

# COCONINO JOINT LAND USE STUDY



JANUARY 2019











# COCONINO **JOINT LAND USE STUDY**

JANUARY 2019





Figure 0.01 Camp Navajo sign (Source: T Mento, *Cronkite News*, 2018)

## PROJECT PARTNERS



This study was prepared under contract with Coconino County with financial support from the Office of Economic Adjustment, Department of Defense. The content reflects the views of the Coconino County JLUS Policy Committee and does not necessarily reflect the views of the Office of Economic Adjustment.



Figure 0.02 Dark sky operations at the U.S. Naval Observatory Flagstaff Station (Source: P Shankland, [nofs.navy.mil](https://nofs.navy.mil), 2018)

Figure 0.03 (Previous page) The peaks from O'Leary Lookout (Source: J Christelman, 2018)



# ACKNOWLEDGMENTS

## PROJECT MANAGER

Jay Christelman, Coconino County, Community Development Director

## POLICY COMMITTEE

**Former Chair:** Celia Barotz, City of Flagstaff, Councilmember

**Chair:** Matt Ryan, Coconino County, District 3 Supervisor

Captain Brent Alfonzo, Naval Air Facility El Centro

Jim Allen, Director, Northern Arizona University (NAU) School of Forestry,  
Director

Lisa Atkins, Arizona (AZ) State Land Department, Commissioner

Art Babbott, Coconino County Board of Supervisors, District 1 Supervisor

Russell Begaye, Navajo Nation, President

Walter Crutchfield, Vintage Partners, Principal

Coral Evans, City of Flagstaff, Mayor

Colonel Ray Garcia, Camp Navajo and Garrison Training Center Commander,  
Arizona Army National Guard

Hannah Griscom, AZ Game and Fish Department, Urban Wildlife Planner

Dr. Jeff Hall, Lowell Observatory, Director

Herman G. Honanie, Hopi Tribe, Chairman

Melanie Lashlee, Parks Area Resident

Dani Lawrence, Northern AZ Association of Realtors, President

Audra Merrick, AZ Department of Transportation (ADOT), North Central District  
Engineer

Mike Nesbitt, Jonesco Trucking, President/Owner

Heather Provencio, US Forest Service Kaibab National Forest, Forest Supervisor

Phil Reap, WL Gore and Associates, Inc.

Rebecca Seeger, AZ Governor's Military Affairs Commission, Commissioner

Dr. Paul Shankland, Naval Observatory Flagstaff Station, Director

John Stigmon, Economic Collaborative of Northern AZ (ECoNA), Vice President

Laura Jo West, US Forest Service Coconino National Forest, Forest Supervisor



## TECHNICAL COMMITTEE

Dorenda Coleman, AZ Army National Guard, Sustainability Manager  
 Mike DiVittorio, Naval Observatory Flagstaff Station, Senior Engineer  
 Mary Beth Dreusike, Naval Region Southwest, Deputy RCPLO  
 Sue Farley, Kaibab National Forest, Environmental Coordinator  
 Dan Folke, City of Flagstaff, Community Development  
 Danelle Harrison, Williams Ranger District, District Ranger  
 Lee Luedeker, AZ Game and Fish, Officer  
 Chris Luginbuhl, Dark Skies Coalition, Astronomer  
 Jess McNeely, Community Development, Coconino County, Assistant Director  
 Hannah Telle, Camp Navajo, Wildlife Biologist/Natural Resource Manager  
 Mike Townsend, Coconino County Manager's Office, Deputy Director  
 Dr. Frederick Vrba, Naval Observatory Flagstaff Station, Senior Scientist

## CONSULTANT TEAM

### **MAKERS architecture and urban design, LLP**

Julie Bassuk, Project Manager  
 Bob Bengford  
 Beth Batchelder  
 Brandon Herman



### **Ecology & Environment, Inc.**

Amy DiCarlantonio



### **Transpo Group, Inc.**

Patrick Lynch



### **ETD, Inc.**

Adrian Dotson  
 Marcella Nez



# TABLE OF CONTENTS

<b>CHAPTER 1: INTRODUCTION</b>	<b>1</b>
JLUS PURPOSE	3
PROJECT OVERVIEW	6
Community Engagement & Feedback	7
<b>CHAPTER 2: STUDY AREA PROFILE &amp; ISSUES</b>	<b>11</b>
COCONINO JLUS STUDY AREA	13
MILITARY INSTALLATIONS	14
Camp Navajo	14
Naval Observatory Flagstaff Station	21
JLUS PARTNERS & KEY STAKEHOLDERS	27
Coconino County	27
Bellemont Interchange	38
City of Flagstaff	40
Lighting Technology Transition	50
United States Forest Service	52
Arizona State Land Department	55
Arizona Department of Transportation	57
Arizona Game & Fish Department	58
Lowell Observatory	60
Flagstaff Dark Skies Coalition	63
Northern Arizona University	64
Area Tribal Nations	65
FEDERAL LEGISLATIVE CONTEXT	67
STATEWIDE LEGISLATIVE CONTEXT	68
<b>CHAPTER 3: COMPATIBILITY STRATEGIES</b>	<b>71</b>
SUMMARY OF ISSUES	73
Dark Skies	73
Land Use	74
Transportation	75
Environmental Health	76
RECOMMENDED STRATEGIES	78
Coordination	79
Plan Updates & Policies	85
Code Updates & Enforcement	89
Land Conservation	93
Forest Management	97
Education	100



## APPENDICES

---

A: IMPLEMENTATION STRATEGIES	A-1
B: IMPLEMENTATION ACTIONS BY PARTY	B-1
C: DRAFT COOPERATION AGREEMENT	C-1
D: FUTURE OF THE COLORADO PLATEAU FORUM REPORT	D-1

# EXECUTIVE SUMMARY



## PROJECT SPONSOR

Coconino County

## MILITARY INSTALLATIONS

Army National Guard Camp Navajo

Naval Observatory Flagstaff Station

## JLUS COMMITTEE MEMBER ORGANIZATIONS

AZ Department of Transportation

AZ Game & Fish Department

AZ Military Affairs Commission

AZ State Land Department

City of Flagstaff

Coconino County

Community Representatives

Economic Collaborative of Northern Arizona

Hopi Tribe

Jonesco Trucking

Lowell Observatory

Navajo Nation

Northern Arizona Association of Realtors

Northern Arizona University

United States Forest Service

United States Naval Observatory

Vintage Partners

WL Gore and Associates, Inc.

A Joint Land Use Study (JLUS) is a cooperative land use planning effort between local governments and military installations. It seeks to ensure the lasting compatibility of military installations and their neighboring communities. A JLUS creates a policy framework and recommends strategies that support a healthy economy, environment, and community, while safeguarding the military's mission.

This JLUS is focused around Army National Guard Camp Navajo (Camp Navajo), Naval Observatory Flagstaff Station (NOFS) and its neighbors. The Department of Defense (DoD) Office of Economic Adjustment (OEA), with contributions from Coconino County and participating municipalities, funded this study.

## JLUS OVERSIGHT

Two committees guided the JLUS. The Policy Committee (PC) was comprised of representatives from Camp Navajo and NOFS as well elected officials and staff from the State of Arizona, Coconino County (the County), Flagstaff (the City), and nearby tribal governments. The Technical Committee (TC) was made up of city and county planning staff, representatives from state and federal agencies, and other stakeholders. Community members provided input and guidance throughout the project.

## STUDY AREA

This JLUS focuses on areas in Coconino County where Camp Navajo and NOFS operations may impact their neighbors and where development and other civilian activities may impact the installations. The JLUS study area is pictured in figure 0.04.

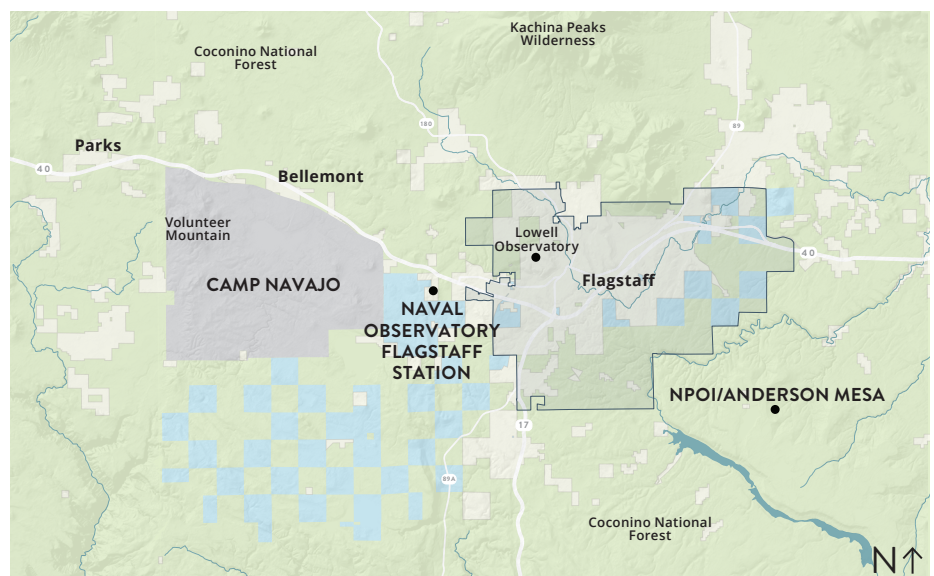
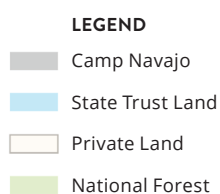


FIGURE 0.04 JLUS Study Area



## CAMP NAVAJO

Camp Navajo has been in operation since 1942, when it was originally used for ammunition and military equipment storage for World War II. Today, the Arizona Army National Guard (AZARNG) uses the installation for two primary functions - munitions storage and training. Most of the original 800 ammunition storage igloos remain intact and are used for munitions storage for the U.S. and other domestic and international entities. The high altitude and natural landscape of Camp Navajo provide unique training conditions for the AZARNG in addition to other national and international military entities.

## NOFS

Established in 1955 two miles west of the city of Flagstaff, NOFS is one of two U.S. Naval Observatory (USNO) sites in the Flagstaff region and is part of a network of several observatories in the unique dark sky region. The second USNO facility is the Navy Precision Optical Interferometer (NPOI) located 15 miles southeast of Flagstaff within the Coconino National Forest. Together with the other area observatories, these highly specialized telescopes rely on dark sky conditions within Flagstaff and Coconino County to conduct their missions.

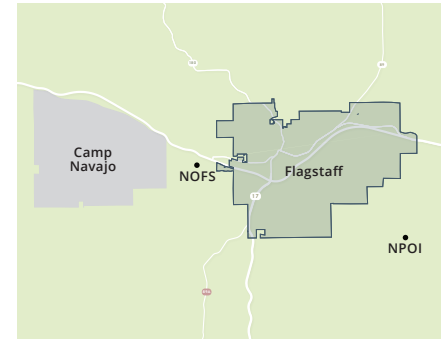


FIGURE 0.05 Camp Navajo and the two USNO observatories (NOFS and NPOI)

# COMPATIBILITY ISSUES AND STRATEGIES

## LAND USE

### ISSUES

**Development Location and Intensity:** Increased development near Camp Navajo or NOFS has the potential to impact their missions by increasing sky brightening, wildlife impacts, trespassing, and operation complaints.

**Land Use Types:** Installation impacts can vary depending on development intensity and characteristics; use types that add outdoor lighting are of specific concern.

**Communication with Installations:** Coordination around land use with Camp Navajo and NOFS is strained due to insufficient liaison personnel.

### STRATEGIES

#### Planning Coordination

- Coordinate and communicate with installations on relevant local development activity and planning efforts.
- Prioritize developing activity center plans for designated areas in western and southern Flagstaff.

#### Land Conservation

- Pursue funding, legislation, Sentinel Landscape designation, and other opportunities to conserve land around the installations.

#### Engagement and Notification

- Fund local planning liaison and engagement personnel at the installations and increase statewide education efforts.
- Increase notification around all statewide military installations.



FIGURE 0.06 View of Camp Navajo and nearby community of Belmont (Source: dema.az.gov)



FIGURE 0.07 NOFS (Source: D Eicher, astronomy.com)



FIGURE 0.08 San Francisco peaks and night sky  
(Source: D Duriscoe, apod.nasa.gov)



FIGURE 0.09 Commercial development in Flagstaff (Source: century21.com)



FIGURE 0.10 Pilot Travel Center in community of Belmont (Source: MAKERS, 2017)

## DARK SKIES

### ISSUES

**Technology Shift:** Although lighting technology has evolved to light-emitting diodes (LEDs), the fixtures and city and county standards have not been updated.

**Enforcement:** Enforcing the city/county lighting ordinance is an ongoing challenge made more acute by staffing shortages.

**Development:** Increased development close to NOFS and NPOI has the potential to increase sky brightening and impact the observatories' mission.

**Additional Barriers:** Frequent wildfires produce thermal and particulate plumes, impeding the visibility and function of area observatories.

### STRATEGIES

#### Dark Sky Code

- Revise lighting codes and street lighting standards and update to address lighting technology changes.
- Adopt dark sky lighting standards in Camp Navajo and Williams.

#### Lighting Specialist Position

- Fund a city, county, or jointly-funded position to lead dark sky efforts, including education and enforcement.

#### Outdoor Lighting Committee

- Establish a committee to oversee code updates and conduct public outreach and education.

## TRANSPORTATION

### ISSUES

**Constrained Overpass Bridge:** The Transwestern Road bridge over I-40 in Bellemont is deteriorated and undersized. Plans for the bridge's replacement do not address the area's multimodal circulation needs.

**Increased Congestion and Lack of Multimodal Mobility:** Existing roads and bridges do not have the capacity to accommodate the projected area development. Additionally, they do not facilitate safe pedestrian and bicycle travel in the Bellemont area.

**Dark Sky Compliance:** New lights being replaced or added through new construction do not always adhere to city and county dark sky goals, policies, and standards.

### STRATEGIES

#### Transwestern Bridge Development

- Coordinate with the Arizona Department of Transportation (ADOT), Camp Navajo, and area businesses to add capacity to the Transwestern Road bridge.

#### Multimodal Study

- Update the 2015 Access Management and Multimodal Transportation Study to incorporate planned activity south of I-40 in Bellemont and on Camp Navajo.

#### Dark Sky Compliance

- Work with ADOT to adopt a lighting policy compliant with city and county dark sky standards.



## ENVIRONMENTAL HEALTH

### ISSUES

**Forest Health:** There is a high risk of catastrophic wildfires in the study area due in part to forest conditions. Efforts to improve forest health are hampered by infrastructure challenges.

**Forest Land Conversion:** Land surrounding both installations is owned by private individuals, the state, or the federal government. This land has the potential to be developed, sold, or “swapped,” which could reduce habitat and impact missions.

**Migration & Wildlife:** Wildlife corridors exist on both sides of Camp Navajo, linking wildland blocks to the north and south. Increased development within these corridors could further fragment species, increase migration activity through Camp Navajo, and impact installation operations.

### STRATEGIES

#### Forest Industry Cluster

- Support efforts to site wood processing plant(s) in the area.

#### Wildlife Protection

- Incorporate wildlife corridors into planning documents and land conservation efforts.

#### Land Conservation

- Pursue funding and opportunities to conserve land around the installations.
- Work with state on coordination and education regarding state-owned land in the area.

#### Forest Restoration

- Support county forest restoration director’s efforts to increase awareness and improve forest health.
- Increase funding and improve forest restoration activities on Camp Navajo and surrounding area to reduce wildfire risk.



FIGURE 0.11 Dense ponderosa pine forest (Source: B Stevens, knau.org)



FIGURE 0.12 Elk in migratory area on Camp Navajo (Source: Camp Navajo, Army National Guard, 2018)

## SUMMARY

Protecting the region’s dark skies and natural areas and improving forest health are priorities for Camp Navajo, NOFS, and the community. Continued collaboration of JLUS partners will be key to successfully addressing issues and achieving JLUS objectives.

### NEXT STEPS

Establishing a JLUS implementation committee by formalizing a cooperation agreement is the most important first step towards implementation. See “Appendix B” for other immediate actions organized by responsible party and “Appendix C” for a draft of the cooperation agreement.

### QUESTIONS? CONTACT:

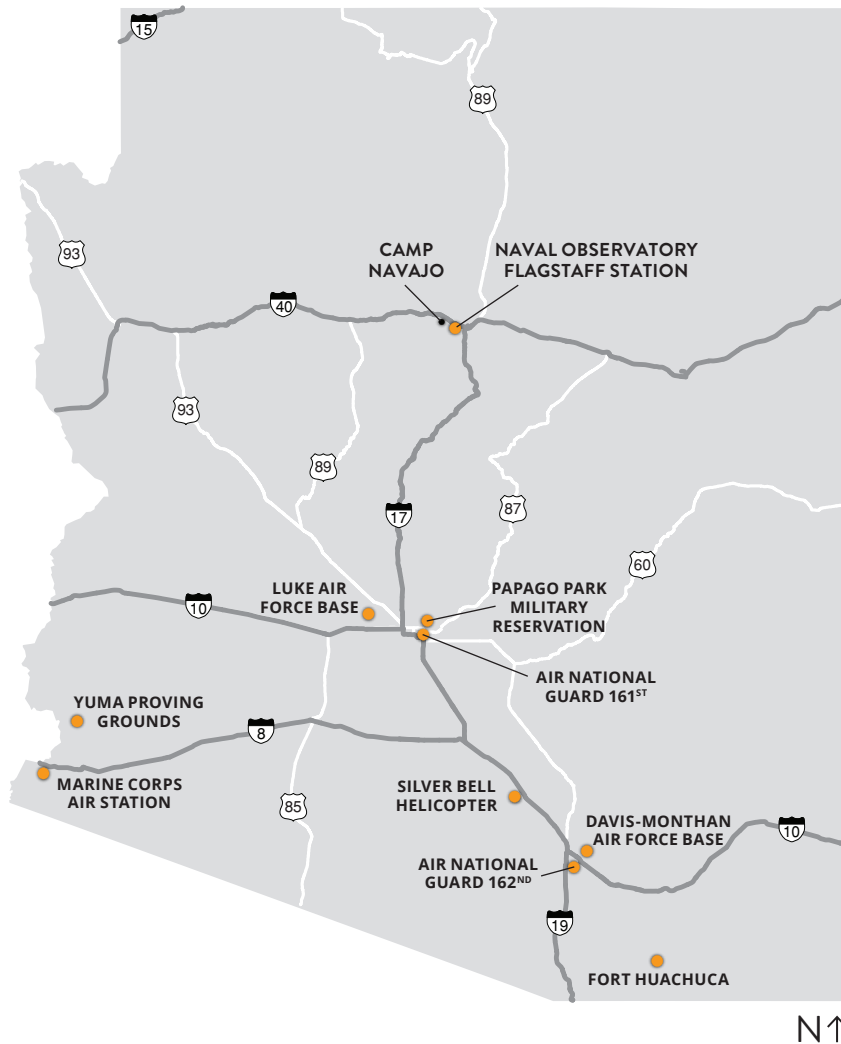
Jay Christelman  
Director of Community Development  
Coconino County  
(928) 679-8867  
jchristelman@coconino.az.gov





# CHAPTER 1

## INTRODUCTION



### ARIZONA: AN UNPARALLELED MILITARY RESOURCE

The diverse network of federal military facilities located in Arizona provides the Department of Defense with unequalled access to high-quality, weather-friendly, cost-effective training for American and allied armed forces. More significantly, this network comprises an integrated array of bases, testing and training facilities, ranges, and airspace that operate within a physical environment that is uniquely suited to their individual and combined mission objectives and to the nation's evolving defense posture (figure 1.02).

FIGURE 1.02 Arizona's major installations and principal National Guard operations



## JLUS PURPOSE

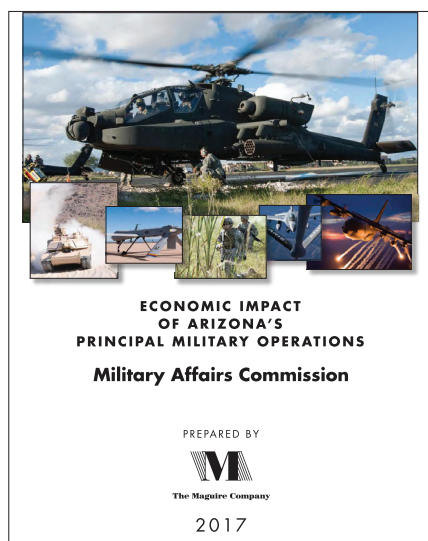


FIGURE 1.03 Source: *Economic Impact of Arizona's Principal Military Operations*, 2017

Joint land use studies seek to accomplish three main objectives:

- **Establish an ongoing framework for cooperative planning between project stakeholders.** These include military installations, local government, state agencies, tribal nations, and surrounding communities.
- **Recommend strategies to encourage compatible development around military installations.** JLUSes encourage cooperative land use planning between military installations and the surrounding communities to ensure community growth and development are compatible with military training and operations.
- **Recommend approaches to reduce impact on neighbors and area development.** JLUSes seek ways to reduce the military's impact on their neighbors and support community goals for a healthy economy, environment, and quality of life.

Central to this JLUS are the United States Naval Observatory Flagstaff Station (NOFS) and the Arizona Army National Guard Camp Navajo (Camp Navajo), both of which are vital components of the state's economy. Arizona hosts six major military installations (including NOFS) and two large Arizona Army National Guard (AZARNG) training sites (including Camp Navajo). The state's military operations employ 46,000 people and support 76,700 jobs statewide. They contribute roughly \$11.5 billion dollars to the state's economy and about \$255.9 million in tax revenues annually. Continued success of military installations is of great value to Arizona (see figure 1.03).

In addition to NOFS and Camp Navajo, this JLUS focuses on the neighboring City of Flagstaff (the City or Flagstaff), Coconino County (the County), nearby communities, and tribal nations. The study is sponsored and managed by Coconino County and funded by the Department of Defense (DoD) Office of Economic Adjustment (OEA), Coconino County, and City of Flagstaff. The Coconino JLUS is one of many similar studies being developed by communities across the country that are located close to military installations.

## JLUS PROGRAM BACKGROUND

Many military installations, including Camp Navajo, were originally developed in remote areas, due to the availability of land and low density surroundings (figure 1.04). Others, such as NOFS, were located for strategic reasons, like the presence of the area's dark skies (figure 1.05). Over time, conflicts between military operations and neighboring communities can arise as development around installations intensifies and expands. Through the JLUS process, these growth conflicts can be anticipated, identified, and prevented or managed.

As of December 2017, over 143 JLUSes have been completed since the program's inception.

## WHAT ARE TYPICAL JLUS RECOMMENDATIONS?

JLUS recommendations often include efforts to:

- Improve public relations, education, and coordination between military installations and their neighboring communities.
- Reduce community impact to military mission by updated local community planning documents and land use and development controls, such as zoning.
- Reduce military operation impacts on surrounding communities.
- Limit incompatible development through partnerships and conservation initiatives.

A JLUS is intended to function as a guiding policy document and will not change any land use requirements, authorize new military activities, or evaluate individual projects in the area.



FIGURE 1.04 Camp Navajo sign



FIGURE 1.05 NOFS sign

## WHY IS THE COCONINO JLUS IMPORTANT?

Camp Navajo's expansive high-altitude base is the largest and only training area of its kind in the southwestern United States (figure 1.06). Additionally, the region's dark skies and efforts to maintain them have made the Flagstaff area an ideal location for NOFS; this is especially critical as dark skies are rapidly disappearing nationwide.

As areas surrounding NOFS and Camp Navajo experience growth and development, proactive measures to ensure long-term compatibility with the military mission will become increasingly important.



FIGURE 1.06 Officer candidate testing at Camp Navajo (Source: A Pujols, dvidshub.net, 2018)

# PROJECT OVERVIEW

This document summarizes the study area, JLUS issues, and recommended strategies to retain compatibility with military operations in the study area. It was developed in the following four phases, illustrated in figure 1.07.

## Phase 1 – Existing Conditions

The team first created a portfolio of existing land use, economic, transportation, and environmental conditions and plans using information from local municipalities, AZARNG, the Navy, and other JLUS stakeholders.

## Phase 2 – Compatibility Analysis

Potential land use, environmental, and installation operational conflicts were identified in this phase. Phase 1 Existing Conditions and Phase 2 Compatibility Analysis are summarized in Chapter 2 on page 11.

## Phase 3 – Conflict Resolution

The team drafted conflict-resolution strategies including regulatory, capital improvement, programmatic, procedural, and operational measures. Strategies are described in Chapter 3 on page 71 and summarized in Appendix A on page A-3.

## Phase 4 – JLUS Document

The JLUS document was compiled to include:

- A description of JLUS stakeholders and relevant issues.
- Recommended strategies with responsible party(ies), costs, and suggested funding mechanisms.
- A recommended organizational structure and process for JLUS participants' continued collaboration.



FIGURE 1.07 Coconino JLUS development phases



## COMMUNITY ENGAGEMENT & FEEDBACK



FIGURE 1.08 A Policy and Technical Committee meeting (Source: MAKERS, 2018)



FIGURE 1.09 Forty-one key stakeholder interviews were conducted (Source: MAKERS, 2017)

Outreach to a diverse audience was a high priority for this JLUS. The team employed multiple strategies to inform and involve community members in the effort.

### POLICY & TECHNICAL COMMITTEE

The 24-member Policy Committee (PC) oversaw the effort. Members included Coconino County and City of Flagstaff elected officials, senior military officials, tribal government leaders, and key stakeholder representatives. The PC approved the JLUS work plan, recommendations, and report. The Technical Committee (TC) was comprised of staff from local jurisdiction planning departments, military installations, and key stakeholders. The number and diversity of the committee members and their work crafting feasible strategies to meet project goals was essential to the success of this JLUS. TC members shared information, supported community outreach, and helped shape the project documents. A full list of PC/TC members can be found on page iii and page iv. See figure 1.08.

### STAKEHOLDER INTERVIEWS

Over 40 interviews were conducted with JLUS stakeholders throughout the project (see figure 1.09). Interviewees included PC and TC members, city and county staff members, and other interested parties. Each stakeholder provided input and discussed how the JLUS could address their concerns.

Interviewees represented the following organizations:

Arizona Army National Guard Camp Navajo	Arizona Commerce Authority
Arizona Department of Emergency and Military Affairs	Arizona Department of Environmental Quality
Arizona Department of Transportation	Arizona Game & Fish Department
Arizona Military Affairs Commission	Arizona State Land Department
City of Flagstaff	Coconino County
• Planning & Development	• Parks & Recreation
• Community Development	• Community Development
• Council	• Facilities Management
• Engineering	• Planning & Zoning Commission
Ecological Restoration Institute	• Board of Supervisors
Economic Collaborative of Northern Arizona	Flagstaff Dark Skies Coalition
Hopi Tribe	Jonesco Trucking
Lowell Observatory	The Nature Conservancy
Naval Air Facility El Centro	Northern Arizona University
Parks Community	Trust for Public Land
TSS Consulting	U.S. Forest Service
U.S. Naval Observatory Flagstaff Station	Vintage Partners

## CAMP NAVAJO TOUR AND BRIEFINGS

Camp Navajo officials conducted a tour of the installation for PC/TC members and other interested parties in November 2017. The tour included stops at a munitions storage igloo and firing range and covered the industrial area known as the “200 Area.” Following the tour, the installation and committee members summarized their respective organizations and missions (see figure 1.10).

## LAND USE STAKEHOLDER SESSION

The project team conducted a land use compatibility strategy meeting to examine growth issues and planning strategies within the city of Flagstaff and Coconino County. This meeting intended to help the team better understand the current situation, identify compatibility issues, and explore strategies to address these issues. Attendees included City of Flagstaff and Coconino County current and long-range planners, NOFS and dark sky representatives, development stakeholders, key public officials, and Camp Navajo representatives.

## ELECTED OFFICIAL BRIEFINGS

Two meetings were scheduled to inform elected officials about the JLUS project progress. The first joint council session between the Flagstaff City Council and the County Board of Supervisors was held on June 4, 2018. JLUS issues and draft strategies were presented and the joint council provided feedback. The second elected official meeting was held on December 3, 2018 to review study results and provide opportunity for officials to weigh in on recommendations.

## MEDIA OUTREACH

The project website, [www.coconinojlus.com](http://www.coconinojlus.com), was particularly important for community members and stakeholders interested in learning about the project or seeing results of a meeting they were unable to attend. As of August 28, 2018, the website had received 768 visits and 2,026 page views. In addition to the website, the team and project committee members shared project information and meeting invitations through social media, newspaper, and radio advertisements and County Commissioner interviews. Meeting invitations were emailed through project distribution lists and fliers were posted in public facilities throughout the study area (see figure 1.11).



FIGURE 1.10 Policy and Technical Committee members toured Camp Navajo (Source: ETD, 2017)

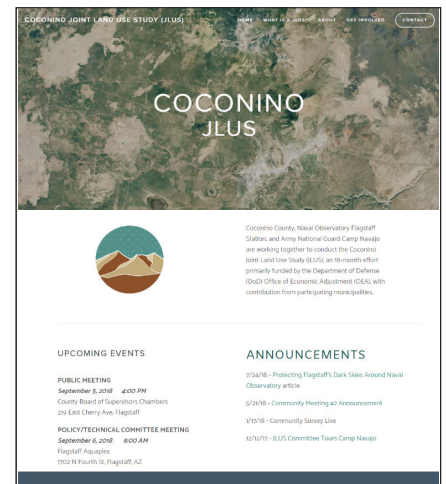


FIGURE 1.11 JLUS website showing project updates



FIGURE 1.12 Workshop participants provide feedback on JLUS issues (Source: MAKERS, 2018)

## COMMUNITY WORKSHOPS

The JLUS team hosted three community workshops to obtain project feedback.

The first meeting occurred on February 6, 2018 in Bellemont. Approximately 30 area residents, PC/TC members, and interested community members attended. Installation briefs and draft compatibility issues were presented. Attendees were invited to provide feedback on workshop boards and encouraged to complete an on-line survey (See Survey Feedback). Participants noted forest land conversion, forest overgrowth, and Bellemont area transportation challenges as the major areas of concern (figure 1.12 and figure 1.13).

The second workshop, held on June 4, 2018 at Flagstaff City Hall, was attended by approximately 20 people who discussed draft recommendations to address JLUS issues. Several Dark Sky Coalition and Coconino Astronomical Society members attended the meeting. Discussion focused around dark sky issues and strategies to protect this asset and the NOFS mission.

The third and final workshop occurred on September 5, 2018 at the County Board of Commissioners' chambers with approximately 30 people attending. The Draft JLUS was presented and comments were encouraged. There was considerable discussion regarding the strategies addressing dark sky enforcement and education through volunteer efforts and funded positions at the City and the County.



FIGURE 1.13 Public workshop participants in Bellemont (Source: MAKERS, 2018)

## SURVEY FEEDBACK

There were just under 130 responses to an online survey about the JLUS military installations, regional priorities, and dark skies initiatives. Major findings from the survey include:

- Thirty-one percent (31%) of respondents were unclear about the NOFS mission, with 63% of respondents believing it has a positive impact on the local economy and 68% stating its mission and purpose are important (figure 1.14).
- Forty-four percent (44%) of respondents are unfamiliar with Camp Navajo's mission and purpose, while 65% believe Camp Navajo has some positive impact on the local economy (figure 1.15).
- National forests and open space polled as the region's most significant asset at 52%, with related outdoor recreation and dark skies assets tied for second at 37%.
- Almost all survey respondents stated they were familiar with Flagstaff's designation as an International Dark Sky City with 84% having visited one of the local observatories. This correlates with awareness and lighting standard compliance for Coconino County and Flagstaff. Almost all respondents have some dark skies awareness and the majority take at least some measures at home or at their place of business to protect dark skies.
- Forest health and resulting issues such as wildfires were the biggest concern for open house attendees, with wildlife protection and retaining the region's dark sky character identified as the second-highest areas of concern.
- Most survey respondents identified themselves as residents of Flagstaff. Nearly all indicated they are not employed by either Camp Navajo or NOFS.

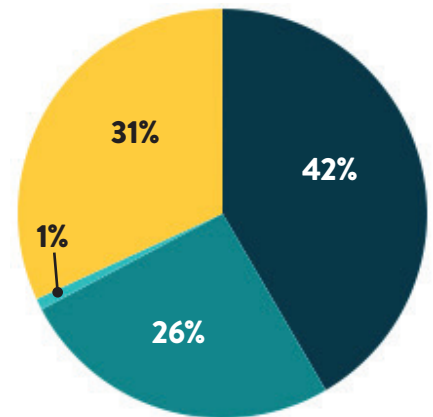


FIGURE 1.14 Perceived importance of NOFS's mission and purpose

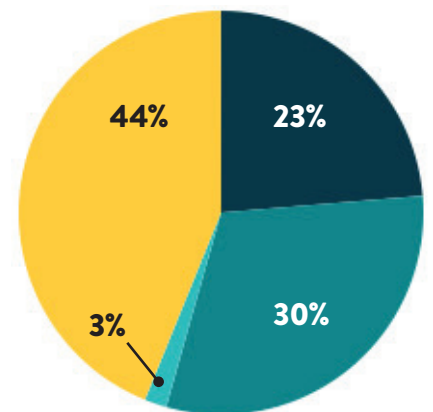


FIGURE 1.15 Perceived importance of Camp Navajo's mission and purpose





## CHAPTER 2

# **STUDY AREA PROFILE & ISSUES**



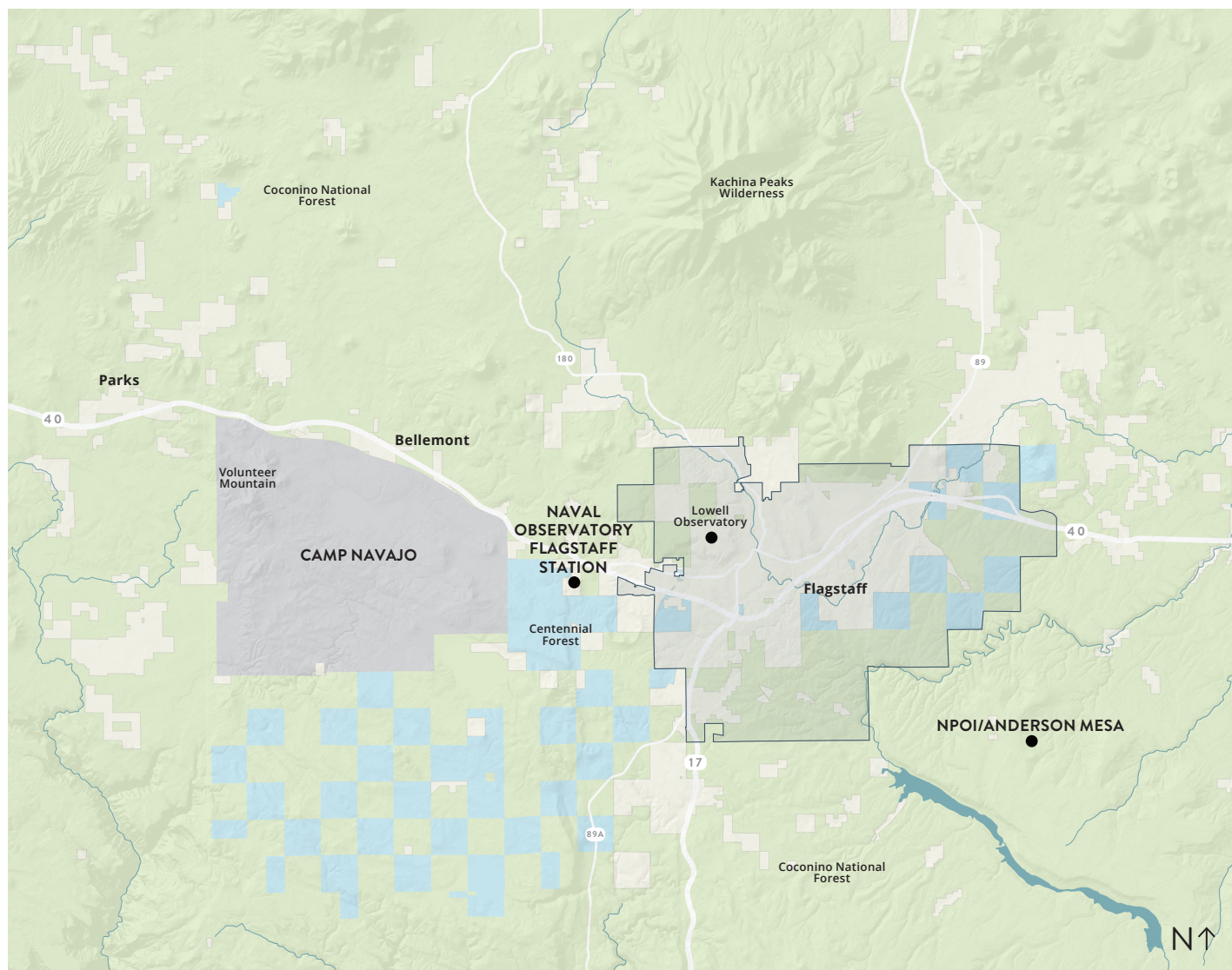


FIGURE 2.02 JLUS study area

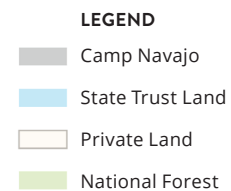


FIGURE 2.01 (Previous page) Humphreys Peak Trail (Source: J Weber, 2018, outdoorproject.com)

## COCONINO JLUS STUDY AREA

This JLUS focuses on areas where Camp Navajo and NOFS operations may impact their neighbors and where development and other activities could potentially impact the installations. The study area includes Camp Navajo and NOFS, in addition to the municipalities surrounding or in close proximity to the installations (See figure 2.02). Regional, land use, and environmental context provide an overview to the items relevant to this JLUS.

The chapter begins by introducing Camp Navajo and NOFS, the two military installations addressed by this JLUS. JLUS partners and stakeholders—including a portion of Coconino County, City of Flagstaff, US Forest Service (USFS), Arizona State Land Department (ASLD), Arizona Department of Transportation (ADOT), Arizona Game and Fish (AZGFD), Lowell Observatory, Flagstaff Dark Skies Coalition, Northern Arizona University (NAU), and area tribal nations—are discussed next. Two special-interest topics relevant to JLUS recommendations are also discussed in the Bellemont Interchange and Lighting Technology Transitions sections. The chapter concludes with a discussion of how the statewide legislative context impacts the JLUS.

# MILITARY INSTALLATIONS

## CAMP NAVAJO

Established in 1942, Camp Navajo was originally used for ammunition and military equipment storage during World War II. Many of the installation's storage bunkers were built by the local population, including people from the Hopi and Navajo tribes. Archaeological sites have been identified on the installation. Camp Navajo's evolution is summarized in the Camp Navajo History sidebar.

Today, the Arizona Department of Emergency and Military Affairs (AZDEMA) oversees Camp Navajo as part of the AZARNG mission. Camp Navajo has two primary functions:

- **Training.** The high altitude and natural landscape are ideal training conditions for the AZARNG as well as other national and international military entities, law enforcement agencies, and National Park Service (NPS) search and rescue.
- **Munitions Storage.** Camp Navajo continues to provide munitions storage for the U.S. and international entities. Most of the original 800 ammunition storage igloos remain intact and cover much of the installation (see figure 2.05 on page 16).

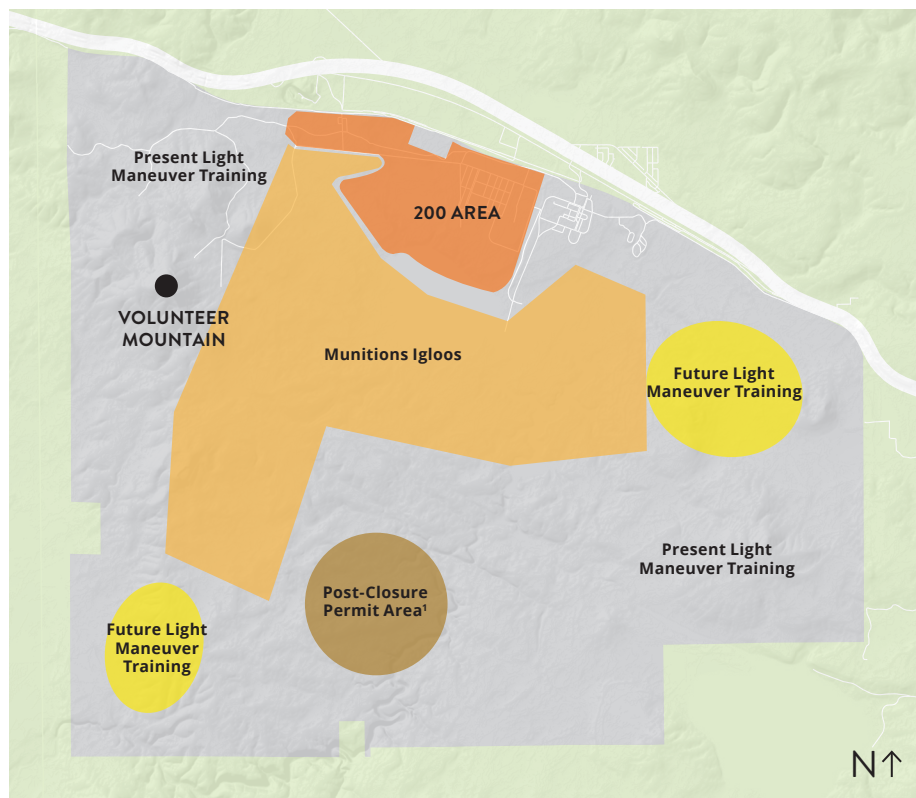
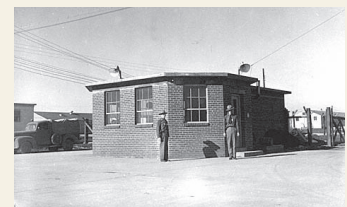


FIGURE 2.03 Camp Navajo areas of note

### CAMP NAVAJO HISTORY



- Constructed in less than one year for \$19 million in 1942
- Originally included 800 ammunition storage igloos, 50 administrative buildings, 227 miles of road, 38 miles of railroad track, and completed utility distribution and collection systems
- Original mission: store ammunition in support of Pacific Theater World War II operations



### TIMELINE

- 1942 - Established as Navajo Ordnance Depot
- 1965 - Name changed to Navajo Army Depot
- 1982 - Transferred control to Arizona National Guard and renamed Navajo Depot Activity

<sup>1</sup> Formerly Open Burn and Detonation Area, see page 16 for more information



## TIMELINE CONT.

- 1993 - U.S. Army federal ammunition mission moved to Hawthorne Army Ammunition Plant in Nevada, renamed Camp Navajo
- 1993 - AZARNG given license to operate the facility as a National Guard training site; use of idle or underutilized storage capacity was approved to generate revenues and support operation
- 1994 - Demilitarization activities cease
- 2002 - Arizona Revised Statute (ARS) limiting Camp Navajo's ability to do commercial and civilian business amended; broadened customer base to include civilian and commercial in addition to federal customers
- 2015 - Replacement of electrical distribution system

## CURRENT INITIATIVES

- Development of up to 800 acres for use as an industrial park
- Replacement of the 65-year-old water distribution system

## POTENTIAL LONG-TERM ACTIONS

- Expansion of storage missions for the U.S. Air Force and U.S. Navy large rocket motor programs

## LEGEND

- Existing Range
- Proposed Range
- Potential Noise Disturbance Areas
- Camp Navajo Boundary

## CURRENT AND FUTURE PLANS

Camp Navajo is in the process of seeking industrial and commercial development opportunities for a section of the base known as the "200 Area" (see figure 2.03). This area's proximity to the highway, existing rail line, and existing infrastructure provide an opportunity to reinvigorate this section of Camp Navajo as an economic engine in the region. The installation is actively seeking commercial opportunities that could provide income for the base and employment opportunities for nearby residents. Development could also benefit the area's forest health. Projects currently being studied include an oriented strand board (OSB) plant and a biomass plant; either would provide much-needed timber processing in the area.

In accordance with state plans and in order to maximize space on base, Camp Navajo plans to expand existing operations by constructing ranges and training maneuver areas along the installation fence line. In addition, six landing and drop zones and 15 bivouac sites have also been proposed. Planned expansion will happen as funding is available and will result in larger areas affected by noise both on and off-base. Potential Noise Disturbance Areas are defined by having noise past the threshold at which Mexican spotted owls respond, shown in figure 2.04 below.<sup>1,2</sup>

<sup>1</sup> "Statewide Operational Noise Management Plan." Arizona Army National Guard, Volume 169. June 2013

<sup>2</sup> "Biological Opinion for Arizona Army National Guard, Camp Navajo, Reinitiation Maneuver Training Center - Light." U.S. Department of the Interior. May 2015

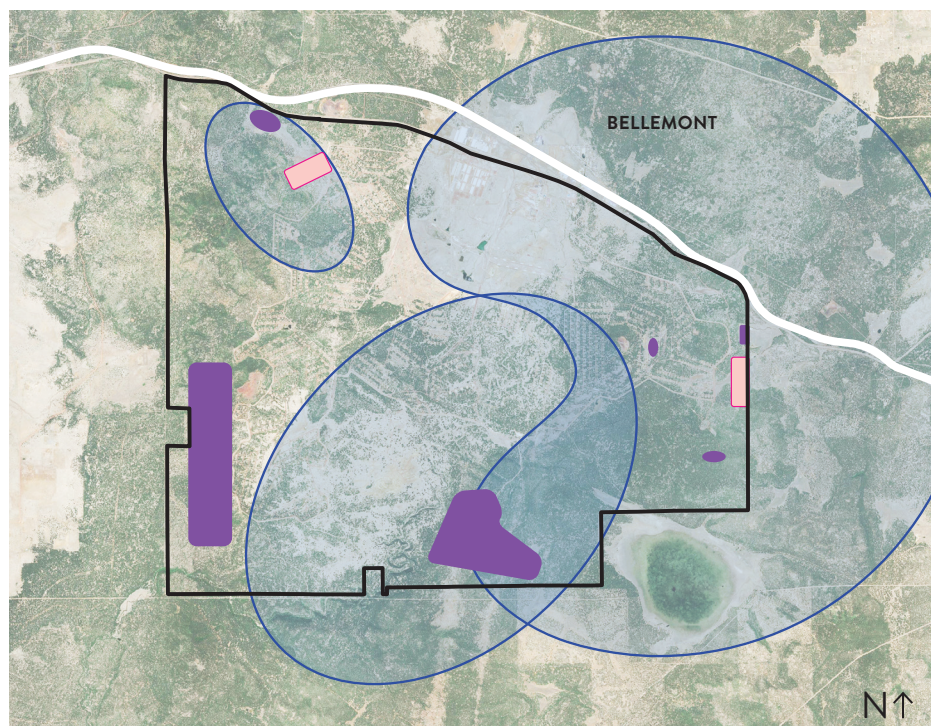


FIGURE 2.04 Future noise impact area

## ONGOING ENVIRONMENTAL REMEDIATION

Past demilitarization operations have resulted in approximately 65 contaminated sites identified through environmental assessments conducted at the end of demilitarization activities in 1994. Most of these sites have since been remediated. However, there is still contamination concern at one 700-acre area, formerly an open burn and detonation area used for demilitarization activities (see figure 2.06). Consequently, the Arizona Department of Environmental Quality (ADEQ) issued a post-closure permit lasting at least 30 years. To avoid further contamination, traffic through this area is restricted. Thus far, no known exposures in excess of applicable health-based levels have been identified and monitoring will continue.

Due to the contamination history, there is concern that increased activity on Camp Navajo, including industrial development, could impact air or water quality or strain area water supplies. Ongoing groundwater sampling monitors water quality for any pollutants that could affect health. Camp Navajo continues to work closely with the ADEQ to evaluate, minimize, and mitigate environmental impacts, which may result from future industrial development. Groundwater monitoring will continue, especially in deep wells, to ensure it remains safe for human consumption per drinking water guidelines.



FIGURE 2.06 Post-closure permit area (Source: Camp Navajo, November 2009)



FIGURE 2.05 Ordnance igloo being constructed in 1942 (Source: Camp Navajo, Army National Guard, 2018)

## VOLUNTEER MOUNTAIN LOOKOUT

Located in the northwest portion of the installation, Volunteer Mountain is a prime feature of Camp Navajo. USFS occupies a lookout tower at the top of Volunteer Mountain during the May-to-September fire season. This location covers Sycamore Canyon and its use as a lookout benefits Camp Navajo, the Bellemont community, and surrounding area. Camp Navajo occasionally uses this facility to monitor aircraft during training exercises.

An amendment to the National Defense Authorization Act (NDAA) permanently transferred ownership of Camp Navajo, including Volunteer Mountain, from the USFS to the DoD in 2017. This ownership transfer agreement requires a Memorandum of Understanding (MOU) be established between the Army and USFS that guarantees USFS use of Volunteer Mountain and ensures the Army maintains the access road. This agreement is currently being developed.

Due to the area's dark sky environment, Volunteer Mountain is also currently being considered as a potential site to accommodate a U.S. naval telescope. (See Naval Observatory Flagstaff Station on page 21 for more information about dark skies and the military mission.)

## LAND MANAGEMENT AND ONGOING INITIATIVES

Camp Navajo maintains the forests and prairies within the installation boundary. Camp Navajo's forests are currently unhealthy and pose a fire hazard similar to many regional forests (See JLUS Issues on page 54 of the United States Forest Service section for more information). Many federally-protected wildlife species and others of conservation concern have been noted on base; future forest thinning practices will need to be sensitive to wildlife in addition to NOFS operations (see Naval Observatory Flagstaff Station on page 21 for more information).

To address forest health, Camp Navajo is currently finalizing a Memorandum of Agreement (MOA) with the Arizona Department of Forestry and Fire Management (ADFFM) to train Camp Navajo personnel in wildfire suppression and prescribed fire support. Camp Navajo is looking into the possibility of a forest industry business cluster as part of the 200 Area development. In addition, the ADFFM can conduct prescribed burns and train wildfire firefighter candidates on base.



## ARMY COMPATIBLE USE BUFFER

In 2015, Camp Navajo finalized an Army Compatible Use Buffer (ACUB) plan. The ACUB identified areas surrounding Camp Navajo with the potential for:

- Military operation noise to affect property owners.
- Safety and security issues to occur along the installation's border.

The study identified 9,714 acres surrounding the base where regulating the type and minimizing the density of development would reduce these compatibility-related risks. These areas include State Trust land, USFS land, and private property (see figure 2.07).

Coconino County purchased the Rogers Lake County Natural Area in 2010 just prior to Camp Navajo establishing the ACUB. The County was also gifted a 240-acre property known as the Frontiere Ranch in 2011. Both of these properties were identified in the ACUB as priority areas to retain in compatible use. AZARNG is working with the Central Arizona Land Trust (CALT) on plans to limit future incompatible development within the ACUB by various conservation efforts. REPI funding was received in 2017 and 2018 in support of the ACUB program at Camp Navajo (see REPI and ACUB Programs sidebar). AZARNG will apply this funding to conservation efforts on other privately-held priority parcels within the ACUB.

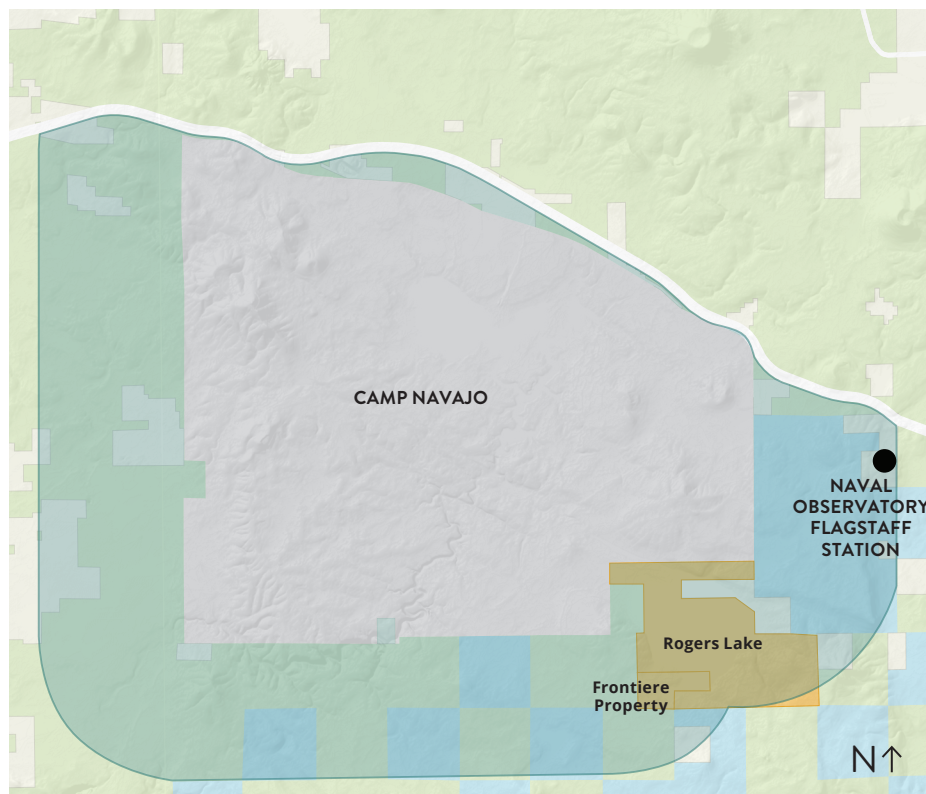


FIGURE 2.07 ACUB and land ownership surrounding Camp Navajo

## REPI AND ACUB PROGRAMS

The DoD's Readiness and Environmental Protection Integration (REPI) Program is a source of funding for conservation efforts. It relies on partnerships among installations, private conservation groups, and state and local governments to share the cost of purchasing easements or properties from willing sellers to preserve compatible land uses and natural habitats near installations.<sup>1</sup>

The Army implements REPI through its ACUB Program, which facilitates partnerships to preserve high-value habitat and limit incompatible development in the vicinity of military installations. The partner, with contributions from the Army, can purchase easements or properties from willing landowners to establish a buffer that is mutually beneficial to the installation and the partner.<sup>2</sup>

<sup>1</sup> Readiness and Environmental Protection Integration (REPI). No date. "About REPI." <http://www.repi.mil/About-REPI/Frequently-Asked-Questions/>. Accessed July 18, 2018.

<sup>2</sup> U.S. Army. No date. "Army Compatible Use Buffer (ACUB) Program." <https://aec.army.mil/index.php/conservation/ACUB>. Accessed July 18, 2018.

### LEGEND

- Camp Navajo
- Army Compatible Use Buffer Area
- State Trust Land
- Private Land
- National Forest
- Conservation and Other Development



## REPI AND ACUB PROGRAMS, CONTINUED

The ACUB process begins at the local level between the installation and partner, who prepare an ACUB proposal to detail the long-term partnership approach to protect the prioritized land. Once the Army has reviewed, approved, and funded the proposal, the partner receives the deeded interest in the property and provides long-term monitoring and management.<sup>34</sup> Key partners have included the AZGFD, ADFFM, the City of Flagstaff, Coconino County, NAU, and U.S. Fish and Wildlife Service.<sup>5</sup>

<sup>3</sup> No date. "Service Programs." <http://www.repi.mil/Buffer-Projects/Service-Programs/>. Accessed July 18, 2018.

<sup>4</sup> No date. "ACUB Proposal Process." <https://aec.army.mil/index.php?cid=473>. Accessed July 18, 2018.

<sup>5</sup> U.S. Navy. No date. *Readiness and Environmental Protection Integration Program Project Profile, U.S. Navy: NO Flagstaff, Arizona.*

## LAND USE ISSUES

### INCOMPATIBLE DEVELOPMENT

As growth pressures within the Flagstaff area push development westward, residential development occurring around Camp Navajo's border may increase. Land surrounding Camp Navajo mostly consists of federal and State Trust land, with some property owned privately or by the county. Any development around Camp Navajo could impact current operations and be incompatible with future operational expansion. While the majority of the surrounding lands are undeveloped and used for timber and/or grazing, the potential for these lands to be developed is an important issue to monitor. See USFS section on page 52 for more information and figure 2.08 below.

### NOISE

Existing and potential future ranges and helicopter operations are estimated to increase noise exposure above the disturbance threshold (see figure 2.04 on page 15). This sound exposure increases effects on wildlife and complaint risk as these munitions create shock waves that travel through the air, rattling windows and causing vibration. These increases could cause compatibility conflicts with the most sensitive land uses. This noise disturbance is most prominent during peak training periods (spring and summer).

### LIGHT POLLUTION

Night operations on Camp Navajo require dark conditions. While the mostly undeveloped land surrounding the base is not a current light pollution issue, potential light from development could hinder the ability to execute night operations. Light in excess of what is needed for safety, security, and task purposes (light pollution) can unintentionally and unduly interfere with the ability for nearby installations to successfully execute their missions.



FIGURE 2.08 Camp Navajo (Source: DEMA.az.gov, 2018)

## JLUS ISSUES, CONTINUED

### HUGHES AVENUE BRIDGE

The Hughes Avenue bridge over the railroad tracks leading to the main Camp Navajo entrance is in need of improvements and no longer meets the needs of the railroad (see figure 2.09). With industrial development and resulting increased traffic, specifically from large trucks to support 200 Area development, plans for this bridge will need to accommodate the future traffic volume and weight.

### GROUNDWATER CONTAMINATION CONCERN

During JLUS outreach, the community expressed concern over potential groundwater contamination due to increased pumping potentially required by some of the industrial uses being considered for development on the 200 Area. No groundwater contamination has been detected at this time. While groundwater in the surrounding communities is not sourced from Camp Navajo, it is important to note the community's concern when planning for future development.

### USE OF VOLUNTEER MOUNTAIN

For continued joint use of the lookout tower on Volunteer Mountain with the USFS and the potential siting of a new NOFS telescope, communication and coordination will be key. Issues with access and conflict with operations need to be addressed as well as continued work on safety for lookout tower personnel.

### UNHEALTHY FORESTS ON CAMP NAVAJO RESTRICT CURRENT AND FUTURE OPERATIONS.

Increased risk of wildfire due to current tree density can reduce or degrade operations and impact training. Forests can be too thick for prescribed burns and this method can potentially interfere with NOFS operational visibility. See Land Management and Ongoing Initiatives on page 17 for more information.

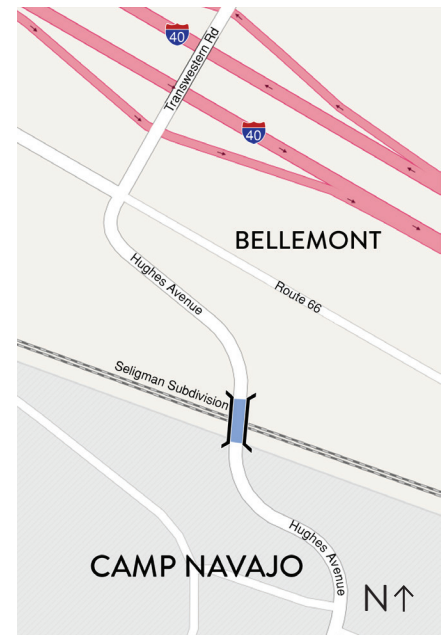


FIGURE 2.09 Hughes Avenue bridge over the railroad tracks

## NAVAL OBSERVATORY FLAGSTAFF STATION

### LIGHT POLLUTION IMPACT

Increased light pollution in the area could negatively affect NOFS's ability to continue to complete its mission.

Arizona is one of the most ideal dark sky locations in the world due to factors such as latitude, altitude, weather, and laminar air flows that improve light clarity. Established in 1955 and located a few miles west of the city, NOFS is one of several observatories and one of two U.S. Naval Observatory (USNO) sites in the Flagstaff region (see figure 2.10). NOFS is the USNO's dark sky site for optical and near-infrared astronomy.

The NOFS mission is:

- To make, analyze, and interpret astrometric and photometric dark sky observations as are required to fulfill the mission of the USNO.
- To conduct a research program to improve the observational methods and the accuracy of astronomical data required by the Navy and other components of the Department of Defense.
- To perform other functions or tasks as may be directed.

Overall, the NOFS mission includes fundamental science and support for the military. Activities include locating and cataloging the positions of stars in the night sky with high accuracy, providing navigational data to the National Aeronautics and Space Administration (NASA), Global Positioning System (GPS) computation, and identifying objects orbiting near U.S. assets in space.



FIGURE 2.10 Naval Observatory Flagstaff Station (Source: Cdoovision.com, 2018)

A second USNO facility, the Navy Precision Optical Interferometer (NPOI), is located approximately 15 miles southeast of Flagstaff within the Coconino National Forest on Anderson Mesa (see figure 2.11). The NPOI is a specialized telescope that has the capability of making high-precision measurements. The NPOI is collocated with facilities run by Lowell Observatory and is a collaborative effort between the USNO, the Naval Research Laboratory, and Lowell Observatory. Constructed in 1992, the NPOI has recently received investments to upgrade its apertures, increasing its light sensitivity. Lighting from increased development south and southeast of the city could be a concern for NPOI operation.



FIGURE 2.11 NPOI facility (Source: dtic.mil, 2018)

## MISSION COMPATIBILITY LIGHT POLLUTION STUDY

The NOFS completed a Mission Compatibility Light Pollution Study (Light Pollution Study) in December 2017. The study evaluated the mission impact from light pollution, presented findings, and outlined recommendations to minimize impacts to the dark sky and the NOFS mission for consideration by Flagstaff and Coconino County (see sidebar Questions Answered by the Light Pollution Study on page 24). Population growth and increased artificial lighting use, particularly near the NOFS, can affect the ability of the Navy to accomplish its mission.

### STUDY AREA AND METHODOLOGY

The study area encompassed approximately 462,792 acres within Flagstaff and Coconino County and analyzed the existing condition and future build-out (~100 years, the same timeline used in the Flagstaff's Regional 2030 plan; see figure 2.12).

The future build-out scenario methodology addressed:

- Existing undeveloped parcels under current zoning and lighting standards.
- Additional light resulting from potential rezoning with Flagstaff's Regional Plan designated activity centers near NOFS (Lighting Zone 1, see Lighting Zones sidebar).
- Lighting on State Trust lands, assuming 97% residential and 3% commercial use.
- Additional non-parcel-based lighting (streetlights and automobile headlights).

### LIGHTING ZONES

The county's relevant lighting zones are delineated as concentric circles based on the distance from NOFS and NPOI (see figure 2.12):

- Zone I—within 2.5 miles
- Zone II—2.5 miles-less than 7 miles
- Zone III—all other county areas

Flagstaff's lighting zones are roughly based on the distance from NOFS and NPOI:

- Zone 1—within 2.5 miles
- Zone 2—2.5-7 miles
- Zone 3—7-35 miles



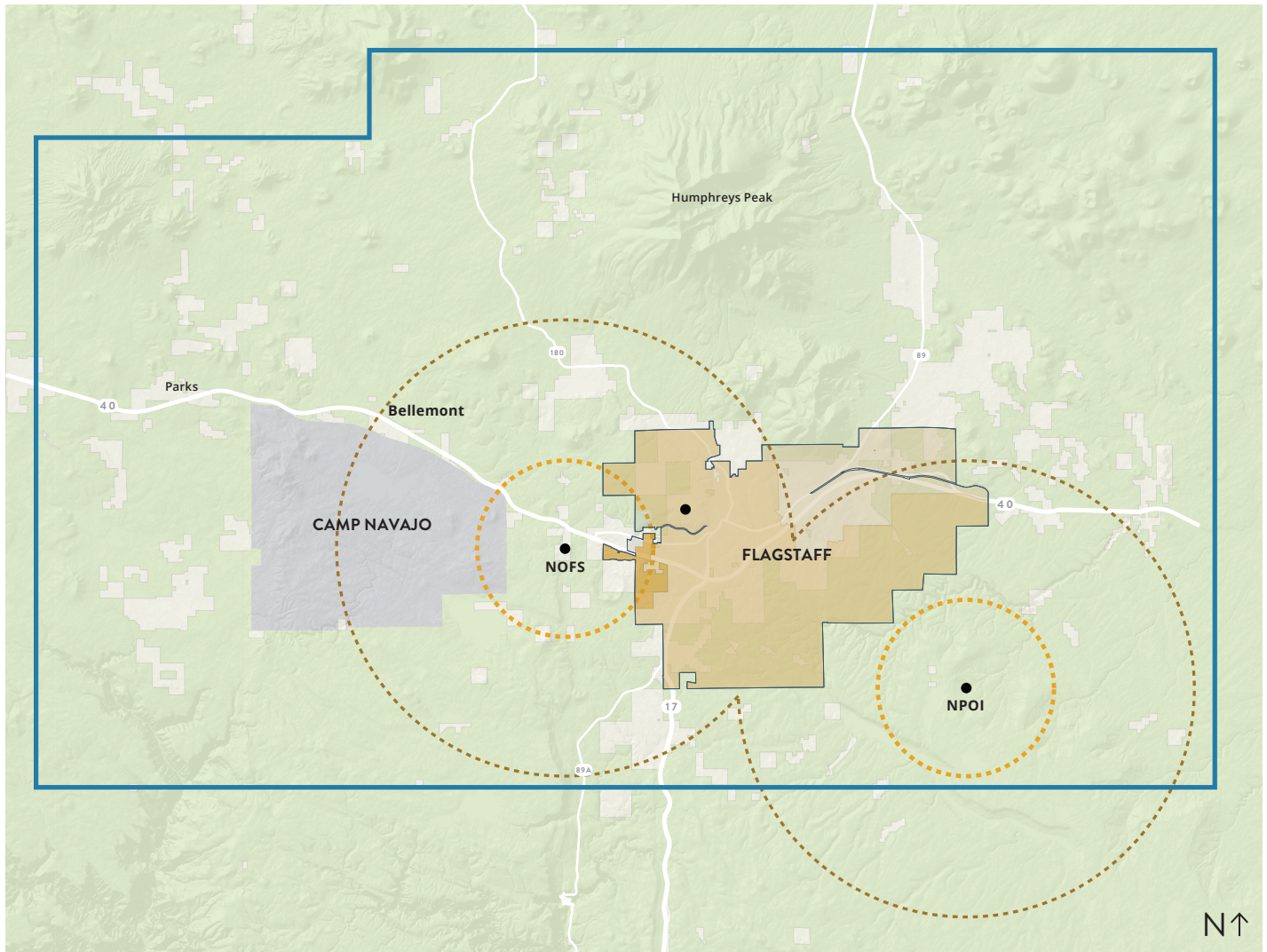


FIGURE 2.12 City and county lighting zones affecting NOFS and NPOI

#### LEGEND

- Light Pollution Study Area of Interest
- Camp Navajo
- County Lighting Zone I
- County Lighting Zone II
- City Lighting Zone 1
- City Lighting Zone 2
- City Lighting Zone 3
- Private Property

### STUDY RECOMMENDATIONS

Command leadership at the NOFS identified a 10% brightening over current conditions as the maximum allowable increase to maintain mission capability. Without effective lighting management, sky brightening at NOFS is anticipated to exceed the 10% limit in the future build-out scenario. NOFS continues to work with the city and county to implement recommendations made by this study (See Light Pollution Study Recommendations sidebar).

The Light Pollution Study received a letter of support from the Dark Sky Working Group (commonly referred to as the Outdoor Lighting Code Working Group) in the fall of 2017. The Flagstaff City Council and Coconino County Board of Supervisors directed staff to work toward implementing recommendations at their June 4, 2018 joint special meeting. More in-depth discussions with the city and county occurred in the latter half of 2018 and are planned for 2019.

#### QUESTIONS ANSWERED BY THE LIGHT POLLUTION STUDY

- What is the expected impact of development in the region on the NOFS' observing conditions?
- Are the current lighting code standards and patterns of expected development compatible with the long-term ability of the NOFS to fulfill DoD mission requirements?



FIGURE 2.13 Dark skies at Bonito Park (Source: D Soltesz, Wikimedia Commons, 2017)

#### LIGHT POLLUTION STUDY RECOMMENDATIONS

1. Encourage canopies in Lighting Zone 1
2. Extend Lighting Zone 2 into Lighting Zone 3
3. Identify and track lighting retrofits (Flagstaff & Coconino County)
4. Modernize measurement of absolute lumens
5. Update residential roadway lighting requirements
6. Align residential "Average Use" standard

## JLUS ISSUES

### LIGHT AND ENCROACHING DEVELOPMENT

Development in Flagstaff and surrounding areas will need to adhere to amended lighting codes to maintain NOFS's mission capability. The location, intensity, and type of development surrounding NOFS will need to be closely managed to minimize impact of potential sky brightening. Enhanced lighting code enforcement activities will also be needed to reduce sky brightening impact. The areas in close proximity to NOFS that could have the highest impact include State Trust, county, and privately held land to the north of NOFS. Flagstaff's activity centers to the west and southeast, as designated in figure 2.34 on page 43, are specific areas of concern for nearby NOFS sites. Light from potential development on Camp Navajo should also be considered.

An additional USNO telescope may be relocated to this area to be monitored by NOFS. Potential sites include Volunteer Mountain on Camp Navajo. With dark skies west of Camp Navajo becoming a mission-critical need, current lighting standards and increased development need to address dark sky requirements.

### PARTICULATE/HEAT DISTURBANCE

While NOFS visible-spectrum telescopes are sensitive to light sources, NOFS near-infrared telescopes, which use infrared light to detect celestial bodies, are sensitive to heat sources. Potential industrial development, specifically large plants such as the OSB or biomass plant, could create visibility issues for infrared telescopes. Forest fires, including prescribed burns and wildfires, are also an issue as they add particulates to the air. Although the need to improve area forest health is important, coordination with NOFS is key to reduce visibility issues due to particulates.

### EDUCATION

Community awareness and support for dark sky preservation has and will continue to play a big role in protecting dark skies and NOFS mission. Increased visibility and knowledge about all observatory missions in the region, including NOFS and Lowell Observatories, is an important factor. Local training of the development community and lighting retailers on dark sky standards and best practices is particularly important. An additional challenge is the shortage of dark sky-compliant lighting fixtures and bulbs at local stores. Lighting retailer awareness also plays an important role in dark sky preservation.



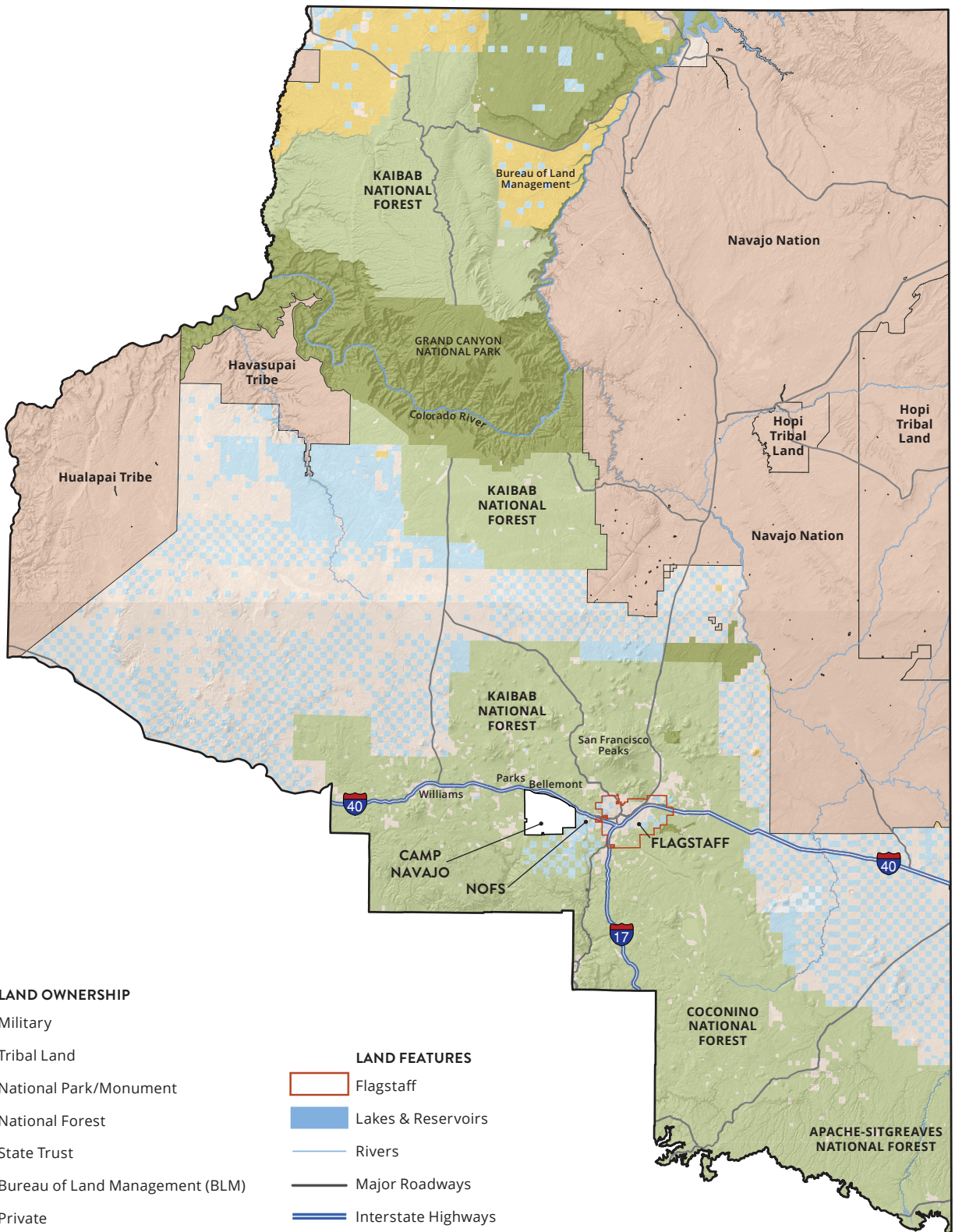


FIGURE 2.14 Coconino County



# JLUS PARTNERS & KEY STAKEHOLDERS

## COCONINO COUNTY

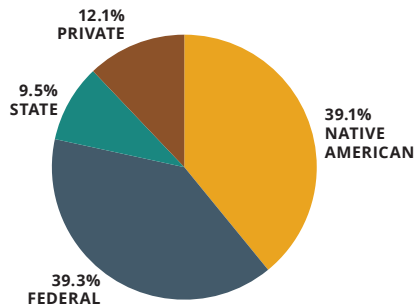


FIGURE 2.15 Land ownership in Coconino County

Located in the north central part of the state, Coconino County is the second-largest county by area in the contiguous United States. The county is bordered to the northwest by part of the Grand Canyon. Its northern boundary is shared by Utah and cuts through the Hopi and Navajo reservations on the east side. The southern border roughly traces the boundary of the Colorado Plateau, with part lying along the Mogollon Rim, then cutting through Sedona to follow Interstate 40 (I-40).

The county features some of the most spectacular landscapes and diverse environments in the Southwest. The Grand Canyon, Vermilion Cliffs, San Francisco Peaks, Oak Creek Canyon, and other unique natural features draw millions of visitors and hundreds of new residents to its communities and open spaces.

Within the unincorporated portions of the county, less than 12% of the land is privately owned. Native American tribes also own approximately 39% of land within the county, both on and off reservation. This includes five tribes, three of which are represented in the JLUS study area (Hopi, Navajo, and San Juan Southern Paiute). The federal government owns and manages more than 39% of land within the county. The primary managers of this federal land include the USFS (27.3%), NPS (6.7%), and Bureau of Land Management (BLM) (5.1%). Parts of four national forests (Apache-Sitgreaves, Coconino, Kaibab, and Prescott) are situated within the county (see figure 2.14 and figure 2.15).

The city of Flagstaff is the county seat (discussed on page 40). Other unincorporated communities in the vicinity of Camp Navajo and NOFS include Bellemont and Parks. The city of Williams lies approximately 15 miles to the west of Camp Navajo.

Planning in this area occurs simultaneously at the regional, county, and local levels. Agencies such as the ASLD, USFS, BLM, and NPS develop plans for managing their lands in coordination with surrounding jurisdiction planning efforts, allowing for cohesive efforts.

The remainder of this section reviews current land use and zoning in Coconino County and its compatibility with Camp Navajo and NOFS (Zoning & Land Use Context on page 31). It also provides more details regarding conservation efforts around Camp Navajo on page 34, land use planning in progress for the community of Bellemont on page 36, and the Bellemont Interchange on page 38.

## COMPREHENSIVE PLAN

The county's Comprehensive Plan was adopted in December 2015 (see figure 2.16). This plan includes a vision statement, guiding principles, and the following elements:

- Sustainability & Resiliency
- Natural Environment
- Water Resources
- Land Use & Growth
- Community Character
- Economic Development
- Parks, Open Space, Trails, & Recreation
- Community Services
- Public Safety
- Circulation
- Energy
- Implementation

The Land Use & Growth element includes a separate section on military installations. This section documents the value of these installations to national security and the local economy and notes that new development and changes in land use can serve as potential threats to the missions of Camp Navajo and NOFS. The plan also references that the installations are seeking partners to help acquire State Trust lands adjacent to their operations in the Centennial Forest to help serve as a buffer to the installation while protecting wildlife.

The plan does not include specific land use designations or classifications for the lands surrounding Camp Navajo and NOFS. However, the plan includes goals and policies that cover the full spectrum of land use issues within the county, including those addressing conservation of landscapes and open spaces, ranch lands, residential and commercial uses, mixed-use and activity centers, industrial uses, public/service uses, and growth strategies (see JLUS-Relevant Land Use Policies).

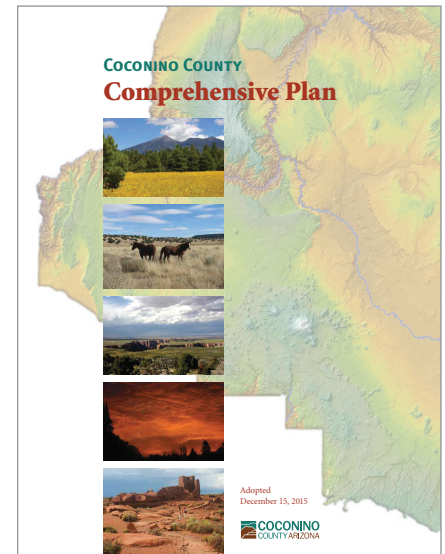


FIGURE 2.16 Source: Coconino County Comprehensive Plan, 2015

## 2015 COCONINO COUNTY COMPREHENSIVE PLAN

### JLUS-RELEVANT LAND USE POLICIES

LU-1: Seek changes to Arizona statutes allowing for State Trust reform or some other form of legislation allowing for the exchange of State Trust lands.

LU-4: The County supports changes to state law to give Counties greater authority over lot splits.

LU-10: In order to protect and maintain the mission of the Department of Defense installations, the County values the findings of the Joint Land Use Study, and incompatible land uses affecting the mission of existing military installations shall be discouraged.

LU-12: The County will work with private landowners, public land managers, tribal entities, and the ASLD to protect open lands for the purposes of maintaining scenic viewsheds, preventing fragmentation, preserving important wildlife habitat, conserving working lands, protecting watersheds and water resources, providing buffers from developed areas, and protecting environmentally sensitive lands.

LU-50: The County strongly supports compact infill development in existing urban, suburban, and rural activity centers before outlying and more remote lands are considered for development.

LU-54: Promote regional collaboration by partnering with federal and state agencies, communities, and private landowners on the protection of environmentally sensitive lands and open space for its value to wildlife and on the preservation of our dark skies to conserve the overall quality of life enjoyed by residents of Coconino County.



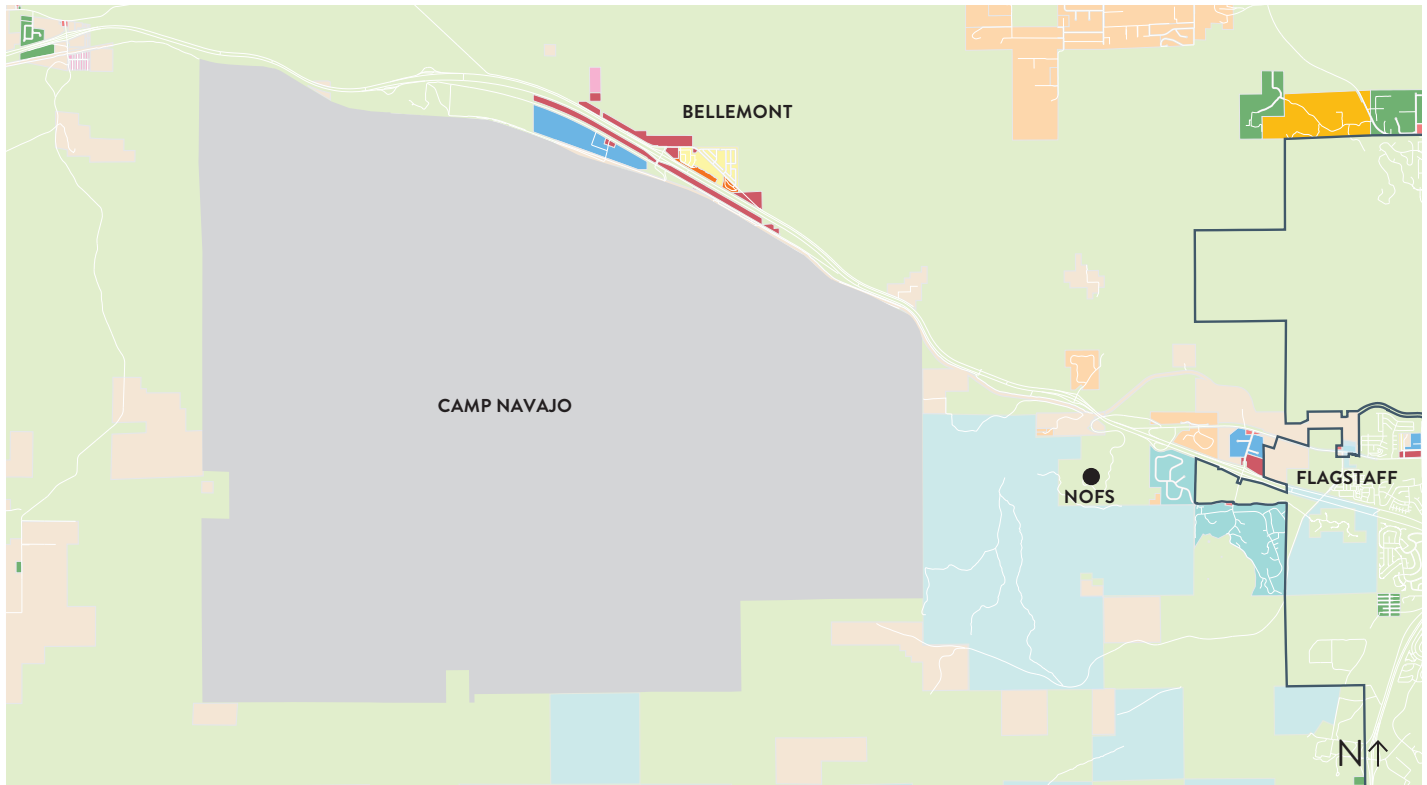


FIGURE 2.17 Coconino County zoning in the vicinity of Camp Navajo and NOFS (see figure 2.18 for Bellemont inset)

**LEGEND**

<span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> Rural Residential (RR)	<span style="display:inline-block; width:15px; height:15px; background-color:teal; border:1px solid black;"></span> Planned Community (PC)
<span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> Residential Single Family (RS-6,000)	<span style="display:inline-block; width:15px; height:15px; background-color:lightorange; border:1px solid black;"></span> General (G)
<span style="display:inline-block; width:15px; height:15px; background-color:orange-red; border:1px solid black;"></span> Residential Single Family (RS-5/A)	<span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span> Light Industrial (M-1)
<span style="display:inline-block; width:15px; height:15px; background-color:red; border:1px solid black;"></span> Residential Multiple Family (RM-10/A)	<span style="display:inline-block; width:15px; height:15px; background-color:green; border:1px solid black;"></span> Agricultural Residential (AR)
<span style="display:inline-block; width:15px; height:15px; background-color:pink; border:1px solid black;"></span> Manufactured Home Park (MHP)	<span style="display:inline-block; width:15px; height:15px; background-color:lightgreen; border:1px solid black;"></span> Open Space and Conservation (OS)
<span style="display:inline-block; width:15px; height:15px; background-color:red; border:1px solid black;"></span> Commercial General (CG-10,000)	<span style="display:inline-block; width:15px; height:15px; background-color:lightblue; border:1px solid black;"></span> State Trust
<span style="display:inline-block; width:15px; height:15px; background-color:darkred; border:1px solid black;"></span> Commercial Heavy (CH-10,000)	<span style="display:inline-block; width:15px; height:15px; border:1px solid black;"></span> Municipal Boundary

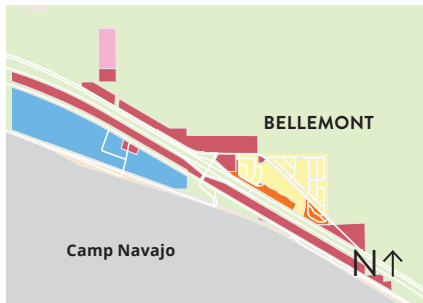


FIGURE 2.18 Bellemont area zoning

**LEGEND**

- Residential Single Family (RS-6,000)
- Residential Multiple family (RM-10/A)
- Manufactured Home Park (MHP)
- Commercial Heavy (CH-10,000)
- General (G)
- Light Industrial (M-1)
- Open Space and Conservation (OS)
- Camp Navajo

## ZONING & LAND USE CONTEXT

The county's zoning designations for the limited number of privately owned lands surrounding Camp Navajo and NOFS are illustrated in figure 2.17 and figure 2.18. Except for the Bellemont area, the privately owned lands surrounding Camp Navajo are all zoned General. The General zone is a rural land use category that requires a 10-acre minimum parcel size and a density of up to one primary dwelling unit and one accessory dwelling unit per parcel. Other permitted uses include general agricultural uses, gardening, and animal keeping. A variety of uses are allowed through the Conditional Use Permit process, including bed and breakfast establishments, agritourism, animal shelters and veterinary facilities, cottage industries, and a broad range of public, natural resource-based, and utility-based uses.

Most of the General-zoned private lands to the west, south, and east of Camp Navajo appear to be used for ranching and forestry as well as some residential parcels. While a number of parcels are at or near the 10-acre zone-minimum size, there are several parcels in the 40-, 80-, 160-, and 240-acre range in the areas surrounding Camp Navajo (and south of NOFS) that could be further subdivided. The State allows property owners to divide properties up to five ways without formal county subdivision review and approval. Consequently, there is potential for those larger parcels surrounding Camp Navajo to be split into numerous 10-acre parcels (each with a home) without the formal subdivision process. This means that the installations would not receive prior notifications. Coconino County's comprehensive plan notes that such lot splits have resulted in whole areas with minimal roads and utility improvements, no open space, habitat fragmentation, and drainage issues.

Within the Bellemont area, the most common zoning districts include:

- Light Industrial (M-1-10,000) (most of area between Old Route 66 and the railroad).
- Commercial Heavy (CH-10,000) (Pilot Travel Center and property between I-40 and Old Route 66).
- Residential Single Family (RS-6,000) (residential lands northeast of the interchange).

No changes to existing zoning are proposed thus far in the ongoing Bellemont Area Plan update.

Surrounding NOFS, privately owned lands outside the Flagstaff city limits are within a great variety of zoning districts, from Open Space and General to Planned Residential District (PRD) as illustrated in figure 2.19 on page 32.

## CITY/COUNTY COORDINATION

Coconino County and Flagstaff have a special arrangement to jointly plan for 460 acres of unincorporated county lands that surround Flagstaff's city limits. This arrangement is coordinated via the Flagstaff Metropolitan Planning Organization (FMPO). The FMPO also includes the Northern Arizona Intergovernmental Public Transportation Authority and ADOT operating as "Partners in Transportation Enhancing Our Community." Flagstaff's 2030 Regional Plan encompasses all lands within the FMPO boundaries, including lands inside and outside Flagstaff city limits. Thus, the 2030 Regional Plan is approved both by the City of Flagstaff and Coconino County. Consequently, the plan's goals and policies help to guide county planning decisions in those 460 unincorporated acres, which include most of Belmont, areas surrounding NOFS, and the eastern portion of Camp Navajo. The plan's theme of concentrating development and protecting open space are consistent with those of the county's comprehensive plan (see figure 2.31 on page 40).

## LIGHTING ZONES & CODES

In 1973, the City and County jointly adopted their first comprehensive lighting codes, which required shielding, light shut-off times for floodlighting and recreational facility lighting, and for direct illumination to be confined to the property boundaries of the light source. Both the City and County undertook another major lighting ordinance update in 1989, which integrated lighting zones and restricted the amount of light per acre in outdoor lighting installations. Since then, the codes have been periodically updated and strengthened. The maximum total outdoor light output standards by lighting zone, measured in lumens per acre, is illustrated in figure 2.20. See figure 2.21 for county lighting zones.

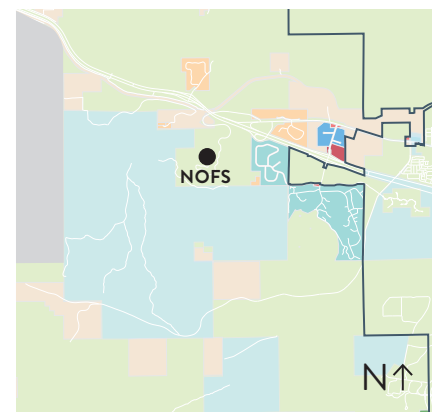


FIGURE 2.19 County zoning surrounding NOFS

### LEGEND

- Rural Residential (RR)
- Commercial General (CG-10,000)
- Commercial Heavy (CH-10,000)
- Planned Community (PC)
- General (G)
- Light Industrial (M-1)
- Open Space and Conservation (OS)
- State Trust
- Municipal Boundary

COUNTY LIGHTING CODE LAND USE	LIGHTING ZONE		
	I	II	III
<b>Commercial, Industrial, and Multiple Family (Lumens per Acre)</b>			
total (shielded + unshielded)	25,000	50,000	100,000
unshielded only	0	3,000	3,000
non-low pressure sodium	2,500	50,000	100,000
<b>Single Family Residential (Lumens per Residence)</b>			
total (shielded + unshielded)	10,000	30,000	30,000
unshielded only	0	2,000	2,000

FIGURE 2.20 Maximum total outdoor light output standards in Coconino County's lighting code (Source: Coconino County Zoning Ordinance).



## LIGHTING CODE IMPLEMENTATION AND ENFORCEMENT

The County requires a lighting permit to accompany any building permit for commercial or public/semi-public use (most uses other than single family dwellings and associated accessory structures). The planners and/or building inspectors inspect construction to ensure lighting was installed consistent with the approved permit prior to issuing a certificate of occupancy.

County staff conducts zoning ordinance enforcement activities (including outdoor lighting) through complaints. Example violations would be installing new or changing existing lighting without a lighting permit, or exceeding the lumen per acre limit in the code.

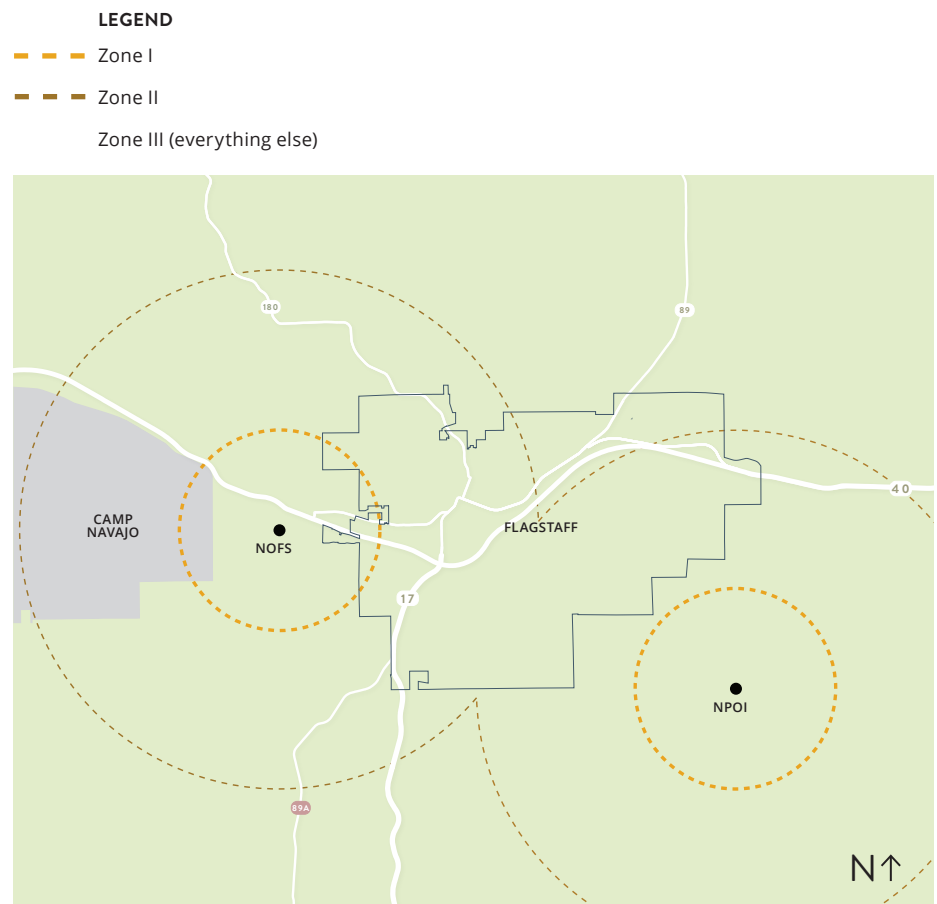


FIGURE 2.21 Coconino County Lighting Zones

## CONSERVATION EFFORTS

Since 2010, there have been several conservation efforts within the county that have helped preserve land between Camp Navajo and NOFS (see figure 2.23).

### ROGERS LAKE COUNTY NATURAL AREA

Rogers Lake is a 1,400-acre ephemeral wetland southeast of Camp Navajo that functions as critical resident and migratory wildlife habitat boasting a rich cultural history (see figure 2.22). Formerly State Trust land, Coconino County purchased this 2,250-acre property in 2010 (including most of Rogers Lake) and created the Rogers Lake County Natural Area (see page 55 for more information on the Arizona State Land Department). In 2012, the County developed the 2014-2024 Management Plan for the area outlining plans to improve forest health and increase passive recreation opportunities by adding a trail system, wildlife viewing platform, etc. Coconino County Parks and Recreation department recently received Arizona Parks and Recreation Association's 2017 Natural Resources Award for improvements to this area. While a plan is not currently in place, the County would eventually like to secure additional land in this area to incorporate more of the Rogers Lake lake bed.



FIGURE 2.22 Aerial of Rogers Lake (Source: coconino.az.gov, 2018)

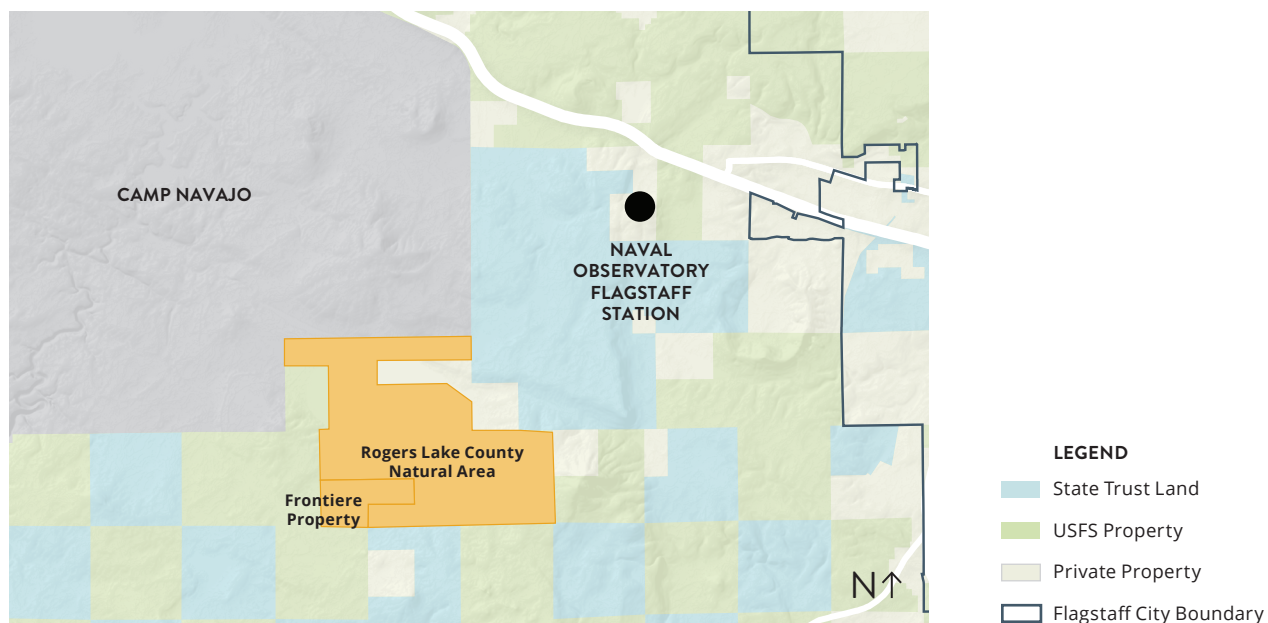


FIGURE 2.23 Land conservation areas around Camp Navajo and NOFS

### ***FRONTIERE PROPERTY***

A 20-acre housing compound at the edge of Rogers Lake (see figure 2.24) was conveyed to Coconino County as a part of a 240-acre donation in 2011. The County is exploring potential uses for this property, which is known as Frontiere Ranch. The County desires development of complementary low-impact uses to help fund management and maintenance of the site over time. Recently, Camp Navajo has been working to establish a conservation easement for this property using REPI Program funds as it is a priority ACUB property.



FIGURE 2.24 Residence on Frontiere property (Source: J Bacon, Arizona Daily Sun, 2018)

## BELLEMONT AREA PLAN UPDATE

Bellemont is an unincorporated community of approximately 900 residents centered on an I-40 interchange eight miles west of Flagstaff (see figure 2.26). It includes all private lands approximately 1.5 miles north and south of the interchange scheduled for improvements (see Bellemont Interchange on page 38 for more information). To the south, Bellemont is bordered by BNSF railroad and Camp Navajo and by Coconino National Forest to the north. Even though Bellemont appears attractive due to accessibility, much of Bellemont is undeveloped, partly due to South Bellemont lacking water and waste water utilities. The areas south of the interstate are industrial, distribution, and service uses while the area north of the interstate, except for the Pilot Travel Center (truck stop), is mostly residential and functions as a bedroom community for Flagstaff.

Coconino County is currently updating the 1985 Area Plan adopted for the community. Upon completion by the end of 2018, the plan will set a 20-year vision for the Bellemont community. The current effort (presently finishing the draft revision stage) has involved local business and property owners, Camp Navajo officials, local service providers, applicable public agencies, and county planners and public officials.

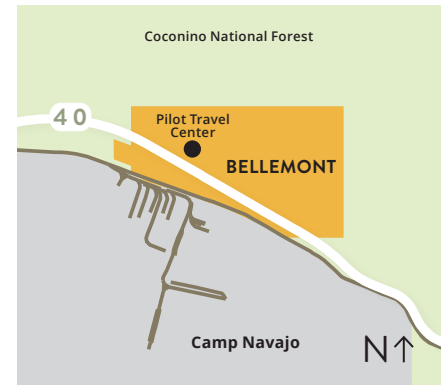


FIGURE 2.26 The community of Bellemont

— BNSF Rail

## CITY OF WILLIAMS

The city of Williams lies approximately 22 miles west of Bellemont on I-40 (figure 2.25) and has a population of 3,023 (2010 census). Williams is known as the “Gateway to the Grand Canyon,” as it is the southern terminus of the Grand Canyon Railway on the Southwest Chief Amtrak train route and is the last town on Historic Route 66 to be bypassed by Interstate 40. There are numerous inns, motels, restaurants, and gas stations that cater to the large influx of tourists, especially during the summer and holiday seasons. The town boasts a rich heritage combining the Old West with a Route 66 design theme which includes colorful vintage-style neon signs.

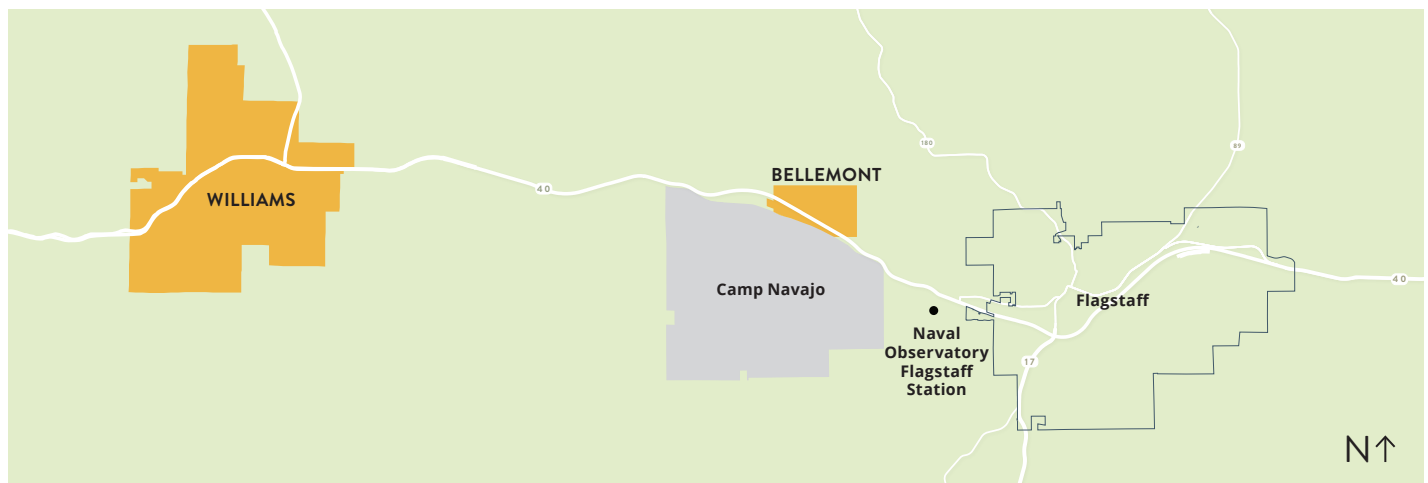


FIGURE 2.25 The city of Williams and community of Bellemont



While Williams lies just outside of the Coconino JLUS Study Area, the potential to locate telescope facilities on Camp Navajo's Volunteer Mountain or other site in the area led to its inclusion in this study.

## JLUS ISSUES

### INCOMPATIBLE DEVELOPMENT

As referenced in the Camp Navajo and NOFS sections, increased development surrounding the installations could impact their missions. While the density limits of area zoning are generally low (10-acre minimum in most areas), there is capacity for a significant amount of new development. This will continue to be an important issue to monitor for the foreseeable future.

### LIGHTING CODE UPDATE

With continued population growth and development pressure in the areas surrounding NOFS combined with changes in lighting technology, updates to the county's lighting code consistent with the Light Pollution Study are needed to protect dark skies and ensure the continued mission of NOFS. An ongoing challenge to the lighting code update is balancing the dark sky protections with the public's need and desire for safety.

### LIGHTING CODE ENFORCEMENT

Enforcing the county's outdoor lighting ordinances and standards is an ongoing challenge made more acute by staffing shortages. Perhaps the biggest current challenge is when an existing use replaces standard bulbs with more efficient, yet brighter white light-emitting diode (LED) bulbs. This is occurring on the full range of land uses outside of the permitting process. A second notable enforcement challenge often comes when unshielded lighting fixtures associated with single family uses are installed outside of the permitting process. There is no established auditing process in place to address such situations. Strong private property rights perspectives in the region also challenge efforts to increase enforcement in the county.

### CONSERVATION

While the county has made great strides to conserve key property around Camp Navajo and NOFS, funding is a limiting factor for further conservation efforts. The county voter base does not favor repeated conservation levies. Other sources of funding, such as the REPI program, or partnerships with non-governmental organizations (NGOs), warrant continued exploration.

# BELLEMONT INTERCHANGE

Interstate 40 (I-40) within the Camp Navajo vicinity serves a multitude of users including local Bellemont residents and businesses, Camp Navajo military traffic, and recreation-based traffic destined for the Grand Canyon and other locations (see figure 2.28).

The Bellemont interchange provides the sole point of access for both Camp Navajo and Bellemont via a diamond interchange. Transwestern Road serves as the north-south connection over I-40 and provides access to the Pilot Travel Center to the north and Camp Navajo to the south. Existing traffic volumes at the interchange and adjacent roadways are low; however, there are operational issues related to the high percentage of heavy truck traffic using the interchange and design issues with the Pilot Travel Center driveway and closely-spaced intersections.

Increased traffic volumes related to additional commercial/industrial development within and around Camp Navajo and the Bellemont area will cause traffic operations to be further strained.

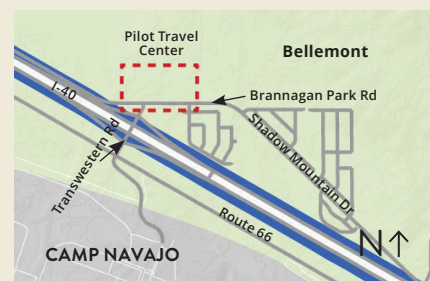


FIGURE 2.28 Bellemont context

Figure 2.27 focus area

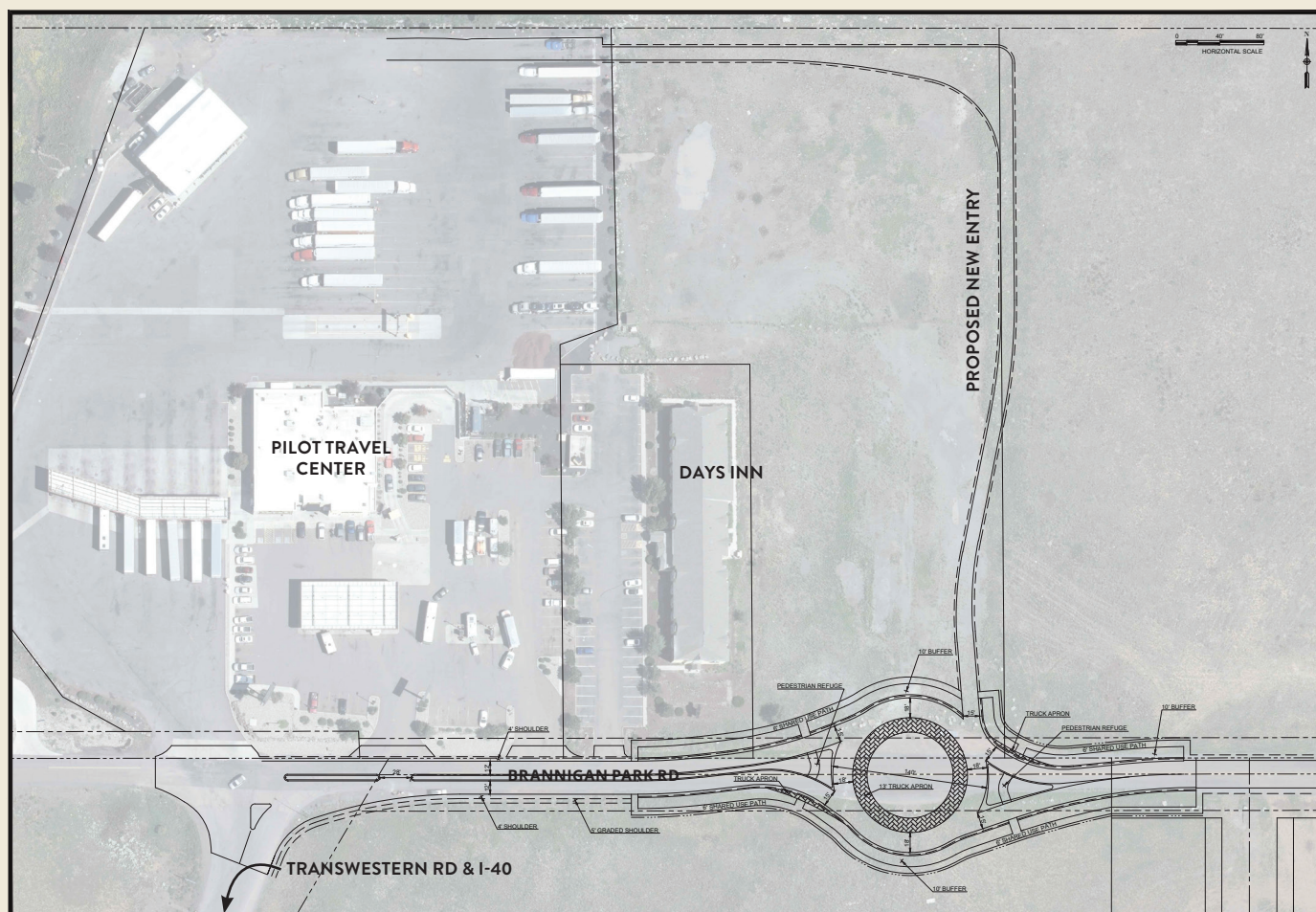


FIGURE 2.27 Proposed roundabout design (Source: *Bellemont Access Improvements Report*, Burgess & Niple, 2017)



**FIGURE 2.29** Pilot Travel Center in Bellemont  
(Source: MAKERS, 2017)



**FIGURE 2.30** Bridge over I-40 looking southwest to Camp Navajo (Source: MAKERS, 2017)

### ***FUTURE PLANS***

There have been several relatively recent planning efforts by the ADOT and Coconino County which have evaluated traffic operations and identified potential improvements in this area. In 2015, ADOT completed the Access Management and Multimodal Transportation Study focusing on traffic operations on the north side of the interchange. The study recommended improvements along Shadow Mountain Drive/Brannigan Park Road, including pedestrian/bicycle improvements and a roundabout east of the Pilot Travel Center (see figure 2.29). The preliminary design of a single-lane roundabout has been completed and final design and construction are planned for 2019 (see figure 2.27).

The Transwestern Road bridge has been identified for deck rehabilitation in ADOT's (2018-2022) Five-Year Transportation Facilities Construction Program. This \$6.6 million project is currently programmed for construction in 2020. The project repairs the two-lane cross-section but does not add width to accommodate a travel lane or a pedestrian/bicycle facility.

## **BELLEMONT INTERCHANGE ISSUES**

### **CONSTRAINED TRANSPORTATION NETWORK**

The current two-lane Transwestern Road bridge over I-40 is unable to accommodate an increase in heavy truck traffic which may result from potential development in the Bellemont area (see figure 2.30). The intersection turning lanes are not long enough to accommodate peak truck and automobile volumes. This limited queue storage and roadway design will result in more frequent blocking of adjacent intersections impacting general traffic operations, safety, and emergency response. ADOT's planned deck rehabilitation project does not address these challenges.

### **INCREASED TRAFFIC VOLUMES AND CONGESTION**

Additional commercial/industrial development within and around Camp Navajo and the Bellemont interchange and the resulting increase in truck traffic will cause overall area operations and safety to further deteriorate. Given the mix of future land uses, the increased number of auto and truck trips will likely increase congestion during both high traffic and typical traffic periods.

### **LACK OF MULTIMODAL MOBILITY**

The lack of pedestrian and bicycle facilities on the bridge has been raised as a critical need by the Bellemont community. As both areas north and south of I-40 continue to grow, the need to travel across the freeway will only increase. Given the limited funding for both the bridge rehabilitation and the Shadow Mountain Drive improvements, additional partnerships will need to be identified to fund additional multimodal improvements at the interchange.

### **LIGHTING FIXTURES**

Early and ongoing coordination with NOFS's officials on interchange lighting plans will be important to minimize sky brightening impacts due to the interchange's close proximity to NOFS.



## CITY OF FLAGSTAFF

The city of Flagstaff is located at the base of the San Francisco Peaks along historical Route 66, with close proximity to multiple national forests and the Grand Canyon. Flagstaff has long been a hub for commerce and tourism and is the county seat for Coconino County.

A major part of Flagstaff's history is tied to the two astronomical observatories in the area—NOFS and Lowell. This early connection to dark sky-related activities has been a defining characteristic for the community, as Flagstaff pioneered dark skies preservation and outdoor lighting policy for over a half-century (first lighting ordinance enacted in 1958). The city of Flagstaff was designated by the International Dark-Sky Association as the world's first International Dark Sky Community in 2001. To a large extent the value and stewardship of dark skies is ingrained within the community and regional identity.

This chapter discusses Flagstaff's Regional Plan on page 42, Zoning & Land Use on page 45, and Lighting Code Implementation and Enforcement on page 49. Issues relevant to the city of Flagstaff are presented in JLUS Issues on page 49.

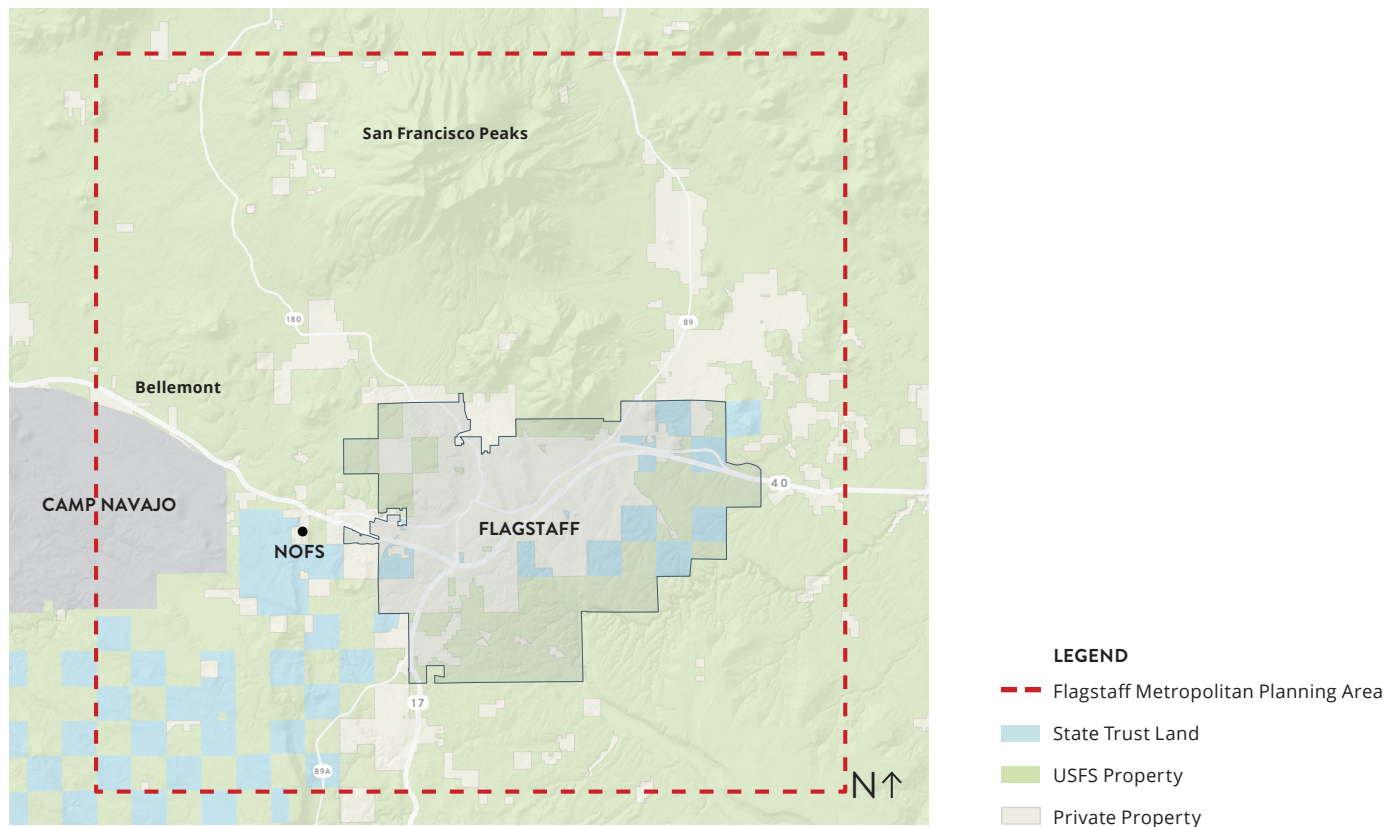


FIGURE 2.31 Flagstaff Metropolitan Planning Organization boundary



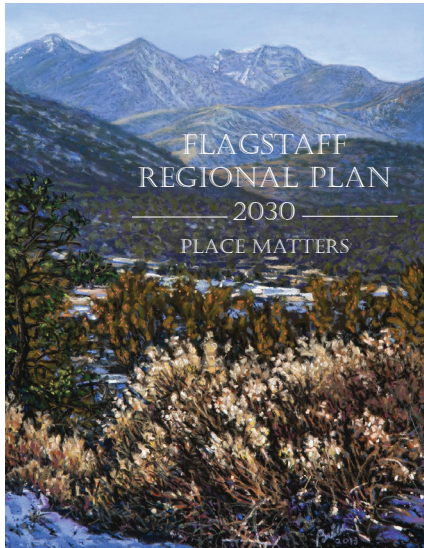


FIGURE 2.32 Source: *Flagstaff Regional Plan 2030*

## CITY OF FLAGSTAFF REGIONAL PLAN 2030

Adopted in 2014 and amended in 2017, the Regional Plan (Plan) is described as the roadmap to implement the community's vision (see figure 2.32). The Plan serves as an amendment to the Coconino County Comprehensive Plan and similarly, it includes goals and policies; tools for decision-makers, developers, and community members; and a framework for general planning. The Plan applies to all land within the city limits and about 460 square miles of the unincorporated county aligned with the FMPO boundary (see figure 2.31).

The Plan emphasizes eight guiding principles to help promote future development (shown in figure 2.33). They focus on:

- People
- Prosperity
- Cooperation
- Smart and Connected Community
- Environment
- Sustainability
- Place
- Trust and Transparency

The Plan includes four natural environment-focused elements, five built environment-focused elements (including growth area and land use), and three human environment-focused elements.



FIGURE 2.33 Flagstaff Regional Plan 2030 guiding principles (Source: *Flagstaff Regional Plan 2030*)

Measures to protect the area's dark skies are emphasized in the Plan for the purpose of protecting the region's character and identity and to protect professional deep space research and the mission of NOFS. The JLUS-Relevant Dark Sky Goals and Policies callout below lists the existing dark skies goals and policies within the Plan.

A major aspect of plans similar to the Regional Plan is to examine and choose the best approach to manage the growth that is anticipated for the next twenty-plus years. While the area covered in the plan is very large, only 14% of the land is privately owned. Topography, transportation and utility infrastructure, and both NOFS and Camp Navajo present limitations on where and how the city can grow. Five growth scenarios were ultimately studied in the plan to explore how Flagstaff can best accommodate growth within its constraints. The preferred scenario adopted in the Plan emphasizes compact forms of development that best preserve open space, maximize the efficiency of the community's infrastructure system, and help create more walkable, mixed-use neighborhoods.

## FLAGSTAFF REGIONAL PLAN 2030

### JLUS-RELEVANT DARK SKY GOALS AND POLICIES

Goal E&C.5. Preserve dark skies as an unspoiled natural resource, basis for an important economic sector, and core element of community character.

Policy E&C.5.1. Evaluate the impacts of the retention of dark skies regarding lighting infrastructure and regulatory changes, land use decisions or changes, and proposed transportation developments within the region.

Policy E&C.5.2. Encourage and incentivize voluntary reduction of "exempt" lighting that degrades night sky visibility, and work to prevent light trespass whenever possible in both public and private areas.

Policy E&C.5.3. Continue to enforce dark sky ordinances.






Policy E&C.5.4. Encourage uses within Lighting Zone 1 of the lighting codes of the City and County that do not require outdoor lighting, and discourage those which require all-night lighting.

*Continues on page 44.*

The city's future growth illustration map in the *Flagstaff Regional Plan 2030* concentrates growth into a collection of urban and suburban activity centers strategically located throughout the community. Three of the centers lie within close proximity to NOFS (highlighted in figure 2.34). Some undeveloped property within these three activity centers retains rural residential zoning. Some of the activity centers also include lands that have not yet been annexed into the city.

The plan identifies general characteristics, desired patterns, density ranges, use mixes, circulation patterns/elements, and illustration examples for the urban and suburban activity centers (See figure 2.37 on page 47). However, the plan also recognizes that more detailed planning will be necessary to foster the desired scale and form at each activity center.

#### LEGEND

-  City of Flagstaff
-  Suburban Activity Center (S)
-  Urban Activity Center (U)
-  Rural Activity Center (R)
-  JLUS-Focus Activity Centers

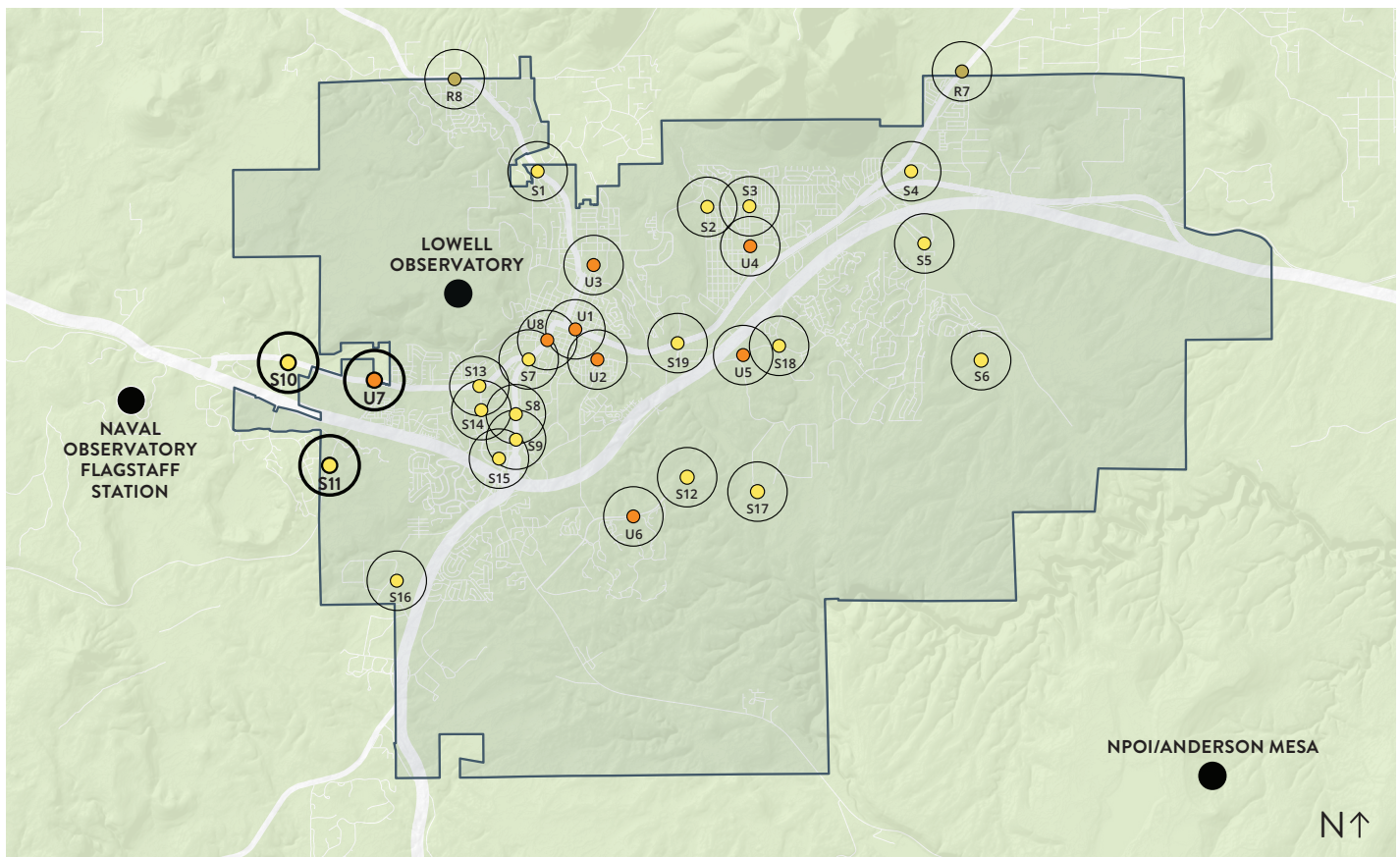


FIGURE 2.34 Flagstaff's designated activity centers and proximity to NOFS, NPOI, and Lowell Observatory

## FLAGSTAFF REGIONAL PLAN 2030 (CONT.)

### JLUS-RELEVANT LAND USE GOALS AND POLICIES

Goal LU.1: Invest in existing neighborhoods and activity centers for the purpose of developing complete, and connected places.

Goal LU.2: Develop Flagstaff's Greenfields in accordance with the Regional Plan and within the growth boundary.

Policy LU.2.2: Design new development to coordinate with existing and future development, in an effort to preserve viewsheds, strengthen connectivity, and establish compatible and mutually supportive land uses.

Policy LU.2.3: New development should protect cultural and natural resources and established wildlife corridors, where appropriate.

Goal LU.3: Continue to enhance the region's unique sense of place within the urban, suburban, and rural context.

Policy LU.3.2: Coordinate land use, master planning, and recreational uses, when feasible, with local, state, and federal land management agencies and tribal land owners.

Goal LU.4: Balance housing and employment land uses with the preservation and protection of our unique natural and cultural setting.

Policy LU.4.1: Develop neighborhood plans, specific plans, area plans, and master plans for all neighborhoods, activity centers, corridors, and gateways as necessary.

Goal LU.5: Encourage compact development principles to achieve efficiencies and open space preservation.

Goal LU.6: Provide for a mix of land uses.

Goal LU.10 Increase the proportion of urban neighborhoods to achieve walkable, compact growth.

Policy LU.10.4: Develop specific plans for neighborhoods and activity centers to foster desired scale and form.

Goal LU.13: Increase the variety of housing options and expand opportunities for employment and neighborhood shopping within all suburban neighborhoods.

Goal LU.18: Develop well designed activity centers and corridors with a variety of employment, business, shopping, civic engagement, cultural opportunities, and residential choices.



## ZONING & LAND USE

Flagstaff's zoning code is the product of a comprehensive, community-wide effort adopted in 2011 (see figure 2.38 on page 47). It is described as a "Place-Based Approach to Zoning" and implements the 2030 Regional Plan. Existing zoning in the western and southern portions of the city is illustrated in figure 2.35. The following bullets highlight the planning, zoning, and land use context for key areas most critical to this JLUS.

- **Urban Activity Center 7** is centered on the West Route 66 and Woody Mountain Road intersection, which is within Lighting Zone 1 and roughly 2.8 miles from NOFS. The future growth illustration map calls for an urban mixture of uses requiring a Specific Plan or Development Master Plan (see figure 2.37 on page 47 for the intended characteristics of urban activity centers). The most intensive development is likely to occur on the undeveloped property southwest of the Route 66 and Woody Mountain Road intersection. The Timber Sky development overlaps the area (see figure 2.36 on page 46).

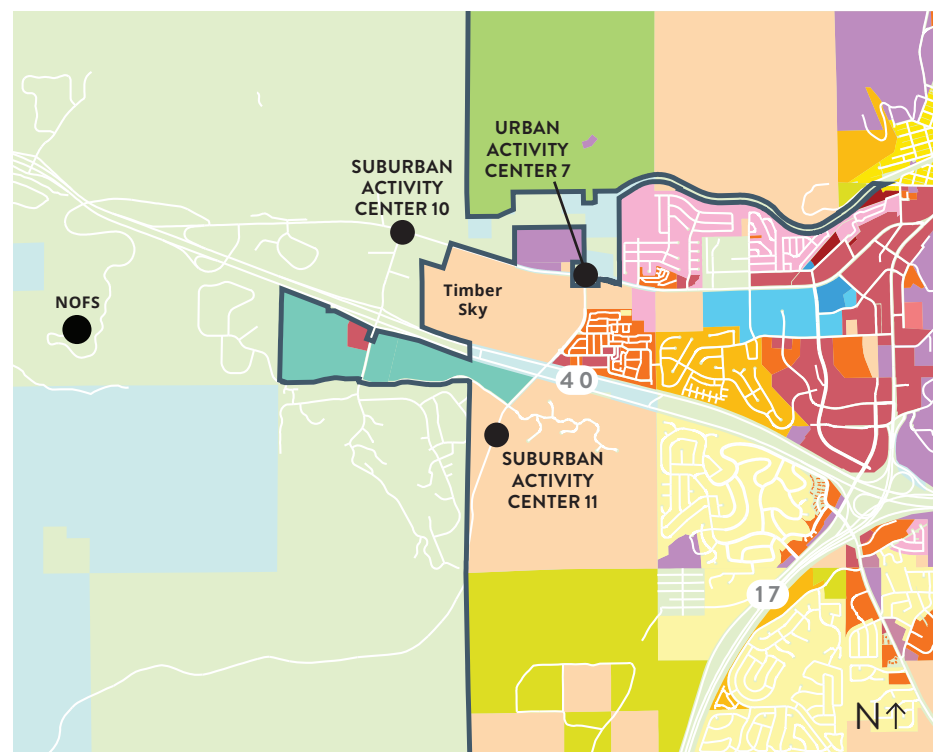
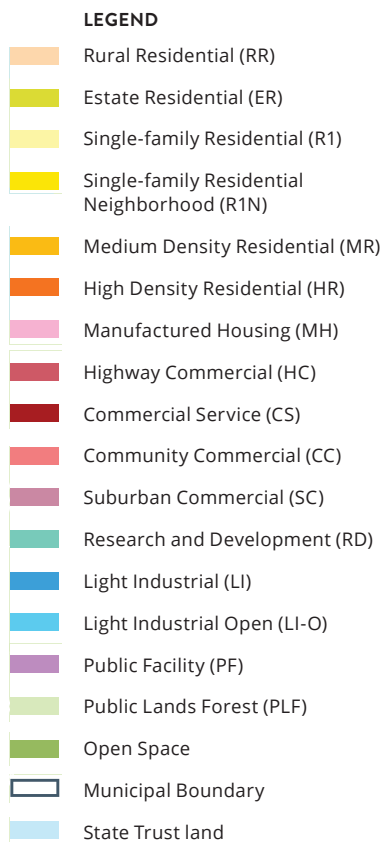


FIGURE 2.35 Flagstaff zoning in areas close to NOFS

- **Suburban Activity Center 10** is centered on the Historic Route 66 and Flagstaff Ranch Road intersection, which is within Lighting Zone 1 and roughly two miles from NOFS. The future growth illustration map emphasizes employment-based uses for this area. Examples include research and development parks, business parks, light industrial, and associated services within a suburban context. Several properties within this area are already developed with distribution warehouses, light industrial, and outdoor storage uses.
- **Timber Sky** is a planned 1,300-unit residential development on 197.58 acres in Lighting Zone 1 between West Route 66, Interstate 40, and Woody Mountain Road (see figure 2.36). The plans include a mixture of high density, medium density, and single-family residential units combined with commercial service and open space. An application to annex the site into the city and rezone the property was approved by the city council in November 2016. Working with the local dark sky community, the Timber Sky development committed to a series of strategies as part of their development agreement with the city of Flagstaff (see Timber Sky's Dark Sky Provisions sidebar).

#### TIMBER SKY'S DARK SKY PROVISIONS

Vintage Partners, the developers for the Timber Sky development, agreed to a series of dark sky strategies that go beyond Lighting Zone 1 standards within their development agreement with the city that will be enforced through covenants, conditions, and restrictions. The provisions include strict lumen limits by use type and zone, more stringent light shielding, and maximized use of motion-sensors to emphasize lighting by demand. The City also approved a modification of development standards to not require street lighting of residential streets.

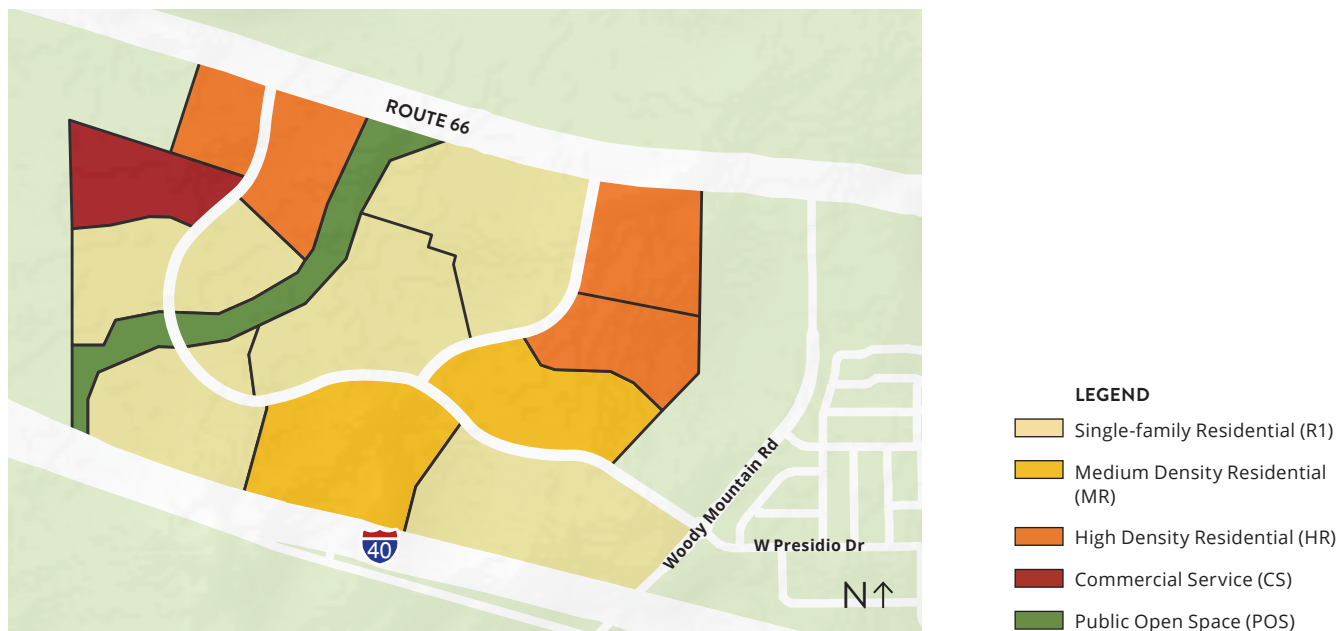


FIGURE 2.36 Zoning designations for Timber Sky properties

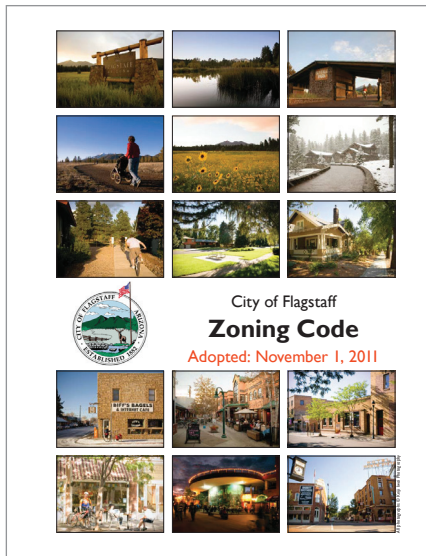


FIGURE 2.38 Source: Flagstaff Zoning Code, 2011

- Research and Development Zone.** This includes properties within Lighting Zone 1 on the south side of Interstate 40 generally between Flagstaff Ranch and Woody Mountain Roads. This property serves as the primary campus for research and development company W.L. Gore & Associates, Inc., the largest private employer in Flagstaff. Increased employment trends at the campus have led to the use of evening and night shifts and may eventually require a parking structure. The company also owns vacant land to the west of Flagstaff Ranch Road which may serve as a possible future expansion area. The company has been exploring ways to reduce lumen output while keeping the campus safe at night through the use of motion sensors, hardware upgrades, and strategic lighting plans.

## URBAN ACTIVITY CENTER CHARACTERISTICS

An area typically located at the intersection of two main thoroughfares. Urban activity centers include mixed-use, mix of housing type, mixed price range, walkable, transit-oriented-design; can include regional commercial or neighborhood commercial.



**Regional Urban Activity Center** - Larger, mixed-use centers at intersections of Regional Travel and Circulation Corridors; with direct access of multiple residential developments; with entertainment and cultural amenities; public spaces; serves regional residents and visitors.

**Neighborhood Urban Activity Center** - smaller, mixed-use centers at intersections of Circulation Corridors and Access Roads; with access to surrounding neighborhood; with local goods and services, public spaces; serves local residents; transit and FUTS access.

Characteristics	Each Activity Center is unique with contextual and distinctive identities, derived from environmental features, a mix of uses, well-designed public spaces, parks, plazas, and high-quality urban design. They are well-designed for the purpose of maintaining a unique sense of place and to attract the residents/clients desired. Refer to <i>A Vision for Our Urban Activity Centers</i> on pg. IX-63.	
Desired Pattern		
Density Range	Residential Only: 13+ units per acre Residential mixed-use: 8+ units per acre	
Intensity	Regional scale and design Floor area ratios (FARs) of 1.0+	Neighborhood scale and design Floor area ratios (FARs) of 0.5+
Mix of Uses	<p>Within commercial core: Government, services, education, offices, retail, restaurant, and tourism-related. Residential opportunities, residential mixed-use, public spaces, place-making.</p> <p>Within the pedestrian shed but not in a commercial core: higher-density residential, live-work units, home-based businesses, educational, greater connectivity to a commercial core.</p>	
Transportation	Easy-to-access parking available via garages, shared lots, and on-street parking. Transit stops and routes centrally located. Bicycle access and parking abundant. Pedestrian-oriented design. Very high road and pedestrian infrastructure connectivity. Block sizes are smaller; gridded street networks preferred where not prohibited by topography.	

FIGURE 2.37 Urban activity center characteristics description (Source: Flagstaff Regional Plan 2030)



- **Suburban Activity Center 11** lies largely on State Trust land along Woody Mountain Road south of Interstate 40. This area is within the city's Lighting Zone 1 and roughly 2.5 miles from NOFS. Suburban activity centers call for a mixture of uses, including commercial retail and service uses, to meet the demand for surrounding residential areas. Residential densities in suburban activity centers, as noted in the Regional Plan, are generally 6-10 units per acre.

## LIGHTING ZONES & CODES

The City of Flagstaff adopted its first lighting code in 1958, which primarily prohibited searchlights. In 1973, the City and County jointly adopted their first comprehensive lighting codes, which required shielding, light shut-off times for floodlighting and recreational facility lighting, and confined direct illumination to the property boundaries of the light source. The City and County undertook another major lighting ordinance update in 1989, which integrated lighting zones and restricted the amount of light per acre in outdoor lighting installations. Since then, the lighting codes have been periodically updated and strengthened. The maximum total outdoor light output standards by lighting zone, measured in lumens per net acre, is shown in figure 2.39.

CITY LIGHTING CODE LAND USE	LIGHTING ZONE		
	1	2	3
<b>Commercial, Industrial, and Multi-family Residential (Lumens per net acre)</b>			
total (fully shielded and partially shielded)	25,000	50,000	100,000
partially shielded only	0	5,500	5,500
non-low pressure sodium	2,500	5,000	10,000
<b>Single-family Residential (Lumens per parcel inclusive of accessory structures)</b>			
total (fully shielded and partially shielded)	10,000	10,000	10,000
partially shielded only	0	4,000	4,000

FIGURE 2.39 Maximum total outdoor light output standards in the city's lighting code (Source: *Flagstaff Zoning Code*)

**SPECTROMETER**

An apparatus used for recording and measuring spectra, especially as a method of analysis.

**LIGHTING CODE IMPLEMENTATION AND ENFORCEMENT**

Flagstaff reviews and approves lighting plans as part of the site plan review process when a project is submitted for a building permit. Staff has the specialized knowledge to ensure the proposed lighting is in compliance with regulations. City staff also performs inspections to ensure lighting was installed consistent with the approved permit prior to issuing a certificate of occupancy.

Flagstaff takes a proactive role in enforcement and, with limited resources, conducts lighting audits on development proposals and completed projects (using a spectrometer) to ensure conformance with lighting zone standards. Considerable challenges persist however, as light bulbs and fixtures are often changed outside of the permitting process. In addition, enforcement is difficult due to the technical nature of the standards and the changing technology and lighting products.

**JLUS ISSUES****HOUSING**

As Flagstaff and the surrounding communities continue to grow and attract more students, vacation homeownership, tourism, and employment opportunities, the demand for housing is increasingly out-pacing supply (including new construction). A very limited supply of developable private land within and surrounding Flagstaff compounds this challenge. New housing development, particularly in areas within close proximity to NOFS, has the potential to increase sky brightening and impact the mission of NOFS.

**COMMERCIAL AND INDUSTRIAL DEVELOPMENT**

As Flagstaff's population continues to grow, the demand for additional commercial and industrial development will also grow. The shortage of developable land zoned for commercial and industrial development is a well-known challenge. Commercial and industrial development tends to include greater outdoor lighting demands than residential uses. Such developments within close proximity to NOFS have the potential to increase sky brightening and impact the NOFS mission.

**LIGHTING CODE AND FIXTURES UPDATES**

As lighting technology improves and changes, the lighting code and city fixtures need updating. These code updates need to take into consideration the public's concern for safety and the feasibility of required lighting changes.

**LIGHTING CODE ENFORCEMENT**

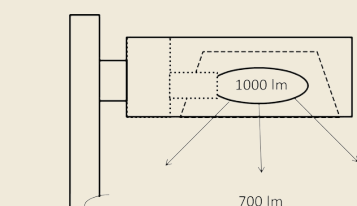
The city faces the same lighting code enforcement JLUS issues as Coconino County. See Lighting Code Implementation and Enforcement on page 33.

## LIGHTING TECHNOLOGY TRANSITION

Since the world's first lighting ordinance was developed in Flagstaff in 1958, a lot has changed in lighting, technology, and telescope sensitivity. Perhaps the change with the most impact is the ongoing shift from conventional bulbs to LED fixtures, which substantially reduce energy use while increasing the brightness of lighting with an intensity that often enhances blue and white colors in the environment. The cooler white LED light can be a challenge for optical telescopes, human comfort, and even public health. These changing conditions prompted the need for the Street Lighting for Enhancing Dark Skies (SLEDS) Study, which began in 2015.

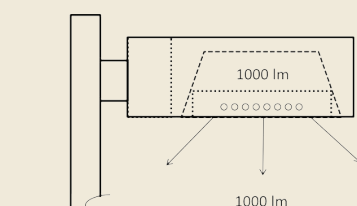
### LIGHTING TECHNOLOGY SHIFT

On average, conventional outdoor lighting fixtures with bulbs waste about 30% of light emitted through absorption into the surrounding light fixture, resulting in an approximately 70% efficiency rate.



Bulb-based: 1,000 bulb lumens = 700 fixture lumens

In comparison, LEDs are 100% efficient and have no emitted light absorbed by the light fixture (see figure 2.41).



LED-based: 1,000 LED lumens = 1,000 fixture lumens

**FIGURE 2.40** Source: *NOFS Mission Compatibility Overview Study Findings and Recommendations Presentation to Coconino County and City of Flagstaff*, 2017



**FIGURE 2.41** Before and after photographs depicting the improvement in sky brightening at Thorpe Park (Source: Flagstaff Dark Skies Coalition, 2018)

### STREET LIGHTING FOR ENHANCING DARK SKIES (SLEDS) STUDY

SLEDS is an ongoing study led by the city of Flagstaff to find an innovative street lighting solution to balance dark sky preservation, safety, and maintenance/cost effectiveness objectives. Low-pressure sodium (LPS) has been the preferred lighting source since 1989 but LPS fixtures are being phased out (see figure 2.40). LPS fixtures are difficult to purchase and have caused structural failures of the pole/mast arm connection due to their size and weight. As a result, it is time to replace approximately 3,700 street lights on arterials and major collectors in the area. SLEDS is exploring the use of narrow-band amber LED technology which achieves safety and cost-effectiveness while preserving the dark sky.

SLEDS completed initial test fixture installations in summer of 2018, testing five new types of LED street light fixtures in five separate locations within the city (see figure 2.42 and figure 2.45). Public feedback was obtained from bus tours as well as a website survey. In addition, the test fixtures evaluated total light output, spectra, and light distribution via in situ photometric testing. Findings from this initial test phase were mixed, showing both positive and negative aspects.

The SLEDS team has continued working with the lighting industry to design improved LED street lighting fixtures, based on issues identified by initial testing. This phase should be completed in early 2019 and lead to the development of new city engineering standards for street lighting for council adoption, and the establishment of city-wide replacement scenarios. SLEDS' recommendations aim to be a model for outdoor LED lighting and have a positive ripple effect across communities.



**FIGURE 2.42** LED test fixture (Source: SLEDS, Flagstaff.az.gov, 2018)



FIGURE 2.43 New LED streetlight being tested in the Cheshire neighborhood as part of SLEDs (Source: Jake Bacon, Arizona Daily Sun)



FIGURE 2.44 Flagstaff resident demonstrating new lighting affect (Source: Jake Bacon, Arizona Daily Sun)

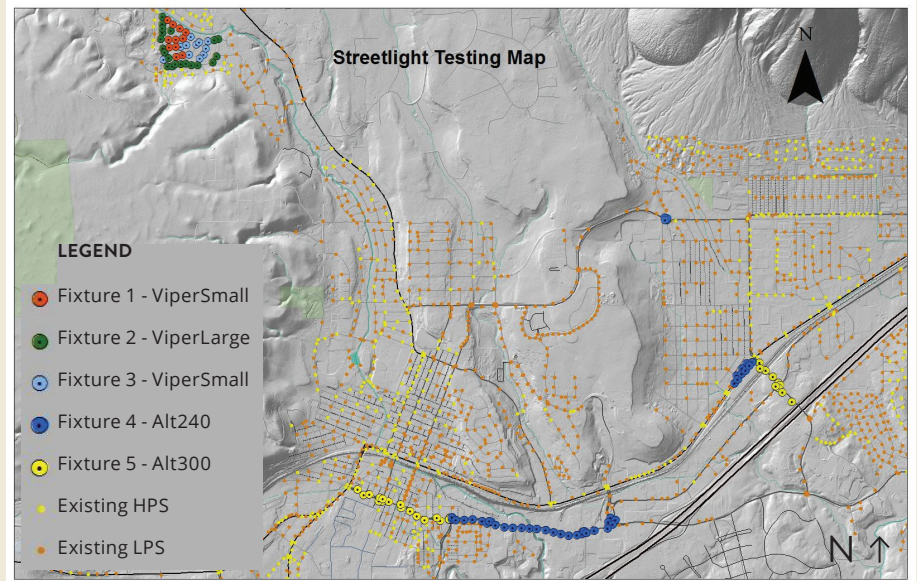


FIGURE 2.45 SLEDs Testing Map (Source: Flagstaff.az.gov, 2018)

## JLUS ISSUES

### TRANSITION TO LEDS

- **Outdoor lighting ordinances do not reflect the new way of measuring light output.** In addition, industry lighting standards of measurement are not compatible with Flagstaff and Coconino County regulations. As conventional lighting wastes about 30% of light emitted to fixture absorption, exchanging conventional bulbs for LEDs under the current city and county outdoor lighting ordinances will result in significantly more light emissions. Based on patterns of expected development and the growth in LED use, current city and county lighting code ordinances need to be updated to ensure long-term NOFS mission sustainment. Updating the city and county outdoor lighting codes to account for the new method for measuring light output is one of the six recommendations in the Light Pollution Study.
- **Bulb replacement conversion to LED outside of the permitting process.** As noted earlier, conversions to LED are occurring throughout the city and county. While these bulbs save money and reduce energy use, they bring noticeable sky brightening impacts.
- **Need for alternative to low-pressure sodium streetlight technology.** LPS has been Flagstaff's preferred street lighting source since 1989; however, LPS fixtures are being phased out and will not be available after July 2019. Therefore, the need to find an alternative to LPS street light technology is time-sensitive based on the increased cost and limited availability of LPS fixtures. Identifying an appropriate alternative, such as narrow spectrum amber LED technology, that can balance dark sky preservation, cost effectiveness, and safety objectives is a high priority in the short term (see figure 2.43, and figure 2.44).



## UNITED STATES FOREST SERVICE

Aside from State Trust lands and some private land holdings, most of the remaining area surrounding Camp Navajo is owned and managed by the USFS. The USFS is part of the Department of Agriculture and administers 154 national forests and 20 national grasslands, which span 193 million acres. The Kaibab and Coconino National Forests lie within the study area and cover over 3.5 million acres with elevations between 3,000 and 12,000 feet. These national assets encompass prairies and forests; ponderosa pine and aspen are the primary tree species. The Kaibab National Forest is split into three sections that range from south of Flagstaff to above the Grand Canyon. The Coconino National Forest surrounds Flagstaff and includes the San Francisco Peaks (see figure 2.46).

### FOREST HEALTH

The current ponderosa pine forest density within and around Camp Navajo and NOFS is up to 1,000 trees per acre, while historic healthy densities are approximately 6 to 60 trees per acre. High tree densities increase the risk of catastrophic fires in a number of ways. They prevent water from reaching the forest floor by “trapping” snow in the canopy where it evaporates before it reaches the ground and can contribute to groundwater recharge. Research has shown that approximately 24% forest canopy cover is the optimum threshold for accumulating and maintaining snowpack.<sup>1</sup> The Kaibab National Forest is the driest forest in the country.

Forest density also prevents diversity in species. Historic forests supported a mixture of grasses reliant on the ample light. These slower-burning grasses have been replaced by needle detritus. Dry forest conditions and needles on the forest floor, combined with connected unhealthy tree crowns, create a highly-flammable condition.

<sup>1</sup> Sankey, Temuulen. “Multi-scale analysis of snow dynamics at the southern margin of the North American continental snow distribution.” *Remote Sensing of Environment*, Volume 169. November 1, 2015.

### RISK OF PRESCRIBED BURNS

Prescribed burns are one method used to reduce the risk of catastrophic wildfires and improve forest health. However, prescribed burns can increase particulate matter and heat in the atmosphere, which can impact public health and/or interfere with astronomical observations. Astronomical observations have a seasonal aspect and many objects are only visible during specific times of the year. If missed due to particulate matter in the air, researchers may have to wait a year to view certain objects.



FIGURE 2.46 Coconino National Forest (Source: Pxhere, 2018)

## 4FRI GOALS



- Restore the structure, pattern, composition, and health of fire-adapted ponderosa pine ecosystems
- Reduce fuels and the risk of unnaturally severe wildfires
- Provide for wildlife and plant diversity

Aside from the increased danger of catastrophic wildfires, high tree densities have a negative impact on aquifers, perennial streams, and the water table. The lack of forest floor vegetation is highly erosive during flooding which often occurs after wildfires. The increase in sediment impacts reservoirs and municipal water resources down-stream, which is costly to treat.

The ongoing Four Forest Restoration Initiative (4FRI) encompasses Coconino, Kaibab, Apache-Sitgreaves, and Tonto forests along the Mogollon Rim and seeks to restore ecosystems to improve forest health and prevent disasters such as wildfire and forest disease (figure 2.47 and 4FRI Goals sidebar). Forest thinning and prescribed burns are two methods to restore forest health and reduce catastrophic fire risk (see Risk of Prescribed Burns sidebar). However, multiple restoration efforts occurring within the county, including 4FRI, Flagstaff Watershed Protection Project and Greater Flagstaff Forest Partnership projects, face forest industry challenges. The greatest challenge for western Coconino County forest restoration is processing forest products.

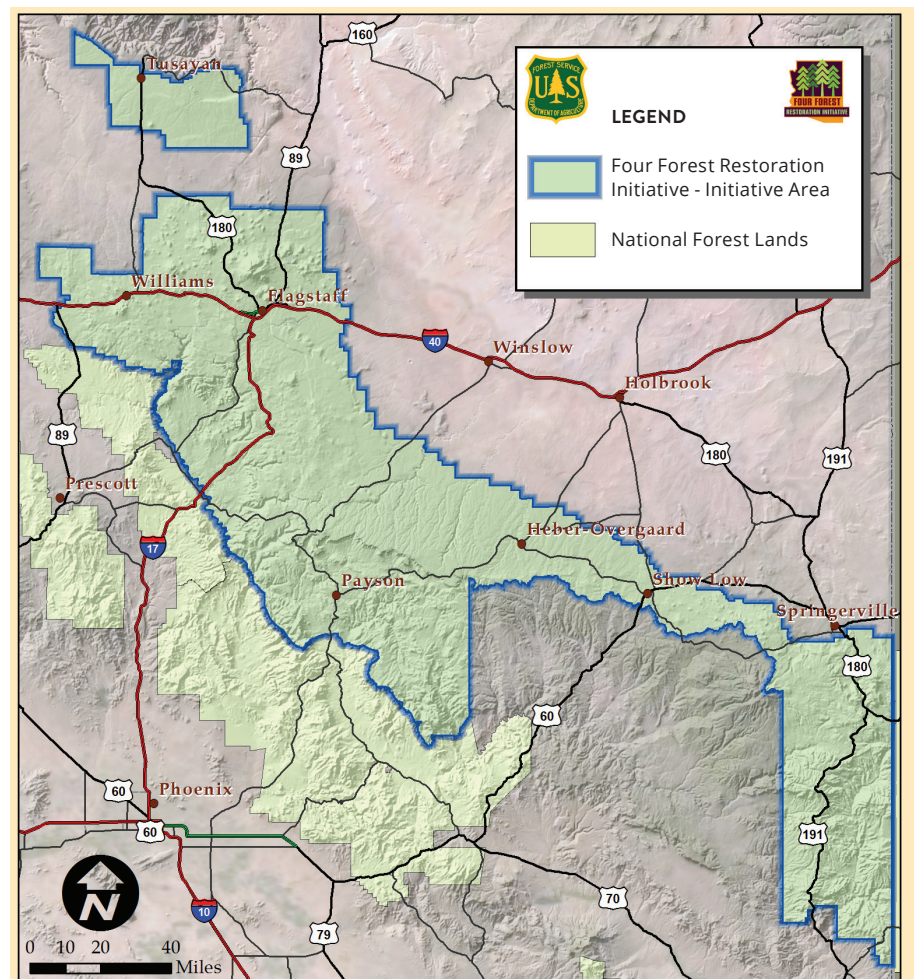


FIGURE 2.47 4FRI project area (Source: fs.usda.gov, 2018)



## JLUS ISSUES

### CATASTROPHIC WILDFIRE AND DISASTER HAZARD

Poor forest health increases the risk of catastrophic wildfires within communities and military installations, as well as related natural disasters, such as flooding. Estimates in the Full Cost Accounting of the 2010 Schultz Fire report put out by the NAU Ecological Restoration Institute estimates the financial impact of the fire to be between \$133 million and \$147 million (see figure 2.48 and figure 2.49). The consequences of poor forest health can be severe and forest fires are the number one public safety risk for Coconino County.

Wildfire risk is even more critical in Wildland Urban Interface (WUI) areas, where structures and other human development meet or intermingle with undeveloped wildland. As fire can move readily between structural and vegetation fuels, new development becomes an ever-increasing threat. Interventions such as prescribed burns, mechanical thinning, and/or buffer creation are especially needed in the WUI portions of the study area and future WUI areas created through development.

Catastrophic wildfires increase the risk of post-fire mudslides, flash flooding, and pest infestation. Areas at high risk for post-fire flooding have been identified in Coconino County by the Arizona Geological Survey. In addition, pests such as bark beetles are attracted to trees that are stressed, diseased, or injured. Trees affected by drought may not be able to fight off infestation of this insect.

### WATER SUPPLY CHALLENGES

Forest overpopulation is connected to watershed health and the area's aquifers. This has been witnessed over the years by the drying up and disappearance of streams and springs. In an already-dry area, this problem is a large part of fire risk and will become a resource problem in the future if not addressed.



**FIGURE 2.49** Schultz Fire June 2010 (Source: USDA Forest Service, Coconino National Forest)



**FIGURE 2.48** Schultz flooding 2010-2014 (Source: Joint Coconino County Board of Supervisors & Flagstaff City Council, *Coconino County Forest Restoration Presentation*)

# ARIZONA STATE LAND DEPARTMENT

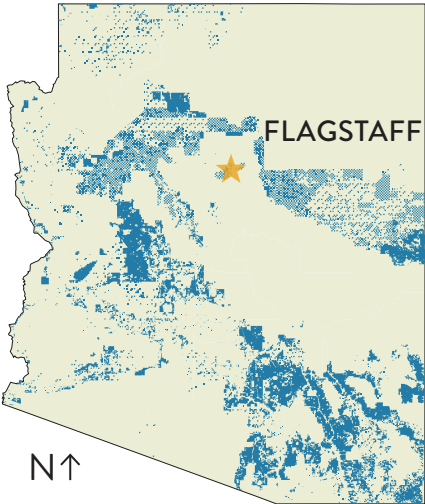


FIGURE 2.50 Arizona State Trust land

The State Land Code was established in 1915 and gave the Arizona State Land Department (ASLD) authority over all State Trust lands granted to the State under provisions from the federal Enabling Act of 1910. ASLD currently manages 9.2 million acres of land, or 13% of land in the state, on behalf of 13 State Trust land beneficiaries (see figure 2.50). The largest beneficiary is the state’s K-12 education.

When managing its portfolio, ASLD is constitutionally mandated to consider the beneficiaries’ interests and their alignment with state policies, including those supporting military compatibility and private property rights. The sale of State Trust land is fairly infrequent and most often occurs in urbanizing areas where there is limited developable land; these transactions provide an opportunity to maximize returns for current and future beneficiaries. The sales process has many steps and includes a property appraisal and an auction.

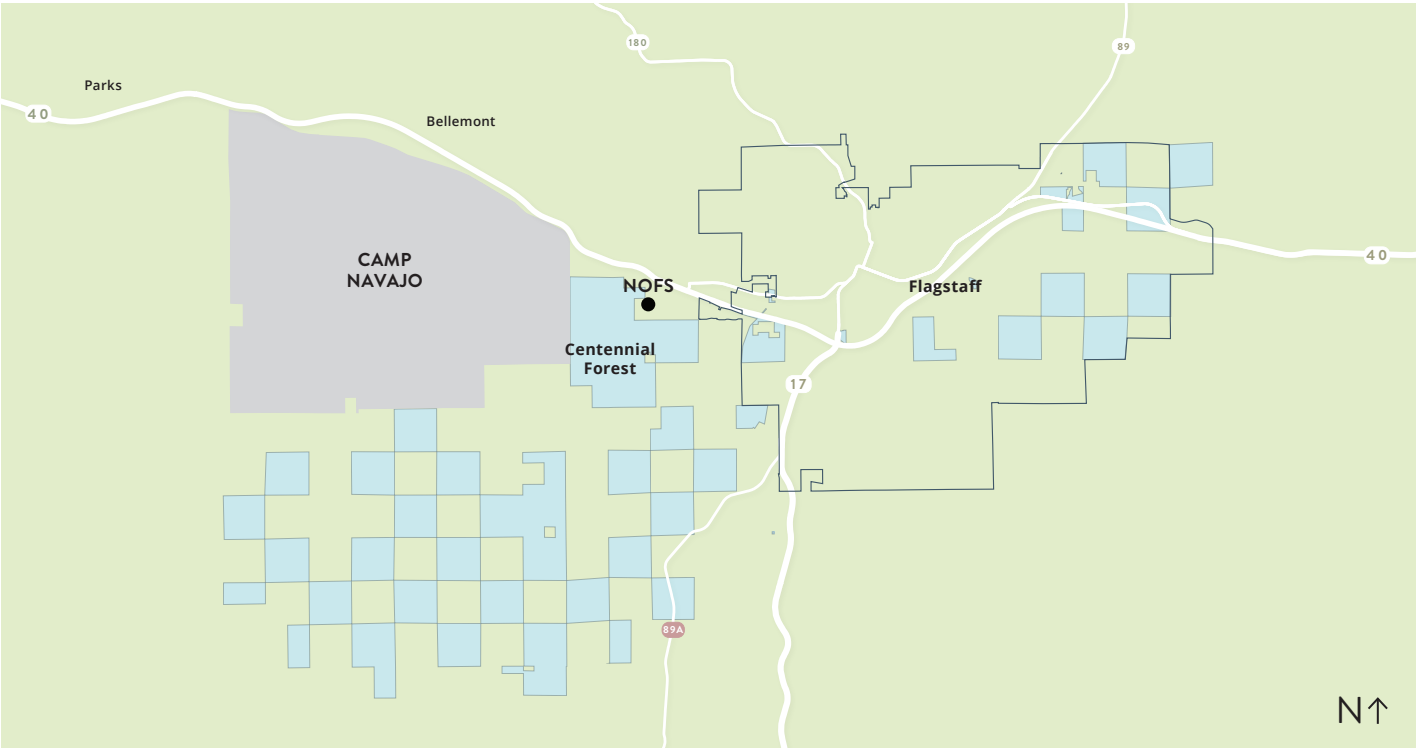


FIGURE 2.51 State Trust land in study area



As shown in figure 2.51, a significant amount of State Trust land surrounds Camp Navajo and NOFS. One of the crucial holdings between both installations is part of the Centennial Forest, an area of approximately 50,000 acres managed by Northern Arizona University. This arrangement was codified in a unique 75-year Intergovernmental Agreement, signed in 1999. This agreement names the “Centennial Forest” and authorizes NAU to conduct research and experimentation on these lands to further forest health, restoration, ecosystem management, and education in the state. See page 64 for more information.

Land conservation around both Camp Navajo and NOFS is a priority. See the Statewide Legislative Context section starting on page 68 for information on legislative tools, such as the Advancing Conservation and Education Act, that could impact State Trust land in the study area.

## JLUS ISSUES

### STATE TRUST LAND SALE IMPACT

The sale and subsequent development of State Trust land located around Camp Navajo and NOFS and outside of Flagstaff’s city limits, though unlikely to occur in the near term, could impact either installation or NAU as noted in the following issue summaries:

- Camp Navajo JLUS Issues, Incompatible Development on page 19.
- NOFS JLUS Issues, Light and Encroaching Development on page 25.
- NAU JLUS Issues, Centennial Forest Preservation on page 64.



FIGURE 2.52 Centennial Forest (Source: trailsoffroad.com, 2018)

## ARIZONA DEPARTMENT OF TRANSPORTATION



FIGURE 2.53 Street lighting in Flagstaff

Arizona Department of Transportation (ADOT) is the lead agency for planning, construction, and maintenance of all state-owned highways and bridges in the state of Arizona. In addition, ADOT owns and maintains the Grand Canyon Airport located approximately 70 miles northwest of Flagstaff. Roadway lighting within the city of Flagstaff is jointly managed and maintained by both the city and ADOT (figure 2.53). The city manages all roadway lighting within city limits, except for major state highways and state-owned intersections which ADOT maintains.

In August 2017, ADOT initiated a maintenance implementation plan to transition existing high-pressure sodium (HPS) roadway lighting fixtures to LED as the HPS fixtures fail. In light-sensitive areas such as the JLUS study area, ADOT typically implements, per standard, 3000 Kelvin (K) “warm white” light fixtures. In other parts of the state such as the Phoenix metropolitan area, ADOT replaces existing light fixtures with 4000K “natural white” lights. Representatives from Flagstaff area observatories (including NOFS) have stated 3000K replacement lighting is incompatible with dark sky research requirements. Understanding these concerns, ADOT plans to review findings from the SLEDS study and determine feasibility for incorporating some of the recommendations into their long-term maintenance plans.

### JLUS ISSUES

#### BELLEMONT INTERCHANGE

Current plans for the interchange do not add capacity for pedestrian, bicycles, or vehicles. See the Belmont Interchange on page 38 for more information.

#### COORDINATION WITH INSTALLATIONS AND PUBLIC AGENCIES

As new projects are developed, early coordination with the installations and affected public agencies doesn’t always occur. Such projects can often be inconsistent with local plans, dark sky policies, and wildlife movement goals (see Wildlife corridors on page 58). Early and ongoing coordination between ADOT and installations, local jurisdictions, and stakeholders is needed, especially involving dark sky efforts.

#### COORDINATION WITH AREA PLANS

As new projects or ongoing LED conversion programs progress, planning is not always coordinated with local plans, dark sky policies, wildlife movement, and highway crossing goals (see Fragmented Wildlife Movement Corridors on page 59). Coordination continues to be a key component in compatibility with the installation missions. Additional coordination between ADOT, Camp Navajo, NOFS, Coconino County, and Flagstaff would be beneficial, especially around dark sky-compliant lighting.

#### ACCOMMODATING CAMP NAVAJO INDUSTRIAL PARK DEVELOPMENT

The 2015 Belmont Access Management & Multimodal Study acknowledged the possibility of new industrial development at Camp Navajo, but didn’t assume its development in area traffic forecasts and calculations. The study noted that if and when such development occurs at Camp Navajo, the traffic forecasts and traffic capacity analysis should be revisited prior to programming the study’s roadway concept.

#### STUDIES AND FUTURE PROJECTS

The 2015 Access Management and Multimodal Transportation Study in Belmont assisted ADOT in determining local transportation needs. There are planned projects in the study area through 2022 (see Belmont Interchange discussion on page 38).

## ARIZONA GAME & FISH DEPARTMENT

The mission for the Arizona Game and Fish Department (AZGFD) is to conserve Arizona's diverse wildlife resources and manage safe, compatible outdoor recreation opportunities. Governed by the Arizona Game and Fish Commission, this department is responsible for establishing policies for the management, preservation, and harvest of the state's wildlife.

### WILDLIFE CORRIDORS

Significant wildlife movement corridors have been recognized by the Arizona Game and Fish Department on both sides of Camp Navajo and NOFS (see figure 2.54). These corridors connect two large wildland blocks (the Mogollon Rim to the south and the San Francisco Peaks to the north) and are important to many species found in the area, including black bear, elk, bobcat, and pronghorn antelope. Rogers Lake is also productive habitat for many migratory water fowl. Protecting wildlife and the habitat they depend on is critical to their survival.

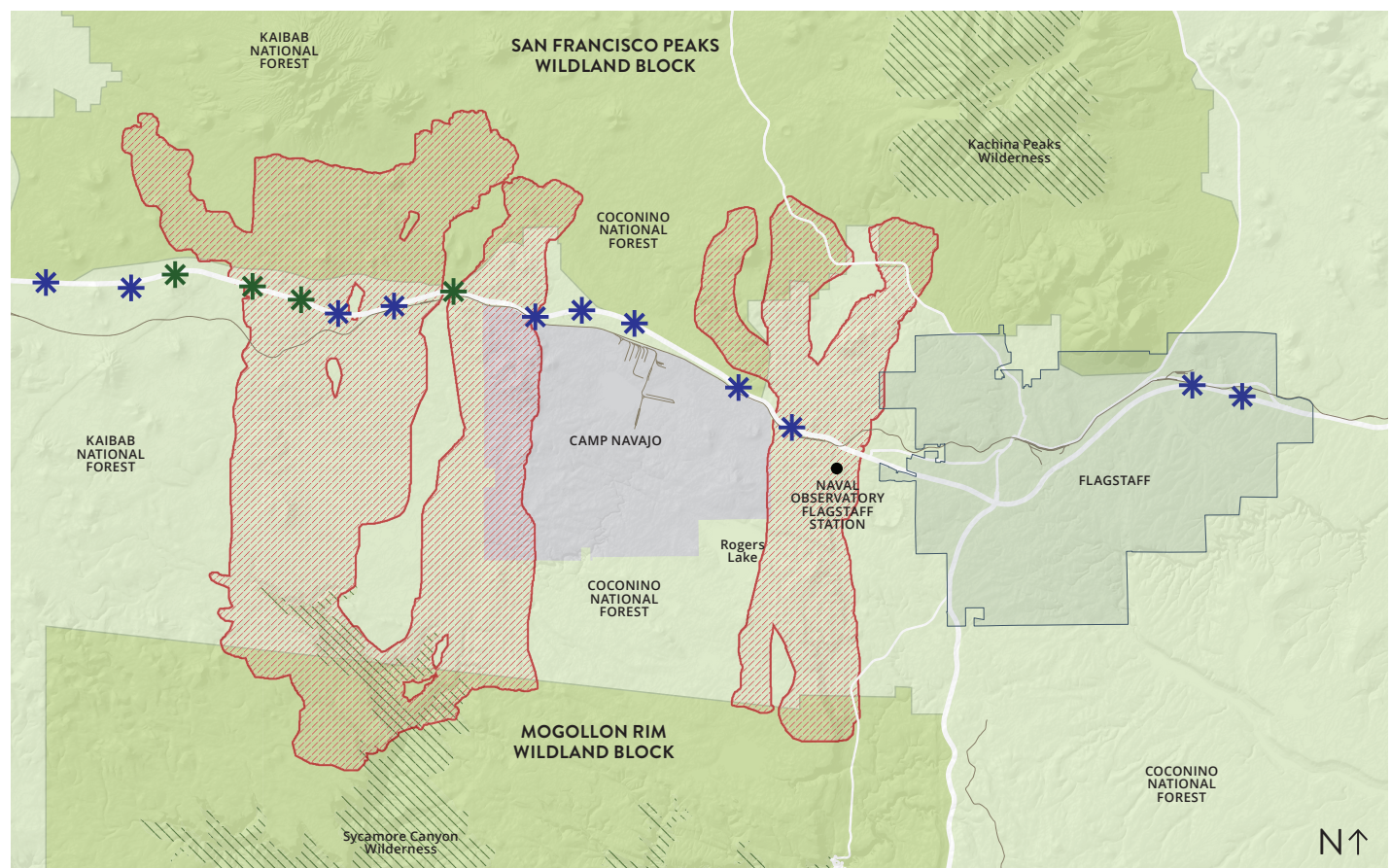


FIGURE 2.54 Important wildlife movement areas (Source: Coconino County Wildlife Connectivity Assessment: Detailed Linkages, 2013 and Camp Navajo, Army National Guard, 2018)



### MOVEMENT OBSTACLES

Existing obstacles to animal movement in the area include Interstate 40, the Burlington Northern Santa Fe railroad, and urban and rural development.

Among species of particular concern is the federally-protected Mexican spotted owl (see figure 2.55), whose habitat has been documented on Camp Navajo. In order to accommodate the breeding season, training and operational activities may be temporarily and physically restricted in four protected activity centers. Development, especially in ACUB lands, could reduce available habitat and increase pressure on remaining habitat within Camp Navajo.<sup>2</sup>

<sup>2</sup> Arizona Army National Guard. 2013. "Army Compatible Use Buffer Maneuver Training Center Camp Navajo, Arizona."

## JLUS ISSUES

### FRAGMENTED WILDLIFE MOVEMENT CORRIDORS

As noted in "Coconino County Wildlife Connectivity Assessment: Detailed Linkages - San Francisco Peaks to Mogollon Rim Linkage Design" (Jessica Gist and Mark Ogonowski, 2013), conversion of forested land for development would fragment wildlife movement corridors and negatively impact wildlife health. This fragmentation will put increasing pressure on activity within Camp Navajo. Physical barriers, such as roads, urban and rural development, railways energy facilities, and utility corridors, can hinder or block animal movement and result in habitat fragmentation. Additionally, light from development can interrupt circadian rhythms and impact night visibility for migratory animals and birds. Maintaining these wildlife corridors is important for the conservation of several regional populations of species.



FIGURE 2.55 Endangered Mexican spotted owl (Source: S. Hedwall, U.S. Fish and Wildlife Service, *Arizona Daily Sun*, 2017)



## LOWELL OBSERVATORY

The Lowell Observatory (Lowell), located on Mars Hill in Flagstaff, is a private, non-profit research institution with a mission to pursue the study of astronomy, conduct pure research in astronomical phenomena, and maintain quality public education and outreach programs (see figure 2.56 and figure 2.57 on page 62). The Observatory was founded in 1894 by Percival Lowell, a wealthy Bostonian who intended to use the facility to study the planet Mars. As one of the oldest observatories in the United States, this observatory has played a role in many scientific advancements, including detection of the expanding nature of the universe in 1912, the discovery of Pluto in 1930, and moon mapping for the Apollo Program in 1963.<sup>3</sup> (See Lowell Timeline sidebar for history.)

<sup>3</sup> Lowell Observatory. 2018a. "About." <https://lowell.edu/about/>. Accessed July 10, 2018.

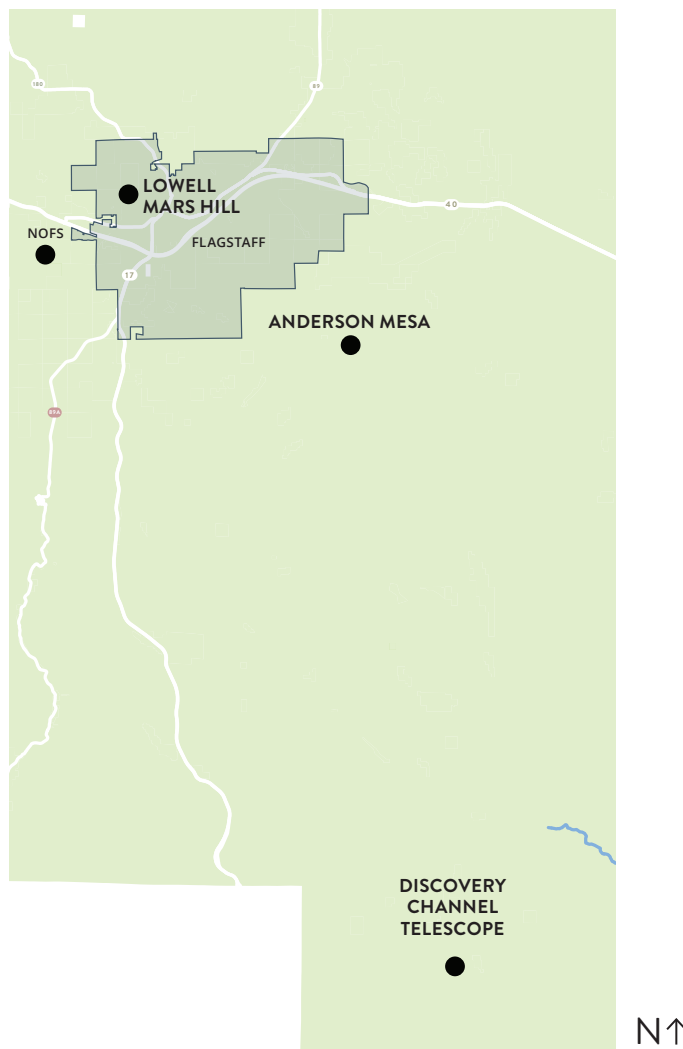
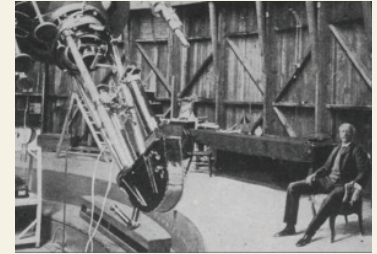
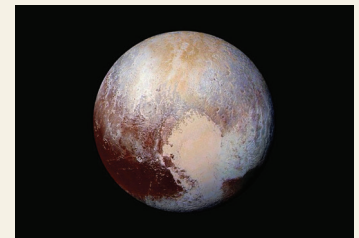


FIGURE 2.56 Telescopes maintained by Lowell, NOFS shown for reference

### LOWELL TIMELINE



- 1894 - Percival Lowell establishes Lowell Observatory to study Mars
- 1895 - Percival Lowell commissions 24-inch refracting Clark Telescope
- 1912 - Expanding nature of universe detected from Lowell

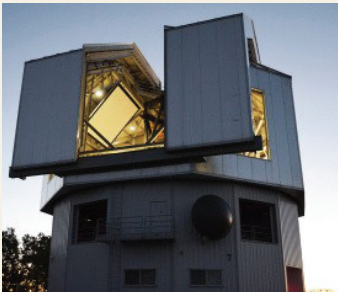


- 1930 - Clyde Tombaugh discovers Pluto
- 1960 - Anderson Mesa site opened



#### LOWELL TIMELINE (CONT.)

- 1963 - Creates maps of moon and visited by training astronauts in Apollo Program
- 1965 - Becomes Registered National Historic Landmark
- 1999 - Recognized by First Lady Hillary Clinton as part of her Save America's Treasures program
- 2011 - Named one of "The World's 100 Most Important Places" in *Time*



- 2012: 4.3-meter DCT is completed



- 2014: Putnam Collection Center opens, housing historical documents and artifacts
- 2015: DCT fully operational

In 1960, Lowell opened its first dark sky site, Anderson Mesa, in Coconino National Forest. In 2012, a second dark sky site, the Discovery Channel Telescope (DCT) facility, also in Coconino National Forest, was opened in partnership with the Discovery Channel (see figure 2.58). Currently, the observatory has a staff of 80 and hosts over 80,000 visitors each year. Though small research telescopes are in operation at the Mars Hill location, most of Lowell's research telescopes are at Anderson Mesa and the DCT facility.<sup>4</sup>

In addition to Lowell's research partnerships with education institutions and corporations, they also partner with government agencies. The NPOI, a specialized telescope capable of high-precision measurements, is a joint project of the USNO and the Naval Research Laboratory (NRL) in cooperation with Lowell.

The NPOI was constructed in 1992 at Anderson Mesa. USNO oversees operations of the NPOI, the NRL provides engineering support, and Lowell Observatory provides infrastructure support. Lowell Observatory is considered an "active observing partner." The NRL has awarded recent investments to Lowell Observatory to upgrade apertures on the NPOI, which will support the development of advanced techniques for high-resolution imaging and, at the same time, increase its light sensitivity.<sup>5, 6</sup>

<sup>4</sup> Lowell Observatory. 2018a. "About." <https://lowell.edu/about/>. Accessed July 10, 2018.

<sup>5</sup> *Journal of Astronomical Instrumentation*. 2013. "The Navy Precision Optical Interferometer (NPOI): An Update." <http://www.dtic.mil/dtic/tr/fulltext/u2/a587430.pdf>. Accessed July 10, 2018.

<sup>6</sup> Navy Prototype Optical Interferometer (NPOI). No date. "Home." <http://www2.lowell.edu/npoi/index.php>. Accessed July 10, 2018.

Lowell is an advocate for dark skies preservation through mitigation of light pollution, which is important to research facilities at Anderson Mesa, the DCT site, and NOFS. Lowell Observatory provides educational information and works with the city of Flagstaff and other local advocates to make Flagstaff a model for dark sky stewardship. For example, the Lowell and the city are currently working with a consulting electrical engineer to develop a LED-based, dark sky-preserving street light solution as part of the ongoing SLEDs project.<sup>7, 8</sup>

The Navy partners with Lowell on some efforts to preserve dark skies, with Lowell Observatory often leading public messaging. Lowell and the Navy work together to ensure that messaging and needs are coordinated for ongoing astronomical research in the region and for the NPOI at Anderson Mesa. In addition to Lowell's research partnerships with education institutions and corporations, Lowell also partners with the government. The NPOI, a specialized telescope capable of high-precision measurements, is a joint project of the USNO and the NRL in cooperation with Lowell.



FIGURE 2.57 Lowell Observatory Mars Hill Clark Telescope Dome (Source: Brewbooks)

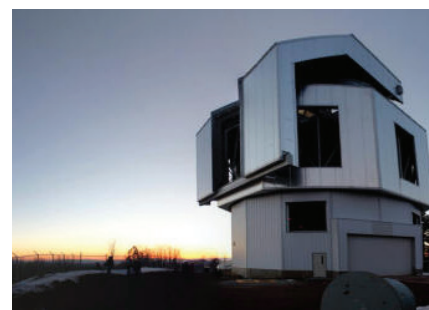


FIGURE 2.58 DCT facility (Source: palomar.edu, 2018)

<sup>7</sup> Sarah Conant . 2017. "Protecting Dark Skies for Astronomy and Life." <https://lowell.edu/protecting-dark-skies-astronomy-life/>. Accessed July 11, 2018.

<sup>8</sup> Lowell Observatory. 2018a. "About." <https://lowell.edu/about/>. Accessed July 10, 2018.

## JLUS ISSUES

### LIGHT POLLUTION

Lowell Observatory facilities face similar light pollution impacts and challenges as NOFS. The Anderson Mesa site is located within the line of sight (approximately eight miles) of Flagstaff City Hall. While future development is constrained by national forest land, increased development in southeast Flagstaff or future land swaps for development purposes could have an impact on Anderson Mesa. Likewise, ensuring proper dark sky preservation in the Anderson Mesa area will also help preserve viewing capabilities at the DCT facility. While located farther from Flagstaff, this 4.3-meter telescope has the greatest need for protected dark skies because of the faint objects it can reach in optimal viewing conditions.

## FLAGSTAFF DARK SKIES COALITION



FIGURE 2.60 Flagstaff Dark Skies Coalition Logo  
(Source: Flagstaff Dark Skies Coalition, 2018)

The Flagstaff Dark Skies Coalition was started in 1999 to “celebrate, promote, and protect the glorious dark skies of Flagstaff and Northern Arizona.”<sup>1</sup> The coalition provides educational information about dark sky preservation, including solutions for individuals and larger entities, such as sports complexes, on their website. As a chapter of the International Dark-Sky Association, the coalition organizes events (e.g., the annual Flagstaff Star Party and conferences) while working to educate the community and local government about the importance of protecting night skies and eco-friendly outdoor lighting.<sup>2</sup> The coalition partners with entities, including local government and the State, who also seek to protect dark skies as an environmental resource.

<sup>1</sup> Flagstaff Dark Skies Coalition (FDSC). 2018a. “Home.” <http://www.flagstaffdarksdies.org/>. Accessed July 11, 2018.

<sup>2</sup> International Dark-Sky Association (IDA). No date. “Our Chapters.” <http://darksdies.org/about/chapters/>. Accessed July 11, 2018.



FIGURE 2.59 2016 Flagstaff Star Party (Source: Flagstaff Dark Skies Coalition, 2016)



## NORTHERN ARIZONA UNIVERSITY

Founded in 1899 with 23 students, NAU now has over 30,000 students enrolled and 151 degree programs. NAU's School of Forestry is ranked 10th in the nation and is known for its commitment to sustainability.

In 1959, the ASLD designated 4,000 acres of forest land to serve as the school's "outdoor laboratory." As described on page 55, in 1999, ASLD and NAU came together again to name the Centennial Forest and designate almost 50,000 additional acres for research and education. This land is owned by ASLD but actively managed by NAU. The forest is divided roughly in half: one piece is located in a continuous stretch west of the Wupatki National Monument north of Flagstaff and the other half is southwest of the city interspersed within the Coconino National Forest in a checkerboard pattern.

The unique Centennial Forest has some of the best examples of ancient ponderosa pine forests remaining in the southwest United States. In addition, the large amount of contiguous land near NAU is well-positioned for landscape-level research. Its close proximity and unique character make the Centennial Forest an extremely valuable asset for the School of Forestry. The portion between Camp Navajo and NOFS is NAU's highest priority as it has historical research value and is most convenient to the NAU campus.

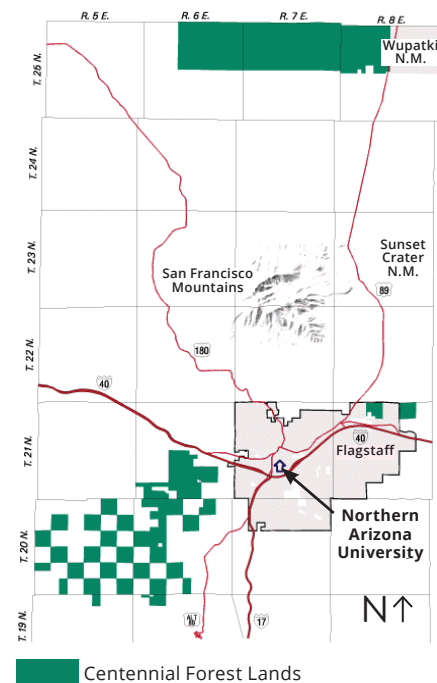


FIGURE 2.61 Centennial Forest (Source: nau.edu, 2018)

### JLUS ISSUES

#### CENTENNIAL FOREST PRESERVATION

NAU management of the Centennial Forest was established in a 75-year intergovernmental agreement between ASLD and NAU signed in 1999. Though this agreement allows the ASLD to dispose of Centennial Forest in compliance with their trust responsibilities, it is unlikely to be sold for development (see sidebar). However, there is not complete assurance the property will not be sold and the agreement limits NAU's ability to obtain grant funding: many funders will not support programs on land not owned by NAU, which affects NAU's ability to manage and oversee research on this critical asset.

#### ASLD ON THE CENTENNIAL FOREST AGREEMENT

The Centennial Forest agreement represents a unique opportunity for NAU and the local community to advance common objectives, and while the Commissioner cannot subordinate the State Trust land to less beneficial uses, she has made it clear that the lands identified in the agreement are unlikely to be sold for development during the term of the agreement.

*Source: December 4, 2018 email from Simone Hall, Director of Policy, Arizona State Land Department*

## AREA TRIBAL NATIONS

The Hopi, Navajo, and San Juan Southern Paiute tribes are located within or nearby the JLUS study area. People from both the Hopi and Navajo nations assisted with construction of Camp Navajo and have remained an integral part of its history. There are tribal holdings throughout the JLUS study area and many recognized sacred landmarks throughout the landscape (see figure 2.62).

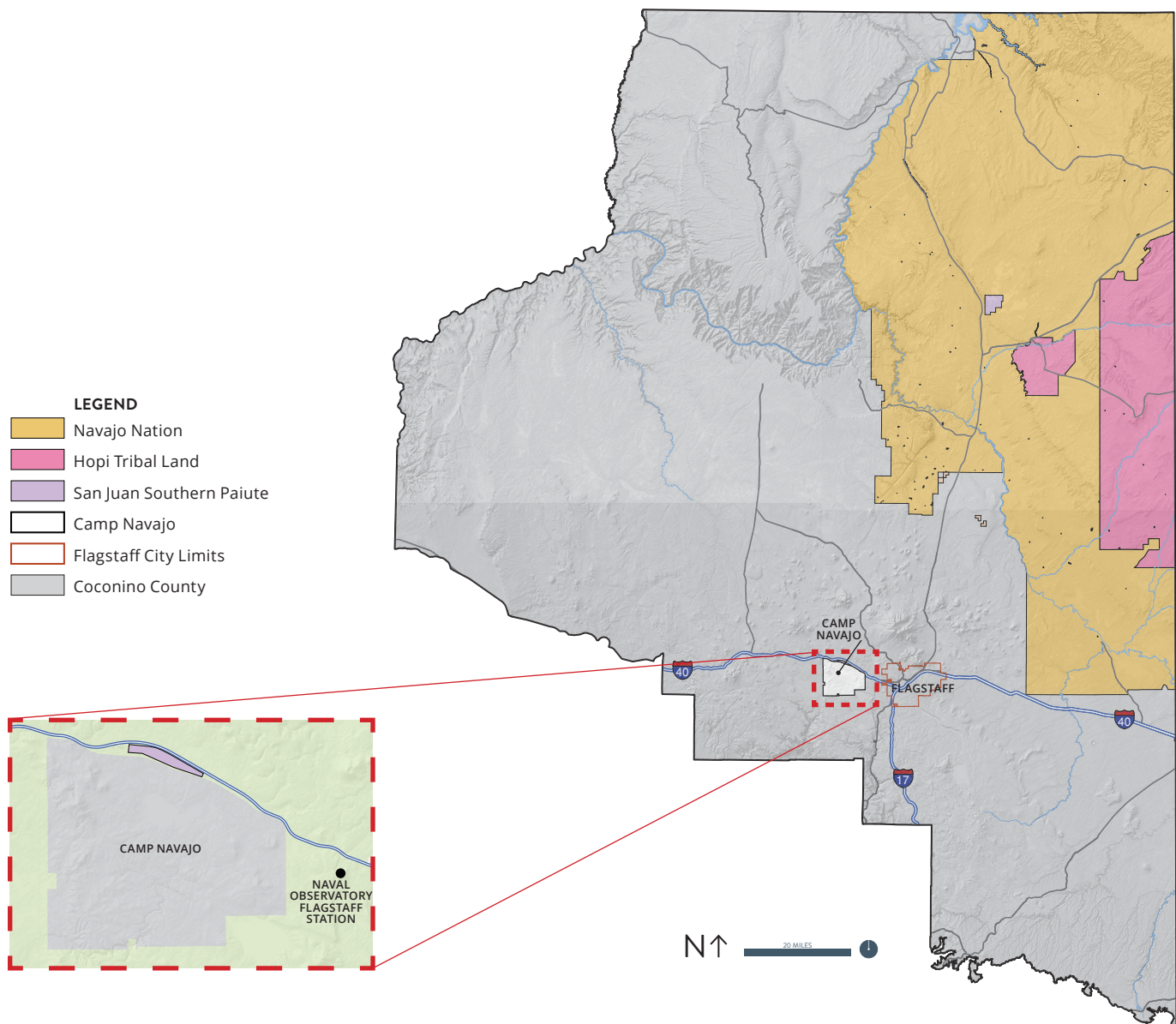


FIGURE 2.62 Tribal holdings in JLUS study area

The Hopi Tribe is a sovereign nation located in northeastern Arizona. The reservation occupies part of Coconino and Navajo counties (see figure 2.63). It encompasses more than 1.5 million acres and is made up of 12 villages on three mesas. As of September 2014, the Hopi Tribe had 14,041 members. The Hopi trace their ancestry to ancient cultures that built many stone structures and left artifacts at the Grand Canyon and across the southwest.

The Navajo Nation extends into the states of Utah, Arizona, and New Mexico, covering approximately 27,413 square miles with a population of 350,000 as of 2016 (see figure 2.64). The discovery of oil on Navajo land in the early 1920's promoted the need for a more systematic form of government. Today they have the largest land area retained by a Native American tribe, including the Four Corners Monument. Members from both the Hopi and Navajo tribes also served a key role in World War II as Code Talkers (see Code Talkers callout for more information).

For several centuries, the San Juan Southern Paiute have inhabited the territory east of the Grand Canyon that is bound by the San Juan and Colorado rivers (see figure 2.65). They share common heritage with the Southern Paiute of Utah, Nevada, and California. The largest of the San Juan Southern Paiute tribal communities is located near Tuba City, about 70 miles north of Flagstaff. The San Juan Southern Paiute own property between Bellemont and Camp Navajo within the study area.



FIGURE 2.63 Hopi Tribe logo (Source: Hopi-nsn.gov, 2018)



FIGURE 2.64 Navajo Nation logo (Source: USGS, 2000)

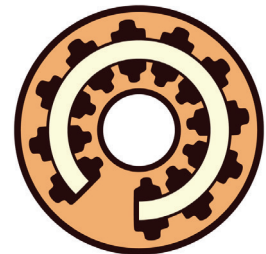


FIGURE 2.65 San Juan Southern Paiute logo (Source: Arizona Centennial Commission, 2018)

#### CODE TALKERS

Over 400 members from the Navajo and Hopi tribes joined other Native Americans serving in World War II as Code Talkers. Soldiers developed codes based on their native languages to transmit critical messages. The Hopi and Navajo soldiers served in the Pacific.



# FEDERAL LEGISLATIVE CONTEXT

This section summarizes federal legislation that could potentially be relevant to this JLUS.

## POTENTIAL FEDERAL LEGISLATION

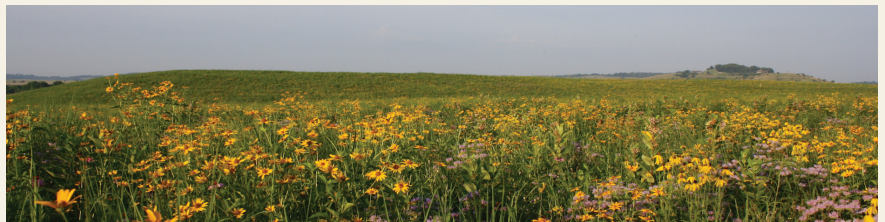
### ADVANCING CONSERVATION AND EDUCATION ACT

The House and Senate have been considering a bi-partisan bill which will allow relinquishment of State Trust land parcels wholly or primarily within eligible areas in lieu of other public lands of equal value within the state. “Eligible areas” are defined as land including the National Park, land having wilderness characteristics, and Sentinel Landscapes (see callout below).

This bill is likely to be considered in the next congressional session and could provide a mechanism to authorize certain sections of State Trust land to be used as public wilderness or working lands in the study area. This mechanism could be more useful if the act’s language was slightly modified to define more ASLD land in the study area as “eligible areas” and/or if some areas were designated as Sentinel Landscapes.

#### SENTINEL LANDSCAPES

The U.S. Departments of Agriculture, Defense, and the Interior are working with a variety of partners to preserve the working and rural character of land near military installations. By strengthening the economies of farms, ranches, and forests, the Sentinel Landscapes program works to conserve compatible land use in areas around installations vital to their mission.





# STATEWIDE LEGISLATIVE CONTEXT

This section summarizes the statewide laws, initiatives, commissions, and agencies most relevant to this JLUS.

## MILITARY INITIATIVES

Since the late 1970s, the State of Arizona has taken steps to ensure DoD's long-term viability in Arizona. These steps support Arizona military installations' ability to continue to perform their vital national defense functions and maintain their critical role in the Arizona economy.

- In December 2003, the Governor's Military Facilities Task Force put forth 27 recommendations to ensure long-term retention of the state's military.
- In May 2004, the governor signed House Bill 2140, a comprehensive military bill that included a number of the Task Force's recommendations, including establishing a Military Affairs Commission (MAC), establishing the Military Installation Fund (MIF), and passing several statutes to address compatibility issues around military airfields. These initiatives and relevant statutes are summarized below.
- In 2014, Governor Brewer issued Executive Order 2014-02 entitled Sustainment of Arizona's Military Installations. This order reinforced the Military Affairs Commission's mission and commitment to support the military in Arizona.

## MILITARY AFFAIRS COMMISSION AND MILITARY INSTALLATION FUND

The MAC's purpose is to ensure that the missions of federal military installations located in Arizona are protected and can meet our country's future needs. To accomplish this, the MAC monitors and makes recommendations on executive, legislative, and federal actions necessary to sustain and grow Arizona's network of military installations, training and testing ranges, and associated airspace. Through the MAC, Arizona keeps issues impacting federal military installations in the forefront and works to balance private property rights while ensuring that the state and local policies not only maintain, but also enhance military missions.

The MAC is comprised of 18 appointed commissioners representing expertise in military affairs, local elected officials, and private property interests; and four advisory members comprising the Arizona adjutant general, the Arizona state land commissioner, a federal land use agency, and a military installation commander.

The MAC oversees the MIF, which is a fund intended to ensure private property rights are addressed alongside efforts to maintain and enhance military missions. The MAC prioritizes property applications as part of the administration of the MIF. To acquire land around installations, five million dollars was originally committed for 20 years through the MIF.

Stakeholders report the following issues with continued use of the MIF:

- The fund is not currently active as the majority of today's legislators do not support state acquisition of private property. Future funding of this initiative is unlikely.
- There are issues with the mechanics of applying the fund; the MAC was not given the authority to acquire lands when this fund was established.
- There is no statewide prioritization for parcel acquisition that would help ensure resources are targeted towards the highest-priority parcels.

## MILITARY COMPATIBILITY STATUTES

In 2004, the State passed several statutes related to protecting military airfields. Most relevant to this JLUS are the following:

- **9-461.06** - *Adoption and amendment of general plan; expiration and re-adoption* and **11-804** - *Comprehensive plan; contents*. These statutes require cities and towns (Title 9) and counties (Title 11) with high noise or accident potential zones around military airports or ancillary facilities to support compatible land uses and continued military operations in their general or comprehensive plans.
- **28-8481** *Planning and zoning; military airport and ancillary military facility's operation compatibility; compliance review; penalty; definitions*. This statute establishes development limits within certain decibel ranges and creates accident potential and clear zones around airfields.
- **28-8484** - *Military airport disclosure; residential property*. This statute requires real estate notification for residential properties around military airports.

Though none of these statutes address military installations other than airfields, they illustrate a mechanism by which compatible land use planning, property owner notifications, and/or land use limitations around military installations could be established.

## RELEVANT STATE LAND STATUTES

### ARIZONA PRESERVE INITIATIVE

The Arizona Preserve Initiative (API) was passed into law in 1996 and designed as a mechanism to preserve State Trust land in and around urban areas for open space. API was originally targeted at land within one mile of a municipality with less than 10,000 people and was later expanded to include specific areas including property southwest of Flagstaff.

Funding for the API, in the form of a public-private matching grant program, was created and funded through 2011. Since then, funding the API has been suspended as there were challenges to this program's success. The API is not currently active. Assuming the program's issues can be resolved, the state land commissioner can be petitioned to nominate and reclassify land around NOFS and Camp Navajo for conservation purposes. There is little current interest in reinvigorating the program or addressing its issues.

### ARIZONA REVISED STATUTES (ARS) TITLES 9 AND 11

Both Titles 9 and 11 in the Arizona Revised Statutes have provisions for allowing trade of State Trust lands within cities, towns, and counties. For the purpose of designating State Trust land as open space, land with equal or greater value within the jurisdiction could be presented as an alternative in accordance with the comprehensive plan. If these provisions were broadened to allow trades statewide, they could potentially be used to help protect State Trust land that is prioritized for conservation in the study area. There is little current interest in broadening these provisions.

### PROPOSITION 207

Arizona Proposition 207, officially titled the "Private Property Rights Protection Act," passed in 2006. The initiative requires the government to reimburse land owners when regulations result in a decrease in a property's value. The proposition also prevents government from exercising eminent domain on behalf of a private party. This proposition makes it challenging to reduce development rights capacity in sensitive areas surrounding the installations through zoning.



# CHAPTER 3

## **COMPATIBILITY STRATEGIES**



THIS PAGE LEFT BLANK INTENTIONALLY

## SUMMARY OF ISSUES

To set the context for recommended strategies, this chapter first reviews JLUS issues grouped in four categories: dark skies, land use, transportation, and environmental health.

### DARK SKIES

The dark sky character of Flagstaff and the surrounding area is critical to the community, Lowell and other observatories, and the NOFS mission (see figure 3.04). The following issues are jeopardizing the area's dark skies.

#### TECHNOLOGY SHIFT

As technology has shifted to more efficient LEDs, less emitted light is being wasted through fixture absorption, resulting in the same fixtures being significantly brighter. City and county lighting codes have not been updated to address this technology shift and the impact of development on dark skies.

#### ENFORCEMENT

Enforcement measures exist but the city and county lack a full-time position dedicated to lighting enforcement. While new development is required to be dark sky-compliant, it is difficult to enforce lighting standards on existing out-of-compliance fixtures or to regulate lighting replacements or changes. The city and county require permits for outdoor lighting changes, however many owners are not aware or do not comply with these requirements.

#### DEVELOPMENT

Increasing development intensity close to NOFS and NPOI, or land uses that emphasize increased outdoor lighting in any lighting zone, have potential to impact the NOFS and NPOI mission.

#### ADDITIONAL BARRIERS

Particulates and thermal plumes, especially those created from wildfires or a potential wood-processing facility, limit visibility and impede function of area telescopes.

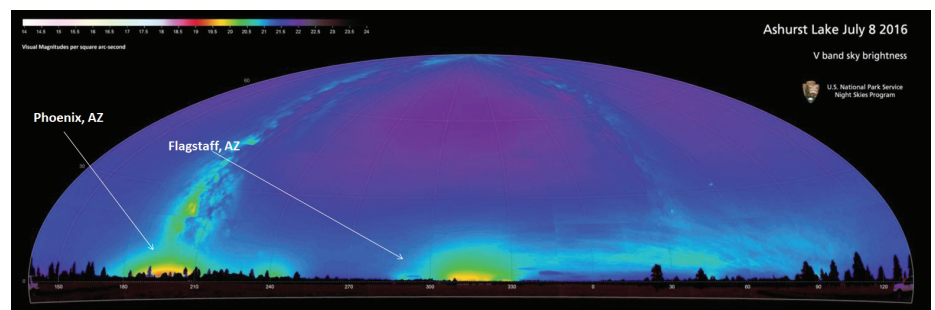


FIGURE 3.04 Sky brightness measured at Ashurst Lake, showing impact of light from Phoenix on dark skies near Flagstaff (Source: A Pipkin, D Duriscoe, C Luginbuhl, 2016)

## LAND USE

Flagstaff and surrounding Coconino County areas have attracted and continue to attract growth at a high rate due to a combination of natural beauty, regional amenities, desirable climate, Northern Arizona University, and unique history and character.

### DEVELOPMENT LOCATION AND INTENSITY

In most cases, the closer new development gets to both Camp Navajo and NOFS, the greater the opportunity to negatively impact both installations. Close-in development increases the opportunity for trespassing onto installations and the likelihood of complaints from Camp Navajo activities. Additionally, it could impact wildlife corridors resulting in shifted wildlife movement that is disruptive to current or future military activity from either installation. Development close to NOFS increases the potential impact to dark skies critical to the NOFS mission. Potential impact from development can vary greatly depending on the type of land use, site layout and design, and outdoor lighting techniques and management.

### LAND USE TYPES

Different types of land uses have the potential to impact the installations to varying degrees. For Camp Navajo, increases in residential density, particularly in areas close to the western, southern, and eastern perimeter, increase the risk of trespassing and complaints about installation activities. Recreational developments (most notably those with overnight guests) can have a similar impact on the base.

In the areas surrounding NOFS, uses that feature outdoor storage and activities that require significant outdoor lighting are a greater concern than fully enclosed uses.

Comprehensive plans and lighting ordinances for Coconino County and Flagstaff include policies to manage the location, intensity, and types of land use and development on privately owned land surrounding the installations. City and county zoning and lighting ordinances regulate the location, intensity, and type of land uses and outdoor lighting. Adjustments to the plans and regulations over time are needed to help manage growth and respond to a broad range of community preferences. Identifying ways for the city and county to manage growth and respond to community preferences while protecting the NOFS and Camp Navajo missions is a goal of this JLUS.



FIGURE 3.05 Pilot station in Belmont (Source: MAKERS, 2017)

## TRANSPORTATION

The Belmont Interchange is the sole point of access for Camp Navajo and the Belmont community and is critical to support and sustain area growth. The current transportation network is primarily oriented to serve automobiles and heavy trucks. Improving multimodal connectivity within the community, especially across the interchange, is needed to meet changing mobility needs (see figure 3.05, figure 3.06, and Belmont Interchange on page 38 for more information).

### CONSTRAINED TRANSPORTATION NETWORK

The current two-lane Transwestern Road bridge over I-40 is unable to accommodate an increase in heavy truck traffic which may result from potential Belmont area development. The limited queue storage and roadway design will result in more frequent blocking of adjacent intersections impacting general traffic operations, safety, and emergency response.

### INCREASED TRAFFIC VOLUMES AND CONGESTION

Additional commercial/industrial development within and around Camp Navajo and the Belmont interchange and the resulting increase in truck traffic will cause overall area operations and safety conditions to deteriorate. Given the mix of future land uses, the increased number of auto and truck trips will likely adversely impact both the typical commuter peak and off-peak time periods.

### LACK OF MULTIMODAL MOBILITY

The lack of pedestrian and bicycle facilities on the bridge has been raised as a critical need by the Belmont community. Given the limited funding for both the bridge rehabilitation and the Shadow Mountain Drive improvements, additional partnerships are needed to fund multimodal improvements at the interchange.



FIGURE 3.06 Aerial view of Belmont interchange



## ENVIRONMENTAL HEALTH

### FOREST HEALTH

Most ponderosa pine forests in the study area are unhealthy, drawing infestations of pests such as bark beetles that are attracted to stressed, diseased, or injured trees (see figure 3.07). Trees affected by drought may not be able to fight off this infestation. Forest health is also directly related to the watershed and area water supply. The dense forests prevent water (primarily in the form of snow) from reaching the ground and recharging area aquifers, creating the dry forests that exist today. Combined with a lack of diverse ground cover and abundance of existing fuels, these attributes create prime conditions for catastrophic wildfires and increase the risk of post-fire mudslides and flash flooding.

To improve forest health, these dense ponderosa forests need to be thinned (see figure 3.08)—an activity hampered by the lack of forestry infrastructure in the region today. There are efforts underway to evaluate the feasibility of developing a forest products complex or processing plants in the area. These may include a sawmill, OSB, other wood products, and (wood) biomass facility.

However, there is some risk involved in conducting wood-processing activities in close proximity to NOFS. Industrial wood-processing plants will generate smoke particles and heat plumes, both of which could create visibility issues for telescopes. The Biomass Feasibility Study for a Wood to Energy Facility at Camp Navajo (Biomass Feasibility Study) was completed in December 2018 by Camp Navajo. This study evaluated the potential for a biomass plant on Camp Navajo's 200 Area. Concurrently, Camp Navajo commissioned a study to model the effects of heat, water, and particulate plumes from the plant on observing conditions at both the NOFS and Volunteer Mountain sites. These studies will help design a wood-processing plant which can improve the area's economic vitality and forest health while limiting impacts to NOFS and other area observatories.

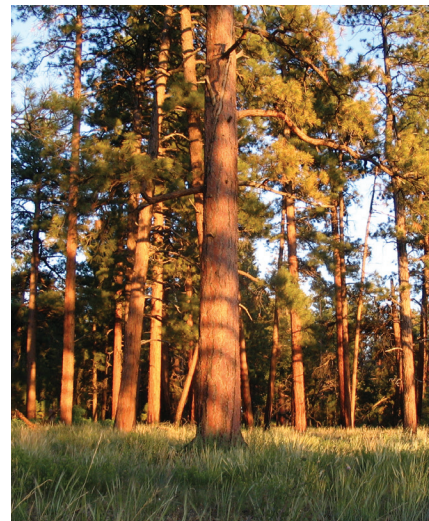


FIGURE 3.07 Typical dense ponderosa pine forest in the area (Source: KNAU, 2018)



FIGURE 3.08 Healthy ponderosa pine forest (Source: Outdoor Project, 2018)

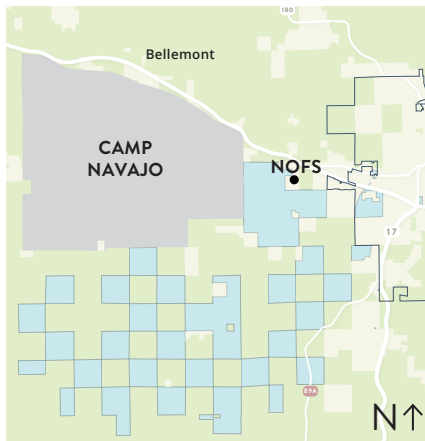


FIGURE 3.09 Land ownership in study area

#### LEGEND

- State Trust Land
- National Forest Land
- Private Ownership

## FOREST LAND CONVERSION

A combination of State Trust, USFS, and private forest lands surround NOFS and Camp Navajo (see figure 3.09). Development of currently forested land has the potential to negatively impact both installations. Camp Navajo's concerns are centered around security and operational impact on land lying within noise buffers or flight paths. Increase in light pollution from development is the primary concern for NOFS. While there are no current plans to sell or swap State Trust or National Forest lands within close proximity to NOFS, the potential future conversion of large tracts in close proximity to the installations is concerning. Forest land conversion could have a major impact on both installation's mission.

## MIGRATION & WILDLIFE

Significant wildlife migration corridors have been recognized by Arizona Game & Fish on both sides of Camp Navajo (see figure 2.54 on page 58). The linkages connect large wildland blocks of the Mogollon Rim and San Francisco Peaks and are important to many species found in the area including black bear, elk, mountain lion, pronghorn antelope, and the endangered Mexican spotted owl (see figure 3.10). Rogers Lake is also productive habitat for many migratory water fowl. Maintaining existing habitat, building crossing structures, and avoiding fragmentation from additional roads are key to ensuring long-term species viability in the region.



FIGURE 3.10 Elk on Camp Navajo (Source: Camp Navajo, Army National Guard, 2018)

## RECOMMENDED STRATEGIES

The following strategies reflect Policy and Technical Committee recommendations to maintain or enhance compatibility around Camp Navajo and NOFS, advance regional economic development, and protect area recreation opportunities and quality of life. Please note, strategies included in the JLUS are not intended to be a comprehensive list of productive actions over time and do not preclude other actions that support compatibility and meet the intent of the JLUS.

Strategies to address JLUS issues have been divided into six categories:

- Coordination
- Plan Updates & Policies
- Code Updates & Enforcement
- Land Conservation
- Forest Management
- Education

Impacted stakeholders that will play a role in executing each strategy are listed in this section. See Appendix A for a condensed list of strategies by category which includes priority-level, anticipated time frame, cost, and potential funding sources. Strategies are organized by primary responsible party in Appendix B.

Please note: the JLUS implementation committee (Strategy #1, established as the first implementation step) will be responsible for overseeing strategy implementation. To avoid unnecessary repetition, the committee has not been noted as an “impacted stakeholder” or “responsible party” after every strategy.

## COORDINATION

### SPOTLIGHT EXAMPLE

#### PIMA COUNTY MILITARY- COMMUNITY RELATIONS COMMITTEE

**Mission:** To address concerns about local military operations (primarily at Davis-Monthan Air Force Base and Air National Guard unit at Tucson International Airport) and their impact on surrounding communities.

**Membership:** Consists of military and civilian stakeholders representing a wide variety of interests.

**Number of Meetings per Year:** Bi-monthly meetings for a total of six per year.

Addressing JLUS issues begins by establishing a JLUS implementation oversight committee and cementing communication pathways between key stakeholders. Coordination activities to address dark skies, land use, forest health, and transportation issues are described below.

### GENERAL STRATEGIES

#### 1. **Complete the cooperation agreement which establishes the JLUS implementation committee (and subcommittee(s) if needed) to oversee JLUS strategy implementation, continue to coordinate, and address compatibility issues into the future.**

Protecting and enhancing compatibility around NOFS and Camp Navajo, supporting economic development, and protecting quality of life will depend on ongoing coordination and actions after the JLUS concludes. Initiating a JLUS implementation committee is suggested to oversee implementation activities and secure funding for strategies in addition to continuing compatibility work post-JLUS. The committee could be in charge of activities such as hosting an ACUB/REPI roundtable.

Initial implementation committee members were selected with the goal of providing balanced representation from key organizations responsible for strategy implementation. Including elected officials within subcommittees could be beneficial to oversee legislative advocacy efforts and continue coordination. Forming this committee while the JLUS is concluding will help maintain momentum and avoid inaction. The Pima County Military/Community Relations Committee can serve as a model (see Spotlight Example sidebar). A cooperation agreement is suggested to formalize participation and communication practices. The draft agreement is included as Appendix C.

*Impacted stakeholders: Coconino County, City of Flagstaff, Camp Navajo, NOFS, AZDEMA*



**2. Improve notification and coordination between Coconino County, Flagstaff, NOFS, and Camp Navajo around potential land use activities and development projects in the study area.**

Flagstaff and Coconino County currently send copies of pre-applications, public hearings, board of supervisors, city council, and other meeting agendas to both installations. For Flagstaff, sending intra-divisional staff meetings agendas to NOFS would enhance this notification by sharing information about projects in the early stages of development. After reviewing the agenda, NOFS can communicate concerns about potential projects to Flagstaff planners for their consideration and communication to developers and property owners.

Notification lists and military base contacts should be periodically reviewed for accuracy. Further, periodic coordination meetings between Camp Navajo, NOFS, and city and county planners should be established to ensure new planning staff understand and can represent compatibility issues to property owners and developers.

*Impacted stakeholders: City of Flagstaff, Coconino County, NOFS, Camp Navajo*

**3. Coordinate with NOFS and Camp Navajo during regional, comprehensive, activity center, and other plan updates in the study area.**

One of the most effective ways to ensure future development remains compatible with military operations is to involve NOFS and Camp Navajo as key stakeholders when city and county plans affecting the study area are updated.

*Impacted stakeholders: City of Flagstaff, Coconino County, NOFS, Camp Navajo*

## DARK SKIES

**4. Establish an outdoor lighting committee that meets regularly.**

There is a need for ongoing dialogue and information sharing between the various stakeholders to maintain momentum on dark sky preservation efforts. Establishing a standing outdoor lighting committee will help facilitate discussions on dark sky trends, bring changes at the observatories to the city and county's attention, and vice versa. See the spotlight example at right for one lighting committee organization. A permanent, focused committee will also help implement dark sky education. Including a non-voting DoD member from both Camp Navajo and NOFS will help ensure the latest information is shared and utilized.

The outdoor lighting committee will oversee:

- Lighting code updates (approval process, code writing, communication/outreach, etc.).
- A public relations campaign as outlined in Strategy #27 (see page 100).
- Ongoing information sharing between local observatories, city and county permitting, and code-enforcement staff so this occurs independent of specific individuals assigned to positions.

### SPOTLIGHT EXAMPLE

#### JOINT CITY OF TUCSON/PIMA COUNTY OUTDOOR LIGHTING CODE COMMITTEE

**Mission:** To review and recommend to elected officials amendments to the outdoor lighting code.

**Authorization:** A.R.S. §11-862, Resolution No. 2011-195

**Membership (Four-Year Term):**

- Seven members appointed by the City/County
- AZ professional electrical engineer
- AZ registered contractor
- Astronomy representative
- Dark sky advocate
- Lighting design representative
- Business community representative
- Public representative

**Number of Meetings per Year:** Not less than monthly during code review and at least annually thereafter.

- Completion and ongoing updates of a dark sky-compliant lighting fixture list and design guidance for homeowners, suppliers, and developers. List to be posted and disseminated as part of Strategy #27 (see page 100).
- Review and development of implementation plan for relevant recommendations presented in the *Let There Be Night Final Report* developed at the 2018 Future of the Colorado Plateau Forum and present plan to JLUS implementation committee. See Appendix D on page D-1 for more information.

The JLUS implementation committee will oversee and receive recommendations and feedback on topics from the outdoor lighting committee. Three options for the committee structure include:

- A City or County mandate to establish a formal committee, such as the Joint City of Tucson/Pima County Outdoor Lighting Code Committee (see Spotlight Example sidebar). This formal structure would require council action and specific membership qualifications.
- An informal group, such as the established Outdoor Lighting Code Working Group, which meets periodically, could be reorganized as a permanent committee with a broad spectrum of stakeholders that meets quarterly.
- Alternatively, the outdoor lighting committee could also be a smaller, informal group separate from the Outdoor Lighting Code Working Group.

*Impacted stakeholders: City of Flagstaff, Coconino County, NOFS, Dark Skies Coalition, Lowell Observatory, Outdoor Lighting Code Working Group*



FIGURE 3.02 McCracken prescribed burn carried out in the Williams Ranger District of the Kaibab National Forest (Source: AZDEQ)

## 5. Formalize communication between the USFS, Camp Navajo, and NOFS to minimize impacts of prescribed burns on NOFS mission.

Both Camp Navajo and the USFS perform controlled burns in the study area (figure 3.02). NOFS has a good working relationship with both organizations, but, it is largely based on established personal connections. Establishing a consistent notification protocol in the form of a letter of commitment, MOU, and/or Camp Navajo command policy will provide a structure so communication regarding prescribed burns occurs regularly and independent of individuals. NOFS is also working to add a discussion forum with USFS to prevent last-minute visibility issues during controlled burns. The USFS should be consulted for input on their preferred notification structure.

*Impacted stakeholders: USFS, Camp Navajo, NOFS, Coconino County, NAU*

## 6. Designate a local community planning liaison officer (CPLO) to serve as NOFS's mission advocate and dark sky expert.

A local CPLO is essential to build community awareness and support for dark sky preservation and the existing NOFS mission. Increased visibility, the ability to connect with local government and the community, and a commitment to sharing knowledge about the importance of dark skies to all regional observatories, including Lowell, are important roles for this position.

The current NOFS CPLO position is stationed at Naval Air Facility (NAF) El Centro, of which NOFS is considered a special area. A strong consensus emerged through the JLUS process that recognized the potential increased effectiveness of a locally stationed CPLO.

The local CPLO position:

- Will provide technical expertise regarding light pollution, thermal plume impacts, and the critical importance of dark sky preservation in support of the NOFS mission.
- Can more effectively encourage compatible land use planning, direct community outreach, and participate in military and community initiatives in the area.
- Will allow NOFS to continue to foster and build relationships with Coconino County, the city of Flagstaff, and community stakeholders.
- Could also work to grow NOFS's partnership with the county and city and coordinate around compatible outdoor lighting and development decisions on a regular basis.

*Impacted stakeholders: NOFS*

### COMMUNITY PLANNING LIAISON OFFICER

An installation CPLO keeps the public informed about the military mission and, at the same time, keeps the commanding officer informed about land use and development in the area.

## FOREST MANAGEMENT

### 7. Support effort to site a wood-processing plant.

One of the biggest contributing factors to poor forest health within the study area is the inability to process wood locally. As discussed in Current and Future Plans on page 15, Camp Navajo's 200 Area is a potential location for a wood-processing plant (OSB, biomass, sawmill, etc., see figure 3.03), and one of the largest undeveloped areas appropriately zoned for industrial use. Results from the Biomass Feasibility Study, completed in December 2018, will assist Camp Navajo in determining appropriate next steps.

Though developing a wood-processing plant in the local area is a priority to improve forest health, there are a number of issues to work through. As is discussed on page 76, NOFS has concerns about the heat and dust particles potentially generated by this activity. Further, potential impacts to area traffic, air quality, water quality, and water quantity should be analyzed so impacts can be avoided, minimized, and, where unavoidable, mitigated.



FIGURE 3.03 OSB plant (Source: Con-Vey Keystone, 2018)

To support development of wood processing in the area, the JLUS recommends coordination to:

- Support the Biomass Feasibility Study in evaluating potential extent of and ability to mitigate for air quality and thermal impact on NOFS mission.
- Build a proactive, robust framework to address air quality, water quantity and quality, and traffic impacts in the area.
- Work with ADEQ to identify opportunities to leverage environmental analysis, outreach, and the permitting process to increase knowledge of local aquifer health.
- Explore options to use sustainable practices such as installing a closed-loop reclaimed water system.

*Impacted stakeholders: Camp Navajo, NOFS, NAU, Wood-Processing Plant Developers, Coconino County, ADEQ, AZDWR, USFS*

## TRANSPORTATION

### 8. To support development of an appropriately sized interchange bridge in Bellemont:

- *Continue to advocate for and identify funding for increased capacity and multi-modal improvements to the interchange bridge.* The Policy Committee submitted a letter to the governor asking that ADOT reconsider its current bridge replacement plans. The letter advocated for a five-lane, dark sky-compliant configuration, with provisions for pedestrian/bicycle facilities. In response to this letter, Governor Douglas Ducey replied that, due to the limited budget, the scope of the repair project cannot increase. Though this near-term project cannot be amended, the bridge capacity and design should be revisited as this area develops. The JLUS implementation committee should continue to coordinate with ADOT and other stakeholders to support infrastructure improvements for the Bellemont interchange that are consistent with the long-term multimodal mobility needs of Camp Navajo and the Bellemont community.
- *Design the interchange bridge near Bellemont with five lanes but build it with three lanes in the near term.* This would retain the flexibility to expand the bridge at a later date, when development in the area requires more capacity and funding is available. See Transportation Strategy #17 in the Plans & Policies section for a recommendation to update the 2015 Bellemont Access Management & Multimodal Study. Updating this study will provide a more accurate estimate of the transportation improvements needed to support future growth in the area.

*Impacted stakeholders: Coconino County, ADOT, Camp Navajo, AZDEMA, area businesses*



**9. Coordinate proactively with ADOT to consider area growth plans and ensure study area roadway lighting is compliant with Flagstaff dark sky standards.**

Proactive coordination with ADOT at the FMPO and at leadership levels is needed to design and implement a plan to transition to lighting compliant with Flagstaff dark sky standards along study area roadways (see figure 3.11 and Strategy #14).

Coordination with ADOT should also occur around planning and design of study area projects to ensure they support planned development, incorporate dark sky lighting, and enhance wildlife crossings. Currently, stakeholders see ADOT plans late in the process when it is difficult to influence change. The design phase is the appropriate time for ADOT to reach out to city and county agencies, stakeholders, the FMPO, and Northern Arizona Council of Governments (NACOG) for input.

A consistent administrative design review process could help build relationships between agencies and benefit the community. Flagstaff's SLEDs project (see Street Lighting for Enhancing Dark Skies (SLEDs) Study on page 50) is an opportunity to coordinate with ADOT to build consensus and help promote the recommendations as a precedent for outdoor, dark sky-compliant, LED lighting solutions.

*Impacted stakeholders: Dark Skies Coalition, ADOT, Camp Navajo, NOFS, Coconino County, City of Flagstaff, AZGFD, NAU, FMPO, NACOG, Lowell Observatory.*



**FIGURE 3.11** Example of ADOT dark sky-compliant lighting along Highway 89A at the Airport Road intersection in Sedona (Source: Gateway to Sedona)

## PLAN UPDATES & POLICIES

### DRAFT BELLEMONT AREA PLAN POLICIES

- New industrial, commercial, and residential developments will prepare lighting plans consistent with Lighting Zone II standards of the current Coconino County Zoning Ordinance.
- Replacement of existing non-conforming lighting on residential, commercial, and industrial property throughout the Bellemont Area Plan is encouraged.
- Consider the proximity to the Naval Observatory Flagstaff Station and consult with the Observatory during design of new development proposals.
- Lighting is discouraged unless it is used for security, and fixtures are downward-facing and fully shielded.
- Motion detectors are recommended for security lights in lieu of dusk-to-dawn lighting.

To establish a cohesive path forward, plans and policies need to work towards compatibility goals. Strategies to guide plan updates and policy suggestions are discussed in this section.

### GENERAL STRATEGIES

#### **10. Adopt the JLUS as a comprehensive plan amendment; support existing and adopt new goals and policies within the plans to best protect the missions of Camp Navajo and NOFS.**

Coconino County, city of Flagstaff, and city of Williams periodically update their comprehensive plans in response to updated state land use planning requirements and evolving local conditions and objectives. The county's comprehensive plan was adopted in December 2015, the city of Flagstaff's plan was last updated in May 2014, and the city of Williams' plan was last updated in 2013. Whereas amendments to the plans may be made every year, major updates typically occur every ten to twenty years. When the cities and county update their plans, this study recommends that they incorporate the JLUS by reference and incorporate JLUS study recommendations into the appropriate elements.

*Impacted stakeholders: Coconino County, City of Flagstaff, NOFS, Camp Navajo, City of Williams*

### DARK SKIES

#### **11. Support adoption of the draft dark skies goals and policies in the Bellemont Area Plan.**

Bellemont's concurrent effort to update the Bellemont Area Plan has resulted in draft dark sky lighting policies (see Draft Bellemont Area Plan Policies sidebar).

*Impacted stakeholders: Coconino County, NOFS*

## 12. Prioritize development of southern and western City of Flagstaff activity center plans in collaboration with NOFS and Camp Navajo.

Activity centers identified in Flagstaff's Regional Plan 2030 emphasize evolving mixed-use activity clusters in urban, suburban, and rural contexts (see figure 3.12). The city intends to produce specific plans to guide development of these centers, planned individually or in groups. Activity centers outside city limits would be planned in conjunction with the county.

It is recommended that the activity centers nearest NOFS have plans developed in collaboration with NOFS. These include centers U7, S10, and S11. The City of Flagstaff should prioritize development of these activity center plans to proactively set the planning context before these areas experience development pressures. Other key centers warranting close coordination with NOFS include S6, S12, S16, and S17 due to their proximity to NOFS or NPOI/Anderson Mesa. As these centers develop, their lighting impact should be considered to ensure compatibility with the NOFS mission.

*Impacted stakeholders: City of Flagstaff, NOFS, Lowell Observatory, Camp Navajo*

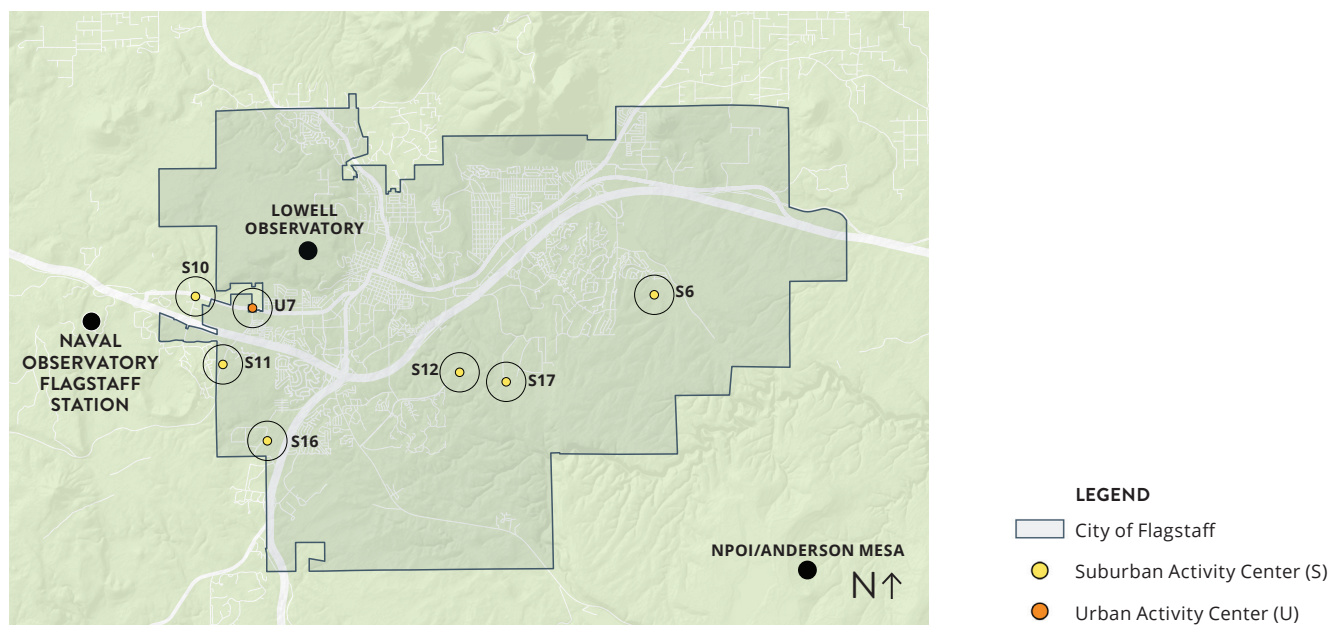


FIGURE 3.12 Activity centers (Source: Flagstaff Regional Plan 2030)

**13. Adopt a Camp Navajo policy to comply with current and future county Lighting Zone I standards in order to protect dark skies.**

Camp Navajo does not currently have policies in place to protect dark skies. With potential development occurring at the 200 Area, lighting impacts could increase. As is shown in figure 3.13, the eastern half of Camp Navajo and the 200 Area are currently in Lighting Zone II. Camp Navajo could adopt a policy to comply with current county Lighting Zone I requirements and future updates related to the Light Pollution Study and SLEDs study. Camp Navajo could also work with the U.S. Army Corps of Engineers (USACE) to adopt a similar approach within the 200 Area and along the site's access roads. These policies will help protect dark skies critical to NOFS and support the potential location of an infrared telescope on Volunteer Mountain.

*Impacted stakeholders: Camp Navajo, USACE, Dark Skies Coalition, NOFS*

**14. Adopt an ADOT policy to use dark sky-compliant lighting that meets Flagstaff standards for roadways in the study area.**

Use Flagstaff SLEDs standards as a model and engage with Flagstaff-area dark sky experts to develop an ADOT policy to use lights that meet Flagstaff dark sky standards. Where feasible, postpone maintenance and lighting replacement projects in the study area until the policy is adopted. See Strategy #9.

*Impacted stakeholders: Dark Skies Coalition, ADOT, Camp Navajo, NOFS, Coconino County, City of Flagstaff, AZGFD, NAU, FMPO, NACOG, Lowell Observatory.*

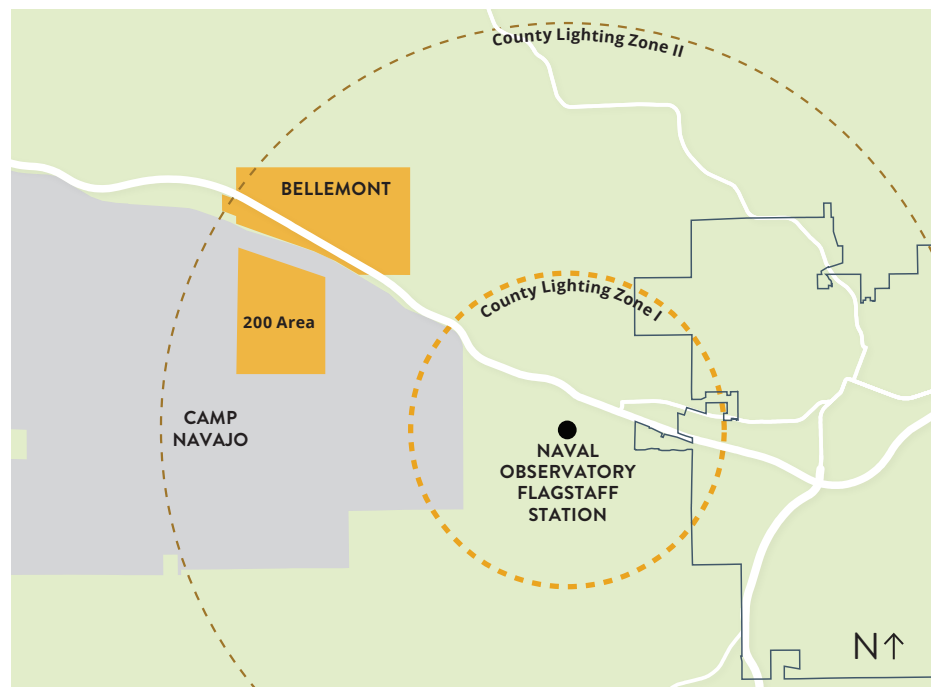


FIGURE 3.13 County lighting zones around Camp Navajo



**15. Adopt dark sky goals and policies in Williams which recognize dark sky regional assets and potential telescope location on Volunteer Mountain.**

The city of Williams adopted and enforces Coconino County's 2001 lighting code but hasn't integrated dark sky goals and policies into their general plan. In light of the potential location of an infrared telescope on Volunteer Mountain or other nearby locations, and considering future potential development within Williams, dark sky goals, policies, codes, and enforcement activities will likely take on greater importance in the future.

*Impacted stakeholders: JLUS Implementation Committee, City of Williams, NOFS, Camp Navajo, Coconino County*

## ENVIRONMENTAL HEALTH

**16. Understanding the important link between wildlife and land conservation, incorporate wildlife corridors into planning documents and land conservation efforts.**

As critical wildlife corridors surround both Camp Navajo, NOFS, and Bellemont (see figure 2.54 on page 58), it is important to recognize and incorporate these corridors into future plans and land conservation efforts. Loss of habitat or connected wildlife corridors could limit wildlife movement and affect Camp Navajo or other property owners in the area. Area plans should incorporate land conservation where appropriate and support adding highway over- and under-passes for wildlife passage across I-40.

*Impacted stakeholders: Coconino County, City of Flagstaff, ADOT, Camp Navajo, AZGFD, USFS, Central AZ Land Trust*

## TRANSPORTATION

**17. Update the 2015 Bellemont Access Management & Multimodal Study to account for potential growth as part of Camp Navajo and adjacent properties on the south side of I-40.**

An update of the 2015 Bellemont Access Management and Multimodal Study is needed to assess future growth potential for the Bellemont area and identify a prioritized list of multimodal transportation improvements.

*Impacted stakeholders: Coconino County, ADOT, Camp Navajo*

## CODE UPDATES & ENFORCEMENT

City and county codes should be periodically updated in response to changing conditions, new mandates, community desires, and technological advances. This section includes strategies to update codes and encourage compliance.

### CITY & COUNTY LIGHTING CODE

**18. Adopt new and periodically review and revise lighting codes to meet emerging technologies and incorporate NOFS Mission Compatibility Light Pollution Study code recommendations.**

Alongside development and approval of this JLUS, the city of Flagstaff and Coconino County are working to update their lighting code to respond to the Light Pollution Study recommendations listed below. This process provides a model for future review and updates to lighting code in response to changing conditions and technology.

The Light Pollution Study evaluated the mission impact from light pollution, presented findings, and outlined recommendations for consideration by the city and county to minimize impacts to the dark sky and the NOFS mission. Five of the recommendations are summarized below and a sixth recommendation is summarized under Strategy #20.

- *Update design standards to encourage/require overhang or canopy-mounting for outdoor lighting in Lighting Zone 1.* Using overhang or canopy mounting for some or all outdoor lighting without increasing the allowed amount of light output (lumens) would have the net effect of reducing outdoor lighting impacts.
- *Extend Lighting Zone 2 in Flagstaff and Coconino County to cover all of existing Lighting Zone 3.* Merging Lighting Zone 2 into the current Lighting Zone 3 in city of Flagstaff and Coconino County could reduce potential sky brightness from future development.
- *Modernize measurement of absolute lumens.* Update the city and county lighting codes to account for the increasing use of LED lighting and the new way of measuring light output (lumens) as opposed to the old way of measuring light output in conventional light fixtures.

- *Update residential roadway lighting requirements (consider making roadway lighting optional or eliminating the requirement).* Approximately 37% of the lighting output from the current Flagstaff roadway lighting inventory is applied on local (i.e., residential) roadways. Reducing the residential roadway lighting standards in the Flagstaff Engineering Design Standards and Specifications would reduce sky brightness.
- *Align the residential average use standard (consider allowing up to 10,000 lumens installed if the average annual usage does not exceed 1,500 lumens).* While the amount and types of lighting associated with single-family homes is generally more difficult to enforce than commercial and multi-family development, local studies have found that single-family residential homes actually used, on average, much less than the allotted lumens per residence in the lighting codes, which measure lumens at maximum output. The actual average use was 1,366 lumens per residence.<sup>1</sup>

*Impacted stakeholders: Coconino County, City of Flagstaff, Outdoor Lighting Code Working Group, Outdoor Lighting Committee, NOFS, Dark Skies Coalition, Lowell Observatory*

## CITY & COUNTY STREET LIGHTING STANDARDS

### **19. Adopt SLEDs Study recommendations for dark sky-friendly lighting in the public right-of-way.**

The city of Flagstaff is in the final stages of the SLEDs Study and will be recommending a path forward for uniform dark sky-compliant lighting standards. Coconino County could apply these recommendations to updating street lights in the county as well.

*Impacted stakeholders: Coconino County, City of Flagstaff, NOFS, Dark Skies Coalition, Lowell Observatory, Developers*

<sup>1</sup> Luginbuhl, C., G. Wesley Lockwood, D. Davis, K. Pick, and J. Selders. 2009. *From the Ground Up I: Light Pollution Sources in Flagstaff, Arizona. Publications of the Astronomical Society of the Pacific*, 121:185.



FIGURE 3.14 Outreach event (Source: International Dark-Sky Association)

## ENFORCEMENT

### 20. Fund a joint Coconino County and city of Flagstaff lighting specialist position for education/enforcement in the next fiscal year (Spring 2019).

As discussed under Mission Compatibility Light Pollution Study on page 22, the Light Pollution Study evaluated the mission impact from light pollution, presented findings, and outlined recommendations for consideration by the city and county to minimize dark sky and NOFS mission impacts. Code amendment recommendations from the study are summarized under Strategy #17. The study also identifies enforcement of lighting codes as a critical step to protecting the NOFS mission.

Currently, the city's Community Code Compliance program consists of two officers and a manager and enforces compliance of all codes city-wide. This staffing level does not allow for proactive lighting code-focused education or enforcement. A full-time position devoted exclusively to lighting enforcement and education in the city and county is needed. The city's Planning and Development Services department requested funding for this position from the city council in 2018 to raise awareness of this need and initiate discussions. The lighting specialist role would include:

- *Establishing a baseline database of non-conforming lights and a program/work plan to review problem parcels, with annual updates.* For each parcel with non-conforming lighting, the database must include, at a minimum, fixture locations, lamp types, wattages, and a photo of each fixture type. There may be funding available from OEA to fund a study that establishes this baseline data.
- *Refining enforcement practices and policies to bring non-compliant fixtures into compliance with dark sky standards.* Assuring lighting code compliance when properties are renovated or lighting is replaced is an existing challenge. Lighting additions and changes on existing commercial, industrial, sport fields, and multi-family/large-scale developments require a permit; however, this is often overlooked. In addition to enforcement, education is needed to build community awareness of permit requirements.
- *Convening an education series for elected officials, local leadership, staff, and the community.*
- *Creating a volunteer dark sky ambassador program and training volunteers to conduct outreach and education (see figure 3.14).* The lighting specialist could also reach a broader audience by creating a volunteer dark sky ambassador program. These volunteers could be trained to lead efforts throughout the city and county.



- *Providing periodic training for developers, realtors, design and building professionals, suppliers, and existing property owners.* This will provide information to design and building professionals about local outdoor lighting code standards and regional best practices so dark sky-compliant design decisions can be considered early in the development process (figure 3.17). Increasing educational efforts for building professionals and existing property owners will improve outdoor lighting compliance in the study area.
- *Leading efforts to develop training and educational materials, such as presentations, fact sheets for permit applications and other uses, specification sheets, and outreach materials (figure 3.15 and figure 3.16).* Training elected officials, staff, and HOAs in the city and county will increase awareness and advance dark sky preservation.

As a first step, the JLUS Policy Committee should send a letter urging the creation of a jointly funded lighting specialist in the upcoming year to the Flagstaff City Council and Coconino County Board of Supervisors.

*Impacted stakeholders: Coconino County, City of Flagstaff, Dark Skies Coalition, NOFS, Outdoor Lighting Code Working Group, Lowell Observatory*



FIGURE 3.15 Astronomy Magazine Flagstaff article September 2017 (Source: Joint City/County Council Work Session Presentation, November 6, 2017)



FIGURE 3.16 Outreach fact sheet (Source: International Dark-Sky Association)



FIGURE 3.17 Rendering of the Timber Sky dark skies master planned community in Flagstaff. Dark sky-compliant outdoor lighting requirements are being written into HOA governing documents to achieve an approximate 30% reduction below city of Flagstaff Lighting Zone 1 standards. (Source: [timberskyhomes.com](http://timberskyhomes.com), 2018)

## LAND CONSERVATION

Land conservation is a community priority and reduces the opportunity for incompatible uses around both military installations. Land conservation strategies addressing JLUS issues are summarized below.

### GENERAL STRATEGIES

#### 21. Continue to pursue funding to conserve critical private land in the study area.

Conservation initiatives in the area could be funded through the DoD's REPI and ACUB programs (see REPI and ACUB Programs on page 18) by partnering with NGOs, through conservation programs such as Sentinel Landscapes (see Sentinel Landscapes on page 67), or by using funding from the United States Department of Agriculture (USDA) where appropriate.

- *Continue to pursue ACUB and REPI program funding and partnerships to limit incompatible development on priority parcels in the study area.* An overview of the ACUB proposal process is shown in figure 3.18. The success of REPI/ACUB proposals is contingent on maintaining momentum with partners at the local level. Additional REPI/ACUB-focused capacity at NOFS and Camp Navajo would be beneficial. At NOFS, a local CPLO would provide this capacity (See Strategy #6 on page 82) and at Camp Navajo, a new community outreach staff person could support this effort (see Strategy #28 on page 101). Training and coordination for real property officers at each base would also be beneficial. The development of a joint ACUB/REPI roundtable hosted by the JLUS implementation committee would ensure that potential partners have a forum in which to exchange ideas, compare areas of interest, and explore future projects ahead of annual ACUB/REPI funding cycles (see Ideas to Reinvigorate Land Conservation Efforts Using REPI/ACUB Funding sidebar).

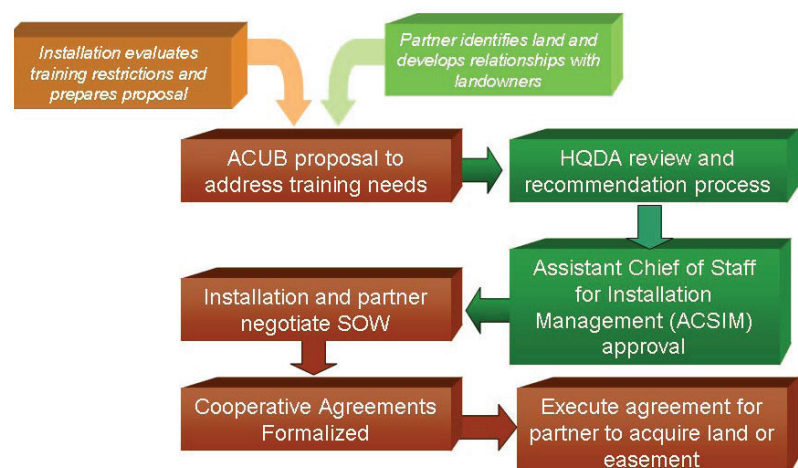


FIGURE 3.18 ACUB proposal process (Source: U.S. Army)

- *Continue to coordinate with the Trust for Public Land, the Central Arizona Land Trust, the Nature Conservancy, and other NGOs to seek funding opportunities and share expertise around priority parcel acquisition and conservation easements.* The Trust for Public Land (TPL) is a non-profit that works to conserve land in addition to creating parks. TPL works with the military, jurisdictions, and private property owners to conserve critical land, as seen at their efforts on the Rogers Lake County Natural Area on page 34. TPL helps to find funding, determine local and state conservation provisions, and identify other entities to partner with, such as USFS or other NGOs. They continue to work in the study area on various conservation efforts.

The Central Arizona Land Trust (CALT) is a non-profit that has been working with private landowners to conserve land in central and northern Arizona since 1989. CALT partners with property owners to establish conservation easements, to preserve lands critical to wildlife and natural resources. They have been a primary partner working to conserve ACUB priority areas.

The Nature Conservancy (TNC) is interested in large-scale conservation and prioritizes protection of waterways, small creeks, headwater areas, and parcels with significant habitat. Coconino County supports a \$400 million per year wildlife recreation economy and the area around Camp Navajo and NOFS have important water springs and wildlife corridors that could align with TNC interests. Wildlife corridor conservation should be prioritized when considering land acquisition in the area surrounding Camp Navajo and NOFS. TNC is also involved with 4FRI and initiatives to improve the health of forests (See 4FRI Goals on page 53).

Other NGOs that have interests and priorities overlapping with the goals of NOFS and Camp Navajo (e.g., preserving private land near Rogers Lake as part of the Rogers Lake County Natural Area) could be considered for partnering on future conservation efforts.

#### IDEAS TO REINVIGORATE LAND CONSERVATION EFFORTS USING REPI/ACUB FUNDING

1. Create a local NOFS CPLO (See Strategy #6) and local Camp Navajo community outreach position (See Strategy #28)
2. Provide REPI/ACUB training for each installation's real property officers
3. Establish a land conservation roundtable with potential REPI/ACUB partners
4. Conduct outreach sessions with land owners to introduce the program and solicit interest

- *Explore partnering with the USDA Natural Resources Conservation Service.* The USDA Natural Resources Conservation Service (NRCS) provides incentives to farmers, ranchers, and forest landowners that would like to put wetlands, agricultural land, grasslands, and forests under long-term easements.<sup>2</sup> The NRCS Arizona State Office provides support to private landowners in Arizona through partnerships with landowners, conservation districts, and state and local governments, American Indian Nations, and rural and urban citizens.<sup>3</sup> Under the Agricultural Land Easements component of the Agricultural Conservation Easement Program, the NRCS helps tribes, state and local governments, and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands.<sup>4</sup> The mission of the NRCS aligns with the goals of REPI/ACUB. Partnering with the NRCS could provide access to funding for easements where conservation priorities for military compatibility align with NRCS and local owner goals.
- *Evaluate the appropriateness of the Sentinel Landscapes program to support conservation goals in the study area.* An overview of the Sentinel Landscapes program is shown on page 67.
- *Conduct outreach sessions with land owners to introduce the programs and solicit interest.* Informing private property owners around Camp Navajo and NOFS about the need for conservation and potential funding methods could be a great opportunity to implement conservation initiatives where aligned with property owner goals.

*Impacted stakeholders: Camp Navajo, NOFS, Coconino County, City of Flagstaff, NGOs (i.e., TPL, Nature Conservancy, Central Arizona Land Trust), AZGFD*

<sup>2</sup> U.S. Department of Agricultural (USDA). No date(a). "About NRCS." <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/>. Accessed July 18, 2018.

<sup>3</sup> NRCS. No date(c). "Programs." <https://www.nrcs.usda.gov/wps/portal/nrcs/az/programs/>. Accessed July 18, 2018.

<sup>4</sup> NRCS. No date(c). "Programs." <https://www.nrcs.usda.gov/wps/portal/nrcs/az/programs/>. Accessed July 18, 2018.



## **22. Continue to work with the Arizona State Land Department regarding State Trust lands in the study area.**

The JLUS implementation committee should coordinate with ASLD, and:

- Continue to advocate and educate regarding the importance of NAU-managed research on the Centennial Forest and retention of forest uses on other ASLD-study-area parcels to the NOFS and Camp Navajo missions.
- Coordinate with Camp Navajo and NOFS when contemplating the sale, transfer, or permitting activities on State Trust lands in the study area.
- Monitor progress, expand applicability, and support federal adoption of the Advancing Conservation and Education Act (see page 67). Advocate for language adjustments that would allow its provisions to apply to more State Trust lands in the study area. If the Act is enacted, areas designated as Sentinel Landscapes would be eligible for in lieu relinquishment; see Strategy #21.

*Impacted stakeholders: ASLD, NAU, NOFS, AZDEMA, Camp Navajo, NGOs (i.e., TPL, Nature Conservancy, Central Arizona Land Trust), Coconino County, AZGFD*

## **23. Advance efforts to support continued conservation of federal land in the study area.**

Over the years there have been land trades or “in lieu of land exchanges” where federal land has changed ownership within Arizona. The most recent proposed exchange in early 2018 would have transferred existing federal land to State Trust land so that existing State Trust land could be transferred to the Hopi tribe, settling a centuries-old land dispute between Navajo and Hopi lands. This would have placed land south of Flagstaff in tribal control, opening up the potential for development in a critical dark sky region. While this transaction did not occur, the potential transfer (and subsequent development) of federal land in the study area should be proactively considered and addressed by the JLUS implementation committee.

To support conservation of federal land in the study area, the JLUS implementation committee should oversee coordination and advancement of the following:

- Establish an MOU or policies within USFS land and resource management planning documents which support military compatibility in the study area. These could commit the USFS to retain federal ownership and national forest designation in the study area and/or to coordinate with Camp Navajo and NOFS when contemplating transferring land or siting approvals.
- Retain the existing county policy that land transferred from federal to private ownership would be zoned open space by default.
- Continuing to advocate and educate regarding the importance of retaining existing national forest to the NOFS and Camp Navajo missions.

*Impacted stakeholders: USFS, Camp Navajo (AZDEMA), NOFS, Coconino County*

## FOREST MANAGEMENT

### COCONINO COUNTY FOREST RESTORATION OBJECTIVES

- Develop a viable forest products industry
- Assist existing forest industry
- Identify and support securing Forest Restoration grants and funding
- Participate in Good Neighbor Authority Agreements with the USFS and State of Arizona
- Assist the USFS in identifying ways to increase restoration work through changes in policies and practices

### CITY OF FLAGSTAFF FOREST RESTORATION OBJECTIVES

- Restored, resilient landscapes
- Protected community and watersheds
- Safe, effective inter-agency response

See Strategy #26.

Strategies to address forest management include supporting the county's forest restoration director's work, improving practices on Camp Navajo, and supporting regional initiatives including efforts by the city of Flagstaff and 4FRI.

### GENERAL STRATEGIES

#### 24. Support county forest restoration director in efforts to advance forest restoration activities.

The Flood Control District (FCD) Board recently created the forest restoration director position to serve as a liaison and facilitator to link county interests with broader regional restoration efforts and opportunities. Responsibilities include supporting forest industry development and FCD agency advocacy (see Coconino County Forest Restoration Objectives sidebar). The new position will help address the need for wood log and woody biomass processing, which is the greatest challenge currently facing western Coconino County forest restoration.

Other forest restoration director responsibilities that support JLUS goals include:

- *Assisting NOFS in developing processes for communication regarding prescribed burns and visibility.* In alignment with Strategy #5, assist NOFS with developing communication protocols with the USFS, Coconino County, City of Flagstaff, and State of Arizona regarding prescribed burns and potential impacts to visibility conditions for astronomical observations.
- *Partnering with the Greater Flagstaff Forest Partnership to develop materials and an outreach plan to educate the community on the importance of thinning and address sensitivity around "healthy" forest image.* Public awareness regarding the need for forest restoration is high in the city and county. It is important to continue to communicate topics such as emerging best practices to improve forest health, the pros and cons of various treatments such as thinning and prescribed burns, the importance of wood processing to forest health in the area, and status of restoration initiatives.
- *Considering creation of a Resource Protection Overlay (RPO) zone in the county, similar to Flagstaff's overlay, which integrates tree-protection provisions supporting dark skies with appropriate thinning practices to promote forest health (see forest resource protection thresholds table on page 98).* The city has resource protection standards for floodplains, steep slopes, and tree protection. Additional mapping and coordination is recommended to evaluate the appropriateness of adopting a similar RPO zone in the county.
- *Incorporating elements of Flagstaff's Wildland-Urban Interface Code in zoning updates where practical, including the ongoing update to the subdivision ordinance.*

- Exploring the opportunity to seek funds to support and expand forest-thinning efforts and contracts in the study area to include private lands and State Trust land.
- Exploring the opportunity to use conservation crews, city of Flagstaff crews, or forestry students to assist with forest thinning in the study area.

*Impacted stakeholders: Coconino County, City of Flagstaff, USFS, NOFS, Camp Navajo, ASLD, NAVFAC, NAU, Greater Flagstaff Forests Partnership*

#### FLAGSTAFF ZONING CODE: SECTION 10-50.90.060 FOREST

**Table 10-50.90.060A, Forest Resource Protection Thresholds as a Percentage of Site**

**Area.** Used to determine the minimum amount of forest resources that must be retained onsite. Threshold percentages apply only after vegetation management provisions (i.e., thinning and debris disposal required over property prior to construction) are implemented.

Public Lands	Residential	Commercial	Industrial	Traditional Neighborhood Community Plans
30%	50%	30%	20%	30%



**FIGURE 3.19** As of December 2018 the Camp Navajo Fire Department is funded to be a 13-member department which covers 28,473 acres of heavily forested land and provides aid to the local fire district, Flagstaff-area fire departments, NOFS, and other federal agencies in the region. (Source: Camp Navajo)

## 25. Increase funding and improve practices to reduce wildfire risk on Camp Navajo.

Reducing wildfire risk on Camp Navajo is critical to ensure the safety of personnel, training groups, and USFS staff manning the Volunteer Mountain lookout. Improving forest health, coordinating with local partners, and expanding safety training and communication practices will reduce this risk.

Camp Navajo has an active forest management plan which includes prescribed burns, but lacks funding to implement. Advancing efforts to improve forest health will decrease high-severity wildfire risk and associated natural disasters such as flooding. Implementing thinning and other practices to improve forest health will reduce the risk of fire within and outside the installation (figure 3.19). Continued coordination with the Coconino County forest restoration director, Flagstaff Fire Department, NAU Ecological Restoration Institute, and USFS will be essential to defining needed improvements and developing a work plan for restorative forest practices.

Safety practices and communication protocols with personnel, trainees, and visitors should be reviewed and updated. This is critical given the large number of visitors that may not be familiar with local best practices.

*Impacted stakeholders: Camp Navajo, Coconino County, NAU, USFS, City of Flagstaff, local fire and emergency service providers*

### DEPARTMENT OF FORESTRY & FIRE MANAGEMENT

Arizona's Department of Forestry & Fire Management provides fire protection to 22 million acres of State Trust and private lands. While they can assist, the ADFFM does not generally provide fire protection on Camp Navajo, NOFS, or any private land in the study area. Private lands are served by either the Flagstaff, Highlands, or Ponderosa Fire Departments. ADFFM did respond to a fire on Camp Navajo in February 2018.

### TREE THINNING PROJECT GIVES NAU FORESTRY STUDENTS REAL-WORLD EXPERIENCE

NAU News July 21, 2017



“Forestry students walked away with real-world experience after being tapped to research and create a prescription to help Northern Arizona University maintain and protect its on-campus ponderosa pine forest while reducing the fire hazard.”

The project’s goals are:

- Promoting healthy forest conditions by reducing competition-related mortality, increasing native understory production and maintaining tree species diversity
- Promoting conditions not conducive to high-severity fire by reducing the amount of forest “litter” and reducing the hazard for crown fire through monitoring tree height
- Providing a safe space for human activities by maintaining appropriate sight lines, cutting down dead branches that stretch into the urban trail, and removing trees that are potentially hazardous to humans

### 26. Support coordinated forest restoration activities (inside and outside of installations) to reduce the threat of high-severity wildfires in the study area.

Continue to advocate for, support, partner, and implement forest restoration activities (such as 4FRI), occurring on Camp Navajo, NOFS, State Trust lands, in the Coconino and Kaibab National Forests, and on adjacent NAU School of Forestry-managed land. Support the city of Flagstaff’s long-term commitment to and track record of actions on wildland fire management and forest health and sustainability within the city and on surrounding USFS property, State Trust land, private lands, Camp Navajo, and NOFS. Flagstaff, in partnership with NOFS, has provided prescribed burns on NOFS since 2012. See city of Flagstaff Forest Restoration Objectives in the sidebar on page 97.

Conducting fire prevention treatments, such as prescribed burns and thinning, are important components to restore fire-adapted ecosystems in the region. The success of creating and developing a sustainable, local industry to harvest (i.e., assist with thinning), process, and sell wood products is critical to forest restoration in the region (see Strategy #7).

4FRI recommends the following restoration activities, in addition to prescribed burns and thinning, to reduce the threat of high-severity wildfires in northern Arizona.

- |  |                         |
|--|-------------------------|
| • Habitat improvements                 | • Reforestation         |
| • Noxious weed removal                 | • Trail maintenance     |
| • Meadow restoration                   | • Watershed maintenance |
| • Road maintenance and decommissioning |                         |

Efforts could include:

- Working with stakeholders and fire ecologists to prioritize areas where forest restoration is most needed to protect military assets and infrastructure as well as nearby private property.
- Implementing the Greater Flagstaff Area Community Wildfire Protection Plan, which incorporates all land in the study area.
- Advocating for the inclusion of priority treatment areas through coordination with partners (e.g., USFS, ADFFM) and their existing projects (e.g., 4FRI). See the Tree Thinning Project Gives NAU Forestry Students Real-World Experience sidebar.
- Increasing capacity to conduct forest restoration in priority treatment areas through grant-writing and partnerships.

*Impacted stakeholders: NAU, USFS, Camp Navajo, NOFS, City of Flagstaff, National Forest Foundation, American Conservation Experience, Arizona State Lands, private land owners, fire departments, and other emergency responders*



## EDUCATION

Educating the community about Camp Navajo and NOFS, the importance of land use compatibility, and dark skies initiatives is key to the success of JLUS implementation.

### DARK SKIES

#### 27. Develop and execute a public relations campaign to increase dark skies awareness and encourage action.

There are existing dark sky education materials including great examples provided by the Dark Skies Coalition on their website (figure 3.20 and figure 3.21). In addition, Flagstaff quarterly newsletters are beginning to reference dark sky themes and the Greater Flagstaff Chamber of Commerce participates in ongoing advocacy for dark sky preservation. Building on these efforts, there is a need to update, maintain, and increase access to information that emphasizes actions to protect this national asset.

There is a need for a public relations expert that could help assemble existing dark sky materials, identify gaps in information, and develop and implement a local public relations campaign for dark sky preservation awareness and actions. New dark sky preservation brochures and a dark sky-compliant lighting fixture list are needed. The public relations campaign could include providing information to local home improvement stores for dissemination at point of sale. Hosting a workshop at a home improvement store could increase interest and allow different light fixtures to be showcased, discussed, etc. Creation of a feedback loop on campaign outreach methods and materials would be beneficial so that adjustments can be made and information is kept current (e.g., dark sky-compliant fixture list can be updated using developer feedback).

In summary, public relations campaign actions could include:

- Developing web-based and other resources to assist the public with dark sky-compliant lighting implementation. Resources should include FAQs and elements that build awareness/encourage replication of regional best practices and successes.
- Coordinating with military public affairs officers to create dark sky brochures for city and county staff for public distribution.
- Supporting efforts to amend area homeowners associations' (HOAs) governing documents to implement dark sky-compliant lighting.
- Posting and advertising the dark sky-compliant fixtures, brands, and design guidance developed in Strategy #4 to assist suppliers, developers, and the public in meeting standards.

*Impacted stakeholders: Dark Skies Coalition, NOFS, Outdoor Lighting Committee, Coconino County, City of Flagstaff, Lowell Observatory*



FIGURE 3.20 Informational brochure (Source: International Dark-Sky Association)

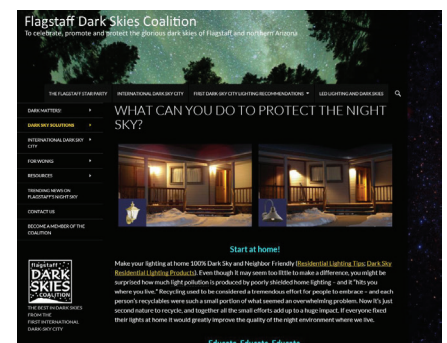


FIGURE 3.21 Dark Skies Coalition website (Source: flagstaffdarkskies.org, 2018)

## MILITARY INSTALLATIONS

### **28. Create a dedicated community outreach position at Camp Navajo.**

A dedicated community outreach staff person would help increase awareness of and build support for Camp Navajo's mission, commercial/ industrial development initiatives, and compatibility efforts. Connecting with local government, collaborating with agency and non-profit partners, and serving as a point person for the community are important roles for this position.

*Impacted stakeholders: AZDEMA, Camp Navajo*

### **29. Organize and launch initiatives to increase the general public's understanding of military operations, economic contributions, and the importance of compatibility.**

There may be a general lack of understanding about the contribution of defense industries to the Arizona economy, diverse military missions, and importance of sustaining compatibility around military bases.

A proactive communication strategy would be beneficial at the local and statewide levels and could include:

- *Issuing more frequent and user-friendly communications from the bases through newsletters, website updates, press releases, social media, and in-person attendance at events and meetings.*
- *Developing tools, presentations, and illustrations to increase general awareness of military missions, economic contribution, and importance of compatibility in the state.* These tools could include a compatibility guidebook to educate citizens, offer technical guidance for local government planners and elected officials, and include useful resources such as: example goals and policies; compatibility checklists; compatibility case examples; communication lists; and glossary of terms.

*Impacted stakeholders: Arizona Military Affairs Commission, AZDEMA, Camp Navajo, NOFS*

**30. Work with the legislature to encourage compatible land use around all military installations in Arizona, including National Guard facilities.**

As discussed on page 69, several state statutes address military compatibility around military airfields. This strategy suggests broadening notification and planning requirements to include all military installations in the state. This would encourage compatibility for new development through land use planning processes and for existing property owners through improved coordination.

Legislation could include requirements to:

- Notify property owners within certain distances of all military installations.
- Require compatible land use plans, goals, policies, and zoning within a certain distance from military bases.
- Require coordination with military installations prior to approving projects within a certain distance from military bases.

*Impacted stakeholders: Arizona Military Affairs Commission, AZDEMA*



# APPENDICES









# APPENDIX A **IMPLEMENTATION STRATEGIES**

THIS PAGE LEFT BLANK INTENTIONALLY

# IMPLEMENTATION STRATEGIES

The 30 strategies in Chapter 3 are summarized in the following matrix and include priority level, anticipated time frame, and a rough estimated cost. Please note, strategies included in the JLUS are not intended to be a comprehensive list of productive actions over time. These recommendations do not preclude any other actions that support compatibility and meet the intent of the JLUS.

## STRATEGY MATRIX KEY

PRIORITY	1	High
	2	Medium
	3	Low
ANTICIPATED TIME FRAME	I	(Immediate) = first 2 years
	I/O	(Immediate/Ongoing)
	O	(Ongoing) = ongoing
	N	(Near Term) = first 3 years
	M	(Medium Term) = 6-10 years
ESTIMATED COSTS	\$	Less than \$10,000
	\$\$	\$10,000 to \$50,000
	\$\$\$	Greater than \$50,000



STRATEGY	Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
<b>COORDINATION</b>						
<b>1</b> Complete the cooperation agreement which establishes the JLUS implementation committee and subcommittees to oversee JLUS strategy implementation, continue to coordinate, and address compatibility issues into the future.	1	County	City, Camp Navajo, NOFS, JLUS stakeholders	I	\$	Staff time
<b>2</b> Improve notification and coordination between Coconino County, Flagstaff, NOFS, and Camp Navajo around potential land use activities and development projects in the study area.	1	City, County	NOFS, Camp Navajo	I/O	\$	Staff time
<b>3</b> Coordinate with NOFS and Camp Navajo during regional, comprehensive, activity center, and other plan updates in the study area.	1	City, County	NOFS, Camp Navajo	O	\$	Staff time
<b>DARK SKIES</b>						
<b>4</b> Establish an outdoor lighting committee that meets regularly to help oversee: - Lighting code updates (approval process, code writing, communication/outreach, etc.). - Public relations campaign as outlined in strategy #27. - Ongoing information sharing between local observatories, city and county permitting, and code-enforcement staff, so this occurs independent of individuals assigned to positions. - Completion and ongoing updates of a dark sky-compliant fixture list and design guidance for homeowners, suppliers, and developers. List to be posted and disseminated as part of outreach strategy #27. - Review and development of implementation plan for relevant recommendations presented in Let There Be Night Final Report developed at the 2018 Future of the Colorado Plateau Forum.	1	City	County, NOFS, Lowell, Dark Skies Coalition, Outdoor Lighting Code Working Group	I/O	\$	Staff time, volunteer time
<b>5</b> Formalize communication between the USFS, Camp Navajo, and NOFS to minimize impacts of prescribed burns on NOFS mission.	1	USFS, Camp Navajo, NOFS	County, NAU	I	\$	Staff time
<b>6</b> Designate a local community planning liaison officer (CPLO) to serve as NOFS's mission advocate and dark sky expert.	1	NOFS		I	\$\$\$	DoD / U.S. Navy

STRATEGY	Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
<b>FOREST MANAGEMENT</b>						
<b>7</b> Support effort to site a wood-processing plant and coordinate to: - Support the Biomass Feasibility Study in evaluating potential extent of and ability to mitigate for air quality and thermal impact on NOFS mission. - Build a proactive, robust framework to address air quality, water quantity and quality, and traffic impacts in the area. - Work with ADEQ to identify opportunities to leverage environmental analysis, outreach, and permitting process to increase knowledge of local aquifer health. - Explore options to use sustainable practices such as installing a closed-loop reclaimed water system.	1	Camp Navajo, NOFS, Wood-Processing Plant Developers	County, NAU, ADEQ, AZDWR, USFS	I	\$	Staff time; private enterprise; potential OEA funds; USFS
<b>TRANSPORTATION</b>						
<b>8</b> To support development of an appropriately-sized interchange bridge in Bellemont: - Continue to advocate for and identify funding for increased capacity and multi-modal improvements to the interchange bridge. - Design the interchange bridge near Bellemont with five lanes but build it with three lanes in the near term.	2	County, ADOT, Camp Navajo, AZDEMA	Area businesses	I/O	\$-\$\$\$	Staff time, private enterprise, AZDEMA, Coconino County, ADOT
<b>9</b> Coordinate proactively with ADOT to consider area growth plans and ensure study area roadway lighting is compliant with Flagstaff dark sky standards (see strategy #14).	1	ADOT, Dark Skies Coalition, NOFS, Lowell	Camp Navajo, County, City, AZGFD, NAU, FMPO, NACOG	I/O	\$	Staff time

STRATEGY	Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
<b>PLAN UPDATES &amp; POLICIES</b>						
<b>10</b> Adopt the JLUS as a comprehensive plan amendment; support existing and adopt new goals and policies to best protect the missions of Camp Navajo and NOFS in the county's and city's comprehensive plan	1	City, County	NOFS, Camp Navajo, City of Williams	N	\$	Staff time
<b>DARK SKIES</b>						
<b>11</b> Support adoption of the draft dark skies goals and policies in the Bellemont Area Plan.	1	County	NOFS	I	\$	Staff time
<b>12</b> Prioritize development of southern and western City of Flagstaff activity center plans in collaboration with NOFS and Camp Navajo.	1	City	NOFS, Camp Navajo, Lowell	N	\$\$\$	City, potential OEA funds
<b>13</b> Adopt a Camp Navajo policy to comply with current and future county Lighting Zone I standards in order to protect dark skies.	2	Camp Navajo, USACE	Dark Skies Coalition, NOFS	N	\$	Staff time
<b>14</b> Adopt an ADOT policy to use dark sky-compliant lighting that meets Flagstaff standards for roadways in the study area. Activities include: - Using Flagstaff SLEDs standards as a model. - Engaging with Flagstaff-area dark sky experts. - Holding study area lighting maintenance and repair until the policy is adopted.	1	ADOT, Dark Skies Coalition, NOFS, Lowell	Camp Navajo, County, City, AZGFD, NAU, FMPO, NACOG	I/O	\$	Staff time
<b>15</b> Adopt dark sky goals and policies in Williams that recognize dark sky regional assets and potential telescope location on Volunteer Mountain.	2	JLUS Implementation Committee, Williams	NOFS, Camp Navajo, County	N	\$	Staff time, potential OEA funds
<b>ENVIRONMENTAL HEALTH</b>						
<b>16</b> Understanding the important link between wildlife and land conservation, incorporate wildlife corridors into planning documents and land conservation efforts.	2	City, County, ADOT	Camp Navajo, AZGFD, USFS, Central AZ Land Trust	I/O	\$	Staff time
<b>TRANSPORTATION</b>						
<b>17</b> Update the 2015 Bellemont Access Management & Multimodal Study to account for potential growth as part of Camp Navajo and adjacent properties on the south side of I-40.	2	County	ADOT, Camp Navajo	I	\$\$-\$\$\$	Staff time; potential OEA funds; County

STRATEGY	Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
<b>CODE UPDATES &amp; ENFORCEMENT</b>						
<i>CITY &amp; COUNTY LIGHTING CODE</i>						
<b>18</b> Adopt new and periodically review and revise lighting codes to meet emerging technologies and incorporate the following NOFS Mission Compatibility Light Pollution Study code recommendations: - Update design standards to encourage/require overhang or canopy-mounting for outdoor lighting in Lighting Zone 1. - Extend Lighting Zone 2 in Flagstaff and Coconino County to cover all of existing Lighting Zone 3. - Modernize measurement of absolute lumens. - Update residential roadway lighting requirements. Consider making roadway lighting optional or eliminating requirement. - Align residential average use standard. Consider allowing up to 10,000 lumens installed if average annual usage does not exceed 1,500 lumens.	1	City, County	Outdoor Lighting Code Working Group, Outdoor Lighting Committee, NOFS, Dark Skies Coalition, Lowell	I/O	\$\$	Staff time
<i>CITY &amp; COUNTY STREET LIGHTING STANDARDS</i>						
<b>19</b> Adopt SLEDs Study recommendations for dark sky-friendly lighting in the public right-of-way.  *\$ - code updates, \$\$\$ - lighting replacement	1	City, County	NOFS, Dark Skies Coalition, Lowell, Developers	I	\$/ \$\$\$ *	Staff time/City and County budgets
<i>ENFORCEMENT</i>						
<b>20</b> Fund a joint Coconino County and city of Flagstaff lighting specialist position for education/enforcement in the next fiscal year (Spring 2019). Responsibilities for this position include: - Establishing a baseline database of non-conforming lights and a program/work plan to review problem parcels, updated annually. - Refining enforcement practices and policies to bring non-compliant fixtures into compliance with dark sky standards. - Convening an education series for elected officials, local leadership, staff, and the community. - Providing periodic trainings for developers, realtors, design and building professionals, suppliers, and existing property owners. - Creating a volunteer dark sky ambassador program and training volunteers to conduct outreach and education. - Leading efforts to develop training and education materials, such as presentations, fact sheets for permit applications and other uses, specification sheets, and outreach materials.	1	City, County	NOFS, Dark Skies Coalition, Lowell, Outdoor Lighting Code Working Group	N	\$\$\$	City, County, potential OEA funds (baseline database; education & training materials development), volunteer time (Dark Sky Ambassadors)



STRATEGY		Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
LAND CONSERVATION							
21	Continue to pursue funding to conserve critical private land in study area: - Continue to pursue ACUB and REPI program funding and partnerships to limit incompatible development on priority parcels in the study area. - Continue to coordinate with Trust for Public Land, the Nature Conservancy, Central Arizona Land Trust, and other NGOs to seek funding opportunities and expertise around priority parcel acquisition and conservation easements. - Explore partnering with the USDA Natural Resources Conservation Service. - Evaluate the appropriateness of the Sentinel Landscapes program to support conservation goals in the study area. - Conduct outreach sessions with land owners to introduce the programs and solicit interest.	2	Camp Navajo, NOFS	County, City, NGOs (i.e., TPL, Nature Conservancy, & Central Arizona Land Trust), AZGFD	O	\$\$\$	REPI/ACUB, AZDEMA, DoD/Navy
22	Continue to work with the Arizona State Land Department regarding State Trust lands in the study area. - Continue to advocate and educate regarding the importance of NAU-managed research on the Centennial Forest and retention of forest uses on other ASLD-study-area parcels to the NOFS and Camp Navajo missions. - Coordinate with Camp Navajo and NOFS when contemplating the sale, transfer, or permitting activities on State Trust lands in the study area. - Monitor progress, expand applicability, and support federal adoption of the Advancing Conservation and Education Act.	2	NOFS, AZDEMA, ASLD, NAU	Camp Navajo, NGOs (i.e., TPL, Nature Conservancy, & Central Arizona Land Trust), County, AZGFD	O	\$	
23	Advance one or more of the following to support continued conservation of federal land in the study area: - Coordinate with USFS, Camp Navajo, and NOFS when contemplating transferring federal land or siting approvals in the study area. - Retain the existing county policy that land transferred from federal to private ownership would be zoned open space by default. - Establish a memorandum of understanding or organizational policies within USFS planning documents that support military compatibility goals and agree to retain federal ownership and national forest land designation in the study area. - Continue to advocate and educate regarding the importance of retaining existing national forest to the NOFS and Camp Navajo mission.	2	USFS, Camp Navajo, AZDEMA, NOFS	County	O	\$	Staff time

STRATEGY	Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
<b>FOREST MANAGEMENT</b>						
<b>24</b> Support county forest restoration director in efforts to advance forest restoration activities. Responsibilities which support JLUS goals include: <ul style="list-style-type: none"> <li>- Assisting NOFS in developing processes for communication regarding prescribed burns and visibility.</li> <li>- Partnering with the Greater Flagstaff Forest Partnership to develop materials and an outreach plan to educate the community on the importance of thinning and address sensitivity around "healthy" forest image.</li> <li>- Considering creation of a Resource Protection Overlay (RPO) zone in the county, similar to Flagstaff's overlay, which integrates tree-protection provisions supporting dark skies with appropriate thinning practices to promote forest health.</li> <li>- Incorporating elements of Flagstaff's Wildland-Urban Interface Code in zoning updates where practical, including the ongoing update to the subdivision ordinance.</li> <li>- Exploring the opportunity to seek funds to support and expand forest-thinning efforts and contracts in the study area to include private lands and State Trust land.</li> <li>- Exploring the opportunity to use conservation crews, city of Flagstaff crews, or forestry students to assist with forest-thinning in the study area.</li> </ul>	2	County	City of Flagstaff, USFS, NOFS, Camp Navajo, ASLD, NAVFAC, NAU, Greater Flagstaff Forest Partnership	M	\$	Staff time

STRATEGY	Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
<b>25</b> Increase funding and improve practices to reduce wildfire risk on Camp Navajo with the following: <ul style="list-style-type: none"> <li>- Update Camp Navajo's safety management practices to include wildfire-aversion measures.</li> <li>- Set up a system to communicate to trainees/visitors.</li> <li>- Continue to coordinate with multiple local organizations to conduct forest restoration activities to improve operations and reduce the threat of high-severity wildfire.</li> </ul>	2	Camp Navajo	County, NAU, USFS, City, local fire and emergency service providers	I	\$	Staff time
<b>26</b> Support coordinated forest restoration activities (inside and outside of installations) to reduce the threat of high-severity wildfire in the study area. Efforts could include: <ul style="list-style-type: none"> <li>- Working with stakeholders and fire ecologists to prioritize areas where forest restoration is most needed in order to protect military assets and infrastructure as well as nearby private property.</li> <li>- Implementing the Greater Flagstaff Area Community Wildfire Protection Plan.</li> <li>- Advocating for the inclusion of priority treatment areas through coordination with partners (e.g., USFS, AZDFFM) and their existing projects (eg., 4FRI).</li> <li>- Increasing capacity to conduct forest restoration in priority treatment areas through grant-writing and partnerships.</li> </ul>	3	NAU, USFS, Camp Navajo	NOFS, City	M	\$	Staff time

STRATEGY	Priority	Primary Responsible Party(ies)	Secondary Responsible Parties	Anticipated Time	Estimated Cost	Potential Funding Source
<b>EDUCATION</b>						
<i>DARK SKIES</i>						
<b>27</b> Develop and execute a public relations campaign to increase dark skies awareness and encourage action that could include: <ul style="list-style-type: none"> <li>- Developing web-based and other resources to assist the public with dark sky-compliant lighting implementation. Include FAQs and elements that build awareness/encourage replication of regional best practices and successes.</li> <li>- Coordinating with military public affairs officers to create dark sky brochures for city and county staff for public distribution.</li> <li>- Supporting efforts to amend area homeowners associations' (HOAs) governing documents to implement dark sky-compliant lighting.</li> <li>- Posting and advertising the dark sky-compliant fixtures, brands, and design guidance developed in Strategy #4 to assist suppliers, developers, and the public in meeting standards.</li> </ul>	2	Dark Skies Coalition, NOFS, Outdoor Lighting Committee	County, City, Lowell	N	\$\$-\$\$\$	Staff time, potential OEA funds
<i>MILITARY INSTALLATIONS</i>						
<b>28</b> Create a dedicated community outreach position at Camp Navajo.	2	AZDEMA, Camp Navajo		N	\$\$\$	AZDEMA
<b>29</b> Organize and launch initiatives to increase the general public's understanding of military operations, economic contributions, and the importance of compatibility. Efforts could include: <ul style="list-style-type: none"> <li>- Issuing more frequent and user-friendly communications from the bases through newsletters, website updates, press releases, social media, and in-person attendance at events and meetings.</li> <li>- Developing tools, presentations, and illustrations to increase general awareness of military missions, economic contribution, and importance of compatibility in the state.</li> </ul>	3	AZ Military Affairs Commission, AZDEMA	Camp Navajo, NOFS	M	\$	Staff time
<b>30</b> Work with the legislature to encourage compatible land use around all military installations in Arizona, including National Guard facilities. Legislation could include requirements to: <ul style="list-style-type: none"> <li>- Notify property owners within certain distances of all military installations.</li> <li>- Require compatible land use plans, goals, policies, and zoning within a certain distance from military bases.</li> <li>- Require coordination with military installations prior to approving projects within a certain distance from military bases.</li> </ul>	2	AZ Military Affairs Commission, AZDEMA		M	\$	Staff time



THIS PAGE LEFT BLANK INTENTIONALLY



# APPENDIX B

## **IMPLEMENTATION ACTIONS BY PARTY**

THIS PAGE LEFT BLANK INTENTIONALLY



# IMPLEMENTATION ACTIONS BY PARTY

In this appendix, the JLUS strategies have been organized by primary responsible party and then grouped by the anticipated time frame. Strategy numbers reference “Chapter 3” and “Appendix A”. Please note, strategies included in the JLUS are not intended to be a comprehensive list of productive actions over time. These recommendations do not preclude any other actions that support compatibility and meet the intent of the JLUS.

## STRATEGIES BY PARTY

---

CAMP NAVAJO	B-4
NAVAL OBSERVATORY FLAGSTAFF STATION	B-7
COCONINO COUNTY	B-9
CITY OF FLAGSTAFF	B-11
U.S. FOREST SERVICE	B-13
U.S. ARMY CORPS OF ENGINEERS	B-14
ARIZONA STATE LAND DEPARTMENT	B-15
ARIZONA DEPARTMENT OF TRANSPORTATION	B-16
ARIZONA DEPARTMENT OF EMERGENCY AND MILITARY AFFAIRS	B-17
ARIZONA MILITARY AFFAIRS COMMISSION	B-19
CITY OF WILLIAMS	B-20
LOWELL OBSERVATORY	B-21
FLAGSTAFF DARK SKIES COALITION	B-22
NORTHERN ARIZONA UNIVERSITY	B-23
OUTDOOR LIGHTING COMMITTEE	B-24



# CAMP NAVAJO

## IMMEDIATE/ONGOING ACTIONS

- 5 Formalize communication between the USFS and NOFS to minimize impacts of prescribed burns on NOFS mission.
- 7 Support effort to site a wood-processing plant and coordinate to:
  - Support the Biomass Feasibility Study in evaluating potential extent of and ability to mitigate for air quality and thermal impact on NOFS mission.
  - Build a proactive, robust framework to address air quality, water quantity and quality, and traffic impacts in the area.
  - Work with ADEQ to identify opportunities to leverage environmental analysis, outreach, and permitting process to increase knowledge of local aquifer health.
  - Explore options to use sustainable practices such as installing a closed-loop reclaimed water system.
- 8 To support development of an appropriately-sized interchange bridge in Bellemont:
  - Continue to advocate for and identify funding for increased capacity and multi-modal improvements to the interchange bridge.
  - Design the interchange bridge near Bellemont with five lanes but build it with three lanes in the near term.
- 21 Continue to pursue funding to conserve critical private land in study area:
  - Continue to pursue ACUB & REPI program funding and partnerships to limit incompatible development on priority parcels in the study area.
  - Continue to coordinate with Trust for Public Land, the Nature Conservancy, Central Arizona Land Trust, and other NGOs to seek funding opportunities and expertise around priority parcel acquisition and conservation easements.
  - Explore partnering with the USDA Natural Resources Conservation Service.
  - Evaluate the appropriateness of the Sentinel Landscapes program to support conservation goals in the study area.
  - Conduct outreach sessions with land owners to introduce the programs and solicit interest.

- 23** Advance one or more of the following to support continued conservation of federal land in the study area:
- Coordinate with the USFS and NOFS when contemplating transferring federal land or siting approvals in the study area.
  - Retain the existing county policy that land transferred from federal to private ownership would be zoned open space by default.
  - Establishing a memorandum of understanding or organizational policies within USFS planning documents that support military compatibility goals and agree to retain federal ownership and national forest land designation in the study area.
  - Continue to advocate and educate regarding the importance of retaining existing national forest to the NOFS and Camp Navajo mission.
- 25** Increase funding and improve practices to reduce wildfire risk on Camp Navajo with the following:
- Update Camp Navajo's safety management practices to include wildfire-aversion measures.
  - Set up a system to communicate to trainees/visitors.
  - Continue to coordinate with multiple local organizations to conduct forest restoration activities to improve operations and reduce the threat of high-severity wildfire.

## NEAR-TERM ACTIONS

- 13** Adopt a Camp Navajo policy to comply with current and future Zone I lighting standards in order to protect dark skies.
- 28** Create a dedicated community outreach position at Camp Navajo.

## MEDIUM-TERM ACTION

- 26** Support coordinated forest restoration activities (inside and outside of installations) to reduce the threat of high-severity wildfire in the study area. Efforts could include:
- Working with stakeholders and fire ecologists to prioritize areas where forest restoration is most needed in order to protect military assets and infrastructure as well as nearby private property.
  - Implementing the Greater Flagstaff Area Community Wildfire Protection Plan.
  - Advocating for the inclusion of priority treatment areas through coordination with partners (e.g., USFS, AZDFFM) and their existing projects (e.g., 4FRI).
  - Increasing capacity to conduct forest restoration in priority treatment areas through grant-writing and partnerships.

# NAVAL OBSERVATORY FLAGSTAFF STATION

## IMMEDIATE/ONGOING ACTIONS

- 5** Formalize communication between the USFS and Camp Navajo to minimize impacts of prescribed burns on NOFS mission.
- 6** Designate a local community planning liaison officer (CPLO) to serve as NOFS's mission advocate and dark sky expert.
- 7** Support effort to site a wood-processing plant and coordinate to:
  - Support the Biomass Feasibility Study in evaluating potential extent of and ability to mitigate for air quality and thermal impact on NOFS mission.
  - Build a proactive, robust framework to address air quality, water quantity and quality, and traffic impacts in the area.
  - Work with ADEQ to identify opportunities to leverage environmental analysis, outreach, and permitting process to increase knowledge of local aquifer health.
  - Explore options to use sustainable practices such as installing a closed-loop reclaimed water system.
- 9** Coordinate proactively with ADOT to consider area growth plans and ensure study area roadway lighting is compliant with Flagstaff dark sky standards.
- 14** Adopt an ADOT policy to use dark sky-compliant lighting that meets Flagstaff standards for roadways in the study area. Activities include:
  - Using Flagstaff SLEDs standards as a model.
  - Engaging with Flagstaff-area dark sky experts.
  - Holding study area lighting maintenance and repair until the policy is adopted.
- 21** Continue to pursue funding to conserve critical private land in study area:
  - Continue to pursue ACUB & REPI program funding and partnerships to limit incompatible development on priority parcels in the study area.
  - Continue to coordinate with Trust for Public Land, the Nature Conservancy, Central Arizona Land Trust, and other NGOs to seek funding opportunities and expertise around priority parcel acquisition and conservation easements.
  - Explore partnering with the USDA Natural Resources Conservation Service.
  - Evaluate the appropriateness of the Sentinel Landscapes program to support conservation goals in the study area.
  - Conduct outreach sessions with land owners to introduce the programs and solicit interest.



- 22** Continue to work with the Arizona State Land Department regarding State Trust lands in the study area.
- Continue to advocate and educate regarding the importance of NAU-managed research on the Centennial Forest and retention of forest uses on other ASLD-study-area parcels to the NOFS and Camp Navajo missions.
  - Coordinate with Camp Navajo and NOFS when contemplating the sale, transfer, or permitting activities on State Trust lands in the study area.
  - Monitor progress, expand applicability, and support federal adoption of the Advancing Conservation and Education Act.
- 23** Advance one or more of the following to support continued conservation of federal land in the study area:
- Coordinate with the USFS and NOFS when contemplating transferring federal land or siting approvals in the study area.
  - Retain the existing county policy that land transferred from federal to private ownership would be zoned open space by default.
  - Establishing a memorandum of understanding or organizational policies within USFS planning documents that support military compatibility goals and agree to retain federal ownership and national forest land designation in the study area.
  - Continue to advocate and educate regarding the importance of retaining existing national forest to the NOFS and Camp Navajo mission.

## NEAR-TERM ACTION

- 27** Develop and execute a public relations campaign to increase dark skies awareness and encourage action that could include:
- Developing web-based and other resources to assist the public with dark sky-compliant lighting implementation, include FAQs, and elements that build awareness/encourage replication of regional best practices and successes.
  - Coordinating with military public affairs officers to create dark sky brochures for city and county staff for public distribution.
  - Supporting efforts to amend area homeowners associations' (HOAs) governing documents to implement dark sky-compliant lighting.
  - Posting and advertising the dark sky-compliant fixtures, brands, and design guidance developed in strategy #4 on page 80 to assist suppliers, developers, and the public in meeting standards.

# COCONINO COUNTY

## IMMEDIATE/ONGOING ACTIONS

- 1 Complete the cooperation agreement which establishes the JLUS implementation committee and subcommittees to oversee JLUS strategy implementation, continue to coordinate, and address compatibility issues into the future.
- 2 Improve notification and coordination between Flagstaff, NOFS, and Camp Navajo around potential land use activities and development projects in the study area.
- 3 Coordinate with NOFS and Camp Navajo during regional, comprehensive, activity center, and other plan updates in the study area.
- 8 To support development of an appropriately-sized interchange bridge in Bellemont:
  - Continue to advocate for and identify funding for increased capacity and multi-modal improvements to the interchange bridge.
  - Design the interchange bridge near Bellemont with five lanes but build it with three lanes in the near term.
- 11 Support adoption of the draft dark skies goals and policies in the Bellemont Area Plan.
- 16 Understanding the important link between wildlife and land conservation, incorporate wildlife corridors into planning documents and land conservation efforts.
- 17 Update the 2015 Bellemont Access Management & Multimodal Study to account for potential growth as part of Camp Navajo and adjacent properties on the south side of I-40.
- 18 Adopt new and periodically review and revise lighting codes to meet emerging technologies and incorporate the following NOFS Mission Compatibility Light Pollution Study code recommendations:
  - Update design standards to encourage/require overhang or canopy-mounting for outdoor lighting in Lighting Zone 1.
  - Extend Lighting Zone 2 in Flagstaff and Coconino County to cover all of existing Lighting Zone 3.
  - Modernize measurement of absolute lumens.
  - Update residential roadway lighting requirements (consider making roadway lighting optional or eliminating requirement).
  - Align residential average use standard (consider allowing up to 10,000 lumens installed if average annual usage does not exceed 1,500 lumens).
- 19 Adopt SLEDS Study recommendations for dark sky-friendly lighting in the public right-of-way.

## NEAR-TERM ACTIONS

- 10** Adopt the JLUS as a comprehensive plan amendment; support existing and adopt new goals and policies to best protect the missions of Camp Navajo and NOFS in the county's and city's comprehensive plan updates.
- 20** Fund a joint Coconino County and city of Flagstaff lighting specialist position for education/enforcement in the next fiscal year (Spring 2019). Responsibilities for this position include:
  - Establishing baseline database of non-conforming lights and a program/work plan to review problem parcels, updated annually.
  - Refining enforcement practices and policies to bring non-compliant fixtures into compliance with dark sky standards.
  - Convening an education series for elected officials, local leadership, staff, and the community.
  - Providing periodic trainings for developers, realtors, design and building professionals, suppliers, and existing property owners.
  - Creating a volunteer dark sky ambassador program and training volunteers to conduct outreach and education.
  - Leading efforts to develop training and education materials, such as presentations, fact sheets for permit applications and other uses, specification sheets, and outreach materials.

## MEDIUM-TERM ACTION

- 24** Support county forest restoration director in efforts to advance forest restoration activities. Responsibilities which support JLUS goals include:
  - Assisting NOFS in developing processes for communication regarding prescribed burns and visibility.
  - Partnering with the Greater Flagstaff Forest Partnership to develop materials and an outreach plan to educate community on the importance of thinning and address sensitivity around "healthy" forest image.
  - Consider creation of a Resource Protection Overlay (RPO) zone in the county, similar to Flagstaff's overlay, that integrates tree-protection provisions supporting dark skies with appropriate thinning practices to promote forest health.
  - Incorporating elements of Flagstaff's Wildland-Urban Interface code in zoning updates where practical, including the ongoing update to the subdivision ordinance.
  - Exploring the opportunity to seek funds to support and expand forest-thinning contracts in the study area to include private lands and State Trust land.
  - Exploring opportunities to use conservation crews, Flagstaff crews, or forestry students to assist with forest-thinning in the study area.

# CITY OF FLAGSTAFF

## IMMEDIATE/ONGOING ACTIONS

- 2 Improve notification and coordination between Coconino County, NOFS, and Camp Navajo around potential land use activities and development projects in the study area.
- 3 Coordinate with NOFS and Camp Navajo during regional, comprehensive, activity center, and other plan updates in the study area.
- 4 Establish an outdoor lighting committee that meets regularly to help oversee:
  - Lighting code updates (approval process, code writing, communication/outreach, etc.).
  - Public relations campaign as outlined in strategy #27 on page 100.
  - Ongoing information sharing between local observatories, city and county permitting, and code-enforcement staff, so this occurs independent of individuals assigned to positions.
  - Completion and ongoing updates of a dark sky-compliant fixture list and design guidance for homeowners, suppliers, and developers. List to be posted and disseminated as part of outreach strategy #27 on page 100.
  - Review and development of implementation plan for relevant recommendations presented in Let There Be Night Final Report developed at the 2018 Future of the Colorado Plateau Forum (see "Appendix D").
- 16 Understanding the important link between wildlife and land conservation, incorporate wildlife corridors into planning documents and land conservation efforts.
- 18 Adopt new and periodically review and revise lighting codes to meet emerging technologies and incorporate the following NOFS Mission Compatibility Light Pollution Study code recommendations:
  - Update design standards to encourage/require overhang or canopy-mounting for outdoor lighting in Lighting Zone 1.
  - Extend Lighting Zone 2 in Flagstaff and Coconino County to cover all of existing Lighting Zone 3.
  - Modernize measurement of absolute lumens.
  - Update residential roadway lighting requirements (consider making roadway lighting optional or eliminating requirement).
  - Align residential average use standard (consider allowing up to 10,000 lumens installed if average annual usage does not exceed 1,500 lumens).
- 19 Adopt SLEDS Study recommendations for dark sky-friendly lighting in the public right-of-way.



## NEAR-TERM ACTIONS

- 10** Adopt the JLUS as a comprehensive plan amendment; support existing and adopt new goals and policies to best protect the missions of Camp Navajo and NOFS in the county's and city's comprehensive plan updates.
- 12** Prioritize development of southern and western City of Flagstaff activity center plans in collaboration with NOFS and Camp Navajo.
- 20** Fund a joint Coconino County and city of Flagstaff lighting specialist position for education/enforcement in the next fiscal year (Spring 2019). Responsibilities for this position include:
  - Establishing baseline database of non-conforming lights and a program/work plan to review problem parcels, updated annually.
  - Refining enforcement practices and policies to bring non-compliant fixtures into compliance with dark sky standards.
  - Convening an education series for elected officials, local leadership, staff, and the community.
  - Providing periodic trainings for developers, realtors, design and building professionals, suppliers, and existing property owners.
  - Creating a volunteer dark sky ambassador program and training volunteers to conduct outreach and education.
  - Leading efforts to develop training and education materials, such as presentations, fact sheets for permit applications and other uses, specification sheets, and outreach materials.

# U.S. FOREST SERVICE

## IMMEDIATE/ONGOING ACTIONS

- 5** Formalize communication between Camp Navajo and NOFS to minimize impacts of prescribed burns on NOFS mission.
- 23** Advance one or more of the following to support continued conservation of federal land in the study area:
  - Coordinate with the USFS and NOFS when contemplating transferring federal land or siting approvals in the study area.
  - Retain the existing county policy that land transferred from federal to private ownership would be zoned open space by default.
  - Establishing a memorandum of understanding or organizational policies within USFS planning documents that support military compatibility goals and agree to retain federal ownership and national forest land designation in the study area.
  - Continue to advocate and educate regarding the importance of retaining existing national forest to the NOFS and Camp Navajo mission.

## MEDIUM-TERM ACTION

- 26** Support coordinated forest restoration activities (inside and outside of installations) to reduce the threat of high-severity wildfire in the study area. Efforts could include:
  - Working with stakeholders and fire ecologists to prioritize areas where forest restoration is most needed in order to protect military assets and infrastructure as well as nearby private property.
  - Implementing the Greater Flagstaff Area Community Wildfire Protection Plan.
  - Advocating for the inclusion of priority treatment areas through coordination with partners (e.g., USFS, AZDFFM) and their existing projects (e.g., 4FRI).
  - Increasing capacity to conduct forest restoration in priority treatment areas through grant-writing and partnerships.

# U.S. ARMY CORPS OF ENGINEERS

## NEAR-TERM ACTION

- 13** Adopt a Camp Navajo policy to comply with current and future Zone I lighting standards in order to protect dark skies.

# ARIZONA STATE LAND DEPARTMENT

## IMMEDIATE/ONGOING ACTION

- 22** Continue to work with the Arizona State Land Department regarding State Trust lands in the study area.
- Continue to advocate and educate regarding the importance of NAU-managed research on the Centennial Forest and retention of forest uses on other ASLD-study-area parcels to the NOFS and Camp Navajo missions.
  - Coordinate with Camp Navajo and NOFS when contemplating the sale, transfer, or permitting activities on State Trust lands in the study area.
  - Monitor progress, expand applicability, and support federal adoption of the Advancing Conservation and Education Act.



# ARIZONA DEPARTMENT OF TRANSPORTATION

## IMMEDIATE/ONGOING ACTIONS

- 8** To support development of an appropriately-sized interchange bridge in Bellemont:
  - Continue to advocate for and identify funding for increased capacity and multi-modal improvements to the interchange bridge.
  - Design the interchange bridge near Bellemont with five lanes but build it with three lanes in the near term.
- 9** Coordinate proactively with ADOT to consider area growth plans and ensure study area roadway lighting is compliant with Flagstaff dark sky standards.
- 14** Adopt an ADOT policy to use dark sky-compliant lighting that meets Flagstaff standards for roadways in the study area. Activities include:
  - Using Flagstaff SLEDs standards as a model.
  - Engaging with Flagstaff-area dark sky experts.
  - Holding study area lighting maintenance and repair until the policy is adopted.
- 16** Understanding the important link between wildlife and land conservation, incorporate wildlife corridors into planning documents and land conservation efforts.

# ARIZONA DEPARTMENT OF EMERGENCY AND MILITARY AFFAIRS

## IMMEDIATE/ONGOING ACTIONS

- 8** To support development of an appropriately-sized interchange bridge in Bellemont:
  - Continue to advocate for and identify funding for increased capacity and multi-modal improvements to the interchange bridge.
  - Design the interchange bridge near Bellemont with five lanes but build it with three lanes in the near term.
- 22** Continue to work with the Arizona State Land Department regarding State Trust lands in the study area.
  - Continue to advocate and educate regarding the importance of NAU-managed research on the Centennial Forest and retention of forest uses on other ASLD-study-area parcels to the NOFS and Camp Navajo missions.
  - Coordinate with Camp Navajo and NOFS when contemplating the sale, transfer, or permitting activities on State Trust lands in the study area.
  - Monitor progress, expand applicability, and support federal adoption of the Advancing Conservation and Education Act.
- 23** Advance one or more of the following to support continued conservation of federal land in the study area:
  - Coordinate with the USFS and NOFS when contemplating transferring federal land or siting approvals in the study area.
  - Retain the existing county policy that land transferred from federal to private ownership would be zoned open space by default.
  - Establishing a memorandum of understanding or organizational policies within USFS planning documents that support military compatibility goals and agree to retain federal ownership and national forest land designation in the study area.
  - Continue to advocate and educate regarding the importance of retaining existing national forest to the NOFS and Camp Navajo mission.

## NEAR-TERM ACTION

- 28** Create a dedicated community outreach position at Camp Navajo.

## MEDIUM-TERM ACTIONS

- 29** Organize and launch initiatives to increase the general public's understanding of military operations, economic contributions, and the importance of compatibility. Efforts could include:
- Issuing more frequent and user-friendly communications from the bases through newsletters, website updates, press releases, social media, and-in person attendance at events and meetings.
  - Developing tools, presentations, and illustrations to increase general awareness of military missions, economic contribution, and importance of compatibility in the state.
- 30** Work with the legislature to encourage compatible land use around all military installations in Arizona including National Guard facilities. Legislation could include requirements to:
- Notify property owners within certain distances of all military installations.
  - Require compatible land use plans, goals, policies, and zoning within a certain distance from military bases.
  - Require coordination with military installations prior to approving projects within a certain distance from military bases.

# ARIZONA MILITARY AFFAIRS COMMISSION

## MEDIUM-TERM ACTIONS

- 29** Organize and launch initiatives to increase the general public's understanding of military operations, economic contributions, and the importance of compatibility. Efforts could include:
  - Issuing more frequent and user-friendly communications from the bases through newsletters, website updates, press releases, social media, and-in person attendance at events and meetings.
  - Developing tools, presentations, and illustrations to increase general awareness of military missions, economic contribution, and importance of compatibility in the state.
- 30** Work with the legislature to encourage compatible land use around all military installations in Arizona including National Guard facilities. Legislation could include requirements to:
  - Notify property owners within certain distances of all military installations.
  - Require compatible land use plans, goals, policies, and zoning within a certain distance from military bases.
  - Require coordination with military installations prior to approving projects within a certain distance from military bases.



# CITY OF WILLIAMS

## NEAR-TERM ACTION

- 15** Adopt dark sky goals and policies in Williams that recognize dark sky regional assets and potential telescope location on Volunteer Mountain.

# LOWELL OBSERVATORY

## IMMEDIATE/ONGOING ACTION

- 9** Coordinate proactively with ADOT to consider area growth plans and ensure study area roadway lighting is compliant with Flagstaff dark sky standards.
- 14** Adopt an ADOT policy to use dark sky-compliant lighting that meets Flagstaff standards for roadways in the study area. Activities include:
  - Using Flagstaff SLEDs standards as a model.
  - Engaging with Flagstaff-area dark sky experts.
  - Holding study area lighting maintenance and repair until the policy is adopted.

# FLAGSTAFF DARK SKIES COALITION

## IMMEDIATE/ONGOING ACTION

- 9** Coordinate proactively with ADOT to consider area growth plans and ensure study area roadway lighting is compliant with Flagstaff dark sky standards.
- 14** Adopt an ADOT policy to use dark sky-compliant lighting that meets Flagstaff standards for roadways in the study area. Activities include:
  - Using Flagstaff SLEDs standards as a model.
  - Engaging with Flagstaff-area dark sky experts.
  - Holding study area lighting maintenance and repair until the policy is adopted.

## NEAR-TERM ACTION

- 27** Develop and execute a public relations campaign to increase dark skies awareness and encourage action that could include:
  - Developing web-based and other resources to assist the public with dark sky-compliant lighting implementation, include FAQs, and elements that build awareness/encourage replication of regional best practices and successes.
  - Coordinating with military public affairs officers to create dark sky brochures for city and county staff for public distribution.
  - Supporting efforts to amend area homeowners associations' (HOAs) governing documents to implement dark sky-compliant lighting.
  - Posting and advertising the dark sky-compliant fixtures, brands, and design guidance developed in strategy #4 on page 80 to assist suppliers, developers, and the public in meeting standards.

# NORTHERN ARIZONA UNIVERSITY

## IMMEDIATE/ONGOING ACTION

- 22** Continue to work with the Arizona State Land Department regarding State Trust lands in the study area.
- Continue to advocate and educate regarding the importance of NAU-managed research on the Centennial Forest and retention of forest uses on other ASLD-study-area parcels to the NOFS and Camp Navajo missions.
  - Coordinate with Camp Navajo and NOFS when contemplating the sale, transfer, or permitting activities on State Trust lands in the study area.
  - Monitor progress, expand applicability, and support federal adoption of the Advancing Conservation and Education Act.

## MEDIUM-TERM ACTION

- 26** Support coordinated forest restoration activities (inside and outside of installations) to reduce the threat of high-severity wildfire in the study area. Efforts could include:
- Working with stakeholders and fire ecologists to prioritize areas where forest restoration is most needed in order to protect military assets and infrastructure as well as nearby private property.
  - Implementing the Greater Flagstaff Area Community Wildfire Protection Plan.
  - Advocating for the inclusion of priority treatment areas through coordination with partners (e.g., USFS, AZDFFM) and their existing projects (e.g., 4FRI).
  - Increasing capacity to conduct forest restoration in priority treatment areas through grant-writing and partnerships.

# OUTDOOR LIGHTING COMMITTEE

## NEAR-TERM ACTION

- 27** Develop and execute a public relations campaign to increase dark skies awareness and encourage action that could include:
- Developing web-based and other resources to assist the public with dark sky-compliant lighting implementation, include FAQs, and elements that build awareness/encourage replication of regional best practices and successes.
  - Coordinating with military public affairs officers to create dark sky brochures for city and county staff for public distribution.
  - Supporting efforts to amend area homeowners associations' (HOAs) governing documents to implement dark sky-compliant lighting.
  - Posting and advertising the dark sky-compliant fixtures, brands, and design guidance developed in strategy #4 on page 80 to assist suppliers, developers, and the public in meeting standards.





# APPENDIX C

## **DRAFT COOPERATION AGREEMENT**

THIS PAGE LEFT BLANK INTENTIONALLY

# DRAFT COOPERATION AGREEMENT

The following is the cooperation agreement drafted for the Coconino JLUS participants to commit to implement the strategies described in Chapter 3. This agreement will formalize coordination between the National Guard, Navy, and the community of stakeholders, making ongoing coordination consistent and predictable.

Agreements are negotiated and the parties are not obligated to implement all the strategies recommended in Chapter 3. This will be up to the JLUS parties during the implementation phase.

This draft cooperation agreement should be finalized prior to completion of this JLUS.

**COOPERATION AGREEMENT  
BETWEEN THE ARIZONA DEPARTMENT OF EMERGENCY AND MILITARY  
AFFAIRS (AZDEMA), CAMP NAVAJO, THE NAVAL OBSERVATORY,  
FLAGSTAFF STATION (NOFS), THE CITY OF FLAGSTAFF AND COCONINO  
COUNTY, ARIZONA  
TO COORDINATE AND IMPLEMENT THE 2017-2018 COCONINO JOINT  
LAND USE STUDY**

**I. Purpose**

It is the purpose of this Cooperation Agreement (Agreement) to encourage and facilitate the cooperation and coordination by and between the Arizona Department of Emergency and Military Affairs, Camp Navajo, the Naval Observatory, Flagstaff Station (NOFS), the City of Flagstaff and Coconino County in implementing the 2017-2018 Coconino Joint Land Use Study (JLUS), with specific emphasis on ensuring mutual compatibility between Camp Navajo, the NOFS and neighboring jurisdictions and municipalities.

**II. Background**

Coconino County was nominated by AZDEMA as a sponsor for a Joint Land Use Study (JLUS) to include Camp Navajo and the NOFS. The City of Flagstaff was identified as an integral partner and participated in the preparation of the JLUS. This study was funded by the Department of Defense (DoD) Office of Economic Adjustment (OEA), with contributions from Coconino County in the form of staff time-match. The JLUS analyzed compatibility issues and proposed strategies to address these issues. Challenges include maintaining mission readiness while planning for future growth in ways to limit encroachment and light pollution that would be incompatible with the mission. The JLUS recommended specific actions to implement the study, one of which was for the stakeholders to create and execute a cooperation agreement for the purpose of implementing the study and ensuring the desired compatibility of uses.

**III. Establishment of and Participation in a JLUS Implementation Committee and Subcommittees**

It is agreed by the parties to this Agreement that there should be established a JLUS Implementation Committee ("the Committee") and that each party will designate a representative who will participate as a member of the Committee. The parties agree that they may change their representative at any time by notifying the Committee in writing of that change. The Committee will establish a regular meeting schedule and will notify the signatories to this Agreement of such schedule. Meeting notices and agendas will be sent to all representatives to the Committee and will be posted on the Coconino County website. Each of the participating parties to this Agreement may designate multiple representatives to the Committee, but only one vote per participating entity will be counted as to any issue to be voted upon. The Committee will elect a Chair, Vice Chair, and Recording Secretary, and define the term for these offices. The Committee will establish its own rules of procedure. The Committee may vote to add additional members to the Committee, who may become voting members upon agreeing to the terms of this Agreement. Any action taken by the Committee shall be advisory in nature only and shall not be binding upon any of the signatories to this agreement. The Committee may form committees or subcommittees to address specific topics, oversee implementation of specific JLUS recommendations, coordinate



with a specific set of stakeholders, and/or complete tasks specified by said subcommittee.

#### IV. Amendment of Agreement

This Agreement may be amended at any time by joint action of the participating entities.

#### V. Duration of Agreement

The initial term of this Agreement shall be one year, beginning on January 1, 2019, and ending on December 31, 2019. This Agreement shall automatically renew for additional one-year terms until terminated by joint action of the participating entities.

#### VI. Execution of Agreement

Coconino County, the City of Flagstaff, The Naval Observatory Flagstaff Station and the Arizona Army National Guard, Camp Navajo hereby agree to the terms of this Cooperation Agreement as indicated by the signature of their designated representative below.

\_\_\_\_\_  
Dr. Paul Shankland,                      Date  
Director,  
Naval Observatory Flagstaff Station

\_\_\_\_\_  
Dorenda Coleman                      Date  
Sustainability Manager,  
AZDEMA, Camp Navajo

\_\_\_\_\_  
MaryBeth Dreusike                      Date  
NRSW Deputy Region CPLO  
Naval Observatory Flagstaff Station

\_\_\_\_\_  
Colonel Raymond Garcia                      Date  
AZDEMA, Camp Navajo

\_\_\_\_\_  
Dan Folke, AICP                      Date  
Community Development Director  
City of Flagstaff

\_\_\_\_\_  
Hannah Telle                      Date  
AZDEMA, Camp Navajo

\_\_\_\_\_  
Jess McNeely, AICP                      Date  
Community Development Assistant  
Director, Coconino County

\_\_\_\_\_  
Jay Christelman  
Community Development Director  
Coconino County



THIS PAGE LEFT BLANK INTENTIONALLY





# APPENDIX D

## **FUTURE OF THE COLORADO PLATEAU FORUM REPORT**



THIS PAGE LEFT BLANK INTENTIONALLY

## Let There Be Night

A Future of the Colorado Plateau Forum  
Presented by Grand Canyon Trust and Museum of Northern Arizona

Wednesday, July 24, 2018 • 6:00-8:00pm • Museum of Northern Arizona

### FINAL REPORT

By John Grahame, Forum Producer

## Introduction

For five years the Future of the Colorado Plateau Forum (FOCPF) series has sought to address the region's most pressing environmental and demographic changes by giving citizens and professionals an open forum to share ideas and perspectives on important issues affecting the southern Colorado Plateau, including land management, water availability, wildlife conservation, energy production, and economic sustainability.

The "Let There Be Night" forum, held on July 24, 2018 at the Museum of Northern Arizona, addressed light pollution and its impact on the future of the area's observatories. Flagstaff is home to two major observatories and is the world's first International Dark Sky City, but light pollution continues to threaten the night. Continued growth and addition of white LED lighting in Flagstaff and throughout the State is affecting all of Arizona.

Despite state-of-the-art lighting ordinances in Flagstaff and Coconino County, poor lighting is too frequently installed without permit or review by local planning departments. The city's astronomy- and dark-sky-friendly low pressure sodium street lights have become obsolete and must be replaced. Most street lighting around the world is being replaced by bright, white LEDs, which dramatically degrade night skies.

Lowell Observatory operates dark-sky sites on Anderson Mesa and near Happy Jack west and south of Flagstaff. The U.S. Naval Observatory (USNO), located just five miles west of Flagstaff, is a dark-sky site for optical and near-infrared astronomy. Development is extending into areas near the USNO, which has determined that if there is a brightening of Flagstaff's dark skies of just 10% over current conditions its critical mission cannot be maintained.

## The Forum

Future of the Colorado Plateau Fora are open to the public, but because of their interactive format the producers try to limit attendance to around 100 participants. Pre-registration is required via the [Eventbrite](#) online platform,

but anyone who shows up with a desire to participate is allowed in. We attempt to collect every participant's name and email address.

Eventbrite provides outreach to the public through its online tools, but we also promoted this forum via Facebook, Twitter, direct email to members of the Museum of Northern Arizona and Grand Canyon Trust, as well as to a mailing list of previous forum attendees. For this event we also published a 1/4 page ad in the Arizona Daily Sun on the Sunday prior to the Wednesday forum. 114 people pre-registered, but there were only 85 actual attendees. It was a beautiful summer evening in Flagstaff, and we have noticed from past events that pleasant weather tends to reduce attendance.

Future of the Colorado Plateau Fora do not attempt a "balanced" format, with presenters on both sides of an issue engaged in point-counterpoint. Instead, we choose to tell a particular "story." Our presenters are invited based on their interest in sharing their role in the story; in this case we asked them to share their involvement in our community's embrace of dark skies and the threat of light pollution to the future of our astronomical industry. After five years of using this format for FOCPP, we know that participants tend to self-select; most attendees will be in support of the observatories and dark skies, not in opposition.

The first hour of the forum took the form of a "living documentary," with a succession of eight-minutes presentations by the following observatory professionals and community leaders:

- Dr. Paul Shankland, Director of the U.S. Naval Observatory Flagstaff Station
- Dr. Jeffrey Hall, Director of Lowell Observatory
- Dr. Michael West, Astronomer and Deputy Director of Science at Lowell Observatory
- Julie Pastrick, President of the Greater Flagstaff Chamber of Commerce
- Dan Folke, AICP, Interim Community Development Director for the City of Flagstaff

The forum's second hour belonged to the participants. They were encouraged to sit at table with the presenter of their choice and to offer ideas and suggestions for how the battle against light pollution in northern Arizona could be better addressed. These ideas were then reported out by the presenters at each table.

## The Survey

The presentations and report-outs were recorded on digital audio. I listened to the recordings and wrote down all ideas and recommendations that were presented or reported out. A total of 49 emerged, and were organized into the following categories:



- Advocacy and Program Development (22)
- Education and Communications (16)
- Compliance and Enforcement (11)

A Survey Monkey poll was built from these 49 ideas and sent out to all the participants and presenters. We asked them to rate each idea from one to five stars, with five being the highest rating and one being the lowest. A 50th question, "Do you have any additional comments, questions, ideas, recommendations, or observations for us," allowed for an open-ended response.

## Results

Invitations to complete the survey were sent via the SurveyMonkey online platform to the 76 valid email addresses we obtained from our registration process. We received 43 complete responses and 1 partial response. 5 opted out or had previously opted out from all SurveyMonkey polls.

The SurveyMonkey summary results are available online at [https://www.dropbox.com/sh/2ya9f6jgntn0vhi/AAByz2\\_KUKf-cKP3Cswpy4W1a?dl=0](https://www.dropbox.com/sh/2ya9f6jgntn0vhi/AAByz2_KUKf-cKP3Cswpy4W1a?dl=0), along with the audio files, individual comments in response to the open-ended question, and a pdf file of this report.

Overall, the respondents gave almost all of the 49 recommendations very high ratings. Every idea but one had a weighted average greater than 4 (out of 5; in SurveyMonkey's star rating system a weight is assigned to each icon in the scale, and a weighted average is calculated in the Analyze Results section). The only one that fell below 4 on the scale (with a score of 3.74, still very positive) was recommendation #11 in the first section, "Support the work of the State of Arizona Military Affairs Commission (MAC) that seeks to 'ensure that private property rights are addressed as efforts are made to maintain and enhance military missions at the military installations located within Arizona.'"

### ***Advocacy and Program Development***

The single highest rating (43 gave it 5 stars, and 3 gave it 4 stars for a weighted average of 4.93) was given to "Encourage the FDSC [Flagstaff Dark Skies Coalition], the City [of Flagstaff], the County [Coconino], and/or APS [Arizona Public Service, the area's electric utility] to provide assistance to residents or businesses to help them improve their lighting." Many of the other highly-rated recommendations reflected this interest in having partnerships and coalitions work together in collaborative and proactive ways to raise public awareness and provide incentives and disincentives to reduce light pollution.

Respondents gave overwhelming support for the work of northern Arizona's astronomy industry and observatories (4.83) and for that of the Flagstaff Dark Skies Coalition (also 4.83). Equally high was support for the City of Flagstaff Interim Community Development Director's request for an additional full-time code compliance lighting specialist to help investigate lighting code violations (4.85). Support the fight against electronic billboards in northern Arizona was also at this high level (4.83).

Two ongoing projects that are actively addressing light pollution issues got very high ratings. Flagstaff's Street Lighting for Enhancing Dark Skies (SLEDs) project is looking at alternative lighting fixtures to replace the City's low-pressure sodium roadway lighting (4.78). (Respondents were also strongly in favor of reducing unnecessary street lighting by limiting hours of use and/or by using motion sensor technology [4.76]). The Coconino County-led Joint Land Use Study (JLUS) is looking at dark sky maintenance around the U.S. Naval Observatory (4.67).

There was strong support for astro-tourism in the region (4.73), and respondents would like businesses to feature items that recognize and promote our dark skies (e.g., "I ♥ Pluto" bumper sticker) (4.22). They would also like to see developed an incentive program for Flagstaff area businesses that recognize stellar dark-sky-friendly lighting with awards or some other form of public recognition (4.74).

There was strong support for asking Arizona Public Service (APS), which supports reducing energy use through the use of more efficient lighting technologies, to promote and subsidize the cost of dark-sky compliant lighting fixtures for both commercial and residential customers (4.7). They would also like APS to participate in and help fund a program that offers filters or shields for offending LED lighting to help bring them into code compliance (4.72).

At the community level, respondents would like to see a program that offers rebates or discounts for dark-sky-friendly lighting similar to what is done for water-saving fixtures (4.62). They would also like a buy-back program for non-conforming lighting tied to municipal services billing (4.31).

Respondents would like to see "Neighbor to Neighbor" programs developed to enable HOAs and other community organizations to help members and residents address light trespass in their neighborhoods (4.59). They would like "maker" workshops offered to help people fabricate simple and inexpensive shields for outdoor lights to eliminate glare and light trespass (4.33). And they liked the idea of a "Master Nocturnalists" program (similar to the Master Gardeners) to develop a pool of local dark skies experts to serve as a resource for policymakers (4.28)

## ***Education and Communications***

Respondents would like the Flagstaff Area Chamber of Commerce and local businesses to do more to help combat light pollution. They would like to see displays developed for local stores that sell outdoor lighting to educate customers about Flagstaff's lighting codes and dark skies culture (4.67). They felt that training needs to be provided to managers and staff of local stores that sell outdoor lighting to educate them about Flagstaff's lighting codes and dark skies culture (4.63).

Businesses should educate their employees about the importance of dark skies to the quality of life and economic well-being of Flagstaff and northern Arizona (4.37). And we should learn how to address the most commonly expressed objection to dark-sky friendly lighting, that safety and security are compromised (4.59).

There was strong support for completion of study by the Economic Policy Institute at NAU's W. A. Franke College of Business on the economic impact of northern Arizona's astronomy industry and dark skies (4.63). And respondents felt the Chamber should host seminars for business and property owners about the benefits of our observatories and dark skies for northern Arizona economic development and tourism (4.5). Current efforts by the Chamber to reach its members and others in the community with a dark skies message and the requirement to use code-compliant fixtures should be evaluated (4.48).

Respondents would like to see an educational program developed for students at Flagstaff's public and charter schools about Flagstaff's observatories and dark sky lighting codes and culture; it should include information about the impacts of light pollution on human and animal health (4.65). NAU freshman and students who choose to live off-campus should be given information about Flagstaff's observatories and dark sky lighting codes and culture (4.39). A Powerpoint should be developed that extols the benefits of dark skies and quality lighting for presentation to civic leagues, social welfare organizations, realtor associations, and other community groups (4.26). Also well supported was the idea of a public art campaign to raise public awareness of Flagstaff's astronomical heritage and dark sky culture (e.g., a downtown astronomy/dark skies mural and pole banners) (4.33).

We should reach out to our neighbors in Tusayan, Williams, Page, and Winslow to help northern Arizona become a Regional Dark Sky Preserve (4.59). We should ask public agencies such as the US Forest Service to include information about northern Arizona's dark skies culture in their public programming and other outreach efforts (4.57). And candidates for local and

regional elections should be asked about their views on the value of dark skies and for their solutions to the problem of light pollution (4.65).

### ***Compliance and Enforcement***

Respondents were strongly in favor of more vigorous and comprehensive enforcement of our dark skies ordinances. They would like Coconino County and the City of Flagstaff to be in sync in terms of updates to and enforcement of their ordinances (4.73). They would like to see a citywide inventory of lighting conducted to enable code enforcement officers to track the installation of non-conforming lighting for all properties (4.43).

Businesses should be required at the time of renewal of their business licenses to demonstrate that they are in conformance with lighting codes via submittal of an updated lumens calculation sheet (4.71). A letter should be sent to both corporate and local leadership of our big box stores from the Northern Arizona Leadership Alliance, Flagstaff Dark Skies Coalition, and Greater Flagstaff Chamber of Commerce about our dark skies values and lighting code requirements (4.6).

Promoters and presenters of outdoor events like evening concerts should be required to meet with City or County staff to address lighting issues before such events are approved (4.49). Community Development should meet with the Board of Directors of Continental Country Club to discuss the messaging and code compliance of events like "Lights on the Lawn" (4.24). And we should be addressing the problem of light pollution from stores that are using indoor lighting projected outward to try to attract customers (4.47).

Respondents would like public agencies such as the US Forest Service and Arizona State Land Department to use code-compliant lighting on their properties (4.69). They would like to see a communication bridge built to NAU, which is not required to comply with Flagstaff's lighting ordinances (4.55).

### **Conclusion**

The 87 people who attended "Let There Be Night" were resolute and creative in their desire to protect our dark skies and observatories from further light pollution. They came up with and then offered strong support for 22 recommendations for new program development and other means to push back against the loss of our dark skies. They offered 16 new and better ways to educate and communicate to the public and to the business community about the issues. And they offered 11 ideas and recommendations for how our dark skies ordinances could be strengthened and enforced.

Above all, the participants and presenters made clear that they want to see cooperation and collaboration among government, non-profit, and private entities in the fight to preserve our dark skies. They want APS to become a community partner in addressing light pollution in its service area, along with a true coalition of the City of Flagstaff, Coconino County, Lowell Observatory, the U.S. Naval Observatory, the Northern Arizona Leadership Alliance, the Greater Flagstaff Chamber of Commerce, the Flagstaff Dark Skies Coalition, the U.S. Forest Service, NAU and other northern Arizona cities, towns and communities.

\*\*\*\*\*

*"Let There Be Night" was presented by the Museum of Northern Arizona (MNA) and the Grand Canyon Trust (GCT). It was produced by John Grahame in association with MNA's Amelia George and GCT's Travis Bruner. Funding is provided by Coconino County, the Geo Fund, and Northern Arizona University's Landscape Conservation Initiative.*

## Addendum

Comments (Ques. 50) from the "Let There Be Night" Survey Monkey poll: "Do you have and additional comments, questions, ideas, recommendations, or observations for us?"

1. This is a very well composed and fairly thorough survey. All items are vital and I marked each with 5 stars, which is highly unusual for me, especially getting real estate agents, NAU, the military, big (and little!) box stores, and motels and law enforcement in line with appropriate lighting - light the ground, not the sky: more and glary light does not necessarily mean more safety. Two items that were not addressed are the overly lit motel rooms with their outdoor, unshielded lights on every room and overly lit and unshielded lights at gas station pumps. As a guide, the eastside Walmart's outdoor parking lot lights are pretty good, the city's LED street lights need better shielding to prevent side spillage. We should not see the "bulb" of the light source from a large distance away.
2. Keep up the great work. The survey serves as a plan template. I'm particularly concerned with Sam's and big chains selling non compliant fixtures.
3. Yes, we must stress that dark skies are not just beneficial to astronomy but also human health, plant and animal well being and broader ecological issues. In addition to Lowell and the USNO there are several hundred private observatories in the



- greater Flagstaff area which are also affected by progressive increases in light pollution.
4. It was an excellent workshop, thanks.
  5. It's hard to dislike any of the suggestions in the survey, which makes it difficult to prioritize which ones to apply resources to first.
  6. Great forum, so many brilliant ideas!
  7. Make available a contact to report light trespass and light code violations with follow up and enforcement.
  8. I think there are many great suggestions presented in these questions, but who will do the work? One of my take aways from the meeting is there is not enough manpower to do the current work. I like the Nocturnalist concept and getting more volunteers to help with some of the work and hiring more people too.
  9. Include Cameron in the conversation about dark skies. Follow up on Sebra's ideas from Camp Verde regarding incentives for businesses' to buy-into their Dark Skies Program. Business earn stars for varying levels of involvement and on-going connections. Walnut Cyn Village is addressing the Dark Skies compliance with our outdoor sconce lights now and should make headway in replacements this summer.
  10. Thank you for your efforts!
  11. At least in our neighborhood, the biggest problem are the neighbors that have their "1,000,000 lumen" floodlights on all night. I have to assume they are totally paranoid, probably a result of where they moved from....
  12. Nice job
  13. Overall the meeting was very informative. The survey did little to help me to differentiate the few "best ideas, "e.g. #45 from the not-so-good ideas. In general proactively earned (or initiated by a person/entity) recognition, subsidy, assistance, etc. is probably more effective than a "simple handout", e.g. #41.
  14. So many great solutions to increase awareness and spread the word.
  15. All good ideas! I entered "5" for the ones I think deserve highest priority, but any would be helpful.
  16. I have asked APS about sponsoring dark sky lighting and their response was that they already do. They give away soft white light bulbs, which are 2700 Kelvins, and since the IDA requires 3000 Kelvins, their view is that their soft white bulbs are already dark sky compliant. Is the City of Flagstaff's Kelvins tolerance more restrictive than 3000? I think it might be a tough sell to get them to agree to going to amber lighting if they are more expensive, unless you can convince the person in charge of

making that decision for APS and catch them in time before adding more soft white bulbs to their promotional inventory. Since Flagstaff is leading the way with Amber lighting, APS may be open to following their lead, but Flagstaff is unique in that regard. They may decide, 2700 Kelvins is good enough for more cities and towns, so why change? Perhaps if all of AZ's dark sky cities and town wrote a letter jointly to APS? This would be hypocritical for us, however, as Town of Camp Verde is using 2700 Kelvin LEDs for street lights and likely won't change them out sooner than 10 years down the road. It's hard to get buy-in for amber lighting, especially when we don't have research telescopes and the general public does not feel a sense of urgency regarding stargazing quality or the health of humans and wildlife. The "why" message is key for outreach and celebrating / publicizing the frontrunners in order to facilitate positive peer influence. I believe influencing culture in a positive way is a better strategy than systematic enforcement, but then again it is more urgent for Flagstaff since Lowell's and the Naval Observatory's missions are at stake. Thank you for the inspiring, well-organized public engagement opportunity. We learned a lot coming up from Camp Verde. Flagstaff is the world's first, Camp Verde is the world's newest, and thereby we hope Flagstaff will see us as their little sister city. It would mean a lot to us to see Flagstaff support our first Dark Sky Festival on Oct 6--details at VisitCampVerde's facebook event. Thank you for your help promoting this celebratory event. sebra.choe@campverde.az.gov

17. Make it easier for people to report lighting code violations to the city and county, and to be able to find out what action was taken.
18. Suggest there be a voluntary light conformance program for residences. Currently single families are not regulated. Develop a voluntary program with a reward or plaque that is placed outside the home to show participation.

###

THIS PAGE LEFT BLANK INTENTIONALLY