UCSD OUTDOOR LIGHTING DESIGN GUIDELINES

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INTRODUCTION

This report presents the Campus Lighting Guidelines for The University of California, San Diego (UCSD). The purpose of this report is to provide a unified lighting system or "language" for architects, engineers and campus facility planners who are developing and evaluating current or future lighting projects, as well as ongoing lighting improvements. The Guidelines combine the UCSD Outdoor Lighting Policy with other primary lighting design objectives to assist in transforming the existing collection of confusing and haphazard lighting fixture patterns to a clear and consistently high-quality luminous environment.

The main objective of the UCSD Outdoor Lighting Policy is to minimize interference with local astronomy by controlling light pollution or “sky glow.” While controlling light pollution has become a primary focus of the campus lighting effort, it must be addressed in conjunction with several other important objectives, such as creating a safe and pleasurable environment that meets the needs of its users. This report is based on the conviction that minimum acceptable levels of light pollution can be achieved without compromising the quality of the campus environment. In fact, given the current lack of consistency of existing road, path and place lighting, new and retrofit lighting designs executed in accordance with these Guidelines should easily increase the clarity, safety and pleasure of the campus experience and reduce light pollution as well.

The Guidelines are not intended to restrict designers – on the contrary – the goal is to provide opportunities for creativity by working with a set of clearly defined objectives and applying fundamental principles of exterior lighting design. Over time there should emerge a campus-wide lighting scheme that speaks the same language, with all of the rich and desirable variation that can be expressed within one language.

Therefore, this report begins with a summary of the objectives that all exterior lighting projects should satisfy. The objectives are followed by a brief review of the fundamental principal of perception and outdoor lighting design to assist designers in better understanding the means to achieve the objectives.

The guidelines follow review of principles and are presented as recommendations, with emphasis on the design vocabulary of lighting to distinguish the hierarchies of roadways, paths and places. Illustrations and a map accompany the Guidelines to illustrate the lighting principles and concepts discussed throughout the report.
OBJECTIVES

I. FUNDAMENTAL OBJECTIVES:

The authors strongly believe that the lighting for any campus should be designed to achieve several fundamental and intimately interrelated objectives:

A. By day and by night, the physical design of the campus should maximize the safety, security, convenience and pleasure of all who use it – students, faculty, employees, visitors, drivers and pedestrians, bicyclist and the disabled alike.

B. By day and by night, the design of the campus should create in the minds of those who use it the image that it is a good place to study and live, an essentially pedestrian community which still allows convenience access to the automobile, a civilized community with attractive natural and built environments designed to meet the needs of the people who use them.

II. SPECIAL OBJECTIVES:

In certain urban settings, special natural or man-made features may produce unique requirements that are adopted as special objectives. Such is the case with UCSD. The San Diego County regulations regarding control of light pollution for Astronomy prompted UCSD to develop its own Outdoor Lighting Policy with the same special objective. Therefore, the reduction of light pollution to minimum acceptable levels has become a special objective for Outdoor Lighting Design Guidelines for this campus.

III. IMPORTANT PRACTICAL OBJECTIVES:

The cost of labor, energy and materials are important factors in any large lighting installation. Practical objectives must include initial cost, energy-efficiency/operating costs, life-cycle costs and maintenance costs.

A summary of objectives for campus Outdoor Lighting Design Guidelines is as follows:

A. To reduce light pollution to minimum acceptable levels thus avoiding interference with local Astronomy, in keeping with the UCSD Outdoor Lighting Policy.

B. To use lighting to optimize:
   1. Safety: Sufficient light levels for safe navigation.
   2. Security: Eliminate conditions that create the perception of fear.
   3. Convenience: Satisfy practical needs of all users.
   4. Pleasure: - Reinforce campus image both day and night.
      - Create a clear and positive identity of UCSD.
- Express individual neighborhoods and institutes.
- Encourage-concentrate pedestrian activities at designated nodes to maximize a sense of community and also maximize security.

C. To create an energy-efficient design, using appropriate light sources properly focused and appropriate light levels for desired tasks and effects.

D. To create a cost-effective design.

E. To employ well-built fixtures whose mountings and locations will promote ongoing ease of maintenance and thus ensure their continued use over the years.

F. To employ lighting controls which are durable, properly engineered and located to ensure ease of maintenance.

G. To employ fixtures that minimize glare at night and which have either an attractive or an unobtrusive appearance both daytime and nighttime.

H. To use standard, off the shelf equipment as much as possible – but to create new “standard” fixtures when necessary for best performance – not merely aesthetic preference.

NOTE:
The terms “clarity” and “hierarchy” are used throughout the Guidelines and are key words in understanding the process of visual perception; i.e., what people see and how that may, or may not, translate into meaningful information. A successful lighting design acknowledges the basic principles of visual perception and employs techniques described herein to create a pleasing luminous environment. The next section is a summary of relevant perception principles and the techniques, or means, to achieve the campus lighting objectives.

In this context the term clarity means being able to see desired information – the entrance to a parking lot, entrance to a building, direction of a path, location of a bus shelter, etc. – in an effortless manner.

The use of hierarchy in this report means prioritizing or ranking the desired information in order of visual importance so that people can make decisions in good time and with maximum safety.
SUMMARY OF LIGHTING PRINCIPLES

I. PRINCIPLES OF VISUAL COMMUNICATION

There is a simple, rational basis for good campus design. The principles underlying the design of good and appropriate campus lighting systems can be derived directly from consideration of the various forms of verbal and nonverbal information required by the users of the campus to perform their tasks accurately, safely, and with convenience and enjoyment. Simply summarized, streets and paths should be designed to minimize “visual noise” (confusing, distracting, unpleasant or inappropriate visual information) and to maximize useful, positive, and pleasurable visual signals that contribute to safety and security, provide positive orientation to location and optical guidance for movement.

Designs that maximize visual signals show evidence that the environment is responsive to the needs of the user and that the Campus cares enough about its users to provide for their enjoyment as well as for their safety, security, and convenience. Among these positive signals are those that clarify the layout of the Campus, define the hierarchy of its streets and paths, emphasize the nature and location of its special neighborhoods and landmarks, and manifest concern on the part of students for the quality of their environment.

II. MEANS OF ACHIEVING OBJECTIVES

A. Safety

1. Adequate illumination for safe pedestrian, bicycle or vehicular navigation to avoid accidents, potholes, collisions, etc.
2. No glare to impair vision and compete with desired visual signals.
3. Lighting should provide optical guidance:
   a. Day (light standards, or poles) and night
   b. Configuration of walks, bike paths, roads and intersections
4. Pattern of lights to provide above information clearly:
   a. Spacing between fixtures
   b. Height of fixtures
   c. Light distribution
   d. Appearance of luminaries:
      • Cut-off (baffled light source)
      • Non-cutoff (visible light source)
      • Semi cut-off (baffled light source with glowing lens or reflector)
   e. Surfaces illuminated: ground, trees, walls, sculpture, etc.
      • Color of light source
5. Other design features for increased clarity:
   a. Pole – color and shape and material differential.
   b. Luminaire – color and shape
c. Accessories (signs, planters, etc.)

6. Lighting for (of) signage to avoid accidents caused by getting lost or confused.
   a. Distant view for drivers-roadway, etc.
   b. Close range view for pedestrian paths, plazas
   c. Well-lit with proper color rendering where critical

B. Security – lighting alone cannot produce security…only perception of security.
   1. Illuminate potential sources of attack near pathways eliminating shadows at walls, bushes, etc.
   2. Light vertical surfaces, not horizontal surfaces to brighten objects in the field of vision to create the perception of well lit, secure spaces:
      a. walls
      b. trees
   3. Enhance selected paths and places to attract maximum number of people for common protection. Concentrating the traffic on primary paths and encouraging activities there also reduces fear of attack and the actual danger more than increased light level alone.
   4. Discourage low traffic unpoliced paths and areas; do not light and/or block off at night, thus avoiding an invitation to use unpoliced paths and areas, and reducing needless pollution.
   5. Shorten perceived distances to refuge: by clear identification of arrival points, and highlighting events and landmarks en route.
   6. Emphasize and delineate destinations and events, in accordance with the Outdoor Lighting Policy:
      a. Nodes
      b. Intersections
      c. Entrances
      d. Bus shelters, telephones, cash card areas
      e. Landmarks: man-made and natural – special building, specimen trees, sculpture, gateways, etc.

C. Convenience – lighting that satisfies the needs of people:
   1. Information: signs, maps.
   2. Places to: rest/relax, read, eat, study, meet, talk, entertain, telephone, bank, vending, bus shelter (wait)
   3. Satisfying convenience needs will result in people traffic = security and pleasure.

D. Pleasure results when the objectives of safety, security, and convenience are achieved very well.
   1. Minimum of visual noise – no glare or visual clutter.
   2. Maximum of signal:
      a. Hierarchy of paths and spaces provides variety and interest. Clear and positive character of UCSD neighborhoods. This results in a
more interesting and varied environment and is a source of identity and pride for students, faculty and staff.

b. When building illumination is useful to safety-security:
   • Highlight unique and distinct features in a manner that articulates those features. Doing so will distinguish the unique character of the various neighborhoods. Pick the most memorable feature for after-hours illumination.
     (1) Building shapes, materials, textures, construction method.
     (2) Transparency of buildings (i.e., highlighted interior walls or ceilings).
   • Integrate lighting with the design of
     (1) Arcades, trellises.
     (2) Entrances
   • Integrate lighting with structures and as part of identifying graphics of:
     (1) Kiosks and marquees to create meeting points at residence courts and to define performance centers and plazas.
     (2) Bus shelters and vending areas to be attractive gathering points as well as functional.
   • Lighted landscape features are carefully selected for information value.
     (1) Specimen trees for orientation.
     (2) Trees that frame vistas.
     (3) Fountains (if permitted by water restrictions)
     (4) Special walls for orientation – optical guidance
   • Artwork important for orientation, attracting congregation (lit with permission of artists and Stuart Collection sculptors).
   • Signs should be well designed and illuminated.
   • Pedestrian activities are encouraged, illuminated, frames.

III. LIGHT POLLUTION

Minimizing Interference with Astronomy:

Any light directed into the sky will add to sky glow. In order to protect astronomical observations the effective sky glow can be minimized by use of selective filters at the telescope. Filtering is most effective when the light source is monochromatic with a very narrow band of wavelengths.

A. Light Distribution
   Achievement of the outlined lighting objectives most efficiently goes a long way towards minimizing light pollution. Efficiency is the result when fixtures are properly focused; when almost all of the light is “on the target” (illuminating those surfaces one wants to see --building and landscape
features, artwork and activities) it is not “into the sky”. Re-radiation of light into the sky from matt finished vertical surfaces such as walls is far less than from horizontal surfaces, (i.e., the pavement) of equal reflectance. Less than 50% of indirect illumination from matt vertical surfaces is directed above horizontal.

Indirect illumination of the sky from both vertical and horizontal surfaces is much reduced in courtyards and narrow streets where much of the light is intercepted by enclosing walls and trees. See illustration #3.

Unshielded or unfocussed non-LPS light for graphics and orientation after hours should be limited to low output incandescent decorative lamps or neon, etc.

B. Light Source Color
The following is a description of various light sources and their pros and cons:

1. Low Pressure Sodium (LPS) – pure yellow light

   PROS:
   a. Due to monochromatic spectral distribution, it is most easy to filter at the telescope.
   b. The most efficient artificial light source for energy conservation.

   CONS:
   a. Poor color rendering is bad for people and perception.
   b. Because of poor color, rendering surfaces by LPS appears less bright than a similar measured level of white light.
   c. Elongated shape of lamps makes good optical control difficult and fixtures much larger than with HID sources.

   RESULT:
   a. Relatively inefficient in illuminating specific areas – most luminaries presently available deliver almost equal light on the “house side” as the road side.
   b. Because LPS lamps are big, they are quite visible even in shielded fixtures, though not as bright as other more compact sources.

NOTE: As a general rule, these Guidelines do not advocate the design of custom fixtures that will be substantially more expensive that standard products for the sake of improved optics or aesthetics. At the same time, designers and engineers should consider exploring new LPS product development. For projects with reasonable fixture quantity (determined by the manufacturer) new or improved products
can often be developed without significant cost increase. For example, using multiple small LPS fixture optics and reduce the fixture length.

2. High Pressure Sodium (HPS) – yellow-white light

**PROS:**
- Color rendering is slightly better than LPS
- Long lamp life
- More efficient than white light sources of similar wattages

**CONS:**
- Although still quite yellow in appearance this source contains enough white light to make astronomical filtering only slightly effective

**RESULT:**
- Even though color rendering is slightly better than LPS, it is not enough of an improvement to make it close to white sources when color rendering is important. It is not recommended for Roadway, Parking, or Path Lighting. HPS may have limited application for landscape and building illumination where maintenance is more important than color rendering.

3. White light source (non LPS): incandescent, fluorescent, metal halide

**PROS:**
- These sources are much better for people and perception
- Compactness of metal halide and incandescent sources are the most efficient for accurate light control for highlighting.
- Incandescent and compact fluorescent sources usually best for integration with structure – trellises, bus shelters and decorative light patterns, etc., where many low intensity sources are desirable for pattern rather than illumination.
- Metal halide is best high intensity source with good color rendering and optical control for sports facilities.

**CONS:**
- Full spectral distribution is impossible for astronomers to filter selectively.
- Typical incandescent sources have short lamp life and may require transformers on circuits (or similar) to extend lamp life.
- Lower wattage fluorescent and metal halide lamps have a shorter lamp life than equivalent HPS lamps.

**RESULT:**
- Should be no limit for use of these sources before the designated
cut-off hour (D.C.H.)*

b. Limit use of white light after the D.C.H. to focus light on a few key student activity areas, campus landmarks and critical signage (as determined by the offices of Facilities Design & Construction and Campus Planning, for example.) The intent is to use white light after the D.C.H. where color rendering and orientation is important, in accordance with the Outdoor Lighting Policy.

* Designated cut-off hour (D.C.H.) shall be as determined in the Campus Outdoor Lighting Policy.
RECOMMENDATIONS

I. FOLLOW 1993 UCSD OUTDOOR LIGHTING POLICY REGARDING LIGHT POLLUTION

II. WORK WITHIN THE FOLLOWING DESIGN VOCABULARY:

A. Roadway Hierarchy – LPS Lighting Only

1. The intent is to make clear by day and night the different types of auto circulation around and through the campus. This hierarchy can be achieved by varying the fixture pattern and the fixture hardware (appearance of the fixture.)

2. Auto Circulation Hierarchy
   a. Perimeter Road – public (city) road defining boundary of campus.
   b. Entry boulevard – ceremonial arrival connecting Perimeter Road to Loop Road
   c. Loop Road – main campus road that connects all neighborhoods
   d. Collector roads – other spines
   e. Service roads – dead-end access roads to buildings. See illustrations #4 and #5.

3. Suggested Auto Circulation Vocabulary
   a. Perimeter Road

   • Remarks:
     The Perimeter Road consists of public roads that define the boundaries of the campus. While not directly pertinent to these Design Guidelines, the Perimeter Road has been included in this discussion to help illustrate the concept of fixture hierarchy. The existing roadway LPS fixtures are widely spaced with no apparent relationship to the campus entries. While no additional illumination is required on this road, positive steps are suggested to reinforce the campus image and clarify the neighborhood entry points. This may be achieved by adding metal signage, consistent with the campus signage system, or color to the existing light poles and adding new light poles where necessary so that all entry roads are bracketed in a similar manner. See illustration #6 for concept.

     If the opportunity occurs in the future, UCSD should try to influence the lighting design of the perimeter roads to enhance the campus definition and image.

   • Pattern of light (existing):
- Location: Campus side of streets
- Height: 30’+ (verify)
- Spacing: sparse (existing)
- Light distribution: cut-off type
- Source: LPS, 180 watts

- **Design features:**
  - Pole style & color: 5” (minimum), square, straight, steel, black color
  - Luminaire style & color: arm-mount, black

b. **Entry Boulevard**

- **Remarks:**
  These are the ceremonial entries of the Campus that connect the Perimeter Road with the Loop Road. Some of the features used to reinforce the ceremonial effect are landscaped median strips, flagpoles and information stations. To support this boulevard quality, lighting should be installed on both sides of the street (in opposite pairs, not staggered.) See illustration #7 for concept. In accordance with UCSD signage system, neighborhood entry signs should occur at the beginning of each entry boulevard for orientation.

- **Pattern of light:**
  - Location: both sides of road
  - Height: 30’ (intent is to match loop road height)
  - Spacing: set corners and intersections, and adjust spacing in between at approximately 90-100’ o.c.
  - Light distribution: cut-off
  - Source: LPS, 180 watts or 2 x 90 watts

- **Design features:**
  - Pole style/color: square, straight, steel, black (match perimeter or campus standard)
  - Luminaire style/color: arm-mount/black

c. **Loop Road**

- **Remarks:**
  The Loop Road should be consistent along its length to give order and clarity as it winds past the distinctly different neighborhoods. The fact that the vegetation along the Loop Road also varies makes the need for a consistent and conspicuous lighting pattern even more important. At present the Loop Road is a confusing collection of fixture types and spacing patterns. At various locations the road is lit from one side, two sides, a staggered pattern and from adjacent parking lots. The fixture types range from arm-mount cut-off type to post-top globes with refractors. See illustrations #8a
and #8b (existing conditions.)

It is recommended that the Loop Road should have light fixtures only on one side – the Campus or “inboard” side. This allows the entry boulevard intersections to be more clearly marked because there is no continuous lighting on that side. A special graphic element or colored pole and fixture are suggested to clearly identify the Loop Road from collector roads. See illustration #9 for concept.

Bus stops could occur on either side of the Loop Road. Bus shelters and entries to neighborhoods should be clearly marked by graphics and/or additional lighting.

- Pattern of light:
  - Location: inboard side of road only
  - Height: 30'
  - Spacing set corners and intersections and adjust spacing in between at approximately 120 - 150' (verify foot-candle requirements)
  - Light distribution cut-off
  - Source LPS, 180 watts or 2 x 90 watts

- Design features:
  - Pole style & color: square, straight, steel, black to match existing
  - Luminaire style & color: arm-mount, black

d. Collector Road

- Remarks:
  There are a few roads that convey vehicular traffic to service roads and connect to the Loop Road around the edges of the neighborhoods. For purposes of the Design Guidelines, these are called Collector Roads. They should be scaled down in importance to differentiate them from the visual clarity of the Loop Road. See illustration #10.

- Pattern of light:
  - Location: one side of street
  - Height: 25'
  - Spacing Approximately 100’ - 125’ (verify foot-candle requirements)
  - Light distribution cut-off
  - Source LPS, 135 watts or 2 x 55 watts

- Design features:
  - Pole style & color: 5” (minimum), square, straight,
Service Road

Remarks:
Service roads are typically dead-end drives that provide service access to various campus buildings. They may be used for student drop-off, deliveries, campus service vehicles and trash collection. The intent is to provide adequate light levels as unobtrusively as possible. See illustration #10.

- Pattern of light:
  - Location: one side of street
  - Height: 20'
  - Spacing: Approximately 90' - 100' (verify foot-candle requirements)
  - Light distribution: cut-off
  - Source: LPS, 90 watts, 55 watts, or $2 \times 35$ watts

- Design features:
  - Pole style & color: square, black
  - Luminaire style & color: arm-mount, black, as appropriate

f. Intersections

Given the hierarchy of roads and paths on this campus, the range of possible intersections is considerable. The lighting, graphic and landscape treatment or lack thereof at certain intersections can mean the difference between optical guidance and confusion, safety and mishap.

Since intersections are the places where people seek information for orientation, they should impart the most important visual signals. Spacing of all light fixtures should begin by establishing the proper bracketing relationship at intersections. Then spacing between intersections can be adjusted according to standard fixture height-to-spacing ratios (typically 1:5, 1:6, etc.) and coordination with trees, bus shelters, building entries, plazas, parking meters, bicycle parking, etc.

Intersections are the crucial links in the pattern of light fixtures. The various auto-to-auto, auto-to-pedestrian, bicycle-to-bicycle-to-pedestrian, pedestrian-to-place conditions should be studied to determine which pattern should dominate or be interrupted by the character of another.

For example, a major or minor pedestrian path crossing any road (except service road) is a critical safety condition. The pedestrian cross-walk should be clearly visible by a change in paving pattern
and visible light sources bracketing the path at either side of the road. (In lieu of or in addition to proper visual signals, many campuses resort to vehicular speed-bumps before cross-walks as an added precaution.)

On the other hand, the intersection of a service road with the Loop Road is of minor significance. While the service road should have a fixture at the intersection (with signage, if appropriate) to mark its location, the character of the Loop Road should remain unbroken. See illustration #11.

g. Parking Areas
The lighting patterns in parking areas should be clearly differentiated from those of the adjacent roads and paths.

While a small parking area or the edge of a large lot may be illuminated with spill lighting from adjacent roadway lighting (so long as minimum illumination – foot candle – levels are met), the continuity of roadway lighting should never be interrupted by illuminating sections of a road with borrowed light from an adjacent parking area (as is currently being done.)

When the edge of the parking lot is close to an illuminated roadway or major path, keep the parking lost lighting poles away from the edge to avoid clutter and confusion. Parking related fixtures along the road should be limited to those defining entrances.

Fixtures not located along the edges of parking lots are best with neutral non-directional shapes. They should appear very different than that used along the roadways to minimize visual noise/confusion.

If a simple, well-organized pattern seems not to be possible, it is likely that the parking arrangement itself is the cause. A well-organized parking pattern with clear circulation pattern should allow a correspondingly well-organized lighting pattern. See illustrations #12 and #13.

B. Path Hierarchy – Low Pressure Sodium, With Exceptions Per Outdoor Lighting Policy

1. Intent is to make clear the different paths by day and night by varying the fixture pattern and hardware. In addition, pedestrian path fixtures should be distinguished from vehicular-oriented fixtures for optical guidance. On the most general level, this is accomplished by making
The path fixture hierarchy should be kept as simple as possible. Only two levels of paths are proposed: Primary paths and secondary paths. Primary paths are the inter-college arteries that carry most of the pedestrian traffic and link major buildings and plazas. Secondary paths are college neighborhood paths that connect buildings, nodes and parking areas, etc. The UCSD 2003 Long Range Development Plan references the major pedestrian walk (figure 9) that shall be used to define the “primary” paths for these guidelines. All other paths should be considered as secondary.

To clearly distinguish the primary paths from the secondary paths, the primary path fixtures should contain a visual light source component. The secondary path fixtures should be cut-off type and remain neutral (or black). By incorporating a visible light component on the primary path fixtures, they provide optical guidance through the Campus and encourage heavier use. This concentration of traffic on the primary paths at night increases the sense of security felt by the campus population. See attached illustration #14 for preliminary path hierarchy diagram.

2. Suggested Path Vocabulary
   a. Primary Path
      • Remarks:
        The visible component of the primary path fixtures may be achieved in a variety of ways and presents opportunities for fixtures to take on unique qualities as they pass through different neighborhoods.

        Examples of visible component options for primary path fixtures:
        - Lantern-like fixture with refractor and LPS lamp (traditional or contemporary)
        - Partly shielded LPS fixture with prismatic lens
        - Shielded fixture with dropped, glowing lens
        - Shielded fixture with glow-top component
        - Shielded fixture with neon band on outside
        - Shielded fixture with decorative incandescent bulbs in dropped lens

        Primary paths may have fixtures on one side or both sides, depending on the path width. Staggered patterns are not recommended because they confuse the optical guidance. While the intent is to make these fixture designs straightforward and cost effective, greater attention to detail is
required than for the secondary path fixtures. Also integration with the approved campus signage system should be carefully considered.

As an optional requirement, it is suggested that all primary (and secondary) path LPS fixtures that pass through or are directly adjacent to the eucalyptus grove have an uplight lens to spill light onto the tree canopies and enhance this unique natural feature of the campus. See illustrations #15a & #15b.

When primary paths cross key intersections and arrive at or border a plaza, node, special area or a special building, the fixture designs may be developed to take on special characteristics.

Some examples of modified path fixtures at nodes are:
- Where a primary path crosses a node, the single post fixture may become a double post fixture to hold a campus map, bulletin board, trash receptacle or other useful component. In accordance with the Outdoor Lighting Policy, optional building façade floods (possibly non-LPS under automatic controls) may be incorporated into the fixture housing. See Illustration #16.
- Where a primary path passes directly in front of a building entrance, the fixtures may become wall-bracket-lanterns. See Illustration #17.
- At plazas, special gathering places and landmarks, the primary path fixtures may give way to a unique lighting assembly more appropriate to the scale and function of the place. See Illustrations #18a & #18b.

The section on Places Hierarchy continues this discussion of fixture configurations as a response to different campus conditions.

- Pattern of light (for new and redeveloped primary paths):
  - Location: narrow path – 1 sided
  - Wide path – 2 sided
  - Height: approximately 15’+
  - Spacing: intersections properly defined, then spaced accordingly at approx. 1.5 or 1.6 (75-90’)
  - Light distribution: shielded and/or non-shielded light component
  - Sources: LPS, with optional non-LPS component (if allowed by the Outdoor Lighting Policy) on automatic controls, 70 or
2x35 watt

- Design Features:
  - Pole style and color: should be consistent along entire path
  - Luminaire style & color: should be consistent along entire path

b. Secondary Path

- Remarks:
  As typical pathways that connect buildings and weave through the neighborhoods secondary paths should be well lit without competing visually with the primary path system or illuminated landmarks for orientation. These fixtures should be simple, cost efficient fixtures with shielded LPS lamps. Poles and luminaire style and material should be black.

- Pattern of light:
  - Location: single-sided, avoid staggered patterns
  - Height: approximately 15’
  - Spacing: intersections properly defined, then spaced accordingly at 1:5 or 1:6
  - Light distribution: cut-off
  - Sources: 90Watt, 55 watt or 35 watt LPS

- Design Features:
  - Pole style & color: black
  - Luminaire style & color: black

C. Places Hierarchy – Low Pressure Sodium and White Light Sources, Per Outdoor Lighting Policy

1. Intent is to light the range of different places in a manner that enhances their unique qualities (or gives them a unique quality through new hardware if they lack special qualities), makes the place memorable, and reinforces rather than competes with adjacent road or path hierarchies. Here is where most non-LPS should be used with a very limited portion operated after the D.C.H. See illustration #19.

2. Places are locations of arrival, gathering, resting, waiting or departing.

3. Places include (but are not limited to) the following:
   a. Academic and residential plazas – “nodes”
   b. Campus entrances
   c. Neighborhood entrances
   d. Building courtyards
   e. Featured buildings, particularly buildings with heavy evening activity
f. Special landscape features, such as large specimen trees, special landscape walls adjacent to walkways

g. Bus shelters

h. Parking areas – particularly drop-off areas

4. Suggested places vocabulary

a. Academic and residential plazas, “nodes”, building courtyards:
   - Integrated lighting concepts:
     - Light important building facades
     - Light arcades
     - Light select building features, such as trellises and canopies
   - Hardware lighting concepts
     - Post-top lanterns surrounding plaza
     - Building-mount lanterns
     - Special kiosk-like lighting elements to incorporate decorative and accent lighting, etc. See illustration #19.

b. University entrances
   - Integrated lighting concepts:
     - Highlight landscape features
     - Highlight flagpoles, sculpture, entry signs, and other man-made features (possibly non-LPS)
   - Hardware lighting concepts:
     - Upwardly directed lighting shall be used on entry signs to maintain a consistency of size, shape, and texture (white light)

c. Neighborhood entrances
   - Integrated lighting concepts:
     - Light gateways and sculpture (with permission)
     - Light landmark facades
     - Light landscape features
   - Hardware lighting concepts:
     - At auto entries bracket both sides of entry road with fixtures. Use two fixtures per pole with luminaires at right angles to express neighborhood entry.
     - At pedestrian entries introduce fixture type with features unique to that campus. Fixtures may be taller and clustered for emphasis.

d. Building features
   - Integrated lighting concepts:
     - Light unique and visually pleasing elements of building
   - Hardware lighting concepts:
     - Install interesting wall-mount or post-top fixtures if building lacks unique features.
     - Install lighting feature on building to mark entries and add interest.
e. Special University approved landscape features (optional lighting):
   • White light sources permitted per Outdoor Lighting Policy restrictions:
     - Up-light one or several key specimen trees per neighborhood
     - Light one or several key planter beds per neighborhood
     - Light one or several landscape walls per neighborhood
     - Integrate lighting into benches or other site furniture where appropriate

f. Low mounted lights such as bollards and step lights should be used sparingly, only as supplementary rather than primary lighting except under special conditions. To avoid glare the light sources or lenses (refracting or diffusing) should never be visible from path directions above horizontal. Therefore, to optimize light distribution, the light sources should be placed as high as possible. Fixtures designed for very low placement tend to be glarey because they usually allow some upward distribution of light. Avoid them. See illustration #20b.

Integrate lighting into walls, planters, and large-scale bollards, etc. by shaping the openings to baffle the lamps. When this is possible, avoid merely installing recessed step light fixtures into those elements. See illustration #20a. Where manufactured recessed step lights or smaller scale bollards are dictated, fixtures that baffle the lamps with shaped openings and simple baffling are more efficient and less distracting than multiple blade louvers. Avoid bollards that are flimsy and easily damaged.

g. Bus shelters:
   Integrate lighting into structure for soft glow or install visible sources for identity.

h. Parking areas: See Parking Section.

III. LPS LUMINAIRE DESIGN

Due to the extremely poor color rendering characteristics of LPS this monochromatic light source has had very limited use in North America. Consequently the range of fixture manufacturers and styles is limited. Also, the elongated arc-tube of these lamps produces very poor optics in standard sized fixtures. Typical LPS roadway fixtures are basically a bulb in a shoebox. The higher the wattage the longer the box. Post top fixtures in lower wattages (and smaller lamps) have a bit more design flexibility and a slightly wider range of available styles.

It is possible and desirable to explore new LPS fixture designs that have improved light distribution in more attractive housings. Given reasonable fixture
quantities for a particular project; several fixture manufacturers should be interested in developing new designs at competitive pricing. This sort of new product development is strongly encouraged to push the state of the art in LPS lighting. Well-designed fixtures will likely become standard very quickly.

IV. QUANTITATIVE LIGHTING CRITERIA

A. Policy light levels vs. Illuminating Engineering Society (IES) recommended levels.

It is the intent of the Lighting Guidelines to provide sufficient light quantity and quality on roads and paths for safety and the perception of security. Quantity of light must be balanced by concern for energy consumption, cost and light pollution. As a general strategy, emphasis should be places on well-lit, clearly visible primary paths that will attract much of the nighttime pedestrian traffic and subordinate certain secondary paths to avoid creating invitations to use potentially unsafe walkways. The campus is riddled with short-cut paths – it is inconceivable to light every earthworn path on campus to achieve minimum light levels and maximum safety.

It has been the experience of the authors that the IES recommended light levels tend to be excessive. The recommendation is to use the IES levels for roadways and paths as a rule of thumb, not a mandate.

Because the monochromatic nature of LPS light is often perceived as less bright than an equal quantity of white light, certain primary paths and gathering places may intentionally exceed the IES recommendations to encourage concentration of use.

Ultimately, the facility management and designers and engineers should evaluate the light quantity and quality on existing LPS walkways to make informed decisions about projected lighting design.

B. For each project, lighting design compliance with Title 24 Energy Code needs further study before final recommendations can be made.
LIST OF ILLUSTRATIONS

1. Fixture placement for optical guidance.
2. Lighting landmarks for orientation.
3. Principle: Up-light intersected by walls may result in less light pollution than a fully shielded fixture.
5. Roadway LPS fixture vocabulary/proposed compact shapes.
6. Perimeter road lighting concept and entry bracketing.
7. Entry boulevard lighting concept.
8a. Loop Road – existing daytime conditions.
8b. Loop Road – existing nighttime conditions.
9. Loop Road lighting concept.
10. Collector road and service road lighting concept.
11. Intersection diagrams for visual signals.
12. Parking lot/roadway lighting diagram.
13. Parking lot lighting diagrams.
14. Proposed primary path with LPS fixtures (for concept only).
15a. Pedestrian paths – lantern style.
15b. Pedestrian paths – shielded (cut-off) style.
16. Primary path at nodes.
17. Lighting of walls adds brightness.
18a. Special feature at performance area – Concept A.
18b. Special feature at performance area – Concept B.
19. Façade and special feature at plazas.
20a. Integrate lighting with walls, planting, benches.
20b. Bollards, steplights.
21. Light pollution from building should be limited
22. Avoid signage with bright background.
23. Proper signage.
24. Neon lighting for landmark and interest.
25. Lighting for orientation – sculpture and bus stop examples.
26. Lighting should highlight architectural features – trellises.
27. Proper landscape lighting.
28. Shuttle stops.
29. Recreation areas.
FIXTURE PLACEMENT FOR OPTICAL GUIDANCE

STAGGERED PATTERN CAUSES CONFUSION

FIXTURE PATTERN ON ONE SIDE CLEARLY DEFINES ROAD/PATH

(NTS)
LIGHTING LANDMARKS FOR ORIENTATION
ROADWAY LPS FIXTURE VOCABULARY
CONVENTIONAL SHAPES (NTS)
Fixtures on one side only – preferred solution

Note:
Driveway fixture in foreground confuses pattern and should be moved

Post-top roadway fixture not recommended

Staggered lighting pattern – not recommended

Road lit from adjacent parking lot fixtures – no optical guidance

LOOP ROAD – EXISTING DAYTIME CONDITIONS
Fixtures on one side only – Preferred solution

Note – Driveway fixture in foreground confuses pattern and should be moved

Staggered lighting pattern – not recommended

Road lit from adjacent parking lot fixtures – no optical guidance

LOOP ROAD – EXISTING NIGHTTIME CONDITIONS
INTERSECTION DIAGRAMS FOR VISUAL SIGNALS (NTS)
IF WALKWAY OCCURS HERE, THE PEDESTRIAN FIXTURES MAY BE SUFFICIENT TO LIGHT THIS HALF OF THE PARKING LOT.

DO NOT PLACE PARKING FIXTURES HERE.
TALL PARKING LOT FIXTURES AT THIS SIDE ONLY.

LOOP ROAD

AT NARROW PARKING LOTS, SPILL LIGHT FROM ADJACENT ROADWAY. LIGHTING CAN LIGHT PORTION OF PARKING LOT, BUT NOT VICE VERSA. INTENT IS TO MAINTAIN CLARITY OF ROADWAY LIGHTING PATTERN FOR OPTICAL GUIDENCE.

PARKING LOT/ROADWAY LIGHTING DIAGRAM
(FOR CONCEPT ONLY)
PARKING LOT FIXTURES CLUSTERED ON TALL POLES (35' ±) IN MEDIAN STRIPS, TYP.

AT LARGE PARKING LOTS CLUSTER FIXTURES ON TALL POLES WHEREVER POSSIBLE SO PATTERN OF FIXTURES LOOKS DISTINCTLY DIFFERENT AND DOES NOT COMPETE WITH ROADWAY FIXTURES.

PARKING LOT/ROADWAY LIGHTING DIAGRAM
(FOR CONCEPT ONLY)
PEDESTRIAN PATHS—STANDARD RECTANGULAR CUT-OFF STYLE

SECONDARY PATH (NEUTRAL)

TYPICAL

AT BUILDINGS AND INTERSECTIONS, ETC.

PRIMARY PATH OPTIONS
(INCREASED VISIBLE COMPONENT)

UPLIGHT LENS OPTION FOR TREES, WHERE ADJACENT.

DARK POLE FINISH

LIGHT POLE FINISH

LPS
NOTE: THESE FIXTURES SHOWN FOR CONCEPT ONLY—NOT FOR STYLE.

2x4A 35W
@ 12.2"

UPLIGHT LENS OPTION ON ALL PRIMARY FIXTURES, MAY BE COVERED WHERE NO TREES ADJACENT.

L.P.S. FIXTURE

REFRACTING GLASS PANEL OPTION FOR INCREASED VISIBLE COMPONENT.

DOUBLE-YOKE OPTION FOR INCREASED VISIBLE COMPONENT.

15'-0"

DARK POLE ON SECONDARY PATHS

LIGHT POLE FINISH ON PRIMARY PATHS FOR INCREASED VISIBLE COMPONENT.

SECONDARY PATH

PRIMARY PATH OPTIONS

PEDESTRIAN PATHS—COMPACT, CUT-OFF STYLE
NOTE: THESE FIXTURES SHOWN FOR CONCEPT ONLY—NOT FOR STYLE.

2XNA 55W
@ 16.7"

SIGN BELOW

L.P.S. FIXTURE

DOUBLE-YOKE OPTION.

UPLIGHT LENS
OPTION IF TREES
ADJACENT.

PRISMATIC GLASS
PANELS OPTION.

OPEN

15'-0"

10'-0"

TRASH RECEPTE.

PRIMARY PATH AT NODES
BUILDING ENTRANCE

NOTE: LANTERNS SHOWN FOR CONCEPT ONLY—NOT FOR STYLE.

LIGHTING OF WALLS ADDS BRIGHTNESS
2XNA 90W
@ 20.8"

SIGN PANEL
BELOW

L.P.S. FIXTURE

640 CLEAR
INCAND

POUSHEP
METAL
REFLECTOR

SPOT OR FLOOD
ADJ. INCAND.

METAL HOUSING

25'-0"

SPECIAL FEATURE LIGHT TOWER
AT PERFORMANCE AREA

FOR CONCEPT ONLY—NOT FOR STYLE
SPECIAL FEATURE
LIGHT TOWER AT PERFORMANCE AREA

FOR CONCEPT ONLY—NOT FOR STYLE
NOTE: THESE FIXTURES ASSEMBLIES ARE SHOWN AS EXAMPLES OF HOW THE PLAZA FIXTURES MAY BE EMBELLISHED IF PLAZAS LACK SPECIAL QUALITIES. PRIMARY PATH FIXTURES MAY INCORPORATE DECORATIVE INCAN OR NEON AS SHOWN, BUT FLOODLIGHTING & DECORATIVE LIGHTING INTEGRATED WITH BUILDINGS & LANDSCAPING IS PREFERRED.

PHONES BELOW

2XN4 55W
@ 16.7"
INTEGRATE LIGHTING WITH WALLS, PLANTING, BENCHS

BAFFLE LAMP WITH SHAPED OPENING RATHER THAN LOUVERS.

AVOID MERELY INSTALLING RECESSED FIXTURES.
Lamps or lens should not be visible

Simple baffling and shaped openings are most efficient, less distracting when illuminated.

BOLLARDS – STEPLIGHTS
LIGHT POLLUTION FROM BUILDING SHOULD BE LIMITED
AVOID SIGNAGE WITH BRIGHT BACKGROUND
NEON LIGHTING FOR LANDMARK AND INTEREST
Positive integration of sculpture lighting

Note – Spot light on top of light pole to light sculpture
Trellis design is major building feature

LIGHTING SHOULD HIGHLIGHT ARCHITECTURAL FEATURES - TRELLISES
INTEGRATED PLANTER LIGHTING

DETAIL—PIPE ADJUSTS TO LEVEL
OF GROUND COVER.

TREE

3' MIN

FIXT. G—ADJUSTABLE SEALED
LAMPHOLDER (300)

NOMINAL 12" Ø TERRA COTTA,
FIBER GLASS OR CAST
ALUMINUM.

4"± (100MM)

ADJUST HEIGHT FOR
GROUND LOUVER.

SPICE BOX

SUPPORT SAKE

GRAVEL

TREE UPLIGHTING DETAIL—OUTDOOR CONDITION

PROPER LANDSCAPE LIGHTING