Joshua Tree National Park
Outdoor Lighting Management Plan

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Plan Objectives

The objectives of this lighting management plan are to provide Joshua Tree National Park a planning strategy and best management practices for outdoor lighting. An important consideration in this document was balancing the need for safety with the sensitivity of the Park's nocturnal environment. The guideline focuses on "off the shelf" solutions, though development of new technologies like LEDs will soon allow parks to more precisely manage outdoor lights; however, for now only mainstream technologies have been included in this document. Simplicity of understanding and implementation of these guidelines were given greater weights than the details of lighting design, visibility research, and energy efficiency.

- Curtail and reverse the degradation of the nighttime visual environment and the night sky, including casual observation, astronomy, and air quality related values.
- Minimize glare, light trespass, obtrusive light, and artificial sky glow by limiting outdoor lighting that is misdirected, excessive, or unnecessary.
- Insure —good neighbor lighting by minimizing light trespass.
- Help minimize suspected health risks to humans from adverse exposure to light at night.
- Help protect natural ecosystems from the damaging effects of night lighting.
- Permit reasonable and rational use of outdoor lighting for nighttime safety, utility, security, and productivity.
- Help to conserve energy and resources.
- Minimize maintenance and operating costs
- Provide some flexibility for architectural and artistic lighting within the above constraints

Scope

This plan is intended to address outdoor lighting within Park boundaries, including developed areas, and exceeds the San Bernardino County Code of Ordinances on Glare and Outdoor Lighting (Chapter 83.07). This plan omits transportation right of ways where state and federal transportation codes may supersede park authority.

Complex facilities and lighting situations may require more guidance than is found here. In those cases, reviewing additional guidelines and consultation with lighting engineers and the NPS Night Sky Team is encouraged.

Purpose and Need

The protection of the natural environment is an integral component to the mission of Joshua Tree National Park. In and around areas of human occupation, modifications to this environment take place and there is a potential for environmental pollution. While safeguards to prevent water, air, and noise pollution have been in place for many decades at most facilities in national parks, attention to the preservation of a natural nocturnal environment with regard to artificial light pollution (or photo-pollution) is not commonly emphasized as much as the other factors. In an area with minimal vegetation such as Joshua Tree's Mojave and Colorado deserts, excessive or stray light may have far reaching impacts upon the land and not be merely confined to the immediate area of its use. These guidelines are intended as a tool for facility and land managers to accomplish visitor enjoyment and environmental preservation objectives with regard to permanently installed outdoor lighting. Minimizing sky glow, glare and visual clutter is essential in maintaining a natural nocturnal lightscape, and sets an important example for park visitors and neighboring communities.

2006 Management Policies

The 2006 NPS Management Policies (slightly modified from the 2001 version) direct the NPS to conserve natural lightscapes. Protection of natural darkness is not only a visitor resource and scenic value; it has important connection to cultural landscapes, ecological integrity, operational efficiency, and sustainability.

4.10 Lightscape Management

The Service will preserve, to the greatest extent possible, the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light. The absence of light in areas such as caves and at the bottom of deep bodies of water influences biological processes and the evolution of species, such as the blind cave fish. The phosphorescence of waves on dark nights helps hatchling sea turtles orient to the ocean. The stars, planets, and earth's moon that are visible during clear nights influence humans and many other species of animals, such as birds that navigate by the stars or prey animals that reduce their activities during moonlit nights.

Improper outdoor lighting can impede the view and visitor enjoyment of a natural dark night sky. Recognizing the roles that light and dark periods and darkness play in natural resource processes and the evolution of species, the Service will protect natural darkness and other components of the natural lightscape in parks. To prevent the loss of dark conditions and of natural night skies, the Service will minimize light that emanates from park facilities, and also seek the cooperation of park visitors, neighbors, and local government agencies to prevent or minimize the intrusion of artificial light into the night scene of the ecosystems of parks. The Service will not use artificial lighting in areas such as sea turtle nesting locations where the presence of the artificial lighting will disrupt a park's dark-dependent natural resource components.

The Service will:

- restrict the use of artificial lighting in parks to those areas where security, basic human safety, and specific cultural resource requirements must be met;
- use minimal-impact lighting techniques;

- shield the use of artificial lighting where necessary to prevent the disruption of the night sky, natural cave processes, physiological processes of living organisms, and similar natural processes.

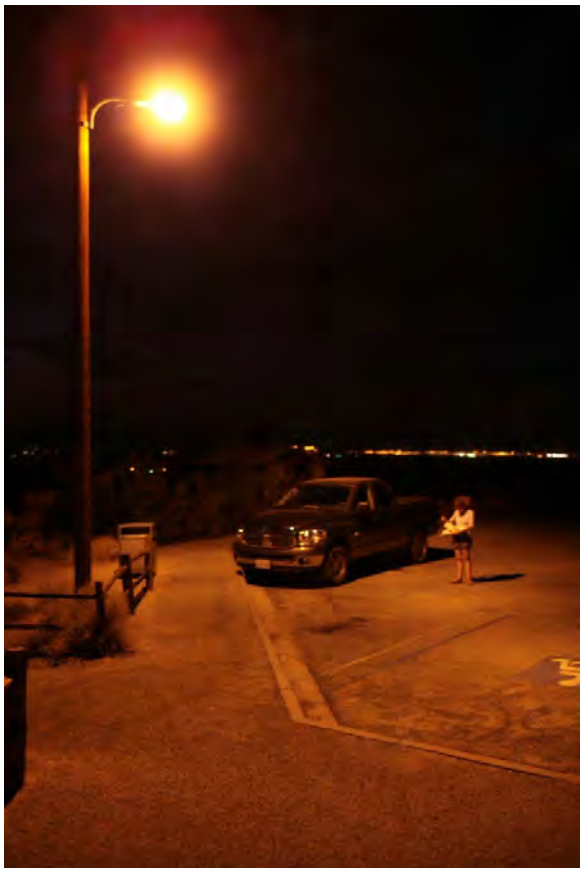
The decision about whether or not to install artificial lighting in particular circumstances is left to the discretion of the superintendent and is made through the planning process.

Outdoor Lighting

Joshua Tree National Park is a popular outdoor recreation destination. Many thousands of visitors seek out the dry, warm climate, and will be active at night, especially in and around developed areas. While the park is primarily a wild area (and its visitors want it to remain so), the safety of humans occupying developed sites is of paramount importance. Therefore, zones of concentrated human use, and especially those areas open to the visiting public, will be illuminated to a level sufficient to ensure their safety. Lighting serves both objective and subjective human needs. Objectively, light is used to provide adequate visual perception in low light. Additionally, the eye cannot easily transition from a bright environment (such as indoors) to a dark environment (such as outdoors at night). Thus outdoor lighting at Joshua Tree is needed to provide a minimal illumination level and ease high contrast transitions.

Human Needs

It is not unreasonable to expect a visitor to carry their own source of illumination when travelling at night by foot. However, visitors to developed areas should be provided enough light to navigate safely from their vehicle to the building doorway or destination of interest. These developed areas are defined by a zone plan for the park, and within them every effort will be made to provide adequate illumination for way finding and navigation via foot. However, visitors will also be advised that their ability to negotiate obstacles at night will be greatly assisted by carrying a flashlight, even a small "keychain" type.



Safety must not be confused with convenience. Just when the boundary is crossed from essential outdoor lighting for safety purposes to inessential outdoor lighting provided for the convenience of humans may in part be subjective. Lighting which enhances outdoor recreational activities in developed areas of Joshua Tree is appropriate. However, any outdoor light must be evaluated as to its necessity based upon the protection of natural and cultural resource values within Joshua Tree. For example, it may be convenient to provide 100 lux of white light in a parking lot that allows excellent color rendition of people and objects and allows one to read a map or similar document by the ambient light alone. Nonetheless, a fully shielded yellow light of 2 lux

intensity will easily meet the safety requirements while drastically mitigating resource impacts.

Security

Safety must also not be confused with security. So-called “security lighting” is effective in preventing crime mainly if it enables people to notice criminal activity as it's taking place, and if it doesn't help criminals to see what they're doing. Therefore, bright, glaring dusk-to-dawn floodlights may fail on both counts if there is no one on patrol at night or they create high contrast shadow areas within which perpetrators of crime may hide from detection while surveying targets using the lighting provided.

While an outdoor light may provide a “feeling” of security to a pedestrian striking out in darkness from the lit interior of a building or vehicle, the actual amount of protection from potential threats will depend on the quality and uniformity of the light and even more on the presence of other safety-enhancing conditions such as the presence of other visitors or park personnel. Ideally, this type of lighting would be controlled by the user, and switched off when they leave the area, or by the use of motion sensors. In either case, dusk-to-dawn lighting is inappropriate for security purposes if no one is present to take advantage of it.

Accessibility Standards

It is a requirement to provide accessible routes which meet standards set by the Americans with Disabilities Act (ADA). However, the ADA does not give guidelines on appropriate lighting levels for accessible routes. Lighting on accessible routes should follow the general guidelines stated here. In order to accommodate people with impaired vision, lighting should maintain a continuous illumination, minimize glare, and not create a spotty effect.

Problems with Light

Light is not innocuous. It is an alteration of our environment like so many other human constructions, but it has received little attention as a significant environment change until recently. As seen from the many images of the Earth from space, outdoor lights have sprung up throughout most of the globe. The simple fact that light is visible from space, directly overhead shows how easily this human tool leaks out into the natural environment.

Light Pollution

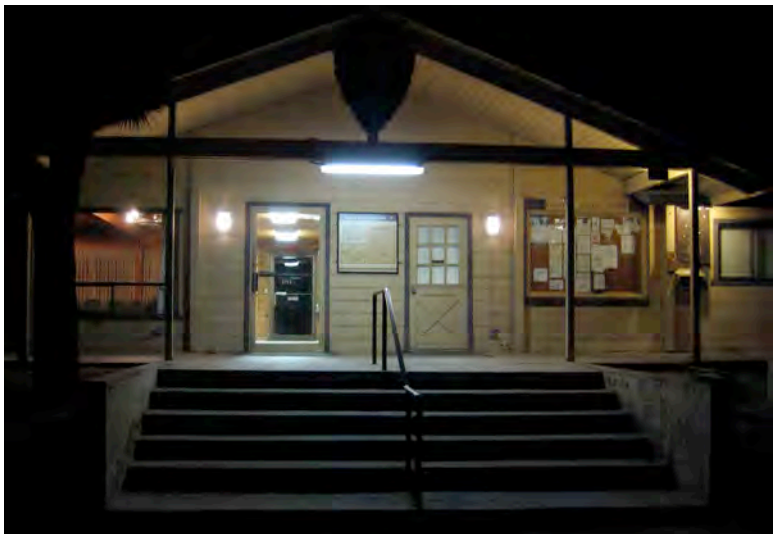
The upward spill of light is often called light pollution. Dust, water vapor and other particles will scatter and reflect light that is emitted into the atmosphere creating sky glow. Light that escapes directly upward into the night sky is a major contributor to the loss of the dark night sky. Even light from a few fixtures can create an unnatural glow over a wide area. Light from cities has been documented by the NPS as being visible from over 200 miles away. Even a lone streetlight in the countryside can be seen for tens of miles if it is unshielded or of excessive intensity. Direct uplight is controlled by using fully shielded (sometimes called full cut-off)

fixtures. This is thought to reduce the overall uplight component to less than 25% of its former value. The reflected light component is controlled by using the minimal illumination level necessary.

Light pollution is not only an annoying modification to the natural environment; it is harmful to many animal species and may significantly alter human behavior, or cause harmful long-term effects to human health. Many people visit national parks seeking peace and quiet, especially at night. Campgrounds have noise curfews which are socially accepted. A light curfew or dusk to dawn light intensity that is low enough to not interfere with natural dark conditions should be expected as well. Minimizing sky glow is essential in maintaining a natural nocturnal lightscape, and sets an important example for park visitors and neighboring communities.

Light Trespass and Glare

Light that shines sideways (horizontally) from a fixture is not only a significant source of light pollution, but it is more apt to trespass into areas where light is not wanted. The surface of an electric lamp or lens of a luminaire has a very high intrinsic brightness per unit area. Such a brilliant source of light can be seen for tens of miles at night if it is unshielded from view. This brings about glare and light trespass, which is the illumination of the land or sky away from the intended task. Glare can cause minor discomfort, or it can completely disable the eye's ability to see properly. Even when present in low levels, it will cause the pupil to constrict down, diminishing the remaining light in the visual field. Glare should be minimized in all circumstances to both improve the lighting quality and to minimize light trespass.



Joshua Tree National Park will eliminate all such situations of light trespass and glare to the extent possible on permanent outdoor light fixtures through shielding, reduction in lamp intensity to below 250 lumens, or removal of the luminaire. Figure 1a-b shows examples of light fixtures that contribute to light trespass and glare, whereas Figure 2a-b shows full cut-off fixtures appropriate for Joshua Tree.

When luminaires on tall poles are employed, some glare is inevitable, but light trespass can still be contained to some extent with proper shielding. For this reason, the use of tall poles is discouraged in the park. While not as economic to install, a greater number of shorter poles fitted with lower intensity luminaires will result in a more sensitive installation for area illumination. Note that lights which are temporary in nature (such as sports fields or yard lights) are not exempt from this guideline. Unshielded lights which may be seen from the wilderness are particularly egregious.

Figure 1a-b. Unshielded fixtures resulting in glare and light trespass.

Figure 2a-b. Full cutoff fixtures fitted with low intensity lamps

Ecological and Health Impacts

Every year there is more research suggesting that artificial light is affecting the natural environment and the biological rhythms of both plants and animals that are critical to native habitat and natural evolution. Effects of artificial light on wildlife can cause avoidance or attraction behavior with diverse and significant consequences that not only affect the species themselves but those on which they prey and those that prey on them. Research to date has concentrated on the effects of artificial light on birds and insects, but there is evidence that light affects larger animals. Mammals that travel long distances to find food or mates, such as mountain lions, may avoid links between natural areas if the areas emit artificial light.

Because the scientific literature is relatively sparse on this topic, there is frequently no species specific information available. However, there are some generalities that are useful guides. Nocturnal predators are particularly affected by artificial light, either positively or negatively, which can have resultant impacts on their prey species. Birds, many of which migrate at night, are particularly prone to disorientation by artificial lights. Certain biomes are believed to be more sensitive. These include wetland and ponds, shorelines, alpine areas, and open country such as deserts and prairie. The NPS is currently working with researchers to provide lighting guidance as it relates to wildlife including protecting sea turtle habitat at Cape Hatteras.

Finally, humans are animals too, and there is a solid body of research potentially linking artificial light at

night to certain health problems.

Sustainable Facilities Management

Outdoor lighting is the last appliance that has received so little energy efficiency scrutiny. Though the different types of lamps are well studied (for example a 4x energy savings is realized by replacing a traditional light bulb with a compact fluorescent), the question of what type of fixture, how much light, and if an area should be lit at all has not seen much discourse. It is estimated that the portion of light that shines upward and creates light pollution represents $2 to $5 Billion annually in the US. Thus, saving our night skies can have tremendous economic and energy benefits.

Designing for Efficiency

The basic tenants of efficiency are to use light only when and where it is needed, and if needed, use the minimum amount to achieve needed visibility using the most efficient light source that meets the task requirement. Lamp technology has evolved much, and efficiencies can be improved 2x-5x (i.e. reducing energy use 50% to 80%) by using modern lamp types. Reducing light levels are a viable solution if illumination can be reduced while still meeting the task, yielding proportional efficiency gains. Full shielding directs light that would go into space downward, further improving efficiency; concurrent elimination of glare usually allows lower illumination levels as well. And finally smart technologies, from the very basic timer or motion sensor, to elaborate computer controlled lighting and LED lamps can further improve efficiencies.

Maintenance Cost

What is energy efficient is almost always cost efficient. But another aspect of cost reduction is maintainability. Lighting design should include workload estimates related to upkeep. Capital cost should be compared with energy efficiency and maintenance intervals to get a true picture of the cost of lighting. All too often, lighting choices are made based only on fixture cost. A $40 yardblaster light can be purchased at a hardware outlet, compared to a high end fixture with sophisticated optics and shielding materials (or luminaire as they are often called) costing $400. However, if the yardblaster is 175 watts and the full cut-off luminaire is 18 watts, the capital cost will be offset by energy savings in 4 years. Over a 20-year fixture lifetime, the difference becomes $1,200.

A similar comparison can be made with lamp lifetimes. A typical incandescent lamp will last about 1,000 hours or less, compared to 10,000 hours for a compact fluorescent lamp (CFL), and 50,000 to 100,000 hours for LED lamps. The old fashioned light bulb will be changed 6 or 7 times before the CFL burns out, more than making up for its higher initial cost.

Design

Lighting is an important element in architecture and landscapes. It can emphasize spaces, highlight the landscape, and serve purposes beyond the basic need for visibility. Design issues can include pole height and pole spacing, fixture appearance, illumination pattern, light level, or light color to name a few. With design and implementation, the use of the appropriate light intensity, color, and duration for a particular task will achieve the objectives of both human safety and resource protection.

In 2008 Joshua Tree National Park conducted a lighting inventory to determine which outdoor lights do not meet IDA standards. In 2010, 98% of the lights were upgraded to meet the IDA standards. Currently

there are no retrofits planned for the next several years, but any future upgrades will be designed to meet IDA standards.

Lamp Color

One element that receives much attention is the color of the light. Different lamp technologies, such as High Pressure Sodium (HPS) or Low Pressure Sodium (LPS) produce yellow light. This monochromatic or color biased light cannot render colors properly (these are often described as having a low color rending index). Many feel that this light has an industrial character. Research indicates that less light is needed (and therefore less energy) for the human eye to see efficiently with a white (blue/green) light source than with a more yellow light source. However, HPS and LPS lights are more efficient than white light sources such as Metal Halide (MH), Mercury Vapor (MV), or even Compact Fluorescent Lamps (CFL), producing more lumens per watt. They are also believed to be less impacting to nocturnal wildlife. For example, LPS is often used on turtle nesting beaches with good success. Additionally, the yellow lights scatter much less in the atmosphere and are 2.5x (HPS) to 5x (LPS) less interfering with human night vision than white light. This is an important factor in maintaining dark night skies.

The color rending abilities and improved visibility of white lights are at odds with their lower energy efficiency, wildlife impact, and night sky impact, causing frequent professional disagreement. The bias of this guideline is to use yellow lights sources as a default when available unless the need for better color rendition is demonstrated.

Historic Integrity

Historic structure and cultural landscapes have particular lighting needs that may not be addressed in this document. Both the light fixtures themselves and the character of the light they produce are of concern. Often there is too much emphasis on selecting fixtures that look of the appropriate period, while the nighttime scene is neglected but just as important to the historic integrity.

Lighting Guidelines

Approaches

There are several ways to define lighting. They can be divided into two categories— prescriptive where the type, size, lamp, etc. of the light is defined, or performance where the resultant illumination levels are defined (see Table 1). The latter is more accurate, but requires computer modeling and photometric data on each light fixture. Because so many of the fixtures used in parks are low cost without photometric or custom designs, and lighting expertise to run computer models is rare, a prescriptive approach is taken here. There are several aspects of lighting design that can be controlled and defined. The designs chosen to be prescribed in this guideline are limited for simplicity.

Table 7. Two categories defining lighting.

Prescriptive Parameters	Performance Parameters
Lumens	Illumination (minimum, avg, max)
Kelvins	Color temperature
Watts	Glare or Glare Ration
Power density	Uniformity (average:minimum)
Lumen density	Uplight and light distribution
Pole spacing	Spill light/light trespass
Pole height	Transition
Fixture shielding and aiming	Down-directed less than 45 degrees of nadir

Table 8. Outdoor lighting zones.

Zone	Description	Typical task	Maximum intensity of task areas	Maximum intensity at zone boundary	Maximum fixture brightness (lumens)	Maximum fixture color temperature (kelvins)
0	Wilderness & undeveloped land	Backcountry hiking and camping	0	0	0	0
1	Entrance Stations, Recreation Sites, parking lots	Developed Camping Rest Room Exterior, Dusk to Dawn fee collection areas, pathway illumination, certain high use parking lots	5	0.01	1,500	<4,000
2	Fuel, Maintenance Yard	Fueling station, equipment delivery	50	2	5,000	<4,000
4	Emergency Services or Loading Dock area	Fire Station Exterior, Warehouse Loading Dock	50	6	5,000	<4,000

*Maximum intensity is illuminance in lux

Zones

Joshua Tree National Park embraces the concept of restricting the use of light and its maximum intensity

based upon the location within the park as it relates to land use and human development (see Table 2). Lighting zones are defined based upon the following guide for permanently mounted fixtures (after IENSA RP-33). The listed "maximum intensity at zone boundary" is an important concept. It defines the allowable "light trespass", or vertical artificial illumination at that point on the land. Such illumination may result from direct glare OR reflected light. This is particularly important at the Zone 1 boundary, beyond which lies Zone 0 (Wilderness). The preservation of wilderness values is of paramount importance in Joshua Tree National Park, including solitude, natural quiet, and a natural dark environment at night.

Note that roadways are NOT considered Zone 1 by default; the vast majority of roads are in Zone 0. Roadway lighting is *strongly discouraged*. In fact, at this time there is NO roadway lighting in the park at all. For any future development, modifications or retrofitting, a lighting zone map will be drafted specifically outlining the boundaries of each zone. "Use of lighting controls" means that lights of an intensity greater than 1,000 lumens MUST be controlled by a manual switch, timer, or motion sensor in addition to or instead of a simple "dusk to dawn" photocell.

Lighting zones must grade from bright to dark incrementally to meet the maximum illuminance at zone boundary requirements. Incompatible uses must be avoided or mitigated (such as a 24 hour gas station bordering a wilderness area) with screening by vegetation, walls, or earth berms, where possible.

Lighting Applicability

Where there is an expectation by the visitor or employee of darkness and people are generally prepared for darkness (either through dark adaptation or carrying their own flashlight), lights should not be installed.

Lights should be installed as an illumination transition on commonly used building egress points, where outdoor work may be done at night, where critical information is posted, to draw nighttime visitors to important information or safety point (such as a phone booth or visitor center entrance), where there is a demonstrated need for protection of assets, where there is an identified safety hazard, or where facilities are commonly used at night (such as a laundry room in residence area).

When choosing whether to light an area, it is important to consider the cumulative effect of the action as well as if the illumination will be successful in its desired function. It is also important to consider illumination transitions; an isolated light may effectively light a small area but will render the surrounding dark area less visible.

Security lighting where no patrols exist (such as a remote storage yard or parking areas) is often counterproductive, inviting crime without the opportunity to intercede.

Lighting Requirements

Exterior Lighting

All permanent exterior lighting shall be fully shielded, use the proper illumination level, and must be less than 4,000 kelvins in color temperature. When fixtures are articulating, such as PAR floodlamps, they should have directional shields, should be aimed within 45 degrees of downward, and should not illuminate areas outside the intended target.

Special Use Lighting

Unshielded and partially shielded fixtures are permitted for low voltage LED pathway lights, under-canopy lights at phone booths, and other guidance lighting provided they are ≤ 7 watts each.

Lighting Controls

Lighting controls include manual switches, photo-switches, dimmers, timers, motion or presence detectors, and any other device which may be used to control a light's operation or intensity. Intelligent use of lighting controls will result in energy conservation and mitigation of light pollution. However, controls will not be used as a substitute for replacing an unshielded light fixture that produces glare or light trespass.

The use of a photo-switch, which uses a photocell to determine the ambient light level and automatically activates a light when it drops below a threshold, is one of the most common outdoor lighting controls. While allowing the convenience of automated activation of outdoor lights, it should be used in combination with other controls to avoid obligatory "dusk to dawn" operation. All outdoor lights within Joshua Tree National Park will be fitted with a user-accessible manual override switch or other control so they may be turned off, if desired.

Motion or presence detectors mitigate light pollution and save energy by automatically activating lights when an object is detected in proximity to the detector location. While these controls are ideal in certain situations, such as security lighting, great care must be taken with the location of the sensor and adjusting its sensitivity. They should not be used near roadways where passing cars will trigger them or in areas frequented by large wild animals, such as coyotes. They also should not trigger for passing pedestrians who are not using the area needing light. Motion sensors are not maintenance-free and must be frequently checked for proper operation.

Timers provide an excellent solution to outdoor lighting control in situations with public access. Lights are often needed only in the evening hours, when the vast majority of visitors are active as compared to late night and early morning. A light curfew may be implemented using a timer. An elegant solution for some applications uses a timer combined with a dimming circuit, where after the curfew lights are dimmed to a minimal level, allowing the facility to still be seen from a distance for those seeking a telephone or information on how to obtain emergency services. Solid-state devices are available which contain an astronomical clock, eliminating the need for photo-switches.

Prescriptions

Maximum Lamp Lumens

The maximum allowable lamp output is 5,000 lumens (except for emergency lighting). In most cases, 500-1,500 lumens will be sufficient. See Table 3 below for the recommended lighting for specific areas.

Table 9. Recommended Lighting for Specific Types of Areas

Type of Area	Maximum Lamp Lumens	Recommended Light Types	Recommended Illuminated Area	Recommended Duty Cycle
Pedestrian Walkways	1,000	Low voltage LED guidance lighting or very low lumen fully shielded lamps. Higher illumination steps or uneven ground.	Pathway and area immediately adjacent to path.	Timer for operation during frequently used times.
Building Egress Points (Public and Staff Buildings)	1,500	CFL 500-1500 lumens. Forward throw fully shielded fixture.	Egress point and surrounding approach. Transition from lit to dark area should be gradual reduction in illumination with no hard shadows.	All night operation at critical safety, frequently used, and visitor contact points. Motion sensors or user accessible switches for other tasks.
Parking Lots	5,000	Not generally recommended. If required, light with LPS or HPS lamps of 3500-5000 lumens (depending on pole height).	Portion of parking lot used at night.	Switched with timers to prevent all-night operation.
Safety and Work Areas (Loading Dock, etc.)	5,000	CFL of 1200-3000 lumens for most applications. Fully shielded lights.	Only immediate work area.	User controlled switches or power-interrupt sensor.

*__Note__: see Table 4 – Lamp Characteristic below for conversion to Watts.

Lamp Selections

The standard lamp shall be a cold-start compact fluorescent lamp (CFL), ideal for its high energy efficiency and range of wattages. These should produce less disruption to the nocturnal species and human experience of the night than a 70-watt High Pressure Sodium (HPS) lamp, provided the CFL lamps are 26 watts or less. Incandescent lamps may be used with motion sensor lights. Lighting requiring more than 2,000 lumens should use HPS lighting.

Lamp Characteristics

Lamp types should be carefully chosen. Proper lumen output, efficiency, color temperature, and spectral characteristics should be key elements in the decision. Other factors to consider should be lamp life, lamp available and cost, aesthetics, and appropriateness. The lamp color should be very warm, warm, or warm white (1,000K, 2,700K, and 3,000K respectively). Avoid purchasing clear colored lamps and pay attention to the color temperature.

The following are allowed under these guidelines when specifically permitted (see Table 4).

Table 10. Typical lamp characteristics

Lamp	Watts	Lumens (initial output)	Lumens/watt (efficiency)	Lifetime (hours)	Color Rendering	Correlated Color Temperature
A-Lamp Incandescent	40	500	12	1,000	100	2,800
	60	850	15	1,000	100	2,800
	100	1,600	16	1,000	100	2,800
Compact Fluorescent	7	400	57	10,000	85	2,700
	13	775	60	10,000	85	2,700
	23	1,400	60	10,000	85	2,700
	26	1,650	65	10,000	85	2,700
	42	2,800	65	10,000	85	2,700
Metal Halide	39	2,800	72	6,000	85	3,000
	50	3,700	75	6,000	85	3,000
	100	7,500	75	6,000	85	3,000
	150	10,500	70	6,000	85	3,000
High Pressure Sodium	35	2,200	50	24,000	40	2,000
	50	3,700	60	24,000	40	2,000
	70	6,200	75	24,000	40	2,000
	100	8,000	80	24,000	40	2,000
	150	14,500	85	24,000	40	2,000
Low Pressure Sodium	18	3,800	150	18,000	0	1,700
	35	6,800	150	18,000	0	1,700
	90	15,300	150	18,000	0	1,700

*__Note__: high color rendering combined with total brightness typically results in higher impact to nocturnal environment.

Decorative Lighting

Decorative lighting is here defined as any light that uses an unshielded fixture (such as globes, lanterns, or bare bulbs). That is, the fixture itself is intended to be attractive or an enhancement to the visual scene. Decorative lighting is strongly discouraged. If decorative lighting must be used the illuminating lamp used within the fixture must not exceed 250 lumens. The use of yellow light or warm (incandescent) lamp is strongly encouraged, and the lights must use intelligent controls (not be on dusk to dawn by default).

Security Lighting

Light may be used as a deterrent to crime, either burglary or violent attacks on people, but its use in a park setting should include a presence detection system (motion sensor or other device) to activate the lights. The concept of deterrence is primarily based upon illumination of the area that is sufficient for the perpetrator to be identified by a witness or seen by law enforcement personnel or surveillance cameras from a distance. Research has shown that about 10 lux of vertical illumination is required for most people to be able to recognize another person's face, though it is not clear that simple recognition allows identification of true hazards. But 10 lux is an enormous amount of light in the dark surroundings of Joshua Tree National Park. One lux is equal to one lumen per square meter, and takes into account the area over which lumens are spread.

The installation of dusk-to-dawn light to achieve 10 lux of vertical illumination in an area such as at Pinto Wye or the Lost Horse Ranger Station would bring about an unacceptable impact to the natural lightscape surrounding the facility. Lower intensity pathway lighting and/or building illumination may be installed to maintain hazard identification. If necessary, brighter "security lights" could be installed if triggered by a motion sensor. These lights should be on a timer to provide automatic activation after the facility is normally closed. They should always include a user-accessible manual switch. Ideally, an alarm, camera surveillance system, and/or night patrol guard should accompany such lighting systems.

Other Situations

Sign Lighting

Internally illuminated signs should be light lettering on a dark background and should not be lit after the related facility has ceased operation for the night. Externally illuminated signs should be lit from the top downward with fully shielded or partially shielded fixtures and should use the minimum amount of light necessary. No specific guidelines are established in this interim guideline, however it is recommended that sign lighting only be employed where it is clearly necessary and that luminance be limited to approximately 1,000 lumens or less per side per modest size sign, depending on viewing distance and ambient light level.

Flag Lighting

The preferred practice for staffed federal facilities is to raise and lower the American flag daily at staffed federal facilities. There are only a handful of federal sites where flags are intended to fly all night, such as the Tomb of the Unknown Soldier. There is a growing misconception that flags should be up all night and should be lit. At active federal sites there is little excuse to not honor the flag daily by its raising and lowing. The Patriot Act of 1976 requires nighttime flags to be lit, but does not in any way indicate patriotic preference for leaving the flag up during darkness. Recently some top-down lighting solutions for flags have come to market. This will allow full compliance of flat lighting if there is such a need.

Spill of Interior Lights through Windows

In Zone 1 areas such as campgrounds, interior lights must be evaluated for light trespass if bright light escapes through windows or open doors. Interior lighting levels are particularly incompatible with outdoor nighttime vision, and when illuminated interior spaces are visible from outdoors visibility can be compromised and impacts on the nighttime environments severe. These situations must be mitigated with proper shielding of the interior fixtures, minimal interior illumination levels, and where appropriate window coverings. It is recommended that the visitor centers at Black Rock, Indian Cove, and Cottonwood run in total darkness at nighttime. If necessary, security lighting that is triggered by motion could be utilized.

Exempt lighting

1) Where OSHA states that specific lighting levels are necessary for work situations these are considered exempt from the Lighting Management Plan. However, although the lighting levels for the actual work environment must meet OSHA requirements all measures outlined in this document must be taken to exercise best energy practices and shield the light from the surrounding environment.
2) Emergency lighting is exempt from these controls provided it is not used for routine maintenance or scheduled functions. Typically, emergency lighting is used once a year or less and is necessary for human safety in emergency or unforeseen circumstances.
3) Traffic safety warning lights and speed indicators are NOT automatically exempt but should be considered on a case by case basis.
4) Holiday lighting is exempt, provided it is only in operation during the holiday period.