	-	-	-	-	-	32	2	34
	fighter	F-15E	17	1	18	0	17	1	18	108	-	108	-	-	-	142	2	144
		F-16A	57	2	59	0	57	2	59	235	-	235	-	-	-	349	4	353
		F-18A/C	8	-	8	100	8	-	8	30	-	30	-	-	-	46	-	46
		F-35A	33	1	34	100	33	1	34	136	-	136	-	-	-	202	2	204
	1-engine turboprop	GASEPV	12	-	12	n/a	12	-	12	-	-	-	-	-	-	24	-	24
	tanker	KC-10A	15	4	19	n/a	13	6	19	-	-	-	-	-	-	28	10	38
	jet trainer	T-38A	15	-	15	n/a	15	-	15	62	-	62	-	-	-	92	-	92
	helicopter	UH60A	14	-	14	n/a	14	-	14	196	-	196	-	-	-	224	-	224
TRANSIENT TOTAL			**233**	**16**	**249**	-	**228**	**21**	**249**	**821**	**-**	**821**	**-**	**-**	**-**	**1,282**	**37**	**1,319**
GRAND TOTAL			**16,500**	**17**	**16,517**		**15,588**	**929**	**16,517**	**16,095**	**-**	**16,095**	**1,879**	**-**	**1,879**	**50,062**	**946**	**51,008**

Notes:
Each closed pattern circuit counted as two operations; table indicates closed pattern operations.
All operations shown to nearest integer

Table C-6 Alternative 1 Proposed Flight Operations at Shaw Air Force Base

Category	Squadron / Unit	Aircraft Type	Departure				Arrival			Closed Pattern			Interfacility			TOTAL		
			Day (0700-2200)	Night (2200-0700)	Total	% of Departures in AB Takeoff Roll	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total
Based		B-737-700	37	1	38	n/a	37	1	38	-	-	-	-	-	-	74	2	76
	55 FS, 77 FS, 79 FS	F-16C	16,230	-	16,230	70%	15,323	907	16,230	15,274	-	15,274	1,879	-	1,879	48,706	907	49,613
	ADAIR	Category C	3,500	-	3,500	-	3,304	196	3,500	350	-	350	-	-	-	7,154	196	7,350
BASED TOTAL			**19,767**	**1**	**19,768**	**-**	**18,664**	**1,104**	**19,768**	**15,624**	**-**	**15,624**	**1,879**	**-**	**1,879**	**55,934**	**1,105**	**57,039**
Transient	twin engine turboprop	C-12	22	1	23	n/a	22	1	23	-	-	-	-	-	-	44	2	46
	transport	C-130E	10	3	13	n/a	9	4	13	54	-	54	-	-	-	73	7	80
	large 4-engine transport jet	C-17	14	3	17	n/a	12	5	17	-	-	-	-	-	-	26	8	34
	transport	C-21A	16	1	17	n/a	16	1	17	-	-	-	-	-	-	32	2	34
	fighter	F-15E	17	1	18	0%	17	1	18	108	-	108	-	-	-	142	2	144
		F-16A	57	2	59	0%	57	2	59	235	-	235	-	-	-	349	4	353
		F-18A/C	8	-	8	100%	8	-	8	30	-	30	-	-	-	46	-	46
		F-35A	33	1	34	100%	33	1	34	136	-	136	-	-	-	202	2	204
	1-engine turboprop	GASEPV	12	-	12	n/a	12	-	12	-	-	-	-	-	-	24	-	24
	tanker	KC-10A	15	4	19	n/a	13	6	19	-	-	-	-	-	-	28	10	38
	jet trainer	T-38A	15	-	15	n/a	15	-	15	62	-	62	-	-	-	92	-	92
	helicopter	UH60A	14	-	14	n/a	14	-	14	196	-	196	-	-	-	224	-	224
TRANSIENT TOTAL			**233**	**16**	**249**	-	**228**	**21**	**249**	**821**	**-**	**821**	**-**	**-**	**-**	**1,282**	**37**	**1,319**
		GRAND TOTAL	**20,000**	**17**	**20,017**		**18,892**	**1,125**	**20,017**	**16,445**	**-**	**16,445**	**1,879**	**-**	**1,879**	**57,216**	**1,142**	**58,358**

Notes:
Each closed pattern circuit counted as two operations; table indicates closed pattern operations.
All operations shown to nearest integer

C.2.3 Runway and Flight Track Use

This section describes the flight tracks used by the aircraft operating out of Shaw AFB as well as the runway utilization. Utilization percentages are provided for each runway in **Table C-7**. Flight track maps for all aircraft are presented on **Figure C-13** (departures), **Figure C-14** (arrivals), and **Figure C-15** (closed patterns). Closed pattern flight tracks represent aircraft patterns that depart and arrive on the same runway. Example flight profiles that use closed pattern flight tracks are simulated flame out and visual flight rules pattern profiles. All contract ADAIR flight tracks which are based on the F-16C aircraft flight tracks are shown on **Figure C-16.**

Table C-7 Runway Usage for Aircraft at Shaw Air Force Base

Based Aircraft		04L	22R	04R	22L
F-16C (w F110-GE-129)	Arrivals	42%	52%	3%	3%
	Departures	40%	50%	5%	5%
	Closed Patterns	41%	51%	4%	4%
	Interfacilities	45%	55%	0%	0%
B-737-300	Arrivals	45%	55%	0%	0%
	Departures	45%	55%	0%	0%
Transient Aircraft		**04L**	**22R**	**04R**	**22L**
All Transient Aircraft	Arrivals	45%	55%	0%	0%
	Departures	45%	55%	0%	0%
	Closed Patterns	45%	55%	0%	0%

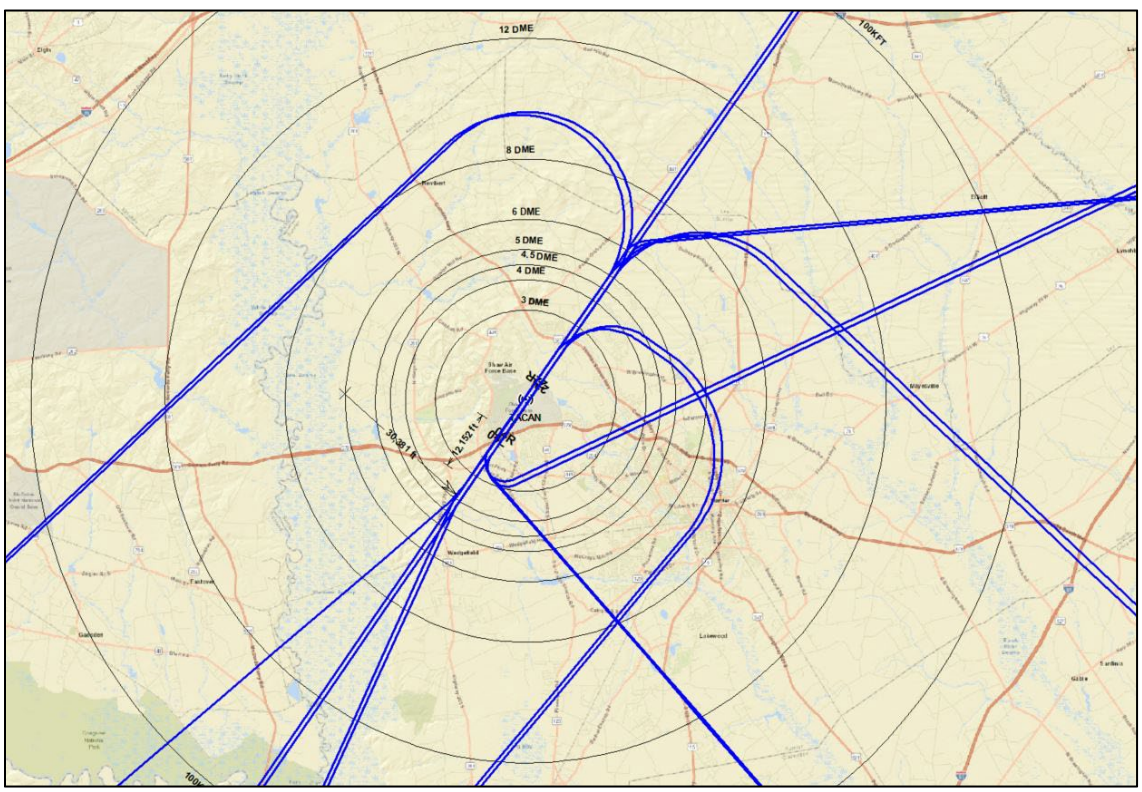


Figure C-13 Departure Flight Tracks at Shaw Air Force Base

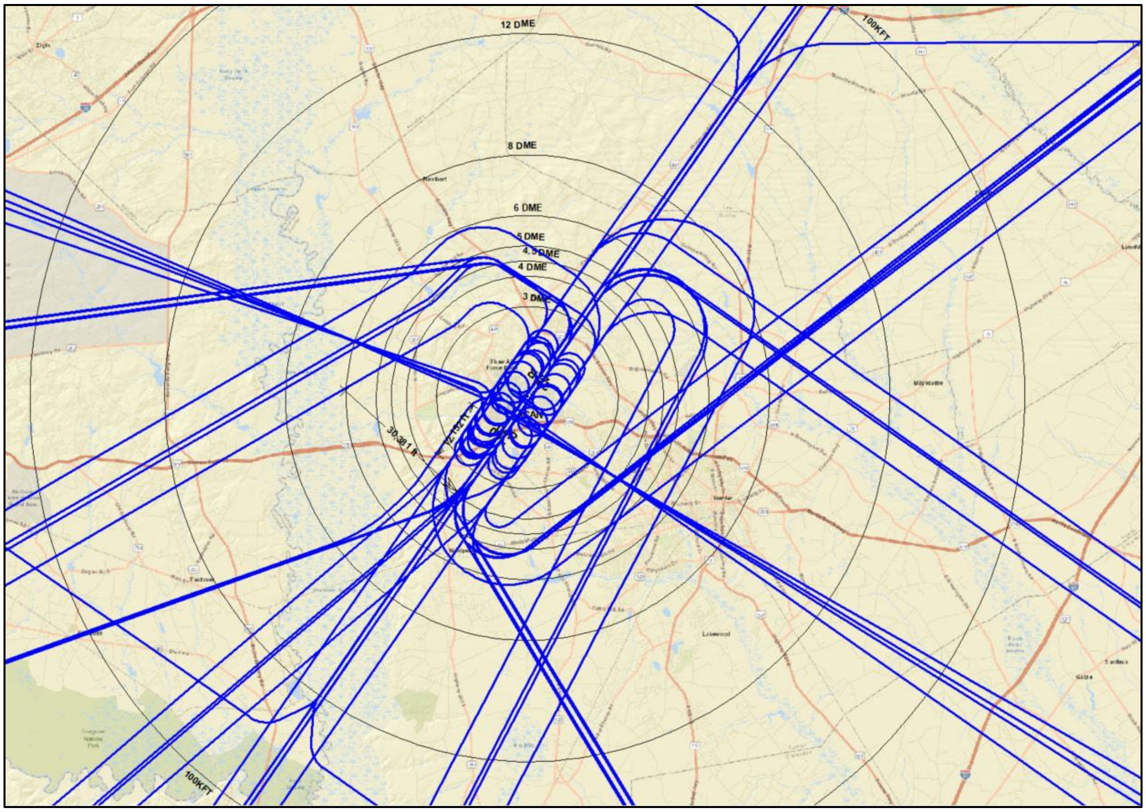


Figure C-14 Arrival Flight Tracks at Shaw Air Force Base

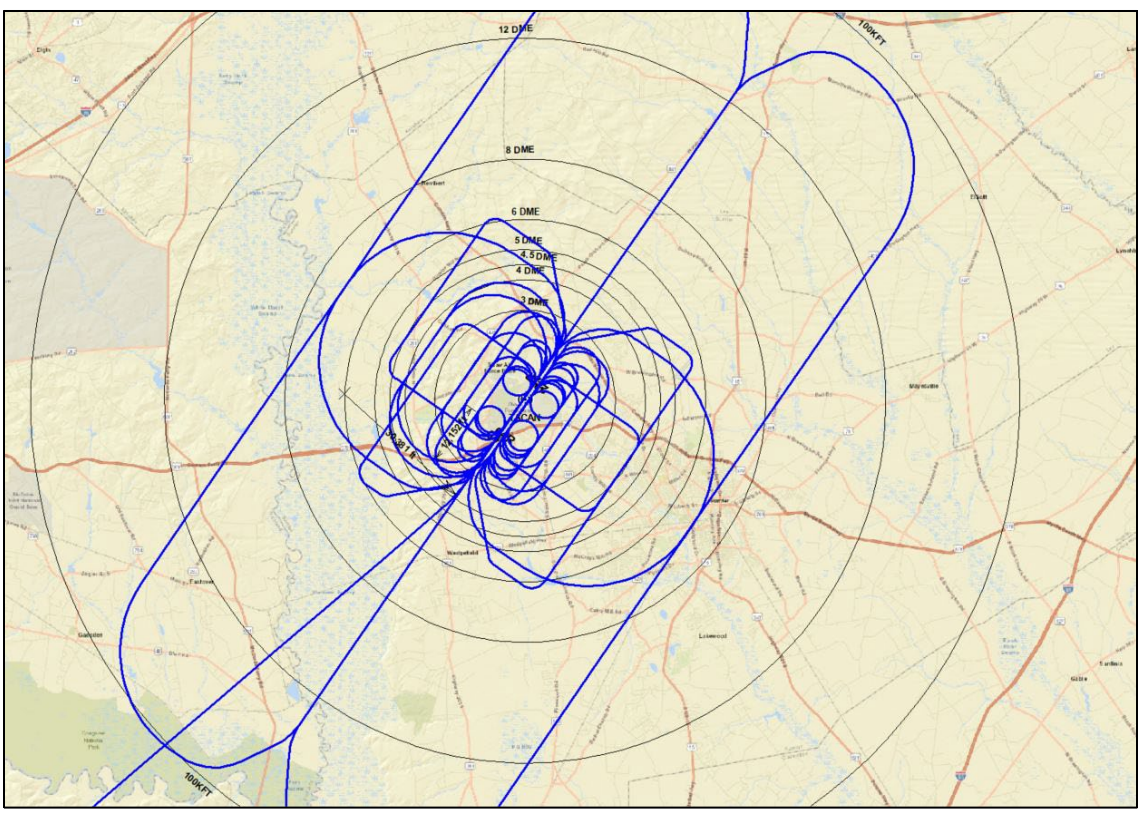


Figure C-15 Closed Pattern Flight Tracks at Shaw Air Force Base

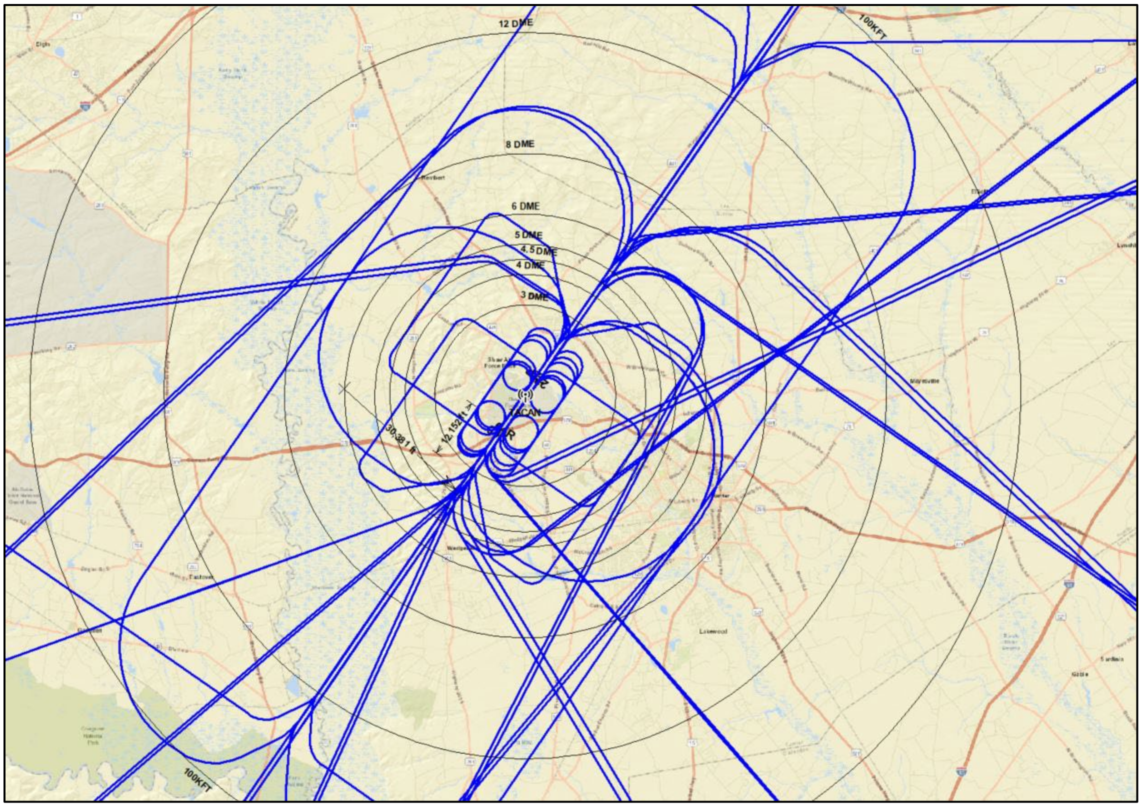


Figure C-16 Contract Adversary Air Flight Tracks at Shaw Air Force Base

C.2.4 Flight Profiles and Aircraft

Representative flight profiles provide the speed and power setting of each type of aircraft as a function of distance along the flight track for the representative maneuvers. For modeling purposes, the appropriate profile is used for all flight tracks that conform to that maneuver type. For example, all overhead break arrival tracks utilize the representative profile for modeling that maneuver.

C.2.4.1 Based Aircraft Representative Flight Profiles and Proposed Adversary Air Flight Profiles for Shaw Air Force Base

This section details the representative flight profiles for the F-16C aircraft that is based at Shaw AFB. Contract ADAIR Category C aircraft flight profiles are shown following the F-16C flight profiles.

Representative Flight Profiles for 20th Fighter Wing F-16Cs

Flight Profile IFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C IFR Arrival Flight Profile F16AI01

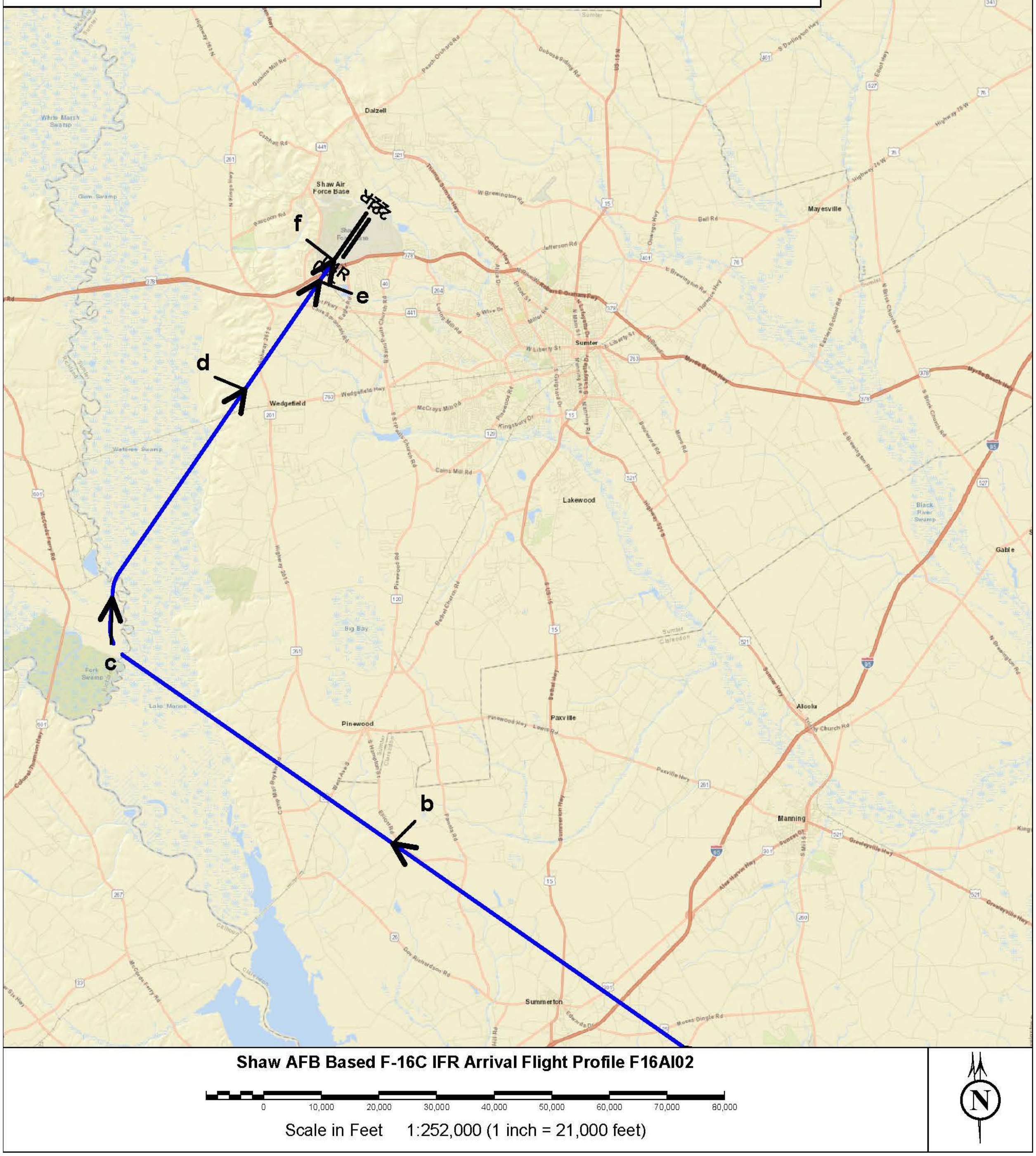
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:252,000 (1 inch = 21,000 feet)

N

Flight Profile IFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				



Shaw AFB Based F-16C IFR Arrival Flight Profile F16AI02

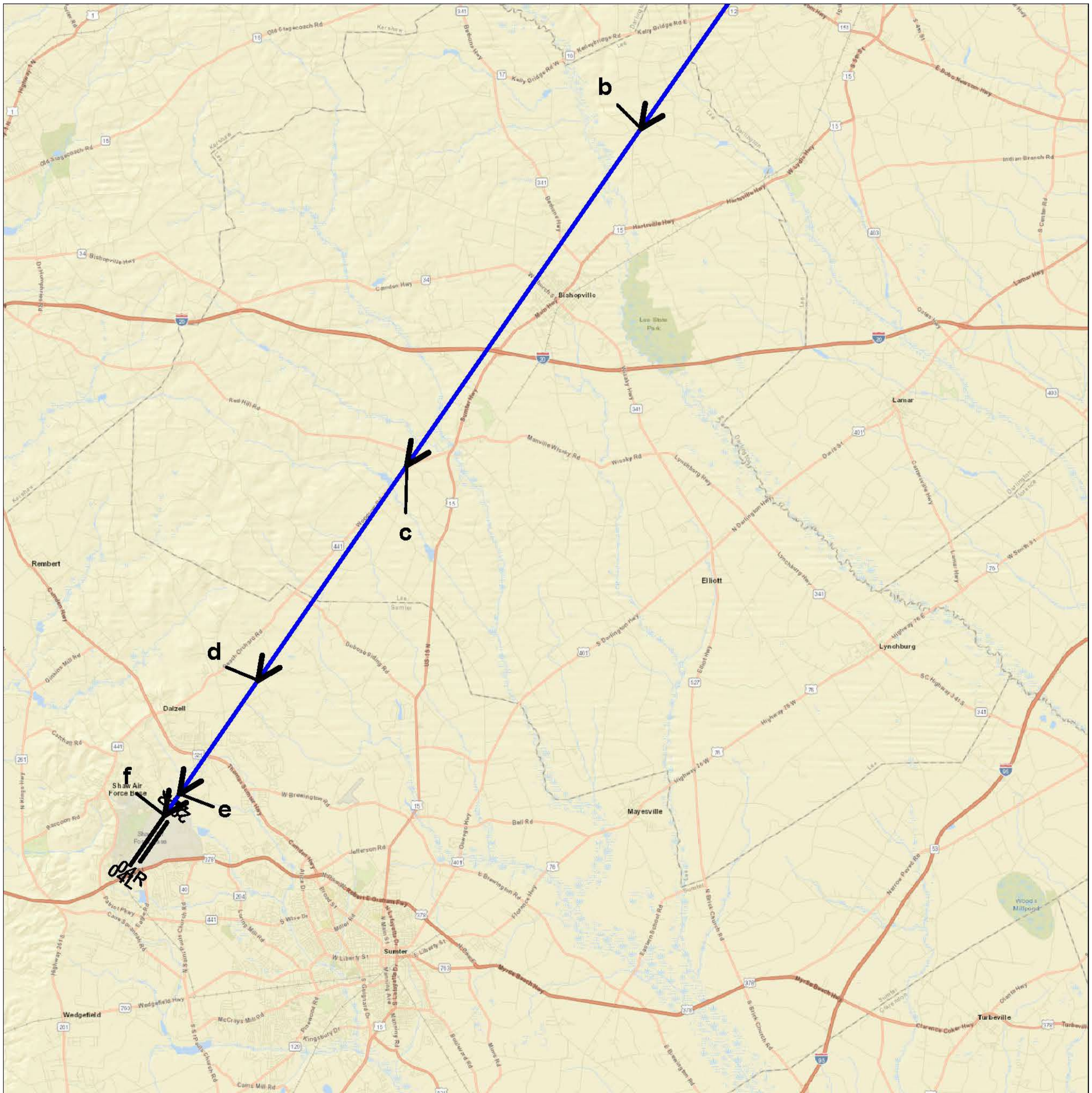
Scale in Feet 1:252,000 (1 inch = 21,000 feet)

Flight Profile IFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	83 Parallel	165				

Shaw AFB Based F-16C IFR Arrival Flight Profile F16AI03

Scale in Feet 1:252,000 (1 inch = 21,000 feet)



Flight Profile IFR Arrival

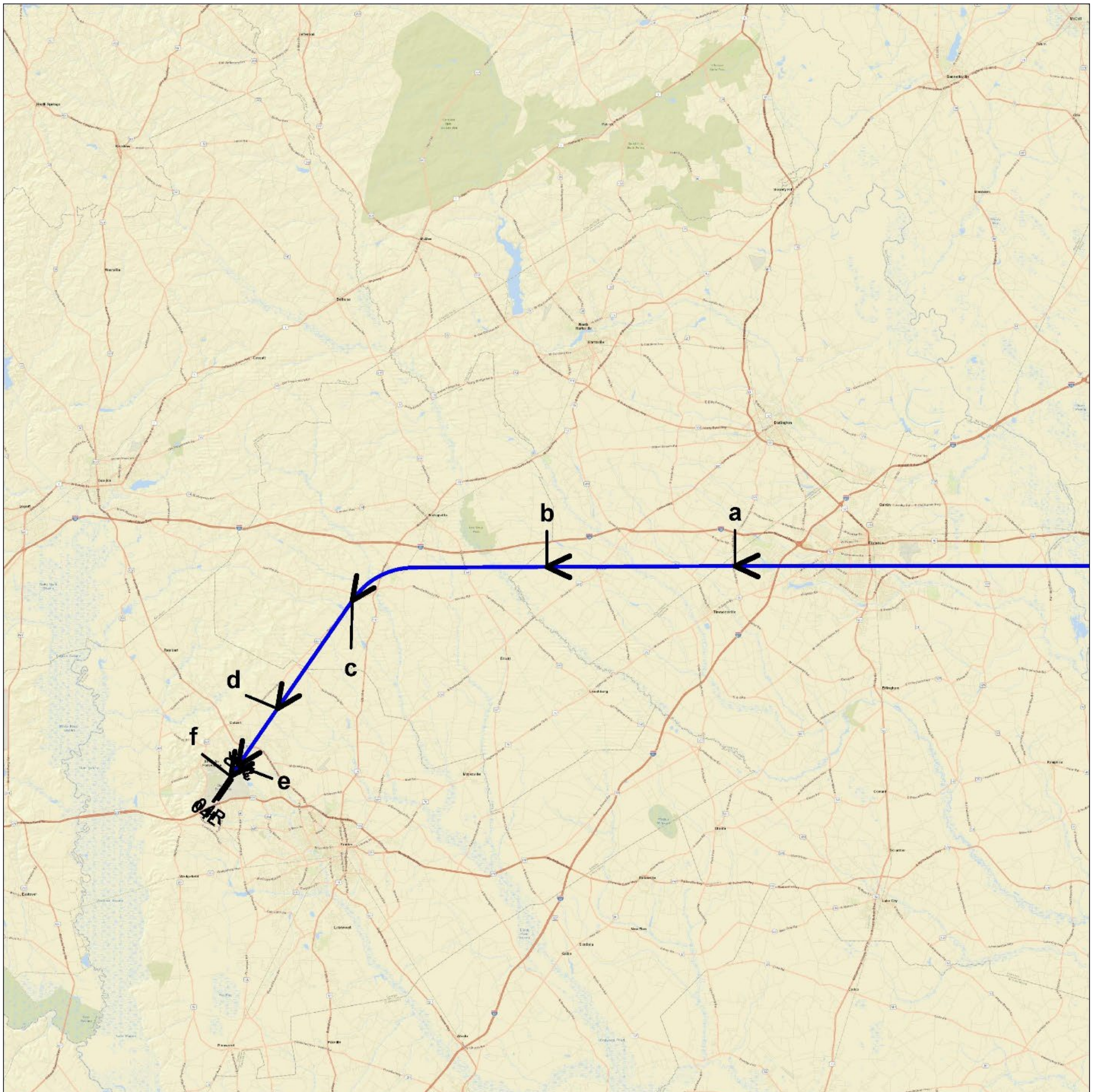
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C IFR Arrival Flight Profile F16AI04

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:254,000 (1 inch = 21,100 feet)

N



Flight Profile IFR Arrival

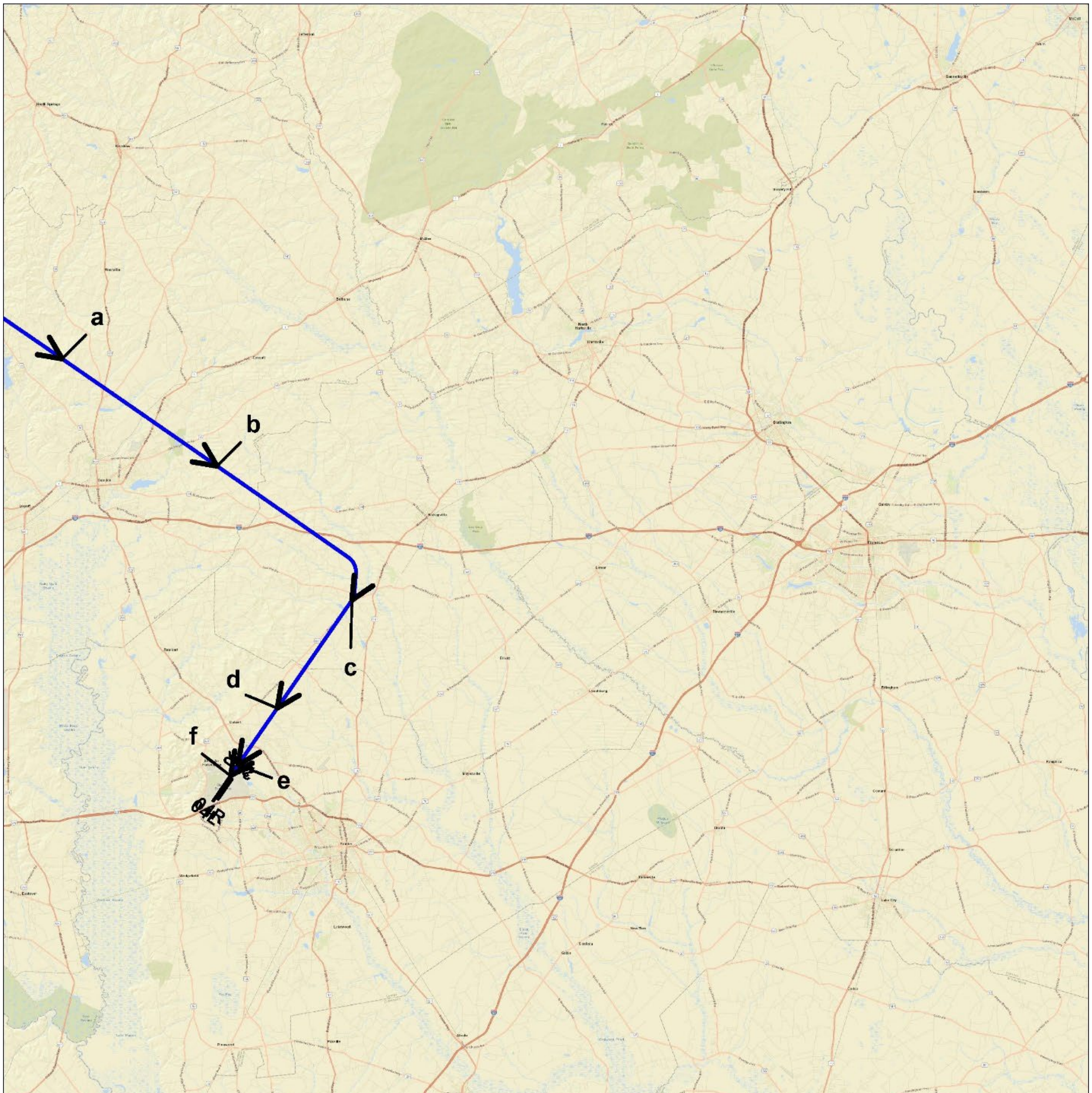
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C IFR Arrival Flight Profile F16AI05

0 20,000 40,000 60,000 80,000 100,000 120,000 140,000 160,000

Scale in Feet 1:506,000 (1 inch = 42,200 feet)

N



Flight Profile IFR Arrival

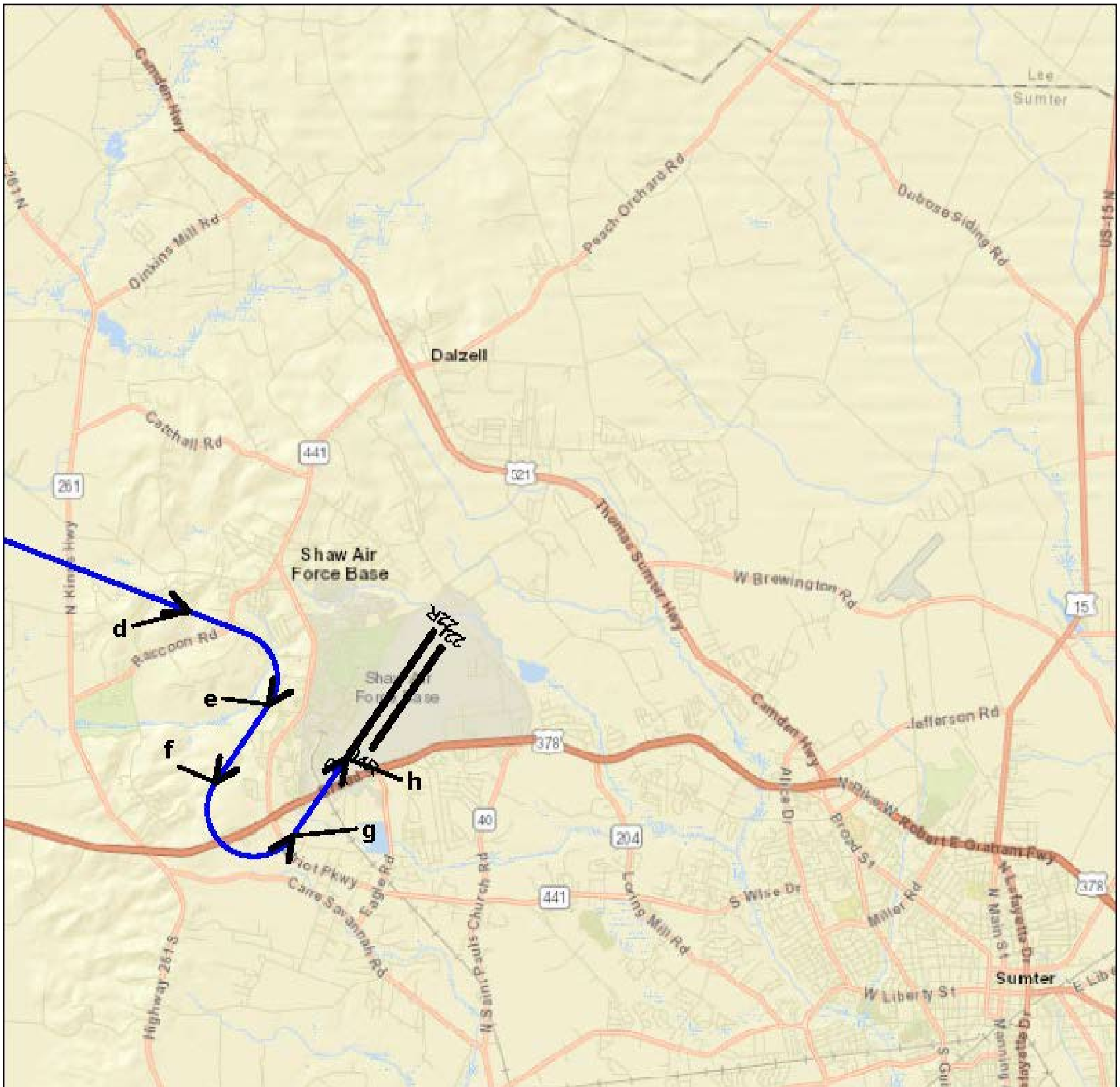
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C IFR Arrival Flight Profile F16AI06

0 20,000 40,000 60,000 80,000 100,000 120,000 140,000 160,000

Scale in Feet 1:506,000 (1 inch = 42,200 feet)

N



Flight Profile Min Risk Arrival

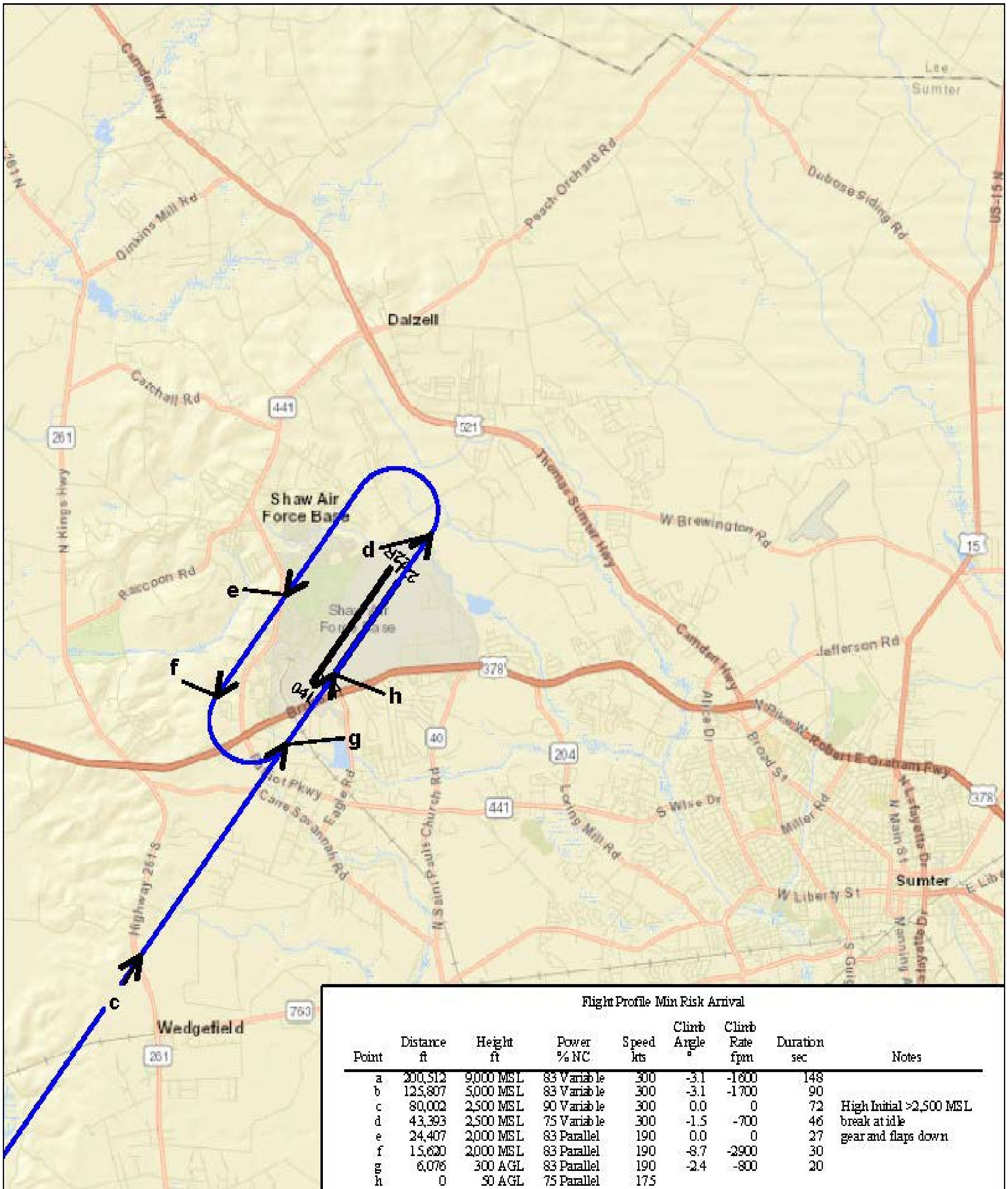
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,512	9,000 MSL	83 Variable	300	-2.4	-1300	186	
b	106,542	5,000 MSL	83 Variable	300	-2.9	-1500	97	
c	57,496	2,500 MSL	90 Variable	300	0.0	0	52	High PI I IS >2,500 MSL
d	31,241	2,500 MSL	75 Variable	300	-3.0	-1300	23	break at idle
e	21,711	2,000 MSL	83 Parallel	190	0.0	0	19	gear and flaps down
f	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30	
g	6,076	300 AGL	83 Parallel	190	-2.4	-800	20	
h	0	50 AGL	75 Parallel	175				

Shaw AFB Based F-16C Min Risk Arrival Flight Profile F16AM02

0 4,000 8,000 12000 16000 20000 24,000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



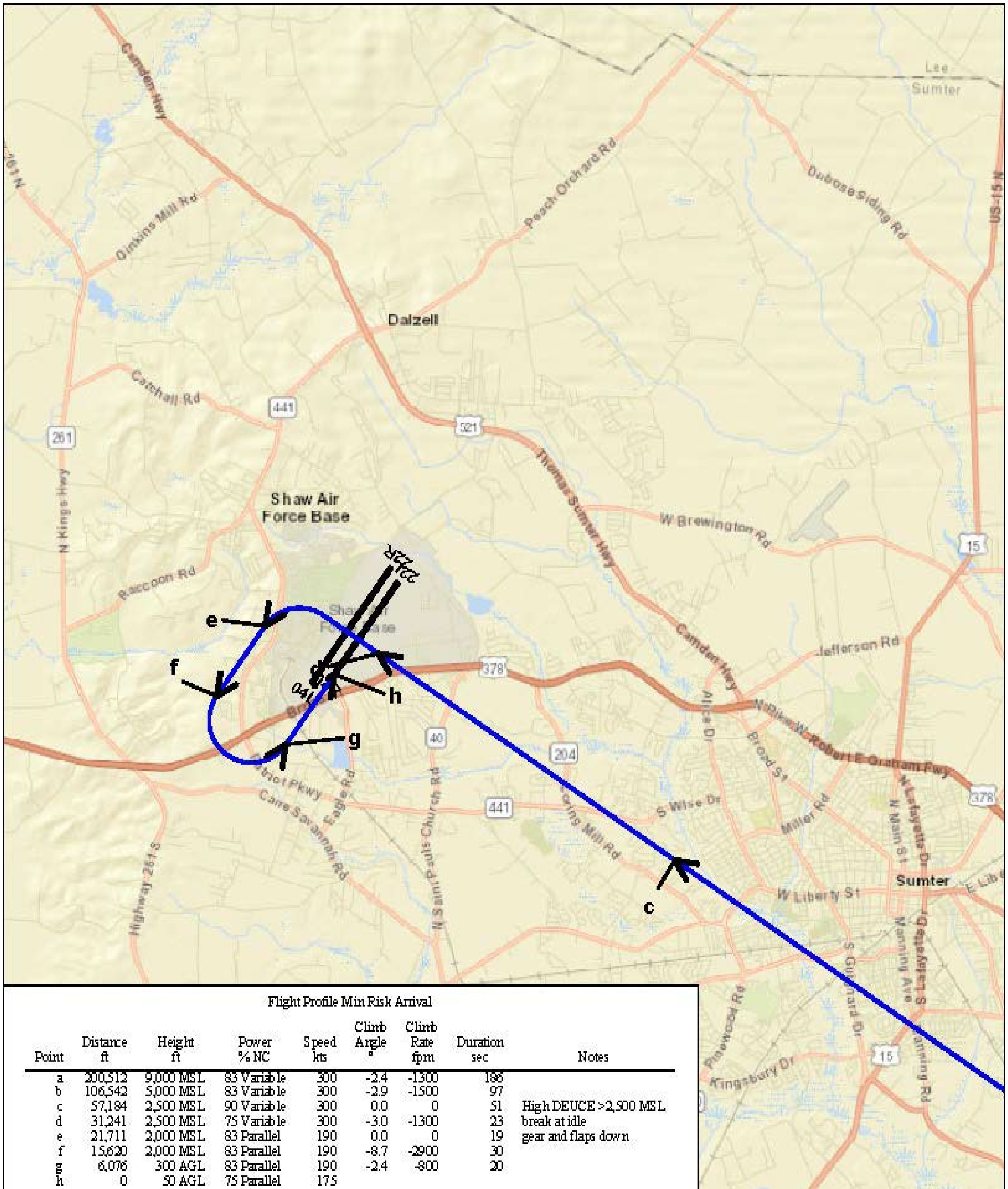
Flight Profile Min Risk Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,512	9,000 MSL	83 Variable	300	-3.1	-1600	148	
b	125,807	5,000 MSL	83 Variable	300	-3.1	-1700	90	
c	80,002	2,500 MSL	90 Variable	300	0.0	0	72	High Initial >2,500 MSL
d	43,393	2,500 MSL	75 Variable	300	-1.5	-700	46	break at idle
e	24,407	2,000 MSL	83 Parallel	190	0.0	0	27	gear and flaps down
f	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30	
g	6,076	300 AGL	83 Parallel	190	-2.4	-800	20	
h	0	50 AGL	75 Parallel	175				

Shaw AFB Based F-16C Min Risk Arrival Flight Profile F16AM04

0 4,000 8,000 12000 16000 20000 24,000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)



Flight Profile Min Risk Arrival

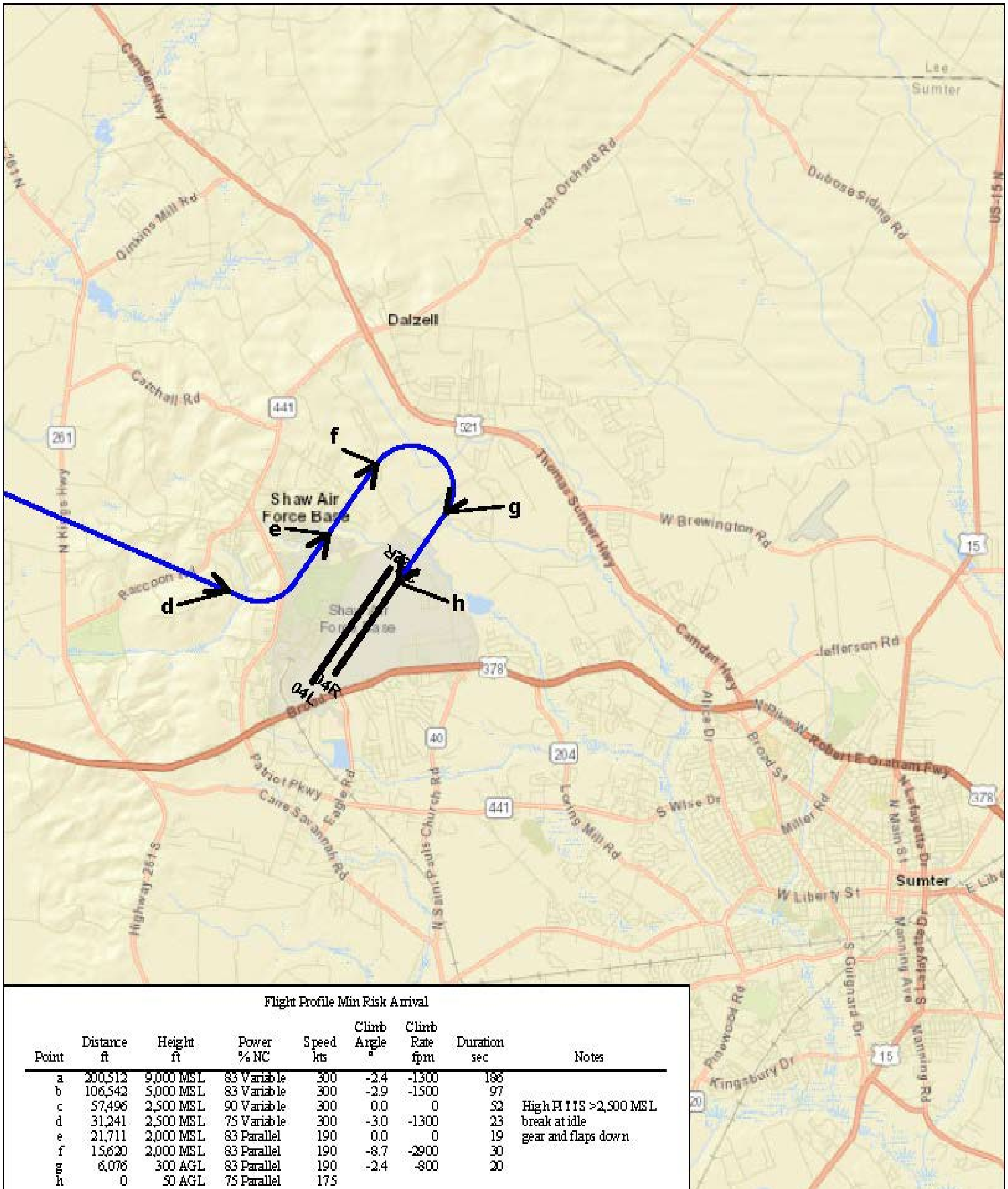
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,512	9,000 MSL	83 Variable	300	-2.4	-1300	186	
b	106,542	5,000 MSL	83 Variable	300	-2.9	-1500	97	
c	57,184	2,500 MSL	90 Variable	300	0.0	0	51	High DEUCE >2,500 MSL
d	31,241	2,500 MSL	75 Variable	300	-3.0	-1300	23	break at idle
e	21,711	2,000 MSL	83 Parallel	190	0.0	0	19	gear and flaps down
f	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30	
g	6,076	300 AGL	83 Parallel	190	-2.4	-800	20	
h	0	50 AGL	75 Parallel	175				

Shaw AFB Based F-16C Min Risk Arrival Flight Profile F16AM06

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Min Risk Arrival

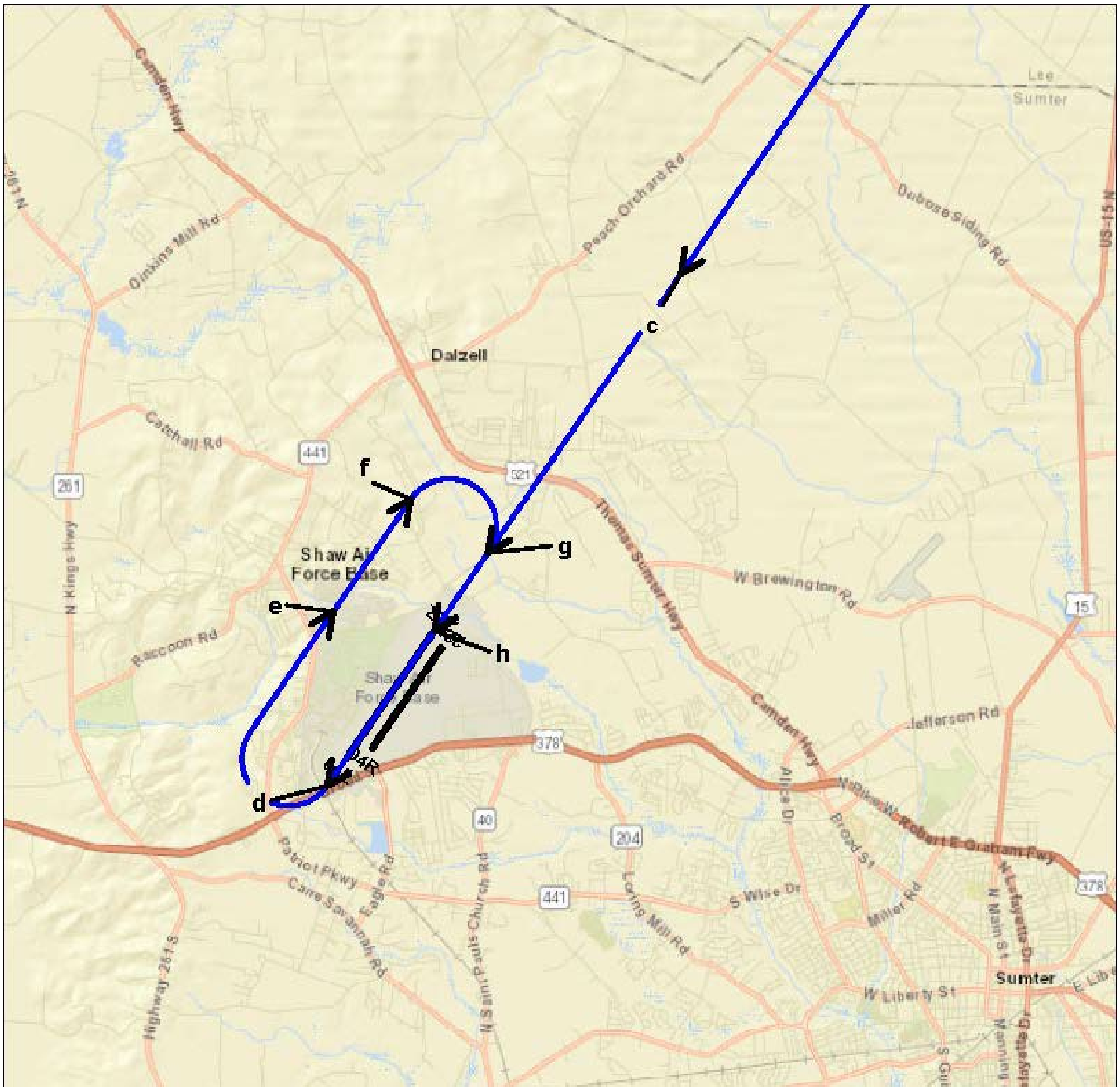
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,512	9,000 MSL	83 Variable	300	-2.4	-1300	186	
b	106,542	5,000 MSL	83 Variable	300	-2.9	-1500	97	
c	57,496	2,500 MSL	90 Variable	300	0.0	0	52	High PITTS >2,500 MSL
d	31,241	2,500 MSL	75 Variable	300	-3.0	-1300	23	break at idle
e	21,711	2,000 MSL	83 Parallel	190	0.0	0	19	gear and flaps down
f	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30	
g	6,076	300 AGL	83 Parallel	190	-2.4	-800	20	
h	0	50 AGL	75 Parallel	175				

Shaw AFB Based F-16C Min Risk Arrival Flight Profile F16AM08

0 4,000 8,000 12000 16000 20000 24,000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Min Risk Arrival

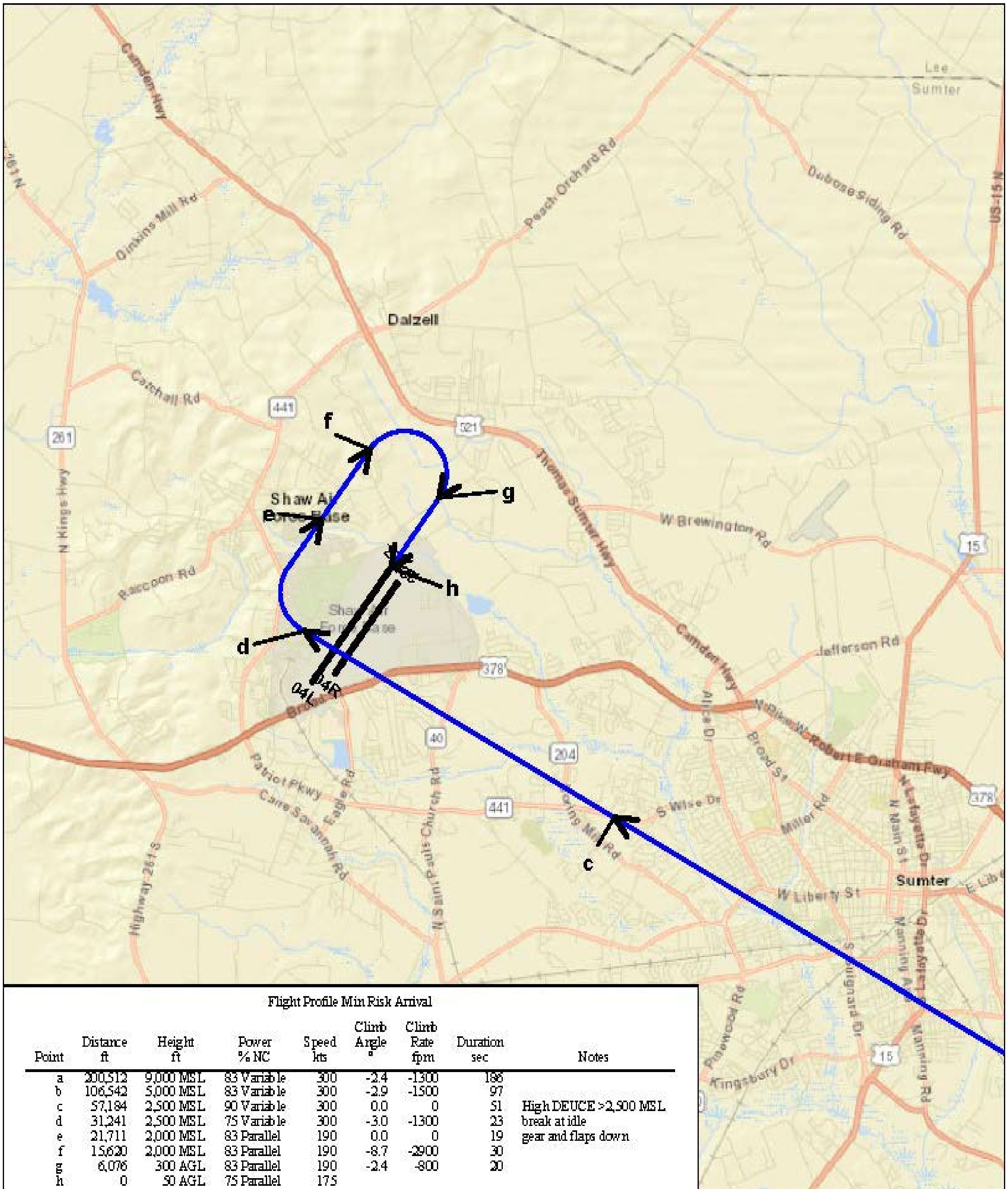
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,512	9,000 MSL	83 Variable	300	-3.1	-1600	148	
b	125,807	5,000 MSL	83 Variable	300	-3.4	-1800	84	
c	83,478	2,500 MSL	90 Variable	300	0.0	0	79	High Initial >2,500 MSL
d	43,393	2,500 MSL	75 Variable	300	-1.5	-700	46	break at idle
e	24,407	2,000 MSL	83 Parallel	190	0.0	0	27	gear and flaps down
f	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30	
g	6,076	300 AGL	83 Parallel	190	-2.4	-800	20	
h	0	50 AGL	75 Parallel	175				

Shaw AFB Based F-16C Min Risk Arrival Flight Profile F16AM10

0 4,000 8,000 12000 16000 20000 24,000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N

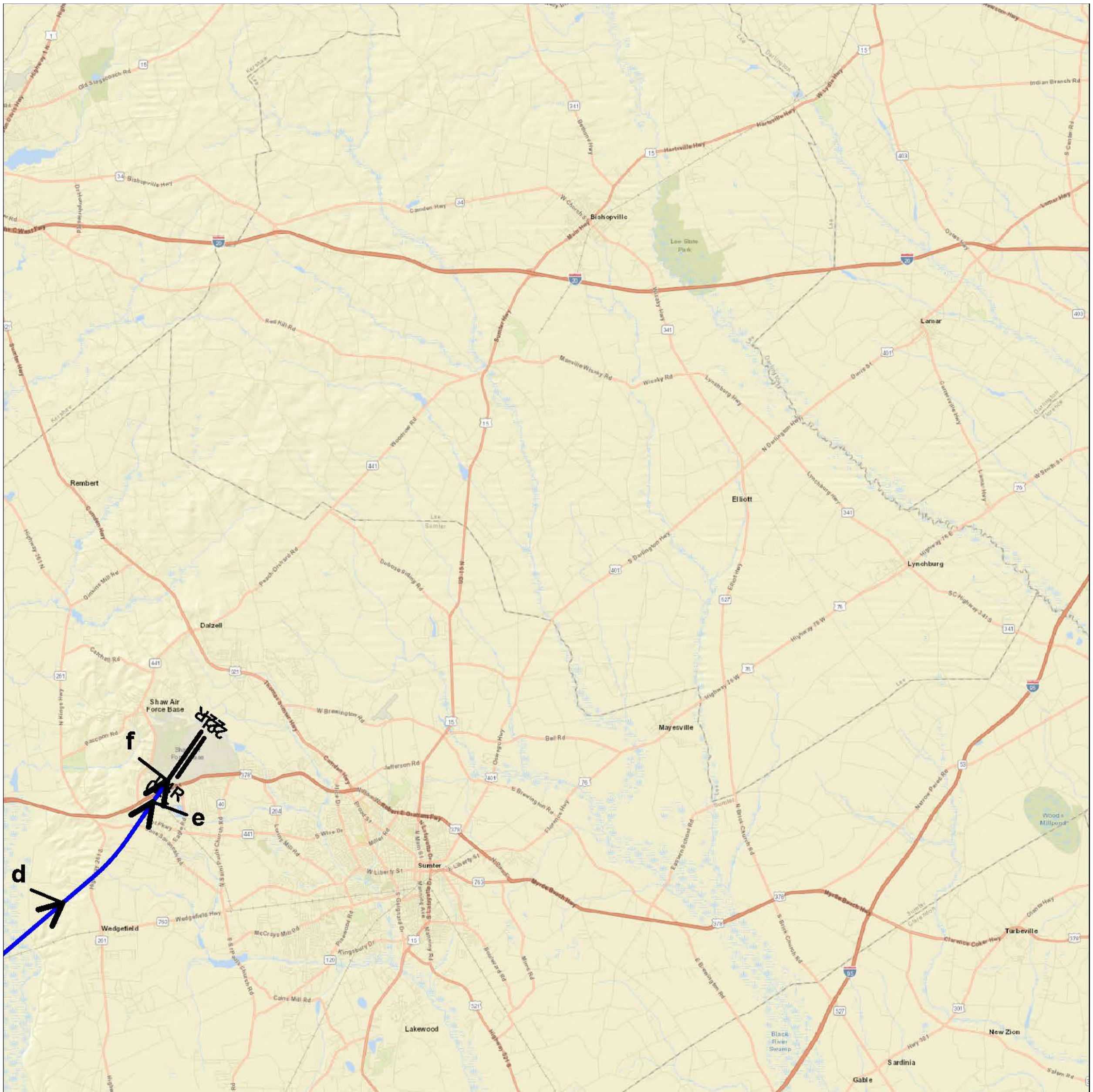


Flight Profile Min Risk Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,512	9,000 MSL	83 Variable	300	-2.4	-1300	186	
b	106,542	5,000 MSL	83 Variable	300	-2.9	-1500	97	
c	57,184	2,500 MSL	90 Variable	300	0.0	0	51	High DEUCE >2,500 MSL
d	31,241	2,500 MSL	75 Variable	300	-3.0	-1300	23	break at idle
e	21,711	2,000 MSL	83 Parallel	190	0.0	0	19	gear and flaps down
f	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30	
g	6,076	300 AGL	83 Parallel	190	-2.4	-800	20	
h	0	50 AGL	75 Parallel	175				

Shaw AFB Based F-16C Min Risk Arrival Flight Profile F16AM12

Scale in Feet 1:102,000 (1 inch = 8,460 feet)



Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

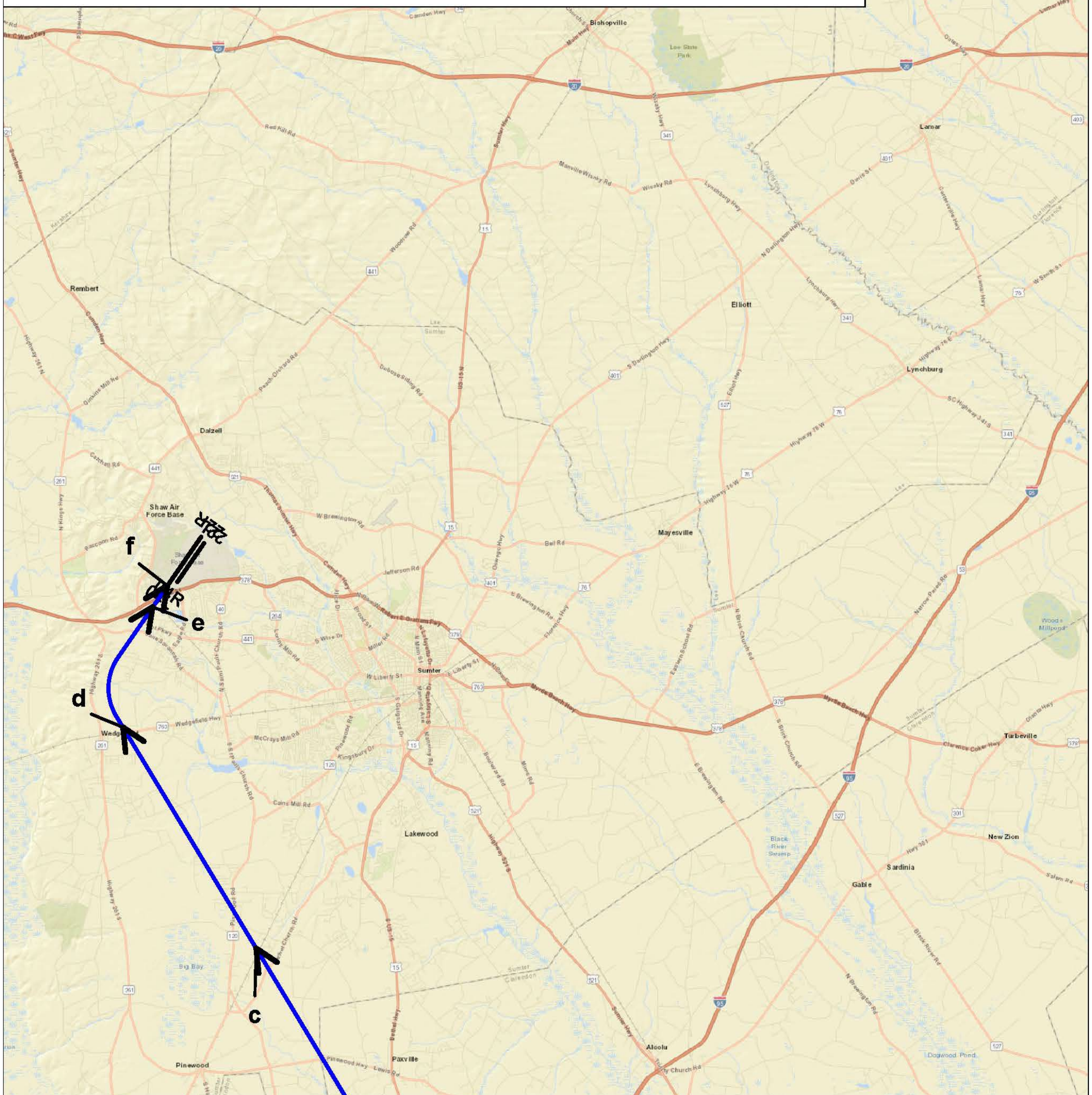
Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS02

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)

Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

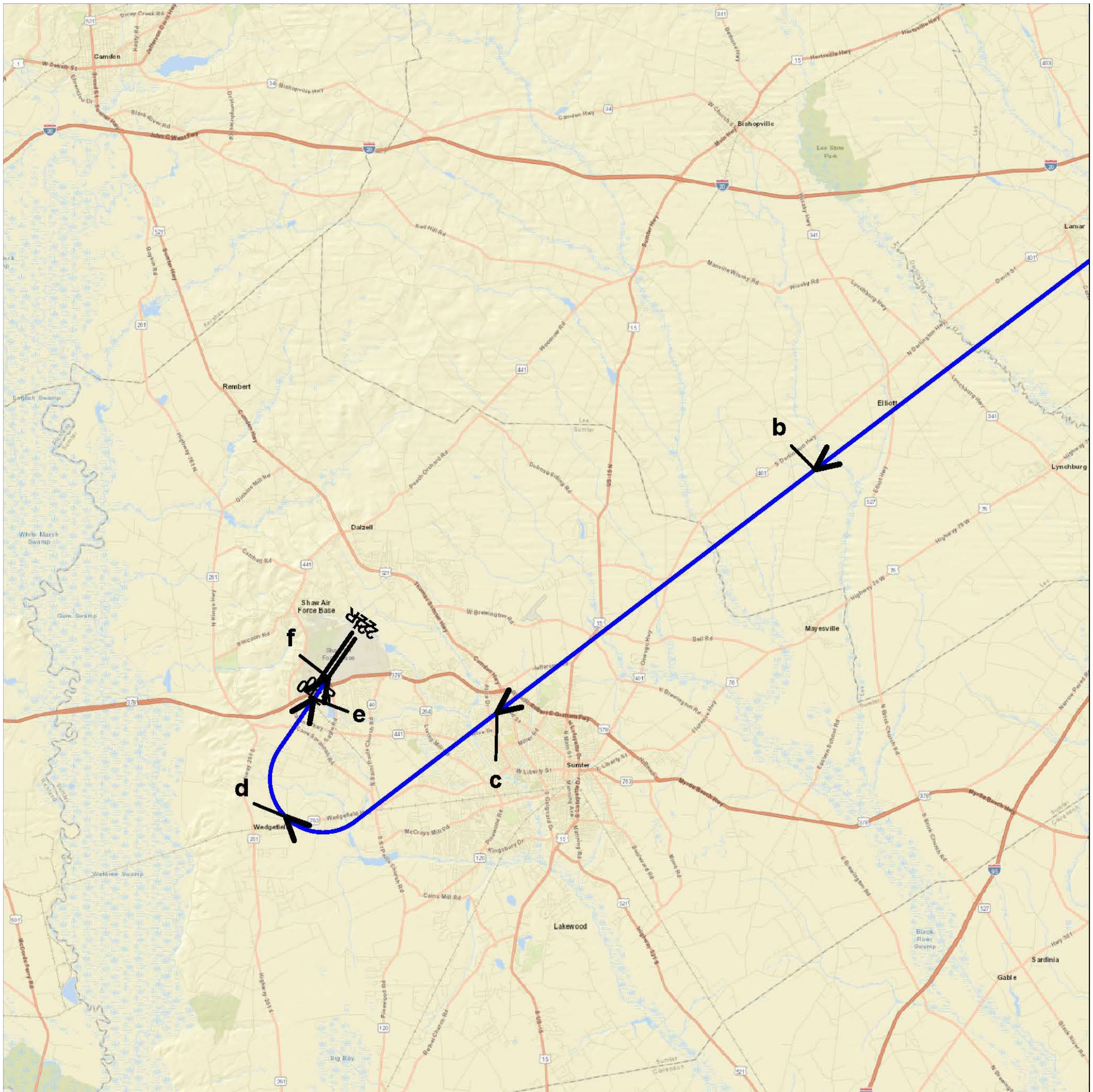


Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS04

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)

N



Flight Profile VFR Arrival

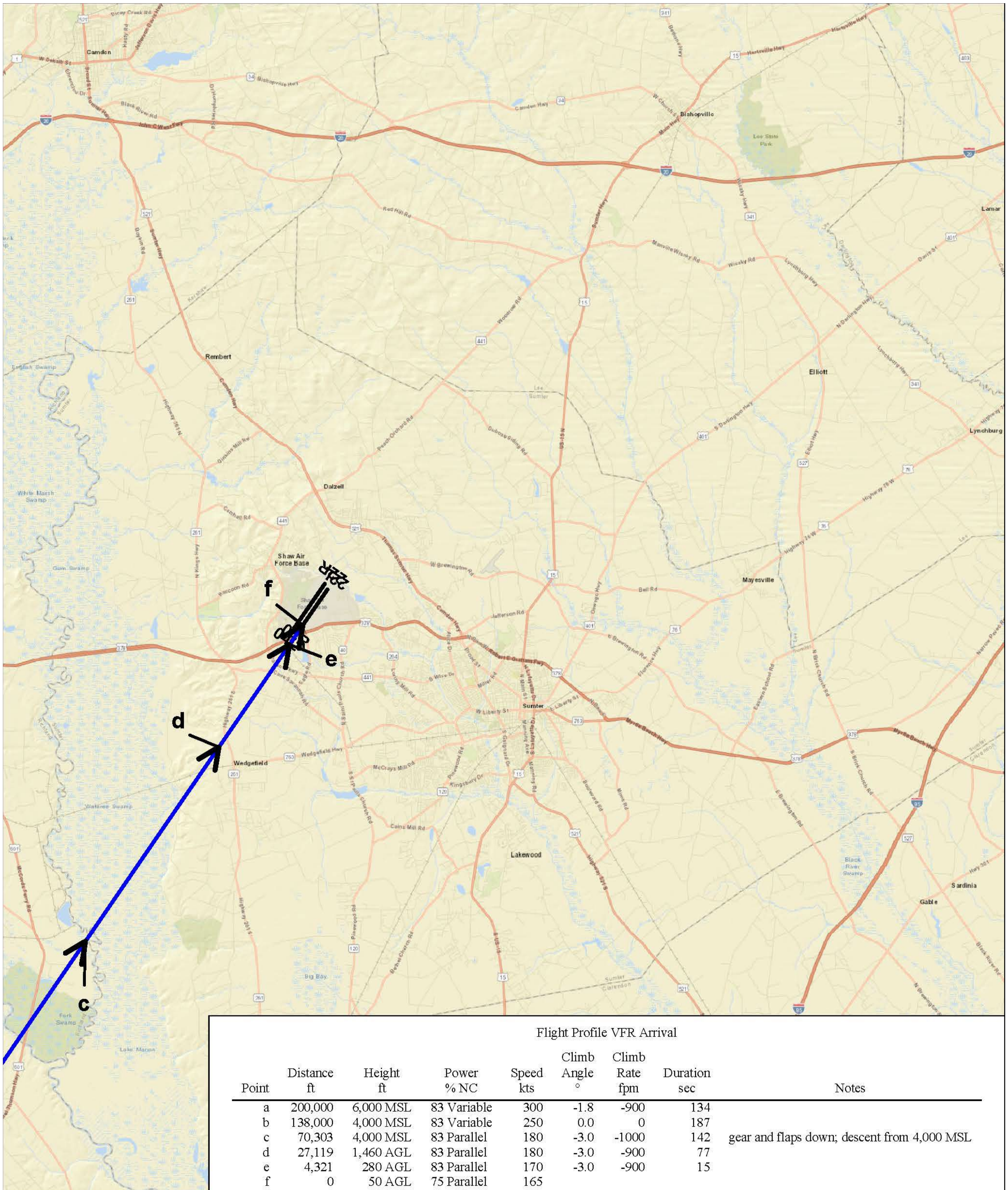
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS06

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



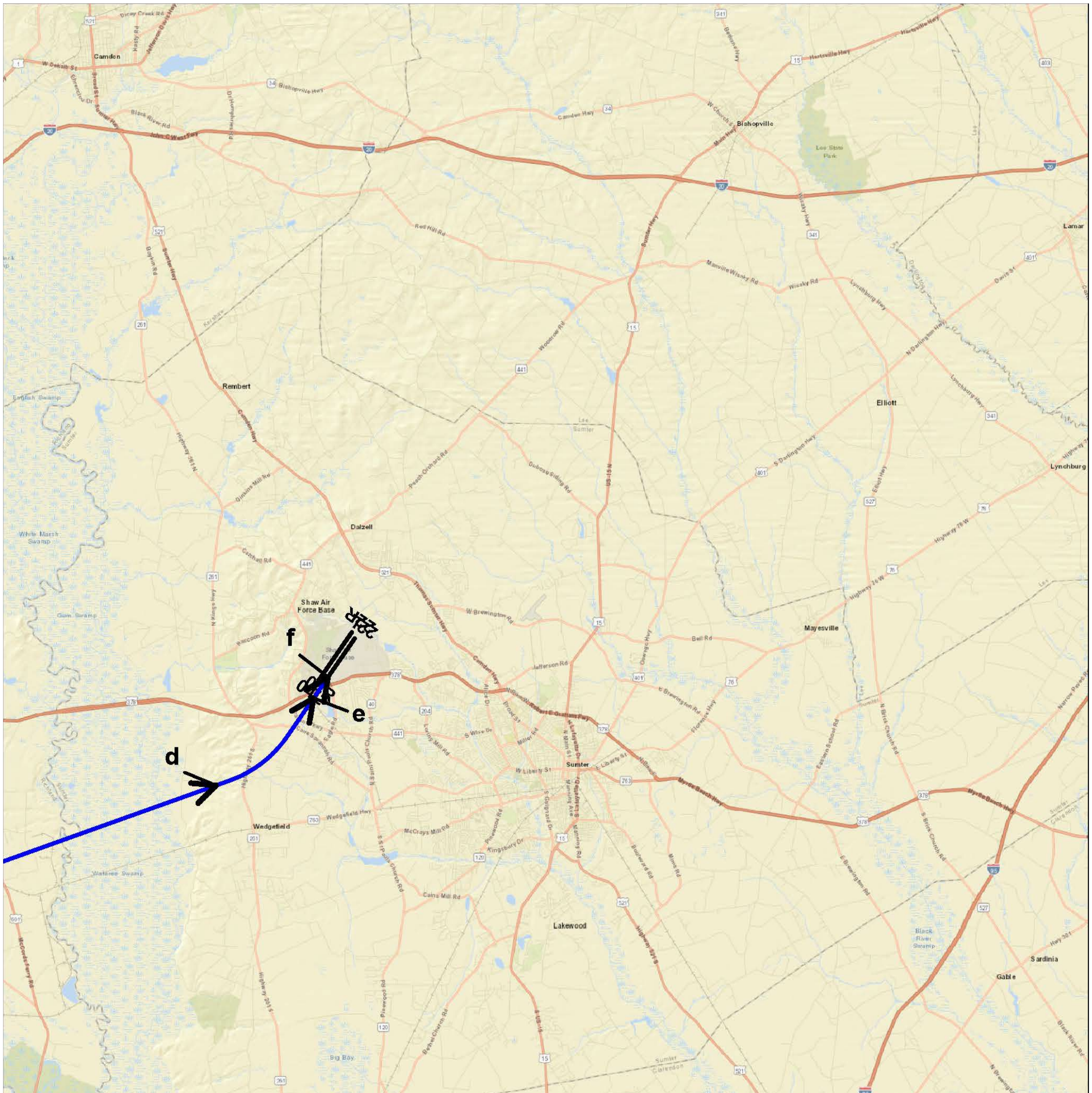
Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS08

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)



Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS10

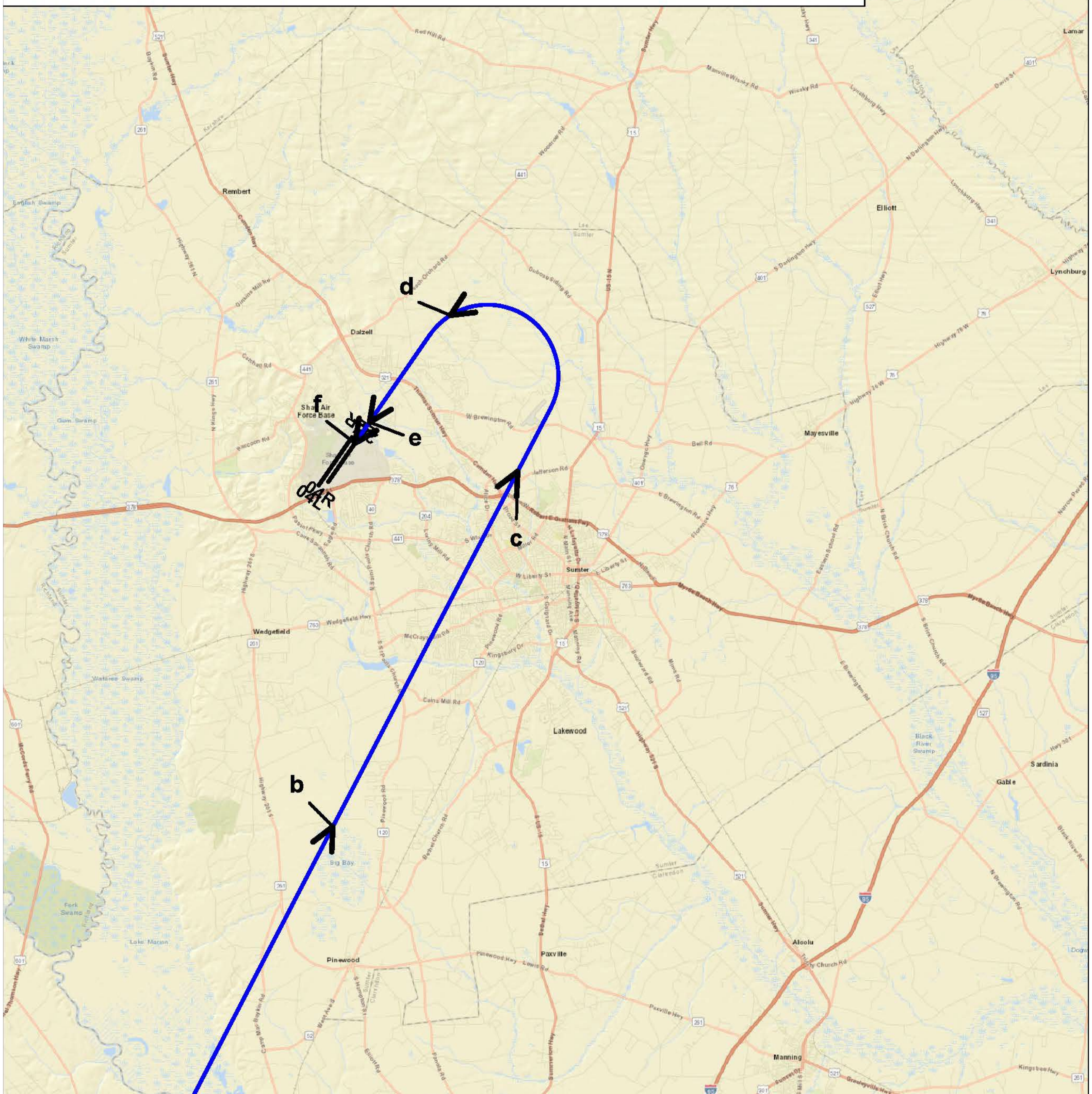
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N

Flight Profile VFR Arrival

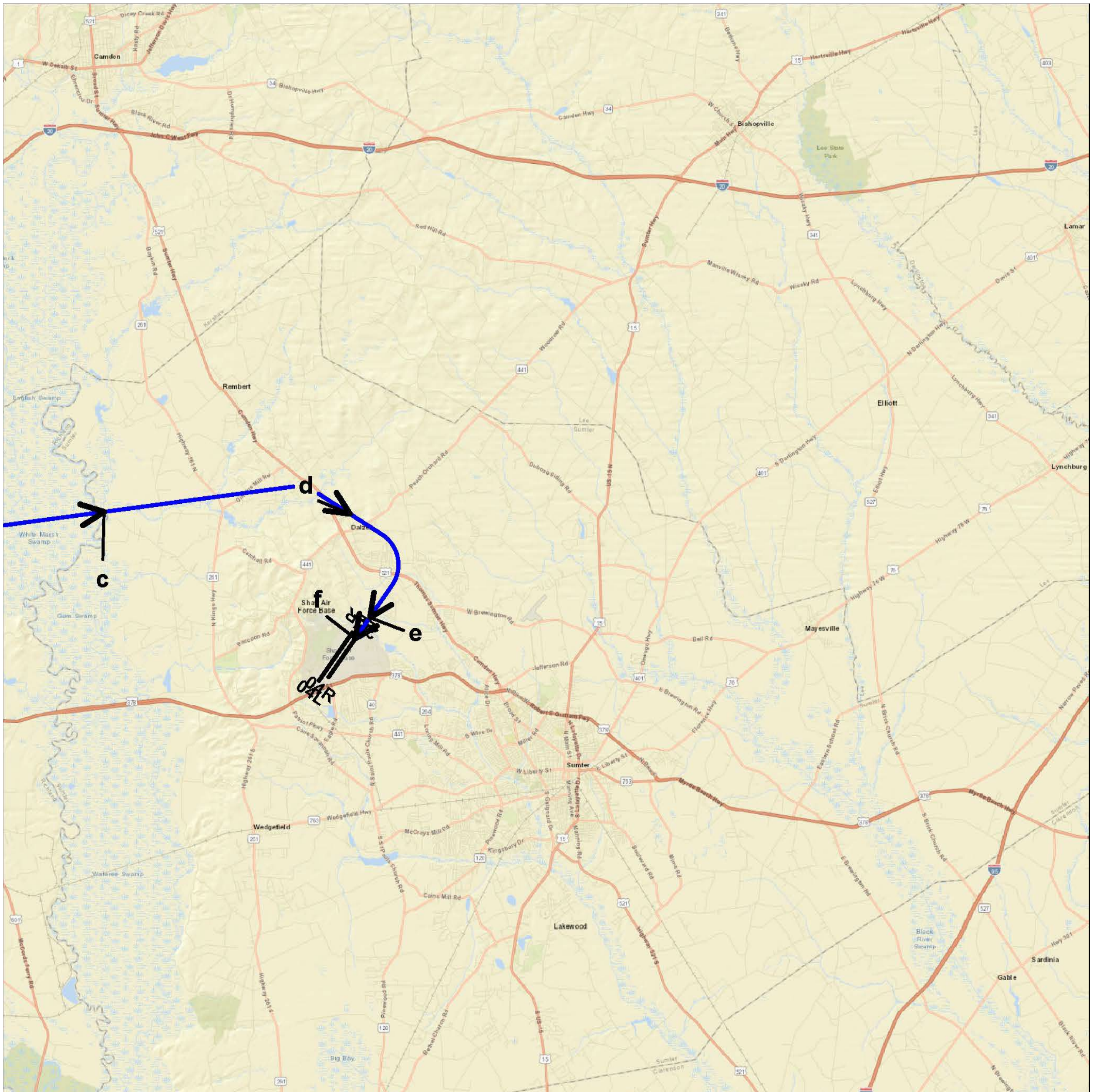
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	196,259	6,000 MSL	83 Variable	300	-2.0	-1000	126	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				



Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS12

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)



Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

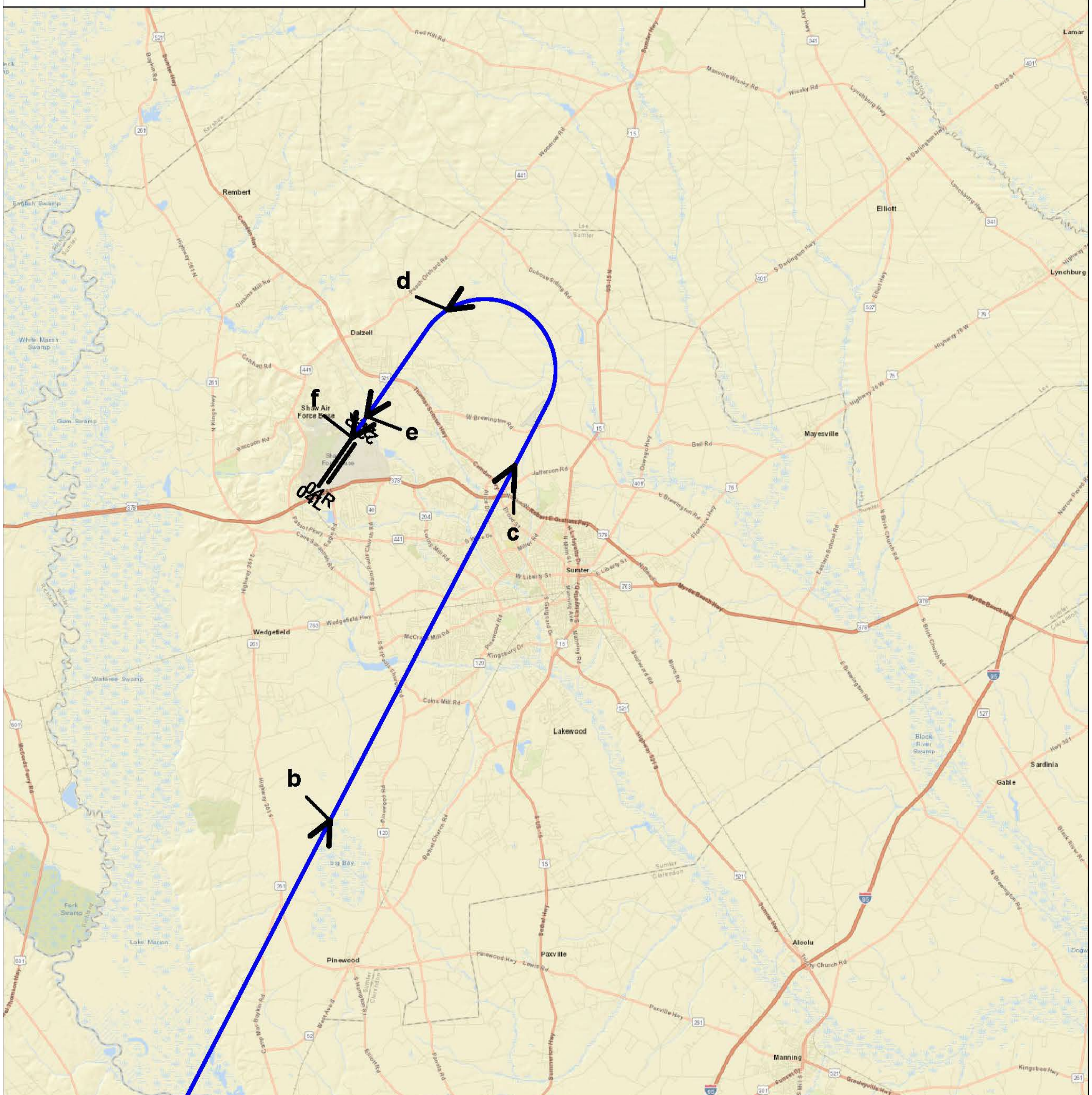
Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS14

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

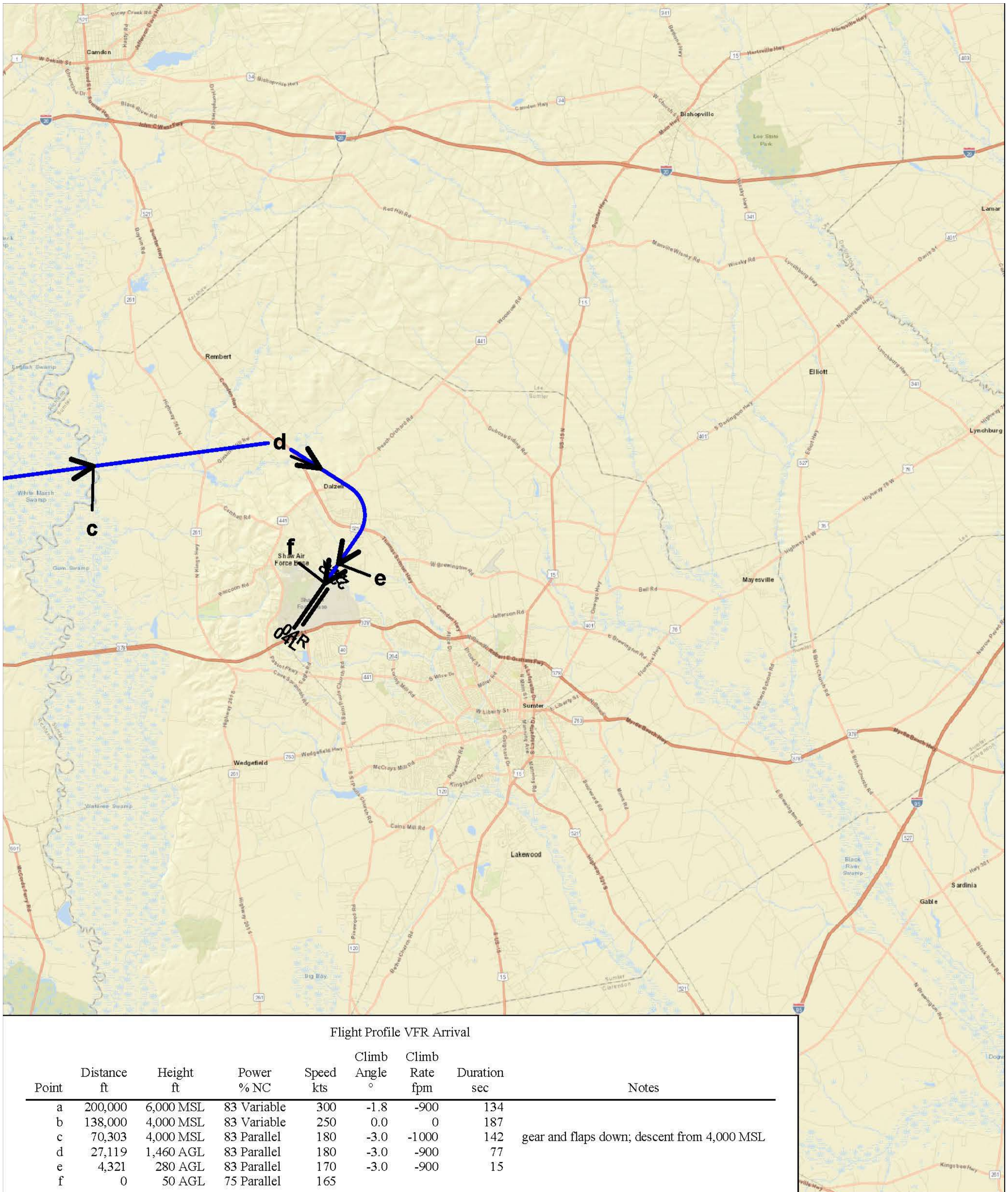
Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	196,259	6,000 MSL	83 Variable	300	-2.0	-1000	126	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				



Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS16

Scale in Feet 1:260,000 (1 inch = 21,700 feet)



Flight Profile VFR Arrival

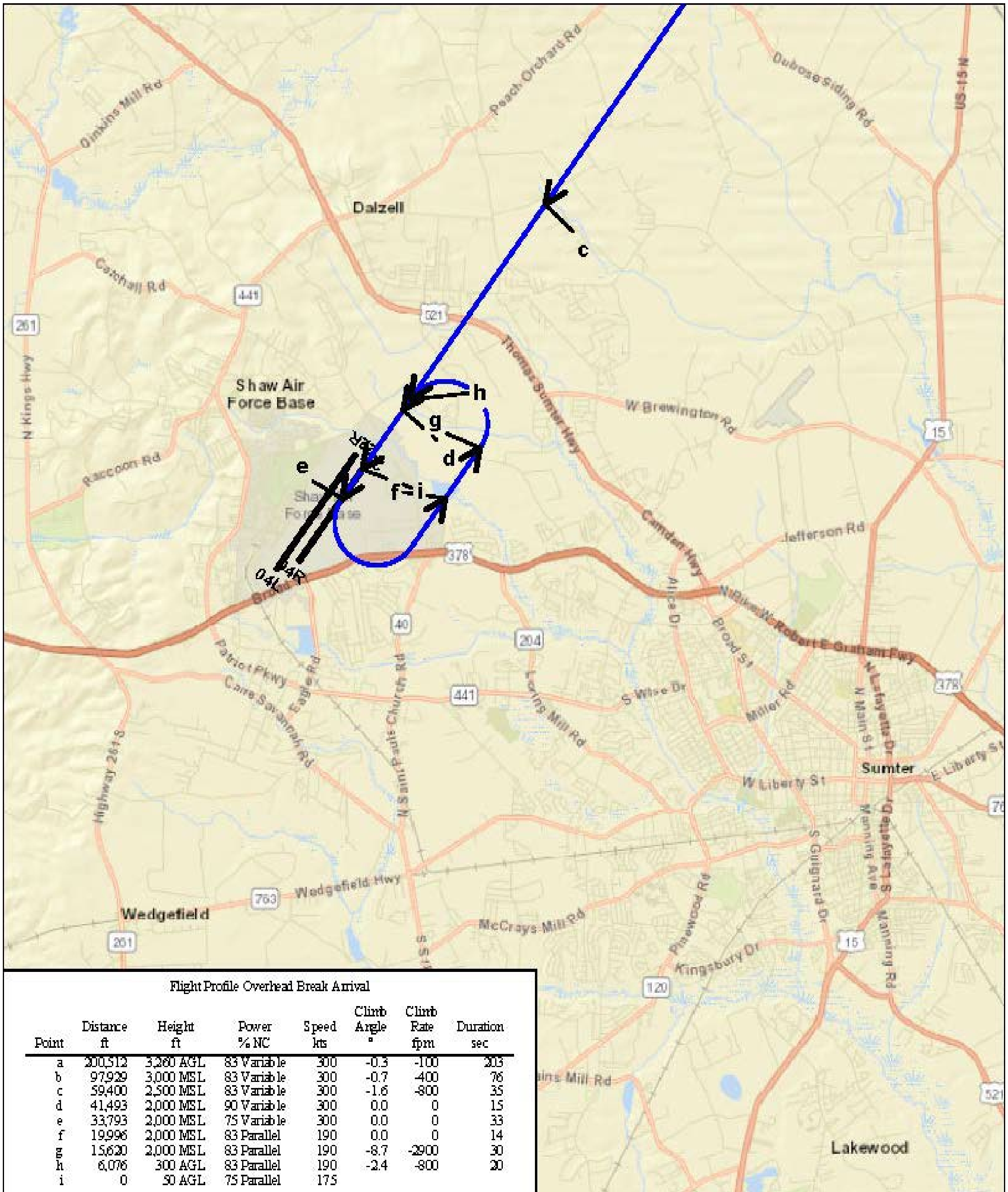
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec	Notes
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134	
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187	
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142	gear and flaps down; descent from 4,000 MSL
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77	
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15	
f	0	50 AGL	75 Parallel	165				

Shaw AFB Based F-16C VFR Arrival Flight Profile F16AS18

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile Overhead Break Arrival

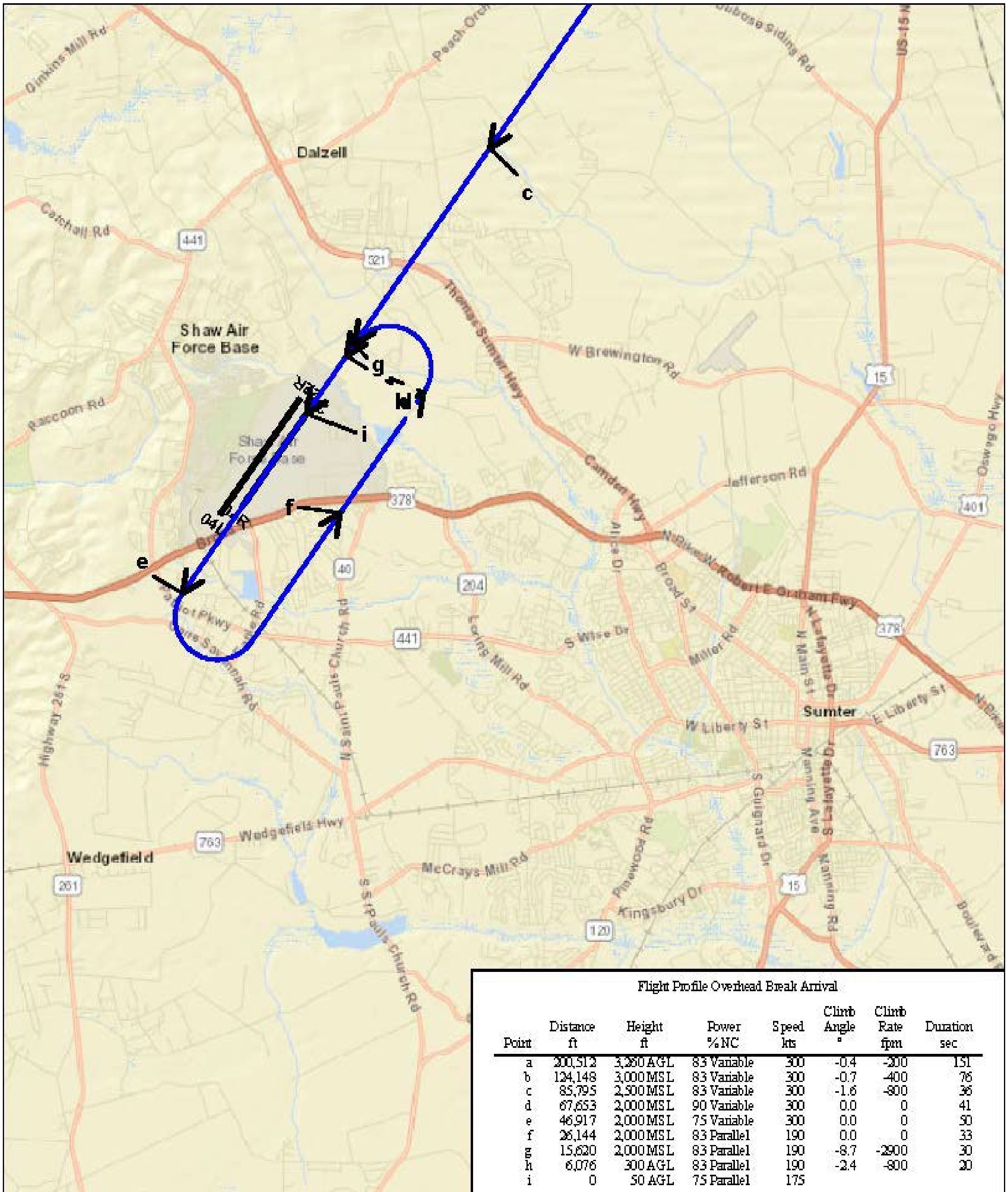
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	203
b	97,929	3,000 MSL	83 Variable	300	-0.7	-400	76
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162LO02

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

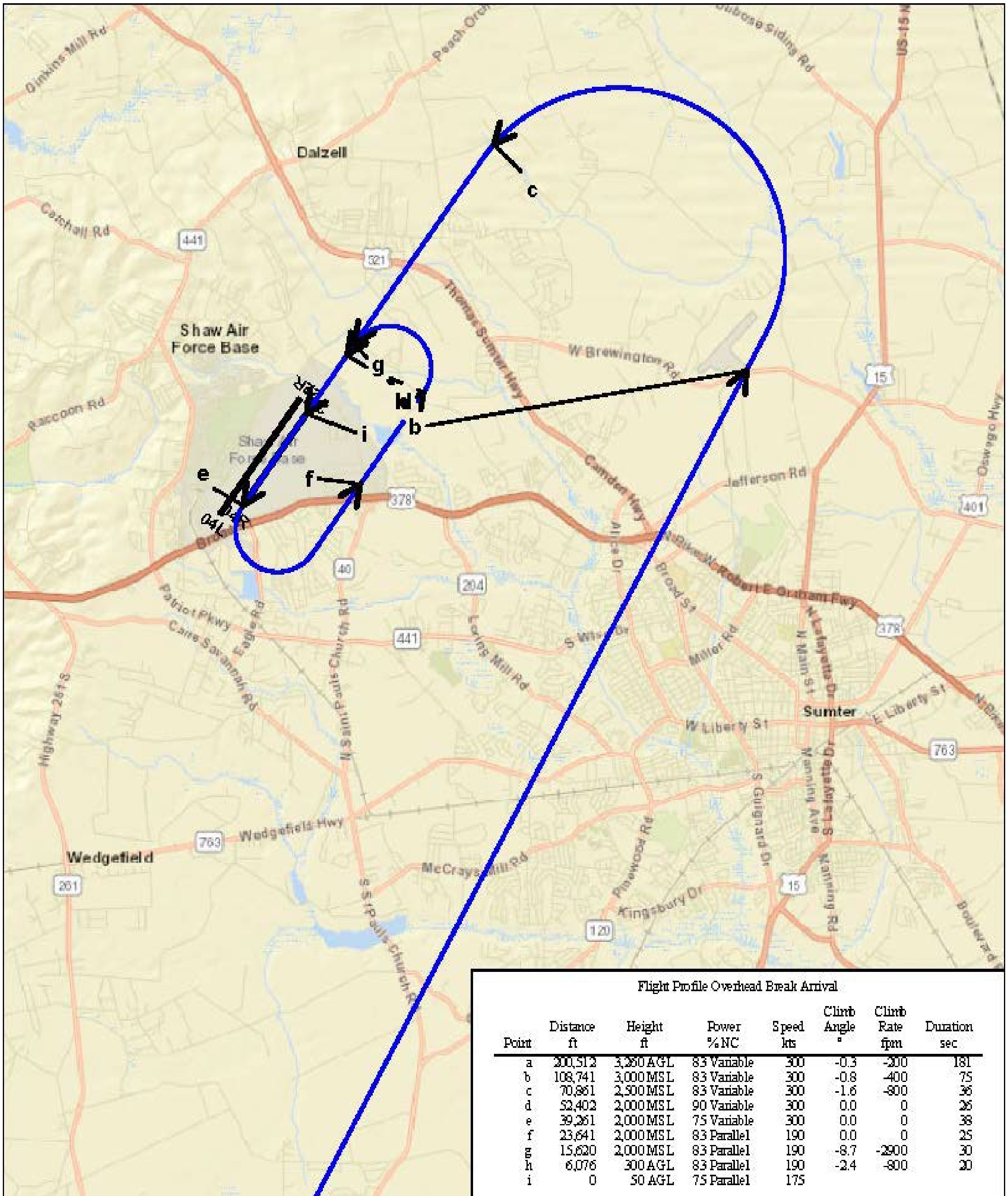
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,250 AGL	83 Variable	300	-0.4	-200	151
b	124,148	3,000 MSL	83 Variable	300	-0.7	-400	76
c	85,795	2,500 MSL	83 Variable	300	-1.6	-800	36
d	67,653	2,000 MSL	90 Variable	300	0.0	0	41
e	46,917	2,000 MSL	75 Variable	300	0.0	0	50
f	26,144	2,000 MSL	83 Parallel	190	0.0	0	33
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162LO08

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N



Flight Profile Overhead Break Arrival

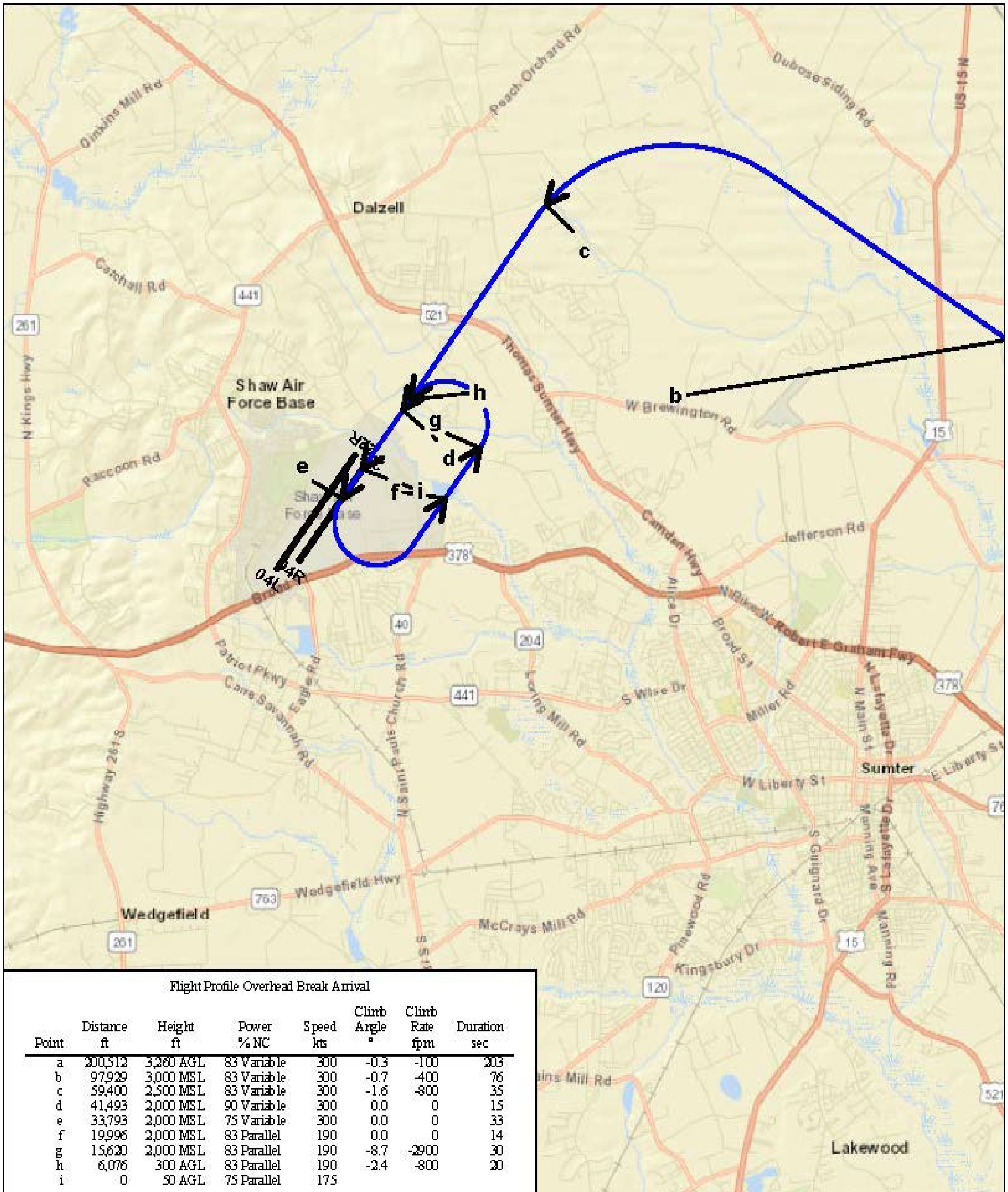
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	181
b	108,741	3,000 MSL	83 Variable	300	-0.8	-400	75
c	70,861	2,500 MSL	83 Variable	300	-1.6	-800	36
d	52,402	2,000 MSL	90 Variable	300	0.0	0	26
e	39,261	2,000 MSL	75 Variable	300	0.0	0	38
f	23,641	2,000 MSL	83 Parallel	190	0.0	0	25
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162LO14

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N



Flight Profile Overhead Break Arrival

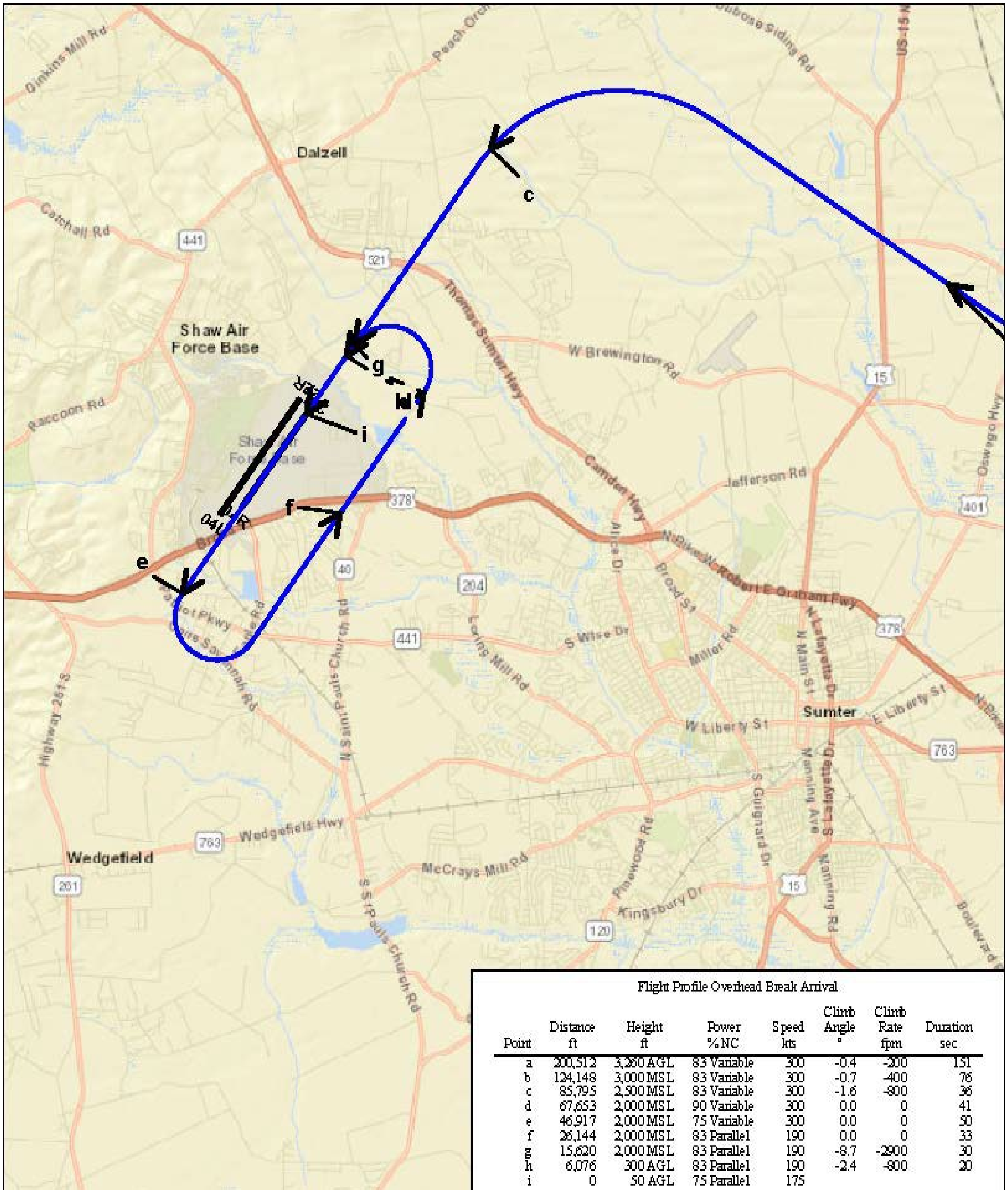
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	203
b	97,929	3,000 MSL	83 Variable	300	-0.7	-400	76
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162LO20

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N

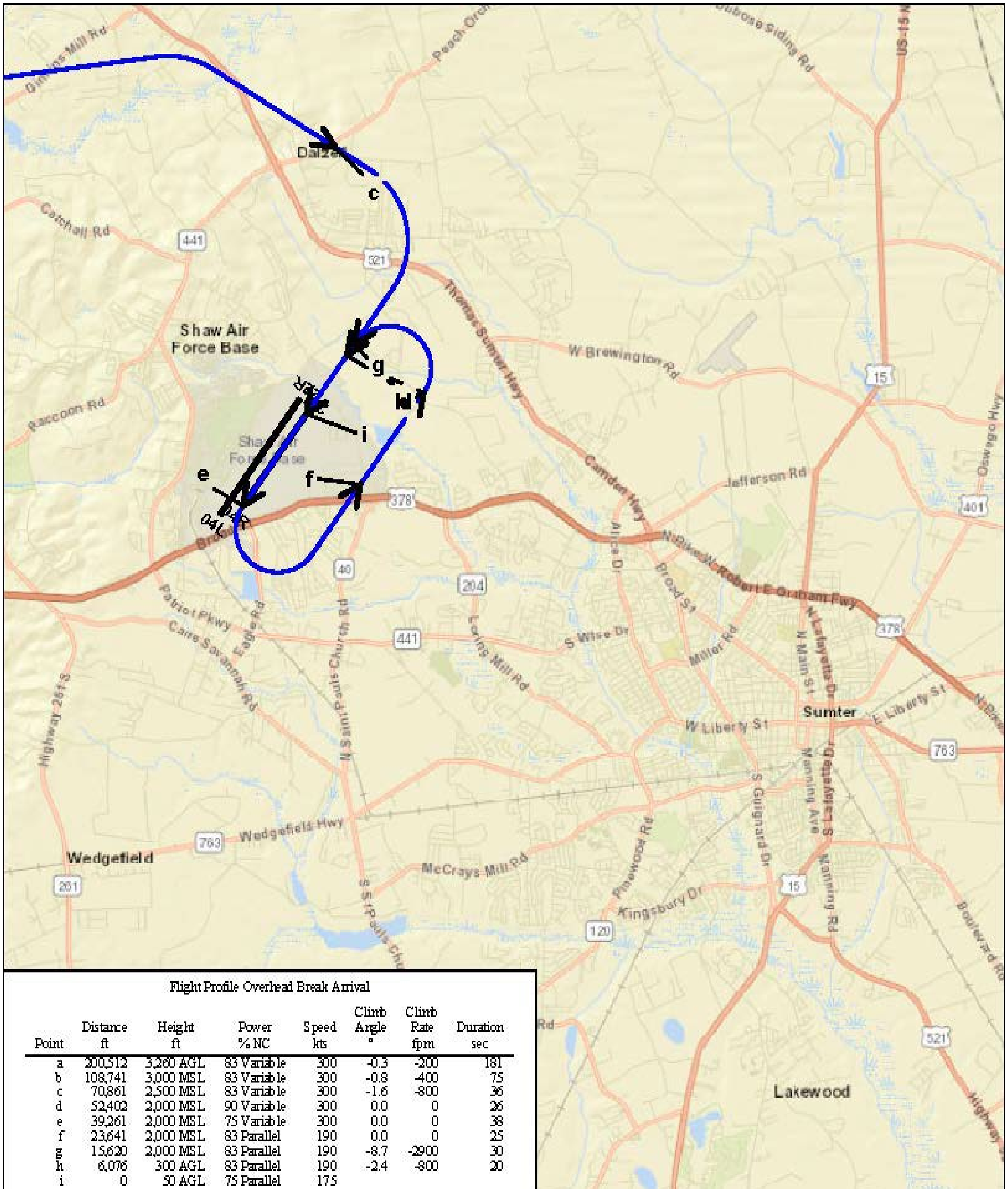


Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	151
b	124,148	3,000 MSL	83 Variable	300	-0.7	-400	76
c	85,795	2,500 MSL	83 Variable	300	-1.6	-800	36
d	67,653	2,000 MSL	90 Variable	300	0.0	0	41
e	46,917	2,000 MSL	75 Variable	300	0.0	0	50
f	26,144	2,000 MSL	83 Parallel	190	0.0	0	33
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162LO26

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



Flight Profile Overhead Break Arrival

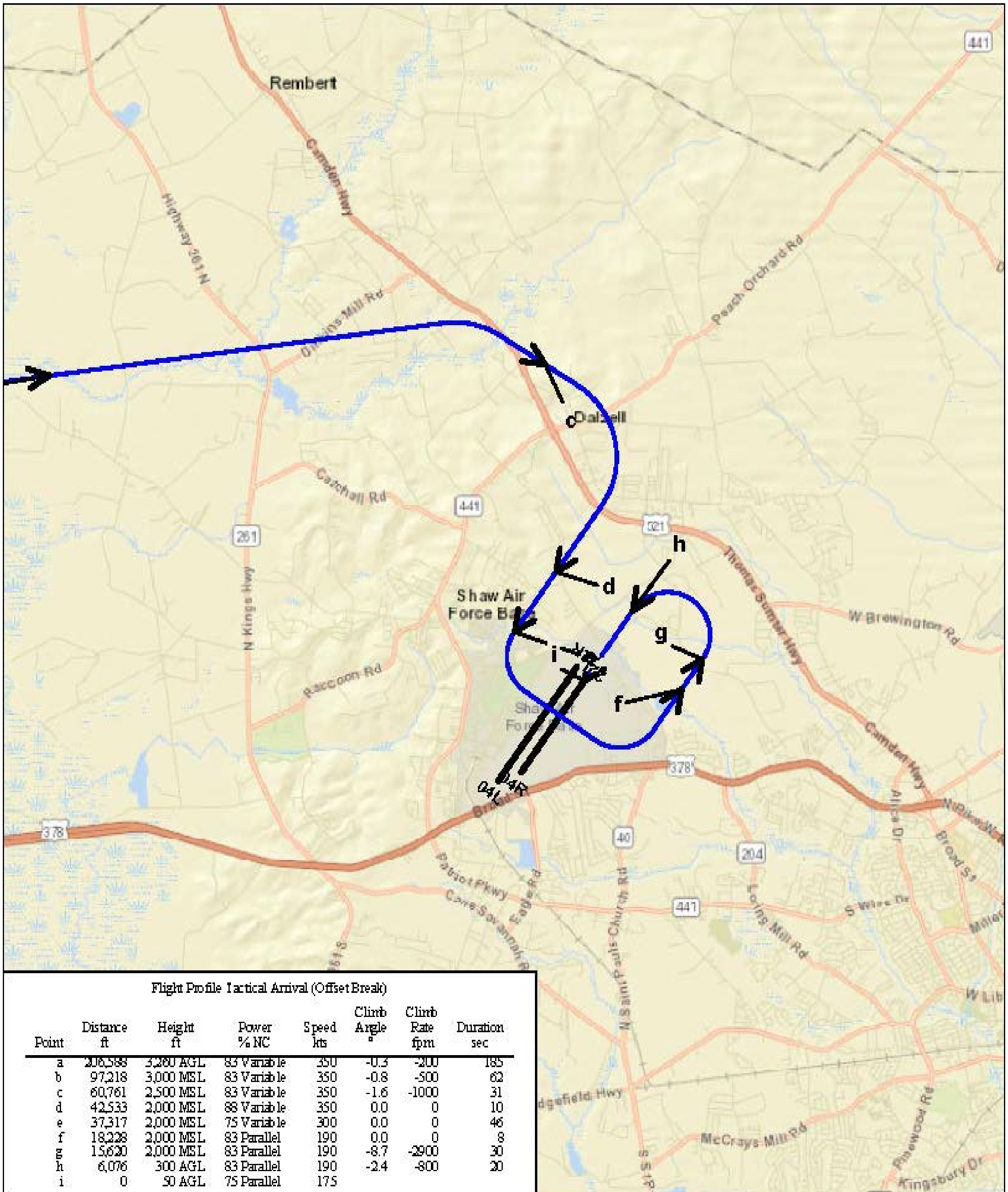
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	181
b	108,741	3,000 MSL	83 Variable	300	-0.8	-400	75
c	70,861	2,500 MSL	83 Variable	300	-1.6	-800	36
d	52,402	2,000 MSL	90 Variable	300	0.0	0	26
e	39,261	2,000 MSL	75 Variable	300	0.0	0	38
f	23,641	2,000 MSL	83 Parallel	190	0.0	0	25
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162LO32

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N



Flight Profile Tactical Arrival (Offset Break)

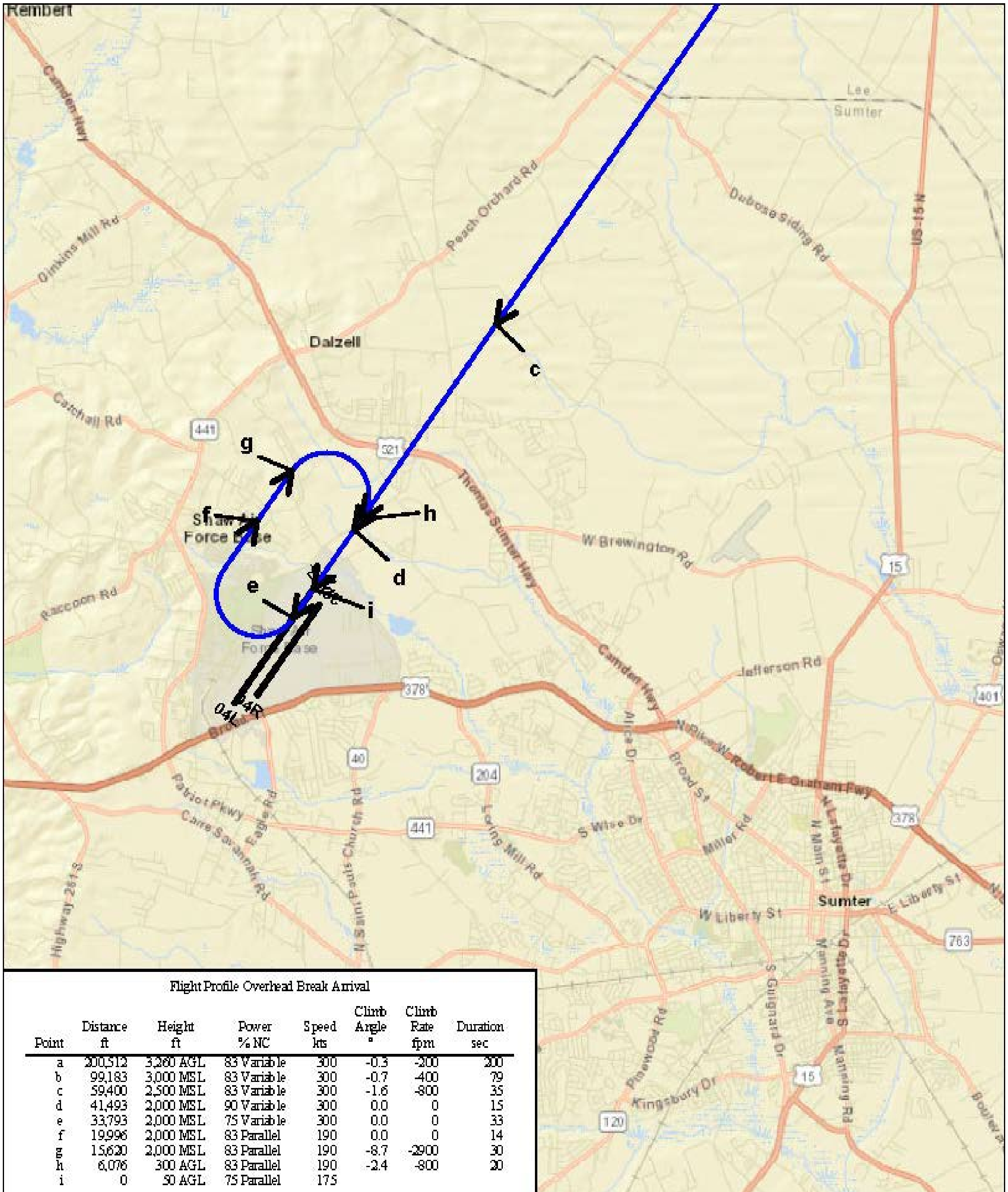
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	206,588	3,280 AGL	83 Variable	350	-0.3	-200	185
b	97,218	3,000 MSL	83 Variable	350	-0.8	-500	62
c	60,761	2,500 MSL	83 Variable	350	-1.6	-1000	31
d	42,533	2,000 MSL	88 Variable	350	0.0	0	10
e	37,317	2,000 MSL	75 Variable	300	0.0	0	46
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Tactical Arrival (Offset Break) Flight Profile F162LO36

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:101,000 (1 inch = 8,430 feet)

N



Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	200
b	99,183	3,000 MSL	83 Variable	300	-0.7	-400	79
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162RO02

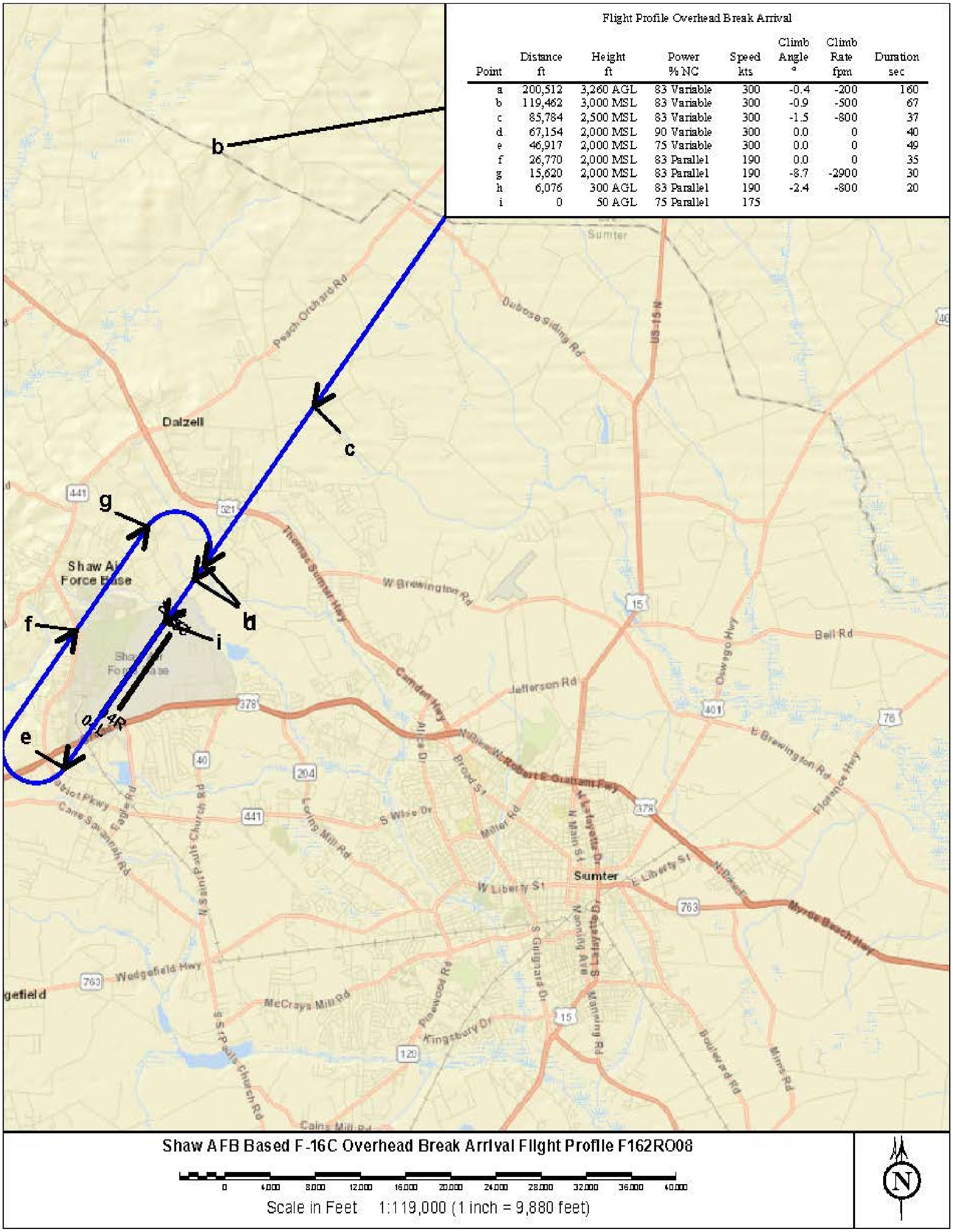
0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,470 feet)

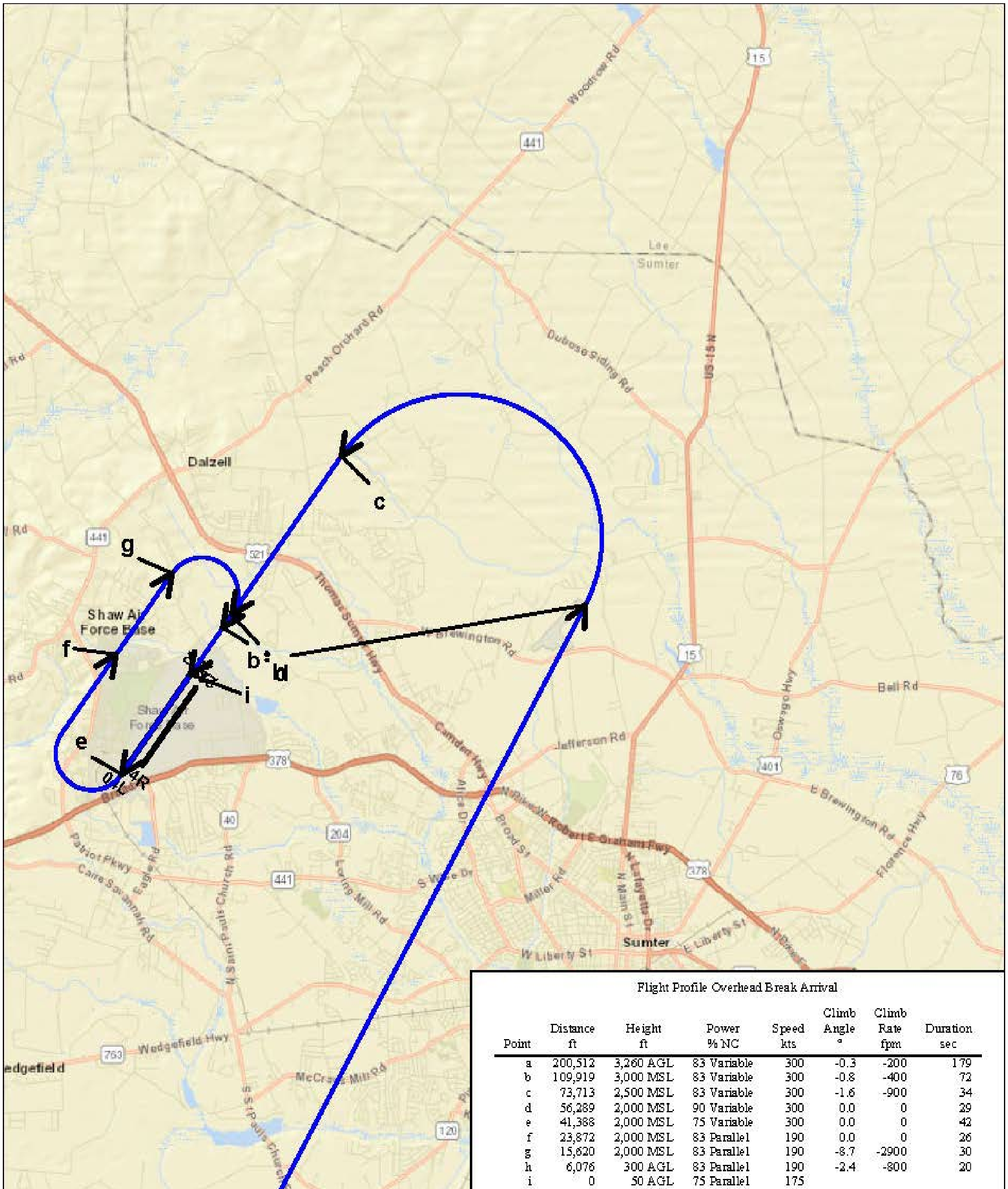
N

Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	160
b	119,462	3,000 MSL	83 Variable	300	-0.9	-500	67
c	85,784	2,500 MSL	83 Variable	300	-1.5	-800	37
d	67,154	2,000 MSL	90 Variable	300	0.0	0	40
e	46,917	2,000 MSL	75 Variable	300	0.0	0	49
f	26,770	2,000 MSL	83 Parallel	190	0.0	0	35
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			



Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162RO08



Flight Profile Overhead Break Arrival

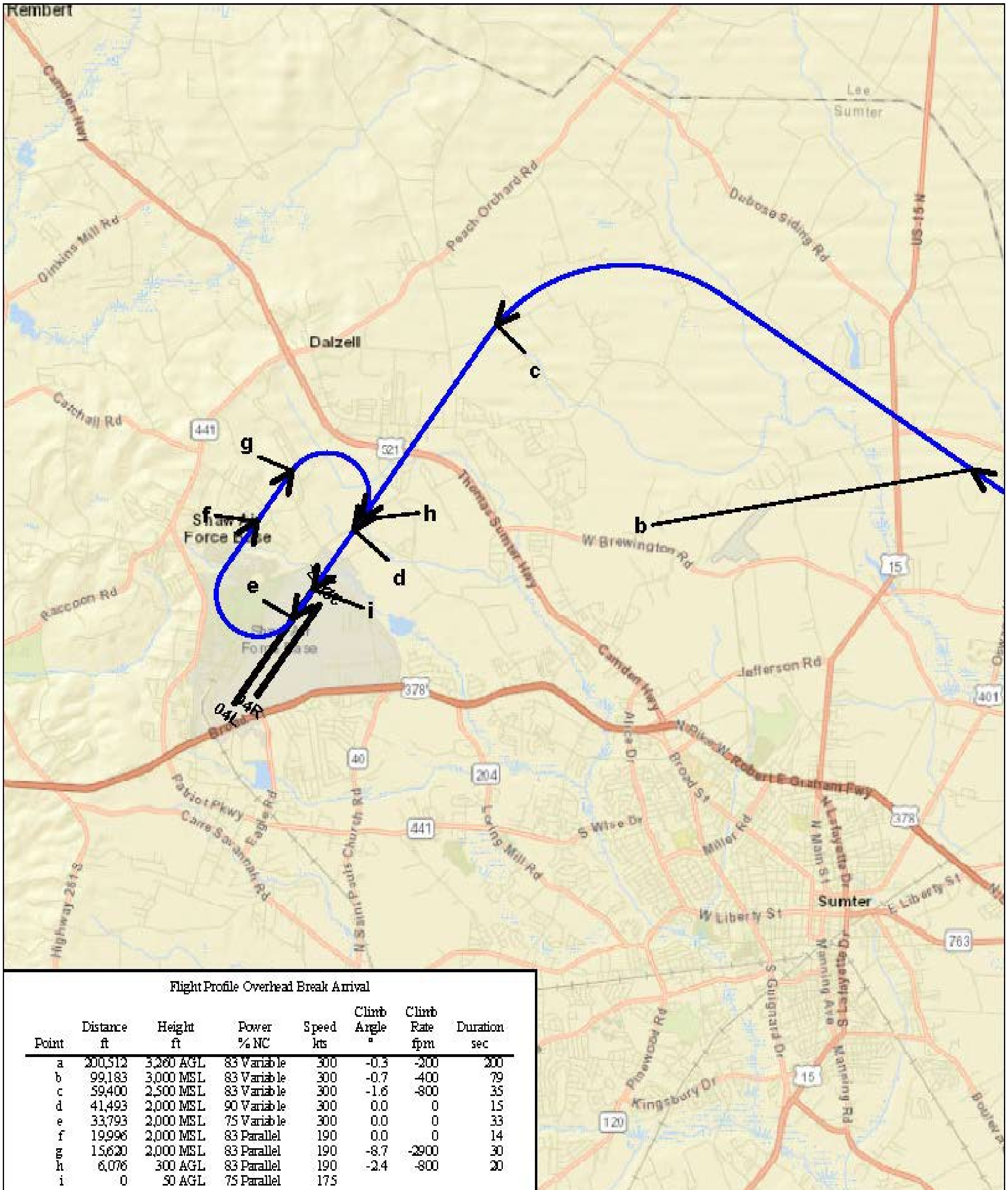
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	179
b	109,919	3,000 MSL	83 Variable	300	-0.8	-400	72
c	73,713	2,500 MSL	83 Variable	300	-1.6	-900	34
d	56,289	2,000 MSL	90 Variable	300	0.0	0	29
e	41,388	2,000 MSL	75 Variable	300	0.0	0	42
f	23,872	2,000 MSL	83 Parallel	190	0.0	0	26
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162RO14

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,880 feet)

N

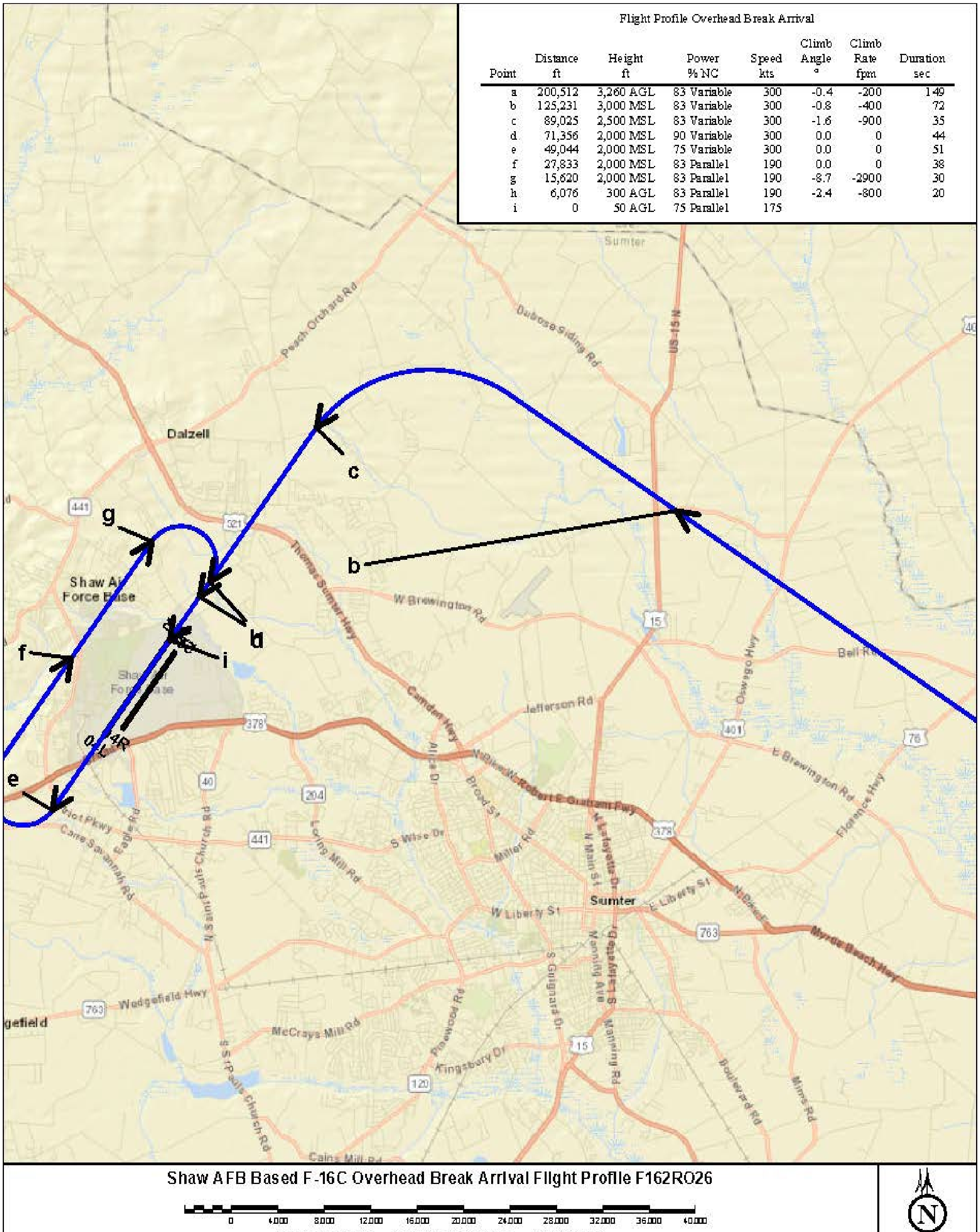


Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	200
b	99,183	3,000 MSL	83 Variable	300	-0.7	-400	79
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162RO20

Scale in Feet 1:102,000 (1 inch = 8,470 feet)



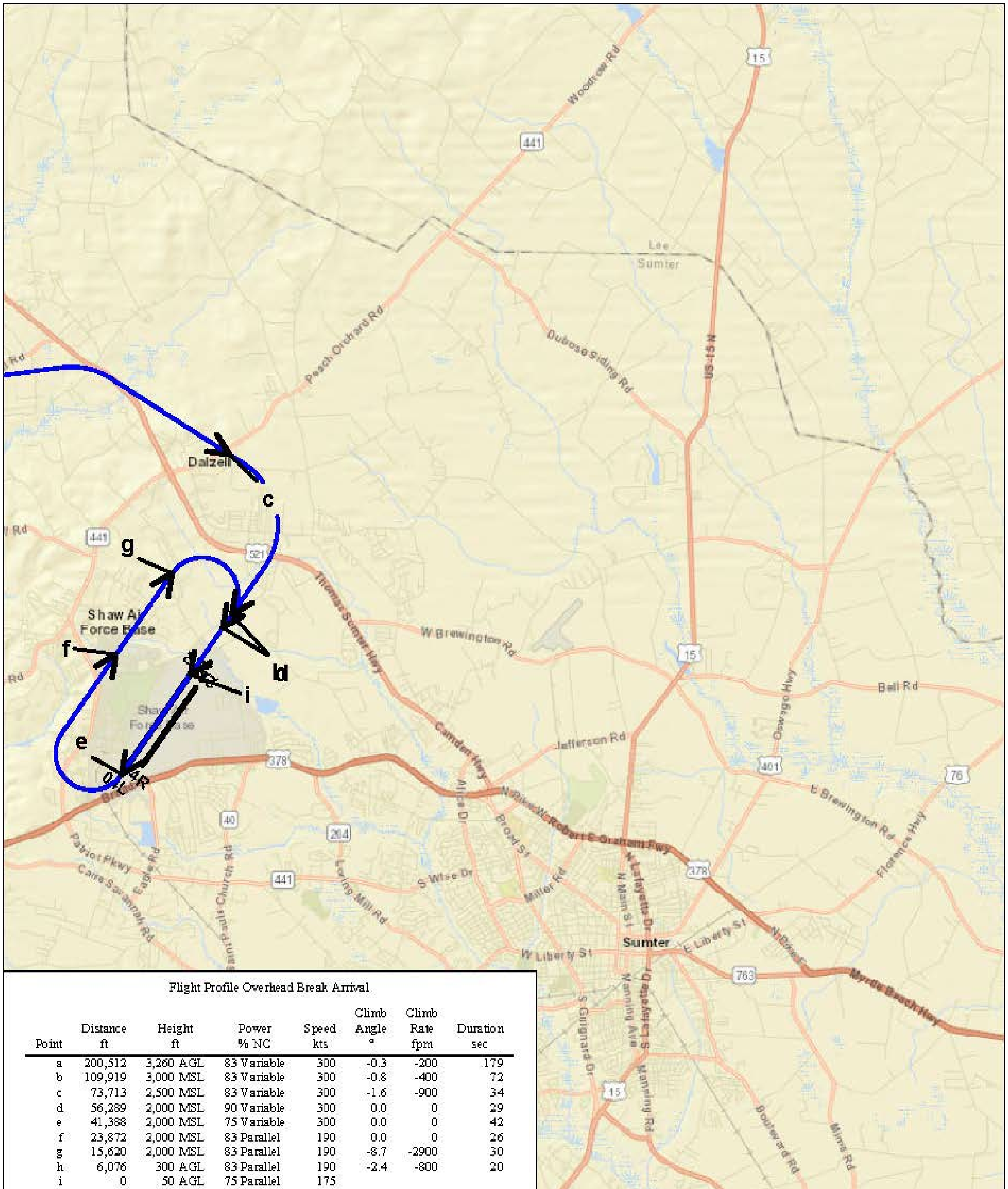
Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	149
b	125,231	3,000 MSL	83 Variable	300	-0.8	-400	72
c	89,025	2,500 MSL	83 Variable	300	-1.6	-900	35
d	71,356	2,000 MSL	90 Variable	300	0.0	0	44
e	49,044	2,000 MSL	75 Variable	300	0.0	0	51
f	27,833	2,000 MSL	83 Parallel	190	0.0	0	38
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162RO26

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,880 feet)



Flight Profile Overhead Break Arrival

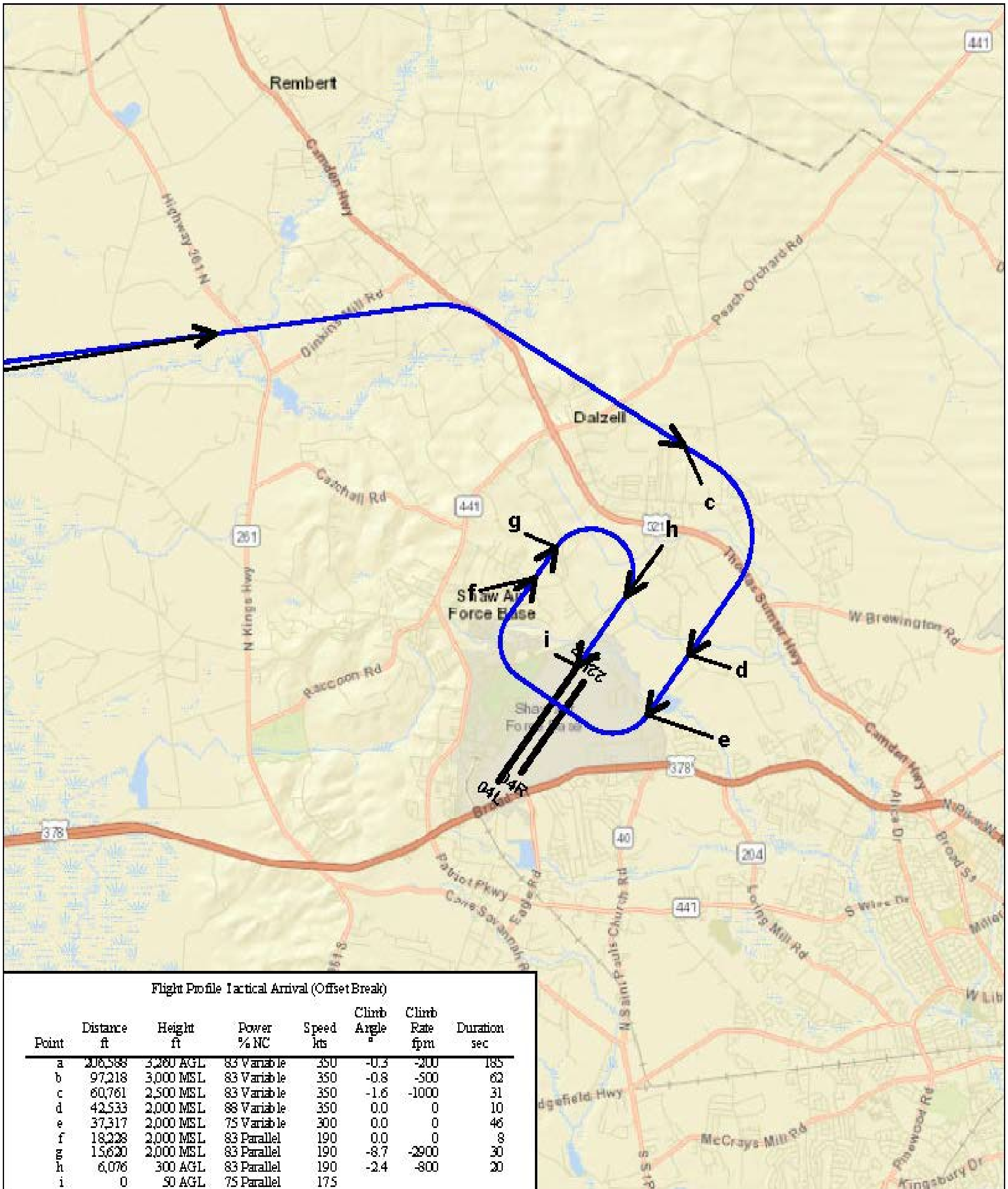
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	179
b	109,919	3,000 MSL	83 Variable	300	-0.8	-400	72
c	73,713	2,500 MSL	83 Variable	300	-1.6	-900	34
d	56,289	2,000 MSL	90 Variable	300	0.0	0	29
e	41,388	2,000 MSL	75 Variable	300	0.0	0	42
f	23,872	2,000 MSL	83 Parallel	190	0.0	0	26
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F162RO32

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,880 feet)

N



Flight Profile Tactical Arrival (Offset Break)

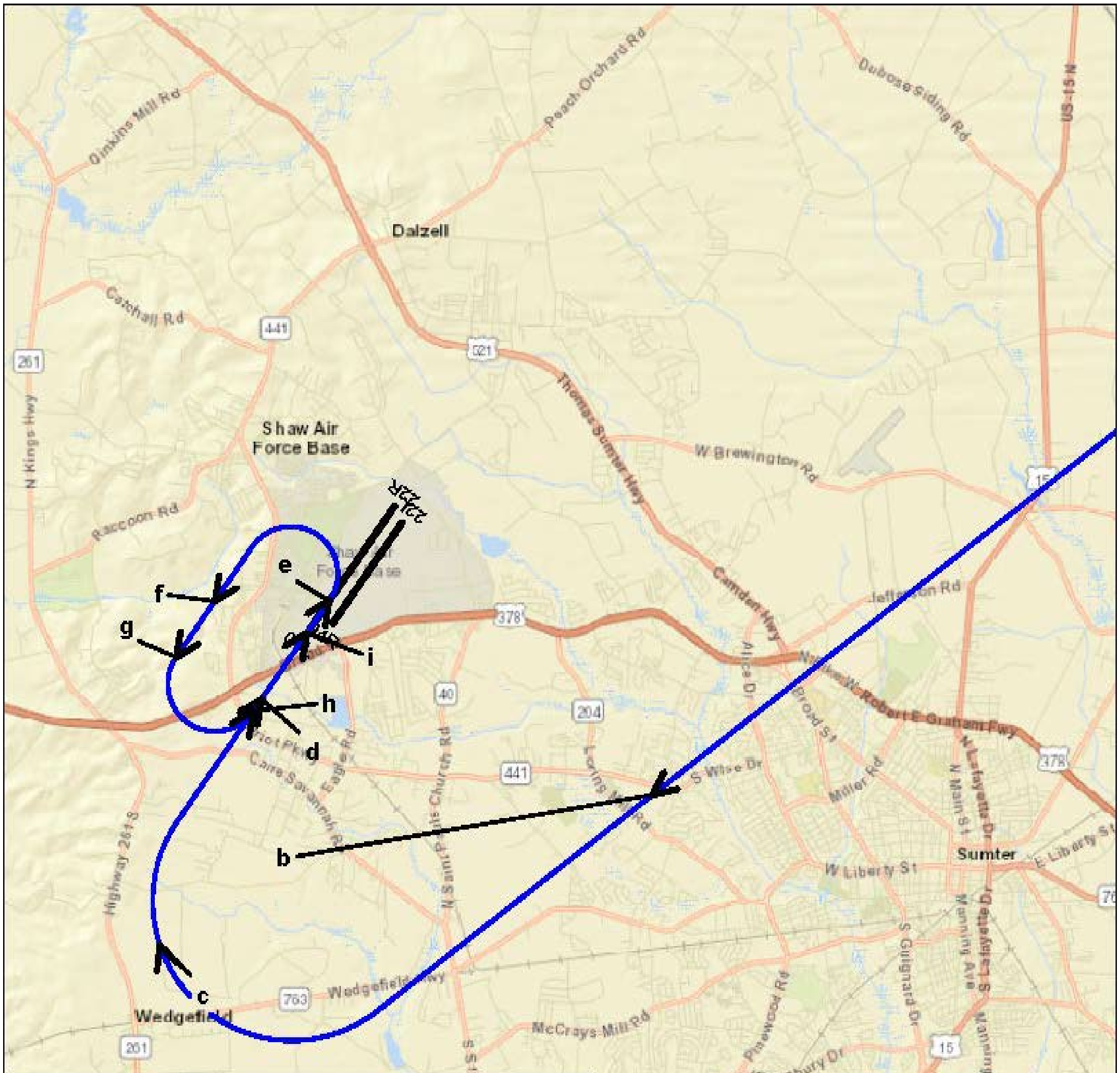
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	206,588	3,280 AGL	83 Variable	350	-0.3	-200	185
b	97,218	3,000 MSL	83 Variable	350	-0.8	-500	62
c	60,761	2,500 MSL	83 Variable	350	-1.6	-1000	31
d	42,533	2,000 MSL	88 Variable	350	0.0	0	10
e	37,317	2,000 MSL	75 Variable	300	0.0	0	46
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Tactical Arrival (Offset Break) Flight Profile F162RO36

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:101,000 (1 inch = 8,430 feet)

N



Flight Profile Overhead Break Arrival

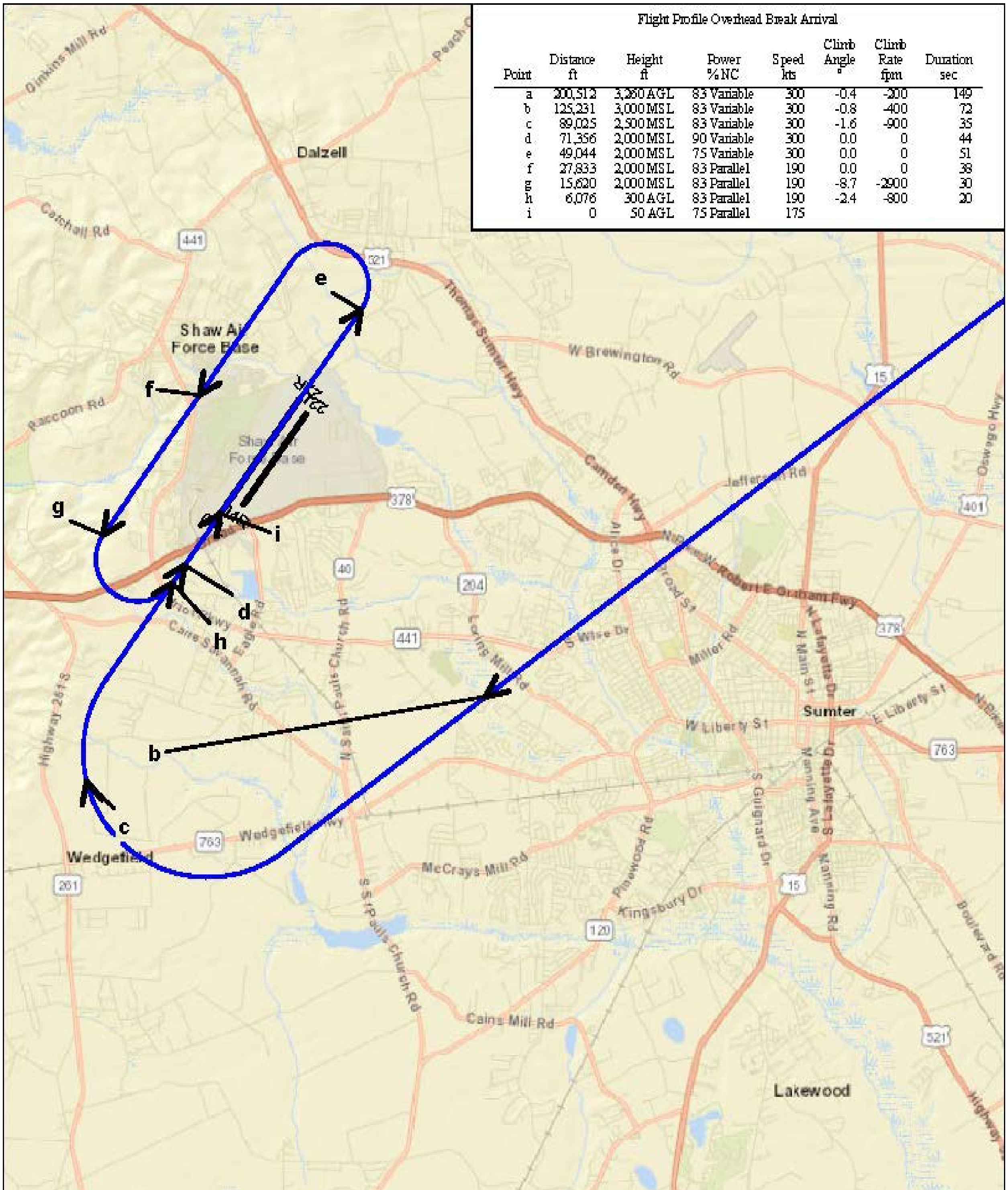
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	200
b	99,183	3,000 MSL	83 Variable	300	-0.7	-400	79
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO02

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

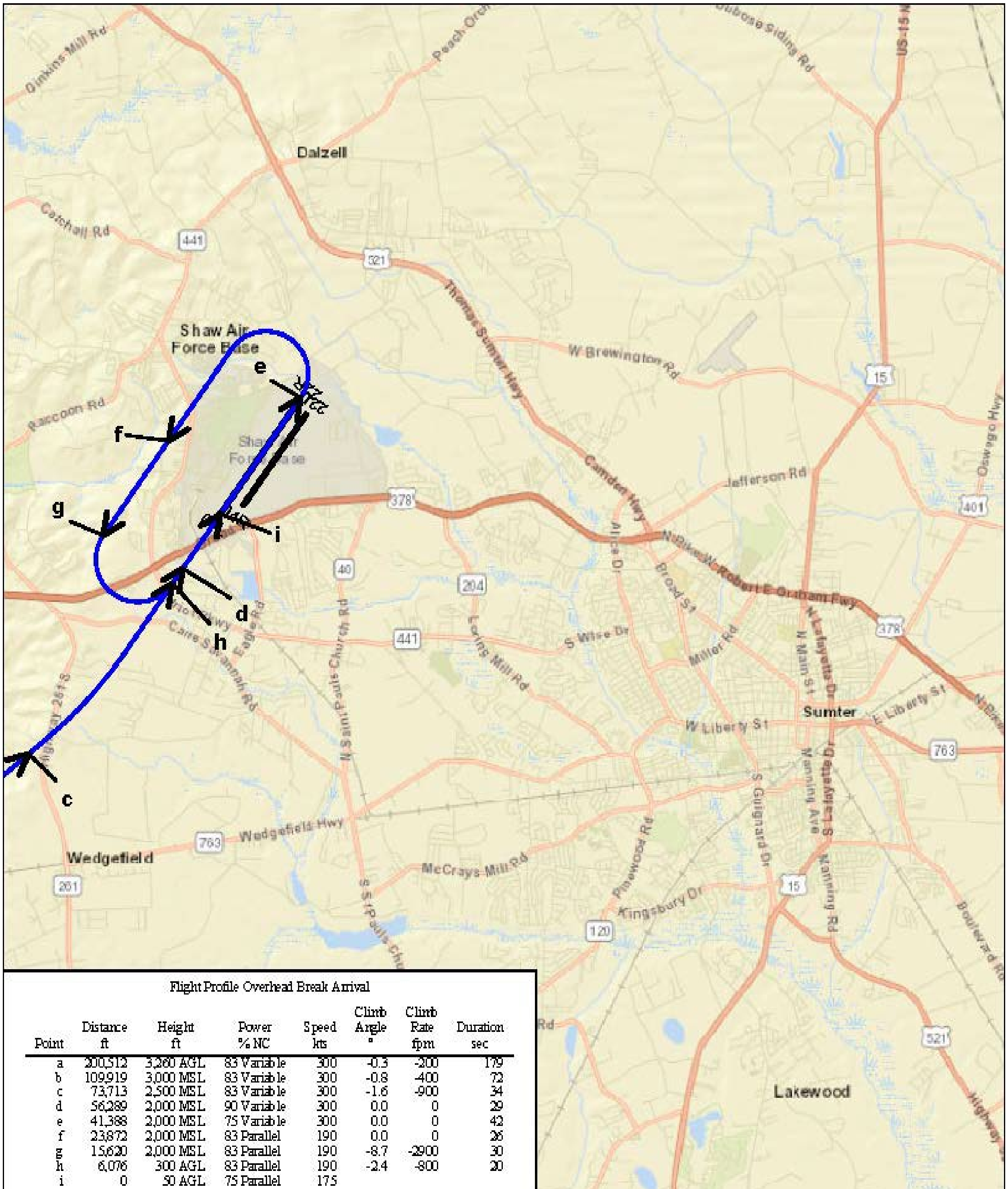
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	149
b	125,231	3,000 MSL	83 Variable	300	-0.8	-400	72
c	89,025	2,500 MSL	83 Variable	300	-1.6	-900	35
d	71,356	2,000 MSL	90 Variable	300	0.0	0	44
e	49,044	2,000 MSL	75 Variable	300	0.0	0	51
f	27,833	2,000 MSL	83 Parallel	190	0.0	0	38
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO08

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N



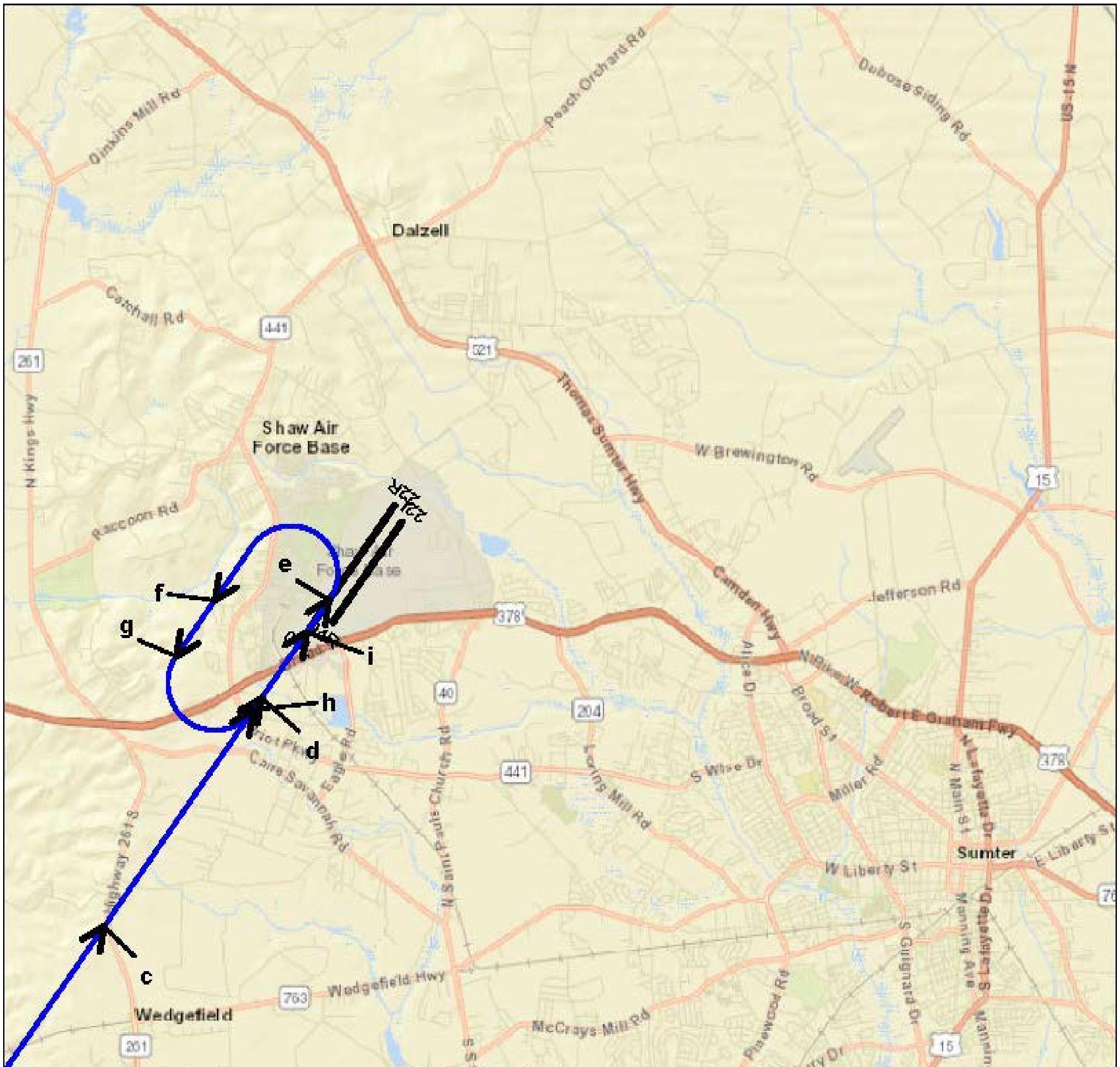
Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	179
b	109,919	3,000 MSL	83 Variable	300	-0.8	-400	72
c	73,713	2,500 MSL	83 Variable	300	-1.6	-900	34
d	56,289	2,000 MSL	90 Variable	300	0.0	0	29
e	41,388	2,000 MSL	75 Variable	300	0.0	0	42
f	23,872	2,000 MSL	83 Parallel	190	0.0	0	26
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO14

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N



Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	200
b	99,183	3,000 MSL	83 Variable	300	-0.7	-400	79
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

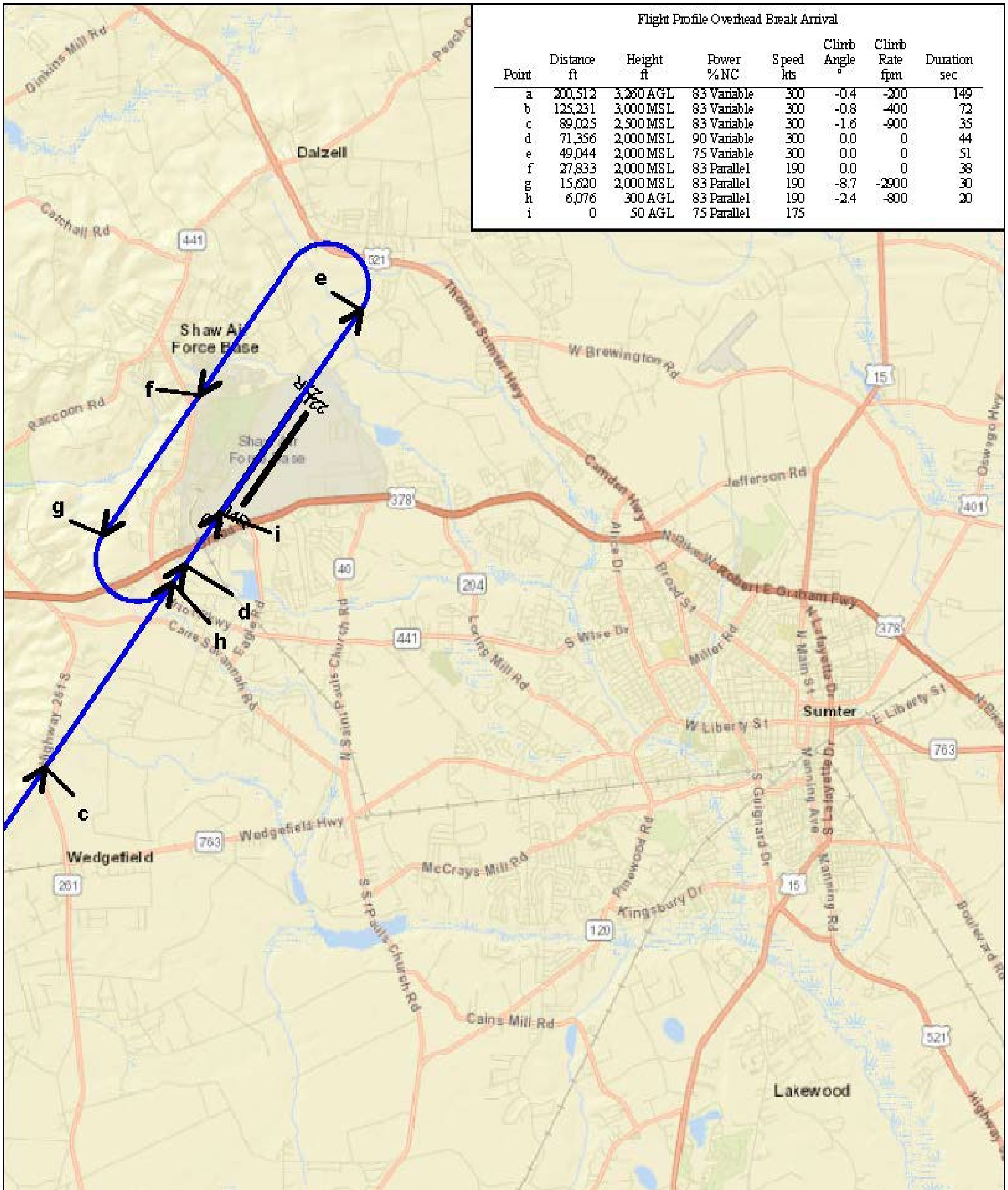
Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO20

0 4,000 8,000 12000 16000 20000 24,000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

Flight Profile Overhead Break Arrival

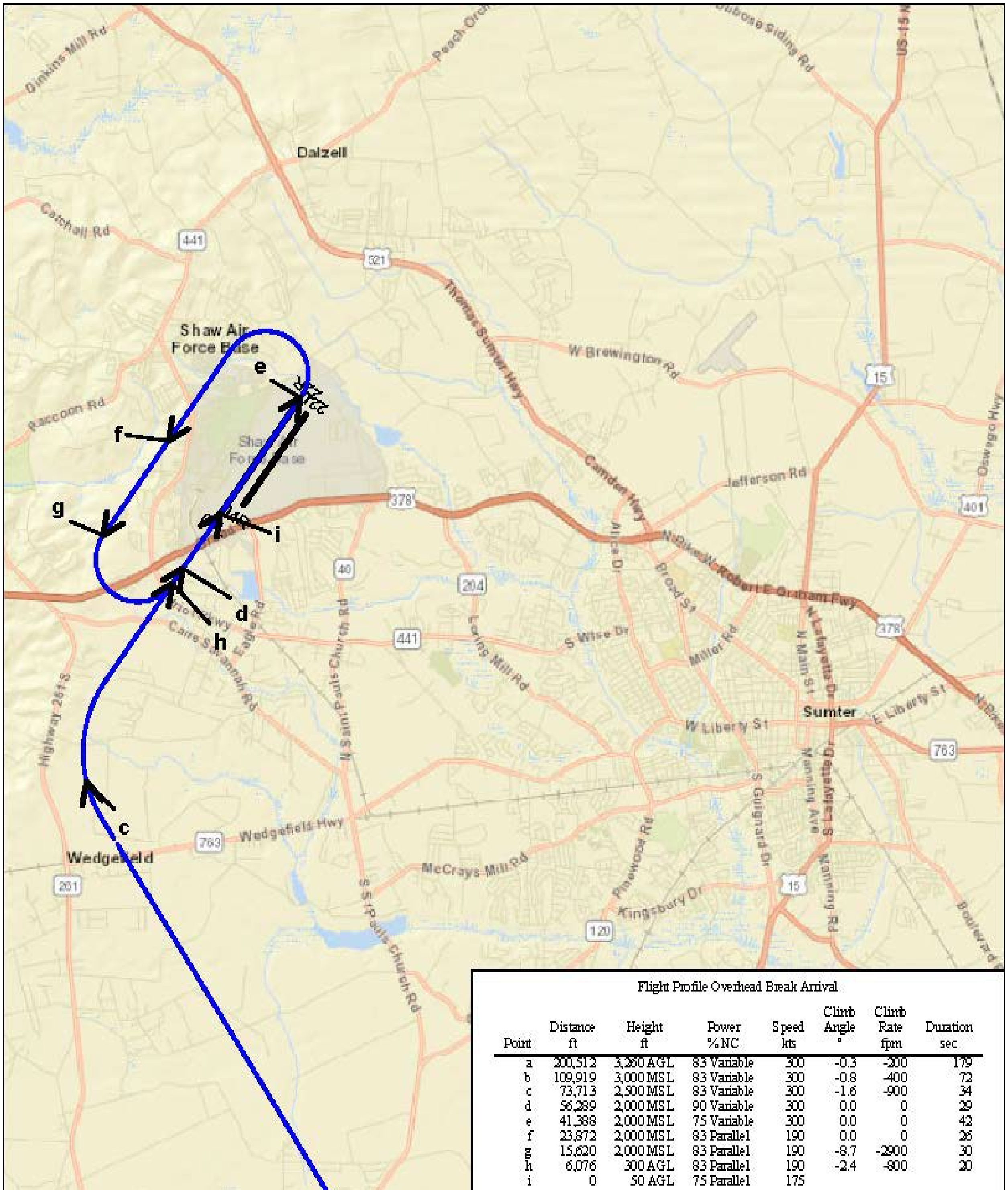
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	149
b	125,231	3,000 MSL	83 Variable	300	-0.8	-400	72
c	89,025	2,500 MSL	83 Variable	300	-1.6	-900	35
d	71,356	2,000 MSL	90 Variable	300	0.0	0	44
e	49,044	2,000 MSL	75 Variable	300	0.0	0	51
f	27,833	2,000 MSL	83 Parallel	190	0.0	0	38
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			



Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO26

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



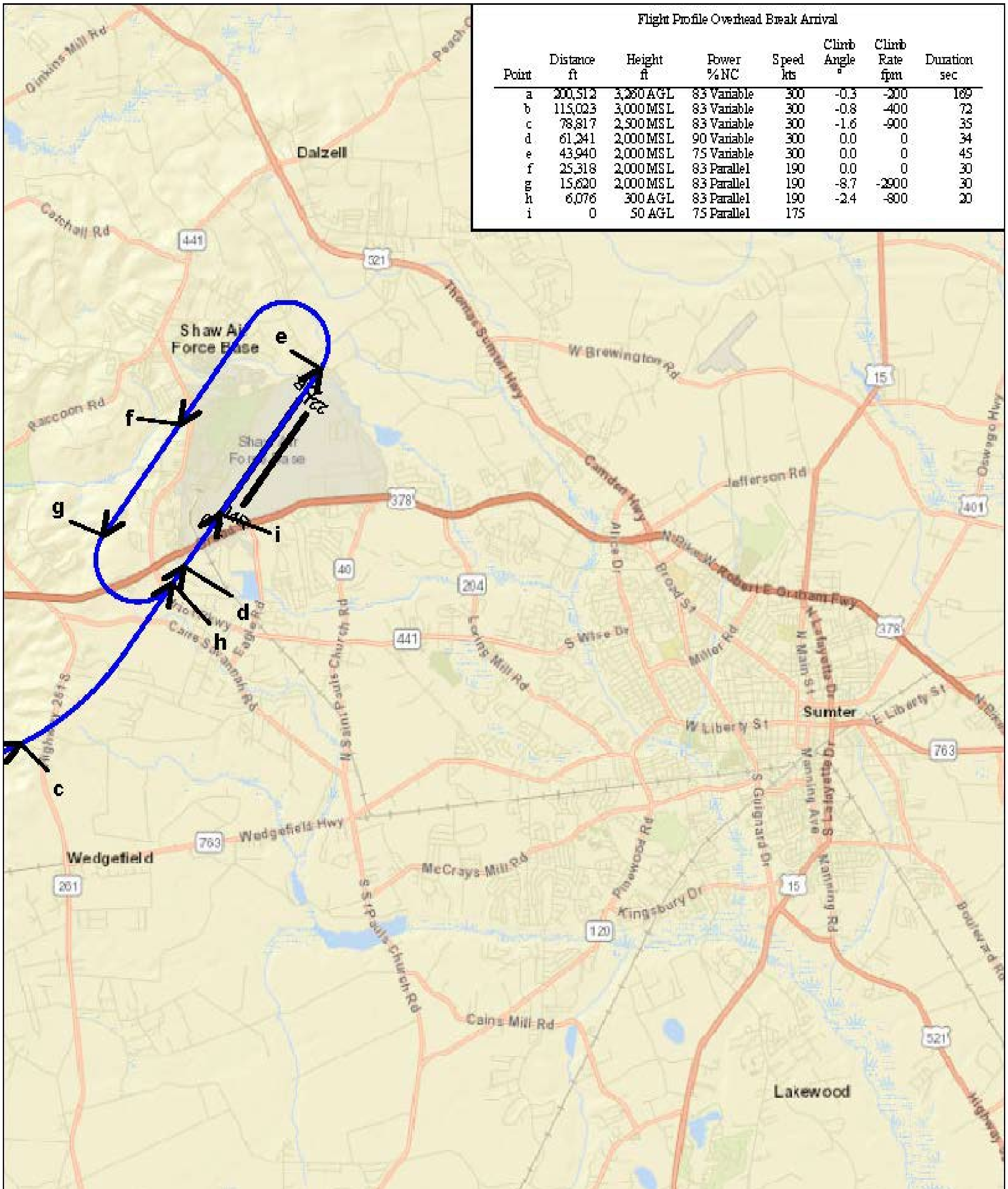
Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	179
b	109,919	3,000 MSL	83 Variable	300	-0.8	-400	72
c	73,713	2,500 MSL	83 Variable	300	-1.6	-900	34
d	56,289	2,000 MSL	90 Variable	300	0.0	0	29
e	41,388	2,000 MSL	75 Variable	300	0.0	0	42
f	23,872	2,000 MSL	83 Parallel	190	0.0	0	26
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO32

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



Flight Profile Overhead Break Arrival

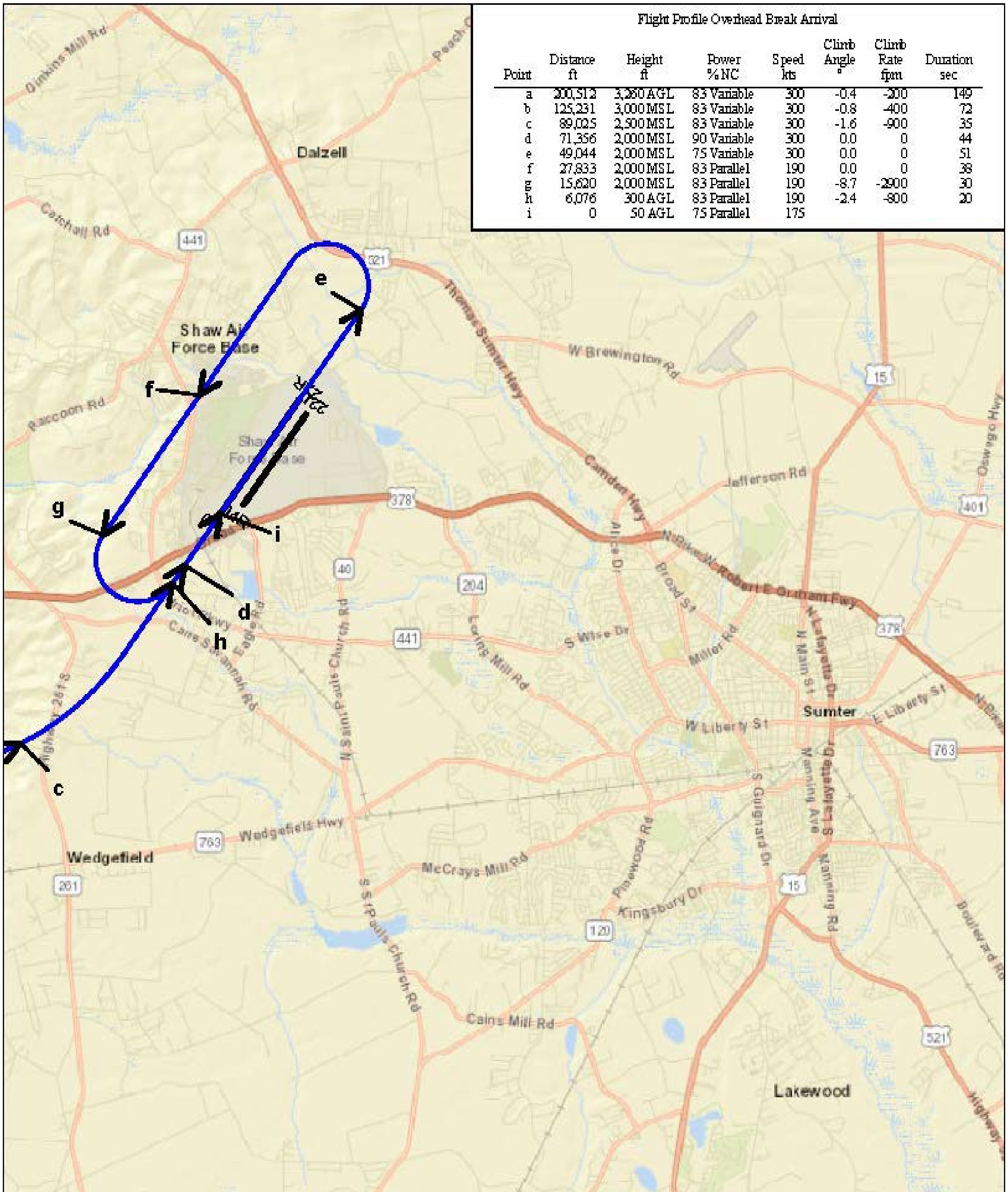
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,280 AGL	83 Variable	300	-0.3	-200	169
b	115,023	3,000 MSL	83 Variable	300	-0.8	-400	72
c	78,817	2,500 MSL	83 Variable	300	-1.6	-900	35
d	61,241	2,000 MSL	90 Variable	300	0.0	0	34
e	43,940	2,000 MSL	75 Variable	300	0.0	0	45
f	25,318	2,000 MSL	83 Parallel	190	0.0	0	30
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO42

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N

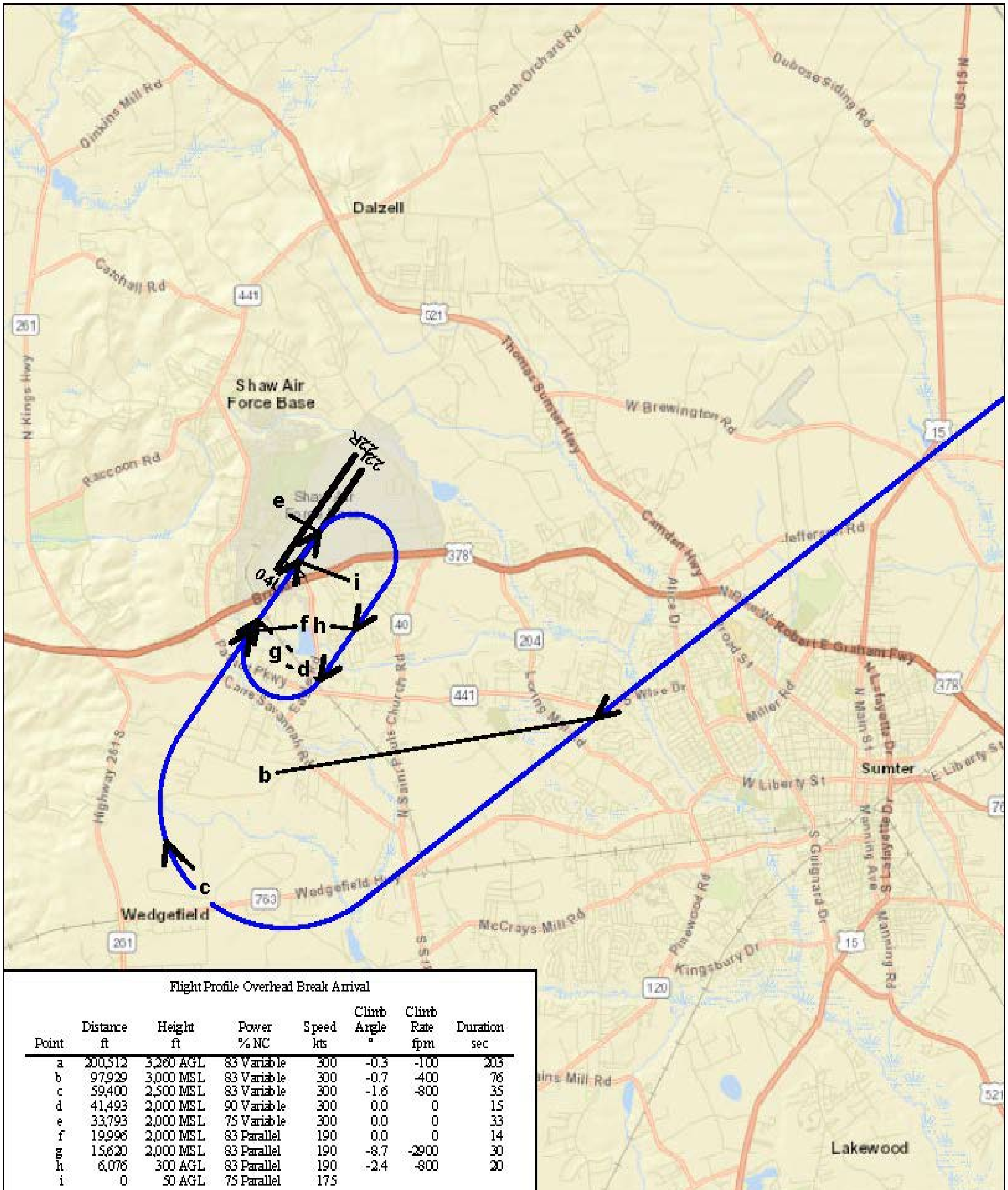


Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	149
b	125,231	3,000 MSL	83 Variable	300	-0.8	-400	72
c	89,025	2,500 MSL	83 Variable	300	-1.6	-900	35
d	71,356	2,000 MSL	90 Variable	300	0.0	0	44
e	49,044	2,000 MSL	75 Variable	300	0.0	0	51
f	27,833	2,000 MSL	83 Parallel	190	0.0	0	38
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Flight Profile Overhead Break Arrival

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164LO44

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



Flight Profile Overhead Break Arrival

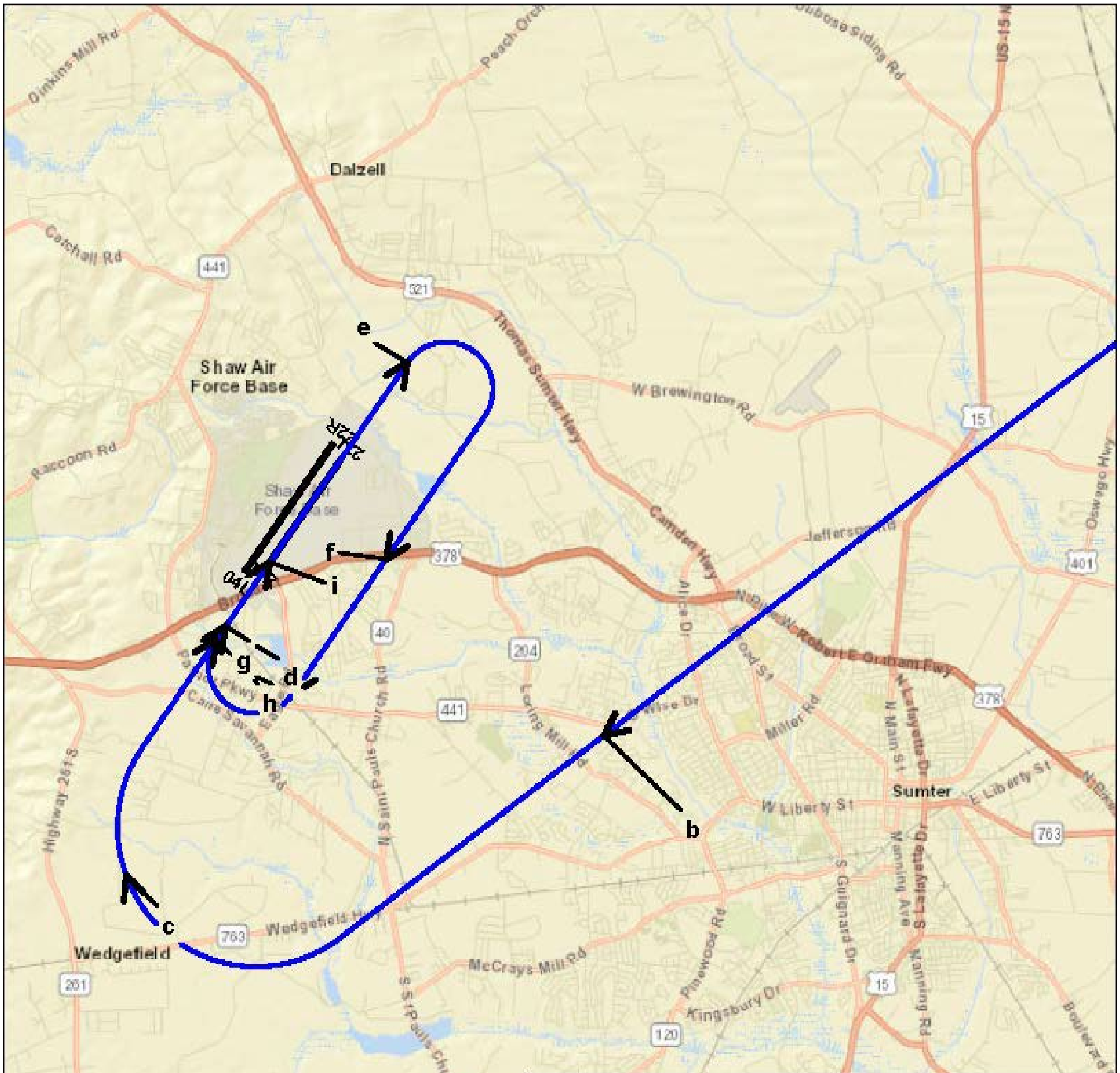
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	203
b	97,929	3,000 MSL	83 Variable	300	-0.7	-400	76
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO02

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

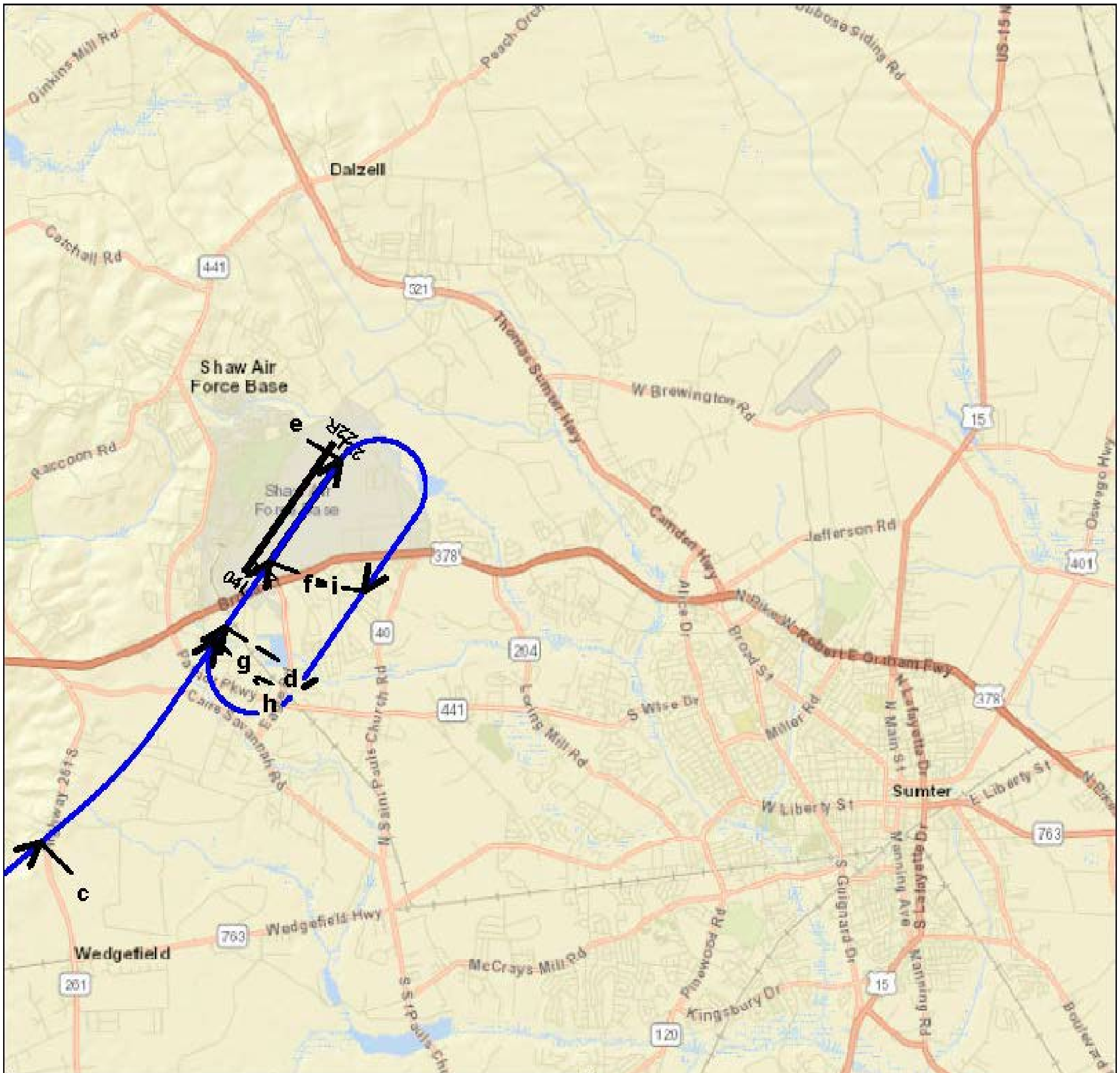
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	151
b	124,148	3,000 MSL	83 Variable	300	-0.7	-400	76
c	85,795	2,500 MSL	83 Variable	300	-1.6	-800	36
d	67,653	2,000 MSL	90 Variable	300	0.0	0	41
e	46,917	2,000 MSL	75 Variable	300	0.0	0	50
f	26,144	2,000 MSL	83 Parallel	190	0.0	0	33
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO08

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N

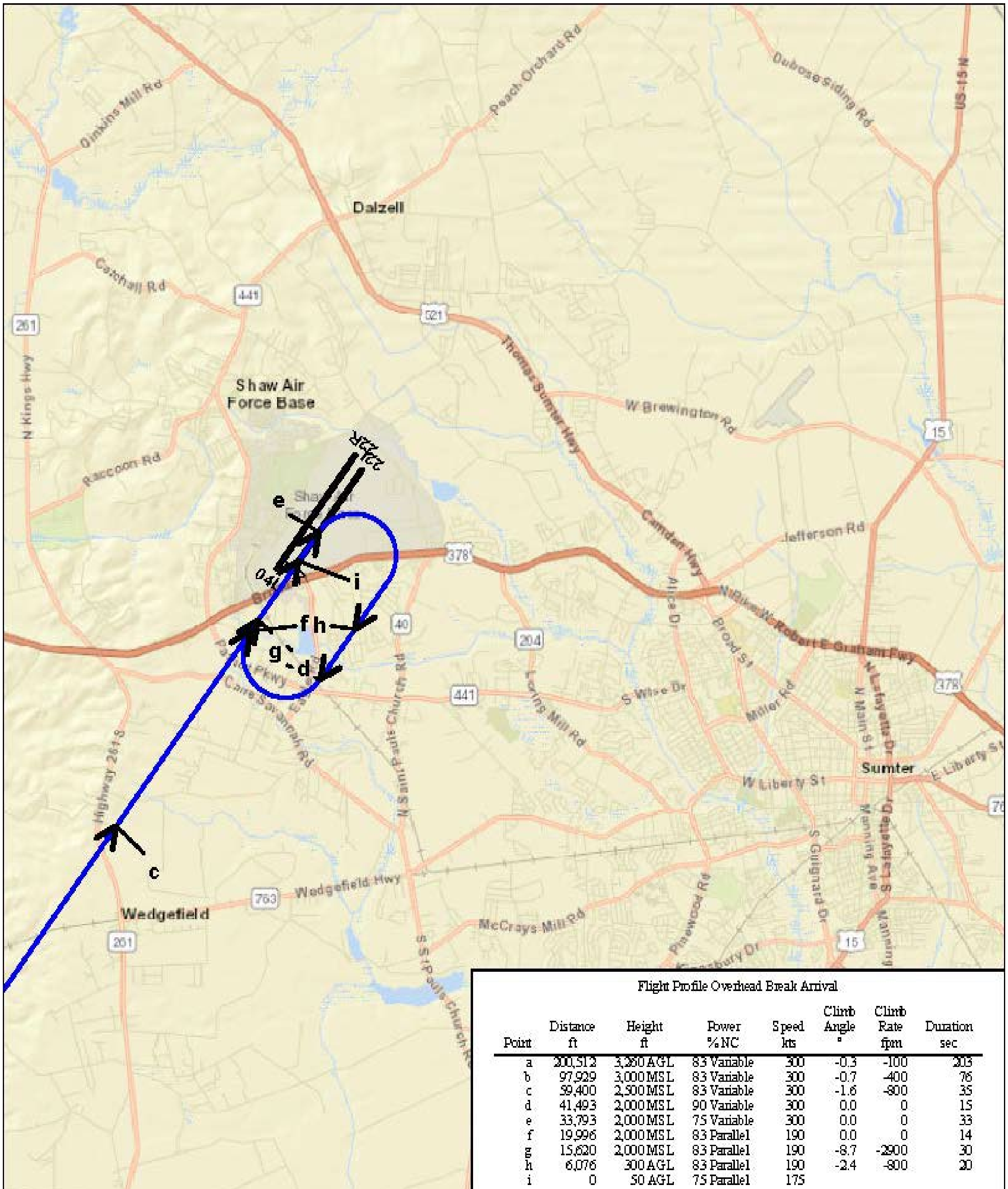


Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	181
b	108,741	3,000 MSL	83 Variable	300	-0.8	-400	75
c	70,861	2,500 MSL	83 Variable	300	-1.6	-800	36
d	52,402	2,000 MSL	90 Variable	300	0.0	0	26
e	39,261	2,000 MSL	75 Variable	300	0.0	0	38
f	23,641	2,000 MSL	83 Parallel	190	0.0	0	25
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO14

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



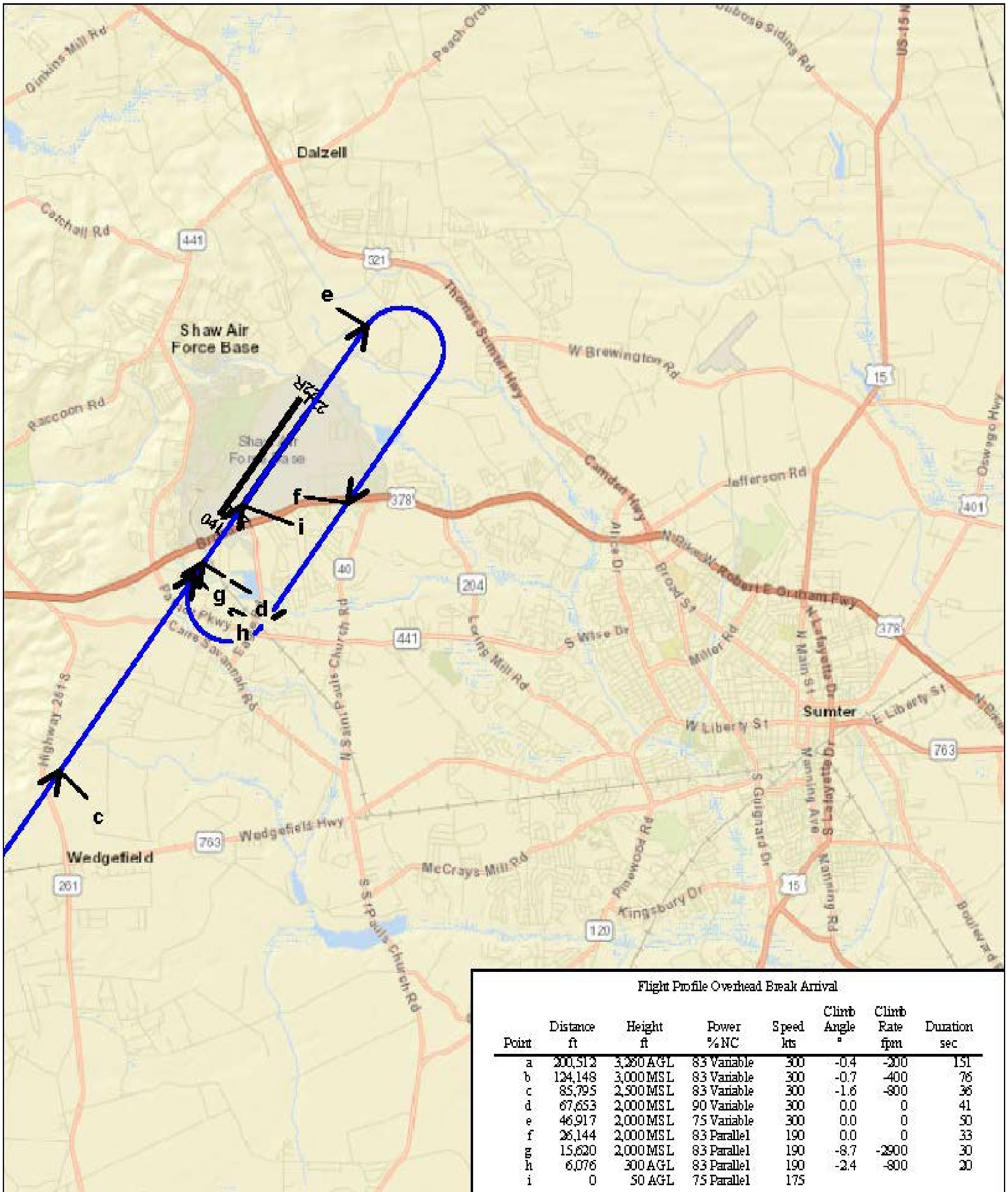
Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	203
b	97,929	3,000 MSL	83 Variable	300	-0.7	-400	76
c	59,400	2,300 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO20

0 4,000 8,000 12000 16000 20000 24,000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)



Flight Profile Overhead Break Arrival

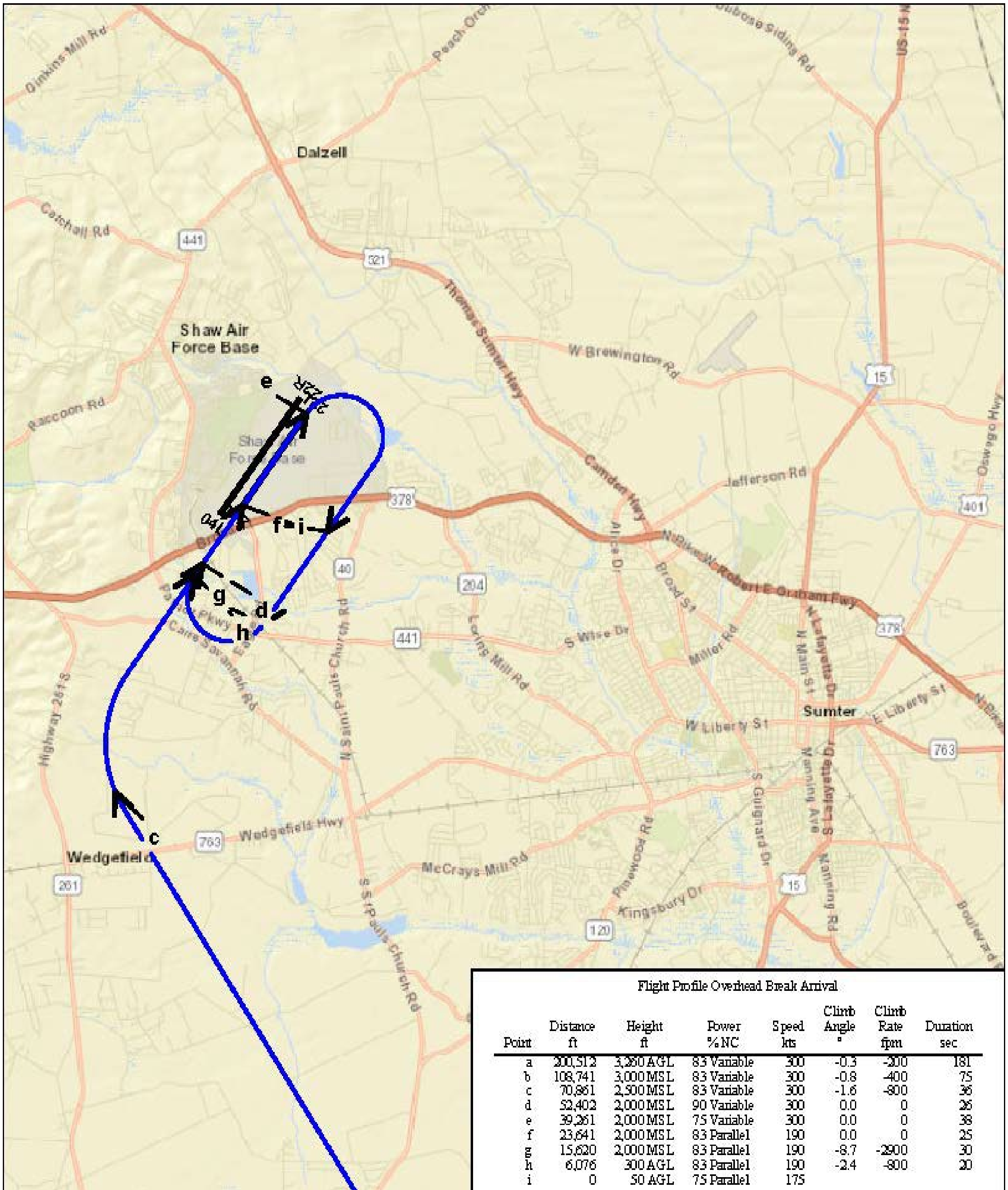
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	151
b	124,148	3,000 MSL	83 Variable	300	-0.7	-400	76
c	85,795	2,500 MSL	83 Variable	300	-1.6	-800	36
d	67,653	2,000 MSL	90 Variable	300	0.0	0	41
e	46,917	2,000 MSL	75 Variable	300	0.0	0	50
f	26,144	2,000 MSL	83 Parallel	190	0.0	0	33
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO26

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N



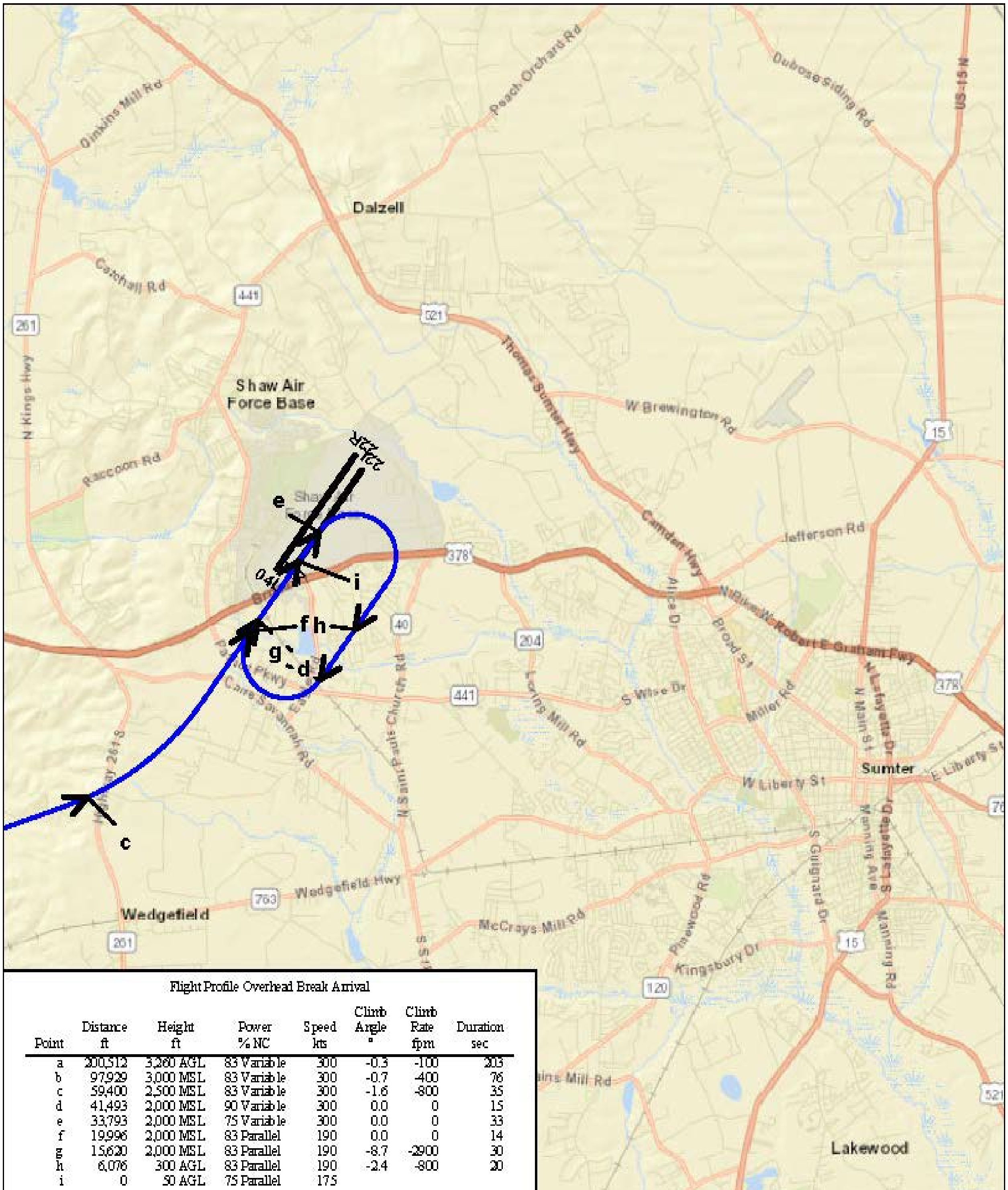
Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-200	181
b	108,741	3,000 MSL	83 Variable	300	-0.8	-400	75
c	70,861	2,500 MSL	83 Variable	300	-1.6	-800	36
d	52,402	2,000 MSL	90 Variable	300	0.0	0	26
e	39,261	2,000 MSL	75 Variable	300	0.0	0	38
f	23,641	2,000 MSL	83 Parallel	190	0.0	0	25
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO32

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



Flight Profile Overhead Break Arrival

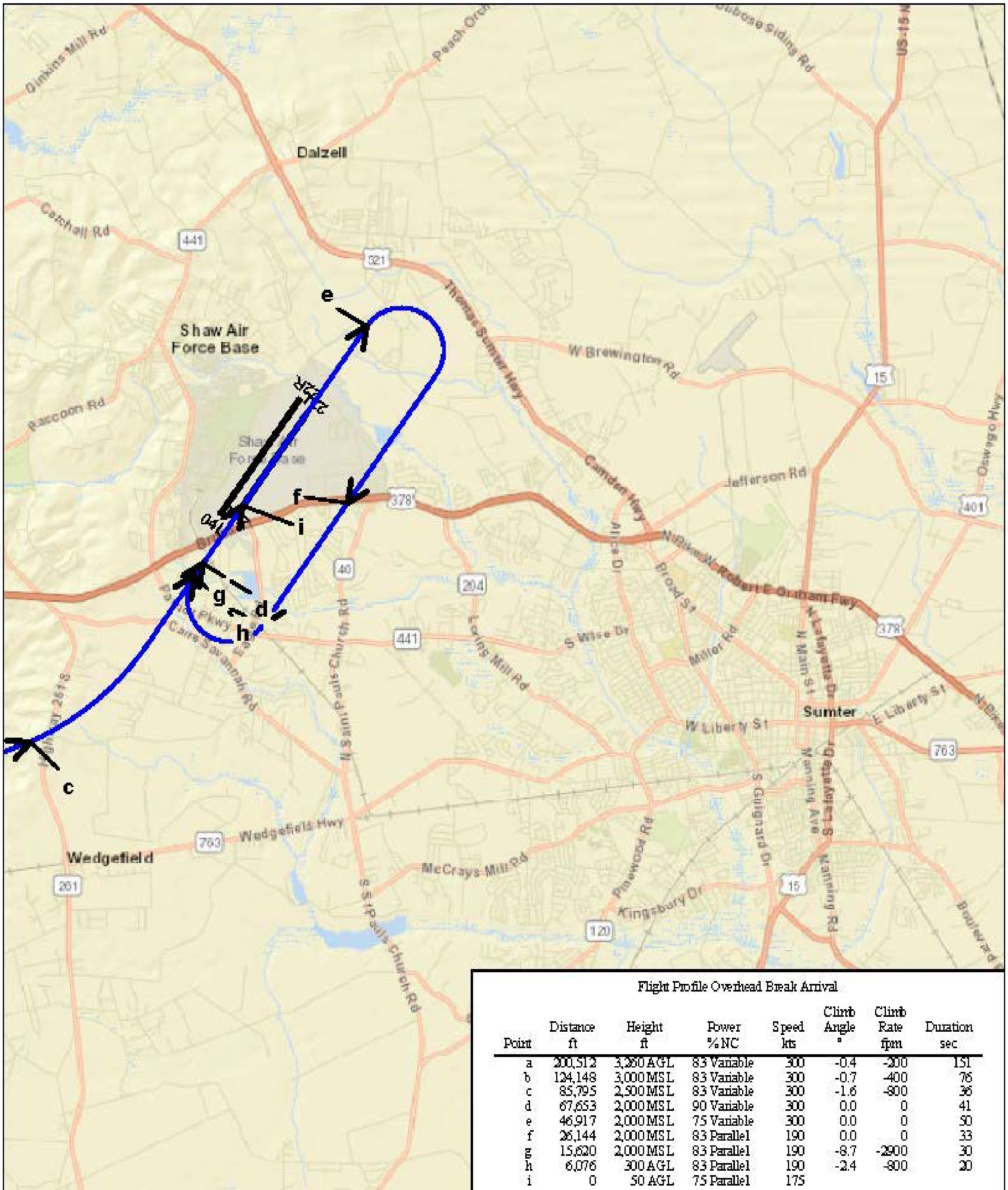
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	203
b	97,929	3,000 MSL	83 Variable	300	-0.7	-400	76
c	59,400	2,500 MSL	83 Variable	300	-1.6	-800	35
d	41,493	2,000 MSL	90 Variable	300	0.0	0	15
e	33,793	2,000 MSL	75 Variable	300	0.0	0	33
f	19,996	2,000 MSL	83 Parallel	190	0.0	0	14
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO38

0 4,000 8,000 12000 16000 20000 24,000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

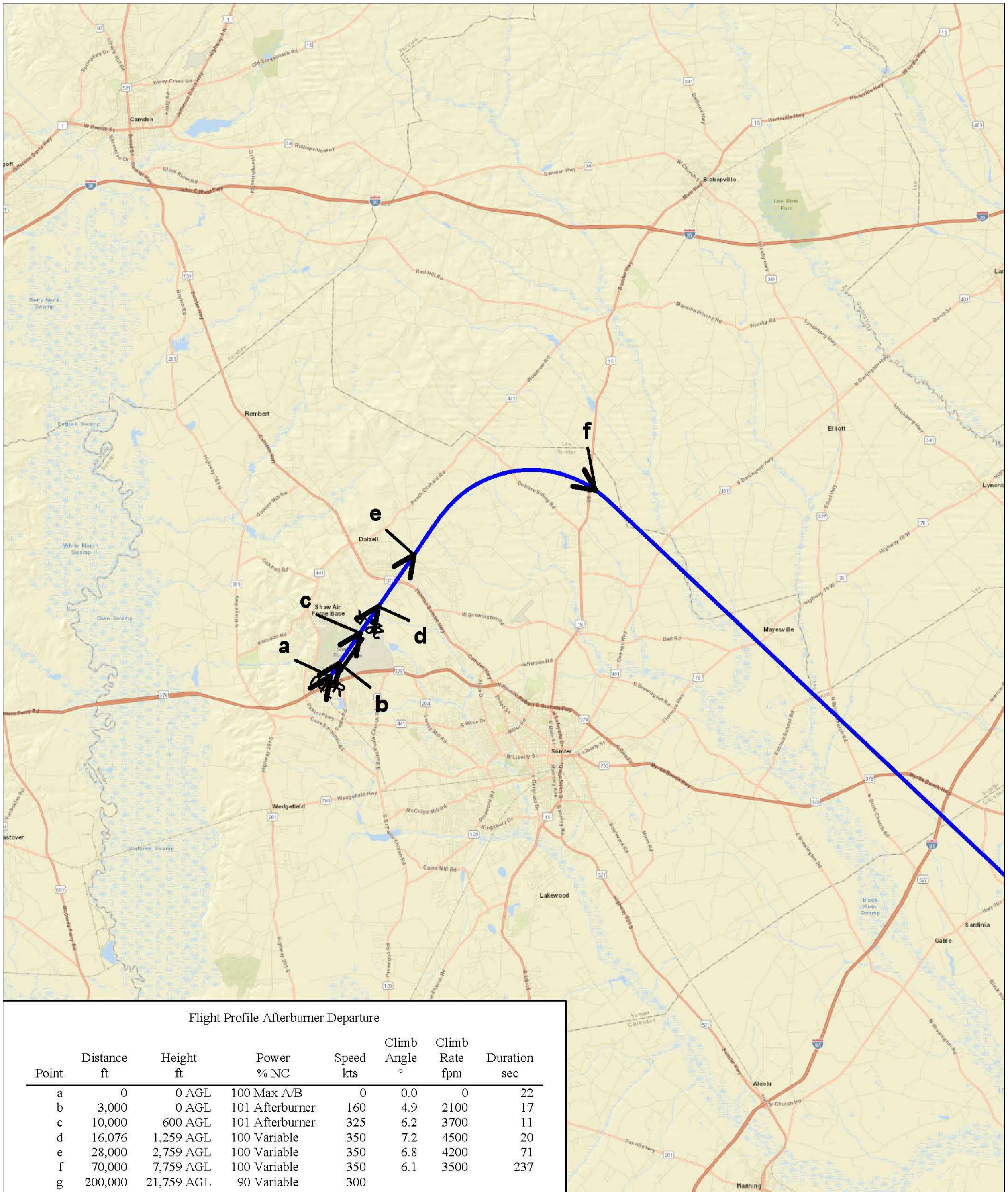
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,280 AGL	83 Variable	300	-0.4	-200	151
b	124,148	3,000 MSL	83 Variable	300	-0.7	-400	76
c	85,795	2,300 MSL	83 Variable	300	-1.6	-800	36
d	67,653	2,000 MSL	90 Variable	300	0.0	0	41
e	46,917	2,000 MSL	75 Variable	300	0.0	0	50
f	26,144	2,000 MSL	83 Parallel	190	0.0	0	33
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Overhead Break Arrival Flight Profile F164RO44

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

N



Flight Profile Afterburner Departure

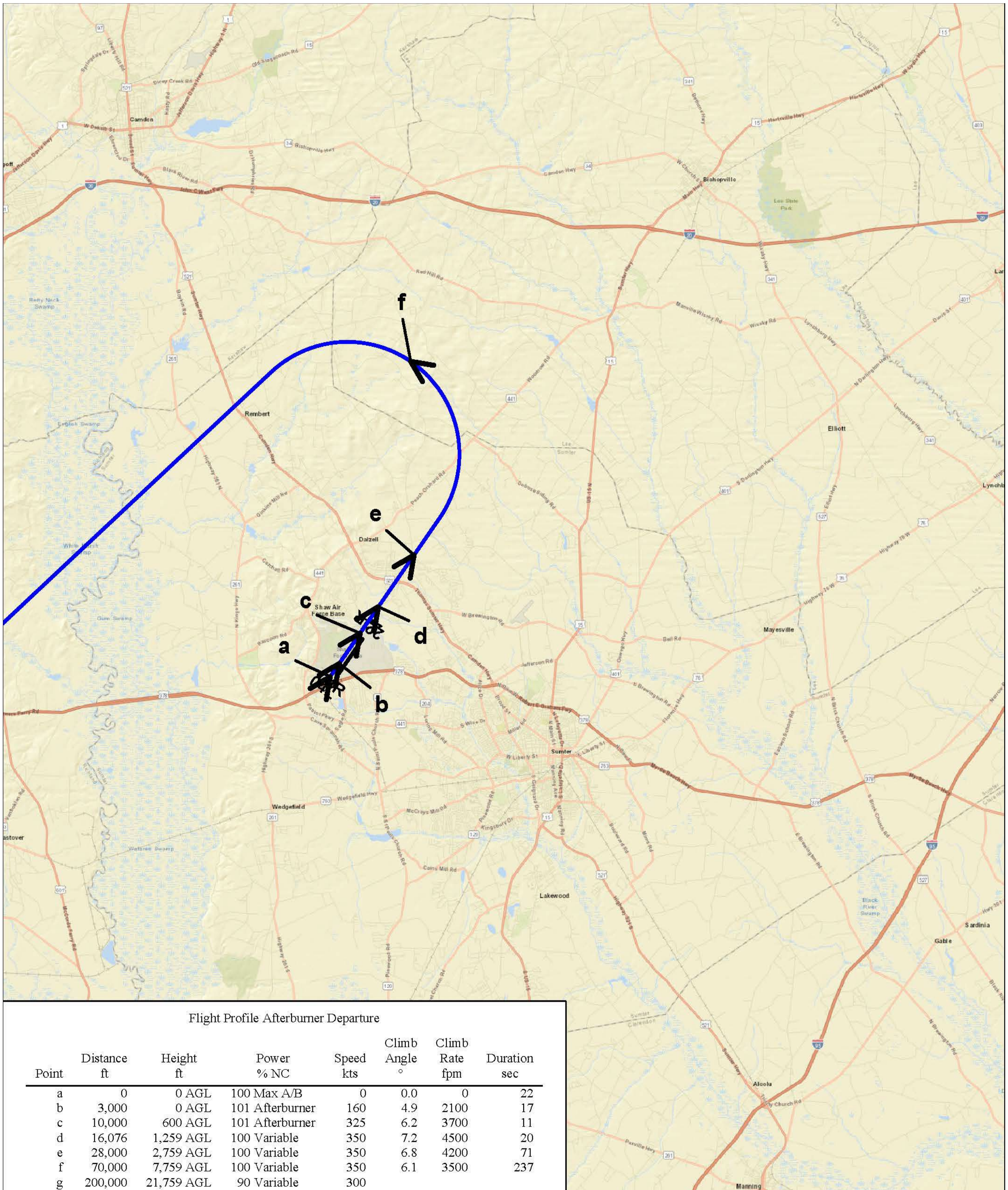
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA02

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

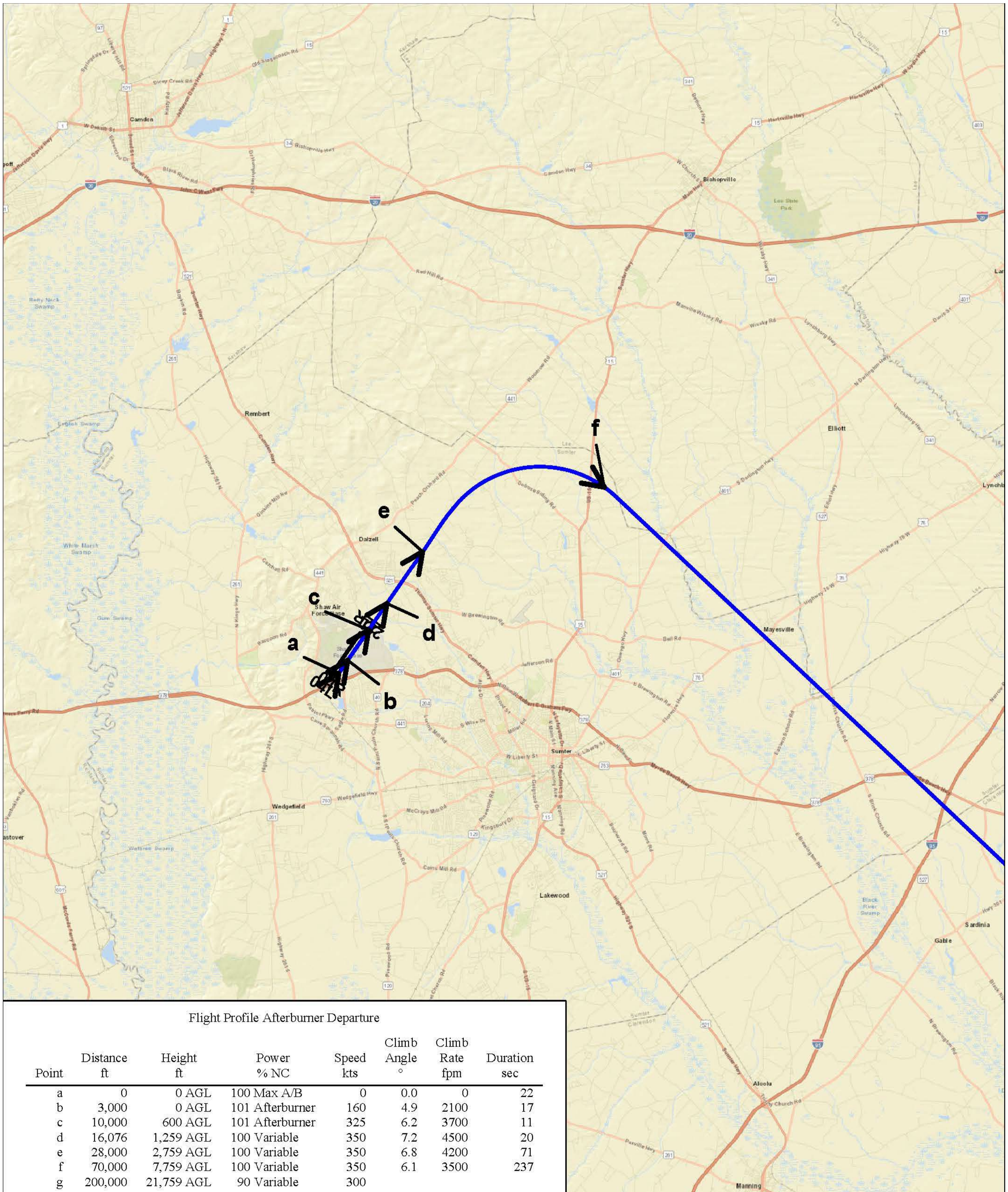
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA04

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

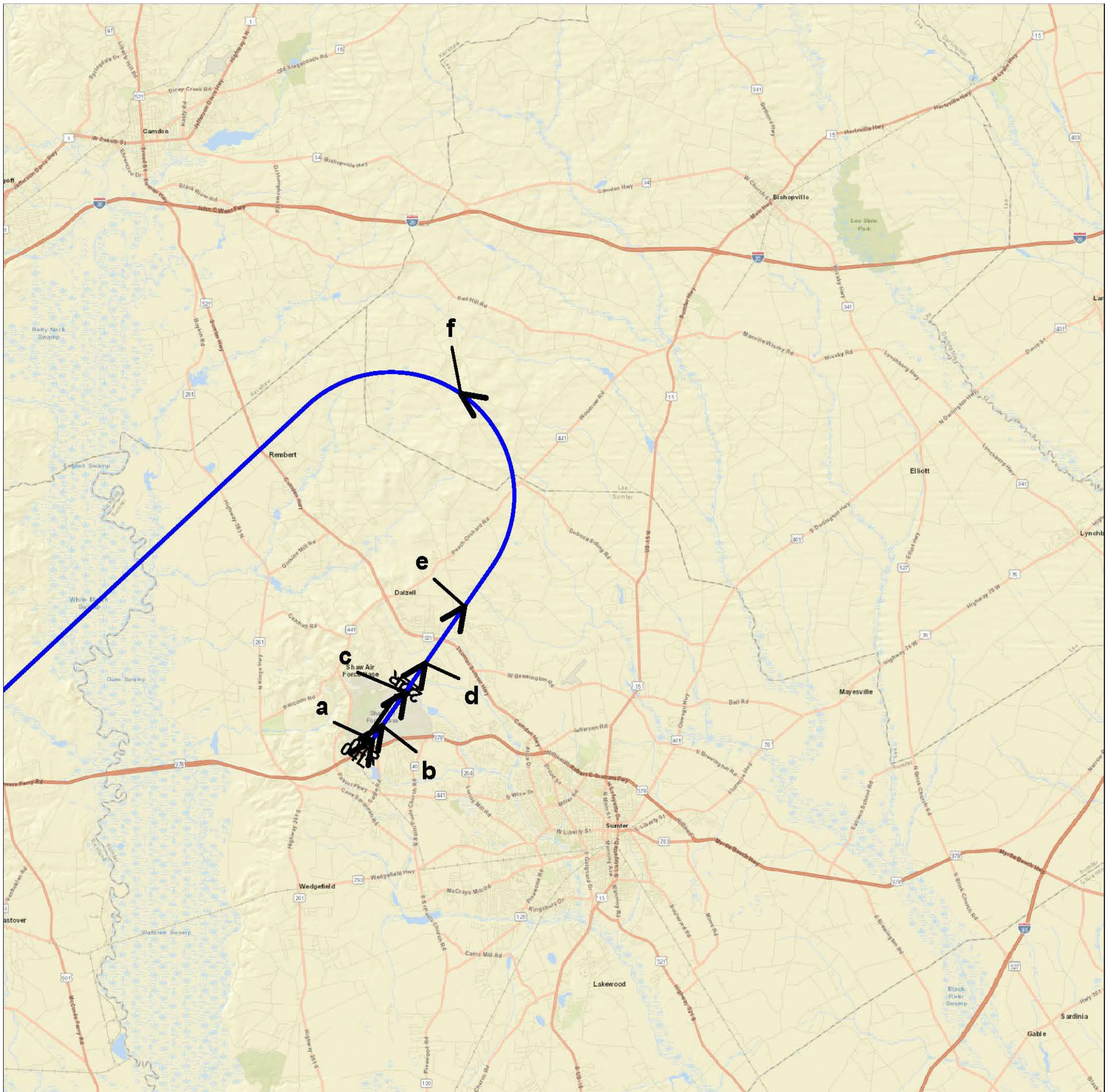
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA06

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA08

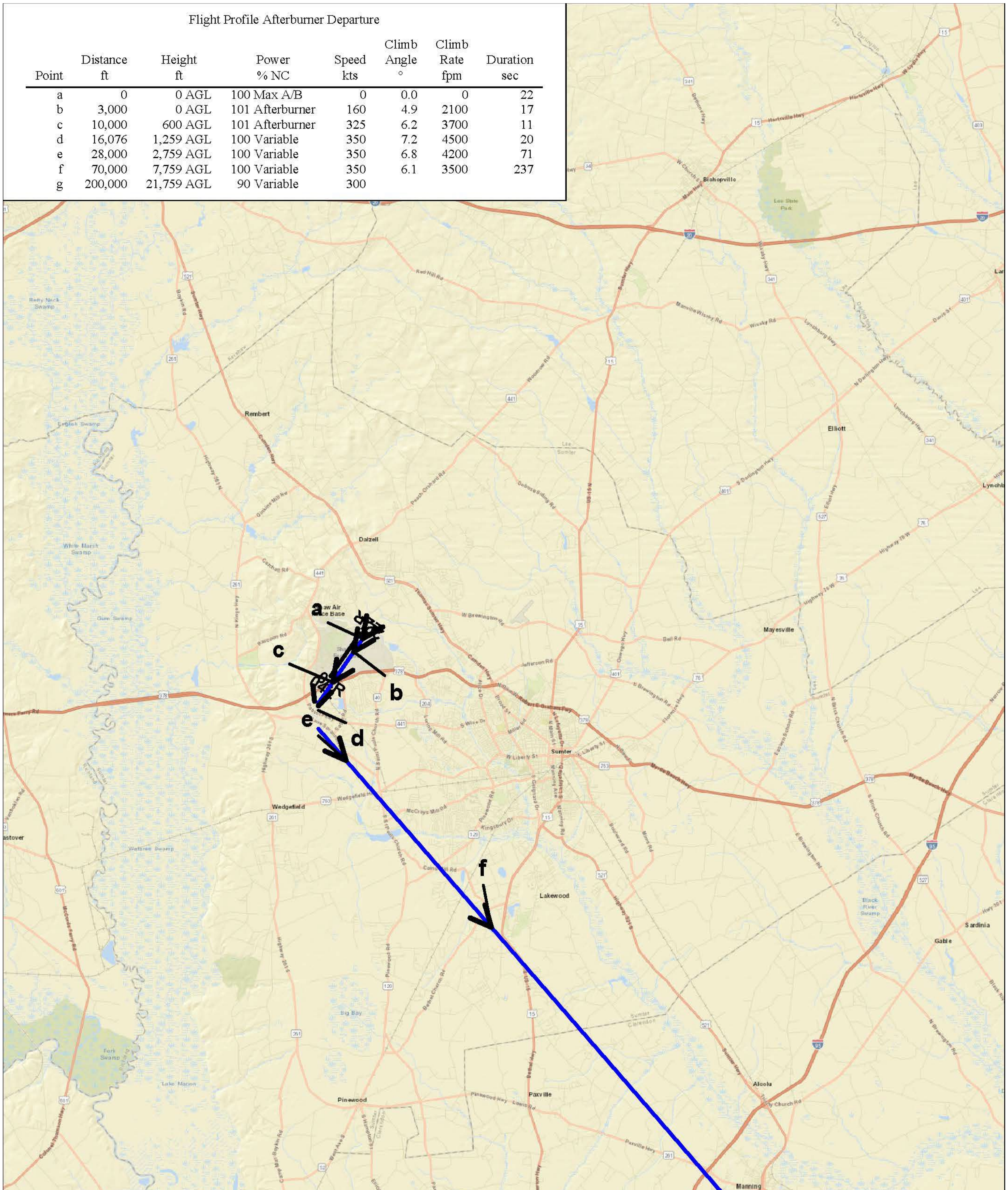
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N

Flight Profile Afterburner Departure

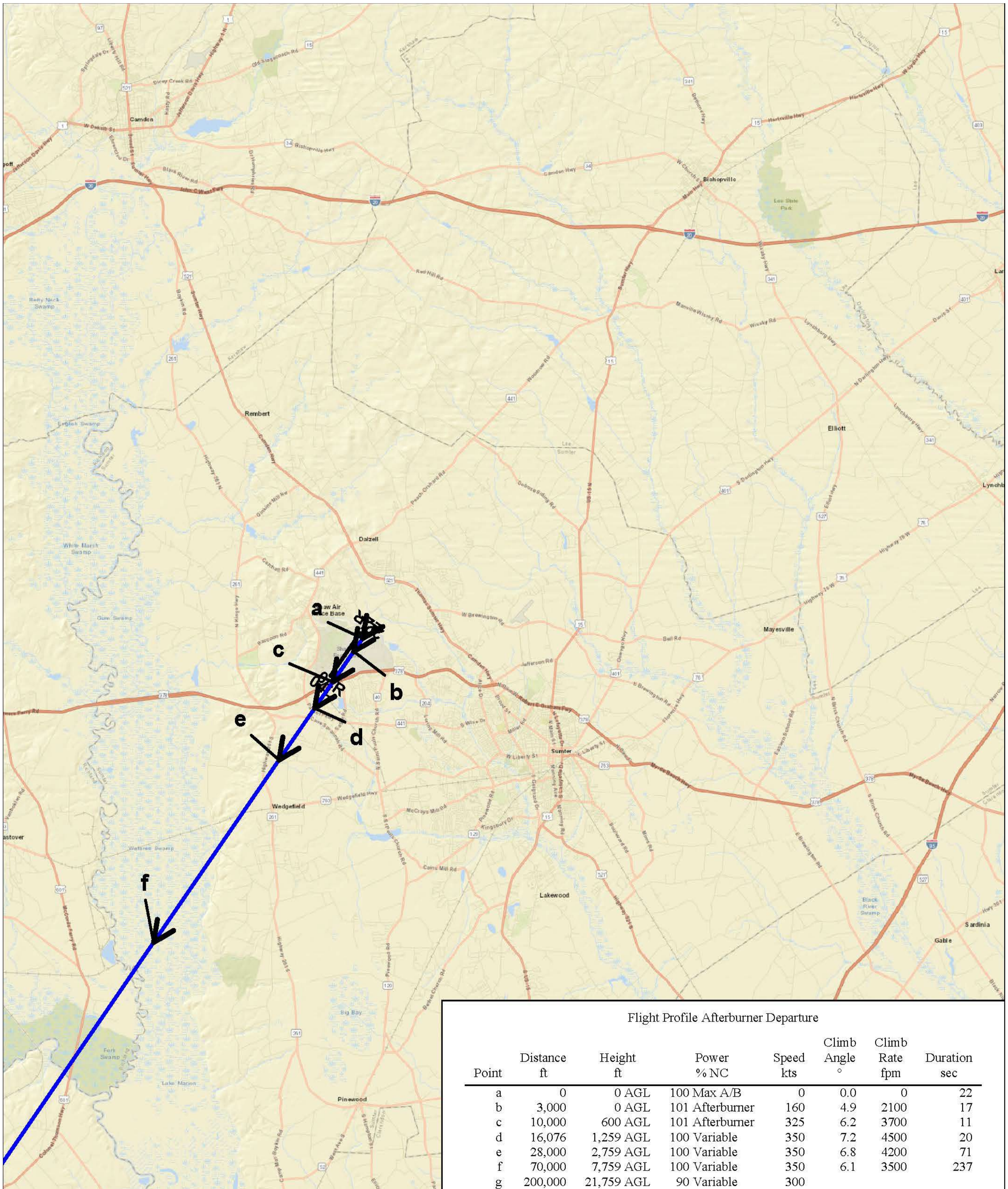
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			



Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA10

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)



Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA12

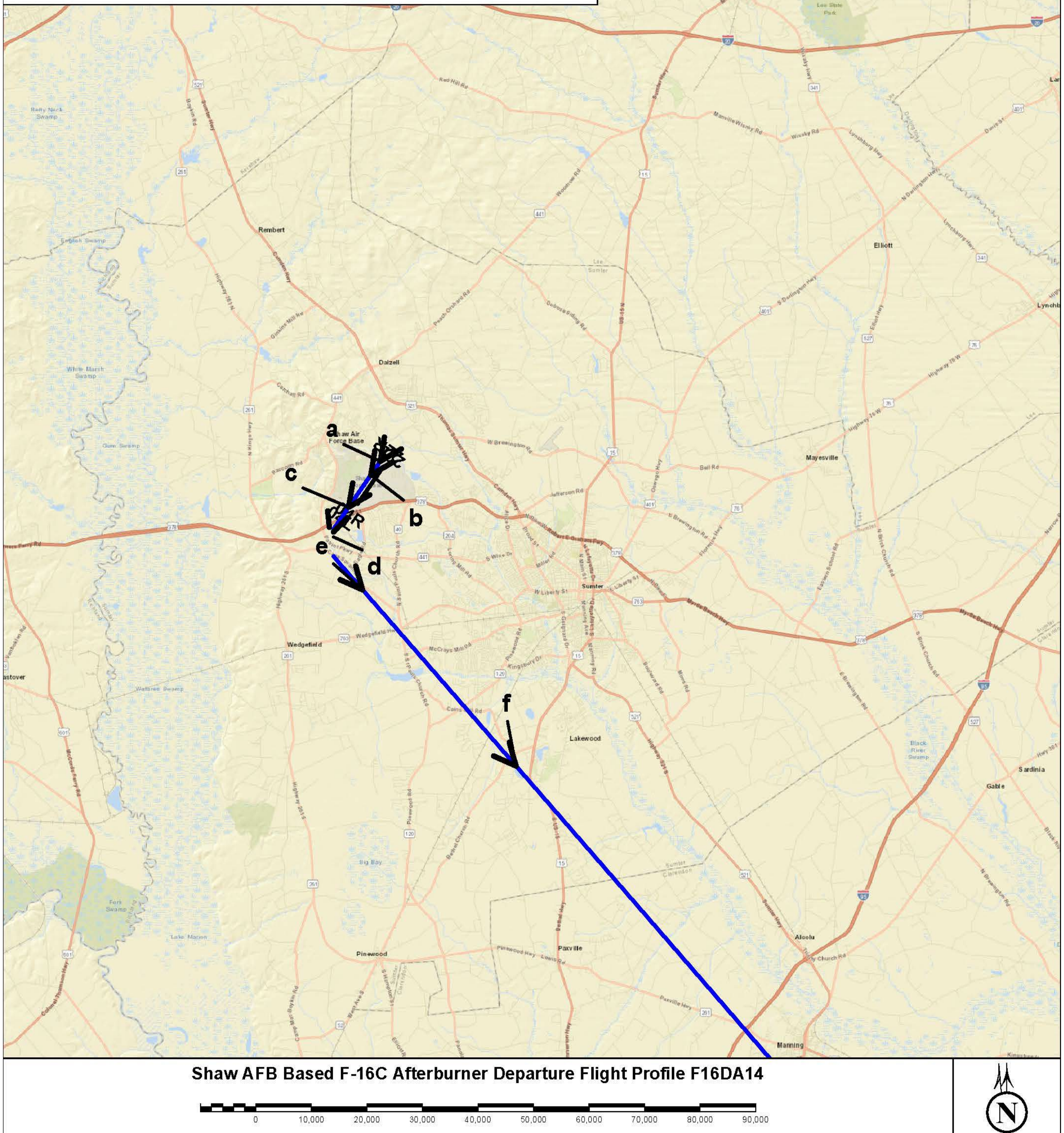
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N

Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			



Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA14

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

Flight Profile Afterburner Departure

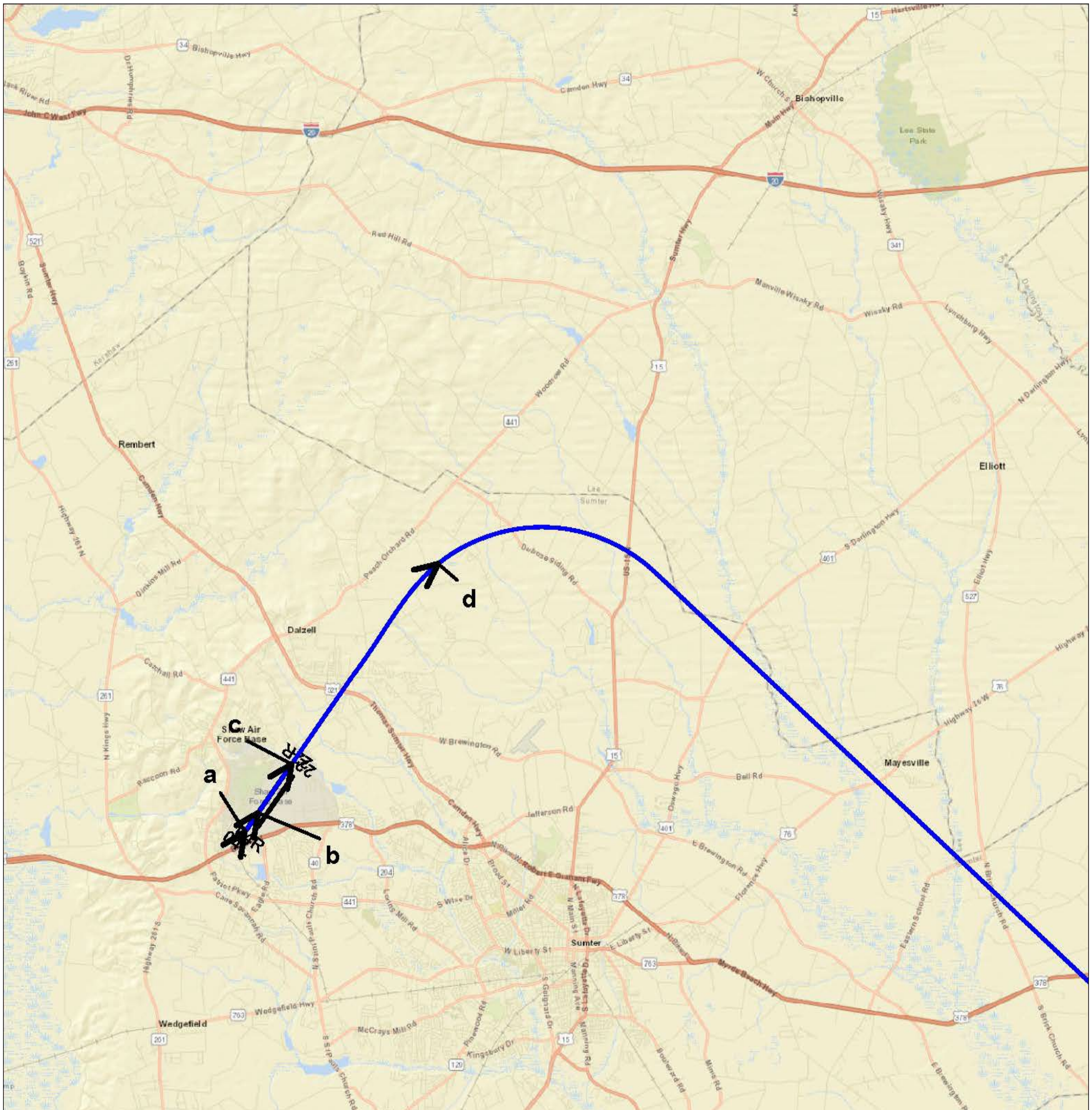
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	101 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Afterburner Departure Flight Profile F16DA16

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:268,000 (1 inch = 22,300 feet)

N



Flight Profile FCF Departure

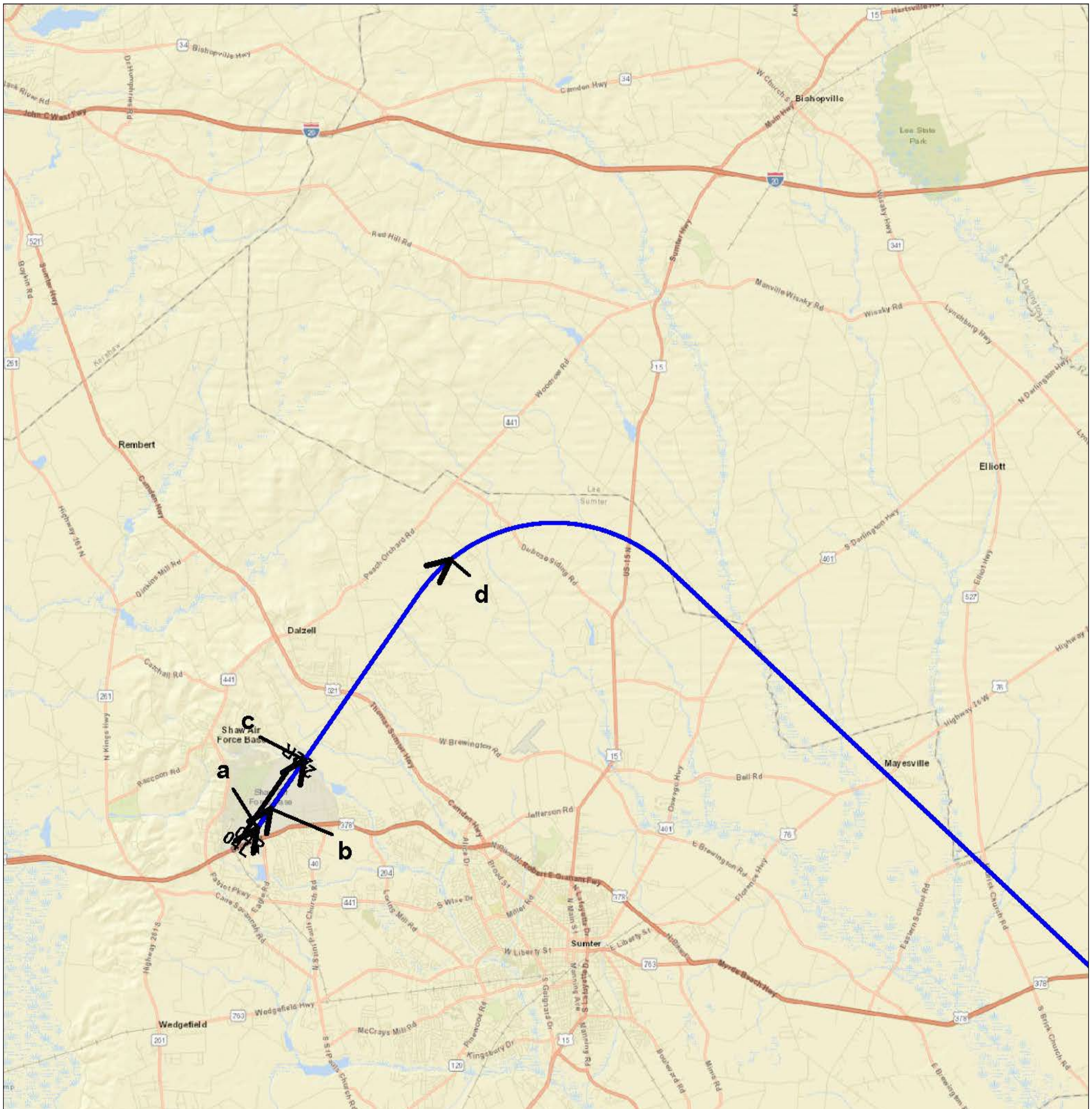
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C FCF Departure Flight Profile F16DF02

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:197,000 (1 inch = 16,400 feet)

N



Flight Profile FCF Departure

Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C FCF Departure Flight Profile F16DF04

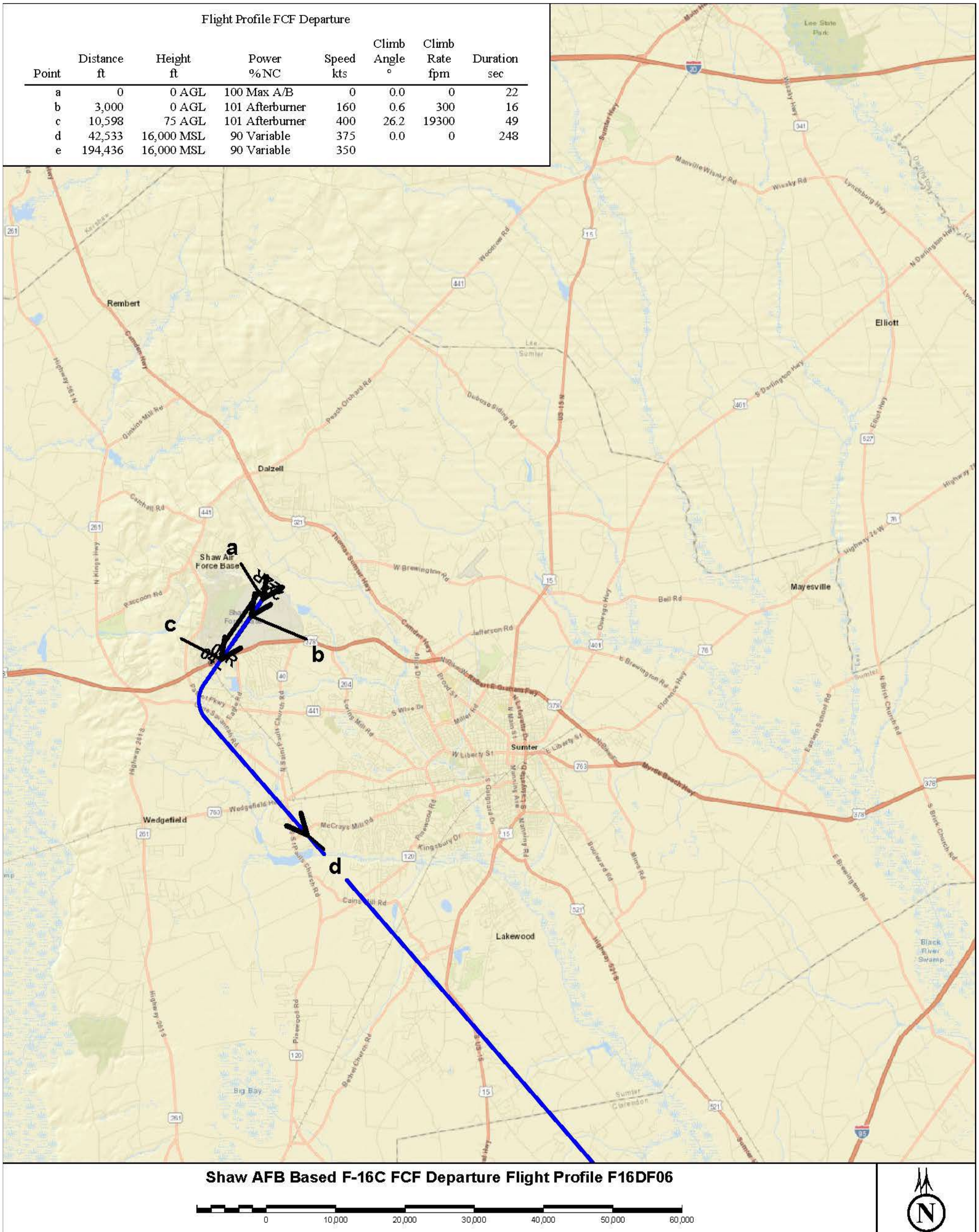
0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:197,000 (1 inch = 16,400 feet)

N

Flight Profile FCF Departure

Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

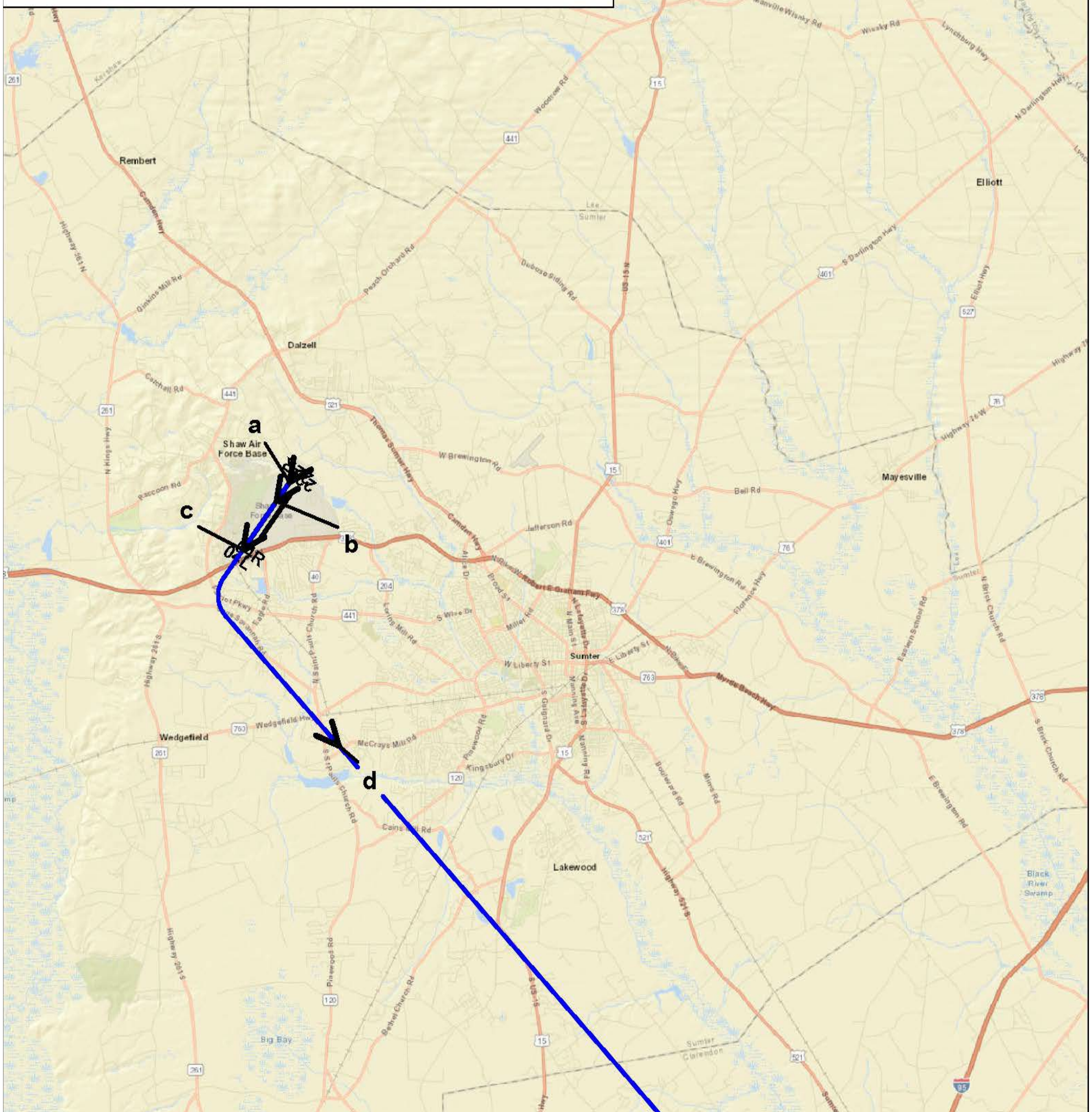


Shaw AFB Based F-16C FCF Departure Flight Profile F16DF06

Scale in Feet 1:198,000 (1 inch = 16,500 feet)

Flight Profile FCF Departure

Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

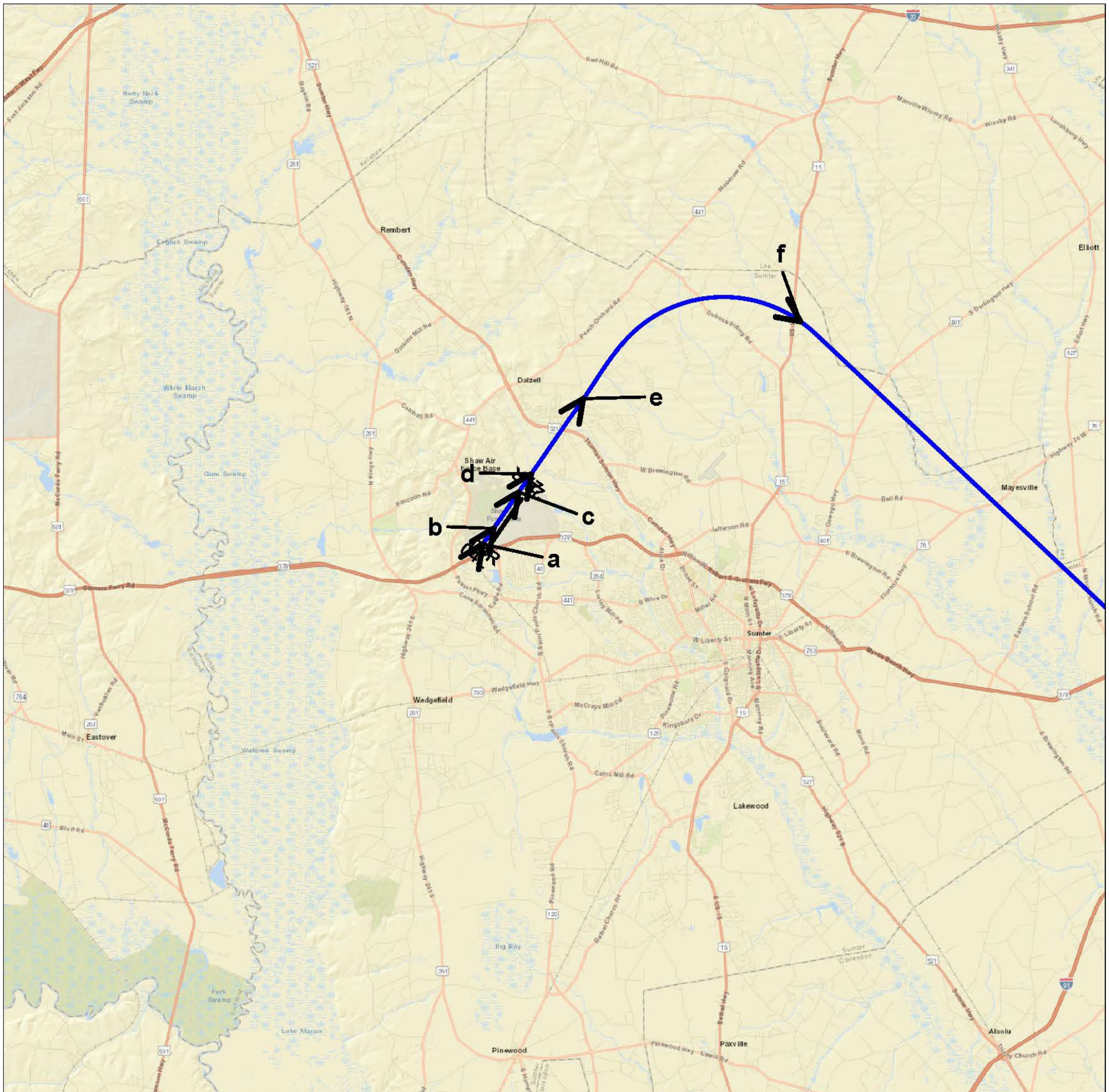


Shaw AFB Based F-16C FCF Departure Flight Profile F16DF08

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:198,000 (1 inch = 16,500 feet)

N



Flight Profile Military Departure

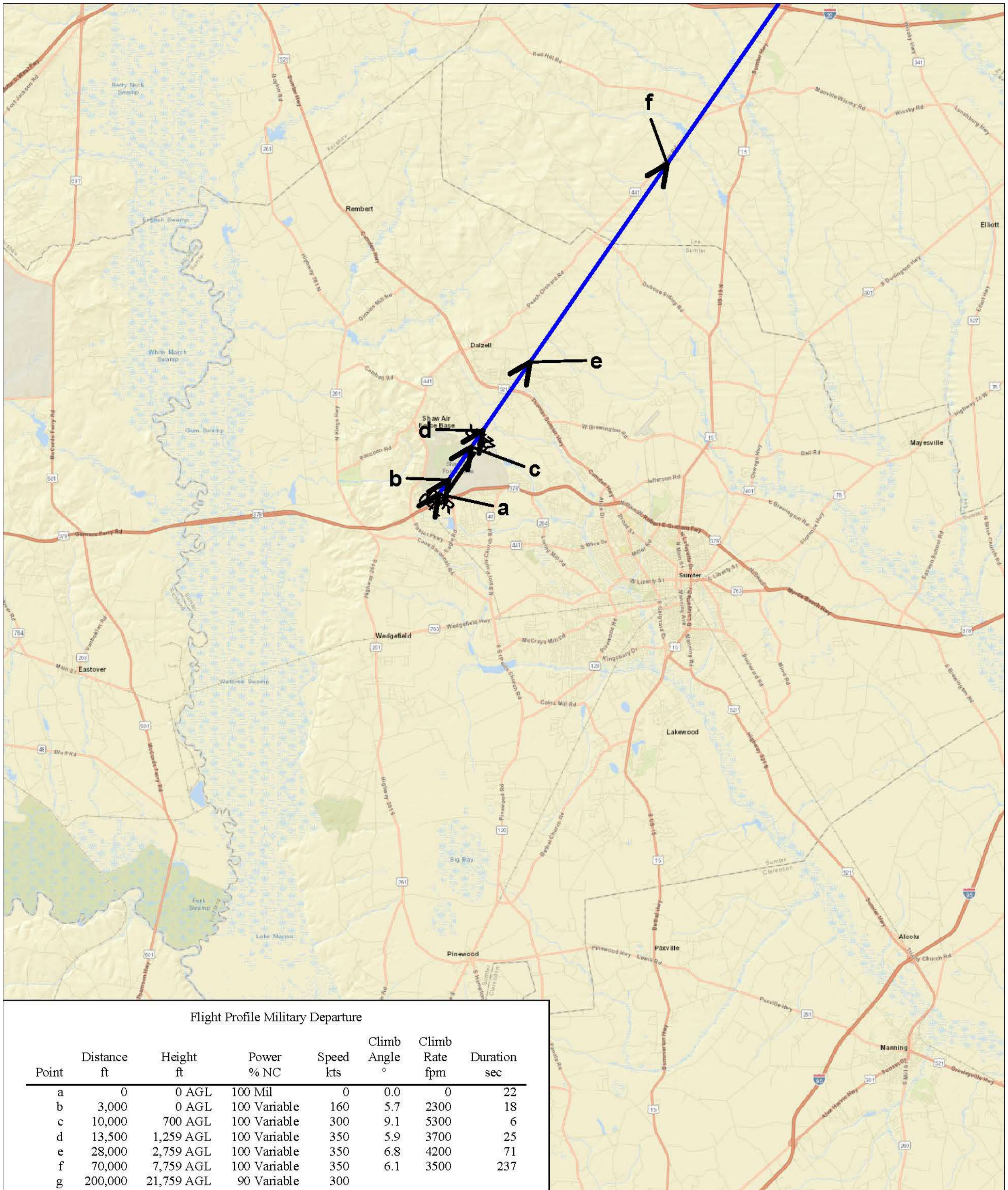
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Variable	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM02

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)

N



Flight Profile Military Departure

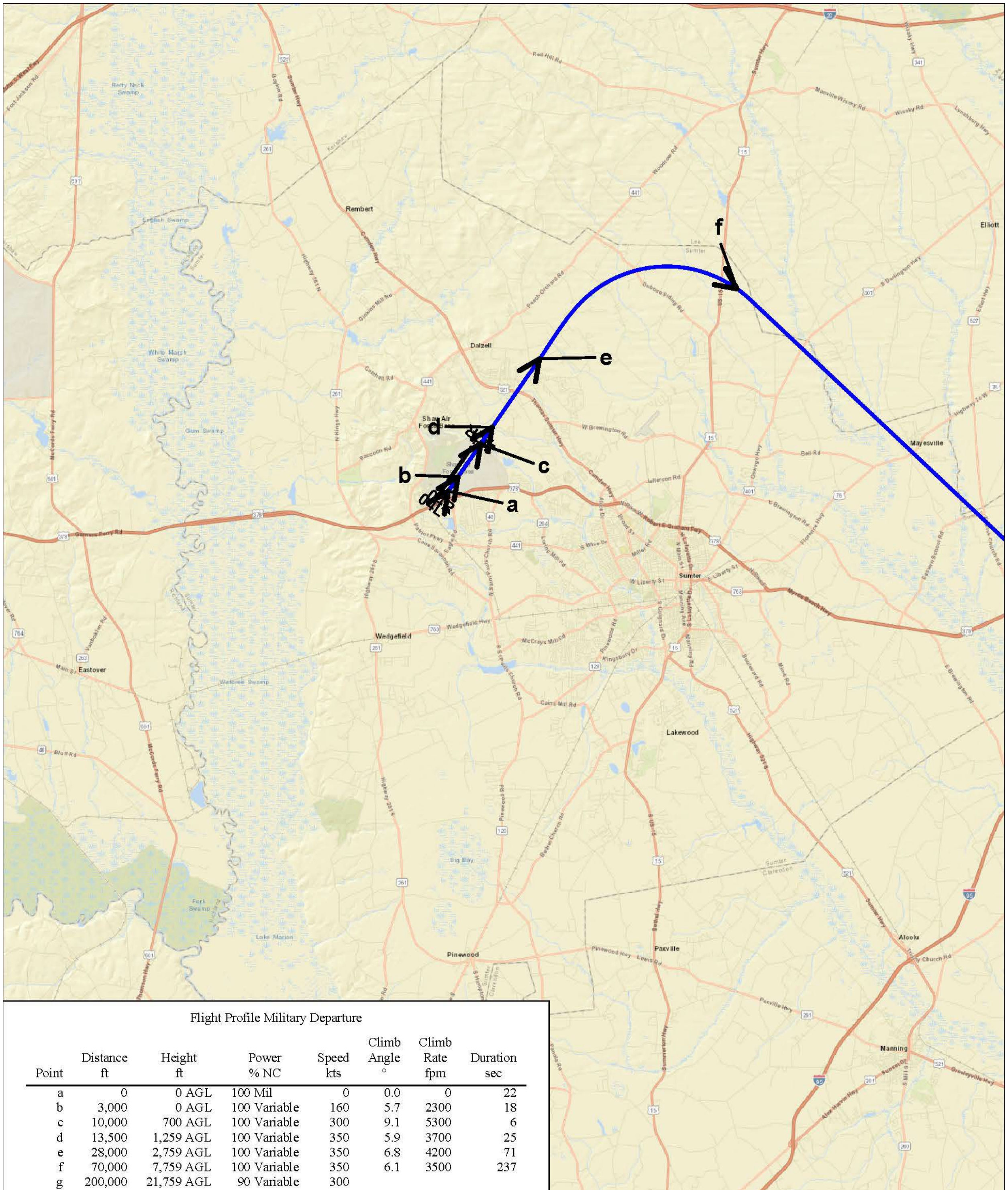
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Variable	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM04

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)

N



Flight Profile Military Departure

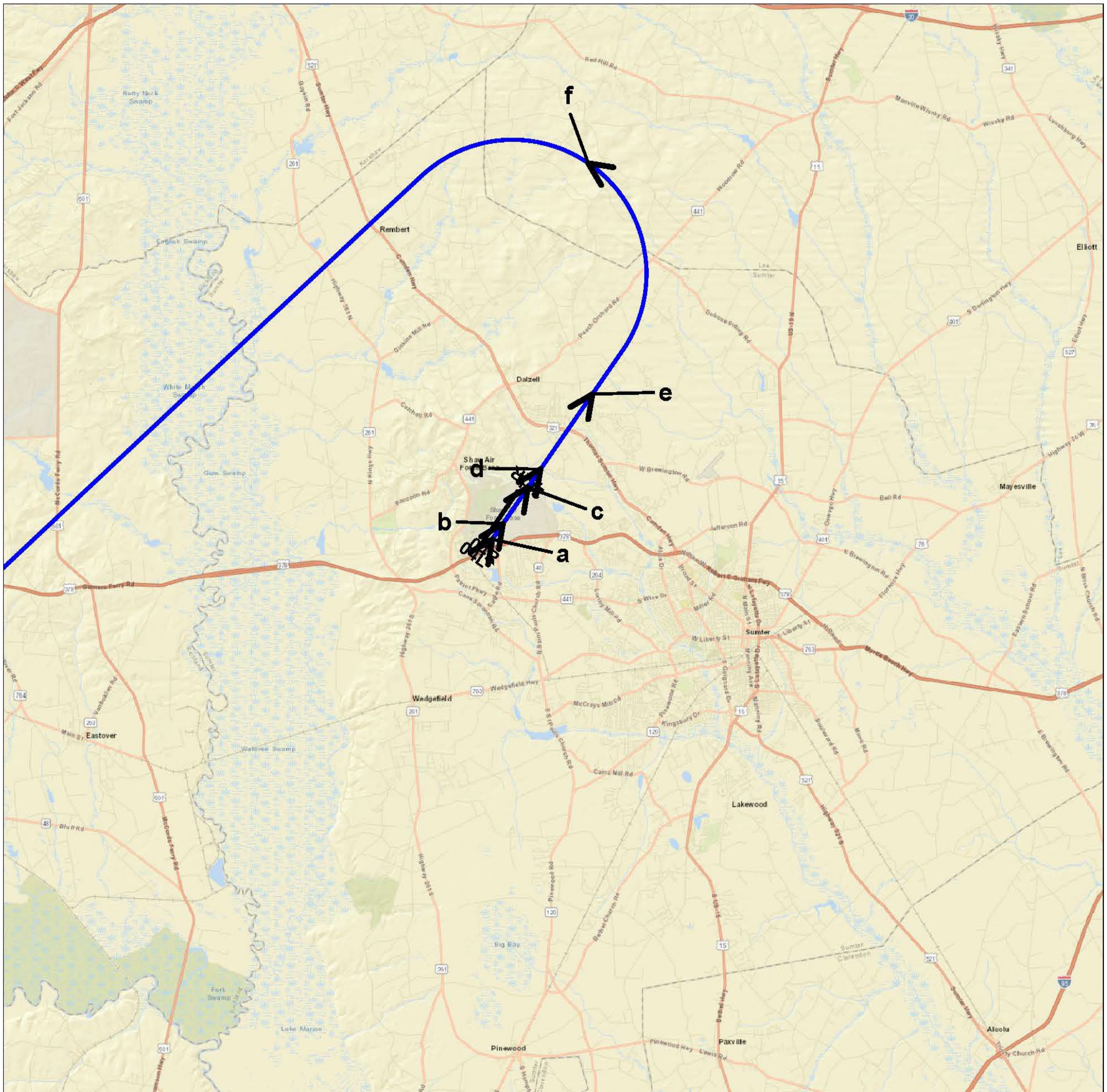
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Variable	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM06

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)

N



Flight Profile Military Departure

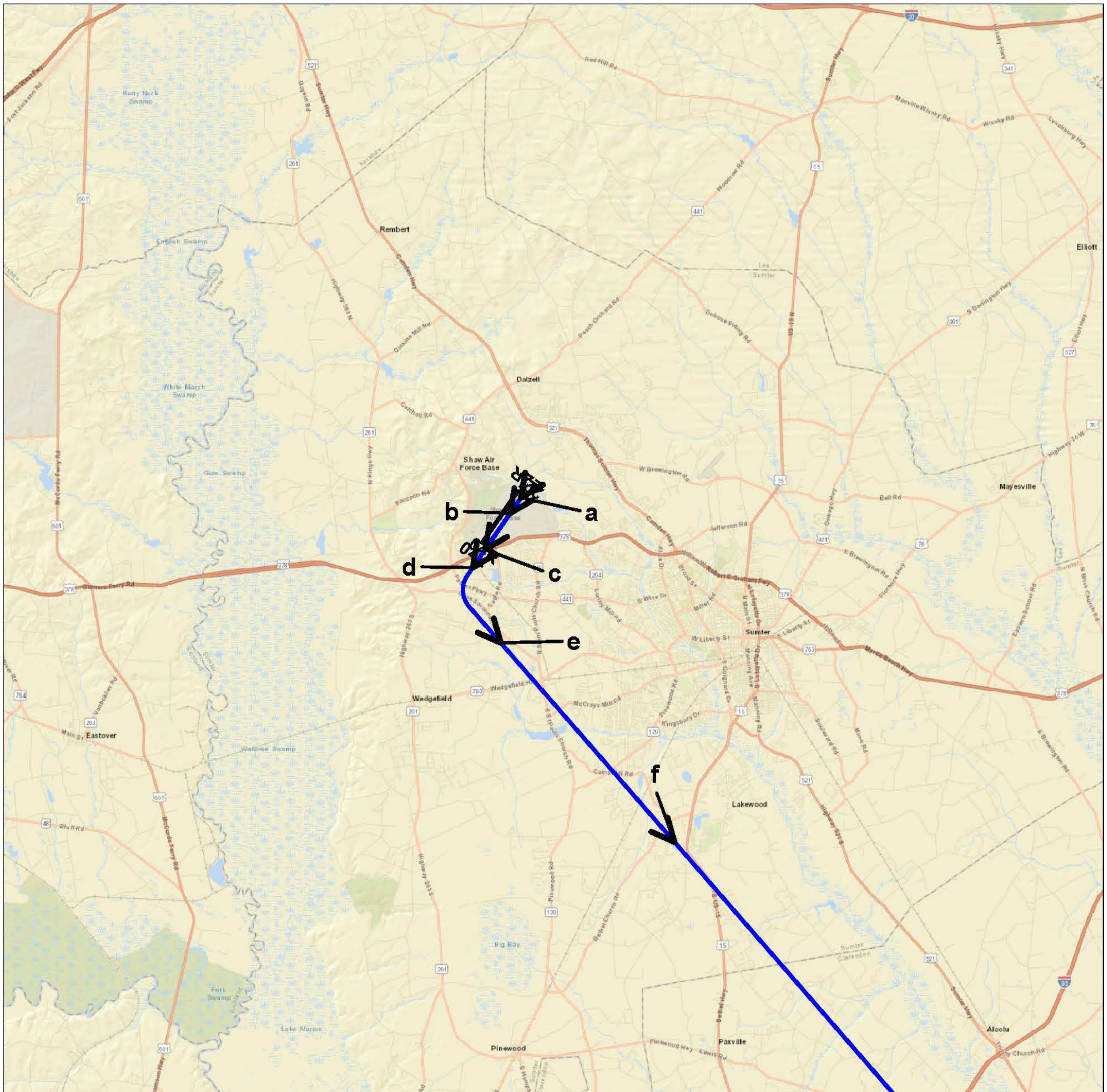
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Variable	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM08

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)

N



Flight Profile Military Departure

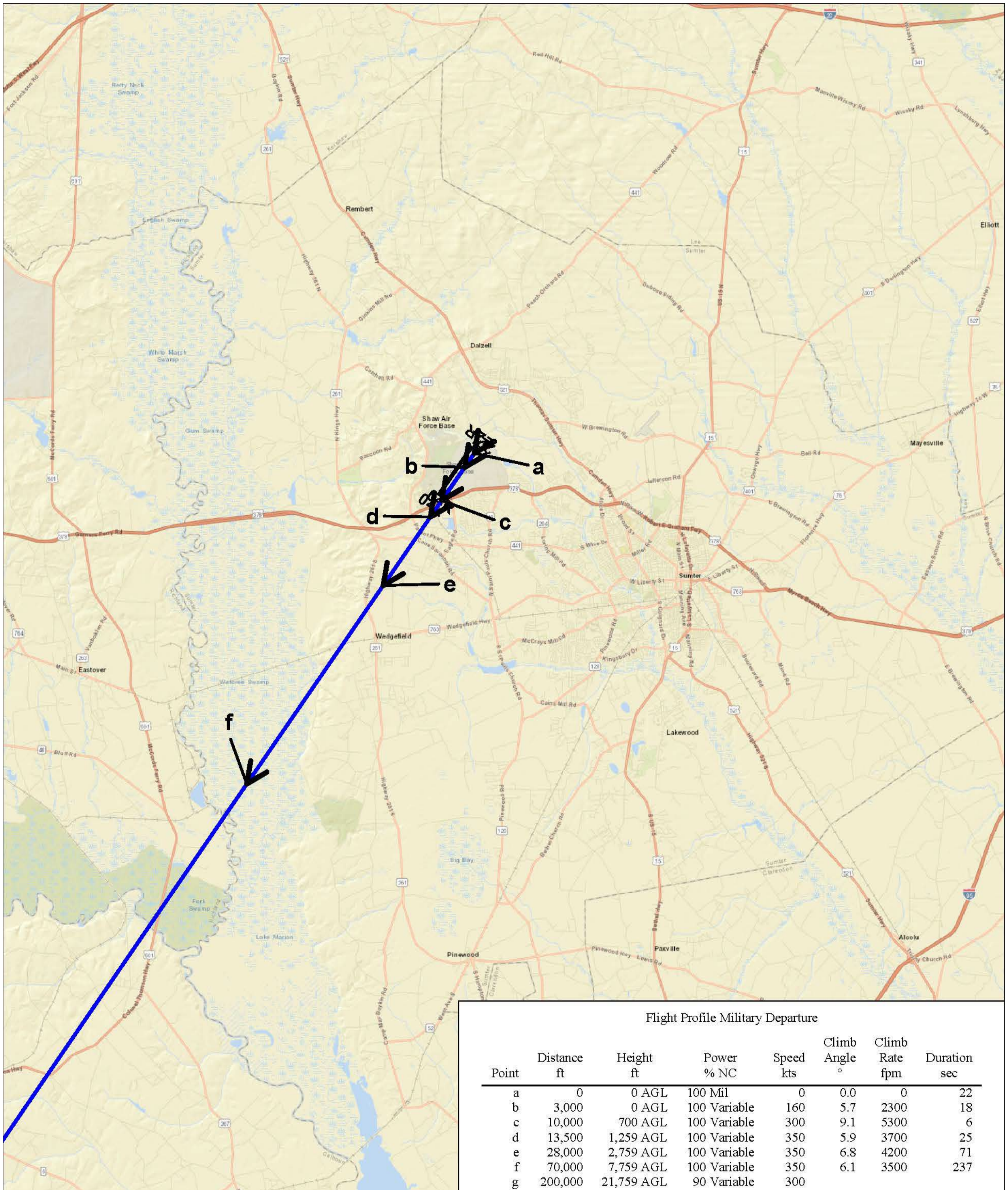
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Variable	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM10

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)

N



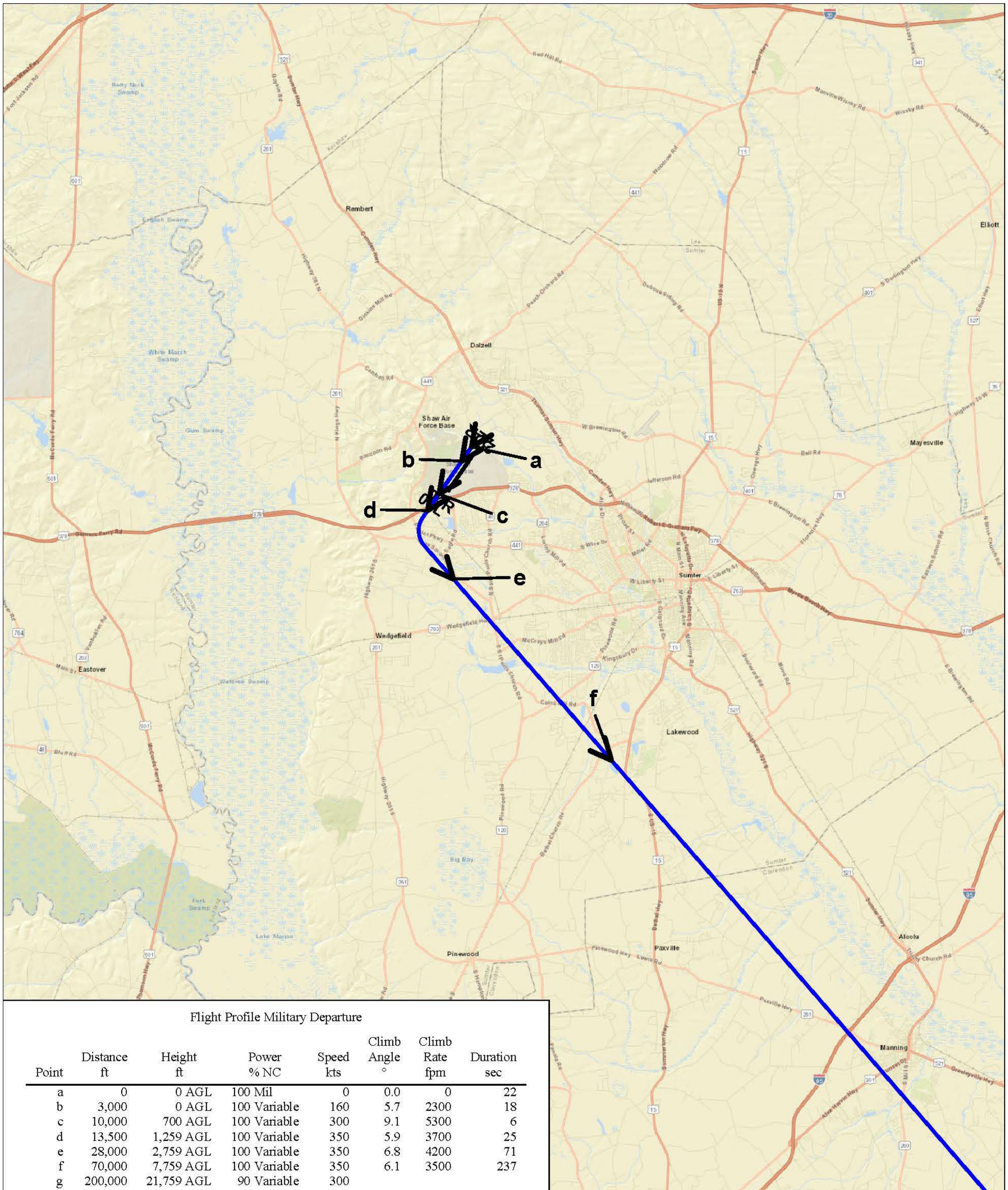
Flight Profile Military Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Variable	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM12

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)



Flight Profile Military Departure

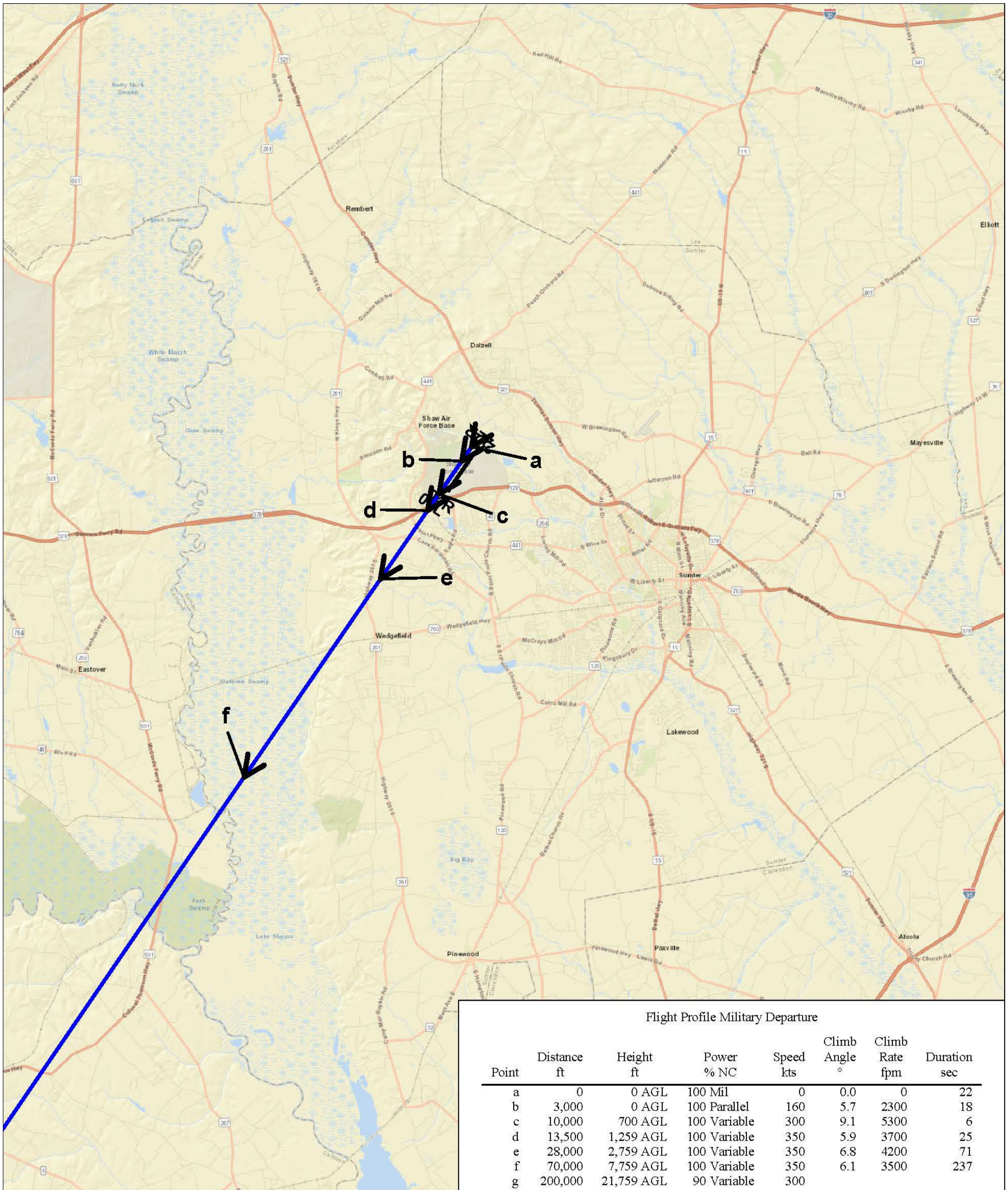
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Variable	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM14

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)

N



Flight Profile Military Departure

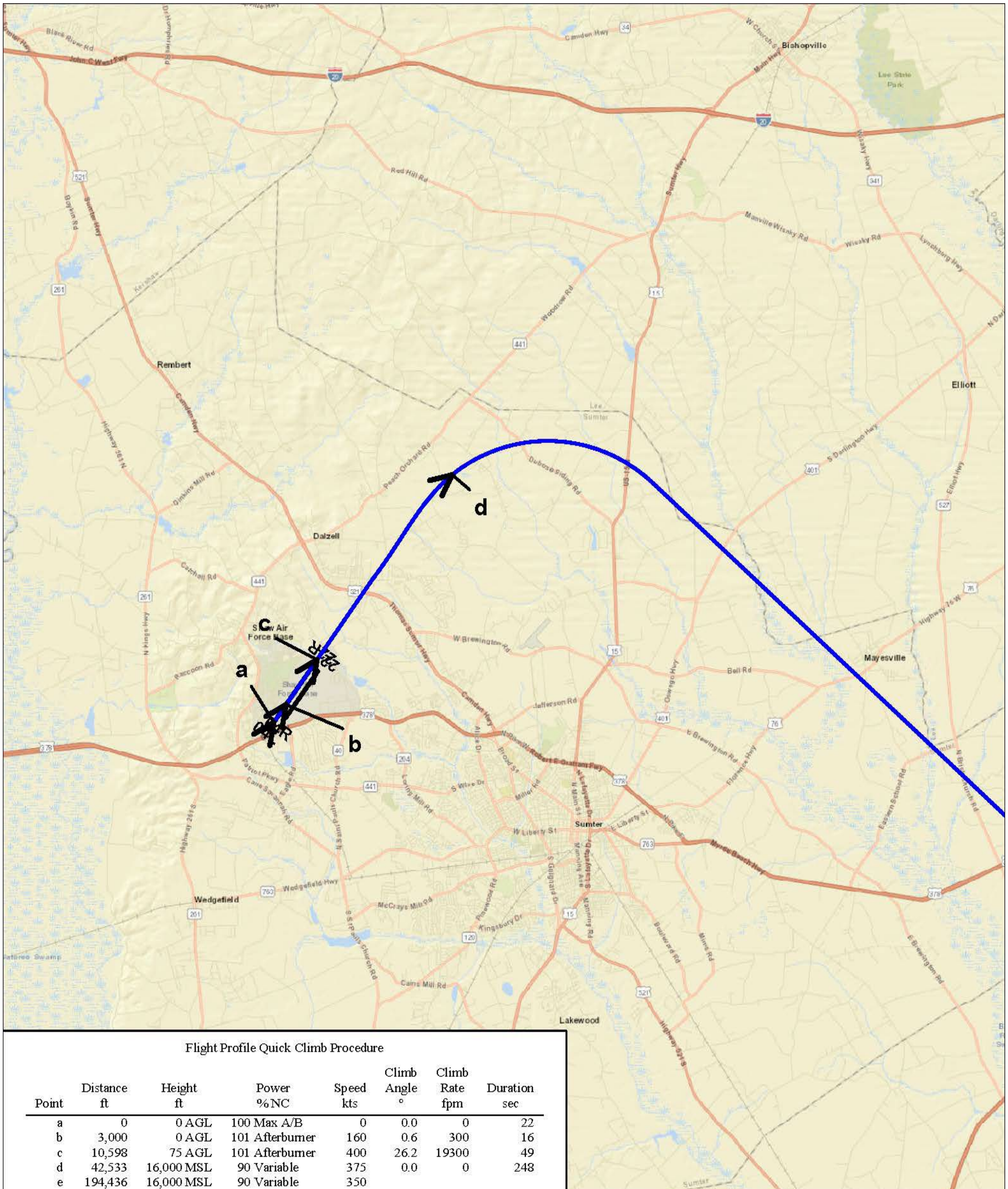
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Mil	0	0.0	0	22
b	3,000	0 AGL	100 Parallel	160	5.7	2300	18
c	10,000	700 AGL	100 Variable	300	9.1	5300	6
d	13,500	1,259 AGL	100 Variable	350	5.9	3700	25
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based F-16C Military Departure Flight Profile F16DM16

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:247,000 (1 inch = 20,600 feet)

N



Flight Profile Quick Climb Procedure

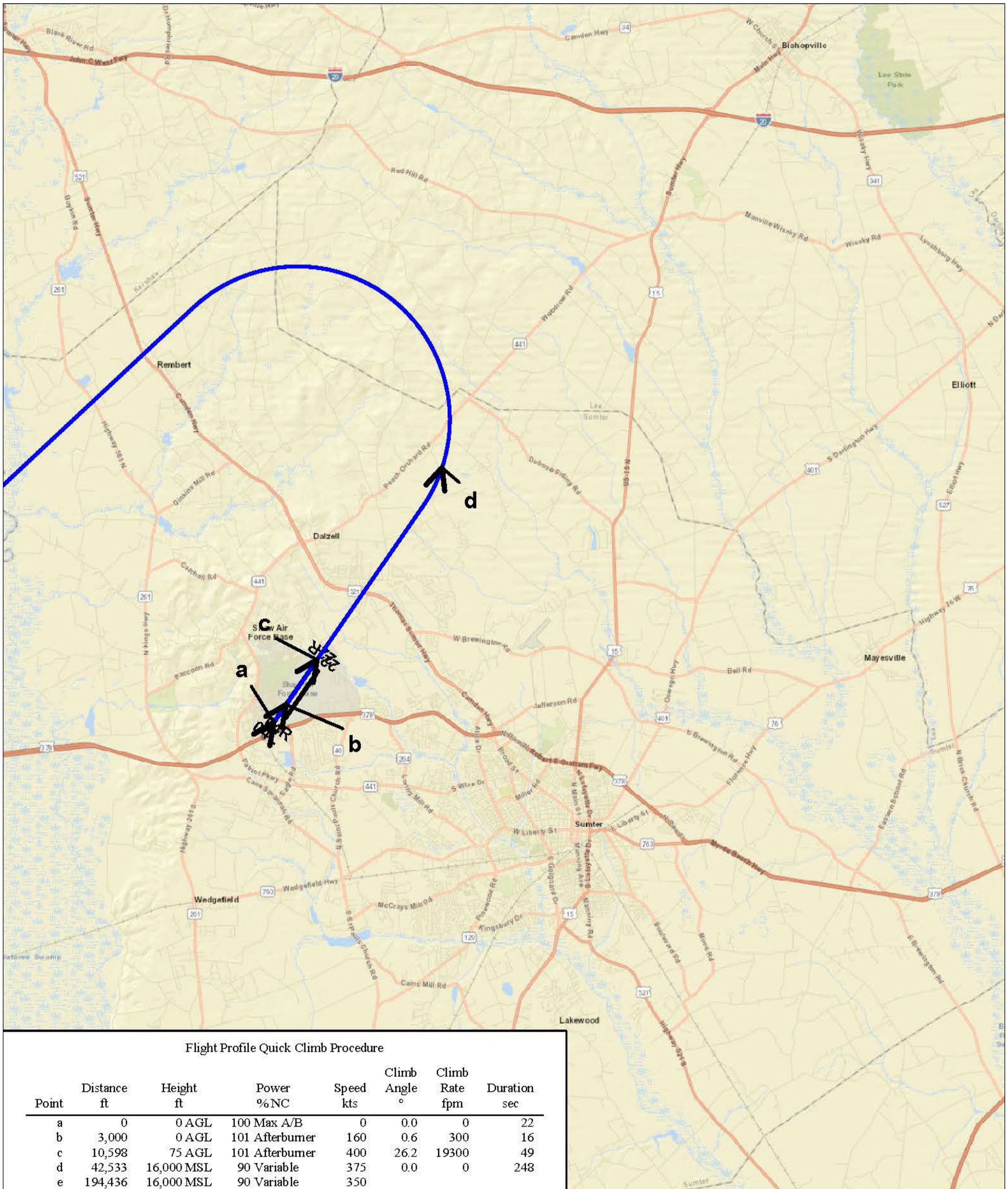
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ02

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:197,000 (1 inch = 16,400 feet)

N



Flight Profile Quick Climb Procedure

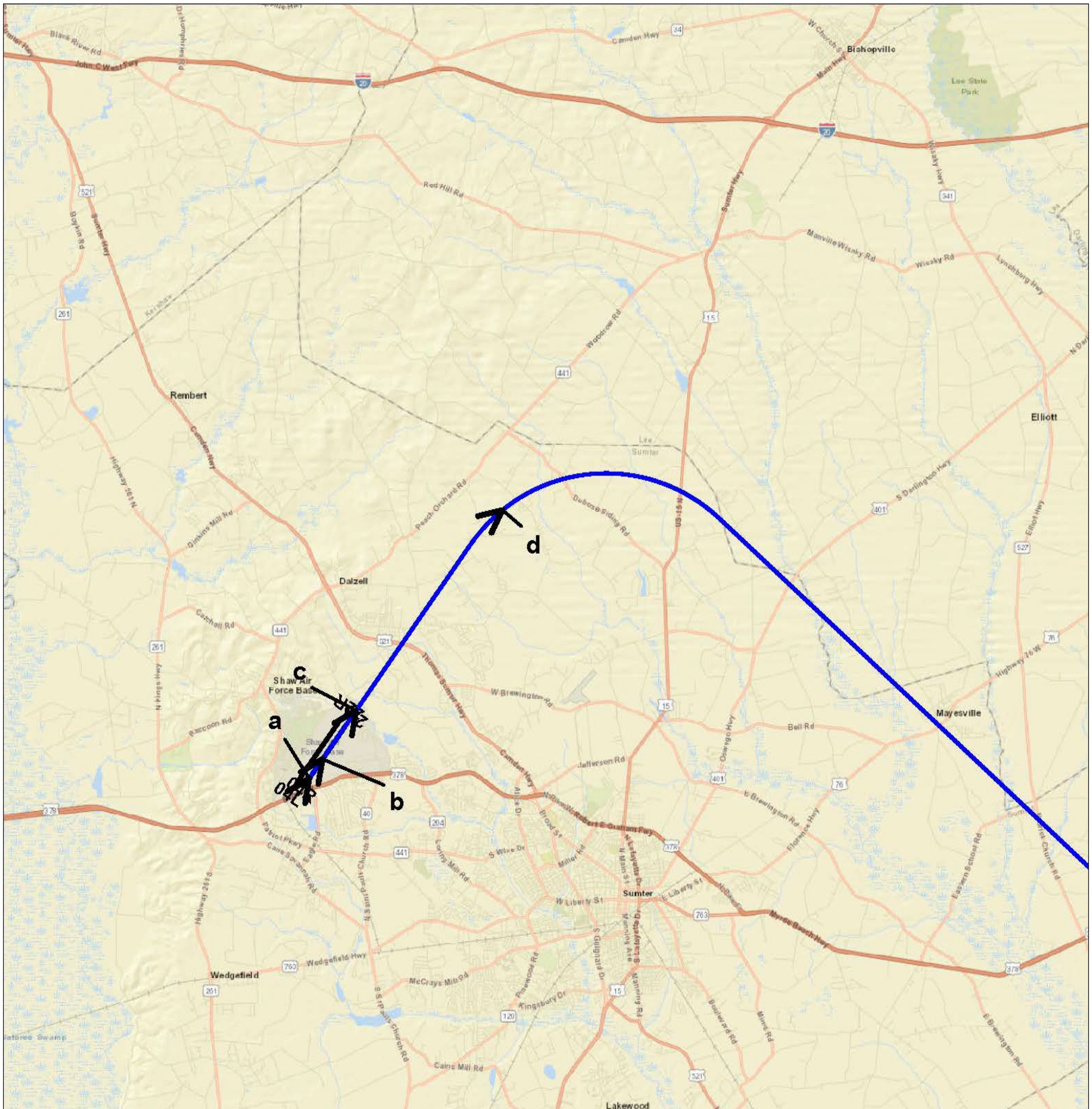
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ04

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:197,000 (1 inch = 16,400 feet)

N



Flight Profile Quick Climb Procedure

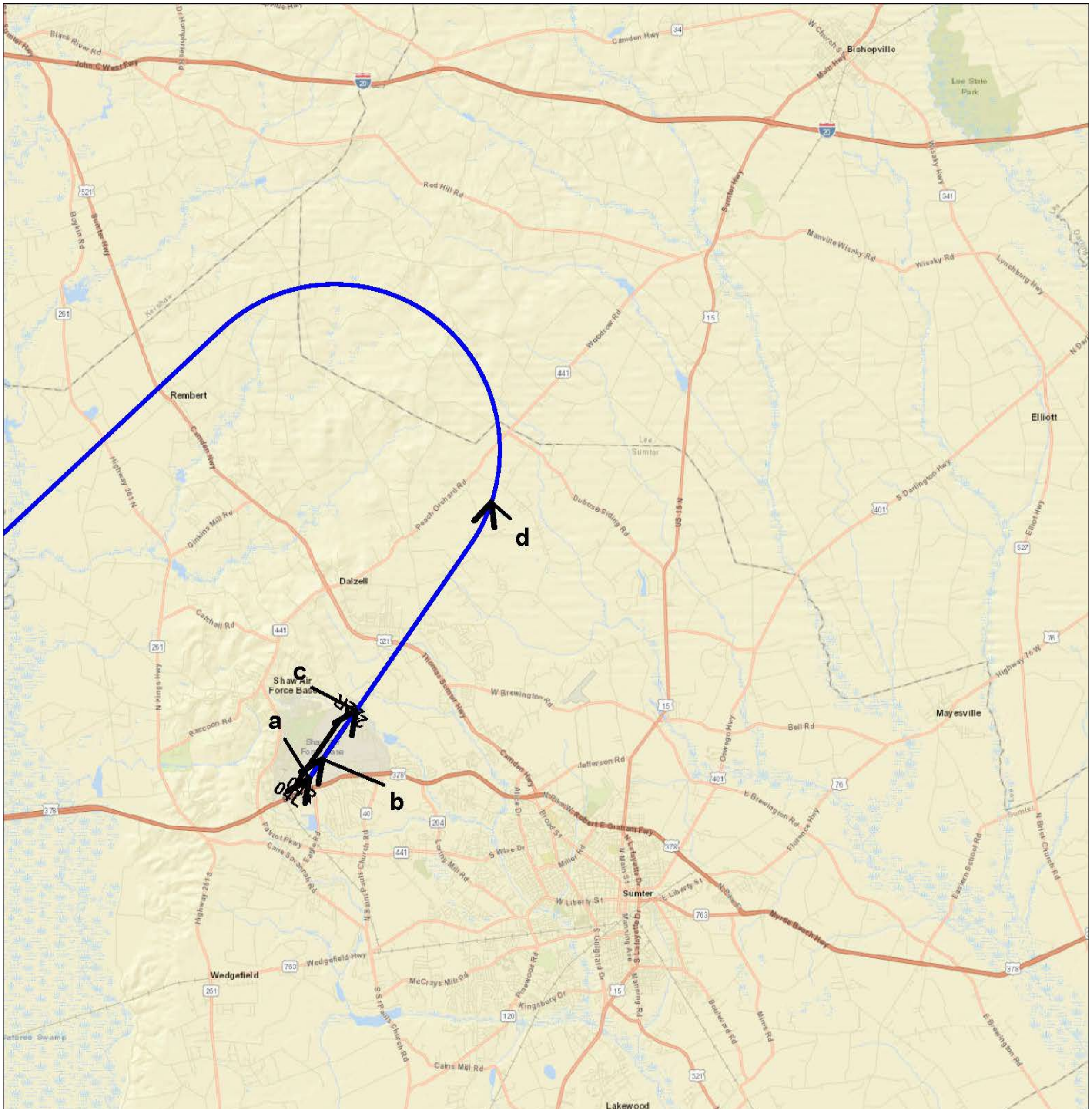
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ06

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:197,000 (1 inch = 16,400 feet)

N



Flight Profile Quick Climb Procedure

Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ08

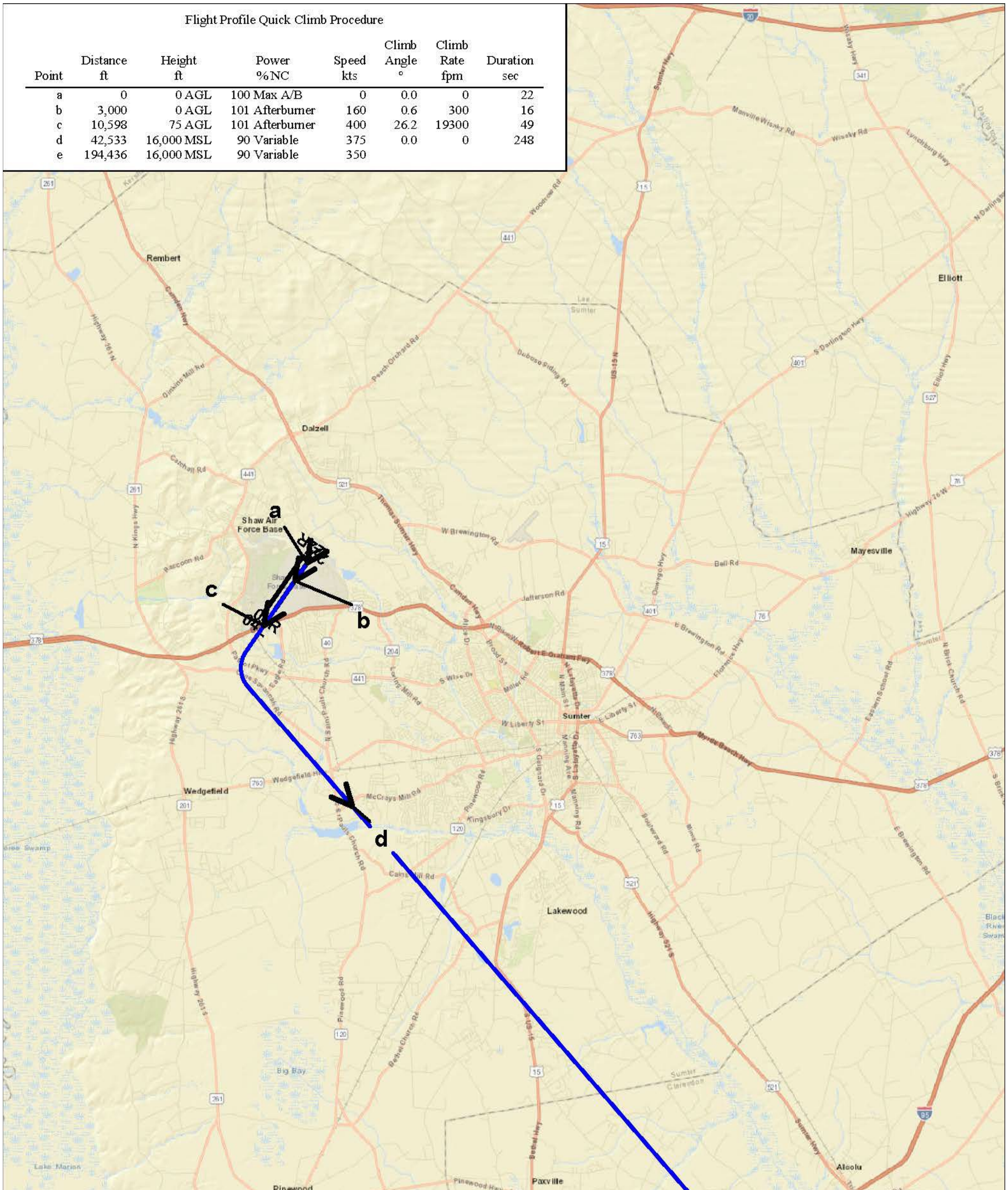
0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:197,000 (1 inch = 16,400 feet)

N

Flight Profile Quick Climb Procedure

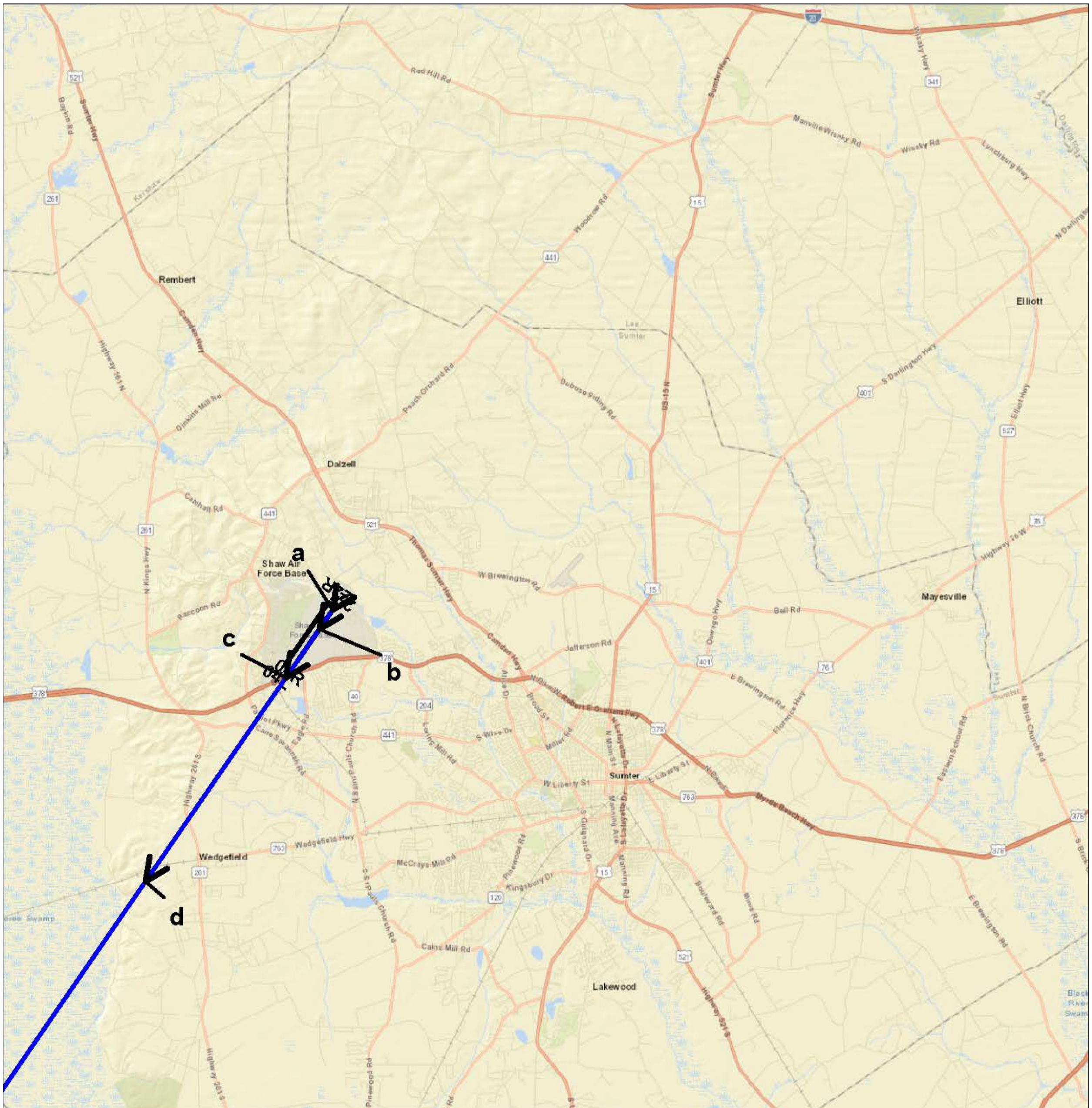
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			



Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ10

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:198,000 (1 inch = 16,500 feet)



Flight Profile Quick Climb Procedure

Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ12

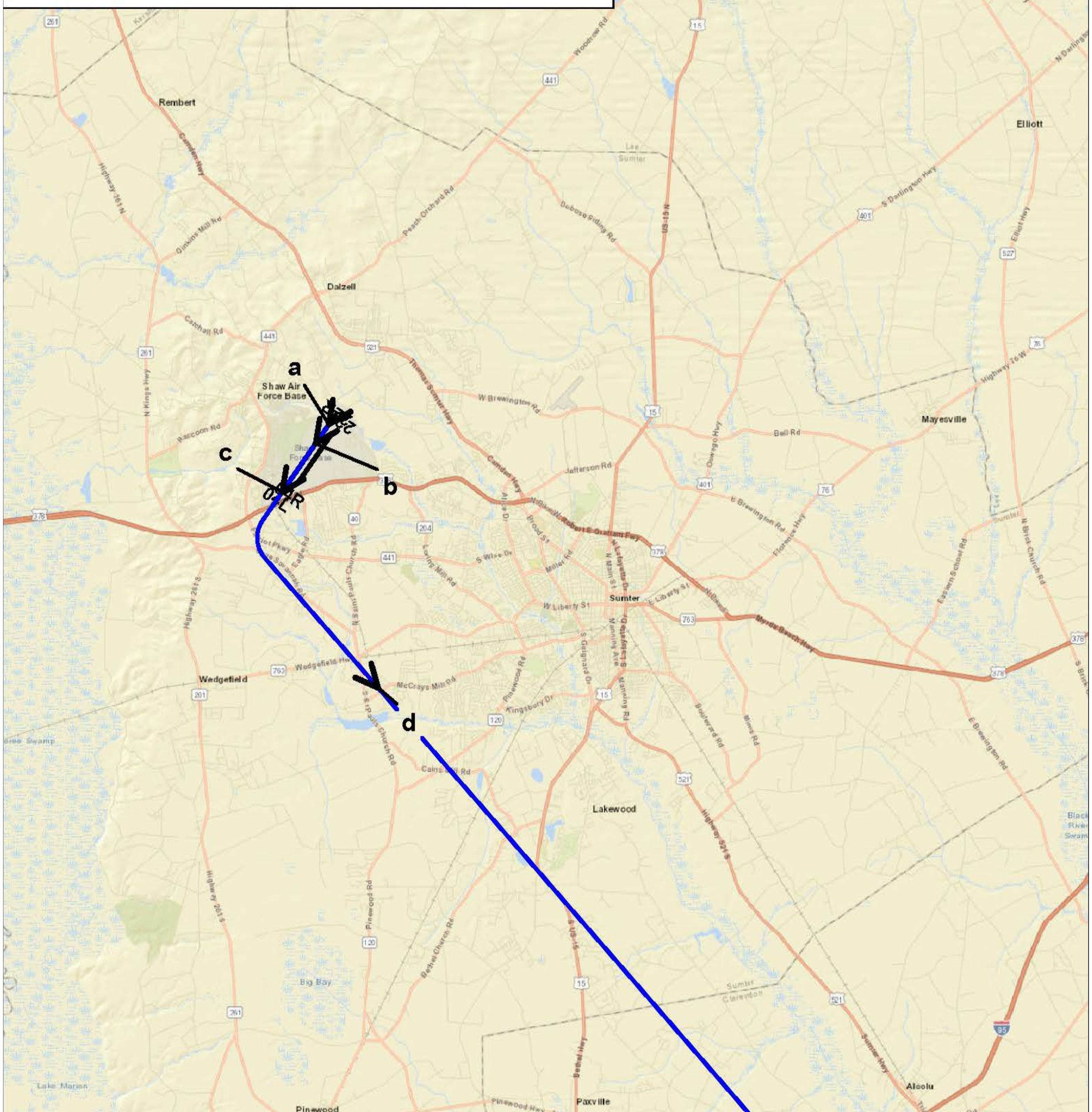
0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:198,000 (1 inch = 16,500 feet)

N

Flight Profile Quick Climb Procedure

Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

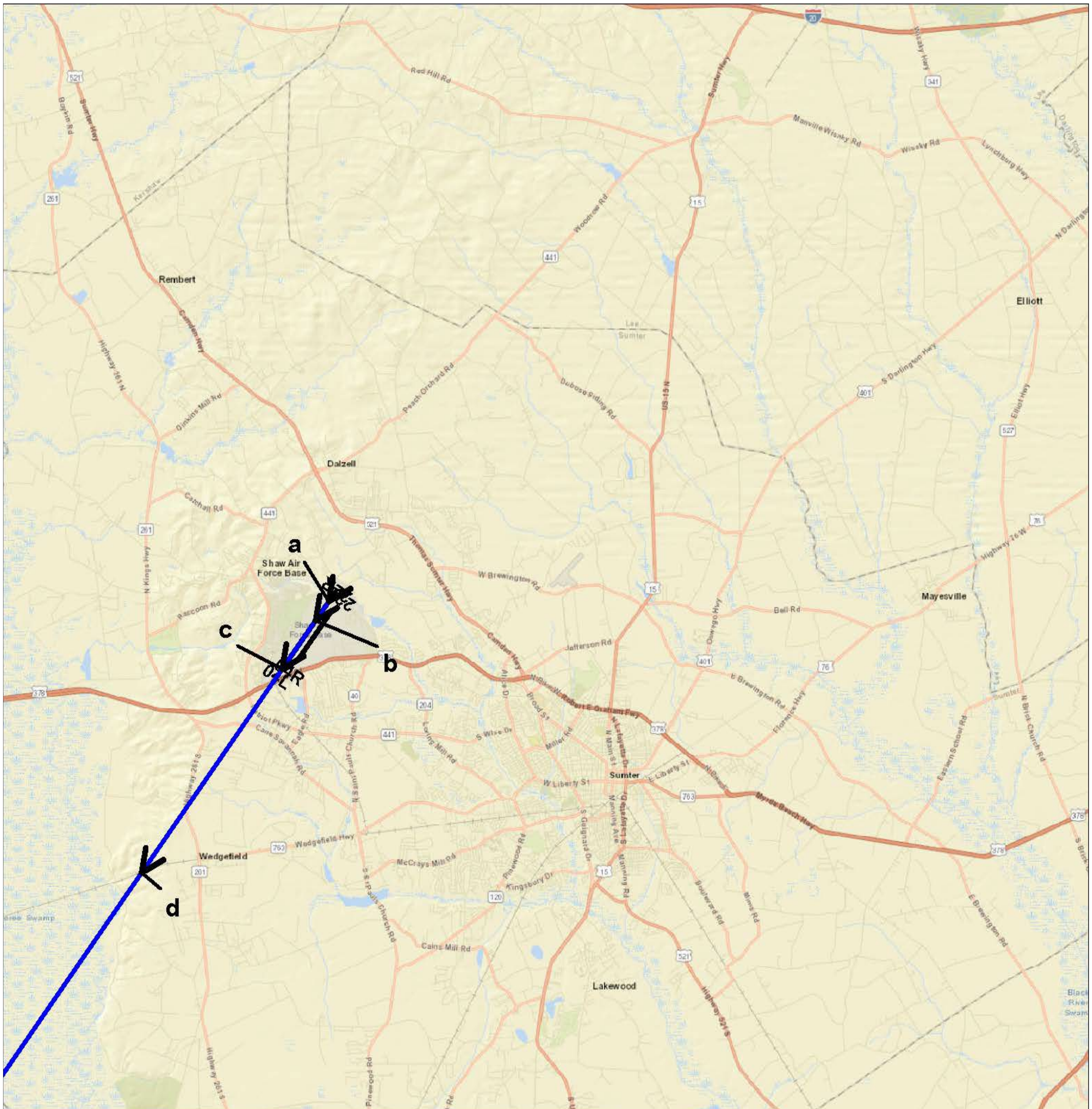


Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ14

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:198,000 (1 inch = 16,500 feet)

N



Flight Profile Quick Climb Procedure

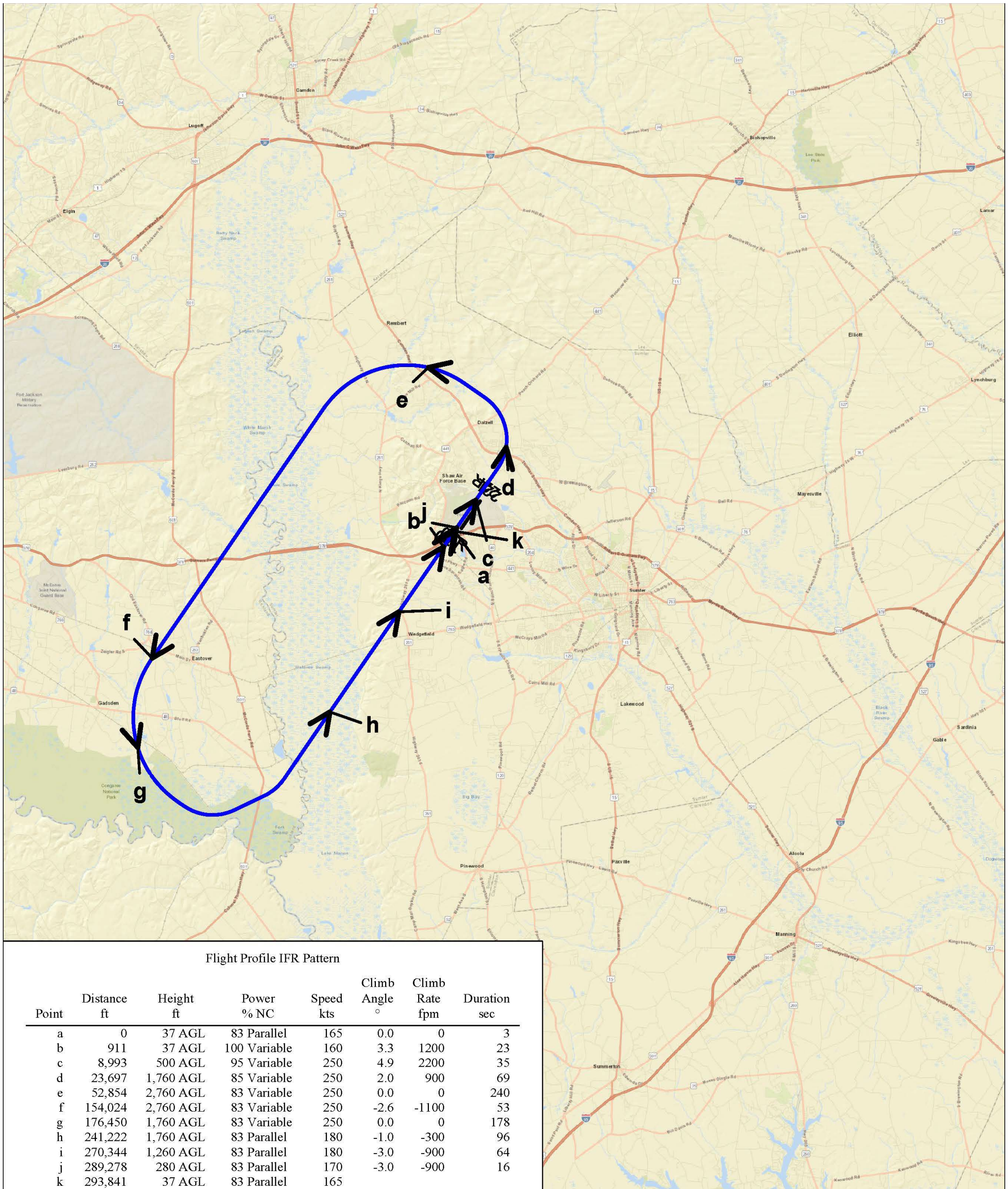
Point	Distance ft	Height ft	Power %NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	100 Max A/B	0	0.0	0	22
b	3,000	0 AGL	101 Afterburner	160	0.6	300	16
c	10,598	75 AGL	101 Afterburner	400	26.2	19300	49
d	42,533	16,000 MSL	90 Variable	375	0.0	0	248
e	194,436	16,000 MSL	90 Variable	350			

Shaw AFB Based F-16C Quick Climb Procedure Flight Profile F16DQ16

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:198,000 (1 inch = 16,500 feet)

N



Flight Profile IFR Pattern

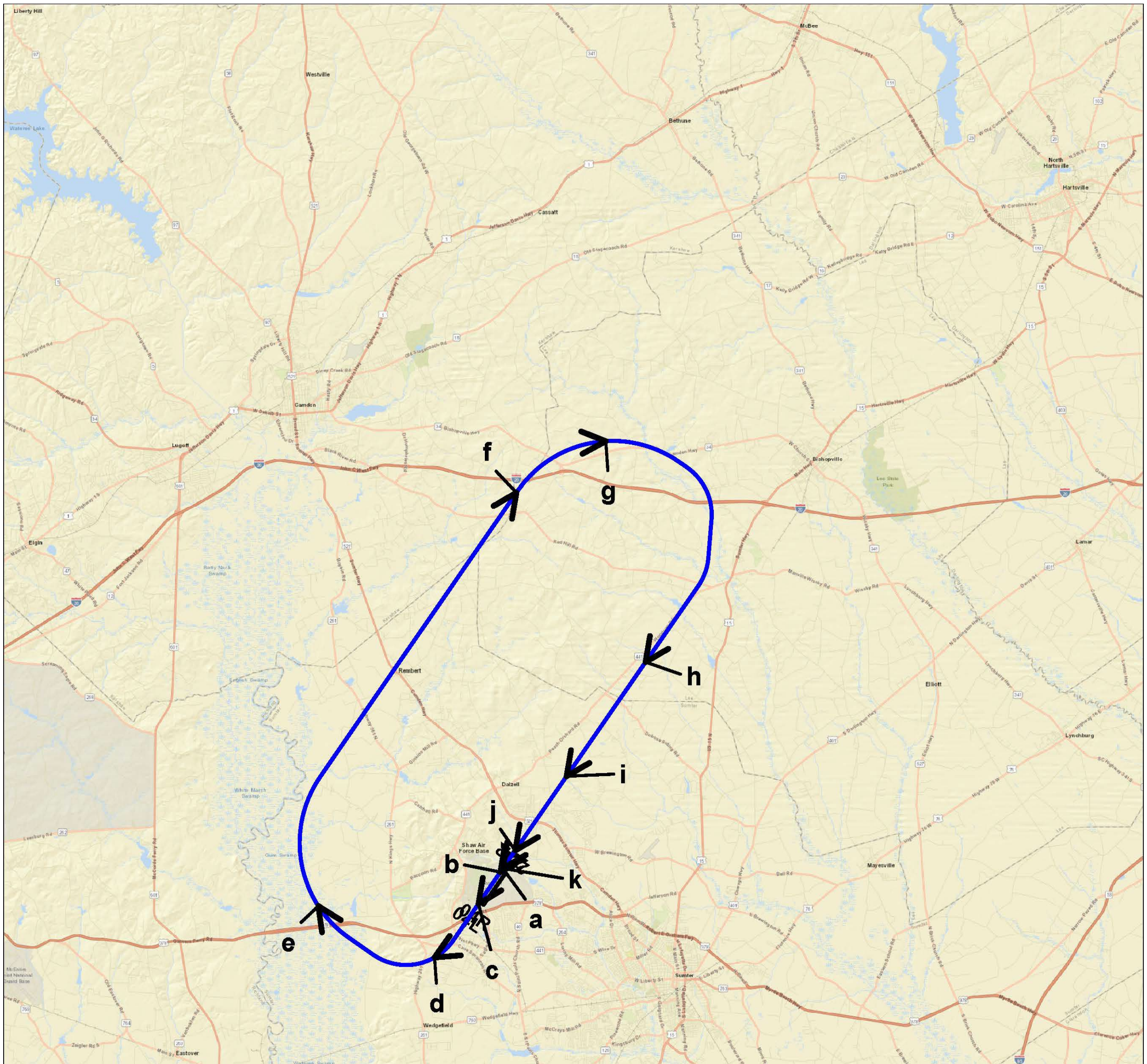
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	37 AGL	83 Parallel	165	0.0	0	3
b	911	37 AGL	100 Variable	160	3.3	1200	23
c	8,993	500 AGL	95 Variable	250	4.9	2200	35
d	23,697	1,760 AGL	85 Variable	250	2.0	900	69
e	52,854	2,760 AGL	83 Variable	250	0.0	0	240
f	154,024	2,760 AGL	83 Variable	250	-2.6	-1100	53
g	176,450	1,760 AGL	83 Variable	250	0.0	0	178
h	241,222	1,760 AGL	83 Parallel	180	-1.0	-300	96
i	270,344	1,260 AGL	83 Parallel	180	-3.0	-900	64
j	289,278	280 AGL	83 Parallel	170	-3.0	-900	16
k	293,841	37 AGL	83 Parallel	165			

Shaw AFB Based F-16C IFR Pattern Flight Profile F16CI01

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:340,000 (1 inch = 28,300 feet)

N



Flight Profile IFR Pattern

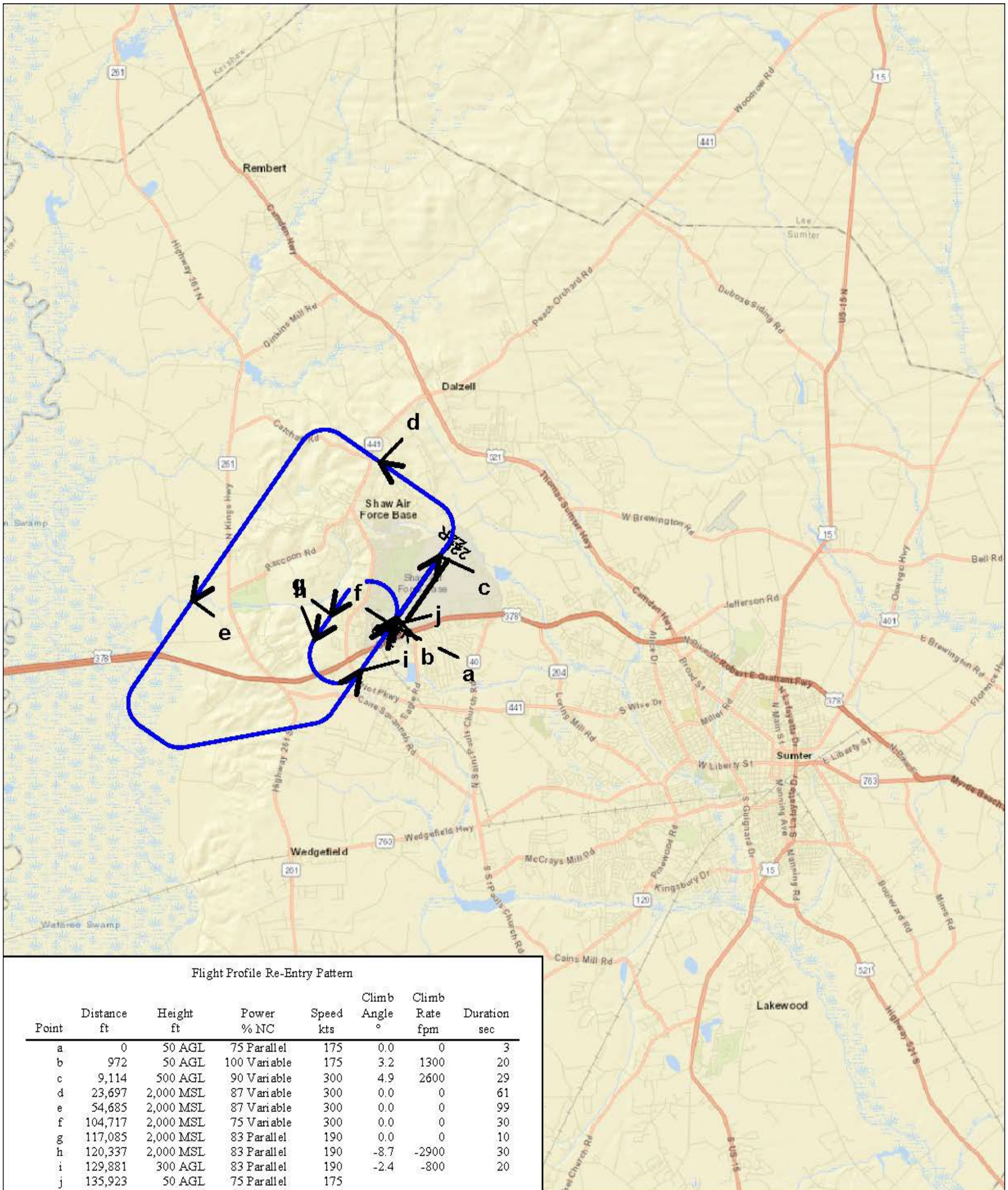
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	37 AGL	83 Parallel	165	0.0	0	3
b	911	37 AGL	100 Variable	160	3.3	1200	23
c	8,993	500 AGL	95 Variable	250	4.9	2200	35
d	23,697	1,760 AGL	85 Variable	250	2.0	900	69
e	52,854	2,760 AGL	83 Variable	250	0.0	0	240
f	154,024	2,760 AGL	83 Variable	250	-2.6	-1100	53
g	176,450	1,760 AGL	83 Variable	250	0.0	0	178
h	241,222	1,760 AGL	83 Parallel	180	-1.0	-300	96
i	270,344	1,260 AGL	83 Parallel	180	-3.0	-900	64
j	289,278	280 AGL	83 Parallel	170	-3.0	-900	16
k	293,841	37 AGL	83 Parallel	165			

Shaw AFB Based F-16C IFR Pattern Flight Profile F16CI03

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:339,000 (1 inch = 28,200 feet)

N



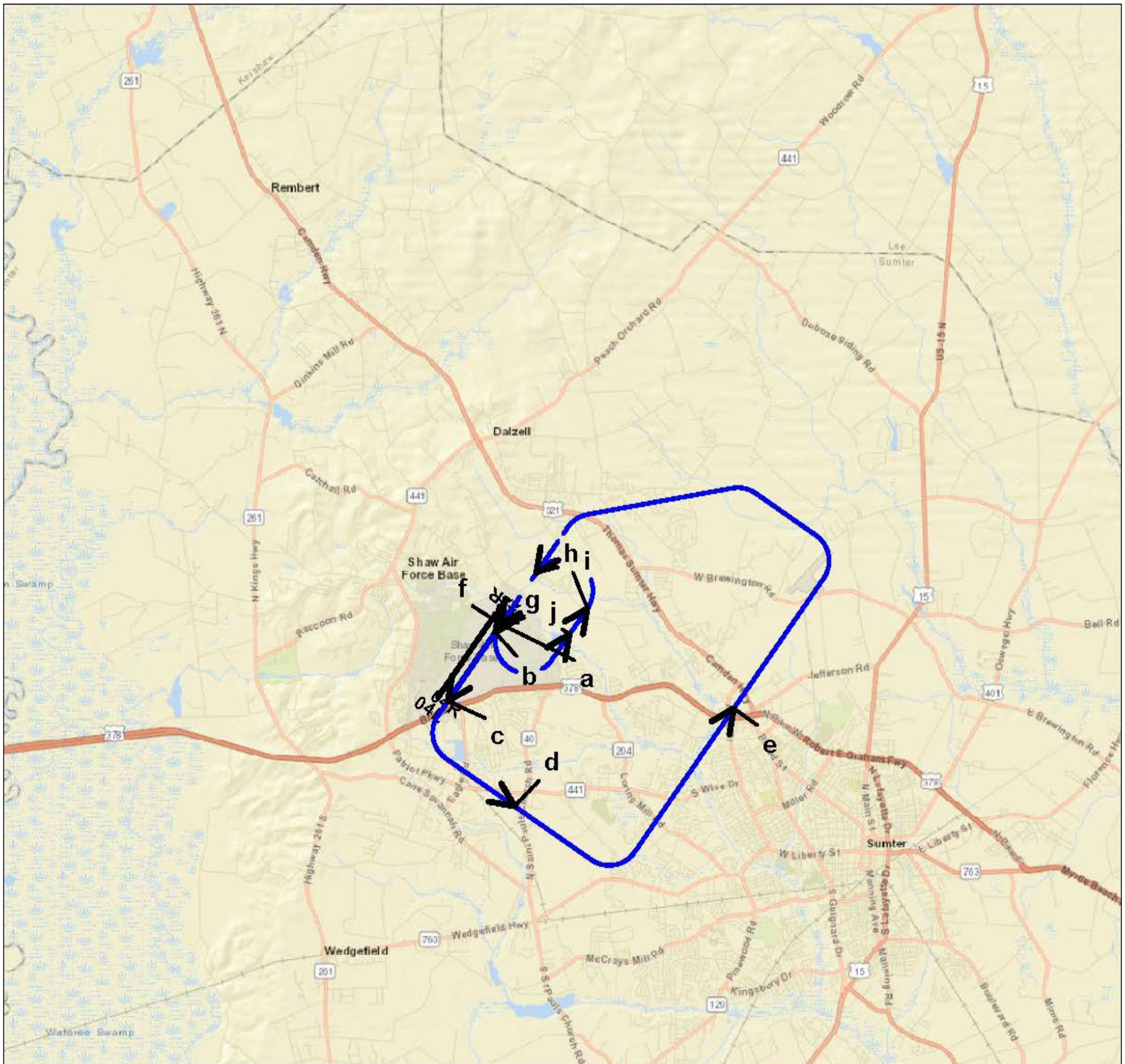
Flight Profile Re-Entry Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	75 Parallel	175	0.0	0	3
b	972	50 AGL	100 Variable	175	3.2	1300	20
c	9,114	500 AGL	90 Variable	300	4.9	2600	29
d	23,697	2,000 MSL	87 Variable	300	0.0	0	61
e	54,685	2,000 MSL	87 Variable	300	0.0	0	99
f	104,717	2,000 MSL	75 Variable	300	0.0	0	30
g	117,085	2,000 MSL	83 Parallel	190	0.0	0	10
h	120,337	2,000 MSL	83 Parallel	190	-8.7	-2900	30
i	129,881	300 AGL	83 Parallel	190	-2.4	-800	20
j	135,923	50 AGL	75 Parallel	175			

Shaw AFB Based F-16C Re-Entry Pattern Flight Profile F16CR01

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:154,000 (1 inch = 12,900 feet)



Flight Profile Re-Entry Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	75 Parallel	175	0.0	0	3
b	972	50 AGL	100 Variable	175	3.2	1300	20
c	9,114	500 AGL	90 Variable	300	4.9	2600	29
d	23,697	2,000 MSL	87 Variable	300	0.0	0	61
e	54,685	2,000 MSL	87 Variable	300	0.0	0	114
f	112,645	2,000 MSL	75 Variable	300	0.0	0	30
g	125,196	2,000 MSL	83 Parallel	190	0.0	0	10
h	128,266	2,000 MSL	83 Parallel	190	-8.7	-2900	30
i	137,810	300 AGL	83 Parallel	190	-2.4	-800	20
j	143,882	50 AGL	75 Parallel	175			

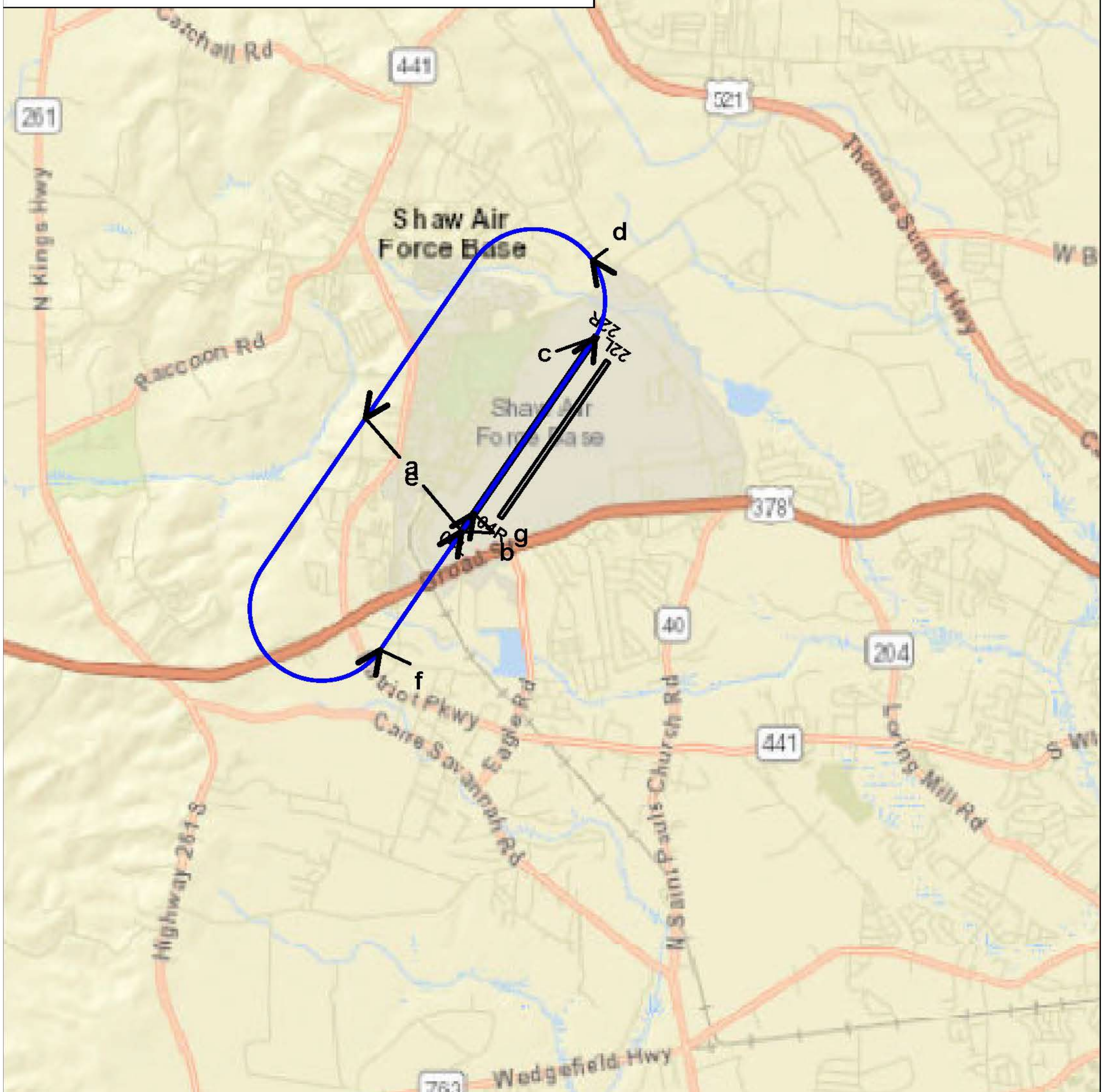
Shaw AFB Based F-16C Re-Entry Pattern Flight Profile F16CR03

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:154,000 (1 inch = 12,900 feet)

Flight Profile SFO Low Key Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	100 Takeoff	165	-3.1	-900	3
b	911	0 AGL	100 Takeoff	160	4.4	1800	23
c	9,965	700 AGL	100 Variable	300	13.1	7700	6
d	13,395	1,500 AGL	100 Variable	350	13.1	8300	24
e	27,390	5,000 MSL	75 Parallel	350	-14.5	-6800	39
f	44,599	300 AGL	75 Parallel	170	-2.4	-700	21
g	50,675	50 AGL	75 Parallel	165			



Shaw AFB Based F-16C SFO Low Key Pattern Flight Profile F16CS01

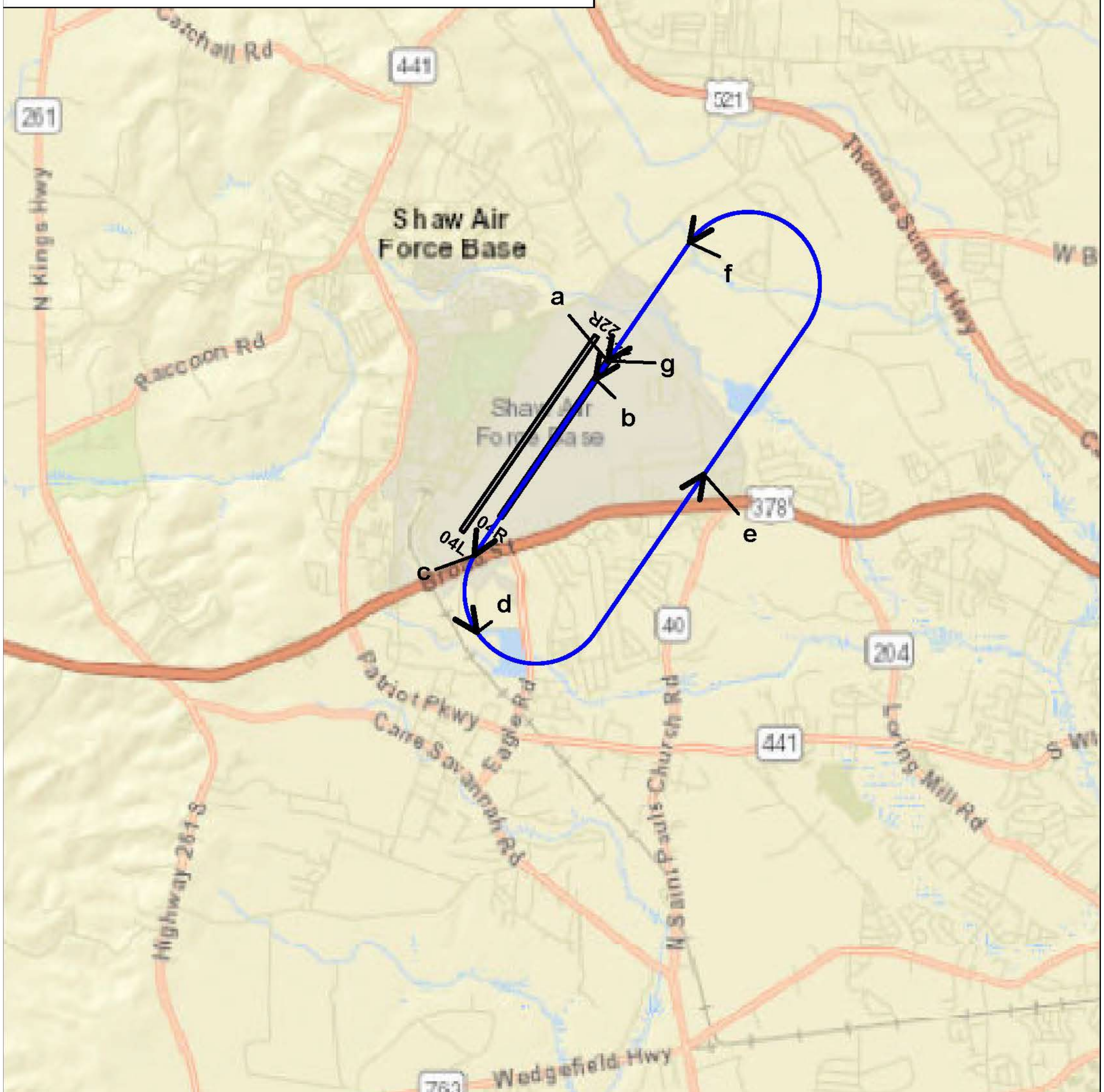
0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:65,700 (1 inch = 5,470 feet)

N

Flight Profile SFO Low Key Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	100 Takeoff	165	-3.1	-900	3
b	911	0 AGL	100 Takeoff	160	4.4	1800	23
c	9,965	700 AGL	100 Variable	300	13.1	7700	6
d	13,395	1,500 AGL	100 Variable	350	13.1	8300	24
e	27,390	5,000 MSL	75 Parallel	350	-14.5	-6800	39
f	44,599	300 AGL	75 Parallel	170	-2.4	-700	21
g	50,675	50 AGL	75 Parallel	165			

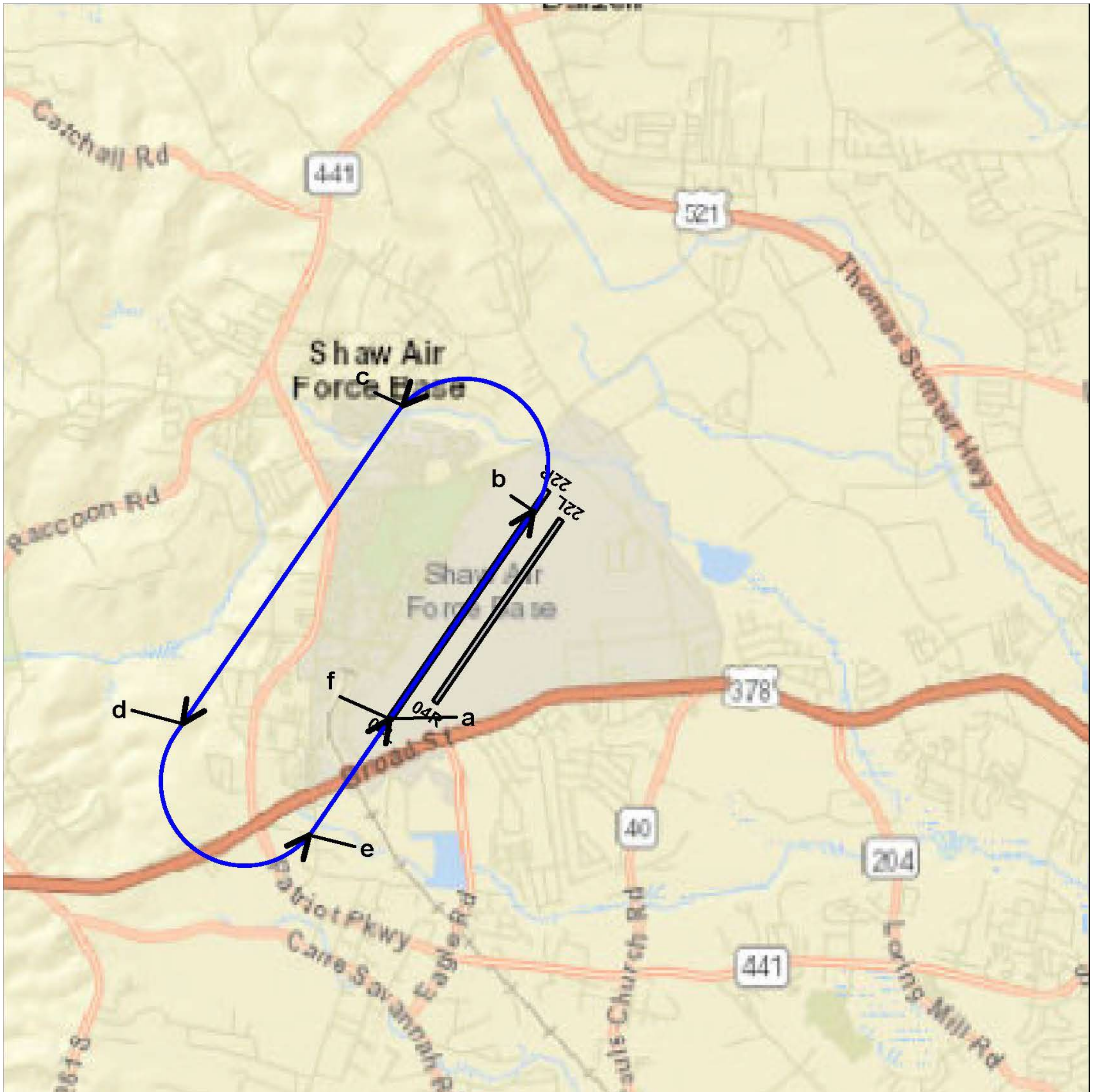


Shaw AFB Based F-16C SFO Low Key Pattern Flight Profile F16CS03

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:65,700 (1 inch = 5,470 feet)

N



Flight Profile VFR Pattern

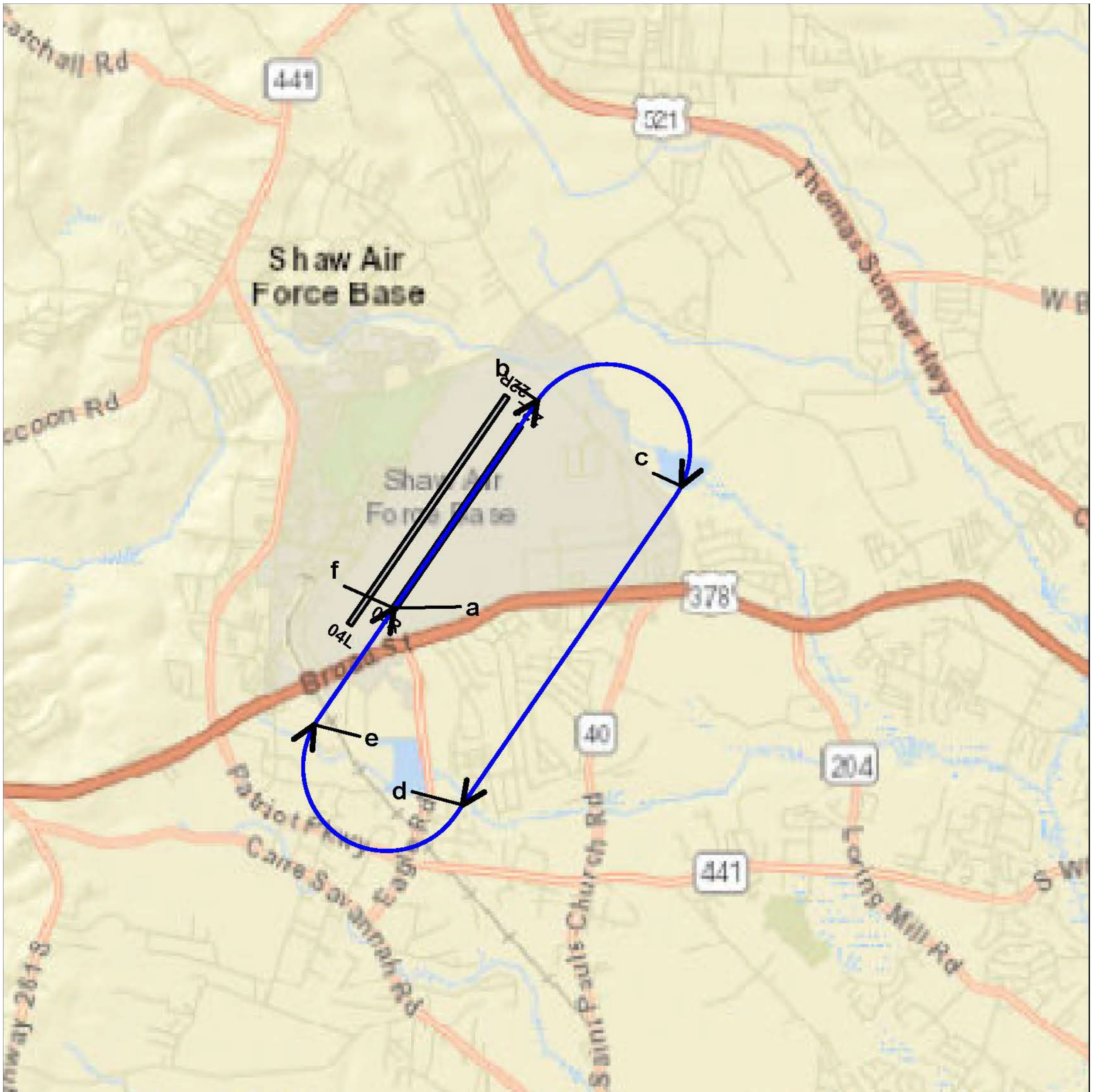
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based F-16C VFR Pattern Flight Profile F16CV01

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:55,500 (1 inch = 4,630 feet)

N



Flight Profile VFR Pattern

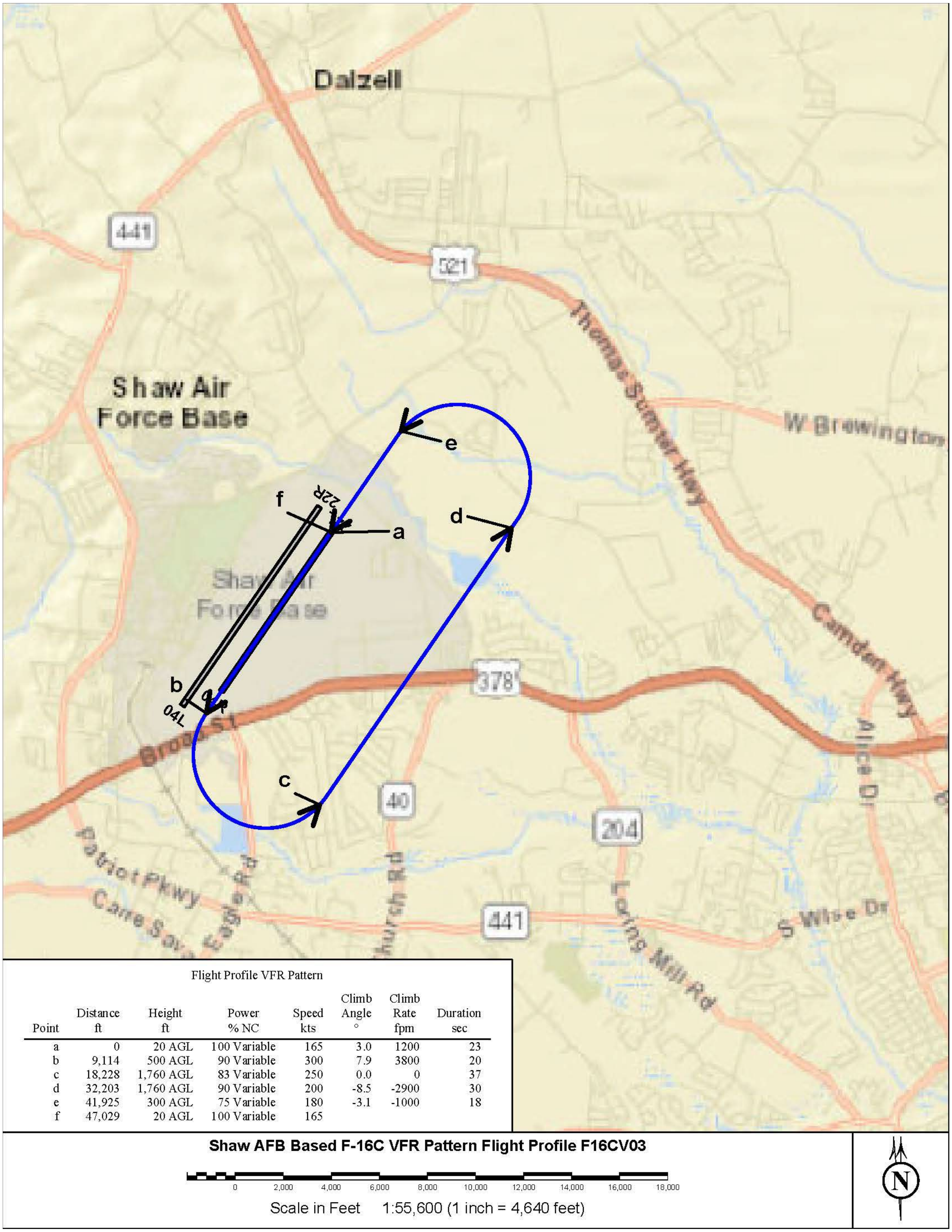
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based F-16C VFR Pattern Flight Profile F16CV02

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:55,600 (1 inch = 4,630 feet)

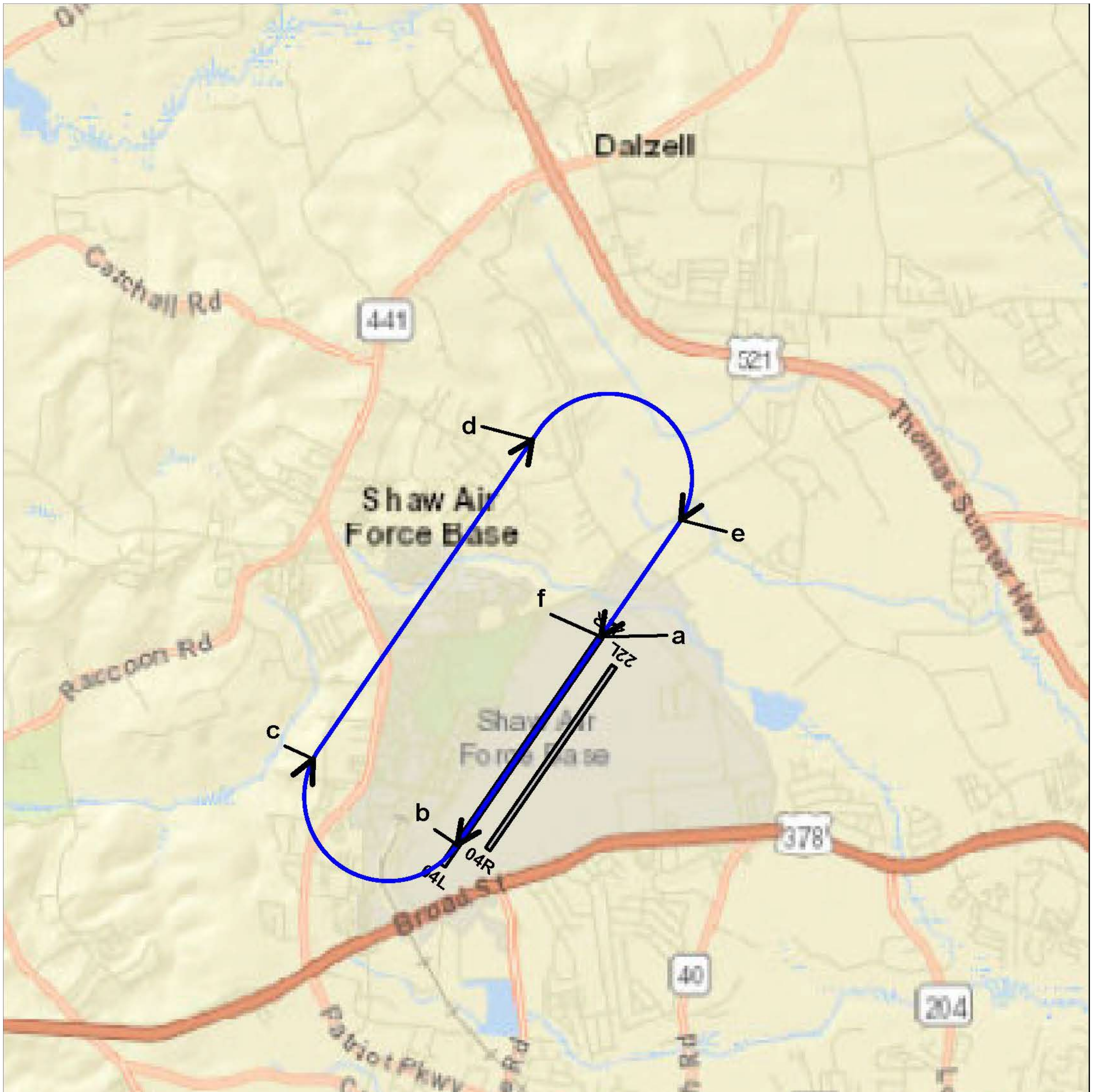
N



Flight Profile VFR Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based F-16C VFR Pattern Flight Profile F16CV03



Flight Profile VFR Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based F-16C VFR Pattern Flight Profile F16CV04

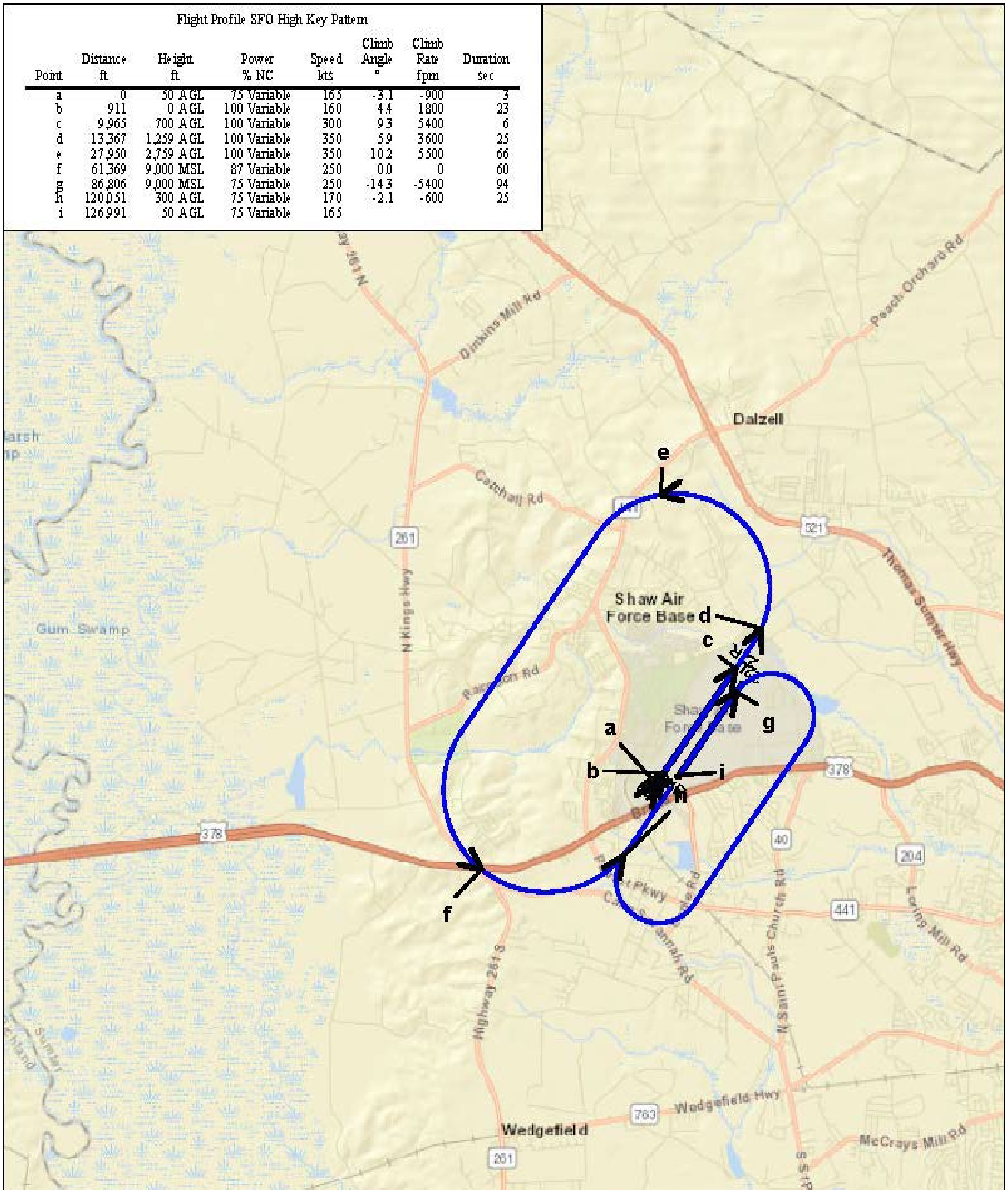
0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:55,500 (1 inch = 4,630 feet)

N

Flight Profile SFO High Key Pattern

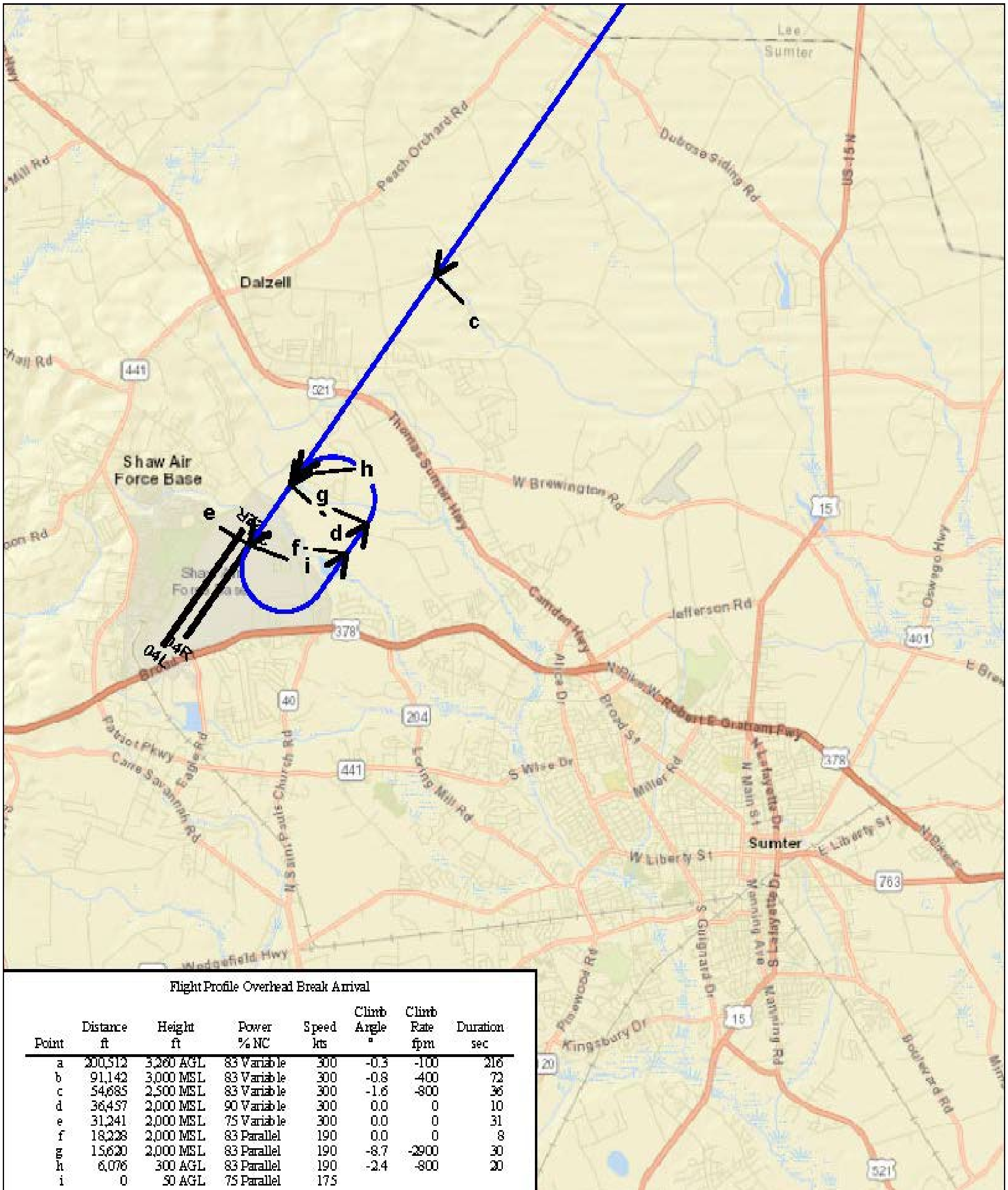
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	75 Variable	165	-3.1	-900	3
b	911	0 AGL	100 Variable	160	4.4	1800	23
c	9,965	700 AGL	100 Variable	300	9.3	5400	6
d	13,367	1,259 AGL	100 Variable	350	5.9	3600	25
e	27,950	2,759 AGL	100 Variable	350	10.2	5500	66
f	61,369	9,000 MSL	87 Variable	250	0.0	0	60
g	86,806	9,000 MSL	75 Variable	250	-14.3	-5400	94
h	120,051	300 AGL	75 Variable	170	-2.1	-600	25
i	126,991	50 AGL	75 Variable	165			



Shaw AFB Based F-16C SFO High Key Pattern Flight Profile F16CS05

Scale in Feet 1:101,000 (1 inch = 8,420 feet)

Flight Profiles for Contract ADAIR Category C Aircraft



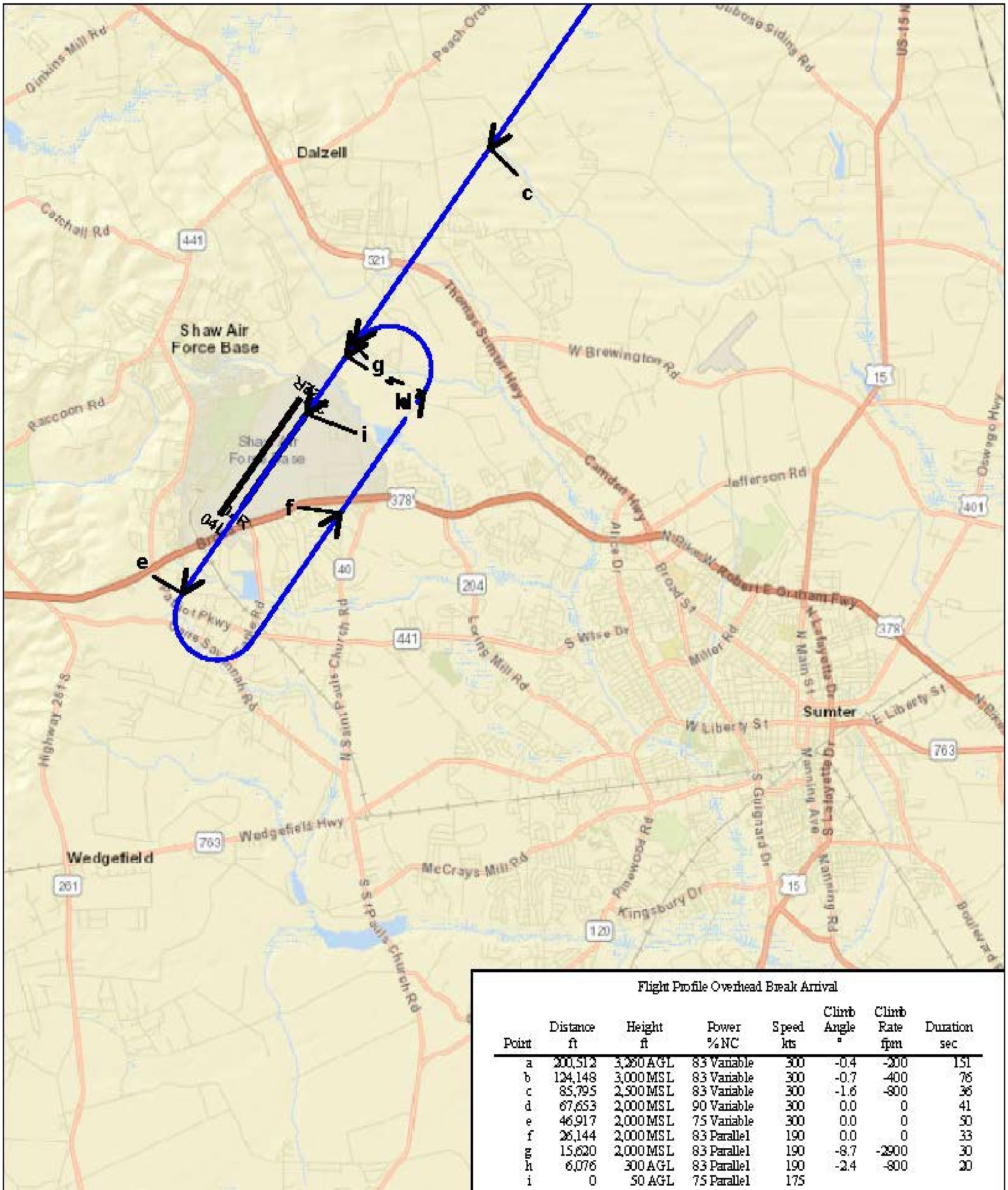
Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	216
b	91,142	3,000 MSL	83 Variable	300	-0.8	-400	72
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2LO01

0 4,000 8,000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,470 feet)



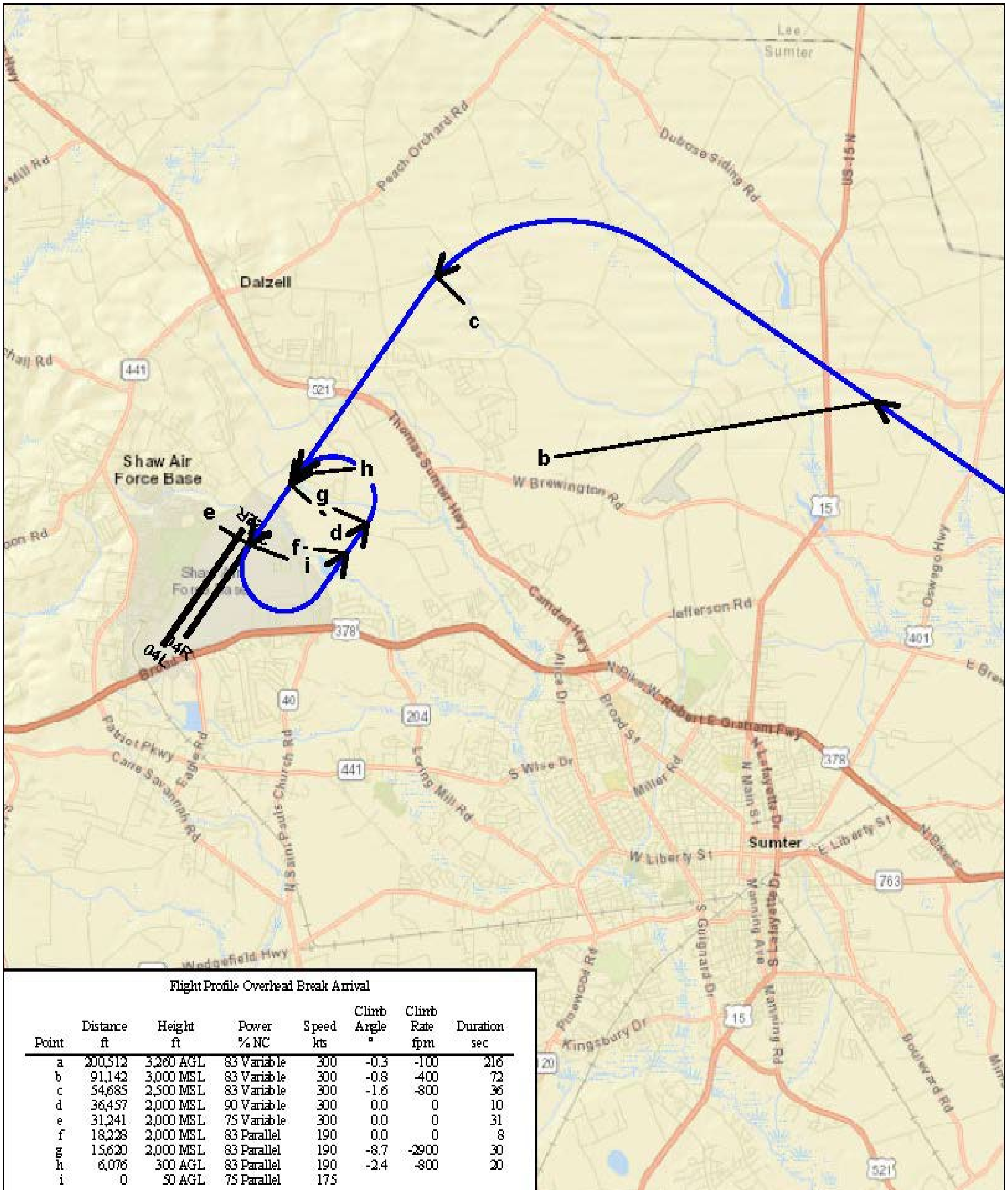
Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	151
b	124,148	3,000 MSL	83 Variable	300	-0.7	-400	76
c	85,795	2,300 MSL	83 Variable	300	-1.6	-800	36
d	67,653	2,000 MSL	90 Variable	300	0.0	0	41
e	46,917	2,000 MSL	75 Variable	300	0.0	0	50
f	26,144	2,000 MSL	83 Parallel	190	0.0	0	33
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2LO08

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



Flight Profile Overhead Break Arrival

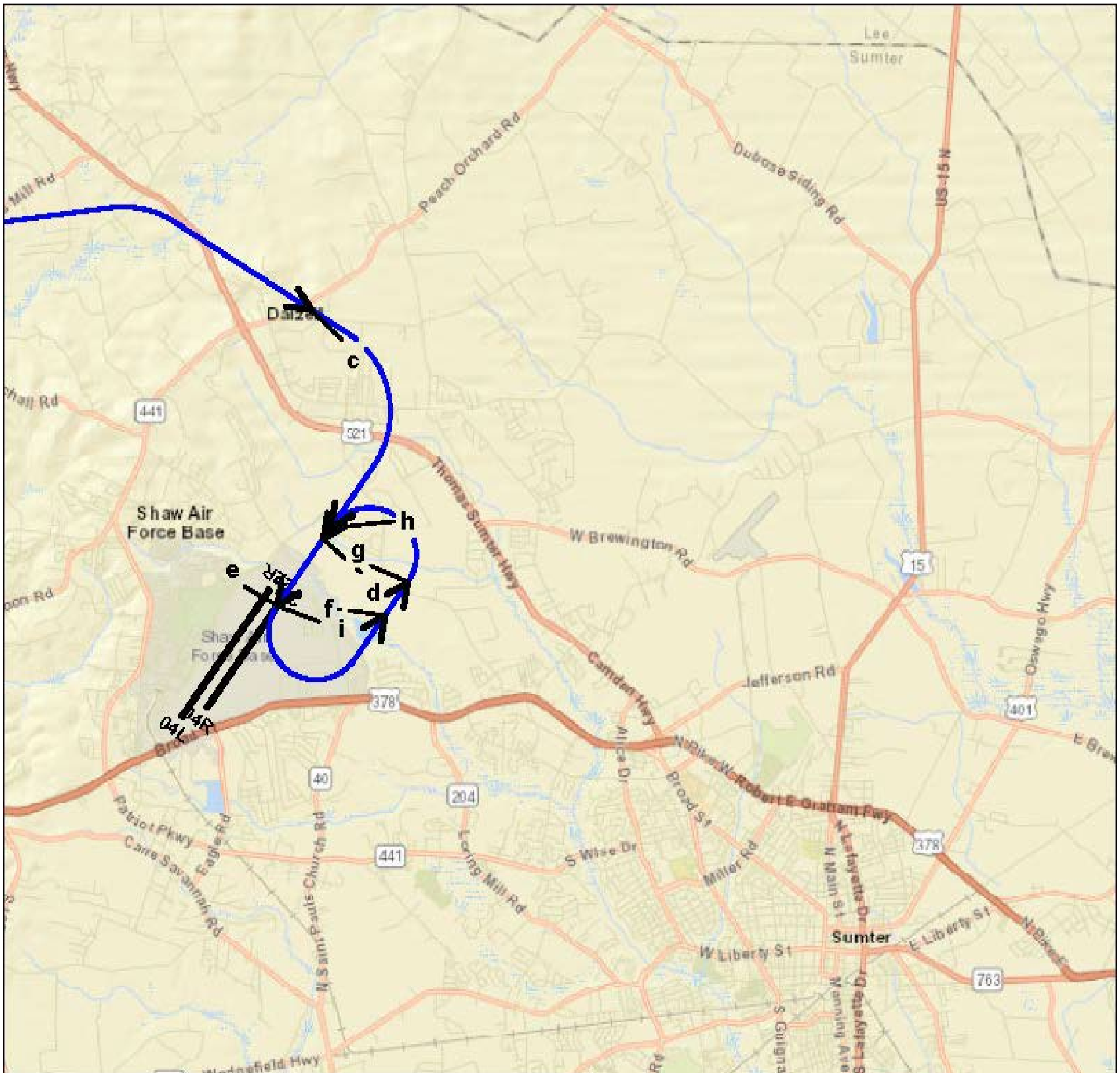
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	216
b	91,142	3,000 MSL	83 Variable	300	-0.8	-400	72
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2LO19

0 4,000 8,000 12000 16000 20000 24,000 28000 32,000

Scale in Feet 1:102,000 (1 inch = 8,470 feet)

N



Flight Profile Overhead Break Arrival

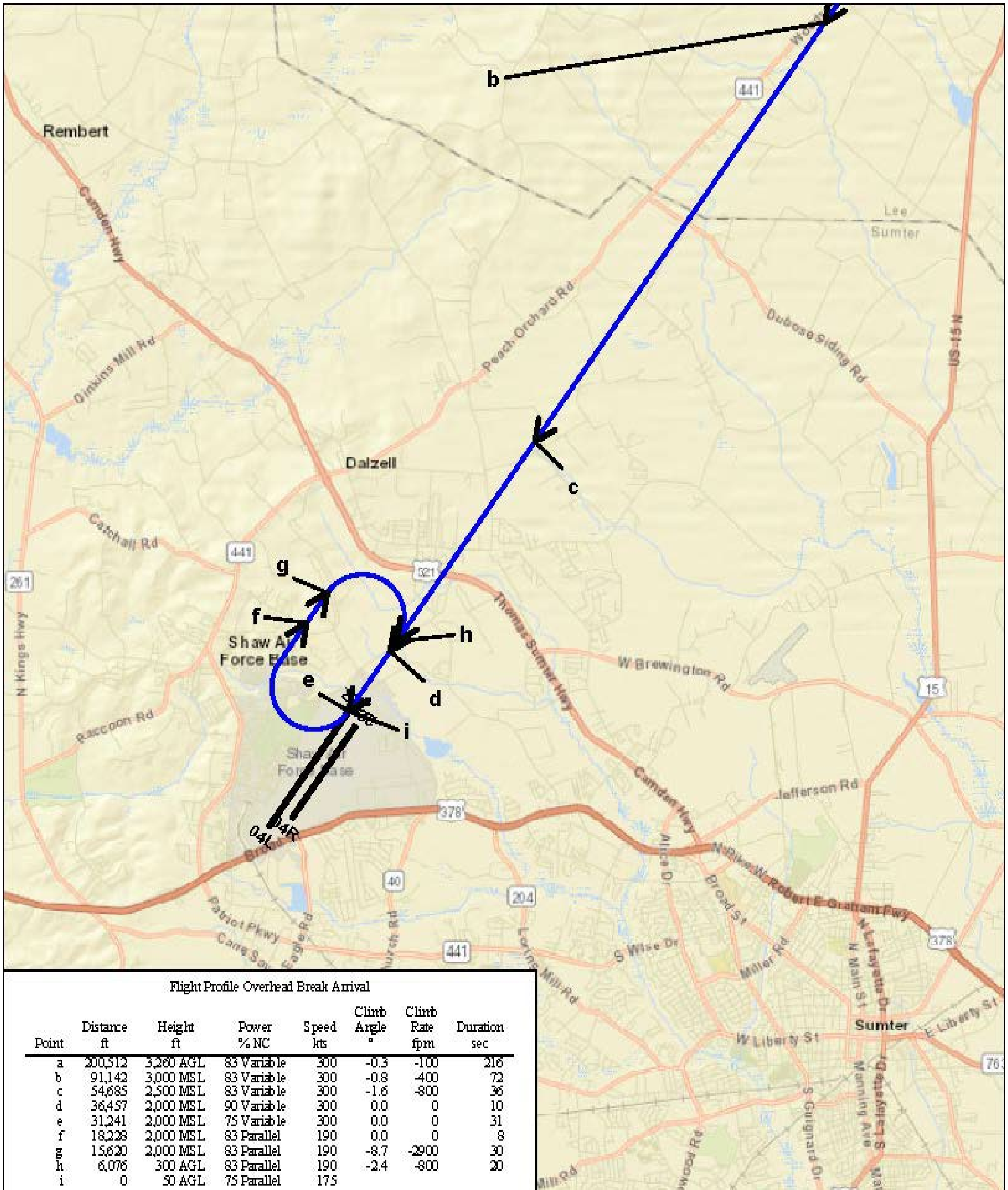
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	216
b	91,142	3,000 MSL	83 Variable	300	-0.8	-400	72
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2LO28

0 4,000 8,000 12000 16000 20000 24,000 28000 32,000

Scale in Feet 1:102,000 (1 inch = 8,470 feet)

N



Flight Profile Overhead Break Arrival

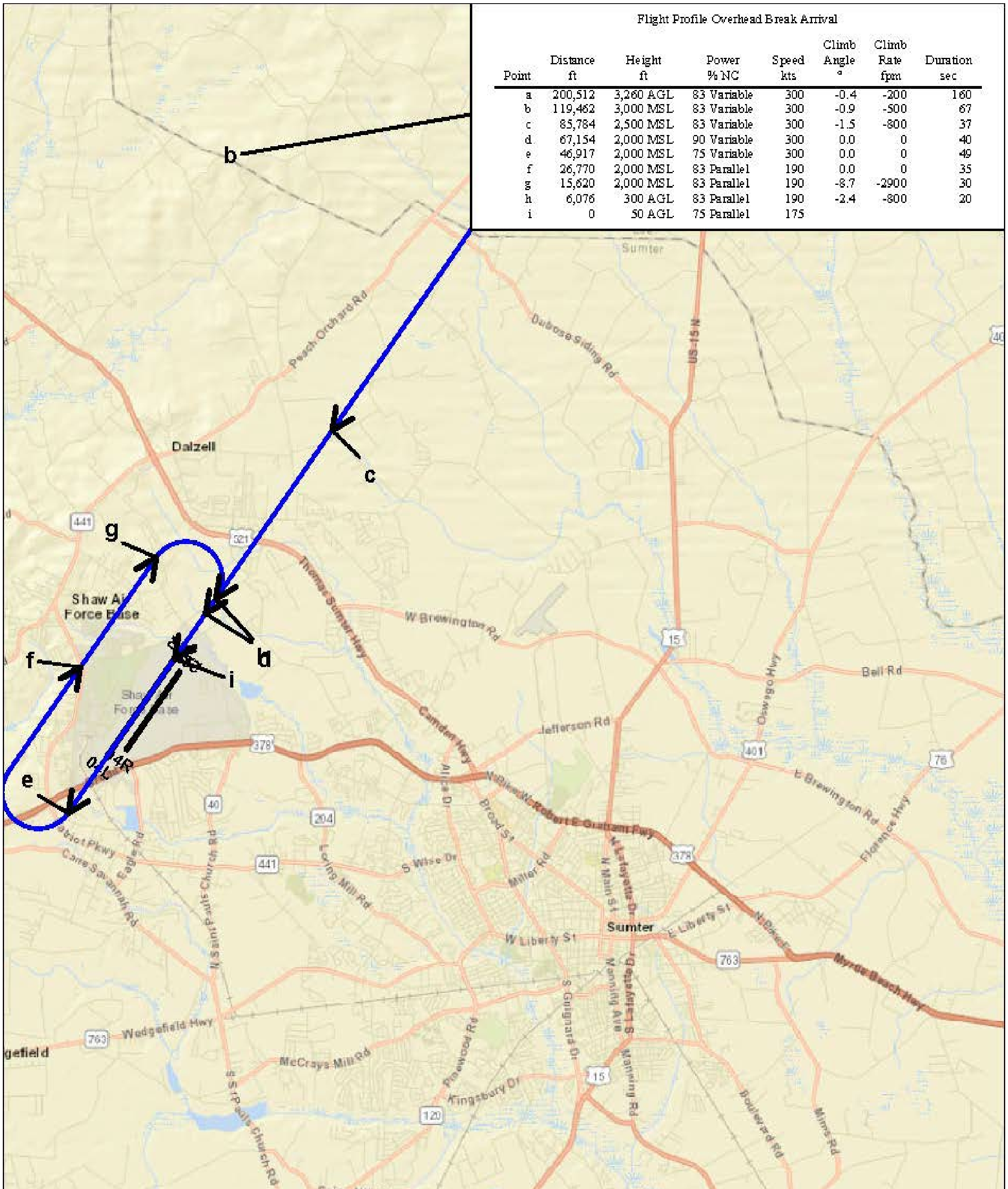
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	216
b	91,142	3,000 MSL	83 Variable	300	-0.8	-400	72
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2R001

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:101,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

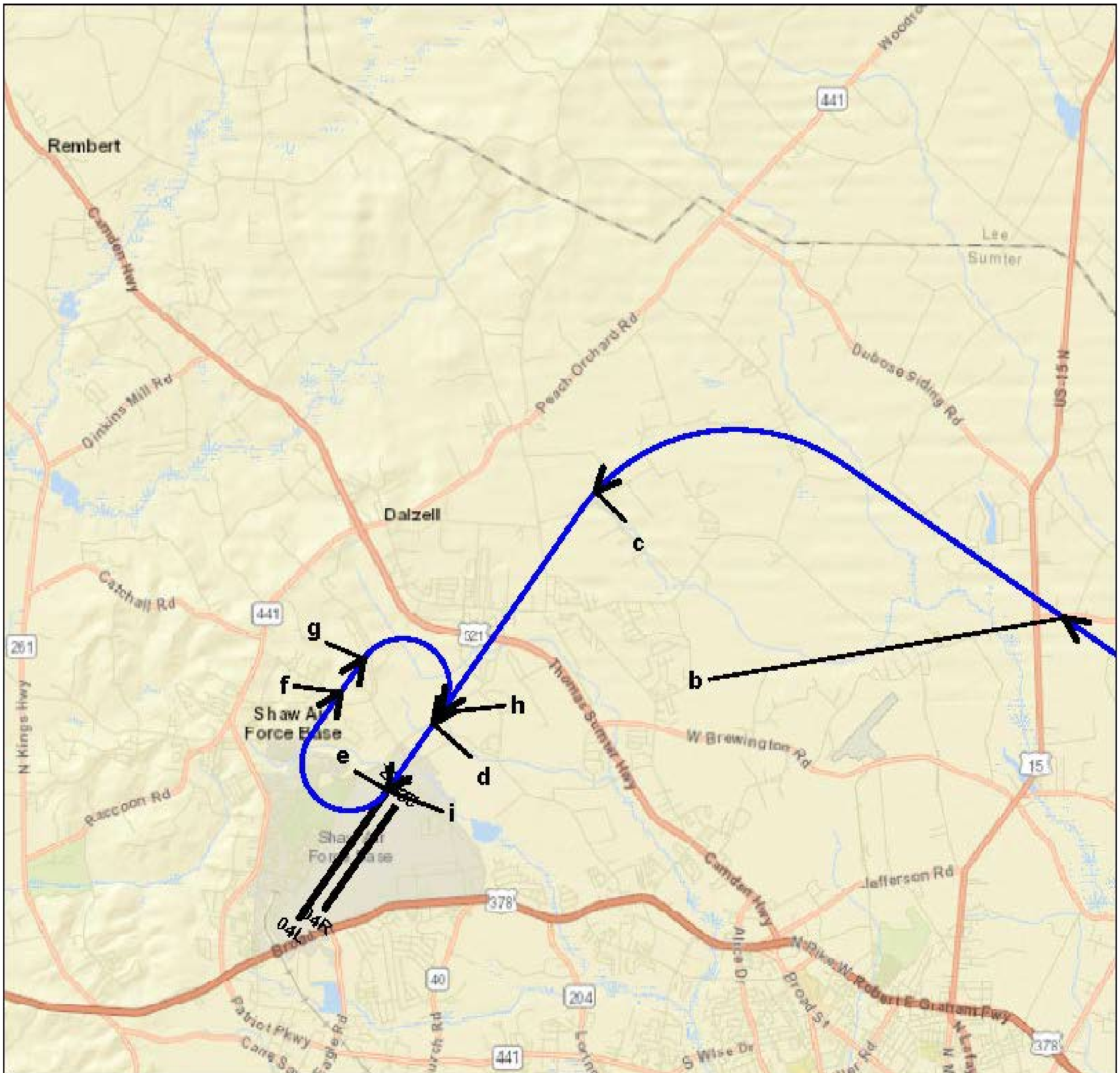
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	160
b	119,462	3,000 MSL	83 Variable	300	-0.9	-500	67
c	85,784	2,500 MSL	83 Variable	300	-1.5	-800	37
d	67,154	2,000 MSL	90 Variable	300	0.0	0	40
e	46,917	2,000 MSL	75 Variable	300	0.0	0	49
f	26,770	2,000 MSL	83 Parallel	190	0.0	0	35
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2RO08

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,880 feet)

N



Flight Profile Overhead Break Arrival

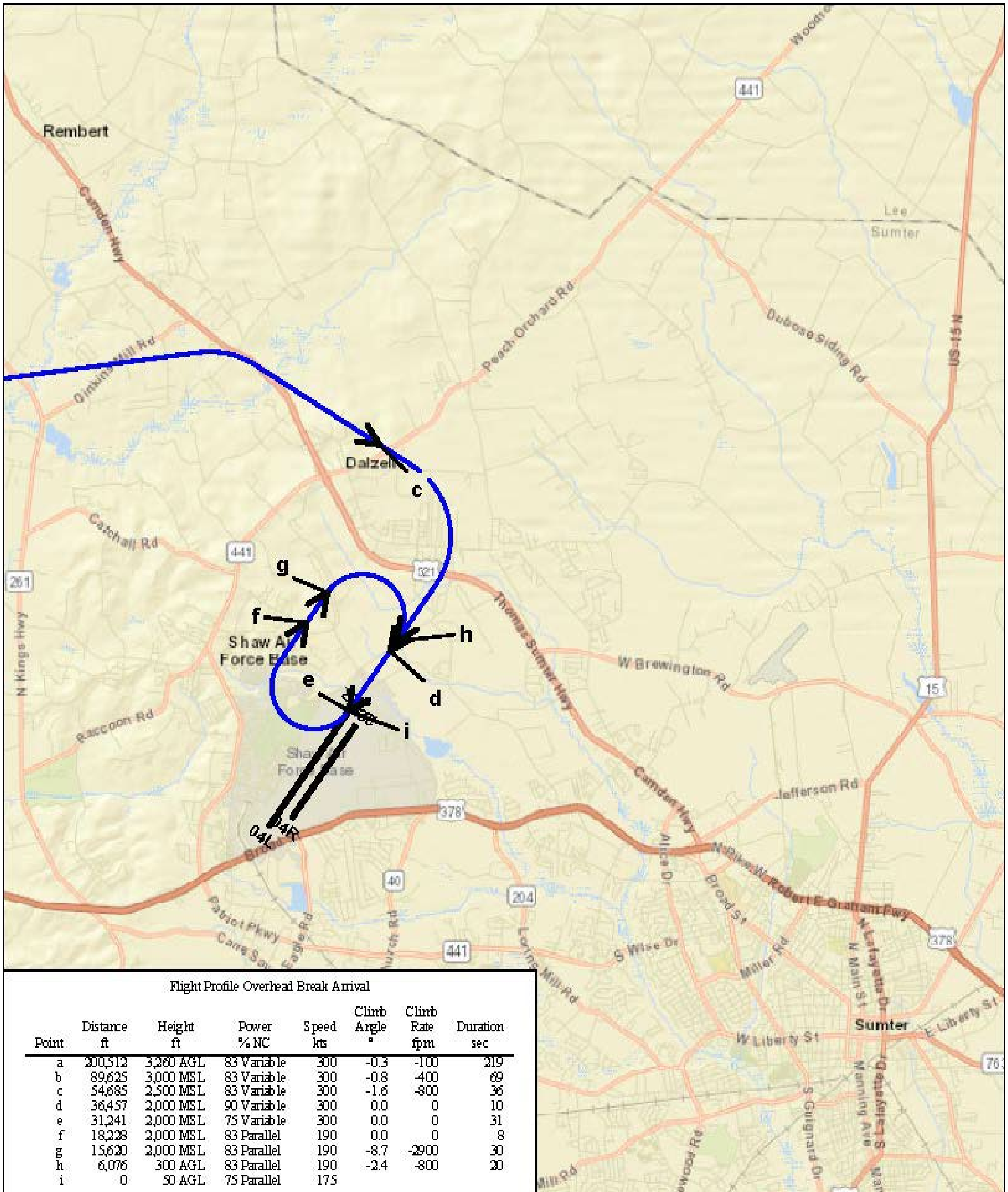
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	219
b	89,625	3,000 MSL	83 Variable	300	-0.8	-400	69
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2RO19

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:101,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

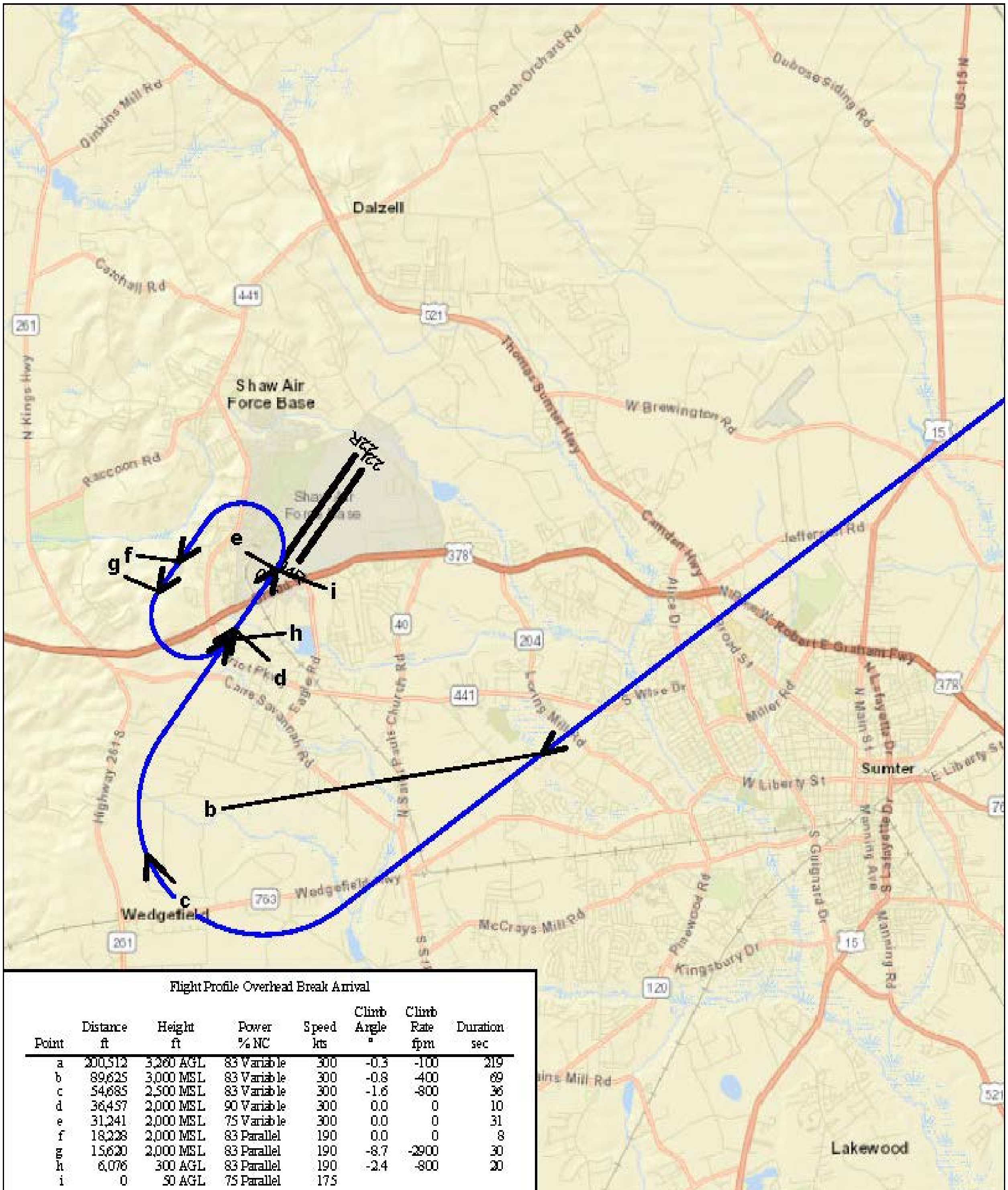
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	219
b	89,625	3,000 MSL	83 Variable	300	-0.8	-400	69
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH2R028

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:101,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

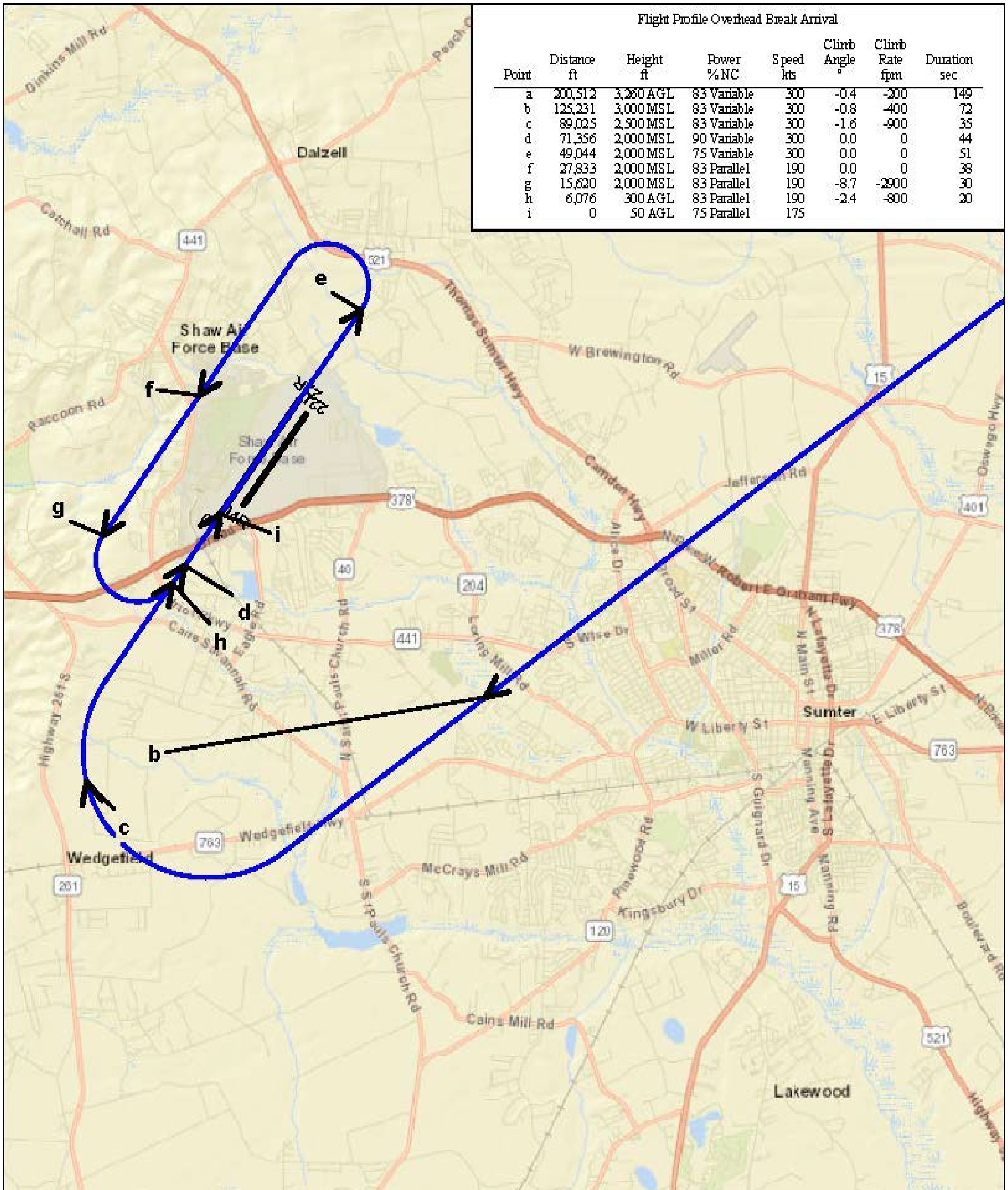
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	219
b	89,625	3,000 MSL	83 Variable	300	-0.8	-400	69
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4LO01

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N

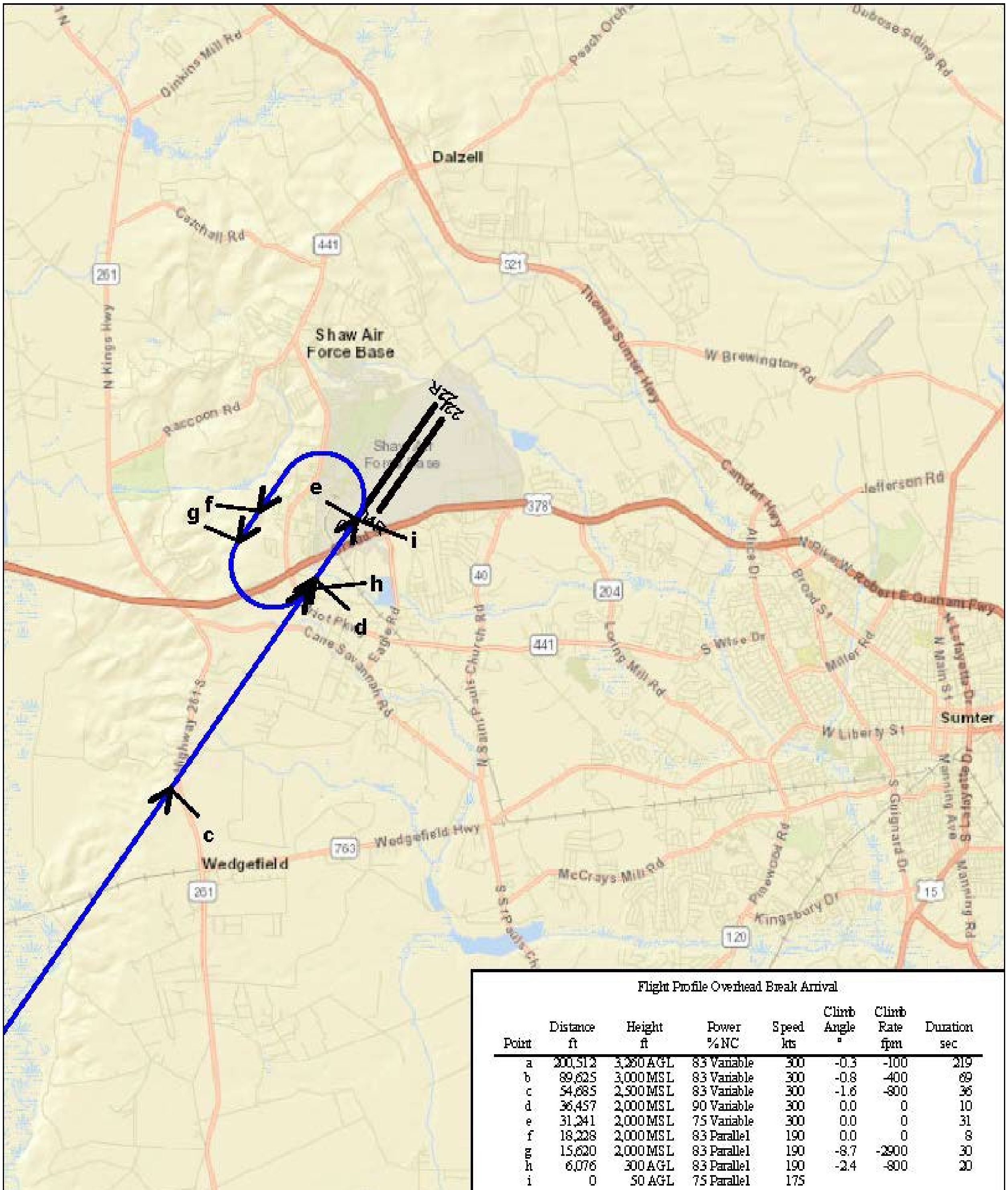


Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	149
b	125,231	3,000 MSL	83 Variable	300	-0.8	-400	72
c	89,025	2,500 MSL	83 Variable	300	-1.6	-900	35
d	71,356	2,000 MSL	90 Variable	300	0.0	0	44
e	49,044	2,000 MSL	75 Variable	300	0.0	0	51
f	27,833	2,000 MSL	83 Parallel	190	0.0	0	38
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4LO08

Scale in Feet 1:102,000 (1 inch = 8,490 feet)

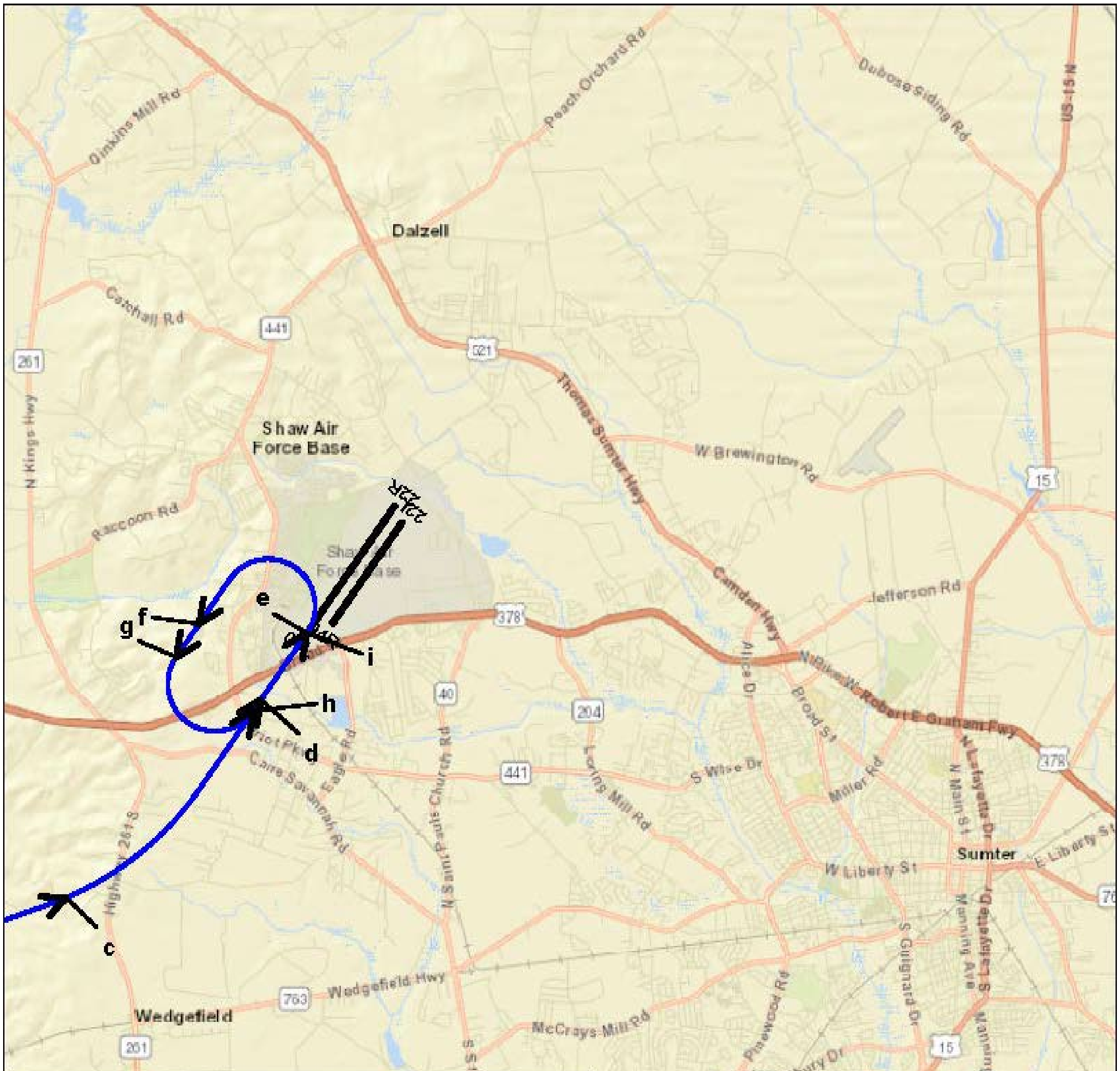


Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	219
b	89,625	3,000 MSL	83 Variable	300	-0.8	-400	69
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4LO19

Scale in Feet 1:102,000 (1 inch = 8,470 feet)



Flight Profile Overhead Break Arrival

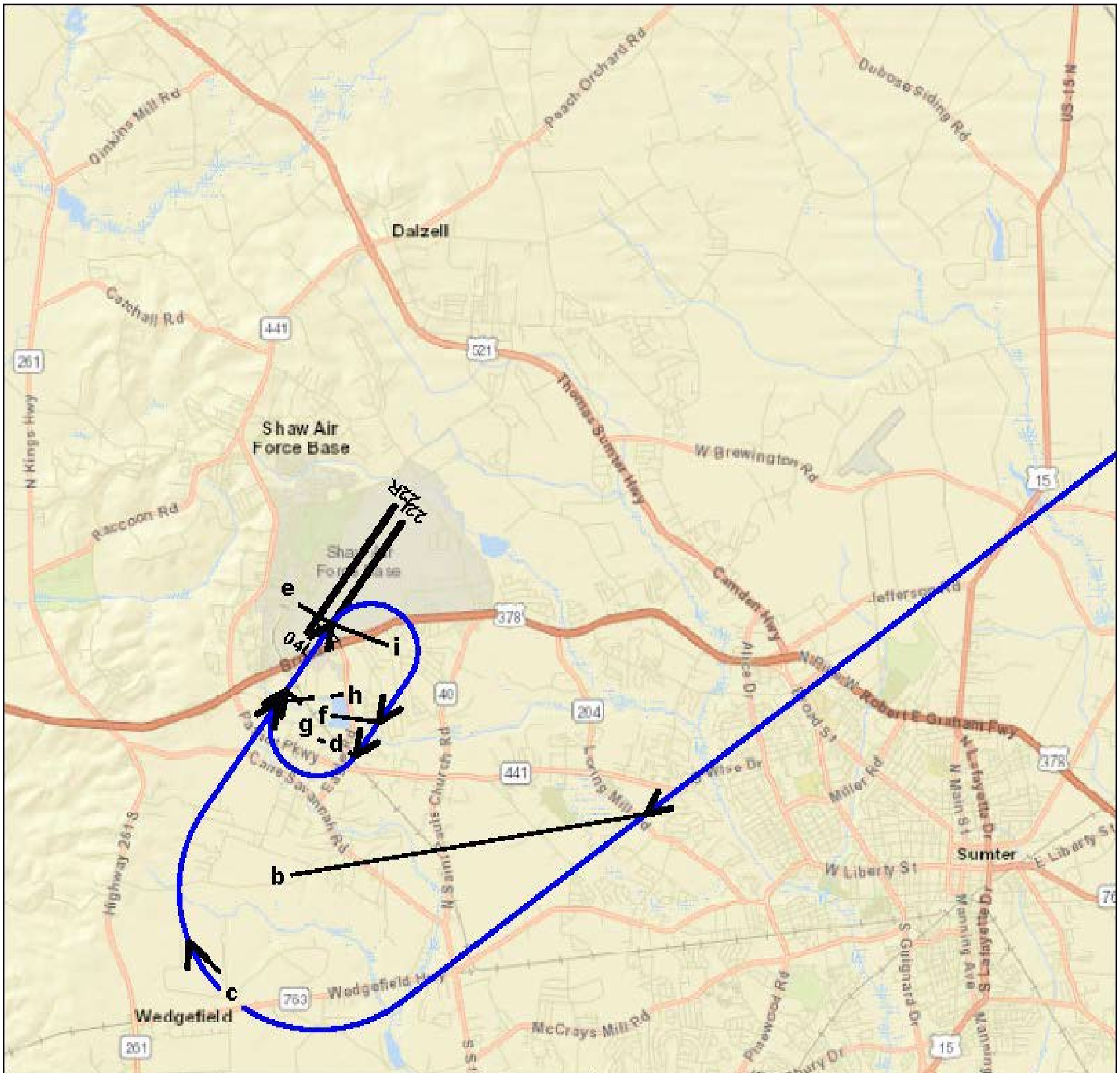
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	219
b	89,625	3,000 MSL	83 Variable	300	-0.8	-400	69
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4L037

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

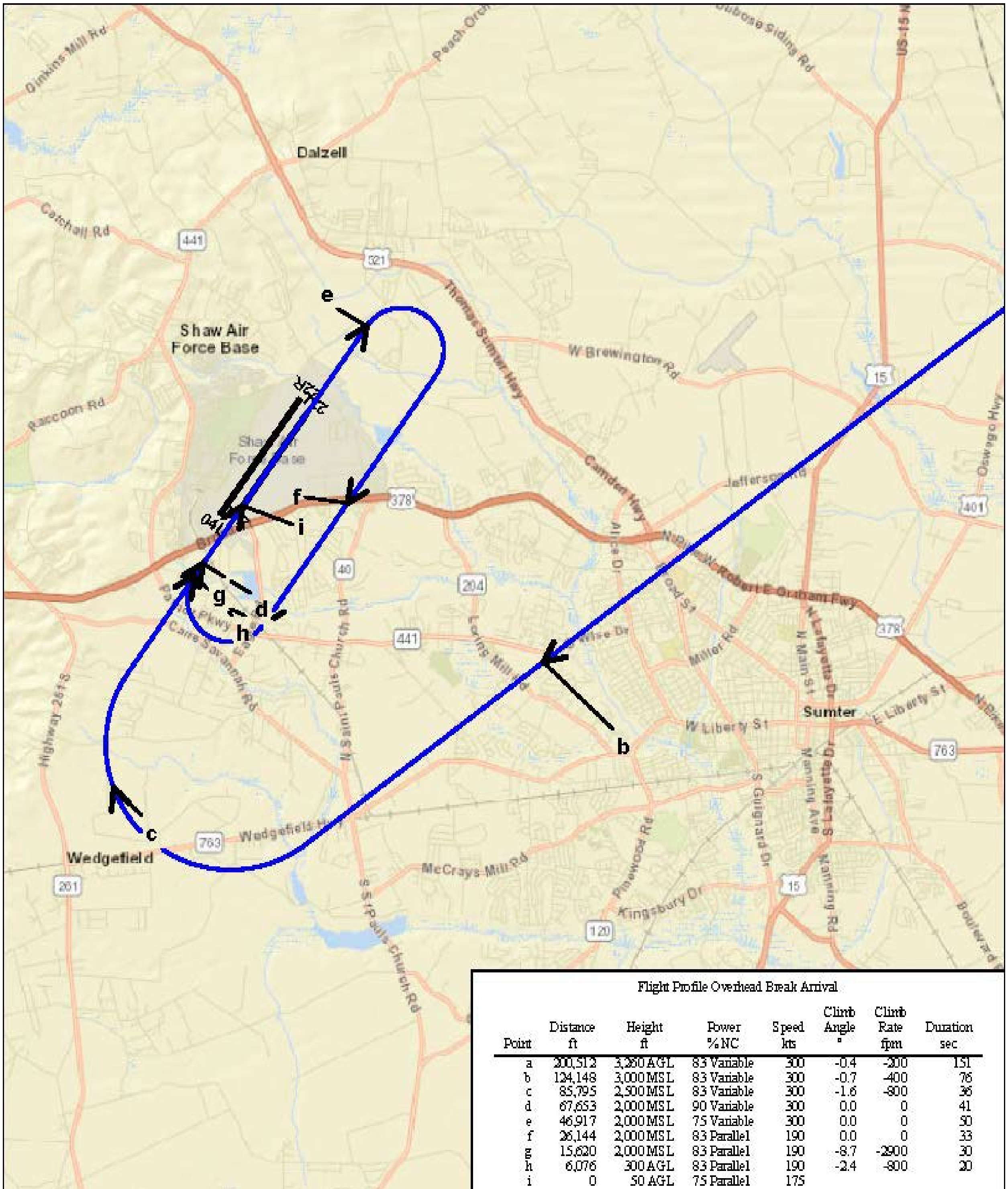
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	216
b	91,142	3,000 MSL	83 Variable	300	-0.8	-400	72
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4R001

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N

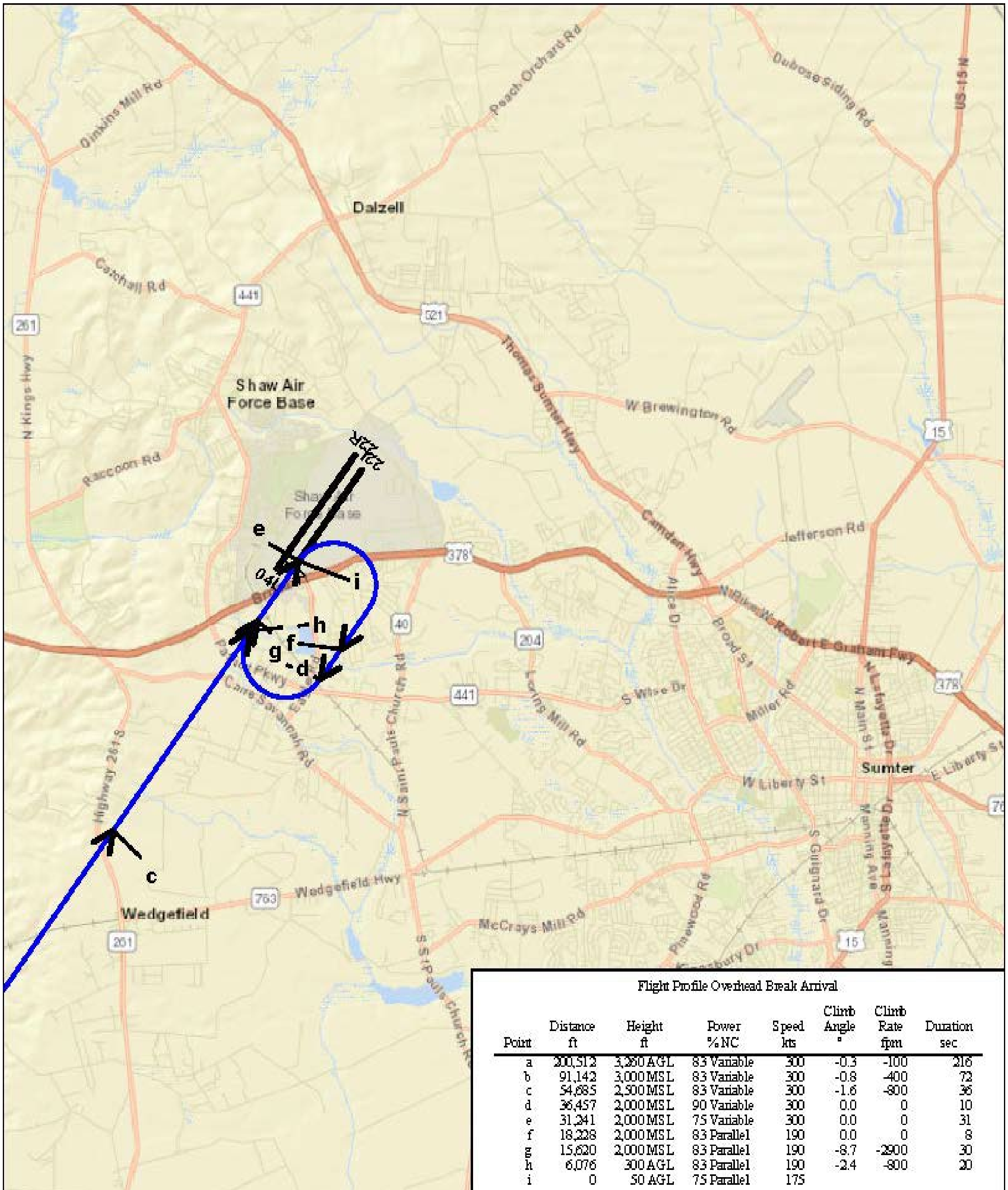


Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.4	-200	151
b	124,148	3,000 MSL	83 Variable	300	-0.7	-400	76
c	85,795	2,500 MSL	83 Variable	300	-1.6	-800	36
d	67,653	2,000 MSL	90 Variable	300	0.0	0	41
e	46,917	2,000 MSL	75 Variable	300	0.0	0	50
f	26,144	2,000 MSL	83 Parallel	190	0.0	0	33
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4RO08

Scale in Feet 1:102,000 (1 inch = 8,490 feet)



Flight Profile Overhead Break Arrival

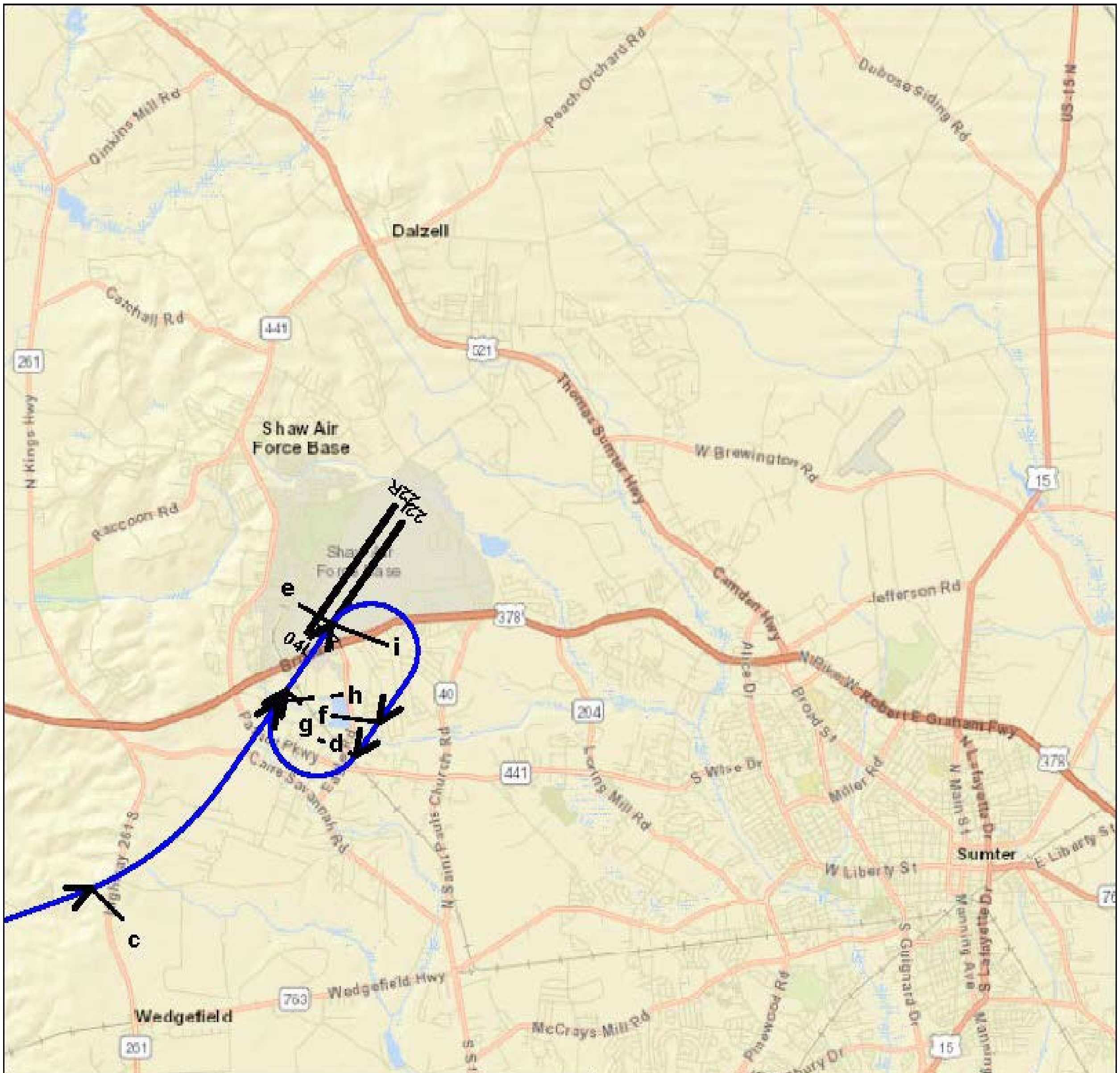
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	216
b	91,142	3,000 MSL	83 Variable	300	-0.8	-400	72
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4RO19

0 4000 8000 12000 16000 20000 24000 28000 32000

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

N



Flight Profile Overhead Break Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,512	3,260 AGL	83 Variable	300	-0.3	-100	216
b	91,142	3,000 MSL	83 Variable	300	-0.8	-400	72
c	54,685	2,500 MSL	83 Variable	300	-1.6	-800	36
d	36,457	2,000 MSL	90 Variable	300	0.0	0	10
e	31,241	2,000 MSL	75 Variable	300	0.0	0	31
f	18,228	2,000 MSL	83 Parallel	190	0.0	0	8
g	15,620	2,000 MSL	83 Parallel	190	-8.7	-2900	30
h	6,076	300 AGL	83 Parallel	190	-2.4	-800	20
i	0	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Overhead Break Arrival Flight Profile ADH4R037

Scale in Feet 1:102,000 (1 inch = 8,460 feet)

Flight Profile IFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Arrival Flight Profile ADHAI01

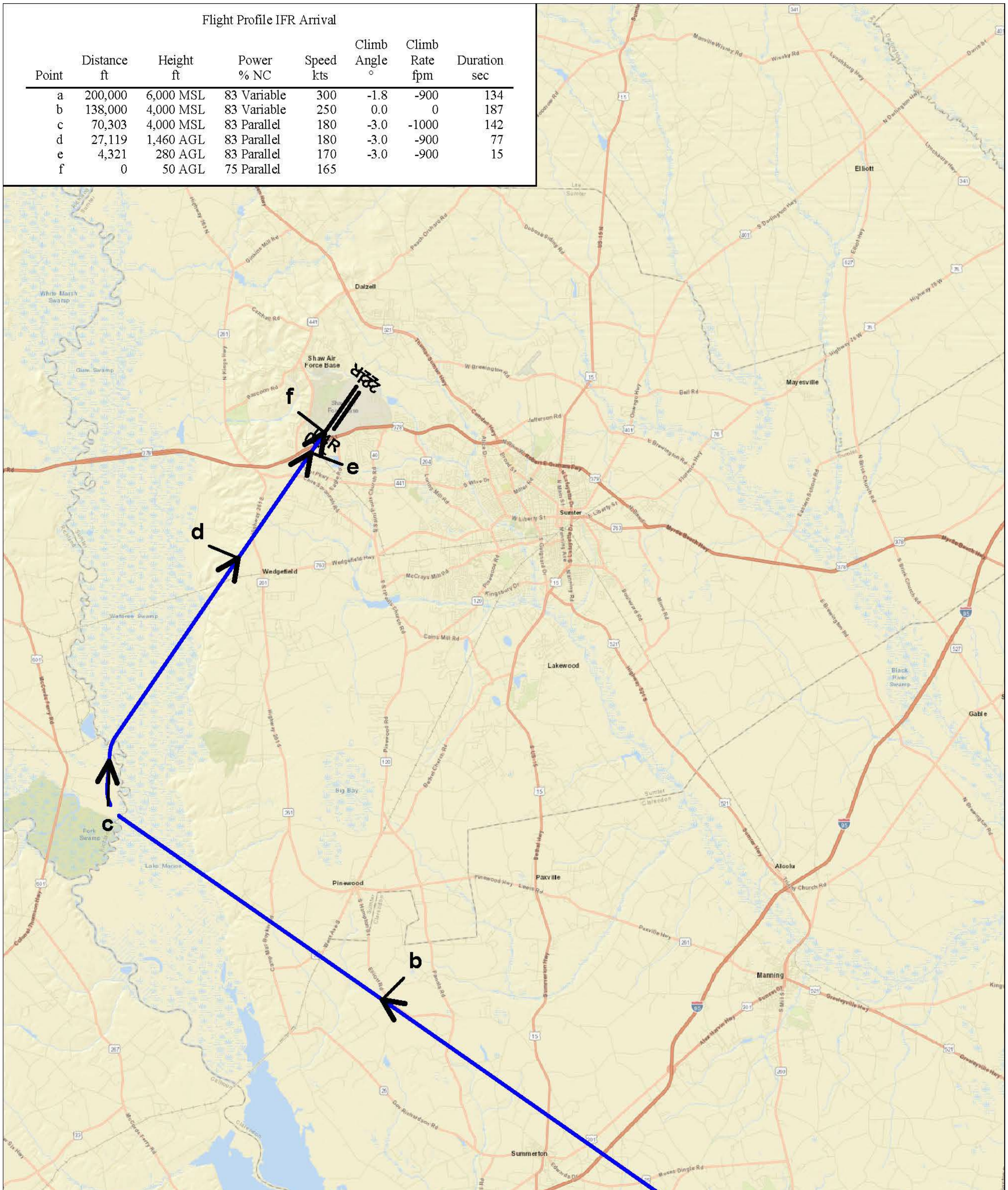
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:252,000 (1 inch = 21,000 feet)

N

Flight Profile IFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			



Shaw AFB Based ADAIR Cat C IFR Arrival Flight Profile ADHAI02

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:252,000 (1 inch = 21,000 feet)

N

Flight Profile IFR Arrival

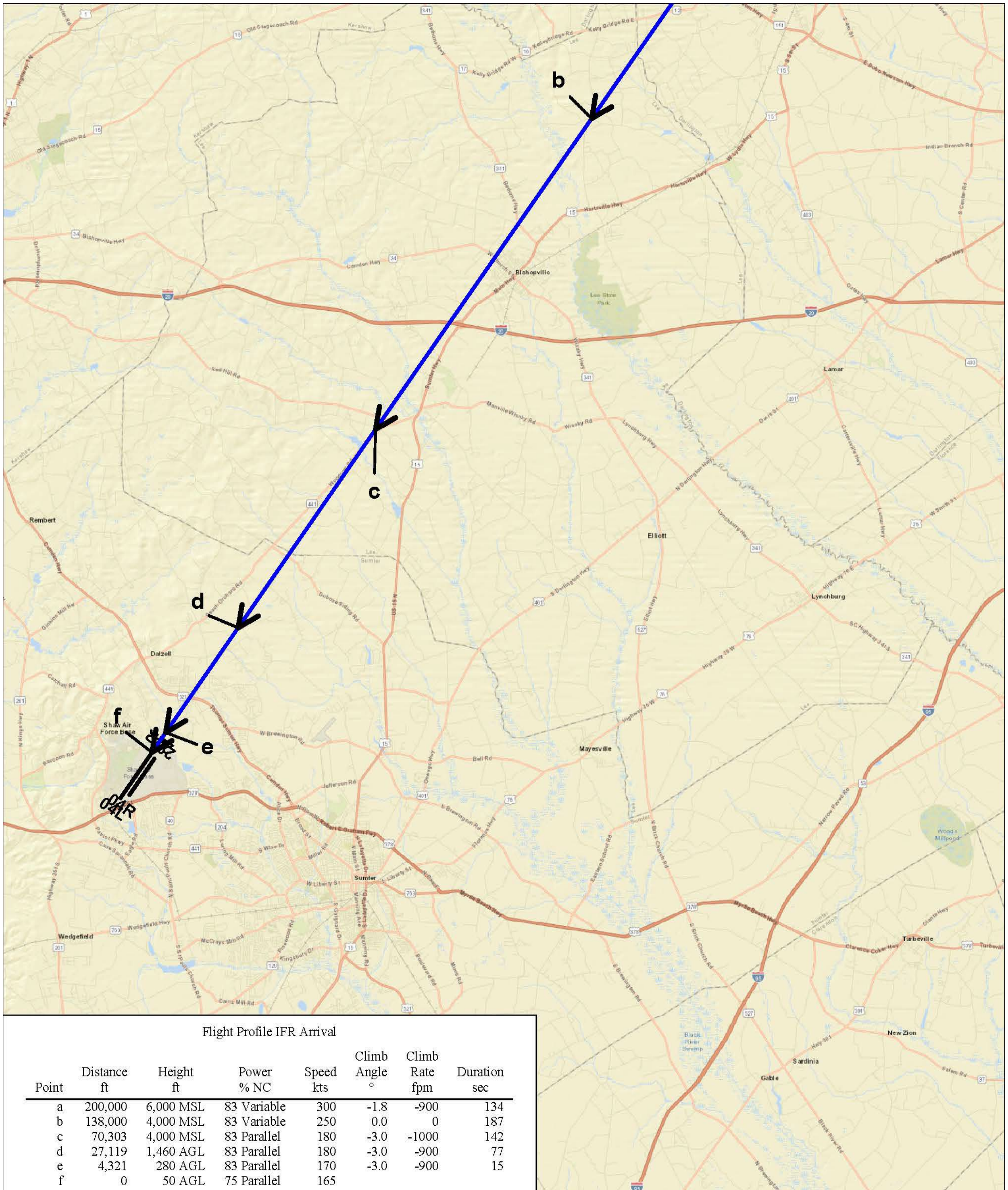
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	83 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Arrival Flight Profile ADHAI03

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:252,000 (1 inch = 21,000 feet)

N



Flight Profile IFR Arrival

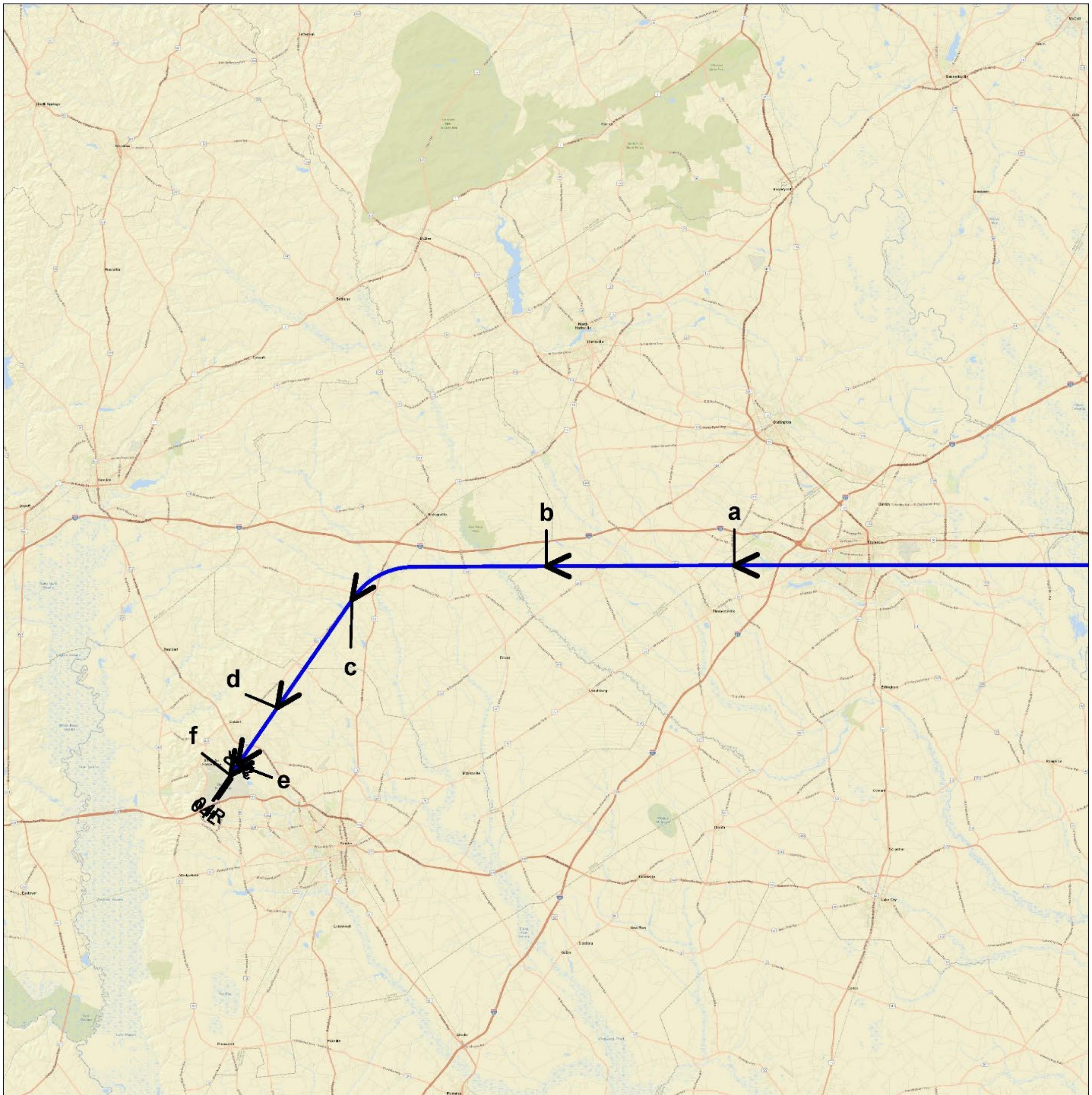
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Arrival Flight Profile ADHAI04

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:254,000 (1 inch = 21,100 feet)

N



Flight Profile IFR Arrival

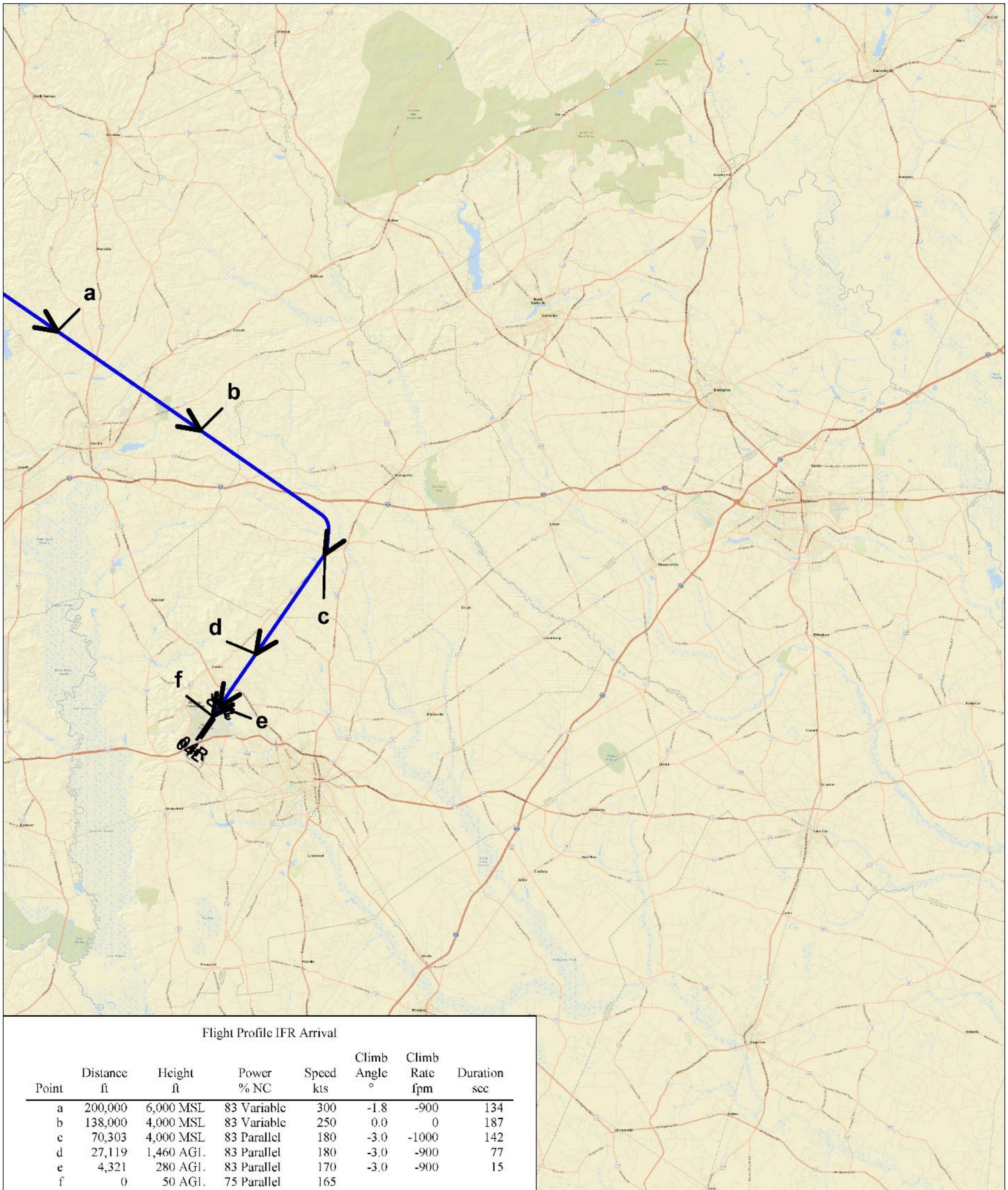
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Arrival Flight Profile ADHAI05

0 20,000 40,000 60,000 80,000 100,000 120,000 140,000 160,000

Scale in Feet 1:506,000 (1 inch = 42,200 feet)

N



Flight Profile IFR Arrival

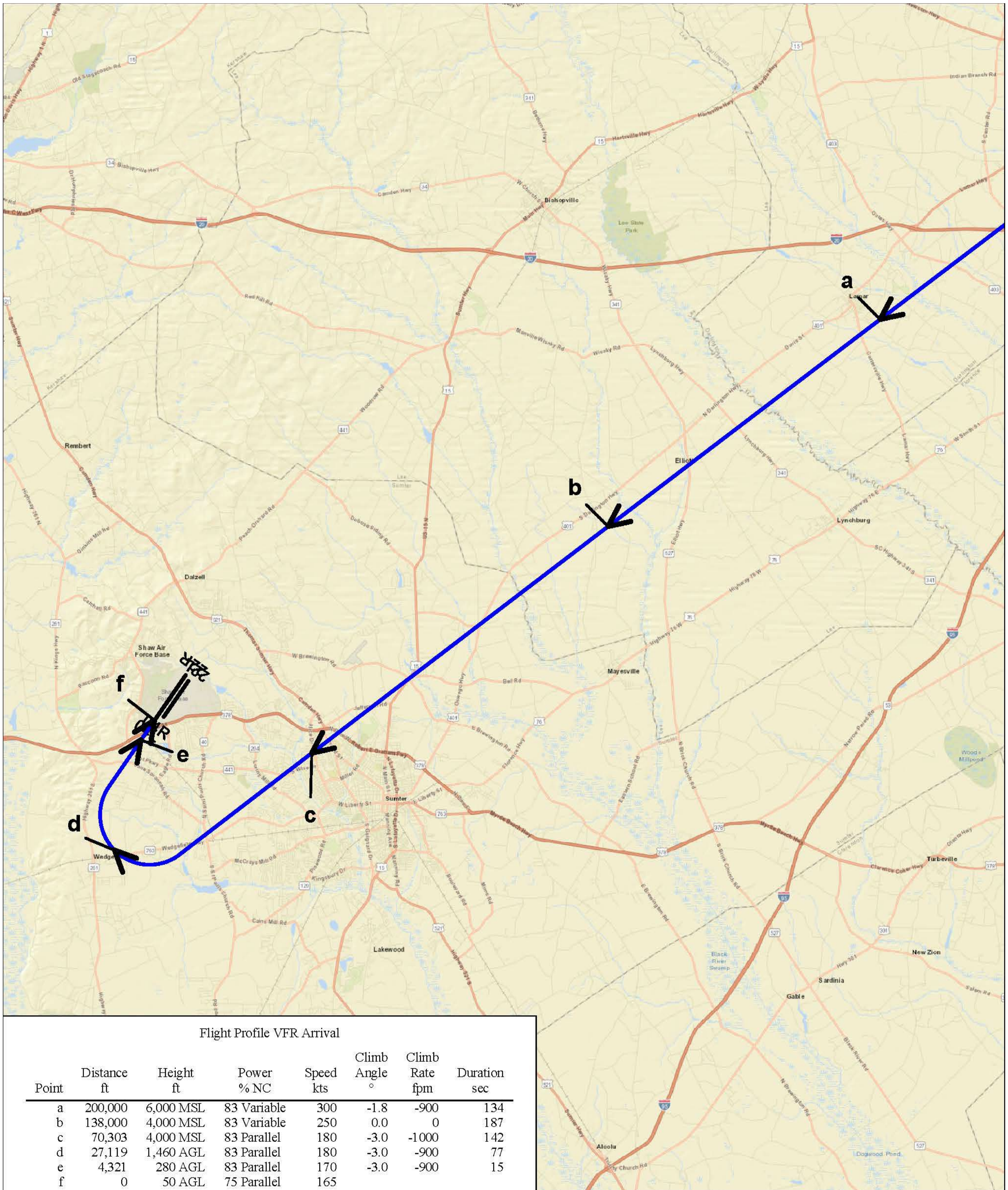
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Arrival Flight Profile ADHAI06

0 20,000 40,000 60,000 80,000 100,000 120,000 140,000 160,000

Scale in Feet 1:506,000 (1 inch = 42,200 feet)

N

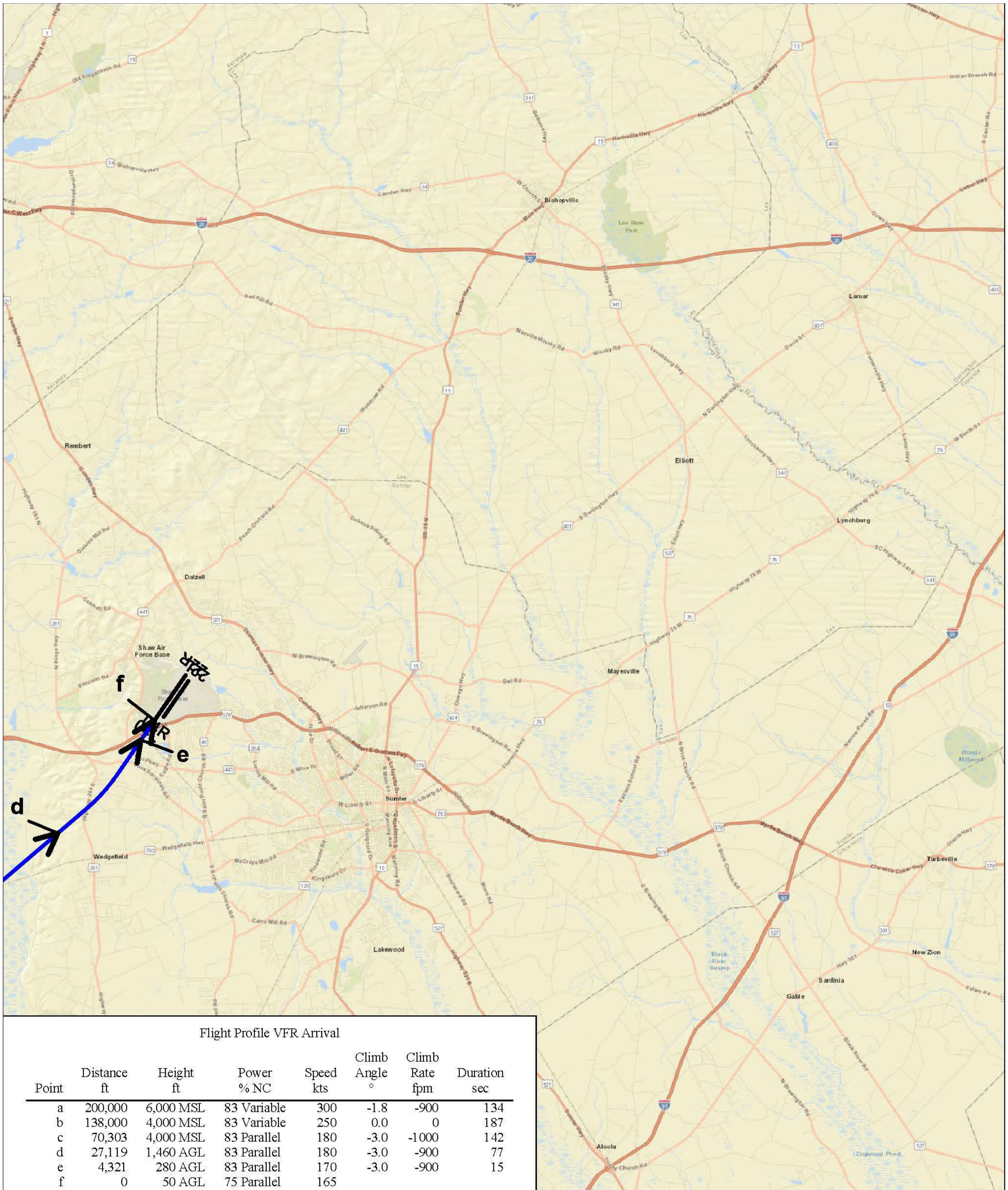


Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS01

Scale in Feet 1:257,000 (1 inch = 21,400 feet)



Flight Profile VFR Arrival

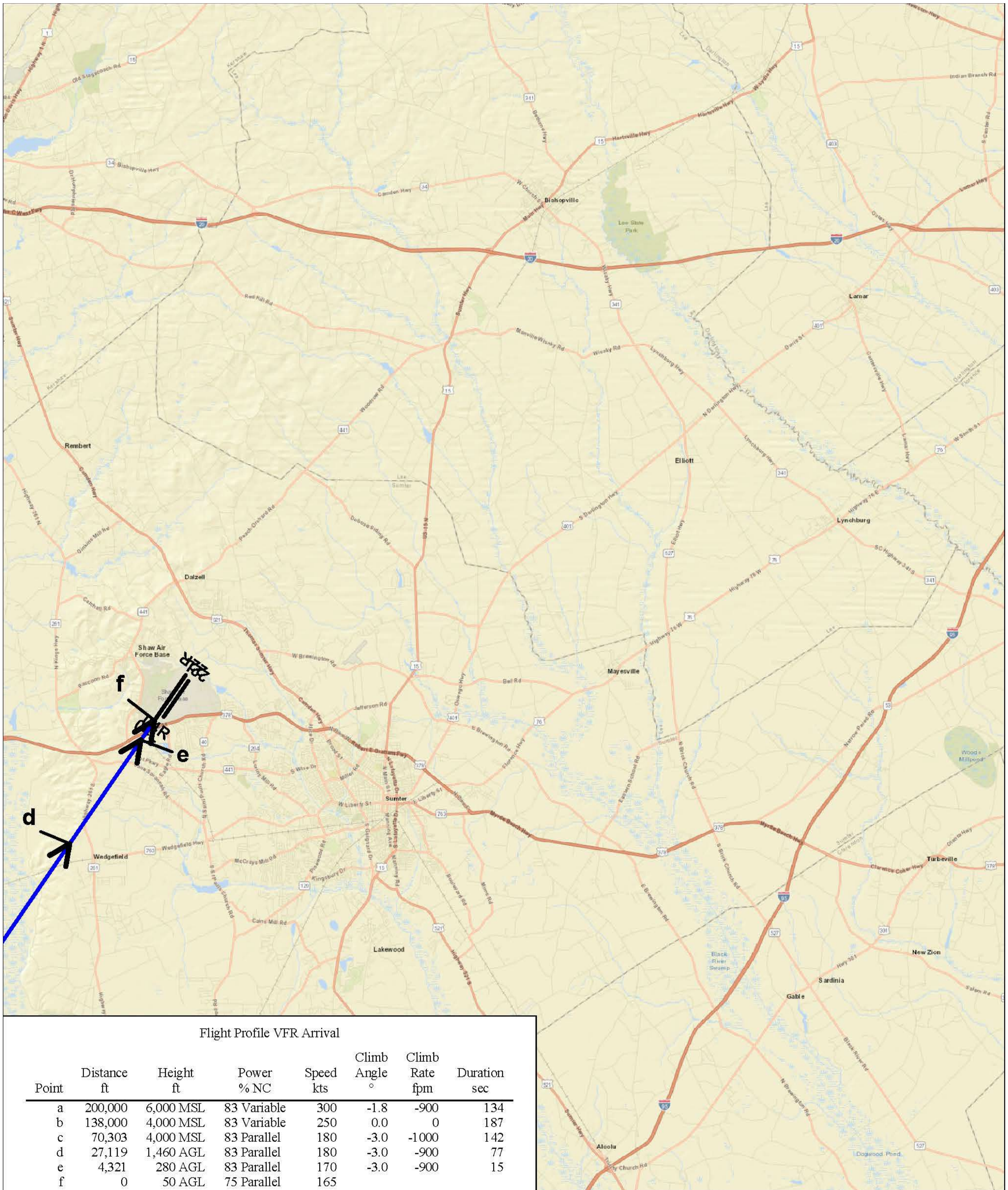
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS02

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)

N



Flight Profile VFR Arrival

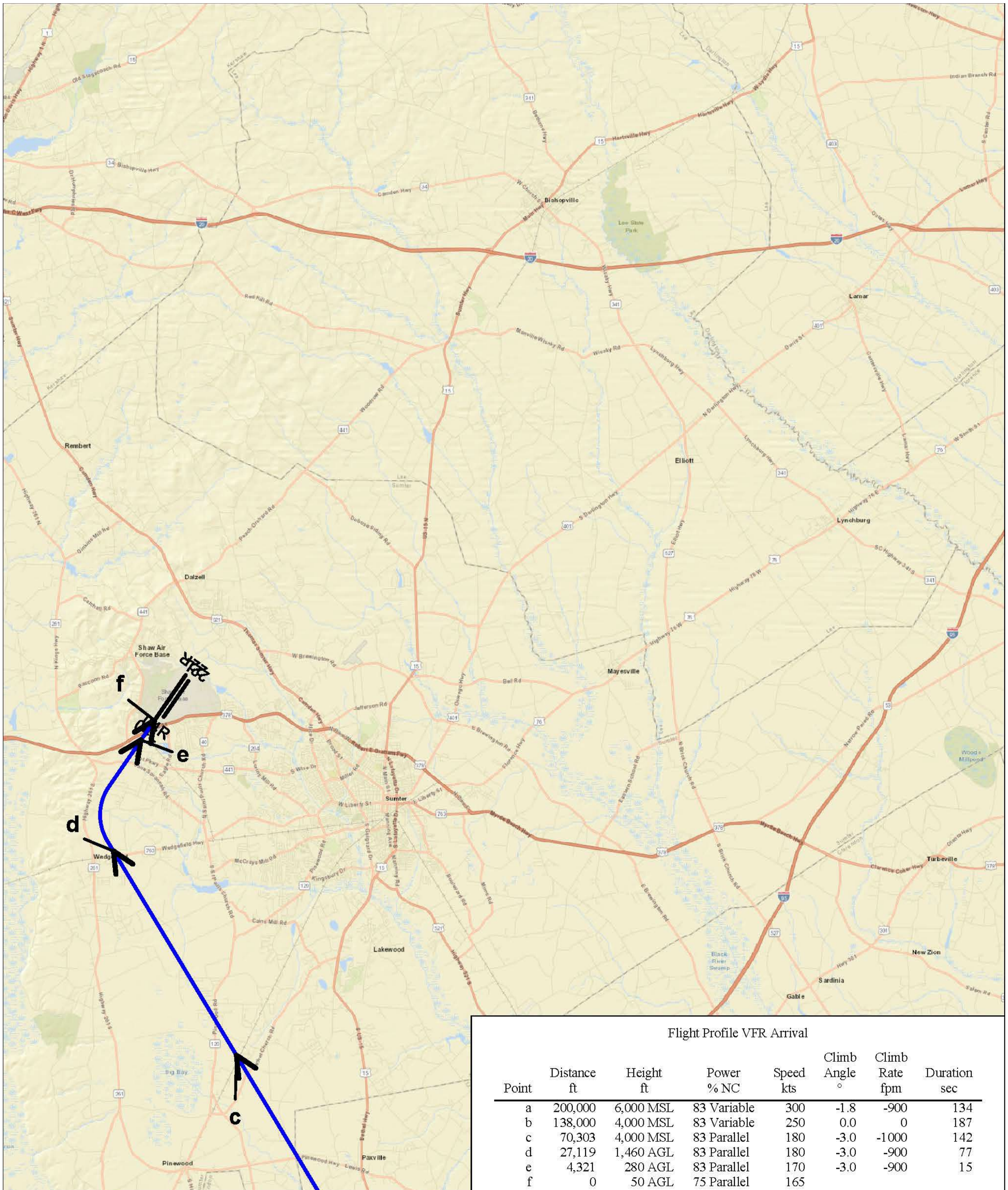
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS03

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)

N



Flight Profile VFR Arrival

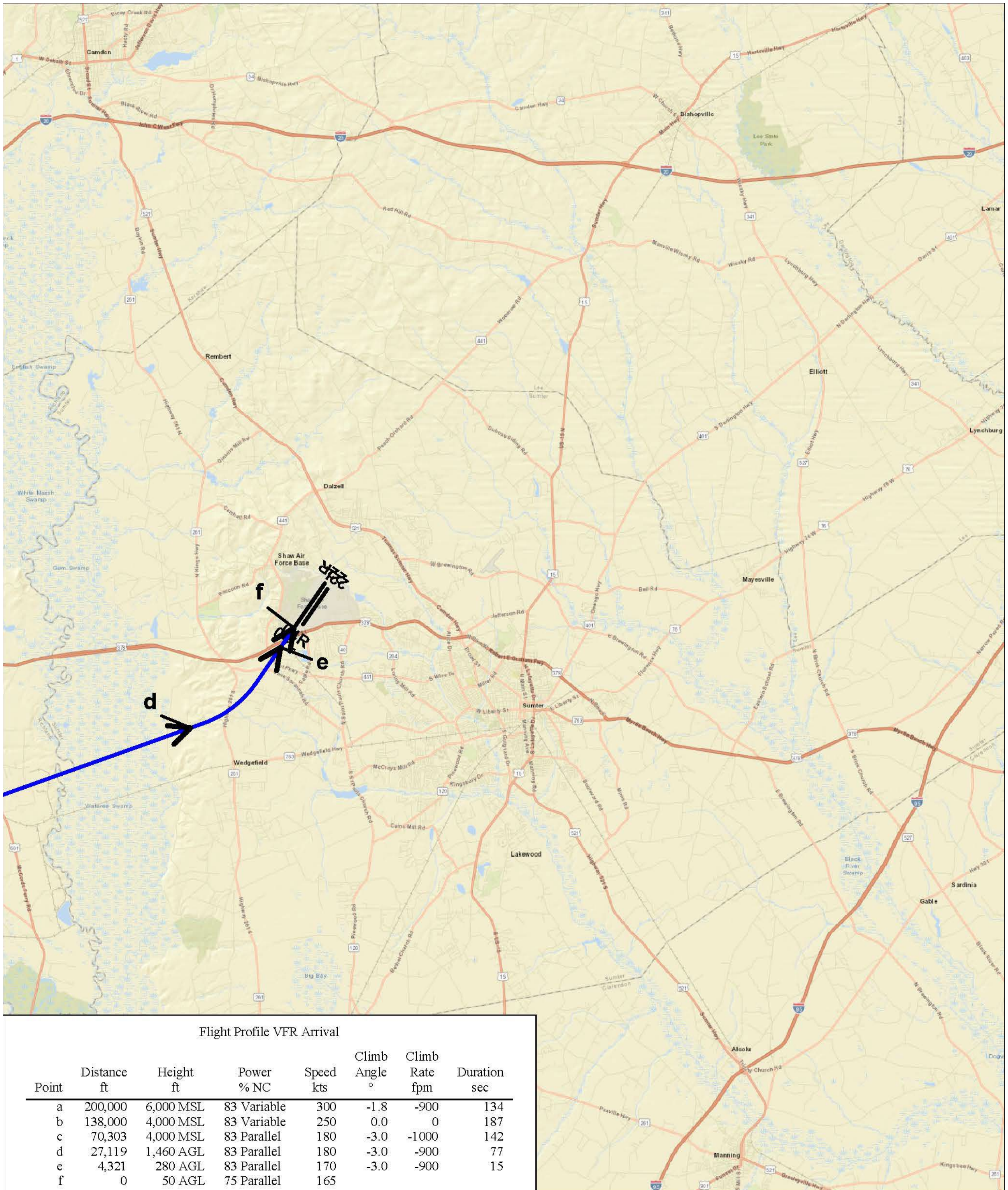
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS04

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)

N



Flight Profile VFR Arrival

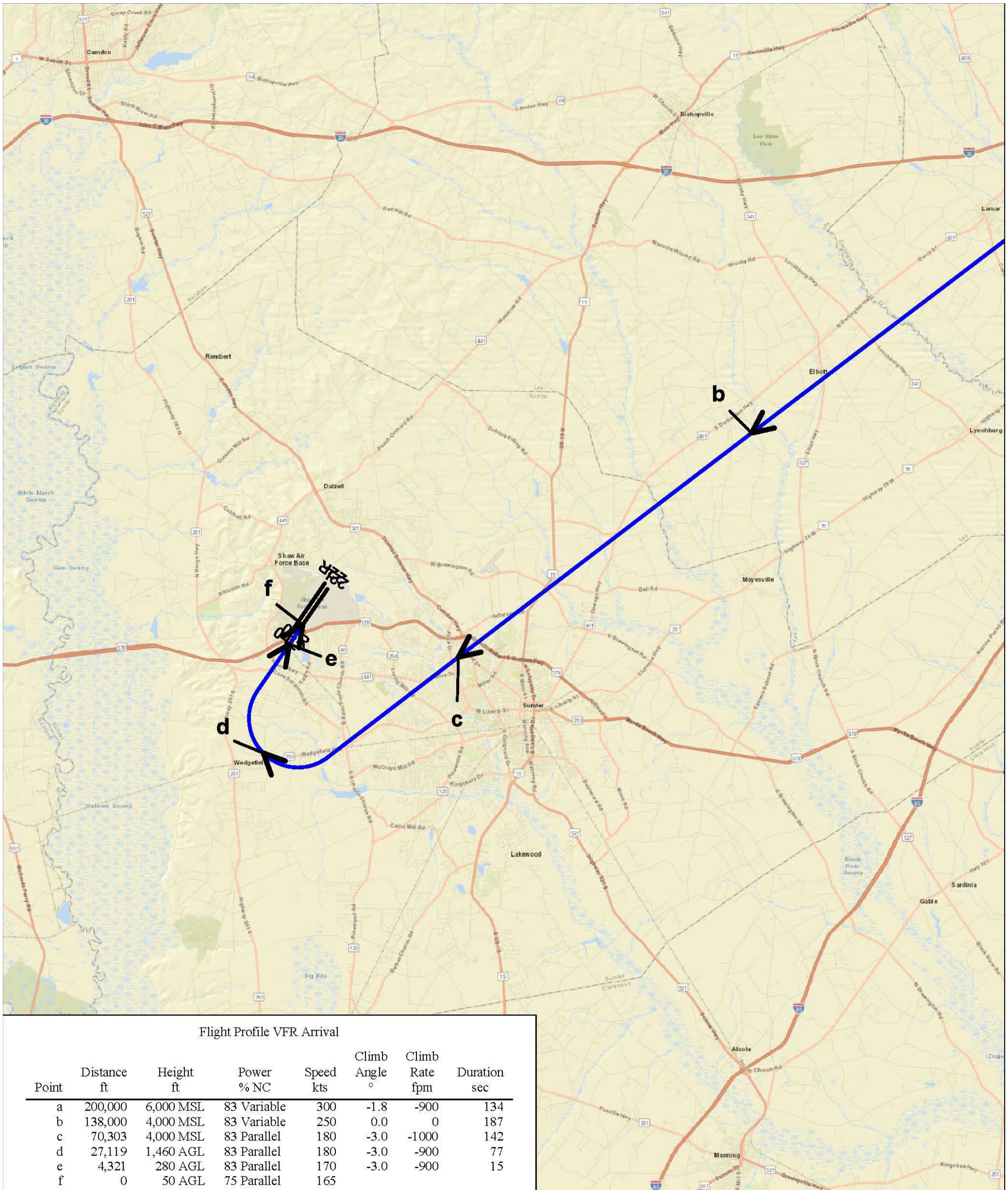
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS05

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile VFR Arrival

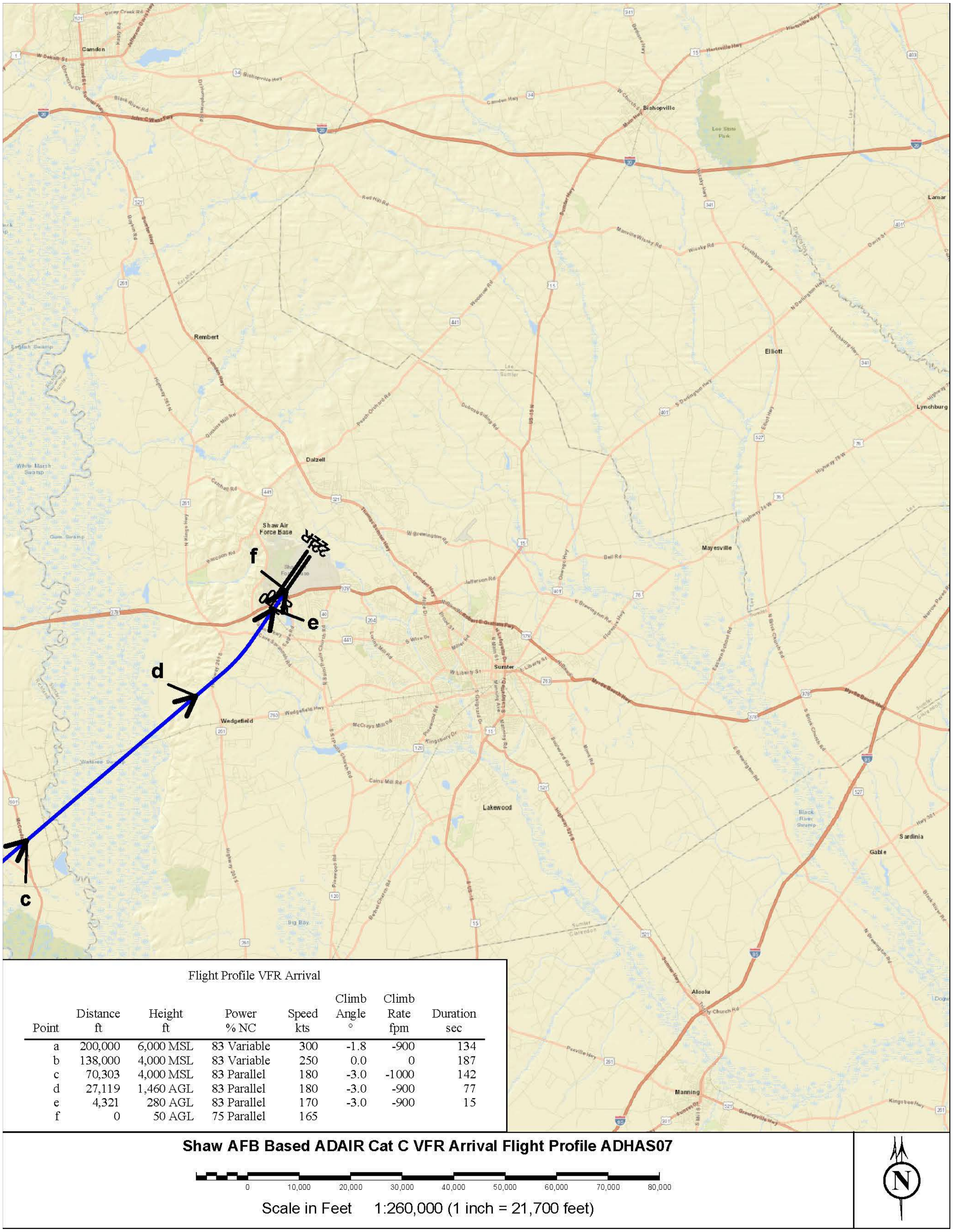
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS06

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS07

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS08

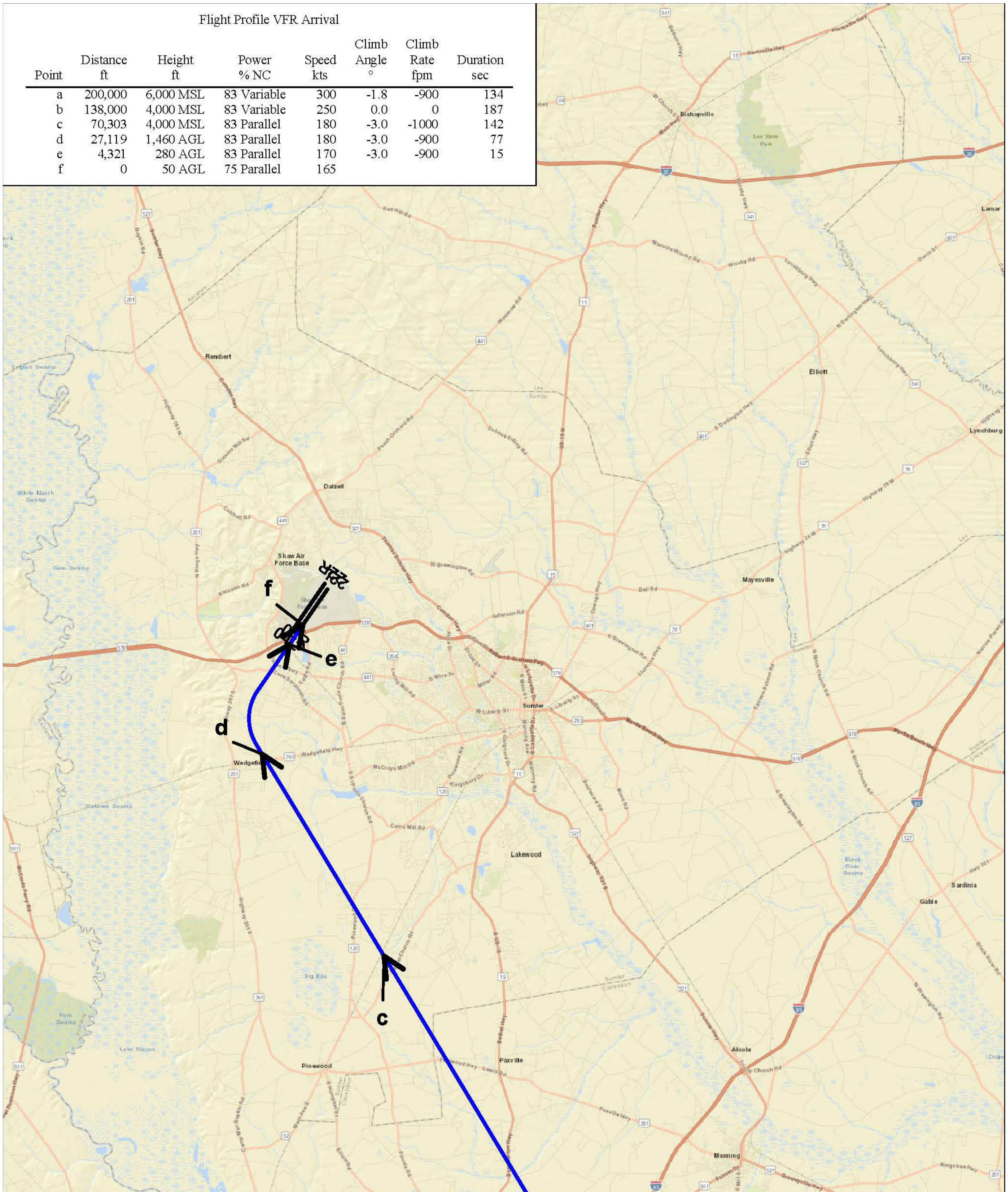
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N

Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

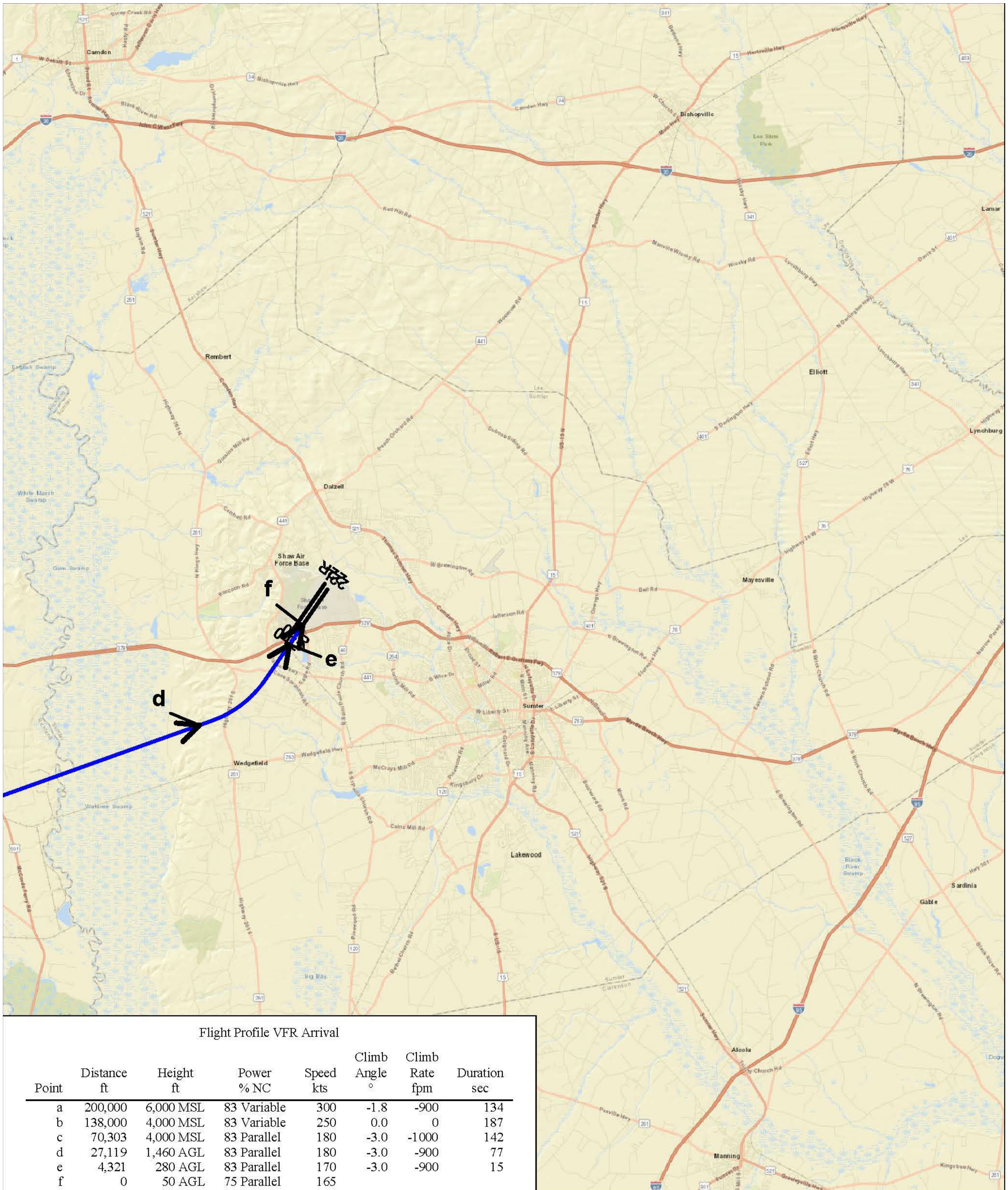


Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS09

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile VFR Arrival

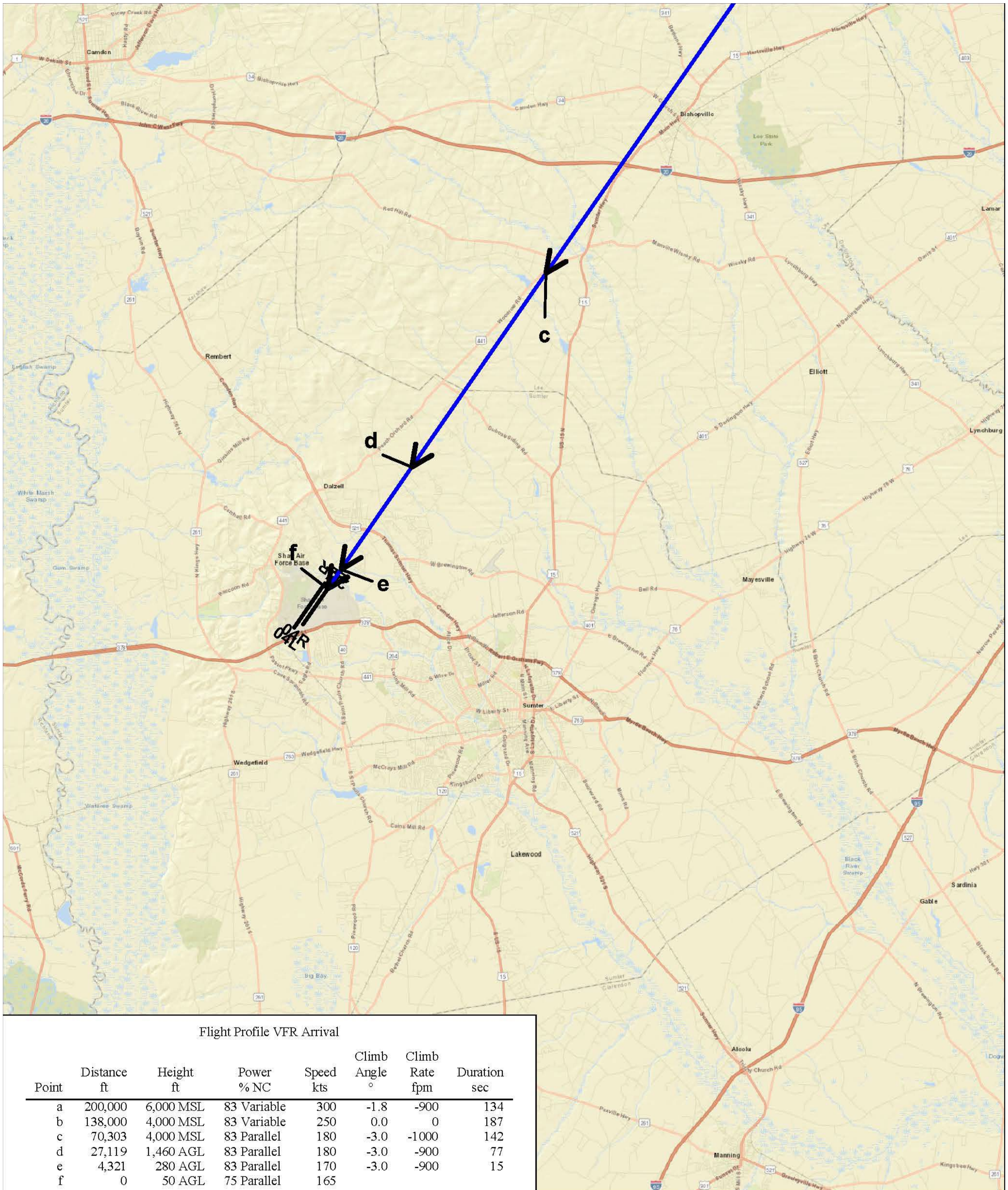
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS10

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



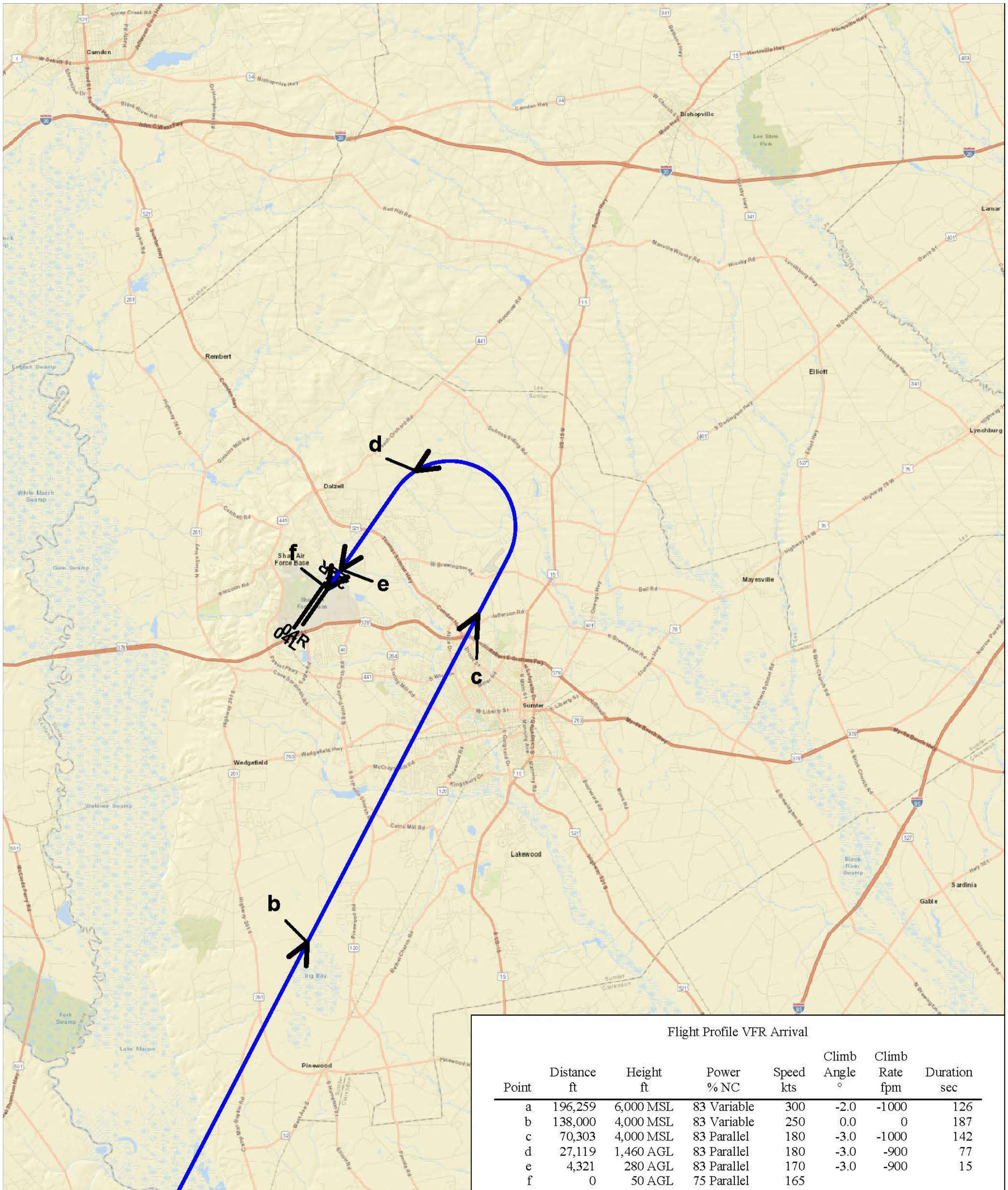
Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS11

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)



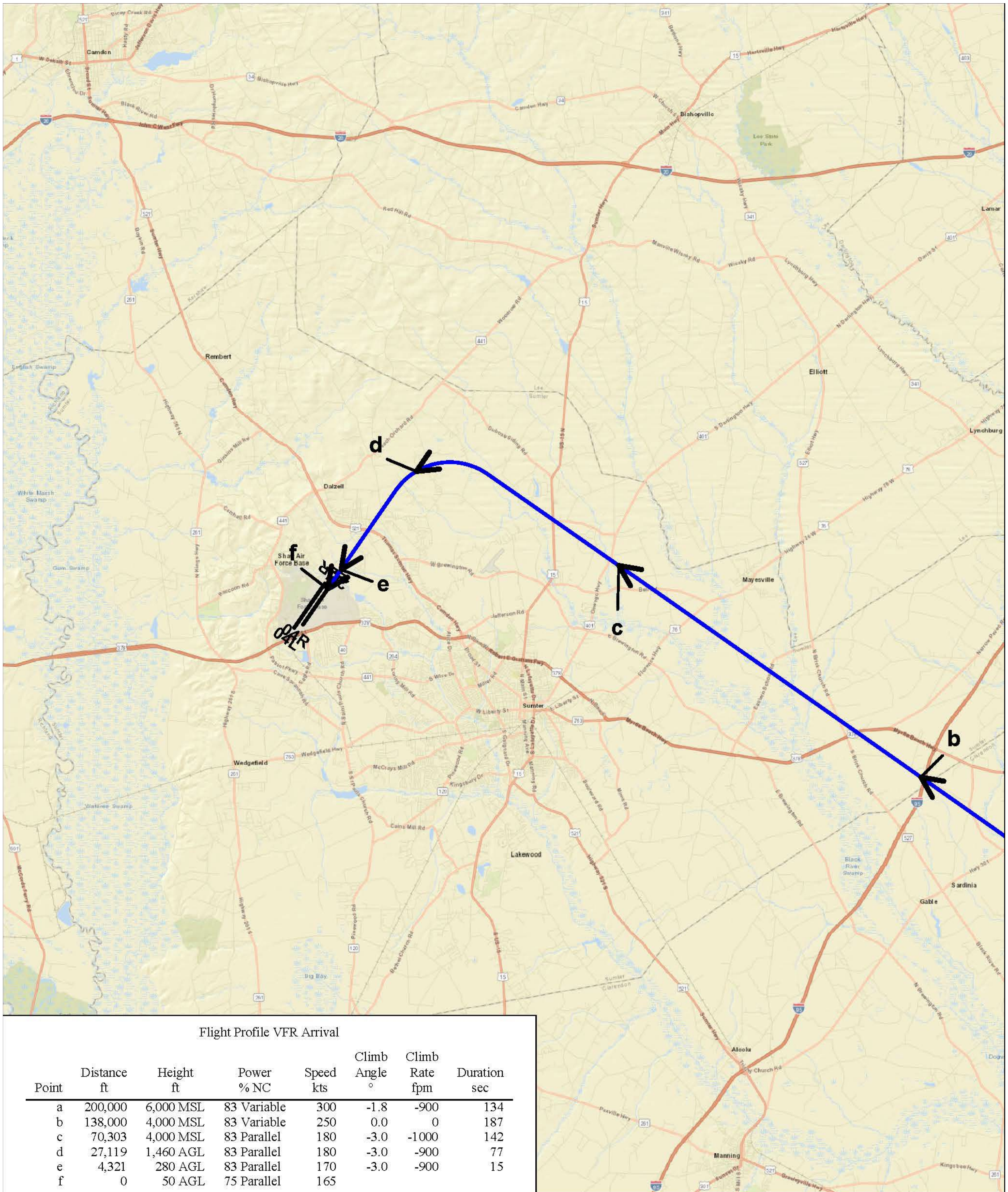
Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	196,259	6,000 MSL	83 Variable	300	-2.0	-1000	126
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS12

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)



Flight Profile VFR Arrival

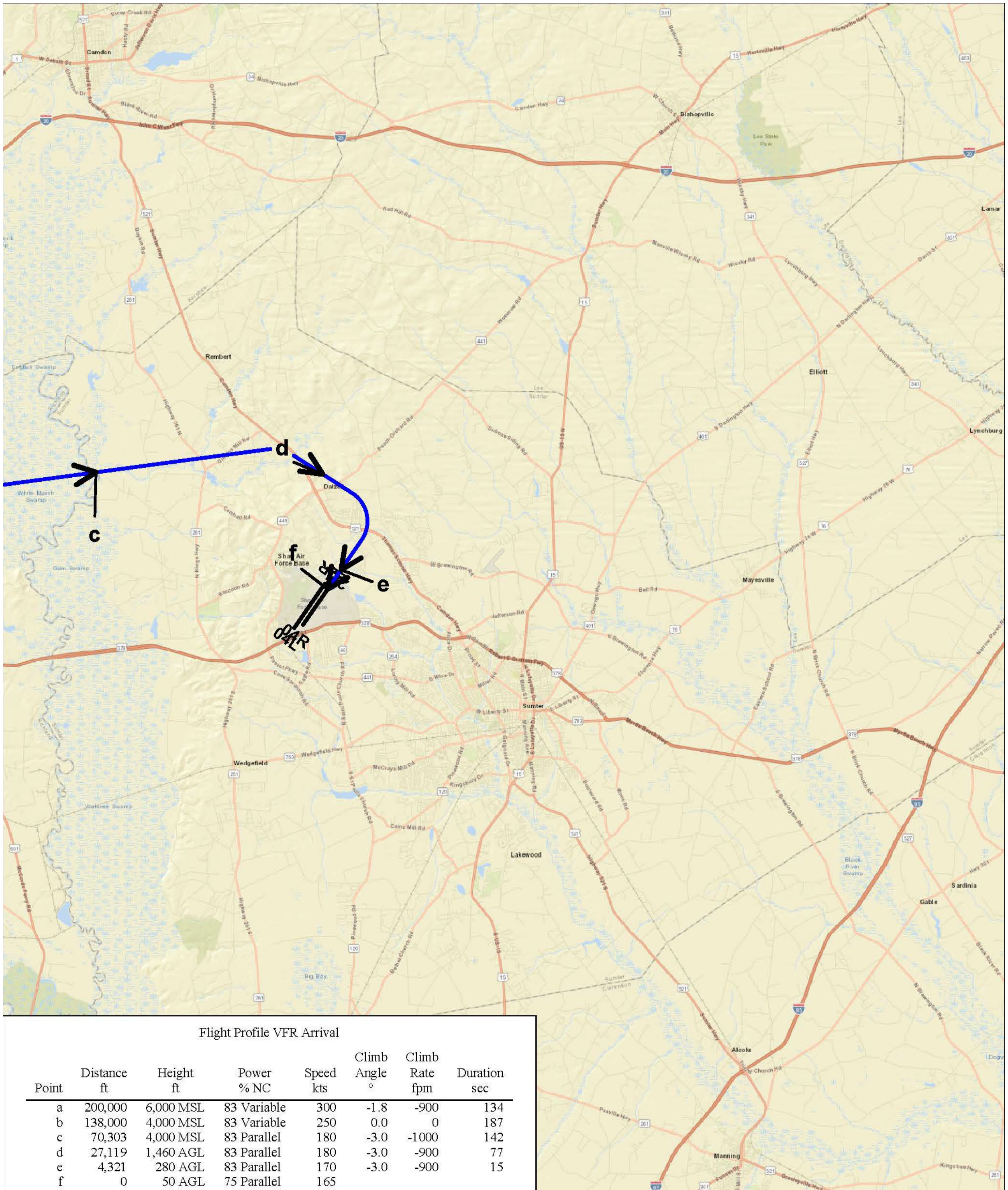
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS13

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile VFR Arrival

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS14

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

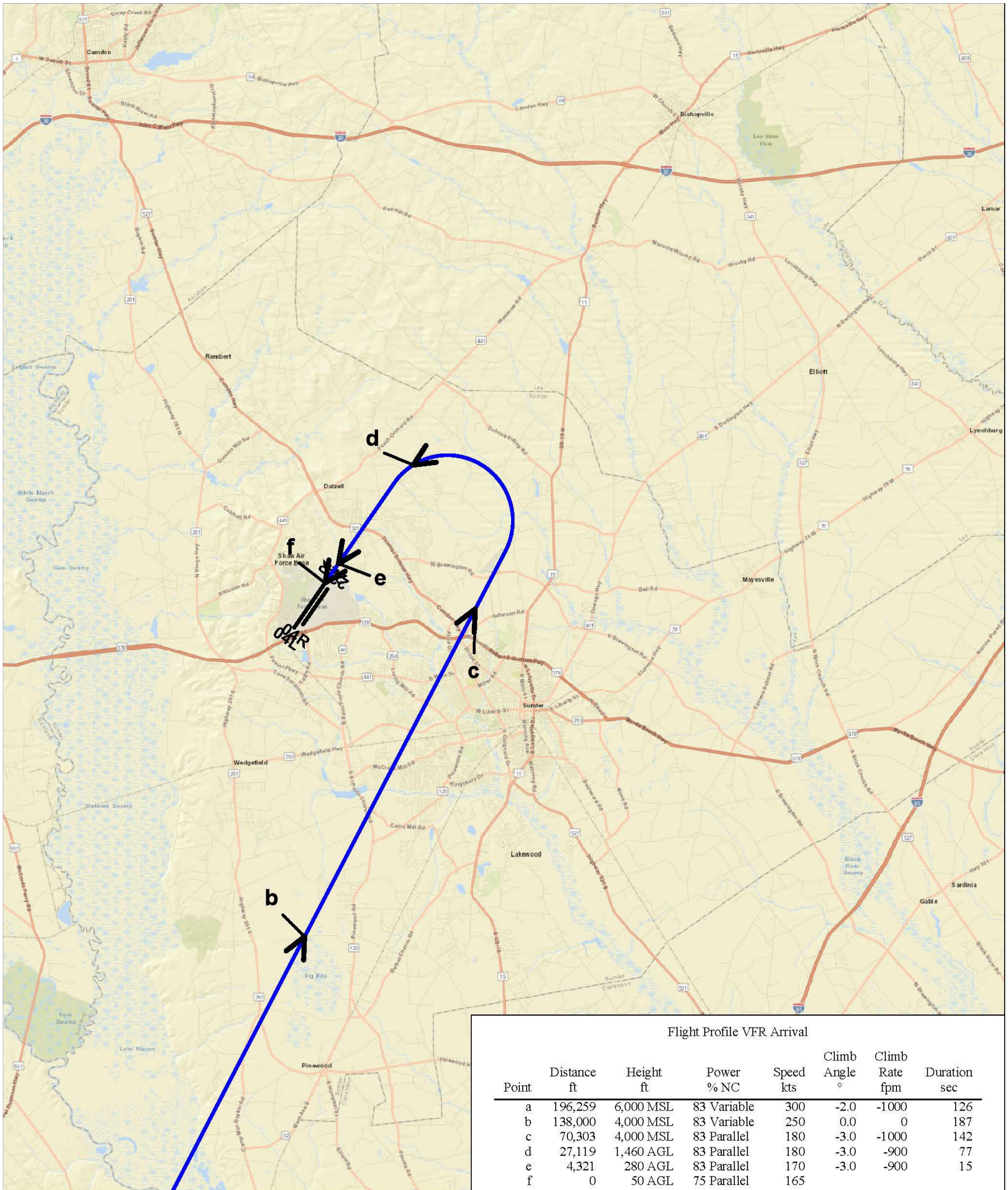
Flight Profile VFR Arrival

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS15

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile VFR Arrival

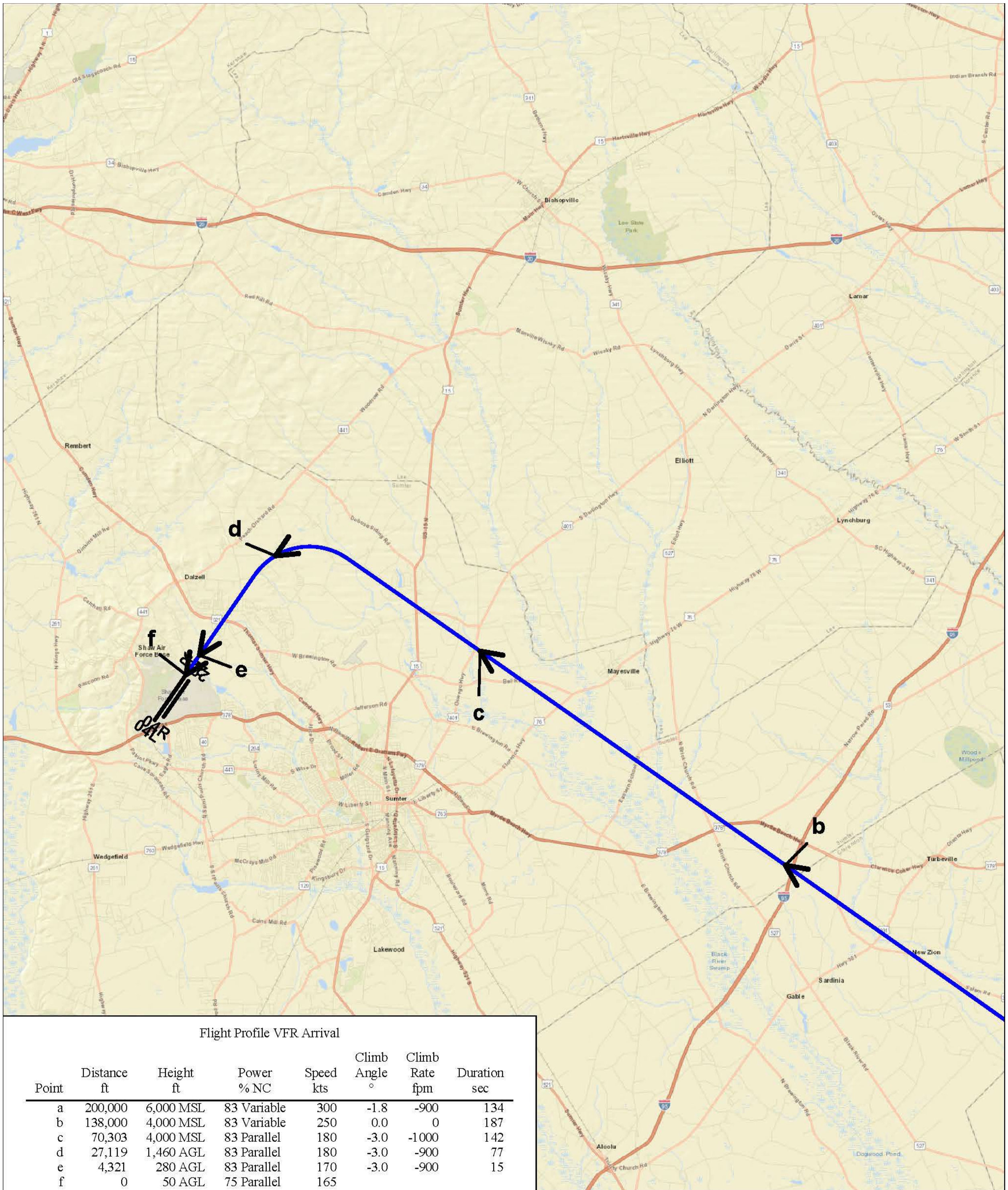
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	196,259	6,000 MSL	83 Variable	300	-2.0	-1000	126
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS16

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile VFR Arrival

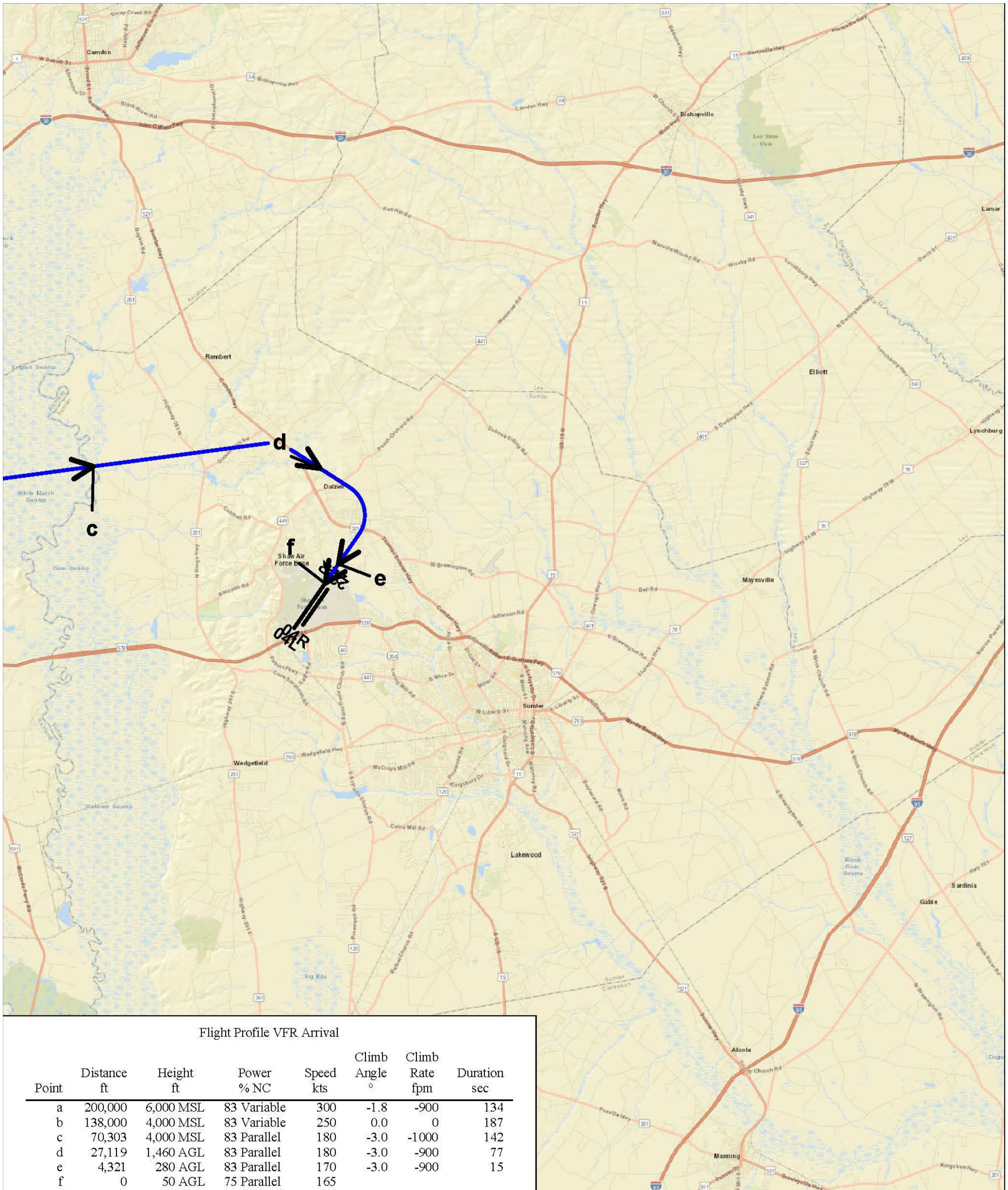
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS17

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)

N



Flight Profile VFR Arrival

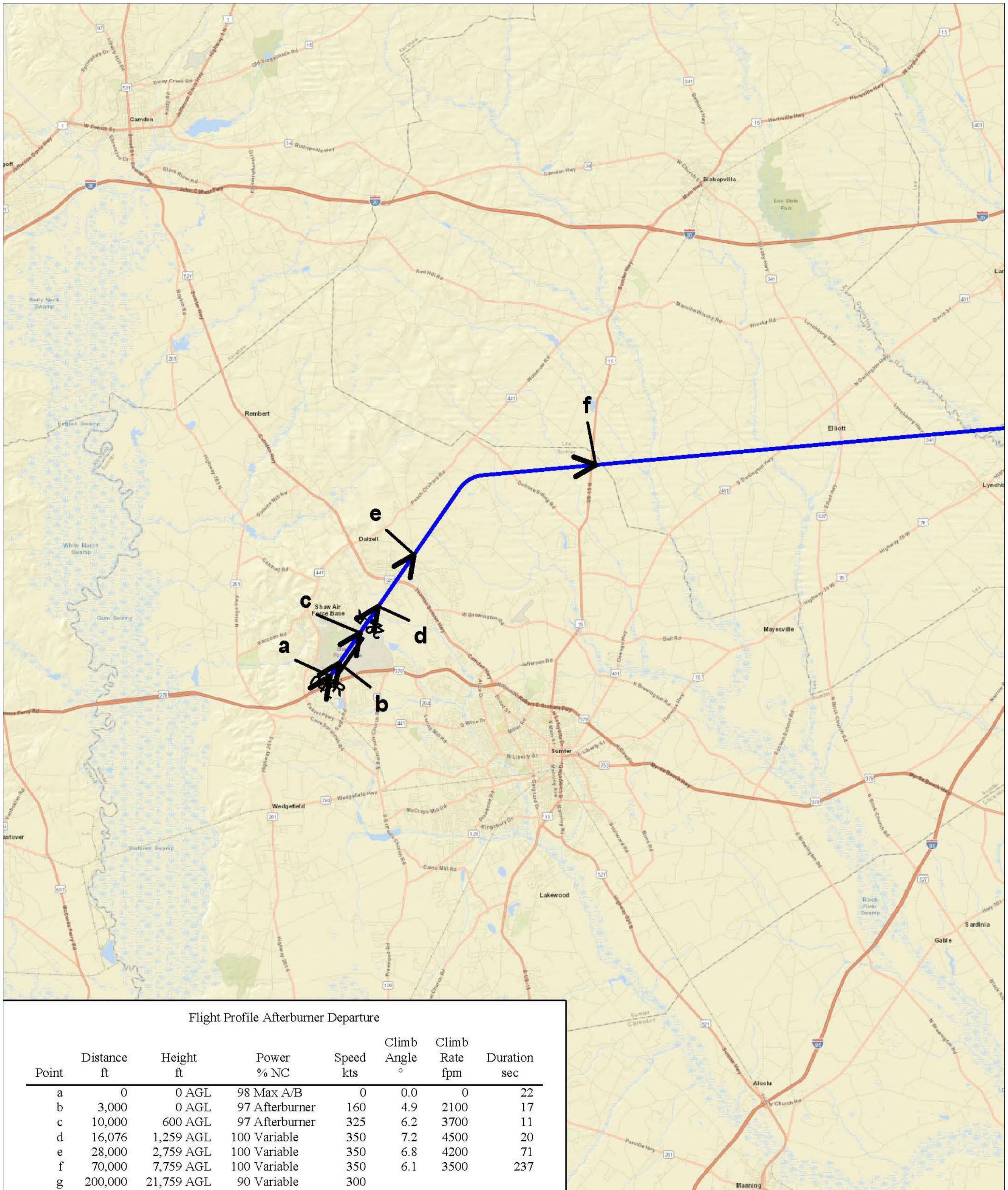
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	200,000	6,000 MSL	83 Variable	300	-1.8	-900	134
b	138,000	4,000 MSL	83 Variable	250	0.0	0	187
c	70,303	4,000 MSL	83 Parallel	180	-3.0	-1000	142
d	27,119	1,460 AGL	83 Parallel	180	-3.0	-900	77
e	4,321	280 AGL	83 Parallel	170	-3.0	-900	15
f	0	50 AGL	75 Parallel	165			

Shaw AFB Based ADAIR Cat C VFR Arrival Flight Profile ADHAS18

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:260,000 (1 inch = 21,700 feet)

N



Flight Profile Afterburner Departure

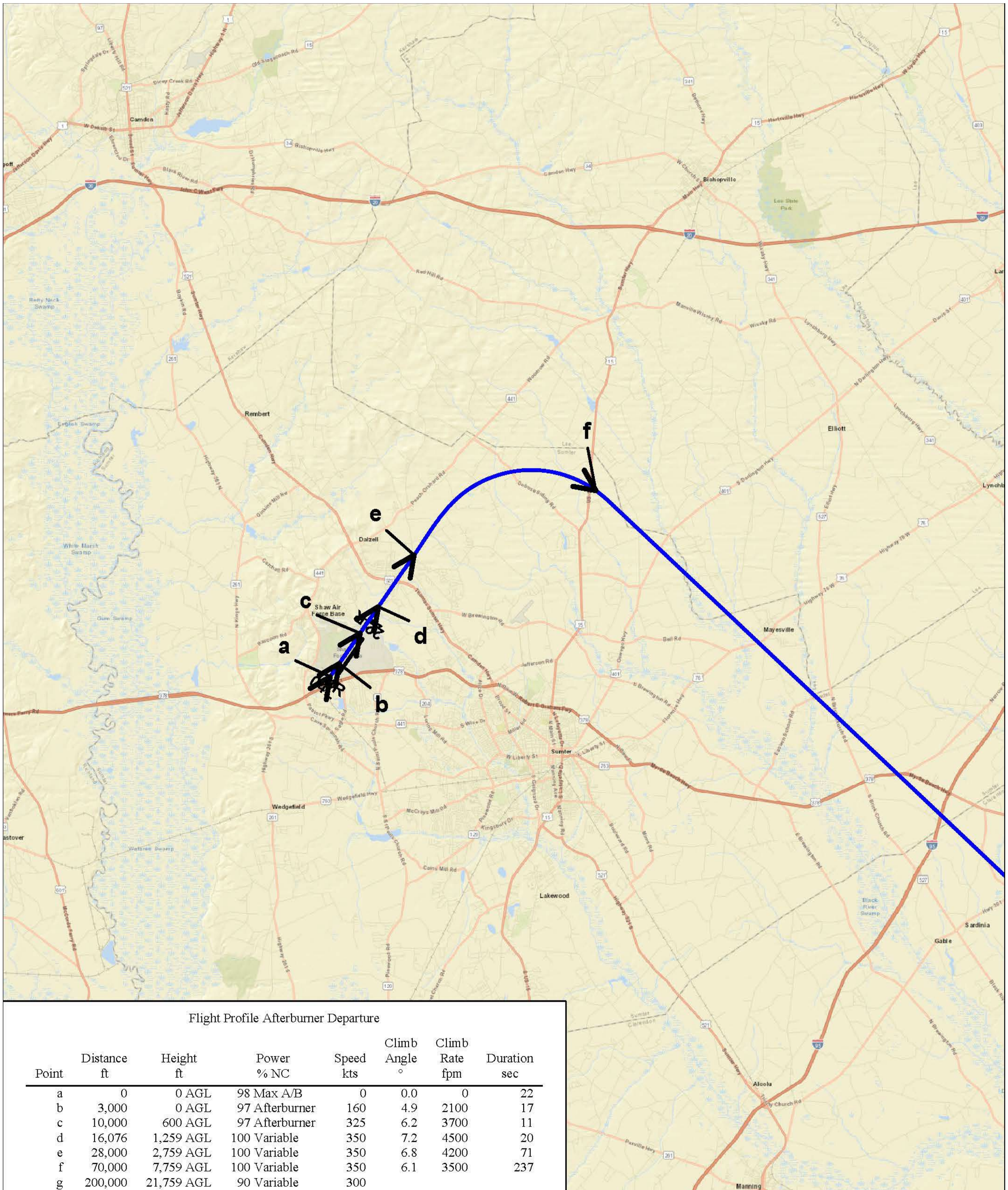
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA01

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

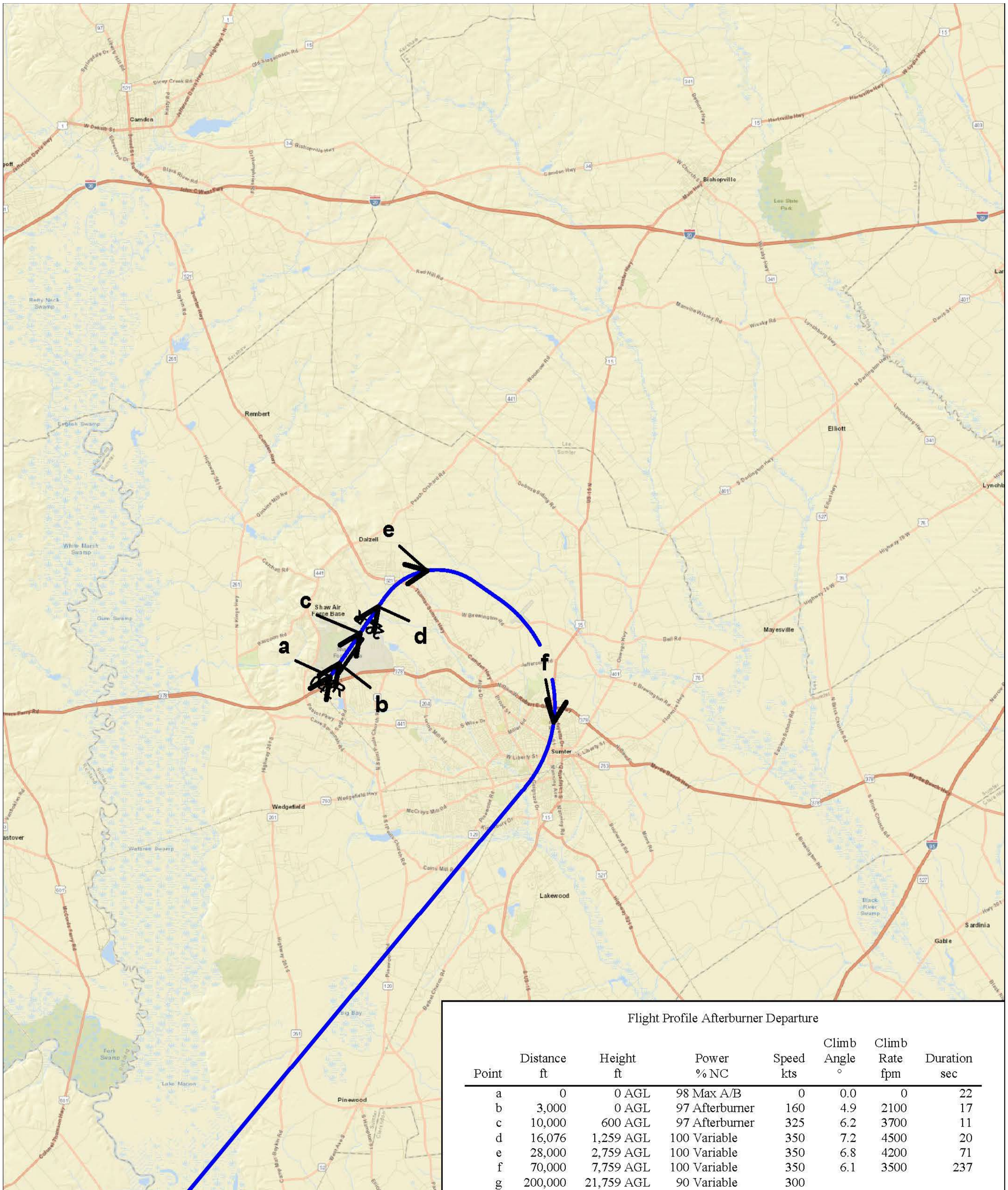
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA02

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

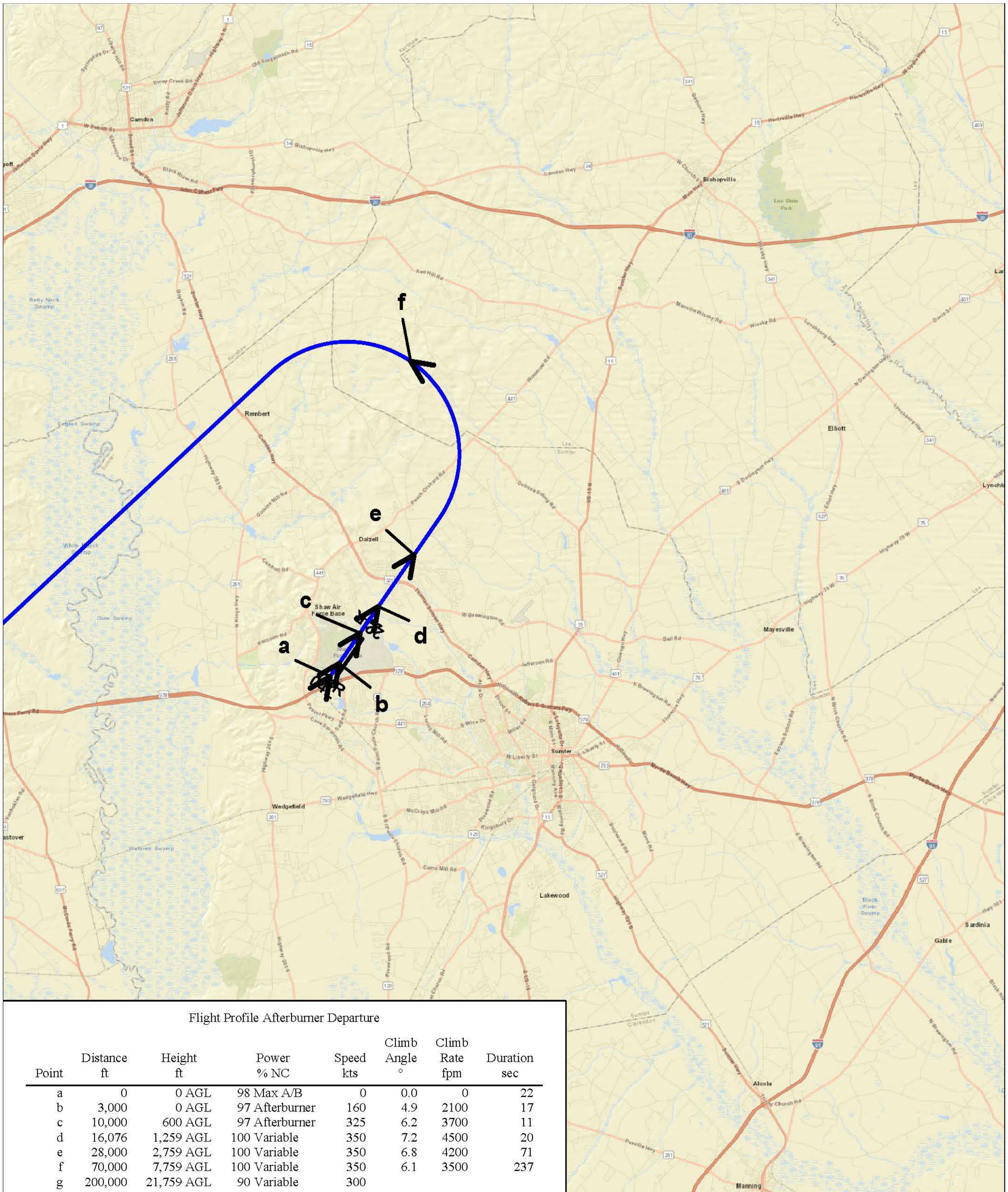
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA03

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



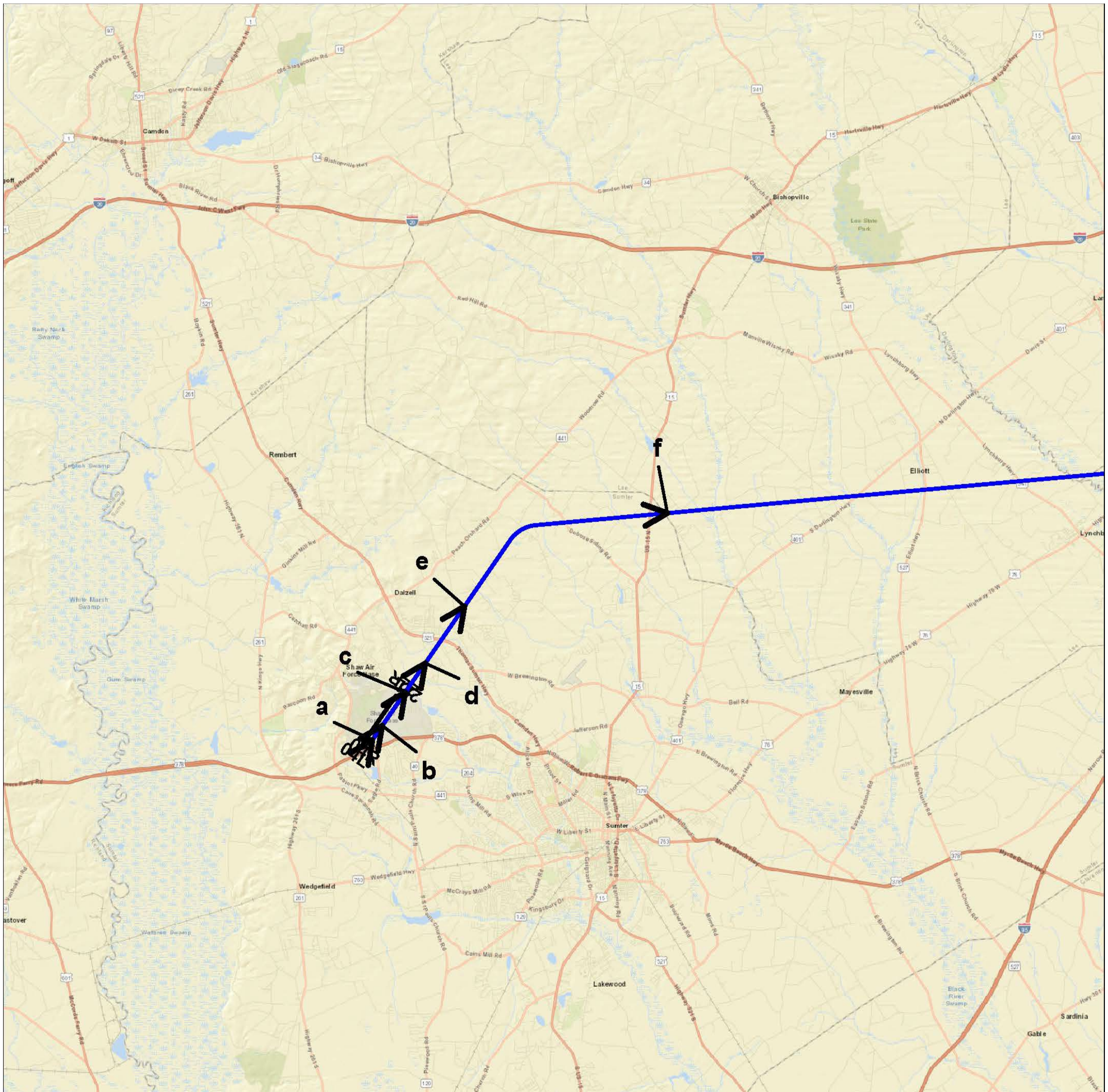
Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA04

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)



Flight Profile Afterburner Departure

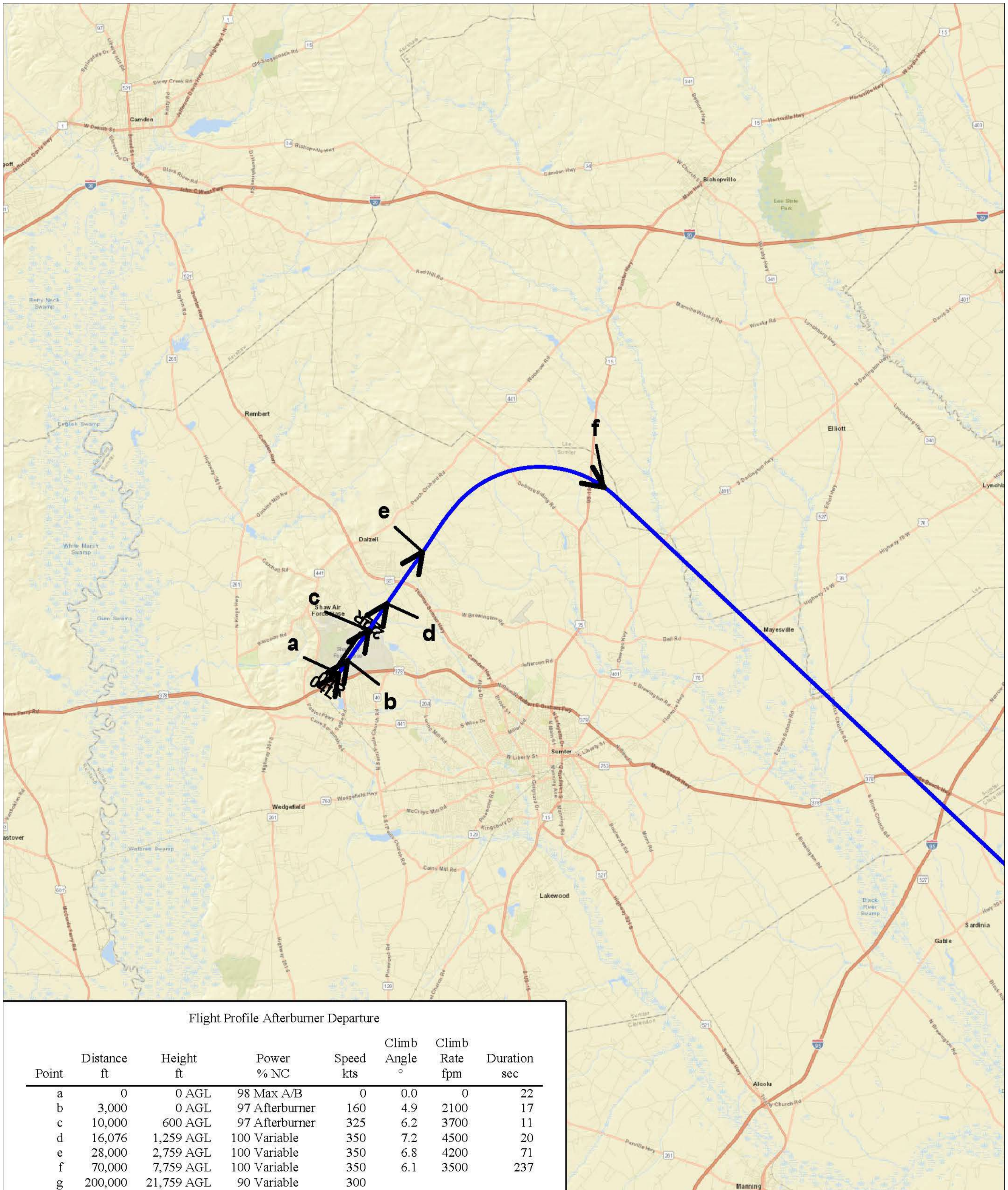
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA05

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

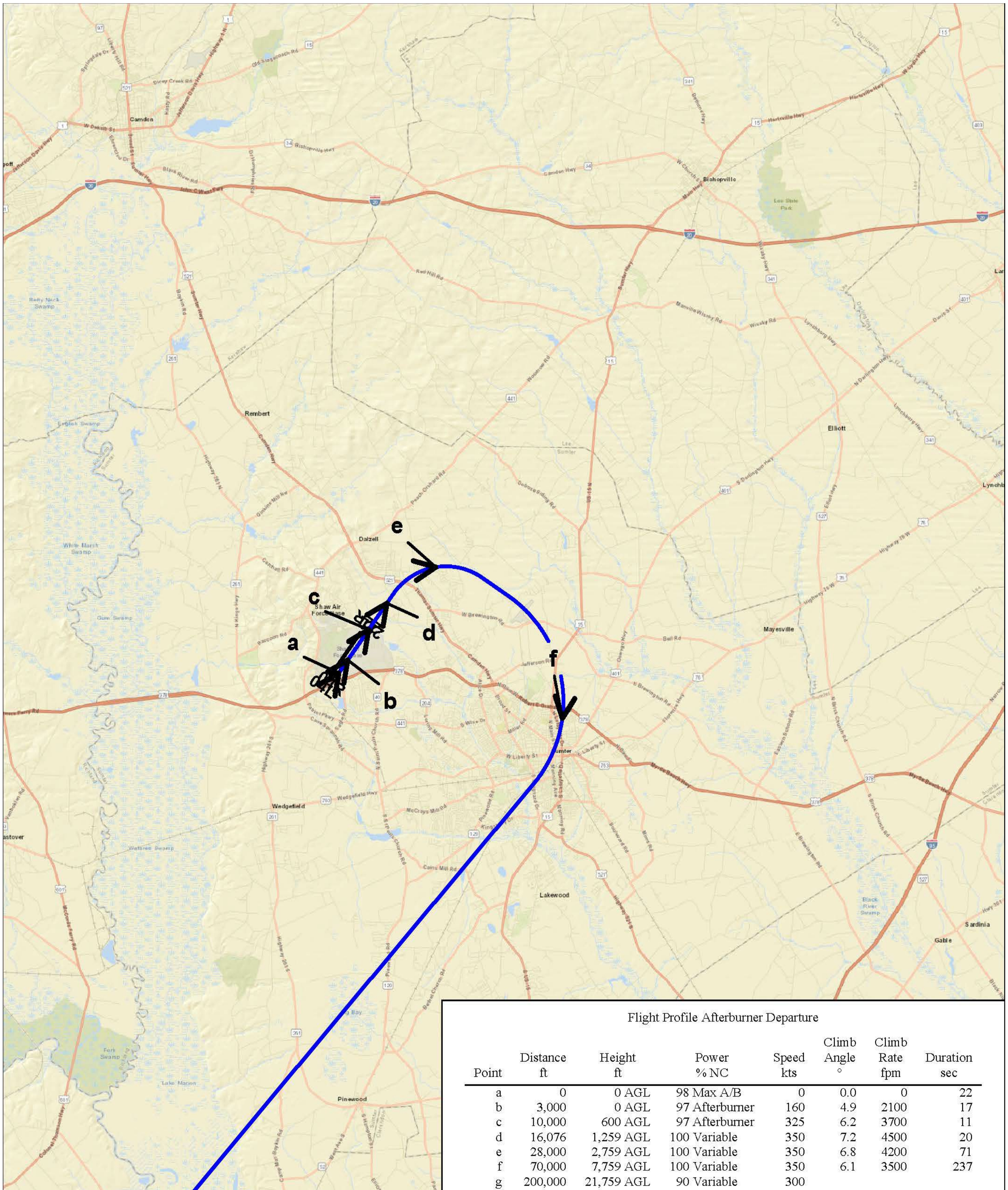
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA06

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



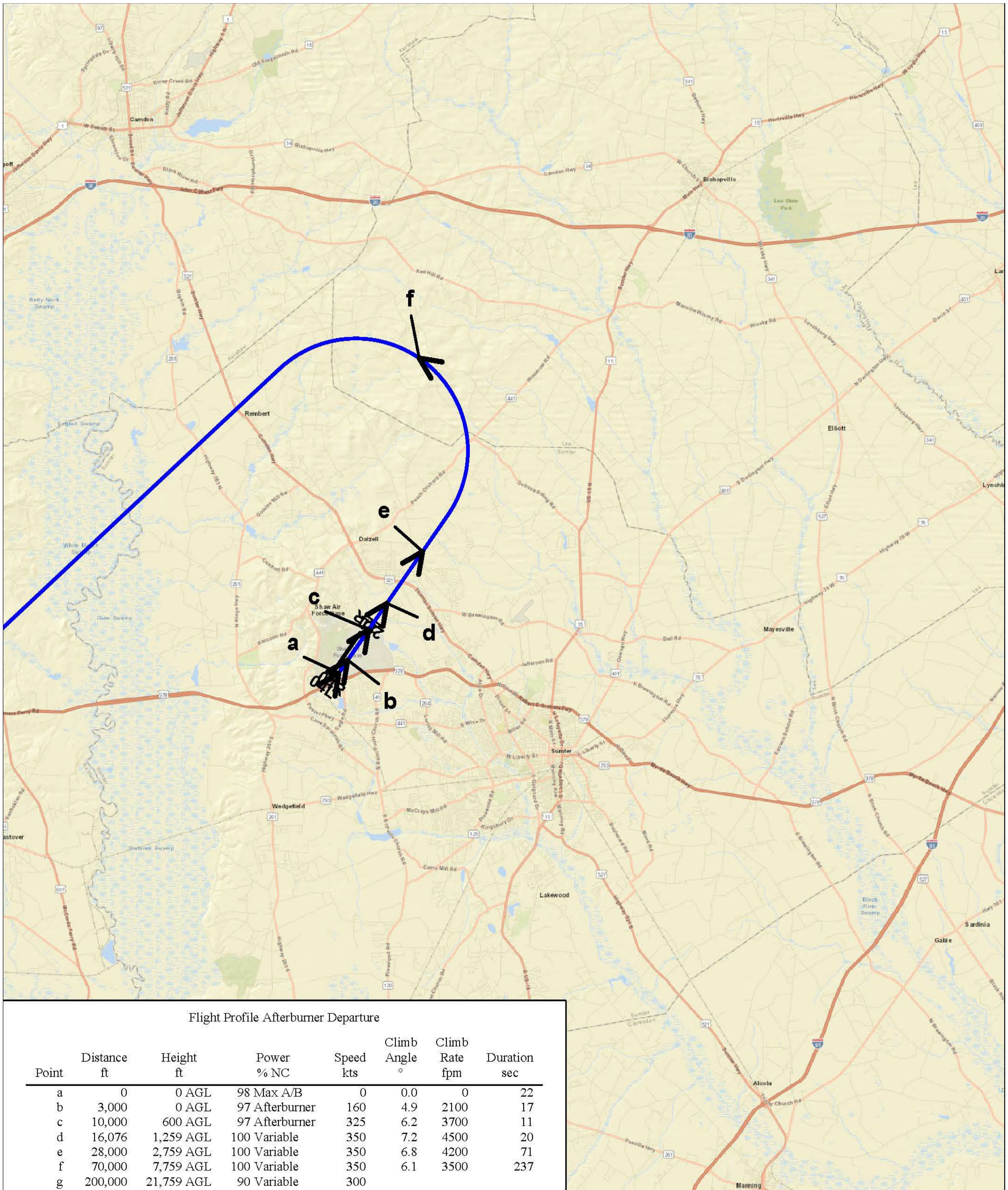
Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA07

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)



Flight Profile Afterburner Departure

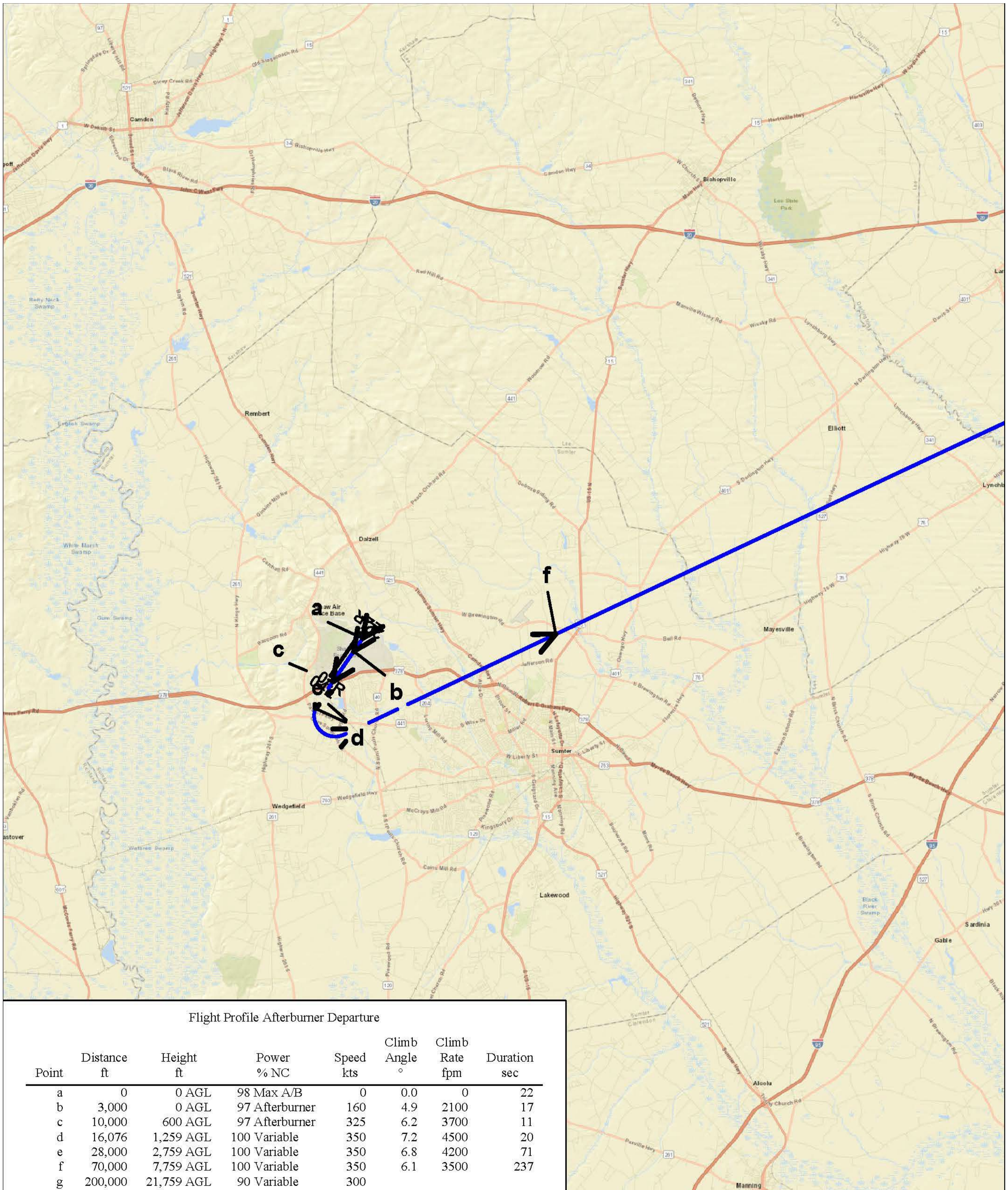
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA08

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA09

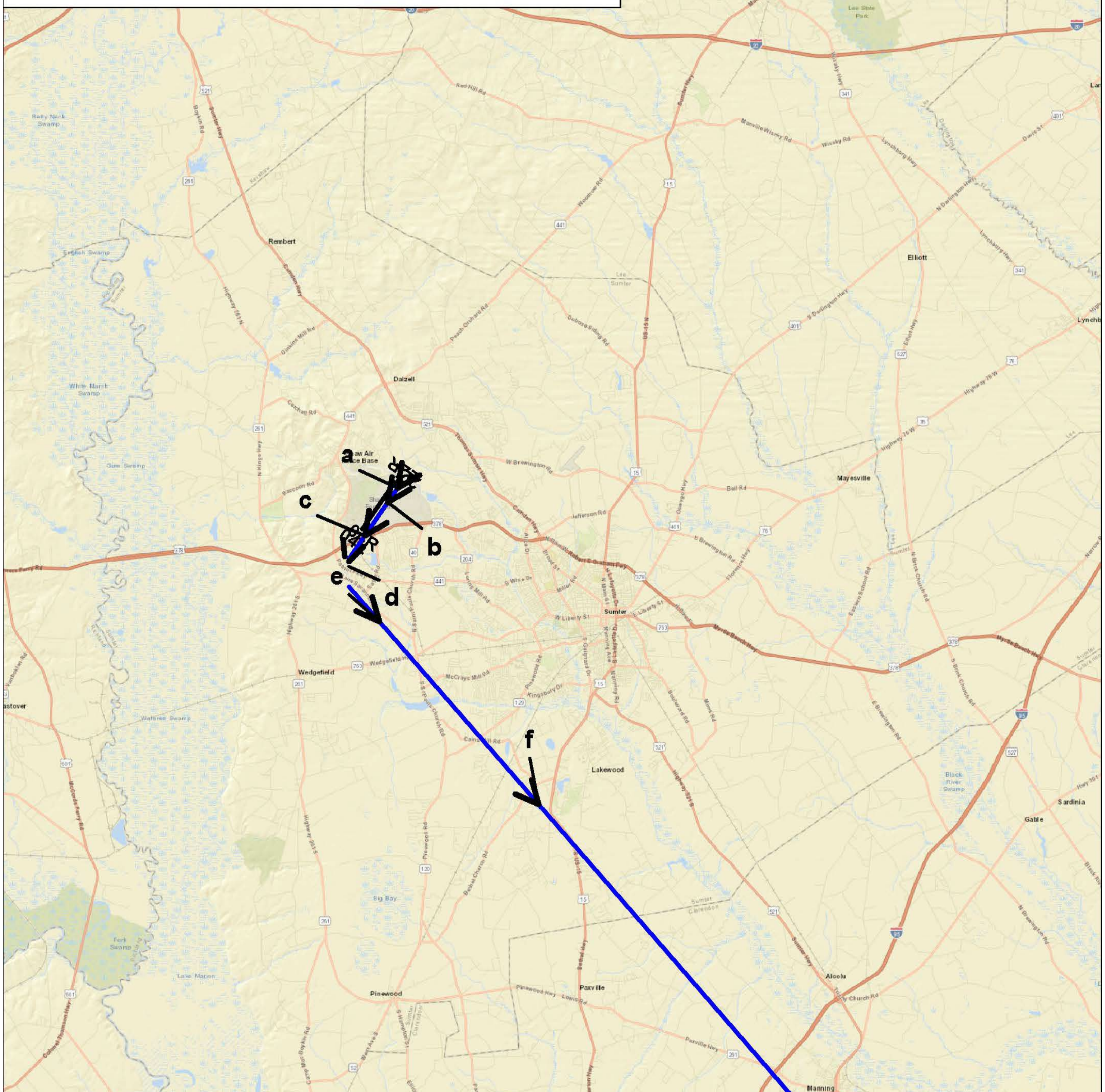
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N

Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

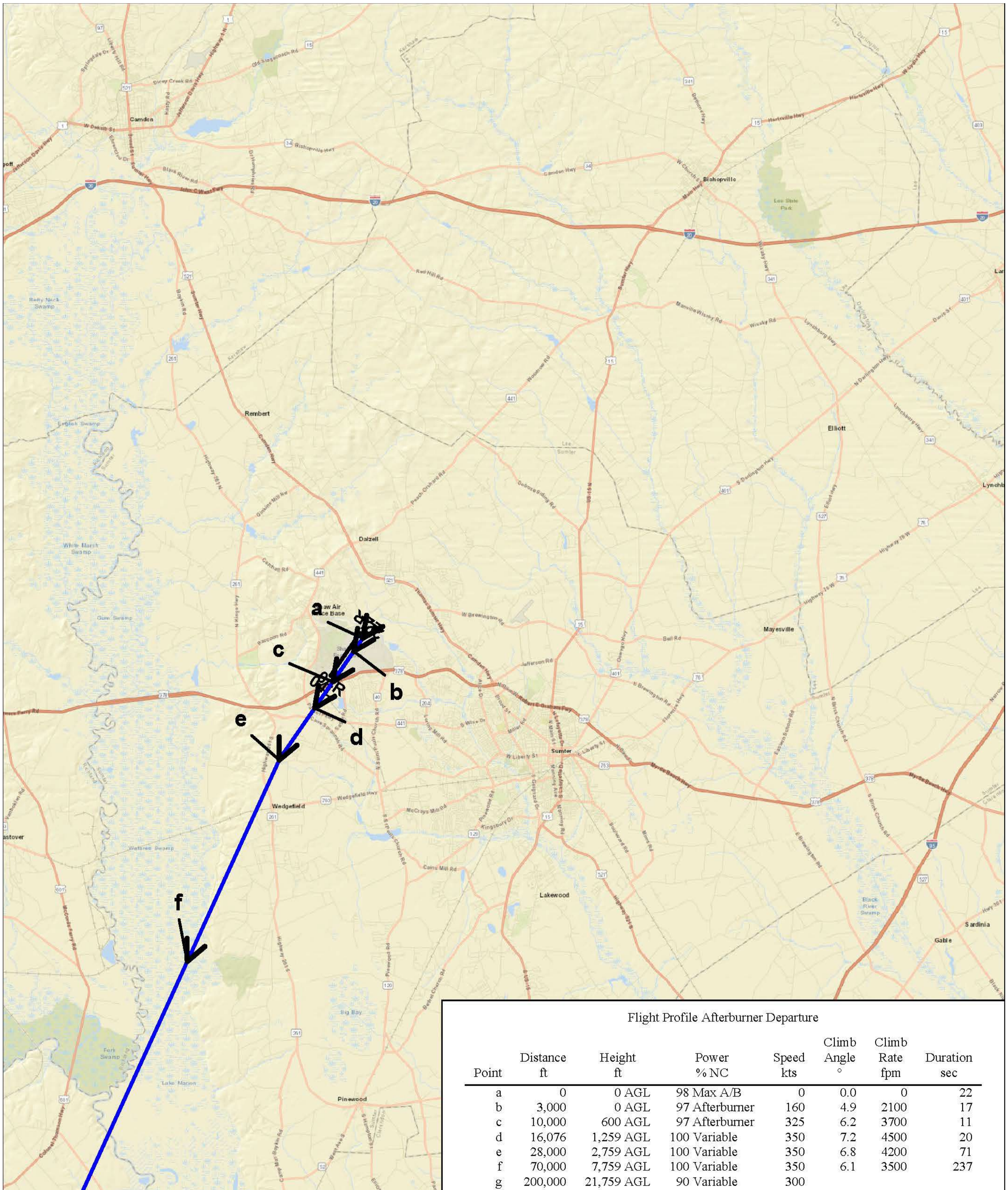


Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA10

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



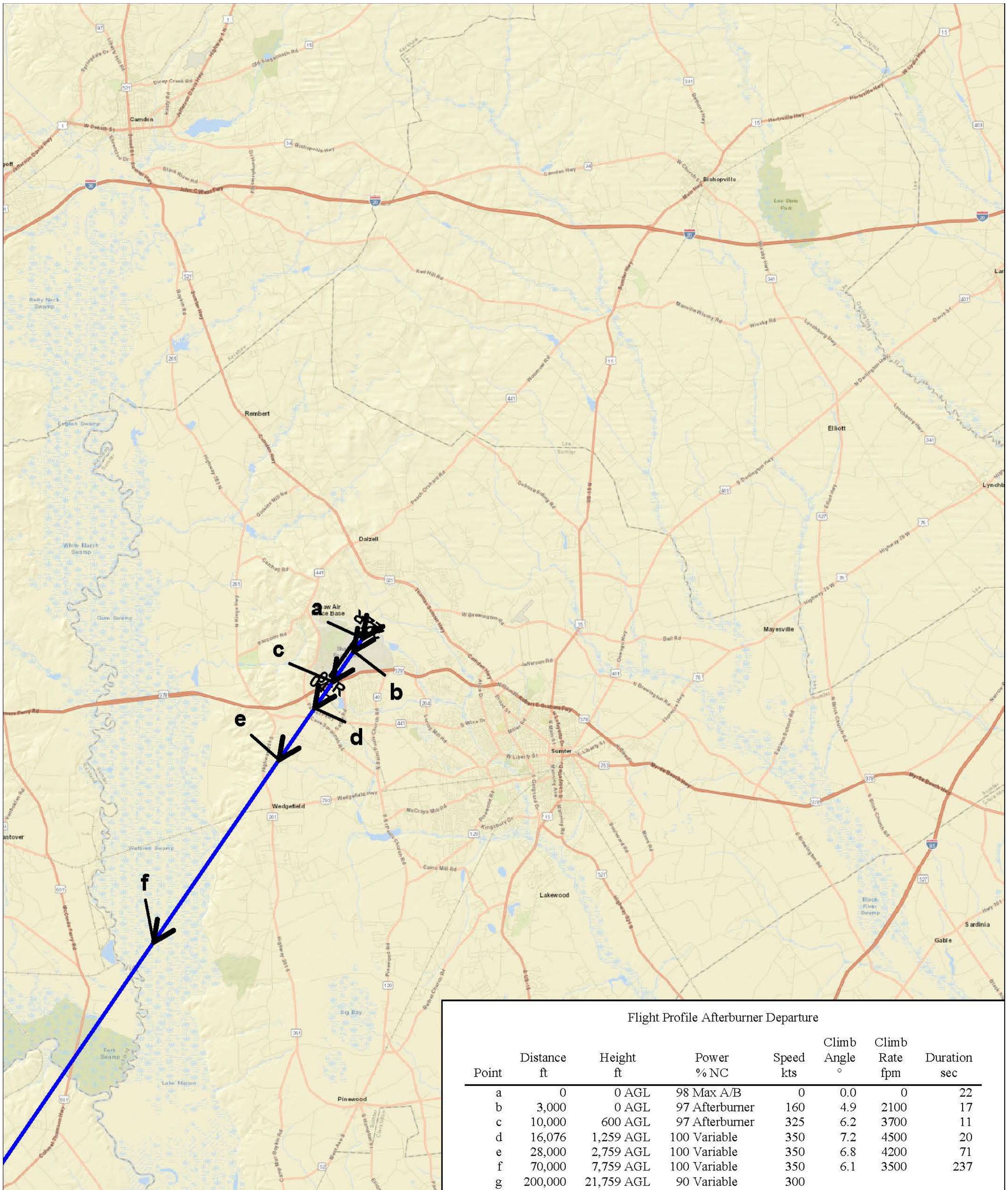
Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA11

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)



Flight Profile Afterburner Departure

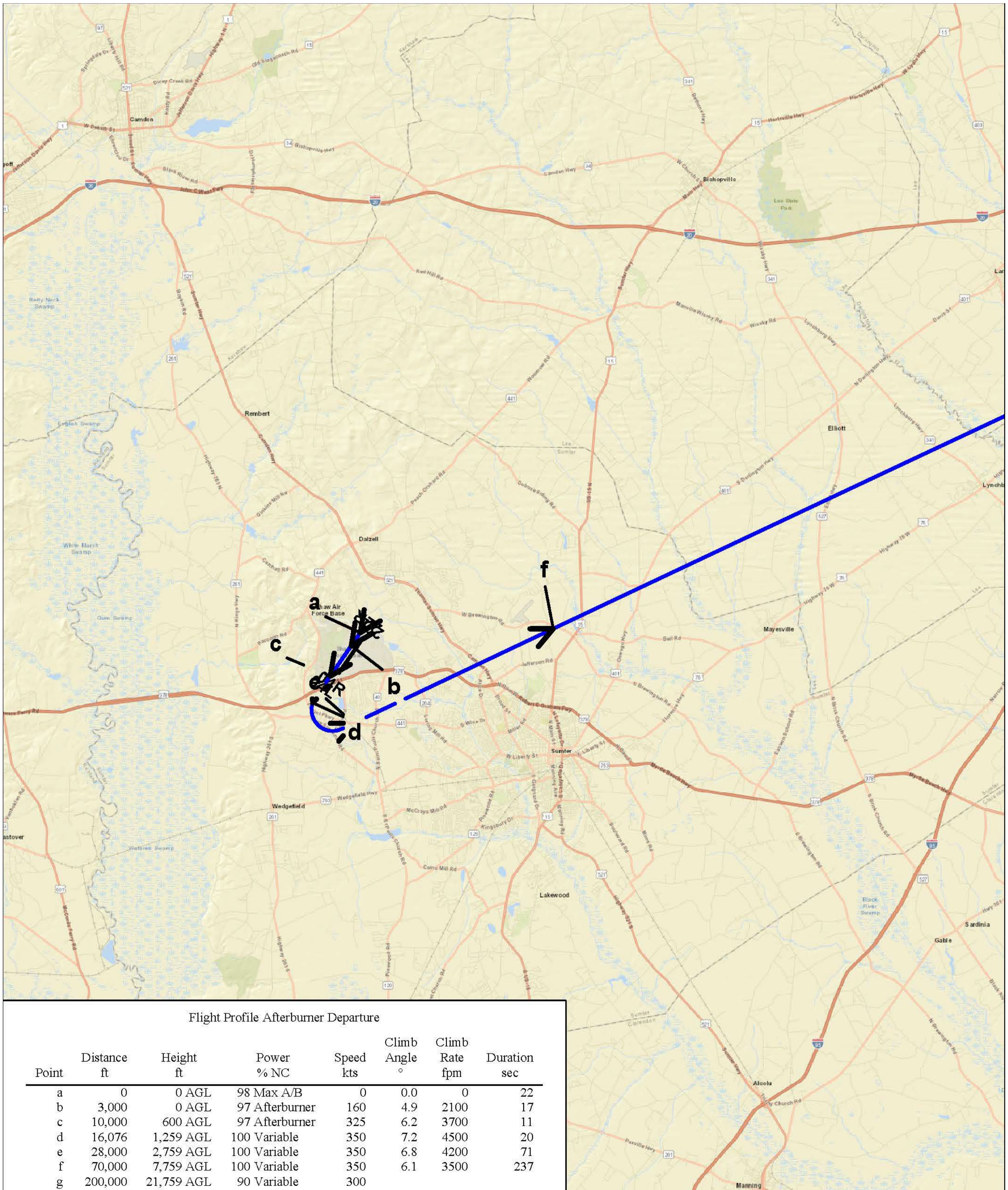
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA12

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N



Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA13

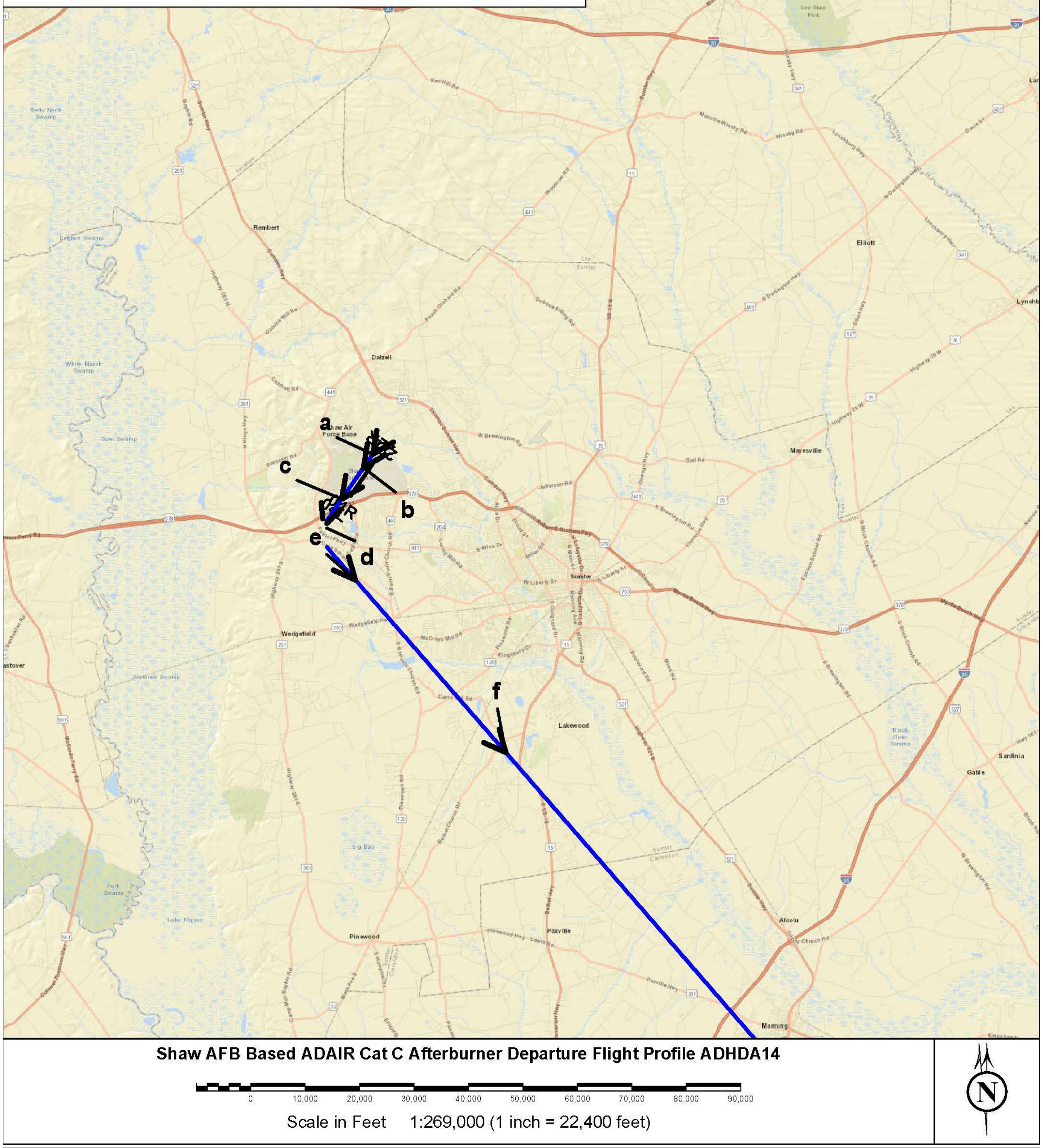
0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N

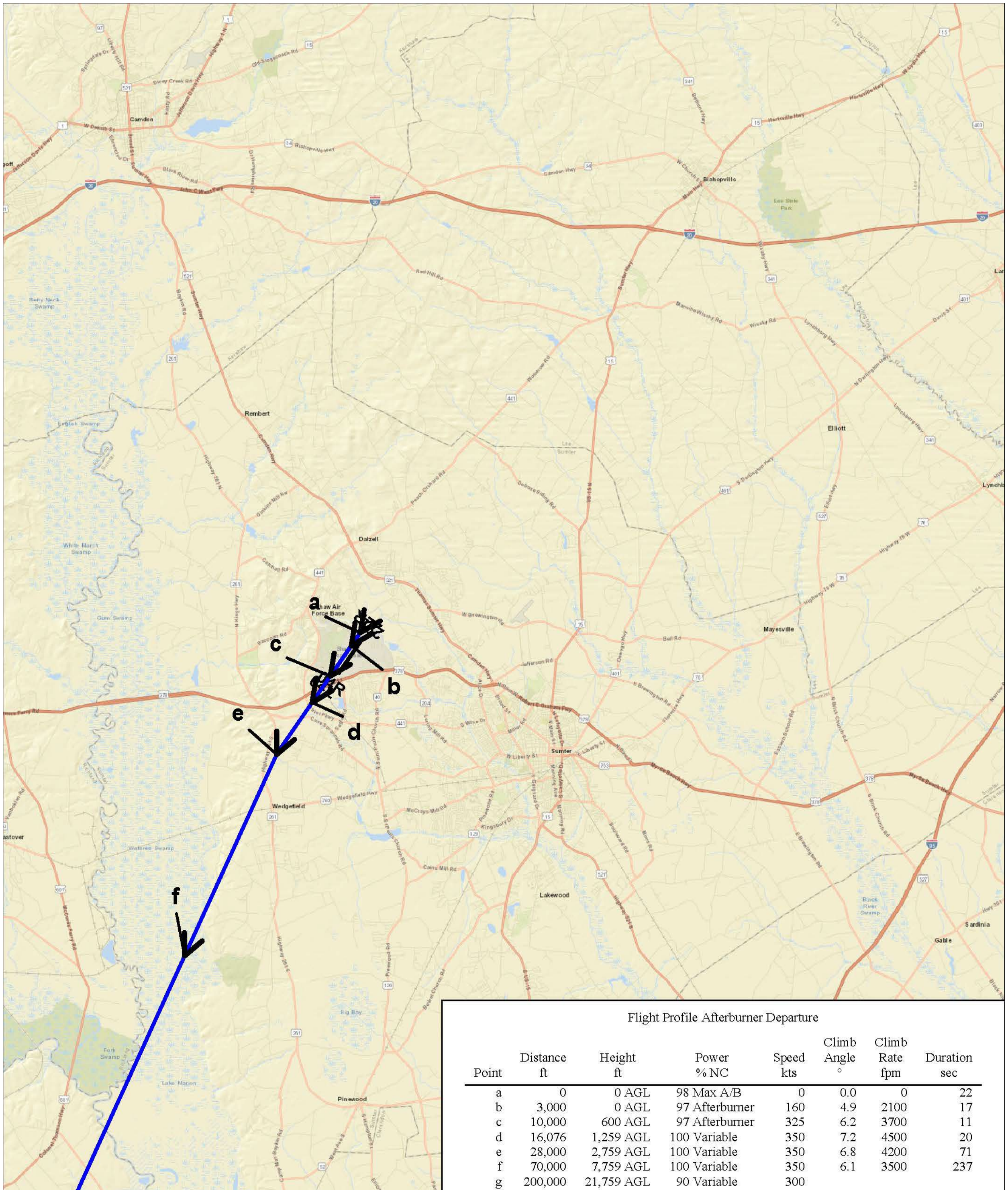
Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			



Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA14

Scale in Feet 1:269,000 (1 inch = 22,400 feet)



Flight Profile Afterburner Departure

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA15

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:269,000 (1 inch = 22,400 feet)

N

Flight Profile Afterburner Departure

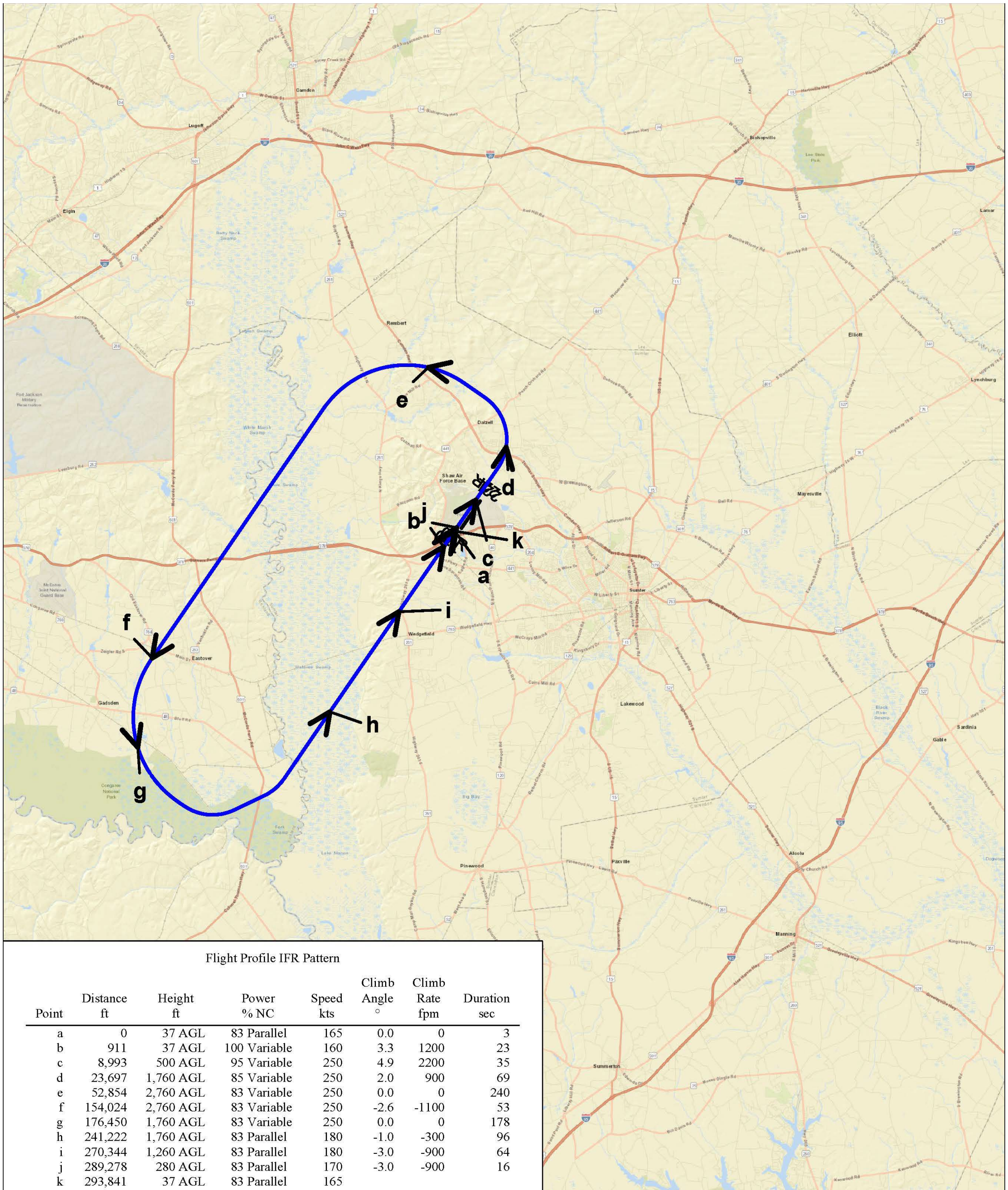
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	0 AGL	98 Max A/B	0	0.0	0	22
b	3,000	0 AGL	97 Afterburner	160	4.9	2100	17
c	10,000	600 AGL	97 Afterburner	325	6.2	3700	11
d	16,076	1,259 AGL	100 Variable	350	7.2	4500	20
e	28,000	2,759 AGL	100 Variable	350	6.8	4200	71
f	70,000	7,759 AGL	100 Variable	350	6.1	3500	237
g	200,000	21,759 AGL	90 Variable	300			

Shaw AFB Based ADAIR Cat C Afterburner Departure Flight Profile ADHDA16

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:268,000 (1 inch = 22,300 feet)

N



Flight Profile IFR Pattern

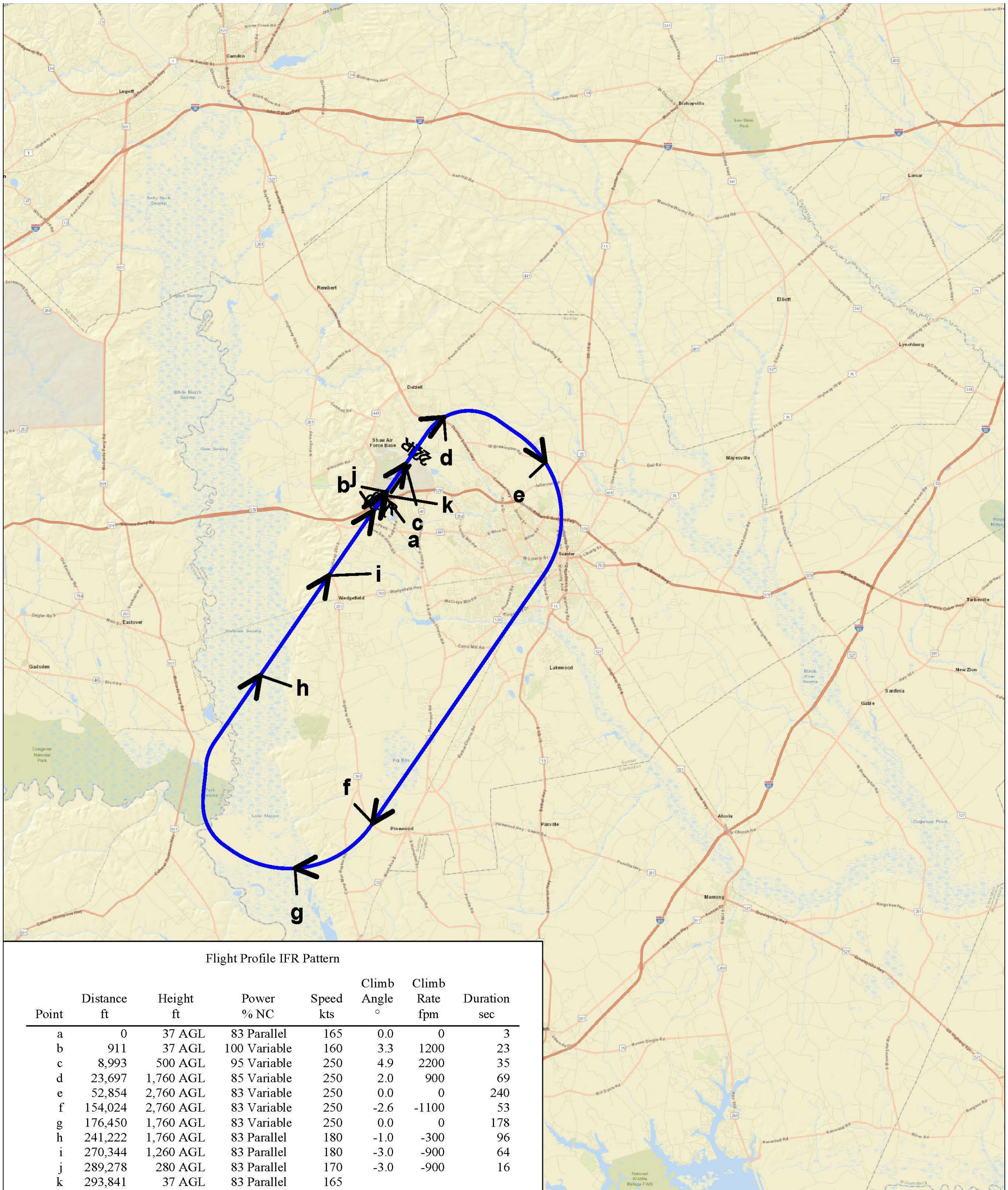
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	37 AGL	83 Parallel	165	0.0	0	3
b	911	37 AGL	100 Variable	160	3.3	1200	23
c	8,993	500 AGL	95 Variable	250	4.9	2200	35
d	23,697	1,760 AGL	85 Variable	250	2.0	900	69
e	52,854	2,760 AGL	83 Variable	250	0.0	0	240
f	154,024	2,760 AGL	83 Variable	250	-2.6	-1100	53
g	176,450	1,760 AGL	83 Variable	250	0.0	0	178
h	241,222	1,760 AGL	83 Parallel	180	-1.0	-300	96
i	270,344	1,260 AGL	83 Parallel	180	-3.0	-900	64
j	289,278	280 AGL	83 Parallel	170	-3.0	-900	16
k	293,841	37 AGL	83 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Pattern Flight Profile ADHCI01

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:340,000 (1 inch = 28,300 feet)

N



Flight Profile IFR Pattern

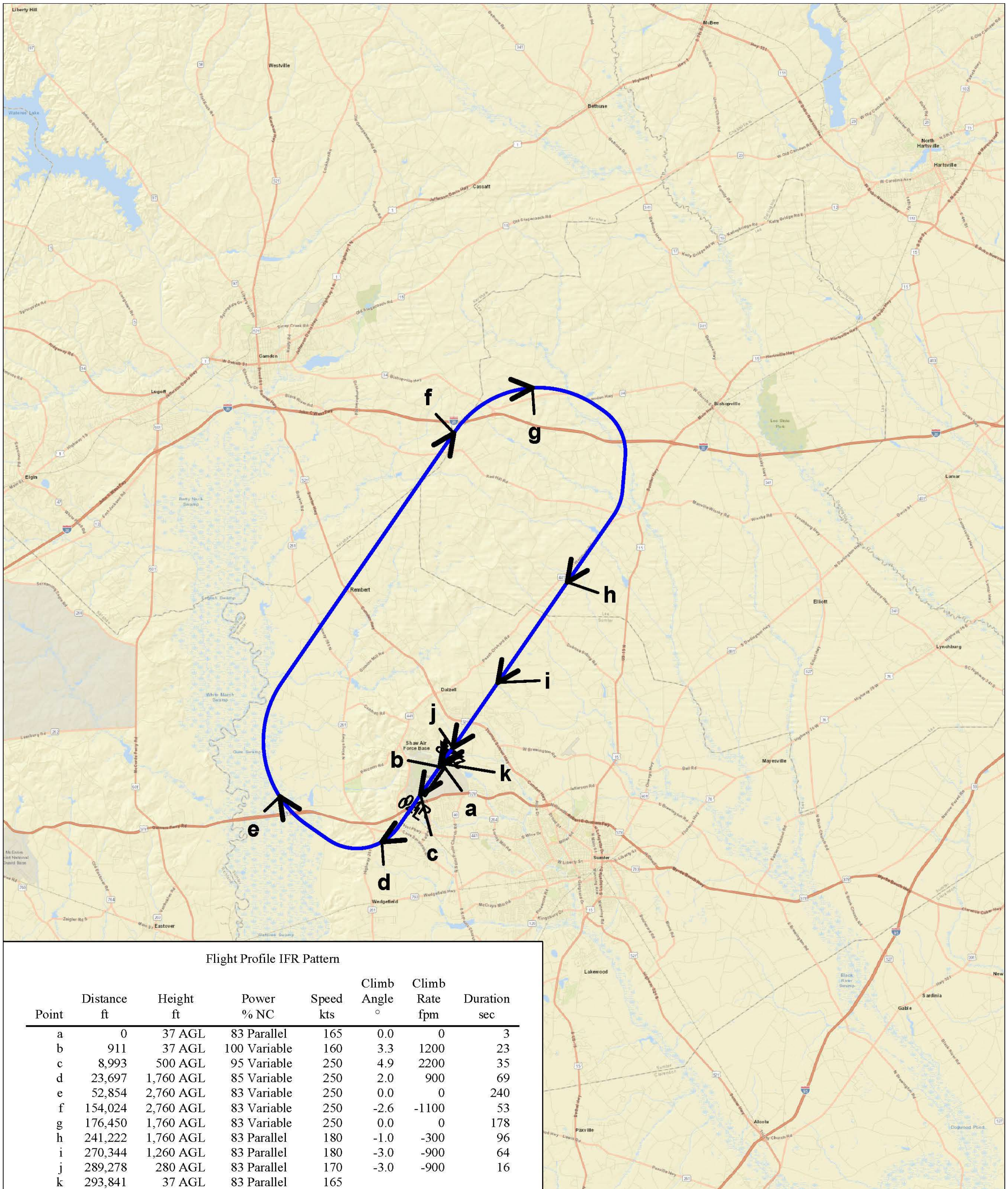
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	37 AGL	83 Parallel	165	0.0	0	3
b	911	37 AGL	100 Variable	160	3.3	1200	23
c	8,993	500 AGL	95 Variable	250	4.9	2200	35
d	23,697	1,760 AGL	85 Variable	250	2.0	900	69
e	52,854	2,760 AGL	83 Variable	250	0.0	0	240
f	154,024	2,760 AGL	83 Variable	250	-2.6	-1100	53
g	176,450	1,760 AGL	83 Variable	250	0.0	0	178
h	241,222	1,760 AGL	83 Parallel	180	-1.0	-300	96
i	270,344	1,260 AGL	83 Parallel	180	-3.0	-900	64
j	289,278	280 AGL	83 Parallel	170	-3.0	-900	16
k	293,841	37 AGL	83 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Pattern Flight Profile ADHCI02

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:341,000 (1 inch = 28,400 feet)

N



Flight Profile IFR Pattern

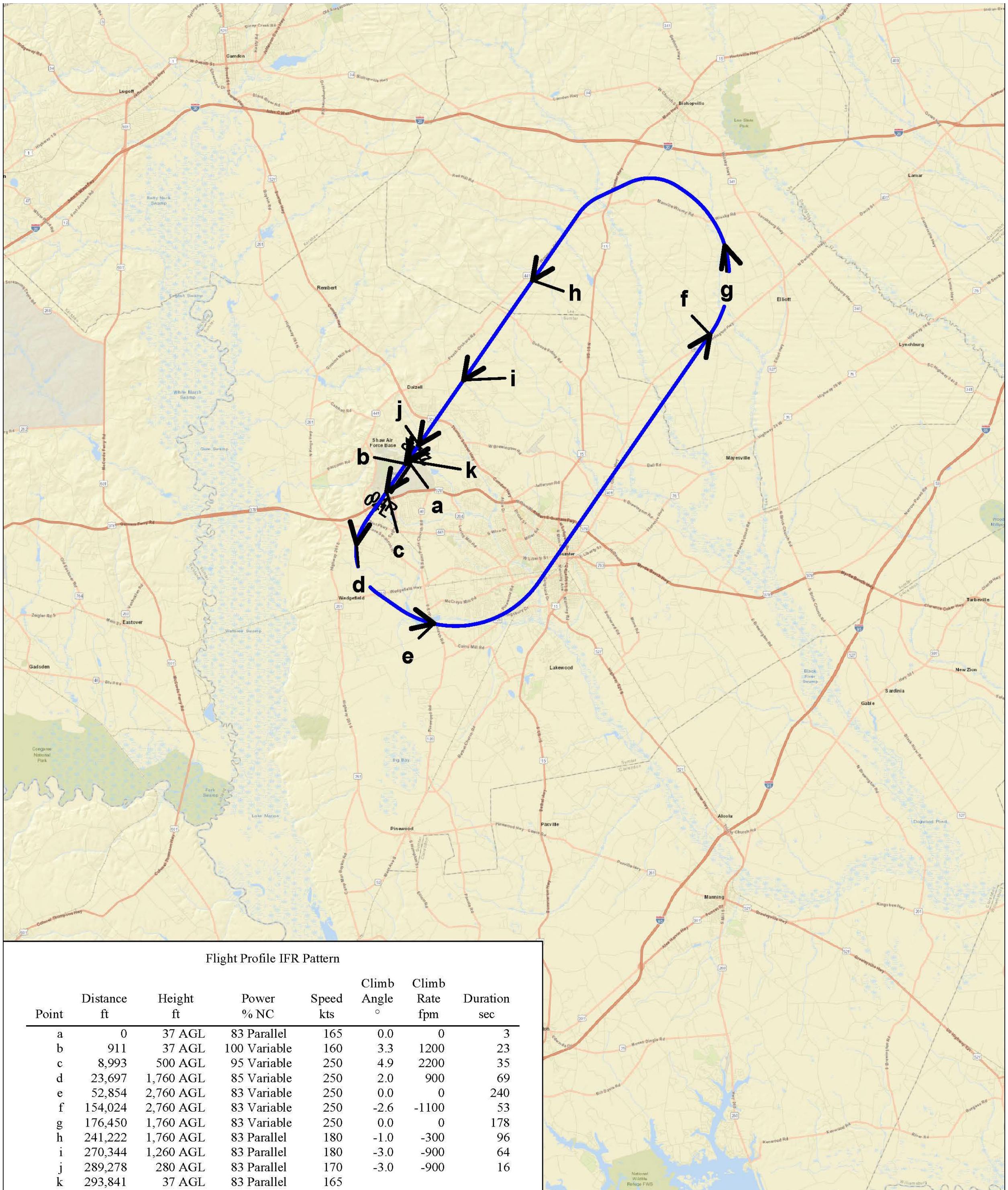
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	37 AGL	83 Parallel	165	0.0	0	3
b	911	37 AGL	100 Variable	160	3.3	1200	23
c	8,993	500 AGL	95 Variable	250	4.9	2200	35
d	23,697	1,760 AGL	85 Variable	250	2.0	900	69
e	52,854	2,760 AGL	83 Variable	250	0.0	0	240
f	154,024	2,760 AGL	83 Variable	250	-2.6	-1100	53
g	176,450	1,760 AGL	83 Variable	250	0.0	0	178
h	241,222	1,760 AGL	83 Parallel	180	-1.0	-300	96
i	270,344	1,260 AGL	83 Parallel	180	-3.0	-900	64
j	289,278	280 AGL	83 Parallel	170	-3.0	-900	16
k	293,841	37 AGL	83 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Pattern Flight Profile ADHCI03

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:339,000 (1 inch = 28,200 feet)

N



Flight Profile IFR Pattern

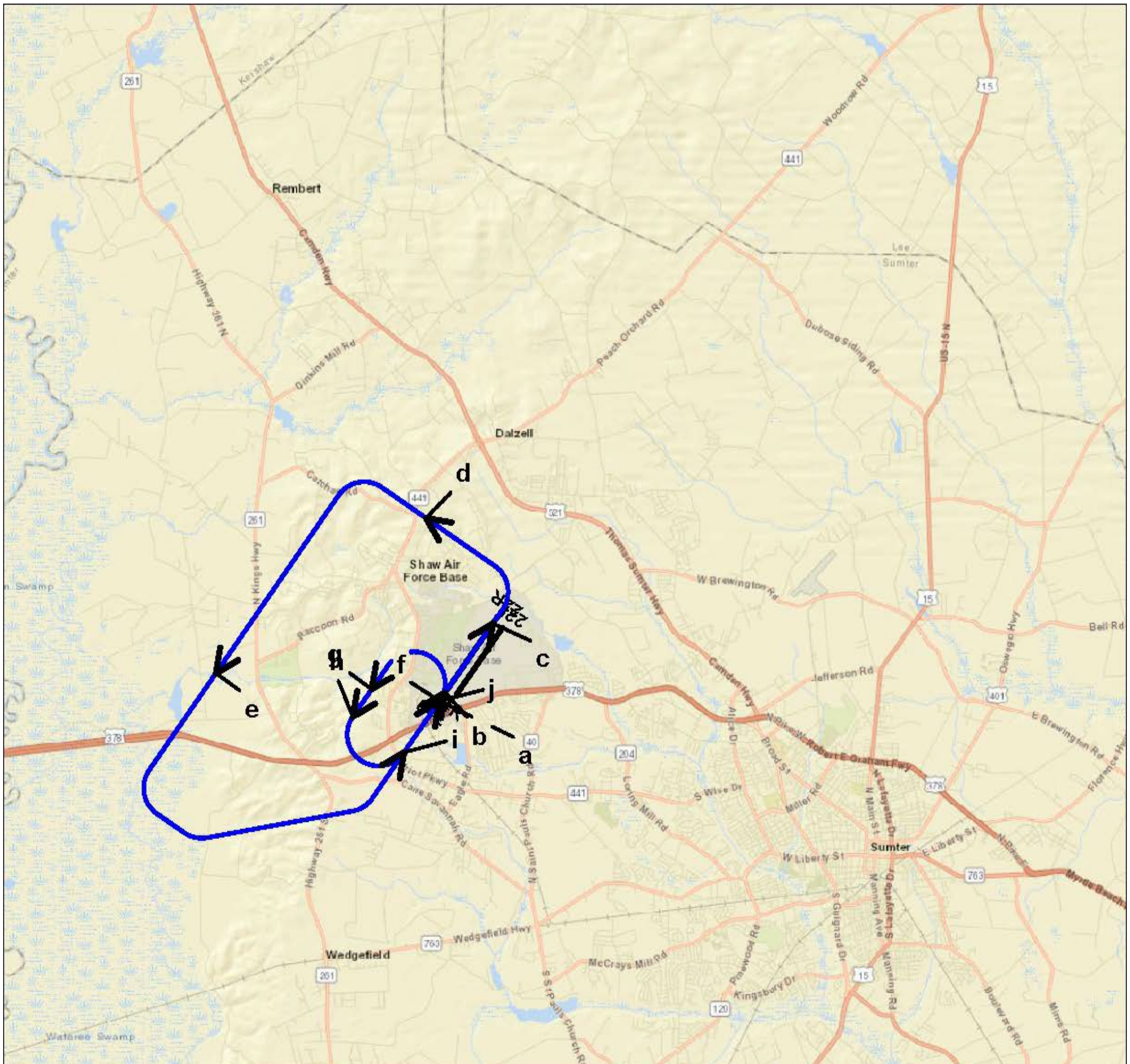
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	37 AGL	83 Parallel	165	0.0	0	3
b	911	37 AGL	100 Variable	160	3.3	1200	23
c	8,993	500 AGL	95 Variable	250	4.9	2200	35
d	23,697	1,760 AGL	85 Variable	250	2.0	900	69
e	52,854	2,760 AGL	83 Variable	250	0.0	0	240
f	154,024	2,760 AGL	83 Variable	250	-2.6	-1100	53
g	176,450	1,760 AGL	83 Variable	250	0.0	0	178
h	241,222	1,760 AGL	83 Parallel	180	-1.0	-300	96
i	270,344	1,260 AGL	83 Parallel	180	-3.0	-900	64
j	289,278	280 AGL	83 Parallel	170	-3.0	-900	16
k	293,841	37 AGL	83 Parallel	165			

Shaw AFB Based ADAIR Cat C IFR Pattern Flight Profile ADHCI04

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:341,000 (1 inch = 28,400 feet)

N



Flight Profile Re-Entry Pattern

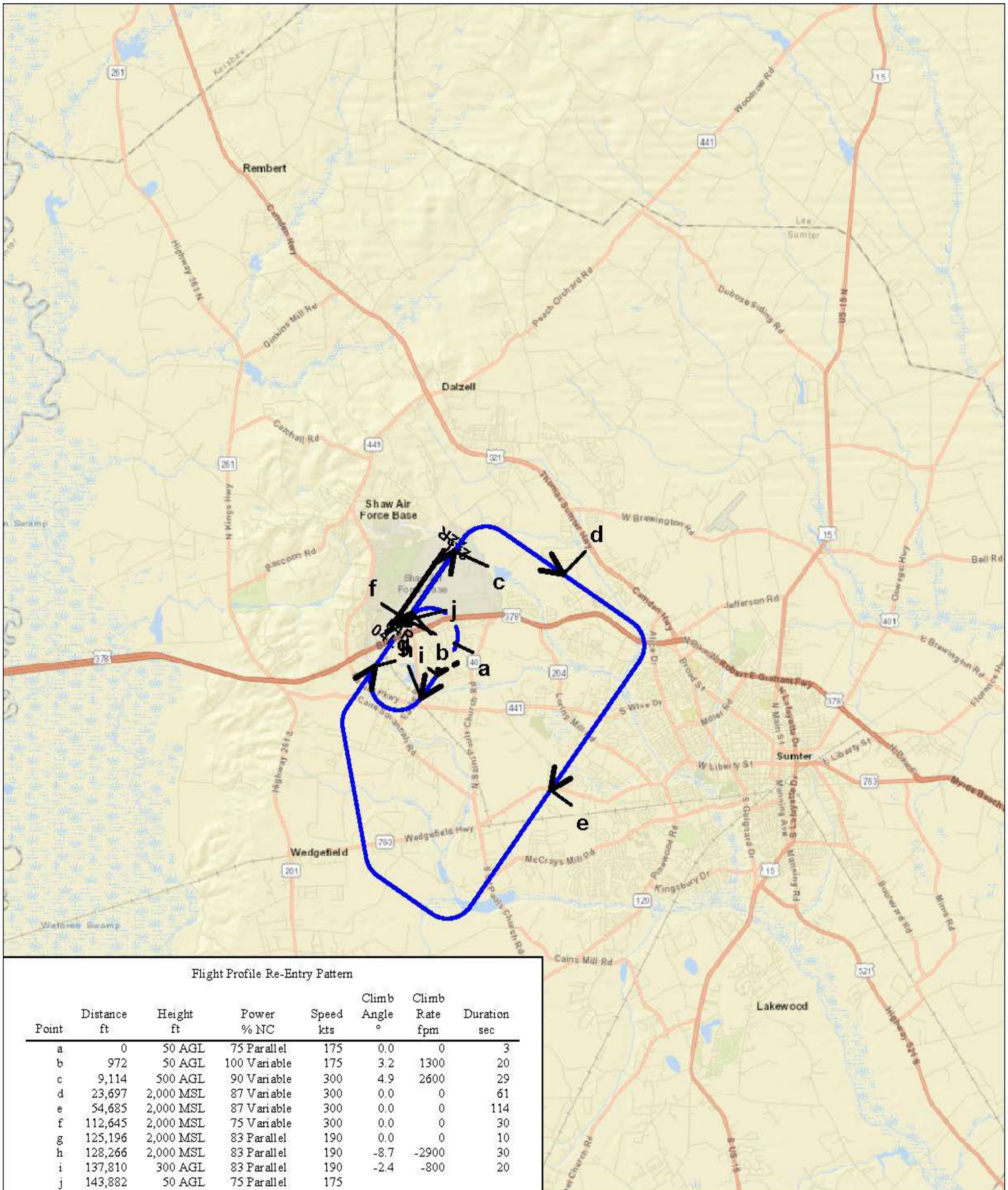
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	75 Parallel	175	0.0	0	3
b	972	50 AGL	100 Variable	175	3.2	1300	20
c	9,114	500 AGL	90 Variable	300	4.9	2600	29
d	23,697	2,000 MSL	87 Variable	300	0.0	0	61
e	54,685	2,000 MSL	87 Variable	300	0.0	0	99
f	104,717	2,000 MSL	75 Variable	300	0.0	0	30
g	117,085	2,000 MSL	83 Parallel	190	0.0	0	10
h	120,337	2,000 MSL	83 Parallel	190	-8.7	-2900	30
i	129,881	300 AGL	83 Parallel	190	-2.4	-800	20
j	135,923	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Re-Entry Pattern Flight Profile ADHCR01

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:154,000 (1 inch = 12,900 feet)

N



Flight Profile Re-Entry Pattern

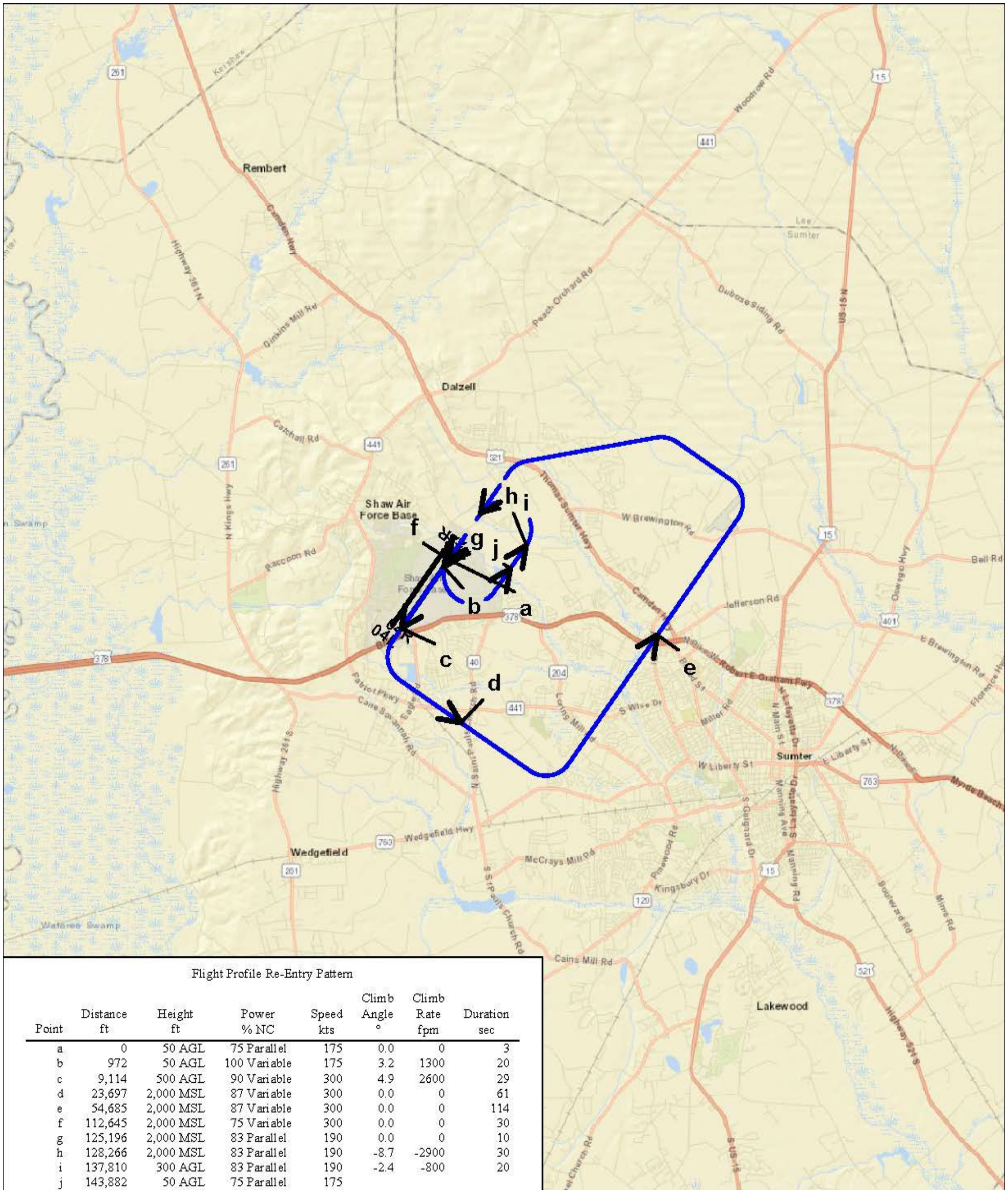
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	75 Parallel	175	0.0	0	3
b	972	50 AGL	100 Variable	175	3.2	1300	20
c	9,114	500 AGL	90 Variable	300	4.9	2600	29
d	23,697	2,000 MSL	87 Variable	300	0.0	0	61
e	54,685	2,000 MSL	87 Variable	300	0.0	0	114
f	112,645	2,000 MSL	75 Variable	300	0.0	0	30
g	125,196	2,000 MSL	83 Parallel	190	0.0	0	10
h	128,266	2,000 MSL	83 Parallel	190	-8.7	-2900	30
i	137,810	300 AGL	83 Parallel	190	-2.4	-800	20
j	143,882	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Re-Entry Pattern Flight Profile ADHCR02

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:154,000 (1 inch = 12,900 feet)

N



Flight Profile Re-Entry Pattern

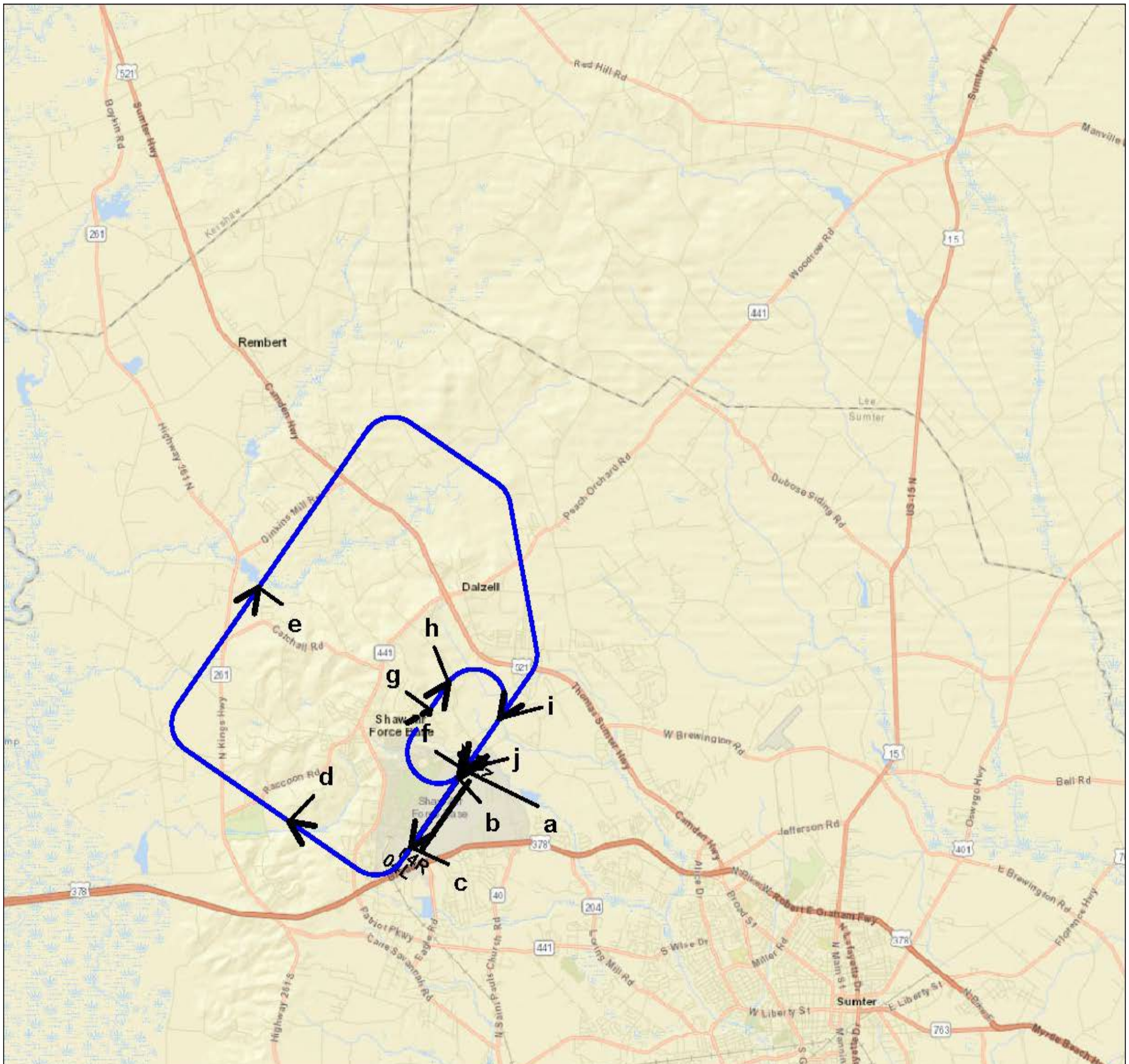
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	75 Parallel	175	0.0	0	3
b	972	50 AGL	100 Variable	175	3.2	1300	20
c	9,114	500 AGL	90 Variable	300	4.9	2600	29
d	23,697	2,000 MSL	87 Variable	300	0.0	0	61
e	54,685	2,000 MSL	87 Variable	300	0.0	0	114
f	112,645	2,000 MSL	75 Variable	300	0.0	0	30
g	125,196	2,000 MSL	83 Parallel	190	0.0	0	10
h	128,266	2,000 MSL	83 Parallel	190	-8.7	-2900	30
i	137,810	300 AGL	83 Parallel	190	-2.4	-800	20
j	143,882	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Re-Entry Pattern Flight Profile ADHCR03

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:154,000 (1 inch = 12,900 feet)

N



Flight Profile Re-Entry Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	75 Parallel	175	0.0	0	3
b	972	50 AGL	100 Variable	175	3.2	1300	20
c	9,114	500 AGL	90 Variable	300	4.9	2600	29
d	23,697	2,000 MSL	87 Variable	300	0.0	0	61
e	54,685	2,000 MSL	87 Variable	300	0.0	0	127
f	118,862	2,000 MSL	75 Variable	300	0.0	0	30
g	131,314	2,000 MSL	83 Parallel	190	0.0	0	10
h	134,483	2,000 MSL	83 Parallel	190	-8.7	-2900	30
i	144,027	300 AGL	83 Parallel	190	-2.4	-800	20
j	150,080	50 AGL	75 Parallel	175			

Shaw AFB Based ADAIR Cat C Re-Entry Pattern Flight Profile ADHCR04

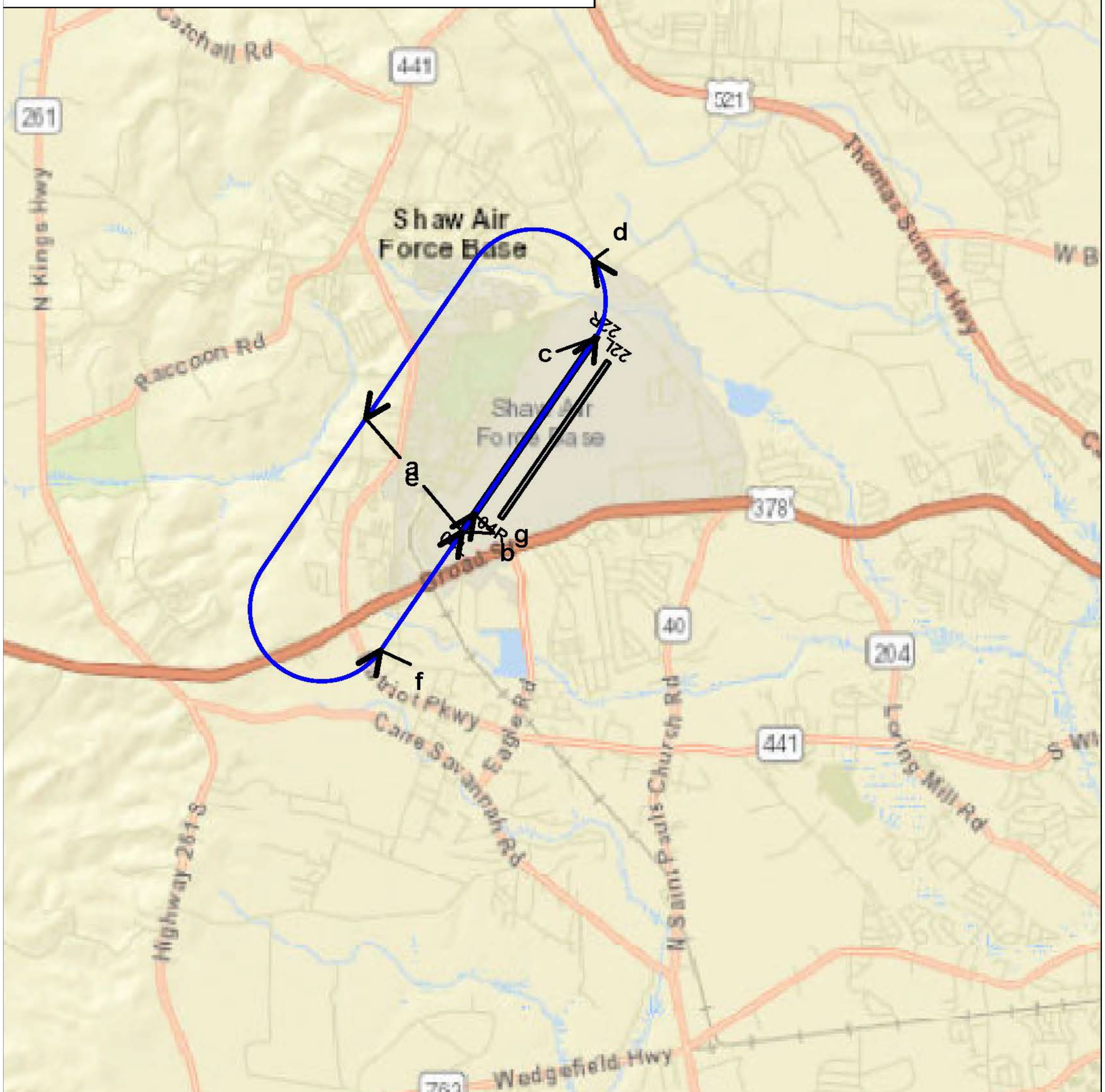
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:154,000 (1 inch = 12,800 feet)

N

Flight Profile SFO Low Key Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	100 Takeoff	165	-3.1	-900	3
b	911	0 AGL	100 Takeoff	160	4.4	1800	23
c	9,965	700 AGL	100 Variable	300	13.1	7700	6
d	13,395	1,500 AGL	100 Variable	350	13.1	8300	24
e	27,390	5,000 MSL	75 Parallel	350	-14.5	-6800	39
f	44,599	300 AGL	75 Parallel	170	-2.4	-700	21
g	50,675	50 AGL	75 Parallel	165			



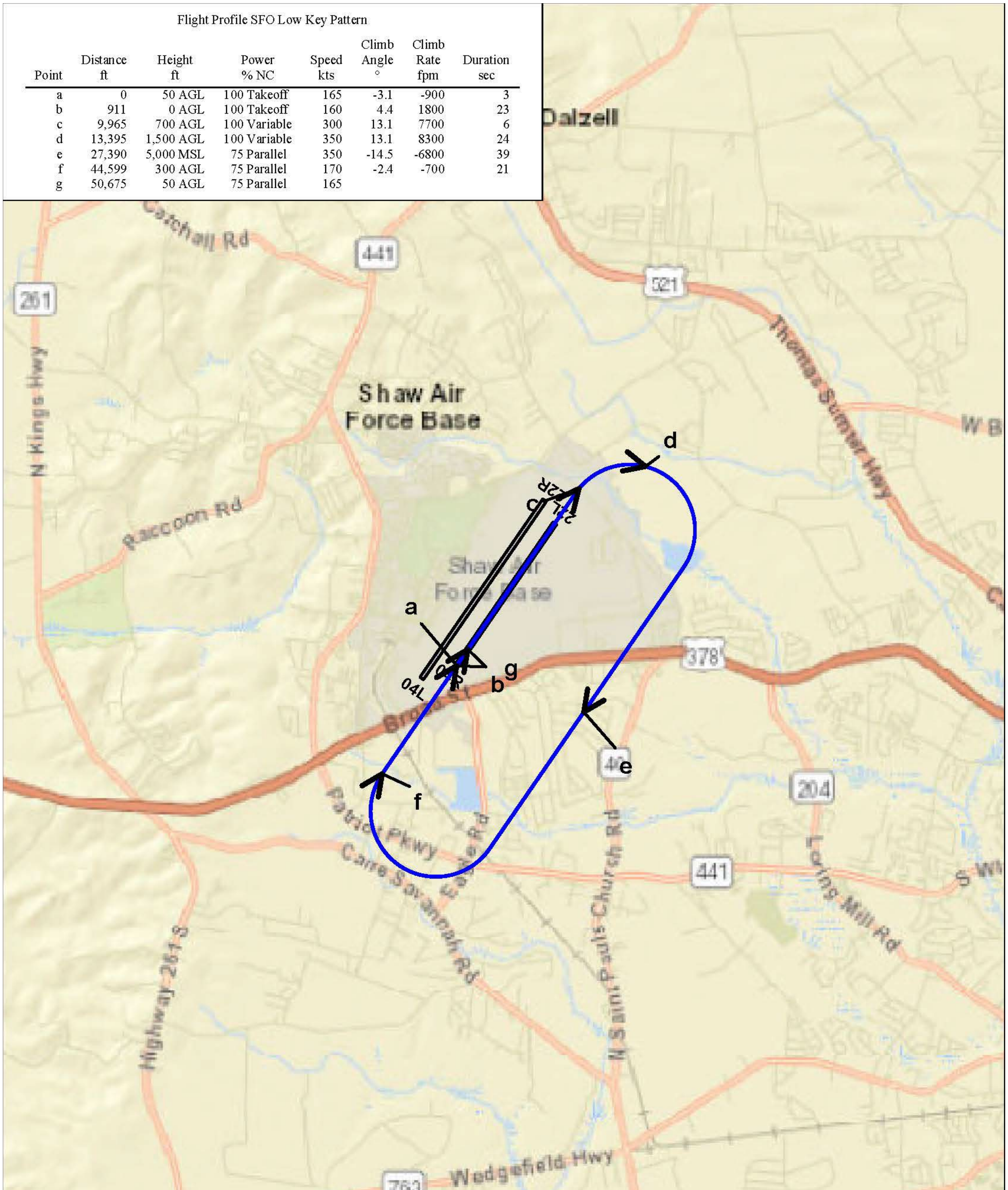
Shaw AFB Based ADAIR Cat C SFO Low Key Pattern Flight Profile ADHCS01

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:65,700 (1 inch = 5,470 feet)

Flight Profile SFO Low Key Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	100 Takeoff	165	-3.1	-900	3
b	911	0 AGL	100 Takeoff	160	4.4	1800	23
c	9,965	700 AGL	100 Variable	300	13.1	7700	6
d	13,395	1,500 AGL	100 Variable	350	13.1	8300	24
e	27,390	5,000 MSL	75 Parallel	350	-14.5	-6800	39
f	44,599	300 AGL	75 Parallel	170	-2.4	-700	21
g	50,675	50 AGL	75 Parallel	165			



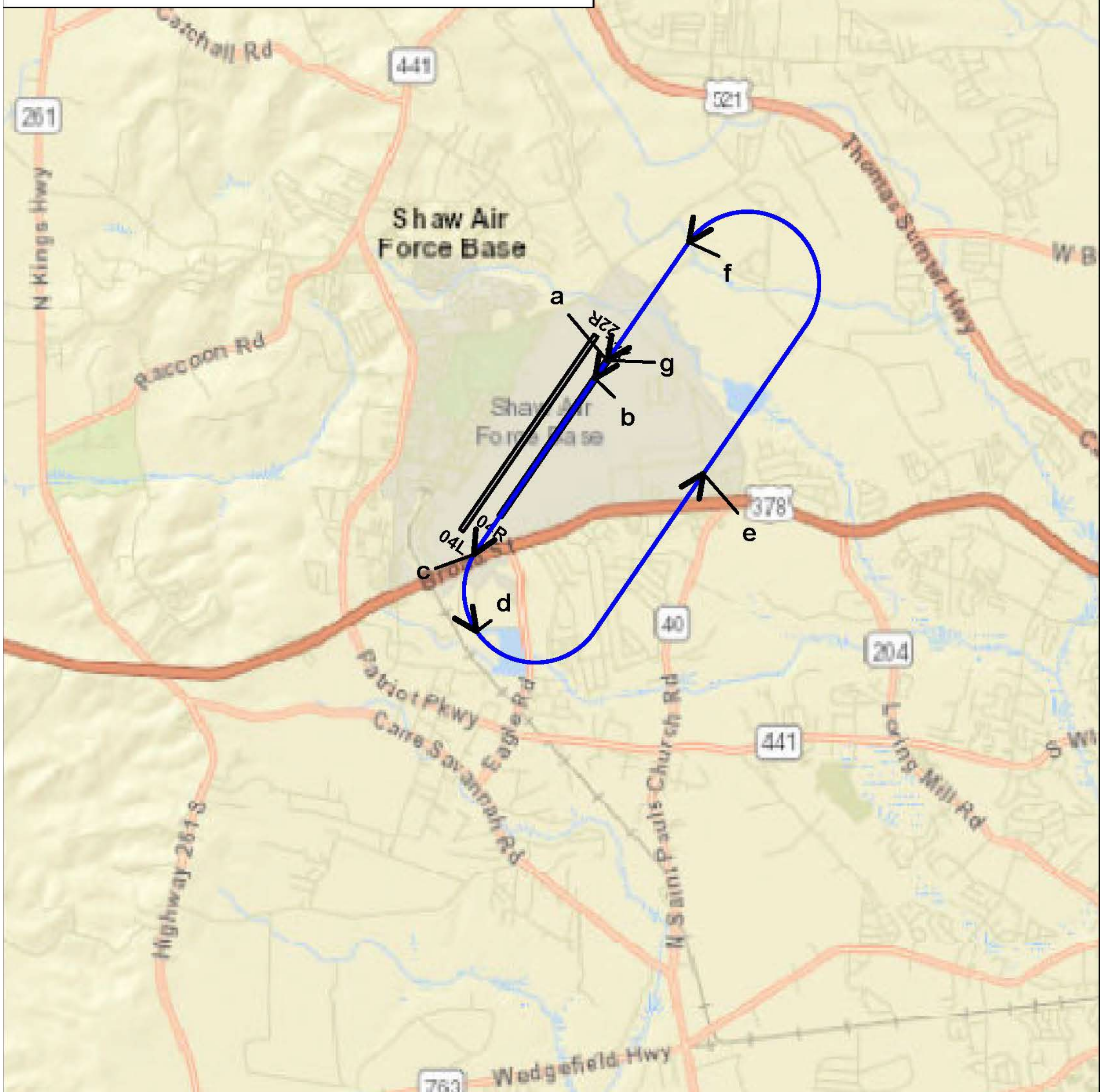
Shaw AFB Based ADAIR Cat C SFO Low Key Pattern Flight Profile ADHCS02

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:65,700 (1 inch = 5,470 feet)

Flight Profile SFO Low Key Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	100 Takeoff	165	-3.1	-900	3
b	911	0 AGL	100 Takeoff	160	4.4	1800	23
c	9,965	700 AGL	100 Variable	300	13.1	7700	6
d	13,395	1,500 AGL	100 Variable	350	13.1	8300	24
e	27,390	5,000 MSL	75 Parallel	350	-14.5	-6800	39
f	44,599	300 AGL	75 Parallel	170	-2.4	-700	21
g	50,675	50 AGL	75 Parallel	165			



Shaw AFB Based ADAIR Cat C SFO Low Key Pattern Flight Profile ADHCS03

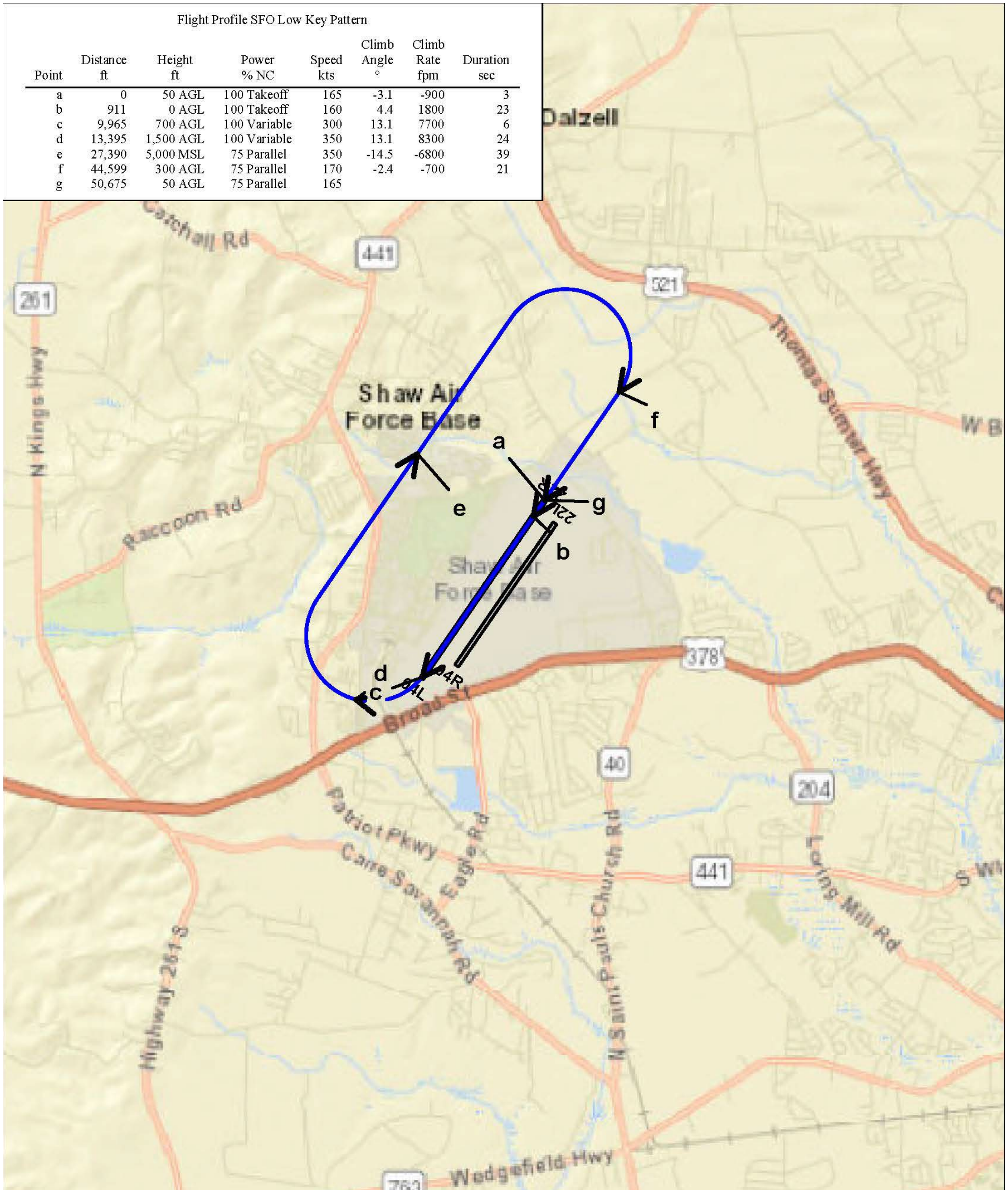
0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:65,700 (1 inch = 5,470 feet)

N

Flight Profile SFO Low Key Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	50 AGL	100 Takeoff	165	-3.1	-900	3
b	911	0 AGL	100 Takeoff	160	4.4	1800	23
c	9,965	700 AGL	100 Variable	300	13.1	7700	6
d	13,395	1,500 AGL	100 Variable	350	13.1	8300	24
e	27,390	5,000 MSL	75 Parallel	350	-14.5	-6800	39
f	44,599	300 AGL	75 Parallel	170	-2.4	-700	21
g	50,675	50 AGL	75 Parallel	165			

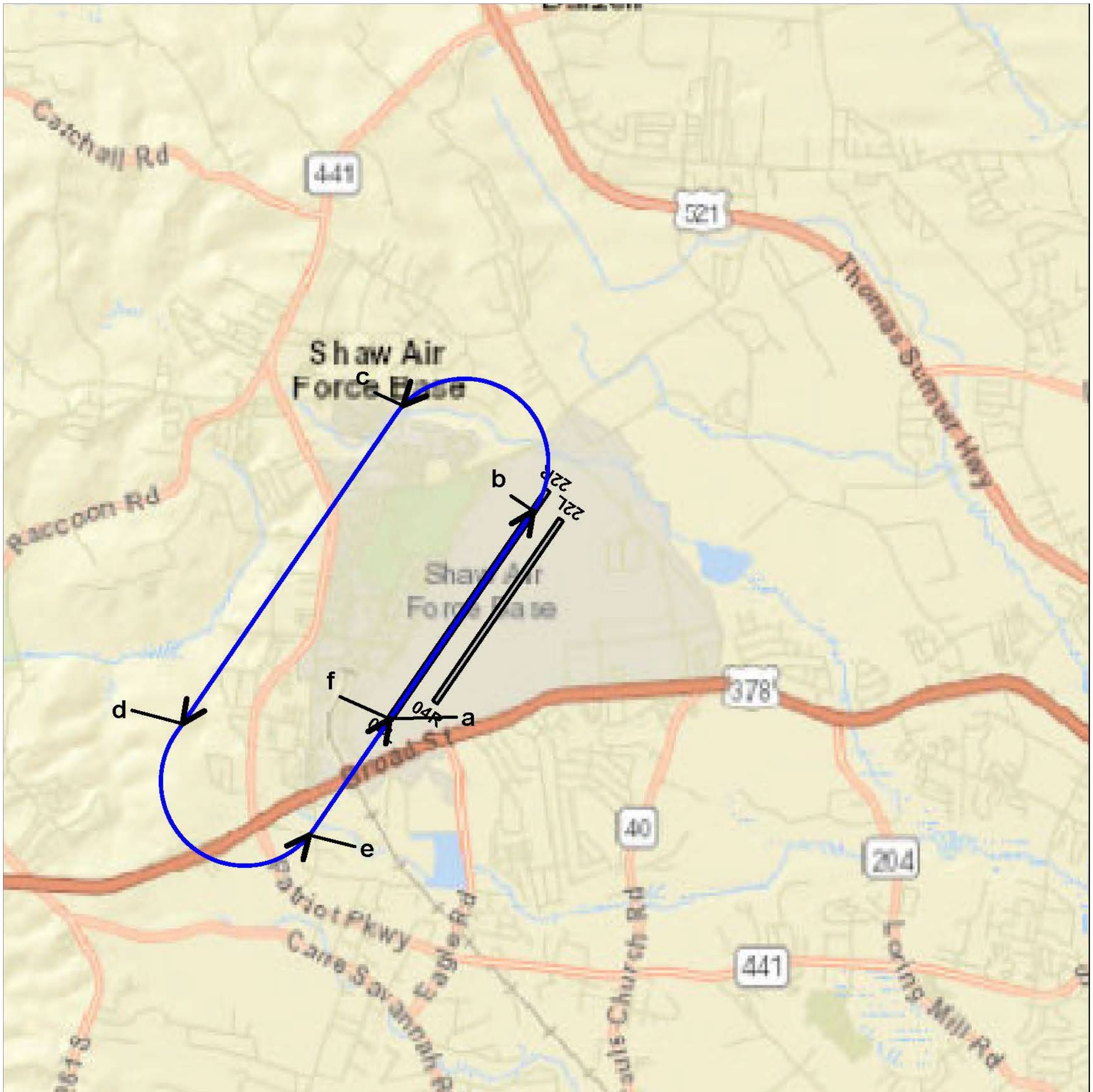


Shaw AFB Based ADAIR Cat C SFO Low Key Pattern Flight Profile ADHCS04

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:65,700 (1 inch = 5,470 feet)

N



Flight Profile VFR Pattern

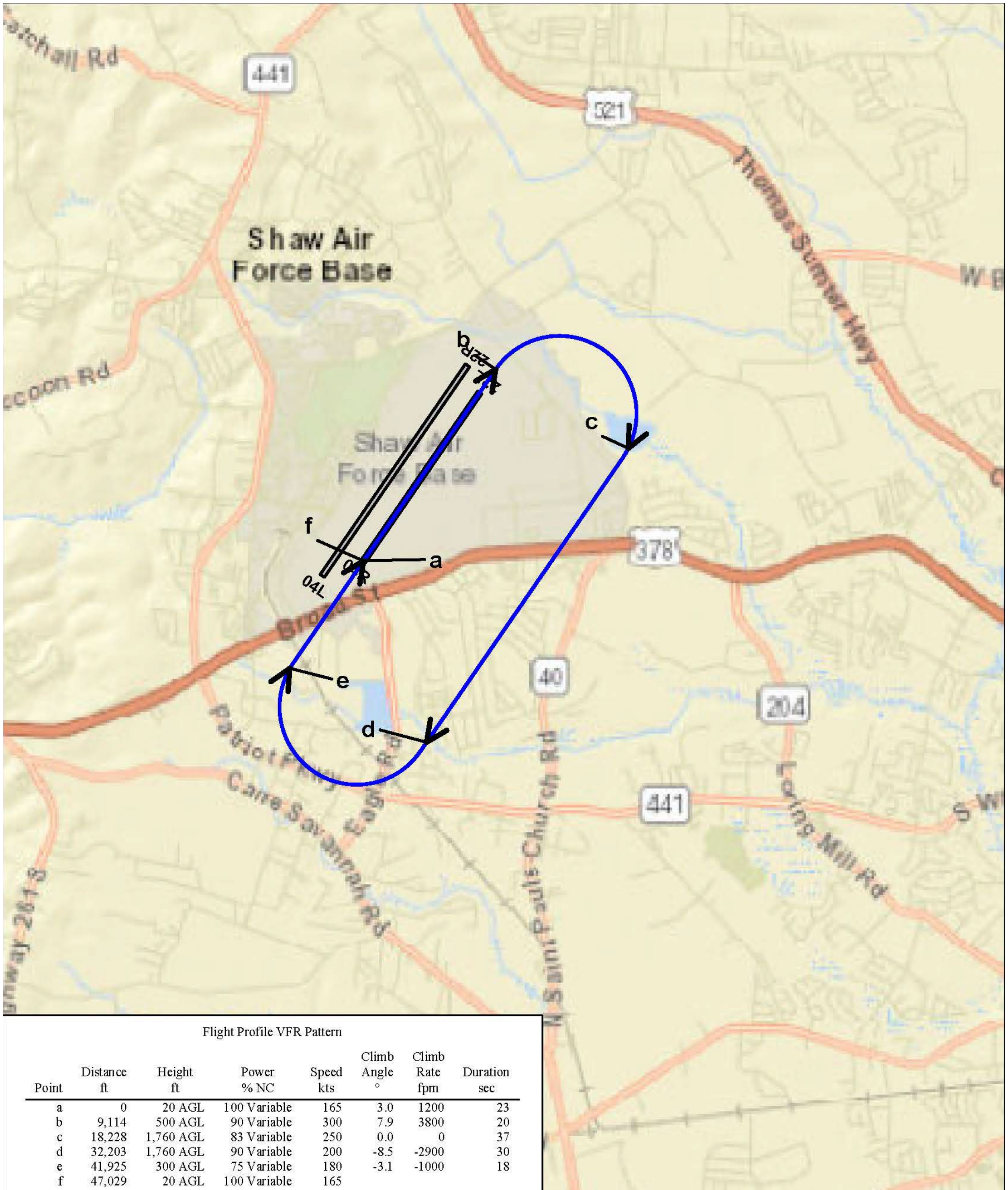
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based ADAIR Cat C VFR Pattern Flight Profile ADHCV01

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:55,500 (1 inch = 4,630 feet)

N



Flight Profile VFR Pattern

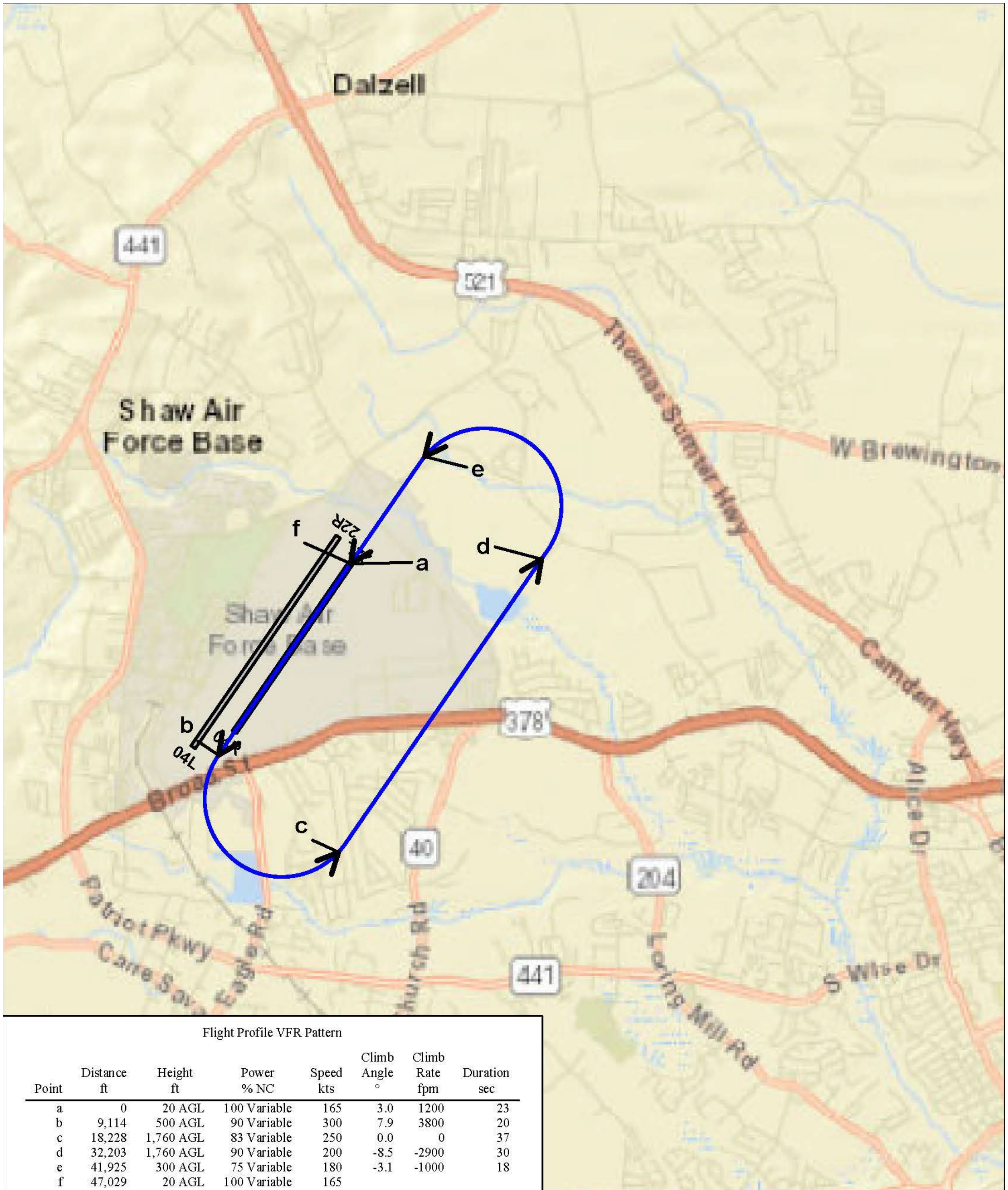
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based ADAIR Cat C VFR Pattern Flight Profile ADHCV02

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:55,600 (1 inch = 4,630 feet)

N



Flight Profile VFR Pattern

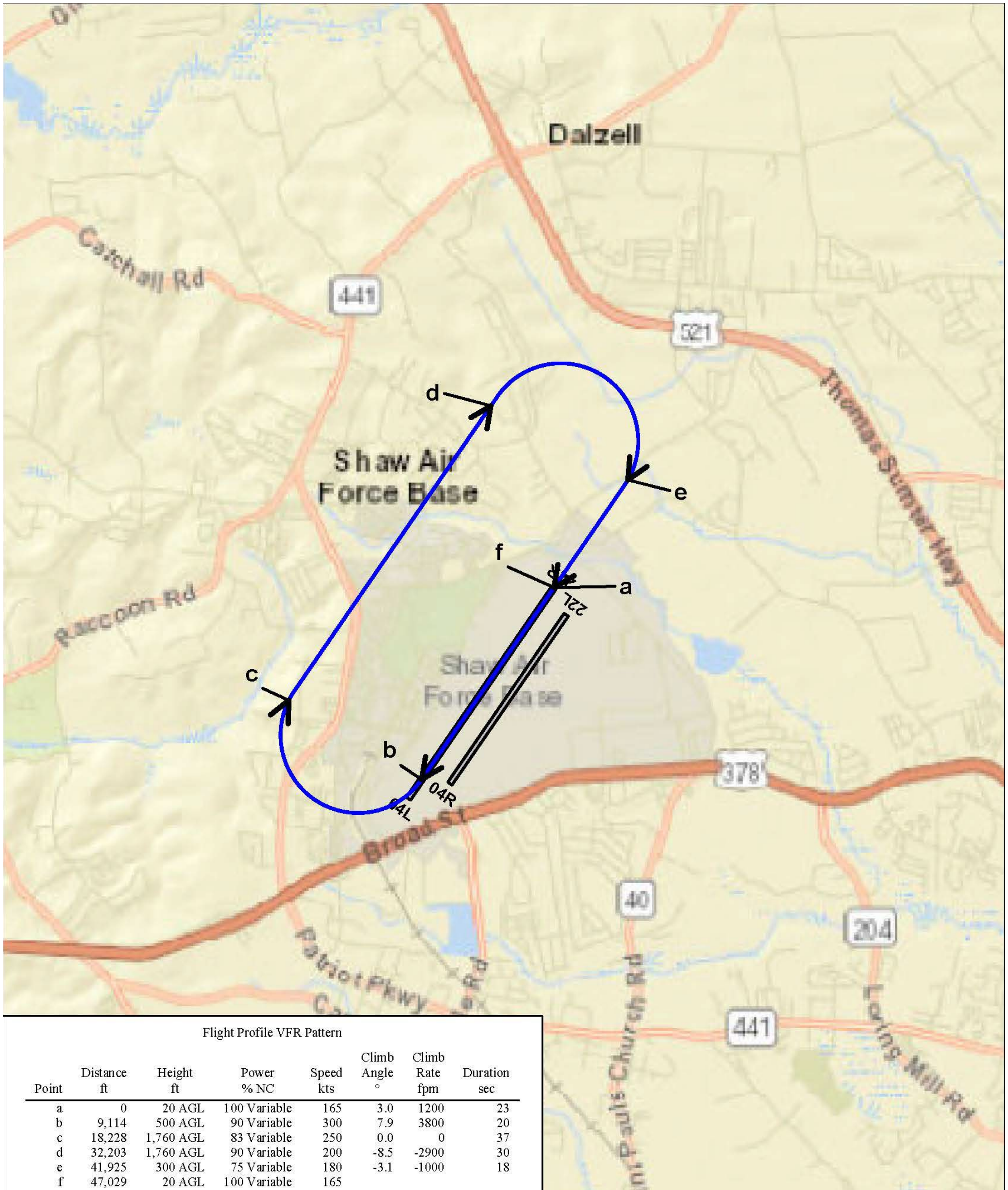
Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based ADAIR Cat C VFR Pattern Flight Profile ADHCV03

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:55,600 (1 inch = 4,640 feet)

N



Flight Profile VFR Pattern

Point	Distance ft	Height ft	Power % NC	Speed kts	Climb Angle °	Climb Rate fpm	Duration sec
a	0	20 AGL	100 Variable	165	3.0	1200	23
b	9,114	500 AGL	90 Variable	300	7.9	3800	20
c	18,228	1,760 AGL	83 Variable	250	0.0	0	37
d	32,203	1,760 AGL	90 Variable	200	-8.5	-2900	30
e	41,925	300 AGL	75 Variable	180	-3.1	-1000	18
f	47,029	20 AGL	100 Variable	165			

Shaw AFB Based ADAIR Cat C VFR Pattern Flight Profile ADHCV04

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:55,500 (1 inch = 4,630 feet)

N

C.2.5 Ground/Maintenance Run-ups

This section details the number, type, and duration of the ground and maintenance engine run-up operations at the airfield. The locations of all static run-up operations at Shaw AFB are shown in **Table C-8** and on **Figures C-17, C-18, and C-19**. **Table C-9** details the number, type, and duration of the on-field maintenance operations.

Table C-8 Static Pad Locations at Shaw Air Force Base

ID	Description	Latitude		Longitude		Heading Degrees East of Magnetic North
04HamHd	Hammer Head (arming area) for Runway 04	33.963218	N	80.481993	W	50
22LHamHd	Hammer Head (arming area) for Runway 22L	33.982719	N	80.461694	W	80
22RHamHd	Hammer Head (arming area) for Runway 22R	33.984713	N	80.464015	W	180
55apron1	55th FS parking spots	33.979758	N	80.471302	W	125
55apron2	55th FS parking spots	33.980453	N	80.470900	W	125
55apron3	55th FS parking spots	33.981118	N	80.470516	W	125
77apron1	77th FS parking spots	33.983502	N	80.468964	W	125
77apron2	77th FS parking spots	33.984152	N	80.468598	W	125
77apron3	77th FS parking spots	33.984818	N	80.468214	W	125
79apron1	79th FS parking spots	33.981698	N	80.470138	W	125
79apron2	79th FS parking spots	33.982281	N	80.469778	W	125
79apron3	79th FS parking spots	33.982804	N	80.469447	W	125
Hot Pits	Hot Pits 1 and 2	33.976228	N	80.473652	W	305 (Hot Pits 1) and 125 (Hot Pits 2)
HushH1	Hush House #1	33.985642	N	80.466657	W	104
HushH2	Hush House #2	33.986128	N	80.466516	W	104
Phase	by EMS	33.973262	N	80.475446	W	125
TrimPad		33.986556	N	80.465921	W	200

Notes:
ID # correspond to the locations show on Figures C-17, C-18, and C-19.
EMS = Equipment Maintenance Squadron; FS = Fighter Squad; ID = identification; N = north; W = west

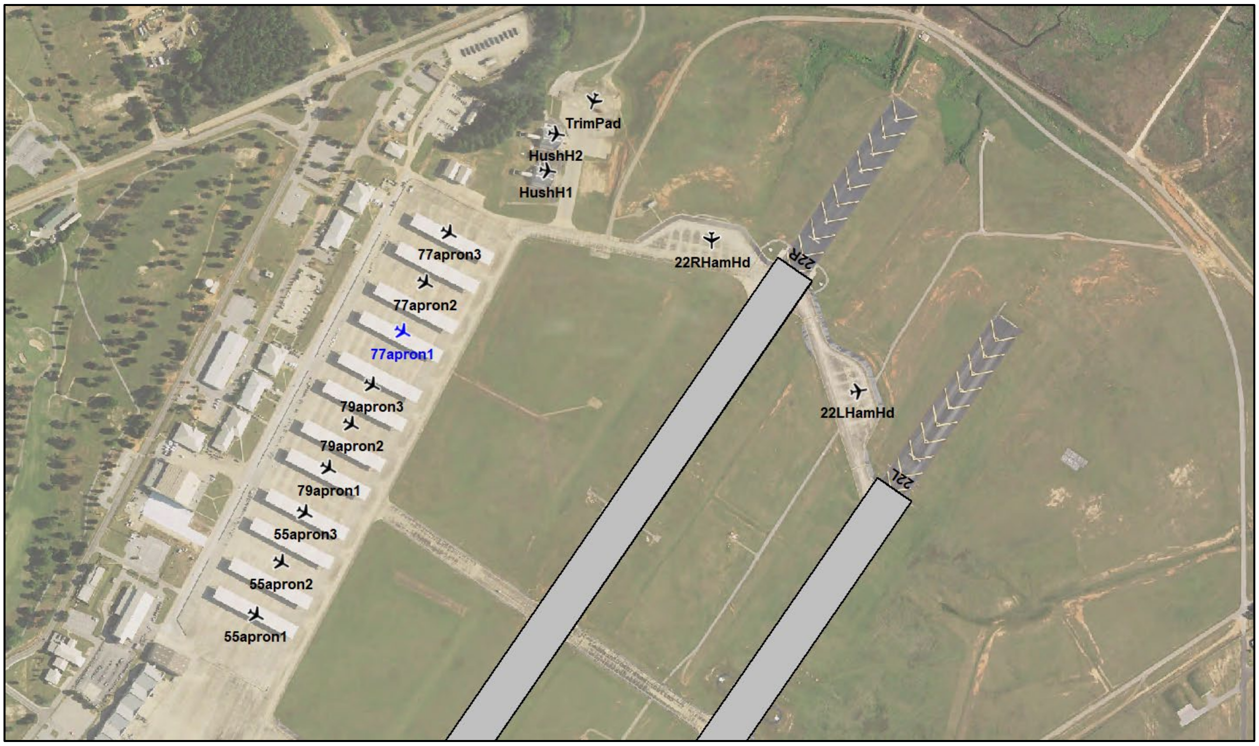


Figure C-17 Static Operations Locations

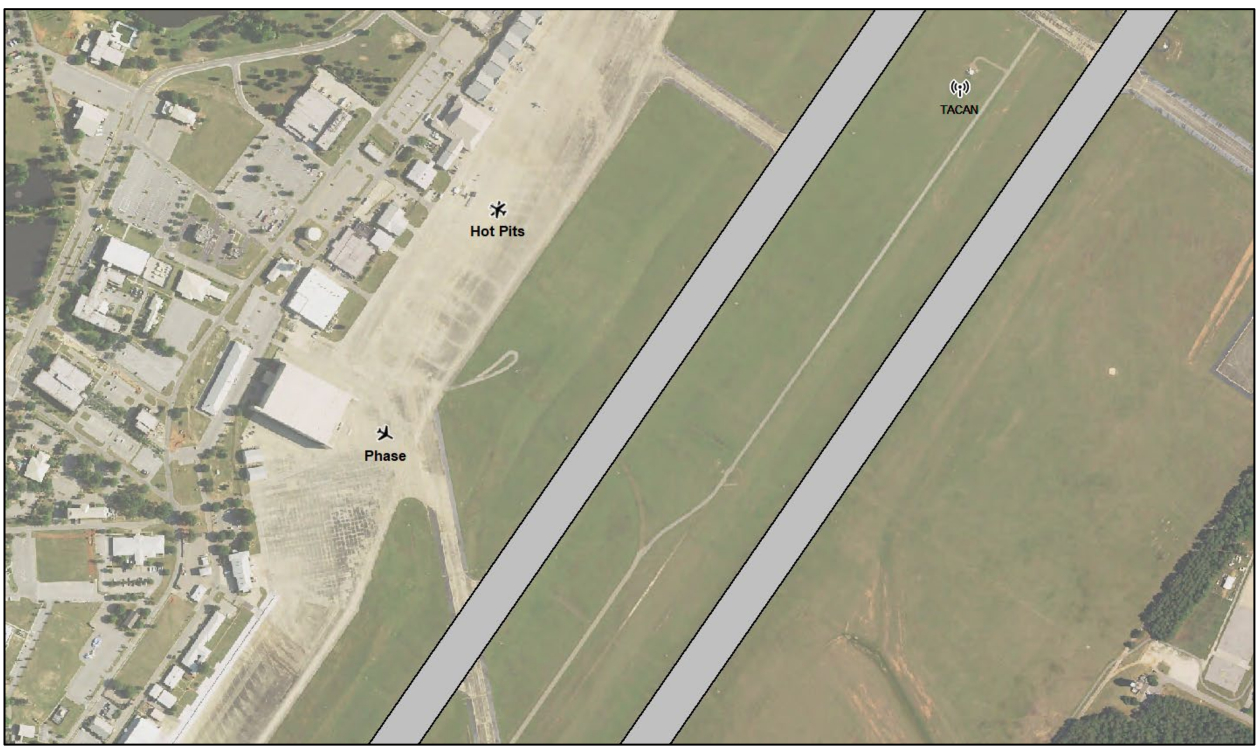


Figure C-18 Static Operations Locations

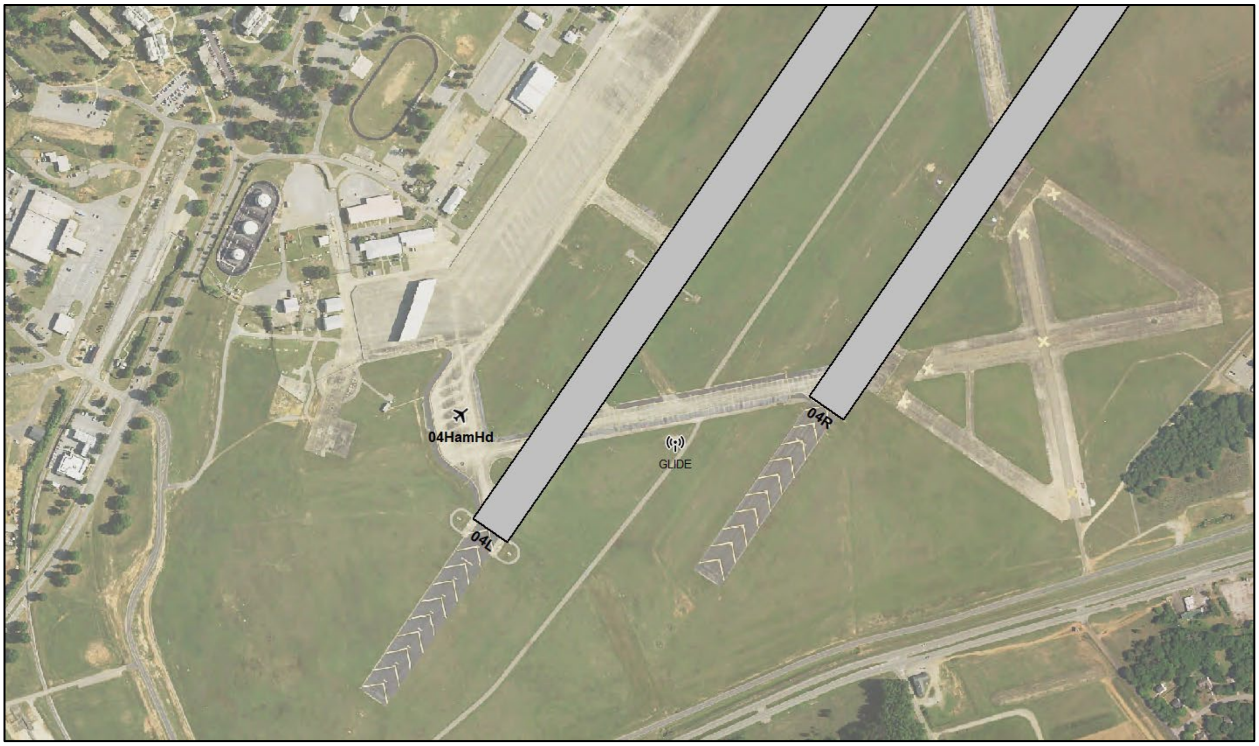


Figure C-19 Static Operations Locations

Table C-9 Location, Type, and Duration of Ground/Maintenance Run-Up Operations at Shaw Air Force Base

Aircraft	Engine	Profile	Pad	Heading	Power	Units	Configuration	Average Annual Day Operations	Average Annual Night Operations	Duration (s)	Number of Engines
F-16C	F110-GE-129	Arm/De-Arm1	04HamHd	50	69	% NC	Variable	3463	182	900	1
F-16C	F110-GE-129	Arm/De-Arm3	22LHamHd	80	69	% NC	Variable	385	20	900	1
F-16C	F110-GE-129	Arm/De-Arm2	22RHamHd	180	69	% NC	Variable	3848	203	900	1
F-16C	F110-GE-129	Arm/De-Arm4	55apron1	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_551	55apron1	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_551	55apron1	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_551	55apron1	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_551	55apron1	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_551	55apron1	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	Arm/De-Arm5	55apron2	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_552	55apron2	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_552	55apron2	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_552	55apron2	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_552	55apron2	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_552	55apron2	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	Arm/De-Arm6	55apron3	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_553	55apron3	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_553	55apron3	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_553	55apron3	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_553	55apron3	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_553	55apron3	125	69	% NC	Variable	80	0	600	1

Table C-9 Location, Type, and Duration of Ground/Maintenance Run-Up Operations at Shaw Air Force Base

Aircraft	Engine	Profile	Pad	Heading	Power	Units	Configuration	Average Annual Day Operations	Average Annual Night Operations	Duration (s)	Number of Engines
F-16C	F110-GE-129	Arm/De-Arm7	77apron1	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_771	77apron1	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_771	77apron1	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_771	77apron1	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_771	77apron1	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_771	77apron1	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	Arm/De-Arm8	77apron2	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_772	77apron2	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_772	77apron2	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_772	77apron2	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_772	77apron2	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_772	77apron2	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	Arm/De-Arm9	77apron3	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_773	77apron3	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_773	77apron3	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_773	77apron3	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_773	77apron3	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_773	77apron3	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	Arm/De-Arm10	79apron1	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_791	79apron1	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_791	79apron1	125	69	% NC	13	8	0	300	1

Table C-9 Location, Type, and Duration of Ground/Maintenance Run-Up Operations at Shaw Air Force Base

Aircraft	Engine	Profile	Pad	Heading	Power	Units	Configuration	Average Annual Day Operations	Average Annual Night Operations	Duration (s)	Number of Engines
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_791	79apron1	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_791	79apron1	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_791	79apron1	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	Arm/De-Arm11	79apron2	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_792	79apron2	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_792	79apron2	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_792	79apron2	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_792	79apron2	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_792	79apron2	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	Arm/De-Arm12	79apron3	125	69	% NC	Variable	855	45	900	1
F-16C	F110-GE-129	F16rmp2_793	79apron3	125	75	% NC	Variable	1710	90	600	1
F-16C	F110-GE-129	F16rmp3_793	79apron3	125	69	% NC	13	8	0	300	1
					80	% NC	19	8	0	600	1
					67	% NC	13	8	0	300	1
F-16C	F110-GE-129	F16rmp5_793	79apron3	125	69	% NC	13	1710	90	1200	1
					81	% NC	Variable	1710	90	7	1
					69	% NC	13	1710	90	240	1
F-16C	F110-GE-129	F16rmp6_793	79apron3	125	69	% NC	13	30	0	300	1
					84	% NC	19	30	0	3000	1
					69	% NC	13	30	0	300	1
F-16C	F110-GE-129	F16rmp8_793	79apron3	125	69	% NC	Variable	80	0	600	1
F-16C	F110-GE-129	F16HOT_PIT1	Hot Pits	305	69	% NC	Variable	256	0	1200	1
F-16C	F110-GE-129	F16HOT_PIT2	Hot Pits	125	69	% NC	Variable	256	0	1200	1
F-16C	F110-GE-129	F16rmp7	Phase	125	69	% NC	13	73	0	1800	1
F-16C	F110-GE-129	TP5	TrimPad	200	69	% NC	13	28	0	300	1
					85	% NC	19	28	0	2400	1
					69	% NC	13	28	0	300	1

Table C-9 Location, Type, and Duration of Ground/Maintenance Run-Up Operations at Shaw Air Force Base

Aircraft	Engine	Profile	Pad	Heading	Power	Units	Configuration	Average Annual Day Operations	Average Annual Night Operations	Duration (s)	Number of Engines
F100-PW-100	F100-PW-100	Hush 1	HushH1	104	68	% RPM	Variable	18	347	816	1
					85	% RPM	Variable	18	347	396	1
					92	% RPM	Variable	18	347	408	1
					92	% RPM	Fixed	18	347	98	1
F100-PW-100	F100-PW-100	Hush 2	HushH2	104	68	% RPM	Variable	1	24	1500	1
					85	% RPM	Variable	1	24	1200	1
					92	% RPM	Variable	1	24	900	1

Notes:
% NC = percent engine core speed; % RPM = percent rotor speed; RPM = revolutions per minute

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C.3 AIR QUALITY

Air quality is an indicator of the suitability of the atmosphere to support human life and the environment, generally described in terms of the types and levels of air pollutants present in outdoor air. This appendix presents an overview of the Clean Air Act (CAA) and the relevant state of South Carolina air quality regulations or standards. It also presents emissions calculations and key assumptions used for the air quality analyses presented in the Air Quality sections of this EA.

C.3.1 Criteria Pollutants and National Ambient Air Quality Standards

The CAA directed the US Environmental Protection Agency (USEPA) to develop, implement, and enforce strong environmental regulations that would ensure clean and healthy ambient air quality. To protect public health and welfare, the USEPA developed numerical concentration-based standards, National Ambient Air Quality Standards (NAAQS), for pollutants that have been determined to impact human health and the environment and established both primary and secondary NAAQS under the provisions of the CAA. NAAQS are currently established for six criteria air pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (including particulates equal to or less than 10 microns in diameter (PM_{10}) and particulates equal to or less than 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb).

In accordance with CAA requirements, the air quality in each region or area is measured by the concentration of various pollutants in the atmosphere. Measurements of these "criteria pollutants" in ambient air are expressed in units of parts per million or in units of micrograms per cubic meter. Regional air quality is a result of the types and quantities of atmospheric pollutants and pollutant sources in an area as well as surface topography, the size of the "air basin," and prevailing meteorological conditions.

The primary NAAQS represent maximum levels of background air pollution that are considered safe, with an adequate margin of safety to protect public health. Secondary NAAQS represent the maximum pollutant concentration necessary to protect vegetation, crops, and other public resources in addition to maintaining visibility standards. The primary and secondary NAAQS are presented in **Table C-10**.

The criteria pollutant O_3 is not usually emitted directly into the air but is formed in the atmosphere by photochemical reactions involving sunlight and previously emitted pollutants, or "O_3 precursors." These O_3 precursors consist primarily of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) that are directly emitted from a wide range of emissions sources. For this reason, regulatory agencies limit atmospheric O_3 concentrations by controlling VOC pollutants (also identified as reactive organic gases) and NO_x.

The USEPA has recognized that particulate matter emissions can have different health affects depending on particle size and, therefore, developed separate NAAQS for coarse particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$). The pollutant $PM_{2.5}$ can be emitted from emission sources directly as very fine dust and/or liquid mist or formed secondarily in the atmosphere as condensable particulate matter, typically forming nitrate and sulfate compounds. Ammonia (NH_3), for example, is evaluated as a precursor of $PM_{2.5}$. Secondary (indirect) emissions vary by region depending upon the predominant emission sources located there and thus which precursors are considered significant for $PM_{2.5}$ formation are identified for ultimate control.

Table C-10 National Ambient Air Quality Standards

Pollutant	Standard Value [6]		Standard Type
Carbon Monoxide (CO)			
8-hour average	9 ppm	(10 mg/m^3)	Primary
1-hour average	35 ppm	(40 mg/m^3)	Primary

Table C-10 National Ambient Air Quality Standards

Pollutant	Standard Value [6]		Standard Type
Nitrogen Dioxide (NO_2)			
Annual arithmetic mean	0.053 ppm	(100 μg/m^3)	Primary and Secondary
1-hour average 1	0.100 ppm	(188 μg/m^3)	Primary
Ozone (O_3)			
8-hour average 2	0.070 ppm	(137 μg/m^3)	Primary and Secondary
Lead (Pb)			
3-month average 3		0.15 μg/m^3	Primary and Secondary
Particulate <10 Micrometers (PM_{10})			
24-hour average 4		150 μg/m^3	Primary and Secondary
Particulate <2.5 Micrometers ($PM_{2.5}$)			
Annual arithmetic mean 4		12 μg/m^3	Primary
Annual arithmetic mean 4		15 μg/m^3	Secondary
24-hour average4		35 μg/m^3	Primary and Secondary
Sulfur Dioxide (SO_2)			
1-hour average 5	0.075 ppm	(196 μg/m^3)	Primary
3-hour average 5	0.5 ppm	(1,300 μg/m^3)	Secondary

Notes:

Source: USEPA, 2023a

[1] In February 2010, the USEPA established a new 1-hour standard for NO_2 at a level of 0.100 ppm, based on the 3-year average of the 98th percentile of the yearly distribution concentration, to supplement the then-existing annual standard.

[2] In October 2015, the USEPA revised the level of the 8-hour standard to 0.070 ppm, based on the annual 4th highest daily maximum concentration, averaged over 3 years; the regulation became effective on 28 December 2015. The previous (2008) standard of 0.075 ppm remains in effect for some areas. A 1-hour standard no longer exists.

[3] In November 2008, USEPA revised the primary Pb standard to 0.15 μg/m^3. USEPA revised the averaging time to a rolling 3-month average.

[4] In October 2006, USEPA revised the level of the 24-hour $PM_{2.5}$ standard to 35 μg/m^3 and retained the level of the annual $PM_{2.5}$ standard at 15 μg/m^3. In 2012, USEPA split standards for primary & secondary annual $PM_{2.5}$. All are averaged over 3 years, with the 24-hour average determined at the 98th percentile for the 24-hour standard. USEPA retained the 24-hour primary standard and revoked the annual primary standard for PM_{10}.

[5] In 2012, the USEPA retained a secondary 3-hour standard, which is not to be exceeded more than once per year. In June 2010, USEPA established a new 1-hour SO_2 standard at a level of 75 parts per billion, based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations.

[6] Parenthetical value is an approximately equivalent concentration for NO_2, O_3, and SO_2.

μg/m^3 = microgram(s) per cubic meter; mg/m^3 = milligram(s) per cubic meter; ppm = part(s) per million; USEPA = United States Environmental Protection Agency

The CAA and USEPA delegated responsibility for ensuring compliance with NAAQS to the states and local agencies. As such, each state must develop air pollutant control programs and promulgate regulations and rules that focus on meeting NAAQS and maintaining healthy ambient air quality levels. Areas designated as “attainment” have demonstrated compliance with NAAQS. An area is designated as unclassified if there is insufficient information for a compliance determination. Maintenance areas are those that were previously designated nonattainment but are now in compliance with the NAAQS. When a region or area fails to meet a NAAQS for a pollutant, that region is classified as “non-attainment” for that pollutant. In such cases the affected state must develop a State Implementation Plan (SIP) that is subject to USEPA review and approval. A SIP is a compilation of regulations, strategies, schedules, and enforcement actions designed to move the state into compliance with all NAAQS. Any changes to the compliance schedule or plan (e.g., new regulations, emissions budgets, controls) must be incorporated into the SIP and approved by USEPA.

In South Carolina, the USEPA delegates the enforcement and maintenance of the NAAQS and other rules of the CAA to the South Carolina Department of Health and Environmental Control (SCDHEC). The state of South Carolina has adopted the federal NAAQS as provided in the SCDHEC Regulation 61-62.5, Standard No. 2, Ambient Air Quality Standards (SCDHEC, 2023). Shaw AFB is in Sumter County, which is in the Camden-Sumter Air Quality Control Region (AQCR) (40 CFR § 81.110). Ambient air quality for the Camden-Sumter Intrastate AQCR is designated as an unclassifiable/attainment area for all NAAQS. Unclassifiable areas are those areas that have not had ambient air monitoring and are assumed to be in attainment with NAAQS. Air quality is typically good (defined as generally low air pollution) near Shaw AFB and is generally affected only locally by military and civilian vehicle emissions, particulate pollution from vehicle traffic, emissions from industrial sources, and nearby construction activities. Mobile sources, such as vehicle and aircraft emissions, are generally not regulated and are not covered under existing stationary source permitting requirements. Stationary emissions sources at Shaw AFB include natural gas boilers, paint spray booths, refueling operations, and emergency power generators.

State Implementation Program

Each state is required to develop a SIP that sets forth how CAA provisions will be imposed within the state. The SIP is the primary means for the implementation, maintenance, and enforcement of the measures needed to attain and maintain the NAAQS within each state and includes control measures, emissions limitations, and other provisions required to attain and maintain the ambient air quality standards. The purpose of the SIP is twofold. First, it must provide a control strategy that will result in the attainment and maintenance of the NAAQS. Second, it must demonstrate that progress is being made in attaining the standards in each nonattainment area. Maintenance areas are subject to a maintenance plan to ensure that compliance is maintained. To demonstrate progress toward attainment or maintenance status, the Air Quality Monitoring Program monitors ambient air throughout the state. The purpose is to monitor, assess, and provide information on statewide ambient air quality conditions and trends. Air monitoring stations collect representative data that indicates how much of a pollutant is in the air. In 2022-2023, the network within South Carolina will be comprised of 70 monitors and samplers at 23 sites (SCDHEC, 2022). While there are no monitoring stations in Sumter County where Shaw AFB is located, there are more than 20 air monitors for criteria pollutants in the surrounding counties of Florence and Columbia (SCDHEC, 2022).

Conformity Rules

The CAA required the USEPA draft general conformity regulations that are applicable in nonattainment areas, or in designated maintenance areas. These regulations are designed to ensure that federal actions do not impede local efforts to achieve or maintain attainment with the NAAQS. The General Conformity Rule and the promulgated regulations found in 40 CFR Part 93, exempt certain federal actions from conformity determinations (e.g., contaminated site cleanup and natural disaster response activities). Other federal actions are assumed to conform if total indirect and direct project emissions are below *de minimis* levels presented in 40 CFR § 93.153. The threshold levels (in tons of pollutant per year) depend upon the nonattainment status that USEPA has assigned to a region. Once the net change in nonattainment pollutants is calculated, the federal agency must compare them to the *de minimis* thresholds. The Proposed Action would occur within areas that are currently in attainment with all NAAQS; therefore, the Proposed Action is not subject to General Conformity Regulations and a General Conformity Applicability Analysis is not required.

New Source Performance Standards

Title I of the CAA Amendments of 1990 requires the federal government to reduce emissions from cars, trucks, and buses; from consumer products such as hair spray and window-washing compounds; and from ships and barges during the loading and unloading of petroleum products to address urban air pollution problems of O_3, CO, and PM_{10}. Under Title I, the federal government develops the technical guidance that states need to control stationary sources of pollutants. For stationary sources, the CAA establishes New Source Performance Standards for specific source categories. Standards and compliance requirements are listed in Title 40 CFR Parts 60 - 61. Title V of the CAA Amendments of 1990 requires state and local agencies to implement permitting programs for major stationary sources. A major stationary source is a facility (plant, base, activity, etc.) that has the potential to emit more than 100 tons annually of any one criteria air pollutant in an attainment area. Compliance requirements under the relevant regulations would not apply to the Proposed Action because emission increases would mainly occur from mobile sources; therefore, the requirements originating from Titles I and V of the CAA Amendments of 1990 are not considered further.

Prevention of Significant Deterioration

Prevention of Significant Deterioration (PSD) applies to new major sources or major modifications at existing sources for pollutants where the area the source is located is in attainment or unclassifiable with the NAAQS (USEPA, 2023b). The rule is to ensure that these sources are constructed or modified without causing significant adverse deterioration of the clean air in the area. Sources subject to PSD review are required to obtain a permit before commencing construction. The permit process requires an extensive air quality review of all other major sources within a 50-mile radius and all Class I areas within a 62-mile radius of the facility. Emissions from any new or modified source must be controlled using the maximum degree of control that can be achieved. The air quality, in combination with other PSD sources in the area, must not exceed the maximum allowable incremental increase as specified in the regulations. The rule also provides special protections for specific national parks or wilderness areas, known as Mandatory Federal Class I Areas (40 CFR Part 81), where any appreciable deterioration in air quality is considered significant. Class 1 areas are given special air quality and visibility protection under the CAA. PSD regulations also define air pollutant emissions from proposed major stationary sources or modifications to be “significant” if a proposed project’s net emission increase meets or exceeds the rate of emissions listed in 40 CFR § 52.21(b)(23)(i); or a proposed project is within 10 miles of any Class I area (wilderness area greater than 5,000 acres or national park greater than 6,000 acres). The goals of the PSD program are to (1) ensure economic growth while preserving existing air quality; (2) protect public health and welfare from adverse effects that might occur even at pollutant levels better than the NAAQS; and (3) preserve, protect, and enhance the air quality in areas of special natural recreational, scenic, or historic value, such as national parks and wilderness areas.

The only Mandatory Federal Class I Area in South Carolina is the Cape Romain Wilderness, located more than 80 miles from Shaw AFB. There are no major sources associated with the Proposed Action, thus, PSD does not apply. Mobile sources, including those from aircraft emissions are generally not part of the PSD permit review process. However, emissions from the Proposed Action have the potential to impact visibility in Class 1 areas, including South Carolina’s national parks and wilderness areas; thus, they are considered for this EA.

C.3.2 Greenhouse Gases and Climate Change Considerations

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere. These emissions are generated by both natural processes and human activities. The accumulation of GHGs in the atmosphere helps regulate the earth’s temperature and are believed to contribute to global climate change. GHGs include water vapor, carbon dioxide (CO_2), methane, nitrous oxide, O_3, and several hydrocarbons and chlorofluorocarbons. Each GHG has an estimated global warming potential (GWP), which is a function of its atmospheric lifetime and its ability to absorb and radiate infrared energy emitted from the earth’s surface. The GWP of a particular gas provides a relative basis for calculating its carbon dioxide equivalent (CO_2e) or the amount of CO_2e to the emissions of that gas. CO_2 has a GWP of 1 and is, therefore, the standard by which all other GHGs are measured.

The USEPA regulates GHG primarily through a permitting program known as the GHG Tailoring Rule. This rule applies to GHG emissions from large stationary sources. In addition to the GHG Tailoring Rule in 2009, the USEPA promulgated a rule requiring sources to report their GHG emissions if they emit more than 25,000 metric tons or more of CO_2e per year (40 CFR § 98.2[a][2]). This rule only applies to large stationary sources of emissions, including fuel combustion sources. Shaw AFB is currently not required to report its GHG emissions to the USEPA, and the activities of Proposed Action are limited to aircraft operations (mobile sources) that are not subject to GHG reporting.

Net GHG emissions in South Carolina are showing a steadily decreasing trend between 2008 and 2020, decreasing from 84.732 to 58.829 million metric tons carbon dioxide equivalent ($MMTCO_2e$) (USEPA, 2023c). South Carolina's emissions have decreased due to various factors, including changes in the energy sector, primarily in power plants. For 2020, South Carolina's GHG emissions for the energy sector totaled 64.241 $MMTCO_2e$ (USEPA, 2023c). To serve as a reference point, projected GHG emission increases from Proposed Action Alternative 1 (Alternative 2 is comparable to Alternative 1, thus only Alternative 1 is presented) were compared against South Carolina's GHG emissions from the energy sector (**Table C-11**). Based on the relative magnitude of the project's GHG emissions, a general inference can be drawn regarding whether the Proposed Action GHG emissions are meaningful with respect to the discussion regarding climate change. As **Table C-11** demonstrates, maximum estimated GHG emissions for the High Emissions Scenario Proposed Action would account for about 0.022 percent of South Carolina's 2020 GHG emissions for the energy sector. GHG emissions for the state are the result of mainly industrial processes, transportation, and electricity generation. GHG emissions that would be generated from Medium and Low Emissions Scenario for Alternative 1 were also similarly compared. The Medium and Low Emissions Scenarios would account for approximately 0.015 percent and 0.010 percent of the state's 2020 GHG energy sector emissions, respectively.

A vast amount of scientific research supports the theory that climate change is affecting weather patterns, average sea levels, ocean acidification, and precipitation rates. Likelihood of occurrence of these patterns are predicted to intensify in the future. Like many locations in the United States, climate trends within the western United States could be adversely affected by global climate change, including mass migration and loss or extinction of plant and animal species. There are scientific studies to indicate that the potential effects of climate change could lead to adverse human health. These include an increase in extreme heat events; increased levels of pollutants in the atmosphere; and an increase in intensity and number of natural disasters, such as flooding, hurricanes, and drought.

Table C-11 Metrics for Greenhouse Gas Emission Impacts

Tons/year of CO_2e ADAIR High Emissions Scenario [1]	Tons/year of CO_2e ADAIR Medium Emissions Scenario [1]	Tons/year of CO_2e ADAIR Low Emissions Scenario [1]	South Carolina's 2020 GHG Emissions (tpy) [2,3]	Proposed Action Percent of South Carolina's 2020 GHG Emissions [4]
15,306	10,456	6,752	67,70,813,847	High Scenario-0.022 Medium Scenario-0.015 Low Scenario-0.010

Notes:

[1] Sum of estimated GHG emissions from airfield flight operations and special use airspace sorties.

[2] Represents MMT CO_2e from energy sector.

[3] Source: USEPA, 2023c; Converted 61.4 MMT CO_2e to tpy by multiplying MMT CO_2e by a factor of 1.1023x1064

[4] Percentage based on worst case (high) emission scenario

CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; MMT = million metric ton(s); tpy = ton(s) per year

C.3.3 Air Conformity Applicability Analysis

Section 176(c) (1) of the CAA contains legislation that ensures federal activities conform to relevant SIPs and thus do not hamper local efforts to control air pollution. Conformity to a SIP is defined as conformity to a SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards. As such, a general conformity analysis is required for areas of nonattainment or maintenance where a federal action is proposed.

The action can be shown to conform by demonstrating that the total direct and indirect emissions are below the *de minimis* levels (**Table C-12**), and/or showing that the Proposed Action emissions are within the State- or Tribe-approved budget of the facility as part of the SIP or Tribal Implementation Plan (USEPA, 2010).

Direct emissions are those that occur as a direct result of the action. For example, emissions from new equipment that are a permanent component of the completed action (e.g., boilers, heaters, generators, paint booths) are considered direct emissions. Indirect emissions are those that occur at a later time or at a distance from the Proposed Action. For example, increased vehicular/commuter traffic because of the action is considered an indirect emission. Construction emissions must also be considered. For example, the emissions from vehicles and equipment used to clear and grade building sites, build new buildings, and construct new roads must be evaluated. These types of emissions are considered direct emissions.

Table C-12 General Conformity Rule De Minimis Emission Thresholds

Pollutant	Attainment Classification	Tons per year
Ozone (VOC and NO_x)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NO_x)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon Monoxide, SO_2 and NO_2	All nonattainment and maintenance	100
PM_{10}	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
$PM_{2.5}$ Direct emissions, SO_2, NO_x (unless determined not to be a significant precursor), VOC and ammonia (if determined to be significant precursors)	All nonattainment and maintenance	100
Lead	All nonattainment and maintenance	25

Notes:

Source: USEPA, 2017

NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulates equal to or less than 2.5 microns in diameter; PM_{10} = particulates equal to or less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

C.3.4 Significance Indicators and Evaluation Criteria

The CAA Section 176(c), *General Conformity*, requires federal agencies to demonstrate that their proposed activities would conform to the applicable SIP for attainment of the NAAQS. General conformity applies only to nonattainment and maintenance areas. If the emissions from a federal action proposed in a nonattainment area exceed annual *de minimis* thresholds identified in the rule, a formal conformity determination is required of that action. The thresholds are more restrictive as the severity of the nonattainment status of the region increases. The Council on Environmental Quality (CEQ) defines significance in terms of context and intensity in 40 CFR § 1508.27. This requires that the significance of the action be analyzed with respect to the setting of the Proposed Action and based relative to the severity of the impact. The CEQ NEPA regulations (40 CFR § 1508.27[b]) provide 10 key factors to consider in determining an impact's intensity.

Based on guidance in Chapter 4 of the *Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide*, *Volume II – Advanced Assessments*, for air quality impact analysis, project criteria pollutant emissions were compared against the insignificance indicator of 250 tons per year (tpy) for PSD major source permitting threshold for actions occurring in areas that are in attainment for all criteria pollutants (25 tpy for lead). These "Insignificance Indicators" were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the NAAQS. These insignificance indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for each criteria pollutant is considered so insignificant that the action would not cause or contribute to an exceedance on one or more NAAQSs. Although PSD and Title V are not applicable to mobile sources, the PSD major source thresholds provide a benchmark to compare air emissions against and to determine project impacts.

For Proposed Action that would occur in nonattainment/maintenance areas, the net-change emissions estimated for the relevant criteria pollutant(s) are compared against General Conformity *de minimis* values to perform a General Conformity evaluation. If the estimated annual net emissions for each relevant pollutant from the Proposed Action are below the corresponding *de minimis* threshold values, General Conformity Rule requirements would not be applicable.

Emissions from the Proposed Action in the vicinity of the Shaw AFB airfield are assessed in the EA and compared to applicable conformity *de minimis* thresholds. An overview of Air Conformity Applicability Model (ACAM) inputs and the methodologies used to estimate emissions are summarized in the following sections.

C.3.5 Emissions Calculations and Assumptions

The following assumptions were used in the air quality analysis for the Proposed Action:

1. No construction would be associated with the Proposed Action. This includes no demolition, earth moving, hauling, or paving.
2. No installation of new air emission sources or modification of existing emission sources at Shaw AFB would be associated with the Proposed Action.
3. For the purposes of ACAM, additional aircraft flight operations were assumed to start January 2024. Thus, steady state conditions were assumed in ACAM, and the estimated annual emissions are the same across all years (i.e., all years from 2024 onwards are representative of the 'worst-case' year). Emissions from the Proposed Action are all additive emissions only and no emissions are assumed to be removed.
4. Mixing height of 3,000 ft (this matches USEPA and DAF Guidance) was assumed. For consideration of potential air quality impacts, it is the volume of air extending up to the mixing height (3,000 ft AGL) and coinciding with the spatial distribution of the region of influence that is considered. Pollutants that are released above the mixing height typically would not disperse downward and thus would have little or no effect on ground level concentrations of pollutants. The mixing height is the altitude at which the lower atmosphere undergoes mechanical or turbulent mixing, producing a nearly uniform air mass. The height of the mixing level determines the volume of air within which pollutants can disperse. Mixing heights at any one location or region can vary by the season and time of day, but for air quality applications an average mixing height of 3,000 ft AGL is an acceptable default value (40 CFR § 93.153[c][2]).

5. Air quality analysis for flight operations was performed using noise data collected and compiled for airspace flight operations (0 to 3,000 ft AGL) for the Proposed Action. Noise data were provided for annual operations by altitude band, engine power, airspeed, and time in minutes and percent time spent in airspace and sub-airspace. Total number of sorties and Time-In-Mode (TIM) per airspace were derived from compiled data. **Table C-13** presents the number of sorties and TIM used as input to ACAM for flight operations.
6. Estimated amount of time each contract ADAIR aircraft would spend within the SUAs at or below 3,000 ft AGL is proportioned equally within each altitude band based on percent time spent between 500 ft (surface) to 3,000 ft. Activity in SUA extending beyond the mixing height (3,000 ft AGL) is not considered for the air quality analysis.
7. ACAM does not have separate inputs for time spent within SUA. To represent the time spent at or below 3,000 ft, time spent in minutes for each SUA was assigned to Climb out/Intermediate power mode within the ACAM Landing and Takeoff input fields. No time was assigned to any other power modes, but default ACAM output also lists trim tests and Touch and Go's; however, all inputs for these fields were set to zero for time spent within the SUA.

Table C-13 Air Conformity Applicability Model Data Inputs for Shaw Air Force Base Contract Adversary Air

Location	Type of Operation	Number of Sorties per Year	Ground Operation Emission Sources
Shaw AFB Airfield	Landing and Takeoff Cycles	3,500 [a]	Auxiliary power unit equipment, aerospace ground equipment, personal vehicle use, aircraft maintenance (solvent use), fuel handling and storage, aircraft trim tests (12, one per aircraft)
	Touch and Go Cycles	525 [b]	
Bulldog MOA	Sorties at ≤3,000 feet AGL	350 [c]	Not Applicable
Gamecock MOA	Sorties at ≤3,000 feet AGL	350 [c]	Not Applicable
Warning Areas (W-161 & W-171)	All Sorties ≥3,000 feet AGL	Not Applicable – No Analysis [1]	Not Applicable

Notes:

[a] Air quality impacts are assessed for the airfield and SUA based on the total annual sorties from the airfield.

[b] Five percent of total sorties flying to the SUA (3,500) would be for contractor proficiency training. Each of those 5 percent sorties is assumed to include three Touch and Go / low approaches.

[c] Impacts would include flare use at and below 3,000 feet.

[1] Sorties occur above the atmospheric mixing height. No emissions calculated.

AFB = Air Force Base; AGL= above ground level; MOA = Military Operations Area

C.3.6 References

South Carolina Department of Health and Environmental Control (SCDHEC). 2022. <https://scdhec.gov/sites/default/files/media/document/BAQ_2022SCAmbientAirMonitoringNetworkPlan_20220701.pdf>. Accessed 30 June 2023.

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USEPA. 2010. 40 CFR Parts 51 and 93, Revisions to the General Conformity Regulations. 75 Federal Register 14283, EPA-HQ-OAR-2006-0669; FRL-9131-7. 24 March.

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USEPA. 2023c. USEPA's Annual Inventory of U.S. Greenhouse Gas Emissions and Sinks and the new Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2020. <https://cfpub.epa.gov/ghgdata/inventoryexplorer/#iallsectors/allsectors/allgas/inventsect/current. Accessed 30 June 2023.

C.3.7 Detailed ACAM Report and Record of Air Analysis (ROAA)

1. General Information

- Action Location
Base: SHAW AFB
State: South Carolina
County(s): Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

- Action Title: SHAW AIR FORCE BASE Combat Air Forces Adversary Air

- Project Number/s (if applicable): N/A

- Projected Action Start Date: 1 / 2024

- Action Purpose and Need:

The purpose of the Proposed Action is to provide dedicated contract ADAIR sorties at Shaw AFB to improve the quality of training and readiness of fighter aircrew of the 20 FW and other units supported by Shaw AFB. Dedicated contract ADAIR would enable the 20 FW to make existing in-house ADAIR resources available for other missions and use those available flying hours more effectively. The Proposed Action would increase the quality of training for fighter aircrew by filling the “near-peer” capacity and capability gap currently present in the ADAIR training program.

The Proposed Action is needed to provide better and more realistic training for the flight training program in support of units at Shaw AFB. Dedicated contract ADAIR is critical to improving pilot readiness as it provides realistic training opportunities to employ CAF tactics and procedures that optimize the training value of every mission and does not displace or interfere with on-base activities.

- Action Description:

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training for Shaw AFB. The Proposed Action includes elements affecting Shaw AFB and military training special use airspace (SUA). The elements affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. The elements affecting the SUA include SUA use and use of defensive countermeasures.

The proposed airfield is analyzed with the addition of an estimated 12 aircraft providing 3,500 annual training sorties. Additional traffic patterns would be anticipated on no more than 5 percent of the annual sortie total, or 175 sorties. The analysis examines three separate emission scenarios: high, medium, and low. No significant construction is anticipated at this time as a result of the action. If it is later determined construction is required at the airfield a separate environmental analysis would be completed as required.

- Point of Contact
Name: Radhika Narayanan
Title: Environmental Scientist
Organization: Versar
Email: rnarayanan@versar.com
Phone Number: n/a

- Activity List:

Activity Type		Activity Title
2.	Aircraft	Shaw AFB Airfield Operations - High Emissions Scenario
3.	Personnel	Commute by New Personnel
4.	Degreaser	Minor Parts Cleaning - ADAIR Contractor Aircraft
5.	Tanks	Jet A Storage
6.	Tanks	Jet A Storage

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Aircraft

2.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Shaw AFB Airfield Operations - High Emissions Scenario

- Activity Description:
ACAM default time in mode used.
Contractor ADAIR sorties and proficiency training based out of Shaw AFB Airfield.
High Emission Scenario: Surrogate for MiG-29. 2x F100-PW-100 Engines; 12 F-15A aircraft.
3,500 sorties (LTOs), 525 TGOs.
ACAM default time in mode used.

- Activity Start Date
Start Month: 1
Start Year: 2024

- Activity End Date
Indefinite: No
End Month: 12
End Year: 2033

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	148.949183
SO_x	64.880440
NO_x	739.663174
CO	1242.629330
PM 10	112.351045

Pollutant	Total Emissions (TONs)
PM 2.5	102.404527
Pb	0.000000
NH_3	0.000000
CO_2e	149091.0

- Activity Emissions [Flight Operations (includes Trim Test & APU) part]:

Pollutant	Total Emissions (TONs)
VOC	86.974660
SO_x	52.396211
NO_x	561.329207
CO	1133.883665
PM 10	93.967386

Pollutant	Total Emissions (TONs)
PM 2.5	84.570648
Pb	0.000000
NH_3	0.000000
CO_2e	139701.6

- Activity Emissions [Aerospace Ground Equipment (AGE) part]:

Pollutant	Total Emissions (TONs)
VOC	61.974522
SO_x	12.484229
NO_x	178.333967
CO	108.745665
PM 10	18.383658

Pollutant	Total Emissions (TONs)
PM 2.5	17.833879
Pb	0.000000
NH_3	0.000000
CO_2e	9389.4

2.2 Aircraft & Engines

2.2.1 Aircraft & Engines Assumptions

- Aircraft & Engine
Aircraft Designation: F-15A
Engine Model: F100-PW-100
Primary Function: Combat
Aircraft has After burn: Yes
Number of Engines: 2

- Aircraft & Engine Surrogate
Is Aircraft & Engine a Surrogate? No
Original Aircraft Name:
Original Engine Name:

2.2.2 Aircraft & Engines Emission Factor(s)

- Aircraft & Engine Emissions Factors (lb/1000lb fuel)

	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CO_2e
Idle	1127.00	3.79	1.07	4.64	49.58	3.13	2.82	3234
Approach	2765.00	1.06	1.07	12.52	3.99	1.57	1.41	3234
Intermediate	7685.00	0.14	1.07	27.09	0.72	0.72	0.65	3234
Military	10996.00	0.12	1.07	35.01	0.70	1.24	1.12	3234
After Burn	54007.00	0.13	1.07	6.62	9.57	0.87	0.78	3234

2.3 Flight Operations

2.3.1 Flight Operations Assumptions

- Flight Operations
Number of Aircraft: 12
Number of Annual LTOs (Landing and Take-off) cycles for all Aircraft: 3500
Number of Annual TGOs (Touch-and-Go) cycles for all Aircraft: 525
Number of Annual Trim Test(s) per Aircraft: 12

- Default Settings Used: Yes

- Flight Operations TIMs (Time In Mode)
Taxi/Idle Out [Idle] (mins): 18.5 (default)
Takeoff [Military] (mins): 0.2 (default)
Takeoff [After Burn] (mins): 0.2 (default)
Climb Out [Intermediate] (mins): 0.8 (default)
Approach [Approach] (mins): 3.5 (default)
Taxi/Idle In [Idle] (mins): 11.3 (default)

Per the Air Emissions Guide for Air Force Mobile Sources, the defaults values for military aircraft equipped with after burner for takeoff is 50% military power and 50% afterburner. (Exception made for F-35 where KARNES 3.2 flight profile was used)

- Trim Test
Idle (mins): 12 (default)
Approach (mins): 27 (default)
Intermediate (mins): 9 (default)
Military (mins): 9 (default)
AfterBurn (mins): 3 (default)

2.3.2 Flight Operations Formula(s)

- Aircraft Emissions per Mode for LTOs per Year
AEM_{POL} = (TIM / 60) * (FC / 1000) * EF * NE * LTO / 2000

AEM_{POL}: Aircraft Emissions per Pollutant & Mode (TONs)
TIM: Time in Mode (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)
NE: Number of Engines
LTO: Number of Landing and Take-off Cycles (for all aircraft)
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for LTOs per Year
AE_{LTO} = AEM_{IDLE_IN} + AEM_{IDLE_OUT} + $AEM_{APPROACH}$ + $AEM_{CLIMBOUT}$ + $AEM_{TAKEOFF}$

AE_{LTO}: Aircraft Emissions (TONs)
AEM_{IDLE_IN}: Aircraft Emissions for Idle-In Mode (TONs)
AEM_{IDLE_OUT}: Aircraft Emissions for Idle-Out Mode (TONs)
$AEM_{APPROACH}$: Aircraft Emissions for Approach Mode (TONs)
$AEM_{CLIMBOUT}$: Aircraft Emissions for Climb-Out Mode (TONs)
$AEM_{TAKEOFF}$: Aircraft Emissions for Take-Off Mode (TONs)

- Aircraft Emissions per Mode for TGOs per Year
AEM_{POL} = (TIM / 60) * (FC / 1000) * EF * NE * TGO / 2000

AEM_{POL}: Aircraft Emissions per Pollutant & Mode (TONs)
TIM: Time in Mode (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)
NE: Number of Engines
TGO: Number of Touch-and-Go Cycles (for all aircraft)
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for TGOs per Year
AE_{TGO} = $AEM_{APPROACH}$ + $AEM_{CLIMBOUT}$ + $AEM_{TAKEOFF}$

AE_{TGO}: Aircraft Emissions (TONs)
$AEM_{APPROACH}$: Aircraft Emissions for Approach Mode (TONs)
$AEM_{CLIMBOUT}$: Aircraft Emissions for Climb-Out Mode (TONs)
$AEM_{TAKEOFF}$: Aircraft Emissions for Take-Off Mode (TONs)

- Aircraft Emissions per Mode for Trim per Year
$AEPS_{POL}$ = (TD / 60) * (FC / 1000) * EF * NE * NA * NTT / 2000

$AEPS_{POL}$: Aircraft Emissions per Pollutant & Power Setting (TONs)
TD: Test Duration (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)
NE: Number of Engines

NA: Number of Aircraft
NTT: Number of Trim Test
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for Trim per Year
$AE_{TRIM} = AEPS_{IDLE} + AEPS_{APPROACH} + AEPS_{INTERMEDIATE} + AEPS_{MILITARY} + AEPS_{AFTERBURN}$

AE_{TRIM}: Aircraft Emissions (TONs)
$AEPS_{IDLE}$: Aircraft Emissions for Idle Power Setting (TONs)
$AEPS_{APPROACH}$: Aircraft Emissions for Approach Power Setting (TONs)
$AEPS_{INTERMEDIATE}$: Aircraft Emissions for Intermediate Power Setting (TONs)
$AEPS_{MILITARY}$: Aircraft Emissions for Military Power Setting (TONs)
$AEPS_{AFTERBURN}$: Aircraft Emissions for After Burner Power Setting (TONs)

2.4 Auxiliary Power Unit (APU)

2.4.1 Auxiliary Power Unit (APU) Assumptions

- Default Settings Used: Yes

- Auxiliary Power Unit (APU) (default)

Number of APU per Aircraft	Operation Hours for Each LTO	Exempt Source?	Designation	Manufacturer

2.4.2 Auxiliary Power Unit (APU) Emission Factor(s)

- Auxiliary Power Unit (APU) Emission Factor (lb/hr)

Designation	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CO_2e

2.4.3 Auxiliary Power Unit (APU) Formula(s)

- Auxiliary Power Unit (APU) Emissions per Year
$APU_{POL} = APU * OH * LTO * EF_{POL} / 2000$

APU_{POL}: Auxiliary Power Unit (APU) Emissions per Pollutant (TONs)
APU: Number of Auxiliary Power Units
OH: Operation Hours for Each LTO (hour)
LTO: Number of LTOs
EF_{POL}: Emission Factor for Pollutant (lb/hr)
2000: Conversion Factor pounds to tons

2.5 Aerospace Ground Equipment (AGE)

2.5.1 Aerospace Ground Equipment (AGE) Assumptions

- Default Settings Used: Yes

- AGE Usage
Number of Annual LTO (Landing and Take-off) cycles for AGE: 3500

- Aerospace Ground Equipment (AGE) (default)

Total Number of AGE	Operation Hours for Each LTO	Exempt Source?	AGE Type	Designation
1	0.33	No	Air Compressor	MC-1A - 18.4hp
1	1	No	Bomb Lift	MJ-1B
1	0.33	No	Generator Set	A/M32A-86D

1	0.5	No	Heater	H1
1	0.5	No	Hydraulic Test Stand	MJ-2/TTU-228 - 130hp
1	8	No	Light Cart	NF-2
1	0.33	No	Start Cart	A/M32A-60A

2.5.2 Aerospace Ground Equipment (AGE) Emission Factor(s)

- Aerospace Ground Equipment (AGE) Emission Factor (lb/hr)

Designation	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CO_2e
MC-1A - 18.4hp	1.1	0.267	0.008	0.419	0.267	0.071	0.068	24.8
MJ-1B	0.0	3.040	0.219	4.780	3.040	0.800	0.776	141.2
A/M32A-86D	6.5	0.294	0.046	6.102	0.457	0.091	0.089	147.0
H1	0.4	0.100	0.011	0.160	0.180	0.006	0.006	8.9
MJ-2/TTU-228 - 130hp	7.4	0.195	0.053	3.396	0.794	0.089	0.086	168.8
NF-2	0.0	0.010	0.043	0.110	0.080	0.010	0.010	22.1
A/M32A-60A	0.0	0.270	0.306	1.820	5.480	0.211	0.205	221.1

2.5.3 Aerospace Ground Equipment (AGE) Formula(s)

- Aerospace Ground Equipment (AGE) Emissions per Year

$AGE_{POL} = AGE * OH * LTO * EF_{POL} / 2000$

AGE_{POL}: Aerospace Ground Equipment (AGE) Emissions per Pollutant (TONs)
AGE: Total Number of Aerospace Ground Equipment
OH: Operation Hours for Each LTO (hour)
LTO: Number of LTOs
EF_{POL}: Emission Factor for Pollutant (lb/hr)
2000: Conversion Factor pounds to tons

3. Personnel

3.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Commute by New Personnel

- Activity Description:
ADAIR Contractor Personnel Commute from off-base (78 Maintenance Personnel & 15 Pilots)

- Activity Start Date
Start Month: 1
Start Year: 2024

- Activity End Date
Indefinite: No
End Month: 12
End Year: 2033

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	2.073982
SO_x	0.014004
NO_x	1.802017
CO	23.875430
PM 10	0.042559

Pollutant	Total Emissions (TONs)
PM 2.5	0.037026
Pb	0.000000
NH_3	0.128801
CO_2e	2034.9

3.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 93
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

3.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

3.4 Personnel Emission Factor(s)

- On Road Vehicle Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.293	000.002	000.224	003.418	000.007	000.006		000.023	00323.554
LDGT	000.377	000.003	000.397	004.865	000.008	000.007		000.024	00417.210
HDGV	000.730	000.005	000.988	014.840	000.019	000.017		000.044	00772.703
LDDV	000.102	000.003	000.133	002.620	000.004	000.004		000.008	00314.924
LDDT	000.240	000.004	000.378	004.471	000.007	000.006		000.008	00446.943
HDDV	000.547	000.013	005.142	001.878	000.171	000.157		000.029	01524.102
MC	002.687	000.003	000.716	013.172	000.027	000.024		000.054	00395.768

3.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_{C} + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_{C}: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

4. Degreaser

4.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Minor Parts Cleaning - ADAIR Contractor Aircraft

- Activity Description:
Small Parts Cleaning (assume 0.5 gal solvent /mo consumed). Major repairs & maintenance conducted off-site.

- Activity Start Date
Start Month: 1
Start Year: 2024

- Activity End Date
Indefinite: No
End Month: 12
End Year: 2033

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.195390
SO_x	0.000000
NO_x	0.000000
CO	0.000000
PM 10	0.000000

Pollutant	Total Emissions (TONs)
PM 2.5	0.000000
Pb	0.000000
NH_3	0.000000
CO_2e	0.0

4.2 Degreaser Assumptions

- Degreaser
Net solvent usage (total less recycle) (gallons/year): 6

- Default Settings Used: Yes

- Degreaser Consumption
Solvent used: Mineral Spirits CAS#64475-85-0 (default)
Specific gravity of solvent: 0.78 (default)
Solvent VOC content (%): 100 (default)
Efficiency of control device (%): 0 (default)

4.3 Degreaser Formula(s)

- Degreaser Emissions per Year

$$DE_{VOC} = (VOC / 100) * NS * SG * 8.35 * (1 - (CD / 100)) / 2000$$

DE_{VOC}: Degreaser VOC Emissions (TONs per Year)
VOC: Solvent VOC content (%)
(VOC / 100): Conversion Factor percent to decimal
NS: Net solvent usage (total less recycle) (gallons/year)
SG: Specific gravity of solvent
8.35: Conversion Factor the density of water
CD: Efficiency of control device (%)
(1 - (CD / 100)): Conversion Factor percent to decimal (Not effected by control device)
2000: Conversion Factor pounds to tons

5. Tanks

5.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Jet A Storage

- Activity Description:
Tank 1 - Accounts for additional fuel throughput due to Contractor ADAIR Sorties. Fuel use estimated based on number of sorties and time in mode. Includes fuel used in Warning Areas and in the vicinity of the airfield.

- Activity Start Date
Start Month: 1
Start Year: 2024

- Activity End Date
Indefinite: No
End Month: 12
End Year: 2033

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.880965
SO_x	0.000000
NO_x	0.000000
CO	0.000000
PM 10	0.000000

Pollutant	Total Emissions (TONs)
PM 2.5	0.000000
Pb	0.000000
NH_3	0.000000
CO_2e	0.0

5.2 Tanks Assumptions

- Chemical

Chemical Name: Jet kerosene (JP-5, JP-8 or Jet-A)
Chemical Category: Petroleum Distillates
Chemical Density: 7
Vapor Molecular Weight (lb/lb-mole): 130
Stock Vapor Density (lb/ft^3): 0.000170775135930213
Vapor Pressure: 0.00725
Vapor Space Expansion Factor (dimensionless): 0.068

- Tank

Type of Tank: Vertical Tank
Tank Height (ft): 24
Tank Diameter (ft): 12
Annual Net Throughput (gallon/year): 2003212

5.3 Tank Formula(s)

- Vapor Space Volume

VSV = (PI / 4) * D^2 * H / 2

VSV: Vapor Space Volume (ft^3)
PI: PI Math Constant
D^2: Tank Diameter (ft)
H: Tank Height (ft)
2: Convertion Factor (Vapor Space Volume is assumed to be one-half of the tank volume)

- Vented Vapor Saturation Factor

VVSF = 1 / (1 + (0.053 * VP * H / 2))

VVSF: Vented Vapor Saturation Factor (dimensionless)
0.053: Constant
VP: Vapor Pressure (psia)
H: Tank Height (ft)

- Standing Storage Loss per Year

SSL_{VOC} = 365 * VSV * SVD * VSEF * VVSF / 2000

SSL_{VOC}: Standing Storage Loss Emissions (TONs)
365: Number of Daily Events in a Year (Constant)
VSV: Vapor Space Volume (ft^3)
SVD: Stock Vapor Density (lb/ft^3)
VSEF: Vapor Space Expansion Factor (dimensionless)
VVSF: Vented Vapor Saturation Factor (dimensionless)
2000: Conversion Factor pounds to tons

- Number of Turnovers per Year

NT = (7.48 * ANT) / ((PI / 4.0) * D * H)

NT: Number of Turnovers per Year
7.48: Constant
ANT: Annual Net Throughput
PI: PI Math Constant
D^2: Tank Diameter (ft)
H: Tank Height (ft)

- Working Loss Turnover (Saturation) Factor per Year

WLSF = (18 + NT) / (6 * NT)

WLSF: Working Loss Turnover (Saturation) Factor per Year
18: Constant
NT: Number of Turnovers per Year
6: Constant

- Working Loss per Year

WL_{VOC} = 0.0010 * VMW * VP * ANT * WLSF / 2000

0.0010: Constant
VMW: Vapor Molecular Weight (lb/lb-mole)
VP: Vapor Pressure (psia)
ANT: Annual Net Throughput
WLSF: Working Loss Turnover (Saturation) Factor
2000: Conversion Factor pounds to tons

6. Tanks

6.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Jet A Storage

- Activity Description:
Tank 2 - Accounts for additional fuel throughput due to Contractor ADAIR Sorties. Fuel use estimated based on number of sorties and time in mode. Includes fuel used in Warning Areas and in the vicinity of the airfield.

- Activity Start Date
Start Month: 1
Start Year: 2024

- Activity End Date
Indefinite: No
End Month: 12
End Year: 2033

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.880965
SO_x	0.000000
NO_x	0.000000
CO	0.000000
PM 10	0.000000

Pollutant	Total Emissions (TONs)
PM 2.5	0.000000
Pb	0.000000
NH_3	0.000000
CO_2e	0.0

6.2 Tanks Assumptions

- Chemical

Chemical Name: Jet kerosene (JP-5, JP-8 or Jet-A)
Chemical Category: Petroleum Distillates
Chemical Density: 7
Vapor Molecular Weight (lb/lb-mole): 130
Stock Vapor Density (lb/ft^3): 0.000170775135930213
Vapor Pressure: 0.00725
Vapor Space Expansion Factor (dimensionless): 0.068

- Tank

Type of Tank: Vertical Tank
Tank Height (ft): 24
Tank Diameter (ft): 12
Annual Net Throughput (gallon/year): 2003212

6.3 Tank Formula(s)

- Vapor Space Volume

$VSV = (PI / 4) * D^2 * H / 2$

VSV: Vapor Space Volume (ft^3)
PI: PI Math Constant
D^2: Tank Diameter (ft)
H: Tank Height (ft)
2: Convertion Factor (Vapor Space Volume is assumed to be one-half of the tank volume)

- Vented Vapor Saturation Factor

$VVSF = 1 / (1 + (0.053 * VP * H / 2))$

VVSF: Vented Vapor Saturation Factor (dimensionless)
0.053: Constant
VP: Vapor Pressure (psia)
H: Tank Height (ft)

- Standing Storage Loss per Year

$SSL_{VOC} = 365 * VSV * SVD * VSEF * VVSF / 2000$

SSL_{VOC}: Standing Storage Loss Emissions (TONs)
365: Number of Daily Events in a Year (Constant)
VSV: Vapor Space Volume (ft^3)
SVD: Stock Vapor Density (lb/ft^3)
VSEF: Vapor Space Expansion Factor (dimensionless)
VVSF: Vented Vapor Saturation Factor (dimensionless)
2000: Conversion Factor pounds to tons

- Number of Turnovers per Year

NT = (7.48 * ANT) / ((PI / 4.0) * D * H)

NT: Number of Turnovers per Year
7.48: Constant
ANT: Annual Net Throughput
PI: PI Math Constant
D^2: Tank Diameter (ft)
H: Tank Height (ft)

- Working Loss Turnover (Saturation) Factor per Year

WLSF = (18 + NT) / (6 * NT)

WLSF: Working Loss Turnover (Saturation) Factor per Year
18: Constant
NT: Number of Turnovers per Year
6: Constant

- Working Loss per Year

WL_{VOC} = 0.0010 * VMW * VP * ANT * WLSF / 2000

0.0010: Constant
VMW: Vapor Molecular Weight (lb/lb-mole)
VP: Vapor Pressure (psia)
ANT: Annual Net Throughput
WLSF: Working Loss Turnover (Saturation) Factor
2000: Conversion Factor pounds to tons

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

ALTERNATIVE 1 - AIRFIELD OPERATIONS

HIGH EMISSIONS SCENARIO – AIRFIELD OPERATIONS-ALT 1

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: SHAW AFB
State: South Carolina
County(s): Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: SHAW AIR FORCE BASE Combat Air Forces Adversary Air

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2024

e. Action Description:

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training for Shaw AFB. The Proposed Action includes elements affecting Shaw AFB and military training special use airspace (SUA). The elements affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. The elements affecting the SUA include SUA use and use of defensive countermeasures.

The proposed airfield is analyzed with the addition of an estimated 12 aircraft providing 3,500 annual training sorties. Additional traffic patterns would be anticipated on no more than 5 percent of the annual sortie total, or 175 sorties. The analysis examines three separate emission scenarios: high, medium, and low. No significant construction is anticipated at this time as a result of the action. If it is later determined construction is required at the airfield a separate environmental analysis would be completed as required.

f. Point of Contact:
Name: Radhika Narayanan
Title: Environmental Scientist
Organization: Versar
Email: rnarayanan@versar.com
Phone Number: n/a

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the General Conformity Rule are:

______ applicable
__X__ not applicable

Total net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving “steady state” (i.e., net gain/loss upon action fully implemented) emissions. The ACAM analysis used the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the USAF Air Emissions Guide for Air Force Stationary Sources, the USAF Air Emissions Guide for Air Force Mobile Sources, and the USAF Air Emissions Guide for Air Force Transitory Sources.

“Insignificance Indicators” were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the National Ambient Air Quality Standards (NAAQSs). These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold for actions occurring in areas that are “Clearly Attainment” (i.e., not within 5% of any NAAQS) and the GCR de minimis values (25 ton/yr for lead and 100 ton/yr for all other criteria pollutants) for actions occurring in areas that are “Near Nonattainment” (i.e., within 5% of any NAAQS). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutant is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQSs. For further detail on insignificance indicators see chapter 4 of the Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide, Volume II - Advanced Assessments.

The action’s net emissions for every year through achieving steady state were compared against the Insignificance Indicator and are summarized below.

Analysis Summary:

2024

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	15.498	250	No
NO_x	74.147	250	No
CO	126.650	250	Yes
SO_x	6.489	250	No
PM 10	11.239	250	No
PM 2.5	10.244	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	15112.6		

2034 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.000	250	No
NO_x	0.000	250	No
CO	0.000	250	No
SO_x	0.000	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	0.0		

The estimated annual net emissions associated with this action temporarily exceed the insignificance indicators. However, the steady state estimated annual net emissions are below the insignificance indicators showing no significant long-term impact to air quality. Therefore, the action will not cause or contribute to an exceedance on one or more NAAQSs. No further air assessment is needed.

Radhika

8/30/2023

Radhika Narayanan, Environmental Scientist

DATE

MEDIUM EMISSIONS SCENARIO – AIRFIELD OPERATIONS-ALT 1

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: SHAW AFB
State: South Carolina
County(s): Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: SHAW AIR FORCE BASE Combat Air Forces Adversary Air

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2024

e. Action Description:

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training for Shaw AFB. The Proposed Action includes elements affecting Shaw AFB and military training special use airspace (SUA). The elements affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. The elements affecting the SUA include SUA use and use of defensive countermeasures.

The proposed airfield is analyzed with the addition of an estimated 12 aircraft providing 3,500 annual training sorties. Additional traffic patterns would be anticipated on no more than 5 percent of the annual sortie total, or 175 sorties. The analysis examines three separate emission scenarios: high, medium, and low. No significant construction is anticipated at this time as a result of the action. If it is later determined construction is required at the airfield a separate environmental analysis would be completed as required.

f. Point of Contact:
Name: Radhika Narayanan
Title: Environmental Scientist
Organization: Versar
Email: rnarayanan@versar.com
Phone Number: n/a

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the General Conformity Rule are:

_____ applicable
__X__ not applicable

Total net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving "steady state" (i.e., net gain/loss upon action fully implemented) emissions. The ACAM analysis used the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the USAF Air Emissions Guide for Air Force Stationary Sources, the USAF Air Emissions Guide for Air Force Mobile Sources, and the USAF Air Emissions Guide for Air Force Transitory Sources.

“Insignificance Indicators” were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the National Ambient Air Quality Standards (NAAQSs). These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold for actions occurring in areas that are “Clearly Attainment” (i.e., not within 5% of any NAAQS) and the GCR de minimis values (25 ton/yr for lead and 100 ton/yr for all other criteria pollutants) for actions occurring in areas that are “Near Nonattainment” (i.e., within 5% of any NAAQS). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutant is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQSs. For further detail on insignificance indicators see chapter 4 of the Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide, Volume II - Advanced Assessments.

The action’s net emissions for every year through achieving steady state were compared against the Insignificance Indicator and are summarized below.

Analysis Summary:

2024

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No

PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No

PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	7.958	250	No
NO_x	44.379	250	No
CO	62.097	250	No
SO_x	4.328	250	No
PM 10	6.476	250	No
PM 2.5	4.306	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	10364.3		

2034 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.000	250	No
NO_x	0.000	250	No
CO	0.000	250	No

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
SO_x	0.000	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	0.0		

None of estimated annual net emissions associated with this action are above the insignificance indicators, indicating no significant impact to air quality.Therefore, the action will not cause or contribute to an exceedance on one or more NAAQSs.No further air assessment is needed.

Radhika

8//30/2023

Radhika Narayanan, Environmental Scientist DATE

LOW EMISSIONS SCENARIO – AIRFIELD OPERATIONS-ALT 1

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: SHAW AFB
State: South Carolina
County(s): Sumter
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: SHAW AIR FORCE BASE Combat Air Forces Adversary Air

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2024

e. Action Description:

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training for Shaw AFB. The Proposed Action includes elements affecting Shaw AFB and military training special use airspace (SUA). The elements affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. The elements affecting the SUA include SUA use and use of defensive countermeasures.

The proposed airfield is analyzed with the addition of an estimated 12 aircraft providing 3,500 annual training sorties. Additional traffic patterns would be anticipated on no more than 5 percent of the annual sortie total, or 175 sorties. The analysis examines three separate emission scenarios: high, medium, and low. No significant construction is anticipated at this time as a result of the action. If it is later determined construction is required at the airfield a separate environmental analysis would be completed as required.

f. Point of Contact:
Name: Radhika Narayanan
Title: Environmental Scientist
Organization: Versar
Email: rnarayanan@versar.com
Phone Number: n/a

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the General Conformity Rule are:

_____ applicable
__X__ not applicable

Total net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving "steady state" (i.e., net gain/loss upon action fully implemented) emissions. The ACAM analysis used the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the USAF Air Emissions Guide for Air Force Stationary Sources, the USAF Air Emissions Guide for Air Force Mobile Sources, and the USAF Air Emissions Guide for Air Force Transitory Sources.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the National Ambient Air Quality Standards (NAAQSs). These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold for actions occurring in areas that are "Clearly Attainment" (i.e., not within 5% of any NAAQS) and the GCR de minimis values (25 ton/yr for lead and 100 ton/yr for all other criteria pollutants) for actions occurring in areas that are "Near Nonattainment" (i.e., within 5% of any NAAQS). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutant is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQSs. For further detail on insignificance indicators see chapter 4 of the Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide, Volume II - Advanced Assessments.

The action's net emissions for every year through achieving steady state were compared against the Insignificance Indicator and are summarized below.

Analysis Summary:

2024

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	43.318	250	No
NO_x	21.054	250	No
CO	224.455	250	Yes
SO_x	3.176	250	No
PM 10	1.854	250	No
PM 2.5	1.798	250	No
Pb	0.000	25	No
NH_3	0.013	250	No
CO_2e	6696.4		

2034 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.000	250	No
NO_x	0.000	250	No
CO	0.000	250	No
SO_x	0.000	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	0.0		

The estimated annual net emissions associated with this action temporarily exceed the insignificance indicators. However, the steady state estimated annual net emissions are below the insignificance indicators showing no significant long-term impact to air quality. Therefore, the action will not cause or contribute to an exceedance on one or more NAAQSs. No further air assessment is needed.

Radhika

8//30/2023

Radhika Narayanan, Environmental Scientist

DATE

ALTERNATIVE 1 - AIRSPACE OPERATIONS

HIGH EMISSIONS SCENARIO – AIRSPACE OPERATIONS-ALT 1

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: SHAW AFB
State: Georgia
County(s): Jefferson; Burke; Johnson; Washington; Jenkins; Emanuel; Glascock; Berkeley; Clarendon; Florence; Georgetown; Williamsburg
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: SHAW AIR FORCE BASE Combat Air Forces Adversary Air

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2024

e. Action Description:

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training for Shaw AFB. The Proposed Action includes elements affecting Shaw AFB and military training special use airspace (SUA). The elements affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. The elements affecting the SUA include SUA use and use of defensive countermeasures.

The proposed airfield is analyzed with the addition of an estimated 12 aircraft providing 3,500 annual training sorties. Additional traffic patterns would be anticipated on no more than 3.5 percent of the annual sortie total, about 123 sorties. The analysis examines three separate emission scenarios: high, medium, and low. No significant construction is anticipated at this time as a result of the action. If it is later determined construction is required at the airfield a separate environmental analysis would be completed as required.

f. Point of Contact:
Name: Radhika Narayanan
Title: Environmental Scientist
Organization: Versar
Email: rnarayanan@versar.com
Phone Number: n/a

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the General Conformity Rule are:

_____ applicable
__X__ not applicable

Total net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving "steady state" (i.e., net gain/loss upon action fully implemented) emissions. The ACAM analysis used the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the USAF Air Emissions Guide for Air Force Stationary Sources, the USAF Air Emissions Guide for Air Force Mobile Sources, and the USAF Air Emissions Guide for Air Force Transitory Sources.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the National Ambient Air Quality Standards (NAAQSs). These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold for actions occurring in areas that are "Clearly Attainment" (i.e., not within 5% of any NAAQS) and the GCR de minimis values (25 ton/yr for lead and 100 ton/yr for all other criteria pollutants) for actions occurring in areas that are "Near Nonattainment" (i.e., within 5% of any NAAQS). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutant is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQSs. For further detail on insignificance indicators see chapter 4 of the Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide, Volume II - Advanced Assessments.

The action's net emissions for every year through achieving steady state were compared against the Insignificance Indicator and are summarized below.

Analysis Summary:

2024

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.008	100	No
NO_x	1.615	100	No
CO	0.043	250	No
SO_x	0.064	250	No
PM 10	0.043	250	No
PM 2.5	0.039	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	192.8		

2034 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.000	100	No
NO_x	0.000	100	No
CO	0.000	250	No
SO_x	0.000	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	0.0		

None of estimated annual net emissions associated with this action are above the insignificance indicators, indicating no significant impact to air quality.Therefore, the action will not cause or contribute to an exceedance on one or more NAAQSs.No further air assessment is needed.

Radhika

8//30/2023

Radhika Narayanan, Environmental Scientist   DATE

MEDUM EMISSIONS SCENARIO – AIRSPACE OPERATIONS-ALT 1

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: SHAW AFB
State: Georgia
County(s): Jefferson; Burke; Johnson; Washington; Jenkins; Emanuel; Glascock; Berkeley; Clarendon; Florence; Georgetown; Williamsburg
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: SHAW AIR FORCE BASE Combat Air Forces Adversary Air

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2024

e. Action Description:

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training for Shaw AFB. The Proposed Action includes elements affecting Shaw AFB and military training special use airspace (SUA). The elements affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. The elements affecting the SUA include SUA use and use of defensive countermeasures.

The proposed airfield is analyzed with the addition of an estimated 12 aircraft providing 3,500 annual training sorties. Additional traffic patterns would be anticipated on no more than 3.5 percent of the annual sortie total, about 123 sorties. The analysis examines three separate emission scenarios: high, medium, and low. No significant construction is anticipated at this time as a result of the action. If it is later determined construction is required at the airfield a separate environmental analysis would be completed as required.

f. Point of Contact:
Name: Radhika Narayanan
Title: Environmental Scientist
Organization: Versar
Email: rnarayanan@versar.com
Phone Number: n/a

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the General Conformity Rule are:

_____ applicable
__X__ not applicable

Total net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving "steady state" (i.e., net gain/loss upon action fully implemented) emissions. The ACAM analysis used the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the USAF Air Emissions Guide for Air Force Stationary Sources, the USAF Air Emissions Guide for Air Force Mobile Sources, and the USAF Air Emissions Guide for Air Force Transitory Sources.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the National Ambient Air Quality Standards (NAAQSs). These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold for actions occurring in areas that are "Clearly Attainment" (i.e., not within 5% of any NAAQS) and the GCR de minimis values (25 ton/yr for lead and 100 ton/yr for all other criteria pollutants) for actions occurring in areas that are "Near Nonattainment" (i.e., within 5% of any NAAQS). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutant is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQSs. For further detail on insignificance indicators see chapter 4 of the Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide, Volume II - Advanced Assessments.

The action's net emissions for every year through achieving steady state were compared against the Insignificance Indicator and are summarized below.

Analysis Summary:

2024

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.001	100	No
NO_x	0.481	100	No
CO	0.099	250	No
SO_x	0.030	250	No
PM 10	0.016	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	92.0		

2034 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.000	100	No
NO_x	0.000	100	No
CO	0.000	250	No
SO_x	0.000	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	0.0		

None of estimated annual net emissions associated with this action are above the insignificance indicators, indicating no significant impact to air quality.Therefore, the action will not cause or contribute to an exceedance on one or more NAAQSs.No further air assessment is needed.

Radhika

8//30/2023

Radhika Narayanan, Environmental Scientist

DATE

LOW EMISSIONS SCENARIO – AIRSPACE OPERATIONS-ALT 1

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: SHAW AFB
State: Georgia
County(s): Jefferson; Burke; Johnson; Washington; Jenkins; Emanuel; Glascock; Berkeley; Clarendon; Florence; Georgetown; Williamsburg
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: SHAW AIR FORCE BASE Combat Air Forces Adversary Air

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2024

e. Action Description:

The DAF is proposing to provide dedicated contract ADAIR sorties for CAF training for Shaw AFB. The Proposed Action includes elements affecting Shaw AFB and military training special use airspace (SUA). The elements affecting Shaw AFB include contract ADAIR aircraft, facilities, maintenance, personnel, and sorties. The elements affecting the SUA include SUA use and use of defensive countermeasures.

The proposed airfield is analyzed with the addition of an estimated 12 aircraft providing 3,500 annual training sorties. Additional traffic patterns would be anticipated on no more than 3.5 percent of the annual sortie total, about 123 sorties. The analysis examines three separate emission scenarios: high, medium, and low. No significant construction is anticipated at this time as a result of the action. If it is later determined construction is required at the airfield a separate environmental analysis would be completed as required.

f. Point of Contact:
Name: Radhika Narayanan
Title: Environmental Scientist
Organization: Versar
Email: rnarayanan@versar.com
Phone Number: n/a

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the General Conformity Rule are:

_____ applicable
__X__ not applicable

Total net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving "steady state" (i.e., net gain/loss upon action fully implemented) emissions. The ACAM analysis used the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the USAF Air Emissions Guide for Air Force Stationary Sources, the USAF Air Emissions Guide for Air Force Mobile Sources, and the USAF Air Emissions Guide for Air Force Transitory Sources.

“Insignificance Indicators” were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the National Ambient Air Quality Standards (NAAQSs). These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold for actions occurring in areas that are “Clearly Attainment” (i.e., not within 5% of any NAAQS) and the GCR de minimis values (25 ton/yr for lead and 100 ton/yr for all other criteria pollutants) for actions occurring in areas that are “Near Nonattainment” (i.e., within 5% of any NAAQS). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutant is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQSs. For further detail on insignificance indicators see chapter 4 of the Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide, Volume II - Advanced Assessments.

The action’s net emissions for every year through achieving steady state were compared against the Insignificance Indicator and are summarized below.

Analysis Summary:

2024

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.069	100	No
NO_x	0.040	100	No
CO	0.741	250	No
SO_x	0.018	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	55.8		

2034 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.000	100	No
NO_x	0.000	100	No
CO	0.000	250	No
SO_x	0.000	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH_3	0.000	250	No
CO_2e	0.0		

None of estimated annual net emissions associated with this action are above the insignificance indicators, indicating no significant impact to air quality. Therefore, the action will not cause or contribute to an exceedance on one or more NAAQSs. No further air assessment is needed.

Radhika

8//30/2023

Radhika Narayanan, Environmental Scientist

DATE

ALTERNATIVE 2 - Airfield Operations

Alternative 2 results are identical to Alternative 1 results and are not duplicated here.

ALTERNATIVE 2- Airspace Operations

Alternative 2 results are identical to Alternative 1 results and are not duplicated here.

C.4 BIOLOGICAL RESOURCES

C.4.1 Federal Regulatory Statutes

Endangered Species Act (ESA). The ESA of 1973 (16 U.S.C. § 1531 et seq.) established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. Sensitive and protected biological resources include plant and animal species listed as threatened or endangered by the USFWS and the National Marine Fisheries Service (NMFS). Endangered species are defined in the ESA as any species in danger of extinction throughout all, or a large portion, of its range. A "threatened species" is defined as any species likely to become an endangered species in the foreseeable future. The USFWS maintains a list of species considered to be candidates for possible listing under the ESA. The ESA also allows the designation of geographic areas as critical habitat for threatened or endangered species. Although candidate species receive no statutory protection under the ESA, the USFWS encourages cooperative conservation efforts for these species because they are species that may warrant protection in the future under the ESA.

Migratory Bird Treaty Act (MBTA). The MBTA of 1918 makes it unlawful for anyone to take migratory birds or their parts, nests, or eggs unless permitted to do so by regulations. Per the MBTA, "take" is defined as "pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR § 10.12). Migratory birds include nearly all species in the United States, with the exception of some upland game birds and nonnative species.

Per EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, all federal agencies undertaking activities that may negatively impact migratory birds are required to follow a prescribed set of actions to further implement the MBTA. Further, EO 13186 directs federal agencies to develop a Memorandum of Understanding with the USFWS that promotes the conservation of migratory birds.

The National Defense Authorization Act for Fiscal Year 2003 (Public Law 107-314, 116 Stat. 38 2458) provided the Secretary of the Interior the authority to prescribe regulations to exempt the armed forces from the incidental take of migratory birds during authorized military readiness activities. Congress defined military readiness activities as all training and operations of the US armed forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use.

Bald and Golden Eagle Protection Act. The Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. § 668 - 668d) provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" a bald or golden eagle. "Disturb" is defined by the Act as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, injury to an eagle, a decrease in productivity by substantially interfering with the eagle's normal breeding, feeding or sheltering behavior, or nest abandonment by substantially interfering with the eagle's normal breeding, feeding or sheltering behavior." The Bald and Golden Eagle Protection Act also prohibits activities around an active or inactive nest site that could result in an adverse impact on the eagle. A Proposed Rule (87 FR 59598, 50 CFR Parts 13 - 22), published 30 September 2022, has been initiated to expedite and simplify the permitting processes authorizing incidental take of eagles. Under this Proposed Rule, the take limit for golden eagles remains set at zero, unless offset with compensatory mitigation.

Marine Mammal Protection Act. The Marine Mammal Protection Act (MMPA) provides protection for all marine mammals, some of which are also protected under the ESA. With some exceptions, the MMPA prohibits "take" of marine mammals, which includes harassment, hunting, capture, collecting, or killing, in US waters and by US citizens on the high seas (50 CFR Part 216). Marine mammals covered by the MMPA include whales, dolphins, porpoises, seals, sea lions, walruses, polar bears, sea otters, manatees, and dugongs.

Magnuson-Stevens Fishery Conservation and Management Act. The Magnuson-Stevens Fishery Conservation and Management Act (MSA) governs marine fisheries management in US federal waters. The MSA (Public Law 94-265) requires fisheries management to prevent overfishing, rebuild overfished stocks, increase the long-term economic and social benefits of fisheries, and ensure a safe and sustainable seafood supply. The MSA designates Essential Fish Habitat (EFH) and directs National Oceanic and Atmospheric Administration (NOAA) Fisheries and the regional fishery management councils to minimize adverse effects on EFH from fishing activities, as well as directs federal agencies to consult with NOAA Fisheries on any actions that occur where EFH is designated.

EO 13112, *Invasive Species*. EO 13112 defines invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm to human health.” Invasive species are highly adaptable and often displace native species. Characteristics of invasive species include high reproduction rates, resistance to disturbances, lack of natural predators, efficient dispersal mechanisms, and the ability to outcompete native species.

C.4.2 Descriptions of Federal Candidate Species and Species Proposed for Federal Listing Potentially Occurring at Shaw Air Force Base

Monarch Butterfly *(Danaus plexippus)*. The monarch butterfly is a butterfly species with a broad global distribution and extensive migratory pathways in North American populations. The monarch butterfly is dependent on milkweed plant species *(Asclepias spp.)* as its larval host plant. The monarch butterfly may occur seasonally in suitable habitats on Shaw AFB and in the overland SUA during migrations.

Tricolored Bat (*Perimyotis subflavus)*. The tricolored bat occurs in forested habitats across the eastern US and roosts in trees, primarily among leaves, during the spring, summer, and fall. In winter, tricolored bats roost in caves and mines, or in human-made structures such as culverts. Tricolored bats are one of the smallest bats in North America, and populations have declined dramatically as a result of white-nose syndrome, a disease caused by a fungal pathogen. The tricolored bat has been documented at Shaw AFB (DAF, 2017) and likely occurs in the overland SUA.

C.4.3 Descriptions of Federally Listed Threatened and Endangered Species Potentially Occurring in the Bulldog Military Operations Area

Red-Cockaded Woodpecker *(Picoides borealis)*. The federally endangered red-cockaded woodpecker typically occupies open, mature stands of southern pines, particularly longleaf pine, for foraging and nesting/roosting habitat (North Carolina Natural Heritage Program, 2020). The red-cockaded woodpecker excavates cavities for nesting and roosting in living pine trees, aged 60 years or older, which are contiguous with pine stands at least 30 years of age to provide foraging habitat. The red-cockaded woodpecker is listed by Georgia DNR as occurring under the Bulldog MOAs (Georgia DNR, 2015).

Wood Stork *(Mycteria americana)*. The wood stork is federally listed as threatened under the ESA. Wood storks typically construct their nests in medium to tall trees that occur in stands located either in swamps or on islands surrounded by relatively broad expanses of open water. During the nonbreeding season or while foraging, wood storks occur in a wide variety of wetland habitats, including freshwater marshes and stock ponds, shallow, seasonally flooded roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs. Wood storks have been documented in Jenkins County under the Bulldog MOAs (Georgia DNR, 2015).

Atlantic Sturgeon *(Acipenser oxyrinchus oxyrinchus)*. The Atlantic sturgeon occurs in rivers and coastal waters from Canada to Florida (NMFS, 2019a). The Atlantic sturgeon is anadromous; they are hatched in the freshwater of rivers, head to sea as juveniles, and return to their birthplace to spawn, or lay eggs, when they reach adulthood. The Atlantic sturgeon is slow-growing and late-maturing and have been recorded to reach up to 16 feet in length and up to 60 years of age. There is designated critical habitat for the Atlantic sturgeon beneath the Bulldog MOAs (NMFS, 2019a; NMFS, 2023; USFWS, 2023).

Shortnose Sturgeon *(Acipenser brevirostrum)*. The shortnose sturgeon is federally endangered throughout its range. The shortnose sturgeon lives in rivers and coastal waters from Canada to Florida (NMFS, 2019a). They are amphidromous fish; they are hatched in freshwater of rivers and spend most of their time in the estuaries of these rivers. Unlike the Atlantic sturgeon, the shortnose sturgeon spends relatively little time in the ocean and generally remains close to shore. In the spring, adults move far upstream and away from saltwater to spawn. After spawning, the adults move downstream to estuaries. The shortnose sturgeon could be found year-round in the Bulldog MOAs (NMFS, 2019a; USFWS, 2023).

Monarch Butterfly (see description provided above for species potentially occurring at Shaw AFB).

Tricolored Bat (see description provided above for species potentially occurring at Shaw AFB).

C.4.4 Descriptions of Federally Listed Threatened and Endangered Species Potentially Occurring in the Gamecock Military Operations Area

Eastern Black Rail *(Laterallus jamaicensis)*. The eastern black rail is a small, secretive bird found in coastal marshes or the uplands around marshes (USFWS, 2019a). The diet of the eastern black rail is believed to include terrestrial invertebrates, as well as small seeds. The eastern black rail could be present in wetlands beneath the Gamecock MOAs.

Northern Long-Eared Bat (NLEB) *(Myotis septentrionalis*). In western South Carolina, the NLEB spends winters hibernating in caves and mines. Since this species is not known to be a long-distance migrant, and caves and subterranean mines are extremely rare in eastern South Carolina, it is uncertain whether or where NLEB hibernate in eastern portions of the states. During the summer, NLEB roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees (typically greater than or equal to 3 inches in diameter at breast height). Males and nonreproductive females may also roost in cooler places, like caves and mines. This bat has also been found, rarely, roosting in structures like barns and sheds, under eaves of buildings, behind window shutters, in bridges, and in bat houses. Foraging occurs on forested hillsides and ridges and occasionally over forest clearings, over water, and along tree-lined corridors. Mature forests may be an important habitat type for foraging. NLEB could occur within the Gamecock MOAs in the summer months.

West Indian Manatee *(Tricherchus manatus)*. West Indian manatees are large, aquatic mammals protected under both the ESA and MMPA (USFWS, 2019a). Manatees are primarily herbivorous, feeding on any aquatic vegetation present, but they may occasionally feed on fish. Manatees are found in marine, brackish, and freshwater systems near shorelines with underwater vegetation including near-coastal waters under the Gamecock MOAs.

Red-Cockaded Woodpecker (see description provided above for species potentially occurring in the Bulldog MOA)

Wood Stork (see description provided above for species potentially occurring in the Bulldog MOA)

Monarch Butterfly (see description provided above for species potentially occurring at Shaw AFB)

Tricolored Bat (see description provided above for species potentially occurring at Shaw AFB)

Atlantic Sturgeon (see description provided above for species potentially occurring in the Bulldog MOA)

Shortnose Sturgeon (see description provided above for species potentially occurring in the Bulldog MOA)

C.4.5 Threatened and Endangered Species and/or Species of Concern Potentially Occurring in Areas Underlying the Offshore Warning Areas

Piping Plover. Piping plover *(Charadrius melodus)* habitat includes sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also essential, especially for roosting piping plovers (USFWS, 2019a). Essential components of the beach/dune ecosystem include surf-cast algae for feeding on prey, sparsely vegetated back beach for roosting and refuge during storms, spits for feeding and roosting, salterns, and wash over areas for feeding and roosting. Wash over areas are broad, unvegetated zones with little or no topographic relief that are formed and maintained by the action of hurricanes, storm surge, or other extreme wave action. The piping plover could be present in the Warning Areas during periods of migration.

Red Knot. The red knot *(Calidris canutus rufa)* is a large sandpiper with short thick legs, a reddish breast and head during breeding season, and gray plumage during the rest of the year (USFWS, 2019a). It is one of the longest-distance migrants, with some birds flying over 9,300 miles from breeding to wintering grounds. The red knot breeds in the Arctic tundra and winters along the southern tip of South America. The primary threat to this species is climate change, where rising sea heights affect its coastal breeding habitat, affecting the ability to forage. The red knot could be present in the airspace under the Warning Areas during periods of migration.

Roseate Tern. The roseate tern *(Sterna dougallii)* is listed as endangered in portions of its range from Canada south to North Carolina across its breeding habitat (USFWS 2019a). In nonbreeding locations across the Western Hemisphere, such as the oceans adjacent to breeding habitat (which includes the Warning Areas), the roseate tern is listed as threatened. The roseate tern feeds on small, schooling fish which are captured by plunge-diving from the air into the water. Northern breeding populations migrate to wintering grounds in the Caribbean off the Atlantic Coast. The rosette tern could be present in the Warning Areas during periods of migration.

Oceanic Whitetip Shark. The oceanic whitetip shark *(Carcharhinus longimanus)* is typically found near the ocean surface in offshore warm waters and distributed worldwide (NMFS, 2019a; USFWS, 2019b). Diet includes bony fish, stingrays, sea turtles, sea birds, gastropods, squid, crustaceans, mammalian carrion, and garbage. Threats to the whitetip shark include bycatch from commercial fishing and shark fin trade. Oceanic white tip sharks are found throughout the world on the outer continental shelf with a minimum depth of 600 ft, including waters found under the offshore Warning Areas year-round.

Giant Manta Ray. The giant manta ray *(Manta birostris)* is a migratory animal with a large, diamond-shaped body (NMFS, 2019a; USFWS, 2019b). They are found in a variety of habitats worldwide including rock and coral reefs, sandy bottoms, seagrass beds, nearshore, and offshore. Threats to the giant manta ray include bycatch. The giant manta ray could be found year-round in the waters under the Warning Areas.

Green Sea Turtle. The green sea turtle diet consists mostly of seagrasses and algae. Green sea turtles are known to occur in nearshore areas as well as bays, lagoons, reefs, and areas with seagrass beds (US Navy, 2018). Green turtles could be found year-round in the waters under the offshore Warning Areas (NMFS, 2019a).

Leatherback Sea Turtle. The leatherback sea turtle is the largest and deepest-diving sea turtle. Leatherback sea turtles feed throughout the epipelagic and into the mesopelagic zones of the water column on gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomas) (US Navy, 2018). The leatherback sea turtle could be found year-round in the waters under the offshore Warning Areas (NMFS, 2019a).

Loggerhead Sea Turtle. Loggerhead sea turtles are the most abundant species of sea turtle found in US coastal waters and inhabit offshore waters in the North Atlantic Ocean (US Navy, 2018; NMFS, 2019a). Their diet primarily consists of whelks and conch. Loggerhead sea turtles are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. There is designated critical habitat in the waters under Warning Area W-161 (NMFS, 2019a).

Kemp's Ridley Sea Turtle. The Kemp's ridley sea turtle is the smallest sea turtle and the only sea turtle that primarily nests during daylight hours. Their diet primarily consists of shrimp, jellies, small fish, and mollusks. Kemp's ridley sea turtles primarily nest in the western Gulf of Mexico but have been observed nesting in North Carolina and Virginia (US Navy, 2018). Kemp's ridley sea turtles could be found year-round in the waters under the offshore Warning Areas.

Blue Whale. The blue whale *(Balaenoptera musculus)* is a baleen whale that occurs globally and the largest animal to have ever lived on Earth (NMFS, 2019a). Blue whales can reach nearly 90 ft in length. Females are slightly larger than males. The blue whale feeds primarily on krill and feeds by gulping. Blue whales are found in all oceans except for the Arctic Ocean. Blue whale's range in the North Atlantic Ocean includes the continental shelf waters from Greenland to the subtropics, including the offshore Warning Areas. The blue whale is migratory and could be found year-round migrating and foraging in the waters under all the offshore Warning Areas.

Fin Whale. The fin whale *(Balaenoptera physalus)* is the second largest whale species and feeds by gulping a wide variety of organisms including small schooling fish, squid, and crustaceans (including krill) (NMFS, 2019a). Fin whales are migratory and travel from the Artic to Antarctic during summer months and use the tropical waters for breeding and calving during the winter months. The fin whale uses the deep, offshore, open seas for habitat and the exact migration patterns are not known. Due to the migratory nature of the fin whale, it could be found year-round migrating and foraging in the waters under the offshore Warning Areas.

North Atlantic Right Whale. The North Atlantic right whale *(Eubalaena glacialis)* is one of the world's most endangered large whales with approximately 400 North Atlantic right whales in the North Atlantic Ocean (NMFS, 2019a; NMFS 2019b). They primarily feed on zooplankton, particularly large calanoid copepods such as Calanus. They currently occur primarily in North Atlantic coastal waters or close to the continental shelf ranging from Nova Scotia, Canada, south to Florida. Critical Habitat for the North Atlantic right whale is present under Warning Area W-161. The North Atlantic right whale could be found calving, migrating, and overwintering in the waters under the offshore Warning Areas year-round.

Sei Whale. The major prey species for the sei whale *(Balaenoptera boreali)* in the North Atlantic are copepods and krill (NMFS, 2019a). Sei whales occur in very low population numbers across the North Atlantic Ocean. They typically occur in deep, oceanic waters of the cool temperate zone and prefer regions of steep bathymetric relief, such as the continental shelf break, canyons, or basins between banks and ledges. The sei whale is migratory and could be found year-round migrating, mating, calving, and foraging in the waters under the Warning Areas.

Sperm Whale. The sperm whale *(Physeter microcephalus)* is the largest of the toothed whales and preys on large, mesopelagic squids and other cephalopods, demersal fish, and benthic invertebrates (NMFS, 2019a). Sperm whales are globally distributed and occur in deep offshore waters including calving, migrating, and foraging in the waters under the offshore Warning Areas year-round.

West Indian Manatee (see description provided above for species potentially occurring in the Gamecock MOA)

C.4.6 References

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APPENDIX D
LIST OF PREPARERS AND CONTRIBUTORS

APPENDIX D – LIST OF PREPARERS AND CONTRIBUTORS

The following individuals assisted in the preparation of this Environmental Assessment:

Dan Becker, GISP
Vernadero Group, Inc.
Information Technology & Services Director
M.A. Geography
B.A. Geography
Years of Experience: 11
Contribution: GIS/Cartography

Jessica Botte
Versar, Inc.
MA.S. Environmental Policy and Management
B.S. Environmental Biology
Years of Experience: 13
Contribution: Technical Editing

Kevin Bradley
KBRWyle
Engineering Manager
B.S. Aerospace Engineering
M.S. Aerospace Engineering
Years of Experience: 23 years
Contribution: Noise, Airspace, and Safety

Mackenzie Caldwell Rohm
Versar, Inc.
M.A. Anthropology/Archaeology
B.A. Anthropology/Archaeology/Sociology
Years of Experience: 22
Contribution: Cultural Resources

Craig Carver
Versar, Inc.
Senior NEPA Specialist
Master of Urban and Regional Planning
B.A. Music
Years of Experience: 13
Contribution: Land Use, Quality Control

Rahul Chettri
Versar, Inc.
Senior Air Quality Engineer
M.S. Environmental Studies
B.S. Economics
Years of Experience: 36
Contribution: Air Quality

Kenneth Erwin
Versar, Inc.
Wildlife Biologist
M.S. Natural Resources
B.S. Wildlife Science
Years of Experience: 10
Contribution: Earth and Water; Quality Control

Maggie Fulton
Vernadero Group, Inc.
Technical Editor
B.A., English
Years of Experience: 32
Contribution: IICEP

Travis Gaussoin
Vernadero Group, Inc.
Information Technology & Services
B.A. Geography
Years of Experience: 7
Contribution: GIS/Cartography

Anička Kratina-Hathaway
Vernadero Group, Inc.
Biologist
M.S. Zoology and Physiology
B.S. Ecology and Organismal Biology
Years of Experience: 15
Contribution: Biological Resources and Hazardous Materials and Wastes

Radhika Narayanan
Versar, Inc.
M.S. Environmental Science
B.S. Chemistry
Years of Experience: 28
Contribution: Air Quality

Angela Northrop
Versar, Inc.
B.S. Marketing
Years of Experience: 25
Contribution: Technical Editing

Christa Stumpf
Versar, Inc.
Program Manager, NEPA Planner
M.S. Forest Resource and Land Use Planning
B.S. Wildland Management
Years of Experience: 28
Contribution: Project Management

Eric Webb
Vernadero Group, Inc.
Vice President and Technical Services Director
Ph.D. Oceanography and Coastal Sciences
M.S. Biology
B.S. Biology
Years of Experience: 27
Contribution: Program Management, Quality Control, Socioeconomics, Environmental Justice

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APPENDIX E
GLOSSARY OF TERMS

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APPENDIX E – GLOSSARY OF TERMS

Above ground level (AGL): Altitude expressed in feet (ft) measured above the surface of the ground. Altitudes are referred to as mean sea level (MSL) when flying above water; while flying over land, both MSL and AGL are used to delineate airspace structure.

Aerospace Ground Equipment (AGE): Support equipment required for aircraft maintenance and sortie generation and is composed of equipment such as generators, air compressors, portable light sources, tow bars, and mobile liquid oxygen and nitrogen sources.

Air Traffic Control Assigned Airspace (ATCAA): Assigned to Air Traffic Control to segregate air traffic between specified activities being conducted within the assigned airspace and other Instrument Flight Rules (IFR) traffic. ATCAA is the equivalent of a Military Operations Area at 18,000 ft MSL and above. This airspace is not depicted on any chart but is often an extension of a Military Operations Area to higher altitudes and usually referred to by the same name. This airspace remains in control of the Federal Aviation Administration when not in use to support general aviation activities.

Class A Airspace: Controlled airspace of defined dimensions within which Air Traffic Control service is provided and all operations must occur under IFR. Class A Airspace is generally from 18,000 ft MSL up to and including 60,000 ft MSL and includes airspace overlying waters within 12 nautical miles of the coast of the 48 contiguous United States and Alaska.

Closed patterns: Consist of two operations, one departure and one arrival (e.g., two closed pattern circuits consist of four total operations).

Countermeasure Chaff: An electronic countermeasure designed to reflect radar waves and obscure aircraft, ships, and other equipment from radar tracking sources. Chaff bundles consist of millions of nonhazardous aluminum-coated glass fibers. When ejected from the aircraft, these fibers disperse widely in the air, forming an electromagnetic screen that temporarily hides the aircraft from radar and forms a radar decoy, allowing the aircraft to defensively maneuver or leave the area.

Countermeasure Flares: Magnesium pellets ejected from military aircraft and provide high-temperature heat sources that act as decoys for heat-seeking weapons targeting the aircraft. These defensive countermeasures are utilized to keep aircraft from being successfully targeted by or escape from weapons such as surface-to-air missiles, air-to-air missiles, anti-aircraft artillery, and other aircraft.

Flight Level (FL): Flight level is vertical altitude expressed in hundreds of feet.

Flight Turn Pattern: An aircraft maneuver designed to allow aircraft to fly, land, complete appropriate post-flight inspections, refuel, and fly again. A turn pattern of 8 x 6 does not require 14 aircraft to execute but rather could be filled with only eight aircraft (notwithstanding impacts of broken aircraft and airspace schedules). The turn pattern and total daily sorties are the same for environmental purposes, because they both indicate the number of takeoffs and landings for any given day. An 8 x 6 represents 14 total sorties for the day even though those sorties may have been flown with only eight total aircraft.

Mean sea level (MSL): Altitude expressed in feet measured above average (mean) sea level. MSL is most commonly used when operating at or below 18,000 ft where clearance from terrain is less a concern for aircraft operation. Altitudes are referred to as MSL when flying above water; while flying over land, both MSL and AGL are used to delineate airspace structure.

Operation: Defined as a single takeoff or landing.

Sortie: A single military aircraft flight from initial takeoff through final landing.

Special use airspace (SUA): Consists of airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of those activities, or both. SUA consist of Military Operations Areas, warning areas, restricted areas, and alert areas. SUA descriptions are contained in FAA Order Joint Order 7400.10E, Special Use Airspace.