# COMMUNITY DEVELOPMENT DEPARTMENT MEMORANDUM

**MEETING DATE:** October 12, 2016

**TO:** Mayor and City Council and Planning and Zoning Commission

**FROM:** Kimberly Johnson, Community Development Director

**SUBJECT:** Lighting Ordinance Amendment

**ATTACHMENTS:** Memo and Attachments-April 27, 2016 Joint Work Session

Meeting Minutes and Attachments-July 27, 2016

**BACKGROUND**

At an April 27, 2016 joint Planning and Zoning Commission/City Council work session, there was discussion of the attached lighting code amendment language recommended by the Planning and Zoning Commission. The minutes from that meeting are also attached. During the discussion, the City Council indicated an interest in pursuing additional information about dark sky regulations at a future joint work session.

At a July 27, 2016 work session, the City Council heard a presentation by Nate Ament, National Park Service and Dr. John Barentine, International Dark-Sky Association regarding the benefits of dark sky ordinances and communities. The presenters provided a wide range of information related to light pollution, night sky friendly lighting, astrotourism, and dark sky regulations and ordinance amendment procedures.

**REQUESTED COUNCIL DIRECTION**

The goal of this joint work session is to revisit the Planning and Zoning Commission recommendations regarding dark sky regulations now that the City Council has more background on the topic.

# COMMUNITY DEVELOPMENT DEPARTMENT MEMORANDUM

| | |
|---|---|
| **MEETING DATE:** | April 27, 2016 |
| **TO:** | Mayor and City Council |
| **FROM:** | Kimberly Johnson, Community Development Director |
| **SUBJECT:** | Lighting Ordinance Amendment |
| **ATTACHMENTS:** | Planning and Zoning Commission Lighting Packet |

**BACKGROUND**

At the November 18, 2015 City Council meeting, Council Member Kocjan brought forward a request by Bryan Hill, Utilities Director, for the Council to consider amending Section 7.5 of the Page Zoning Ordinance regarding lighting. The request was to make a simple change to eliminate language that references specific lighting technology (sodium pressure) to allow light-emitting diode (LED) light fixtures.

**CITY COUNCIL DISCUSSION**

The City Council unanimously approved the recommendation, directing staff to bring forward amended language that removes references to specific lighting technology. Because State Statutes and the Page Zoning Ordinance require a Planning and Zoning Commission recommendation and public hearing, staff brought draft language to the Planning and Zoning Commission on December 1 for a preliminary discussion.

**PLANNING AND ZONING COMMISSION DISCUSSION**

The Planning and Zoning Commission has discussed lighting ordinance amendments at each of its January-April meetings. Based on input from members of the public and extensive discussion by the Commission, the Planning and Zoning Board is of the general consensus that the City should incorporate more stringent dark sky lighting regulations into the Zoning Ordinance. The Commission has also extensively discussed the issue of non-conforming lighting; however, consensus on this issue was less strong. Some members of the Commission feel that all non-conforming lighting should be brought into compliance within a defined time frame, while others feel that non-conforming lighting should be handled as businesses expand or site improvements are made.

The Planning and Zoning Commission is bringing forward two options for discussion with the City Council. The first option is preliminary draft language that would modify existing Zoning Ordinance language regarding lighting. This option incorporates more stringent Dark Sky provisions while providing for LED lighting which has a Corrected Color Temperature (CCT) of 2700K or less. CCT is a measure in degrees Kelvin (°K) of light's warmness or coolness. The cooler the light the more blue, and thus the more scatter. This option also recommends that all non-conforming lighting be brought into compliance upon written complaint, or upon any maintenance, lamp replacement, upgrade or system expansion.

The second option for consideration is the Sedona lighting ordinance. This lighting ordinance is a comprehensive dark sky ordinance. It incorporates many of the provisions of the Flagstaff Dark Sky ordinance, but it is not as complicated and does not include lighting zones. In this code, nonconforming lighting is addressed by requiring partial to full compliance at various thresholds of site improvements or expansion.

**REQUESTED COUNCIL DIRECTION**

The goal of this meeting is for the City Council and Planning and Zoning Commission to discuss possible amendments to the lighting ordinance which would provide for the use of LED lighting technology. A broader discussion about incorporating more stringent dark sky requirements is also necessary, as is a discussion of how non-conforming lighting is to be addressed.

**Page Outdoor Lighting Ordinance Information March 30,2016**

**Introduction**

Page is a unique small town in northern Arizona that has many qualities that make it a beautiful and desirable location to live and visit.Although the city of Page is remotely located, visitation has surged in the past several years due to local attractions such as Antelope Canyon, Horseshoe Bend and other natural landscape features.

An additional, but sometimes overlooked, natural resource available in Page is a Dark Sky. In fact, nighttime dark sky measurements have shown that the night sky is among the darkest and least light polluted dark skies in the nation. A recent survey of visitors performed by the National Park Service revealed that the number one request by tourists was to have more Night Sky programs. The NPS is responding by expanding their Dark Sky Initiative.

As Page grows in response to increasing tourism, its surrounding natural resources, which are the source of the increased visitation, must be protected. The beautiful nighttime Dark Sky needs to be kept dark and free of light pollution that can cause an urban light cloud that is prevalent in all large metropolitan areas. Light pollution that causes an urban light cloud destroys the dark sky and the beautiful view of the starry heavens above.

Safety and security are also priorities with regards to outdoor lighting systems. If lighting systems are installed with shielded fixtures, amber light sources and not overdone then safety and security can be accomplished without resulting in excess light pollution. Proper installation of outdoor lighting systems can be a win-win with regards to all priorities: safety, security and preventing light pollution.

Implementing an outdoor lighting ordinance is an important tool for guiding proper installation of lighting systems to achieve safety and security while minimizing light pollution to be able to protect the local dark sky resource that visitors and locals value.

**Main Points of an Outdoor Lighting Ordinance**

1. **Purpose: Introduction stating objectives and local intent**

   This is an introductory statement regarding what the local priorities are for having an outdoor lighting ordinance. Safety, security and minimizing energy waste are always top priorities of a lighting ordinance.

   Since Page is remotely located far away from nighttime light sources and has clean, haze-free air, the nighttime dark sky above Page and the surrounding area is a unique and valuable resource not commonly available to most other tourist destinations. Due to the local dark sky value and uniqueness, protecting the dark sky and minimizing light pollution needs to be specifically addressed in the Page Lighting Ordinance rules.

## 2. Applicability

This is a statement and/or set of rules that legally defines how and where the lighting ordinance rules apply. This section specifically identifies lighting on buildings, parking lots, landscape, and recreational lighting such as parks.

Athletic field lighting and right-of-Way lighting applications are addressed in separate sections. Additionally, specific special lighting applications such as gas station canopies, lighted signs and residential home lighting are addressed under specific sections.

## 3. Specify Fully Shielded Light Fixtures

Outdoor lighting fixtures that are not shielded are a main contributor to light pollution and glare. Excessive glare from a light fixture actually reduces safety and security in a similar manner that car headlights on high-beam reduce one's ability to see the road safely while driving on the highway.

A main component of proper lighting system installation is to ensure the light is projected where it is needed and not allowed to spill out into the sky or beyond where it is supposed to be. Shielded lighting fixtures with a full horizontal, 90 degree cutoff ensure that light is emitted down and not into the sky. In addition to full cut-off shielding, hoods on the light fixtures can ensure that light is directed to exactly where it is required and not allowed to spill over on to adjacent property. Hooded fixtures also help prevent of minimize glare by shielding the actual light source from one's eyes.

Wall Pack type light fixtures, a type of unshielded, wall-mounted light fixture, are a major contributor to glare and light pollution. These types of fixtures are in common use in Page and actually reduce safety and security due to excessive glare. These type of fixtures need to be specifically prohibited in the lighting ordinance rules.

Pole-mounted street light fixtures need to be specified as fully shielded and to direct the light to the street and not allow light to spill over to adjacent property. This may require that the light source be recessed up and into the light fixture as opposed to having a surface-mounted light source that allows the emitted light to spread beyond the street area where it is supposed to be directed.

## 4. Specify Amber Colored Light Sources

Simply stated, blue colored light scatters in the atmosphere and orange light, or amber light, does not scatter. This is why the sky is blue during the day and why sunsets and sunrises are a beautiful red-orange color. The natural phenomenon of blue light scattering in the atmosphere is known as Rayleigh Scattering.

At night, outdoor lighting sources that contain blue light are a major contributor to light pollution and an urban light cloud. Bright white light sources such as metal-halide, mercury vapor, and 4100 K white LED contain a significant amount of blue light. At night, the blue wavelength light scatters and causes the dark sky to be washed out in a light haze that blocks visibility of stars and constellations.

Sodium vapor light sources are a narrow band light source that contains little to zero blue light component. Sodium vapor lamps that are fully shielded are "Dark Sky" compliant. Sodium vapor lamps are favored for outdoor lighting systems in areas that want to preserve and protect their dark nighttime skies.

If LED lighting technology is going to be used for outdoor lighting it needs to be specified to have a color corrected temperature (CCT) of 2700 K or less. Some communities that desire maximum dark sky protection specify that the LED light source be a "narrow-band amber" LED. This is accomplished by installing amber filters in the light fixture.

White light sources need to be prohibited in all installations except for athletic fields. Occasionally, a low-level white light source is permitted for automobile dealerships so that color rendition of cars for sale is improved. Metal halide and mercury vapor lights used under gas station canopies should be prohibited.

**5. Specify Amount of Light for an Area**

It is not uncommon for some outdoor lighting system installations to have too much light for the needed application. For example, some parking lots can be over-illuminated thinking that it increases safety and security. In most cases, over-illuminating an area actually decreases safety and security due to excessive glare and high contrast shadows.

The quantity of light per square foot needs to be determined before new lighting systems are installed. Pole-mounted lighting needs to be spaced efficiently to cover the required area without trying to light a distant area with a brighter light source.

Over-illuminating an area is a significant contributor to light pollution that is very preventable without sacrificing safety and security.

The lighting ordinance needs to contain a specification for quantity of light in lumens per area as in square foot or acre.

**6. Specify How to handle Non-Conforming Lighting**

Non-conforming light sources are unshielded light fixtures, light sources that contain blue light, improperly directed light fixtures, too bright of a light source, light sources that spill over to adjacent property and improperly installed light fixtures.

Most of the non-conforming light fixtures in Page were installed in violation of the existing Page Lighting Ordinance. And, they are currently operating in violation of the lighting ordinance.

The new revised Lighting Ordinance needs to specifically specify that non-conforming lighting systems need to be corrected upon complaint of maintenance.

**7. Special conditions and exceptions**

Lighting ordinance often contain special provisions and exceptions for specific lighting situations. For example, lighting of athletic fields is specified to be able to have a higher quantity of light, metal-halide lighting source and must be turned off by 11:00 PM.

Gas station canopy lighting specifies that light fixture must be flush with the bottom surface of the canopy. Also, bright white metal-halide lamps need to be prohibited for gast station canopies.

**8. Definitions**

Lighting ordinances, as well as many other ordinances, contain a definitions section to specifically clarify the word definitions in the ordinance language.

**7.5 Lighting**

**7.5.1 Purpose**

These regulations are intended to establish standards that ensure minimal light pollution, reduce glare, increase energy conservation, while providing for night safety, utility, security and productivity.

It is recognized that naturally dark landscapes and star-filled skies are valued by many, and that poor lighting practices in outdoor lighting waste energy, hamper the reasonable use and enjoyment of property and can endanger the public welfare by producing unnecessary glare.

Accordingly, it is the intent of this Ordinance to encourage lighting practices and systems which will minimize light pollution, light trespass, and conserve energy while maintaining night-time safety, utility, security and productivity.

**7.5.2 Applicability**

These standards shall apply to all outdoor lighting, but not limited to, search, spot, or floodlights for: buildings and structures, recreational areas, parking lot lighting, landscape lighting, other outdoor lighting. Additionally, the provisions of this code apply to the construction, alteration, movement, enlargement, replacement and installation of outdoor lighting throughout the City of Page, Arizona.

**7.5.3 Non-Residential Lighting**

The following standards apply to the lighting of all outdoor facilities except Public or Private athletic/Arena recreation Facilities.

A. The height of any fixture or illumination source shall not exceed 20 feet.

B. All Lighting sources shall be hooded or shielded so that they are not visible from any adjacent or nearby lot or real property.

C. Lights or illuminating units shall not direct light, either directly or indirectly or through a reflecting device, upon any adjacent or nearby real property.

D. Lighting fixtures shall be ~~sodium pressure and~~fully shielded to prevent the formation of an urban light cloud.

E. The rated color corrected temperature (CCT) of light sources shall not exceed 2700K in order to minimize Rayleigh scattering.

F. The use of wall pack light fixtures in any application is prohibited.

G. The use of metal halide or mercury vapor light sources in any application is prohibited.

Recreational or athletic lighting exempted from the above standards shall meet the following:

H. All metal halide/quartz fixtures shall be filtered by glass, acrylic, or translucent enclosures.

I. No lighting of 150 watts or greater shall be used after 11:00 p.m. without a Temporary Use Permit.

**7.5.3.A Security, Landscaping or other Lighting**

All other outdoor lights shall be shielded and directed according to the following schedule:

| Wattage of Light Source | Shielded Required | Directed Downward |
|---|---|---|
| Up to 100 | Yes-Full | Yes |
| 100 - 175 | Yes-Full | Yes |
| Over 175 | Yes-Full | Yes |

**7.5.4 Residential Lighting**

All exterior lighting shall be limited to 100 watts unless filtered, shielded or screened to minimize any light impact onto adjoining property.

**7.5.5 Other pole-mounted lighting (parking, walkways, etc.)**

All lights mounted on poles eight feet or greater in height shall be directed down. The light source shall be shielded so that it will not be visible from any adjacent or nearby real property. The rated color corrected temperature (CCT) of light sources shall not exceed 2700K.

**7.5.6 Searchlights**

The operation of searchlights shall be allowed subject to the following conditions:

A. During the months of May through October, searchlights shall be operated only between the hours of 6:00 a.m. and 11:00 p.m.;

B. During the months of November through April, searchlights shall be operated only between the hours of 7:00 a.m. and 10:00 p.m.

C. Searchlights shall not be operated on residentially zone properties except for grand openings or new developments.

**7.5.7 Lighting of Right-of-Ways**

Lighting of public and private right-of-ways shall be fully shielded and comply with the following:

A. Luminaires shall be fully shielded such that the light source will not be visible from any adjacent or nearby real property.

B. The rated Color Corrected Temperature (CCT) of light sources shall not exceed 2700K.

**7.5.8 Non-Conforming Lighting**

A. All non-conforming lighting fixtures and lighting installations shall be brought into conformance upon a registered written complaint.

B. All non-conforming lighting fixtures and lighting installations shall be brought into conformance upon performing any maintenance, lamp replacement, upgrade or system expansion.

**7.5.9 Definitions**

A. **Fully Shielded Fixture:** An outdoor light fixture shielded in such a manner that all light emitted by the fixture, either directly from the lamp or indirectly from the fixture, is projected below the horizontal plan as determined by photometric test or certified by the manufacturer.

B. **Glare:** The sensation produced by a bright source within the visual field that is sufficiently brighter than the level to which eyes are adapted to cause annoyance, discomfort, or loss in visual performance and visibility; blinding light. The magnitude of glare depends on such factors as size, position, brightness of the source, and on the brightness level to which the eyes are adapted.

C. **Lumen:** The unit used to measure the actual amount of light which is produced by a lamp. Lumen output of most lamps is listed on the packaging. For example, a 60-watt incandescent lamp produces 950 lumens while a 55-watt low-pressure sodium lamp produces 8000 lumens.

D. **Installed Lighting:** Attached, or fixed in place, whether or not connected to a power source.

E. **Light Pollution:** Any adverse effect of manmade light including, but not limited to, discomfort to the eye or diminished vision due to glare, light trespass, uplighting, the uncomfortable distraction to the eye, or any manmade light that diminishes the ability to view the night sky.

F. **Light Trespass:** Light falling on the property of another or the public right-of-way when it is not required to do so.

G. **Luminaire:** The complete lighting assembly, less the support assembly.

H. **Rayleigh Scattering:** The scattering of light by particles that are very small in relation to the wavelength of light. This type of scattering in the atmosphere makes the daytime sky appear blue because blue light is scattered more efficiently than red light.

I. **Skyglow:** The overhead glow from light emitted sideways and upwards. Skyglow is caused by reflection and scattering of light by dust, water vapor, and other particles suspended in the atmosphere. A significant cause of skyglow is the use of bright white light sources for outdoor lighting applications. Skyglow reduces one's ability to view the night sky.

J. **Uplighting:** Fully shielded lighting that is directed in such a manner as to shine light rays above the horizontal plane.

K. **Urban Light Cloud:** See Skyglow.

# Outdoor Lighting Code

**City Of Sedona**
**Community Development Department**
102 Roadrunner Drive Sedona, AZ 86336
(928) 282-1154 · www.sedonaaz.gov

## Sedona Land Development Code Article 9 Development Standards, 911 Outdoor Lighting.

**911.01** Purpose and Intent. It is the purpose and intent of this Code to balance the goals of the Sedona Community Plan to maintain its small-town character with the need to provide for safe lighting practices and to minimize light pollution for the enjoyment of Sedona's citizens and visitors.

A. The use of outdoor lighting is often necessary for adequate nighttime safety and utility, but common lighting practices can also interfere with other legitimate public concerns. Principles among these concerns are:

1. The degradation of the nighttime visual environment by production of unsightly and dangerous glare;
2. Lighting practices that interfere with the health and safety of Sedona's citizens and visitors;
3. Unnecessary waste of energy and resources in the production of too much light or wasted light;
4. Interference in the use or enjoyment of property which is not intended to be illuminated at night, and the loss of the scenic view of the night sky due to increased urban sky-glow.

B. The concerns of safety, utility and aesthetic appearance need not compete. Good modern lighting practices can provide adequate light for safety and utility without excessive glare or light pollution. In nearly all cases, careful attention to when, where and how much nighttime lighting is needed will lead to better lighting practices.

C. The topography and atmospheric conditions in northern Arizona are uniquely suited for government, military, commercial, and private astronomical observation in the area. Unnecessary or excessive uses of outdoor nighttime lighting have an adverse impact on astronomical observation even at relatively distant observatories.

D. Accordingly, it is the intent of this Code to require lighting practices and systems which will minimize light pollution, glare, light trespass, and conserve energy while maintaining nighttime safety, utility, security and productivity.

**911.02** Conflict Regulations. Where any provision of federal, state, county, or city statutes, codes, or laws conflicts with any provision of this Code, the most restrictive shall govern unless otherwise regulated by law.

**911.03** Definitions. See Article 2 SLDC for definitions pertaining to outdoor lighting.

**911.04** Applicability.

A. New Uses, Buildings and Major Additions or Modifications. If the total cumulative increase in floor area is greater than 50% for single-family residential or greater than 25% for all other uses, or if the total cumulative cost of any exterior modification, alteration or repair is greater than 25% of the valuation of the building as determined by the Director, then all outdoor lighting fixtures shall meet the requirements of this Code for the entire site, including previously installed and any new outdoor lighting. Cumulative modification or replacement of outdoor lighting constituting 25% or more of the permitted lumens for the parcel, no matter the actual amount of lighting already on a nonconforming site, shall constitute a major addition for purposes of this section.

B. Minor Additions. If the total cumulative increase in the floor area is 50% or less for single-family residential or 25% for all other uses, or if the total cumulative cost of any exterior modification, alteration or repair is less than 25% of the valuation of the building as determined by the Director, then full conformance of the existing portion of the building or structure is not required. However, such projects shall require the submission of a complete inventory and Site Plan detailing all existing and any proposed new outdoor lighting.

C. New Lighting. Any new lighting on the site shall meet the requirements of this Code with regard to shielding and lamp type; the total outdoor light output after the modifications are complete shall not exceed that on the site before the modification, or that permitted by this Code, whichever is larger.

D. Resumption of Use after Abandonment. If a property or use with nonconforming lighting is abandoned as defined in Article 12 SLDC, Nonconforming Situations, then all outdoor lighting shall be reviewed and brought into compliance with this Code before the use is resumed.

E. Public Roadways. In general this Code does not apply to city and state rights-of-way. However, all such street lights must be fully shielded.

**911.05** Outdoor Lighting Standards.

A. Low Pressure Sodium Lighting. Due to their high energy efficiency, long life and spectral characteristics, low pressure sodium (LPS) lamps are the preferred illumination source throughout the city. Their use is to be encouraged, when not required, for outdoor illumination whenever its use would not be detrimental to the use of the property. Ten percent white light added to LPS light permits nearly normal color perception.

1. Class 1 Lighting. Low pressure sodium (LPS) lamps are not required. Businesses who chose to use LPS as their primary lamps are eligible to apply for an additional 10% increase in the lumens per acre allowed for their site.

2. Class 2 Lighting. Low pressure sodium (LPS) lamps are required. Up to 10% of the total lumens per acre allowed may be white light.

B. Light Trespass Standard. All light fixtures, including security lighting, shall be aimed and shielded so that the direct illumination shall be confined to the property boundaries of the source. Particular care is to be taken to assure that the direct illumination does not fall onto or across any public or private street or road. Motion sensing light fixtures shall be fully shielded and properly adjusted, according to the manufacturer's instructions, to turn off when detected motion ceases.

C. Lamp and Shielding. All light fixtures are required to be fully shielded and shall be installed in such a manner that the shielding complies with the definition of fully shielded light fixtures for all uses, including single-family and multifamily residential uses, except as provided below.

1. All lamp types above 2,000 lumens shall be fully shielded.

2. Partially shielded light fixtures may be permitted subject to the approval of the Director. Partially shielded light fixtures are limited to a maximum of 5,500 lumens per net acre and shall not exceed 2,000 per lamp (see subsection 911.05(D) of this section).

D. Total Outdoor Light Output Standards – Nonresidential and Multifamily Uses.

1. Total outdoor light output shall not exceed 100,000 lumens per net acre for all development except single-family residential uses. This cap is not intended to be achieved in all cases or as a design goal. Instead, design goals should be the lowest levels of lumens necessary to meet the lighting requirements of the site. Partially shielded light fixtures are limited to a maximum of 5,500 lumens per net acre and are counted towards the 100,000 lumens per net acre cap.

2. Seasonal decorations, permitted between Thanksgiving and January 15, are not counted toward these limits. Lighting used for external illumination of signs is counted.

E. Total Outdoor Light Output Standards – Single-Family Residential Uses.

1. Outdoor lighting for single-family residential uses is not subject to a lumens per net acre cap.

2. Outdoor lighting for single-family residential uses is subject to the lamp fixture and shielding requirements.

F. Parking Lot Standards. Parking lots shall be considered Class 2 lighting. Parking lot lighting poles shall be sized in such a manner that the top of any luminary does not exceed 12 feet above adjacent grade.

G. Lighting Time Limitations.

1. Class 1 lighting, including but not limited to sales, service, commercial, assembly, repair, maintenance, and industrial areas, may only continue in operation until 11:00 p.m. or for as long as the area is in active use but once off remain off during nonbusiness hours.

2. Class 2 lighting shall have no time restrictions except as specified by any conditions of approval. Uses

that do not require all-night illumination are encouraged to turn off their outdoor lighting during night hours whenever possible.

3. Class 3 lighting, except for flagpole lighting, must be extinguished after 11:00 p.m. or when the business closes, whichever is later, except that low-wattage holiday decorations may remain on all night from Thanksgiving to January 15.

4. Multi-class lighting, except for security lighting, must conform to the time limitations of the strictest class.

H. Multi-Class Lighting Standard. Multi-class lighting must conform to the shielding and timing restrictions, if any, that apply to the most restrictive included class.

I. Class 3 Lighting Standards.

1. All Class 3 lighting must be selected, designed, installed, and aimed so that there is a minimum amount of spill beyond the area intended to be lighted.

2. Permanent exposed string lighting is not permitted.

3. All Class 3 lighting must comply with the light trespass standards as described in subsection 911.05(B) of this section.

4. All Class 3 lighting shall comply with the lamp and shielding standards as described in subsection 911.05(C) of this section.

5. a. Subject to the approval of the Director, uplighting or ground-mounted lighting may be allowed to accent unique features of a building and/or surrounding landscaping (such as outstanding architectural features, specimen trees with dense year-round foliage or large native shrub masses). Uplighting or ground-mounted lighting shall be designed and installed in such a manner as to minimize glare with special consideration in areas where there is vehicle and pedestrian traffic.

b. All lighting which is directed upwards shall be placed in such a manner that the angle of the lamp shall not be greater than 45 degrees measured from a horizontal plane to a line projected through the center of the lamp, and fixtures shall be fully shielded to contain and direct the light onto the feature to be lighted.

J. Signs. See Article 11 SLDC, Sign Regulations.

K. Mercury vapor light bulbs and fixtures in use for outdoor lighting on the effective date of the ordinance codified in this Code shall not be used after July 1, 2006.

L. Searchlights, floodlights, laser source lights, strobe or flashing lights, illusion lights or any similar high intensity light shall not be permitted except in emergencies by police and fire personnel at their direction. Spot lights are permitted and must be directed downward 45 degrees from any neighboring property.

M. On projects where an engineer or architect is required, the developer shall verify in writing to the city that all outdoor lighting was installed in accordance with the approved plans.

**911.06** Special Uses.

A. Recreational Facilities.

1. Lighting for outdoor athletic fields, courts or tracks shall be considered Class 1.

2. Lighting allowed in this subsection shall be subject to approval. When the proposed lumens per acre exceed the lumens per net acre limits, the installation shall be designed to achieve no greater than the minimum illuminance levels for the activity as recommended by the Illuminating Engineering Society of North America (IESNA).

3. Every such lighting system design shall be certified by an Arizona registered engineer as conforming to all applicable restrictions of this Code.

4. Such lighting shall not include any light trespass as determined by the Director.

5. All events shall be scheduled so as to complete all activity and lights turned off by 10:00 p.m.

6. Fully shielded lighting shall be required for fields designed for amateur, recreational or nonprofessional sports activity. For professional level sports facilities where fully shielded fixtures are not utilized, acceptable luminaries shall include those which:

a. Are provided with internal or external glare control louvers, or both, and installed so as to minimize uplight and off-site light trespass as determined by the Director; and

b. Are installed and maintained with aiming angles that permit no greater that 2% of the light emitted by each fixture to project above the horizontal.

B. Outdoor Display Lots. Light for outdoor display lots shall be considered Class 1, and shall conform to the lumens per net acre limits except as follows:

1. All such lighting shall utilize fully shielded luminaries that are installed in a fashion that maintains the fully shielded characteristics.

2. When the proposed lumens exceed the per acre limits, the installation shall be designed to achieve no greater than the minimum illuminance levels for the activity as recommended by the Illuminating Engineering Society of North America (IESNA).

3. Such lighting shall not include any light trespass as determined by the Director.

4. Every such lighting system design shall be certified by an Arizona registered engineer as conforming to all applicable restrictions of this Code.

5. Lighting Time Limitations. Outdoor display lot lighting shall conform to the hours of operation as established under Class 1 lighting standards. Any lighting on after the time limitations shall be considered Class 2 lighting and shall conform to all restrictions of this Code applicable to this class.

C. Service Station Canopies.

1. Class 2. Lighting for service station canopies shall be considered Class 2 lighting.

2. Shielding. All luminaries shall be flush with the lower surface of canopies and utilize flat glass or plastic covers.

3. Total Under-Canopy Output. The total light output used for illuminating service station canopies, defined as the sum of under-canopy initial bare-lamp outputs in lumens, shall not exceed 40 lumens per square foot of canopy. All lighting mounted under the canopy, except internally illuminated signs, shall be included in the total. Fifty percent of the total lumen output of all lamps mounted within or under a canopy shall be included in the lumen per acre cap.

D. Other Lighting on Parcels with Special Uses. All site lighting not directly associated with the special uses as permitted shall conform to all lighting standards described in this Code.

**911.07** Plan Submittal and Evidence of Compliance.

A. Plan Submittal. Whenever a person is required to obtain a permit for outdoor lighting or signage, a conditional use permit, subdivision approval or any development plan approved by the city, including all city projects, or whenever a person requests a rezoning, the applicant shall, as part of the application process, submit sufficient information to enable the Director to determine whether proposed lighting complies with this Code. All applications may be subject to review and action by the Planning and Zoning Commission at the discretion of the Director.

B. Applications. All applications shall include the following:

1. A Site Plan indicating the location of all lighting fixtures, both proposed and any already existing on the site.

2. A description of each illuminating device, fixture, lamp, support and shield, both proposed and existing. The description shall include, but is not limited to, manufacturer's catalog cuts and illustrations (including sections where required); lamp types, wattages and initial lumen outputs.

3. Such other information that the Director may determine is necessary to ensure compliance with this Code.

C. Plan Approval. If the Director determines that any proposed lighting does not comply with this Code, the permit shall not be issued or the plan approved.

D. Lamp or Fixture Substitution. Should any outdoor light fixture or the type of light source therein be changed after the permit has been issued, a change request must be submitted to the Director for approval, together with adequate information to assure compliance with this Code, which must be received prior to substitution.

E. Certification of Installation. For all projects where the total initial output of the proposed lighting equals or exceeds 100,000 lamp lumens, certification that the lighting, as installed, conforms to the approved plans shall be provided by a certified engineer before the Certificate of Occupancy is issued. Until this certification is submitted, approval for use of a Certificate of Occupancy shall not be issued for the project.

**911.08** Approved Materials and Methods of Construction or Installation/Operation – Approval of Alternatives. The provisions of this Code are not intended to prevent the use of any design, material, or method of installation or operation not specifically prescribed by this Code, provided any such alternate has been approved by the Director. The Director may approve any such proposed alternate providing that it:

A. Provides at least approximate equivalence to that applicable specific requirement of this Code.

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

**911.09** Exemptions and Nonconforming Lights.

A. All nonconforming outdoor light fixtures lawfully installed prior to and operable on the effective date of the ordinance codified in this Code are exempt from all requirements of this Code. However, there shall be no change in use or lamp type, or any replacement (except for same-type and same-output lamp replacement) or structural alteration made, without conforming to all applicable requirements of this Code.

B. In the event that an outdoor lighting fixture is abandoned or is damaged to the point of requiring repairs for safe operation, the repaired or replacement fixture shall comply with the provisions of this Code.

C. Emergency lighting, used by police, firefighting, or medical personnel, or at their direction, is exempt from all requirements of this Code for as long as the emergency exists.

D. Swimming Pool and Decorative Water Fountain Lighting. Underwater lighting used for the illumination of swimming pools and decorative water fountains is exempt from the lamp type and shielding standards, though they must conform to all other provisions of this Code.

**PAGE CITY COUNCIL**
**WORK SESSION**
**JULY 27, 2016**

A Work Session of the Page City Council was held at 5:30 p.m. on July 27, 2016, in the Council Chambers at City Hall in Page, Arizona. Mayor Bill Diak presided. Vice Mayor John Kocjan, Councilors Mike Bryan, Scott Sadler, Levi Tappan, Korey Seyler and Dennis Warner were present.

Mayor Diak called the meeting to order.

Staff members present: City Manager, J. Crystal Dyches; City Attorney, Joshua Smith; Administrative Assistant Lona Shugart; Planning and Zoning Director, Robin Crowther; and Community Development Director, Kim Johnson.

**Discussion pertaining to a Dark Sky presentation**

Mayor Diak introduced Nate Ament.
Mr. Ament is from the National Park Service, and over the last four years he has been with the Colorado Plateau Dark Sky Cooperative. Nate has served as liaison between 35 plus national and state parks, and over 75 partners while fostering stewardship of night sky resources across the region. During this time, Nate has assisted 15 parks and communities in their International Dark Sky Place application process, and coordinated numerous night sky related events. Nate holds a B.S. in Environmental Science, specializing in restoration issues and water resources. As a graduate student at Colorado State University, he conducted research in invasive species ecology and remote sensing technology at the Natural Resource Ecology Lab in partnership with the USGS and NASA. Nate vividly remembers watching a brilliant fireball from high in the Andes on one of the darkest nights in his memory.

Mayor Diak introduced Dr. John Barentine.
Mr. Barentine is an Arizona native and comes to IDA from the "dark side" of science – professional astronomy. He grew up in Phoenix and was involved in amateur astronomy from grade school. Later, he attended the University of Arizona beginning research at the National Optical Astronomy Observatories and National Solar Observatory headquarters in Tucson. From 2001-2006 he was on the staff of Apache Point Observatory in New Mexico, serving first as an observing specialist on the Astrophysical Research Consortium 3.5 meter telescope, and then as an observer for the Sloan Digital Sky Survey. 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 in Austin. John has contributed to science in fields ranging from solar physics to galaxy evolution while helping develop hardware for ground-based and aircraft-borne astronomy. Throughout his career, he has been involved in education and outreach efforts to help increase the public understanding of science. He is the author of two

books on the history of astronomy, *The Lost Constellations* and *Unchartered Constellations*. The asteroid (14505) Barentine is named in his honor.
Mr. Nate Ament gave a power point presentation pertaining to "The Dark Skies of Page and Glen Canyon, and the opportunity to preserve the dark skies." The dark sky presentation is attached hereto and by this reference made a part of herein.

There was discussion.

Dr. John Barentine gave a presentation regarding "Estimating the Potential Economic Value of the Night Skies Above the Colorado Plateau". A handout was provided and is attached hereto and by this reference made a part of herein.

There was discussion.

**ADJOURN**
The meeting was adjourned at 6:33 p.m.

Lona Shugart
Acting City Clerk

William R. Diak
Mayor

CERTIFICATION

I hereby certify that the foregoing minutes are a true and correct copy of the minutes of the City Council Special Meeting, held on the 27th day of July, 2016. I further certify that the meeting was duly called and held and that a quorum was present.

Dated this 10th day of August, 2016

Lona Shugart, Acting City Clerk

# The Dark Skies of Page and Glen Canyon

*Dan Duriscoe - NPS*

COLORADO PLATEAU
DARK SKY COOPERATIVE

## A Unique Opportunity in a Rare and Dark Place

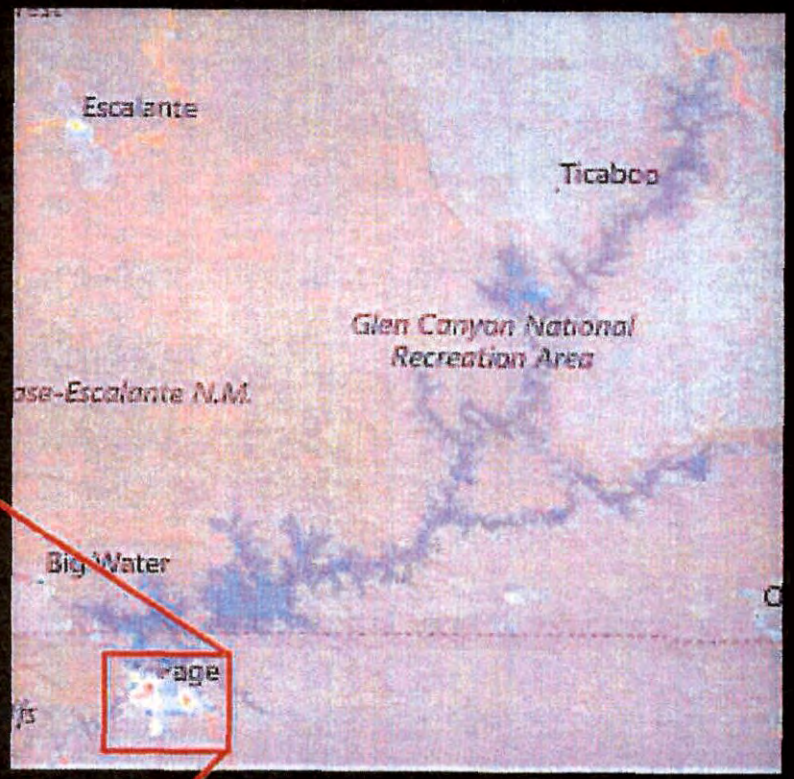
Nate Ament, NPS - July 2016

Why?

Since 1996, more than half of the world lives in an urban environment...

4/5 of the U.S. population cannot see the Milky Way from where they live...

# Surrounded by the darkest skies in North America



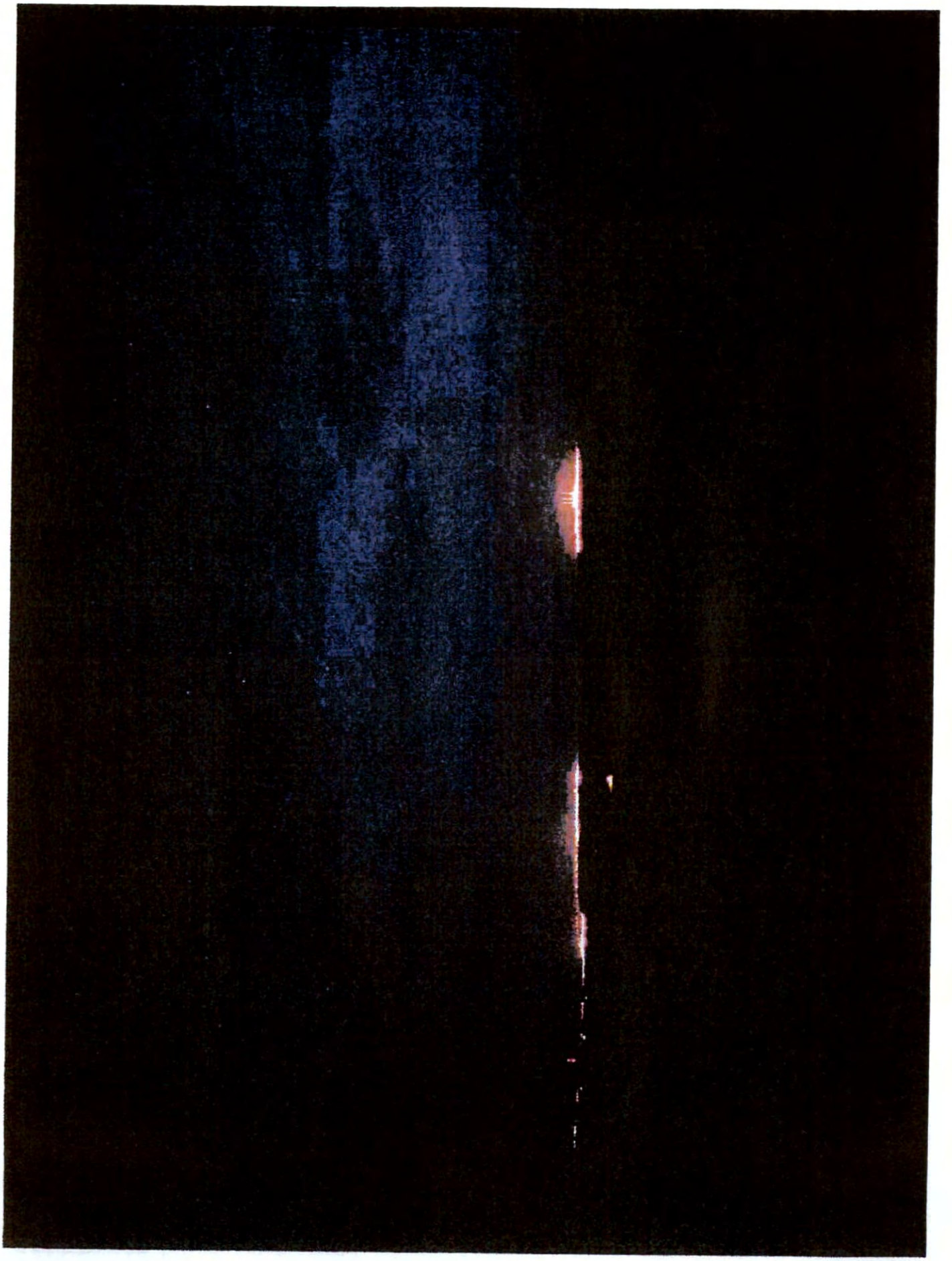
Flagstaff, AZ

Population ~ 70,000

Page, AZ

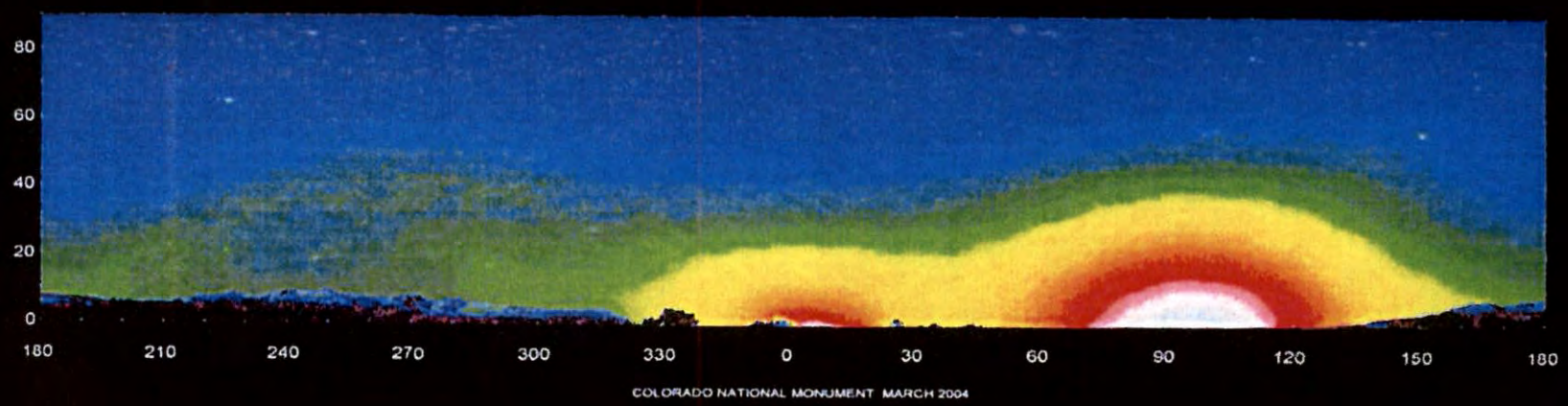
Population ~ 7,000

Same Scale



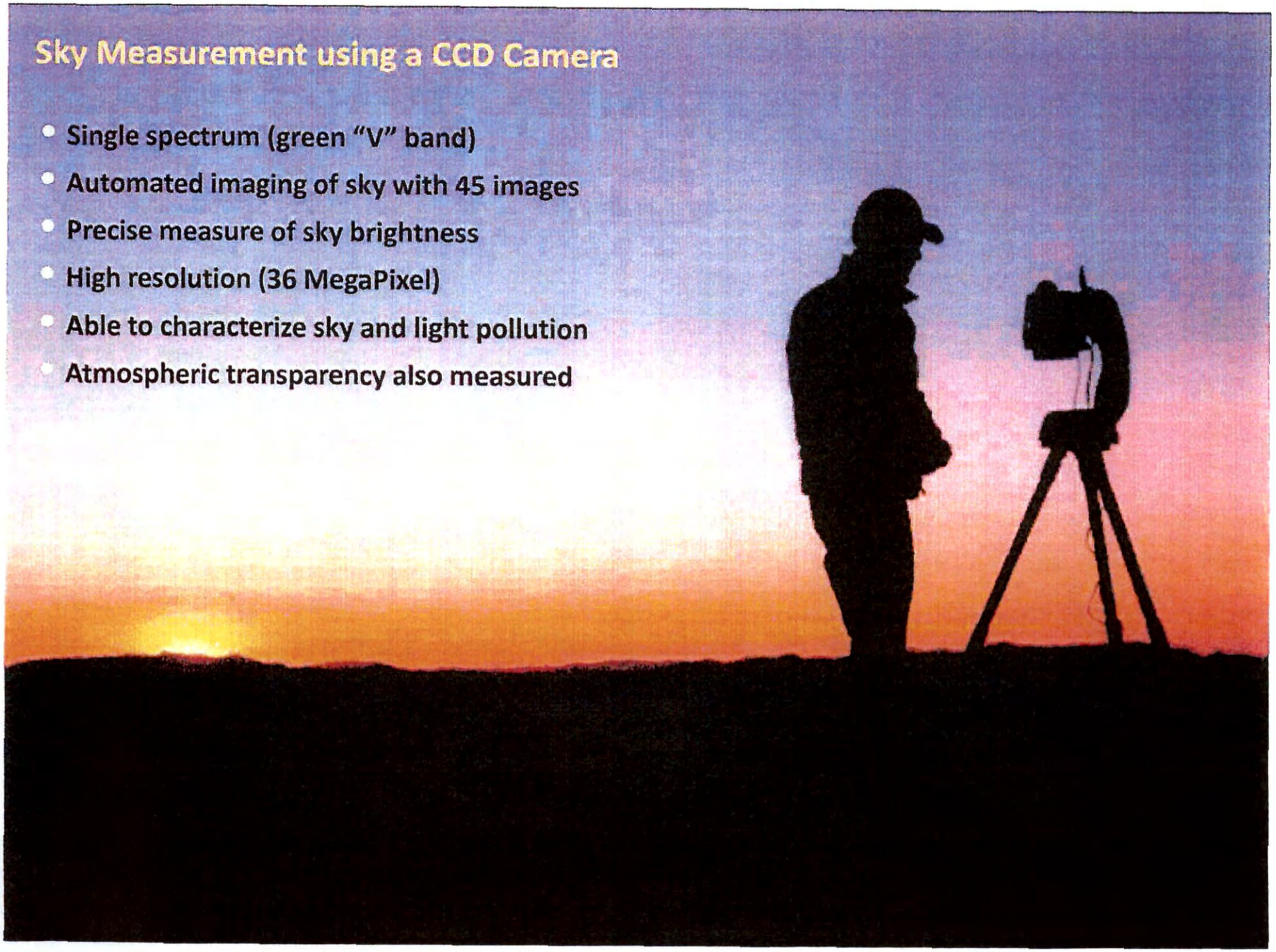
# How do we measure anthropogenic (human-produced) light?

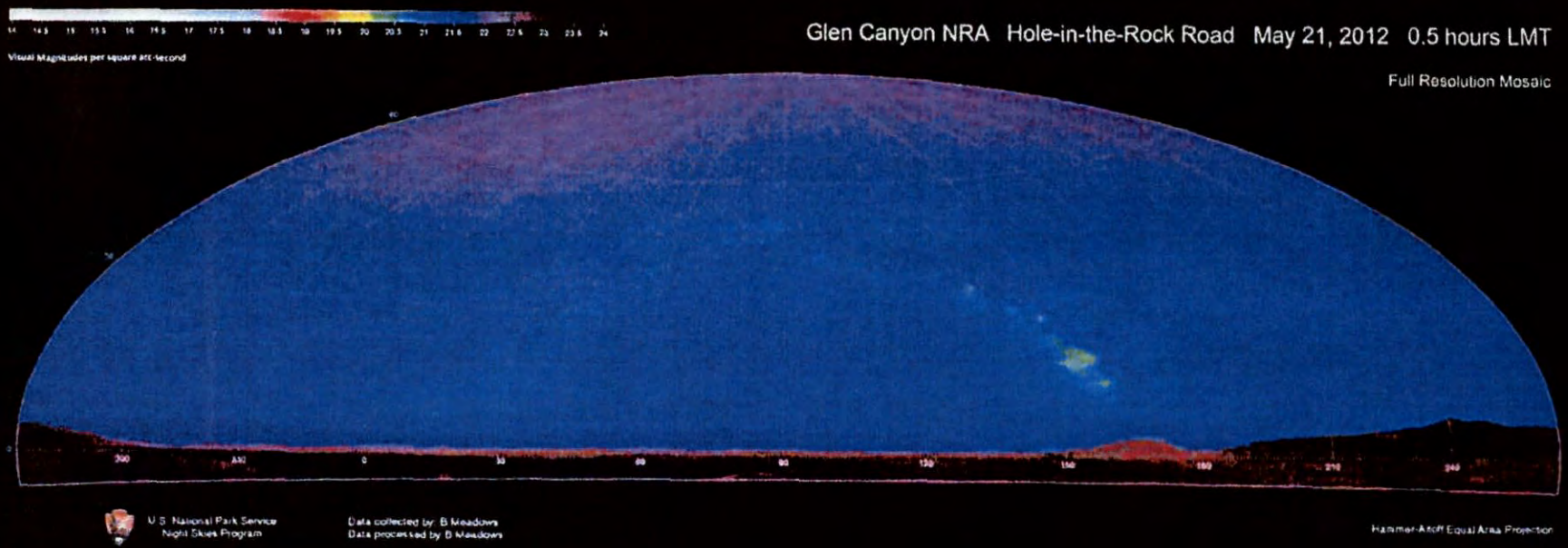
NPS Night Sky Team – Based in Ft Collins, CO

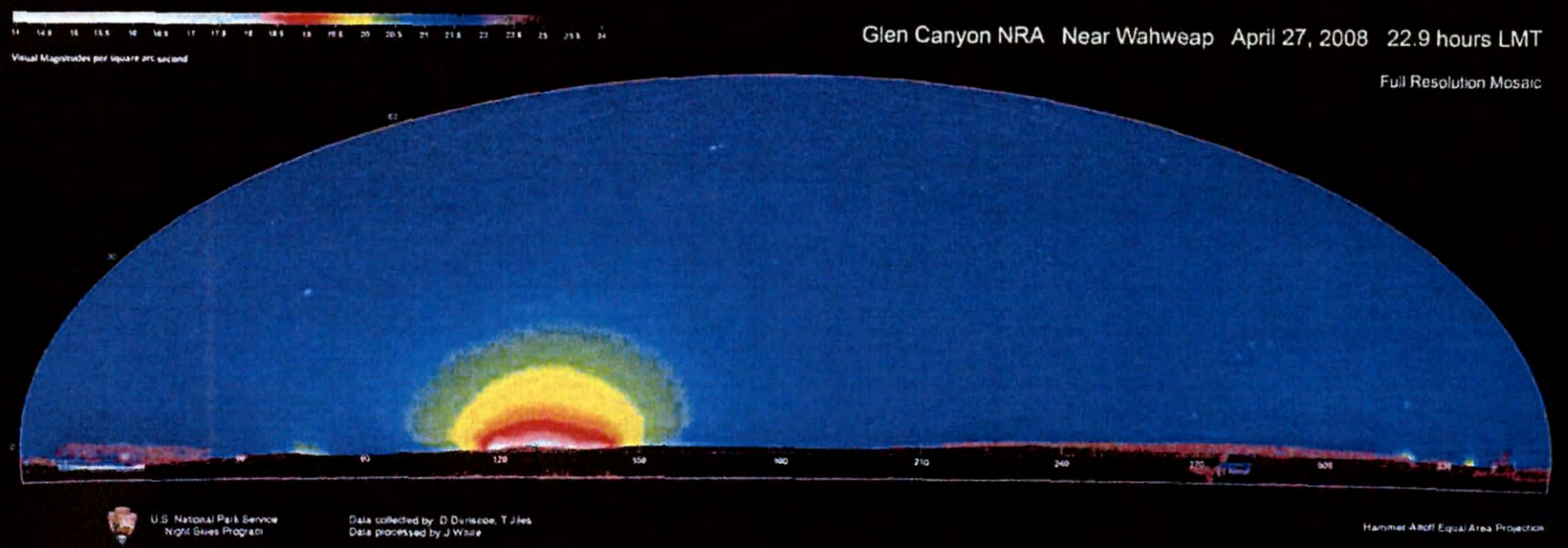


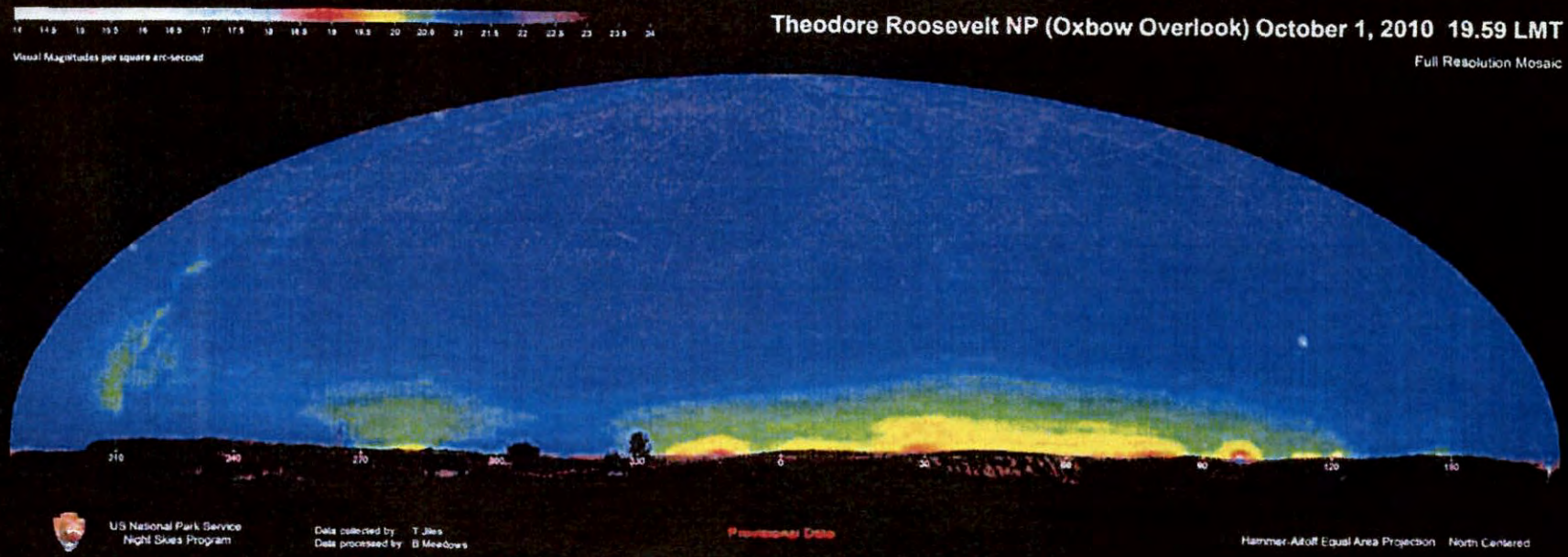
## Sky Measurement using a CCD Camera

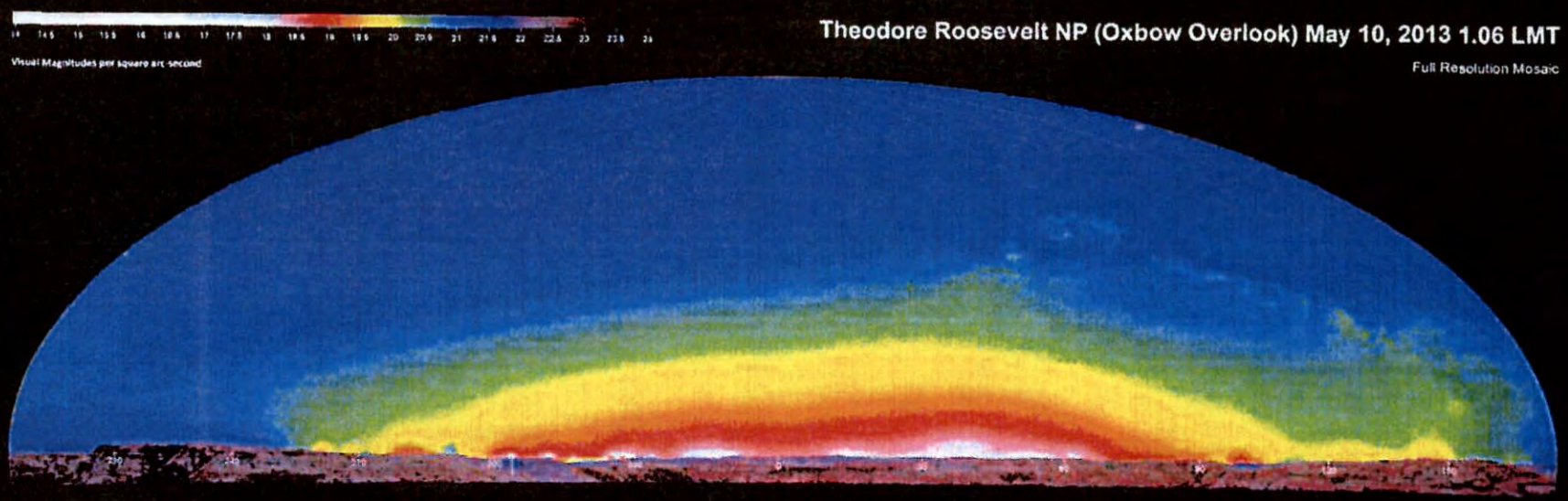
- Single spectrum (green "V" band)
- Automated imaging of sky with 45 images
- Precise measure of sky brightness
- High resolution (36 MegaPixel)
- Able to characterize sky and light pollution
- Atmospheric transparency also measured




Visual Magnitudes per square arc-second
Glen Canyon NRA Hole-in-the-Rock Road May 21, 2012 0.5 hours LMT
Full Resolution Mosaic
U.S. National Park Service
Night Skies Program
Data collected by: B Meadows
Data processed by: B Meadows
Hammer-Aitoff Equal Area Projection


Visual Magnitudes per square arc-second
Glen Canyon NRA Near Wahweap April 27, 2008 22.9 hours LMT
Full Resolution Mosaic
U.S. National Park Service
Night Skies Program
Data collected by: D Duriscoe, T Giles
Data processed by: J Wise
Hammer-Aitoff Equal Area Projection


Theodore Roosevelt NP (Oxbow Overlook) October 1, 2010 19.59 LMT
Full Resolution Mosaic
Visual Magnitudes per square arc-second
US National Park Service
Night Skies Program
Data collected by: T Jiles
Data processed by: B Meadows
Provisional Data
Hammer-Aitoff Equal Area Projection North Centered

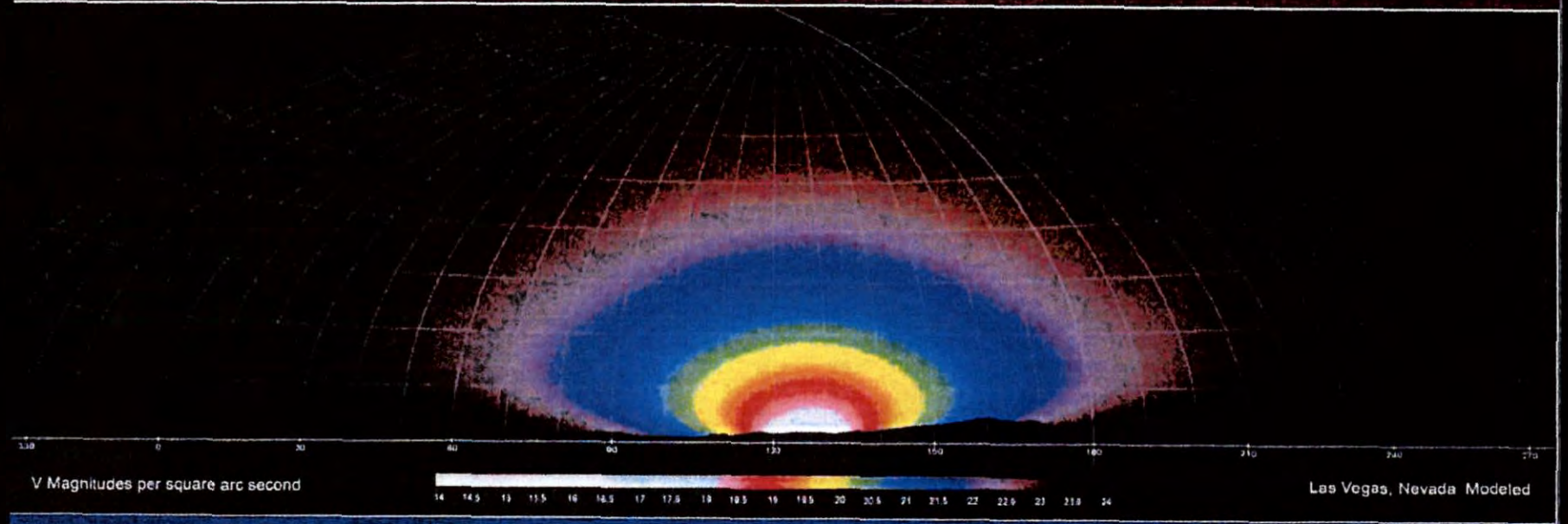

Theodore Roosevelt NP (Oxbow Overlook) May 10, 2013 1.06 LMT
Full Resolution Mosaic
Visual Magnitudes per square arc-second
US National Park Service
Night Skies Program
Data collected by: J White, B Meadows
Data processed by: J White
Provisional Data
Hammer-Aitoff Equal Area Projection North Centered

# Las Vegas, Nevada Modeled Current Anthropogenic Sky Glow

| Population (2010 census) | Lumens per capita (VIIRS) | Estimated Lumens per capita (model fit) | Percent uplight |
|---|---|---|---|
| 1,757,861 | 7680 | 6528 | 10.0 |

Lumens/capita ratio to Flagstaff

3.15




Distance to City Center 67.0 km

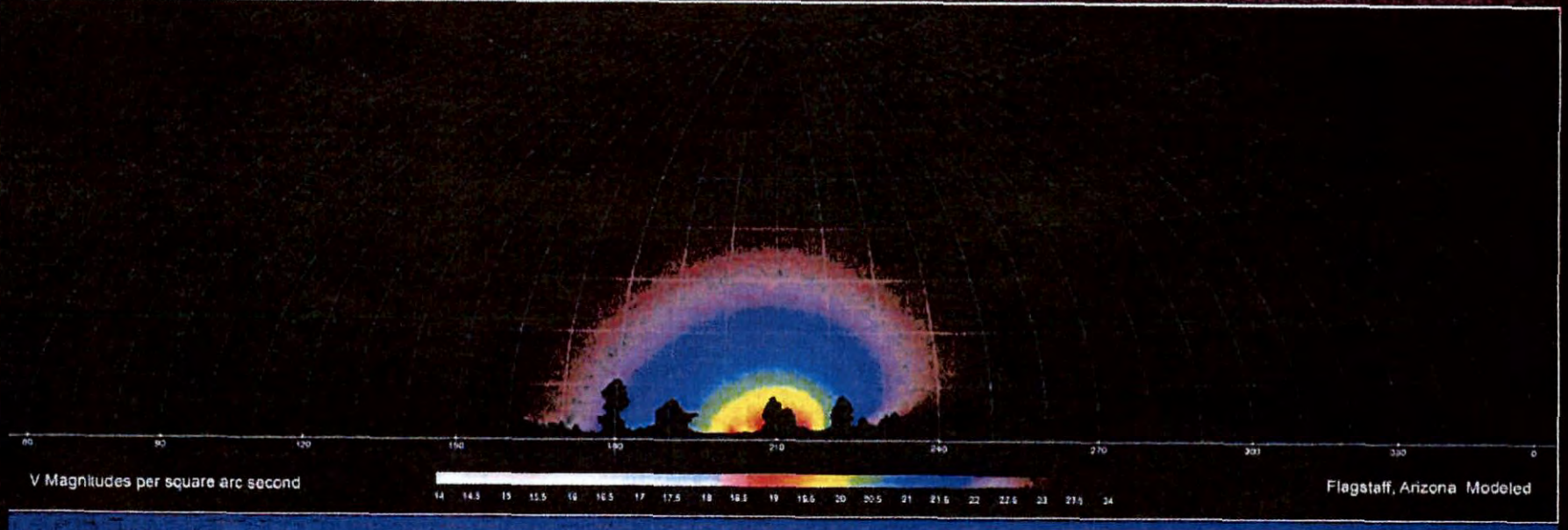
# Flagstaff, Arizona Modeled Current Anthropogenic Sky Glow

| Population (2010 census) | Lumens per capita (VIIRS) | Estimated Lumens per capita (inventory) | Percent uplight |
|---|---|---|---|
| 75,785 | 2075* | 2075 | 8.0 |

Lumens/capita ratio to Flagstaff

1.0

* Calibration point



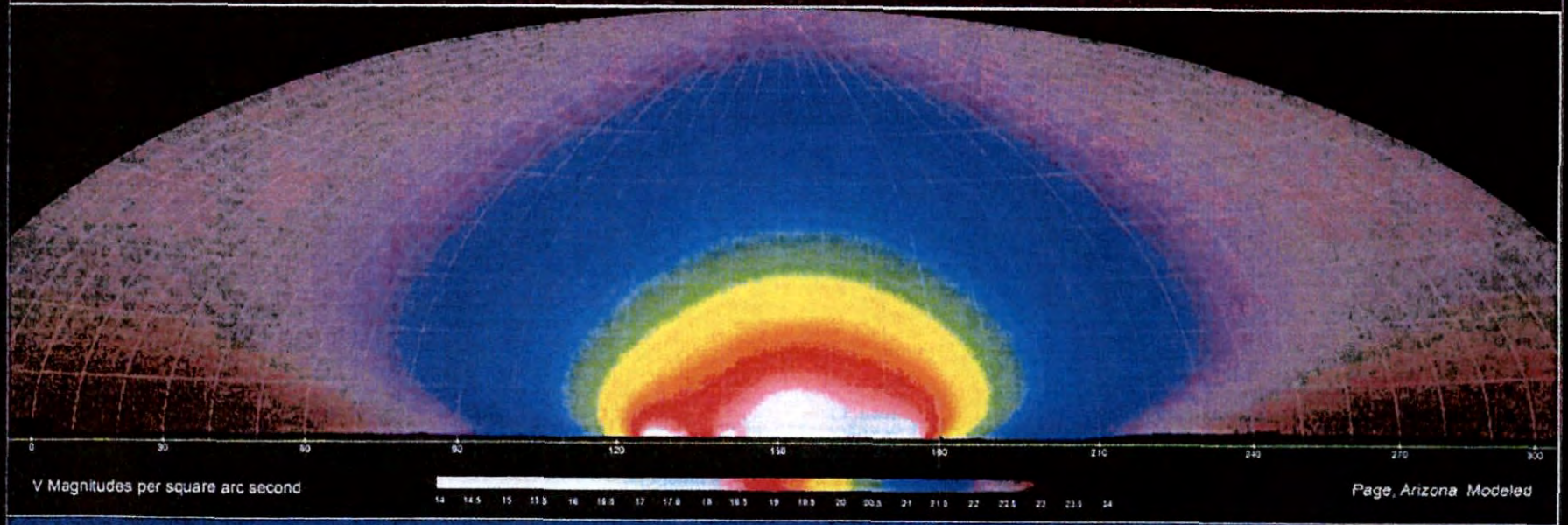

Distance to City Center 21.8 km

# Page, Arizona Modeled Current Anthropogenic Sky Glow

| Population (2010 census) | Lumens per capita (VIIRS) | Estimated Lumens per capita (model fit) | Percent uplight |
|---|---|---|---|
| 8,690 | 10,368 | 5702 | 10.0 |

Lumens/capita ratio to Flagstaff

2.75



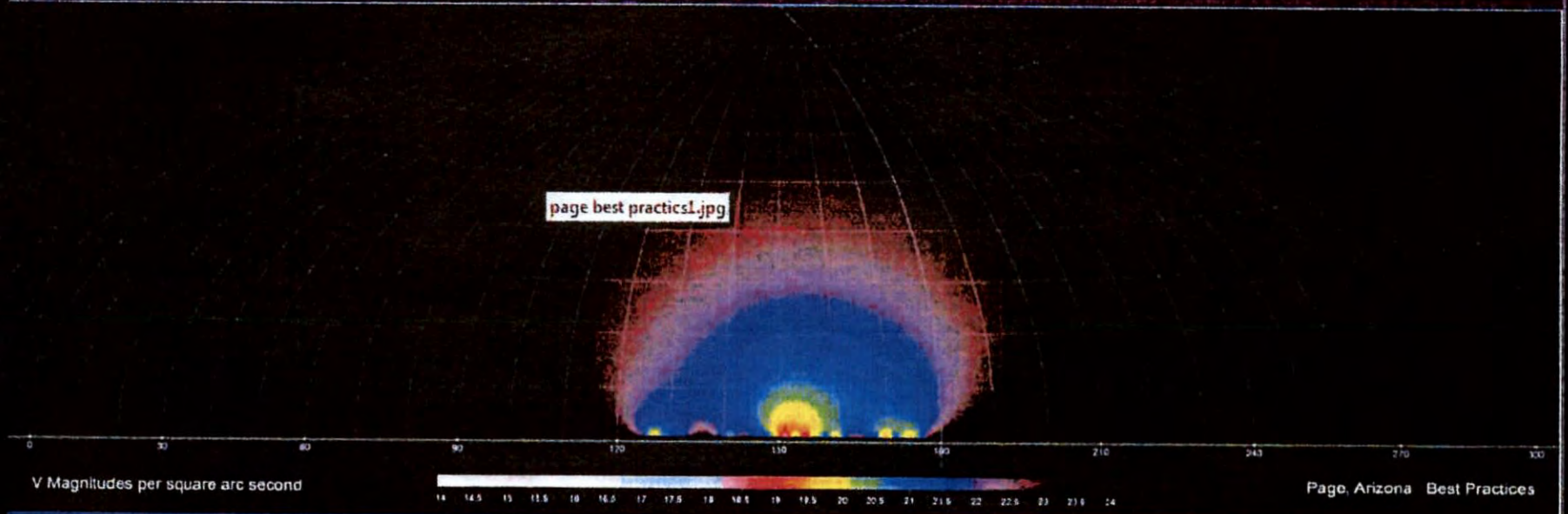

Distance to City Center 8.1 km

# Page, Arizona Modeled Best Practices Anthropogenic Sky Glow

| Population (2010 census) | Lumens per capita (VIIRS) | Estimated Lumens per capita (best prac.) | Percent uplight |
|---|---|---|---|
| 8,690 | -- | 2075 | 0.0 |

Lumens/capita ratio to Flagstaff

1.0

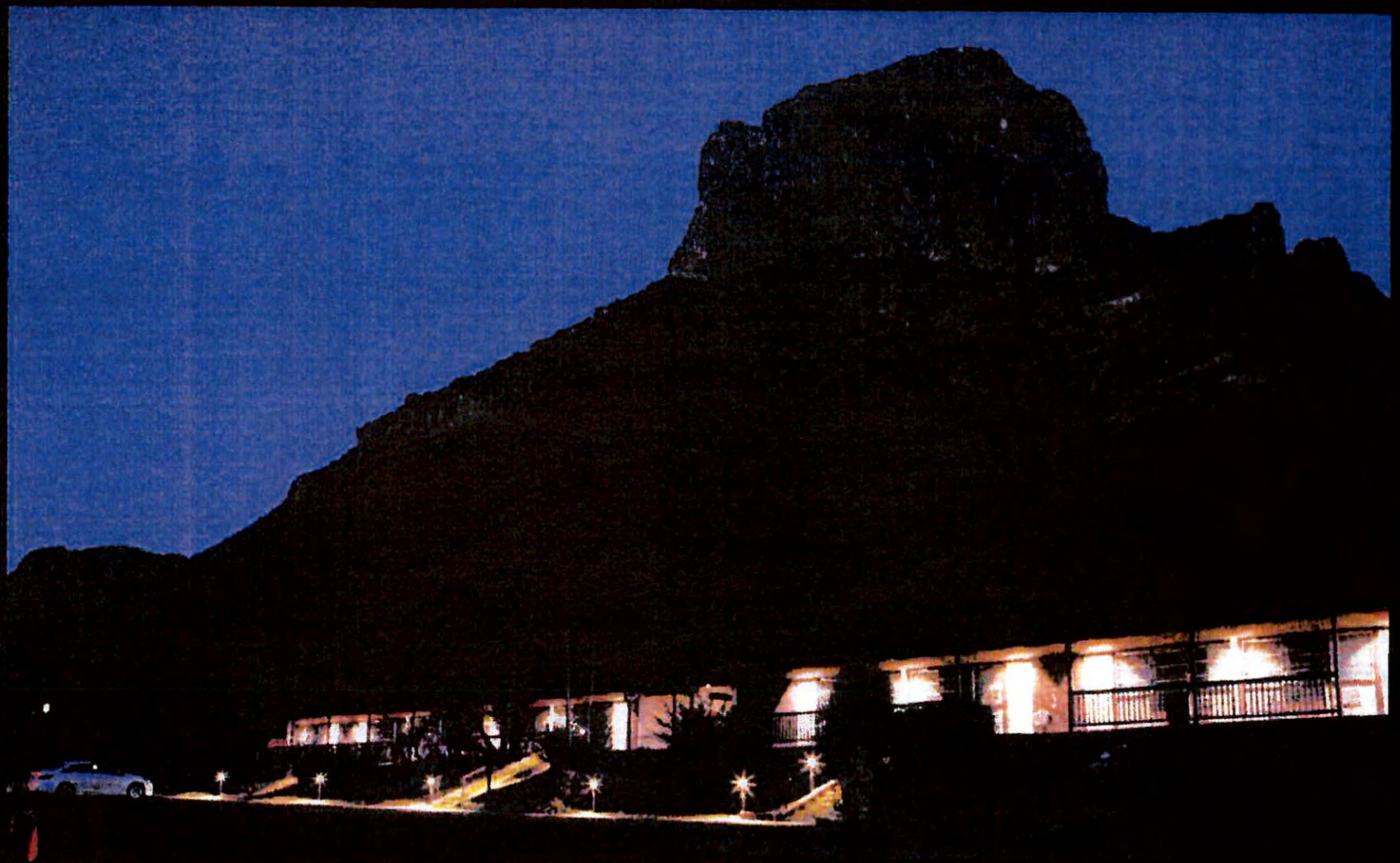



Distance to City Center 8.1 km

## Night Sky Friendly Lighting

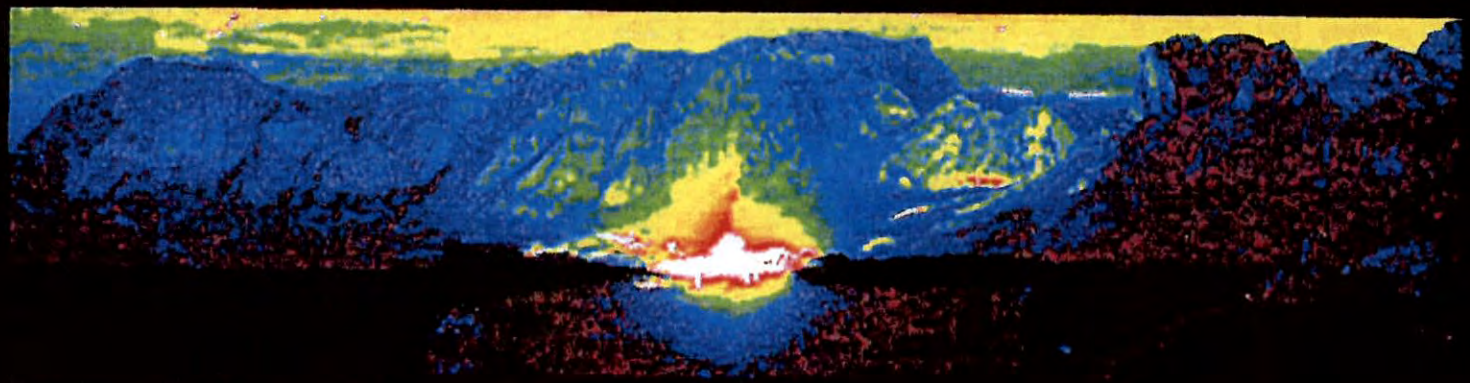
- Use light only where needed
- Use light only when needed
- Shield light to reduce glare and improve efficiency
- Use yellow / amber light when practical
- Use the minimum necessary for the task
- Use energy efficient lamps

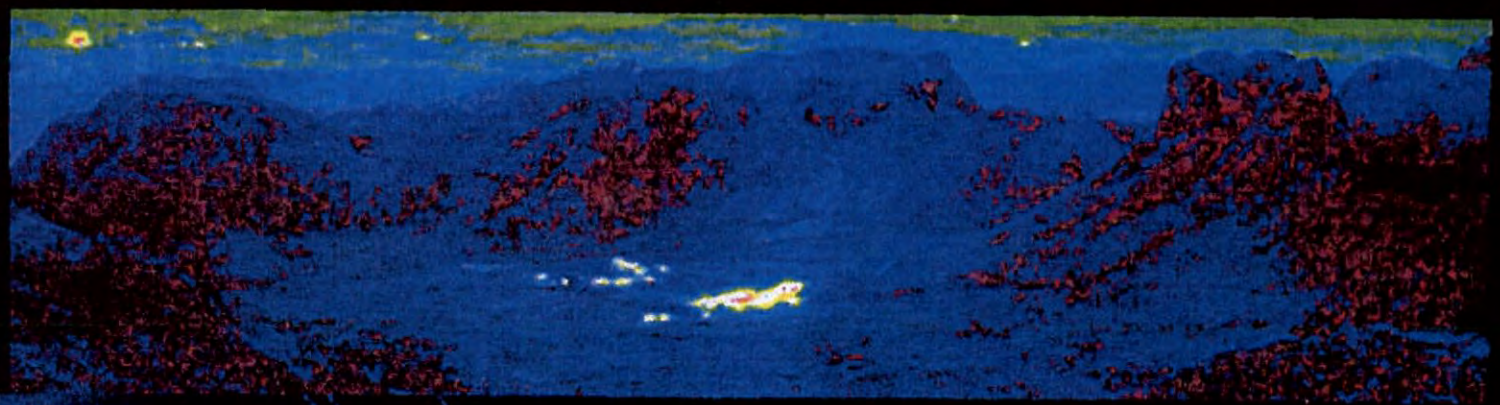
# Lighting Retrofits at Big Bend by Musco



# Chisos Basin, Big Bend NP – **98%** reduction in wattage, energy consumption, and associated CO2 emissions

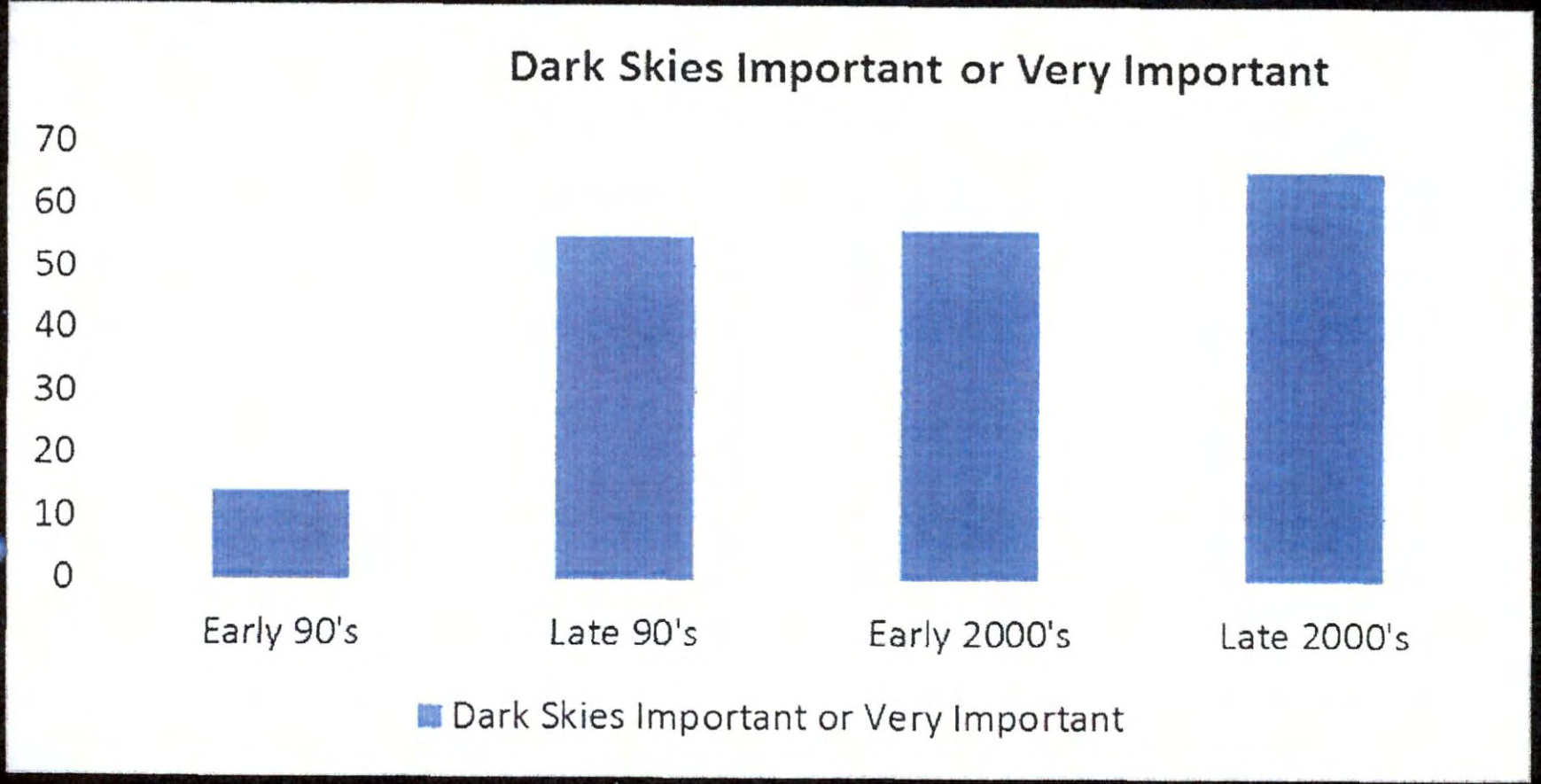
Panorama from Emory Peak 2003 (top) and August 2011 (bottom)





False color enhances dynamic range, two different cameras are not calibrated exactly to each other, but approximately so. 2003 a clearer night, distant landscape brighter.

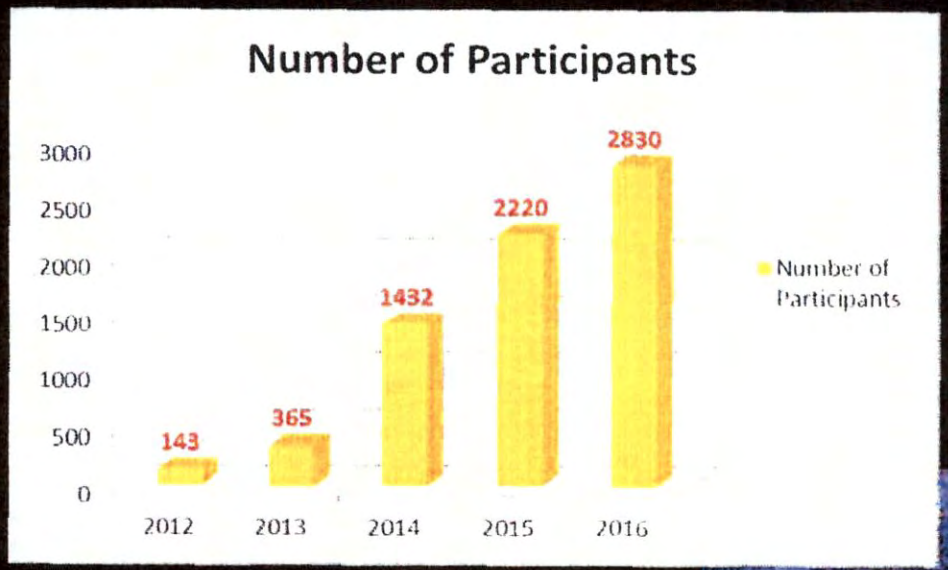
# Importance to NPS visitors

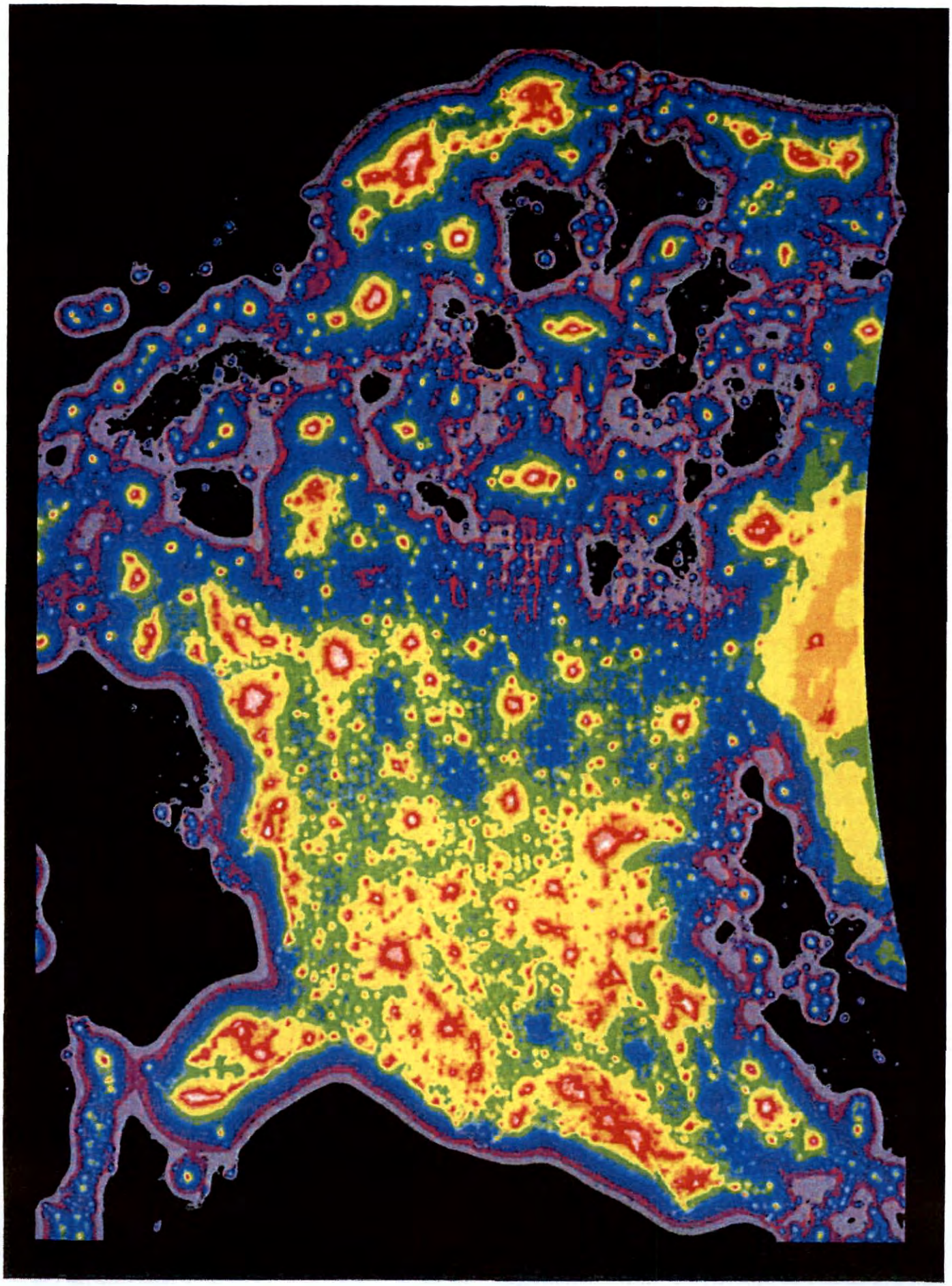



*(Mitchell & Gallaway, 2015)*

# Astronomy programs are consistently the most popular ranger led programs

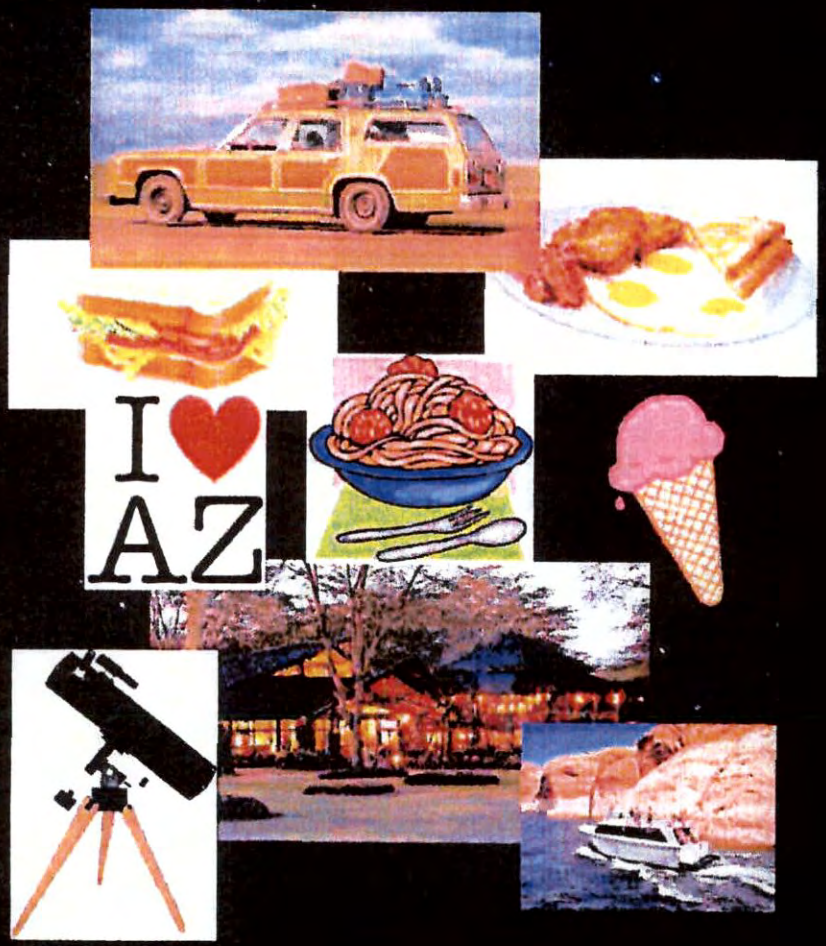
# Rapid increase in popularity in Moab area parks





# Astrotourism

Day Visit = $90



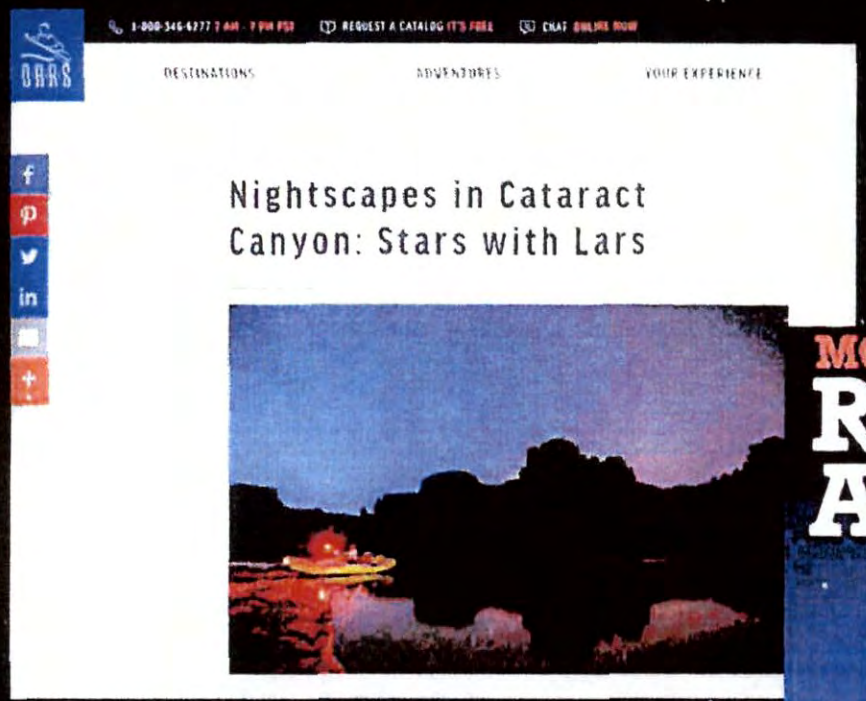

Overnight Visit = $270-$390

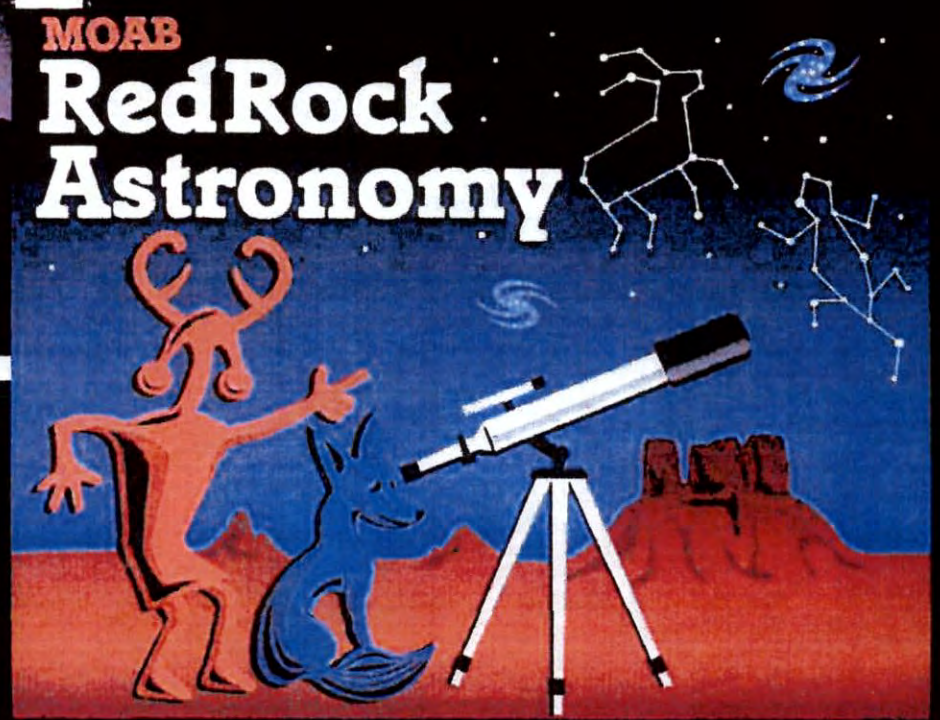
# Estimating Potential Economic Value

- Spending per party increase from $90 to $270-390 (day vs. overnight)
- Change represents an additional $2.5 billion value added to Colorado Plateau economies over 10 years
- Increase the **# of** visitors during the off-peak seasons and provide a longer more sustained period of tourism activity

# Work with guides and local business

# Tourism Opportunities



# Tourism Opportunities

Deseret News

Southern Utah expects some stellar tourism

## Moab Dark Skies

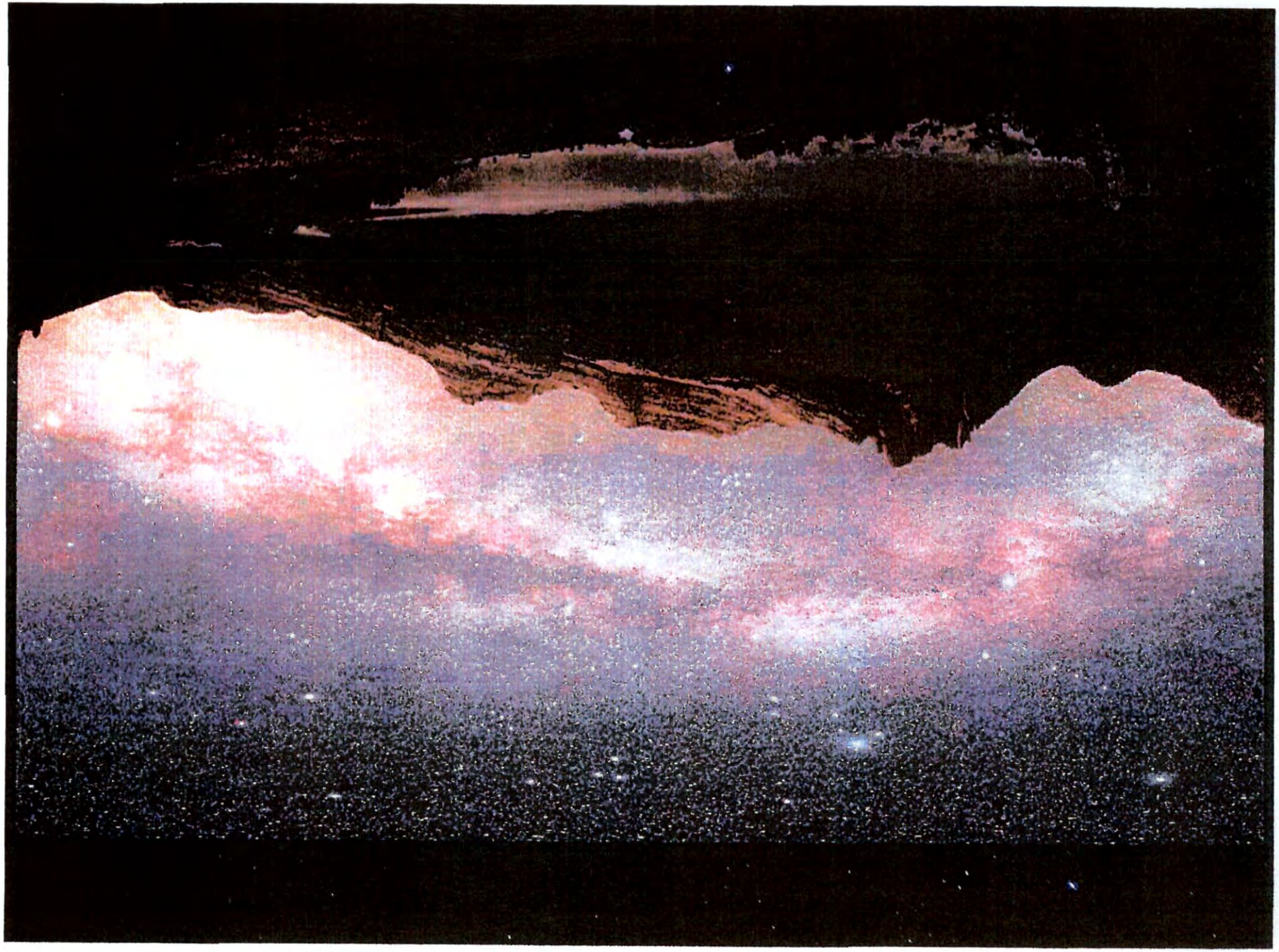
*Live and Play under the Milky Way*

# Astrotourism and Economic Benefits

- Bryce Canyon (2012) – Astronomy related attendance accounted for over 50,000 visits and $2 million contributed to local economies
- Tourism office campaigns have increased some park visitation by up to 30% (Mighty Five- Zion)

# International Dark Sky Parks / Places

SE



Wally Pacholka / AstroPics.com

# Questions? Ideas?

NATE AMENT
nathan_ament@nps.gov
435-719-2349

cpdarkskies.org

Colorado Plateau Dark Sky Cooperative is on Facebook