



## **Memorandum**

**To:** Planning Commission  
**From:** Thomas Dansie, Director of Community Development  
**Date:** September 28, 2023  
**Re:** Potential Ordinance Amendment: Light Trespass Standards

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### ***Executive Summary***

The Town regulates outdoor lighting in order to achieve its dark sky preservation goals. The Town's standards for outdoor lighting are designed to allow adequate outdoor lighting for safety and security purposes, while also protecting dark night sky. The Town's outdoor lighting regulations have been helpful in preserving the quality of the night sky.

The Town's outdoor lighting standards do not regulate light trespass from interior lights. Both the Planning Commission and Town Council have expressed concern over the impacts of light trespass from interior lights. This memo presents options for regulation of light trespass from interior lights. The Commission should discuss this issue and give staff feedback on how to proceed.

### ***Background***

The Town has a longstanding goal to protect the quality of the dark night skies in Zion Canyon. The community recognizes the importance of dark night skies as a key element of the Town's village character. The General Plan encourages the Town to protect and preserve the dark night sky (see Land Use and Town Appearance, Sub-Goal A1; Natural and Cultural Resources, General Goal; Natural and Cultural Resources, Sub-Goal B).

In order to protect the night sky the Town has adopted outdoor lighting regulations. [Chapter 10-15C](#) of the Town Code regulates outdoor lighting. The purposes of the outdoor lighting regulation are:

- A. To encourage outdoor lighting practices that will minimize light pollution, glare, light trespass and sky glow in order to preserve the natural dark of the night sky and to prevent lighting nuisances on properties.
- B. To promote energy conservation.
- C. To maintain nighttime safety, utility and security.
- D. To maintain an uncluttered nighttime appearance in the Town.
- E. To prevent unnecessary or inappropriate outdoor lighting.
- F. To minimize nighttime impacts on nocturnal wildlife.
- G. To maintain the rural atmosphere and village character of the Town.
- H. To encourage the low-level outdoor lighting through the use of low wattage bulbs, fully shielded light fixtures, and limits on the location and uses of outdoor lighting.

The outdoor lighting standards in Chapter 10-15C do a good job of accomplishing these purposes. In fact, the Town has recently been designated as an International Dark Sky Community, in large part based on adoption and enforcement of these standards. However good the outdoor lighting standards in the Town are, their positive impact on the dark night sky can be frustrated by the effects of unregulated interior light.

Light from interior sources spilling through windows can create a number of negative impacts on the Town's village character. Such light can spill upwards into the night sky, degrading the quality of the dark sky. It can trespass onto adjacent properties, causing nuisance for property owners. And it can cause structures to be much more visible at night than they are during the day. If located on hilltops or ridgelines, these structures can have a "lighthouse" effect and be visible from far distances.

With very limited exception, the Town Code currently does not regulate light from interior light sources.

In furtherance of the Town's dark sky preservation goals, the Council and Commission have expressed interest in researching potential options to regulate interior lighting. The Council and Commission have both clarified that such regulations should be targeted toward the commercial zones, and not necessarily the residential zones.

#### *Interior Lighting Regulation Issues*

As discussed above, the Town's outdoor lighting regulations establish standards for the design of outdoor light fixtures, the total amount of outdoor illumination allowed on a property, the placement of outdoor light fixtures, and other aspects of the outdoor light fixtures themselves. It would be difficult to craft similar regulations for interior lighting. Such regulations would be near impossible to enforce. Further, the Town's concern is not illumination inside a structure, rather it is the illumination emanating from the structure that is of concern.

Therefore, staff suggests any regulation of interior lighting be solely targeted to mitigating the effects of interior lighting as seen from outside the structure. The following are potential options that the Commission can consider:

- Require the light source of an interior light fixture to not be visible from outside the property boundaries.
- Require window coverings on windows larger than a certain size, and which are visible from outside the property (or from specific locations in the community - e.g. SR9)

These two standards are fairly straightforward and relatively easy to enforce. These standards (or standards like them) could be easily incorporated into the Code and enforced during the DDR stage, and as part of the construction and Certificate of Occupancy process. However, as efficient as they may be, these standards may not be the most effective way to mitigate issues of interior lighting as seen from outside.

Another option is to adopt a standard that prohibits any light trespass from interior windows falling outside the property boundaries. Light trespass could be defined as any illumination originating inside the property (whether from outdoor or interior lighting) from falling outside the property boundaries. This standard gets to the core of the issue and is in line with the Town's dark sky preservation goals. However, this standard is also much more complex to enforce.

Measuring light trespass requires sensitive photo optical equipment, as well as the knowledge and skill to use it. Thus, in order to be able to enforce a light trespass standard the Town would need to invest in equipment and training.

Additionally, there are various sources of light already existing in the community: streetlights, light reflected off the ground from existing lighting, and ambient light from the cumulative effect of all the artificial light already existing in the Town. Isolating light trespass caused by a specific property or light source from all this other light can be difficult.

Finally, virtually every property in the community already contributes some degree of light trespass, however minimal. Determining what an acceptable level of light trespass is, and what constitutes a light trespass violation, will require some legislative discretion.

The Code Enforcement Officer has been experimenting with a method to measure and quantify light trespass that accounts for the difficulties of light trespass enforcement discussed above. (See attached technical memo.) This method can be further refined if the Commission wishes to pursue a light trespass standard.

### ***Requested Direction***

The Commission should discuss the best way to mitigate the negative impacts of interior lighting on the Town's dark night sky. The easiest way to do this is through simple standards such as a requirement for window coverings in large windows. However, these simple standards may not be the most effective in preserving a dark night sky. A more complex light trespass standard could be more effective in accomplishing the Town's dark sky goals—it will also be more difficult to administer and enforce.

## Indoor Light Trespass from Commercial Properties *(can quantify both indoor and outdoor trespass)*

**Problem:** In addition to outdoor lighting, significant light trespass from indoor lighting degrades our night sky. Current outdoor lighting codes try to regulate light trespass without an illumination metric and method to determine actual effectiveness of the code regulated fixture physical designs.

**Goal:** Provide a method of quantifying indoor lighting light trespass at property boundaries. Ideally, the method should be easily implemented by a code enforcement department and easy to demonstrate trespass issue to property owner. In its final form the method and data should be defensible in the court of law if necessary.

### Search for a solution:

1. Initial investigation centered around analyzing photos taken at various distances and exposures of commercial properties. After many attempts to gather and analyze data it quickly became apparent that quantifying and comparing data of various properties was possible but would be very difficult to implement by typical code enforcement personnel. The direct photo method would be very time consuming difficult to convince the property owner of a light trespass issue.
2. The availability of light meter sensitive enough to measure low light levels of some properties was not available but might simplify method and measurements in the future. Results would provide less visual intuitive feedback to the property owner but could be calibrated to current best method 3. Below.

### Current best method:

3. Current best method is to analyze a photo of a standardized target illuminated by the property of interest. With known exposure settings and standardized illuminated targets, the only remaining variable is distance which is known to obey the inverse square law where as light travels twice the distance the brightness decreases by 4 times. In actual practice, some locations will require methods to isolate indoor and outdoor illumination sources.

### Best Method in Practice:

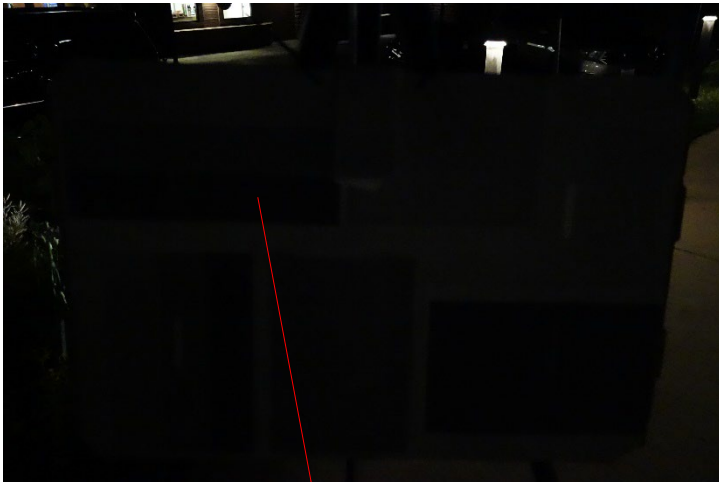
**Target property:** illumination target contaminated by street light and monument sign. Future optimization will implement gratings to remove contamination sources.



**Illuminated target:** The target is areas of 0-80% gray. Variations in gray level may be used for extra level of confirmation of illumination levels. Original concept was to introduce shadow effects for visual effect to property owners. In the final implementation, calibrated gray level targets may be required.



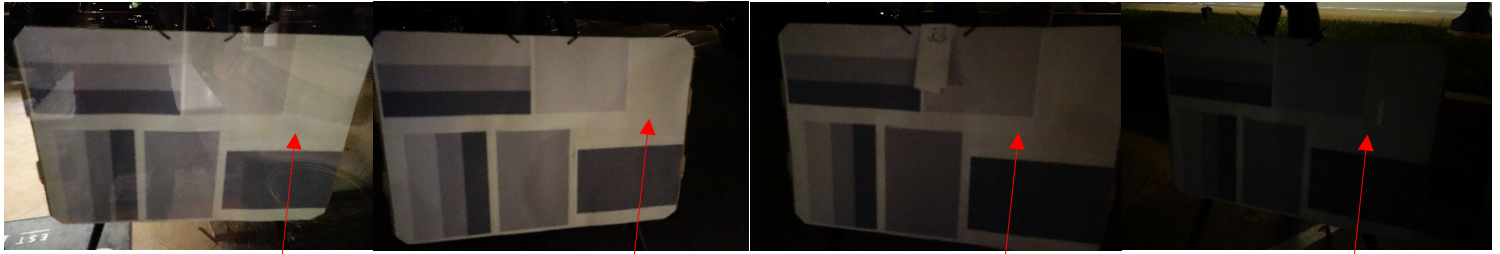
Target facing away from property vs. toward property:



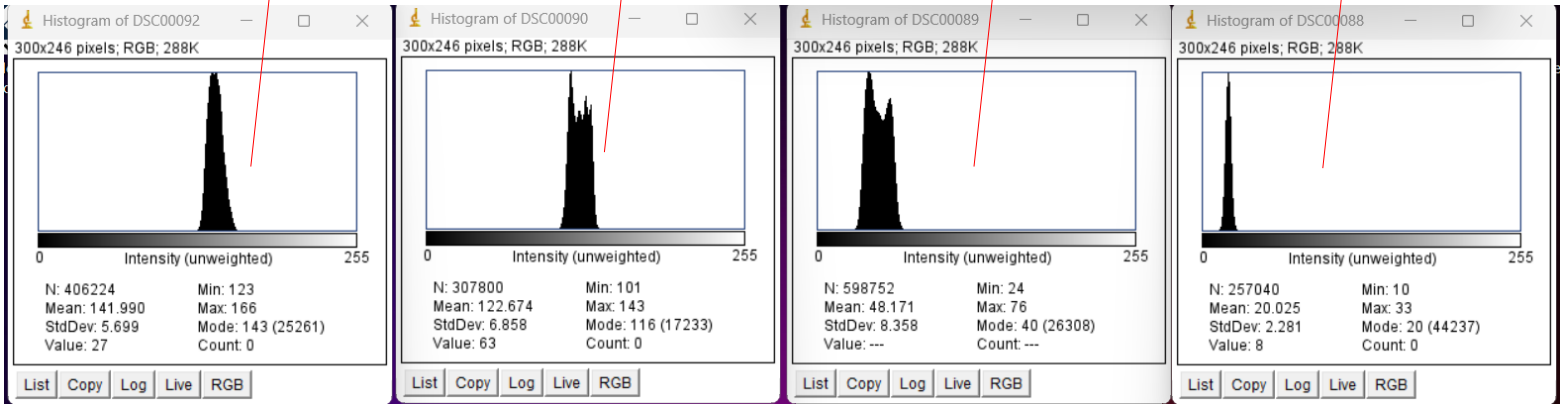
Target facing away enhance to show when analyzed the illumination information is still there.



**Sequence:** at window, ¼ back, ½ back, 1 back (all relative parking lot distance not absolute). The first photo was taken with the target very close to the building window. In the future the target will be placed against the window to eliminate the glare and get a more accurate illumination level leaving the indoor lighting. As the target is removed away from the building the illumination level falls off according to the inverse square law.



Shown below: Histograms of the intensity of the same specific patch of the photos above. The quantitative analysis supports the visual qualitative data from the photos. Any developed codes will use the quantitative analysis data.



**Visual and Intuitive:** So far only visual data has been shown. If we go and take the same photos with same exposure settings at the same distances, we can compare the relative light trespass differences between 2 or more properties. This visual representation is will be very valuable for Planning and Town Council.

**Summary:** This method can detect and quantify light trespass. The discussion so far is more of a qualitative demonstration. Analyzing the photos will give a non-absolute quantitative component that will mirror the qualitative(visual) information. Ideally, we need an “absolute” quantitative measurement to develop and enforce a code and qualitative measurements to explain and educate code.

### Next Steps:

1. Acquire sensitive and accurate illumination meter to get “absolute” quantitative illumination measurements for metrics to use in developing enforceable codes.
2. Streamline process with accurate distance matrix and exposure matrix
3. Automate program to summarize and document analyzed photo data.
4. Develop methods to isolate indoor light sources, exterior light sources, off property light sources.

