Kartchner Caverns State Park
Benson, Arizona, USA

International Dark Sky Park

(Silver Tier)

Nomination Package

Prepared by the Huachuca Astronomy Club of Southeastern Arizona

2017 Revision by the Oracle Dark Skies Committee

Table of Contents

List of Figures

List of Tables

1. Letter of Nomination

April 16, 2017

International Dark-Sky Association
Board of Directors
3223 N. First Avenue
Tucson, AZ, 85719-2103

Dear IDA Directors,

As the Park Manager of Kartchner Caverns State Park, Benson, Arizona, I strongly support this nomination to be an International Dark Sky Park. Our visitors appreciate the magnificent night skies, and we believe this official recognition will greatly assist us in meeting the goal of educating the public in the importance of dark skies.

Several years ago, Kartchner Caverns became one of the first state parks in the world to earn *Global Star Park* status. UNESCO, Astronomers without Borders, The Starlight Heritage, and the One Star at a Time organizations, support this recognition program.

Kartchner Caverns uses only the correct amount of light when, and where it is needed. The lights are low level, and shielded where appropriate. Cochise County, which surrounds the park, has one of the most progressive outdoor lighting ordinances in the world. Sierra Vista, located about twenty-five miles to the South of the park, has also enacted strong light pollution controls. Kartchner volunteer Bob Gent is currently working with the city of Benson to update their outdoor lighting code. It will include lumen densities reduced by 50 percent, digital sign brightness limits at night, and much more.

With these ordinances in place, Arizona State Parks is able to maintain the dark sky around the park. The park typically reaches 21.30 magnitudes per arc second SQM readings. Additional details will be included in this nomination package.

The park hosts night sky special events every year. In the recent past, our astronomer volunteers have scheduled several programs at Kartchner Caverns. These have included two Star Night Parties with a lecture and telescope viewings, programs during Cave Fest, and Family Campout Dark Sky programs. The park and volunteers also hosted a group of South Korean dignitaries who were here to observe lighting regulations in practice in Southern Arizona. These are just some of the park's achievements, and we hope you agree that Kartchner Caverns State Park deserves the International Dark-Sky Park award.

If you have questions, please feel free to contact me directly. Thank you again for your consideration for this award.

Sincerely,

Jake McCoy
Park Manager III
Kartchner Caverns State Park

1300 W. Washington Street. Phoenix, AZ 85007
Phone/TTY: (602) 542-4174. Fax (602) 542-4188

2. Letters of Support

The following letters document local support for Kartchner Caverns State Park (KCSP) being designated as an "International Dark Sky Park":

Smithsonian Astrophysical and MMT Observatory

Huachuca Astronomy Club

Certificate of Appreciation from Arizona State Parks Board of Directors

Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

MMT Observatory
Smithsonian Institution &
The University of Arizona®

October 21, 2015

IDA Board of Directors
3223 North First Avenue
Tucson, AZ 85719

Dear IDA Board of Directors:

This letter is to express our support for designating the Kartchner Caverns State Park as an International Dark Sky Park. Arizona has a long history of astronomical research and hosts several world-class astronomical observatories. The preservation of dark skies is of paramount importance for optical astronomical research, such as that conducted at our observatories.

The Kartchner Caverns State Park initiative for designation as an International Dark Sky Park is beneficial in many ways, such as encouraging continued monitoring of the already excellent outdoor lighting ordinances of Sierra Vista and Cochise County, and inspiring and educating the public about the importance of preserving our dark skies.

We commend the effort to include Kartchner Caverns State Park as an International Dark Sky Park and hope that it will lead to a broader conservation of the region's dark skies for all to enjoy.

Sincerely,

G. Grant Williams
Director, MMT Observatory

Joannah L. Hinz
Assistant Staff Scientist, MMT Observatory

Emilio Falco
Project Director, Whipple Observatory

MMT Observatory • The University of Arizona • Tucson, Arizona 85721 • PHONE: 520.621.1558 • FAX: 520.621.4144

Huachuca Astronomy Club of Southeastern Arizona
Post Office Box 922
Sierra Vista, AZ 85636-0922

May 22, 2015

International Dark-Sky Association
Jim Dougherty, President
J. Scott Feierabend, Executive Director
3223 N. First Avenue
Tucson Arizona USA 85719-2103

Dear Jim and Scott:

We are writing to nominate Kartchner Caverns State Park, Benson, Arizona, USA to be an International Dark-Sky Park. This park has gone above and beyond to promote and preserve our magnificent night sky, and we would appreciate your prompt approval of this request. This nomination package will highlight many of the outstanding achievements at the park, but we would like to summarize a few key points in this letter.

Based upon their outstanding efforts to preserve the night sky, Kartchner became one of the first two state parks in the world to earn ***Global Star Park*** status. This program is supported by ***UNESCO, Astronomers without Borders, the Starlight Heritage, and the One Star at a Time*** organization. This award was presented to Kartchner on March 3, 2011.

Why did they win this prestigious award? Kartchner uses only the right amount of light when it is needed. Their lights are low level, and shielded. Also, Cochise County which surrounds Kartchner has one of the best outdoor lighting ordinances in the world. On numerous events held at Kartchner, we used Sky Quality Meter (L Model) to measure sky brightness at 21.3 magnitude per arc second squared. These are pristine night skies worthy of the IDSP award.

Kartchner Caverns hosts many night sky appreciation events every year. This year for example, we are on schedule to hold seven events at Kartchner. We hold star parties in the spring and fall and use the theater for talks about astronomy, the night sky, and how to protect it. This year we are also on tap to give light pollution talks at both Cave Fests. In other news, we hosted a group of Korean dignitaries who are considering outdoor lighting laws in Korea. During Arizona State Parks Family Campouts, we bring telescopes and share in the wonders of the night sky. There are just a few of the many achievements, and we hope you agree that Kartchner deserves International Dark-Sky Park award.

We would be pleased to meet with you to discuss in more detail the many outstanding accomplishments of Kartchner Caverns State Park. If you have questions, I can be reached at RLGent@cox.net on email, or 520-378-2915 by phone.

Sincerely,

Robert L. Gent, Lt Col, USAF, Ret.
Board Member and Past President, Huachuca Astronomy Club,
Arizona State Parks RIM Astronomer, and
Past President, International Dark-Sky Association

Resolution
In Recognition of

Huachuca Astronomy Club

WHEREAS: On November 5, 1999, Kartchner Caverns opened to the public.

WHEREAS: Kartchner Caverns has a $12.3 million impact on Cochise County through direct, indirect, and induced income.

WHEREAS: The Huachuca Astronomy Club recognized the importance of keeping Kartchner Caverns open to the public and recognized that the budget constraints affecting the State of Arizona made it difficult for the Arizona State Parks Board to commit adequate funds to operate the park. The agreement with the Huachuca Astronomy Club demonstrates it is committed to helping keep Kartchner Caverns open to the public.

WHEREAS: The Huachuca Astronomy Club has performed this task beyond expectation by providing Star Night speakers and telescopes to enhance the visitors experience at Kartchner Caverns State Park events; and

WHEREAS: The Huachuca Astronomy Club continues to provide superb service to the Arizona State Parks Board and the people of Arizona, in times of need and times of plenty; it is hereby

RESOLVED:

That the Arizona State Parks Board expresses sincere gratitude for the work and accomplishments of the Huachuca Astronomy Club; and

That this Resolution be entered into the records of the Arizona State Parks Board and a copy be presented to the Huachuca Astronomy Club as a token of the high regard held by the Arizona State Parks Board.

Dated this thirtieth day of November 2011.

Tracey Westerhausen, Chair
Arizona State Parks Board

Arizona State Parks Board Members

Walter D. Armer, Jr., Reese Woodling, Larry Landry, Alan Everett, William C. Scalzo
Maria Baier, State Land Commissioner
Renée E. Bahl, Executive Director

3. Kartchner Caverns State Park History and Information

3.1 History of Kartchner Caverns State Park

In November 1974, Gary Tenen and Randy Tufts were exploring the limestone hills at the eastern base of the Whetstone Mountains. They were looking "for a cave no one had ever found" and found it. The two kept the cave a secret until February 1978 when they told the property owners, James and Lois Kartchner, about their awesome discovery.

Since unprotected caves can be seriously damaged by unregulated use, they knew the cave had to be protected. Late in 1984, Randy Tufts came to the Arizona State Parks office in Phoenix for a meeting with Charles R. Eatherly, Special Projects Coordinator for the Arizona State Parks Board. Tufts was advised that acquiring a site and creating a State Park was a lengthy process and could take from two to five years with no guarantee of success, and each step of the process would be open to the public.

In 1985, shortly after learning about "Secret Cave," Governor Bruce Babbitt, who has a degree in geology, was given a tour through the cave by Tufts and Tenen. At the time, State finances were very limited. Staff worked with Governor Babbitt on the potential of a State land exchange as one possibility.

On April 27, 1988, the Kartchner family, Randy Tufts, and Gary Tenen were introduced in both the Senate and House. They all joined Arizona State Parks Board members and staff that afternoon in the Governor's office to witness the signing of the bill by Governor Rose Mofford to acquire land for Kartchner Caverns a State Park.

Overcoming more than 10 years of challenges in research, planning, construction, legislative threats, mining concerns, and legal issues, the upper caverns were ready to open to the public. The developments to this point had cost over $28 million. The opening of Kartchner Caverns State Park was held on November 5, 1999. The lower caverns opened to the public four years later November 11, 2003. Governor Janet Napolitano attended this celebration.

Suzanne Pfister and Governor Janet Napolitano at the Big Room Dedication in 2003

In February of 2010, Kartchner was used at the request of an astronomer traveling from Johnson Space Center in Texas, to use telescopes to track an asteroid crossing in front of a star. This was the first of many night sky programs and in 2011, Kartchner Caverns was designated a Global Star Park. Sky quality measurements and night sky programs have continued every year since then.

In 2016, Kartchner Caverns State Park was voted the "Best Cave in the USA" by readers of "USA Today":

3.2 Park Information

Kartchner Caverns State Park (Figure 3.1) is located on approximately 718 acres, and it borders on the west side of Arizona State Highway 90, a few miles south of Benson, Arizona. It also borders the east side of the Whetstone Mountains and the Coronado National Forest. The elevation is 4,582 feet at the entry gate, and the highest point in the park is about 5,100 feet above sea level. Just west of Kartchner Caverns State Park, Apache Peak towers at 7,711 feet elevation. There are a number of hiking trails inside the park that also reach out of the park and into the national forest. The terrain is desert grasslands with some areas of Chihuahuan desert.

The Discovery Center is located on the northeast end of the main parking lot. The facility consists of the front desk, a theater presentation, museum, gift shop, an amphitheater, and food concession. At the Front Desk, customers may get park information, pick up reservation tickets or purchase walk-up tickets. (Walk up tickets may or may not be available on any given day, reservations are highly recommended.)

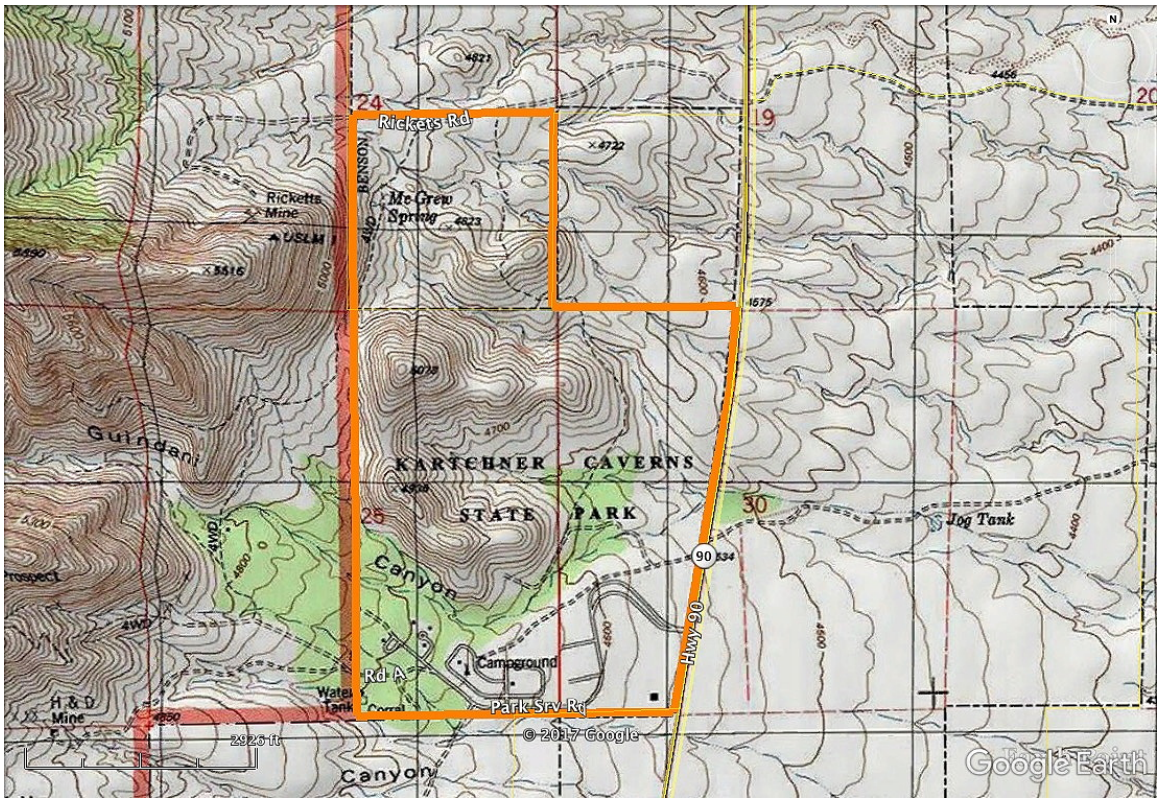


Figure 3.1 Park Location and Boundary

(Map scale in lower left-hand corner to 2926 feet.)

3.3. Kartchner Caverns State Park Outreach Programs

In the Tenen–Tufts Theater, a video presentation (15 minutes long) plays twice an hour. The program highlights the discovery aspect of the cave. The Museum contains exhibits on cave formations, cave life, hydrology, and history. The Gift Shop

offers a wide array of cave related and southwestern themed souvenirs, gifts and practical items to meet the needs of travelers. The amphitheater may host a variety of interpretive programs, weddings or other special events. There is also a Discovery Center Scavenger Hunt for Kids.

Visitors to Kartchner Caverns find that the Discovery Center is well-named. Caves are mysterious and unfamiliar to humans. These dark caverns peak our curiosity and lead us to seek answers for our many questions. Numerous interactive displays in the museum give visitors the opportunity to discover the answers for themselves.

Introductory panels in the geology exhibits show how caves form, why the formations look as they do and locations of other caves. Other displays are specific to Kartchner Caverns, one of the most-studied public caves. It ranks in the top ten caves worldwide for its unique mineralogy. Here you can touch local rock types. A cut-away view of the cave hill highlights some major features and tour routes at the touch of a button. Take a virtual tour of some of the cave's most prominent formations at the Underground Journey exhibit. The hands-on hydrology display allows visitors to follow water underground, usually hidden from our view and shows why water is essential to the cavern remaining a "living" cave.

Though geology is the focus of many of the museum displays, exhibits also showcase cave and surface ecology, paleontology, archaeology, and history. The cave ecosystem is dependent upon a summer colony of cave myotis bats. Their guano nurtures a miniature world of amazing creatures. Explore the regional displays to educate yourself on the area's plants, animals, and other attractions found aboveground. Paleontological studies inspired displays describing the area's distant past. Bones, many from extinct animals, were discovered during the caverns' development. Evidence of human habitation on the park property is also displayed.

Original 86,000-year-old sloth bones and a 36,000-year-old Horse skull are now on display in the Discovery Center. There are also small bones from bear, extinct antelope, bob cat, ringtail cat, and rabbit.

Kartchner Caverns has an intriguing story of discovery and development. A 15-minute video featuring the discoverers tells the story of finding and protecting the cave. View their meager caving equipment, and put yourself in their boots by crawling through simulated cave openings.

Arizona State Parks' consultation with cave experts prior to development resulted in a display showing problems facing public caves and the importance of preserving them. Hopefully, the museum exhibits inspire visitors to appreciate and help preserve all caves.

Kartchner Caverns State Park was registered with the Global Star Park Network (now defunct) in March 2011:


One Star at a Time
Congratulates
Arizona State Parks and Huachuca Astronomy Club
for establishing the public stargazing site
Kartchner Caverns State Park
at Benson, Arizona, United States of America
which is now registered with the Global StarPark Network as part of the worldwide effort to preserve humanity's heritage of connecting with the starlit firmament.
Presented this Third day of March, Two-Thousand Eleven.
STARLIGHT
A COMMON HERITAGE
Coordinator of the StarLight Initiative
One Star at a Time
One Star at a Time Co-Chairperson
ASTRONOMERS WITHOUT BORDERS
President of Astronomers Without Borders
The Global StarPark Network and its objectives
of night environment protection, education and improvement
of the human habitat are supported by the UNESCO-MaB Programme.

4. Kartchner Caverns State Park Dark Sky Event Location

4.1 Kartchner Caverns State Park Map

The following map of Kartchner Caverns State Park shows the main road, trail, facilities, and parking lot.

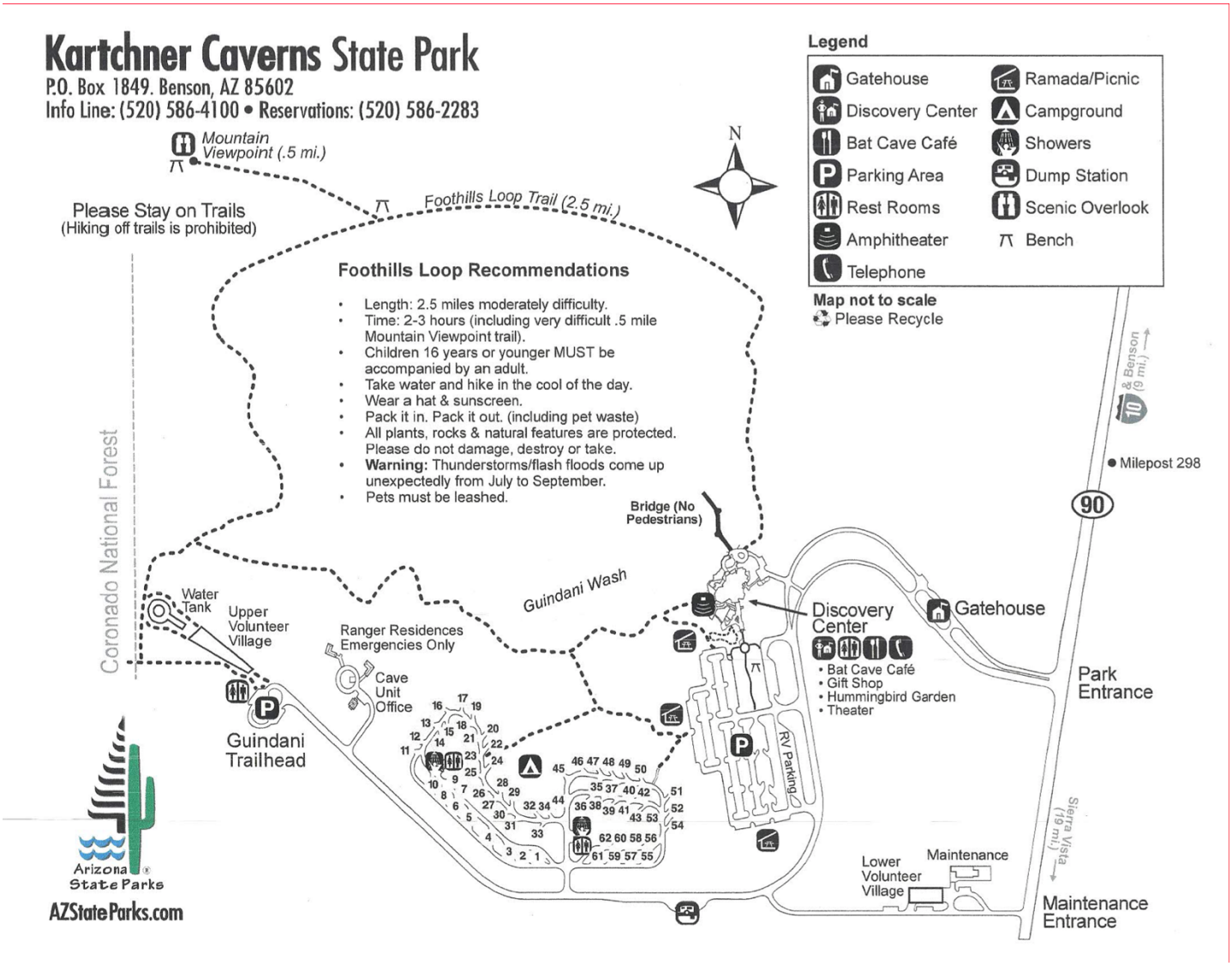


Figure 4.1 Main Park Map

The satellite image (from the Apple Maps application) shows the Park.

Figure 4.2 Satellite Day Image Park Area

As can be seen in Figures 4.2, there are no structures nearby that are sources of light pollution.

Star parties are normally conducted from the main parking lot near the Discovery Center.

4.2 Day Photographs

The following photographs show the excellent sky views from Kartchner Caverns State Park.

Figure 4.3 Park Entrance

Figure 4.4 View to North from Main Parking Lot towards Discovery Center

Figure 4.5 View to East (Dragoon Mountains, land of legendary Apache Chief Cochise)

Figure 4.6 View to South

Figure 4.7 View to West towards the Whetstone Mountains

5. Kartchner Caverns State Park Night Sky Quality

5.1 Satellite Image

Figure 5.1 is a NASA satellite image from 2012 showing southeastern Arizona. The large bright area to the upper left is Phoenix and Maricopa County. Near the center of the image is the metro Tucson area with the Interstate 19 corridor extending south to Nogales at the International Border. Kartchner Caverns State Park is located southeast of Tucson and is to the right of the red arrow. Recent sky quality measurements show Kartchner Caverns State Park is about 21.3 MPAS.

Figure 5.1 Satellite Night Image of Southeast Arizona

5.2 Light Pollution Map

A portion of the "New World Atlas of the Artificial Night Sky Brightness" (http://cires.colorado.edu/artificial-sky) provides an indication of the sky brightness as seen in southeastern Arizona (Figure 5.2; North at the top). Kartchner Caverns is marked by the red arrow.

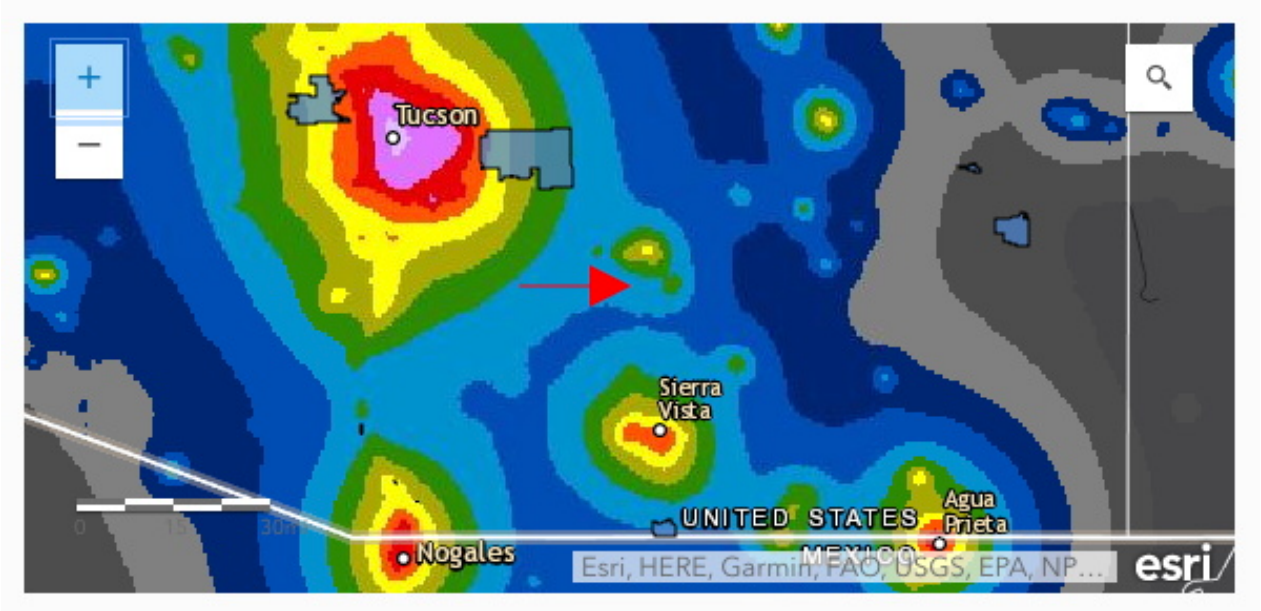


Figure 5.2 Night Sky Brightness Southeastern Arizona

The next section documents actual sky quality measurements at Kartchner Caverns State Park.

5.3 Sky Quality Measurements

Sky Quality Measurements were taken at Kartchner Caverns State Park on different nights, at various times, and under varying sky conditions. Measurements were made using a Unihedron Sky Quality Meter with Lens (SQM-L), serial number 4435. The meter measures the sky brightness in units of "magnitudes per square arc second". Since most astronomers and the knowledgeable public think in terms of "what's the faintest star visible?" the following chart developed by K. Fisher (http://www.unihedron.com/projects/darksky/images/MPSASvsNELM.jpg) provides a conversion to visual magnitudes.

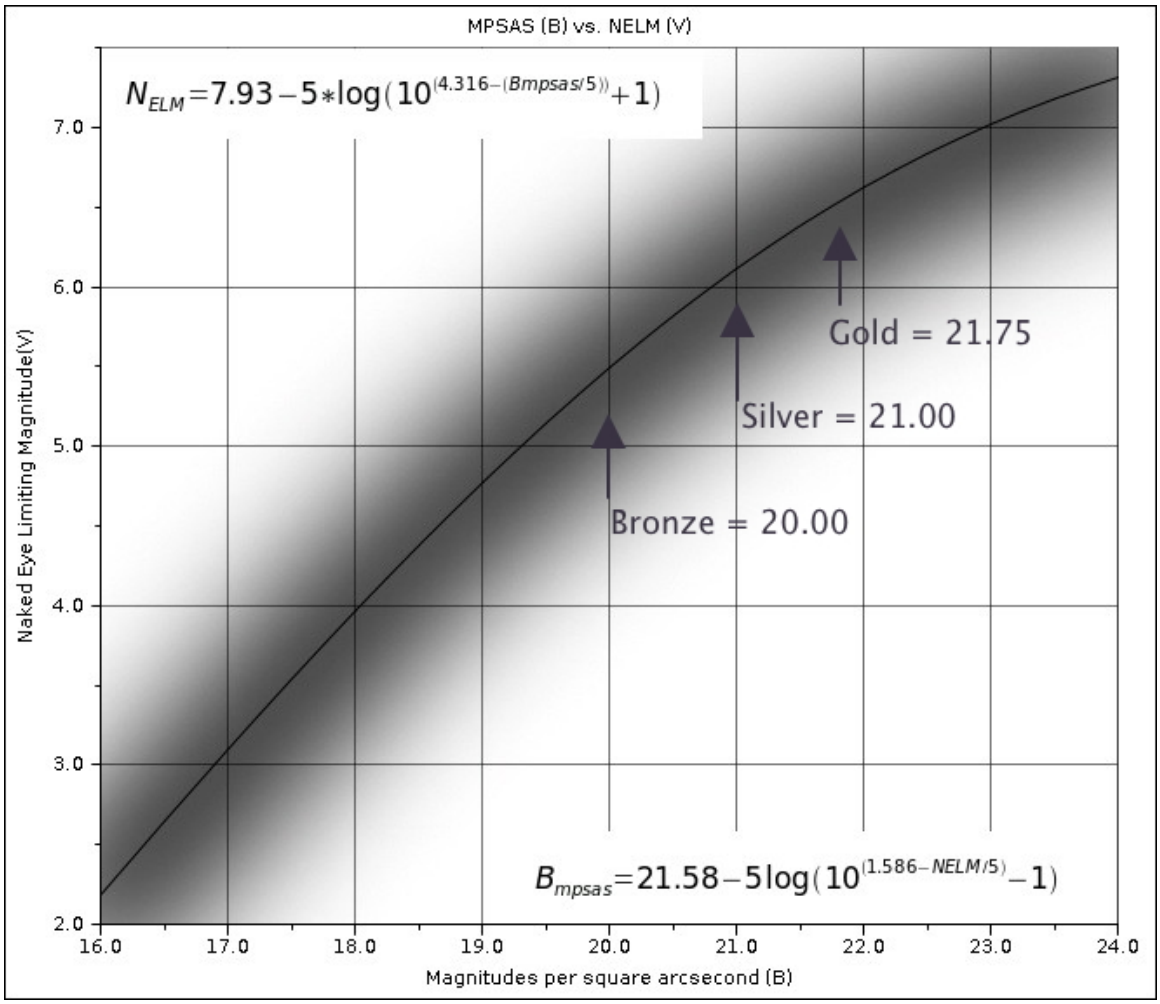


Figure 5.3 Sky Quality Chart vs IDSP Tiers

The "International Dark Sky Park" levels of Gold, Silver, and Bronze have been added to the chart.

The following letter shows the night sky quality measurements taken at the Park during 2011-2015.

Sky Quality Measurements

Kartchner Caverns State Park, Arizona

October 19, 2015

Kartchner Caverns State Park, Benson, Arizona fully supports Night Sky Quality measurements. For the past five years, the ASP RIM astronomer and Board members of the Huachuca Astronomy Club of Southeastern Arizona have taken multiple SQM-L readings at each star night event when there were clear skies, no moon present, and at least 2.5 hours after sunset. The average reading over the past four years is approximately 21.28 magnitude per arc-second squared, so this is clearly a dark sky location. Here is a sampling of readings from past measurements:

March 26, 2011: 21.29 magnitude per arc-second squared, 21.35 magnitude per arc-second squared (MPAS) and 21.28 MPAS at approximately 21:00 MST.

September 24, 2011: No readings due to clouds

March 16, 2012: No readings on Saturday night due to party cloudy. Friday night, the SQM-L reading was 21.30 MPAS.

September 9, 2012: 21.15 MPAS at approximately 21:05 MST

March 16, 2013: 21.35 MPAS at about 21:00 MST

October 6, 2013: 21.25 MPAS at 20:45 MST

March 22, 2014: No SQM readings taken

September 20, 2014: No readings due to clouds

October 17, 2015: No readings due to overcast weather

RL Gent

Robert L. Gent, Lt Col, USAF, Ret.
Arizona State Parks RIM Astronomer
Past President, International Dark-Sky Association
Member of the Board, Huachuca Astronomy Club of Southeastern Arizona
Sierra Vista, AZ USA
RLGent@cox.net

Sierra Vista
EXTRAORDINARY SKIES.
UNCOMMON GROUND.

In April 2017, new SQM reading were taken, as documented here:

Sky Quality Measurements

Kartchner Caverns State Park, Arizona

April 19, 2017

On April 18, 2017, Kartchner Volunteer Bob Gent visited the park to take multiple SQM-L readings, to take night sky photographs, and to check for lights that are not code compliant. The skies were clear, moonless, and steady. Winds were mostly calm, and the temperature was 72 degrees Fahrenheit on arrival. By departure, there were slight breezes. These measurements showed better dark skies than measurements taken at Kartchner in the past. Possible reasons for this are that the park was not crowded, and the vehicle traffic was less. Also, some measurements were taken along a trail which is more distant from campgrounds and buildings.

Sunset was at 6:53 pm Mountain Standard (Arizona) Time, and the moon did not rise until 12:33 am, April 19, 2017. All the following readings were taken at Kartchner on April 18, 2017. The SQM-L model used was serial number 12.7 4435: Here is a sampling of the magnitude per arc-second (MPAS) readings from these measurements:

==========

9:20 pm MST: 21.50 MPAS from main parking lot. This was the average of five readings aimed close to zenith. Note: parking lot lights went off at about 8:20 pm.

==========

9:22 pm MST: 21.33 MPAS from main parking lot. Pointed in director NW over Whetstone Mountains toward Tucson. The instrument elevation was approximately 30 degrees.

==========

9:25 pm MST: 21.17 MPAS from main parking lot. Aimed South toward Sierra Vista at about 30 degrees elevation.

==========

9:40 pm MST: 21.51 MPAS from Guindani Trail towards mountains, about 0.1 mile past Volunteer Campground. Taken towards zenith with multiple measurements averaged.

==========

9:50 pm MST: 21.64 MPAS. Best reading along Guindani Trail, pointed towards zenith.

==========

Robert L. Gent, Lt Col, USAF, Ret.
Kartchner Caverns Volunteer and Arizona State Parks RIM Astronomer
Past President, International Dark-Sky Association
Sierra Vista, AZ USA

The darkest reading was 21.51, which puts Kartchner Caverns in the “Silver Tier”.

In May 2017, Kartchner Caverns State Park purchased a Unihedron SQM-L. This new meter will be used for future night sky quality readings.

5.4 Night Sky Photographs

Photographs of the night sky as seen from Kartchner Caverns were taken on 18 April 2017 by Bob Gent, KCSP volunteer, local amateur astronomer, and IDA member, using a Canon DSLR SL1. These photos provide an approximation of what the human eye would see.

Figure 5.4 Orion in Southwest (8 seconds, ISO3200, FL 18mm)

Figure 5.5 Southeast View towards Tombstone (15 seconds, ISO6400, FL 18mm)

Figure 5.6 South View towards Sierra Vista (15 seconds, ISO3200, FL 18mm)

Figure 5.7 North View over Discovery Center (15 seconds, ISO3200, FL 18mm)

Figure 5.8 Northwest view towards Tucson (15 seconds, ISO12800, FL 18mm)

Figure 5.9 Orion (2.5 seconds, ISO12800, FL 75mm)

Figure 5.10 Pleiades (3.2 seconds, ISO12800, FL 75mm)

Figure 5.11 is a photograph (13 seconds, ISO1600, FL 18 mm) was taken from about three miles south of Kartchner looking South towards Sierra Vista. The most distant glare and sky glow on the right side is from Fort Huachuca. The bright glare to the left is a sports field in Sierra Vista:

Figure 5.11 Skyglow from Sierra Vista and Fort Huachuca

Figure 5.12 is a photograph (1/4sec, ISO1600, FL 20 mm) is a closer view of the sports field in Sierra Vista (about 25 miles from KCSP). The most distant glare and sky glow on the right side is from Fort Huachuca. Note that with the much faster shutter speed and the lower ISO, the off-site spill is still noticeable.

Figure 5.12 Sierra Vista sports field lighting

6. Kartchner Caverns State Park Lighting Inventory

The following inventory of outdoor lighting fixtures at Kartchner Caverns State Park was prepared in May 2015.

000000v2_29 May 2015
S. Crye, R. Casavant

2015 IDSP Applic_KCSP Surface Lighting Inventory_29May2015_S. Crye, R. Casava

Map Site	Location Name	Unit description	Watts	# lights	Misc. info
		halogen (H), compact fluorescent light (CFL), 4-ft fluorescent light (F), incandescent (I), mercury vapor (Hg)			directed/shielded by unit housing or overhang (S), bug light (BL), motion detector (M), day/night sensor (DN), toggle switch (TS), timer (T)
1	Maintenance Bldg	H	60w	5	M, DN
		CFL	14w	3	S, BL, M, DN
		F	35w	8	S (under awning), TS
2	Sewer plant, machine shed	H	60w	4	TS
		CFL	7w	2	S, BL, TS
		F	35w	3	S, TS
3	Tram tug barn	F	35w	32	S, M, TS
4	Electrician trailer	H	25w	2	S (under awning), M
5	Lower volunteer village	H	50w	2	TS
		CFL	14w	10	S, BL, bollard, DN
6	Upper volunteer village	CFL	14w	4	S, BL, bollard, DN
7	Trailhead parking / restroom	CFL	14w	9	S, BL, bollard, DN
8	Cave Unit/RM Office	H	60w	2	M
		CFL	14w	17	S, wall mounts & bollards, BL, DN
9	PM Residence 1	H	35w	8	M, TS
10	PM Residence 2	H	35w	8	M, TS
11	Campground W	CFL	14w	4	S, bollards, BL, DN
12	Campground E	CFL	14w	4	S, bollards, BL, DN
13	DC parking lot	CFL	14w	37	S, bollards, BL, DN
14	DC staff ramada	F	35w	4	S, DN, TS

Table 6.1 Kartchner Caverns State Park Lighting Inventory

000000v2_29 May 2015
S. Crye, R. Casavant

15	DC Family Ramada / Hummer Gardens	CFL	14w	19	S, bollards, BL, DN, T
		H	25w	28	S, TS
		F	35w	12	S, TS
16	VIsitor Ctr (DC)	CFL	14w	64	S, wall mounts, bollards, BL, DN, T
17	Tram bridge, DC Amphitheater	I	25w	38	S, TS, T
18	Tram loading area	Hg	250w	4	TS
19	Tram road	CFL	14w	68	S, wall mounts, bollards, BL, DN, T
	Cave portals	H	25w	10	S, TS, alarm system
20	North interp shed	I	25w	2	S, TS
21	Park Gatehouse	CFL	14w	3	S, BL, DN, TS
22	Park Entrance Sign	LED	25w	4	S, DN

Misc. notes
1 -- Steve C believes that KCSP used to host 34 types of light; currently only 12 types used today
2 -- Might be interesting to compare 2004 annual electrical consumption with 2014 data
3-- Bob Gent--IDA rep and ASP RIM Specialist to conduct independent survey

Table 6.1 Kartchner Caverns State Park Lighting Inventory (continued)

Shielded lights are along the pathway from the main parking lot to the Discovery Center:

Figure 6.1 Pathway lights

During an inspection of outdoor lighting at KCSP, four fixtures were inventoried that were not compliant with Cochise County lighting codes. Three CFL Fixtures are located on a maintenance building near Highway 90 (item 1 in inventory). The other CFL fixture is located at item 7, a trailhead bathroom near the rear of the park. In April 2017, the non-compliant lighting was addressed. As seen in the photographs in Figure 6.2, shields were installed on lights at the maintenance shop and cave unit office. The exterior of 3 square lights at the gatehouse and 1 square light at the Guindani restroom was painted with black high temperature paint so that the only light emitting from these is now directed towards the ground.

Figure 6.2 Light fixtures brought up to code

Figure 6.2 (continued) Light fixtures brought up to code

Figure 6.2 (continued) Light fixtures brought up to code

In May 2017, four fully shielded Portfolio porch lights were purchased for use on new cabins at Kartchner Caverns State Park. These lights will be documented in the first "International Dark Sky Park" annual update.

7. Kartchner Caverns State Park Star Parties & Related Events

Kartchner Caverns State Park frequently holds events that take advantage of the dark night sky as seen from the Park, as well as events to educate and entertain the public on science, environmental, and cultural topics related to the Park. Section 7.1 provides a selection of these events that have occurred over recent years.

7.1 Selected Past Events

During calendar year 2015, Kartchner Caverns hosted seven night sky appreciation and preservation programs. This began on January 10, 2015, when we hosted a Korean regional governor and his staff at the park. We briefed the visitors on the Cochise County light pollution code as well as other related topics. We also set up a telescope for them and discussed our night sky quality monitoring program. This activity supported international efforts in South Korea to promote dark sky preservation.

Visiting Korean dignitaries with AZ State Parks RIM Astronomer Bob Gent on January 10, 2015 at KCSP

On February 14, 2015, KCSP hosted Cave Fest. As part of this program, the KCSP astronomer gave a talk to a full theater on the importance of dark sky preservation. In past years, similar dark sky programs were given at other Cave Fests.

SCHEDULE of EVENTS

Saturday

10:00 – "First Day Journey" Movie, hosted by Ranger Erika Way

11:00 – Cave Restoration – Park Ranger Erika Way

12:00 – Cave Inhabitants – Ranger Siria Navarro

1:00 – The Development of Kartchner Caverns – Ranger Chuck Duncan

2:00 – Preservation & Appreciation of Our Night Skies – Astronomer Robert Gent

3:00 – Basin and Range Block Faulting – Ranger Jennifer Van Horn

Sunday

10:00 – "First Day Journey" Movie, hosted by Ranger Erika Way

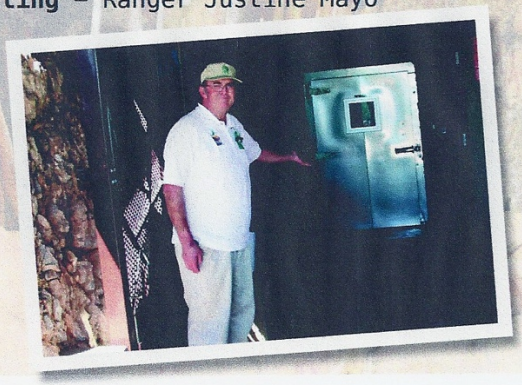
11:00 – Don't call me a Pig; Javelinas – Ranger Rachel Powell

12:00 – Nocturnal Animals – Ranger Peter Kane

1:00 – Rusticles – Ranger Sinda Sutton

2:00 – Karst– Ranger Lindsey Spencer

3:00– Recycling – Ranger Justine Mayo



CAVE FEST 2015

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KARTCHNER CAVERNS STATE PARK

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Arizona State Parks

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On March 14 and October 17, 2015, KCSP hosted international astronomy day activities. These are held twice every year and Kartchner, and night sky protection and appreciation is always on the agenda. KCSP has helped develop a state-wide program of dark sky appreciation.

The following photo was taken of the night sky during one of the many astronomy programs at Kartchner Caverns. It has been used to raise awareness of night sky.

KCSP Park Astronomers Bob Gent (left) and Ted Forte (right) with co-discoverer of Kartchner Caverns, Gary Tenen (center) during astronomy program, March 14, 2015.

Cave discoverer, Gary Tenen at telescope

KCSP astronomers and volunteers have worked with the Arizona State Parks headquarters to design, print, and distribute hundreds of flyers expressing the importance of dark skies. This flyer is one example from six years ago.

At one of the first star nights on September 11, 2010, AZ state parks RIM astronomer JD Maddy explains the importance of protecting dark skies.

In summary, Kartchner Caverns State Park is committed to dark sky preservation, public education, and assisting businesses and communities with planning. We will continue to monitor night sky quality, to host multiple dark sky events every year, and to do all we can to help others understand the importance of this issue.

8. Kartchner Caverns State Park Outdoor Lighting Policy

8.1 Kartchner Caverns State Park Outdoor Lightscape Management Plan

Outdoor Lightscape Management Plan

Kartchner Caverns State Park, Arizona

October 26, 2015

Kartchner Caverns State Park will to protect and preserve it's night sky through the following actions, many are already in place.

Wherever possible, the park will meet or exceed the Cochise County light pollution code. Most lighting already meets this standard, and unshielded lighting will be shielded within five years.

Before adding any new outdoor lighting, the park will determine what areas need lighting, and when the lighting is required. Lighting levels and curfews will be used.

All new lighting over 500 lumens will be shielded with no light above horizontal.

In accordance with the county lighting code and IDA standards, the park will not use lighting with correlated color temperatures above 3,000K. The adverse impact to wildlife and sky glow will then be minimized.

The park will continue to recognize dark skies as an important resource to be preserved.

The park will continue to measure night sky quality with assistance form the Huachuca Astronomy Club. Measurements have been taken for over five years, and this will be continued.

Member astronomers in Kartchner Caverns State Park's volunteer RIM program (Resource Inventory-Monitoring) have helped revise and strengthen outdoor lighting codes in the region including Cochise County, Sierra Vista, and other areas.

The park will continue to support astronomy outreach and night sky preservation. For 2015, seven different programs were held at Kartchner. In once case, international VIP visitors from Korea met at Kartchner to discuss local lighting ordinances and techniques used to promote them. The park will continue to promote dark sky awareness at least four times per year, but often more frequently. Acknowledgement of the dark sky environment and IDA initiative for preservation and protection are integrated into cave tours and the park camping experience.

Kartchner Caverns and Arizona State Parks has published, printed, and mounted large posters displayed on walls in the visitor center.

On various occasions, Kartchner Caverns has distributed flyers and practice guides developed by the International Dark-Sky Association. With assistance from the Huachuca Astronomy Club of Southeastern Arizona, regional handouts have been written, published and distributed. If supplied, informational materials and general lighting guidelines can be provided to overnight campers by our camp-hosts.

If awarded IDSP status, the park is prepared to install a sign on the main entry way or at the Discovery Center acknowledging the award.

The park will submit annual reports to IDA by October 1 describing activities taken to maintain dark sky park status as well as progress in shielding any unshielded fixtures. Two times each year RIM astronomers will continue to monitor SQM (Sky Quality Meter) levels at key locations on park.

The park currently meets the SQM levels for a silver tier application. Average SQM readings are about 21.30 magnitudes per arc-second squared. Some remote sections of the park may actually exceed this level and qualify for gold tier.

A separate night sky quality measurement report has been completed and is included in the IDSP application package.

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9. Local Government Lighting Codes

9.1 Cochise County Zoning Regulation Article 16, Light Pollution

Cochise County Arizona

Light Pollution Zoning Regulations

Approved by Board of Supervisors on December 2, 2014

Effective date January 1, 2015

ARTICLE 16

LIGHT POLLUTION

Contents of Article 16

1601 Purpose

1601.01 To achieve effective and efficient lighting, while preserving the safety, security, and well-being of County residents and visitors.

1601.02 To protect and enhance the lawful nighttime use and enjoyment of all property through protection of and access to the dark night skies, and to encourage the conservation of energy and other resources.

1601.03 To specify and encourage lighting practices and systems that will minimize the adverse man-made light pollution effects of sky-glow, glare and light trespass.

1601.04 To ensure that all signs installed in the County are compatible with the County's largely rural character, are in compliance with the Comprehensive Plan, and to ensure that no sign shall be brighter than is necessary for clear and adequate visibility.

1602 Administration

1602.01 Conformance with Applicable Codes

All outdoor electric illuminating devices shall be installed in conformance with all provisions of these Zoning Regulations, Cochise County Subdivision Regulations, and any applicable building codes. Where any provision of any of the Arizona Revised Statutes, or any Federal Law, or any related Cochise County regulation conflicts with the requirements of this Article, the most restrictive shall govern.

1602.02 Approved Material and Methods of Installation

The provisions of this Article are not intended to prevent the use of any material or method of installation not specifically proscribed by this Article, provided any such alternate has been approved. The County Zoning Inspector may approve any such alternate provided the proposed design, material, or method:

A. Provides approximate equivalence to those specific requirements of this Article, or

B. Is otherwise satisfactory and complies with the intent of this Article.

1602.03 Applicability

A. New Uses, Buildings and Additions or Modifications:

The requirements of this Article shall apply to any and all new uses and to additions to existing land uses, developments, buildings, or structures.

1. If a major addition occurs on a property with a non-residential use, the entire property shall comply with the requirements of this Article. For purposes of this section, major additions are additions of 50-percent or more in terms of additional dwelling units, gross floor area, or seating capacity, either with a single addition or with cumulative additions subsequent to the effective date of this provision.

2. Minor additions (defined as additions or modifications less than 50-percent of existing uses) on a property with a non-residential use shall require the submission of a complete inventory and site plan detailing all existing and any proposed new outdoor lighting. Any new lighting on the site shall meet the requirements of this Article with regard to shielding and lamp type; the total amount of lumens after the modifications are complete shall not exceed that on the site before the modification, or that permitted by this Article, whichever is larger.

B. Change of Use. Whenever the use of any existing building, structure, or premises is changed to a new use, all outdoor lighting shall be reviewed and brought into compliance with all provisions of this Article before the new use commences.

C. Resumption of Use after Abandonment. If a property or use with non-conforming lighting is abandoned as defined in Section 1603, then all outdoor lighting shall be reviewed and brought into compliance with all provisions of this Article before the use is resumed.

1602.04 Special Use Authorization Requirements

Any application or lighting installation not meeting all requirements of this Article, including, but not limited to height, shielding, curfew, or lumen caps shall require a Special Use Authorization pursuant to Article 17. At the time of Special Use Authorization submittal, the proposed installation shall be certified by a knowledgeable Arizona Registered professional with complete specifications, including total lumen/ nit count to meet the requirements of off-site glare and light trespass, as specified in this Article.

1603 Definitions

Abandonment - The discontinuation of use for a period of three years or more.

Class 1 Lighting - All outdoor lighting used for, but not limited to, outdoor sales or eating areas, assembly or repair areas, recreational facilities and other similar activities where COLOR RENDITION is important. Class 1 lighting includes metal halide, liquid crystal display (LCD), light emitting diode (LED), plasma, quartz halogen and similar light sources and technologies.

Class 2 Lighting - All outdoor lighting used for, but not limited to, illumination for walkways, roadways, equipment yards, parking lots, and outdoor security where GENERAL ILLUMINATION for safety or security is the primary concern.

Class 3 Lighting - All outdoor lighting used for DECORATIVE effects, including but not limited to, architectural illumination, flag and monument lighting, and illumination of vegetation.

Color Rendition - The ability of a light source to faithfully reproduce the colors seen in an object.

Correlated Color Temperature (CCT) - This temperature best indicates the colors of light shining from a bulb or lamp. CCT is listed with all new lighting sources (lamps and bulbs), and by standard, the temperature is given in degrees Kelvin. Low Kelvin numbers represent "warm light and higher numbers represent "cool light".

Decorative - Class 3 lighting which is used for non-utilitarian purposes such as lighting building exteriors, fountains, flags, landscaping, holiday and seasonal decorations.

Developed Site - Acreage refers to the developed area of the site, including, but not limited to area used for buildings, structures, storage and service areas, parking, loading, driveway areas, required setback areas and required landscaping related to the use, but not areas that are only cleared.

Foot-candle - A unit of illumination produced on a surface. For the purpose of this Article, one foot candle is equivalent to one lumen.

General Illumination - Outdoor lighting used for, but not limited to, illumination for walkways, roadways, equipment yards, parking lots, and outdoor security where safety or security of the grounds is the primary concern.

IESNA - Illuminating Engineering Society of North America.

Illuminance - The amount of light striking a surface area, measured in footcandles or lux. For conversion purposes, 1 footcandle (fc) is equal to 10.76 lux (lx).

Installed - The attaching, or assembling in place of any outdoor light fixture.

Lamp - A generic term for a source of "light" often called a "bulb," "tube", "diode", "module", "display," or an "array."
LED (Light Emitting Diode) - A semiconductor diode or bulb that emits light when voltage is applied to it and is used in electronic devices.

Light Fixture, Fully Shielded - A light fixture constructed, installed, and maintained in such a manner that all light emitted by the fixture, either directly from the lamp or indirectly by reflection or refraction from any part of the fixture, is projected below a horizontal plane running through the lowest part of the fixture.

A practical way to determine if a fixture or tube is fully shielded: if the lamp or tube, any reflective surface, or lens cover (clear or prismatic) is visible when viewed from above or directly from the side, from any angle around the fixture or tube, the fixture or tube is not fully shielded.

Light Fixture, Outdoor - A complete lighting assembly (including the lamp, housing, reflectors, lenses and shields), less the support assembly (pole or mounting bracket). Includes luminous tubes, lamps, or similar devices, permanently installed or portable, used for illumination, decoration, or advertisement.

Light Trespass - Stray electric light in excess of the levels specified in Section 1605.01 falling where it is not wanted or needed. Direct or reflected light that has its source on one site, and illuminates areas beyond the property boundaries. Light trespass is typically produced by stray light from unshielded or misdirected outdoor lighting, and includes glare from direct viewing.

Lumen - A unit used to measure the total amount of light that is produced by a lamp. For the purpose of this code, one lumen is equivalent to one foot candle.

Luminaire - A light fixture, including the complete lighting assembly (including lamps, housings, reflectors, lenses and shields), but excluding the support assembly.

Nit - A unit of luminance measured as one candela per meter-squared.

Opaque - Opaque means a material that does not transmit light from an internal illumination source.

Outdoor Light Fixtures - Outdoor electric illuminating devices, outdoor fixtures, lamps and other devices; searchlights, spot lights, flood lights, permanently installed or portable, used for illumination, emergency, security or commercial purposes. Such devices shall include, but are not limited to, lights for:

a. Parking lots
b. Roadways
c. Buildings and structures
d. Recreational areas and facilities
e. Landscaping decorative effects
f. Billboards and signs (advertising and other)
g. Product display areas

Outdoor Recreational Facility - An area designed for active recreation, whether publicly or privately owned, including but not limited to parks, baseball or softball diamonds, soccer and football fields, golf courses, tennis courts, and roping/equestrian arenas.

Person - Shall mean any private individual, tenant, lessee, owner, or any commercial entity including but not limited to companies, partnerships, joint ventures, or corporations.

Residential Lighting - Residential refers to outdoor lighting for single household dwellings.

Searchlight - A lighting assembly designed to direct the output of a contained lamp in a specific tightly focused direction (a beam) with a reflector located external to the lamp and with a swiveled or gimbaled mount to allow the assembly to be easily redirected. Such lights are commonly used to sweep the sky for advertisement purposes.

Shield - A device that is attached onto or inserted into a luminaire to alter the direction of light being emitted. A luminaire that has a shield attached or inserted is considered to be "shielded."

Sign, Digital - A type of electronic display that can show programming, menus, information, advertising, and other messages. Digital signs are lighted typically animated, flashing and utilize technologies such as LCD, LED, plasma displays, or projected images to display content.

Sign, Illuminated - For the purposes of this Article, a sign lighted by or exposed to artificial lighting either by lights within the sign or directed toward the sign.

Sky-glow - The undesirable and unnecessary emission of light rays, directly or indirectly, into the night sky.

Uplighting - A lamp or light designed or positioned to cast its light upwards.

Use, Non-Residential - The use of land for a purpose other than single-household dwelling units.

Watt - The unit used to measure the electrical power consumption (not the light output) of a lamp.

1604 Procedures for Lighting Compliance

1604.01 Applications

A. Any individual applying for a building or use permit under these Zoning Regulations intending to install outdoor light fixtures shall as a part of said application submit evidence that the proposed work will comply with this Article.

B. All other individuals intending to install, replace or improve any outdoor light fixture shall comply with the provisions of this Article, and if a permit is required by these Zoning Regulations or Building Codes, submit an application to the County Zoning Inspector providing evidence that the proposed work will comply with this Article.

1604.02 Contents of Application or Submission

The following plans and descriptions shall be sufficiently complete to enable the County Zoning Inspector to readily determine whether the project will be in compliance with the requirements of this Article. If such plans and descriptions are not sufficient to enable this ready determination, by reason of the nature or configuration of the devices, fixtures or lamps proposed, the applicant shall submit evidence of compliance prepared by a certified illumination engineer. The submission shall contain:

A. Plans indicating the location on the premises, and the type of all illuminating devices, existing and proposed, as well as total lumens or nits emitted.

B. Description of the existing and proposed illuminating devices, fixtures, lamps, supports and other devices, and the initial lumen output. This description shall include but is not limited to, manufacturers' catalog cuts, photographs, diagrams and/or drawings.

1604.03 Issuance of Permits

Upon compliance with these lighting provisions, as well as the other requirements for permit issuance, the County Zoning Inspector shall issue a permit. The appeal procedures of these Zoning Regulations for decisions of the County Zoning Inspector shall apply in the event of any dispute as to the application of this Article.

1604.04 Amendment to Permit

Substitution of outdoor light fixtures or lamps after a permit has been issued requires County Zoning Inspector approval prior to installation. Amendments to permits for the installation of outdoor light fixtures require adequate information to assure compliance with Section 1604.02 of this Article.

1604.05 Accessibility for Inspections

The Applicant will provide a means to safely inspect any digital sign over five-feet tall from the ground.

1605 General Requirements

1605.01 Light Trespass and Glare

A. All fixtures and lamps shall be located, installed, directed, shielded, and maintained to avoid light trespass and to minimize direct light and/or glare on neighboring properties and roadways. Accent lighting shall be directed onto the building or object and not toward the sky or onto adjacent properties.

B. For a receiving residential site, the level of light trespass shall not exceed 0.2-lumens as measured with a lumen meter's sensor perpendicular to the light source at a height of five-feet above the ground and located five-feet inside the receiving property line. For a receiving non-residential site, the level of light trespass shall not exceed 0.5-footcandles under the same parameters.

1605.02 Height

A. Residential Sites: The overall height of lighting fixtures (including the base) shall not exceed 20-feet above ground level, except for residential sites with a minimum parcel size of four-acres or larger, lighting fixtures which are located 50-feet or more from any property line shall not exceed 30-feet in height (including the base) above ground level. Digital signs shall meet all requirements per Section 1907.02 of Article 19.

B. Non-Residential Sites: Except as provided herein for specific uses, the overall height of lighting fixtures (including the base) on all non-residential sites shall not exceed 30-feet above ground level, except in the GB, LI and HI zoning districts, the overall height of lighting fixtures located at least 100-feet from any property line shall not exceed 35-feet in height above ground level (including the base). Digital signs shall meet all requirements per Section 1907.02 of Article 19.

1605.03 Lighting Types, Shielding and Curfew Requirements

A. Lighting Types

1. All street lights shall be fully shielded.

2. Low Pressure Sodium lamps are the preferred lamp type for minimizing adverse effects on astronomical observations.

B. General Shielding Requirements

1. All light fixtures required to be fully shielded shall be installed and maintained in a fashion that maintains the fully-shielded characteristics.

2. All uplighting is prohibited, except

   a. The lighting of one flagpole. The light shall be focused on the flag and shall not exceed 2,000 lumens. Off-site glare and light trespass shall be eliminated by the use of shielding. Flags that include advertising, business trademarks or symbols, or other forms of commercial communication may not be uplighted at any time.

b. Low voltage or solar landscape lighting not exceeding 150 lumens per fixture.

C. Shielding Requirements for Residential Uses

1. For residential uses, any lamp type with output of 1,000 lumens or more shall be fully shielded. If multiple lamps of less than 1,000lumens are used, and the total lumens are greater than 1,000 lumens in total then shielding is required.
2. Lighting for multiple household dwellings is not considered Residential, and must comply with all requirements for Non-Residential lighting, including, but not limited to lumen caps and curfews for decorative lighting.
3. All light fixtures located within 25-feet of the property line adjacent to a residential use shall use fully shielded luminaries.

D. Shielding and Curfew Requirements for Non-Residential Uses

1. All Non-Residential light fixtures except for unshielded signs shall be fully-shielded.
2. Any Class 1 (Color Rendition), Class 2 (General Illumination), or Class 3 (Decorative Illumination) lamp type shall be shielded in accordance with Table 16.1.
3. All Class 1 (Color Rendition) and Class 3 (Decorative Illumination) lighting shall be extinguished between 11 p.m. (or when the business closes, whichever is later) and sunrise, except:
   a. Seasonal decorations using typical unshielded low-lumen incandescent lamps shall be permitted from Thanksgiving to January 15.
   b. Low voltage landscape lights rated at 150 lumens or less provided the total unshielded lumens do not exceed 1,000 lumens.
   c. Self-contained solar lights rated at 10 watts or less.
4. All light fixtures located within 25-feet of the property line adjacent to a residential use shall use fully shielded luminaires.

1605.04 Total Outdoor Light Output

A. Total outdoor light output, including that for all signs, shielded or unshielded, shall not exceed the limits in Table 16.1. The values in this table are upper limits and not design goals; design goals should be the lowest levels that meet the requirements of the task to reduce glare and reduce energy costs.

B. Shielded flood lights, properly aimed down, at no more than 45 degrees, not to exceed 2,000 lumens per bulb and controlled by a motion sensor device shall be exempt from lumen caps, provided fixtures remain on for short periods only, and not to remain on over 10 minutes after the area has been vacated.

C. Low voltage seasonal decorations, permitted between Thanksgiving and January 15, are not counted toward these limits.

D. Total outdoor light output for various zoning districts is specified in Table 16.1. These maximums are referred to as lumen caps.

Table 16.1

MAXIMUM TOTAL OUTDOOR LIGHT OUTPUT STANDARDS LUMEN CAPS

All Uses in Commercial and Industrial Zoning Districts (NB, GB, LI, HI)[5]	
Total shielded	150,000-lumens per acre of developed site [1, 4, 5]
Total Unshielded	3,000-lumens per acre of developed site [2,3,5]
Non-Residential Uses in Residential and Rural Zoning Districts [6]	
Total shielded	75,000-lumens per acre of developed site [1,4,5]
Unshielded	3,000-lumens per acre of developed site [2,3,5]
Residential Uses in Residential and Rural Zoning Districts Lots one acre or larger	
Shielded	20,000-lumens per acre of developed site [5]
Unshielded	2,000-lumens per acre of developed site [2, 3]
Residential Uses in Residential and Rural Zoning Districts Lots less than one acre	
Shielded	10,000-lumens per residence
Unshielded	2,000-lumens per residence [2, 3]
Digital Signs	
Limited to one sign per developed site with a maximum of 200-nits per site	
Correlated Color Temperature (CCT)	
Maximum CCT of 3,000K permitted for non-residential lamps	

[1] Lumens for all signs are to be included in these caps except as provided in Section 1607.02.

[2] Any lamp with output of 1,000-lumens or more shall be fully shielded.

[3] Does not include the 2,000 lumen lighting exception for flagpoles (Section 1605.03) and floodlights on a motion sensor (1605.04).

[4] All lighting except for safety lighting (Class 2) shall be extinguished between 11 p.m. (or close of business, whichever is later) and sunrise.

[5] Acreage refers to the developed area of the site, including, but not limited to area used for buildings, structures, storage and service areas, parking, loading, driveway areas, required setback areas and required landscaping related to the use, but not areas that are only cleared.

1606 Prohibitions

1606.01 Searchlights, Laser Lights

The operation of searchlights, laser lights, or any similar high intensity light for outdoor advertising or commercial purposes is prohibited.

1606.02 Recreational Facilities

No outdoor recreational facility, public or private, including those with non-conforming lighting shall be illuminated after 11 p.m. except to conclude a specific scheduled event that was unable to conclude before the curfew due to unusual circumstances.

1606.03 Mercury Vapor

The installation of new mercury vapor outdoor light fixtures is prohibited. The use of legal, non-conforming (installed prior to March 3, 1982) mercury vapor light fixtures is prohibited after January 1, 2011.

1607 Signage

1607.01 External Illumination

External illumination for signs shall conform to the shielding restrictions and lumen caps of Table 16.1. All upward-directed sign lighting is prohibited.

1607.02 Internal Illumination

A. Outdoor internally illuminated signs are considered unshielded and shall be adequately sealed and maintained to prevent light leakage.

B. Neon signs shall be treated as internally illuminated signs for the purpose of this Article. Neon lighting extending beyond the sign area shall be considered Class 3 decorative lighting, and shall be subject to the standards applicable for such lighting including, but not limited to, the shielding standards and lumen caps of Table 16.1.

C. Digital Signs
Digital signs that meet the standards as listed in Article 19 are permitted. Digital signs shall be considered unshielded and restricted to total lumen cap per Table 16.1 of this Article. Applicant must supply documentation indicating maximum nit capability for each segment of a digital sign, and demonstrate ability to meet the total nit cap per Table 16.1 of this Article.

16076.03 Other Illuminated Panels

Other internally-illuminated panels or decorations not considered to be signage according to this Article, such as illuminated canopy margins or building faces shall be considered Class 3 Lighting and shall be subject to the standards applicable for such lighting including, but not limited to, the shielding standards and lumen caps of Table 16.1.

1607.04 Curfew

A. Illumination for advertising signs, both externally and internally illuminated, shall be turned off at 11 p.m., or when the business closes, whichever is later. Signs subject to curfews are encouraged to have automatic shut-off timers. Internally illuminated signs with an opaque or dark-colored background and lighter text and symbols are not subject to the curfew, provided at least 50% of the sign is dark colored.

B. Digital signs shall be permitted from sunrise to sunset, except as permitted in Article 19.

1608 Permanent Exemptions

1608.01 Nonconforming Fixtures

Except as provided in Section 1602.03, all outdoor light fixtures existing and legally installed after March 3, 1982 and prior to December 1, 2005, with the exceptions found in Section 1606.02 (curfew for outdoor recreation facilities) and 1606.03 (mercury vapor), may remain "non-conforming" indefinitely; provided, however, that no change in use, fixture replacement, structural alteration, or restoration after abandonment of outdoor light fixtures shall be made unless it thereafter conforms to the provisions of this Article.

1608.02 Fossil Fuel Fixtures
Light produced by the combustion of natural gas or other utility-type fossil fuels is exempt from the lumen cap and shielding requirements of this Article.

1608.03 Equipment and Signal Lights
Equipment and signal lights necessary for agricultural equipment or required by state or federal regulations shall be by the least obtrusive means that meets the applicable operating or regulatory requirements.

1608.04 Federal and State Facilities
Those facilities and lands owned, operated, or protected by the U.S. Federal Government or the State of Arizona are exempt by law from all requirements of these provisions. Voluntary compliance with the intent of this Article at those facilities is encouraged.

1608.05 Emergency Lighting
Temporary lighting to facilitate immediately necessary repairs or similar emergency, such as actions of a public or private utility company necessary to continue or resume service shall be allowed. Lights shall be arranged to reflect light away from and prevent glare to adjoining residential properties and public rights of way to the extent feasible.

1608.06 Agricultural operations
Those agricultural operations that meet the minimum requirements for zoning exemption are also exempt from this Article.

1608.07 Special Exemption
The Zoning Inspector may grant a special exemption to the requirements of this Article only upon a written finding that there are extreme geographic or geometric conditions warranting the exemption and that there are no conforming fixtures that would suffice.

1609 Temporary Exemptions

1609.01 Requests for Temporary Exemptions

Any individual as defined herein may submit a written request to the County Zoning Inspector for a "temporary exemption" to the requirements of this Article. Such exemption will be valid for 30 days, renewable at the discretion of the County Zoning Inspector. The request for Temporary Exemption shall contain at least the:

A. *Specific exemptions requested.*
B. *Specific reasons why the requirements listed in this Article cannot be met.*
C. *Type and use of exterior light involved.*
D. *Duration of time for requested exemption.*
E. *Type and number of lamps and calculated lumens.*
F. *Total lumens of lamp or lamps.*
G. *Proposed location and height of exterior lights.*
H. *Previous temporary exemptions, if any.*
I. *Physical size of exterior light and type of shielding provided.*

In addition to the data above, the County Zoning Inspector may request any additional information to allow a reasonable evaluation of the Request for Temporary Exemption.

1609.02 Appeals for Temporary Exemptions

The County Zoning Inspector, within 15 days from the date of the properly completed Request for Temporary Exemption, shall approve or reject the Request in writing. If rejected, the individual making the Request shall have the right of appeal to the appropriate Board of Adjustment as any other appeal of the County Zoning Inspector's determinations.

1609.03 Private Security Lighting/ Lighting Installed by an Electric Utility

Non-compliant lighting that was installed in good faith by an electric utility shall be brought into conformance with this Article within 5 years of adoption; however, individual light fixtures which are the subject of a citizen complaint or County enforcement action shall be brought into conformance within 30 days of notification of the property owner.

1610 Special Activities

1610.01 Outdoor Recreational Facilities

A. Shielding: All outdoor recreational facilities shall utilize fully-shielded luminaires that are installed in a fashion that maintains the fully-shielded characteristics.

B. Height: The maximum height for pole-mounted luminaires for outdoor recreational facilities is 40-feet.

C. Lighting for public and private outdoor athletic fields, courts, tracks or arenas, shall be considered Class 1 (Color Rendition).

D. Facility lighting shall meet shielding, lumen caps, height limits and all other restrictions of this Article:

1. A Special Use Authorization is required. As part of the Special Use Authorization application process, the lighting system design and installation shall be certified by a knowledgeable Arizona Registered professional or other certified lighting specialist as achieving the minimum illuminance level for the specific activity as recommended by the Illuminating Engineering Society of North America (IESNA) and conforming to all other applicable provisions of this Article, and shall be installed and maintained so as to minimize uplight and offsite light trespass, and with aiming angles that permit no greater than five-percent of the light emitted by each fixture to project above the horizontal.

E. Off-site Trespass: The facility shall limit off-site trespass to the maximum extent possible and shall not cause light trespass onto residentially zoned or developed properties.

F. Curfew: All events shall be scheduled to complete activity before 11 p.m. Illumination of the playing field, court or track shall be permitted after the curfew only to conclude a scheduled event that was unable to conclude before the curfew due to unusual circumstances.

G. All lighting not directly associated with the playing field (e.g. parking lot lighting, concession stand lighting, etc.) shall use Class 2 lighting and shall conform to all requirements of Section 1605 of this Article.

1610.02 Outdoor Display Lots

Lighting for display lots shall be considered Class 1 (Color Rendition), and shall be in compliance with the following standards:

A. Shielding: All display lot lighting shall utilize fully-shielded luminaires that are installed in a fashion that maintains the fully-shielded characteristics.

B. Height: The maximum height for pole-mounted luminaires for outdoor display lots is 40-feet.

C. Display lot lighting shall meet shielding, lumen caps, height limits, and all other restrictions of this Article.

D. If meeting all requirements is infeasible, pursuant to Section 1602.04 a Special Use Authorization is required. As part of the Special Use Authorization application process, the lighting system design and installation shall be certified by a knowledgeable Arizona Registered professional or other certified lighting specialist as achieving the minimum illuminance levels as recommended by IESNA and conforming to all applicable provisions of this Article.

E. Curfew: Display lot lighting shall be turned off between 11 p.m. and sunrise or within 30 minutes after closing of the business, whichever is later. Lighting in the display lot after this time shall be considered Class 2 lighting and shall conform to all restrictions of this Article, including the lumen caps in Table 16.1.

F. Off-site trespass: The facility shall limit off-site trespass to the maximum extent possible and shall not cause light trespass onto residentially zoned or developed properties

1610.03 Service Station Under Canopy Lighting

Lighting for service station canopies shall be considered Class 1 lighting (Color rendition) and shall be subject to the curfew requirements in Section 1605.03 of this Article.

A. Shielding: All luminaires are to be flush with, or recessed into the lower surface of service station canopies and shall be fully shielded and utilize flat lenses.

B. Total Under-Canopy Output: The total light output used for illuminating service station canopies is defined as the sum of all under-canopy initial bare lamp outputs in lumens and shall not exceed 40 lumens per square foot of canopy. Twenty-five percent of the lumens from fully shielded outdoor lighting fixtures installed under canopies shall be counted toward the lumens caps in Table 16.1.

C. Illuminated canopy margins shall be considered Class 3 (Decorative) lighting.

1610.04 Wireless Communications Towers

If tower lighting is required, it shall be the least obtrusive that meets FAA requirements.

1611 Enforcement

1611.01 Violations Deemed a Nuisance

Any outdoor lighting established or maintained in violation of the Article is unlawful and constitutes a public nuisance. The Applicant will provide a means to safely inspect any digital sign over five-feet tall from the ground.

1611.02 Action to Enforce Regulations

For any violation of this Article, the County Attorney may, and upon order of the Board of Supervisors shall, commence all necessary actions or proceedings to enforce this Article including, but not limited to, actions to abate, enjoin, or remove the violating outdoor lighting fixture.

1611.03 Jurisdiction of Hearing Officer

The Hearing Officer who has been designated to hear zoning violation proceedings under these Zoning Regulations shall also hear any violation proceedings under this Article.

1611.04 Rules of Procedure

The rules of procedure for hearings on zoning violations before the County Hearing Officer shall apply to violation proceedings arising under this Article.

1611.05 Remedies

All remedies concerning this Article shall be cumulative and not exclusive. Conviction and punishment of any person hereunder shall not relieve such persons from the responsibility of correcting prohibited conditions or removing prohibited outdoor lighting fixture, and shall not prevent the enforced correction or removal thereof. In addition to the other remedies provided herein, any adjacent or neighboring property owner specially damaged by the violation of any provision of this Article may institute, in addition to any other appropriate remedy or preceding an action for injunction, mandamus, or proceeding to prevent, abate, or remove such unlawful outdoor lighting fixture.

1611.06 Penalties

A. Any person, firm or corporation whether as principal, owner, agent, tenant, employee or otherwise, who violates any provisions of this Article or who violates or fails to comply with any order or regulation made hereunder shall be guilty of a misdemeanor, and upon conviction thereof, shall be punishable as provided for Class 2 misdemeanors by Arizona Revised Statutes. Such person, firm, or corporation shall be deemed guilty of a separate offense for each and every day during which such violation or failure to comply with this Article is committed, continued, or permitted.

B. Paragraph A notwithstanding, each violation of this Article or failure to comply with any order or regulation hereunder may be processed by the County Zoning Inspector as a violation subject to a civil penalty as provided by Arizona Revised Statutes and heard by a duly appointed Hearing Officer, pursuant to the written rules of procedure for such hearings, as approved by the Board of Supervisors. Each day the violation continues, a separate violation will be incurred. Maximum fines are $750.00 for individuals and $10,000.00 for an enterprise, defined as a corporation, association, labor union, or legal entity.

9.2 Cochise County Zoning Regulation Article 24, Severability

ARTICLE 24

SEVERABILITY

2401 Severability

The various parts of these Zoning Regulations are hereby declared to be severable. If any article, section, subsection, sentence, clause, phrase, or word of these Zoning Regulations is for any reason held to be invalid or unconstitutional by any court of competent jurisdiction, such decision shall not affect the validity of the remainder of these Zoning Regulations.

2402 Repeal of Conflicting Regulations

All regulations or ordinances or a portion of same in conflict with these Zoning Regulations, or inconsistent with the provisions of these Zoning Regulations, are hereby repealed to the extent necessary to give these Zoning Regulations full force and effect.

2403 Effective Date

These Zoning Regulations shall become effective beginning January 1, 2015 and remain in full force and effect thereafter.

APPROVED AND ADOPTED BY THE COCHISE COUNTY BOARD OF SUPERVISORS THIS 2nd DAY OF DECEMBER 2014 PER ZONING ORDINANCE NUMBER 14-10

9.3 Sierra Vista Development Code Article 151.11 Outdoor Light Control

DEVELOPMENT CODE

ARTICLE 151.11
OUTDOOR LIGHT CONTROL

Section 151.11.001
Purpose

It is the intention of this Article to encourage good lighting practices that are designed to conserve energy, improve nighttime safety, and enhance security. The intent of this Article is also to specify and encourage lighting practices and systems that will minimize the adverse light pollution effects of sky-glow, glare and light trespass.

Section 151.11.002
Conformance with Applicable Codes

A. All outdoor lighting fixtures shall be installed in conformance with the provisions of this Article and any other building code requirements, as applicable.

B. Where any provisions of any of the Arizona Revised Statutes, any federal law, or any companion ordinance conflict with the requirements of this Outdoor Light Control Article, the most restrictive provision shall govern.

C. All new development and those portions of any addition to an existing commercial, industrial, or multi-family development requiring a commercial site plan review and requiring outdoor lighting shall meet the requirements of this Article.

D. All outdoor light fixtures, existing and fully installed, or for which a building permit has been issued prior to the effective date of this Article, shall be considered legal non-conforming (see Article 151.24). No modification or replacement shall be made to a nonconforming fixture unless the fixture thereafter conforms to the provisions of this Article, except that lamp and related apparatus (lens,

ballast, etc.) replacement is allowed. Abandoned site lighting fixtures shall be regulated according to the provisions of Article 151.24.

E. Legal, non-conforming lighting fixtures may continue to be used provided such fixtures are turned off between the hours of 10:00 p.m. (or when the business activities cease, whichever is later) and sunrise. This requirement does not apply to fixtures used for safety or security purposes. Non-conforming lights that are improperly aimed and, as a result, are considered a detriment to public health, safety, and welfare shall be regulated under the City's public nuisances and property maintenance codes.

F. A reduction of non-conforming lighting fixtures is required on an existing developed commercial site where a site plan or modified site plan review is required for new development. This reduction shall be as determined by the City. Possible means for this reduction are as follows:

1. Appropriate fixture aiming to reduce light trespass;

2. Tilting any existing fixtures to a horizontal position to maximize available shielding;

3. Adding shielding to fixtures when possible;

4. Utilizing motion sensors or automatic shutoff devices to eliminate unnecessary use of energy resources.

G. Conforming lighting fixtures shall be turned off between the hours of 10:00 p.m. (or when the business activities cease, whichever is later) and sunrise. This requirement does not apply to fixtures used for safety or security purposes. (Sign lighting cannot be used for security lighting purposes.)

Section 151.11.003
Applicability to New Development

A. For commercial and industrial site plan approval, sufficient information to verify compliance with this Article shall be submitted. Submitted information shall include the following:

1. Plan indicating the location and height of all exterior pole-mounted and wall-mounted light fixtures.

2. Lighting fixture cutsheets that are legible and clearly indicate all applicable elements of the proposed fixture.

3. Luminaire schedule specifying the per-acre lumen count for the site (see Table 151.11-1 for lumen cap limits) and specifying the uniformity ratio (see Section 151.11.008). The luminaire schedule shall also indicate the lumen level***s*** (see Section 151.11.004.E, Total Light Output).

4. If the required lighting information is not sufficient to determine compliance with this article, additional information may be required, including a photometric analysis or other evidence prepared by a certified illumination engineer.

Section 151.11.004
General Requirements

A. Shielding. All exterior light fixtures, shall be fully shielded and maintained in a manner that retains the fully shielded characteristics. Building interior lighting that causes outdoor glare shall be screened in a manner that eliminates glare that is visible from a public roadway. Light trespass and glare onto adjoining properties shall be minimized.

B. Adjacent Residential Zone Shielding Requirement. Lighting shall be oriented to direct light away from adjoining residential zone districts. Where standard light shielding is insufficient to protect adjoining residential properties from light trespass, additional house-side shielding may be required, as determined during the site plan review.

C. Height.

1. The maximum overall height of lighting fixtures, including the base, shall not exceed the height allowed in the applicable zone district (including reductions in height mandated by proximity to adjoining residential zones, if applicable).

2. Light fixtures in a Multi-Family Residential zone district shall not exceed 30 feet.

3. Wall-mounted lighting fixtures shall not be located above the roofline and shall not exceed the applicable zone district height.

D. Minimum Lighting Requirements

1. Driveway Entrances. See Article 151.08.010.

2. Multi-family residential, commercial, and industrial development shall maintain safely lit parking lots, and walkways to units and other buildings, and shall maintain landscaping to ensure such safety over time.

3. Commercial and industrial development where parking lot islands are required shall ensure during design and construction that required landscaping will not interfere with required light fixtures over time.

E. Total Outdoor Light Output.

1. Total outdoor light output shall not exceed the limits in Table 151.11-1 (with the exception of "E" below).

2. Lighting Areas.

   a. Area 1 consists of all commercial and industrial zoned properties and multi-family development requiring a commercial site plan review, and is adjacent to any residential zone district or use.

   b. Area 2 consists of all other commercial and industrial zoned properties and multi-family development requiring a commercial site plan review.

Table 151.11-1
Lumen Cap Limits Per Developed Acre*

	Light Fixtures Using All Low-Pressure Sodium**	Light Fixtures Using Other Light Types
Area 1	200,000 Lumens***	150,000 Lumens***
Area 2	250,000 Lumens***	200,000 Lumens***

* Developed acre consists of all improved surface area including buildings, structures, storage and service areas, parking, loading, driveway areas, required setback areas and required landscaping related to the use, but not areas that are only cleared.

** Low Pressure Sodium lamps are the preferred lamp type.

F. Service Station Canopy Lighting.

1. Light fixtures mounted under canopies shall be recessed or fully shielded.

2. Under-canopy lighting shall be limited to 60 lumens per square foot of canopy area and shall not count toward the lumen cap levels shown in Section 151.11.004D.

G. Light Emitting Diode (LED) Lighting

1. LED lights used in private development shall conform to the lighting requirements in this Code and shall be filtered to have a Correlated Color Temperature (CCT) maximum of 3,000K.

2. LED lights used on public roadways shall conform to the requirements of Development Code Article 151.09.010 and shall be filtered to have a Correlated Color Temperature (CCT) maximum of 3,000K.

Section 151.11.005
Residential Lighting

A. Residential lighting that directly shines onto neighboring properties shall be prohibited. Permanently used lighting fixtures associated with residential uses shall be fully shielded. Unshielded lights, whose glare is mitigated by features such as porches, overhangs, walls, or temporary usage, may be considered compliant provided such lighting minimizes light trespass onto neighboring properties. Use of motion sensors is encouraged.

B. Residential uses, when consisting of five or more residential units on a single lot, shall meet the commercial zone district lighting standards.

Section 151.11.006
Prohibitions

A. Recreational Facilities. Existing outdoor recreational facilities, public or private, with non-conforming illumination, shall not be illuminated after 11:00 p.m., except to conclude a specific recreational or sporting event, or any other activity that was in progress prior to 11:00 p.m. All new recreational facilities shall meet the shielding standards in Section 151.11.004.A.

B. Mercury Vapor. No replacement equipment other than bulbs for mercury vapor lighting fixtures shall be sold in the state after January 1, 1991, and the use of mercury vapor light fixtures is prohibited after January 1, 2011, (A.R.S. 49-1104). No new mercury vapor outdoor light fixtures shall be installed after the effective date of this Article.

C. Searchlights, Laser Lights. The operation of searchlights and/or laser lights for advertising or commercial purposes is prohibited (except as allowed under 151.11.010 Exemptions).

D. All upward-directed lighting is prohibited, except as allowed under 151.11.010.

Section 151.11.007
Signage

Other Illuminated Panels. Other internally-illuminated panels or decorations not considered to be signage according to Code, such as illuminated canopy margins or building faces shall be subject to the standards applicable for such lighting including, but not limited to, the shielding standards in Section 151.11.004 and lumen cap limits in Table 151.11-1.

Section 151.11.008
Outdoor Parking Lots

A. Outdoor parking lots used during hours of darkness shall be lighted.

B. The roof level of a multi-level parking facility is considered an outdoor parking lot.

C. The lighting design shall provide for uniform light (no dark areas or pockets) and be sufficient for safety and identification of features. A uniformity ratio of not more than 4 to 1 (average to minimum) shall be provided.

Section 151.11.009
Security Lighting

A. Security lighting is the minimum lighting necessary to reduce the negative impacts of crime as determined by a business owner but shall not exceed 50 percent of the normal site lighting.

B. Sensor technologies, timers, or other means to activate additional lighting during times when it will be needed are encouraged. Such lighting shall be the minimum necessary and shall generally be utilized only for short duration.

Section 151.11.010
Exemptions

A. Fossil Fuel Light. Light produced directly or indirectly by the combustion of natural gas or other utility-type fossil fuels.

B. Seasonal decorations using typical unshielded low-wattage type lamps.

C. Low voltage landscape lights not exceeding 20 watts per fixture, provided they are fully shielded and aimed away from public roadways.

D. Self-contained solar lights not exceeding 600 lumens per fixtures.

E. A flagpole illuminated with an upward-directed light provided the lumen count does not exceed 4,000 and off-site glare and light trespass are eliminated by shielding.

F. Decorative neon used solely for architectural embellishment.

G. Floodlight Fixtures. Incandescent or parabolic aluminized reflector (PAR) floodlights, or similar fixtures, which are shielded and properly aimed (no more than 45 degrees, or half way between straight down and horizontal), not to exceed 2,000 lumens and used for short time periods only, shall be exempt from lumen caps. Such fixtures shall be controlled by timers or motion sensors, and shall not remain on over 10 minutes after the area has been vacated.

H. Building Accent Lighting. Lighting intended for the architectural illumination of buildings shall be allowed and shall not count toward lumen caps. Such lighting shall be fully shielded and aimed only at building walls with no spillover to the sides or top of a building wall. Such lighting shall also be turned off between the hours of 11:00 p.m. (or when the business closes, whichever is later) and sunrise.

I. Temporary Exemptions. Any individual may submit a written request for a temporary exemption to the requirements of this Article. Exemptions may be granted for periods up to seven calendar days. The request shall include the specific exemption requested, the need for the exemption, the type and use of exterior light involved, and any other information that shall enable the City to evaluate the need for the exemption and any conditions that shall be attached to the approval.

Section 151.11.011
Special Use Permit for Waivers

A. Any application or lighting installation not meeting all requirements of this Code, including, but not limited to height, shielding, curfew or lumen caps, shall require a Special Use Permit, and must demonstrate that the proposed lighting will not cause off-site glare or light trespass.

B. The Special Use Permit application shall be accompanied by the lighting system design and shall be certified by an Arizona Registered Professional or other certified lighting specialist. Certification is to verify that the minimum illuminance level for the specific activity has been achieved, as recommended by the Illuminating Engineering Society of North America (IESNA), and that all other applicable provisions of this Article have been met.

C. The process for a Special Use Permit requires the Permit to be reviewed by the Commission and the Commission's recommendation forwarded to the Council for consideration. The meeting notifications are provided to the community through a published notice and posting on the property 15 days before the hearing. Any appeals of the Council decision will go to the Hearing Officer under the provisions of Article 151.30, Appeals and Variances.

10. Light Pollution Control/Restoration Community Projects

10.1 Public Outreach

Kartchner Caverns State Park has taken a leadership role in preservation and restoration of dark skies. Park volunteers have served on lighting technical committees for cities and counties in SE Arizona.

For example, park volunteers were instrumental in the development and update of the Cochise County Light Pollution code revised in December 2014 (Section 9.1).

KCSP volunteers have addressed the Sierra Vista City Council and planning commission on the revised outdoor lighting code, enacted in May 2015 (Section 9.3). The City of Sierra Vista revised its lighting code on May 28, 2015. In additional to other improvements, the revision included a max CCT of 3,000K, a max value of 100 nits on all signs including digital, and this edition included other changes such as adding a requirement for residential shielding.

Additionally, KCSP volunteers have given dark sky presentations to the Sierra Vista Chamber of Commerce and to the Amerind Foundation. The park also installed a large poster recognizing the importance of night sky preservation and appreciation in the main entry to the Discovery Center.

The City of Benson is considering an update to their outdoor lighting code. Volunteers from KCSP and the Huachuca Astronomy Club have offered to assist in this code update.

11. IDA International Dark Sky Park Program

11.1 Program Criteria Compliance Checklist

The IDA Dark Sky Park Program Guidelines (October 2014 version) was used in the preparation of this Nomination Package. The following checklist shows the Kartchner Caverns State Park compliance status with reference to the appropriate sections of this Nomination Package.

IDSP Program Criteria	**Compliance Status**	**Section Discussed**
ELIGIBILITY (ALL MUST BE MET)		
A) All protected public lands, whether managed by national, state, provincial, or local agencies, are eligible.	√	3
B) Private lands whose owners consent to legal covenant requirements of regular nighttime public access to designated areas of their property in perpetuity are also eligible.	Not applicable	
C) Regular visitation by the public is essential to meet the goals of the IDSP program. The Park must provide the opportunity for public nighttime access, with or without supervision. A portion of designated land may meet this requirement, or access must be available for a fraction of the length of the night.	√	3 4 7
D) The Park must provide an exceptional dark sky resource, relative to the communities and cities that surround it. Core night sky quality must fit in one of the three tier qualifications Gold, Silver, or Bronze.	√	5
MINIMUM REQUIREMENTS [see Program Guidelines for sub-requirements]		
A) A quality comprehensive Lightscape Management Plan (LMP)	√	8
B) The Park's commitment to dark skies and lightscape management)	√	8
C) The Park's commitment to public education	√	7 10

Table 11.1 IDSP Program Criteria compliance

11.2 Program Criteria Tier Compliance

The following table shows the three "International Dark Sky Park" designation tiers (Gold, Silver, and Bronze) and what tier Kartchner Caverns State Park meets for each indicator.

GOLD, SILVER, AND BRONZE TIER DESIGNATION

Indicator	Gold	Silver	Bronze
Philosophy	Nighttime environments that have negligible to minor impacts from light pollution and other artificial light disturbance, yet still display outstanding quality night skies and have superior nighttime lightscapes. ✓	Nighttime environments that have minor impacts from light pollution and other artificial light disturbance, yet still display good quality night skies and have exemplary nighttime lightscapes.	Areas not meeting the requirements of *Silver*, yet still offering people, plants, and animals a respite from a degraded nocturnal environment and suitable for communicating the issue of light pollution and connecting people with the many aspects of the night sky.
Artificial Light and Skyglow	Typical observer is not distracted by glary light sources. Light domes are only dim and restricted to sky close to horizon. ✓	Point light sources and glary lights do not dominate nighttime scene. Light domes present around horizon but do not stretch to zenith.	Areas with greater artificial light and skyglow than *Silver*, but where aspects of the natural sky are still visible.
Observable Sky Phenomena	The full array of visible sky phenomena can be viewed—e.g. aurora, airglow, Milky Way, zodiacal light, and faint meteors. ✓	Brighter sky phenomena can be regularly viewed, with fainter ones sometimes visible. Milky Way is visible in summer and winter.	Many sky phenomena cannot be seen. Milky Way is seen when pointed out to the average person, as is the Andromeda Galaxy.
Nocturnal Environment	Area is devoid of obvious lights that can cause wildlife disorientation. Artificial light levels are thought to be below the threshold for plant and animal impact. Ecological processes related to nocturnality are unaltered. No lighting atop towers or buildings within park boundary. ✓	Areas that have minor to moderate ground illumination from artificial skyglow. Lights that may cause disorientation to wildlife are distant. Disruption of ecological processes is minor with no impairment to plants or wildlife.	Areas with greater nocturnal impact than *Silver*, but where ecosystems are still functional.
Visual Limiting Magnitude	Equal or greater than 6.8 under clear skies and good seeing conditions	6.0 to 6.7 under clear skies and good conditions	5.0 to 5.9 under clear skies and good seeing conditions
Bortle Sky Class	1-3	3-5 ✓	5-6
Unihedron Sky Quality Meter	> 21.75	21.74-21.00	20.99-20.00

6

Table 11.2 IDSP Program Tier Designation

12. Miscellaneous Materials

12.1 Media Coverage

The following article from the "Sierra Vista Herald" covered the 18 March 2017 event at Kartchner Caverns State Park and is used with permission.

Protecting Arizona's dark skies

by Dana Cole, Sierra Vista Herald

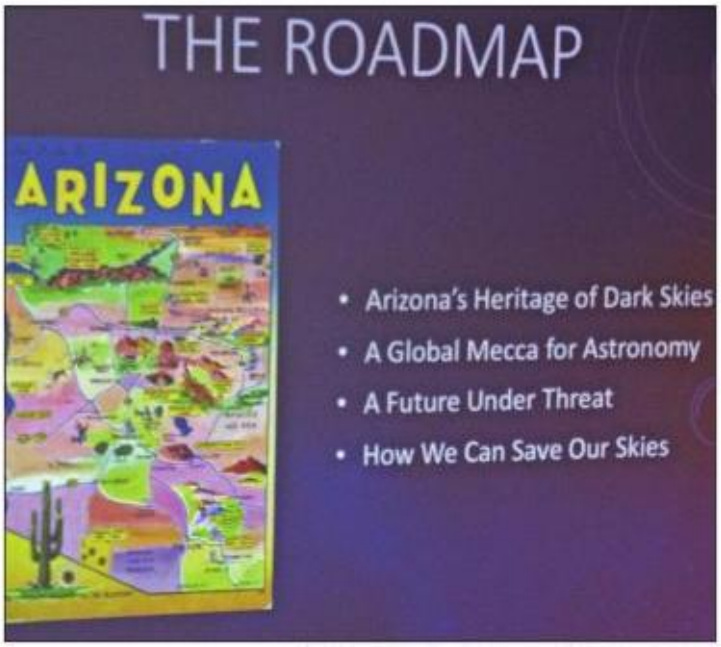
April 5, 2017

Huachuca Astronomy Club of Southeastern Arizona members patiently wait for the skies to clear Saturday afternoon at Kartchner Caverns in Benson. Clouds prevented club members and attendees from observing the sun while using special hydrogen alpha solar filters. The Astronomers of Verde Valley were also on hand for the viewing.

BENSON — Uncooperative weather forced astronomers to pack up early Saturday for the annual spring astronomy program at Kartchner Caverns State Park, but a presentation in Kartchner's Discovery Center auditorium was conducted as planned.

Ten astronomers volunteered for the event — designed as an educational program for the public — to help encourage the protection of dark skies. The program started with solar telescopes set up at 1 p.m. for the public's benefit, but cloudy, rainy weather ended the daytime and nighttime viewing.

As with Kartchner's past astronomy events, there was a 5:30 p.m. presentation in the facility's auditorium. Guest speaker John Barentine, Ph.D., astronomer and program manager for the International Dark-Sky Association, spoke about the future of Arizona's night skies and the importance of preserving the dark skies from the growing threat of light pollution.



SIERRA VISTA HERALD STAFF PHOTO BY DANA COLE

Four key topics discussed by John Barentine, Ph.D., program manager for the International Dark-Sky Association during his lecture Saturday evening as part of an astronomy program at Kartchner Caverns State Park.

His talk, "Arizona's Night Skies: Past, Present and the Future," started with a review of archaeological and historical evidence for astronomy in Arizona's past. He touched on the relationship prehistoric cultures had with the night sky, dating as far back as the 1300s, noting that early cultures relied on the dark sky for farming, warfare and religion.

He spoke of the arrival of the Europeans in the 1500s and credited Father Kino as being the first European astronomer in the New World.

"Percival Lowell is the beginning of modern astronomy in Arizona," Barentine said. He built an observatory in Flagstaff in the early 1900s where he studied Mars, a planet that he adamantly believed was inhabited. It's a belief he maintained until his death in 1916.

In 1930, Pluto was discovered at Lowell Observatory.

The history of astronomy and its importance in Arizona continues with the founding of Kitt Peak in Tucson in 1958 and its collection of world class telescopes. After looking at several different sites throughout the United States, the National Science Foundation settled on Kitt Peak. Today, 60 years after its founding, the site is home to the densest collection of research telescopes in the world.

Arizona also is the first planetary research site in the world, with its laboratory on the University of Arizona campus. In addition, the UA is currently building mirrors for the biggest telescopes in the world, said Barentine, representing an important science and engineering investment.
"That means money," Barentine said.

But to keep conditions right for Arizona, it requires a good economic argument.

"The Arizona Astronomy and Space Science sector commissioned a study in mid-2000 that determined the annual value of astronomy to the Arizona economy is about $250 million," Barentine said. That amount is equivalent to (roughly) what a state would expect to make if awarded the Super Bowl.

So, what does astronomy's future look like in Arizona given the explosive growth from cities like Phoenix?

Arizona's night skies are getting brighter, Barentine warned.

The light pollution that comes with a growing city could threaten the important work being conducted at Kitt Peak and other observatories throughout the state, Barentine warned.

Astronomy has a future in Arizona, but part of that will depend on what cities do about light pollution in the future. Making better decisions about lighting in terms of policy and technology in the future will help to maintain the state's dark skies.

"By and large, we are wasting a lot of light," Barentine said. "If we could just combine the light that we generate to the ground where it is needed and not emit it up into the night sky, we would save about 50 percent of the light that we generate."

In the United States alone, that's a waste of about $20 billion a year from residential lighting alone.

Barentine recommends using light only when needed, shielding light so it's directed to the ground and using such adaptive controls as motion sensors as important steps in protecting the night.

He also praised lighting codes that have been adopted by Cochise County and Sierra Vista and said that Benson is well on its way.

SIERRA VISTA HERALD STAFF PHOTO BY DANA COLE

Bob Gent, an astronomer with the Huachuca Astronomy Club, left, introducing speaker John Barentine, Ph.D., program manager of the International Dark-Sky Association. Barentine presented on the importance of protecting Arizona's dark skies Saturday evening during an astronomy event at Kartchner Caverns.

Barentine grew up in Phoenix and was involved in amateur astronomy there from grade school. He attended the University of Arizona, beginning research in jobs at the National Optical Astronomy Observatories and National Solar Observatory headquarters in Tucson. He obtained a master's degree in physics at Colorado State University and a master's and Ph.D. in astronomy at the University of Texas at Austin. The asteroid (14505) Barentine is named in his honor.

Dana Cole

Benson and Tombstone Reporter
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13. Document Revisions

1.0	26 October 2015	Initial submittal to IDA
1.1	21 January 2016	Supplemental material submitted to IDA
1.2	14 April 2017	Reformatted revision draft for internal review
1.3	30 April 2017	Final draft for internal review
1.4	7 May 2017	IDA submittal
1.5	16 June 2017	Added boundary map, updated park description