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**Environmental Review for
United States Air Force Operational
Capability Enhancement in Australia**

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**Headquarters Pacific Air Forces
Joint Base Pearl Harbor-Hickam, Hawaii**

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15 May 2013

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Cover Sheet
Final Environmental Review
United States Air Force
Operational Capability Enhancement in Australia

Responsible Agencies: Headquarters Pacific Air Forces (HQ PACAF)

Proposed Action: Enhance United States Air Force (USAF) capabilities in the Northern Territory of Australia.

For more information, contact: William H. Bushman, USAF NEPA Center/ PACAF Program Manager, 210-395-8448

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Abstract: HQ PACAF proposes to establish new and increased combined exercises and interoperability at Royal Australian Air Force (RAAF) Bases Darwin and Tindal, located in the Northern Territory of Australia. This ER provides environmental analysis and documentation for these activities outside of the United States. The ER was prepared in accordance with Executive Order 12114, *Environmental Effects Abroad of Major federal Actions*, Department of Defense Directive (DoDD) 6050.7, *Environmental Effects Abroad of Major Department of Defense Actions*, Title 32 of the Code of Federal Regulations (CFR) Parts 187 and 989, and applicable international agreements between the U.S. government and the government of Australia. This ER includes a statement of actions to be taken; identification of the important environmental issues involved; aspects of the actions taken or to be taken by the USAF that minimize the impact on the environment; and actions known to have been taken or planned to be taken by the government of any participating and affected foreign nations that may affect environmental considerations.

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1 **Executive Summary**

2 **Introduction**

3 The United States (U.S.) Pacific Air Forces (PACAF) and the Air Force Civil Engineering
4 Center (AFCEC) prepared this Environmental Review (ER) in accordance with Executive
5 Order (EO) 12114 *Environmental Effects Abroad of Major Federal Actions*, Department of
6 Defense Directive (DoDD) 6050.7 *Environmental Effects Abroad of Major Department of Defense*
7 *Actions*, and applicable international agreements between the U.S. government and
8 government of Australia. The purpose of the ER is to survey the important environmental
9 issues involved with the proposed action and identify necessary impact minimization
10 measures to be taken by the U.S. Air Force (USAF).

11 **Proposed Action**

12 The Proposed Action is to increase USAF use of Royal Australian Air Force (RAAF) Bases
13 Darwin and Tindal for aircraft training, interoperability exercises, and humanitarian
14 missions. RAAF Bases Darwin and Tindal are located in the Northern Territory of Australia.
15 PACAF initially proposes to use existing airfield, refueling, and aerospace ground
16 equipment (AGE) storage at the RAAF bases. The USAF will require access to adequate
17 runways, taxiways, aprons, jet fuel receipt/ delivery/ storage, maintenance warehouses,
18 billeting capacity, and other supporting infrastructure (communications, medical, and
19 security) to support training and interoperability exercises. PACAF also proposes long-term
20 capital improvements at RAAF Bases Darwin and Tindal, contingent upon appropriation
21 and authorization from the U.S. Congress. Such improvements will support periodic
22 training exercises, and a wide spectrum of missions. Approximately 280 U.S. airmen will
23 deploy to RAAF Base Darwin and 340 to RAAF Base Tindal during the training exercises.
24 The aircraft to be used during the training exercises include fighters, bombers, and tankers
25 at both installations. Additionally, unmanned aerial vehicles (UAVs) will be used at RAAF
26 Base Tindal.

27 **RAAF Bases Darwin and Tindal Important Environmental Issues**

28 This ER evaluated the potential environmental effects of the Proposed Action for the
29 following environmental resources: utilities, water quality, hazardous materials and waste,
30 transportation, air quality and greenhouse gases, biological resources, wildfire, heritage,
31 health and safety, and noise. The potential effects to these resources were evaluated relative
32 to the existing environment. For each environmental resource or issue, anticipated direct
33 and indirect effects were assessed, considering both short-term and long-term project
34 effects. Table ES-1 summarizes the potential environmental issues and necessary impact
35 minimization measure for each resource analyzed.

Table ES-1
Impact Minimization Summary Table
PACAF Australia ER

Environmental Issue	Impact Minimization Measure or Best Management Practices (BMPs)
RAAF Base Darwin	
Utilities	
The base is currently operating at the edge of its current electrical capacity.	Backup electrical capacity will be supplied during exercises, if necessary.
Solid waste management and recycling are important issues to the RAAF.	When planning for exercises, USAF personnel will coordinate with the Estate Manager for additional solid waste trucks. Recycling will be a priority.
Water Quality	
Stormwater runoff could impact Rapid Creek.	Stormwater BMPs will be included in the design of any proposed capital improvement facilities.
Fuel spills could enter Rapid Creek.	BMPs will be implemented to prevent spills from entering Rapid Creek and USAF units will implement spill prevention measures.
Hazardous Materials and Hazardous Waste	
Potential discovery of contaminated landfills during construction.	If a landfill is discovered, operations will cease and the RAAF will be contacted immediately and allowed to manage the cleanup.
Use of hazardous materials and waste generation.	All USAF activities will follow established Department of Defense (DoD) guidelines.
The use of hydrazine is a specific concern to the RAAF Defence Support Group (DSG).	Hydrazine will be handled in accordance with established neutralization procedures (Technical Order 1F-16C-2-49GS-00-1).
Transportation	
Increased traffic could negatively affect the installation's transportation infrastructure.	USAF personnel will be transported by bus during the joint training exercises when possible. The use of personal vehicles will be limited.
Air Quality and Greenhouse Gases	
Increased dust emissions during construction activities.	Standard dust control BMPs such as watering bare ground will be implemented during construction.
Biological Resources	
Impacts to protected Australian wildlife.	Airmen and construction contractors will be informed of the protected status of all Australian vertebrates and advised to avoid harm to any animals.
Potential introduction of organisms exotic to Australia.	USAF will conform to the policy and procedures agreed on during the 2013 Talisman Sabre exercises.
Heritage	
Disturbance to a previously unidentified archaeological site.	If artifacts are discovered, operations will cease and RAAF DSG personnel will be contacted.

Table ES-1
Impact Minimization Summary Table
PACAF Australia ER

Environmental Issue	Impact Minimization Measure or Best Management Practices (BMPs)
A negative effect on the historic character of RAAF Base Darwin.	New facilities will follow the RAAF Base Darwin Master Plan (Woods Bagot, 2009).
Health and Safety	
Potential wildlife strikes by aircraft.	Any incidents of wildlife strikes by aircraft will be reported to the RAAF DSG.
Disease-carrying insects may be present during exercises and construction.	Precautions will be taken to avoid being bitten as outlined by the Northern Territory Department of Health.
Inadvertent discovery of unexploded ordnance (UXO) during construction.	Any discovery of UXO will result in ceasing operations and notification of the RAAF DSG.
Noise	
Increased noise to surrounding community.	Aircraft will be operated in compliance with aircraft operating and local noise abatement procedures. Current rules restrict fighters from departing after 10 PM.
RAAF Base Tindal	
Utilities	
The base is currently operating at the edge of its current electrical capacity.	Backup electrical capacity will be supplied during exercises, if necessary.
Solid waste management and recycling are important issues to the RAAF.	When planning for exercises, USAF personnel will coordinate with the Estate Manager for additional solid waste trucks. Recycling will be a priority.
Water Quality	
Stormwater runoff could impact Tindal Creek.	Stormwater BMPs will be included in the design of any capital improvement facilities.
Fuel spills could enter Tindal Creek or groundwater.	BMPs will be implemented to prevent spills from entering Tindal Creek or sinkholes and USAF personnel will implement spill protection measures.
Hazardous Materials and Hazardous Waste	
Potential discovery of contaminated areas during operations.	If a contaminated area is discovered, the RAAF will be contacted immediately and allowed to manage the cleanup.
Use of hazardous materials and waste generation.	All USAF activities will follow established U.S. DoD guidelines.
The use of hydrazine is a specific concern to the RAAF DSG.	Hydrazine will be handled in accordance with established neutralization procedures (Technical Order 1F-16C-2-49GS-00-1).
Transportation	
Increased traffic could negatively affect the installation's transportation infrastructure.	USAF personnel will be transported by bus during the joint training exercises when possible. The use of personal vehicles will be limited.

Table ES-1
Impact Minimization Summary Table
PACAF Australia ER

Environmental Issue	Impact Minimization Measure or Best Management Practices (BMPs)
Air Quality and Greenhouse Gases	
Increased dust emissions during construction activities.	Standard dust control BMPs, such as watering bare ground, will be implemented during construction.
Biological Resources	
Impacts to protected Australian wildlife.	Airmen and construction contractors will be informed of the protected status of all Australian vertebrates and advised to avoid harm to any animals. If a sensitive species is identified by RAAF personnel in the vicinity of the Proposed Action, operations will cease and measures will be taken under the guidance of RAAF DSG personnel to avoid harming the organism.
Potential introduction of organisms exotic to Australia.	USAF will conform to the policy and procedures agreed on during the 2013 Talisman Sabre exercises.
Heritage	
Disturbance to a previously unidentified archaeological site.	If artifacts are discovered, operations will cease and RAAF DSG personnel will be contacted.
Health and Safety	
Potential wildlife strikes by aircraft.	Any incidents of wildlife strikes by aircraft will be reported to the RAAF DSG.
Disease-carrying insects may be present during exercises and construction.	Precautions will be taken to avoid being bitten as outlined by the Northern Territory Department of Health.
Inadvertent discovery of UXO during construction.	Any discovery of UXO will result in ceasing operations and notification of the RAAF DSG.
Noise	
Increased noise to surrounding community.	Aircraft will be operated in compliance with aircraft operating and local noise abatement procedures. Current rules restrict fighters from departing after 10 PM.

1 Conclusion

- 2 In accordance with the DoDD 6050.7 and EO 12114, the findings in this ER verify the
- 3 Proposed Action will have no significant impact on the quality of the natural or physical
- 4 environment at RAAF Bases Darwin or Tindal.

1 SECTION 1.0

2 **Introduction**

3 This section describes the purpose and need for the Proposed Action, summarizes the scope
4 of the Environmental Review (ER), and explains applicable regulatory requirements.

5 This ER has been prepared in accordance with U.S. Air Force (USAF or Air Force)
6 obligations under Executive Order 12114, *Environmental Effects Abroad of Major federal*
7 *Actions*; U.S. Department of Defense Directive (DoDD) 6050.7, *Environmental Effects Abroad of*
8 *Major Department of Defense Actions* (which was formally promulgated and published at 32
9 CFR 187); USAF environmental planning regulations (32 CFR 989); and applicable
10 international agreements between the United States (U.S.) government and the government
11 of Australia.

12 **1.1 Background**

13 The U.S. has been a Pacific power for more than a century and U.S. economic and security
14 interests are inextricably linked to the Asia-Pacific region (Department of Defense [DoD],
15 2010 and 2012). However, due to the vast distances of the Pacific and low density of U.S.
16 basing and infrastructure, there is a premium on forward stationed and deployed U.S.
17 forces. The U.S. DoD seeks to strengthen its Asia-Pacific alliances, augment its forward
18 presence in the region (DoD, 2010), and rebalance toward the Asia-Pacific region (DoD,
19 2012).

20 On 16 November 2011, President Obama of the United States and Australian Prime Minister
21 Gillard announced a plan to expand the U.S. military presence in Australia. During the
22 announcement, Prime Minister Gillard agreed to greater access by U.S. military aircraft to
23 Royal Australian Air Force (RAAF) facilities in Australia's Northern Territory. The purpose
24 of the expanded presence of U.S. forces is to enhance U.S. and Australian interoperability,
25 training, and response to challenges, including humanitarian assistance and disaster relief
26 operations in the Asia-Pacific region (White House, 2011).

27 The U.S. and Australian militaries have trained and exercised together for more than 60
28 years under the Australia-New Zealand-U.S. alliance. The U.S. military and Australian
29 Defence Force (ADF) have conducted major bilateral training exercises for decades, the two
30 largest of which, Exercises Talisman Sabre and Pitch Black, take place in the Northern
31 Territory, among other RAAF locations.

32 **1.2 Purpose and Need for the Proposed Action**

33 The U.S. Pacific Air Forces (PACAF) is planning to increase use of RAAF airfields located in
34 the Northern Territory of Australia. The increased use of these airfields by the USAF will
35 expand current RAAF-USAF interoperability and exercise capabilities, and develop stronger
36 regional military-to-military training relationships. There is also a need for additional
37 airfield capacity and access to training ranges across the U.S. Pacific Command
38 (USPACOM) Area of Responsibility (AOR), including Northern Australia, to better provide

1 humanitarian assistance and disaster relief operations, as well as satisfy other joint and
2 combined operational requirements.

3 **1.3 Objectives of the Proposed Action**

4 The objectives of the Proposed Action are:

- 5 • Increase interoperability between U.S. and Australian forces;
- 6 • Improve training and exercise opportunities between the USAF and RAAF; and
- 7 • Increase airfield capacity in the Northern Territory of Australia to support USAF-RAAF
8 joint efforts.

9 **1.4 Location of the Proposed Action**

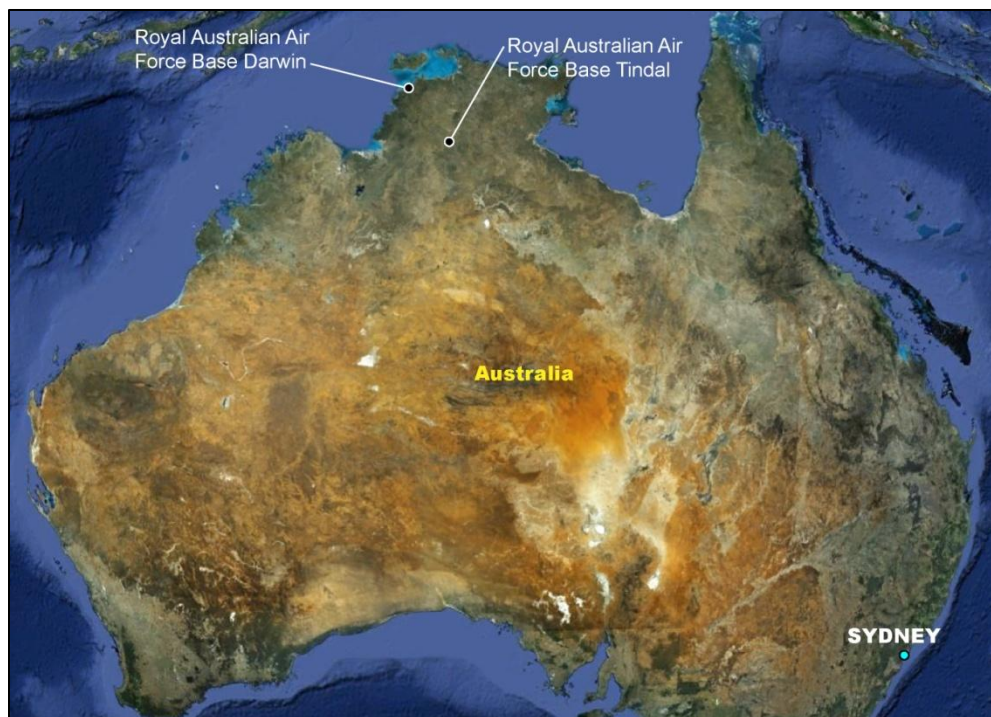
10 Under the Proposed Action, the USAF will increase its use of RAAF Bases Darwin and
11 Tindal, both located in the Northern Territory of Australia.

12 RAAF Base Darwin encompasses approximately 3,212 acres (1,300 hectares) near the city of
13 Darwin on the north-central coast of Australia (see **Figure 1-1**). Darwin International
14 Airport (DIA) is co-located northwest of RAAF Base Darwin, and the combined RAAF
15 Base/ Airport site is identified as a Joint User Airport. Military and civil aircraft operations
16 are coordinated by the Darwin Air Traffic Control tower, and the two entities share
17 management of much of the airfield. RAAF Base Darwin is home to:

- 18 • No. 396 Expeditionary Combat Support Wing;
- 19 • No. 92 Wing Detachment Darwin - surveillance and response;
- 20 • No. 452 Squadron Headquarters;
- 21 • No. 452 Squadron Darwin Flight - air traffic control;
- 22 • No. 13 (City of Darwin) Squadron;
- 23 • No. 1 Airfield Operations Support Squadron Detachment Darwin - air movements;
- 24 • Darwin Area Health Centre; and
- 25 • No. 114 Mobile Control and Reporting Unit - radar operations.

26 RAAF Base Tindal covers approximately 30,146 acres (12,200 hectares) near the town of
27 Katherine, about 198 miles (320 kilometers) south of Darwin (see **Figure 1-1**). RAAF Base
28 Tindal is the primary tactical fighter base in the Northern Territory and hosts both
29 Australian and foreign fighter squadrons for training exercises. The base lies adjacent to
30 Stuart Highway, which provides direct access to both Katherine and Darwin. RAAF Base
31 Tindal is home to:

- 32 • No. 75 Squadron - F/A-18 Hornet;
- 33 • No. 452 SQN Tindal Flight - air traffic control;
- 34 • No. 1 Combat Logistics Squadron;
- 35 • No. 322 Expeditionary Combat Support Squadron;
- 36 • No. 1 Air Terminal Squadron Detachment Tindal;
- 37 • No. 2 Expeditionary Health Squadron Detachment Tindal;
- 38 • No. 3 Control and Reporting Unit Detachment Tindal; and
- 39 • A detachment of the Army's North-West Mobile Force (NORFORCE).



1 **Figure 1-1**
 2 General Map of Proposed Action
 3 PACAF Australia ER

4 **1.5 Organization of the Environmental Review**

5 This ER contains all of the required sections outlined in DoDD 6050.7. The document is
 6 organized into the following sections:

- 7 • **Section 1.0, Introduction**, provides background information about the Proposed Action,
 8 the purpose and need for the Proposed Action, and a brief description of how the
 9 document is organized.
- 10 • **Section 2.0, Description of the Proposed Action**, presents a detailed description of the
 11 Proposed Action.
- 12 • **Section 3.0, RAAF Base Darwin Important Environmental Issues**, provides a description
 13 of the existing conditions of the environmental resources potentially affected, and the
 14 potential impacts to those resources at RAAF Base Darwin. Additionally, actions that
 15 will minimize or ameliorate impacts of the Proposed Action on the environment are
 16 discussed.
- 17 • **Section 4.0, RAAF Base Tindal Important Environmental Issues**, provides a description
 18 of the existing conditions of the environmental resources potentially affected, and the
 19 potential impacts to those resources at RAAF Base Tindal. Additionally, actions that will
 20 minimize or ameliorate impacts of the Proposed Action on the environment are
 21 discussed.
- 22 • **Section 5.0, Summary of Impact Minimization Measures**, provides a summary of the
 23 actions taken by the USAF that ameliorate or minimize the impacts to the environment.

-
- 1 • *Section 6.0, Contributing Actions*, presents a statement of actions of participating and
2 affected foreign governments that may affect environmental considerations.
- 3 • *Section 7.0, Coordination*, provides a list of agencies/individuals contacted for
4 information in the preparation of this document.
- 5 • *Section 8.0, List of Preparers*, lists the names and qualifications of the document
6 preparers.
- 7 • *Section 9.0, Acronyms and Abbreviations*, presents a list of acronyms and abbreviations
8 used in this ER.
- 9 • *Section 10.0, References*, provides a listing of the references used in preparing this ER.
- 10 • *Appendix A, Air Emission Calculations*, provides the calculations used to evaluate
11 aircraft air emissions.
- 12 • *Appendix B, Aircraft Noise Study*, details the modeling performed to calculate the
13 aircraft noise impacts.

1 SECTION 2.0

2 **Description of the Proposed Action**

3 The Proposed Action is to increase USAF use of RAAF Bases Darwin and Tindal for aircraft
4 training, interoperability exercises, and humanitarian missions. PACAF initially proposes to
5 use existing airfield, refueling, and aerospace ground equipment (AGE) storage at the RAAF
6 bases. The USAF will require access to adequate runways, taxiways, aprons, jet fuel receipt/
7 delivery/ storage, maintenance warehouses, billeting capacity, and other supporting
8 infrastructure (communications, medical, and security) to support training and
9 interoperability exercises.

10 PACAF also proposes long-term capital improvements at RAAF Bases Darwin and Tindal,
11 contingent upon appropriation and authorization from the U.S. Congress. Such
12 improvements will support periodic training deployments of a variety of USAF and
13 joint/combined platforms, and a wide spectrum of missions.

14 Aircraft used during the proposed training exercises at RAAF Base Darwin will include a
15 combination of bombers, tankers, and fighters, while at RAAF Base Tindal, the proposed
16 training exercises will involve the use of bombers, tankers, fighters, and unmanned aerial
17 vehicles (UAVs). Most of these aircraft have operated at both bases in the past, with the
18 exception of bombers and UAVs at RAAF Base Tindal.

19 **2.1 Capital Improvements**

20 Airfield resources at RAAF Bases Darwin and Tindal will be upgraded to facilitate use by
21 USAF aircraft. The following is a description of the proposed capital improvement activities
22 at each base.

23 **2.1.1 RAAF Base Darwin**

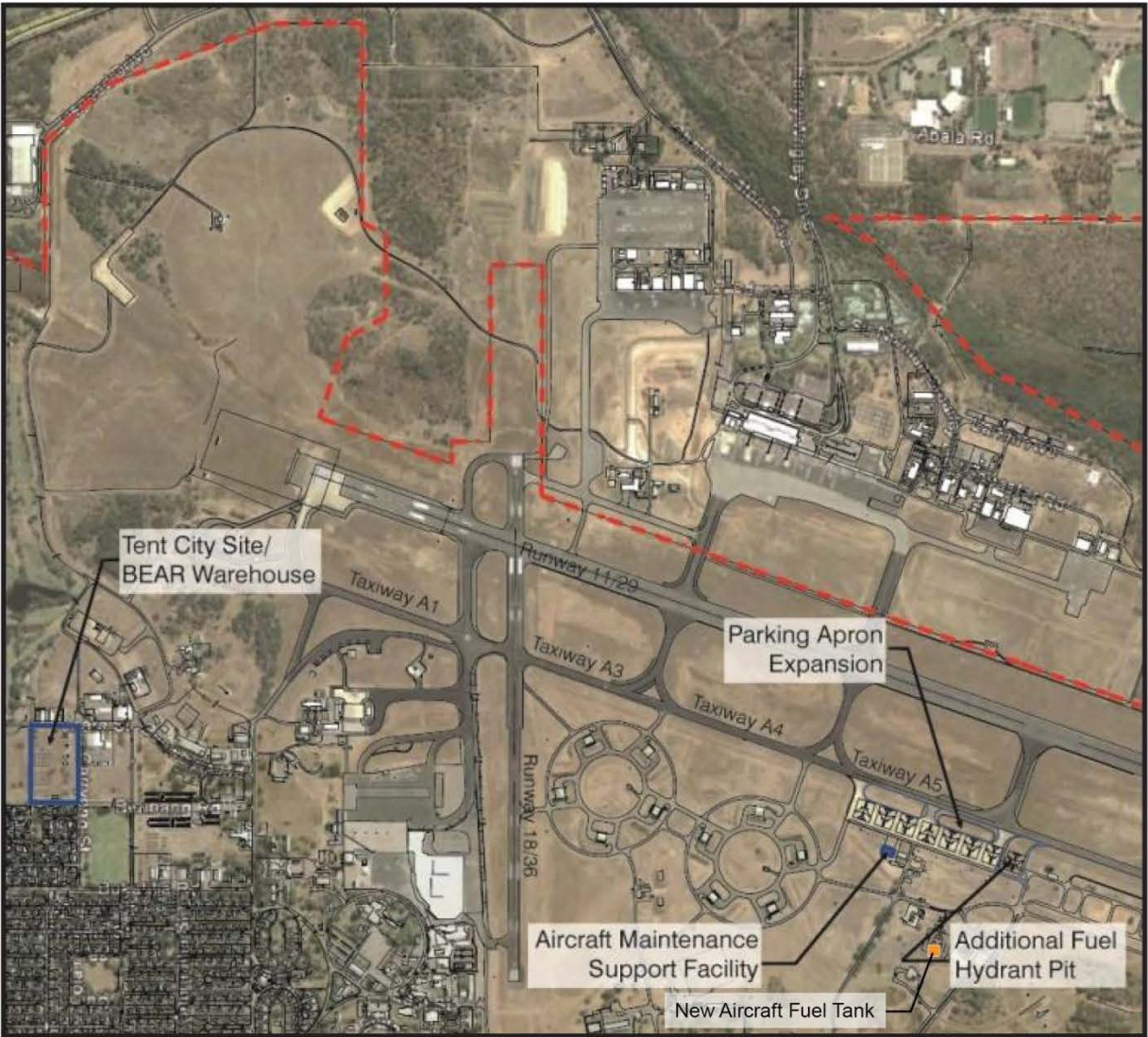
24 In order to accommodate USAF aircraft operations, the following proposed capital
25 improvements may be made at RAAF Base Darwin to enhance current capability. All of
26 proposed capital improvement sites on RAAF Base Darwin are located in the vicinity of the
27 airfield. Please see **Figure 2-1** for location details (PACAF, 2013).

- 28 • Construct an aircraft maintenance support facility (6,700 square feet [ft²], or 622 square
29 meters [m²]);
- 30 • Construct a warehouse to store the Basic Expeditionary Airfield Resource (BEAR) kits
31 (latrines, showers, and billeting shelters) (13,973 ft², or 1,298 m²);
- 32 • Extend the ramp at the bomber replenishment area (BRA);
- 33 • Construct an aboveground fuel storage tank near Tank Farm #7; and
- 34 • Designate a billeting area for approximately 280 airmen; billeting requires access to 8
35 acres (3.2 hectares) of land with proximity to water, power, and sewer.

1 2.1.2 RAAF Base Tindal

2 In order to accommodate USAF aircraft operations, the following proposed capital
3 improvements will need to be made at RAAF Base Tindal. Most of the proposed capital
4 improvement sites are located in the vicinity of the airfield; however, the proposed billeting
5 is located on an unused golf course. Please see **Figure 2-2** for location details (PACAF, 2013).

- 6 • Extend and widen the runway to facilitate bomber aircraft usage;
- 7 • Build two runway ramps for the bombers, one for armed bombers and one for unarmed
8 bombers;
- 9 • Build a fuel storage tank;
- 10 • Construct a hangar (26,715 ft² [2,482 m²]) for the Global Hawk UAVs;
- 11 • Construct a support facility for fuel storage and cooling (900 ft² [84 m²]);
- 12 • Construct two warehouses (6,700 ft² [622 m²] and 13,973 ft² [1,298 m²]);
- 13 • Build an earthen-covered munitions igloo; and
- 14 • Designate a billeting area for approximately 340 airmen; billeting requires access to 8
15 acres (3.2 hectares) of land with proximity to water, power, and sewer.



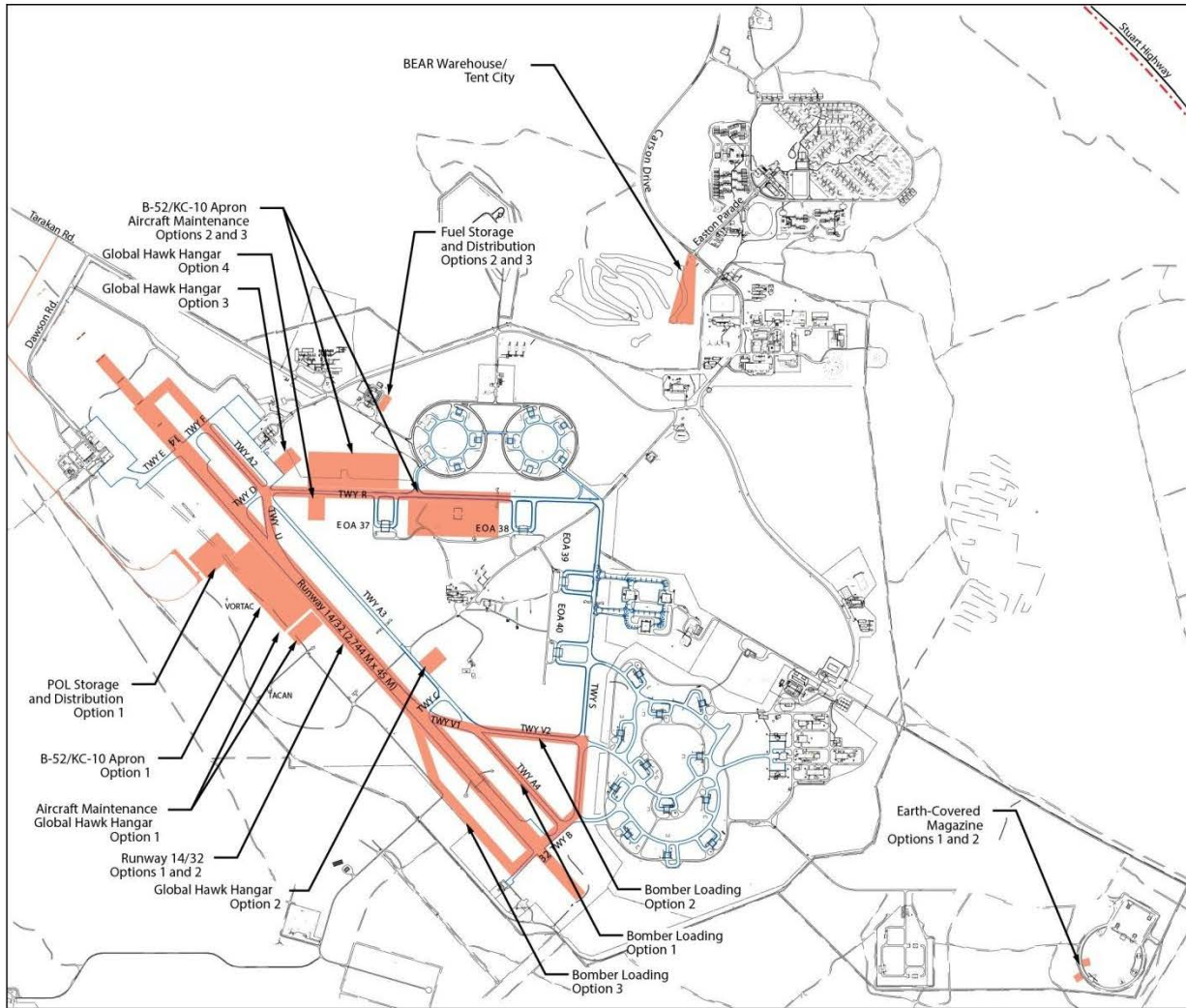
Legend

- RAAF Base Darwin Boundary
- ▭ Project Boundary

Scale: 1:20,000



Figure 2-1
RAAF Base Darwin Capital Improvements
PACAF Australia ER



Legend

- - - RAAF Base Tindal Boundary
- Airfield Pavement
- Project Site Option

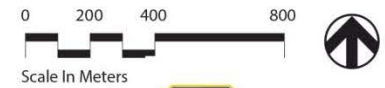


Figure 2-2
RAAF Base Tindal Capital Improvements
PACAF Australia ER

1 2.2 General Operating Plan

2 The USAF is preparing to conduct two 15-day exercises annually in the Northern Territory
3 of Australia. These operations will be performed jointly with the RAAF and other allied
4 nations, and will be in addition to existing annual exercise operations such as Talisman
5 Sabre and Pitch Black. These exercises will not occur concurrently with Talisman Sabre or
6 Pitch Black, but could be conducted as an extension of those maneuvers. The proposed
7 exercises will occur during the regional dry season (March–November).

8 Airmen and aircraft will be stationed at RAAF Bases Darwin and Tindal during the
9 exercises, while training events will occur primarily on Bradshaw Field and Delamere
10 Training Ranges. Roles to be practiced during the training events include:

- 11 • Low-level flying;
- 12 • Air-to-air combat;
- 13 • Air-to-ground attack (bombing, missiles and gunnery);
- 14 • Airborne early warning and control;
- 15 • Air-to-air refueling; and
- 16 • Tactical air transport.

17 The RAAF has employed Bradshaw Field and Delamere Training Ranges for a number of
18 years, and the environmental impacts associated with their use were analyzed in accordance
19 with the *Australian Environment Protection (Impact of Proposals) Act of 1974*. Because the
20 proposed training activities listed above fall within the scope of events analyzed in
21 Australian environmental impact statements (EISs) for these ranges (RAAF, 1997; RAAF,
22 1983), impacts resulting from the use of these training ranges are not considered further in
23 this ER.

24 Below is an explanation of the typical exercise operations to be performed at RAAF Bases
25 Darwin and Tindal.

26 2.2.1 RAAF Base Darwin

27 Approximately 280 U.S. airmen will deploy to RAAF Base Darwin to take part in the
28 proposed exercises. Ideally, these airmen will stay in local hotels; however, if space is not
29 available, a tent city or trailer (dismountable) billeting area will be established. BEAR kits
30 containing the necessary billeting assets will be permanently stored in a warehouse on the
31 installation.

32 The aircraft to be used during the training exercises at RAAF Base Darwin include fighters,
33 bombers, and tankers. Characteristically, F-15, B-1, and KC-10 aircraft will be used, although
34 other aircraft, including F-16s, may participate in the exercises as well. **Table 2-1** below
35 details the notional exercise participation at RAAF Base Darwin.

Table 2-1

Notional Exercise Participation RAAF Base Darwin
PACAF Australia ER

Aircraft Type	Number of Aircraft	Missions per Day	Personnel
Bombers	2	2	75
Tankers	2	2	60
Fighters	24	12	145
TOTAL	28	16	280

1 Operation of these aircraft requires approximately 90,000 gallons (339,000 liters) of fuel per
 2 day. Fuel supply will follow existing RAAF supply chains. USAF aircraft will be maintained
 3 by USAF personnel and will require the use and generation of hazardous materials, such as
 4 lubricants and detergents.

5 **2.2.2 RAAF Base Tindal**

6 Operations during the proposed exercises will be larger at RAAF Base Tindal than at RAAF
 7 Base Darwin. Approximately 350 US airmen will deploy to RAAF Base Tindal to participate
 8 in the proposed exercises. Billeting will be similar to the arrangements at RAAF Base
 9 Darwin. Hotels are preferred but tent cities or trailers will be used if needed. BEAR kits
 10 containing the necessary billeting assets will be permanently stored in a warehouse on the
 11 installation.

12 The aircraft to be used during the training exercises at RAAF Base Tindal include fighters,
 13 bombers, tankers, and UAVs. Typically, F-15, B-52, KC-10, and RQ-4 aircraft will be used,
 14 although other aircraft, including F-16s, may also participate in the exercises. **Table 2-2**
 15 below details the notional exercise participation at RAAF Base Tindal.

Table 2-2

Notional Exercise Participation RAAF Base Tindal
PACAF Australia ER

Aircraft Type	Number of Aircraft	Missions per Day	Personnel
Bombers	2	2	75
Tankers	2	2	60
Fighters	24	12	145
UAVs	3	2	60
TOTAL	31	18	340

16 Operation of these aircraft requires approximately 90,000 gallons (339,000 liters) of fuel per
 17 day. Fuel supply will follow existing RAAF supply chains. USAF aircraft will be maintained
 18 by USAF personnel and will require the use and generation of hazardous materials, such as
 19 lubricants and detergents.

1 SECTION 3.0

2 **RAAF Base Darwin Important Environmental**
3 **Issues**

4 This section presents information on the potential environmental issues that may result
5 from USAF operations at RAAF Base Darwin. These issues were identified during a site visit
6 to the installation by PACAF engineers, Air Force Civil Engineer Center (AFCEC) National
7 Environmental Policy Act (NEPA) managers, and USAF environmental contractors on 6-9
8 November 2012. The information provided below is based on personal conversations with
9 RAAF Defence Support Group (DSG) environmental and estate managers, as well as
10 documents provided during the meetings.

11 **3.1 Utilities**

12 **3.1.1 Energy**

13 Energy on RAAF Base Darwin is purchased from the local electric company, and the USAF
14 will have no responsibility in managing this contract. According to Gary Want, Estate
15 Manager, RAAF Base Darwin, the base is operating on the edge of its available electrical
16 capacity. USAF planners should plan on providing backup power for essential operations.
17 The base has natural gas onsite that could be used for electricity generation, or diesel/JP8
18 fuel.

19 **Impact Minimization:** USAF planners will consider backup electrical generation during
20 training exercises to reduce impacts to the current system.

21 Electricity availability is not expected to be a major obstacle during construction or during
22 conduct of the joint training exercises.

23 **3.1.2 Drinking Water**

24 Drinking water on RAAF Base Darwin is provided by the City of Darwin. Water
25 interruptions are rare and should not be a problem. The drinking water systems on base are
26 operated by the installation's base engineering operations contractor. The USAF will have
27 no responsibility in operating this drinking water system.

28 According to Robyn Maurer, Senior Environment Manager, RAAF DSG, this drinking water
29 system has supported exercises totaling more than 2,000 temporary personnel. Therefore,
30 with the PACAF planning factor of 280 USAF personnel for two 15-day joint training
31 exercises, drinking water should not be an issue.

32 **Impact Minimization:** Not applicable.

33 Drinking water is not expected to be a problem for the joint training exercises.

1 3.1.3 Wastewater

2 Wastewater on RAAF Base Darwin is treated at the City of Darwin wastewater treatment
3 plant (WWTP). The USAF will have no involvement or responsibility in operating that
4 facility.

5 The City of Darwin has a population in excess of 200,000, making it the largest and most
6 populated city in the Northern Territory. USAF personnel may be housed in base lodging, a
7 tent city, or in hotels in the City of Darwin. If the tent city plan is implemented, PACAF will
8 attempt to connect the latrine and shower facilities to the installation's wastewater collection
9 system. According to Robyn Maurer, RAAF DSG, the 280 USAF personnel projected for the
10 two 15-day joint training exercises will have a minimal effect on the City of Darwin's
11 WWTP.

12 **Impact Minimization:** Not applicable.

13 Wastewater treatment is not expected to be a problem during construction or during the
14 joint training exercises.

15 3.1.4 Solid Waste

16 Solid waste on RAAF Base Darwin is collected by an off-base contractor and transported to
17 a solid waste disposal facility in the City of Darwin. The solid waste disposal contract is
18 managed by the installation's base engineering operations contractor, and the USAF will
19 have no responsibility in managing this contract.

20 According to Robyn Maurer, RAAF DSG, the disposal of additional solid waste from
21 previous training exercises has not been a problem. Recycling is important to RAAF Base
22 Darwin and the local community, and will be emphasized to units participating in these
23 joint training exercises. Types of source separation (such as food/wet waste, plastic, metal,
24 and paper) will be discussed as part of exercise planning because recycling rules may
25 change over time. Sufficient containers for the waste separation will be addressed as part of
26 the exercise planning. Hazardous waste disposal is discussed in Section 3.3, *Hazardous*
27 *Material and Hazardous Waste*, of this document.

28 **Impact Minimization:** When planning for exercises, coordination with the Estate Manager
29 for additional trucks or frequency of solid waste removal may be necessary. Recycling solid
30 waste will be a priority.

31 Solid waste disposal is not expected to be a problem during construction or during conduct
32 of the joint training exercises.

33 3.2 Water Quality

34 There is a surface water monitoring program at RAAF Base Darwin and RAAF DSG
35 personnel stated there were no current surface water quality concerns. The only water
36 quality report received during the sites visits was written in 2002. The report indicated there
37 were no significant surface water concerns and conditions meet the *Australian Water Quality*
38 *Guidelines for Fresh and Marine Waters*, developed by the Australian and New Zealand
39 Environmental and Conservation Council in 2000 (URS, 2002).

1 The main surface water drainage system on RAAF Base Darwin is Rapid Creek, which
2 drains to the north (**Figure 3-1**). Rapid Creek is the most important catchment on RAAF
3 Base Darwin because it is the facility's only freshwater creek system and accounts for more
4 than half of the total area of the installation. There is also a 37-acre (15-hectare) wetland,
5 Marrara Swamp, which is located at the head of Rapid Creek (RAAF, 2000).

6 Rapid Creek is a major concern for the local and Aboriginal communities, and a number of
7 advisory committees actively monitor the catchment. Stormwater from the airfield drains
8 toward Rapid Creek and its associated wetland. The proposed USAF activities could impact
9 the water quality of Rapid Creek by increasing the risk of fuel spills, the addition of
10 impervious area, and runoff from construction.

11 **Impact Minimization:** Stormwater runoff from construction activities and the increased
12 impervious area will be addressed in the design of all capital improvement projects. Best
13 management practices (BMPs), such as the installation of oil/water separators near
14 refueling areas, will be implemented to prevent fuel spills from reaching Rapid Creek.
15 USAF units will be directed to carefully implement spill prevention practices in handling
16 and/or storing fuel.

17 Impacts to Rapid Creek will likely be an issue during the RAAF Siting Board, and it is
18 important that BMPs are included in facility designs. Potential BMPs include oil/water
19 separators and a dyke network of containment systems.

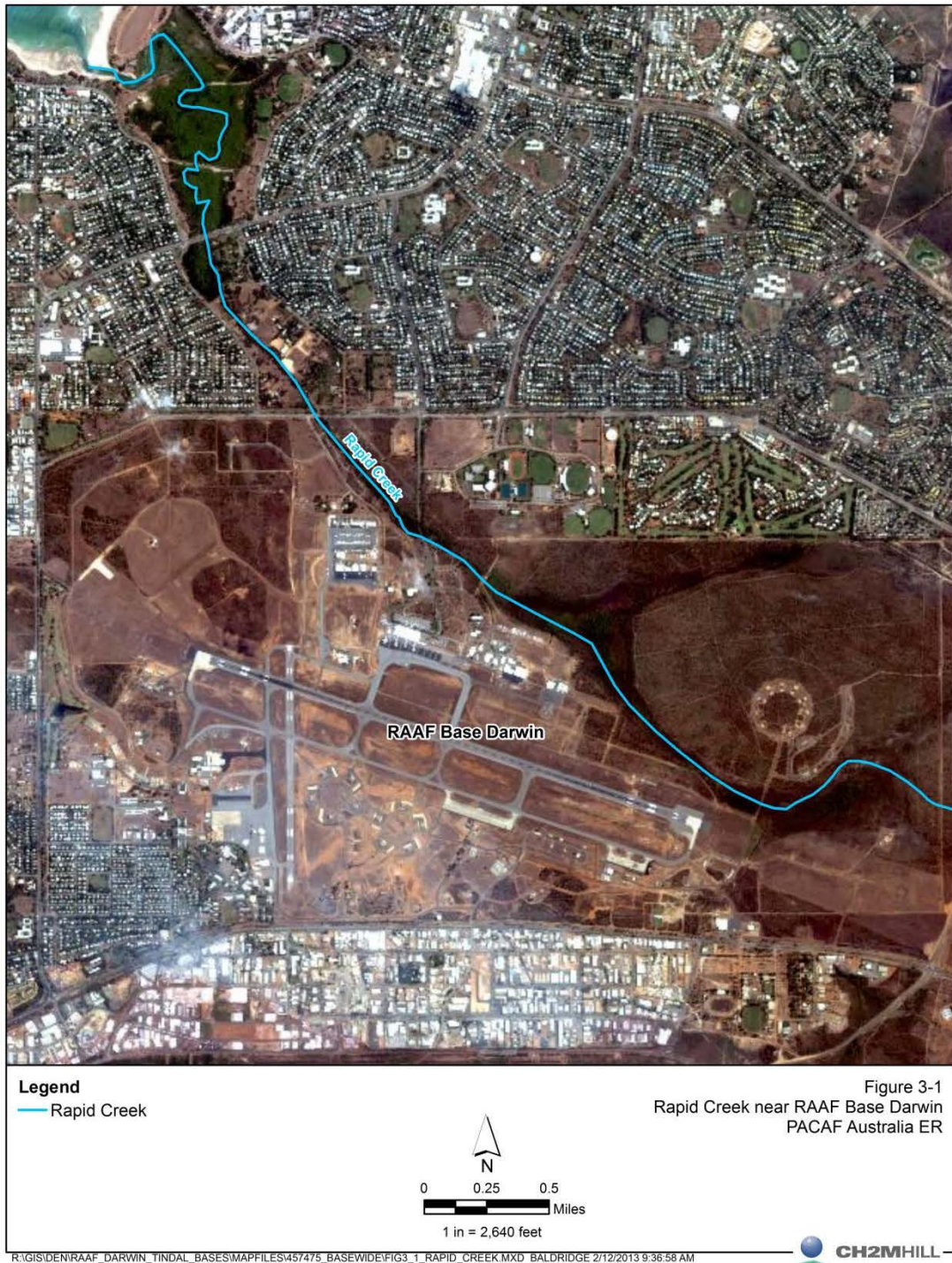
20 **3.3 Hazardous Material and Hazardous Waste**

21 **3.3.1 Existing Contamination**

22 Numerous landfill sites are located on RAAF Base Darwin. These landfills contain debris
23 from the Japanese bombing of Darwin during World War II (WWII) (including aircraft
24 wreckage, demolition material, and damaged stocks) as well as demolition debris from
25 damaged buildings and other facilities caused by Cyclone Tracey in 1972. The exact location
26 of the landfills sites cannot be easily determined by visible surface markings and survey
27 drawings. Attempts have been made to locate the landfills (**Figure 3-2**), although new sites
28 are continually identified. Material buried at these sites includes asbestos, metals (including
29 lead), ammunition, and unexploded ordnance (UXO) (RAAF, 2000).

30 **Impact Minimization:** Should suspected contaminated material be discovered during
31 construction, activities would cease and a RAAF DSG officer will be contacted immediately.
32 The RAAF DSG officer will assess the material and, if necessary, arrange for a properly
33 trained and licensed contractor to clean up the contaminated material (Gilligan, 2012).

34 Impacts from existing contamination are not expected to be a problem during construction
35 or during conduct of the joint training exercises.





1 3.3.2 Hazardous Materials and Waste

2 The most significant environmental issue on RAAF Base Darwin is the storage and handling
3 of hazardous materials, particularly fuels (RAAF, 2000). Apart from catastrophic events,
4 such as aircraft accidents, the primary potential for soil, surface water, and groundwater
5 contamination during normal base operations results from the storage and handling of
6 aviation fuel.

7 Hazardous substances stored at RAAF Base Darwin include bulk liquid oxygen, bulk liquid
8 nitrogen, liquid petroleum gas in tanks and cylinders, oxygen, acetylene, compressed air,
9 argon, solvents, paints, sodium hypochlorite, and chemical maintenance substances (RAAF,
10 2000). Generally, hazardous waste is containerized and transported by contractors to
11 Adelaide, located on the south-central coast of Australia.

12 The only unique hazardous materials the USAF will transport when deploying to Australia
13 is hydrazine. Otherwise, the hazardous materials utilized will be standard petroleum, oils,
14 and lubricants currently used on Australian aircraft. Hydrazine was of specific concern to
15 the RAAF DSG. Hydrazine is a highly toxic and flammable propellant used in F-16 aircraft.
16 Hydrazine is not currently used by the RAAF, although it has been used by other nations
17 operating on RAAF Base Darwin that fly F-16 aircraft.

18 **Impact Minimization:** Hazardous material and hazardous waste management plans will be
19 developed specific to USAF operations at RAAF Base Darwin. All hazardous material used
20 by the USAF will be handled in accordance with U.S. Department of Defense (DoD)
21 operating procedures and regulations, including Air Force Joint Manual (AFJMAN) 23-209,
22 *Storage and Handling of Hazardous Materials*. Specifically, all hazardous material dispensing
23 areas will be properly maintained, drums/containers must not be leaking, drip
24 pans/absorbent materials will be placed under containers as necessary to collect drips or
25 spills, container contents will be clearly marked, and all personnel handling the hazardous
26 material will be properly trained. Additionally, a hazardous waste accumulation point will
27 be operated to provide appropriate segregation for different waste streams. When available,
28 USAF will use established RAAF hazardous waste accumulation points. Hydrazine will be
29 handled in accordance with established neutralization procedures (Technical Order 1F-16C-
30 2-49GS-00-1).

31 The use and management of hazardous materials were the most significant environmental
32 issues raised by RAAF environmental personnel during the site visit. The largest concern
33 was the potential for fuel spills to impact Rapid Creek. It is important that the USAF adhere
34 to its established protocols, and BMPs, such as oil/water separators, are put in place to
35 reduce the likelihood of spills reaching Rapid Creek.

36 3.4 Transportation

37 Ground transportation to RAAF Base Darwin is by way of Stuart Highway, which passes
38 outside the facility's Main Gate. Most material is shipped into the Port of Darwin and
39 trucked by road train to the installation.

40 According to Robyn Maurer, RAAF DSG, the anticipated additional bus and truck traffic
41 needed to support joint exercises will have minimal impact on traffic along Stuart Highway.
42 Large training exercises conducted in the past have caused major impacts to base traffic and

1 parking, but have not adversely impacted traffic on the highway. Similarly, previous
2 construction projects on RAAF Base Darwin have not caused apparent impacts to Stuart
3 Highway traffic.

4 **Impact Minimization:** USAF personnel will have limited access personal vehicles while
5 onsite and will rely on RAAF-provided buses or rental buses/trucks when possible, thereby
6 reducing the traffic footprint during the proposed exercises.

7 Traffic is not expected to be a problem during construction or during conduct of the joint
8 training exercises.

9 **3.5 Air Quality and Greenhouse Gases**

10 Air quality in Australia is regulated by the Ambient Air Quality -- National Environment
11 Protection Measure (AAQ NEPM). This measure requires each jurisdiction to submit an
12 annual air monitoring compliance report. A screening analysis is performed to determine
13 which pollutants should be monitored based on the level of concern for an impact. Based on
14 the most recent screening analysis, completed in 2001, the primary pollutants of concern in
15 the Darwin area are from particulates (particulate matter less than 10 micrometers [PM₁₀]
16 and 2.5 micrometers [PM_{2.5}] in aerodynamic diameter). The screening analysis indicated that
17 nitrogen oxides (NO_x), sulfur dioxide (SO₂), carbon monoxide (CO), ozone (O₃), and lead
18 aerosols were not a cause for concern relative to the AAQ NEPM standards (Northern
19 Territory, 2010).

20 In the United States, air quality is regulated at the federal level by the *Clean Air Act* (CAA).
21 One component of the CAA is that areas are classified either as attainment if the measured
22 ambient concentrations of pollutants are below federal standards, non-attainment if
23 measured concentrations exceed the standards, or unclassified if not enough monitored data
24 exist for that area. In the United States, fewer controls or emission limitations are placed on
25 projects located in an attainment or unclassified area. Additionally, significance thresholds,
26 the quantitative amount of emissions a project can emit before causing a significant impact
27 to air quality, are also defined based on a project's area classification. In the United States, if
28 a project is below the threshold of significance, then it is not expected to cause an impact to
29 air quality.

30 Australia does not have quantifiable significance thresholds for projects to determine the
31 potential impact to air quality. Therefore, for the purposes of this evaluation, the U.S.
32 standards are used as a quantitative threshold based on the Australian ambient air
33 conditions. For example, based on the 2010 ambient air monitoring report, the Darwin area
34 met the AAQ NEPM standards. Therefore, the existing conditions of the ambient air in the
35 Northern Territory would be considered in attainment or unclassified by U.S. standards,
36 and the corresponding U.S. quantitative threshold of significance will be used to determine
37 the potential impact to air quality for the project.

38 Air quality was not a resource of concern for RAAF Base Darwin DSG personnel. The RAAF
39 is not considered a large emitter of pollutants under the *Waste Management and Pollution
40 Control Act* (Department of Natural Resources, Environment, the Arts and Sport, 2011), and
41 is not required to obtain an environmental license under this act. This further indicates that
42 air quality is not an issue for concern.

1 Greenhouse gases (GHGs) are regulated at the national level by the National Greenhouse
 2 and Energy Reporting (NGER). Currently, the RAAF is not a part of the NGER reporting
 3 program so it is unlikely that the project will cause a significant GHG impact.

4 **Sources and Thresholds**

5 The construction of the capital improvements and the joint exercises will generate air
 6 emissions. Construction sources will include earth moving equipment, building equipment,
 7 delivery trucks, and personnel transport. These sources will generate U.S.-recognized
 8 criteria pollutants (particulates PM₁₀ and PM_{2.5}, CO, NO_x, SO₂, and GHG pollutants (carbon
 9 dioxide [CO₂]). The scale and duration of construction will be a source of short-term,
 10 temporary emissions. Construction emissions will also result in far fewer emissions than
 11 operation of the training activities, which are quantified below. Therefore, only the
 12 emissions associated with the training operations were quantified to determine the relative
 13 impact to air quality in the region.

14 Joint exercise emission sources will include aircraft, fueling/ground equipment, commercial
 15 buses (personnel transportation), fuel transfer operations, on-the-ground stationary
 16 combustion equipment, and fuel storage tanks. It is assumed that the primary source of
 17 emissions will be from the combustion of fuel in aircraft, and that the other sources will be
 18 relatively minor by comparison. The total fuel combusted per aircraft engine was used in
 19 conjunction with the Air Force Center for Engineering and the Environment (AFCEE) *Air*
 20 *Emissions Factor Guide to Air Force Mobile Sources* (AFCEE Mobile Guide) to estimate the
 21 operational emissions (AFCEE, 2009). Aircraft emissions will include the following
 22 components: approach, takeoff, and climb out (idle time was not included in accordance
 23 with the AFCEE Mobile Guide because it is not a part of standard training activities). These
 24 estimated emissions were compared to the relative thresholds identified below to determine
 25 if air quality in the region would be impacted.

26 Because the Northern Territory is the equivalent of a U.S. attainment area, the proposed
 27 thresholds of significance for criteria pollutants would be the General Conformity
 28 thresholds for an attainment or unclassified area, which is 100 tons per year. In Australia,
 29 the national reporting framework for GHGs is the *National Greenhouse and Energy Reporting*
 30 *(NGER) Act*. The facility-level reporting in Australia is 25,000 metric tons (MT) per year,
 31 which is similar to the U.S. Council on Environmental Quality (CEQ) guidance; however,
 32 this is simply a reporting threshold and does not necessarily indicate a significant impact. If
 33 the GHG emissions are likely to be greater than 25,000 MT of CO₂ equivalents (CO₂e), then
 34 the emissions were quantified. The environmental issues associated with ambient air quality
 35 and GHG emissions are discussed in the following sections.

36 **3.5.1 Ambient Air Quality**

37 The Darwin/Palmerston region (population of 124,760) and Alice Springs (27,895 residents)
 38 area are the only areas in the Northern Territory that exceed the population threshold for
 39 ambient air quality monitoring (Northern Territory, 2010).

40 The primary air pollutant of concern in the Northern Territory was particulates from
 41 landscape fires in the Darwin region (Northern Territory, 2011). NO_x, SO₂, CO, O₃, and lead
 42 aerosols were not a cause for concern in the Darwin/Palmerston region relative to the

1 Ambient Air Quality National Environment Protection Measure (NEPM) standards
2 (Northern Territory, 2010).

3 Based on the 2010 ambient air monitoring report, the Darwin area met the AAQ NEPM
4 standards. Therefore, the existing conditions of the ambient air in the Darwin area would be
5 classified as the equivalent of attainment in the United States.

6 Based on 2010 – 2011 inventory data, the RAAF is not currently required to obtain air
7 permits or register as a part of the National Pollution Inventory (NPI) (NPI, 2012b). This is
8 consistent with requirements in the United States, where military aircraft engines are
9 exempt from the federal aircraft engine NO_x emissions standards in 40 CFR 87 and are not
10 subject to permitting requirements or other federal stationary or mobile source emissions
11 standards or regulations.

12 As shown in **Table 3-1**, the estimated emissions for the aircraft training operations at RAAF
13 Base Darwin are all less than 100 tons per year for U.S. criteria pollutants. Details of the air
14 emission calculations are included in **Appendix A**.

Table 3-1

Estimated Emissions for Aircraft Training Operations, RAAF Base Darwin
PACAF Australia ER

Aircraft Type	Emissions (ton/year)				
	NO _x	CO	VOC	PM ₁₀	PM _{2.5}
Bomber (B-52)	23	13	4	1	1
Tanker (KC-135)	29	13	0.1	0.4	0.3
Fighter (F-22)	25	16	1	5	4
Darwin Aircraft Total Annual Criteria Emissions:	77	42	5	7	6

Notes: Numbers in columns may not add up exactly due to rounding.

VOC = volatile organic compound

15 Because the primary air quality issue in the Darwin area is from dust, and the particulate
16 emissions associated with the training activities are much lower than 100 tons per year, it is
17 unlikely the additional training will create an environmental impact to air quality in the
18 region. However, prevention of dust emissions during construction is advised.

19 **Impact Minimization:** The use of standard BMPs, such as watering bare areas, to control
20 dust emissions will be implemented during construction.

21 Ambient air quality should not be an issue during construction or during conduct of the
22 joint training exercises.

1 3.5.2 Greenhouse Gas

2 The Australian NGER Scheme was introduced in 2007 to provide data and accounting in
 3 relation to GHG emissions and energy consumption and production. The two components
 4 of the NGER Scheme directly relative to the RAAF are the carbon pricing mechanism and
 5 the GHG reporting thresholds (NGER, 2012a). Because the RAAF is not a registered GHG
 6 reporter, it is not considered one of “Australia’s biggest polluters” of GHGs and, therefore,
 7 will not have to pay a price for its carbon emissions (NGER, 2012c). However, it is likely that
 8 the RAAF will still be affected by the NGER Scheme because it is expected that costs for
 9 petroleum products will increase to offset the costs the suppliers are required to pay for
 10 “their carbon pollution.”

11 To provide an estimate of the impact of GHG emissions during USAF operations, the GHG
 12 emissions associated with the combustion of fuel from aircraft during training exercises
 13 were quantified. These emissions at RAAF Base Darwin were approximately 25,300 MT
 14 CO₂e. Although these emissions are just slightly above the quantification threshold of 25,000
 15 MT CO₂e, they are much lower than permit thresholds for stationary sources in the United
 16 States. Furthermore, because these sources are not stationary sources, they would likely still
 17 not be considered a major source of GHG pollutants because most of the regulations are
 18 aimed at reducing stationary source emissions. In addition, the installation is taking steps to
 19 decrease its carbon footprint at RAAF Base Darwin, which will reduce the facility’s impact
 20 to climate change through the generation of fewer GHG emissions.

21 **Impact Minimization:** Not applicable.

22 GHG emissions should not be an issue during construction or during conduct of the joint
 23 training exercises.

24 3.6 Biological Resources

25 3.6.1 Sensitive Species

26 USAF operations will take reasonable steps to protect known U.S. endangered or threatened
 27 species and Australian protected species and their habitats. The following discussion covers
 28 both U.S. and Australian sensitive species.

29 Twenty-one Australian animal species are listed as threatened or endangered under the U.S.
 30 *Endangered Species Act* (ESA). Of the 21 Australian species, two occur within the vicinity of
 31 RAAF Base Darwin: the saltwater crocodile (*Crocodylus porosus*), which is listed as
 32 threatened, and the false water mouse (*Xeromys myoides*), which is listed as endangered.

33 The saltwater crocodile is found in Australian coastal waters, estuaries, freshwater lakes,
 34 inland swamps, and marshes. While the saltwater crocodile is listed on the ESA, it is listed
 35 as a species of least concern in the Northern Territory under the Australian EPBC and the
 36 *Territory Parks and Wildlife Conservation Act of 2009* (Australia, 2013). The U.S. ESA
 37 designation was in response to over-exploitation for the skin trade, and makes it illegal to
 38 trade non-captive-bred specimens in the United States (*Federal Register*, 1996). While
 39 saltwater crocodiles may occur on RAAF Base Darwin, they prefer marine environments
 40 and are unlikely to be found in the vicinity of the Proposed Action. Furthermore, saltwater
 41 crocodiles are a very large (up to 5 meters [15 feet] in length) and aggressive species.

1 Airmen and contractors will be made aware of the protected status of the species in the
2 United States and warned, for their own protection, to avoid the species and its habitat.

3 Forty-eight species in the vicinity of RAAF Base Darwin are listed as threatened or
4 vulnerable under the Australian *Environment Protection and Biodiversity Conservation Act*
5 (*EPBC*) of 1999. This list includes the U.S. ESA-listed false water rat, which is EPBC-listed as
6 vulnerable. Extensive threatened species surveys were conducted on RAAF Base Darwin in
7 2012. The survey focused on EPBC-listed species, including the false water rat. No listed
8 species were identified during the survey; however, suitable habitat for the false water rat
9 was present in the Marrara Swamp area (EcoLogical, 2012). Because the proposed capital
10 improvement sites and exercise operations areas are all located in highly disturbed and
11 developed areas and away from the Marrara Swamp, the likelihood of USAF actions at
12 RAAF Base Darwin impacting a listed species is remote.

13 Despite the lack of EPBC-listed species found on the installation, all Australian native
14 vertebrate animals living in the Northern Territory are protected under the *Northern*
15 *Territory of Australia Territory Parks and Wildlife Conservation Act of 2011*. Therefore, it is
16 important that USAF operations do not harm native Australian vertebrates.

17 **Impact Minimization:** Airmen and construction contractors will be informed of the
18 protected status of all Australian vertebrates and advised to avoid harming any animals.

19 Construction and operation activities are not expected to impact sensitive species.

20 **3.6.2 Biosecurity**

21 The natural landscapes of the Northern Territory are largely still intact, due to the relative
22 isolation and remoteness (Northern Territory, 2011). Consequently, exotic weeds, pests, and
23 diseases can have devastating effects on soil, native vegetation, wildlife, crops, and
24 livestock. Insects are the pest that poses the greatest potential risk to the Northern Territory.

25 The Australian Government Department of Agriculture, Fisheries, and Forestry (DAFF)
26 manages quarantine controls to minimize the risk of exotic pests and diseases entering the
27 country. DAFF (formerly the Australian Quarantine and Inspection Service [AQIS])
28 develops procedures and provides services to ensure adequate quarantine and inspection
29 occurs for all vessels, aircraft, vehicles, machinery, goods, cargo, and personal effects
30 entering Australia from foreign nations. The RAAF, along with a number of other regional
31 organizations, has developed plans to control the spread of exotic species (RAAF, 1999;
32 Northern Territory, 2011). RAAF Base Darwin has approved quarantine wash facilities for
33 cleaning vehicles and equipment returning from overseas, with captured solids regarded as
34 quarantine waste (RAAF, 2001).

35 The United States normally asserts the privilege of sovereign immunity for all U.S. State
36 aircraft vessels, and thus does not consent to the boarding and inspection of such aircraft
37 and vessels by foreign government authorities. However, satisfaction of Australia's
38 biosecurity requirements is essential to control the risks posed by weeds, pests, and
39 diseases. Further, Article 13 of the 1963 Agreement between the Government of the
40 Commonwealth of Australia and the Government of the United States of America
41 concerning the Status of United States Forces in Australia states that the U.S. Government
42 shall conform to Australian laws and regulations, including quarantine laws. Consequently,

1 all USAF aircraft, equipment, and food supplies (including meals ready to eat [MREs]) will
2 need to undergo a quarantine process prior to operations in Australia.

3 **Impact Minimization:** The USAF will conform to the policy and procedures agreed to by
4 DAFF, U.S. DoD, and the U.S. Department of Agriculture (USDA) for the Talisman Sabre
5 exercise in 2013. This policy regarding biosecurity was developed by the U.S. Embassy in
6 Australia and USPACOM for sovereign immune assets (U.S. vessels and aircraft) entering
7 Australia for the Talisman Sabre combined military exercises on mainland Australia. The
8 U.S. does not normally assert sovereign immunity for U.S. machinery, vehicles, goods,
9 cargo, or personal effects that are off-loaded from a U.S. aircraft. Unless sovereign immunity
10 is specifically asserted, such items will undergo normal DAFF-approved biosecurity
11 inspections upon arrival into Australia or by special arrangement prior to departure for
12 Australia.

13 Biosecurity is a very important issue in Australia because the country is relatively free of
14 many of the animal and plant diseases affecting other nations. If the USAF conforms to the
15 2013 Talisman Sabre quarantine agreements, biosecurity should not be a problem during
16 construction or during conduct of the joint training exercises.

17 **3.7 Wildfire**

18 Wildfires generally occur at RAAF Base Darwin every dry season. The most susceptible area
19 is Marrara Swamp, although isolated pockets and boundaries may also be burned out.
20 Lightning strikes or arson by local children are generally thought to be the main cause of the
21 wildfires. A network of firebreaks exists on RAAF Base Darwin, particularly in the explosive
22 ordnance storage area and around the boundary fence line (RAAF, 2000). The RAAF Base
23 Darwin DSG has an active fire management program, which includes prescribed burning
24 during the wet season (Wildman Land Management, 2005) and the DIA manages the fire
25 response for the RAAF Base Darwin airfield.

26 **Impact Minimization:** Not Applicable.

27 Wildfires are not expected to be a problem during construction or during conduct of the
28 joint training exercises.

29 **3.8 Heritage**

30 **3.8.1 Aboriginal Heritage**

31 The northern portion of RAAF Base Darwin is located on the Rapid Creek catchment, which
32 incorporates part of the traditional land of the Larrakia peoples. Their association with the
33 area continues today. Nonetheless, the Northern Territory Aboriginal Areas Protection
34 Authority has no registrations of sacred or significant sites located on RAAF Base Darwin,
35 although a few potential sites have been identified in the Marrara Swamp area (RAAF,
36 2001). These sites are located away from any proposed USAF-sponsored capital
37 improvements sites and expected USAF activity areas.

38 **Impact Minimization:** Given the extent of clearing and ground disturbance in the airfield
39 area, it is unlikely that new Aboriginal heritage sites would be found during construction or
40 the exercise operations. However, if any artifacts are discovered during construction or

1 exercises, all activities at the site will cease and RAAF DSG contacted. The RAAF DSG will
2 manage the site in accordance with Australian regulatory requirements.

3 Impacts to Aboriginal heritage sites are not expected to be a problem during construction or
4 during conduct of the joint training exercises.

5 **3.8.2 European Heritage**

6 RAAF Base Darwin contains a largely intact set of buildings illustrating the form and layout
7 of an Australian Air Force Base built in the lead-up to WWII. The southwest corner of RAAF
8 Base Darwin has been identified as a heritage precinct due to the presence of buildings
9 dating from the original development of the base. Remnants of structures such as defensive
10 positions and the railway used to service the base in WWII remain scattered throughout the
11 installation. While these structures are not listed with the current Heritage Precinct area on
12 the Commonwealth Heritage List, they add heritage value to the facility. The heritage
13 district and individual historic features are located away from the airfield and proposed
14 USAF capital improvement sites (Environmental Resource Management, 2005).

15 **Impact Minimization:** New structures will be designed in accordance with the standards
16 detailed in the RAAF Base Darwin Master Plan Report (Woods Bagot, 2009), thereby
17 ensuring that any new facilities integrate with the historic character of the installation.

18 Impacts to European heritage sites are not expected to be an issue during construction or
19 during conduct of the joint training exercises.

20 **3.9 Health and Safety**

21 **3.9.1 Wildlife Strikes**

22 Wildlife can pose a significant hazard to the safe conduct of aircraft operations. The vast
23 majority of bird or wildlife strikes occur either on or within the immediate proximity of a
24 runway, and in many strike events, damage is sustained to the aircraft. In serious incidents,
25 damage from a strike could result in the aircraft being unable to maintain safe operations.
26 The airfield at RAAF Base Darwin is a particular challenge due to the tropical environment
27 supporting numerous bird and animal species, including bats and migratory birds (DIA,
28 2011).

29 DIA is responsible for implementing the bird and animal hazard management system for
30 the runways it shares with RAAF Base Darwin. DIA has developed a program that consists
31 of a combination of facets of bird and other animal management to provide a safe operating
32 environment for all aircraft utilizing the airfield. The following are a few methods used to
33 deter wildlife away from the airfield:

- 34 • Manage grass height;
- 35 • Control vegetation;
- 36 • Perform landscaping to avoid roosting opportunities;
- 37 • Avoid the creation of perches;
- 38 • Remove dead animals, termite mounds, and nests;
- 39 • Coordinate land use off base; and
- 40 • Report wildlife activity and incidents (DIA, 2011).

1 **Impact Minimization:** DIA has an ongoing wildlife management program and, therefore,
 2 wildlife strikes should not be a major issue during conduct of the joint training exercises.
 3 However, The USAF will report any wildlife strikes to RAAF DSG, which will communicate
 4 the information to DIA. This will allow the DIA to properly manage bird strikes on the
 5 RAAF Base Darwin airfield.

6 Wildlife strikes should not be an issue during USAF operations.

7 **3.9.2 Insect-Borne Disease**

8 The area around RAAF Base Darwin is classified as a potential entry point for mosquito-
 9 borne diseases by the World Health Organization (WHO). Mosquito-borne diseases of
 10 concern around Darwin chiefly originate from Asia and include Ross River virus, Barmah
 11 Forest virus and Murray Valley encephalitis. Marrara Swamp is considered a major
 12 mosquito-breeding area and is located less than 1,300 feet (400 meters) from the airstrip.
 13 RAAF Base Darwin has an ongoing mosquito management strategy (RAAF, 2001).

14 The period of greatest mosquito activity in the Northern Territory occurs during the wet
 15 season in December and January (Northern Territory Department of Health, 2012), and not
 16 during the expected period of the joint training exercises. Nonetheless, mosquitoes are
 17 present outside this period and measures will be taken to reduce the likelihood of mosquito
 18 bites.

19 **Impact Minimization:** USAF personnel will implement the following personal protection
 20 measures while in the Northern Territory to reduce the risk of contracting and spreading
 21 insect-borne illnesses:

- 22 • Avoid areas known to have high mosquito activity (i.e., Marrara Swamp);
- 23 • Remain inside insect-screened buildings when possible;
- 24 • Use mosquito nets at temporary camps or unscreened buildings;
- 25 • Use repellents containing DEET;
- 26 • Avoid the use of white light at campsites (Northern Territory Department of Health,
 27 2011); and
- 28 • Treat uniforms with permethrin.

29 Insect-borne diseases should not be a problem during the joint training exercises; however,
 30 precautions should be taken to avoid mosquito bites.

31 **3.9.3 Unexploded Ordnance (UXO)**

32 The inadvertent discovery of UXO on RAAF Base Darwin during construction is possible.
 33 During WWII, the Japanese bombed Darwin on 62 occasions (Environmental Resource
 34 Management, 2005). According to Gary Want, Estate Manager, RAAF Base Darwin, UXO
 35 has mostly been found in the Darwin harbor area. However, RAAF Base Darwin was a
 36 frequent Japanese target and UXO has been discovered on the installation. Therefore, all
 37 construction and USAF personnel will be made aware of the potential for UXO discovery. If
 38 a fragment of UXO or suspected UXO is discovered, personnel will be directed to stop work,
 39 leave the ordnance untouched, evacuate the area, and contact RAAF personnel.

1 **Impact Minimization:** UXO training as prescribed by RAAF Base Darwin and PACAF will
 2 be provided to appropriate construction and USAF personnel to reduce risks associated
 3 with potential UXO contact.

4 UXO is not expected to be a major issue during construction or during conduct of the joint
 5 training exercises.

6 **3.10 Noise**

7 The U.S. DoD requires assessment of potential noise impacts and encroachment in
 8 accordance with DoDD 3200.15, *Sustainment of Ranges and Operating Areas*. Guidance for
 9 noise analysis is provided by the Defense Noise Working Group (DNWG). USAF noise
 10 policy is specified in Air Force Instruction (AFI) 32-7063, *Air Installation Compatible Use Zone*
 11 *Program* and Air Force Handbook (AFH) 32-7084, *Air Installation Compatible Use Zones*
 12 *(AICUZ) Program Managers Guide*. The RAAF DSG provides guidance for Australian noise
 13 analysis. The noise metrics used by U.S. DoD and RAAF DSG are different; however,
 14 metrics used by RAAF DSG are recommended as supplemental metrics by DNWG.
 15 Therefore, the noise analysis in this ER provides utility for PACAF and RAAF DSG decision
 16 makers.

17 While the proposed PACAF exercises will be relatively small, there are sensitivities of how
 18 noise is assessed and presented to Australian decision makers and the public. There is
 19 growing concern among the local community regarding military fighter aircraft noise at
 20 RAAF Bases Darwin and Tindal, among other Australian locations. BaseWatch, a
 21 community action group in Darwin, has become increasingly active over the past 2 to 3
 22 years, according to RAAF DSG Northern Territory environmental managers.

23 The noise analysis was conducted according to established U.S. DoD guidelines and best
 24 practices, and leveraged the DoD NOISEMAP suite of computer-based modeling tools. The
 25 suite primarily includes BaseOps, NMAP, the Advanced Acoustic Model (AAM), and
 26 NMPlot.

27 Four categories of aircraft are modeled: Fighters (e.g., F-15 and F-22), Tankers (e.g., KC-10
 28 and KC-135), Bombers (e.g., B-1 and B-52), and Reconnaissance (RQ-4). The loudest aircraft
 29 type of each category (on a single-event basis) was modeled, i.e., F-22 for Fighters, KC-10A
 30 for Tankers, and B-1 for Bombers. The Citation X (CITX) was chosen as a conservative
 31 surrogate for RQ-4 flight operations because there are no acoustic reference data for the RQ-
 32 4 in the models. The T-45 was selected as the surrogate for RQ-4 run-up operations because
 33 there are no acoustic reference data for the RQ-4 (or for the CITX) in the models.

34 The United States and Australia rely on cumulative metrics for evaluation of noise exposure.
 35 In the United States, the DoD (DoDI 4165.57) requires cumulative noise exposure to be
 36 described and presented in terms of Day-Night Average Sound Level (DNL). DNL is a
 37 composite noise metric accounting for the sound energy of all noise events in a 24-hour
 38 period. Flight and run-up events are measured in terms of their (integrated, normalized to 1
 39 second) Sound Exposure Level (SEL) and (instantaneous) Maximum Sound Level (Lmax),
 40 respectively. SEL and Lmax are expressed in A-weighted decibels (dB or dBA). In order to
 41 account for increased human sensitivity to noise at night, a 10-dB penalty is applied to
 42 nighttime events (10 p.m. to 7 a.m. period).

1 The RAAF DSG requires cumulative noise exposure to be described in terms of the
2 Australian Noise Exposure Forecast (ANEF). Like DNL, ANEF is a composite noise metric
3 accounting for the sound energy of all noise events in a 24-hour period; however, ANEF is
4 based on Effective Perceived Noise Level (EPNL) for flight events and Tone-Corrected
5 Perceived Noise Level (PNLT) for run-up events. EPNL and PNLT are expressed in decibels
6 of perceived noise (PNdB). The other differences between DNL and ANEF are ANEF's
7 nighttime period is from 7 p.m. to 7 a.m. and its nighttime penalty is 6 dB.

8 DNWG has provided guidance for supplemental noise metrics including Number of Events
9 (at or) Above a Selected Threshold (NA) and Time (at or) Above a Selected Threshold (TA)
10 (DNWG, 2009). For NA and TA, thresholds of 70, 85, and 100 dBA L_{max} were selected. As
11 companion to the NA and TA maps, the L_{max} was also computed with showing contours of
12 70, 85, and 100 dBA.

13 Baseline military and civilian activity at Darwin was previously modeled using the Federal
14 Aviation Administration's (FAA) Integrated Noise Model (INM) Version 6.2a for the ANEF,
15 L_{max} , and NA metrics. The prior Darwin INM files were provided by RAAF DSG (DSG,
16 2010). The baseline data were re-run in INM with appropriate weather conditions to
17 compute average annual day (AAD) DNL. AAD considers total annual operations averaged
18 over 365 days. NMAP was used to compute DNL and ANEF for PACAF exercise aircraft
19 operations. AAM was used to compute NA, TA, and L_{max} . NMAP 7.2 is not able to
20 compute NA, TA, or L_{max} . Full details of modeling assumptions and methodology are
21 provided in **Appendix B**.

22 DNL and ANEF were computed for both AAD and average busy day (ABD) operations.
23 L_{max} , NA, and TA were only computed for ABD, where ABD represents a typical PACAF
24 exercise day as shown in **Table 3-2**. USAF policy for significant noise impact is determined
25 on a case-by-case basis due to the wide variety of aircraft (e.g., fighters, heavies, props, etc.)
26 and operation types (year-round operations to short-duration exercises) at differing
27 locations (urban to rural). In general, an increase of 2 dB or greater within the AAD DNL 65-
28 dB noise contour is considered significant.

29 The AAD DNL for the Baseline and the Proposed Action are shown in **Figure 3-3** and
30 **Figure 3-4**, respectively. Comparison of the Proposed Action to the Baseline AAD DNL is
31 shown in **Figure 3-5**. From **Figure 3-5**, it can be seen that the increase in AAD DNL for the
32 Proposed Action is minimal for all areas with some increase west of the runway. No noise
33 sensitive area within the AAD DNL 65-dB noise contour will experience an increase of 2 dB
34 or greater. Therefore, in accordance with USAF policy, there is no significant impact from
35 the Proposed Action. Further, minimal impacts to wildlife are expected as animal
36 populations residing in the regions are accustomed to aircraft noise and the minimal
37 increase should not result in a noticeable increase in disturbance compared to current
38 conditions.

39 The ABD DNL is shown in **Figure 3-6** to depict elevated noise exposure during the
40 proposed exercise.

41 Noise levels at select points of interest (POIs), shown in **Figure 3-7**, were also computed. The
42 POIs are located north and southwest of the airfield and consist of four hospitals, eight
43 schools, and seven places of worship. ABD noise levels for all metrics are tabulated for each

1 POI in **Table 3-2**. ABD represents noise levels experienced during an exercise day. ABD
2 DNL will not exceed 65 dB at any POI. The supplement metrics are more instructive for
3 understanding exposure during an exercise day. At nine POIs, up to 14 events (12 fighter
4 and two bomber departures) will exceed 70 dB for up to 8.5 minutes per day, but much less
5 at most POIs. At eight POIs, up to one event would exceed 85 dB for less than 1 minute per
6 day. No event will exceed 100 dB at any POI. This analysis assumes a conservative
7 (overestimate) worst-case scenario with the loudest fighters (F-22) and bombers (B-1). If
8 different aircraft were used, then the exposure will be less. Additionally, the levels
9 presented reflect outdoor noise levels. Indoor noise levels will be attenuated by
10 approximately 15 or 25 dB for windows open or closed, respectively (USEPA, 1974). The
11 intuitive conclusion is that noise exposure at the POI during the proposed exercise will be
12 noticeable with single events noise levels increasing above ambient noise levels; however,
13 exposure will not be intrusive or significant.

14 Noise contour maps of Lmax, NA, TA, and ANEF are presented in **Appendix B**.

15 **Impact Minimization:** Aircraft will be operated in compliance with aircraft operating and
16 local noise abatement procedures. Current rules restrict fighters from departing after 10 PM.

17 The proposed PACAF exercises at RAAF Base Darwin will not cause significant noise
18 impacts based on USAF policy.

Table 3-2
 POI Noise Exposure for ABD Aircraft Operations at RAAF Base Darwin
PACAF Australia ER

PIO		DNL (dB)	Lmax (dB)	NA (events)			TA (minutes)		
ID	Description			70 dB Lmax	85 dB Lmax	100 dB Lmax	70 dB Lmax	85 dB Lmax	100 dB Lmax
DH-1	Royal Darwin Hospital	<45	80	2	0	0	1.4	0	0
DH-2	Darwin City Medical Centre	<45	79	2	0	0	1.2	0	0
DH-3	Darwin Day Surgery	57	90	13	1	0	6.4	0.5	0
DH-4	Top End Medical Centre	50	81	10	0	0	2.4	0	0
DS-1	Nightcliff Middle School	55	89	9	1	0	5.6	0.4	0
DS-2	Millner Primary School	63	94	14	1	0	7.7	0.7	0
DS-3	Jingili Primary School	57	87	14	1	0	7.2	0.4	0
DS-4	Anula Primary School	56	86	14	1	0	8.5	0.2	0
DS-5	Alawa Primary School	54	85	14	0	0	4.8	0	0
DS-6	Wagaman Primary School	52	83	14	0	0	4.4	0	0
DS-7	Sanderson Middle School	53	84	14	0	0	6.1	0	0
DS-8	Northern Territory Open Education Centre	57	90	10	1	0	6.0	0.5	0
DW-1	Islamic Society of Darwin	50	81	10	0	0	2.4	0	0
DW-2	Christ Cathedral Anglican	<45	77	2	0	0	1.3	0	0
DW-3	Lutheran Church of Australia	61	93	14	1	0	7.1	0.8	0
DW-4	Greek Orthodox Church	<45	80	2	0	0	1.2	0	0
DW-5	Abundant Life Christian Church	46	78	2	0	0	2.1	0	0
DW-6	Darwin Baptist Church	55	87	14	1	0	6.7	0.4	0
DW-7	Assemblies of God	52	84	14	0	0	4.0	0	0

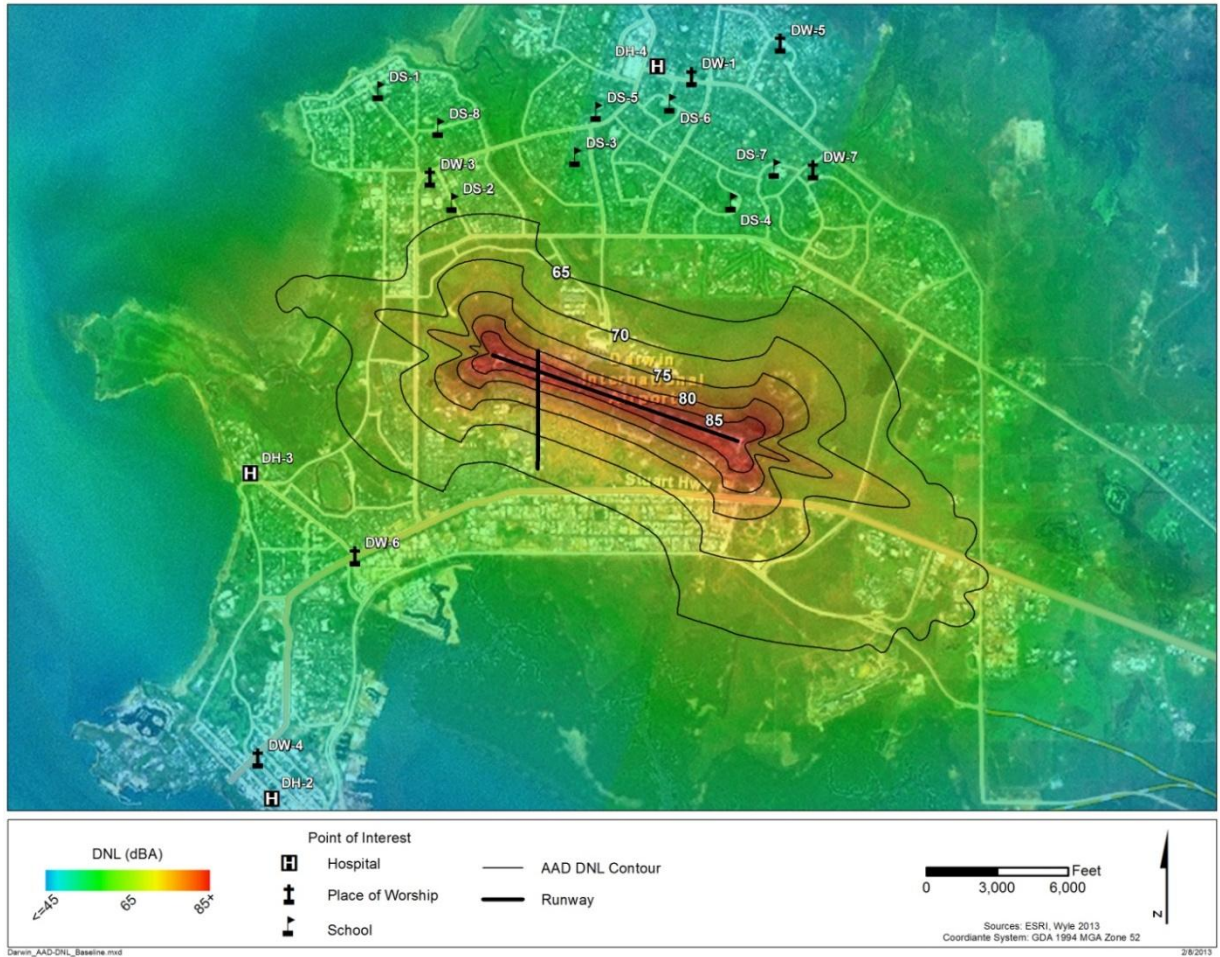


Figure 3-3
 DNL Contours and Gradient for Baseline AAD Aircraft Operations at RAAF Base Darwin
 PACAF Australia ER

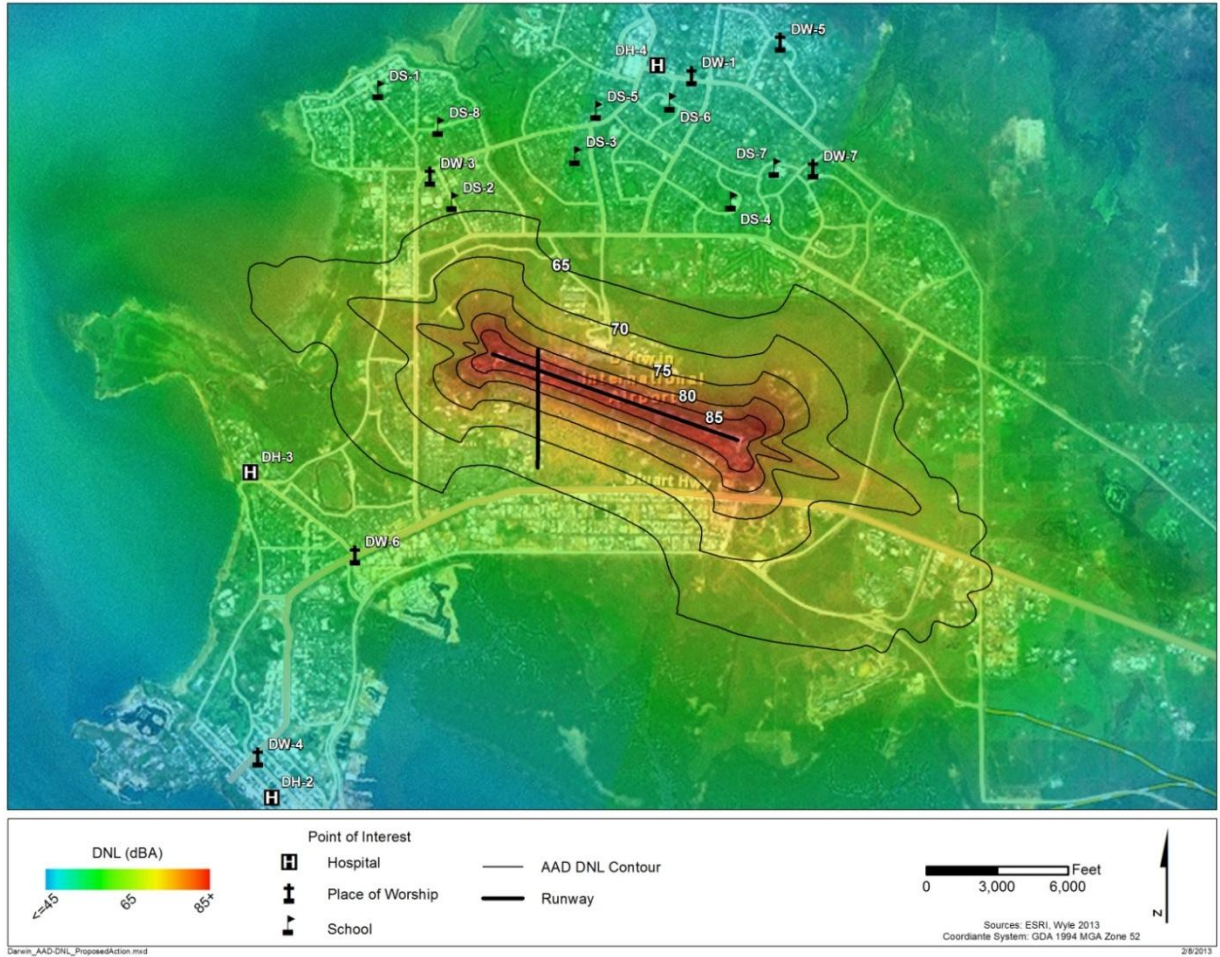


Figure 3-4
DNL Contours and Gradient for Proposed Action AAD Aircraft Operations at RAAF Base Darwin
PACAF Australia ER



Figure 3-5
 Comparison of Baseline and Proposed Action DNL Contours for AAD Aircraft Operations at RAAF Base Darwin
 PACAF Australia ER

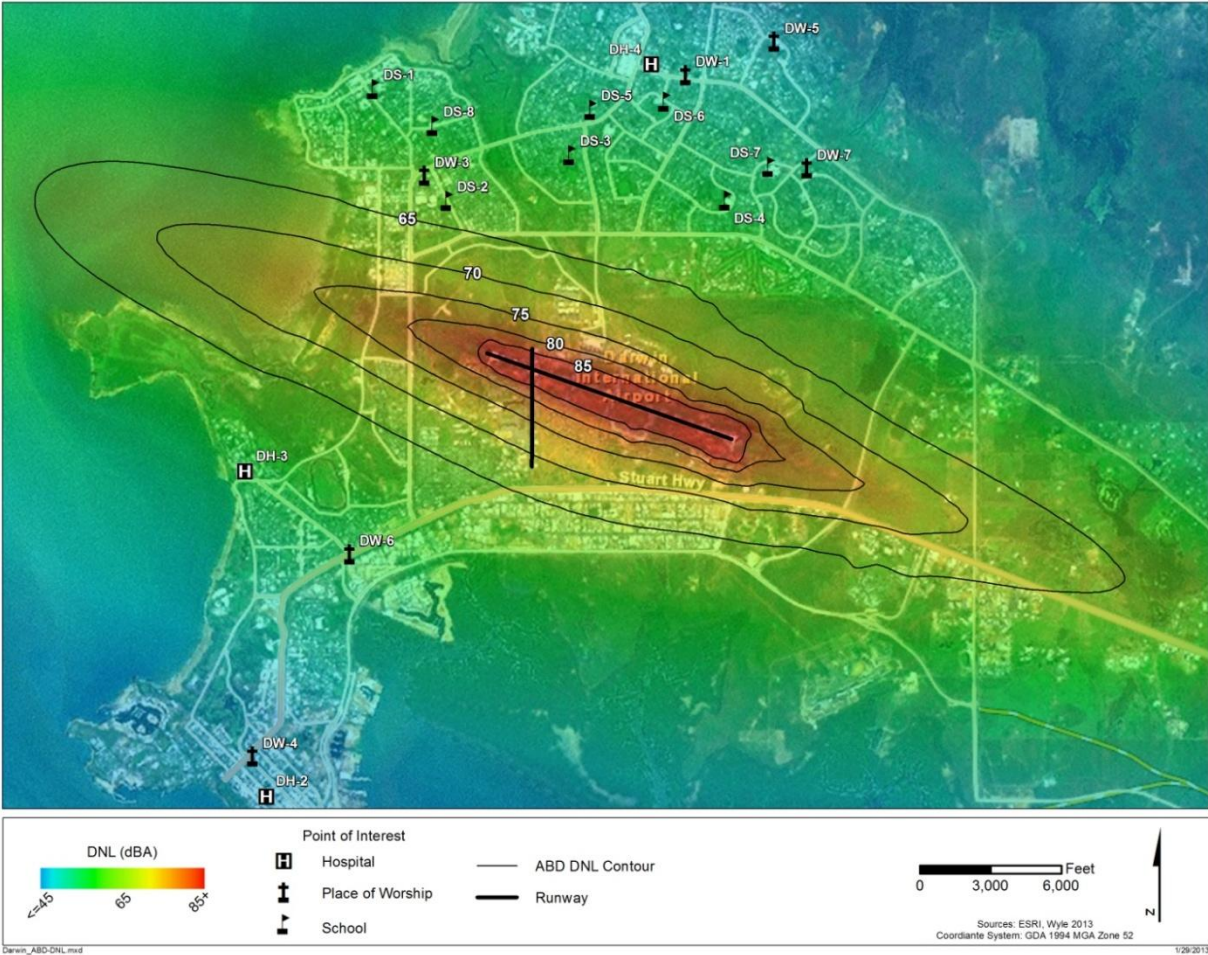


Figure 3-6
DNL Contours and Gradient for PACAF Exercise ABD Aircraft Operations at RAAF Base Darwin
PACAF Australia ER



Figure 3-7
Representative Points of Interest for RAAF Base Darwin
PACAF Australia ER

1 SECTION 4.0

2 **RAAF Base Tindal Important Environmental**
3 **Issues**

4 This section presents information on the potential environmental issues that may result
5 from USAF operations at RAAF Base Tindal. These issues were identified during a site visit
6 to RAAF Base Tindal by PACAF engineers, AFCEC NEPA managers, and USAF
7 environmental contractors on 12-15 November 2012. The information provided below is
8 based on personal conversations with RAAF DSG environmental and estate managers, as
9 well as documents provided during the meetings.

10 **4.1 Utilities**

11 **4.1.1 Energy**

12 Energy on RAAF Base Tindal is obtained via a high-voltage power line from the City of
13 Darwin, 177 miles to the north. Once the electricity reaches the base, electrical service is
14 provided by the RAAF Base Tindal base engineering operations contractor. The base has an
15 emergency electrical generation capability.

16 According to David Marshal, Base Support Manager, DSG, RAAF Base Tindal, the base is
17 operating on the edge of its available electrical capacity. USAF planners may want to plan
18 on providing backup power for essential operations. The base has natural gas onsite that
19 could be used for electricity generation, or diesel/JP8 fuel. If a tent city is sited on the golf
20 course at RAAF Base Tindal, electricity is available nearby.

21 **Impact Minimization:** USAF planners will consider supplying backup electrical generation
22 during training exercises.

23 Electricity availability is not expected to be a major problem during construction or during
24 conduct of the joint training exercises.

25 **4.1.2 Drinking Water**

26 Drinking water on RAAF Base Tindal is provided by the nearby community of Katherine.
27 The Katherine water supply is a mixture of water from the Katherine River and bores
28 (wells). Groundwater recharge for the bores (wells) is thought to originate from the area of
29 RAAF Base Tindal. Therefore, protecting the groundwater recharge area on base from
30 contamination is important to the local community. The water is treated, chlorinated, and
31 piped approximately 6 miles (10 kilometers) to RAAF Base Tindal. Water interruptions have
32 occurred periodically, primarily during the wet season when pipes break and the water
33 treatment system is shut down to prevent contamination of the system. Drinking water
34 distribution systems on RAAF Base Tindal are operated by the base operating contractor,
35 and the USAF will have no responsibility in operating this drinking water system.

36 According to David Marshal, Base Support Manager, RAAF Base Tindal, the installation
37 consumes approximately 1.3 million gallons (5 mega liters [ML]) of drinking water per day.

1 RAAF Base Tindal has a 1.6-million-gallon (6-ML) storage tank and chlorination unit.
2 During periods of interruption, the base uses the water in the storage tank. If necessary,
3 drinking water can be trucked to the installation. The base is currently converting irrigation
4 systems to bore (well) water, which could reduce the facility's daily drinking water
5 consumption. This drinking water system has supported exercises involving more than
6 2,000 temporary personnel in addition to the 1,200 personnel stationed on the base.
7 Therefore, with the PACAF planning factor of 340 USAF personnel for two 15-day joint
8 training exercises, adequate drinking water should not be a problem. Bore (well) water may
9 be used for construction.

10 **Impact Minimization:** Not applicable.

11 Adequate drinking water is not expected to be a problem during conduct of the joint
12 training exercises.

13 **4.1.3 Wastewater**

14 Wastewater on RAAF Base Tindal is treated at the WWTP located on the south side of the
15 installation. The treatment facility consists of aerated lagoons and spray irrigation in eight
16 circular areas. The plant is designed to treat wastewater from a total of 3,100 personnel. The
17 WWTP is operated by the RAAF Base Tindal operating contractor, and the USAF will have
18 no involvement or responsibility in operating the facility.

19 The current resident population on Tindal RAAF is 1,200 military and family members.
20 David Marshal, Base Support Manager, RAAF Base Tindal, indicated there were no
21 reported problems with wastewater treatment during previous training exercises involving
22 more than 2,000 transient personnel. However, the capacity of the WWTP could possibly be
23 expanded, if necessary, with the addition of a mechanical aerator. The USAF is planning for
24 only 340 USAF personnel to take part in the two 15-day joint training exercises. The WWTP
25 will be treating wastewater from less than 1,600 personnel (1,200 resident RAAF members
26 and 340 temporary USAF personnel) during the training exercises, well below the designed
27 wastewater treatment capacity of 3,100 personnel.

28 **Impact Minimization:** Not applicable.

29 Wastewater treatment is not expected to be a problem during construction or during
30 conduct of the joint training exercises.

31 **4.1.4 Solid Waste**

32 Solid waste on RAAF Base Tindal is collected by an off-base contractor and transported to a
33 solid waste disposal facility in Katherine. The solid waste disposal contract is managed by
34 the DSG RAAF Base Tindal base engineering operations contractor, and the USAF will have
35 no responsibility in managing this contract. According to David Marshal, Base Support
36 Manager, RAAF Base Tindal, the disposal of the additional solid waste from previous
37 training exercises has not been a problem. Recycling is important to RAAF Base Tindal and
38 the local community, and will be emphasized to units participating in joint training
39 exercises. Types of source separation (such as food/wet waste, plastic, metal, and paper)
40 will be discussed as part of exercise planning because recycling rules may change over time.
41 Sufficient containers for the waste separation will be addressed as part of exercise planning.

1 Hazardous waste disposal is discussed in Section 4.3, *Hazardous Material and Hazardous*
2 *Waste*, of this document.

3 **Impact Minimization:** When planning for exercises, coordination with the solid waste
4 disposal contractor for additional trucks or frequency of removal will be conducted as
5 necessary. Recycling will be a priority.

6 Solid waste disposal is not expected to be a problem during construction or during conduct
7 of the joint training exercises.

8 **4.2 Water Quality**

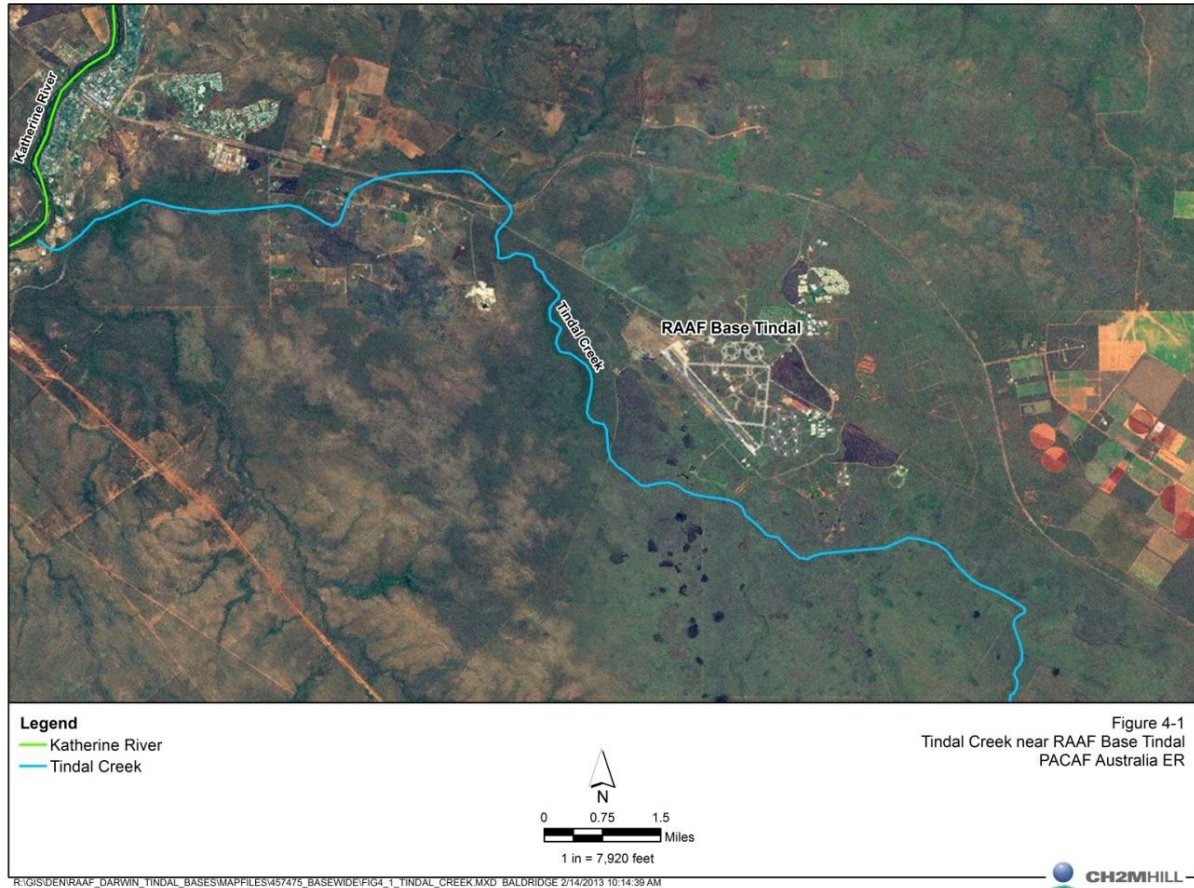
9 **4.2.1 Surface Water**

10 Most of RAAF Base Tindal lies within the Tindal Creek catchment area. Tindal Creek is an
11 ephemeral tributary of the Katherine River, which is located approximately 12 miles
12 (20 kilometers) south of the base (**Figure 4-1**). Tindal Creek is typically dry between May
13 and November.

14 The Katherine River is a primary source of water for the town of Katherine and RAAF Base
15 Tindal, and is a major concern to the local community. Stormwater from the airfield drains
16 toward Tindal Creek and ultimately the Katherine River (SKM, 2001). The proposed USAF
17 activities could impact water quality of Tindal Creek catchment areas by increasing the risk
18 of fuel spills, the addition of impervious area, and runoff from construction.

19 **Impact Minimization:** Stormwater runoff from construction activities and the increased
20 impervious area will be addressed in the design of all proposed capital improvement
21 projects. BMPs, such as the installation of oil/water separators near refueling areas, will also
22 be put in place to prevent fuel spills from reaching Tindal Creek.

23 Impacts to Tindal Creek will likely be an issue during the RAAF Siting Board, and it is
24 important BMPs are included in facility designs. Potential BMPs include oil/water
25 separators and a dyke network of containment systems.



1 4.2.2 Groundwater/ Sinkholes

2 RAAF Base Tindal is built on a limestone landscape, which is responsible for numerous
 3 sinkholes found onsite. The sinkholes are formed by groundwater eroding limestone rock
 4 underlying the surface. Many sinkholes have been identified on the south side of the airfield
 5 (Figure 4-2), and new sinkholes are constantly being formed through the movement of
 6 groundwater (SKM, 2007). Due to the hydrogeology within the area of RAAF Base Tindal,
 7 groundwater is the most significant pathway for soil and water contamination to reach
 8 potentially sensitive receptors (AECOM, 2009). Any spills occurring in the southern portion
 9 of the airfield would likely enter the sinkholes and directly impact groundwater.

10 **Impact Minimization:** Sinkholes will be accounted for during the siting phase of any capital
 11 improvement facilities. In addition, BMPs, such as a dyke network, will be put in place to
 12 prevent any spills from entering the sinkholes on the south side of the airfield.

13 Sinkholes could be an issue during USAF-sponsored construction activities and during
 14 conduct of the joint training exercises. It is important that precautions are taken to avoid
 15 construction near sinkholes, and that BMPs are put in place to prevent spills from entering
 16 the sinkholes.



4.3 Hazardous Material and Hazardous Waste

4.3.1 Existing Contamination

A review of the history of RAAF Base Tindal as well as the installation's current uses identified the following activities that may have contaminated soil and or groundwater on the facility (AECOM, 2009):

- Use of aldrin up until 1988;
- Uncontrolled dumping of waste in various landfills and burial sites;
- Burial of crashed aircraft;
- Detonation of expired ordnance;
- Leaks from underground storage tanks;
- Fuel or chemical spills;
- Discharge of contaminated wastewater; and
- The old base sewage system.

Many of the potentially contaminated sites are located in the vicinity of the airfield. Consequently, airmen and contractors working on the installation should remain vigilant and report any areas contaminated with suspected hazardous material to RAAF DSG personnel.

Impact Minimization: Personnel working on RAAF Base Tindal will report the discovery of any contaminated areas to RAAF DSG personnel.

Impacts from existing contamination are not expected to be a problem during construction or during conduct of the joint training exercises.

4.3.2 Hazardous Material Handling and Management

The handling and management of hazardous material are significant issues at RAAF Base Tindal. Apart from catastrophic events such as aircraft accidents, the largest potential for soil, surface water, and groundwater contamination during normal base operations results from the storage and handling of aviation fuel. This is a particular concern on RAAF Base Tindal because fuel spills near sinkholes would directly affect groundwater.

Other hazardous substances stored at RAAF Base Tindal include bulk liquid oxygen, bulk liquid nitrogen, liquid petroleum gas in tanks and cylinders, oxygen, acetylene, compressed air, argon, solvents, paints, sodium hypochlorite, and chemical maintenance substances (SKM, 2000). Generally, hazardous waste is containerized and transported by contractors to Adelaide, located on the south-central coast of Australia.

The only unique hazardous materials the USAF will transport when deploying to Australia is hydrazine. Otherwise, the hazardous materials utilized will be standard petroleum, oils, and lubricants currently used on Australian aircraft. Hydrazine was of specific concern to the RAAF DSG. Hydrazine is a highly toxic and flammable propellant used in F-16 aircraft. Hydrazine is not currently used by the RAAF, although it has been used by other nations operating on RAAF Base Tindal that fly F-16 aircraft.

Impact Minimization: Hazardous material and hazardous waste management plans will be created specifically for RAAF Base Tindal. All hazardous material used by the USAF will be

1 handled in accordance with U.S. DoD operating procedures and regulations, including
2 AFJMAN 23-209, *Storage and Handling of Hazardous Materials*. Specifically, all hazardous
3 material dispensing areas will be properly maintained, drums/containers must not be
4 leaking, drip pans/absorbent materials will be placed under containers as necessary to
5 collect drips or spills, container contents will be clearly marked, and all personnel handling
6 the hazardous material will be properly trained. Additionally, a hazardous waste
7 accumulation point will be operated to provide appropriate segregation of different waste
8 streams. When available, USAF will use established RAAF hazardous waste accumulation
9 points. Hydrazine will be handled in accordance with established neutralization procedures
10 (Technical Order 1F-16C-2-49GS-00-1).

11 The use and management of hazardous materials were the most significant environmental
12 issues identified by RAAF environmental personnel during the site visit. It is important that
13 the USAF adheres to its established guidance documents, and that appropriate BMPs are
14 put in place to reduce the likelihood of a spill reaching Tindal Creek or a sinkhole.

15 **4.4 Transportation**

16 Ground transportation to RAAF Base Tindal is by way of Stuart Highway, which connects
17 Darwin to Adelaide. Most material is shipped into the Port of Adelaide & Brisbane and
18 trucked by road train to the town of Katherine and RAAF Base Tindal. Stuart Highway is
19 generally a two-lane highway with frequent passing lanes designed for traffic to pass heavy,
20 slow-moving trucks. This highway connects sparsely populated areas throughout the
21 central part of Australia.

22 According to David Marshal, Base Support Manager, RAAF Base Tindal, the anticipated
23 additional truck traffic needed to support the USAF joint training exercises will have
24 minimal effect to traffic on Stuart Highway. Large training exercises conducted in the past
25 have had minimal impact on Stuart Highway traffic, and previous construction projects on
26 RAAF Base Tindal have had no apparent effect on highway traffic. USAF personnel should
27 be transported by bus or truck if they go off base during exercises. The additional number of
28 vehicles resulting from the joint training exercises is expected to have minimal impact both
29 on and off base.

30 **Impact Minimization:** USAF personnel will have limited access to personal vehicles while
31 onsite and will rely on RAAF-provided buses or rental buses/trucks when available.

32 Traffic is not expected to be a problem during construction or during the joint training
33 exercises.

34 **4.5 Air Quality and Greenhouse Gases**

35 The primary pollutants of concern in the Northern Territory are from particulates (PM₁₀,
36 PM_{2.5}) and GHG pollutants. However, the overall air quality in the Katherine region would
37 be considered unclassified by U.S. standards, and air quality was not a resource of concern
38 for RAAF Base Tindal DSG personnel.

1 Sources and Thresholds

2 The scale and duration of construction at RAAF Base Tindal will be a source of short-term,
3 temporary emissions, and construction emissions will be significantly less than the emission
4 resulting from operation of the training activities, which are quantified below. Therefore,
5 only the emissions associated with the joint training exercises were quantified to determine
6 the relative impact to air quality in the region.

7 Joint exercise emission sources will include aircraft, fueling/ground equipment, commercial
8 buses (personnel transportation), fuel transfer operations, on-the-ground stationary
9 combustion equipment, and fuel storage tanks. It is assumed that the primary source of
10 emissions will be from the combustion of fuel in aircraft, and that the other sources will be
11 minor relative to these emissions. The total fuel combusted per aircraft engine was used in
12 conjunction with the AFCEE Mobile Guide to estimate the operational emissions (AFCEE,
13 2009). Aircraft emissions include the following components: approach, takeoff, and climb
14 out (idle time was not included in accordance with the AFCEE Mobile Guide because it is
15 not a part of standard training activities). These estimated emissions were compared to the
16 relative thresholds identified below to determine if air quality in the region would be
17 impacted.

18 Because the Northern Territory is the equivalent of a U.S. attainment or unclassified area,
19 the proposed thresholds of significance for criteria pollutants are the General Conformity
20 thresholds for an attainment or unclassified area, which is 100 tons per year. In Australia,
21 the national reporting framework for GHG is the NGER. The facility-level reporting is
22 25,000 MT, which is similar to the U.S. CEQ guidance; however, this does not necessarily
23 indicate a significant impact. If the GHG emissions are likely to be greater than 25,000 MT of
24 CO₂e, the emissions were quantified. The environmental issues associated with ambient air
25 quality and GHGs are discussed in the following sections.

26 4.5.1 Ambient Air Quality

27 There is no specific evaluation of the air quality near RAAF Base Tindal because the
28 Katherine area is under the necessary population thresholds for monitoring. Therefore, the
29 Katherine area would be considered unclassified by U.S. standards.

30 Based on 2010 – 2011 inventory data, the RAAF is not currently required to obtain air
31 permits or register as a part of the NPI (NPI, 2012b). This is consistent with requirements in
32 the United States, where military aircraft engines are exempt from the federal aircraft engine
33 NO_x emissions standards in 40 CFR 87 and are not subject to permitting requirements or
34 other federal stationary or mobile source emissions standards or regulations.

35 Emissions associated with the proposed training exercises were quantified based on project-
36 specific data for equipment type and fuel usage, which was done in accordance with the
37 methodology and emission factors in the *Air Emission Factor Guide to Air Force Mobile Sources*
38 (AFCEE, 2009). As shown in **Table 4-1**, the estimated emissions for the aircraft training
39 operations at RAAF Base Tindal are all less than 100 tons per year for U.S. criteria
40 pollutants. Details of the air emission calculations are included in **Appendix A**.

Table 4-1
Estimated Emissions for Aircraft Training Operations, RAAF Base Tindal
PACAF Australia ER

Aircraft Type	Emissions (ton/year)				
	NO _x	CO	VOC	PM ₁₀	PM _{2.5}
Bomber (B-52)	23	12	4	1	1
Tanker (KC-135)	29	13	0.1	0.4	0.3
Fighter (F-22)	25	16	1	5	4
UAV	1	1	0.03	0.2	0.2
Tindal Aircraft Total Annual Criteria Emissions:	78	42	5	7	6

Notes: Numbers in columns may not add up exactly due to rounding.

1 The primary air quality issue in the Northern Territory is from dust, or particulate matter.
2 The significance threshold used for this project is 100 tons per year. The estimated
3 particulate emissions associated with the increased training activities are less than 10 tons
4 per year, which is substantially lower than the 100-ton-per-year threshold. Therefore,
5 because the emissions estimated from the additional training activities are much lower than
6 the threshold of significance, it is not likely that the additional training will create an
7 environmental impact to air quality in the region. However, prevention of dust emissions
8 during construction is advised.

9 **Impact Minimization:** The use of standard BMPs, such as watering bare areas, to control
10 dust emissions will be used during construction.

11 Ambient air quality should not be an issue during construction or during conduct of the
12 joint training exercises.

13 4.5.2 Greenhouse Gas

14 The two components of the NGER Scheme that relate to the RAAF are the GHG reporting
15 thresholds and carbon pricing mechanism (NGER, 2012a). RAAF Base Tindal was not listed
16 as a registered GHG reporter for fiscal year 2010 – 2011 (NGER, 2012c). Therefore, the RAAF
17 is not considered one of “Australia’s biggest polluters” of GHGs, and will not have to pay a
18 price for its carbon emissions.

19 The GHG emissions associated with the combustion of fuel from aircraft during training
20 exercises were quantified to provide an estimate of the impact of GHG emissions. These
21 emissions at RAAF Base Tindal were approximately 25,600 MT CO₂e. Although those
22 emissions are just slightly above the NGER facility threshold of 25,000 MT CO₂e, the
23 installation is taking steps to decrease its carbon footprint at RAAF Base Tindal, which
24 would reduce the installation’s impact to climate change through the generation of fewer
25 GHG emissions. Furthermore, because these sources are not stationary sources, they would
26 likely still not be considered a major source of GHG pollutants because most of the
27 regulations are aimed at reducing stationary source emissions.

28 **Impact Minimization:** Not applicable.

1 GHG emissions should not be an issue during construction or during conduct of the joint
2 training exercises.

3 **4.6 Biological Resources**

4 **4.6.1 Sensitive Species**

5 Of the 21 Australian species listed as threatened or endangered in the ESA, only the
6 saltwater crocodile's range occurs on RAAF Base Tindal, although it is listed as a species of
7 least concern under the *Territory Parks and Wildlife Conservation Act*. Airmen and contractors
8 will be made aware of the protected status of the species in the United States and warned,
9 for their own protection, to avoid the species and its habitat.

10 The region around RAAF Base Tindal has 30 EPBC-listed species and 50 species listed as
11 threatened in the Northern Territory (Northern Territory, 2011). There are no listed plant
12 species on RAAF Base Tindal; however, some endemic plant species are present in the
13 region, including vegetation on limestone outcrops and mesophyll vine forests found in
14 sinkholes. Some sensitive animal species have been found on RAAF Base Tindal, including
15 the red goshawk (*Erythrotriorchis radiatus*), which is EPBC-listed as vulnerable. Termite
16 mounds are also prevalent throughout the Katherine/RAAF Base Tindal area, and are a
17 significant feature of the local ecosystem (SKM, 2001).

18 The airfield and surrounding area are heavily developed and disturbed; therefore, the
19 likelihood of USAF operations affecting sensitive species is remote. RAAF Base Tindal
20 environmental personnel regularly monitor the airfield for sensitive species and have seen
21 no need to perform sensitive species surveys in response to the Proposed Action.

22 Although it is unlikely USAF operations would impact ESA- or EPBC-listed species, all
23 Australian native vertebrate animals living in the Northern Territory are protected under
24 the *Territory Parks and Wildlife Conservation Act of 2009*. Therefore, it is important that USAF
25 operations do not harm native Australian vertebrates.

26 **Impact Minimization:** Airmen and construction contractors will be informed of the
27 protected status of all Australian vertebrates and advised to avoid harming any animals. If a
28 sensitive species is identified by RAAF personnel in the vicinity of the Proposed Action,
29 operations will cease and measures will be taken under the guidance of RAAF DSG
30 personnel to avoid harming the organism.

31 Construction and operation activities are not expected to impact sensitive species.

32 **4.6.2 Biosecurity**

33 The natural landscapes of the Northern Territory are largely still intact due to the relative
34 isolation and remoteness (Northern Territory, 2011). Consequently, exotic weeds, pests, and
35 diseases can have devastating effects on soil, native vegetation, wildlife, crops, and
36 livestock. Insects are the pest that poses the greatest potential of risk to the Northern
37 Territory.

38 DAFF manages quarantine controls to minimize the risk of exotic pests and diseases
39 entering the country. DAFF develops procedures and provides services to ensure adequate
40 quarantine and inspection occurs for all vessels, aircraft, vehicles, machinery, goods, cargo,

1 and personal effects entering Australia from foreign nations. The RAAF, along with a
 2 number of other regional organizations, have developed plans to control the spread of
 3 exotic species (RAAF, 1999; Northern Territory, 2011).

4 The United States normally asserts the privilege of sovereign immunity for all U.S. State
 5 aircraft and vessels, and thus does not consent to the boarding and inspection of such
 6 aircraft and vessels by foreign government authorities. However, satisfaction of Australia's
 7 biosecurity requirements is essential to control the risks posed by weeds, pests, and
 8 diseases. Further, Article 13 of the 1963 Agreement between the Government of the
 9 Commonwealth of Australia and the Government of the United States of America
 10 concerning the Status of United States Forces in Australia states that the U.S. Government
 11 shall conform to Australian laws and regulations, including quarantine laws. Consequently,
 12 all USAF aircraft, equipment, and food supplies (including MREs) will need to undergo a
 13 quarantine process prior to operations in Australia.

14 **Impact Minimization:** The USAF will conform to the policy and procedures agreed to by
 15 DAFF, U.S. DoD and the USDA for the Talisman Sabre exercise in 2013. This policy
 16 regarding biosecurity was developed by the U.S. Embassy in Australia and USPACOM for
 17 sovereign immune assets (U.S. vessels and aircraft) entering Australia for the Talisman
 18 Sabre combined military exercises on mainland Australia. The U.S. does not normally assert
 19 sovereign immunity for U.S. machinery, vehicles, goods, cargo, or personal effects that are
 20 off-loaded from a U.S. aircraft or vessel. Unless sovereign immunity is specifically asserted,
 21 such items will undergo normal DAFF-approved biosecurity inspections upon arrival into
 22 Australia or by special arrangement prior to departure for Australia.

23 Biosecurity is a very important issue in Australia because the country is relatively free of
 24 many of the animal and plant diseases affecting other nations. If the USAF conforms to the
 25 2013 Talisman Sabre quarantine agreements, biosecurity should not be a problem during
 26 construction or during conduct of the joint training exercises.

27 4.7 Wildfire

28 Historically, at least one wildfire occurs on RAAF Base Tindal each year, usually during the
 29 dry season. The installation manages its own fire management program and has dedicated
 30 fire crews (GHD, 2008). The current fire regime consists of a series of annual infrastructure
 31 and boundary protection burns undertaken in May/June, and firebreaks around the airfield
 32 boundary (RAAF Base Tindal, 2001).

33 **Impact Minimization:** Not applicable.

34 Wildfires are not expected to be a problem during construction or during conduct of the
 35 joint training exercises.

36 4.8 Heritage

37 4.8.1 Aboriginal Heritage

38 Aboriginals have long used the Katherine/RAAF Base Tindal area as a hunting and
 39 gathering region. Many plant and animal species in the area have been, and still are, a
 40 favored part of the local Aboriginal diet (SKM, 2001). The most likely areas to contain

1 archaeological sites are along watercourses and around rock outcrops. Forty-nine
 2 Aboriginal archaeological sites have been identified within the RAAF Base Tindal perimeter
 3 (AECOM, 2012), all of which are located away from the airfield and potential capital
 4 improvement sites, including the golf course.

5 **Impact Minimization:** Given the extent of clearing and ground disturbance in the airfield
 6 and golf course areas, it is unlikely that new Aboriginal heritage sites would be found in the
 7 vicinity of any construction or operation areas. However, if any artifacts are discovered
 8 during construction, all activities at the site will cease and the RAAF DSG contacted. RAAF
 9 DSG will manage the site in accordance with Australian regulatory requirements.

10 Impacts to Aboriginal heritage sites are not expected to be a problem during construction or
 11 during conduct of the joint training exercises.

12 **4.8.2 European Heritage**

13 Although the airfield at RAAF Base Tindal was originally constructed in 1942 in response to
 14 Japanese aggression in the region, no aircraft were stationed there until 1988. The original
 15 airfield was rebuilt in the 1970s (Air Force, n.d.). Consequently, there are limited historic
 16 heritage sites located on the base.

17 **Impact Minimization:** Not applicable.

18 Impacts to European heritage sites will not be a problem during construction or during
 19 conduct of the joint training exercises.

20 **4.9 Health and Safety**

21 **4.9.1 Wildlife Strikes**

22 Wildlife can pose a significant hazard to the safe conduct of aircraft operations. The vast
 23 majority of bird or wildlife strikes occur either on or within the immediate proximity of a
 24 runway, and in many of those events, damage is sustained to the aircraft. In serious
 25 incidents, damage from a strike could result in the aircraft being unable to maintain safe
 26 operations.

27 RAAF Base Tindal has an ongoing wildlife strike mitigation plan. Wildlife deterrents on the
 28 installation include:

- 29 • Removal of roosting sites;
- 30 • Removal of pools and depressions;
- 31 • Removal of waste;
- 32 • Removal of tall vegetation; and
- 33 • Education of base personnel (Kinhill Engineers, 1987).

34 **Impact Minimization:** The USAF will report any wildlife strikes to the RAAF DSG, so that
 35 the RAAF can properly manage its bird strike program.

36 RAAF Base Tindal has an ongoing wildlife strike management program and, therefore, bird
 37 or wildlife strikes should not be a significant problem during the joint training exercises.

4.9.2 Insect-Borne Disease

Mosquito-borne diseases of concern around RAAF Base Tindal mainly originate from Asia and include Ross River virus, Barmah Forest virus and Murray Valley encephalitis. RAAF Base Tindal has an ongoing mosquito management strategy. Surveys at RAAF Base Tindal identified potential breeding sites for pests and disease-carrying mosquito species. Potential breeding sites include the network of open unlined drains, the sewage ponds, and borrow pits. Various artificial water-holding receptacles, such as tires and drums, are also potential breeding sites (SKM, 2001).

The period of greatest mosquito activity in the Northern Territory is during the wet season in December and January (Northern Territory Department of Health, 2012), and not during the expected period for the joint training exercises. Nonetheless, mosquitoes are present outside this period and measures will be taken to reduce the likelihood of mosquito bites.

Impact Minimization: USAF personnel will implement the following personal protection measures while in the Northern Territory to reduce the risk of contracting and spreading insect-borne illnesses:

- Avoid areas known to have high mosquito activity;
- Remain inside insect-screened buildings when possible;
- Use mosquito nets at temporary camps or unscreened buildings;
- Use repellents containing DEET;
- Avoid the use of white light at campsites (Northern Territory Department of Health, 2011) ; and
- Treat uniforms with permethrin.

Insect-borne diseases should not be a problem during exercises; however, precautions will be taken to avoid bites by mosquitoes.

4.9.3 Unexploded Ordnance (UXO)

Inadvertent discovery of UXO on RAAF Base Tindal is possible but not likely, according to David Marshal, Base Support Manager, RAAF Base Tindal. Because the possibility exists, however, precautions will include making all construction and USAF personnel aware of the potential for UXO discovery. If a fragment of UXO or suspected UXO is discovered, personnel will be directed to stop work, leave the ordnance untouched, evacuate the area, and contact RAAF personnel.

Impact Minimization: UXO training as prescribed by RAAF Base Tindal and PACAF will be provided to appropriate construction and USAF personnel to reduce risks associated with potential UXO contact.

UXO is not expected to be a major issue during construction or during conduct of the joint training exercises.

4.10 Noise

The methodology for analyzing RAAF Base Tindal was the same as for RAAF Base Darwin (Section 3.10). However, baseline data were not available for RAAF Base Tindal. Therefore, comparison could not be made between the Baseline and the Proposed Action. The AAD

1 DNL, shown in **Figure 4-3**, includes the PACAF exercises only and, thus, is artificially small
 2 because it disregards based military aircraft (including fighters) at RAAF Base Tindal. The
 3 ABD DNL is shown in **Figure 4-4**.

4 Noise exposure was computed for five POIs (one hospital, two schools, and two places of
 5 worship) near Katherine, which is approximately 10 miles (16 kilometers) from RAAF Base
 6 Tindal. The POIs are shown in **Figure 4-5** with noise levels listed in **Table 4-2**.

7 RAAF Base Tindal is located away from populated areas and noise sensitive areas,
 8 including aboriginal communities. No POI will experience an ABD DNL above 45 dB.
 9 Additionally, noise events at the POI will only exceed 70 dB for a fraction of a minute per
 10 day. This indicates that PACAF exercises may be noticeable above ambient noise levels in
 11 Katherine if only for a short duration. Noise exposure due to the proposed exercises will not
 12 cause significant impacts to the region surrounding RAAF Base Tindal or to the town of
 13 Katherine. Further, minimal impacts to wildlife are expected as animal populations residing
 14 in the effected region are accustomed to aircraft noise and the minimal increase should not
 15 result in a noticeable increase in disturbance compared to current conditions.

16 Noise contour maps of Lmax, NA, TA, and ANEF are presented in **Appendix B**.

17 **Impact Minimization:** Aircraft will be operated in compliance with aircraft operating and
 18 local noise abatement procedures. Current rules restrict fighters from departing after 10 PM.

19 The proposed PACAF exercises at RAAF Base Tindal will not cause significant noise
 20 impacts based on USAF policy.

Table 4-2

POI Noise Exposure for ABD Aircraft Operations at RAAF Base Tindal
 PACAF Australia ER

PIO		DNL (dB)	Lmax (dB)	NA (events)			TA (minutes)		
ID	Description			70 dB Lmax	85 dB Lmax	100 dB Lmax	70 dB Lmax	85 dB Lmax	100 dB Lmax
TH-1	Katherine Hospital	<45	74	<1	0	0	0.4	0	0
TS-1	St. Joseph's College	<45	69	0	0	0	0	0	0
TS-2	Katherine High School	<45	74	<1	0	0	0.2	0	0
TW-1	Anglican Church of Australia	<45	67	0	0	0	0	0	0
TW-2	Heritage Christian Church	<45	79	<1	0	0	0.4	0	0

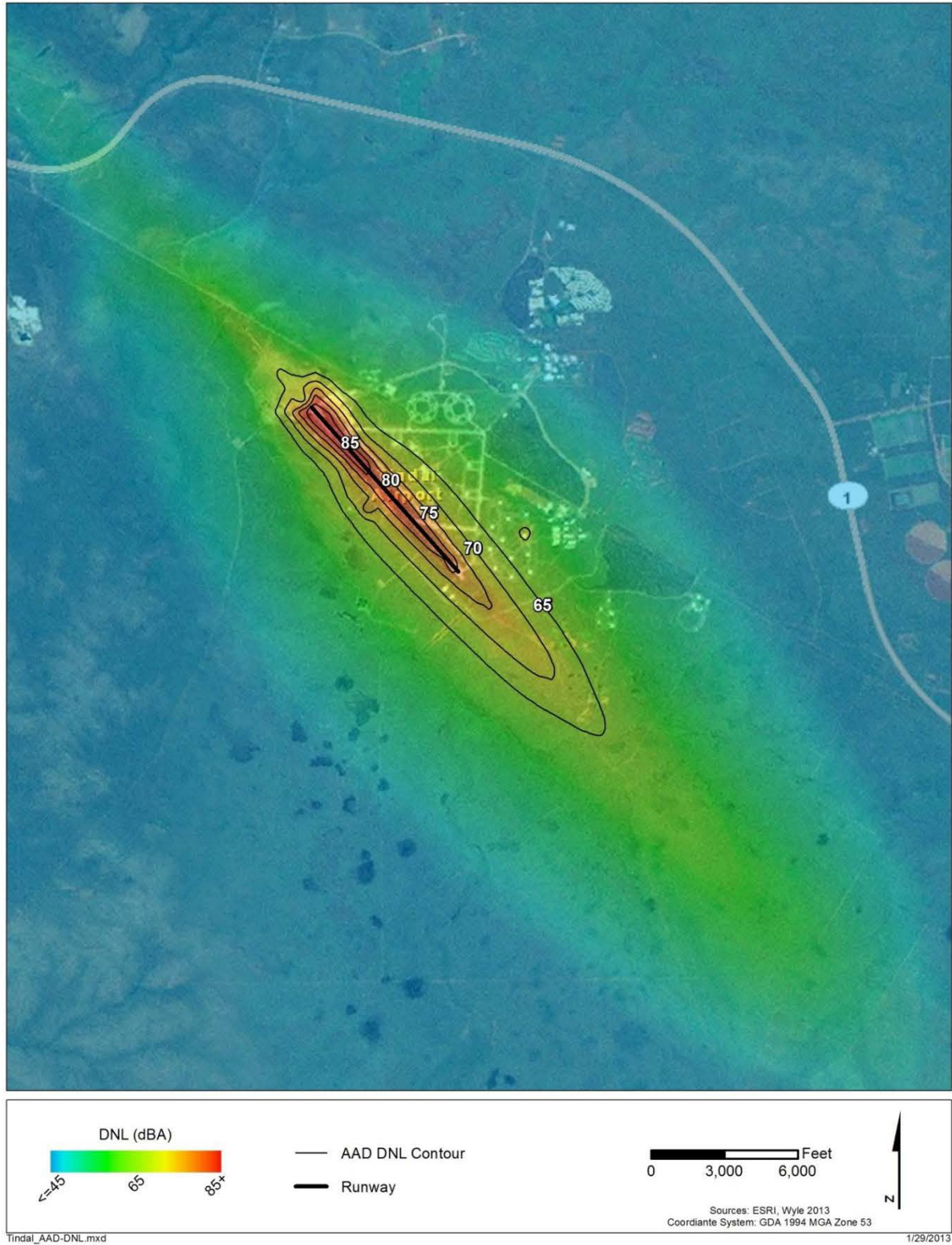


Figure 4-3
 DNL Contours and Gradient for PACAF Exercise AAD Aircraft Operations at RAAF Base Tindal
 PACAF Australia ER

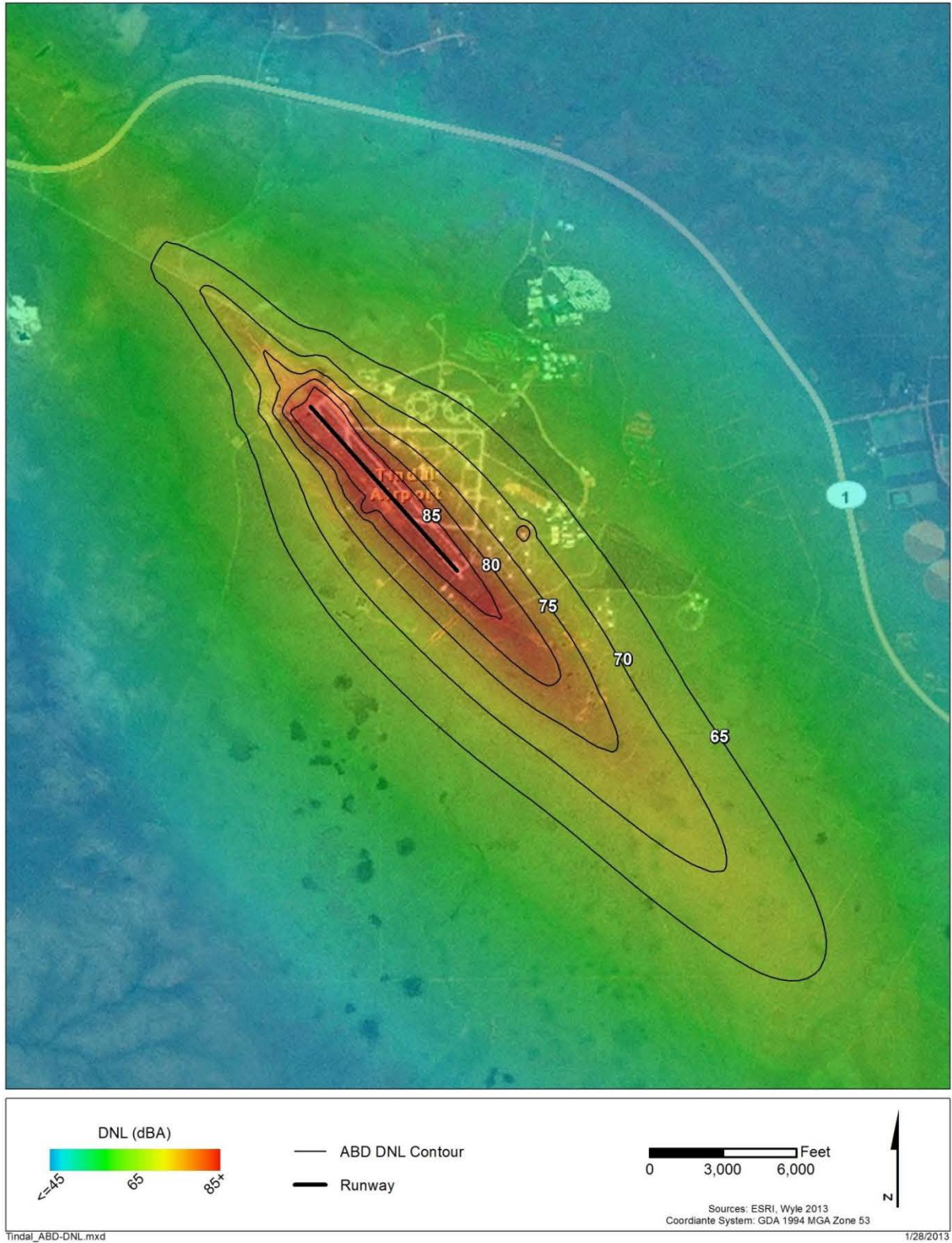


Figure 4-4
DNL Contours and Gradient for PACAF Exercise ABD Aircraft Operations at RAAF Base Tindal
PACAF Australia ER



Figure 4-5
 Representative Points of Interest for RAAF Base Tindal
 PACAF Australia ER

1 SECTION 5.0

2 **Summary of Impact Minimization Measures**

3 **Table 5-1** provides a summary of the environmental issues resulting from USAF operations
 4 at RAAF Bases Darwin and Tindal, and the associated impact minimization measures.

Table 5-1
 Impact Minimization Summary Table
PACAF Australia ER

Environmental Issue	Impact Minimization Measure or BMP
RAAF Base Darwin	
Utilities	
The base is currently operating at the edge of its current electrical capacity.	Supply backup electrical capacity during exercises, if necessary.
Solid waste management and recycling are important issues to the RAAF.	When planning for exercises, USAF personnel will coordinate with the Estate Manager for additional solid waste trucks. Recycling will be a priority.
Water Quality	
Stormwater runoff could impact Rapid Creek.	Stormwater BMPs will be included in the design of any proposed capital improvement facilities.
Fuel spills could enter Rapid Creek.	BMPs will be implemented to prevent spills from entering Rapid Creek and USAF units will implement spill prevention measures.
Hazardous Materials and Hazardous Waste	
Potential discovery of contaminated landfills during construction.	If a landfill is discovered, operations will cease and the RAAF DSG will be contacted immediately and allowed to manage the cleanup.
Use of hazardous materials and waste generation.	All USAF activities will follow established U.S. DoD guidelines.
The use of hydrazine is a specific concern to the RAAF DSG.	Handle hydrazine in accordance with established neutralization procedures (Technical Order 1F-16C-2-49GS-00-1).
Transportation	
Increased traffic could negatively affect the installation's transportation infrastructure.	USAF personnel will be transported by bus during the period of the joint training exercise, whenever possible and the use of personal vehicles will be limited.
Air Quality and Greenhouse Gases	
Increased dust emissions during construction activities	Standard dust control BMPs such as watering bare ground will be implemented during construction.

Table 5-1
Impact Minimization Summary Table
PACAF Australia ER

Environmental Issue	Impact Minimization Measure or BMP
Biological Resources	
Impacts to protected Australian wildlife.	Airmen and construction contractors will be informed of the protected status of all Australian vertebrates and advised to avoid harm to any animals.
Potential introduction of organisms exotic to Australia.	USAF will conform to the policy and procedures agreed on during the 2013 Talisman Sabre exercises.
Heritage	
Disturbance to a previously unidentified archaeological site.	If artifacts are discovered, operations will cease and DSG personnel will be contacted.
A negative effect on the historic character of RAAF Base Darwin.	New facilities will follow the RAAF Base Darwin Master Plan (Woods Bagot, 2009).
Health and Safety	
Potential wildlife strikes by aircraft.	Report any incidents to the RAAF DSG.
Disease-carrying insects may be present during exercises and construction.	Take precautions to avoid being bitten as outlined by the Northern Territory Department of Health.
Inadvertent discovery of UXO during construction.	Cease operations and notify the RAAF DSG.
Noise	
Increased noise to surrounding community.	Aircraft will be operated in compliance with aircraft operating and local noise abatement procedures. Current rules restrict fighters from departing after 10 PM.
RAAF Base Tindal	
Utilities	
The base is currently operating at the edge of its current electrical capacity.	Supply backup electrical capacity during exercises, if necessary.
Solid waste management and recycling are important issues to the RAAF.	When planning for exercises, coordinate with the Estate Manager for additional solid waste trucks. Recycling will be a priority.
Water Quality	
Stormwater runoff could impact Tindal Creek.	Stormwater BMPs will be included in the design of any capital improvement facilities.
Fuel spills could enter Tindal Creek or groundwater.	BMPs will be implemented to prevent spills from entering Tindal Creek or sinkholes and USAF personnel will implement spill protection measures.
Hazardous Materials and Hazardous Waste	
Potential discovery of contaminated areas during operations.	If a contaminated area is discovered, the DSG will be contacted immediately and allowed to manage the cleanup.

Table 5-1
Impact Minimization Summary Table
PACAF Australia ER

Environmental Issue	Impact Minimization Measure or BMP
Use of hazardous materials and waste generation.	All USAF activities will follow established U.S. DoD guidelines.
The use of hydrazine is a specific concern to the RAAF DSG.	Handle hydrazine in accordance with established neutralization procedures (Technical Order 1F-16C-2-49GS-00-1).
Transportation	
Increased traffic could negatively affect the installation's transportation infrastructure.	USAF personnel will be transported by bus during the period of the joint training exercise, whenever possible and the use of personal vehicles will be limited.
Air Quality and Greenhouse Gases	
Increased dust emissions during construction activities	Standard dust control BMPs, such as watering bare ground, will be implemented during construction
Biological Resources	
Impacts to protected Australian wildlife.	Airmen and construction contractors will be informed of the protected status of all Australian vertebrates and advised to avoid harm to any animals. If a sensitive species is identified by RAAF personnel in the vicinity of the Proposed Action, operations will cease and measures will be taken under the guidance of RAAF DSG personnel to avoid harming the organism.
Potential introduction of organisms exotic to Australia.	USAF will conform to the policy and procedures agreed on during the 2013 Talisman Sabre exercises.
Heritage	
Disturbance to a previously unidentified archaeological site.	If artifacts are discovered, operations will cease and RAAF DSG personnel will be contacted.
Health and Safety	
Potential wildlife strikes by aircraft.	Report any incidents to the RAAF DSG.
Disease-carrying insects may be present during exercises and construction.	Take precautions to avoid being bitten as outlined by the Northern Territory Department of Health.
Inadvertent discovery of UXO during construction.	Cease operations and notify the RAAF DSG.
Noise	
Increased noise to surrounding community.	Aircraft will be operated in compliance with aircraft operating and local noise abatement procedures. Current rules restrict fighters from departing after 10 PM.

1 SECTION 6.0

2 **Contributing Actions**

3 The following is a list of the actions known to have been taken or planned by the Australian
4 government, or other nation, that may affect environmental considerations. These actions
5 are expected to have an additive effect on environmental resources within the region.
6 However, due to the minimal environmental impact expected from the proposed action, the
7 cumulative effect should be less than significant.

- 8 • In addition to the USAF operations detailed in this ER, Prime Minister Gillard and
9 President Obama also agreed to the increased use of the Northern Territory by the U.S.
10 Marine Corps (USMC) (White House, 2011). USMC operations began in April 2012 with
11 a company-sized unit of 200 marines and are projected to increase to approximately
12 2,500 marines by 2017. Marines are expected to spend most of their time at the Mount
13 Bundy and Bradshaw Training Areas (*Marine Corps Times*, 2012).
- 14 • The Australian military performs a number of large-scale multilateral training exercises
15 annually. These exercises include operations such as Pitch Black and Talisman Sabre, in
16 which the U.S. takes part. During these exercises, numerous Australian military facilities
17 are utilized, including RAAF Bases Darwin and Tindal. Exercises such as Pitch Black
18 and Talisman Sabre involve thousands of military personnel from various nations
19 (Aurecon, 2012).
- 20 • RAAF Bases Darwin and Tindal are actively used facilities; therefore, the infrastructure
21 on both bases is continually maintained and future development is planned. Detailed
22 lists of proposed infrastructure projects on RAAF Base Darwin can be found in the
23 RAAF Base Darwin Master Plan (Woods Bagot, 2009). The RAAF Base Tindal Master
24 Plan, however, currently is being updated.

1 SECTION 7.0

2 **Coordination**

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19 Not Applicable

1 SECTION 8.0

2 **List of Preparers**

3 The following individuals contributed to the preparation of this EA.

Table 8-1
List of Preparers
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1 SECTION 9.0

2 **Acronyms and Abbreviations**

3	AAD	average annual day
4	ABD	average busy day
5	AAM	Advanced Acoustic Model
6	AAQ	ambient air quality
7	ADF	Australian Defence Force
8	AFCEC	Air Force Civil Engineer Center
9	AFCEC Mobile Guide	<i>AFCEC Air Emissions Factor Guide to Air Force Mobile Sources</i>
10	AFH	Air Force Handbook
11	AFI	Air Force Instruction
12	AFJMAN	Air Force Joint Manual
13	AGE	aerospace ground equipment
14	AICUZ	Air Installation Compatible Use Zones
15	ANEF	Australian Noise Exposure Forecast
16	AOR	Area of Responsibility
17	AQIS	Australian Quarantine and Inspection Service
18	BEAR	Basic Expeditionary Airfield Resource
19	BMP	best management practice
20	BRA	bomber replenishment apron
21	CEQ	Council on Environmental Quality
22	CFR	Code of Federal Regulations
23	CITX	Citation X
24	CO	carbon monoxide
25	CO ₂	carbon dioxide
26	CO _{2e}	CO ₂ equivalents
27	DAFF	Department of Agriculture, Fisheries and Forestry
28	dB	decibels

1	dBA	A-weighted decibels
2	DIA	Darwin International Airport
3	DNL	Day-Night Average Sound Level
4	DNWG	Defense Noise Working Group
5	DoD	U.S. Department of Defense
6	DoDD	U.S. Department of Defense Directive
7	DoDI	U.S. Department of Defense Instruction
8	DSG	Defence Support Group
9	EBPC	Environment Protection and Biodiversity Conservation Act
10	EIS	environmental impact statement
11	EPNL	Effective Perceived Noise Level
12	ER	environmental review
13	FAA	Federal Aviation Administration
14	ft ²	square feet
15	GHG	greenhouse gas
16	INM	Integrated Noise Model
17	Lt. Col.	Lieutenant Colonel
18	L _{max}	Maximum Sound Level
19	m ²	square meters
20	Maj.	Major
21	ML	mega liters
22	MRE	meal ready to eat
23	MT	metric ton
24	NA	Number of Events (at or) Above a Selected Threshold
25	NEPA	National Environmental Policy Act
26	NEPM	National Environment Protection Measure
27	NGER	National Greenhouse and Energy Reporting
28	NMAP	Noise Map
29	NO _x	oxides of nitrogen
30	NORFORCE	North-West Mobile Force

1	NPI	National Pollution Inventory
2	O ₃	ozone
3	PACAF	U.S. Pacific Air Forces
4	PM ₁₀	particulate matter less than 10 micrometers in aerodynamic diameter
5		
6	PM _{2.5}	particulate matter less than 2.5 micrometers in aerodynamic diameter
7		
8	PNdB	decibels of perceived noise
9	PNLT	Tone-Corrected Perceived Noise Level
10	POI	point of interest
11	RAAF	Royal Australian Air Force
12	SEL	Sound Exposure Level
13	SO ₂	sulfur dioxide
14	TA	Times (at or) Above a Selected Threshold
15	U.S.	United States
16	UAV	unmanned aerial vehicle
17	USAF	U.S. Air Force
18	USDA	U.S. Department of Agriculture
19	USMC	U.S. Marine Corps
20	US PACOM	U.S. Pacific Command
21	U.S.T.	United States Treaties and other international agreements
22	UXO	unexploded ordnance
23	WHO	World Health Organization
24	WWII	World War II

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Appendix A
Air Emission Calculations

USAF Darwin

Training Frequency (day/yr):	30
JP8 fuel used density (lb/gal) ¹ :	6.67

Aircraft Type	Engine Type ²	Fuel (gal) / day	Personnel	Emissions (ton/day)					Emissions (ton/year)					CO ₂ EF (lb/gal) ⁴	CO ₂ Emissions (Metric Tonnes/year)
				NOx	CO	VOC	PM10	PM2.5	NOx	CO	VOC	PM10	PM2.5		
Bomber (B-52)	TF33-P-3/103	32000	75	0.78	0.42	0.13	0.05	0.04	23.31	12.48	3.79	1.45	1.31	20.88	9,091
Tanker (KC-135)	F108-CF-100	30000	60	0.96	0.44	0.00	0.01	0.01	28.77	13.33	0.11	0.35	0.32	20.88	8,522
Fighter (assume F-22)	F119-PW-100	27000	145	0.82	0.53	0.03	0.16	0.14	24.57	16.00	0.84	4.82	4.34	20.88	7,670
Aircraft Total:									76.65	41.81	4.74	6.62	5.97		25,283

Engine	Power Setting	Duration in power setting (min) ³	% of time	Emission Factors (lb/1000 lb fuel burned) ⁴					Fuel (gal/day)	Emissions (lb/day)				
				NOx	CO	VOC	PM10	PM2.5		NOx	CO	VOC	PM10	PM2.5
TF33-P-3/103 (Bomber)	Idle	Not included for Training (32.8+14.9)	0%	1.39	94.87	86.69	1.9	1.71	0	0	0	0	0	0
	Approach	5.2	62%	6.36	5.23	1.31	0.35	0.32	19810	840	691	173	46	42
	Intermediate = climbout	2.5	30%	7.86	1.86	0.98	0.68	0.61	9524	499	118	62	43	39
	Military = takeoff	0.7	8%	12.05	1.29	0.98	0.39	0.35	2667	214	23	17	7	6
F108-CF-100 (Tanker)	Idle	Not included for Training (32.8+14.9)	0%	3.93	27.13	0.88	0.12	0.11	0	0	0	0	0	0
	Approach	5.2	62%	6.94	6.38	0.04	0.11	0.1	18571	860	790	5	14	12
	Intermediate = climbout	2.5	30%	13.5	1.34	0.03	0.13	0.12	8929	804	80	2	8	7
	Military = takeoff	0.7	8%	15.25	1.12	0.03	0.13	0.12	2500	254	19	1	2	2
F119-PW-100 (F-22)	Idle	Not included for Training (9.2+6.7)	0%	3	48.2	6.48	2.49	2.24	0	0	0	0	0	0
	Approach	4	68%	6.6	7.9	0.29	2	1.8	18305	806	965	35	244	220
	Intermediate = climbout	1.4	24%	12.4	2.1	0.48	1.41	1.27	6407	530	90	21	60	54
	Military = takeoff	0.5	8%	19.8	0.8	0	1.12	1.01	2288	302	12	0	17	15
	AB	NA	0%	7.4	16.1	0.19	NA	NA	0	0	0	0	0	0

Calculated Values

Site Data or Data from Reference Material

Assumed Data

1 Conversion Values Table 2-9 AFCEE, 2009.

2 The APU emissions are not included in this estimate because their emission factors are lower than the main engine emission factor. Engine types were taken from Table 1-2 (AFCEE, 2009).

No emission factors were available for UAVs; therefore, it was assumed that the F-22 would be similar in nature to provide an estimate of the total emissions.

3. Assumed USAF-general for duration in power setting for F-22 and USAF B-52 and KC-135 for Bomber and Tanker, respectively (Table 1-8; AFCEE, 2009).

4. Emission factors are taken from Table 1-4 and 1-9 (AFCEE, 2009).

Notes:

TGO and LFB emissions are calculated in essentially the same manner as LTO emissions. Due to the nature of the operational and training requirements for the cycle, however, the taxi/idle-in and taxi/idleout modes are not included.

Reference: Air Emissions Factor Guide to Air Force Mobile Sources, December 2009.

USAF Tindal

Training Frequency (day/yr): 30
 JP8 fuel used density (lb/gal)¹: 6.67

Aircraft Type	Engine Type ²	Fuel (gal) / day	Personnel	Emissions (ton/day)					Emissions (ton/year)					CO ₂ EF (lb/gal) ⁴	CO ₂ Emissions (Metric Tonnes/year)
				NOx	CO	VOC	PM10	PM2.5	NOx	CO	VOC	PM10	PM2.5		
Bomber (B-52)	TF33-P-3/103	32000	75	0.78	0.42	0.13	0.05	0.04	23	12	4	1	1	20.88	9,091
Tanker (KC-135)	F108-CF-100	30000	60	0.96	0.44	0.00	0.01	0.01	29	13	0.1	0.4	0.3	20.88	8,522
Fighter (assume F-22)	F119-PW-100	27000	145	0.82	0.53	0.03	0.16	0.14	25	16	1	5	4	20.88	7,670
UAV	NA	940	60	0.03	0.02	0.00	0.01	0.01	1	1	0.03	0.2	0.2	20.88	267
Aircraft Total:									78	42	5	7	6		25,550

Engine	Power Setting	Duration in power setting (min) ³	% of time	Emission Factors (lb/1000 lb fuel burned) ⁴					Fuel (gal/day)	Emissions (lb/day)				
				NOx	CO	VOC	PM10	PM2.5		NOx	CO	VOC	PM10	PM2.5
TF33-P-3/103 (Bomber)		Not included for Training (32.8+14.9)												
	Idle		0%	1.39	94.87	86.69	1.9	1.71	0	0	0	0	0	0
	Approach	5.2	62%	6.36	5.23	1.31	0.35	0.32	19810	840	691	173	46	42
	Intermediate = climbout	2.5	30%	7.86	1.86	0.98	0.68	0.61	9524	499	118	62	43	39
	Military = takeoff	0.7	8%	12.05	1.29	0.98	0.39	0.35	2667	214	23	17	7	6
F108-CF-100 (Tanker)		Not included for Training (32.8+14.9)												
	Idle		0%	3.93	27.13	0.88	0.12	0.11	0	0	0	0	0	0
	Approach	5.2	62%	6.94	6.38	0.04	0.11	0.1	18571	860	790	5	14	12
	Intermediate = climbout	2.5	30%	13.5	1.34	0.03	0.13	0.12	8929	804	80	2	8	7
	Military = takeoff	0.7	8%	15.25	1.12	0.03	0.13	0.12	2500	254	19	1	2	2
F119-PW-100 (F-22)		Not included for Training (9.2+6.7)												
	Idle		0%	3	48.2	6.48	2.49	2.24	0	0	0	0	0	0
	Approach	4	68%	6.6	7.9	0.29	2	1.8	18305	806	965	35	244	220
	Intermediate = climbout	1.4	24%	12.4	2.1	0.48	1.41	1.27	6407	530	90	21	60	54
	Military = takeoff	0.5	8%	19.8	0.8	0	1.12	1.01	2288	302	12	0	17	15
	AB	NA	0%	7.4	16.1	0.19	NA	NA	0	0	0	0	0	0
UAV		Not included for Training (9.2+6.7)												
	Idle		0%	3	48.2	6.48	2.49	2.24	0	0	0	0	0	0
	Approach	4	68%	6.6	7.9	0.29	2	1.8	637	28	34	1	9	8
	Intermediate = climbout	1.4	24%	12.4	2.1	0.48	1.41	1.27	223	18	3	1	2	2
	Military = takeoff	0.5	8%	19.8	0.8	0	1.12	1.01	80	11	0	0	1	1
	AB	NA	0%	7.4	16.1	0.19	NA	NA	0	0	0	0	0	0

Calculated Values
 Site Data or Data from Reference Material
 Assumed Data

1 Conversion Values Table 2-9 AFCEE, 2009
 2 The APU emissions are not included in this estimate because their emission factors are lower than the main engine emission factor. Engine types were taken from Table 1-2 (AFCEE, 2009).
 No emission factors were available for UAVs; therefore, it was assumed that the F-22 would be similar in nature to provide an estimate of the total emissions.
 3 Assumed USAF-general for duration in power setting for F-22 and USAF B-52 and KC-135 for Bomber and Tanker, respectively (Table 1-8; AFCEE, 2009).
 4 Emission factors are taken from Table 1-4 and 1-9 (AFCEE, 2009).

TGO and LFB emissions are calculated in essentially the same manner as LTO emissions. Due to the nature of the operational and training requirements for the cycle, however, the taxi/idle-in and taxi/idleout modes are not. Thus a shallow mixing zone height will result in a shorter TIM (and fewer emissions), and a high mixing zone height will result in a longer TIM (and more emissions). While emissions occurring anywhere within this zone will

Reference: Air Emissions Factor Guide to Air Force Mobile Sources, December 2009

1
2

Appendix B
Aircraft Noise Study

- 1 *Do to size limitations the Aircraft Noise Study can be found on the project SharePoint site.*
- 2 *The study will be included in all hardcopies of the document.*

**Aircraft Noise Study for PACAF Exercises
at RAAF Bases Darwin and Tindal,
Northern Territory, Australia**



Contract Number: HC1047-05-D-4005

Task Order: TAT 203

20 February 2013

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1.0 Introduction

The United States (US) Pacific Air Forces (PACAF) is proposing to conduct two 15-day exercises per year at Royal Australian Air Force (RAAF) Bases Darwin and Tindal. RAAF Base Darwin is co-located with Darwin International Airport.

The US Department of Defense (DoD) requires analysis of potential noise impacts and encroachment per DoDD 3200.15. Guidance for noise analysis is provided by the Defense Noise Working Group (DNWG). US Air Force (USAF) noise policy is specified in AFI 32-7063 and AFH 32-7084. The Australian Defence Support Group (DSG) is responsible for assessing environmental impacts on Australian military installations. DSG provides guidance for Australian noise analysis. The noise metrics used by DoD and DSG are different; however, metrics used by DSG are recommended as supplemental metrics by DNWG. Therefore noise analysis in this Technical Note (TN) holds utility for PACAF and DSG decision-makers.

While the proposed USAF exercises would be relatively small, there are sensitivities of how noise is assessed and presented to the Australian public. There is growing concern among the local community regarding military fighter aircraft noise at Darwin and Tindal, among other locations. A community action group in Darwin called BaseWatch has become increasingly active over the past 2-3 years, according to DSG Northern Territory (NT) environmental managers.

This Technical Note (TN) describes the aircraft noise exposure for the proposed PACAF exercises. The exercise is notional for current planning purposes. The categories of aircraft involved in the exercises would be fighters, tankers, bombers, and reconnaissance. The reconnaissance aircraft would only utilize RAAF Base Tindal. With two 15-day exercises per year, either base would endure 30 days of proposed PACAF activity per year.

Section 2 describes the methodology used to perform the noise analysis. Sections 3 and 4 describe the modeled operations and noise exposure at RAAF Bases Darwin and Tindal, respectively.

2.0 Methodology

2.1 Noise Model, AAD and ABD Metrics and Significance Thresholds

This noise analysis was conducted according to established DoD guidelines and best practices and leveraged the DoD NOISEMAP suite of computer-based modeling tools (Czech and Plotkin 1998; Page et al, 2012; Wasmer and Maunsell 2006a; Wasmer and Maunsell 2006b). The suite primarily includes BaseOps, NMAP, the Advanced Acoustic Model (AAM) and NMPlot. NMAP and AAM are semi-empirical models starting their calculations from databases of measured noise levels of dedicated flyovers and run-ups. NMAP's acoustic database is called NOISEFILE and AAM's acoustic database is comprised of Network Common Data Form (NetCDF) files. The versions of NMAP and AAM used for this TN were 7.2 and 1.4.8, respectively.

Four categories of aircraft are modeled -- Fighters (e.g., F-15 Eagle, F-22 Raptor), Tankers (e.g., KC-10 Extender, KC-135 Stratotanker), Bombers (e.g., B-1 Lancer, B-52 Stratofortress) and Reconnaissance (RQ-4 Global Hawk). The loudest aircraft type of each category (on a single-event basis) was modeled, i.e., F-22 for Fighters, KC-10A for Tankers and B-1 for Bombers. The Citation X (CITX) was chosen as a conservative surrogate for RQ-4 flight operations because there is no acoustic reference data for the

RQ-4 in the models. The T-45 was chosen as the surrogate for RQ-4 run-up operations because there is no acoustic reference data for the RQ-4 (or for the CITX) in the models.

NMAP’s database included the aircraft of interest but for AAM, the NetCDF files needed to be developed. NetCDF files basically describe spheres of one-third octave band sound pressure levels (called “noise spheres”) for each aircraft type. A noise sphere consists of spectral noise levels at a specified angular resolution and radius.

The spheres utilized for this project are summarized in Table 2-1. Each aircraft has a set of spheres for different power condition or aircraft configuration (i.e. in flight, static, gear down, afterburner, etc.). The data values of the noise sphere come from either measured or legacy data sources. Legacy data comes via INM’s or NMAP’s database and is in the form of SEL as a function of power setting and nominal spectral levels. Different aircraft types have different directional noise shapes, so these spectral levels are adjusted to account for the directionality of a certain aircraft type. For example, fighter jets have a different “noise footprint” on the ground than tankers. Other considerations, such as Doppler shifts, are also taken into account in the spectral directionality of the sphere data.

Table 2-1. Sphere Summary

Vehicle Category	Aircraft Type	Data Source	Longitudinal Directivity	Lateral Adjustments
Fighters	F-22	Measured Data	Measured	Side-by-side + Rectangular Jet
Tankers	KC-10A	INM	INM Cardioid	None
Bombers	B-1	Noisefile	Nominal Fighter Shape	Side-by-side Jet
Reconnaissance	Citation X / T-45 ⁽¹⁾	Noisefile /INM	INM Cardioid	INM Fuselage-Mounted

Notes: (1) T-45 Used for Static Data, Citation X used for Flight Data

The US and Australia rely on cumulative metrics for evaluation of noise exposure. In the US, the DOD via DOD Instruction (DODI) 4165.57 requires cumulative noise exposure be described and presented in terms of Day-Night Average Sound Level (DNL). DNL is a composite noise metric accounting for the sound energy of all noise events in a 24-hour period. Flight and run-up events are measured in terms of their (integrated, normalized to one second) Sound Exposure Level (SEL) and (instantaneous) Maximum Sound Level (L_{max}), respectively. SEL and L_{max} are expressed in A-weighted decibels (dB or dBA). In order to account for increased human sensitivity to noise at night, a 10 dB penalty is applied to nighttime events (10:00 p.m. to 7:00 a.m. time period).

In Australia, the DSG requires cumulative noise exposure be described in terms of the Australian Noise Exposure Forecast (ANEF). Like DNL, ANEF is a composite noise metric accounting for the sound energy of all noise events in a 24-hour period, but ANEF is based on Effective Perceived Noise Level (EPNL) for flight events and Tone-Corrected Perceived Noise Level (PNLT) for run-up events. EPNL and PNLT are expressed in decibels of perceived noise (PNdB). The other differences between DNL and ANEF are ANEF’s nighttime period is from 7:00 p.m. to 7:00 a.m. and its nighttime penalty is 6 dB.

NMAP and AAM can directly compute US NEF but not ANEF. US NEF has the following features:

- a) Daytime period of 7:00 a.m. to 10:00 p.m.
- b) Nighttime period of 10:00 p.m. to 7:00 a.m.
- c) Nighttime weighting of 12.2 PNdB (multiplier of 16.67).

To compute ANEF, evening (7:00 p.m. to 10:00 p.m.) operations were assigned to the nighttime period and the resultant ANEF nighttime (7:00 p.m. to 7:00 a.m.) operations were divided by 4.1675 (i.e. 16.67/4) prior to entry to NMAP or AAM. The FAA's Integrated Noise Model (INM) can compute ANEF directly (see below for how INM was applied and its citation).

Due to their 24-hour nature, DNL and ANEF require flight and run-up operations to be described on a daily basis. Per DODI 4165.57, cumulative noise exposure can be presented in terms of annual average daily (AAD) operations and/or average busy day (ABD) operations. AAD is simply the number of annual operations divided by 365. ABD is defined as the number of operations occurring during the exercises divided by the number of exercise days. For this TN, as there are two identical exercises, each lasting 15 days, the total number of annual exercise operations is divided by 30.

Table 2-1 lists the noise metric computed for this TN, contours shown and thresholds chosen. For DNL and ANEF, contour levels of 65-85 dB DNL and 20-40 PNdB, in 5 dB increments are presented. This TN also includes presentation of DNWG supplemental metrics of Number of Events (at or) Above a Selected Threshold (NA) and Time (at or) Above a Selected Threshold (TA) (DNWG 2009). For NA and TA, thresholds of 70, 85 and 100 dBA L_{max} were selected. As companion to the NA and TA maps, the L_{max} was also computed with showing contours of 70, 85 and 100 dBA. All of the metrics, except ANEF, were computed for the ABD (PACAF exercises only).



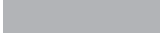
The official 2030 ANEF at Darwin is based on 173 flying days during the wet season (low-tempo) and includes civilian and military activity. It was previously modeled using standard weather values of 59°F and 70% RH (DSG 2010). This is considered baseline at Darwin. PACAF exercise activity was scaled to the 173 flying days with the same weather condition to make direct comparison of ANEF for contribution of proposed action.

ANEF contours are formally adopted and designate official forecast of aircraft operations noise. Scenarios other than the official ANEF are considered by DSG to be a concept and denoted as Australian Noise Exposure Concept (ANEC). Inclusion of the PACAF exercise in the 2030 ANEF is considered a concept and will be referred to as the Proposed Action ANEC or ANEC, for the purposes of this report.

As depicted in Table 2-2, NMAP was used to compute DNL and ANEC for PACAF exercise aircraft operations. The FAA's Integrated Noise Model (INM), Version 6.2a (FAA 2002), was used to compute ANEF for non-PACAF aircraft at Darwin. AAM was used to compute NA, TA and L_{max} . NMAP 7.2 is not able to compute NA, TA or L_{max} . INM 6.2a was used on previous DSG analyses (DSG 2010).

Table 2-2. Metrics Computed and Types of Daily Events

Metric	Contours or Thresholds Shown/ Computed	Darwin	Tindal
DNL (dBA)	65, 70, 75, 80, 85	Baseline = ANEC1+ANEC2+ANEC3; Proposed = Baseline+PACAF aircraft; AAD only	AAD, ABD (PACAF exercises only)
ANEF (PNdB)	20, 25, 30, 35, 40	2030 ANEF = ANEC2 for non-PACAF aircraft; Proposed = 2030 ANEF + PACAF aircraft; averaged over 173 days	AAD only (PACAF exercises only)
NAxxxALM	70, 85, 100 dBA; 1, 15, 30 events per 24 hours	ABD only (PACAF exercises only)	
TAxxxALM	70, 85, 100 dBA; 1, 5, 10, 15 minutes per 24 hours		
Lmax (dBA)	70, 85, 100		

 = INM for non-PACAF exercise aircraft + NMAP for PACAF exercise aircraft
 = NMAP
 = AAM

Noise-sensitive land uses, such as housing, schools, places of worship, and medical facilities are considered as being compatible in areas where the AAD DNL is less than 65 dB. Noise sensitive land uses are discouraged in areas where the AAD DNL is between 65 and 69 dB, and strongly discouraged where the AAD DNL is between 70 and 74 dB. At higher levels, i.e. greater than 75 dB, land use and related structures are not compatible and should be prohibited.

NMAP, AAM and INM can incorporate the number of day, evening, and night operations, flight paths, and profiles of the aircraft to calculate the noise metrics at many points five feet above the surface around the two bases. This process results in a “grid” file containing noise levels at different points of a user specified rectangular area. For NMAP and AAM, the spacing of the grid points for this study was 500 feet. INM computes an irregular grid with ‘refinement’ and ‘tolerance’ parameters. Consistent with previous DSG analyses of Darwin, a refinement and tolerance of 10 and 0.1 dB, respectively, were used.

The programs can also compute all metrics for specific Points of Interest (POI), e.g., noise-sensitive receptors, and determine the primary contributors to the overall DNL at each point. For this study, five POIs were modeled in the vicinity of Tindal, and 19 POIs were modeled in the vicinity of Darwin. See Sections 3 and 4 for further discussion of the POIs and the resulting noise levels at each POI.

In calculating time-average sound levels for airfields, the reliability of the results varies at lower levels (below 45 dB DNL/ L_{eq}). This arises from the increasing variability of individual aircraft sound levels at the longer distances due to atmospheric effects on sound propagation and to the presence of other sources of noise. Also, when flight activity is infrequent, the time-averaged sound levels are generated by only a few individual aircraft noise events, which may not be statistically representative of the given aircraft modeled. Time-averaged outdoor sound levels less than 45 dB DNL are well below any

currently accepted guidelines for aircraft noise compatibility. Most of the guidelines for the acceptability of aircraft noise are on the order of 65 dB and higher. Therefore, DNL less than 45 dB are presented herein as “<45 dB”. Furthermore, ANEF less than 0 PNdB are presented as “<0 PNdB”.

The models listed herein are the most accurate and useful for comparing "before-and-after" noise levels that would result from alternative scenarios when calculations are made in a consistent manner. The programs allow noise exposure prediction of such proposed actions without actual implementation and/or noise monitoring of those actions.

2.2 Geospatial Data

The NOISEMAP suite of programs includes the ability to account for atmospheric sound propagation effects over varying terrain, including hills and mountainous regions, as well as regions of varying ground acoustical impedance—for example, water around coastal regions. This feature is used in computing the NMAP- and AAM-generated noise levels presented in this analysis. By including terrain in the propagation calculations, the shielding effect of landforms can be included in the analysis.

Elevation grid files with a grid point spacing of 500 feet were created from the 1 arc-second Shuttle Radar Topographic Mission (SRTM) derived smoothed Digital Elevation Model (DEM-S) Version 1.0 data (Geoscience Australia 2012). This data represents ground surface topography, excluding vegetation features, and has been smoothed to reduce anomalies and improve the representation of surface shape. The data provides substantial improvements in the quality and consistency of the data relative to the original SRTM data, but is not free from artifacts. SRTM data is 'first return' data, i.e., the elevations measured are that of the first reflective surface that the radar signal encounters. While vegetation was removed from this final dataset, man-made structures such as urban areas and power line towers were not. Although INM cannot account for the shielding effect of landforms, it can account for the elevation of the terrain.

Acoustical impedance describes how sound is reflected or absorbed by the surface. Sound tends to travel farther over hard surfaces, such as pavement or water, than it does over soft surfaces, such as plowed earth or vegetation. This feature was used for computing the noise levels presented in this analysis. The Katherine River northwest of RAAF Tindal, and the Beagle Gulf and Port Darwin surrounding RAAF Darwin were modeled as hard surfaces with acoustical impedance (flow resistivity) of 1,000,000 kPa-s/m². This is consistent with standard practice, and all non-water surfaces in the study area were modeled with "soft" acoustical impedance (flow resistivity) of 200 kPa-s/m².

INM's algorithms approximate “soft” ground impedance for all surfaces.

3.0 RAAF Darwin

RAAF Darwin is co-located with Darwin International Airport (DRW) in Darwin, Northern Territory (NT). With a population of approximately 212,000, the city of Darwin holds approximately 90 percent of the population of the NT (233,000 people). DRW is one of a small handful of Australian airports which do not operate with a nighttime curfew. The preponderance of activity is civilian passenger jets with large percentage of operations occurring between 11:00 p.m. and 3:00 a.m. These are typically in-bound international flights with connections to Sydney, Brisbane or Melbourne. The midnight departures from DRW are scheduled to arrive between 6:00 a.m. and 7:00 a.m. at other major Australian airports in order to match their morning international connections (Robinson 2012a).

No permanent military aircraft are based at RAAF Darwin. However, RAAF Darwin is used for several Australian and multi-nation military exercises. Examples of on-going joint exercises are Pitch Black and

Talisman-Sabre which occur biennially on alternating years. Such military exercises typically occur during the dry season (May-Oct) (Robinson 2012a).

The following three subsections detail the modeling data and the resultant noise exposure in the vicinity of RAAF Darwin.

3.1 Modeling Data

As provided by PACAF (Robinson 2012b), Table 3-1 details the proposed flight operations at RAAF Darwin which would total nearly 1,000 annual PACAF military operations. There would be two exercises per year, and each exercise would last 15 days resulting in a total of 30 operating days per year for PACAF aircraft at RAAF Darwin. The temporal utilization of each aircraft category was from interviews with RAAF operators (Robinson 2012a). No departure flight operations occurring during the DNL nighttime period (10:00 p.m. to 7:00 a.m.) are anticipated. Two percent of Fighter arrivals would be during the DNL nighttime period whereas five percent of Tanker and Bomber arrivals would be during the DNL nighttime period. No pattern operations are forecast.

The Fighters would perform only pitch-out arrivals with no straight-in arrivals while the Tankers and Bombers would perform only straight-in arrivals.

The runway and flight track utilization percentages are listed in Table 3-2. For each operation type and all three modeled aircraft types, Runways 29 and 11 would be used for 65 and 35 percent of flight operations, respectively. Runway utilization was derived from previous Darwin modeling (DSG 2010).

Table 3-2 also lists the flight track utilization. As there would only be one flight track per combination of operation type and runway, this portion of Table 3-2 is blank. The modeled flight tracks for the PACAF aircraft at DRW are presented in Figure 3-1. The modeled arrival and departure KC-10 and B-1 flight tracks are straight-out departures and straight-in arrivals. The modeled F-22 departures are straight-out. The modeled F-22 arrivals are pitch-out arrivals derived from a Wyle F-22 pilot (Batterton 2013a) which break at the beginning of the runway, have an abeam distance of 1 nm, a 1 nm downwind segment, and a 1 nm final leg.

With regard to flight profile utilization in Table 3-2, the Bomber category was modeled with the B-1 aircraft type. As such, it was assumed all B-1 departures would employ afterburner takeoffs. Conversely, the Fighter category is assumed to never utilize afterburners on takeoff. Representative profiles for each modeled aircraft type are presented in Appendix A. F-22 profiles were reviewed and modified via flight simulator by a Wyle F-22 pilot (Batterton 2013b).

As NOISEMAP requires events to be input on an average daily basis, the annual flight operations of Table 3-1 were divided by the number of flying days shown in Table 3-1 for the ABD case (and the L_{max} , TA and NA metrics) or by 365 for the AAD DNL case.

Run-ups are events that take place with the aircraft parked on the ground and the engine running to conduct various pre-flight checks, tests or repairs. Sometimes the engine may be removed from the aircraft, but for all run-ups at Darwin, the engines would remain in-frame.

At RAAF Darwin, all three modeled aircraft perform various types of run-ups. Table 3-3 presents the annual run-up events for PACAF exercises at RAAF Darwin. Figure 3-2 presents the modeled run-up pad locations listed in Table 3-3. All three modeled aircraft are expected to perform 5-minute pre-flight checks at the hammerheads of the runways. Fighters, Tankers and Bombers would perform “warm-up” run-ups prior to each departure at their respective ramp location. The F-22, KC-10 and B-1 warm-ups would be 15 minutes, 5 minutes and 30 minutes, respectively. The B-1 would also conduct 5-minute “cool down” run-ups after each arrival. All of these run-ups would be at relatively low power settings.

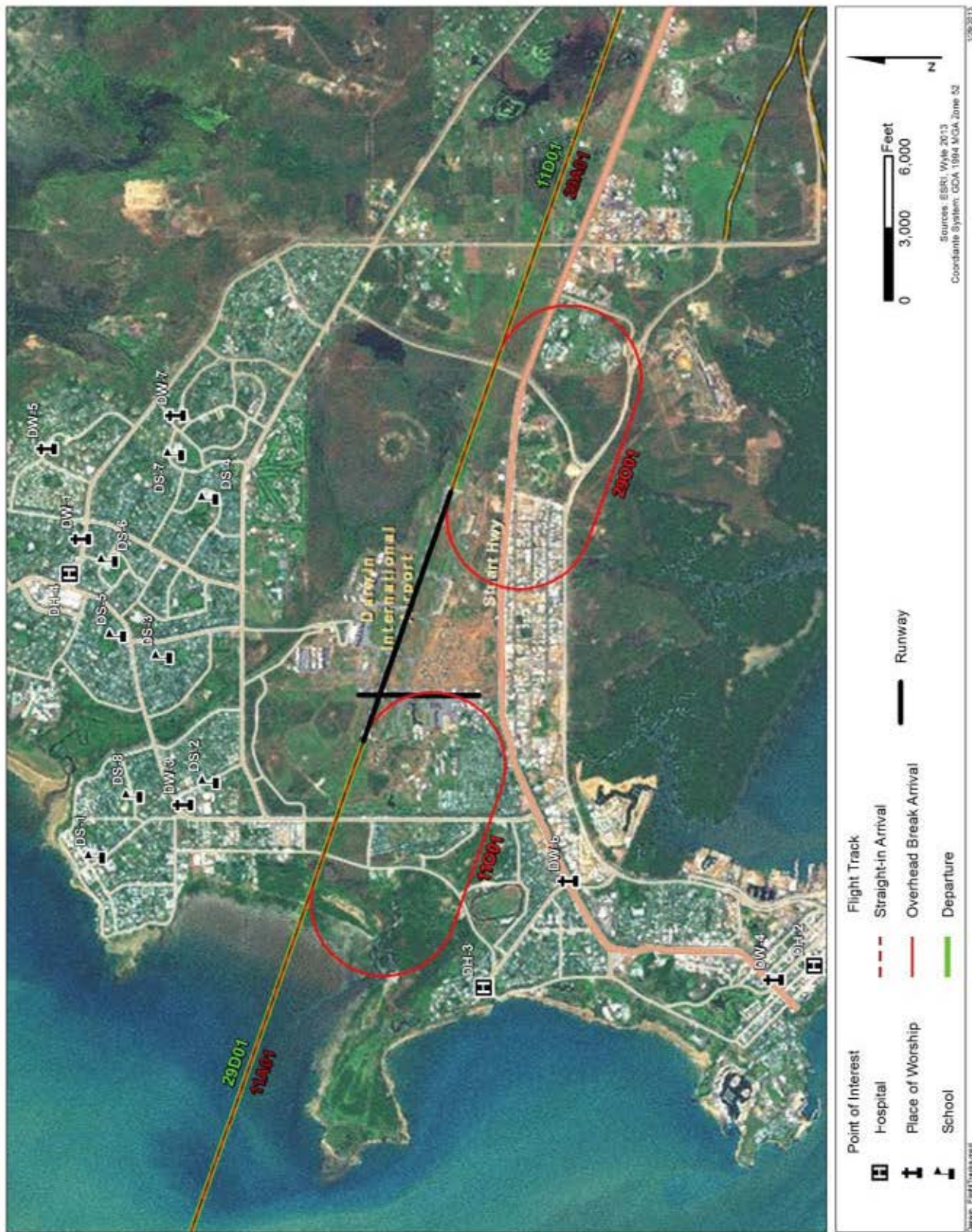


Figure 3-1. Modeled Flight Tracks at RAAF Darwin



Figure 3-2. Modeled PACAF Aircraft Run-up Locations at RAAF Darwin

Table 3-1. Annual Flight Operations for PACAF Exercises at RAAF Darwin (2 x 15 day Exercises per Year)

Group	Modeled Aircraft Type	Number of Flying Days (1)	Temporal Departure Utilization			Temporal Arrival Utilization		
			Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)
Fighter (F-15E, F-22)	F-22	30	95%	5%	0%	90%	8%	2%
Tanker (KC-10)	KC-10A	30	95%	5%	0%	55%	40%	5%
Bomber (B-1, B-52)	B-1	30	95%	5%	0%	55%	40%	5%
Reconnaissance	n/a	n/a	95%	5%	0%	90%	8%	2%

Group	Modeled Aircraft Type	Number of Flying Days (1)	Departure				Straight-in Arrival				Pitch-Out Arrival				Total			
			Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total
Fighter (F-15E, F-22)	F-22	30	342	18	-	360	-	-	-	-	324	29	7	360	666	47	7	720
Tanker (KC-10)	KC-10A	30	57	3	-	60	33	24	3	60	-	-	-	-	90	27	3	120
Bomber (B-1, B-52)	B-1	30	57	3	3	63	33	24	3	60	-	-	-	-	90	27	6	123
Reconnaissance	n/a	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL			456	24	3	483	66	48	6	120	324	29	7	360	846	101	16	963

Note:

1) 2 exercises per year, 15 days per exercise

Table 3-2. Runway and Flight Track Utilization of Modeled PACAF Aircraft at RAAF Darwin

Modeled Aircraft Type	Operation Type	Runway				Flight Track				Profile					
		ID	Percentages (1)			ID	Description	Percentages (2) (if not 100%)			ID	Description	Percentages (3) (if not 100%)		
			Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)			Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)			Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)
F-22	Departure	11	35%	35%	35%	11D01	Straight Out Departure				101	Afterburner	0%	0%	0%
		29	65%	65%	65%	29D01	Straight Out Departure				100	Mil			
	Straight-in Arrival	11	35%	35%	35%	11A01	Straight In Arrival				103	Afterburner	0%	0%	0%
		29	65%	65%	65%	29A01	Straight In Arrival				102	Mil			
	Pitch-out Arrival	11	35%	35%	35%	11O01	Pitch-out Arrival; Break at beginning of runway; 1 NM Abeam; 1 NM Downwind; 1 NM Final				120	Standard Arrival			
		29	65%	65%	65%	29O01	Pitch-out Arrival; Break at beginning of runway; 1 NM Abeam; 1 NM Downwind; 1 NM Final				121	Standard Arrival			
KC10A	Departure	11	35%	35%	35%	11D01	Straight Out Departure				200	Standard Departure			
		29	65%	65%	65%	29D01	Straight Out Departure				201	Standard Departure			
	Straight-in Arrival	11	35%	35%	35%	11A01	Straight In Arrival				210	Standard Arrival			
		29	65%	65%	65%	29A01	Straight In Arrival				211	Standard Arrival			
B-1	Departure	11	35%	35%	35%	11D01	Straight Out Departure				300	Afterburner			
		29	65%	65%	65%	29D01	Straight Out Departure				301	Afterburner	0%	0%	0%
	Straight-in Arrival	11	35%	35%	35%	11A01	Straight In Arrival					Mil	0%	0%	0%
		29	65%	65%	65%	29A01	Straight In Arrival				310	Standard Arrival			
										311	Standard Arrival				

Note:

- 1) within runway op type
- 2) within specific runway
- 3) within specific flight track

Table 3-3. Annual PACAF Run-up Events at RAAF Darwin (2 x 15 Day Exercises per Year)

Aircraft Type	Engine Type	Run-up Type	In-frame / Out-of-frame	Run-up Pad ID	Magnetic Heading (degrees)	Pad%	Annual Events				Power Setting	Duration (Minutes Per Event)	# of Engines Running (per event)
							Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total			
F-22	F119-PW-100	15 min Warm-up	In-frame	FRA1	20	50%	171	9	-	180	10% ETR	15	2
				FRA2	20	50%	171	9	-	180	10% ETR	15	2
		Hammerhead pre-flight checks	In-frame	HH11	20	35%	120	6	-	126	10% ETR	5	2
			In-frame	HH29	20	65%	222	12	-	234	10% ETR	5	2
KC-10A	CF6-50C2	5 min Warm-up	In-frame	BRA1	20	50%	29	2	-	30	24% N1	5	3
				BRA2	20	50%	29	2	-	30	24% N1	5	3
		Hammerhead pre-flight checks	In-frame	HH11	20	35%	20	1	-	21	24% N1	5	3
			In-frame	HH29	20	65%	37	2	-	39	24% N1	5	3
B-1	F101-GE-100	30 min warm-up/ 5 min cool-down	In-frame	BRA1	20	50%	29	2	2	32	80% RPM	30	4
						50%	17	12	2	30	80% RPM	5	4
				BRA2	20	50%	29	2	2	32	80% RPM	30	4
						50%	17	12	2	30	80% RPM	5	4
		Hammerhead pre-flight checks	In-frame	HH11	20	35%	20	1	1	22	80% RPM	5	4
				HH29	20	65%	37	2	2	41	80% RPM	5	4

3.2 Noise Exposure

Figure 3-3 shows the Baseline 65 dB to 85 dB DNL contours in 5 dB increments at Darwin for annual average daily (AAD) operations. Baseline represents all existing and forecasted civilian and military activity as modeled previously in the 2030 ANEC, including low-tempo wet season activity, high-tempo dry season activity and helicopter activity. All operations were averaged over 365 days and modeled for weather conditions specific to season, i.e. wet season corresponds to November-April conditions and dry season corresponds to May-October conditions. Weather data used was the 56-year average for the 3pm temperature and relative humidity obtained from Australian Bureau of Meteorology (ABM 2012a).

USAF policy for significant noise impact is determined on a case-by-case basis due to the wide variety of aircraft, e.g. fighters, heavies, props, etc. and operation types (year-round operations to short-duration exercises) at differing locations (urban to rural). In general, a 2 dB or greater increase within the AAD 65 dB DNL contour is considered significant.

Figure 3-4 shows the resultant 65 dB to 85 dB DNL contours in 5 dB increments for Proposed Action Darwin AAD, i.e. Baseline plus PACAF exercises. Comparison of Proposed Action to Baseline is shown in Figure 3-5. It can be seen that the increase in AAD DNL for the Proposed Action would be minimal for all areas with some increase to the west of Runway 29. No noise sensitive area within the AAD 65 dB DNL contour would experience an increase greater than or equal to 2 dB DNL. Therefore, per USAF policy, there would be no significant impact or potential for harm from the Proposed Action.

Figure 3-6 shows the resultant 65 dB to 85 dB DNL contours in 5 dB increments for Darwin ABD PACAF exercises only, i.e. average noise exposure during the exercise. The 65 dB DNL contour would extend approximately 2.25 miles to the northwest from the shoreline and approximately 3.3 miles from the threshold of the approach end of Runway 29 to the southeast. The halfwidth of the 65 dB DNL contour, i.e., distance perpendicular to Runway 11/29, would be approximately 4800 feet.

Among the PACAF aircraft, DNL exposure would be dominated nearly equally by the Fighter and Bomber flight operations. This is because the modeled B-1 bomber departs using afterburner (AB). Other bomber aircraft would likely generate less exposure than the Fighters because other bomber aircraft (i.e., B-52) do not have AB capability.

Figures 3-7 through 3-13 show the 24-hour L_{max} , NA and TA contours and gradients for Darwin ABD PACAF exercises only, per Table 2-2.

Figure 3-14 shows the resultant 20 dB to 40 dB ANEC contours in 5 dB increments for Darwin ABD (173 days). Figure 3-12 includes non-exercise aircraft. The 20 PNdB ANEC contour would extend approximately 2.4 miles to the northwest from the shoreline and approximately 3.75 miles from the threshold of the approach end of Runway 29 to the southeast. The halfwidth of the 20 PNdB ANEC contour would be approximately 1 mile. ANEC exposure would be dominated by PACAF's Bomber flight operations.

The modeled Points of Interest (POI) selected for RAAF Darwin were depicted in the aforementioned figures but are shown by themselves in their entirety in Figure 3-13. The POIs are located north and southwest of the airfield and consist of 4 hospitals, 8 schools and 7 places of worship. Two of the POIs (DH-1 Royal Darwin Hospital and DW-2 Christ Cathedral Anglican) are too far north and south of the airfield to be included in the extents of Figures 3-3 through 3-12.

Table 3-4 presents the noise metrics computed for ABD operations for each of the 19 POI for RAAF Darwin. No POIs would be exposed to DNL greater than or equal to 65 dB. The POI with the greatest DNL would be DS-2 (Millner Primary School) with a DNL of 63 dB.

Table 3-4 also lists the L_{max} , NA and TA for each of the Darwin POI. L_{max} would range from 77 dB at DW-2 (Christ Cathedral Anglican) to 94 dB at DS-2 (Millner Primary School). Correspondingly, no events or time at or above 100 dB L_{max} would occur at the selected POI. The greatest NA 70 dB L_{max} would be 14 at 9 of the 19 POI (i.e., 6 schools and 3 places of worship). This analysis assume conservative (over-estimate) worst-case scenario with loudest fighters (F-22) and bombers (B-1). If different aircraft were modeled then the exposure would be less. Additionally, the levels presented reflect outdoor noise levels. With open or closed windows, indoor noise levels would be attenuated by approximately 15 or 25 dB, respectively (USEPA 1974). The intuitive conclusion is that noise exposure at the POI during the proposed exercise would be noticeable with single events noise levels increasing above ambient noise levels; however cumulative daily exposure will not be intrusive or significant.

Table 3-5 presents the noise metrics computed for AAD operations for each of the 19 POI for RAAF Darwin. No POI would be exposed to DNL greater than or equal to 65 dB due to PACAF operations.

All POI would be exposed to ANEF less than or equal to 20 PNdB due to PACAF and non-PACAF operations. The POI with the greatest DNL and ANEF would be DS-2 (Millner Primary School) with a DNL of 52 dB and an ANEF of 20 PNdB.

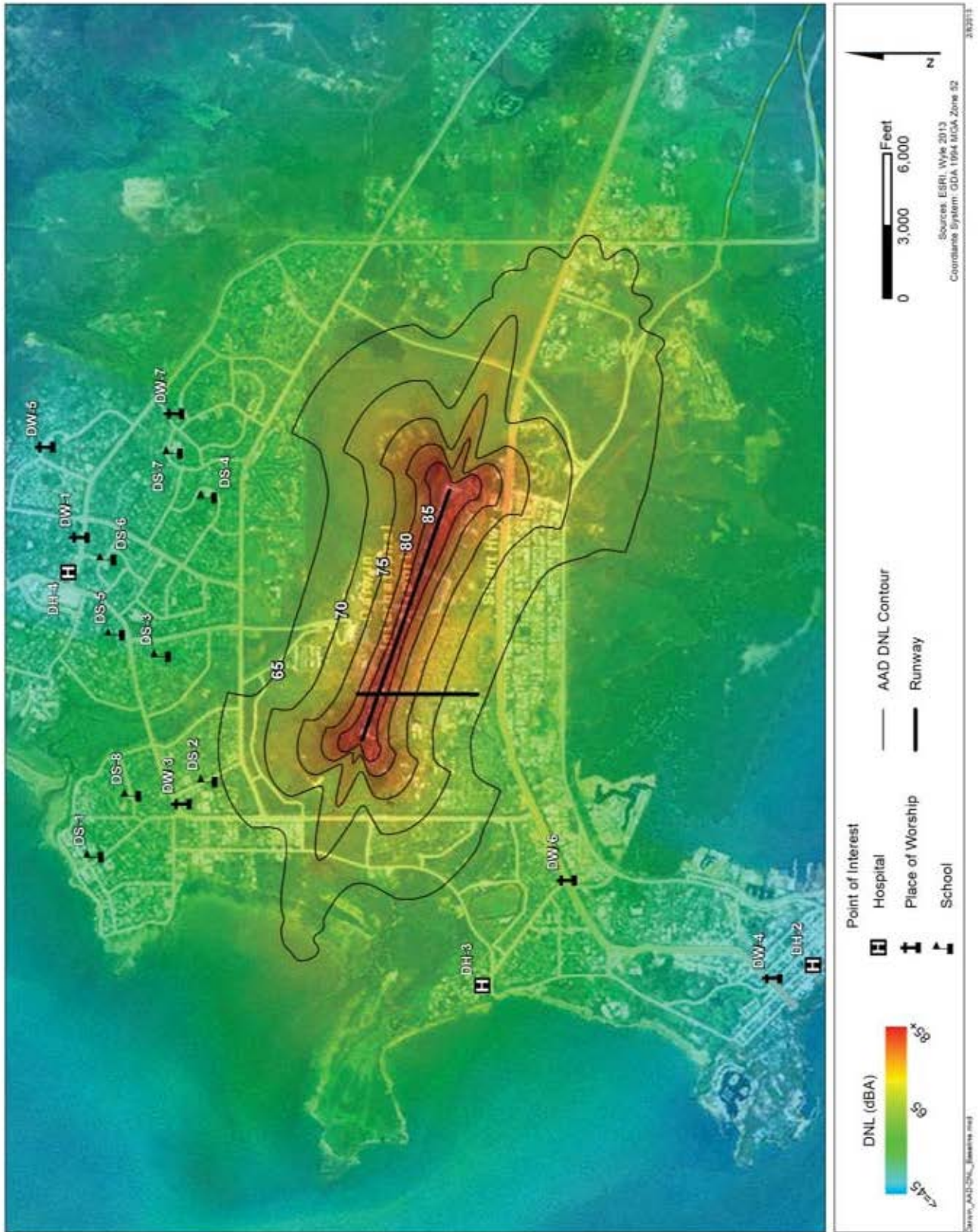


Figure 3-3. DNL Contours and Gradient for Baseline AAD Aircraft Operations at RAAF Darwin

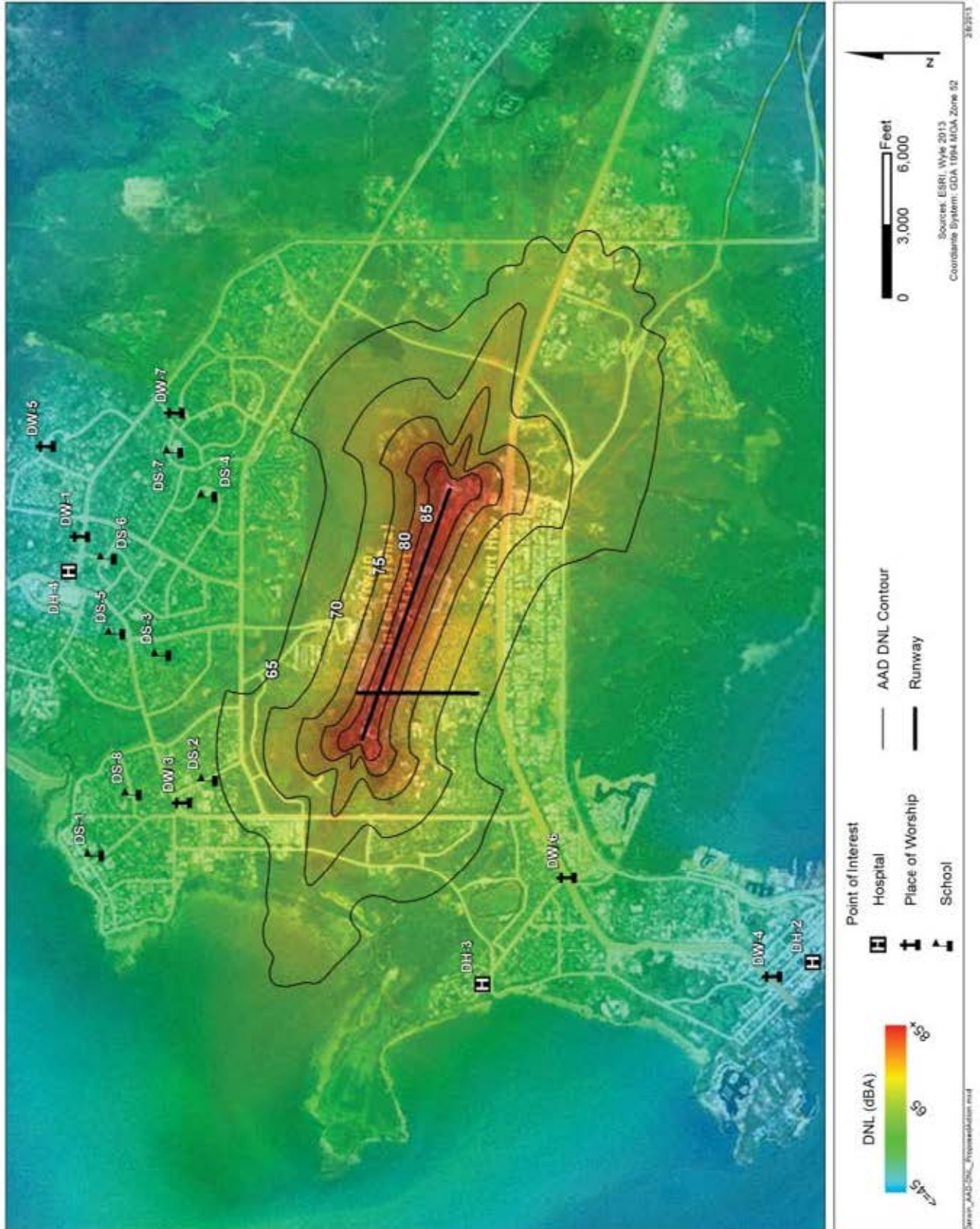


Figure 3-4. DNL Contours and Gradient for Proposed Action AAD Aircraft Operations at RAAF Darwin



Figure 3-5. Comparison of Baseline and Proposed Action DNL Contours for AAD Aircraft Operations at RAAF Darwin

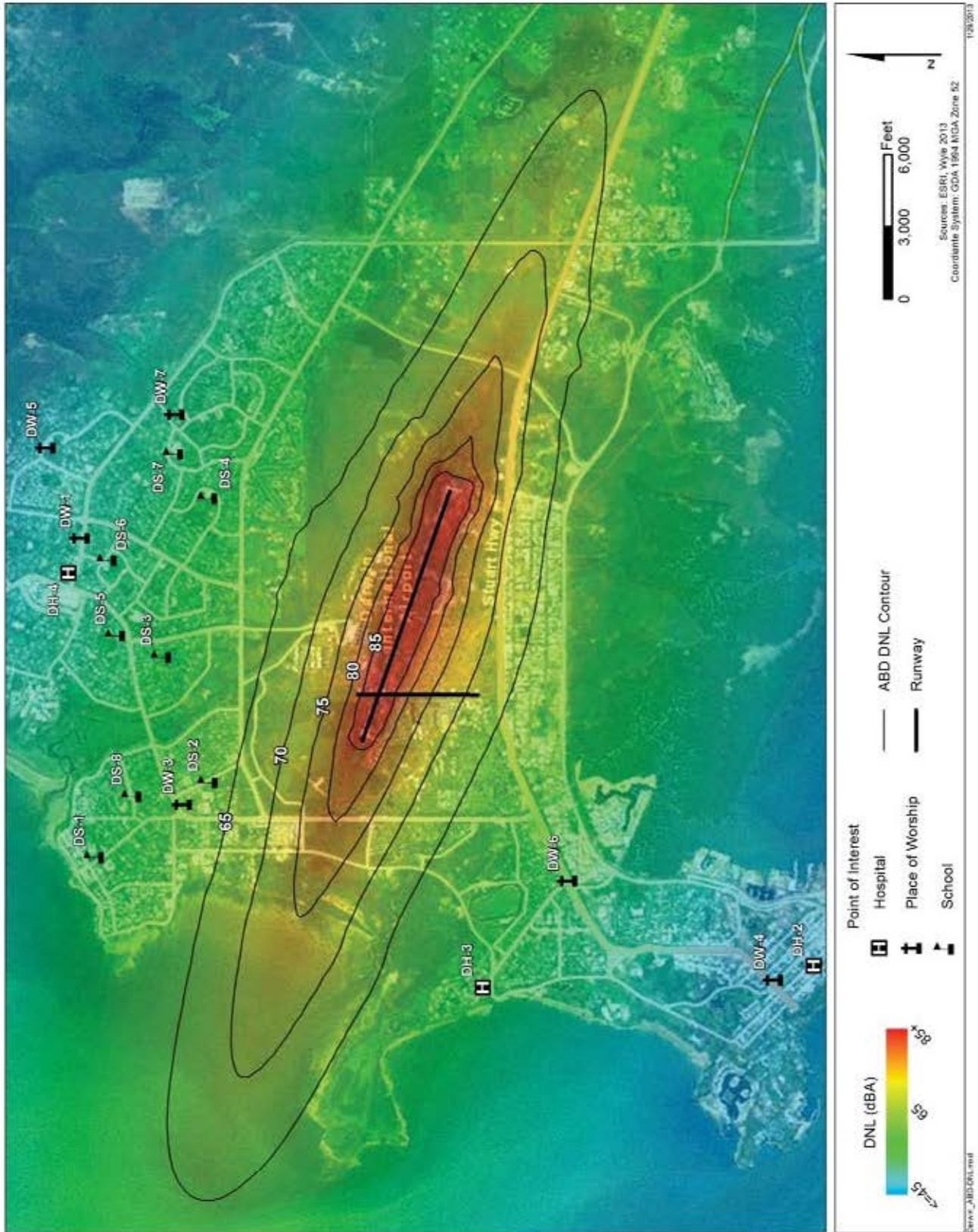


Figure 3-6. DNL Contours and Gradient for PACAF ABD Aircraft Operations at RAAF Darwin

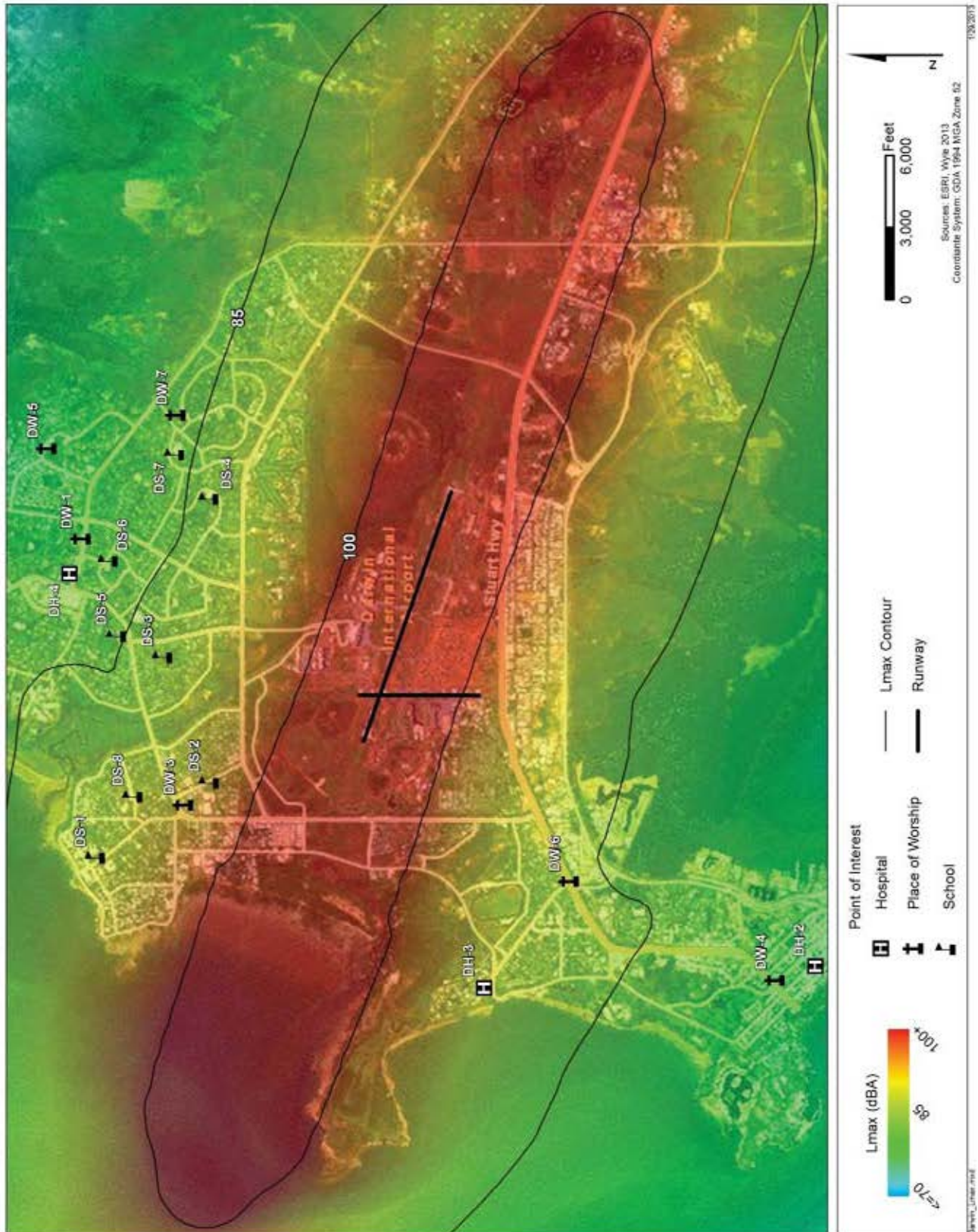


Figure 3-7. A-weighted Maximum Sound Level Contours and Gradient for PACAF Aircraft Operations at RAAF Darwin

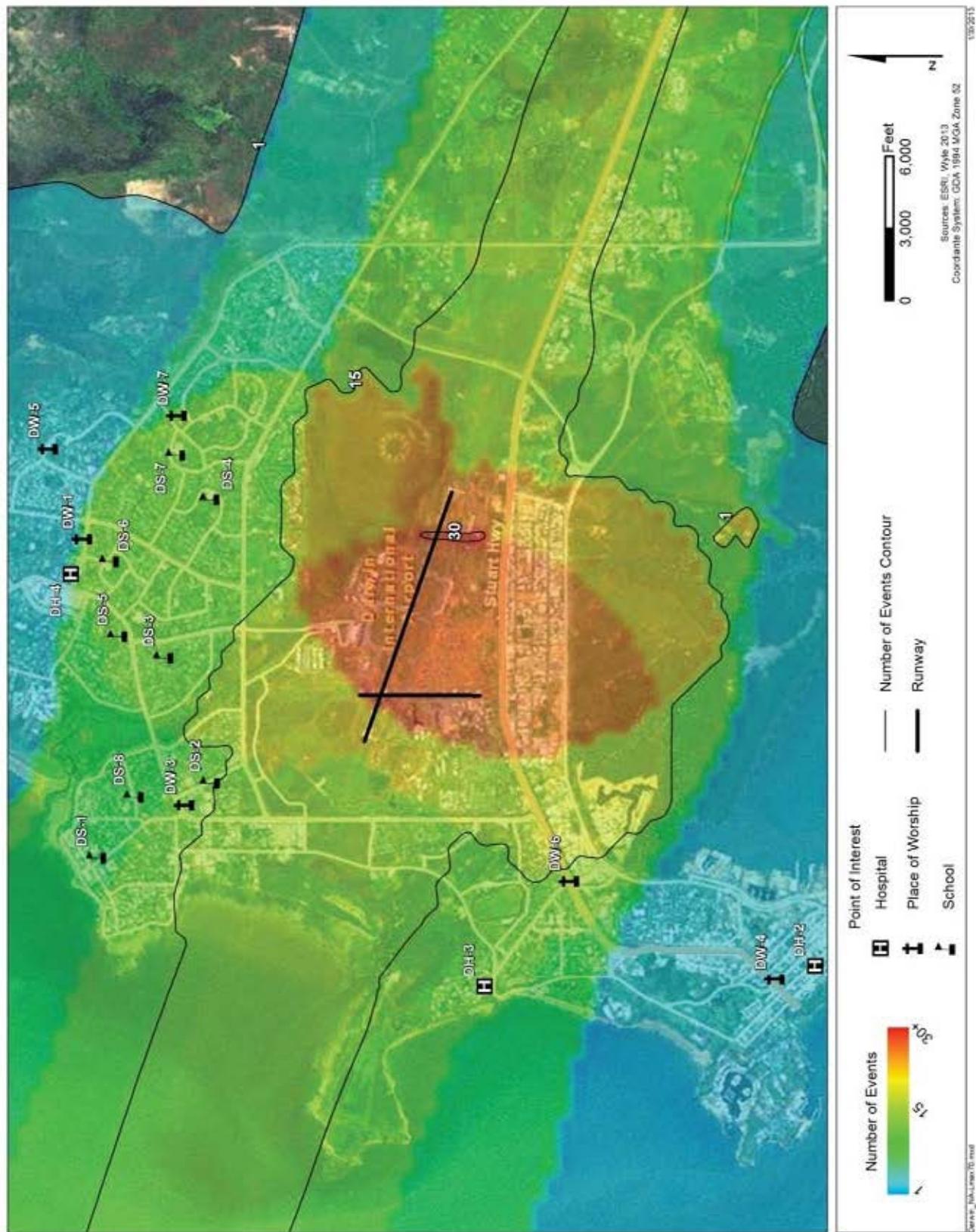


Figure 3-8. NA070ALM Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Darwin

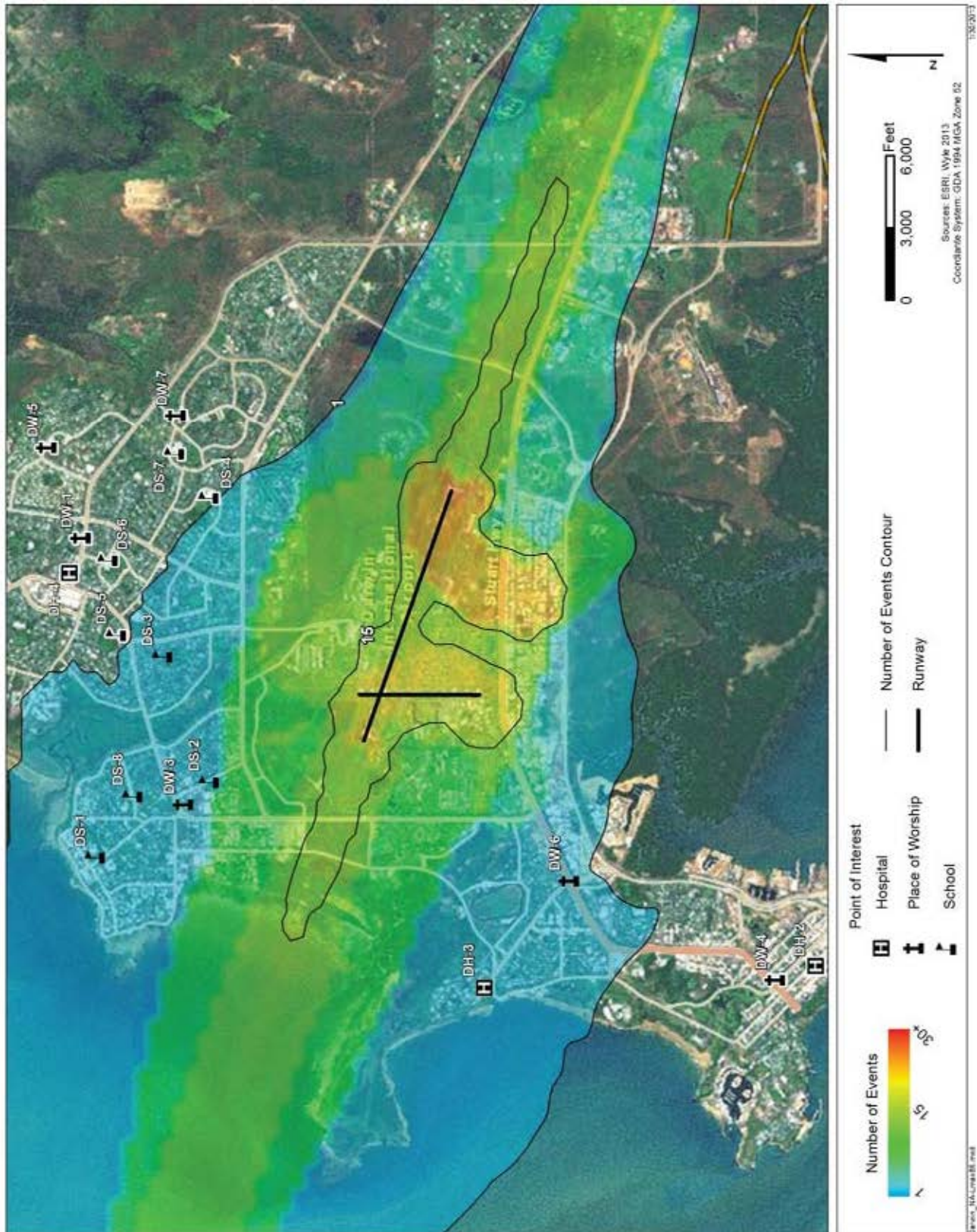


Figure 3-9. NA085ALM Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Darwin

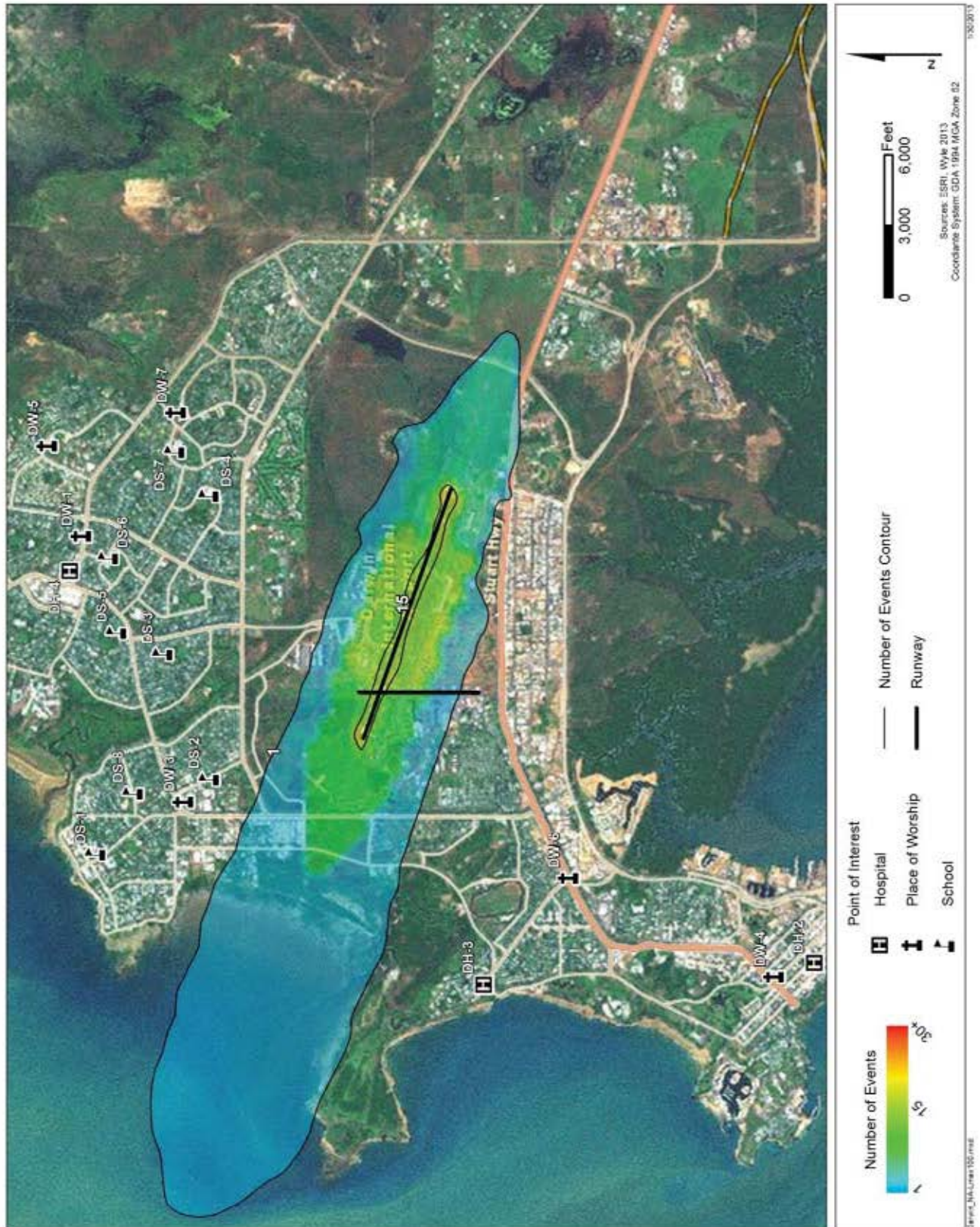


Figure 3-10. NA100ALM Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Darwin

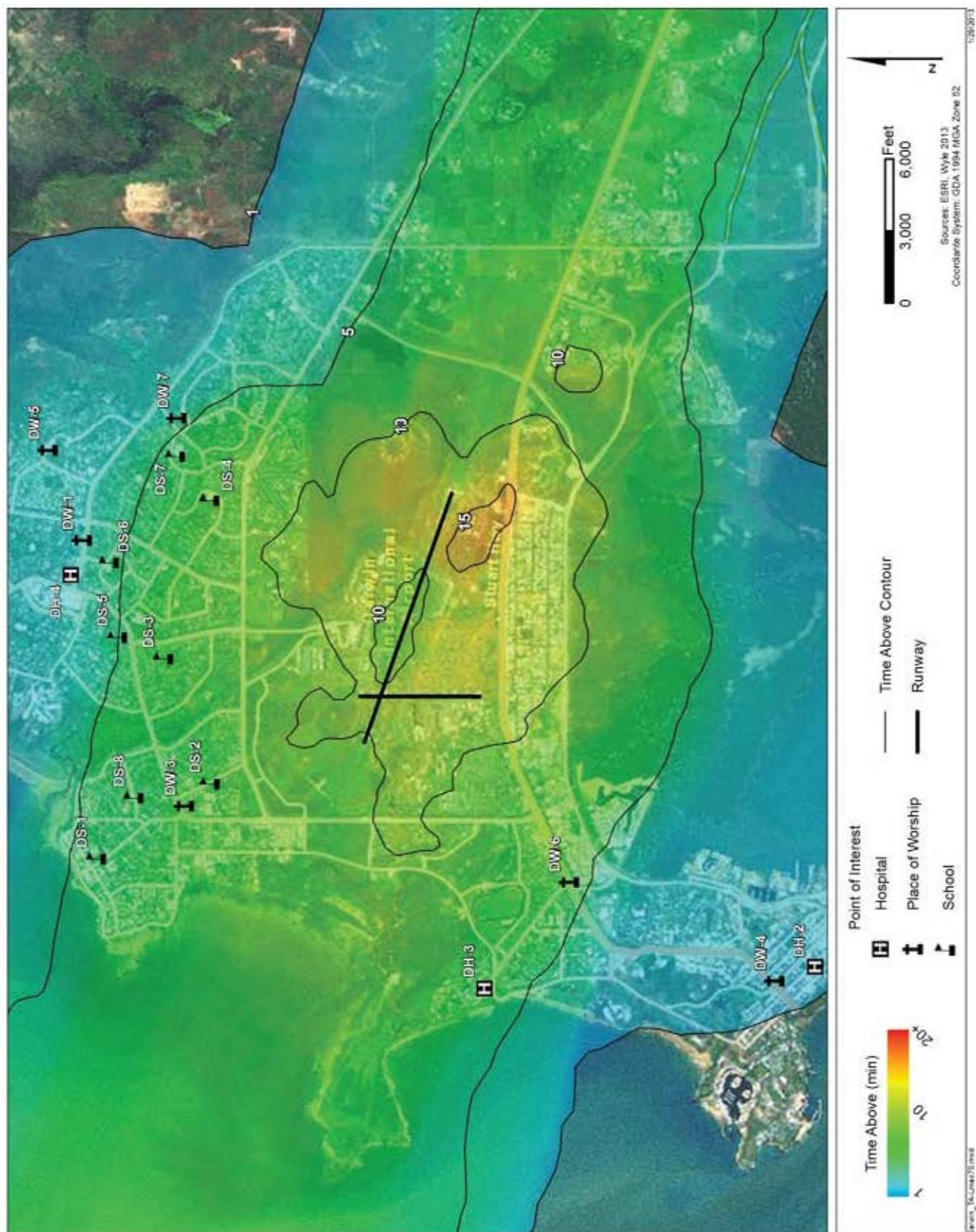


Figure 3-11. TA070 Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Darwin

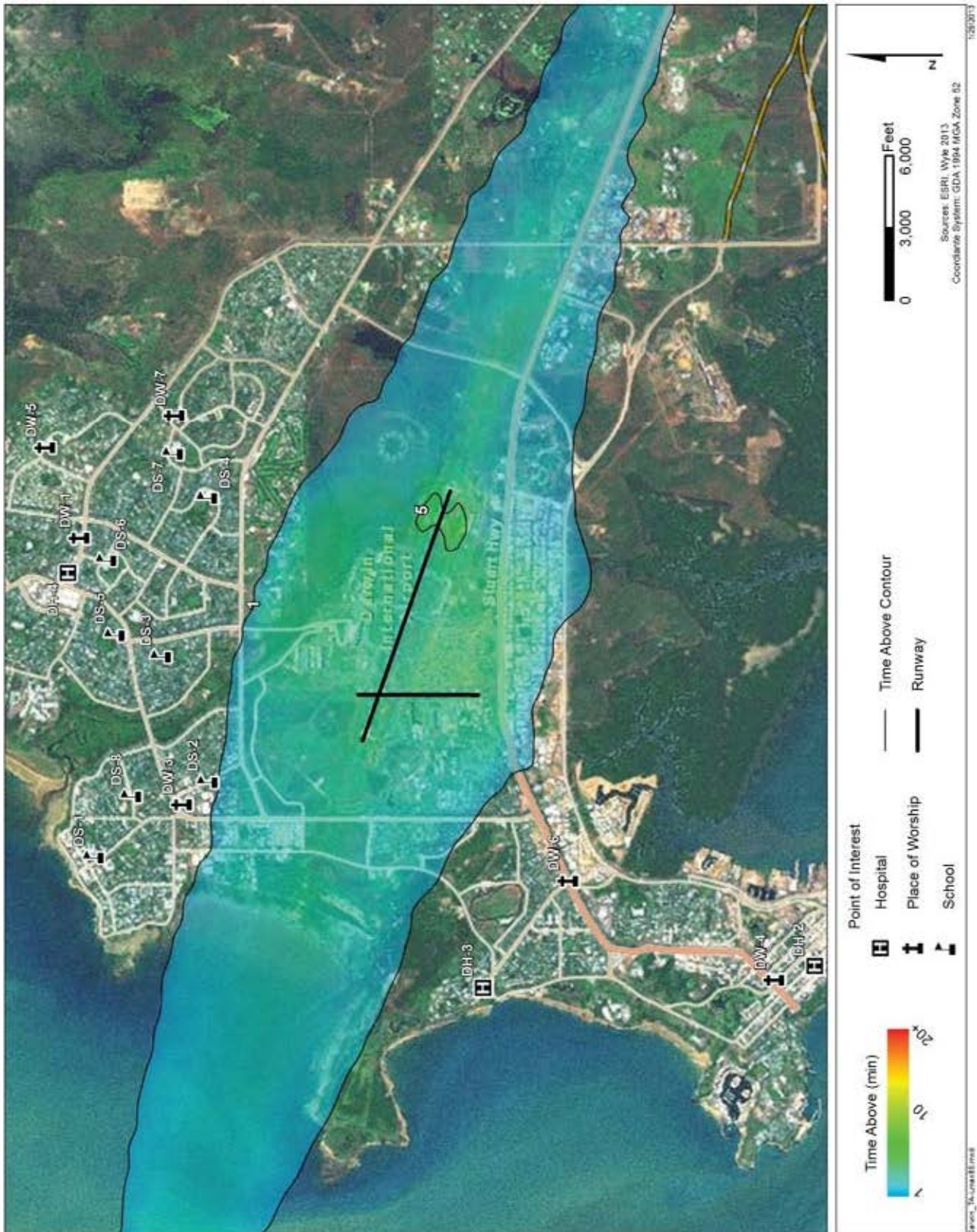


Figure 3-12. TA085 Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Darwin

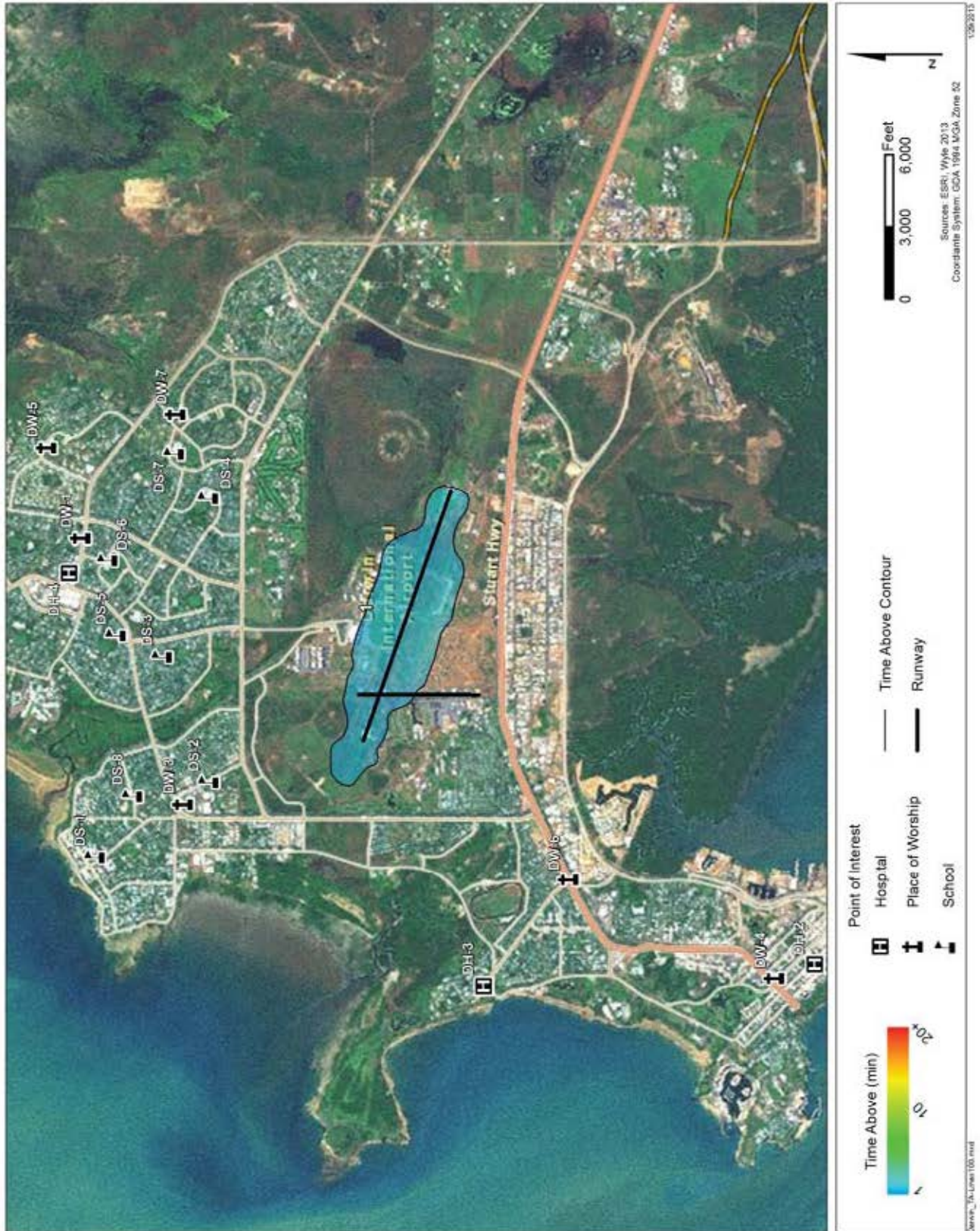


Figure 3-13. TA100 Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Darwin

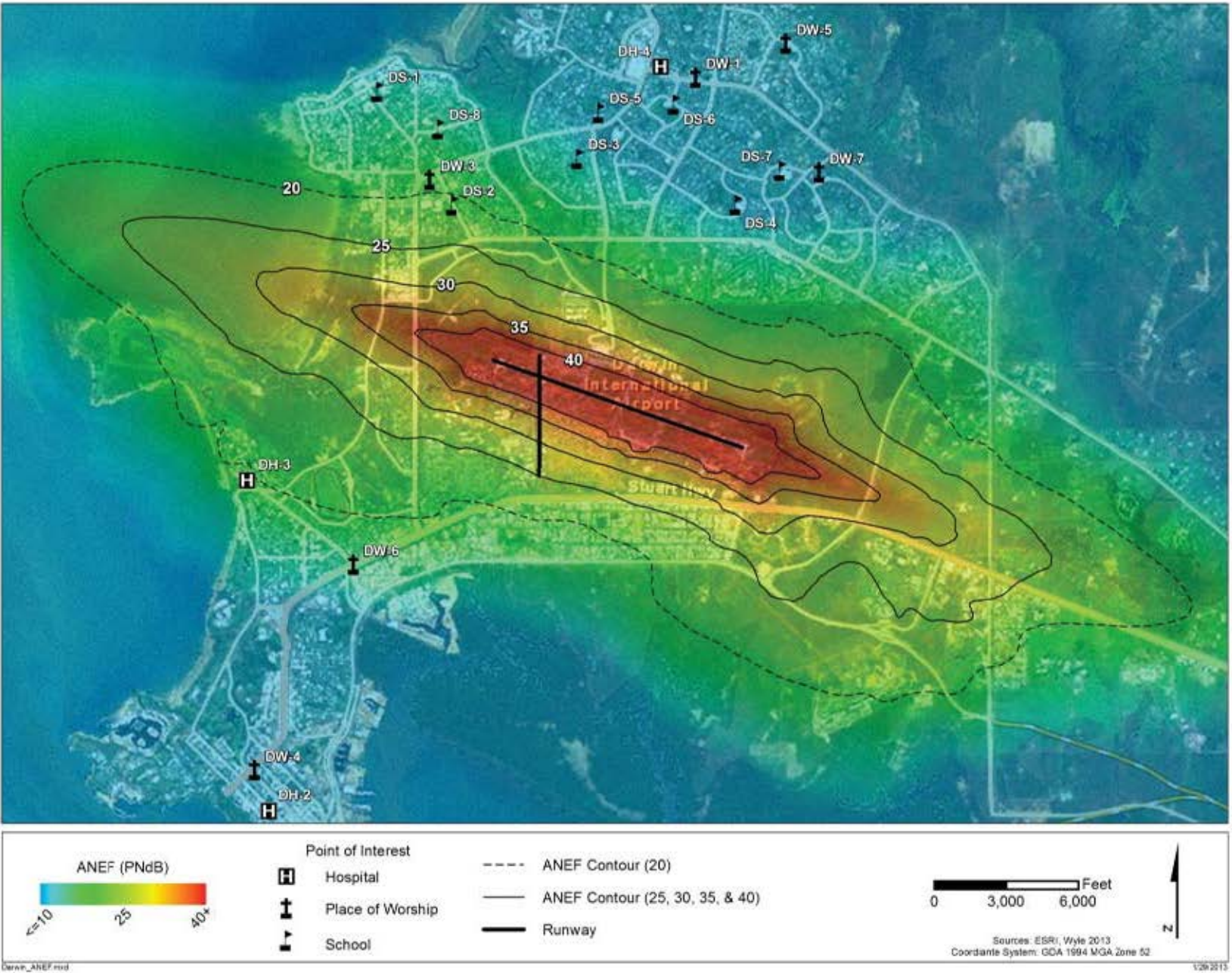


Figure 3-14. ANEC Contours and Gradient for Proposed Action AAD Aircraft Operations at RAAF Darwin



Figure 3-15. Representative Points of Interest for RAAF Darwin

Table 3-4. Noise Exposure at Representative POI for ABD Aircraft Operations at RAAF Darwin

POI		DNL (dB)	Lmax (dB)	NA (events)			TA (minutes)		
ID	Description			70 dB Lmax	85 dB Lmax	100 dB Lmax	70 dB Lmax	85 dB Lmax	100 dB Lmax
DH-1	Royal Darwin Hospital	<45	80	2	0	0	1.4	0	0
DH-2	Darwin City Medical Centre	<45	79	2	0	0	1.2	0	0
DH-3	Darwin Day Surgery	57	90	13	1	0	6.4	0.5	0
DH-4	Top End Medical Centre	50	81	10	0	0	2.4	0	0
DS-1	Nightcliff Middle School	55	89	9	1	0	5.6	0.4	0
DS-2	Millner Primary School	63	94	14	1	0	7.7	0.7	0
DS-3	Jingili Primary School	57	87	14	1	0	7.2	0.4	0
DS-4	Anula Primary School	56	86	14	1	0	8.5	0.2	0
DS-5	Alawa Primary School	54	85	14	0	0	4.8	0	0
DS-6	Wagaman Primary School	52	83	14	0	0	4.4	0	0
DS-7	Sanderson Middle School	53	84	14	0	0	6.1	0	0
DS-8	Northern Territory Open Education Centre	57	90	10	1	0	6.0	0.5	0
DW-1	Islamic Society of Darwin	50	81	10	0	0	2.4	0	0
DW-2	Christ Cathedral Anglican	<45	77	2	0	0	1.3	0	0
DW-3	Lutheran Church of Australia	61	93	14	1	0	7.1	0.8	0
DW-4	Greek Orthodox Church	<45	80	2	0	0	1.2	0	0
DW-5	Abundant Life Christian Church	46	78	2	0	0	2.1	0	0
DW-6	Darwin Baptist Church	55	87	14	1	0	6.7	0.4	0
DW-7	Assemblies of God	52	84	14	0	0	4.0	0	0

Table 3-5. Noise Exposure at Representative POI for AAD Aircraft Operations at RAAF Darwin

Point of Interest		DNL (dBA)			ANEF (PNdB)		
ID	Description	Baseline	Baseline + Proposed Action	Increase re Baseline (dB)	2030 ANEF	2030 ANEF + Proposed Action	Increase re 2030 ANEF (PNdB)
DH-1	Royal Darwin Hospital	45.7	45.9	0.2	0	1	1
DH-2	Darwin City Medical Centre	45.9	46.0	0.1	0	1	1
DH-3	Darwin Day Surgery	60.7	60.8	0.1	18	19	1
DH-4	Top End Medical Centre	49.7	50.0	0.3	1	3	2
DS-1	Nightcliff Middle School	54.8	55.2	0.4	6	13	7
DS-2	Millner Primary School	63.7	64.0	0.3	15	21	6
DS-3	Jingili Primary School	56.4	56.8	0.4	8	12	4
DS-4	Anula Primary School	56.1	56.4	0.3	8	10	2
DS-5	Alawa Primary School	53.1	53.5	0.4	4	8	4
DS-6	Wagaman Primary School	51.4	51.7	0.3	3	5	2
DS-7	Sanderson Middle School	53.6	53.9	0.3	4	7	3
DS-8	Northern Territory Open Education Centre	58.1	58.4	0.3	9	15	6
DW-1	Islamic Society of Darwin	50.0	50.3	0.3	1	3	2
DW-2	Christ Cathedral Anglican	<45	<45	0.1	0	0	0
DW-3	Lutheran Church of Australia	61.2	61.5	0.3	13	19	6
DW-4	Greek Orthodox Church	47.1	47.2	0.1	0	1	1
DW-5	Abundant Life Christian Church	47.9	48.2	0.3	0	1	1
DW-6	Darwin Baptist Church	58.9	59.0	0.1	14	15	1
DW-7	Assemblies of God	53.9	54.1	0.2	4	7	3

Note: see Table 2-2 for composition of scenarios

4.0 RAAF Tindal

RAAF Tindal is a relatively isolated RAAF base. The nearest town, Katherine, is approximately 16 km (10 mi) from RAAF Tindal with a population of approximately 6,000 persons (Robinson 2012a).

The following three subsections detail the modeling data and the resultant noise exposure in the vicinity of RAAF Tindal.

4.1 Modeling Data

As provided by PACAF (Robinson 2012b), Table 4-1 details the proposed flight operations at RAAF Tindal which would total just over 1,000 annual PACAF military operations. The same flight operations are conducted at Tindal as Darwin. There would be two exercises per year, and each exercise would last 15 days resulting in a total of 30 operating days per year for PACAF aircraft at RAAF Tindal. The temporal utilization of each aircraft group was provided by interviews with RAAF (Robinson 2012a). No departure flight operations occurring during the DNL nighttime period (10:00 p.m. to 7:00 a.m.) are anticipated. Two percent of Fighter and Reconnaissance arrivals would be during the DNL nighttime period whereas five percent of Tanker and Bomber arrivals would be during the DNL nighttime period. No pattern operations are forecast.

The Fighters would perform only pitch-out arrivals with no straight-in arrivals while the Tankers and Bombers would perform only straight-in arrivals.

The runway and flight track utilization percentages are listed in Table 4-2. For each operation type and all four modeled aircraft types, Runways 14 and 32 would be used for 95 percent of flight operations, respectively (Robinson 2012a).

Table 4-2 also lists the flight track utilization. As there would only be one flight track per combination of operation type and runway, this portion of Table 4-2 is blank. The modeled flight tracks for the PACAF aircraft at Tindal are presented in Figure 4-1. The modeled arrival and departure KC-10, B-1 and RQ-4 flight tracks are straight-out departures and straight-in arrivals. The modeled F-22 departures are straight-out. The modeled F-22 arrivals are pitch-out arrivals derived from a Wyle F-22 pilot (Batterton 2013a) which break at the beginning of the runway, have an abeam distance of 1 nm, a 1 nm downwind segment, and a 1 nm final leg.

With regard to flight profile utilization in Table 4-2, the Bomber category was modeled with the B-1 aircraft type. As such, it was assumed all B-1 departures would employ afterburner takeoffs. Conversely, the Fighter category is assumed to never utilize afterburners on takeoff. Representative profiles for each modeled aircraft type are presented in Appendix B. F-22 profiles were reviewed and modified via flight simulator by a Wyle F-22 pilot (Batterton 2013b).

As NOISEMAP requires events to be input on an average daily basis, the annual flight operations of Table 4-1 were divided by the number of flying days shown in Table 4-1 for the ABD case (and the L_{max} , TA and NA metrics) or by 365 for the AAD DNL case.

Run-ups are events that take place with the aircraft parked on the ground and the engine running to conduct various pre-flight checks, tests or repairs. Sometimes the engine may be removed from the aircraft, but for all run-ups at Tindal, the engines would remain in-frame.

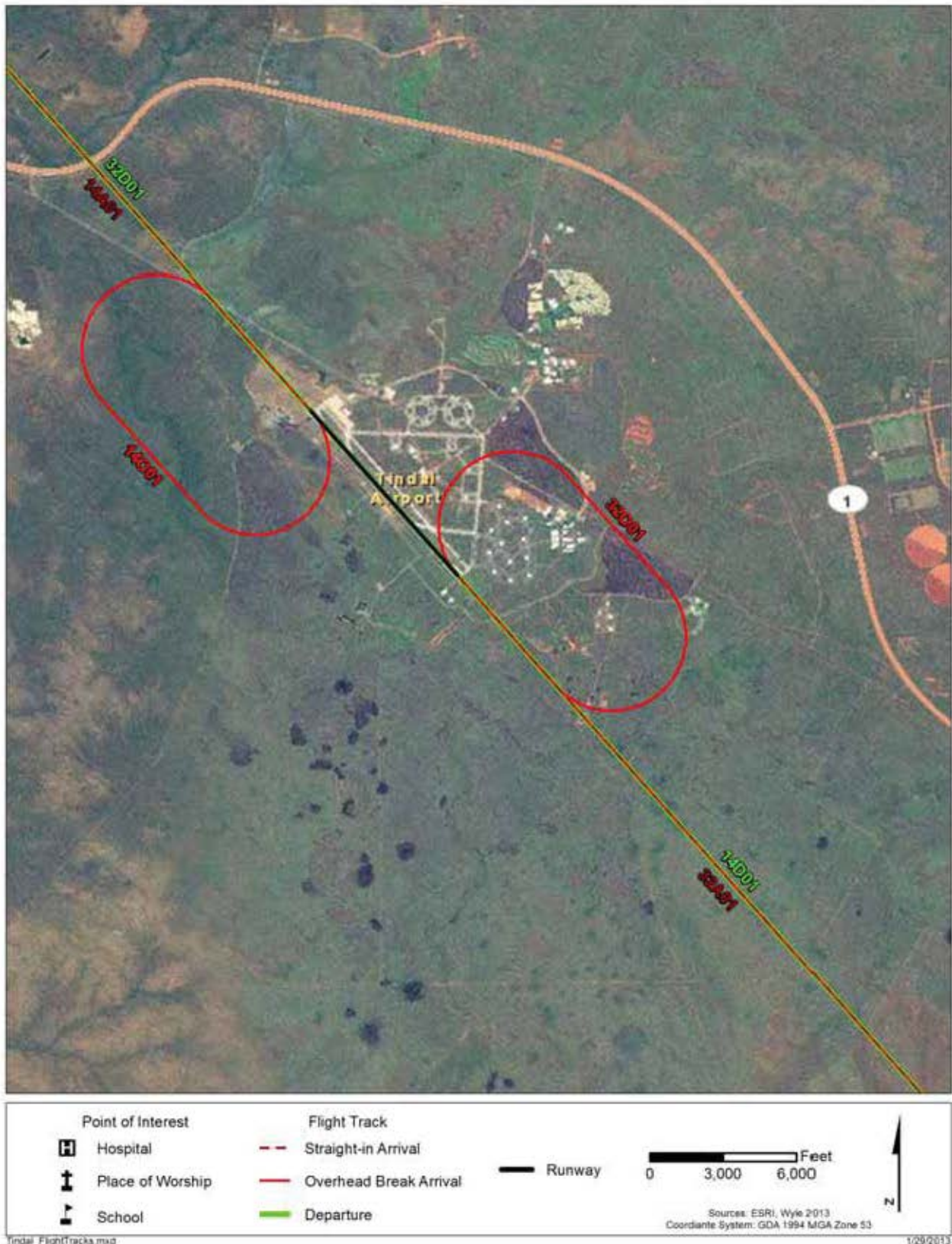


Figure 4-1. Modeled Flight Tracks at RAAF Tindal



Figure 4-2. Modeled PACAF Aircraft Run-up Locations at RAAF Tindal

Table 4-1. Annual Flight Operations for PACAF Exercises at RAAF Tindal (2 x 15 day Exercises per Year)

Group	Modeled Aircraft Type	Number of Flying Days (1)	Temporal Departure Utilization			Temporal Arrival Utilization		
			Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)
Fighter (F-15E, F-22)	F-22	30	95%	5%	0%	90%	8%	2%
Tanker (KC-10)	KC-10A	30	95%	5%	0%	55%	40%	5%
Bomber (B-1, B-52)	B-1	30	95%	5%	0%	55%	40%	5%
Reconnaissance (RQ-4)	CITX	30	95%	5%	0%	90%	8%	2%

Group	Modeled Aircraft Type	Number of Flying Days (1)	Departure				Straight-in Arrival				Pitch-out Arrival				Total			
			Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total	Day (0700-2200)	Evening (1900-2200)	Night (2200-0700)	Total	Day (0700-2200)	Evening (1900-2200)	Night (2200-0700)	Total	Day (0700-2200)	Evening (1900-2200)	Night (2200-0700)	Total
Fighter (F-15E, F-22)	F-22	30	342	18	-	360	-	-	-	-	324	29	7	360	666	47	7	720
Tanker (KC-10)	KC-10A	30	57	3	-	60	33	24	3	60	-	-	-	-	90	27	3	120
Bomber (B-1, B-52)	B-1	30	57	3	-	60	33	24	3	60	-	-	-	-	90	27	3	120
Reconnaissance (RQ-4)	CITX	30	57	3	-	60	54	5	1	60	-	-	-	-	111	8	1	120
TOTAL			513	27	-	540	120	53	7	180	324	29	7	360	957	109	14	1,080

Note:

1) 2 exercises per year, 15 days per exercise

Table 4-2. Runway and Flight Track Utilization for Modeled PACAF Aircraft at RAAF Tindal

Aircraft ID	Operation Type	Runway			Flight Track				Profile						
		ID	Percentages (1)			ID	Description	Percentages (2) (if not 100%)			ID	Description	Percentages (3) (if not 100%)		
			Day (0700- 1900)	Evening (1900- 2200)	Night (2200- 0700)			Day (0700- 1900)	Evening (1900- 2200)	Night (2200- 0700)			Day (0700- 1900)	Evening (1900- 2200)	Night (2200- 0700)
F-22	Departure	14	95%	95%	95%	14D01	Straight-out Departure				100	MIL Departure			
			95%	95%	95%						101	A/B Departure	0%	0%	0%
		32	5%	5%	5%	32D01	Straight-out Departure				102	MIL Departure			
	Straight-in Arrival	14	0%	0%	0%	14A01	Straight-in Arrival								
		32	0%	0%	0%	32A01	Straight-in Arrival								
	Pitch-out Arrival	14	95%	95%	95%	14O01	Pitch-out Arrival; Break at the numbers, 1 NM Abeam, 1 NM Downwind, 1 NM Final				120	Standard Arrival			
		32	5%	5%	5%	32O01	Pitch-out Arrival; Break at the numbers, 1 NM Abeam, 1 NM Downwind, 1 NM Final				121	Standard Arrival			
	KC-10A	Departure	14	95%	95%	95%	14D01	Straight-out Departure				200	Standard Departure		
32			5%	5%	5%	32D01	Straight-out Departure				201	Standard Departure			
Straight-in Arrival		14	95%	95%	95%	14A01	Straight-in Arrival				210	Standard Arrival			
		32	5%	5%	5%	32A01	Straight-in Arrival				211	Standard Arrival			
B-1	Departure	14	95%	95%	95%	14D01	Straight-out Departure				300	A/B Departure			
		32	5%	5%	5%	32D01	Straight-out Departure				301	A/B Departure			
	Straight-in Arrival	14	95%	95%	95%	14A01	Straight-in Arrival				310	Standard Arrival			
		32	5%	5%	5%	32A01	Straight-in Arrival				311	Standard Arrival			
CITX	Departure	14	95%	95%	95%	14D01	Straight-out Departure				400	Standard Departure			
		32	5%	5%	5%	32D01	Straight-out Departure				401	Standard Departure			
	Straight-in Arrival	14	95%	95%	95%	14A01	Straight-in Arrival				410	Standard Arrival			
		32	5%	5%	5%	32A01	Straight-in Arrival				411	Standard Arrival			

Note:

- 1) within runway group
- 2) within specific runway
- 3) within specific flight track

At RAAF Tindal, all four modeled aircraft perform various types of run-ups. Table 4-3 presents the annual run-up events for PACAF exercises at RAAF Tindal. Figure 4-2 presents the modeled run-up pad locations listed in Table 4-3. Same as at Darwin, all aircraft categories, except Reconnaissance, are expected to perform 5-minute pre-flight checks at the hammerheads of the runways. Fighters, Tankers and Bombers would perform “warm-up” run-ups prior to each departure at their respective ramp location. The F-22, KC-10, B-1 and T-45 warm-ups would be 15 minutes, 5 minutes, 30 minutes and 5 minutes, respectively. The B-1 would also conduct 5-minute “cool down” run-ups after each arrival. All of these run-ups would be at relatively low power settings.

Table 4-3. Annual PACAF Run-up Events at RAAF Tindal (2 x 15 Day Exercises per Year)

Group	Aircraft Type	Engine Type	Run-up Type	In-frame / Out-of-frame	Run-up Pad ID	Magnetic Heading (degrees)	Pad %	Annual Events				Power Setting	Duration (Minutes per event)	Engines Running (per event)
								Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)	Total			
Fighter (F-15, F-22, F-16)	F-22	F119-PW-100	15 min Warm-up	In-frame	Fighters	180	100%	342	18	-	360	10% ETR	15	2
			Hammerhead pre-flight checks	In-frame	HH14F	220	95%	325	17	-	342	10% ETR	5	2
					HH32F	220	5%	17	1	-	18	10% ETR	5	2
Tanker (KC-135, KC-10)	KC-10A	CF6-50C2	5 min Warm-up	In-frame	BRA1	40	50%	29	2	-	31	24% N1	5	3
			Hammerhead pre-flight checks	In-frame	BRA2	40	50%	29	2	-	31	24% N1	5	3
					HH14	40	95%	54	3	-	57	24% N1	5	3
					HH32	40	5%	3	-	-	3	24% N1	5	3
Bomber (B-1, B-52)	B-1	F101-GE-100	30 min Warm-up / 5 min Cool-down	In-frame	BRA1	40	50%	29	2	-	31	80% RPM	30	4
							50%	17	12	2	31	5	4	
					BRA2	40	50%	29	2	-	31	80% RPM	30	4
			50%	17			12	2	31	5	4			
			Hammerhead pre-flight checks	In-frame	HH14	40	95%	54	3	-	57	80% RPM	5	4
					HH32	40	5%	3	-	-	3	80% RPM	5	4
Reconnaissance (RQ-4)	T-45	F405-RR-401	5 min Warm-up	In-frame	RQ-4	220	100%	57	3	-	60	55% RPM	5	1

4.2 Noise Exposure

Baseline noise data was not available for RAAF Tindal. Several squadrons of fighter aircraft are based and exercises are hosted at Tindal. It is expected that the proposed PACAF exercises would be a relatively small contribution to the overall noise exposure. In lieu of baseline data, the noise analysis below only depicts the PACAF exercise.

Figure 4-3 shows the resultant 65 dB to 85 dB DNL contours in 5 dB increments for Tindal ABD PACAF exercises only. The 65 dB DNL contour would extend approximately 1.75 miles to the northwest from the approach end of Runway 14 and approximately 4 miles from the threshold of the approach end of Runway 32 to the southeast. The halfwidth of the 65 dB DNL contour, i.e., distance perpendicular to Runway 14/32, would be approximately 1 mile. The exposure would extend more to the southeast due to the runway utilization being heavily weighted to Runway 14.

Figure 4-4 shows the resultant 65 dB to 85 dB DNL contours in 5 dB increments for the Tindal AAD PACAF exercises only. It is anticipated the contours for AAD operations would be approximately 10 dB less than the contours for the ABD operations. The 65 dB DNL contour would extend approximately 2000 feet to the northwest from the approach end of Runway 14 and approximately 1.7 miles from the threshold of the approach end of Runway 32 to the southeast. The halfwidth of the 65 dB DNL contour would be approximately 2000 feet.

Among the PACAF aircraft, DNL exposure would be dominated nearly equally by the Fighter and Bomber flight operations.

Figures 4-5 through 4-11 show the 24-hour L_{max} , NA and TA contours and gradients for Tindal ABD PACAF exercises only, per Table 2-2.

Figure 4-12 shows the resultant 20 dB to 40 dB ANEC contours in 5 dB increments for Tindal ABD (30 days). Figure 3-5 includes only PACAF exercise aircraft. The 20 PNdB ANEC contour would extend approximately 2 miles to the northwest from the approach end of Runway 14 and approximately 4 miles

from the threshold of the approach end of runway 32 to the southeast. The halfwidth of the 20 PNdB ANEC contour would be approximately 1 mile. ANEC exposure would be primarily dominated by PACAF's Bomber flight operations.

The modeled POIs selected for RAAF Tindal were depicted in the aforementioned figures but are shown by themselves in their entirety in Figure 4-13. The POIs are located in the vicinity of the town of Katherine, 16 km northwest of Tindal, and consist of Katherine Hospital, two schools and two places of worship. None of the POIs are in proximity to the DNL and ANEC contours of Figures 4-3, 4-4 or 4-12.

Table 4-4 presents the noise metrics computed for ABD operations for each of 5 POI for RAAF Tindal. No POIs would be exposed to DNL greater than or equal to 65 dB. All POIs would have DNL less than 45 dB.

Table 4-4 also lists the L_{max} , NA and TA for each of the Tindal POI. L_{max} would range from 67 dB at TW-1 (Anglican Church of Australia) to 79 dB at TW-2 (Heritage Christian Church). Correspondingly, no events or time at or above 85 dB L_{max} would occur at the selected POI. The greatest NA 70 dB L_{max} would be less than 1 at TH-1, TS-2 and TW-2.

Table 4-5 presents the noise metrics computed for AAD operations for each of the 5 POI for RAAF Tindal. No POI would be exposed to DNL greater than or equal to 65 dB due to PACAF operations and no POI would be exposed to PACAF ANEC greater than or equal to 0 PNdB.

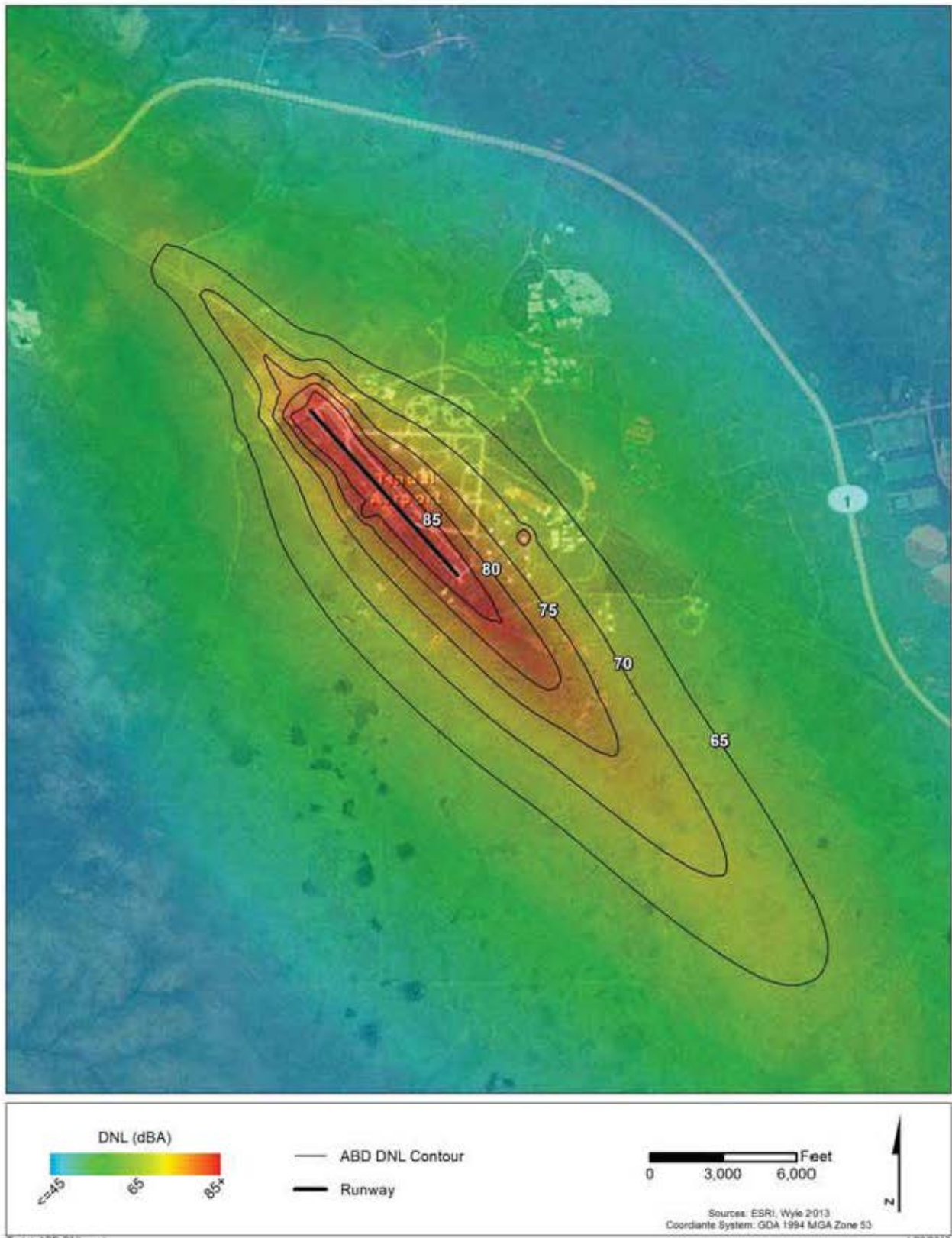


Figure 4-3. DNL Contours and Gradient for PACAF ABD Aircraft Operations at RAAF Tindal

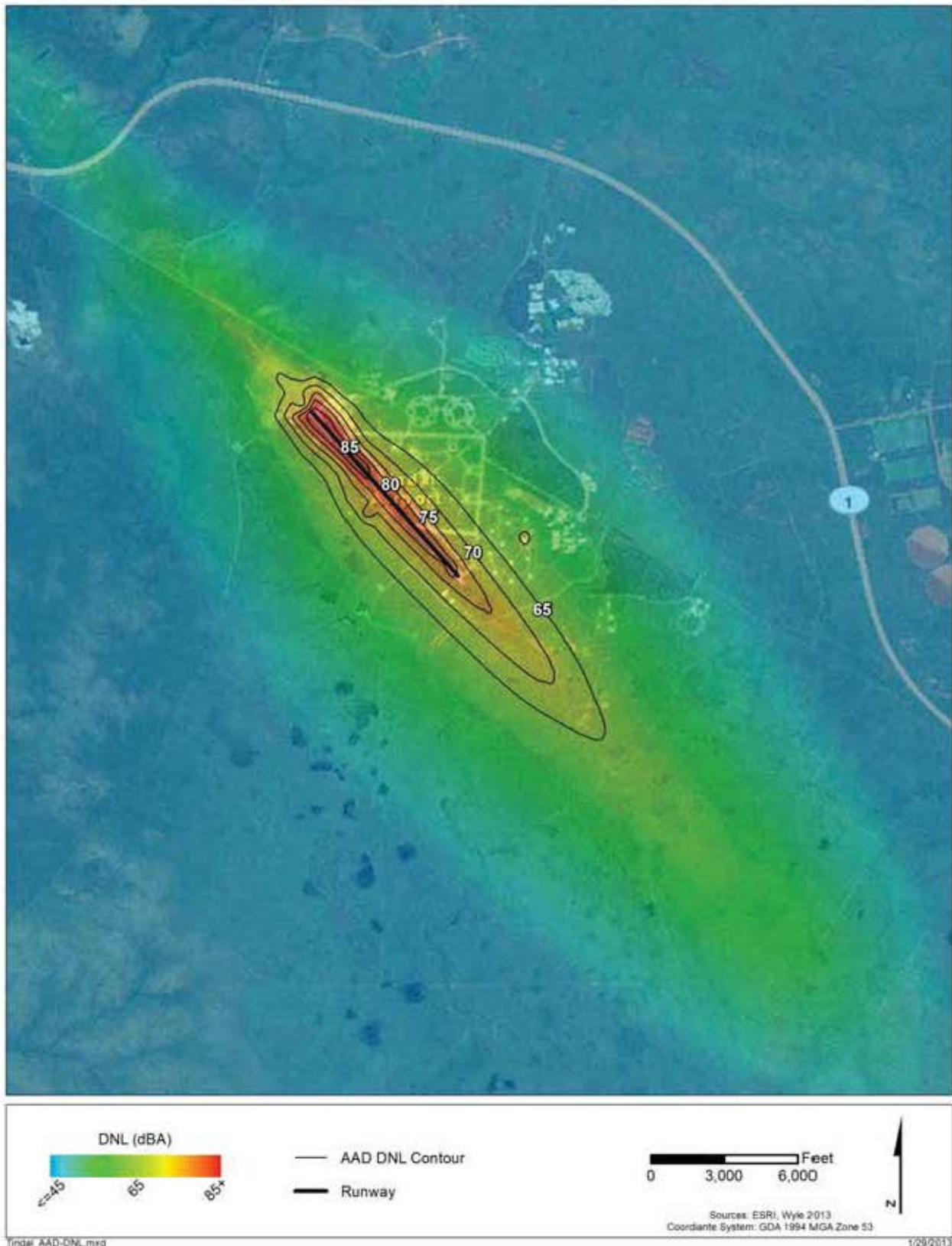


Figure 4-4. DNL Contours and Gradient for PACAF AAD Aircraft Operations at RAAF Tindal

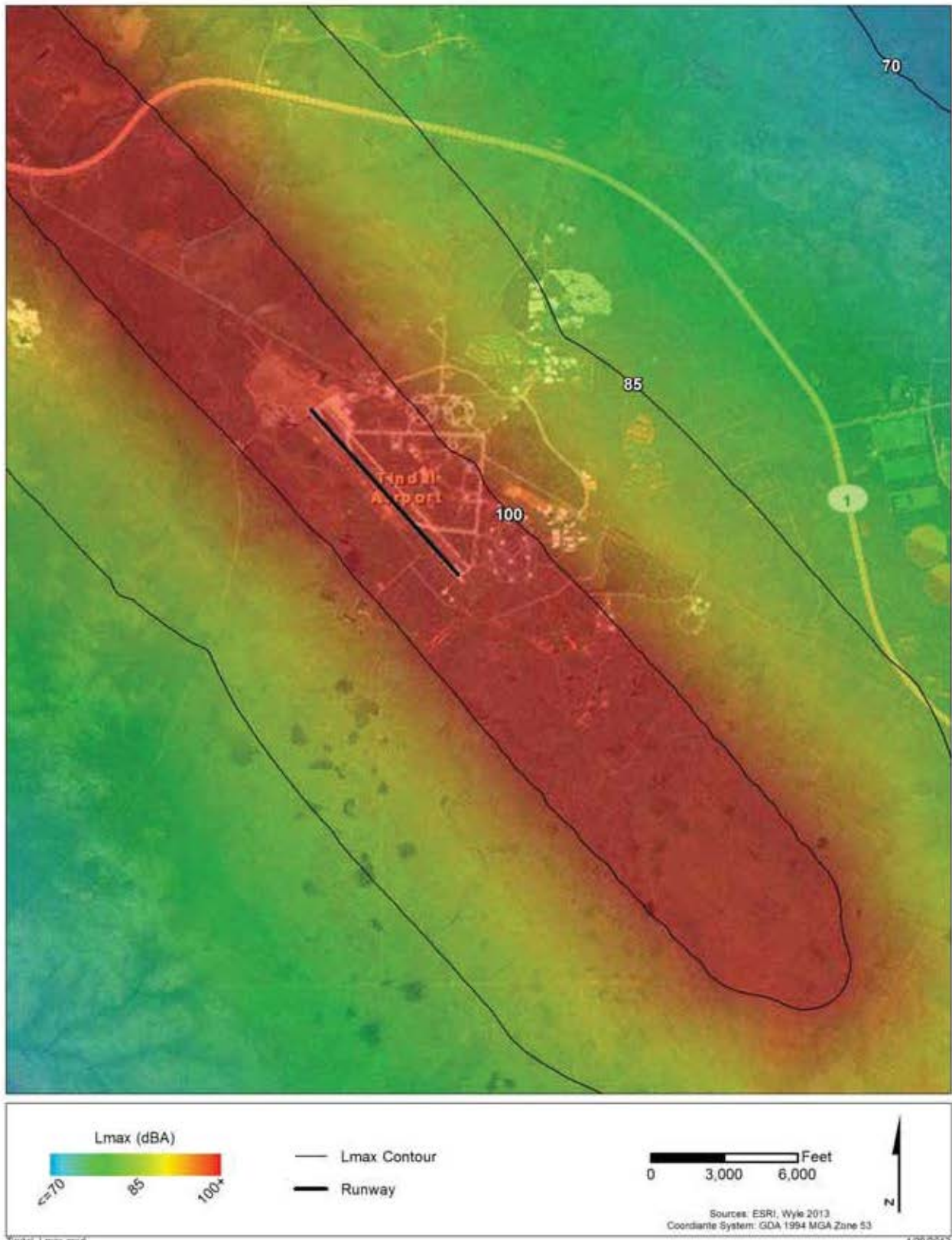


Figure 4-5. A-weighted Maximum Sound Level Contours and Gradient for PACAF Aircraft Operations at RAAF Tindal

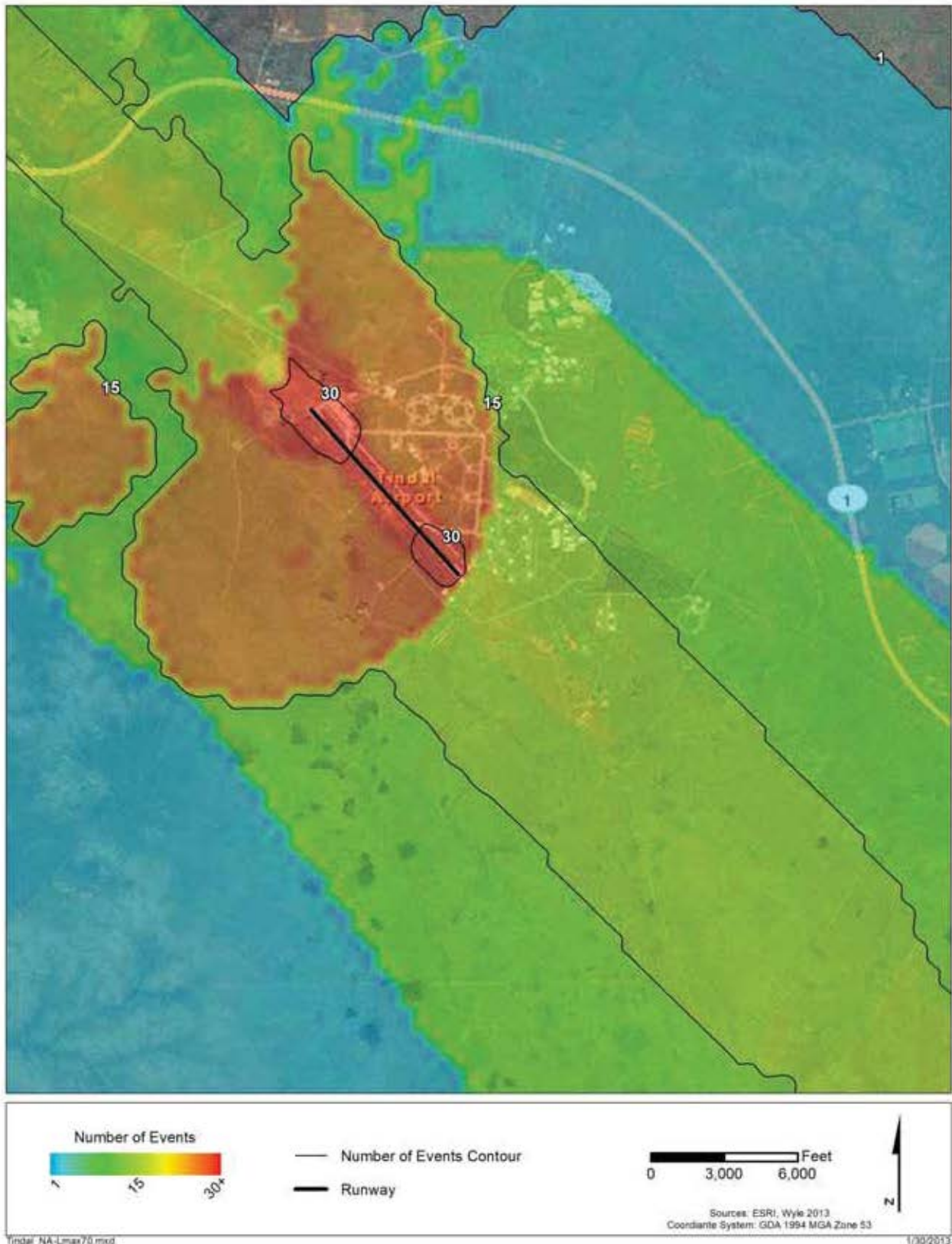


Figure 4-6. NA070ALM Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Tindal

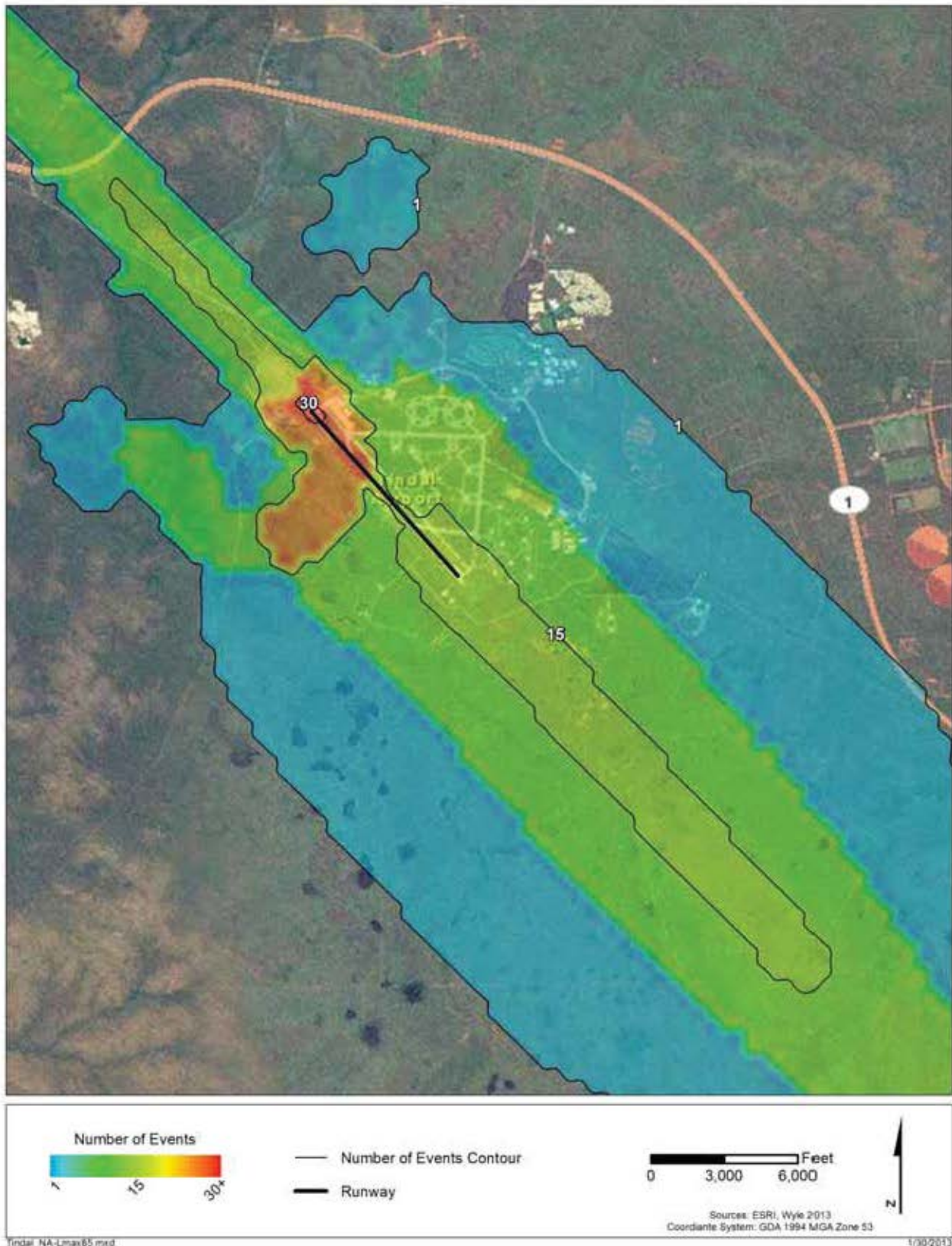


Figure 4-7. NA085ALM Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Tindal

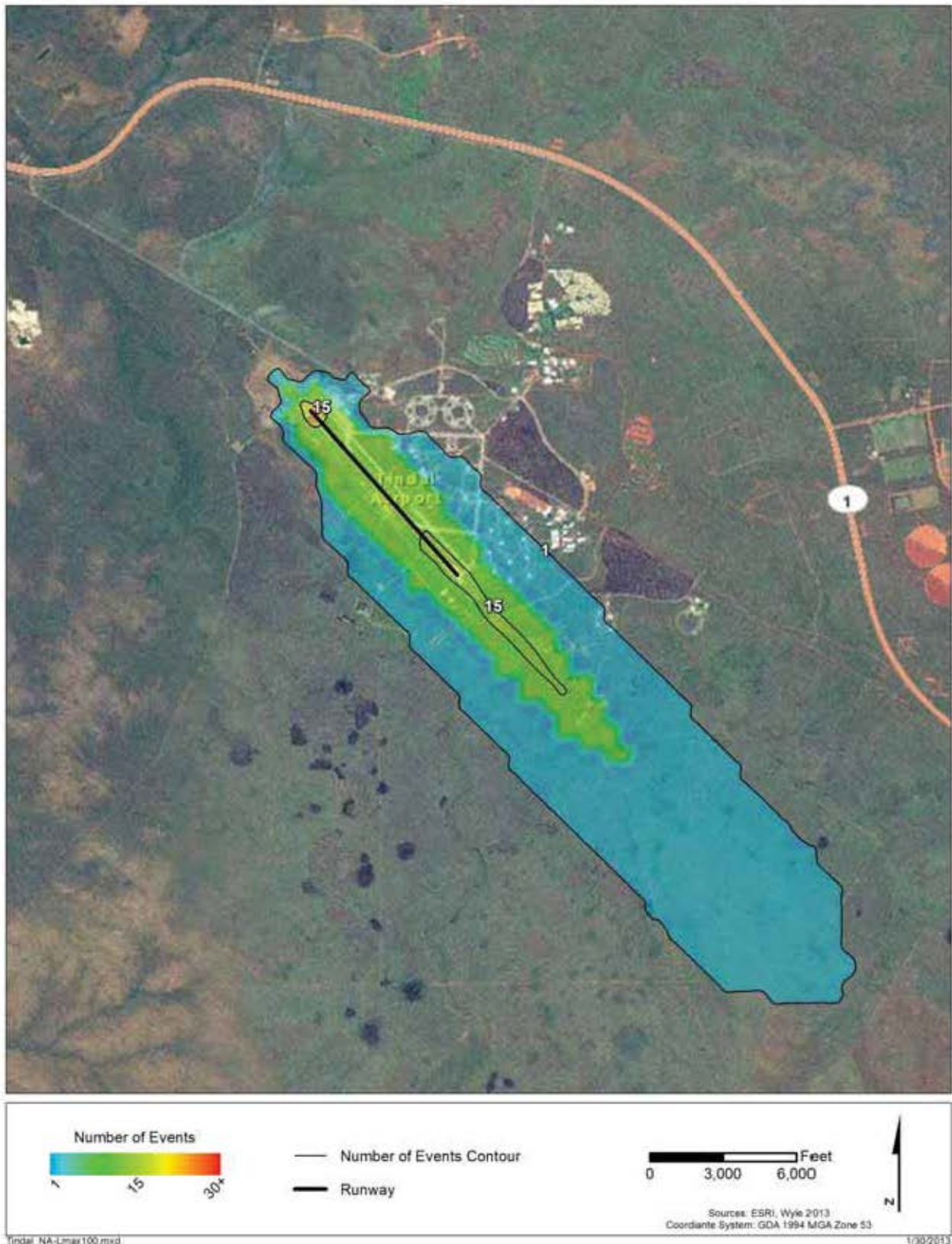


Figure 4-8. NA100ALM Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Tindal

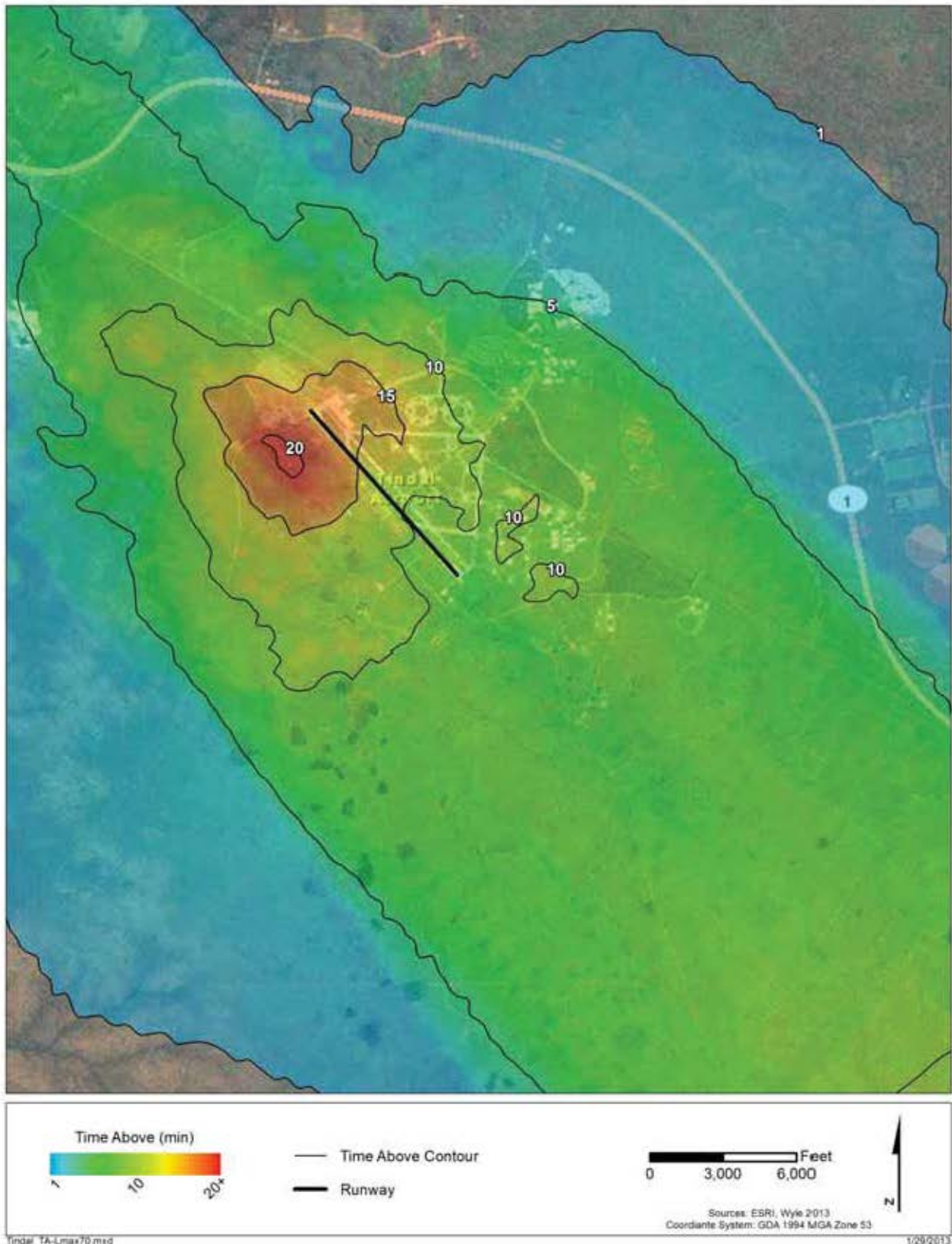


Figure 4-9. TA070 Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Tindal

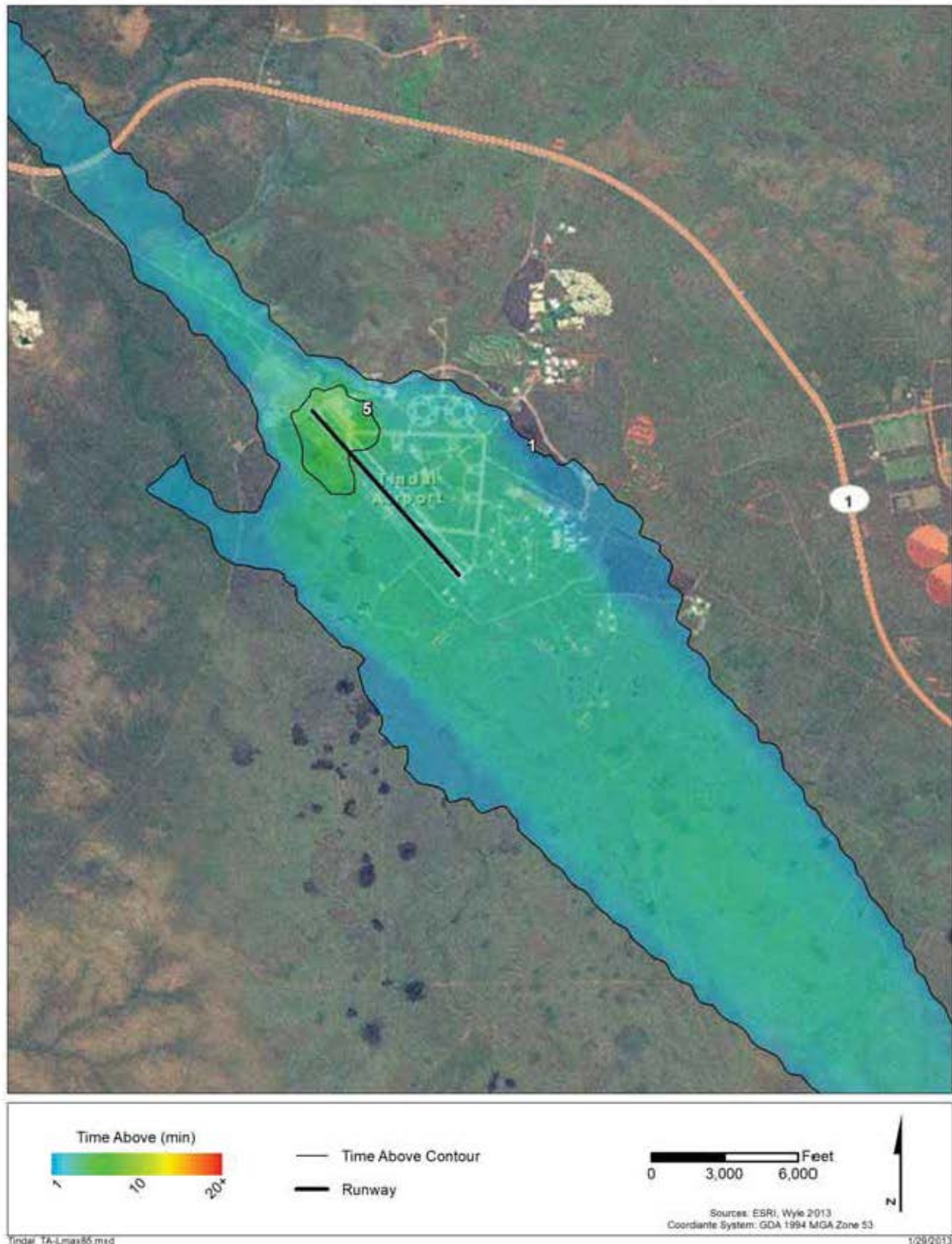


Figure 4-10. TA085 Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Tindal



Figure 4-11. TA100 Contours and Gradient for ABD PACAF Aircraft Operations at RAAF Tindal

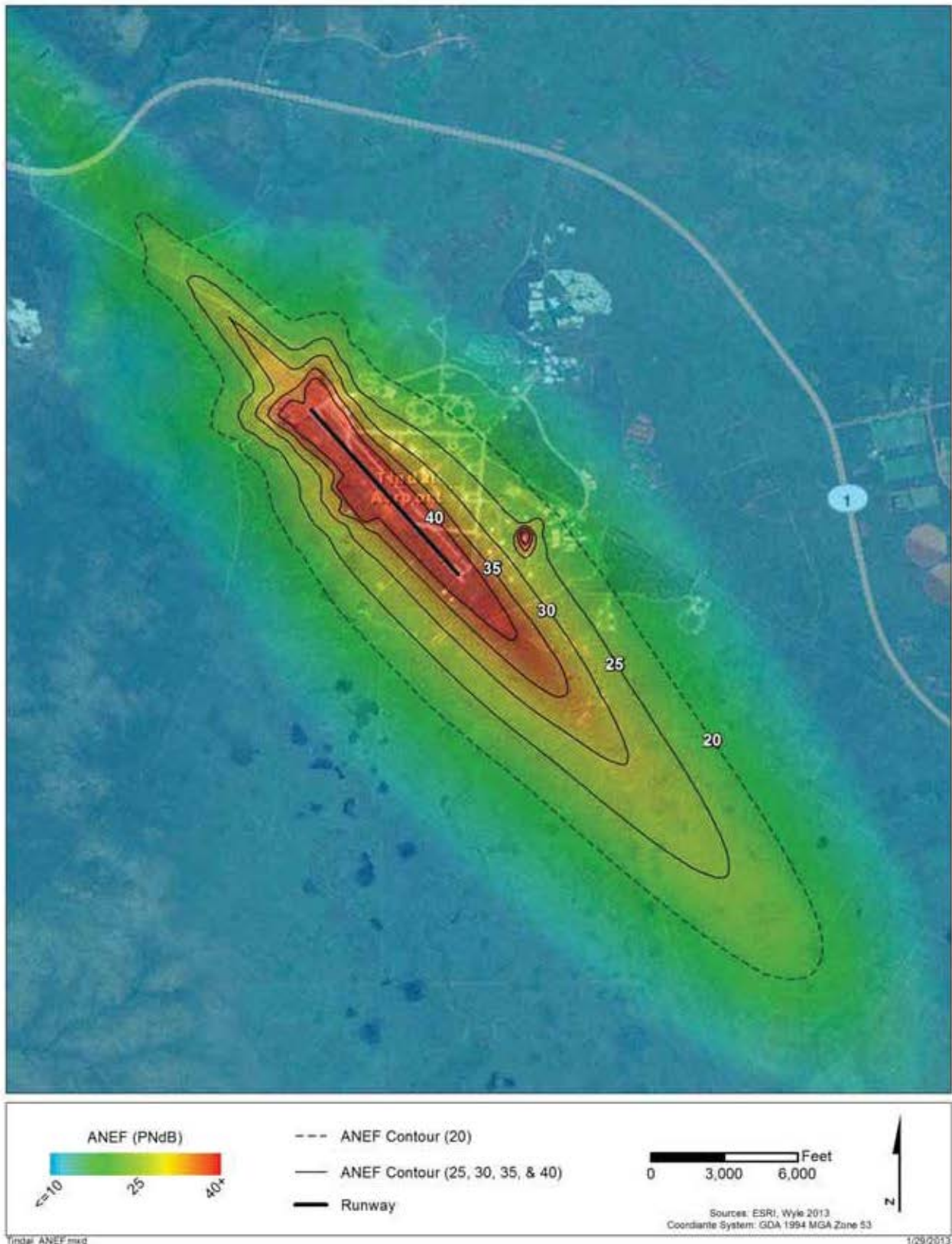


Figure 4-12. ANEC Contours and Gradient for AAD Aircraft Operations at RAAF Tindal



Figure 4-13. Representative Points of Interest for RAAF Tindal

Table 4-4. Noise Exposure for Representative POI for ABD Aircraft Operations at RAAF Tindal

POI		DNL (dB)	Lmax (dB)	NA (events)			TA (minutes)		
ID	Description			70 dB Lmax	85 dB Lmax	100 dB Lmax	70 dB Lmax	85 dB Lmax	100 dB Lmax
TH-1	Katherine Hospital	<45	74	<1	0	0	0.4	0	0
TS-1	St Joseph's College	<45	69	0	0	0	0	0	0
TS-2	Katherine High School	<45	74	<1	0	0	0.2	0	0
TW-1	Anglican Church of Australia	<45	67	0	0	0	0	0	0
TW-2	Heritage Christian Church	<45	79	<1	0	0	0.4	0	0

Table 4-4. Noise Exposure for Representative POI for AAD Aircraft Operations at RAAF Tindal

POI ID	POI Description	DNL (dB)	ANEF (PNdB)
TH-1	Katherine Hospital	<45	0
TS-1	St Joseph's College	<45	0
TS-2	Katherine High School	<45	0
TW-1	Anglican Church of Australia	<45	0
TW-2	Heritage Christian Church	<45	0

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