

Saguaro National Park

Urban Night Sky Place Application



October 2023

Points of Contact:

Adam Springer, adam.springer@nps.gov

Table of Contents

BACKGROUND	3
Daytime Surroundings.....	5
Nighttime Surroundings	7
PUBLIC ACCESS	11
Signage Displaying Name of Place & Management Agency	13
SKY QUALITY MONITORING	16
Night Sky Photography.....	24
DARK-SKY OUTREACH & EDUCATION.....	28
Nighttime Research Programs	30
Previous Outreach & Education Events	31
COMMUNITY SUPPORT	41
PLANS FOR NIGHTTIME VISITOR USE	41
LIGHT FIXTURE RETROFITS	42
Non-Compliant Fixtures Planned for Future Mitigation	50
ADDRESSING FUTURE THREATS	50
APPENDIX A. Saguaro National Park Lighting Management Plan	52
APPENDIX B: Letters of Nomination & Support	63
APPENDIX C. Record of Lighting Retrofit Funding and Spending	73
APPENDIX D: Retrofit Fixture Specification Sheets.....	80
APPENDIX E: Historic Structures Report, Greene Property	94
APPENDIX F: Sky Quality Monitoring Datasheets	98
APPENDIX G: Legal Boundary Maps	99
APPENDIX H. Results from Tucson Mountains & Rincon Mountains Survey (2011)	102
APPENDIX I. Interpretation & Education Programs	105

BACKGROUND



Figure 1. A solstice marker at the Tucson Mountain District of Saguaro NP. NPS Photo.

Saguaro National Park (SNP) is a 92,867-acre unit of the National Park Service, 77% (71,604 acres) of which is federally designated wilderness. The park is comprised of two districts, the Tucson Mountain District (TMD), which lies on the west side of Tucson, and the Rincon Mountain District (RMD) on the east side of Tucson. As the City of Tucson, Arizona (pop. 545,000) has grown in recent decades and steadily expanded closer to the park boundaries, impacts to the dark night sky have also grown. Dark night skies are one of many natural resources threatened by urbanization at SNP. However, SNP continually strives to preserve dark skies for the enjoyment of park visitors as well as wildlife health and ecosystem function. SNP also provides meaningful opportunities for the public to connect to the night sky and aims to demonstrate best lighting practices to the community.

SNP is located on the ancestral lands of the Tohono O’odham people. The Hohokam and Tohono O’odham were inhabitants and stewards of the land for the millennia before SNP existed. Evidence of the long period of human occupancy on this landscape and their connection to astronomical events remains today (Figure 1).

Before SNP was set aside as a protected area, human habitation and land use practices in the Tucson Basin had begun to cause major negative impacts to local ecosystems. These practices included grazing livestock, wood-cutting, hunting and trapping wildlife, introducing exotic species, suppressing wildfires, and fast-growing development. In 1933, Saguaro was first designated as a national monument (Presidential Proclamation 2032) and later upgraded to national park status in 1994 (Presidential Proclamation 3439; Public Laws 94-578, 102-61 & 103-364). These protections during the last 90 years have helped preserve dark night skies directly adjacent to the rapid urbanization and growth in nearby Tucson.

SNP protects a superb example of the Sonoran Desert ecosystem featuring exceptional stands of saguaro cacti, important wildlife habitat (including crucial habitat for threatened and endangered species), and critical riparian areas, as well as associated mountain ranges. The RMD encompasses a large portion of the Rincon Mountains, a “Sky Island” mountain range and the largest roadless Sky Island in the US. The Madrean Sky Islands are a series of isolated mountain ranges that rise from the desert into mixed-conifer forests at high elevations, linking the Colorado Plateau to the Sierra Madre Occidental in Mexico. SNP ranges in elevation from 2,180 feet (TMD) to 8,666 feet (RMD) spanning desert, grassland, woodlands, and mixed conifer forest habitats. Additionally, SNP is situated at the convergence of two deserts, the Sonoran and Chihuahuan. Elevational gradients and the blending of temperate and subtropical biomes makes SNP a globally significant biodiversity hotspot. The park also protects significant cultural resources, including historic structures and districts listed or eligible for the National Register of Historic Places, and places important to Native American cultural traditions.

The outstanding qualities for which the park was established are increasingly challenging to maintain as conditions within and around the park change. However, it is our mission to facilitate meaningful connections between people and the natural surroundings, including night skies, for generations to come.

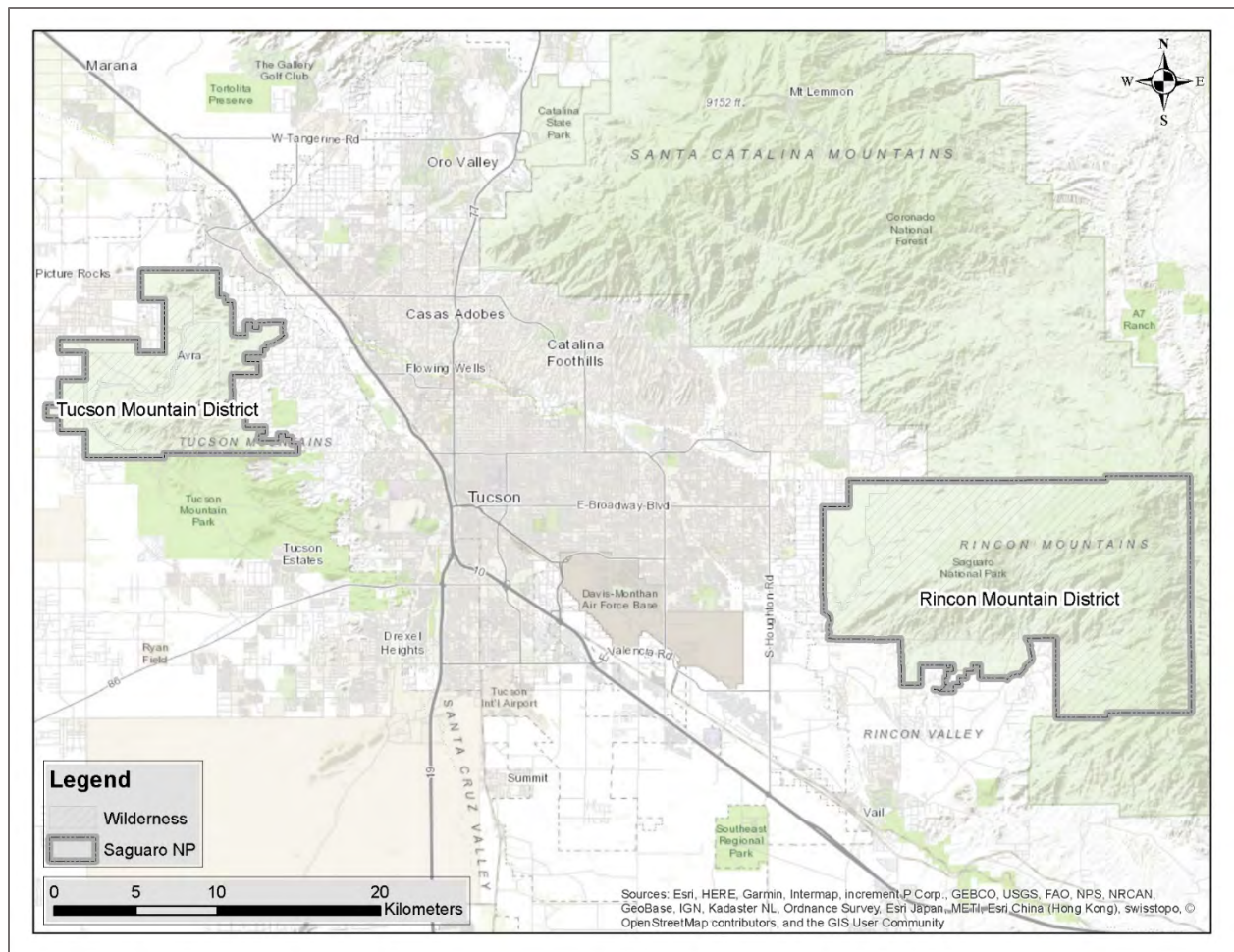


Figure 2. Saguaro National Park's two districts (Tucson Mountain District & Rincon Mountain District) relative to the City of Tucson. See Appendix G for more legal boundary maps.

Daytime Surroundings

The RMD and TMD are both large blocks of protected lands, predominantly comprised of designated wilderness. The RMD is surrounded on two sides by the Coronado National Forest, including two wilderness areas: the Pusch Ridge Wilderness and Rincon Mountain Wilderness. The TMD is a peninsula of protected open space, now being increasingly surrounded by suburban and urban landscapes on three sides, but with vast protected open space to the west on the Tohono O'odham Nation Reservation and the Ironwood Forest National Monument.

Vegetation within the park varies with elevation from desert scrub at the lowest elevations (~2,200 ft.) to mixed conifer forest at the upper elevations (~8,600 ft). These surrounding vegetation communities provide generally unobscured views of the night sky at low elevations, with generally dense canopy at the highest elevations within the park.

In 1976, SNP gained status as a Class I Airshed in accompaniment with the congressional designation of the Saguaro Wilderness. Under the Clean Air Act (1970), Class I Airsheds are afforded the highest protections to maintain visibility and air quality. Air quality is in fair condition at SNP; however, an ozone monitor at the park consistently measures the highest ozone levels in the Tucson area, with one to

several exceedances of EPA ozone standards every year going back to at least 1988. While ozone exceedances continue to occur at the park, especially on the hottest and sunniest days, a downward trend in exceedances is observable over the past three decades. Reducing air pollution is crucial to mitigating the effects of climate change and continuing to improve air quality in a warming and drying climate.

Monitoring air quality is connected to visibility which is an important factor for night sky viewing. Air pollution can create haze that affects visible distance. Natural haze may also develop from dust, wildfires, or other occurrences. Haze is composed of particulates which can scatter artificial light at night, temporarily reducing clarity and visible colors. Haze may affect nighttime stargazing during the summer months, but the number of haziest days is trending downward in accordance with the Clean Air Act goal of reaching no human caused impairment. SNP closely monitors air quality and makes monitoring data available to the public on the park website (<https://www.nps.gov/sagu/learn/nature/air-quality.htm>). Visitors can also visit the AirNow website to check current air quality conditions in the park and be alerted to ozone exceedances.

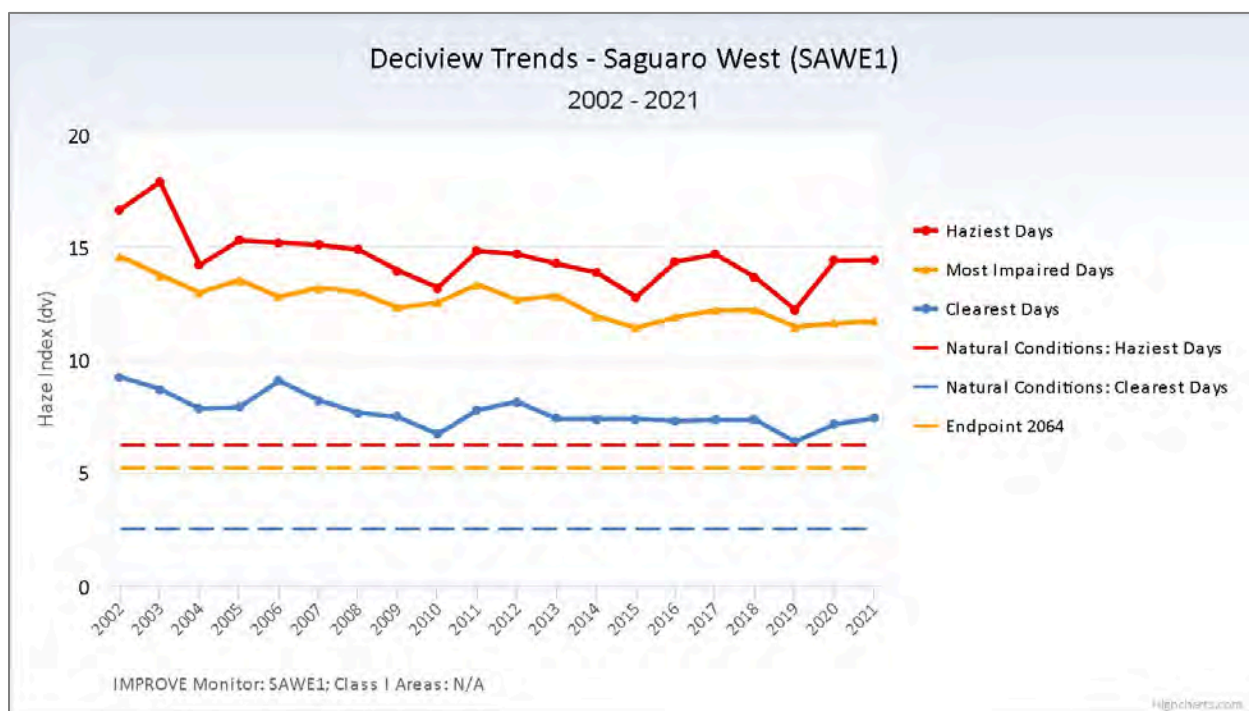


Figure 3. Long-term trend in haze at Saguaro NP (2002-2021).

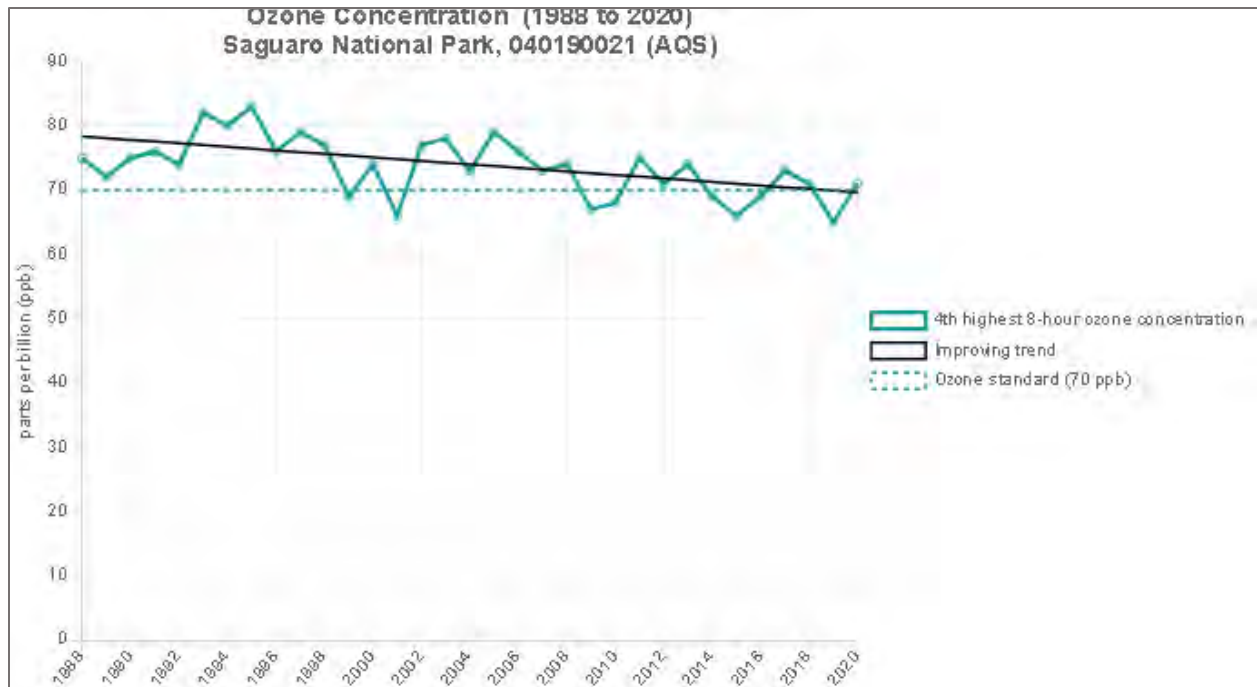


Figure 4. Ozone concentration at Saguaro NP (1988-2020).

Nighttime Surroundings

While both districts are adjacent to the City of Tucson, ordinances passed by the City of Tucson and Pima County, including the Pima County Buffer Overlay Zone (1988) and the Outdoor Lighting Code (2012) have helped attenuate some of the immediate impacts to the park through lower density development and progressive lighting management. Expanses of designated wilderness within the park districts significantly protect the interior from artificial light and preserve natural darkness character.

Saguaro National Park is located within a region that preserves and celebrates dark night skies. The park is surrounded by world-class astronomical research programs and a community of night sky specialists operating from Kitt Peak National Observatory, Mount Graham International Observatory, Fred Lawrence Whipple Observatory, Steward Observatory, Mount Lemmon Observatory (Figure 6), and the headquarters for DarkSky International. SNP has an important role in collaborating with these technical experts along with amateur enthusiasts to support the stewardship and promotion of night sky resources.

Our initial lighting inventory found 187 fixtures within the park, of which 86 (46%) required retrofits to meet DarkSky standards. All retrofits have been completed except 16 (9%) remaining fixtures. These remaining noncompliant fixtures are planned for mitigation in the coming year. Modifications included a variety of techniques such as the decommission of fixtures; installation of fully shielded fixtures; use of low-lumen lamps that do not exceed 3000 K; and use of timer/motion sensor controls. See Tables 8 and 9 for Lighting Inventory details.



Figure 5. Sky glow seen looking west from the RMD Visitor Center towards Tucson. This location is at the westernmost (and closest) edge of the park to Tucson. NPS Photo.

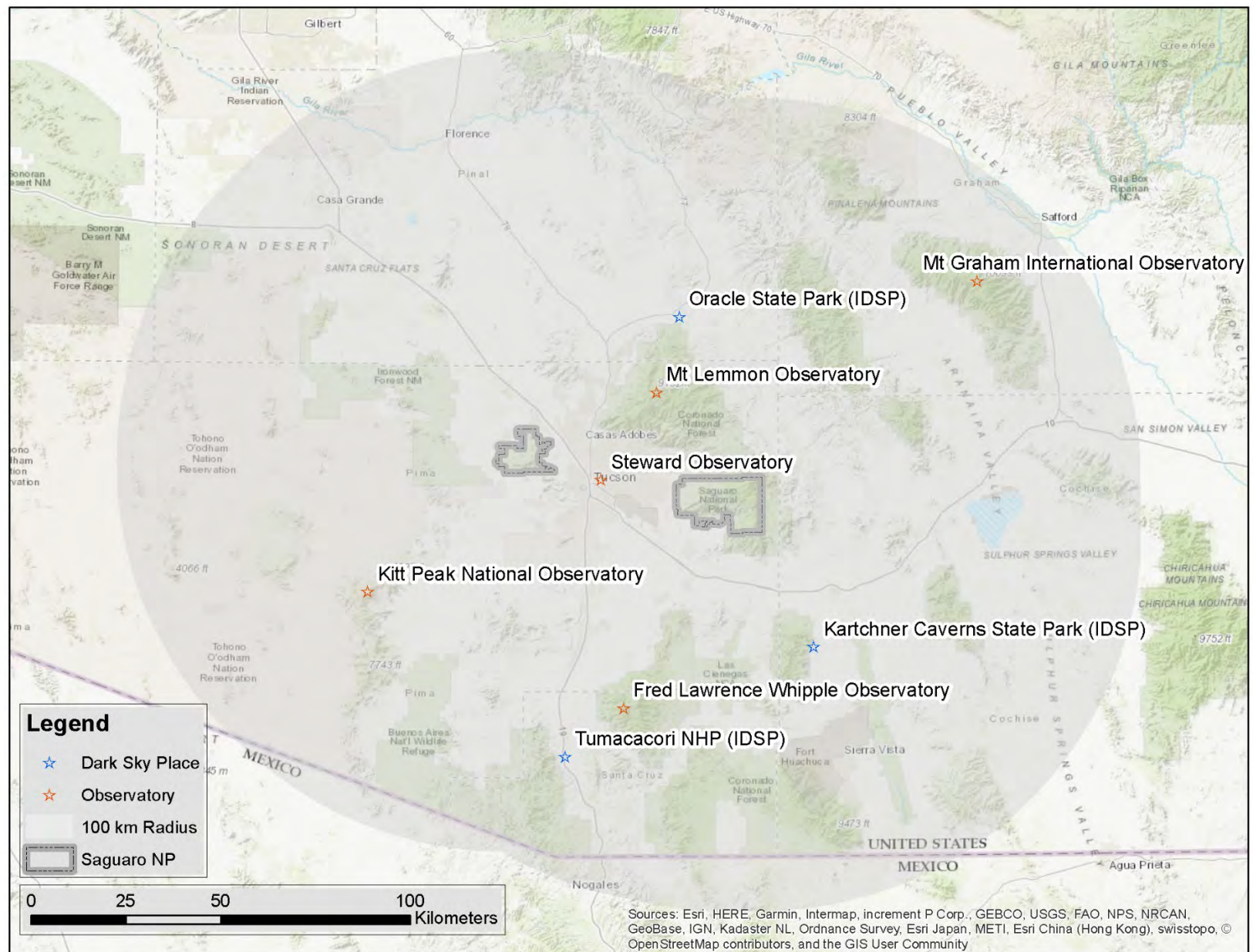


Figure 6. Saguaro NP relative to the City of Tucson, nearby astronomical observatories, and certified Dark-Sky Places within 100 km of the park.



Figure 7. Nocturnal wildlife activity at Saguaro NP. **Clockwise from top left:** mule deer, ringtail, bobcat, wood rat, mountain lion, and striped skunk. NPS Photos

PUBLIC ACCESS

The park clearly displays entrance signs at all public access points including roadways, trailheads, and cross-boundary through-trails (e.g., Arizona National Scenic Trail). The RMD only has one road entrance, but the TMD has commuter routes with through-routes traversing the park.

As described in the Saguaro NP Superintendent's Compendium (2019):

(a)(1) The following visiting hours and public use limits are established for all or for the listed portions of the park, and the following closures are established for all or a portion of the park to all public use or to a certain use or activity:

Visiting Hours:

- *Park visitor centers will be open daily from 9:00 am to 5:00 pm.*
- *Both visitor centers will be open year-round, except Thanksgiving and Christmas Day.*
- *The Cactus Forest Loop Drive is open from:*
 - *5:00 am to 8:00 pm. February 1st through October 31st.*
 - *5:00 am to 6:00 pm. November 1st through January 31st.*
- *Hohokam and Golden Gate Roads are open to vehicular traffic from dawn to dusk, year- round.*

While the Cactus Forest Loop, Hohokam, and Golden Gate roads close to motor vehicle traffic during listed hours, they all are open to pedestrians and cyclists 24 hours a day. All remaining park trails, roads, and campgrounds stay open throughout the night and can be accessed from multiple access points (Figures 8 & 9). Additionally, the frontcountry locations identified in the compendium above may be open during special events.

Daytime temperatures in the Tucson area regularly exceed 100° F during the summer months. Nighttime visitation is especially popular during this season when visitors can recreate with decreased discomfort and danger of extreme heat.

Overnight camping is available in the RMD at six backcountry campgrounds (Douglas Spring, Juniper Basin, Grass Shack, Happy Valley, Spud Rock, Manning Camp) year-round. Permits are required.

Both park districts offer designated stock trails for visitors that enjoy horseback riding. Many of these trails are accessible throughout the night, as well.

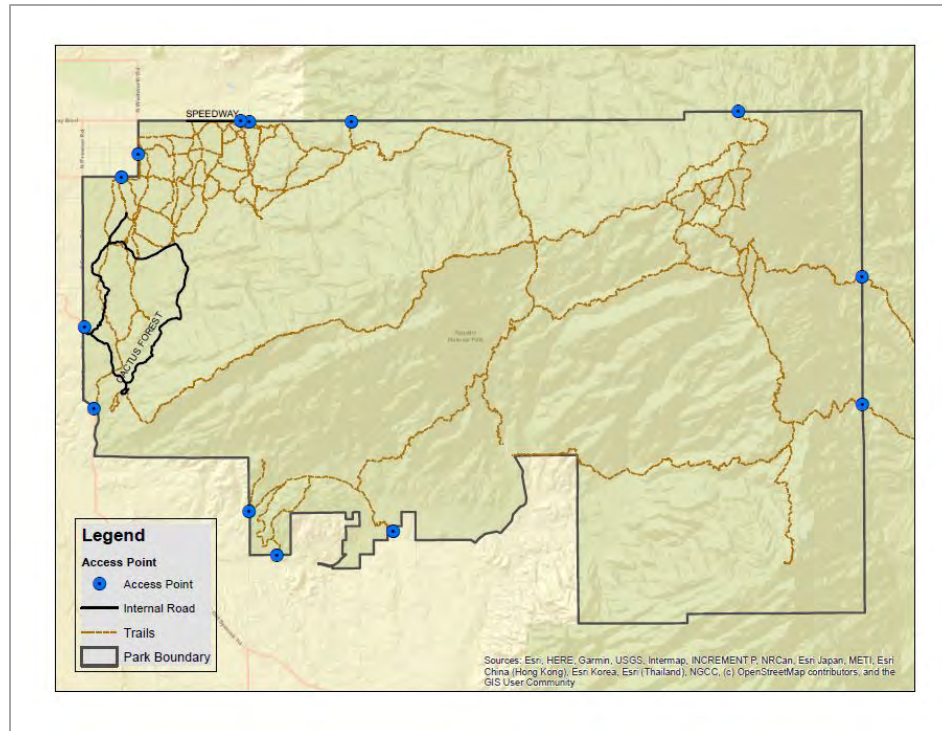


Figure 8. Access points open to the public 24 hours a day in the Rincon Mountain District. All trails allow pedestrians, and stock and bicycles are allowed on select trails. The Cactus Forest Loop Drive, while closed to vehicles, is open to both pedestrians and cyclists at nighttime.

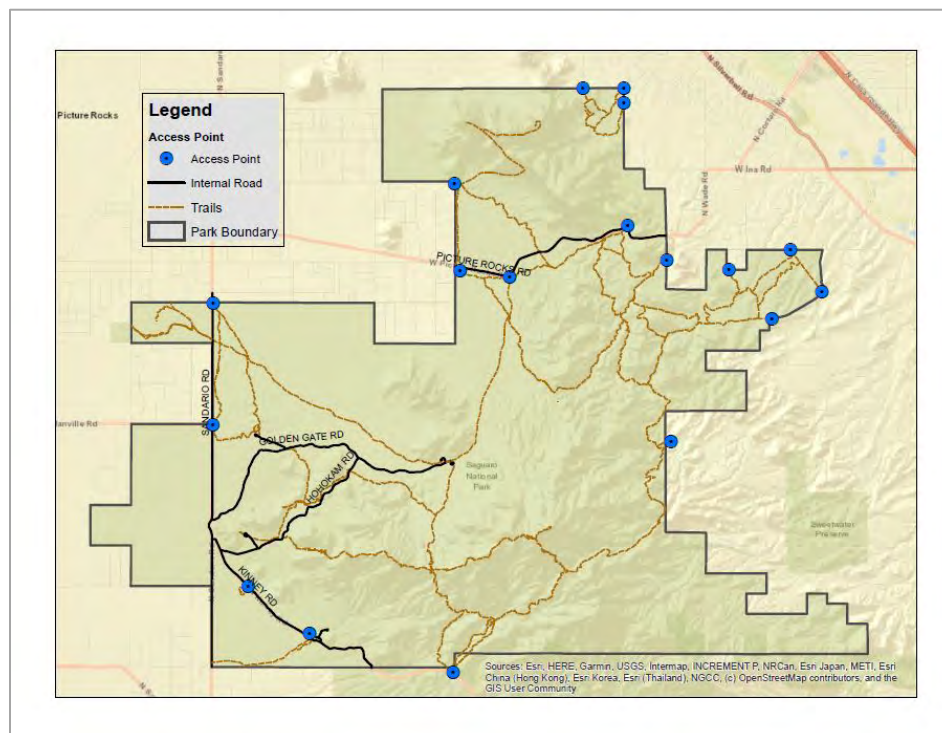


Figure 9. Access points open to the public 24 hours a day in the Tucson Mountain District. All trails allow pedestrians, and stock and bicycles are allowed on select trails. Hohokam and Golden Gate Roads, while closed to vehicles, are open to both pedestrians and cyclists at nighttime.

Signage Displaying Name of Place & Management Agency

Signs indicating the Name of Place and Management Agency are clearly displayed at all roads and trails entering the park. These signs are placed at the following locations:

Rincon Mountain District

- Old Spanish Trail at park entrance (3693 South Old Spanish Trail)
- Arizona National Scenic Trail at southern boundary
- Arizona National Scenic Trail at northern boundary
- Douglas Spring Trailhead at the eastern terminus of Speedway Boulevard
- Wildhorse Trailhead, along Speedway Boulevard
- Broadway Trailhead, along Broadway Boulevard
- Cactus Forest Trail, along Old Spanish Trail
- Loma Alta Trailhead, along Camino Loma Alta
- Miller Creek Trail at eastern boundary
- Turkey Creek Trail at eastern boundary

Tucson Mountain District

- Sandario Road, 68 m south of intersection with Rutasill Road
- Sandario Road, 72 m north of intersection with Fort Lowell Road
- Kinney Road, 15 m north of intersection with Mile Wide Road
- Picture Rocks Road, 470 m east of intersection with Tula Lane
- Picture Rocks Road, 1 km west of intersection with Wade Road
- El Camino del Cerro Trailhead at the western terminus of W El Camino del Cerro
- Cam-Boh Trailhead, along Picture Rocks Road
- King Canyon Trailhead, along Kinney Road
- additional signs are located at interior trailheads

Saguaro NP will recognize UNSP certification with the installation of DarkSky signage and/or placards clearly visible to park visitors. It is anticipated that this signage will be placed on main entrance signs into each park district and/or prominently at each Visitor Center. The park will begin developing designs, compliance packages, and funding proposals for this project following official certification.



Figure 10. Main entrance sign at Saguaro NP - Rincon Mountain District, along Old Spanish Trail.



Figure 11. Entrance sign at Saguaro NP - Tucson Mountain District, along Kinney Road.



Figure 12. Park entrance sign entering the northeast side of the Tucson Mountain District from Picture Rocks Road.



Figure 13. Entrance sign at park boundary on the northwest side of the Tucson Mountain District, along Picture Rocks Road.



Figure 14. Entrance sign at park boundary on the southwest side of the Tucson Mountain District, along Sandario Road.

SKY QUALITY MONITORING

In June 2020, the park acquired two Unihedron Sky Quality Meters to begin taking field measurements to determine sky darkness. The SQM-L (narrow field of view with lens) model was chosen because of its higher accuracy in more urban areas. This equipment was used to collect baseline data for UNSP certification and for future monitoring to determine darkness trends within Saguaro NP (see Appendix F for SQM datasheet).

Dating back to 2001, NPS staff from the Natural Sounds and Night Sky Division began collecting sky quality readings at NPS units across the country, including SNP (Table 1). Additionally, SNP coordinated a one night, intensive cross-mountain transect (inset box below) in 2011. SNP did not, however, begin systematic, regular sky quality readings until beginning this application in 2020 (Tables 2&3).

Table 1. Sky readings collected by NPS staff from the Natural Sounds & Night Sky Division at Saguaro NP.

Category	Rincon Peak 4/3/2008	Wasson Peak 10/23/2011
Bortle Class	4	No data
Synthetic SQM	21.36	20.35
SQI All-sky	58.0	33.3
SQI to Z.A. 70°	72.1	42.5
Stars visible	3040	1820

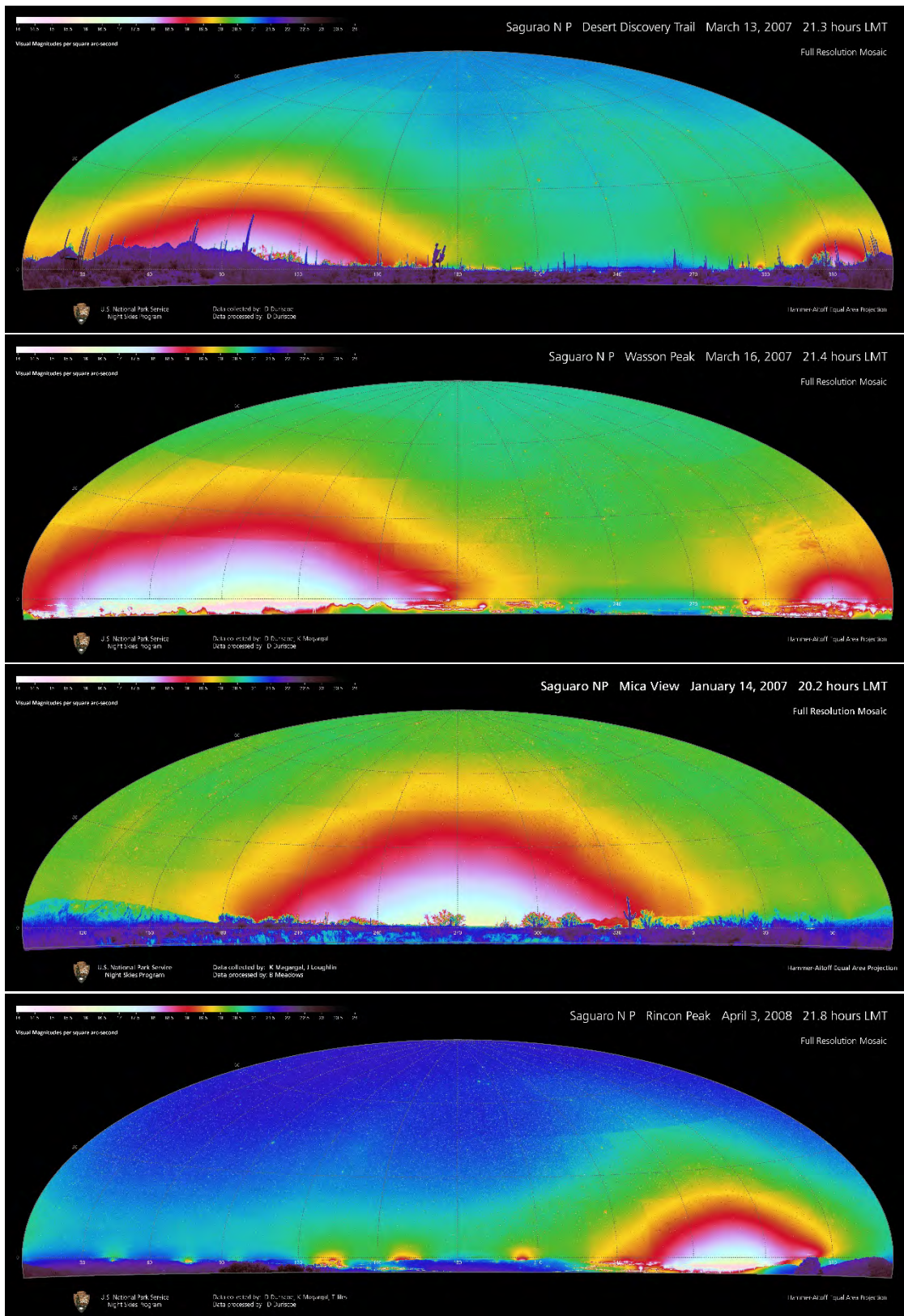


Figure 15. Observed Sky Brightness Mosaics (from top: Desert Discovery Trail, Wasson Peak, Mica View, and Rincon Peak). NPS Natural Sounds & Night Skies Division (2007-2008).

Tucson Mountain & Rincon Mountain Transect (2011)

Prior to initiation of this application, on October 21, 2011, the NPS conducted a one-night transect of dark sky readings across the Tucson Mountains and Rincon Mountains as part of a National Geographic-sponsored BioBlitz event. Volunteers hiked as much as 18 miles roundtrip into the backcountry to take SQM readings across more a distance of more than 40 miles. See Appendix H for more information.

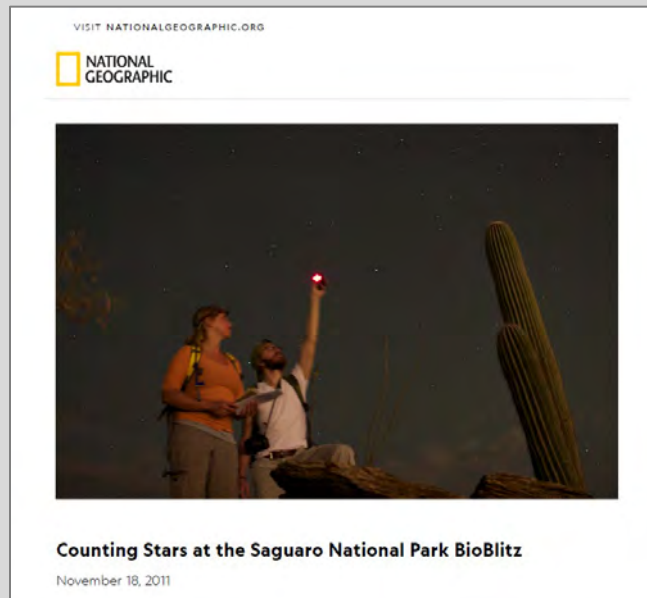


Figure 16. National Geographic article from the 2011 Tucson Mountain/Rincon Mountain surveys.

Recent data shows that both park districts possess areas of good quality darkness with SQM readings consistently above 20 magnitudes per square arcsecond (on a scale of 16.00 – 22.00; 22 representing the least amount of luminance). In the RMD, high elevation wilderness sites consistently read above 20, and Rincon Peak held the highest SQM value at 21.57. The high elevation RMD sites are only accessible by foot and are the farthest from the city of Tucson and other developed areas. In the TMD, Desert Discovery Trail also consistently is measured above 20 and is the darkest monitoring site in the district. Desert Discovery is located along a trafficked through-road, but the nearby development is lower density compared to other sites.

As expected, sites located closer to developed areas and at the margins of the park districts had lower SQM readings. Nonetheless, the lowest recorded value was still above 18 (18.71) at Mica View Picnic Area in the RMD.

Park staff and volunteers will continue to monitor sky quality and provide results in annual reports to DarkSky after earning certification. The most recent measurements were collected in May 2023. All low elevation sites at the RMD and TMD are easily accessible for monitoring. High elevation sites are exceptionally difficult to access, requiring hikes exceeding 20 miles, more than 5,000' elevation gain and backcountry camping. These most remote sites will be monitored opportunistically as staff and volunteers are working in these areas.

Table 2. Sampling dates and locations at Saguaro NP – **Rincon Mountain District**. All readings taken with Unihendron sky quality meter with narrow field of view. Data source: NRCA, NPS.

		Location	Date	SQM Value
Low Elevation	RMD Visitor Center	RMD Visitor Center	8/6/2020	19.38
			8/19/2020	19.65
			2/11/2021	20.17
			3/6/2021	20.02
			4/8/2021	20.08
			5/20/2023	20.19
	Mica View Picnic Area	Mica View Picnic Area	3/12/2007*	20.43
			8/6/2020	18.71
			8/19/2020	19.57
			2/11/2021	20.29
			3/6/2021	20.00
			4/8/2021	20.09
			5/20/2023	19.82
	Riparian Overlook	Riparian Overlook	8/6/2020	19.51
			8/19/2020	20.02
			2/11/2021	20.33
			3/6/2021	20.22
			4/8/2021	20.17
			5/19/2023	20.33
	Javelina Picnic Area	Javelina Picnic Area	8/6/2020	20.45
			8/19/2020	19.90
			2/11/2021	20.42
			3/6/2021	20.19
			4/8/2021	20.38
			5/20/2023	20.39
	Broadway Trailhead	Broadway Trailhead	8/19/2020	19.77
			2/11/2021	20.33
			3/6/2021	19.99
			4/8/2021	20.03
			5/20/2023	20.23
	Douglas Springs Trailhead (Speedway)	Douglas Springs Trailhead (Speedway)	8/19/2020	20.06
			2/11/2021	20.61
			3/6/2021	20.27
			5/20/2023	20.48
	Camino Loma Alta Trailhead	Camino Loma Alta Trailhead	8/6/2020	20.25
			8/19/2020	20.30
			2/11/2021	20.64

High Elevation		3/6/2021	20.68
		4/8/2021	20.22
		5/20/2023	20.32
	Cell Hill (Manning Cabin)	6/23/2020	21.17
		7/9/2020	20.50
		8/5/2020	21.33
		10/9/2020	21.08
		11/4/2020	21.26
		4/28/2021	21.24
		4/20/2023	21.10
	Reef Rock	6/23/2020	21.24
		11/2/2020	21.02
	Mica Mountain	6/23/2020	21.36
		11/3/2020	20.35
	Spud Rock	6/23/2020	21.34
		11/3/2020	21.39
	Rincon Peak	4/3/2008	21.36
		7/26/2020	21.32
		10/3/2020	20.98
		4/29/2021	21.57
	Dark Spring	9/18/2020	21.50
*2007 readings collected by the NPS Intermountain Region for separate project.			

Table 3. Sampling dates and locations at Saguaro NP – **Tucson Mountain District**. All readings taken with Unihendron sky quality meter with narrow field of view. Data source: NRCA, NPS.

	Location	Date	SQM Value
Low Elevation	TMD Visitor Center (Red Hills)	8/18/2020	19.99
		2/11/2021	20.81
		3/5/2021	20.70
		4/7/2021	20.67
		5/19/2023	20.58
	Desert Discovery Trail	3/17/2007*	20.95
		8/18/2020	20.33
		2/11/2021	20.87
		3/5/2021	20.78
		4/7/2021	20.73
	Signal Hill	8/18/2020	19.91
		5/19/2023	19.91
	Sendero Esperanza Trailhead	8/18/2020	19.85
		2/11/2021	20.60
		3/5/2021	20.57
		4/7/2021	20.41
		5/19/2023	19.88
	Cam-Boh Picnic Area	8/18/2020	19.72
		2/11/2021	20.49
		3/5/2021	20.47
		4/7/2021	20.37
	Contzen's Pass	8/18/2020	19.47
	King Canyon Trailhead	8/18/2020	19.96
		5/19/2023	20.53
	El Camino del Cerro Trailhead	8/18/2020	18.84
		2/11/2021	20.41
		3/5/2021	20.31
		4/7/2021	20.08
		5/19/2023	18.26
High Elevation	Wasson Peak	3/16/2007*	20.65
		10/23/2011	20.63
		1/8/2021	19.26
		2/10/2021	20.39
		3/06/2021	20.46
		4/08/2021	20.44
*2007 readings collected by the NPS Intermountain Region for separate project.			

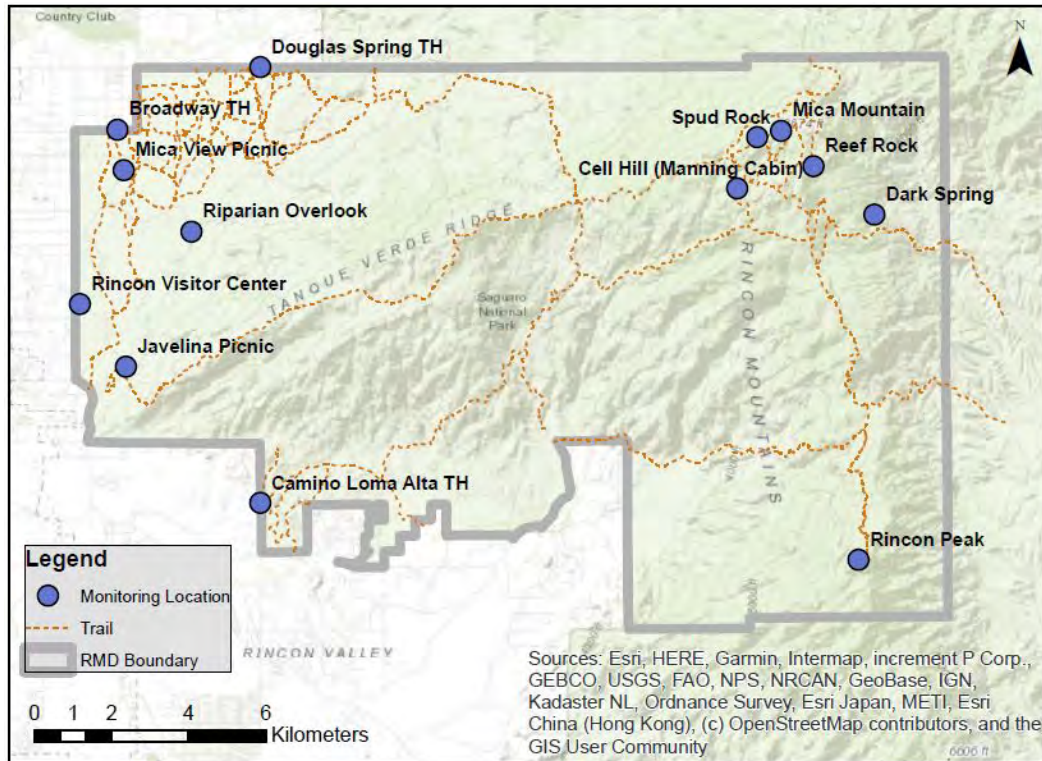


Figure 17. SQM monitoring locations at the Rincon Mountain District. Low elevation sites are located on the east side of the RMD and will be used for long-term monitoring. High-elevation sites are located on the west side of the RMD and will only be monitored opportunistically.

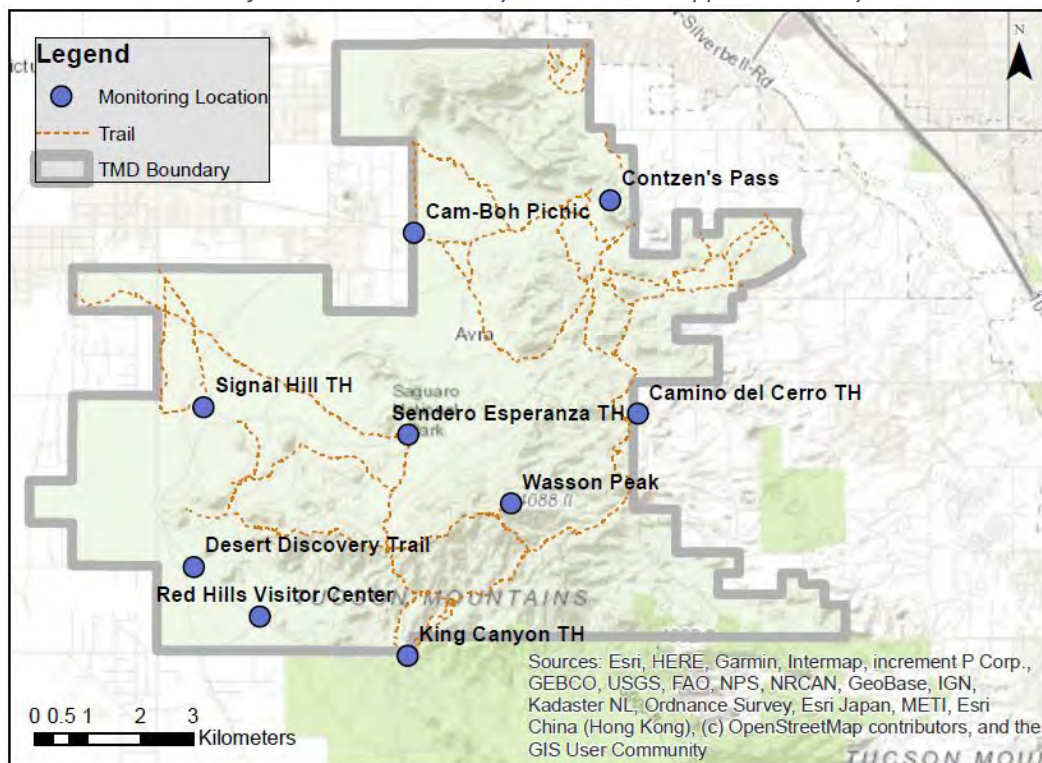


Figure 18. SQM monitoring locations at the Tucson Mountain District. All sites except for Wason Peak (high elevation) will be used for long-term monitoring.

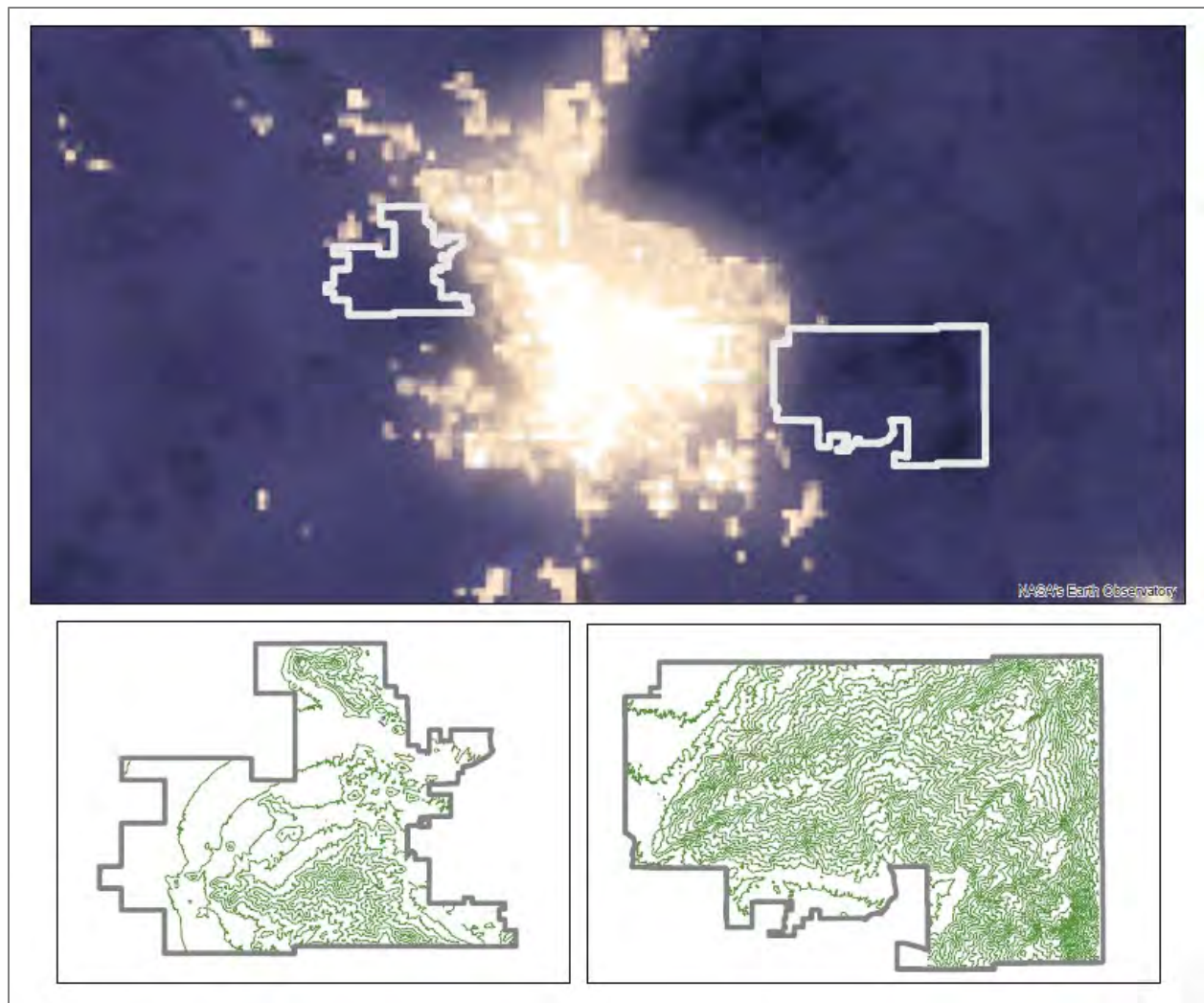


Figure 19. Nighttime satellite view of the Tucson metropolitan area in relation to the Saguaro NP boundary. Insets showing topography of the TMD and RMD add to an understanding of darkness within SNP. Data Source: NASA Earth Observatory-Earth At Night (2016)

Using NASA Earth at Night data, we can clearly view the artificial light emitted from the City of Tucson in relation to SNP. Within the park boundaries, light pollution abruptly drops into expanses of wilderness which become darker as visitors travel into the interior of the park districts. At the RMD, skyglow remains visible at the western boundary and can be seen looking west from exposed ridgetops and summits. As visitors travel to other areas of the district, the topography quickly becomes very rugged. The Tanque Verde Ridge obscures Tucson skyglow from the Rincon Valley and Heartbreak Ridge. Steep canyons, bedrock outcrops, and mountain slopes shield the western horizon and allow for darkness to dominate. At the TMD, the topography is similarly rugged and provides a buffer to the city skyglow. Light pollution is plainly visible from the eastern boundary and ridgetops and summits. However, the Wasson Ridge and Panther/Safford Ridge protect darkness in the central and western spans of the district. This creates surprisingly dark and accessible night skies in SNP, despite proximity to an urban center.

Night Sky Photography

Night sky photography in Saguaro NP demonstrates mitigation of light trespass from the City of Tucson. Expanses of designated wilderness without any artificial lighting buffer public users from nearby sky glow and help preserve conditions within the interior of the park. City skyglow is, of course, visible on the distant horizon when viewing from the margins of the park boundary. However, just a short distance into the park allows for accessible and high-quality viewing of dark night skies. When looking the opposite direction from the city, light trespass is minimal and dark starry skies are dominant. As visitors travel deeper into the park, larger expanses of darkness and changes in topography can obscure any indication of city light trespass, allowing for optimal dark sky viewing. It is common to be able to see an array of astronomical features year-round in Saguaro NP, including constellations, planets, and the Milky Way galaxy. Figures 20-23 showcase a series of night sky photos taken by park staff. The dramatic contrast between night sky views looking towards versus away from the city is shown in Figures 20-21.



Figure 20. The iconic saguaro cacti against the starry night sky in the Tucson Mountain District. **Left:** Looking towards the city and out from the park, stars are still very visible despite skyglow and suburban artificial light trespass. **Right:** Looking away from the city and into the park, even more stars are visible, and the Milky Way galaxy is striking. NPS Photos. (Camera Settings – Left: ISO1600, f/2, 11s, FUJIFILM X-T3; Right: ISO2500, f/3.5, 40.3s, NIKON D7100)

Additionally, the park is a destination for professional and amateur photographers alike wanting to capture the beautiful night sky framed by iconic saguaro cacti. Some of their work can be explored in the tagged photos of @saguaronationalpark on Instagram.



Figure 21: **Top:** Comparison of city skyglow to park darkness in the RMD. Photo pair was taken at the same location (Tanque Verde Ridge Trail), looking in opposite directions. **Bottom:** Comparison of city skyglow to park darkness in the TMD. Photo pair was taken at the same location (Sweetwater Trail), looking in opposite directions. NPS Photos (Camera Settings – Top Left: ISO2000, f/1.8, 1/3s, Apple iPhone 11 Pro Wide Camera; Top Right: ISO2500, f/3.5, 25.6s, NIKON D7100; Bottom Left: ISO1250, f/1.8, 1.0s Apple iPhone 11 Pro Wide Camera; Bottom Right: ISO4000, f/1.8, 1.1s, Apple iPhone 11 Pro Wide Camera)



Figure 22: *The city seen from Wasson Peak, Tucson Mountain District. Photo shows large expanse of darkness and absence of artificial light in the foreground which is within the park boundary. NPS Photo (Camera Settings – ISO5000, f/1.8, 1/4s, Apple iPhone 11 Pro Wide Camera)*



Figure 23: Dark skies seen from the popular Tanque Verde Ridge Trail, Rincon Mountain District. NPS Photo.
(Camera Settings – Top: ISO5000, f/1.8, 1.0s, Apple iPhone 11 Pro Wide Camera; Middle: ISO2500, f/3.8, 39.7s, NIKON D1700; Bottom: ISO800, f/1.8, 15s, Samsung Ultra Note 20)

DARK-SKY OUTREACH & EDUCATION

Outreach programs at the park incorporate informational brochures from DarkSky International at the Visitor Centers, tabling events outside of park facilities, and tabling events held within the park. The Visitor Centers are stocked with information about shielded lights and proper CCT that is permanently available in the building, along with being brought out for select outreach events. Staff and volunteers have been provided with trainings to ensure their ability to answer questions pertaining to dark skies and proper lighting from visitors.



*Figure 24. An assortment of brochures made available at the Visitor Centers and night sky programming events.
NPS Photo.*

For select events held at the park a separate table is set up that is designated as the dark-sky table. This table displays informational brochures and a matching game designed to inform visitors of the impacts light pollution has on wildlife, energy consumption, and human health, among others. The park strives to provide information that encourages the public to make changes to their home lighting as well.

The park uses its Facebook and Instagram social media platforms to communicate how the night sky influences wildlife, people, and science. These online posts cover a wide range of topics from prominent figures in astronomy to how nocturnal animals see in the dark to plants that need the nighttime to what light pollution is. The scope of these posts varies extensively to appeal to a wide audience and to show the large impact the night sky has on everything. Beginning in 2021, the park became a participant in International Dark-Sky Week (IDSW) by featuring night-themed social media posts and related hash-tagging. Additionally, special IDSW programs were launched in 2022 with great success.

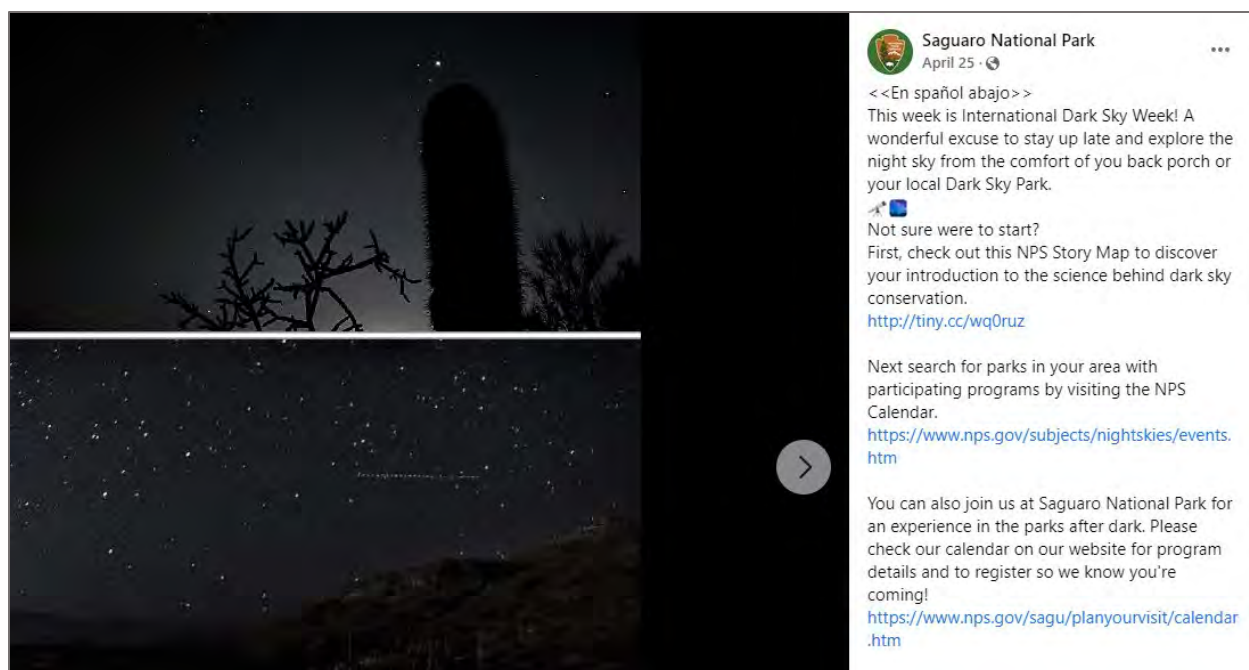


Figure 25: Saguardo NP Facebook post during IDSW 2022 with links to night sky event calendars and resources.

SAGUARO NATIONAL PARK

Dark Sky Week Evening Hike (East District)

REPEATING EVENT
SPECIAL EVENT

25
APR
7:00 pm

Day(s): Every day until April 30, 2022 (except for 04/27)
Date(s): April 25, 2022, to April 30, 2022
Time(s): 7 pm — 9 pm
Duration: 2 hours

View Details ›

SAGUARO NATIONAL PARK

Celebrate the night sky with telescopes at the Rincon Mountain Visitor Center with the Tucson Amateur Astronomers!

MULTIDAY EVENT
SPECIAL EVENT

25
APR
7:00 pm

Day(s): Monday
Date(s): April 25, 2022, to April 27, 2022
Time(s): 7 pm — 9 pm
Duration: 2 hours

View Details ›

Figure 26: Excerpt from SNP website (nps.gov/sagu) showing event schedule for IDSW 2022.

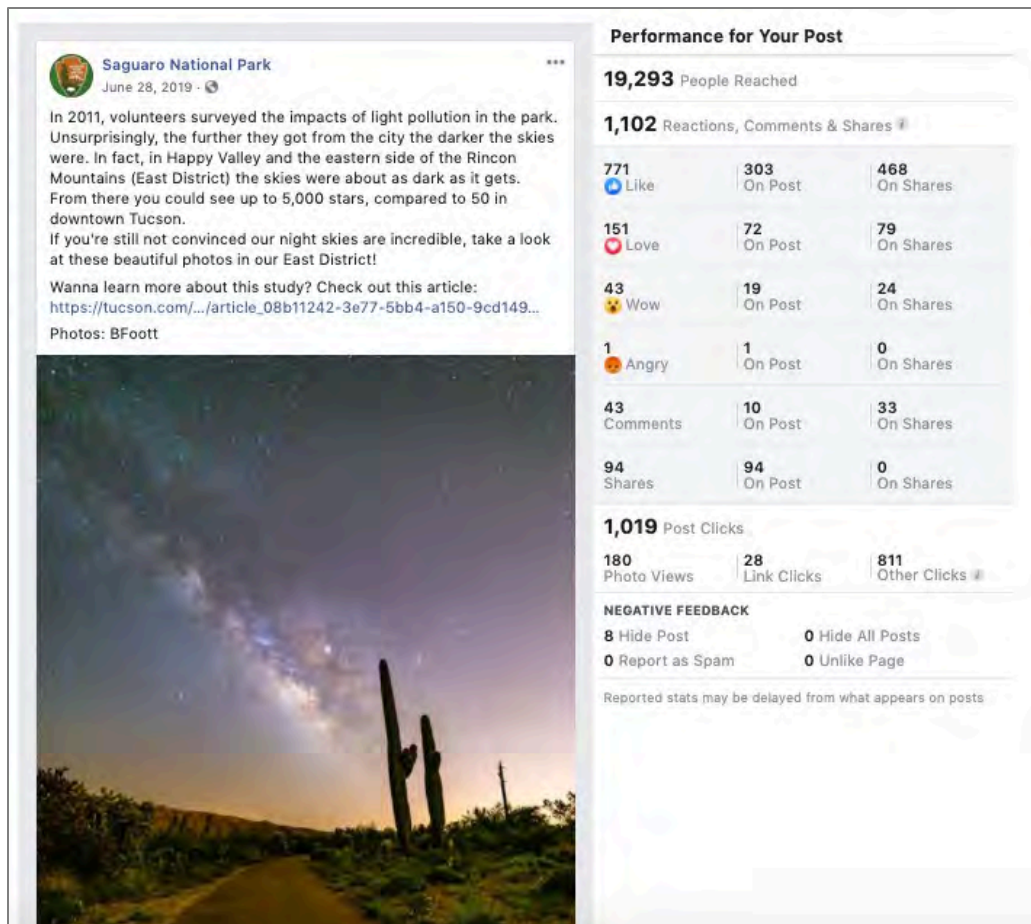


Figure 27. A Saguaro NP social media posting from June 2019, which reached over 19,000 people.

Nighttime Research Programs

In 2017 and 2018, the park hosted PhD candidate Megan Bonham while completing her dissertation research in southern Arizona. In her research she attended all night sky programs at Saguaro NP and interviewed participants. The results of her work, *“Experiences with the Nighttime Environment: How Darkness Affects Human Relationships with Nature”* has been well received and won the PhD student paper competition at the International Association for Society and Natural Resources conference in 2018. Her work has informed our park programs and is being used to improve the effectiveness to reach public audiences.

The park has also supported academic research and citizen science events with night sky themes. These events have included BioBlitz style inventories of nocturnal insects using blacklights, bat inventories, and scorpion inventories.

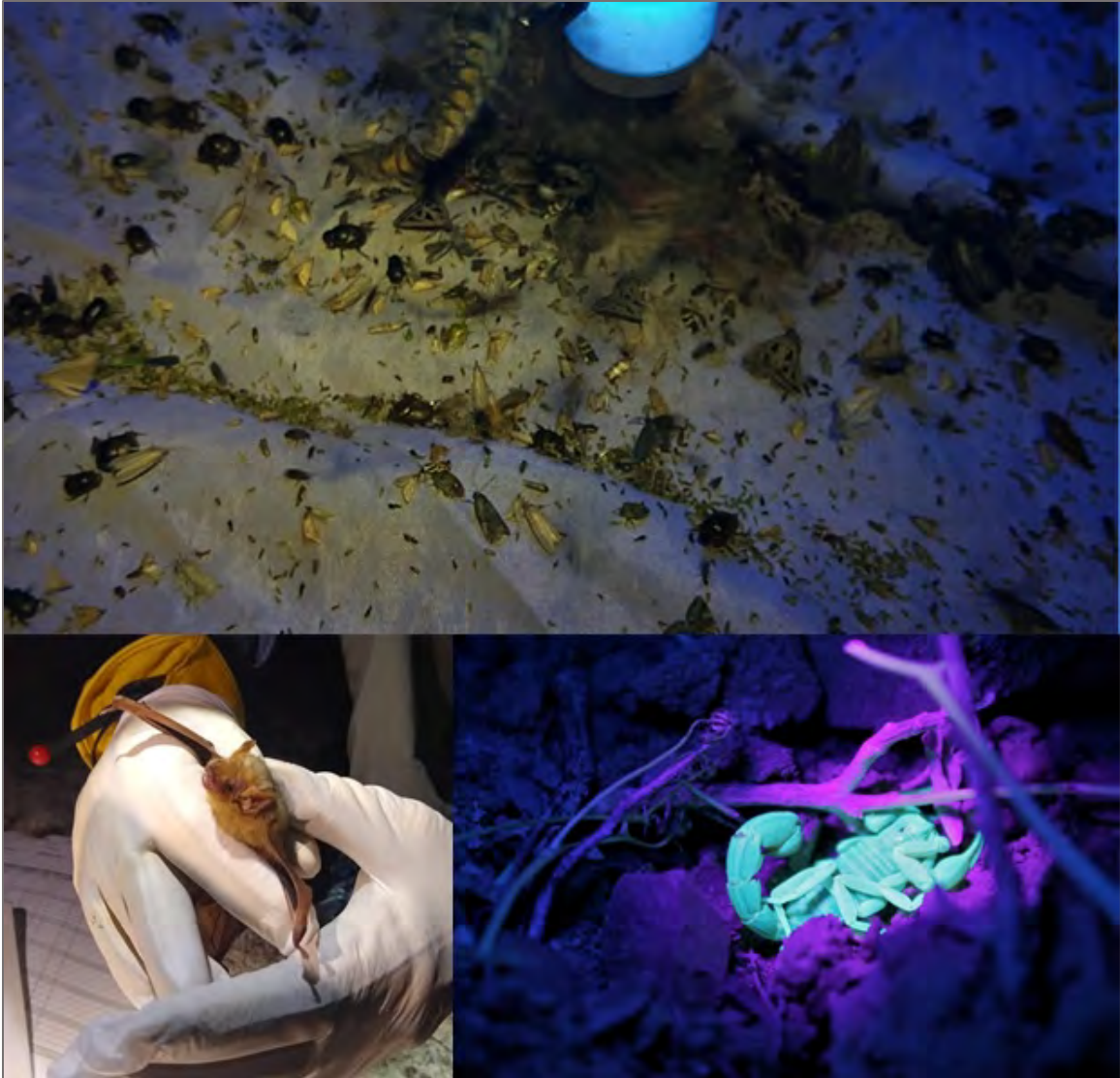
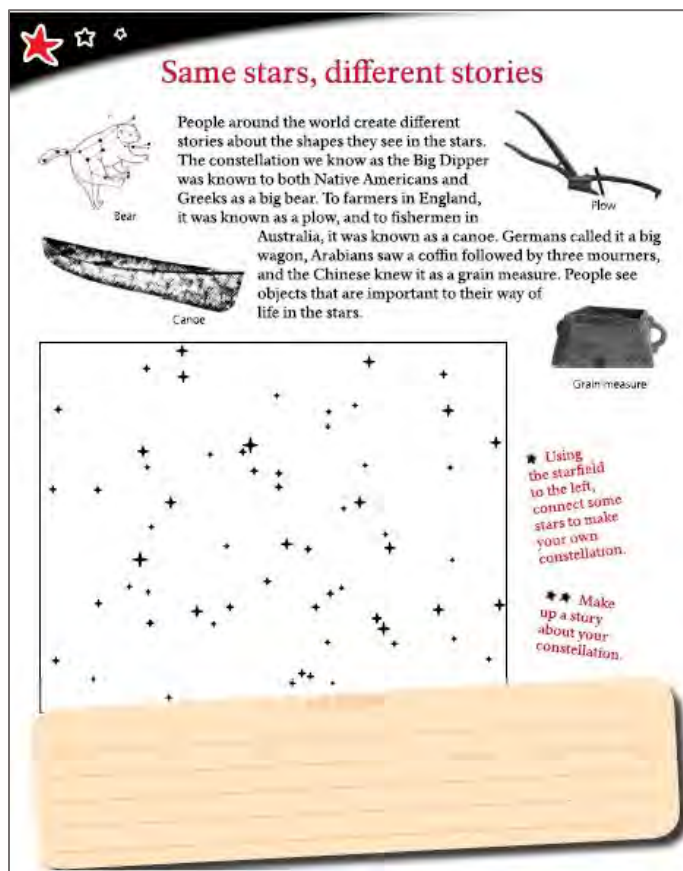


Figure 28. Clockwise from top: nocturnal insects attracted to a blacklight during an insect BioBlitz event in 2019; a scorpion detected by blacklight; a western yellow bat captured during an inventory at Saguaro NP in 2019. NPS Photo.

Previous Outreach & Education Events

SNP has *had* a robust night-themed education and outreach program for several years and is continuing to grow. The program includes a variety of activities tailored to a range of experience level and interests. These activities include youth programs, moonrise talks, star parties, and a selection of hikes during full moons from short, flat terrain to an 8-mile hike with 1,800' elevation gain. The programs are concentrated during months when the weather is most comfortable and *safe for attendees, as well as when there is a seasonal increase in staffing to lead events.*



Figures 29. Saguaro NP night sky-themed program materials. Top left: Educational program “Goodnight, Saguaro” is offered to elementary and middle school. Top right: “Help keep dark skies dark!” teaches basic principles of dark-sky friendly lighting to children and youth. Bottom: “Same stars, different stories” activity helps create personal connections to the night sky.

Table 4. Dates of 43 Night Sky Program Events held at Saguaro NP in 2019.¹

Date	District	Event	Attendance
1/3/2019	RMD	Star Party	* ²
1/4/2019	RMD	Night Walk	*
1/18/2019	RMD	Sunset & Moonrise Hike	*
1/19/2019	RMD	Sunset Hike	*
2/9/2019	RMD	Sunset Hike	4
2/15/2019	RMD	Night Walk	11
2/17/2019	RMD	Sunset & Moonrise Hike	11
2/19/2019	RMD	Full Moon Hike	11
2/22/2019	RMD	Special Group Night Walk	22
2/23/2019	RMD	Sunset Hike	14
2/28/2019	RMD	Star Party	23
3/1/2019	RMD	Night Walk	5
3/15/2019	RMD	Night Walk	11
3/17/2019	RMD	Sunset & Moonlight Hike	9
3/20/2019	RMD	Full Moon Hike	19
3/28/2019	RMD	Star Party	33
3/29/2019	RMD	Night Walk	16
4/6/2019	RMD	Sunset Hike	12
4/11/2019	RMD	Star Party	20
4/12/2019	RMD	Night Walk	13
4/15/2019	TMD	Wasson Peak Moonlight Hike	n/a
4/17/2019	TMD	Sunset Hike	n/a
4/19/2019	TMD	Moonrise Over the Mountains	n/a
4/19/2019	RMD	Full Moon Hike	15
4/20/2019	RMD	Sunset Hike	12
6/22/2019	TMD	Scorpions of the Tucson Mountains	n/a
8/15/2019	RMD	Full Moon Hike	rain
10/13/2019	RMD	Full Moon Hike	21
11/7/2019	TMD	Wasson Peak Moonlight Hike	n/a
11/9/2019	TMD	Sunset Hike	n/a
11/10/2019	RMD	Full Moon Hike	n/a
11/12/2019	TMD	Moonrise Over the Mountains	10
11/21/2019	RMD	Star Party	5 / rain
11/29/2019	RMD	Night Walk	15
11/30/2019	RMD	Sunset Hike	5
12/8/2019	TMD	Moonlight Excursion	n/a
12/11/2019	RMD	Family-Friendly Full Moon Hike	17
12/12/2019	RMD	Full Moon Hike	12

¹ Event schedule: <https://www.nps.gov/sagu/planyourvisit/calendar.htm>

² Program cancelled due to federal government shutdown.

12/13/2019	RMD	Night Walk	15
12/19/2019	RMD	Star Party	22
12/21/2019	RMD	Sunset Hike	12
12/27/2019	RMD	Holiday Caravan	85
12/28/2019	RMD	Sunset Hike	25
TOTAL			505

Table 5. Dates of **28** Night Sky Program Events at Saguaro NP in 2020.* Due to the COVID-19 pandemic, planned programs/events were suspended starting in March 2020.

Date	District	Event	Attendance
1/1/2020	TMD	Moonlight Excursion	n/a
1/4/2020	RMD	Sunset Hike	13
1/9/2020	RMD	Sunset & Moonrise Hike	7
1/10/2020	RMD	Night Walk	19
1/11/2020	RMD	Sunset Hike	15
1/16/2020	RMD	Star Party	4 (rain)
1/24/2020	RMD	Night Walk	18
1/25/2020	RMD	Sunset Hike	16
2/1/2020	RMD	Sunset Hike	14
2/7/2020	TMD	Sunset Hike	n/a
2/7/2020	RMD	Sunset & Moonrise Hike	9
2/9/2020	RMD	Full Moon Hike	9
2/9/2020	TMD	Moonrise Over the Mountains	n/a
2/15/2020	RMD	Sunset Hike	43
2/20/2020	RMD	Astronomy Night for Little Rangers	14
2/21/2020	RMD	Night Walk	16
2/21/2020	RMD	Special Group Night Walk	25
2/22/2020	RMD	Sunset Hike	2
2/29/2020	RMD	Sunset Hike	21
3/5/2020	TMD	Sunset Hike	n/a
3/5/2020	TMD	Moonlight Excursion	n/a
3/5/2020	TMD	Moonrise Over the Mountains	n/a
3/5/2020	TMD	Wasson Peak Moonlight Hike	n/a
3/6/2020	RMD	Sunset & Moonrise Hike	7
3/7/2020	RMD	Sunset Hike	13
3/9/2020	RMD	Full Moon Hike	15
3/12/2020	RMD	Star Party	rain
3/14/2020	RMD	Sunset Hike	21
TOTAL			301
<i>*Events suspended due to onset of COVID-19 pandemic*</i>			



Figure 30. A poster from a series of collaborative events between Kitt Peak National Observatory and Saguaro NP.

In the wake of the COVID-19 pandemic, the park's in-person programs were suspended in March 2020 in alignment with guidance from the Centers for Disease Control and Prevention (CDC). Programming was planned to resume in the Winter of 2021, however the emergent Omicron variant further delayed regular events until January of 2022. The long hiatus did allow staff to dedicate more time to developing and planning new types of nighttime programs, such as "Chasing Shadows", a nighttime photography workshop (see Appendix I for program descriptions).

Despite safety challenges during the COVID-19 pandemic, Saguaro NP was still able to host a small number of dark-sky activities with the Cactus Rangers, an educational youth program. The park also regularly offered virtual night sky education programs for 2nd-6th Grade classrooms over Zoom and during virtual afterschool programs. Additionally, Saguaro NP participated in the 2021 International Dark Sky Week (IDSW) on social media.

Table 6. Dates of 94 Night Sky Program Events at Saguaro NP in 2021-2022 during the COVID-19 pandemic.

Date	District	Event	Attendance
4/17/2021	Online	Virtual Astronomy Festival (w/TAAA)	>400
7/24/2021	TMD	Cactus Rangers Moonlight Hike	8
10/16/2021	TMD	Cactus Rangers Night Photography Workshop	12
1/13/2022	TMD	Wasson Peak Moonlight Hike	10
1/14/2022	TMD	Moonlight Reflections	12
1/15/2022	TMD	Sunset Hike	10
1/16/2022	TMD	Canyon Shadows	7
2/12/2022	TMD	Wasson Peak Moonlight Hike	9
2/12/2022	RMD	Sunset Hike	4
2/13/2022	TMD	Moonlight Reflections	12
2/14/2022	TMD	Sunset Hike	11
2/14/2022	RMD	Sunset Hike	7
2/15/2022	TMD	Trailing Shadows	10
2/15/2022	RMD	Sunset Hike	3
2/20/2022	RMD	Sunset Hike	8
2/21/2022	RMD	Sunset Hike	3
2/22/2022	RMD	Sunset Hike	11
2/25/2022	RMD	Sunset Hike	8
2/27/2022	RMD	Sunset Hike	10
2/28/2022	RMD	Sunset Hike	8
3/3/2022	RMD	Sunset Hike	7
3/4/2022	RMD	Sunset Hike	2
3/5/2022	TMD	Night Photography Workshop - Chasing Shadows	No Data
3/5/2022	RMD	Sunset Hike	10
3/11/2022	RMD	Sunset Hike	4
3/12/2022	TMD	Silhouettes at Sundown	13
3/13/2022	TMD	Wasson Peak Moonlight Hike	Cancelled
3/13/2022	RMD	Sunset Hike	13
3/14/2022	TMD	Moonlight Reflections	12
3/15/2022	TMD	Sunset Hike	11
3/16/2022	TMD	Trailing Shadows	10
3/16/2022	TMD	Star Party – Walter Douglas School Group	~25
3/19/2022	TMD	Night Photography Workshop (w/ Parks in Focus)	9
3/19/2022	RMD	Sunset Hike	4
3/20/2022	RMD	Sunset Caravan	3
3/26/2022	RMD	Sunset Hike	10
4/1/2022	RMD	Sunset Hike	8
4/3/2022	RMD	Sunset Hike	12
4/4/2022	RMD	Sunset Hike	12
4/8/2022	RMD	Sunset Hike	11
4/9/2022	TMD	Silhouettes at Sundown	11
4/9/2022	RMD	Sunset Hike	18

4/10/2022	TMD	Wasson Peak Moonlight Hike	14
4/11/2022	TMD	Moonlight Reflections	16
4/12/2022	TMD	Trailing Shadows	13
4/17/2022	RMD	Sunset Hike	4
4/22/2022	RMD	Dark Sky Hike	22
4/23/2022	TMD	Silhouettes at Sundown	15
4/23/2022	RMD	Dark Sky Hike	15
4/24/2022	RMD	Dark Sky Hike	23
4/25/2022	RMD	Dark Sky Hike	27
4/25/2022	RMD	IDSW Star Party w/ TAAA	50
4/26/2022	RMD	Dark Sky Hike	18
4/26/2022	RMD	IDSW Star Party w/ TAAA	30
4/27/2022	RMD	IDSW Star Party w/ TAAA	30
4/28/2022	RMD	Dark Sky Hike	15
4/29/2022	RMD	Dark Sky Hike	26
4/30/2022	TMD	Night Photography Workshop - Chasing Shadows	18
4/30/2022	RMD	Dark Sky Hike	40
5/1/2022	RMD	Sunset Hike	6
5/28/2022	TMD	Night Photography Workshop - Chasing Shadows	No data
6/3/2022	RMD	Night Comes Alive	6
6/4/2022	TMD	Silhouettes at Sundown	No data
6/18/2022	TMD	Silhouettes at Sundown	No data
6/24/2022	RMD	Night Comes Alive	4
7/1/2022	RMD	Night Comes Alive	2
7/22/2022	RMD	Night Comes Alive	0
8/12/2022	RMD	Night Comes Alive	17
9/2/2022	RMD	Night Comes Alive	8
9/10/2022	RMD	Art in the Park – Dark Sky Designs	20
9/16/2022	RMD	Night Comes Alive	13
9/23/2022	RMD	Night Comes Alive	6
9/30/2022	RMD	Night Comes Alive	2
10/1/2022	RMD	International Observe the Moon Night	3
10/14/2022	RMD	Star Party	41
10/30/2022	RMD	Night Comes Alive	10
11/4/2022	RMD	Night Comes Alive	7
11/26/2022	RMD	Night Comes Alive	3
12/2/2022	RMD	Night Comes Alive	0
12/5/2022	RMD	Night Comes Alive	2
12/9/2022	RMD	Night Comes Alive	0
12/10/2022	RMD	Sunset Hike	7
12/11/2022	RMD	Sunset Hike	9
12/15/2022	RMD	Sunset Hike	7
12/16/2022	RMD	Night Comes Alive	0
12/16/2022	RMD	Star Party	16

12/17/2022	RMD	Sunset Hike	16
12/18/2022	RMD	Sunset Hike	14
12/22/2022	RMD	Sunset Hike	10
12/23/2022	RMD	Night Comes Alive	4
12/24/2022	RMD	Sunset Hike	12
12/29/2022	RMD	Sunset Hike	28
12/30/2022	RMD	Holiday Caravan (night)	148
12/31/2022	RMD	Sunset Hike	21
TOTAL			1,586

Table 7. Dates of 123 Night Sky Program Events at Saguaro NP in 2023³.

Date	District	Event	Attendance
1/1/2023	RMD	Sunset Hike	0
1/5/2023	RMD	Sunset Hike	6
1/6/2023	RMD	Night Comes Alive	18
1/7/2023	RMD	Sunset Hike	18
1/8/2023	RMD	Sunset Hike	5
1/9/2023	RMD	Night Comes Alive	4
1/10/2023	RMD	Sunset Hike	8
1/12/2023	RMD	Night Comes Alive	4
1/12/2023	RMD	Sunset Hike	18
1/13/2023	RMD	Night Comes Alive	7
1/14/2023	RMD	Sunset Hike	17
1/15/2023	RMD	Sunset Hike	5
1/17/2023	RMD	Sunset Hike	5
1/18/2023	RMD	Night Comes Alive	2
1/19/2023	RMD	Sunset Hike	6
1/20/2023	RMD	Night Comes Alive	18
1/22/2023	RMD	Sunset Hike	15
1/23/2023	RMD	Night Comes Alive	2
1/23/2023	RMD	Sunset Hike	10
1/26/2023	RMD	Sunset Hike	6
1/27/2023	RMD	Night Comes Alive	3
1/28/2023	RMD	Sunset Hike	14
1/29/2023	RMD	Sunset Hike	11
1/30/2023	RMD	Night Comes Alive	4
1/31/2023	RMD	Sunset Hike	18
2/2/2023	RMD	Night Comes Alive	4
2/2/2023	RMD	Sunset Hike	14
2/3/2023	RMD	Night Comes Alive	2
2/5/2023	RMD	Sunset Hike	18
2/6/2023	RMD	Night Comes Alive	2
2/7/2023	RMD	Night Comes Alive	14

³ Regular night sky programs at the Tucson Mountain District have occurred throughout 2022 and 2023, but statistics are unavailable due to a staffing vacancy.

2/7/2023	RMD	Sunset Hike	14
2/9/2023	RMD	Sunset Hike	18
2/10/2023	RMD	Night Comes Alive	16
2/11/2023	RMD	Sunset Hike	8
2/12/2023	RMD	Sunset Hike	17
2/13/2023	RMD	Night Comes Alive	0
2/16/2023	RMD	Sunset Hike	18
2/17/2023	RMD	Night Comes Alive	16
2/18/2023	RMD	Sunset Hike	26
2/19/2023	RMD	Sunset Hike	17
2/20/2023	RMD	Night Comes Alive	11
2/23/2023	RMD	Sunset Hike	30
2/24/2023	RMD	Night Comes Alive	10
2/25/2023	RMD	Sunset Hike	10
2/26/2023	RMD	Sunset Hike	6
2/27/2023	RMD	Night Comes Alive	12
3/1/2023	RMD	Sunset Hike	22
3/2/2023	RMD	Night Comes Alive	0
3/2/2023	RMD	Sunset Hike	8
3/3/2023	RMD	Night Comes Alive	0
3/4/2023	RMD	Sunset Hike	17
3/6/2023	RMD	Night Comes Alive	3
3/7/2023	RMD	Sunset Hike	12
3/8/2023	RMD	Night Comes Alive	12
3/9/2023	RMD	Sunset Hike	33
3/11/2023	RMD	Sunset Hike	25
3/12/2023	RMD	Sunset Hike	14
3/13/2023	RMD	Night Comes Alive	15
3/14/2023	RMD	Sunset Hike	28
3/15/2023	RMD	Night Comes Alive	0
3/16/2023	RMD	Sunset Hike	13
3/17/2023	RMD	Night Comes Alive	12
3/17/2023	RMD	Star Party	80
3/19/2023	RMD	Sunset Hike	8
3/21/2023	RMD	Sunset Hike	5
3/22/2023	RMD	Night Comes Alive	3
3/23/2023	RMD	Sunset Hike	38
3/24/2023	RMD	Night Comes Alive	9
3/25/2023	RMD	Sunset Hike	12
3/26/2023	RMD	Sunset Hike	23
3/27/2023	RMD	Night Comes Alive	4
3/28/2023	RMD	Sunset Hike	21
3/29/2023	RMD	Night Comes Alive	5
3/30/2023	RMD	Sunset Hike	13
3/31/2023	RMD	Night Comes Alive	3
4/1/2023	RMD	Sunset Hike	22
4/2/2023	RMD	Sunset Hike	30
4/3/2023	RMD	Night Comes Alive	7

4/4/2023	RMD	Sunset Hike	14
4/6/2023	RMD	Sunset Hike	16
4/7/2023	RMD	Night Comes Alive	18
4/8/2023	RMD	Sunset Hike	29
4/9/2023	RMD	Sunset Hike	23
4/10/2023	RMD	Night Comes Alive	6
4/11/2023	RMD	Sunset Hike	8
4/12/2023	RMD	Night Comes Alive	8
4/13/2023	RMD	Sunset Hike	6
4/14/2023	RMD	Night Comes Alive	17
4/15/2023	RMD	Sunset Hike	15
4/16/2023	RMD	Sunset Hike	15
4/17/2023	RMD	Night Comes Alive	12
4/18/2023	RMD	Star Party	200
4/18/2023	RMD	Night Comes Alive	8
4/19/2023	RMD	Night Comes Alive	13
4/20/2023	RMD	Night Comes Alive	16
4/20/2023	TMD	Dark Skies over Saguaro	200
4/21/2023	RMD	Night Comes Alive	15
4/22/2023	RMD	Night Comes Alive	16
4/22/2023	RMD	Star Party	164
4/23/2023	RMD	Night Comes Alive	17
4/25/2023	RMD	Sunset Hike	14
4/26/2023	RMD	Night Comes Alive	8
4/27/2023	RMD	Sunset Hike	3
4/28/2023	RMD	Night Comes Alive	6
4/29/2023	RMD	Sunset Hike	11
4/30/2023	RMD	Sunset Hike	6
5/1/2023	RMD	Night Comes Alive	13
5/2/2023	RMD	Sunset Hike	7
5/3/2023	RMD	Night Comes Alive	3
5/4/2023	RMD	Sunset Hike	7
5/6/2023	RMD	Night Comes Alive	5
5/8/2023	RMD	Explore the Night	22
5/10/2023	RMD	Explore the Night	2
5/12/2023	RMD	Explore the Night	16
5/13/2023	RMD	Explore the Night	2
5/15/2023	RMD	Explore the Night	4
5/17/2023	RMD	Explore the Night	4
5/20/2023	RMD	Explore the Night	8
5/22/2023	RMD	Explore the Night	5
5/24/2023	RMD	Explore the Night	14
5/26/2023	RMD	Explore the Night	3
5/26/2023	RMD	Explore the Night	9
5/29/2023	RMD	Explore the Night	11
TOTAL			2,023

COMMUNITY SUPPORT

Saguaro NP has an extensive network of supporters for designating the park as an UNSP. Funding for uncompliant lighting fixture replacement was provided by the Friends of Saguaro National Park. Pima County has long supported dampening the effects of urbanization on the park with the 1988 passage of the Pima County Buffer Overlay Zone. This zoning ordinance attenuates the effects of the city, including lighting, on the park. Furthermore, the City of Tucson and Pima County support dark skies initiatives as with the passage of the 2012 Outdoor Lighting Code. See Appendix A – Lighting Management Plan for supporting management documents. Within the NPS, we also receive support from technical specialists in the Natural Sounds & Night Skies Division and Air Quality Divisions.

The park has proactively reached out to community partners and adjoining neighborhoods to inform them about our UNSP application and have received letters of support from seven organizations. See Appendix B for Letters of Community Support.



Figure 31. The Milky Way seen over the historic Manning Cabin located at high elevation in the Rincon Mountains, Saguaro NP. Photo: NPS/ S. Bolyard.

PLANS FOR NIGHTTIME VISITOR USE

Night sky programs and events are among the most popular at the park. With a warm climate, visitors are often eager to have outdoor activities in the evenings. Park trails are open 24 hours per day, and the Cactus Forest Loop Drive at RMD closes to vehicles in the evenings but is open to hikers and cyclists

throughout the evening and night. With the great response to our night sky programs, we anticipate growth in interest and utilization to continue to increase going forward.

Tumacácori National Historical Park is a close partner of Saguaro NP and a certified International Dark-Sky Place. As a result of this strong established relationship, Tumacácori NHP has already committed to working closely with Saguaro to cross-promote and collaborate on night sky initiatives. We plan to continue developing partnerships with the nearby observatories and other DarkSky designations in our area, working towards common goals and increasing community interest. See Appendix B for formal agreement.

Additionally, we have created a Dark-Sky webpage (<https://www.nps.gov/sagu/dark-skies-over-saguaro.htm>) that is in the process of being built out to reach virtual park visitors. This site will include educational information on nocturnal wildlife, effects of light pollution, dark-sky friendly lighting practices, UNSP certification, community resources, and the value of dark skies.

LIGHT FIXTURE RETROFITS

In 2020, Dr. Bryan Boulanger (Professor of Civil and Environmental Engineering, Ohio Northern University) traveled to SNP to conduct a Lighting Inventory in partnership with SNP staff. Boulanger has worked closely with the NPS for several years and has extensive experience conducting lighting inventories at NPS units across the country. Out of a total 187 fixtures, this initial assessment concluded that 72 fixtures required action to meet DarkSky standards.

The findings of Boulanger's assessment were used to obtain support and funding from the Friends of Saguaro National Park (FOSNP), a close partner and local non-profit organization. FOSNP raised a total of \$6000 in private donations to commit to the dark-sky project and use towards purchasing recommended DarkSky-compliant lighting retrofits. See Appendix C for documentation of allotted FOSNP funding and spending records. The new fixtures were procured and installed in-house by the Saguaro NP Maintenance & Facilities staff.

SNP staff have implemented the actions recommended by Boulanger and additional recommendations from DarkSky International staff. Currently, 16 fixtures (9%) of the park's total 187 remain incompatible with the standards for an Urban Night Sky Place.












Figure 32. NPS interns receive hands-on training retrofitting fixtures at the TMD. NPS Photo.



Figure 33. Retrofitted wall sconces at the TMD Maintenance building fully shield light but preserve safety for employees working in dark conditions. NPS Photo.

Table 8. Tucson Mountain District light fixtures in compliance with DarkSky International standards.

Location	Fixture ID	Image	Description (fixture, lamp, height, CCT)	Fully Shielded	Application	Special Purpose	DarkSky Compliant	Comments
Red Hills Visitor Center	146-148		3 wall sconces, LED, 9.5', 2700 K	Yes	Pathway	No	Yes	
	149		1 recessed light, LED, 9.5', 2700 K	Yes	Entrance/ Egress	No	Yes	
	143-145, 150-152, 154-156, 160, 163		11 recessed lights, LED, 9.5'-12.5', 1600-2700 K	Yes	Entrance/ Egress or Area	No	Yes	
	153, 161-162		3 recessed lights, fluorescent, 9.5'-12.5', 2700K	Yes	Entrance/ Egress or Area	No	Yes	
	157-159, 164-172, 176-188		25 recessed lights, LED, 1', 2700 K	Yes	Pathway	No	Yes	
	132-142		11 bollards, no lamp, 3', n/a	-	-	Physical Protection	Yes	Fixtures decommissioned; bollards remain in place for physical barrier
Operations Building	118-122		5 wall sconces, LED, 8', 5000 K	Yes	Area	Motion Sensor	Yes	Controlled by standalone motion sensor on 5-minute timer
	123-130		8 recessed lights, LED, 9.5', 1600-2700 K	Yes	Area	No	Yes	
	131		1 wall sconce, LED, 7', 2700 K	Yes	Entrance/ Egress	No	Yes	


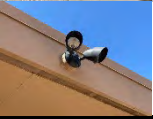










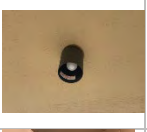









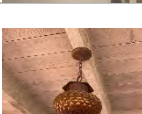

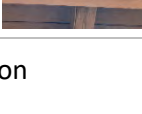
Quarters 30, 31, 32	99-105		7 wall sconces, LED, 7', 2700 K	Yes	Area	No	Yes	
	110, 113-115		4 flood lights, halogen, 9', 2700 K	Yes	Area	No	Yes	
Maintenance	89-90, 93-94, 96-98		7 wall sconces, LED, 8'- 9.5', 2700 K	Yes	Area	No	Yes	
	95		1 ceiling mount, fluorescent, 10.5', 3000 K	Yes	Entrance/ Egress	Motion Sensor	Yes	Under covered awning; flat cover on fixture
	91-92		2 ceiling mounts, fluorescent, 10.5', 5000 K	No	Area	Timer Switch; Safety/ Security	Yes	Under covered awning in recessed maintenance storage area; operated with 5-minute timer





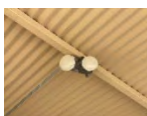












Table 9. Rincon Mountain District light fixtures in compliance with DarkSky International standards.

Location	Fixture ID	Image	Description (fixture, lamp, height, CCT)	Fully Shielded	Application	Special Purpose	DarkSky Compliant	Comments
Fire Operations	1-3		3 lamp posts, HPS, 16', 1800 K	Yes	Parking	No	Yes	
	4-9		6 recessed lights, HPS, 4', 1800 K	Yes	Entrance/ Egress	No	Yes	
	10-11		2 wall sconces, LED, 7', 2700 K	Yes	Entrance/ Egress	No	Yes	
Quarters 14, 15, & 16 (National Register District – Eligible)	35		1 flood light, halogen, 7', 2700 K	Yes	Entrance/ Egress	Motion Sensor	Yes	Halogen lamp w/ motion sensor
	38-39		2 wall sconces, LED, 7', 2700 K	No	Entrance/ Egress	Historic	Yes	Mission 66 historic structure; bulbs replaced with soft white, LED, 2700 K, 450 lumen bulb.
Headquarters/ Annex	45, 52		2 wall sconces, fluorescent, 7', 2700 K	Yes	Entrance/ Egress	No	Yes	
	46		1 wall sconce, fluorescent, 7' 1600 K	Yes	Entrance/ Egress	Motion Sensor	Yes	
	47-50		4 ceiling mounts, LED, 8.5', 2700 K	Yes	Pathway	No	Yes	
	59		1 ceiling mount, LED, 8' 2700 K	Yes	Area	No	Yes	

Rincon Mountain Visitor Center (National Register - Listed)	53-58		6 ceiling mounts, fluorescent, 10', 2700 K	Yes	Area	Historic	Yes	Mission 66 Historic Structure; bulbs replaced with soft white, LED, 2700 K, 450 lumen bulb.
	61-62		2 wall sconces, LED, 9', 2700 K	No	Area	Historic	Yes	
	63, 65-68		5 recessed lights, LED, 1', 3000K	Yes	Pathway	No	Yes	
	64, 69-76		9 in-ground, LED, 0', 3000 K	No	Pathway	Timer; Safety/ Security	Yes	Operated by timer; fixtures used for initial orientation during night sky programs in outdoor patio then turned off as program begins.
	77-78		2 wall pack lights, LED, 8', 1600 K	Yes	Area	No	Yes	
Greene Property (National Register - Eligible)	12		1 wall sconce, no lamp, 6', n/a	No	Entrance/ Egress	Historic	Yes	Decommissioned, fixture left in place for historic appearance
	13		1 wall sconce, no lamp, 6', n/a	No	Entrance/ Egress	Historic	Yes	
	16		1 wall sconce, no lamp, 6', n/a	No	Entrance/ Egress	Historic	Yes	
	19-20		2 wall sconces, no lamp, 6', n/a	No	Entrance/ Egress	Historic	Yes	
	23-24		2 hanging lights, incandescent, 7.5', 2700 K	No	Area	Historic	Yes	
	14, 15, 17, 18, 22, 25, 26, 28		8 flood lights, no lamp, 8-10', n/a	N/A	N/A	No	Yes	Fixtures removed

	21		1 lamp post, LED, 28', 3000 K	Yes	Area	No	Yes	
	27		1 wall sconce, LED, 6', 2700 K	No	Entrance/Egress	Historic	Yes	National Register eligible property: bulb replaced with soft white, LED, 2700 K, 450 lumen bulb; structure and fixture are not used at night
Helipad	29-30		2 ceiling mounts, LED, 11.5', 2700 K	Yes	Area	No	Yes	
	31-32		2 wall sconces, LED, 8.5', 2700 K	Yes	Area	No	Yes	
	33		1 flood light, LED, 7', 2700 K	No	Entrance/Egress	Timer; Safety/Security	Yes	

Table 10. Fixtures Not Yet Compliant with DarkSky International's standards for Urban Night Sky Places.

Location	Fixture ID	Image	Description (fixture, lamp, height, CCT)	Fully Shielded	Application	Special Purpose	DarkSky Compliant	Additional Image	Comment
Rincon Mountain District									
Rincon Mountain Visitor Center	60		1 ceiling mount, fluorescent, 8', 2700 K	Yes	Area	No	Pending		
Horse Corral	40 41		2 ceiling mount, LED, 8'-10', 2700 K	Pending	Area	Safety/ Security	Pending		Mules are loaded at corral once per week in summers between 4 AM to 6 AM. In the short-term, SNP will install a timer for minimal compliance; however, long-term plans for the location are to improve illumination of the corral and tack shed with dark sky friendly lighting that will enhance safe work around pack stock.
	42 43		2 flood lights, LED, 9-11', 5000 K	Pending	Entrance/ Egress	Safety/ Security	Pending		
Quarters 14,15,16	34, 37, 85-88		6 flood lights, LED, 7', 5000 K	Yes	Entrance/ Egress	Motion Sensor	Yes		All 14 floodlights are on 5-minute timers and minimally compliant. These fixtures will be replaced with night sky friendly models.
Headquarters/Annex	44, 51		2 flood lights, LED, 8', 5000 K	Yes	Entrance/ Egress	Motion Sensor	Yes		
Maintenance	79-84		6 flood lights, LED, 8-12', 5000 K	Yes	Entrance/ Egress	Motion Sensor; Safety/ Security	Yes		
Tucson Mountain District									
Quarters 30, 31, 32	106 107		2 ceiling mounts, fluorescent, 9.5', 3000 K	Pending	Area	No	Pending		Buildings eligible for the National Register of Historic Places. Lights are being evaluated with the SNP Archeologist to assess mitigation options.
	108 109		2 ceiling mounts, fluorescent, 9.5', 2700 K	Pending	Area	No	Pending		
	111 112 116 117		4 ceiling mounts, fluorescent, 9.5', 2700 K	Pending	Area	No	Pending		
Red Hills Visitor Center	173 174 175		3 recessed lights, LED, 7.5', 2700 K	Pending	Entrance/ Egress	No	Pending		Fixtures will be replaced in alignment with DarkSky standards.

Non-Compliant Fixtures Planned for Future Mitigation

Twelve fixtures (#60, 106, 107, 108, 109, 111, 112, 116, 117, 173, 174, 175) are located beneath architectural features that prevent upward skyglow, but project light horizontally. SNP staff misclassified these fixtures as compliant during the initial assessment, but after further consultation with DarkSky staff has plans to replace. These fixtures were not included in the original budget request from Friends of Saguaro National Park. The fixtures will be replaced in FY2024.

Four fixtures (#40, 41, 42, 43) at the Horse Corral are also planned for further mitigation. The current lights are typically used from 4:00 AM to 6:00 AM, once a week during the packing season (March to November) and are operated by switch. SNP will be putting these lights on a two-hour timer in the short-term to provide minimal UNSP compliance with a safety exemption. Longer-term, a holistic plan will be developed for the corral to improve illumination in this area while adhering to UNSP standards.

In summary, 16 fixtures (11 at TMD; 5 at RMD) are pending replacement. This represents 9% of the total 187 fixtures at SNP. SNP is committed to bringing the park to 100% compliance, with plans to complete this work in FY2024.

ADDRESSING FUTURE THREATS

Increased development continues to be one of the greatest threats to preserving the night sky at SNP. The park actively monitors any development projects close to our border which may have an impact on the park. We work closely with the City of Tucson, Pima County, and project proponents to raise awareness about the potential impacts and find solutions to lessen those impacts whenever possible. UNSP certification aligns with the park's efforts to advocate for preservation and improvement of dark skies through responsible outdoor lighting practices and planning.

Although skyglow from the adjacent urban area limits the park from pursuing a higher level of DarkSky certification, our proximity to Tucson provides exceptional opportunities for people to connect to night skies. Experiencing the night sky from within the Saguaro Wilderness can be spectacular for nearby city dwellers. The number of visible stars drastically increases just a short distance into the park compared to within Tucson. Saguaro NP is readily accessible to the community, about a 20-minute drive to either district from the center of town. In addition, we connect with those that cannot drive to the park through a variety of outreach programs like the Mobile Ranger, and digitally over social media and the park's website. We will continue to share the message that even near an urban center such as Tucson, quality darkness does exist. It can be found not only in natural spaces, but also where artificial outdoor lights are used properly. There are easy changes we can make to our outdoor lighting that will make a big difference in our night skies when we all work together. Improving the natural darkness of our night skies is a worthy and achievable goal.

The park relies on outreach and education to spread awareness about the value of natural darkness, teach strategies to mitigate light pollution, and encourage connections to the night sky. Our nighttime programming has been ongoing for several years and will continue to develop. Additionally, we hope to serve as a role model to the community and facilitate conversations about collaborating to protect the night sky. The City of Tucson already has strong lighting policies in place. Still, the park aims to empower more people to convert their existing lighting fixtures to dark-sky friendly standards at home. Our retrofitted lighting fixtures demonstrate how fully shielded lower-intensity lighting still provides adequate illumination for safety. These steps move us forward and expand the dark-sky movement.

Awareness of dark skies and responsible lighting practices has grown internally at the park while pursuing the UNSP certification. Previously, the Interpretation Division was the only work unit actively working with dark sky topics. Now, a park-wide, interdisciplinary awareness has been created around these topics and implications for park resources and visitors.

Earning UNSP certification is an achievement that the park looks forward to celebrating. We hope to host a celebratory event with our partners, including DarkSky International, FOSNP, and TAAA. We look forward to joining the community of designated DarkSky-certified areas and continuing to build partnerships between the National Park Service and other organizations and individuals in the stewardship of dark night skies.

APPENDIX A. Saguaro National Park Lighting Management Plan



National Park Service
U.S. Department of the Interior
Saguaro National Park
Tucson, Arizona

Lighting Management Plan



NPS Photo: Starry night and city sky glow seen from Saguaro National Park, Tucson Mountain District.

Lighting Management Plan

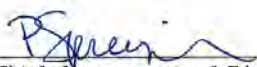
Saguaro National Park

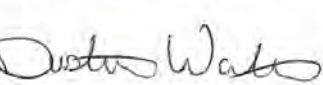
SEPTEMBER 2023


Approved:  9/25/2023
Superintendent

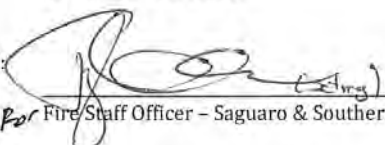
Concurred:  9/25/2023
Chief of Science & Resource Management

Concurred:  9/25/23
Chief of Facilities Management

Concurred:  9/25/2023
Chief of Interpretation & Education

Concurred:  9/25/2023
Chief of Visitor & Resource Protection

Concurred:  9/25/23
Administration Officer

Concurred:  9/25/2023
For Fire Staff Officer - Saguaro & Southern Arizona Parks Group

Concurred:  9/25/2023
Zone Safety Manager, Southern Arizona Parks

PURPOSE

Saguaro National Park (SNP) is located within a region that preserves and widely celebrates dark night skies. The park is surrounded by world-class astronomical research programs and a community of night sky enthusiasts operating from Kitt Peak National Observatory, Mount Graham International Observatory, Fred Lawrence Whipple Observatory, Steward Observatory, Mount Lemmon Observatory, and shares a hometown with the headquarters for DarkSky International. SNP has an important role in collaborating with these many partners to support the stewardship and promotion of night sky resources.

The objectives of this Lighting Management Plan (LMP) are to:

- Establish a formal policy for protecting night sky resources.
- Outline best practices for managing outdoor lighting in park operations.
- Identify interpretation and education programs that promote awareness and stewardship for protecting dark skies, wildlife conservation, human health, and energy consumption/loss.
- Provide guidelines for use of lights by park visitors and partners.
- Establish operational procedures that enable the park to be certified as an Urban Night Sky Place (UNSP) and maintain that status over time.

While preserving natural darkness is the principal objective for this LMP, these actions have cross-cutting benefit to a diversity of NPS management objectives: protecting park resources; reducing energy use; providing for public enjoyment; and supporting researchers and scientific interests of the night sky and related topics. Furthermore, implementation of this plan will benefit a wide array of special designations that overlap the park boundary:

- Saguaro Wilderness
- Tucson Mountain Park Historic District
- Santa Cruz Valley National Heritage Area
- Arizona National Scenic Trail
- Tucson Sky Islands Important Bird Area
- Tucson Mountains Important Bird Area

This plan was developed in alignment with the City of Tucson and Pima County's Outdoor Lighting Code (2012) and guiding principles from DarkSky International.

LEGAL REQUIREMENTS, AUTHORITIES & POLICIES

An assortment of laws and directives at the bureau, park, and local community levels serve as guidelines for this LMP. From the NPS Organic Act (1916) to the Superintendent's Compendium (2021), more than a century of management directives and guidance documents were consulted in development of this LMP. This document also references county and city policies and ordinances for additional guidance. This LMP meets or exceeds all applicable agency policies regarding outdoor lighting, and adheres to all the following national, regional, and local laws, regulations, and ordinances.

SERVICEWIDE & NATIONAL-LEVEL GUIDANCE

NPS Organic Act (1916). The Organic Act was passed to protect and manage national park lands of the United States. The act directs the broad preservation of ecological and scenic values within federal lands.

"The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The Wilderness Act (1964). The Saguaro Wilderness was federally designated in 1976 with the full protections afforded by the Wilderness Act. This designated wilderness area comprises 77% of SNP's area. The park manages this area in accordance with the Wilderness Act to preserve naturalness, opportunities for solitude, and untrammeled qualities, which benefits dark night skies and their enjoyment.

NPS Management Policies (2006), § 4.10 Lightscape Management. Within this service-wide management document, this section outlines general guiding principles for lighting along with specific guidance for park operations:

"The Service will preserve, to the greatest extent possible, the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light. The stars, planets, and earth's moon that are visible during clear nights influence humans and many other species of animals, such as birds that navigate by the stars or prey animals that reduce their activities during moonlit nights."

Improper outdoor lighting can impede the view and visitor enjoyment of a natural dark night sky. Recognizing the roles that light and dark periods and darkness play in natural resource processes and the evolution of species, the Service will protect natural darkness and other components of the natural lightscape in parks. To prevent the loss of dark conditions and of natural night skies, the Service will minimize light that emanates from park facilities, and also seek the cooperation of park visitors, neighbors, and local government agencies to prevent or minimize the intrusion of artificial light into the night scene of the ecosystems of parks."

The Service will

- *restrict the use of artificial lighting in parks to those areas where security, basic human safety, and specific cultural resource requirements must be met;*
- *use minimal-impact lighting techniques;*
- *shield the use of artificial lighting where necessary to prevent the disruption of the night sky, natural cave processes, physiological processes of living organisms, and similar natural processes. The decision about whether or not to install artificial lighting in particular circumstances is left to the discretion of the superintendent and is made through the planning process."*

The NPS Director's Call to Action Report (2011). The Director's Call to Action Report outlines 36 action items to kick off the second century of the National Park Service. Dark-sky initiatives were identified among the Service's highest-level goals.

"Starry, Starry Night: Action 27: Lead the way in protecting natural darkness as a precious resource and create a model for dark sky protection by establishing America's first Dark Sky Cooperative on the Colorado Plateau in collaboration with other federal agencies, partners, and local communities."

The Green Parks Plan (2012). The Green Parks Plan is a long-term strategic plan for management of NPS operations in a sustainable manner, and identifies careful lighting management as a component of meeting those objectives:

"The NPS will minimize the impact of facility operations on the external environment. Outdoor experiences can be adversely affected by facility operations. Exterior lighting can reduce dark night sky quality and vehicle traffic can diminish the natural silence and sounds of an ecosystem. Reducing the impact of NPS operations on the environment will improve the visitor experience and protect natural and cultural resources through the preservation of night skies, natural sounds, water quality, ecosystems, and viewsheds."

Objectives: (1) The NPS will reduce light pollution from park facilities with the goal of dark night sky preservation...(3) The NPS will ensure that all facilities and operations are sustainably integrated into the park landscape to minimize impact on the natural and cultural environment."

PARK-LEVEL GUIDANCE

Saguaro NP General Management Plan (2008). The GMP identifies management of the lightscape and night sky as priority resource management objectives:

- *The National Park Service will cooperate with park visitors, neighbors, and local government agencies to find ways to prevent or minimize the intrusion of artificial light into the night scene in the park.*
- *In natural areas, artificial outdoor lighting will be limited to basic safety requirements and will be shielded when possible.*
- *The park staff will evaluate the impacts on the night sky caused by park facilities. If light sources in the park are affecting night skies, the staff will study alternatives such as shielding lights, changing lamp types, or eliminating unnecessary sources.*

Saguaro NP Foundation Document (2014). The park's Foundation Document identifies night skies as a valuable resource, particularly within the Saguaro Wilderness. The document also identifies threats to night skies from increasing urbanization surrounding the park and the need for the park to gather additional data for improving the preservation of dark night skies.

Saguaro NP Natural Resource Condition Assessment (2017). This technical document identifies significant park resources and characterizes their current condition and trend towards improvement or degradation. The assessment identifies the night sky as a priority resource at risk due to encroaching urbanization surrounding the two districts. The document concludes that

current conditions of night sky viewing within the park as a significant concern and identifies collaborating with the external sources of light pollution to reduce impacts within the park.

Saguaro NP Resource Stewardship Strategy (2019). This planning document identifies dark night skies as a high priority resource with the following stewardship goals:

- *Review current all-sky data to assess if current conditions have been altered and require new all-sky data to be collected....*
- *Work with [the NPS Night Sky & Natural Sounds Division] to model, study, and analyze how....developments could impact the park's nocturnal environment and model/analyze potential light mitigation.*
- *Ensure night sky-related research is incorporated into park education and interpretation program.*
- *Encourage and promote dark sky-related activities in the park, even if conducted by non-NPS people or organizations (e.g., classes, events).*
- *Continue park-run education and interpretive programs related to the importance of dark night skies and nocturnal environment.*
- *Add information to the park's website about night skies and its values to park resources and share with partners who may be unaware of the issue.*

Saguaro NP Superintendent's Compendium (2021), 36 CFR 2.2 – Wildlife Protection. The compendium outlines prohibited uses of lighting by visitors because of impacts to wildlife:

(e) The following areas are closed to the viewing of wildlife with the use of an artificial light: All areas within park boundaries are closed to the use of artificial lights (other than UV) for the purpose of viewing wildlife. The Superintendent may, on a case-by-case basis, approve the use of artificial light for the purpose of filming or scientific viewing of wildlife in accordance with DO/RM-53 Filming Guidelines and Saguaro Resource Management Guidelines. Determination: Animal's natural habits and activities can be adversely affected while being artificially illuminated. Some of these activities include feeding, resting and mating.

LOCAL-LEVEL GUIDANCE

Pima County Buffer Overlay Zone (1988). This county ordinance established a one-mile buffer around parks to lessen impacts from the urbanized area on SNP and other parks within the county. With respect to lighting, it indicates that,

"[E]xternal lighting shall be limited to that necessary to provide the functional requirements of safety, security and identification, and shall be in accordance with the county outdoor lighting code (Title 15)."

City of Tucson/Pima County Outdoor Lighting Code (2012). This code jointly adopted by the City of Tucson and Pima County outlines parameters set forth to meet progressive lighting management objectives. SNP benefits from this code and supports it through implementation of this LMP,

"The purpose of this code is to preserve the relationship of the residents of the City of Tucson, Arizona and Pima County, Arizona to their unique desert environment through protection of access to the dark night sky. Intended outcomes include continuing support of astronomical

activity and minimizing wasted energy, while not compromising the safety, security, and wellbeing of persons engaged in outdoor nighttime activities. It is the intent of this code to control the obtrusive aspects of excessive and careless outdoor lighting usage while preserving, protecting, and enhancing the lawful nighttime use and enjoyment of any and all property. It is recognized that developed portions of properties may be required to be unlit, covered, or have reduced lighting levels in order to allow enough lumens in the lighted areas to achieve light levels in accordance with nationally recognized recommended practices."

OUTDOOR LIGHTING GUIDELINES

The general park policy for lighting is to favor natural darkness, except where lighting is needed for minimum safety and security purposes. With 77% of the park being designated as wilderness for the past 45 years, the vast majority of the park has a long history of being managed to limit artificial lighting.

Park use of artificial outdoor lighting is concentrated in six developed areas across the two districts (Table 1). The park has 187 external fixtures. All fixtures are either compliant with dark sky standards or planned for modification to these standards within the next year.

Table 1. Developed Areas at Saguaro National Park with Artificial Lighting.

District	Area
Rincon Mountain District	Administrative complex, including Visitor Center, maintenance facility, offices, and residence
	Corral & tack shed
	Helibase and USGS Geomagnetic Observatory
	Historic Gist House (Greene Property)
	Fire building
Tucson Mountain District	Administrative complex including Red Hills Visitor Center, maintenance facility, offices, and residences

Lighting of vehicle exteriors, tents, and other personal property belonging to park visitors shall be limited by the park in such a way as to provide for reasonable use while maintaining the natural character of the park and avoiding the creation of nuisance for other visitors. All lighting shall be restricted in intensity and extent to provide for the legitimate needs of visitors at their campsites and shall be extinguished no later than the general park curfew hour. Inappropriate, high-intensity light painting of park landscapes, the use of searchlights, and similar uses of outdoor lighting by visitors is prohibited.

The park will maintain adherence to DarkSky International's standards for Urban Night Sky Places by utilizing the following guidelines:

- **Location.** No new lighting will be installed outside the six developed areas identified in Table 1 unless necessary for safety and/or security purposes. Any new properties acquired by the park will be brought into adherence with DarkSky International standards. New infrastructure projects in these developed areas will not include exterior lighting unless necessary for minimum safety requirements to meet OSHA standards. In these cases, the lighting elements will adhere to the parameters of this LMP. Additionally, no illuminated signs will be installed.
- **Technical Specifications.** All fixtures will be fully shielded to minimize light trespass, glare, and skyglow. Fully shielded lighting fixtures must either be constructed so that all the light emitted by the fixtures is projected below the horizontal plane of the lowest point of the fixture in all directions or installed in locations where the architectural details of the building ensure that emitted light is projected below the horizontal plane of the lowest point of the eave in all directions.

Warm white LED lighting will be used, and strong blue-content lighting will not be used. Lamps are not to exceed a correlated color temperature (CCT) of 3000 K. The only exceptions will be for timer-controlled (less than five-minute duration), motion-triggered security lights; short-duration irregular use of safety lighting, when necessary, as determined by the Zone Safety Manager and park Safety Officer; or where consultation with the Arizona SHPO the park determines that a fixture contributes to the historical significance of the building. In these cases of historic buildings, the fixture and its operation will follow the parameters of the *Historic Structures* section of this document.

- **Time of Operation.** Lighting in developed areas past regular daytime operation hours generally reduces visitors' enjoyment of the park at night. For this reason, all outdoor lighting will be turned off except minimal lighting necessary for visitor safety, security lights managed by motion-sensor and timer-controlled (less than five-minute duration), or when used specifically for limited-duration interpretation programs. Products with dimming, motion-sensor, and timer capabilities will be considered when installing any new required safety lighting in developed areas.
- **Energy Efficiency.** When selecting replacement lamps and fixtures, units will be purchased that optimize energy efficiency. Traditional incandescent lighting will not be used and will be replaced by warm white LED lighting or other high-efficiency, low blue light alternatives (CCT \leq 3000 K). Strong blue light-content lamps will not be used despite energy efficiency due to the negative impacts to skyglow, wildlife health, and human health.
- **Periodic Inspection.** Park staff will periodically conduct comprehensive assessments of all lighting to ensure that the standards of this LMP are maintained over time and identify any additional measures that may be taken to enhance the goals of this LMP.

HISTORIC STRUCTURES

The park has several structures that are either eligible or listed on the National Register of Historic Places. All lighting fixtures and lamps compatible with the period of significance will be maintained in consultation with the structures' Determinations of Eligibility and in consultation with the Arizona State Historic Preservation Office. Any fixtures not necessary for safe egress or beneficial to the historic interpretation of the facility will be disabled from use. For fixtures that are necessary, under DarkSky International guidance, unshielded lighting will utilize lamps with less than 500 lumens and correlated color temperature less than 3000 K.

OUTREACH & EDUCATION

For several years, SNP has had a robust education and outreach program focused on the night sky. This program has included partnerships with Kitt Peak Observatory, full moon hikes, moonrise events, star parties, tabling events, Visitor Center displays, and social media posts. The park will continue to offer these programs and expand outreach through increased partnerships. After receiving certification, the park will post DarkSky International certification signage at the Visitor Centers for both districts to inform the public about the park's status as an Urban Night Sky Place.

In alignment with DarkSky International recommendations, the park will also collaborate in promoting other dark-sky places within 100 km. For SNP, those places include Tumacacori NHP, Oracle State Park, and Kartchner Caverns State Park. Additionally, prominent observatories at Kitt Peak, Mount Lemmon, Mount Graham, and Mount Hopkins all fall within that 100 km distance. The park will work with these partners to raise the profile of dark-sky resources through outreach and education programs.

REPORTING & REVIEW

DarkSky International requires that Urban Night Sky Places submit an annual report each January. SNP will adhere to those guidelines by continuing to collect and report on night sky darkness readings throughout the year. Additionally, the park will review this plan annually to identify any potential improvements and periodically conduct comprehensive review of all lighting to ensure ongoing compliance with this plan.

REFERENCES

- Albers, S. & D. Duriscoe. 2001. Modeling light pollution from population data and implications for National Park Service Lands. *The George Wright Forum* 18(4): 56-68.
- Boulanger, B. September 2020. External lighting assessment conducted for Saguaro National Park. Report to Saguaro National Park.
- City of Tucson & Pima County. 2012. Outdoor Lighting Code. Adopted by City of Tucson Ordinance #10963 on February 7, 2012. https://www.tucsonaz.gov/files/pdsd/codes-ordinances/2012_outdoor_lighting_code.pdf
- National Park Service Organic Act. 1916. **54 U.S.C. §§ 100101 et seq.** 1970.
- National Park Service. 2006. Management Policies, Section 4.10 Lightscape Management. https://www.nps.gov/policy/MP_2006.pdf
- National Park Service. 2007. Interim Lighting Guidelines (Draft). National Park Service Report.
- National Park Service. 2011. Director's Call to Action. National Park Service Report. https://www.nps.gov/calltoaction/PDF/Directors_Call_to_Action_Report.pdf

- National Park Service. 2012. The Green Parks Plan
<https://www.nps.gov/subjects/sustainability/upload/NPS-Green-Parks-Plan-2016.pdf>
- Pima County. 1988. Buffer Overlay Zone Ordinance. Chapter 18.67. http://pimacounty-az.claws.us/code/coord_title18_ch18.67
- Saguaro National Park. 2008. General Management Plan.
https://www.nps.gov/sagu/learn/management/upload/SAGU_Abbrev_WEB_part1.pdf
- Saguaro National Park. 2014. Foundation Document.
https://www.nps.gov/sagu/learn/management/upload/SAGU_FD_2014-2.pdf
- Saguaro National Park. 2017. Natural Resources Condition Assessment. National Park Service Publication.
- Saguaro National Park. 2019. Resource Stewardship Strategy. National Park Service Publication.
- Saguaro National Park. 2019. Superintendent's Compendium.
<https://www.nps.gov/sagu/learn/management/upload/SAGU-Superintendent-s-Compendium-2019-FINAL.pdf>
- Valentine-Darby, P., L. Baril, K. Struthers, C. Filippone, D. Swann, A. Mathis, and N. Chambers. 2017. Saguaro National Park: Natural resource condition assessment. Natural Resource Report NPS/SODN/NRR—2017/1364. National Park Service, Fort Collins, Colorado.
- Wilderness Act. 1964. The Wilderness Act. Public Law 88-577 (16 U.S.C. 1131-1136).
<http://wilderness.nps.gov/document/wildernessAct.pdf>

APPENDIX B: Letters of Nomination & Support



Southern Arizona Chapter

May 17, 2021

International Dark-Sky Association
Board of Directors
5049 E. Broadway Blvd. #105
Tucson, Arizona 85711

RE: NOMINATION OF SAGUARO NATIONAL PARK FOR URBAN NIGHT SKY PLACE

Dear IDA Board of Directors,

As a Lifetime Member of the International Dark-Sky Association (IDA) and the Southern Arizona IDA Chapter Leader, it gives me great pleasure to nominate the Saguaro National Park (East and West locations) to be designated as an Urban Night Sky Place (UNSP) per IDA requirements. The Park is located in the Greater Tucson, Arizona area.

Our Southern Arizona IDA Chapter has been working for over twenty-five years to carry out the IDA mission focusing on education of citizens to help them understand the importance of protecting and restoring our night skies. We cover the Greater Tucson area from Nogales, Arizona to the North of Tucson. Saguaro National Park has one location to the East of Tucson and one to the West of Tucson. These areas serve over a million residents plus many out of area visitors. Having the Park designated an International Dark-Sky UNSP, in conjunction with their ongoing educational outreach activities would be a huge asset for all of us to help carry out the IDA mission. We have more amateur and professional astronomers and telescopes in our area than anywhere else in the USA. Every part of the dark sky that the United States Department of the Interior, National Park Service can help preserve and share with the public is important to our area.

If approved, our Chapter is available to assist Saguaro National Park staff as necessary to be sure their UNSP status is maintained. Thank you for your consideration to include this very significant and important National Park.

Sincerely,

A handwritten signature in black ink, appearing to read 'Joe Frannea', written in a cursive style.

Joe Frannea
Chapter Leader
(520) 575-7126

joef@sa-ida.org www.sa-ida.org



United States Department of the Interior
NATIONAL PARK SERVICE
Saguaro National Park
3693 South Old Spanish Trail
Tucson, Arizona 85730



September 25, 2023

UNSP Application Review Board
DarkSky International
3223 North First Avenue
Tucson, AZ 85719

Dear Application Review Board,

As the Superintendent of Saguaro National Park, I strongly support this application for Urban Night Sky Place (UNSP) designation. The park is surrounded by world-class astronomical research programs at Kitt Peak National Observatory, Mount Graham International Observatory, Fred Lawrence Whipple Observatory, Steward Observatory, Mount Lemmon Observatory, along with DarkSky International's headquarters in Tucson. Saguaro NP is excited for the opportunity to officially join this vibrant community of night sky specialists and amateur enthusiasts located in our region who take great interest and pride in our dark night skies.

Since 2019, my staff have been working across disciplines to compile this application package, replace incompatible lighting fixtures and bulbs, and develop a robust outreach and education program focused on night sky resources. We believe our contributions to the UNSP program would be significant. With districts located on both the west and east sides of Tucson, the park is readily accessible to the city's more than 500,000 residents. Our dark sky readings collected as part of this application show that the park's night skies remain remarkably dark despite our proximity to this large urban center. This is partly due to our expansive designated Wilderness area that comprises 77% of the park's 92,405 acres.

Through the actions outlined in our application we have demonstrated a commitment to enhancing protection of our night skies by modeling best lighting practices; supporting astronomical researchers and hobbyists; reducing energy waste; and hosting engaging events like moonlight hikes and star parties. Saguaro National Park will serve as a retreat from the nearby urban environment for visitors to experience the night sky unspoiled by the intrusion of artificial light and to learn about astronomy, reducing sky glow, and the importance of natural darkness.

The park looks forward to advancing the complementary goals of DarkSky International and the National Park Service through this designation.

Sincerely,

Leah McGinnis
Park Superintendent



May 21, 2021

Dark Sky Places Committee
International Dark Sky Association
5049 E Broadway Blvd, #105
Tucson, AZ 85711

Re: Saguaro National Park Designation as Urban Night Sky Place

Dear Committee Members:

I am pleased to offer the support of the Pima County Office of Sustainability & Conservation for Saguaro National Park's application for designation as an Urban Night Sky Place by the International Dark Sky Association.

As a community, we appreciate every opportunity to enjoy the spectacular night skies and wildlife diversity of southern Arizona. Although the Tucson metropolitan area doesn't have the same dark skies as more rural areas in our region where astronomical observatories such as Kitt Peak and the Fred Lawrence Whipple Observatory on Mount Hopkins are located, we appreciate the efforts of the park and its partners to promote education, appreciation, and enjoyment of this unique landscape for our residents and visitors alike. Saguaro National Park, which adjoins Tucson Mountain Park on the west, is critical in preserving wildlife habitats and migration corridors, which can be disrupted by lights.

This designation not only recognizes the dedication of park staff to this effort, but will help increase awareness of the value and significance of dark sky resources through regular education and interpretive programming, including the popular star viewing events it conducts in cooperation with local astronomy clubs.

Saguaro National Park was protected as a national monument 88 years ago at the urging of local citizens to protect some of the best remaining examples of saguaro forests and Sonoran Desert habitats, which were rapidly disappearing. We are very proud of its place in our region, and we continue to support its preservation and education mission, which with this designation, will extend to our dark skies.

We hope this designation will ensure that the National Park Service will continue to provide dark sky education and awareness to future generations of Park visitors who will in turn be inspired to appreciate and become stewards of the night skies that we all share.

Sincerely,

Linda Mayro, Director
Sustainability & Conservation



Sky Island Alliance
3127 N Cherry Avenue
Tucson, AZ 85717
louise@skyislandalliance.org
(520) 624-7080

May 11, 2021

Dark Sky Places Committee
International Dark Sky Association
5049 E Broadway Blvd, #105
Tucson, AZ 85711

Dear Dark Sky Places Committee,

Sky Island Alliance enthusiastically offers support for Saguaro National Park's application for designation as an Urban Night Sky Place by the International Dark Sky Association. The Park's commitment to maintain excellent habitat conditions for the region's biodiversity is exemplary. This designation will serve as a model for other landowners and managers in the region to take meaningful actions that protect the nighttime environment for the benefit of wildlife and people.

In the Sky Island region, our understanding of the necessity of darkness to maintain natural nocturnal conditions for the diversity of resident and migratory wildlife species is on the rise. Our network of wildlife cameras around Saguaro National Park show that a majority of medium to large mammals are primarily active at night—a critical adaptation to avoid heat during the warmest months of the year in the Sonoran Desert. By continually protecting darkness at Saguaro National Park on the western and eastern edges of Tucson, the Park will institutionalize these vital nocturnal refuges and migratory corridors for species like mountain lion, black bear, ringtail, lesser long-nosed bats, and elf owls. Given that the Park is so close to urban Tucson and offers critical wildlife habitat corridors to adjacent protected lands, preventing light pollution here will benefit species that range across a much larger area in this intermountain region.

We appreciate the efforts of Saguaro National Park and its partners to promote education, appreciation, and enjoyment of Sky Island habitats which can be disrupted by lights. This designation not only recognizes the dedication of Park staff to this effort, but will help increase awareness of the value and significance of dark sky resources through regular education and interpretive programming, including the popular star viewing events it conducts in cooperation with local astronomy clubs and nocturnal wildlife watching.

Saguaro National Park was protected as a National Monument 88 years ago at the urging of the local community to protect some of the best remaining examples of saguaro forests and Sonoran Desert habitats which were rapidly disappearing. We are very proud of its place in our region and we continue to support its preservation and education mission which, with this designation, will extend to our dark skies. We hope this designation will ensure that the National Park Service will continue to provide dark sky education and awareness to future generations of visitors who will in turn be inspired to appreciate and become stewards of the night skies that we all share.

Sincerely,

Louise Misztal
Executive Director



Tucson Amateur Astronomy Association

PO Box 41254 Tucson, AZ 85717

November 11, 2021

Board of Directors
International Dark-Sky Association
3223 N 1st Ave
Tucson, AZ 85719-2103

IDA Board of Directors,

The Tucson Amateur Astronomy Association (TAAA) strongly supports the Saguaro National Park application for Dark-Sky Park designation. The skies at both parks are incredibly dark, making astronomy a perfect adjunct to any daytime hiking and sightseeing. TAAA has done many astronomy events at both parks, supporting routine events at Saguaro East over the past several years and events supporting the University of Arizona Astronomy Dept classes at Saguaro West. We averaged 3-5 telescopes and about 50 participants for each event. The talks provided by the Rangers during the Saguaro East monthly astronomy events undoubtedly spurred many visitors to pursue an

interest in science and astronomy, promoting this valuable commodity in the Tucson community. The dark skies at both parks enabled this valuable educational outreach and Tucson is incredibly lucky to have these parks and the dedicated staff supporting our dark skies, in our own backyard!

When out-of-town visitors inquire where to do some dark sky observing, one of the places I frequently send them is Saguaro National Park. Having another Dark Sky Park in the Tucson vicinity will continue our tradition of dark skies and astronomy for future generations.

Sincerely,

Jim Knoll
Star Party Manager
Tucson Amateur Astronomy Association
astronomy-events@tucsonastronomy.org
(520) 241-3113



<http://www.tucsonastronomy.org>



Friends of Saguaro National Park

Providing financial and volunteer support for Saguaro National Park



December 2, 2021

To Whom it May Concern:

On behalf of the Board of Directors for Friends of Saguaro National Park (FOSNP), I am pleased to offer our support for Saguaro National Park's application for designation as an Urban Night Sky Place by the International Dark Sky Association.

FOSNP is the official nonprofit philanthropic partner of Saguaro National Park created to help preserve, protect, and enhance the fragile environment and unique cultural heritage of the Sonoran Desert at Saguaro National Park. We help protect natural and cultural resources, preserve native landscapes, promote environmental education, improve recreational trails, enhance visitor experiences, strengthen community partnerships, and build environmental stewardship for Saguaro National Park through philanthropy, education, volunteerism, and public awareness.

As a community, we appreciate every opportunity to enjoy the spectacular night skies and wildlife diversity of southern Arizona. Although the Tucson metropolitan area doesn't have the same dark skies as more rural areas, we are happy to support the parks efforts to promote education, appreciation, and enjoyment for local residents and visitors and aid in preserving wildlife habitats and migration corridors which can be disrupted by lights.

This designation not only recognizes the dedication of park staff to this effort but, will help increase awareness of the value and significance of dark sky resources through regular education and interpretive programming, including the popular star viewing events it conducts in cooperation with local astronomy clubs.

Saguaro National Park was first protected as a national monument in 1933 at the urging of local citizens to protect some of the best remaining examples of saguaro forests and Sonoran Desert habitats which were rapidly disappearing. We are very proud of its place in our region, and we continue to support its preservation and education mission which, with this designation, will extend to our dark skies.

We hope this designation will ensure that the National Park Service will continue to provide dark sky education and awareness to future generations of visitors who will in turn be inspired to appreciate and become stewards of the night skies we all share.

Sincerely,

Fred Stula
Executive Director

2700 North Kinney Road • Tucson, Arizona 85743 • Phone (520) 733-8610
Email: fosnp@friendsofsaguaro.org • Web: www.friendsofsaguaro.org

November 29, 2021

X9 Board of Directors
X9 Ranch Owners Association
7001 S X9 Ranch Road
Vail, AZ 85641

International Dark-Sky Association
Board of Directors
5049 E. Broadway Blvd. #105
Tucson, Arizona 85711

Dear IDA Board of Directors,

As representatives of the X9 Ranch Owners Association, we are pleased to offer our full support of Saguaro National Park's application for designation as an Urban Night Sky Place by the International Dark-Sky Association.

As a community bordering Saguaro National Park, residents of X9 Ranch are fortunate to enjoy spectacular night skies and diverse southern Arizona wildlife adjacent to the Tucson metropolitan area. We are grateful for the efforts of the park and its partners to promote education, appreciation, and enjoyment for both residents and visitors to this region. Importantly, these efforts also aid in preserving wildlife habitats and migration corridors that can be disrupted by lights.

In addition to recognizing the dedication of park staff to this effort, the Urban Night Sky Place designation helps increase awareness of the value and significance of dark sky resources. This is accomplished through regular education and interpretive programming, including the popular star viewing events it conducts in cooperation with local astronomy clubs.

Saguaro National Park was protected as a national monument 88 years ago at the urging of local citizens to protect some of the best remaining examples of saguaro forests and Sonoran Desert habitats that were rapidly disappearing. We are very proud of its place in our region and we continue to support its preservation and education mission which, with this designation, will extend to our dark skies.

We hope this designation ensures that the National Park Service will continue to provide dark sky education and awareness to future generations of resident and visitors. We further hope that all will in turn be inspired to appreciate and become stewards of the night skies we all share.

Sincerely,

Board of Directors
X9 Ranch Owners Association

Chris Bixler, President
Michael Dennis, Vice President
Mary Ann Kellogg, Secretary/Treasurer



December 10, 2021

International Dark-Sky Association
Board of Directors
5049 E. Broadway Blvd. #105
Tucson, Arizona 85711

Dear IDA Board of Directors,

I am pleased to support the Saguaro National Park's application for designation as an Urban Night Sky Place by the International Dark Sky Association.

As a community, we appreciate every opportunity to enjoy the spectacular night skies and wildlife diversity of southern Arizona. Although the Tucson metropolitan area doesn't have the same dark skies as more rural areas, we appreciate the efforts of the park and its partners to promote education, appreciation, and enjoyment for our residents and visitors and aid in preserving wildlife habitats and migration corridors which can be disrupted by lights.

This designation not only recognizes the dedication of park staff to this effort, but will help increase awareness of the value and significance of dark sky resources through regular education and interpretive programming, including the popular star viewing events it conducts in cooperation with local astronomy clubs.

Saguaro National Park was protected as a national monument 88 years ago at the urging of local citizens to protect some of the best remaining examples of saguaro forests and Sonoran Desert habitats which were rapidly disappearing. We are very proud of its place in our region and we continue to support its preservation and education mission which, with this designation, will extend to our dark skies.

We hope this designation will ensure that the National Park Service will continue to provide dark sky education and awareness to future generations of visitors who will in turn be inspired to appreciate and become stewards of the night skies that we all share.

Sincerely,

A handwritten signature in black ink, which appears to read "Regina Romero". The signature is fluid and stylized, with the first and last names being clearly legible.

Regina Romero, City of Tucson Mayor

Mayor Regina Romero's Office • 255 W. Alameda St. • Tucson, AZ 85701
520.837.4262 • tucsonaz.gov/mayor

Michael H Franz

5055 S Camino de Oeste | Tucson, AZ 85746 | 520-343-1521 | michaelhfranz@gmail.com

December 20, 2021

Dark Sky Places Committee
International Dark Sky Association
5049 E. Broadway Blvd.
Tucson, AZ 85711

Dear Committee members:

I offer my full and enthusiastic support for Saguaro National Park becoming an Urban Night Sky Place. As an engineering professional in service of telescope projects in the Tucson vicinity, I depend on our dark skies; and they are of inestimable value to our community of scientists and engineers. Without the precious natural clarity and darkness of the local atmosphere, we would founder.

It is only fitting and natural that a precious, natural, local jewel, Saguaro National Park, would exist under pristine Tucson area night skies. Indeed, such a unique and valuable natural asset *must* exist under a dark night sky: so many of the inhabitants of the park live primarily nocturnal existences within the park boundaries. And those creatures are as much a feature of our precious desert heritage as are the Park's stately saguaros.

And what a powerful statement the establishment of Saguaro National Park as an Urban Night Sky Place would make.

It is vital that we act decisively to protect our dark skies, and there is no stronger statement that I can think of than for our community, Saguaro National Park, the International Dark Sky Association, and the citizens of Pima County and Tucson, Arizona to stand together in support of one of our most valuable local resources: the dark, Southern Arizona night sky.

Sincerely,



Michael H Franz
R&D Mechanical Engineer IV
University of Arizona Steward Observatory



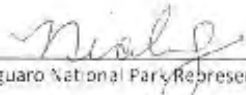
United States Department of the Interior
NATIONAL PARK SERVICE
Saguaro National Park
3693 South Old Spanish Trail
Tucson, Arizona 85730



BY SIGNING, I REFER TO:

Cross Promotion & Coordination Agreement between Saguaro National Park and Tumacacori National Historical Park

In accordance with requirements from the International Dark Sky Association, Saguaro National Park and Tumacacori National Historical Park hereby agree to coordinate and cross promote their programs. This will primarily include sharing program events digitally but may also include posters, and flyers. Additionally, the parks agree to share dark sky education pamphlets and other dark sky media that the parks create.


Saguaro National Park Representative


Tumacacori National Historical Park Representative

APPENDIX C. Record of Lighting Retrofit Funding and Spending



Friends of Saguaro National Park

Providing financial and volunteer support for Saguaro National Park



MEMORANDUM

TO: Leah McGinnis, Superintendent, Saguaro National Park
Andy Fisher, Chief of Interpretation, Saguaro National Park

FROM: Fred Stula, Executive Director, Friends of Saguaro National Park

RE: 2022 Park Project Allocation Requests

Date: January 13, 2022

The Friends of Saguaro National Park Board of Directors approved 18 cash project requests, as submitted by the Park at today's meeting. These approved projects collectively total \$119,886.

The Board also approved 1 special appeal cash project request. This project totals \$8,000 and will be available to the Park once the funds are secured.

Additionally, the Board approved the use of the cash (unrestricted & restricted) total for the required in-kind match portion of 10 NextGen Task Agreements totaling \$113,026.

Approved projects (and amounts) are listed below. I will need a written request from an authorized National Park Service representative in order to release the funds to the NPS, or to pay a third-party vendor. Please recognize or acknowledge FOSNP for its support of these important projects and activities.

Cash Project Requests

1. Volunteer Appreciation Picnic and Volunteer Supplies (\$3,500 unrestricted)
2. Interpretation: Curriculum Based Program (\$4,185 restricted, \$1,050 unrestricted)
3. Visitor & Resource Protection: Public Search and Rescue Supplies (\$2,074 unrestricted)
4. Facilities Maintenance: Mule for Trail Work (\$8,000 unrestricted)
5. Resource Management: Manning Cabin and Rincon Fire Lookout Assessment (\$2,500 unrestricted)

6. Interpretation: Education Rangers & Hiking Clubs (\$20,874 unrestricted, \$15,038 restricted)
7. Visitor & Resource Protection: Ranger Bicycle Program (\$560 unrestricted)
8. Interpretation: Cactus Rangers (\$1,875 unrestricted)
9. Interpretation: Community Engagement Events (\$12,200 unrestricted)
10. Interpretation: Youth Camps (\$8,350 unrestricted)
11. Interpretation: Tribal Engagement (\$4,500 unrestricted)
12. Resource Management: Herpetology Project (\$2,100 restricted)
13. Visitor & Resource Protection: Wellness Psychologist (\$4,000 unrestricted)
14. Interpretation: Visitor Center Webcams (\$930 unrestricted)
15. Interpretation: Visitor Center WiFi (\$8,600 unrestricted)
16. Facilities Maintenance: Livestock Training (\$8,000 unrestricted)
17. Interpretation: Mobile Visitor Center Wrap (\$6,550 unrestricted)
18. Facilities Maintenance: Dark Sky Lights (\$5,000 unrestricted)

Special Appeal Cash Project Requests

1. Facilities Maintenance: Mule for Trail Work (\$8,000)

In-Kind Match Project Requests for NextGen Task Agreements

1. Facilities Maintenance: Trails (\$9,475)
2. Resource Management & Facilities Maintenance: Trails (\$7,537)
3. Facilities Maintenance: Tradeskills (\$12,161)
4. Resource Management: General (\$7,537)
5. Facilities Maintenance: Trails (\$10,810)
6. Facilities Maintenance: Manning Camp (\$7,502)
7. Resource Management: Stream Restoration (\$12,507)
8. Resource Management: Herpetology Project (6,118)
9. Resource Management: Invasive Species (\$9,379)
10. NextGen Contingency (\$30,000) This request is for future NextGen funding needs.

Re: [EXTERNAL] Re: Dark Sky Funding

From: "Bell, Sam" <Sam_Bell@nps.gov>

Date: 04/20/2021 01:26PM

To: fosnp_contact <fosnp@friendsofsaguaro.org>, "Goepfrich Jr., Richard A" <Richard_Goepfrich@nps.gov>

Cc: "Torok, Michelle" <Michelle_Torok@nps.gov>

PX 05AGU0034.00.1

Fred- see attached remaining receipt for Dark Sky light fixture upgrade. The total for all receipts in the upgrade came out to \$993.71. I can provide photographs of the new fixtures vs. the old if you would like.

Michelle- Which account should I apply these charges to on my CC log?

Rich- Once the switch is delivered and installed, dark sky compliance will be complete.

Sam Bell
Maintenance Supervisor
Tucson Mountain District
Saguaro National Park
2700 N. Kinney Road
Tucson, Arizona 85743
Cell: (520) 274-0535
Office: (520) 733-5144

From: fosnp@friendsofsaguaro.org <fosnp@friendsofsaguaro.org>

Sent: Tuesday, March 30, 2021 12:23 PM

To: Goepfrich Jr., Richard A <Richard_Goepfrich@nps.gov>

Cc: Bell, Sam <Sam_Bell@nps.gov>; Torok, Michelle <Michelle_Torok@nps.gov>

Subject: [EXTERNAL] Re: Dark Sky Funding

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Hi Rich,

You are approved to spend \$1,000 on this project; 1) please make the purchases and email me the receipt, 2) I will mail Michelle the reimbursement check.

Thank you,

-fs

Order #76892665

Status: Processing
Purchased On: Build.Com
Placed On: 3/30/2021

Shipping

Samuel Bell
Tucson, AZ 85743

Standard Delivery

Payment

Samuel F Bell
Tucson, AZ 85730

(2808) - \$716.56



Progress Lighting Single Light 7" Tall LED Outdoor Cylinder Wall Sconce \$675.36

Model: P5674-31/36K

Color/Finish: Black

\$96.48 (Qty: 7)

Subtotal:
Shipping:
Tax:

\$675.36
\$0.00
\$41.20

Grand Total:

\$716.56

Chat with an E...

[EXTERNAL] Order Confirmation #S2105965 - Gordon Electric Supply, Inc.

customerservice@gordonelectric.com <customerservice@gordonelectric.com>

Mon 4/19/2021 9:50 AM

To: Bell, Sam <Sam_Bell@nps.gov>

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Web Order Confirmation

GORDON ELECTRIC SUPPLY - KANKAKEE
1280 N. HOBBIE
KANKAKEE, IL 60901-9486
1-815-938-4700 Fax 815-932-7484

Shipping Address:
SAM BELL
2700 N KINNEY ROAD
TUCSON, AZ 85743

Shipping Instructions
**EMAIL: SAM_BELL@NPS.GOV

Order Date	Order #
04/19/2021	S2105965

Billing Address:
SAGUARO NATIONAL PARK
3693 S OLD SPANISH TRAIL
TUCSON, AZ 85730

Order Details
Ship Via: UPS GROUND
Ordered By: SAM BELL
Phone #: 520-733-5144
PO #: WEB1618851025188
Release #:

Description	Order Qty	Unit Price	Ext Price
INTERMATIC FF2H 2 HOUR 120-277 V SPST	1ea	\$28.81/ea	\$28.81
INTERMATIC T7802B NEMA 1 - 208-277 V DPDT SEPARATE CLOCK MOTOR AND CIRCUIT TERMINALS Note: ***Above may not be returnable!***	1ea	\$156.87/ea	\$156.87
Order Comments: *** Payment processed byAuthorizeNet Transaction id42824285476 *** Notes: By Placing this Order you Agree to Gordon Electric Supply's Terms & Conditions of Use, Terms & Conditions of Sale, Shipping Policy, and Return Policy - 2	Subtotal		\$185.68
	Tax		\$0.00
	Freight		\$14.90
	Handling		\$0.00
	Total		\$200.58

[EXTERNAL] Light Disty.com: New Order # A22327963

Sales <sales@lightdisty.com>

Tue 3/30/2021 12:11 PM

To: Bell, Sam <Sam_Bell@nps.gov>

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

LightDisty.com

THANK YOU FOR YOUR ORDER FROM
LIGHT DISTY.COM.

Once your package ships we will send an email with a
link to track your order. Your order summary is below.
Thank you again for your business.

Order Questions?

Call Us: 303-648-4084

Email: support@lightdisty.com

Your order #A22327963

Placed on March 30, 2021 1:07:32 PM HDT

Item	SKU	Qty	Subtotal
Hales A19FR6/827/ECO/LED ProLED LED ECO A19 6w 2700k 80971	A19FR6/827/ECO/LED	40	\$54.00
Subtotal			\$54.00
Shipping & Handling			\$22.57
Grand Total			\$76.57

BILL TO:
Samuel Bell
3693 S Old Spanish Trail
Tucson, Arizona, 85730
United States
T: 520-733-5144

SHIP TO:
Sam Bell
2700 N Kinney Road
Tucson, Arizona, 85743
United States
T: 520-733-5144

SHIPPING METHOD:
Ground - Ground

PAYMENT METHOD:
Debit or Credit Card
Credit Card Type:
Visa
Credit Card Number:
xxxx-2808
Payer Email:
sam_bell@nps.gov

FRIENDS OF SAGUARO NATIONAL PARK 9055

National Park Service
Item Description:
Dark Sky Fixtures
ATP- Dark Sky Project (unstrctd)

Check Number: 9055
Check Date: 4/26/2021
Check Amount: \$993.71

FRIENDS OF SAGUARO NATIONAL PARK
2700 N. KINNEY ROAD
TUCSON, ARIZONA 85743

BBVA
TUCSON, ARIZONA
91-574/1221

DATE
4/26/2021

AMOUNT
\$ 993.71

Nine hundred ninety three dollars and 71/100

PAY
TO THE
ORDER
OF:

National Park Service
3693 S Old Spanish Trl.
Tucson, AZ 85730

W U
W U
W U
W U

1009055 122105744 2519844519

FRIENDS OF SAGUARO NATIONAL PARK 9055

PRODUCT SOLIH4S USE WITH 11384 ENVELOPE Deluxe Corporation 1-800-328-0204 or www.deluxe.com/shop PRINTED IN U.S.A.

Receipts for Dark-sky fixture retrofit

From: "Bell, Sam" <Sam_Bell@nps.gov>
Date: 01/24/2022 09:24AM
To: fosnp_contact <fosnp@friendsofsaguaro.org>
Cc: "Torok, Michelle" <Michelle_Torok@nps.gov>, "Byers, Kimberly L" <Kimberly_Byers@nps.gov>, "Goepfrich Jr., Richard A" <Richard_Goepfrich@nps.gov>

Fred- See attached receipt for the second purchase of fixtures used in the dark-sky retrofit. Total is \$667.48

Michelle/Kim- On my CC statement, I listed **PX.DSAGU0034.00.1** as the account to charge. Let me know if I need to make a correction.

Let me know if I need to do anything else for this purchase.

Sam Bell
Maintenance Supervisor
Tucson Mountain District
Saguaro National Park
2700 N. Kinney Road
Tucson, Arizona 85743
Cell: (520) 274-0535
Office: (520) 733-5144

Attachments (1 file, 78.5 KB)

- TMD light fixture receipt 11.29.21.pdf (78.5 KB)

Order #79778743

Status: Delivered
Purchased On: Build.Com
Placed On: 11/29/2021

Shipping

Samuel Bell
Tucson, AZ 85743
Standard Delivery

Payment

Samuel Bell
Tucson, AZ 85730

(6026) - \$667.48



Progress Lighting Cylinder 1 Light Outdoor Wall Sconce with Metal Cylinder Shade - 7" Tall \$629.10
Model: P5674-31
Color/Finish: Black
\$62.91 (Qty. 10)

Subtotal:	\$629.10
Shipping:	\$0.00
Tax:	\$38.38
Grand Total:	\$667.48

Chat with an E...

FRIENDS OF SAGUARO NATIONAL PARK

1143

National Park Service
Item Description:
Dark Sky Light Fixture Replacement
ATP-Dark Sky Lights (unrstd)

Check Number: 1143
Check Date: 1/31/2022
Check Amount: \$667.48

FRIENDS OF SAGUARO NATIONAL PARK 2700 N. KINNEY ROAD TUCSON, ARIZONA 85743		PNC BANK, INDIANA, INC. NEW ALBANY, IN 054 71-906/830	DATE 1/31/2022	1143
Six hundred sixty seven dollars and 48/100		AMOUNT \$ 667.48		
PAY TO THE ORDER OF:	National Park Service 3693 S Old Spanish Trl. Tucson, AZ 85730	AUTHORIZED SIGNATURE 		

⑈001143⑈ ⑆063009060⑆ 3911162426⑈

FRIENDS OF SAGUARO NATIONAL PARK

1143

PRODUCT 221143

USE WITH 51564 ENVELOPE

Deluxe Corporation 1-800-325-0504 or www.deluxe.com/shop

PRINTED IN U.S.A.

043803 5142001 10/14/2021 21 29 11

Shipping

Standard Delivery

Ben Darnell
3693 S Old Spanish Trail
Tucson, AZ 85730
5207335147

Payment

Visa (3920) - \$1,023.06

Ben Darnell
3693 S Old Spanish Trail
Tucson, AZ 85730
5207335147

Item(s)

 **P5774 Progress Lighting P5774**
Color/Finish: Black
8 @ \$66.00 each
Estimated Delivery on Tue, Apr 12th

 **P5674 Progress Lighting P5674**
Color/Finish: Black
8 @ \$71.03 each
Estimated Delivery on Tue, Apr 12th

Order Summary

Subtotal:	\$964.24
Shipping:	FREE
Tax:	\$58.82
Grand Total:	\$1,023.06

Bld.com Dark Skies
Lighting
BD-22-66
PX.DSAGU0034.00.1

Printed On: April 6, 2022 15:41:40 EDT

Page 1 of 1

BD-22-62
Lights for Dark Skies
PX.DSAGU0034.00.1

**BEN DARNELL**

Order # WD99431361

PO/Job Name: saguaro

Buy Online Pickup In Store

Ordered
4/6/2022
Complete
4/6/2022

Item Description	Qty	Unit Price	Discount	Net Unit Price	Pri Tax Amount
40-Watt Equivalent A19 Non-Dimmable LED Light Bulb Soft White (8-Pack) SKU: 1302827863	3	\$10.98	\$0.00	\$10.98	\$32.94
Subtotal				\$10.98	\$32.94
Shipping					FREE
Sales Tax					\$2.87
Order Total					\$35.81

APPENDIX D: Retrofit Fixture Specification Sheets



DATE: TYPE:

NAME:

PROJECT:

Halogen/incandescent

P5674-31

Cylinder

5" wall cylinder. The P5674 Series are ideal for a wide variety of interior and exterior applications including residential and commercial. This modular approach results in an encapsulated luminaire that unites performance, cost and safety benefits.

- Black finish.
- Powder coat finish.
- Ideal for a wide variety of interior and exterior applications.
- Die-cast aluminum wall brackets and heavy duty aluminum framing.

Category: Outdoor

Finish: Black (powder coat paint)

Construction: Aluminum Construction

Glass/Shade: Metal shade



Width: 5"
Height: 7-1/4"
Depth: 8"
H/CTR: 2-1/2"

MOUNTING	ELECTRICAL	LAMPING	ADDITIONAL INFORMATION
Wall mounted Mounting plate for outlet box included Back plate covers a standard 4" octagonal recessed outlet box 4.5" W.	Pre-wired 6" of wire supplied 120 V	Quantity: One 75w max. PAR-30 or BR-30 E26 base porcelain socket	UL-CUL Wet location listed 1 year warranty

Cylinder

Wall Mounted - Wet Location Listed **PROGRESS LED**

Description:

5" LED wall cylinder/wall lantern in Black. The P5674 Series are ideal for a wide variety of interior and exterior applications including residential and commercial. The Cylinders feature a 120V alternating current source and eliminates the need for a traditional LED driver. This modular approach results in an encapsulated luminaire that unites performance, cost and safety benefits.

Specifications:

- Black finish.
- Die-cast aluminum construction with durable powder coated finish
- 484 lumens 24 lumens/watt (delivered)
- 3000K color temperature, 90+ CRI
- Meets California Title 24 high efficacy requirements for outdoor use only.
- Dimmable to 10% brightness (See Dimming Notes)
- Back plate covers a standard 4" recessed outlet box: 4.5 in W.
- Mounting plate for outlet box included
- 6 in of wire supplied

Performance:

Number of Modules	1
Input Power	16.9 W
Input Voltage	120V
Input Frequency	60 Hz
Lumens/LPW (Source)	484/24 (LM 82)
Lumens/LPW (Delivered)	504/29.8 (LM 79)
CCT	3000 K
CRI	90 CRI
Life (hours)	60000 (L70/TM 21)
EMI/RFI	FCC Title 47, Part 15, Class B
Max. Operating Temp	30 °C
Warranty	5-year Limited Warranty
Labels	cCSAus Wet Location Listed

P5674-31/30K



Dimensions:

Width: 5 in
Height: 7-1/2 in
Depth: 8 in
H/CTR: 2-1/2 in

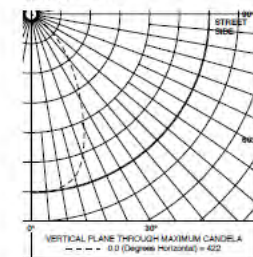
Cylinder

Wall Mounted - Wet Location Listed **PROGRESS LED**

Photometrics:

ELECTRICAL DATA	P5674-31/30K
Input Voltage	120V
Input Frequency	60 Hz
Power Factor	0.93
THD	<20%
EMI/RFI	FCC Title 47, Part 15, Class B
Operating Temperature	-30 °C to 30 °C
Dimming	Yes*
Over-voltage, over-current, short-circuit protected	
*See Dimming Notes for more information	

P5674-31/30K
LED Light Engine: 3000 K 90 CRI
System Wattage: 16.9
Fixture delivered lumens: 504
Fixture Efficacy: 29.8
Spacing Criteria: 1



CANDELA DISTRIBUTION		
DEG	CANDELA	LUMENS
0	0.0	
5	421	40
15	398	111
25	295	135
35	181	113
45	95	73
55	29	26
65	4	4
75	1	1
85	0	0
90	0	

ZONAL LUMEN SUMMARY		
ZONE	LUMENS	% FIXT
0-30	285	56.6
0-40	399	79.1
0-60	499	98.9
0-90	504	100.0
90-180	0	0.0
0-180	504	100.0



DATE: TYPE:

NAME:

PROJECT:

Halogen/incandescent

P5774-31

Cylinder

5" flush mount cylinder. The P5774 Series are ideal for a wide variety of interior and exterior applications including residential and commercial.

- Black finish.
- Powdercoat finish.
- Ideal for a wide variety of interior and exterior applications.
- Heavy duty aluminum framing.

Category: Outdoor

Finish: Black (powder coat paint)

Construction: Aluminum Construction



Diameter: 5"
Height: 6-3/4"

MOUNTING	ELECTRICAL	LAMPING	ADDITIONAL INFORMATION
Ceiling mounted Mounting strap for outlet box included Unit covers a standard 4" octagonal recessed outlet box 5.1406" W., 6.75" ht., 5.1406" depth	Pre-wired 6" of wire supplied 120 V	Quantity: One 75w max. PAR-30 or BR-30 E26 base porcelain socket	UL-CUL Wet location listed 1 year warranty

Photometrics:

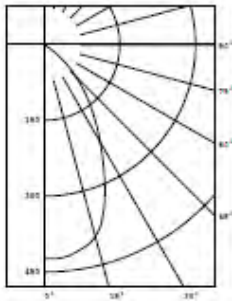
PS774-31/30K

ELECTRICAL DATA		PS774-31/30K
Input Voltage		120V
Input Frequency		60 Hz
Input Current		
Input Power		17.1
Power Factor		0.931
THD		<20%
FCC		FCC Title 47, Part 15, Class B
Operating Temperature		-30 °C to 30 °C
Dimming		Yes ^A

^ASee Dimming Notes for more information

PS774-31/30K

LED Light Engine: 3000 K 90 CRI
System Wattage: 17.1
Fixture delivered lumens: 481
Fixture Efficacy: 28.1
Spacing Criteria: 0.9



CANDELA DISTRIBUTION

DEG	CANDELA	LUMENS
0	423	
5	423	40
15	393	109
25	282	129
35	172	108
45	88	68
55	23	22
65	3	3
75	1	1
85	0	0
90	0	

ZONAL LUMEN SUMMARY

ZONE	LUMENS	%FIXT
0-30	278	57.9
0-40	386	80.4
0-60	476	99.1
0-90	481	100.0
90-180	0	0.0
0-180	481	100.0



Project:

Fixture Type:

Location:

Contact:

One-Light Outdoor

Ceiling mounted • Damp location listed **PROGRESS LED**

Description:

5" flush mount cylinder. The PS774 Series are ideal for a wide variety of interior and exterior applications including residential and commercial. The Cylinders feature a 120V alternating current source and eliminates the need for a traditional LED driver. This modular approach results in an encapsulated luminaire that unites performance, cost and safety benefits.

Specifications:

- Black (-31) (powder coat paint)
- Die cast and extruded aluminum Construction
- Ideal for a wide variety of interior and exterior applications.
- Die-cast aluminum construction with durable powder coated finish
- 484 lumens 24 lumens/watt (delivered)
- 3000K color temperature, 90+ CRI
- Dimmable to 10% brightness (See Dimming Notes)
- Unit covers a standard 4" octagonal recessed outlet box
- Mounting strap for outlet box included
- 6" of wire supplied
- Meets California Title 24 high efficacy requirements for outdoor use only

Performance:

Number of Modules	1
Input Power	17.1w
Input Voltage	120V
Input Frequency	60 Hz
Lumens/LPW (Delivered)	484/24 (LM-79)
CCT	3000 K
CRI	90 CRI
Life (hours)	60,000 (L70/TM-21)
FCC	FCC Title 47, Part 15, Class B
Min. Start Temp	-30 °C
Max. Operating Temp	30 °C
Warranty	5 year warranty
Labels	cCSAus Damp location listed
	Meets California Title 24 high efficacy requirements
	for outdoor use only

PS774-31/30K

Images:



Dimensions:

Diameter: 5"
Height: 6-1/2"

FF Series

Spring Wound Countdown Timers - Commercial

The FF Series Commercial Countdown Timers are designed to replace any standard wall switch and do not require electricity to operate. These energy-efficient switches automatically limit the ON times for fans, lighting, motors, heaters, and other energy consuming loads. A commercial "brushed metal" look plate (plastic construction) meets NEC requirements.

Features

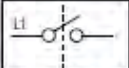
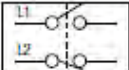
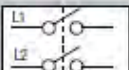
- No electricity required to operate
- Replaces any standard or decorator single-gang wall switch
- Automatically limits ON time for energy consuming loads
- Quick and easy installation
- Time-saving up front terminal connection with teeter-type terminals
- Brushed metal look switch plate meets NEC requirements (plate is included)
- Incandescent/fluorescent/CFL/LED compatible
- No neutral connection is required



Without HOLD
FF5M



With HOLD
FF6HH

Without HOLD	With HOLD	Maximum Time	Switch Type
SPST			
FF5M	FF5MH	5 min	 SPST Configuration
FF15MC	FF15MH	15 min	
FF30MC	FF30MH	30 min	
FF60MC	FF60MHC	60 min	
FF2H	—	2 hr	
FF4H	—	4 hr	
FF6H	FF6HH	6 hr	
FF12HC	FF12HHC	12 hr	
2-Circuit (1) NO + (1) NC			
FF315M	—	15 min	 For SPST Configuration Jumper L1 & L2 Together
FF330M	—	30 min	
FF360M	—	60 min	
FF32H	FF32HH	2 hr	
FF34H	FF34HH	4 hr	
FF36H	—	6 hr	
FF312H	FF312HH	12 hr	
DPST			
FF415M	—	15 min	 DPST Configuration
FF430M	—	30 min	
FF460M	—	60 min	
FF46H	—	6 hr	
FF412H	—	12 hr	

Accessories/Replacement

Knob Wall Switch FF Series - White	146MT577
Knob Wall Switch FF Series - Black	146MT579
Faceplates	See page 172



Rating	
Operating Voltage	125-277 VAC, 50/60 Hz
Resistive	20 A, 125 VAC, 50/60 Hz; 10 A, 250/277 VAC, 50/60 Hz
Incandescent	7 A, 125 VAC, 50/60 Hz
Motor	1 HP, 125 VAC, 50/60 Hz; 2 HP, 250 VAC, 50/60 Hz
Operating Temperature	32° F to 104° F (0° C to 40° C)
Dimensions H x W x D	4.125" X 1.75" X 1.25" (104.8mm x 44.5mm x 31.8mm)
Warranty	1-year limited

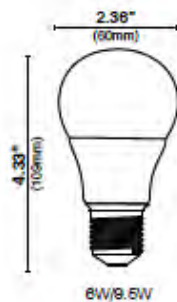
Note: Not for use with sunlamps, saunas, or loads that could cause personal injury if timed incorrectly.

ProLED. ECO A19 Series

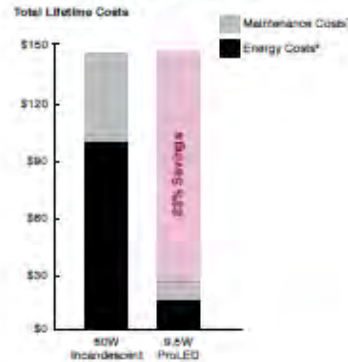
Product #: _____ Type: _____
Project: _____ Date: _____
Comments: _____ Initials: _____

Specifications

- 2700K, 3000K & 5000K options
- 15,000 hour life
- UL Listed for damp locations
- **Not for use** in enclosed luminaires
- 82 CRI for quality and consistent color rendering
- No Mercury or UV/IR emissions
- Economical alternative to Compact Fluorescent and Incandescent lamps
- 3-Year Limited Warranty
- Non-Dimmable



Savings Comparison



* Maintenance costs based on 15 minutes at \$40 per hr.
* Energy costs based on \$0.11 kWh.

Ordering Information



	Watt	Base	Product #	Product Code	Volts	Color Temp.	CRI	Lumens	Useful Life*	Pkg. Qty.	MOL	Equivalent Wattage
⊙	6	E26	80071	A19FR6827/ECOL.EO	120	2700K	82	450	15,000	1/6	4.33"	40W
⊙	6	E26	80072	A19FR6830/ECOL.EO	120	3000K	82	450	15,000	1/6	4.33"	40W
⊙	9.5	E26	80073	A19FR6827/ECOL.EO	120	2700K	82	800	15,000	1/6	4.33"	60W
⊙	9.5	E26	80074	A19FR6830/ECOL.EO	120	3000K	82	800	15,000	1/6	4.33"	60W
⊙	9.5	E26	80075	A19FR6850/ECOL.EO	120	5000K	82	800	15,000	1/6	4.33"	60W

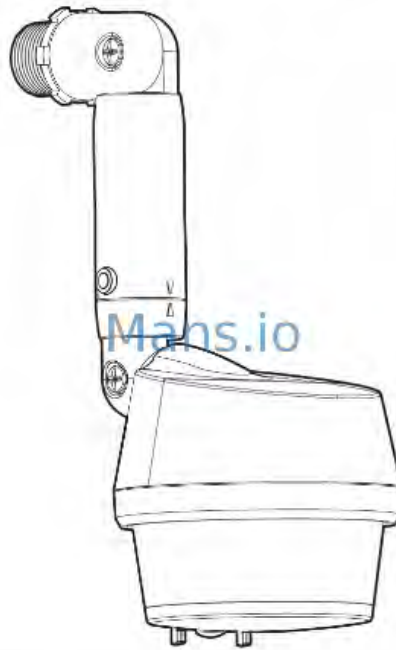
⊙ NEW ITEM

* Useful Life is defined as the point in time at which the lamp will maintain at least 70% of its initial lumens. The lamp will continue to burn past this point, but at decreased light levels.

Replacement lamps use only 1/6 the energy of incandescent.

Warranty - Commercial / Industrial: This product is warranted for 3 years from the date of purchase.

RS-2701 MOTION SENSOR



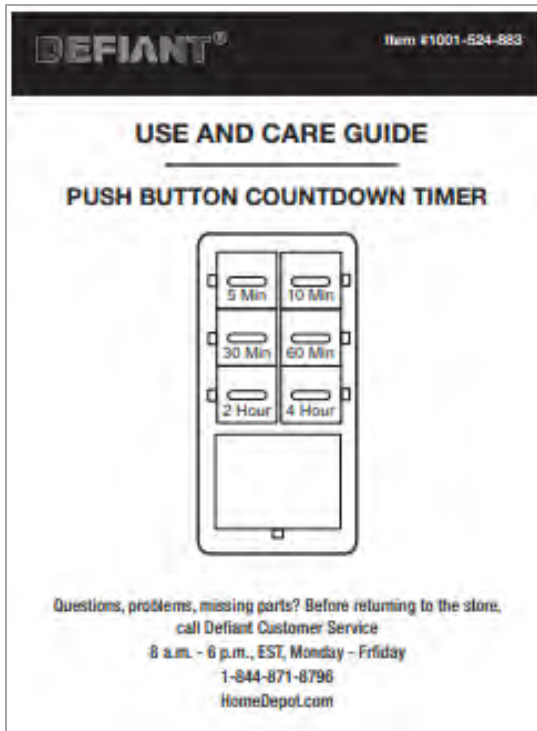
Questions, problems, missing parts? Before returning to the store,
call Defiant Customer Service
8 a.m. - 7 p.m., EST, Monday - Friday, 9 a.m. - 6 p.m., EST, Saturday

1-866-308-3976

HOMEDEPOT.COM

Specifications

Detection Range	Up to 70 ft. (21m) - Varies with surrounding temperature
Sensing angle	Up to 270°
Time delay	1, 5 or 10 minutes
HI-LO timer	OFF, Dusk-to-Dawn, Seasonally adjusted timer mode
Operating modes	Auto, Manual, Eco, Smart
Lamp Type	Wattage
Lamp Load	300W (Max)



Specifications			
Dimensions			
Product Depth (in.)	1.75 in	Product Height (in.)	4.2 in
Product Width (in.)	1.75 in		
Details			
Amperage (amps)	15 A	Color Family	White
Color/Finish	White - 1-Pack	Compatible Bulb Type	CFL,Incandescent,LED
Electrical Features	Indicator Light,Programmable	Electrical Product Type	Timer
Indoor/Outdoor	Indoor	Maximum time setting (min.)	240
Mounting Type	In-Wall	Rating	General Purpose
Returnable	90-Day	Timer Type	Digital
Voltage	120 volt	Wattage (watts)	1800 W
Warranty / Certifications			
Manufacturer Warranty	1 Year Limited Warranty		

STL200

RAB



STEALTH Sensor with special 200° detection pattern to provide wide coverage side to side. Excellent for building perimeter protection. Lens masks allow customization of detection zone.

Color: Bronze

Weight: 1.0 lbs

Project:

Type:

Prepared By:

Date:

Technical Specifications

Compliance

UL Listed:

Suitable for wet locations

Electrical

Power Consumption:

1W

Surge Protection:

Withstands up to 6000 volts

Wall Switch Manual Override:

Two flip logic prevents activation by momentary power outages. Override resets to auto at dawn. No extra wiring needed.

RF Immunity:

Circuits fully shielded for maximum radio frequency immunity

Voltage:

120 Volts AC 60 Hertz

Switching Capacity:

1000 watts incandescent @ 120 volts, 8 amps

Sensor Specifications

Time Adjustment:

5 seconds to 12 minutes

Wide Sensitivity Control:

Adjustable from 100% to 30%

Advanced Detection Logic:

Minimizes false triggers

Photoelectric Control:

Deactivates lights during daylight. Fully adjustable for 24 hour operation or custom applications.

Detection:

200° view

Construction

Temperature Compensation:

Sensitivity adjusts automatically for consistent detection in hot and cold ambient temperatures

Horizontal Lock, No-tool Joints:

Keeps sensing pattern level for fast, error-free installation

Technical Specifications (continued)**Construction****Floodlights:**

Precision die cast aluminum, 1/2" NPS threaded arm with serrated locking swivel fits all standard mounting boxes and covers.

Lens Mask:

Customized press apply lens mask included to reduce coverage easily

LED Characteristics**LED Detection Indicator:**

Shows when sensor is detecting in daytime and glows red at night for "on-guard" deterrence

Color Matched Lens:

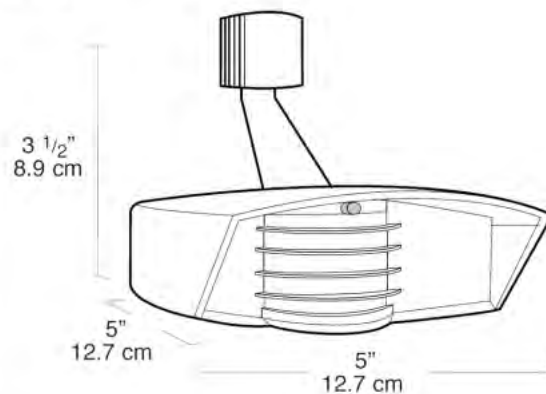
Dark lens with bronze units, white lens with white units

Other**Warranty:**

10 year sensor warranty

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions**Features**

- Not compatible with LED lamps
- Temperature compensation
- Radio frequency immunity
- 6000 volt surge protection
- LED detection & "on guard" indicator
- Color matched vandal resistant lens and grill
- Protected manual override with auto reset
- Can be wired in parallel

Mechanical Time Switch - 24-Hour Mechanical Time Switch, 120 VAC, 60Hz, SPST, Indoor Metal Enclosure, 1 Hour Interval

Item T101



PRODUCT DESCRIPTION

The T100 Series Mechanical Time Switch has proven it can stand the test of time. These dependable time switches can handle electrical loads up to 40 A per pole and allow for up to 12 ON/OFF operations per day. A manual override switch provides added convenience.

FEATURES

- ▶ Direct 24-hour control of most loads
- ▶ Up to 12 ON/OFF operations each day with minimum ON/OFF times of one hour
- ▶ Manual override
- ▶ One ON and one OFF tripper included

APPLICATIONS

- ▶ Timing/Scheduling ON/OFF
- ▶ Indoor Lighting Control

TECHNICAL DATA

General	
Model Number	T101
Description	24-Hour Mechanical Time Switch, 120 VAC, 60Hz, SPST, Indoor Metal Enclosure, 1 Hour Interval
UPC Code	078275000018
Brand	Intermatic
Country of Origin (Intermatic)	MEXICO
Warranty Period	1-Year limited
Application Compatibilities	LED; HID
Control Specifications	
Minimum ON/OFF Times	1 hour
Maximum ON/OFF Operations	12
Skipper Wheel	Not Included
Timing Interval	1 hr
Operation Mode	24 hour
Has Manual Override	Yes
Mechanical Specifications	
Enclosure Type	Indoor type 1 metal
Number of Trippers Included	1 ON/1 OFF
Dimensions	
Product Dimensions (H x W x D) in	7 7/8 x 5 1/8 x 3 7/16 in
Wire Size Min	#14 AWG
Wire Size Max	#8 AWG
Knockout Dimensions Bottom	(2) combination 1/2" - 3/4"
Knockout Dimensions Back	(1) combination 1/2" - 3/4"

Load Ratings

Tungsten Range(s)	40 A, 120-240 VAC, 60 Hz
Electronic Ballast	16 A
Electronic Ballast Load Ratings Ranges	16 A, 120 VAC
Inductive	40 A, 240 VAC, 60 Hz; 40 A, 208 VAC, 60 Hz; 40 A, 120 VAC, 60 Hz
Motor	2 HP, 24 FLA @ 120 VAC, 60 Hz; 5 HP, 28 FLA @ 240 VAC, 60 Hz
Resistive Load Ratings Ranges	40 A, 120-240 VAC, 60 Hz
Inductive Load Ratings Ranges	40 A, 120-240 VAC, 60 Hz
Pilot Duty Load Ratings Ranges	1000 VA, 120-240 VAC, 60 Hz

Electrical Specifications

Wiring Option	Terminals
Input Voltage Range(s)	120 VAC, 60 Hz
Number of Circuits	1
Switch Type	SPST
Maximum Power Consumption (W)	3 W

Packaging

Shipping Weight (lbs)	2.744
Unit Carton Dimensions (H x W x L) in	8.25 x 3.5 x 5.5 in

Environmental Specifications

Temperature (operation)	-40 °F to 130 °F / (-40 °C to 54 °C)
-------------------------	--------------------------------------

Standards and Certifications

UL Certification	cULus
CSA Certification	cCSAus
Other Certifications and Compatibilities	LED
UL File Number	UL917
CSA File Number	C22.2-177; LR3730
California Proposition 65	Lead

APPENDIX E: Historic Structures Report, Greene Property

*George Clayton Greene House, Saguaro National Park
Historic Structures Report*

Existing Conditions & Assessment - Electrical

Electrical - Service and Panels

The existing electrical service for the building is 240/120v, 100A, one-phase, using a direct read utility meter. The utility transformer serving the building is a pole mounted one-phase unit located near the main house driveway. The service runs overhead to the service mast, then down to the service disconnect mounted on the exterior (Figure 4-320). There are several additional non-compliant disconnects and non-compliant taps to the service that were installed over the years, some serving the outbuildings (Figure 4-321).

There are subpanels located in each unit serving local loads.

Condition: Poor

The electrical service and subpanel were installed in 1961-63, all equipment is lacking maintenance and are unserviceable. As mentioned above, there are many code violations with non-compliant disconnects and feeder taps (Figure 4-323). Federal Pacific equipment was observed which is no longer in business; making the panels obsolete and non-serviceable. FPE panels have a high risk for electric shock and are a fire hazard. The service attachment point is approximately six inches above the structure where code minimum is three feet.

Electrical - Distribution System

Receptacles for general power/convenience use are in poor condition. The spacing of devices does not meet current electrical code requirements. The kitchen receptacles and exterior receptacles are not GFCI protected and arc fault protection is not provided on any electrical circuits. Many of the



Figure 4-320. Existing electrical service for Guest House in poor condition (SJH, 04/25/2019)



Figure 4-321. Existing taps located at Guest House serving out buildings (SJH, 04/25/2019)



Figure 4-322. Non-compliant service mast (SJH, 04/25/2019)

receptacles do not appear to have a ground connection. Electrical codes have required grounding type receptacles for many code versions. Both code compliant grounded and non-compliant non-grounded receptacles are in use, most are damaged.

Branch circuit wiring is Type NM (non-metallic Romex), has not been installed per electrical codes and is in need of replacement. The cable has been installed outdoors, exposed to the elements.

Appliances: There are two existing kitchens with electric ranges, both are unserviceable.

Condition: Poor

Lack of GFCI and arc fault protection, is a violation of current NEC code, and potential hazard for electric shock. Non-grounded electrical receptacles also pose the risk of electric shock, or fatal injury in the event that a bare hot wire is touching a metal piece of the electrical equipment using the device (Figure 4-324). Exposed, damaged Type NM can be seen throughout the interior and exterior areas in violation of NEC (Figure 4-325). NM cable is to be run in conduit or concealed except in unfurnished areas such as attics and basements. Devices (switches and receptacles) on the exterior of the building do not have weatherproof covers and pose the risk of electric shock during wet conditions.

Electrical - Lighting, Emergency Lighting, and Exit Signs

Exterior building mounted lighting is limited to a few surface mounted incandescent sconce fixtures. Most fixtures have visible damage and do not appear to be in working order:

Bathrooms have vanity and a surface light, kitchens have surface mounted flood light

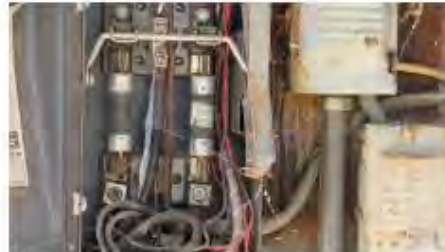


Figure 4-323. Non-compliant taps within main disconnect (SJH, 04/59/2019)



Figure 4-324. Damaged receptacle (SJH, 04/59/2019)



Figure 4-325. Type NM cable on exterior (SJH, 04/25/2019)

type fixtures, all with obsolete incandescent lamps. Bedrooms currently do not have any overhead lighting.

Due to the residential use of the space, there are no exit or egress lighting requirements.

Condition: Poor

All fixtures and wiring are in poor condition, most fixtures have visible damage and are beyond their life expectancy. Incandescent lamps appear to be used throughout which is extremely energy inefficient and does not meet current design standards. Exterior building mounted fixtures are not dark sky compliant and are not wired per current electrical code requirements (Figure 4-326). It is not anticipated that any fixtures will be reused; however a full review of all existing fixtures will be coordinated with park staff to determine if any historic fixtures are to be refurbished and reused.



Figure 4-326. Damaged exterior luminaire with exposed NM cable (SJH, 04/25/2019)

Electrical - Fire Protection & Detection System

Battery powered smoke detectors were found however coverage is inadequate throughout. The existing devices are obsolete, inoperable and not located where required by current codes.

Condition: Poor

There is no working fire protection, fire alarm smoke detection, or notification systems.

Electrical - Tele/Data Communications System

The existing telephone line is overhead from utility. There is a telephone termination box mounted adjacent to the main electrical disconnect. Telephone cabling is free run, exposed, along the exterior of the building before poking through the walls into individual spaces. Within the building, there are many installations where telephone cabling is routed along the surface of the walls

to phone jacks which have been added though the years. There does not appear to be any data cabling within the building.

There appears to be an existing intercom system within the residence. The intended use of the system is currently unknown and is likely no longer operational.

Condition: Poor

The exposed cabling routed along the interior and exterior of the building is subject to damage and is in poor condition (Figure 4-327). Device locations throughout the building are minimal and do not meet modern needs for communication access.

Electrical - Lightning Protection System

No lightning protection system exists on the structure.



Figure 4-327. Low-voltage cabling routed across floor and coiled in corner of room (SJH, 04/25/2019)

APPENDIX F: Sky Quality Monitoring Datasheets

Night Sky: Light Survey

Observer(s):

Date:

Sunrise Time:

Sunset Time:

Moonrise Time:

Moonset Time:

Start Time:

End Time:

Air Temp (indicate F or C):

Relative Humidity (%):

Windspeed (mph):

Cloud Cover: 0% 1-25% 25-50% 50-75% 75-100%

Wind Speed:

Moon phase:

Device Used:

Location description or name:	Location description or name:
Lat/Long (or UTM's, if easier):	Lat/Long (or UTM's, if easier):
Time:	Time:
SQM Readings (take 6, disregard the first):	SQM Readings (take 6, disregard the first):
1. 4.	1. 4.
2. 5.	2. 5.
3. 6.	3. 6.
Notes:	Notes:

APPENDIX G: Legal Boundary Maps

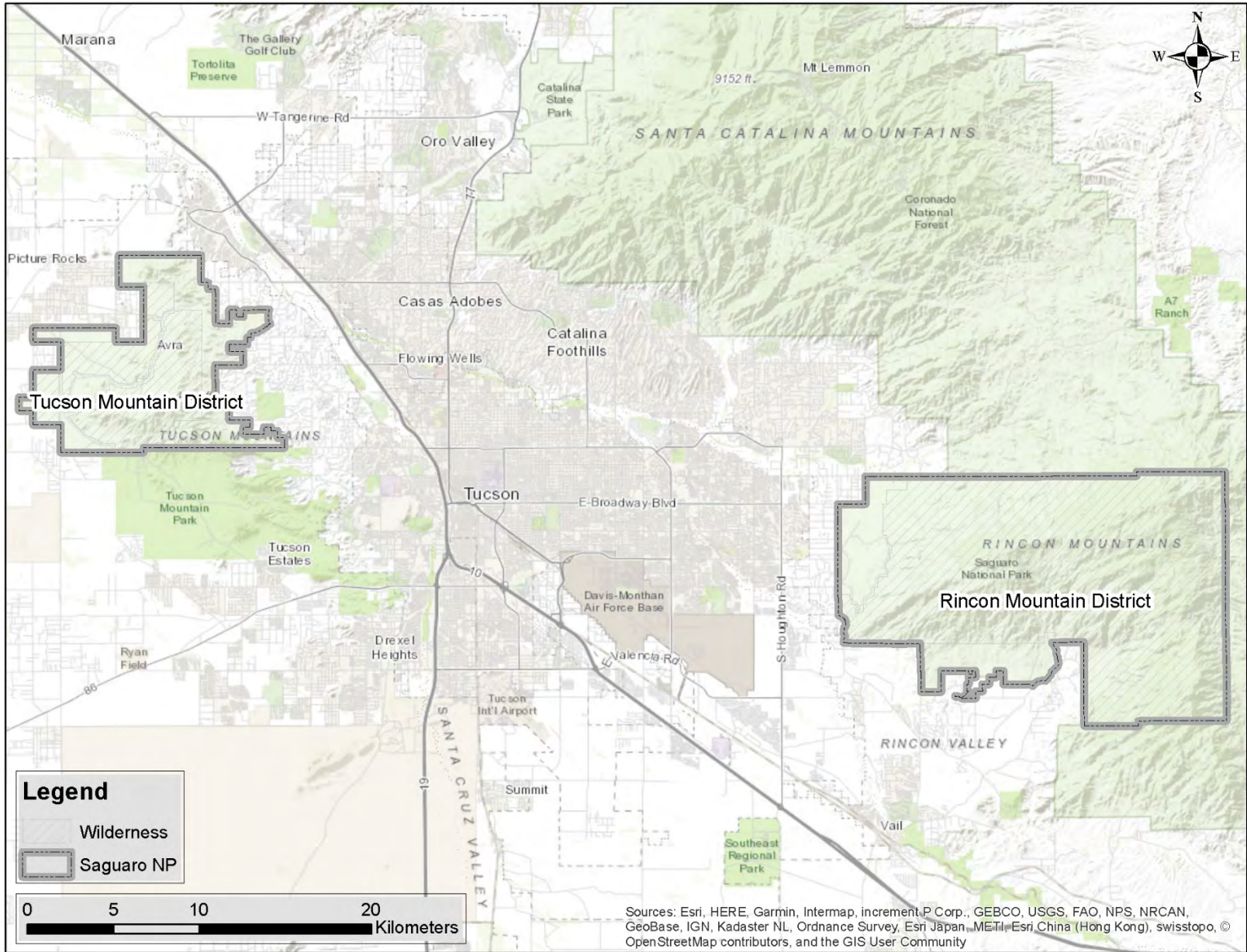


Figure 1. Saguaro National Park's two districts (Tucson Mountain District & Rincon Mountain District) relative to the City of Tucson.

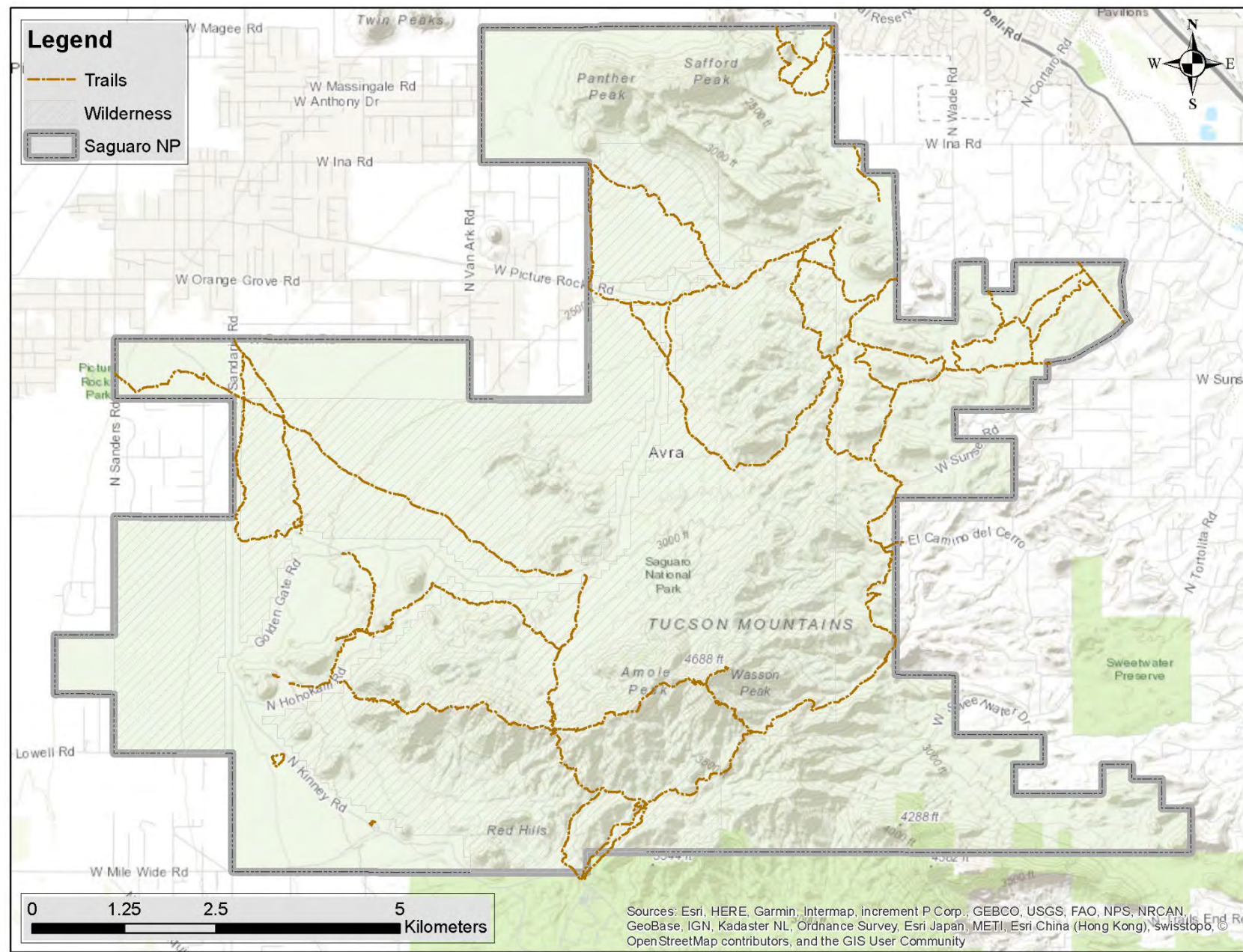


Figure 2. Saguaro National Park, Tucson Mountain District.

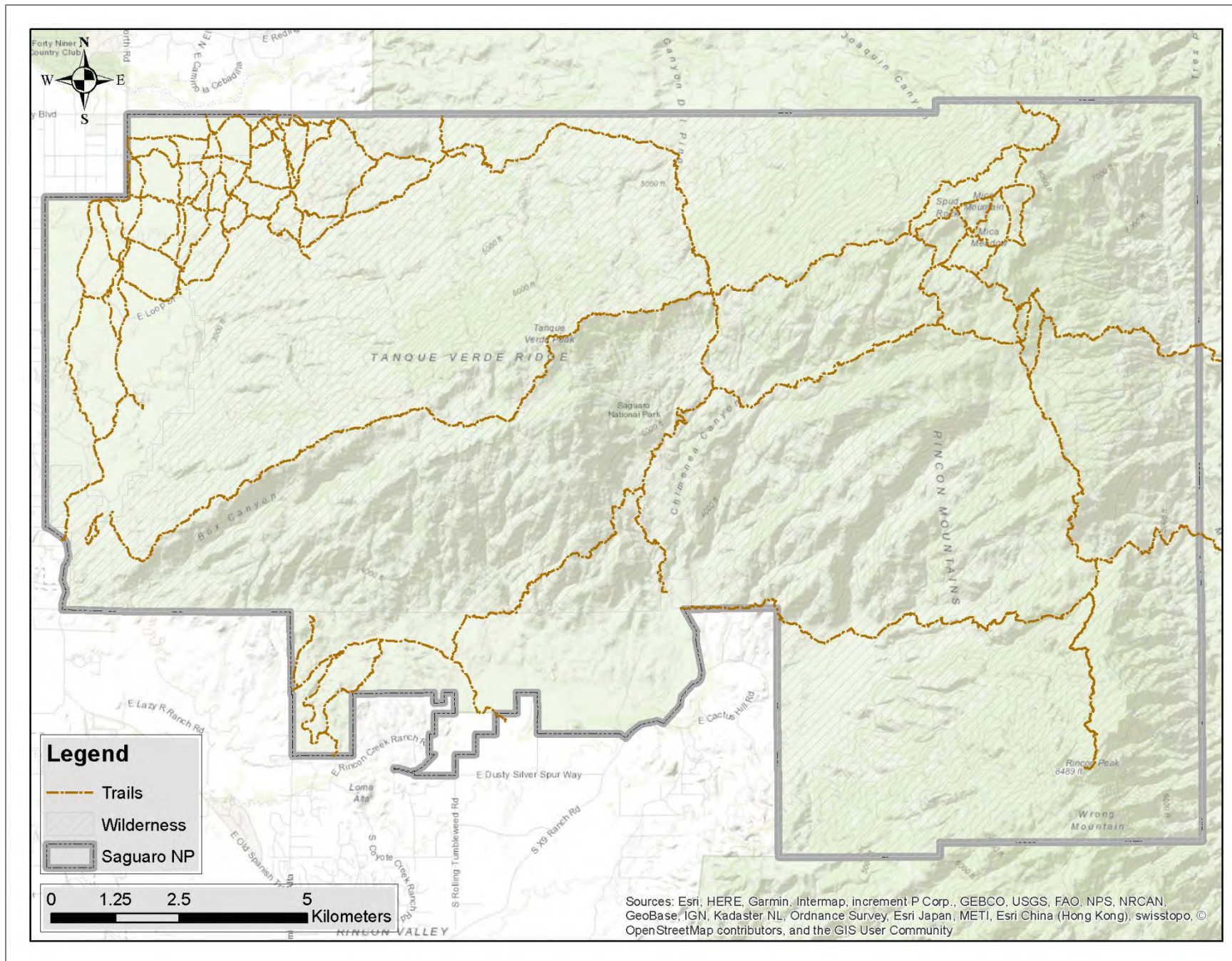


Figure 3. Saguaro National Park, Rincon Mountain District.

APPENDIX H. Results from Tucson Mountains & Rincon Mountains Survey (2011)

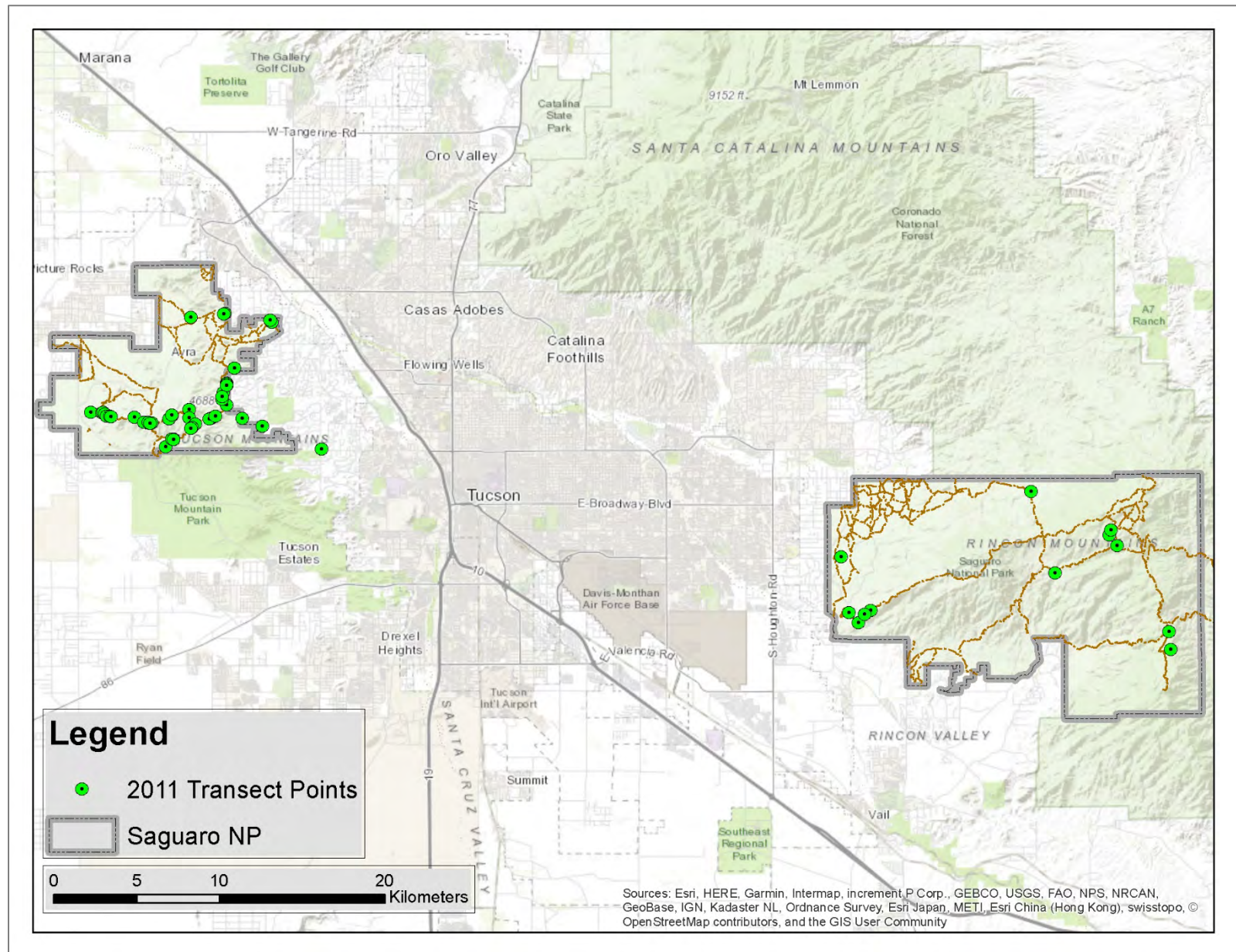


Figure 4. Tucson Mountain & Rincon Mountain transect conducted on October 21, 2011. See Globe at Night (<https://www.globeatnight.org/mapapp/>) for additional information.

Table 1. Results from October 21, 2011 survey of the Tucson Mountains & Rincon Mountains. See *Globe at Night* (<https://www.globeatnight.org/mapapp/>) for additional information.

Obs ID	Latitude	Longitude	Obs Time	Limiting Mag	SQM Reading	SQM Serial	Cloud Cover	Constellation	Sky Comment	Location Comment
16005	32.2529	-111.162	19:02	3	20.22	5363	clear	Cygnus		
16007	32.2957	-111.118	19:02	4	19.85	5410	clear	Cygnus	Two small clouds, probably outside theFOV.	First reading from the parking lot
16008	32.2877	-111.123	19:16	4	19.95	5410	clear	Cygnus	No more noticeable clouds	Down in a wash
16010	32.2871	-111.123	19:17	2	20	5492	1/4 of sky	Cygnus		
16013	32.1621	-110.724	19:32	4	20	5422	clear	Cygnus	Clear, but just a few clouds to the west. Lm slightly less Than 4	
16021	32.1926	-110.729	19:50	5	20.24	5405	1/4 of sky	Cygnus		
16024	32.2824	-111.125	19:49	4	20.01	5410	clear	Cygnus	Clear sky	Higher up the hillside. Great view of the city lights.
16035	32.2756	-111.123	20:18	4	20	5410	clear	Cygnus	Clear	Hillside to the north, wash to the south
16049	32.2789	-111.126	20:46	4	20.07	5410	clear	Cygnus	Clear;	Ever upward
16062	32.2684	-111.133	21:16	5	20.16	5410	clear	Cygnus	Clear	~3500 ft up
16064	32.2682	-111.134	21:29	5	20.18	5410	clear	Cygnus	Clear	Altitude; 3615 ft
16072	32.1566	-110.718	20:13	4	20.08	5422	clear	Cygnus	Mostly clear but a few clouds to the west. Limiting magnitude just under 4' but more than 3.5.	
16074	32.1633	-110.71	21:33	4	20.26	5422	1/4 of sky	Cygnus	Cloud cover has increased to the East and West, but Zenith was still clear.	Location was in a slight valley between two rises.
16075	32.1613	-110.714	20:44	4	20.27	5422	clear	Cygnus	SKy Mostly Clear, with some clouds to the wouth, but less than 1/4 coverage.	
16077	32.2863	-111.123	20:13	3	19.8	5492	1/4 of sky	Cygnus		
16083	32.2696	-111.13	21:54	3	20.23	5492	1/2 of sky	Cygnus		
16085	32.2804	-111.126	22:31	3	20.19	5492	1/4 of sky	Cygnus		
16087	32.2658	-111.171	23:45	4	20.62	5363	clear	Cygnus		
16090	32.2698	-111.158	22:50	4	20.31	5363	clear	Cygnus		
16091	32.268	-111.16	22:50	4	20.28	5430	clear	Cygnus		
16092	32.2703	-111.158	22:50	4	20.36	5443	clear	Cygnus		
16094	32.2733	-111.147	22:30	4	20.11	5430	clear	Cygnus		
16096	32.2688	-111.147	21:10	4	20.32	5363	clear	Cygnus		
16099	32.2655	-111.143	20:58	4	20.23	5363	clear	Cygnus		
16102	32.2636	-111.145	20:20	4	20.19	5363	clear	Cygnus		
16103	32.2629	-111.146	20:20	4	20.07	5430	clear	Cygnus		
16105	32.257	-111.157	19:45	4	20.2	5363	clear	Cygnus		

16106	32.257	-111.158	19:45	4	19.93	5430	clear	Cygnus		
16107	32.2569	-111.157	19:45	4	20.29	5443	clear	Cygnus		
16108	32.2518	-111.062	19:55	5	19.53	5373	clear	Cygnus	very slight cloud cover near horizon	far west end of Grant/Ironwood Hill
16139	32.2716	-111.21	19:15	3	20.63	5407	clear	Cygnus	light haze in the south west.	
16140	32.2714	-111.203	19:00	5	20.26	5490	clear	Cygnus	Clear	National park. No streetlights, little to no development.
16142	32.2717	-111.202	19:09	6	20.23	5452	clear	Cygnus		
16143	32.2709	-111.201	19:30	3	20.36	5452	clear	Cygnus	Hazy	State park
16144	32.2696	-111.2	19:46	6	20.28	5452	clear	Cygnus	thin high clouds	State park
16145	32.2695	-111.198	19:57	4	20.35	5452	clear	Cygnus		State park
16146	32.2694	-111.197	0:00	6	20.23	5452	clear	Cygnus		Valley
16147	32.2691	-111.182	0:00	5	20.44	5452	clear	Cygnus		
16149	32.266	-111.174	21:03	4	20.49	5452	clear	Cygnus		State park.
16150	32.2663	-111.176	21:16	4	20.46	5452	clear	Cygnus		Close to Tucson lights
16151	32.2662	-111.173	21:29	4	20.46	5452	clear	Cygnus		
16152	32.2657	-111.172	21:45	5	20.48	5452	clear	Cygnus		Close to Tucson lights
16153	32.3209	-111.094	20:20	3	19.53	5492	clear	Cygnus		
16155	32.322	-111.095	21:20	3	19.7	5492	clear	Cygnus		
16156	32.2685	-111.113	21:52	3	20.15	5492	clear	Cygnus		
16157	32.2643	-111.1	20:21	3	20.11	5492	clear	Cygnus		
16159	32.3234	-111.146	22:00	4	20.54	5492	clear	Cygnus		
16160	32.3256	-111.124	22:40	3	20.32	5492	clear	Cygnus		
16161	32.3254	-111.125	23:08	4	20.35	5492	clear	Cygnus		
16162	32.1415	-110.518	20:28	3	23.76		clear	Cygnus		
16163	32.1513	-110.519	20:12	6	23.35		clear	Cygnus		
16164	32.1983	-110.552	21:00	4	20.76	5457	clear	Cygnus		
16165	32.2041	-110.557	21:30	4	20.8	5457	1/4 of sky	Cygnus		
16166	32.2067	-110.556	22:00	4	20.9	5457	1/4 of sky	Cygnus	Slightly More Cloud Cover	
16168	32.2279	-110.607	19:30	6	21.56	5967	clear	Cygnus		Douglas Springs Campground SAGU
16169	32.1836	-110.592	22:00	5	20.8	5457	clear	Cygnus		

APPENDIX I. Interpretation & Education Programs

OBJECTIVE

The focus of EVERY night sky program/event is to showcase the value and importance of darkness in the park, actions the park is taking to model best practices, and what every visitor can do to protect these resources.

REGULAR, RECURRING PROGRAMS

1. Night Comes Alive – Rincon Mountain District

Description: A 2-hour, 2.5-mile hike in the dark side of the park. Meets at the Loma Alta Trailhead. Every week on Monday, Wednesday, and Friday from January through March.

2. Sunset Hikes (recurring weekly) – Rincon Mountain District

Description: Climb a half-mile up the Tanque Verde Ridge to enjoy a desert sunset with a ranger guide. Meets at the Javelina Picnic Area. Every week on Sunday, Tuesday, Thursday, and Saturday from January through May. Duration: 1 hour and 30 minutes

3. Sunset Hike [Moon Hike Series] – Tucson Mountain District

Description: A 4 hour, 3.5-mile round trip hike that climbs 700 feet to a beautiful ridgeline for the sunset. This hike is scheduled to take up to 4 hours; includes breaks, short discussions, and time to watch the sunset. Duration: 4 hours

4. Star Parties (recurring monthly at both districts)

Description: Join us for some stargazing among the saguaros! Telescopes will be provided. Accessible program. Duration: 2.5 hours.

5. Silhouettes at Sundown– Tucson Mountain District

Description: Trek along an arroyo as the setting sun magically silhouettes the Southwest's most famous icon – the giant saguaro. This walk is one-third sandy wash with a few rock outcroppings, one-third hill with a gentle grade, and one-third gentle trail. This event is scheduled to be roughly 3 hours long, beginning at the King Canyon Trailhead and covering a total distance of 2.5 miles. Duration: 3 hours.

6. Wasson Peak Full Moon Hike – Tucson Mountain District

Description: A 7-hour, 8-mile round trip hike that climbs 1700 feet to the highest point in the Tucson Mountains, arriving just in time to enjoy the 360-degree view of the sunset. The descent of the trail is solely under the light of the moon. The hike is at an easy pace but is considered somewhat difficult due to rough terrain and hiking after dark. This hike is scheduled to take up to 7 hours; includes breaks, short discussions, and time to watch the sunset.

7. Twilight Glow to Moon Shadows – Tucson Mountain District

Description: This hike allows you to enjoy the beauty of the changing light as the sun sets and the moon rises. This 3 hour, 2 ½ mile round trip hike follows gentle grades along a trail, a sandy wash and a dirt road. This hike is scheduled to take up to 3 hours; includes breaks, short discussions, and time to watch the sunset.

8. Moon Over the Mountains – Tucson Mountain District

Description: Come out to the Red Hills Visitor Center and enjoy a short talk about the moon and the music of two of our talented volunteer musicians as the full moon rises above the beautiful array of Saguaro Cacti. Bring a chair and dress for the cool desert evenings. Programs last roughly 45 mins.
Duration: 1 hour

9. Observe the Moon Night – Rincon Mountain District

Description: Take a walk in the desert under the light of Earth's natural satellite- the Moon. We'll share activities featuring our nearest celestial neighbor, its myths, its realities, and its place in all of our lives. Meets at the Rincon Mountain Visitor Center, 1 hour duration.

SPECIAL EVENTS

10. International Dark Sky Week (recurring annually)

Evening Hikes & Star Parties (Both Districts)

Description: Join us each evening for a celebration of International Dark Sky Week! Each evening will be a different hike that celebrates and explores the Sonoran Desert after hours. Program topics will vary and includes viewings of the night sky with discussions of nocturnal plants and animals and the effects of light pollution. Come discover the night with us and explore the park after dark!

11. Art in the Park - Dark Sky Designs – Rincon Mountain District

Description: Saguaro National Park preserves 140 square miles of darkness on the edge of the sprawling city of Tucson. Learn about the importance of dark skies to the park's wildlife, and to all of us, as we seek certification of the park as an Urban Night Sky Place. Park staff will highlight steps the park is taking to insure dark skies for present and future generations. Remember: "Half the Park is after dark!" Instruction in watercolor painting techniques (materials provided) and a chance to create your own mixed-media night skyscape in watercolor and crayon. Programs will be offered hourly throughout the day at the visitor center

12. Holiday Caravan – Rincon Mountain District

Description: A guided, starlight auto tour of the Cactus Forest drive, celebrating nature's bounty at the turn of the year. Explore the solstice holiday on a unique nighttime drive through the park's loop, featuring several stops along the 8-mile drive. Includes a ¼ mile walk along an accessible trail. Auto tours will be offered every ½ hour, 5 – 8 p.m. Each tour lasts approximately 1½ hours.