

**TOPICAL RESPONSE 2: LIGHTING**

This topical response is provided due to the number of commenters that raised questions on lighting including intensity of lights, frequency/duration of use, and dark sky impacts.

**Background**

A lighting impact study was undertaken to determine whether the proposed Campus Life Project (CLP) components will result in negative light pollution impacts and, in particular, potential glare or light trespass impacts. The lighting impact study methodology and thresholds of significance were based on illumination industry standards, in conjunction with established California Environmental Quality Act (CEQA) guidelines. The Draft EIR “Technical Lighting Report” (contained in Appendix G) analyzed a variety of factors and took physical measurements at 15 “Receptor Sites” in the vicinity of campus determine the potential for new CLP lighting to result in significant impacts in areas beyond the campus’ property line.

The Technical Lighting Report evaluated the following forms of quantitative lighting conditions:

- Illuminance (or light falling on a surface), used to calculate light trespass; and
- Luminance (visual brightness), used to calculate glare.

The CLP would have potential significant impacts if light from its components caused offsite areas to exceed the standards establishing thresholds of significance for light trespass or glare. An explanation of these standards/thresholds follows.

*Thresholds of Significance for Light Trespass*

“Light trespass” is a perceived nuisance condition where excessive artificial lighting falls outside the property line of a proposed project. Light trespass is one of the most common forms of light pollution, and is of particular concern where it may impact neighboring residential properties. Light trespass is evaluated by measuring the project’s illuminance (light falling on a surface), which is the measured or calculated light incident upon a receptor site measured in footcandles (fc). The Technical Lighting Report calculated illuminance at 15 Receptor Sites in the areas surrounding the University.

A CLP component will create a significant impact if it creates a substantial change in light levels, i.e., light trespass, outside the property line. For the purposes of this analysis, light contribution of 0.5 fc or more, beyond the property line, is the measure used for the threshold of significance.<sup>2</sup> For reference, the illuminance directly below a streetlight is 2 fc, the midpoint between two street lights is approximately 0.5 fc, and illuminance caused by a full moon is approximately 0.1 fc.

A CLP component will also create a significant impact if it creates light trespass into natural vegetated and/or habitat areas surrounding the component site. In such areas, a measurement of 0.1 fc is used to determine significance. This measurement for meeting the threshold is consistent with the Illuminating Engineering Society of North America (IESNA)<sup>3</sup> guidelines. Receptor Sites surrounding CLP Component Site 5 (Enhanced Recreation Area) were evaluated using this criterion, as well as sites in the

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<sup>2</sup> The perception of illuminance level is relative to the contextual light levels; see section 2.3.1.1 of the Technical Lighting Report, Draft EIR Appendix G, for an explanation of the relative nature of the perception of illuminance.

<sup>3</sup> *The IESNA Lighting Handbook: Reference & Application*. Ninth Edition. Illuminating Engineering Society of North America, New York. 2000.

Santa Monica Mountains Conservancy (the Conservancy)-owned Malibu Bluffs and other vegetated areas in and around the campus.

Importantly, there are no standard numeric thresholds regulating light trespass that have been uniformly applied in areas surrounding Pepperdine University. Although Los Angeles County does not have a numeric threshold of significance, the lighting studies conducted for the Draft EIR identify and refer to a number of non-binding standards that support the 0.5 fc and 0.1 fc threshold levels applied in this section. The IENSA, for example, has developed an approach designed to address a broad range of settings and scenarios, with recommended thresholds based on existing ambient conditions. Based on the IESNA approach, the 0.5 fc standard is appropriate for the off-site areas, which most closely fall within the characterization of low-to-medium levels of ambient brightness, and the 0.1 fc standard, as the most conservative standard that exists, is applied to areas that are “intrinsically dark, such as a National Park” and are therefore appropriate for the natural areas surrounding the proposed CLP.

*Thresholds of Significance: Glare*

“Glare” is defined as visual discomfort resulting from high contrast in brightness levels that may occur in either day or nighttime views. Glare is evaluated by measuring the project’s luminance, which is the visible surface brightness of objects within one’s field of view measured in footlamberts. Levels of glare are expressed by a contrast ratio, or “luminance ratio”. The luminance ratio describes the range of difference between a bright foreground object and a darker background.

The contrast or luminance ratio takes into account the way the eye takes in multiple illuminated elements within its view and is established by the maximum measured or calculated point value<sup>4</sup> (of appearance of brightness) to the average point value<sup>5</sup> (of appearance of brightness). With this ratio, the human eye can evaluate the relative brightness of specific objects within a given context or point of view. This contrast ratio provides a quantitative threshold measurement to designate glare. Based on studies of luminance documented in the *IESNA Lighting Handbook*<sup>6</sup> the following contrast ratios and their impacts are utilized by the Technical Lighting Report:

- Contrast ratios of 1:1 to 3:1 are not differentiable to the human eye.
- Contrast ratios between 3:1 and 10:1 are considered “Low Contrast”, which means the difference in brightness can be perceived, but does not cause discomfort.
- Contrast ratios between 10:1 and 30:1 are considered “Mid Contrast”, which again means differences in brightness can be perceived, but the differences do not rise to a level of discomfort or “glare.”
- Contrast ratios above 30:1 are considered “High Contrast” and classified as glare by the IENSA. Note: For the purposes of the Draft EIR, this contrast ratio is used as the measurement for the threshold of significance for glare impacts.<sup>7</sup>

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<sup>4</sup> In evaluation of existing conditions, measured points are used. For future conditions, calculated points are used. In both cases, these points show the maximum luminance value visible from a specified point of view and receptor site.

<sup>5</sup> At each receptor site, a grid of luminance measurements is taken that extends 30 degrees from the top to bottom and 90 degrees from left to right. Calculation or measurement points are taken at 6 degree increments horizontally, and 3 degree increments vertically. The average point value represents the average of all measured or calculated points values.

<sup>6</sup> See *supra* footnote 3.

<sup>7</sup> All on-campus measured contrast ratios exceeded the 30:1 ratio. The lowest existing contrast ratio on Campus was measured to be 36.4:1 at Receptor Site C. A photograph of existing nighttime conditions at Receptor Site C is provided on page 42 of the Lighting Impact Study, Appendix G of the DEIR.

With this background, the following section of the Topical summarizes the CLP's potential light trespass and glare impacts.

### **CLP Impacts on Light Trespass and Glare**

To evaluate whether or not the CLP would cause light trespass and/or glare, the Technical Lighting Report investigated light trespass and glare conditions at a variety of physical locations in the vicinity of the University (again, the 15 "Receptor Sites"). Commenters specifically expressed concerns about potential impacts at the Conservancy-owned Malibu Bluffs. A summary of those impacts follows.

#### **Evaluation of Impacts at Malibu Bluffs**

##### *Receptor Site T Measurements*

The Technical Lighting Report evaluated impacts at Receptor Site T, (see Draft EIR Figure 5.7.2-1), which is located on a trail that crosses a level terrace surface in a natural area of Conservancy-owned Malibu Bluffs property approximately 500 feet south of PCH and 450 feet westerly of the centrally located picnic area in the developed area of the Malibu Bluffs Community Park. Receptor Site T, which has distant views of CLP Component Site 3 (Upgraded NCAA Soccer Field), represents a worst-case location that could potentially experience adverse light and glare impacts within the Conservancy-owned Malibu Bluffs property since it is closest to CLP light sources. Other potential viewing sites are located farther away and at lower elevations than Receptor Site T; thus providing more opportunities for intervening terrain and vegetation to block views of Component 3. It is located approximately 3,200 feet (0.6 mile) from the athletic field lighting proposed at Component 3. The site is located near the center of one of the proposed overnight camping locations in the park and has a direct view of the intersection at John Tyler Drive and PCH. See Section 4.4.15 of the Technical Lighting Report.

##### *Light Trespass / Illuminance*

In the existing condition, the illuminance levels at Receptor Site T were measured to be 0.003 fc, on February 2, 2010. To evaluate light trespass, the Technical Lighting Report calculated the future illuminance contribution from the simultaneous lighting of the CLP components (including the Enhanced Recreation Area, and Upgraded NCAA Soccer Field), and related projects (including baseball field) and found that in this circumstance no significant impact would result. The calculated future contributed illuminance from the CLP and related project lighting is 0.003 fc. Under the mitigated conditions, contributed illuminance is calculated to be 0.002 fc. If only one of these athletic facilities were operating with the required mitigations, the contributed illuminance is calculated to be 0.001 footcandles. Such an illuminance contribution is far below the most restrictive threshold of significance used to evaluate the effect of light trespass, and it should be noted that it is within the range of illuminance under existing conditions. The light trespass contribution of the CLP and related projects at Receptor Site T will be imperceptible. Further, a full moon could increase the light level to as much as 0.1 fc, 33 times more illumination than the illuminance contribution of the CLP lighting. With these considerations, it is clear that the CLP lighting has no effect on the illuminance conditions, and would not result in light trespass at the Conservancy-owned Malibu Bluffs. To ensure no significant impacts, the Technical Lighting Report also studied glare at the Conservancy-owned Malibu Bluffs.

##### *Glare & Contrast / Luminance*

The evaluation of the luminance or glare conditions determined that CLP lighting, even with simultaneous operation of CLP project and related projects, will not result in a significant impact on Receptor Site T.

### *Measuring Brightness at Malibu Bluffs*

In the existing condition, the luminance levels at Receptor Site T were measured to be a maximum of 3.324 footlamberts and average 0.127 footlamberts, resulting in a contrast ratio of 26.2:1. This represents a contrast condition within the high range of “Mid Contrast”, which means that differences in brightness are perceptible, but do not cause discomfort or glare.

The future luminance levels at Receptor Site T are calculated to be a maximum of 6.150 footlamberts and an average of 0.211 footlamberts for the non-mitigated CLP lighting and the related projects, resulting in a contrast ratio of 29.1:1, which is still within the “Mid Contrast” band. For the mitigated CLP and related project lighting, the future luminance condition is calculated to be a maximum of 3.740 footlamberts and an average of 0.131 footlamberts, resulting in a contrast ratio of 28.6:1, a less than significant contrast ratio and below the level of discomfort or glare.

### *Viewing the Lighting Fixtures from Malibu Bluffs*

Other commenters expressed concerns that the CLP’s sports lighting would be visible from Malibu Bluffs. View study analysis has shown that the CLP Athletic lighting fixtures will be visible from Site Receptor Site T (see **Figure 1**). However, because the fixtures (or luminaires) are fully shielded and aimed downward, the light sources (lamps) will not be visible from Receptor Site T. As shown in **Figure 2**, the proposed pole heights are designed to enable steep aiming angles that reduce light trespass and glare impacts. Further, this design approach is most sensitive to concerns related to sky glow and coincides with the recommendations to reduce or mitigate sky glow provided by the International Dark Sky Association (IDA) and IESNA. Additionally, the implementation of Mitigation Measure 5.7.2-6 ensures that poles that are visible to the general public will incorporate exterior textures and color coatings that will blend with prevailing background colors and textures.

For a complete review of CLP lighting impacts at all Site Receptors, please see Draft EIR Appendix G.

### **Effects of Sky Glow and Dark Sky Ordinances**

Commenters have expressed concerns that the CLP may cause “sky glow”, a form of light pollution.

#### *Sky Glow*

“Sky glow” is created when light is reflected and scattered by dust and gas particles in the atmosphere. Nighttime sky glow is caused primarily by light that is emitted upward, but can also be caused by light that is reflected from the ground, or by natural sources such as the moon and stars. Sky glow is inherently inconsistent, and can vary widely depending on weather conditions, the amount of dust and gas in the atmosphere and even the viewing angle. Human made causes of sky glow include electric light that is emitted directly upward into the sky (uplight), or reflected off of the ground or other surface. Such light illuminates the aerosol particles within the atmosphere and results in a luminous background.

#### *Nature of Emitted Light and Sky Glow*

Light that results in sky glow is redirected back to the ground as a result of the initial angle of light and the presence of particulates and aerosols within the atmosphere. As shown in **Figure 3**, light emitted between 80 and 100 degrees from nadir<sup>8</sup> has the greatest effect on sky glow where it is most aerosol dependent. Light emitted at these angles has a greater effect in rural areas in which buildings do not

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<sup>8</sup> Nadir is the direction pointing directly below a particular location.



# Visible D Receptor T

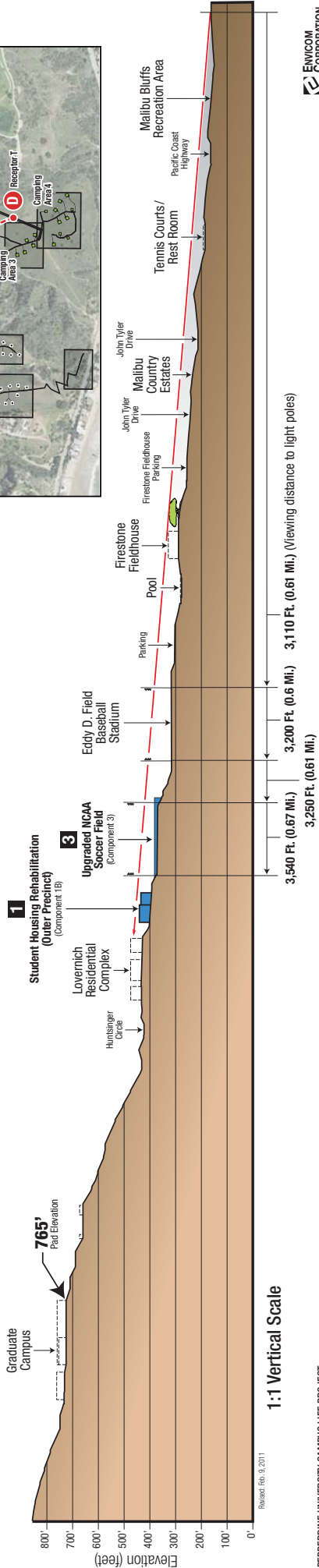
Photographic view corresponds to the orientation of the terrain view profile from Receptor T.



Receptor Site "T" is situated on a trail that leads from a proposed parking area to campsites in Camping Areas 3 and 4. Receptor Site "T" has a higher elevation than any of the campsites and the view from it represents the "worst-case" view of Component 3 from anywhere within the Malibu Bluffs Recreation Area.

## View profile from Receptor T

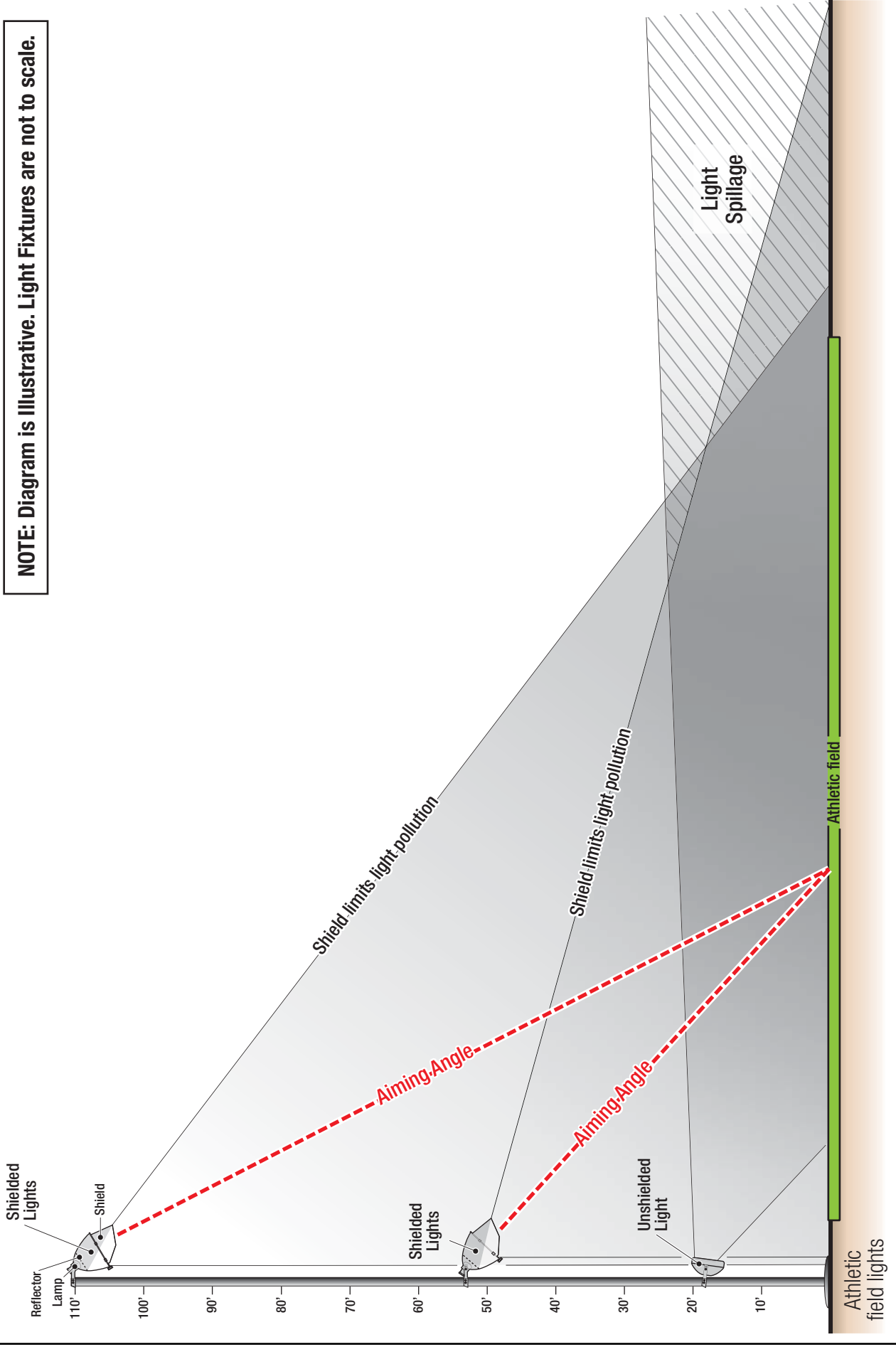
View profile from Receptor Site "T" within Malibu Bluffs Recreation Area



PEPPERDINE UNIVERSITY CAMPUS LIFE PROJECT

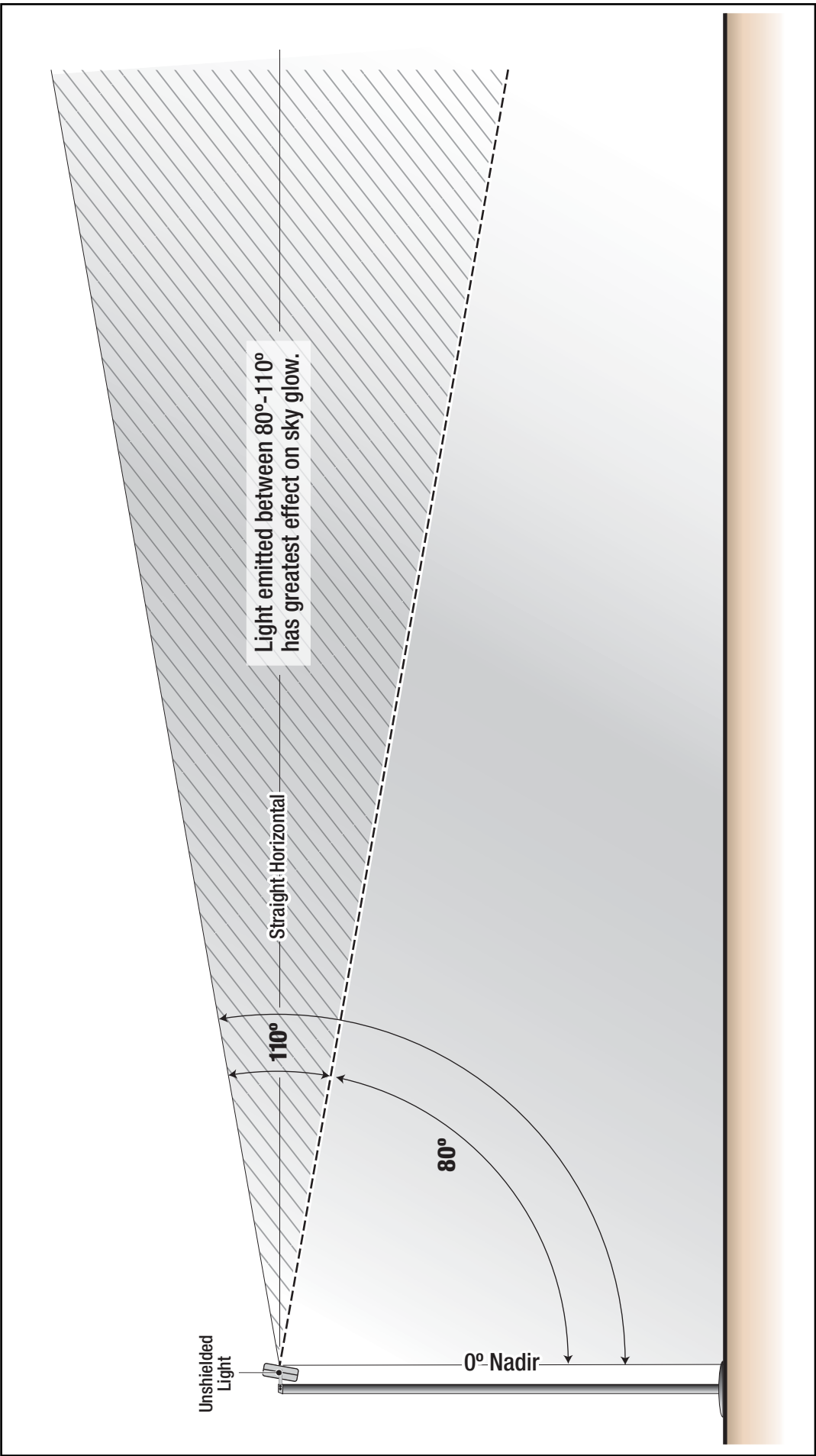
Terrain Cross-Sections and Line-of-Site View Profile from Receptor T within Malibu Bluffs Recreation Area

**NOTE: Diagram is Illustrative. Light Fixtures are not to scale.**



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obstruct the light emitted at these angles. Light emitted between 0 and 80 degrees is far less likely to result in sky glow because the light travels downward towards the ground rather than horizontally into the sky.

#### *CLP Impacts on Sky Glow*

As indicated in Section 5.2.5 of the Technical Lighting Report, the CLP's proposed lighting improvements are based on design principles and recommendations provided by the IDA and IESNA to prevent or minimize all forms of light pollution, including glare, light trespass, and sky glow. Such practices include the use of cutoff and shielded fixtures to prevent light from being directed into the sky or to neighboring properties. Because the existing area and sports lighting are not shielded, the implementation of the design criteria would align Pepperdine more with the design standards associated with dark sky and improve the overall lighting environment.

#### *Calculating Future Impacts of Lighting on Sky Glow*

The IESNA and the IDA do not recognize or endorse a calculation method to analyze the future impacts of lighting on sky glow. Rather, these organizations provide design principles to reduce or curtail the impact of lighting upon sky glow. These principles are utilized within the proposed lighting improvements outlined in Section 5.2.5 of the Technical Lighting Report and include the use of cutoff and shielded fixtures. Further, it requires that all fixtures aimed upward are focused upon an architectural element and restrict the amount of light entering the night sky.

Specifically, the future CLP Athletic (and related baseball field) and Project site lighting have been designed based on IESNA and IDA recommendations for the reduction of light pollution (sky glow) and include the following:

1. Limit flux (light emitted from fixture) above horizontal with the use of cutoff and shielded luminaires.
2. Minimize non-target illumination. All proposed luminaires are aimed downward or restrict light onto illuminated surface (such as a field of play or sign) to restrict the amount of light escaping into the night sky.
3. Reduce outdoor light levels during times of low use.

Further reducing the potential for creating sky glow, the CLP lighting elements have been designed to use a variety of non-binding "dark sky" ordinances and policies as models for good design (both of which are designed to decrease sky glow).

#### *CLP Consistency with Local Dark Sky Policies*

No adopted locally dark sky ordinances apply to the Project site. While regulation of light trespass is commonplace within Los Angeles County, and the City of Malibu, these jurisdictions do not regulate lighting based upon visibility of the night sky (i.e. sky glow). However, the lighting proposed as part of the CLP meets a number of instructive, non-binding dark skies policy guidelines.

#### *Los Angeles County Malibu Local Coastal Program Land Use Plan*

The Los Angeles County Malibu Local Coastal Program Land Use Plan does not include policies that regulate light trespass, light spill, or decreased visibility of night sky due to lighting.



*County of Los Angeles: The Proposed Santa Monica Mountains Local Coastal Program, Coastal Zone Plan*

While not applicable to the Project since it is a draft document not yet adopted, the only land use plan that differentiates between light spill as a nuisance (light trespass) and light spill as a cause of decreased visibility of the night sky is the County's, *The Proposed Santa Monica Mountains Local Coastal Program, Coastal Zone Plan*. The draft Conservation of Open Space Policy identified in *The Proposed Santa Monica Mountains Local Coastal Program, Coastal Zone Plan* (Section II, Conservation of Open Space Element, Policy CO-56) states that the purpose of the draft policy is to maintain the visibility of the night sky, and requiring users to "Control lighting to preserve the visibility of the night skies and stars," (Section II. G. Conservation and Open Space Element. Scenic Resources CO-56).<sup>9</sup> The lighting design guidelines provided in Section 5.2.5 of the of the Technical Lighting Report align with this draft policy because it requires that all Campus Life Project athletic lighting have shielding and specific aiming criteria as well as cutoff (i.e., blocking light emitted above the horizon) for Campus Life Project site lighting.

Further, the proposed project lighting for the Campus Life Project also meets proposed requirements of draft policy LU-31 of *The Proposed Santa Monica Mountains Local Coastal Program, Coastal Zone Plan* which provides a draft policy for private residential zones, primarily for security purposes and in order to limit light trespass and light pollution. The draft policy is to:

Limit exterior lighting, except when needed for safety. Require that new exterior lighting installations use low-intensity directional lighting and screening to minimize light spillover and glare, thereby preserving the visibility of a natural night sky and stars and minimizing disruption of wild animal behavior, to the extent consistent with public safety.

Again, the CLP's lighting design guidelines provided in Section 5.2.5 of the Technical Lighting Report align with this draft policy by utilizing low-intensity directional lighting and providing screening to minimize spillover and glare.

*CLP Consistency with Other Recommended Dark Sky Best Management Practices (BMPs)*

The IDA provides recommended BMPs for outdoor lighting installations and guidelines for lighting regulations. *The IDA Simple Guidelines for Lighting Regulations for Small Communities, Urban Neighborhoods, and Subdivisions* is informative as a specific example of a Dark Sky guideline. The Project incorporates numerous BMPs and technologies described by the IDA, including the use of full shielding and limiting luminaire wattage, as appropriate.

*Conclusion*

The lighting guidelines designated within Section 5.2.5 of the Technical Lighting Report are based on design principles and recommendations provided by the IDA and IESNA to prevent or minimize all forms of light pollution, including glare, light trespass, and sky glow. These are the same practices required within some other jurisdiction's local ordinances and policies and include the use of shielded fixtures. The proposed lighting improvements exceed many such guiding industry standards with the planned implementation of cutoff luminaires for site lighting to reduce sky glow and minimize the direct view of the light source. Further, because the existing site and athletic lighting are not shielded, the implementation of the design criteria, which includes cutoff shielded light fixtures, would align

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<sup>9</sup> If adopted, CO-56 would be applicable to the project site.

Pepperdine more with the design standards associated with dark sky and improve the overall lighting environment.