Lighting Assessment Final Report of the Glendale Neighborhood, Salt Lake City, UT

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Dark Skies Capstone
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Abstract

Over the course of the spring 2023 semester we have been working as a team to determine the safety hazards caused by artificial lighting present in Glendale, Utah, a neighborhood on the Westside of Salt Lake City. Throughout this process we worked with the Glendale community and engaged them with education about dark sky conservation, outreach to the residents, policy suggestions, art by creating a dark sky inspired mural at the Glendale Wallace Stegner Academy, and taking measurements to examine the amount of lighting pollution in their neighborhood.

We measured locations using a luminance meter and illuminance meter in several areas of Glendale. We wanted to make sure to have a comprehensive set of measurements from different areas of the community so we took measurements in areas of single family homes, public spaces like schools and libraries, large and small intersections, industrial sites such as a car dealership, and the Fife wetlands which is a heavily trafficked park the Glendale community is trying to turn into a wildlife preserve.

The measurements we took have shown us there is inconsistent lighting, over-lit environments, areas of high contrast, under-lit environments, and lastly excessive glare. Our research leads us to believe the lighting issues we have identified could be fixed with minor interventions such as dimmers, light shields, light angles, and replacement of light bulbs with lower color temperature.

Introduction

Background

Environmental Justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (Department of Energy, n.d.). Light pollution is an environmental justice issue and is the main theme we have focused on for our semester-long project. Light pollution, or artificial light at night, is the excessive or poor use of artificial outdoor light. It disrupts the natural patterns of wildlife, contributes to the increase in air pollutants in the atmosphere, disrupts human sleep, obscures the stars in the night sky, to name a few impacts. While it isn't talked about much, especially because the issue of light pollution is a relatively new area of research, light pollution disproportionately affects low income and minority neighborhoods. These areas typically do not have the resources to measure light pollution or replace harmful lights and they may not recognize light pollution as a priority.

Motivation

Throughout this semester we have been working with Glendale, a neighborhood on the West side of Salt Lake City, to research and examine how light pollution may affect the health, quality of outdoor experiences, and safety of its residents. As this has been a historically underserved population of Salt Lake City residents, we aim to create a more equitable environment for this community by being able to understand the ways in which light pollution may be affecting them. Our goal is to provide education to the community of Glendale, measure lighting in areas of high activity, and give recommendations on how to improve the light quality within the area in an aim to increase quality of life to the Glendale Community. By doing so we hope the Glendale community is able to better understand the hazards caused by artificial lighting and ultimately consider ways to better serve their community and residents by making adjustments to current lighting.

Project Overview

Our semester-long project focuses on connecting with the community of Glendale within Salt Lake City, Utah. Our project uses four facets of community engagement: education, art, observations, and policy. Our observation and policy elements went hand in hand, we decided on eight specific areas within Glendale to take measurements on light pollution in the area. Then, based on these results we formulated recommendations we gave to the Glendale community to help decrease the light pollution the community experiences. Our art portion became a mural of Utah we painted at the Wallace Stegner Academy, which is a charter school with a location in the Glendale Community. This mural has five areas each with a different Utah landscape and time of night to depict dark sky preservation efforts our state has been making. We planned our education portion of our community engagement to be teaching the community about light pollution and dark sky conservation at the University of Utah South Physics Observatory Star Party which happens every Wednesday, but because of the unprecedented winter, both days were canceled.

We connected with the community of Glendale through two neighborhood council meetings, one in February and one in April. Here we provided information about what light pollution is and general information about how it can be prevented. During the first meeting, we asked the neighborhood council members and the community of Glendale for suggestions regarding areas in their community that may have poor lighting. We received insight and suggestions from the city council members. We applied this feedback by measuring the light pollution of some of the sites they mentioned. At the end of the semester we incorporated the Glendale Community into our measurements by presenting our findings at the April 19th neighborhood council meeting. During this presentation of our findings, we also gave recommendations and suggestions on how the community could incorporate these dark sky implementations into future infrastructure projects.

Education

Our intention was to spread awareness about dark sky studies and the impacts of light pollution at the star party hosted by the University of Utah. The star parties are a regular event held every Wednesday night at the South Physics Observatory. We had a presentation prepared as well as a few demos surrounding light pollution. However, the star parties we scheduled on 3/22/23 and 3/29/23 were canceled due to weather conditions stemming from our unprecedented winter.

Our demos included a constellation bingo, where the participants could look through their telescopes to cross off constellations they saw. In our other demonstration we were going to take a flashlight and shine it right above the telescope so people could see the difference excess light causes on stargazing.

We also had a video at the end of our presentation provided by the International Dark Sky Association that was informational and covered the idea of light pollution and dark sky preservation. Our goal with showing this video was reaching a wide audience and allowing them to come and go as they please. Since the star parties are an open event, people arrive and leave at different times so those who may have missed our presentation could still learn something through the video.

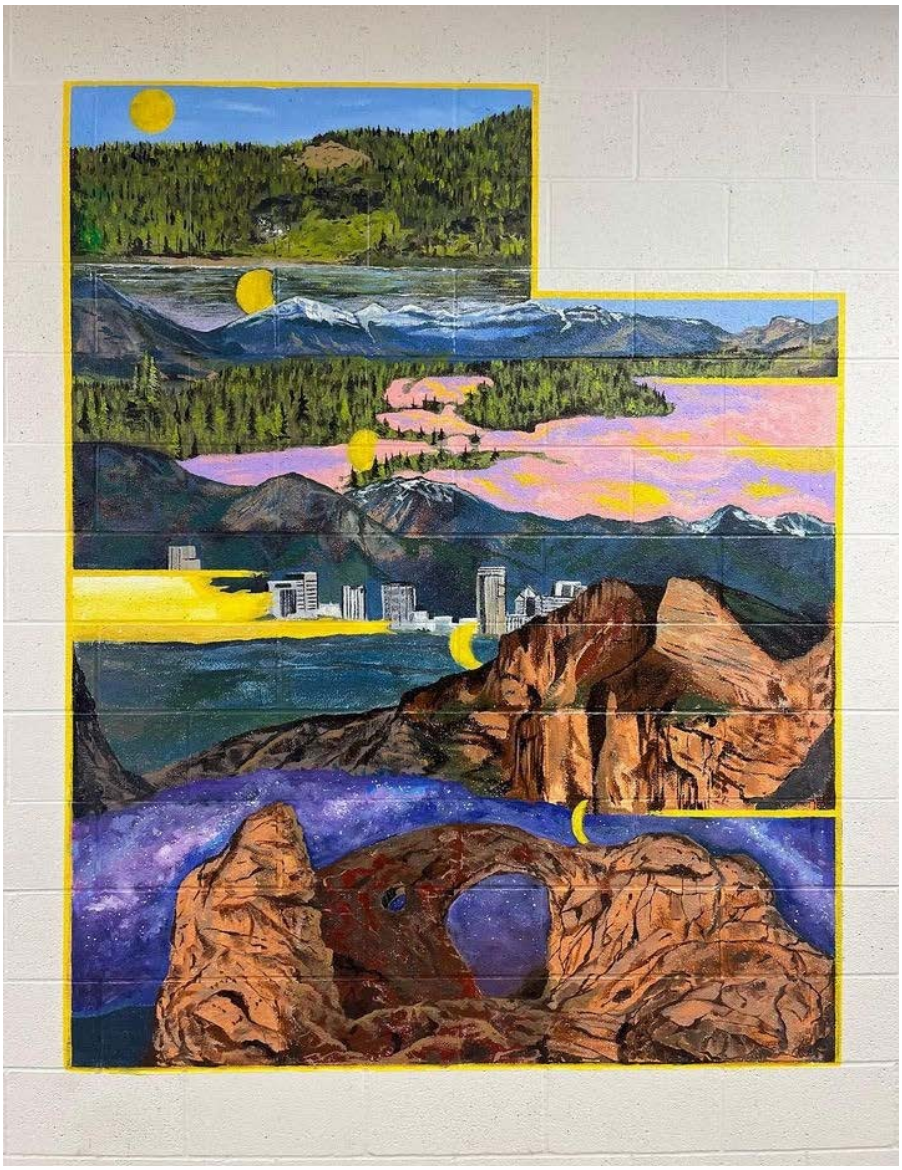
We also presented at a neighborhood council meeting where we informed the board and the community about what light pollution was and some examples of what it can look like within the city. We followed up with them with our findings and educated them on how various lighting issues may be solved within the Glendale community.

Mural

We partnered with local Salt Lake City muralist Josh Scheuerman to create a mural representing important aspects of dark skies. Located at Glendale's Wallace Stegner Academy, this mural depicts the night sky of Utah through various lenses. It consists of five different panels, each one showing a different landscape and time of day. We wanted this mural to incorporate parts of Utah we all know and love including the sunsets of Salt Lake City, dusk in the snowy Rocky Mountains, and viewing the night sky at Capitol Reef National Park, which is a dark sky designated park.

We painted this mural over the course of a day and it is now on display at Glendale's Wallace Stegner Academy. We hope having this mural in a place where the next generation can look at it will encourage them to get involved with preventing light pollution and seeking to promote environmental justice later in their lives.

Above is what we painted on 4/15/23. Josh came back later after we finished and added more details to create our finished piece. He added details such as including a border, adding gold leaf on the moon phases, adding definition to the trees, and other finishing touches.



This is the finished mural after Josh finished all the details.

Community Engagement

As a part of our policy portion, we met with the Glendale community at their February and April Neighborhood Council Meetings; along with meeting with the Glendale neighborhood Council Board members. At the February meeting we presented what light pollution is and how it may affect different aspects of their community. We asked for input on where the community believed there needed to be changes to lighting in their community. We didn't get much input from the community at the February city council meeting but we gained valuable information from the neighborhood council board.

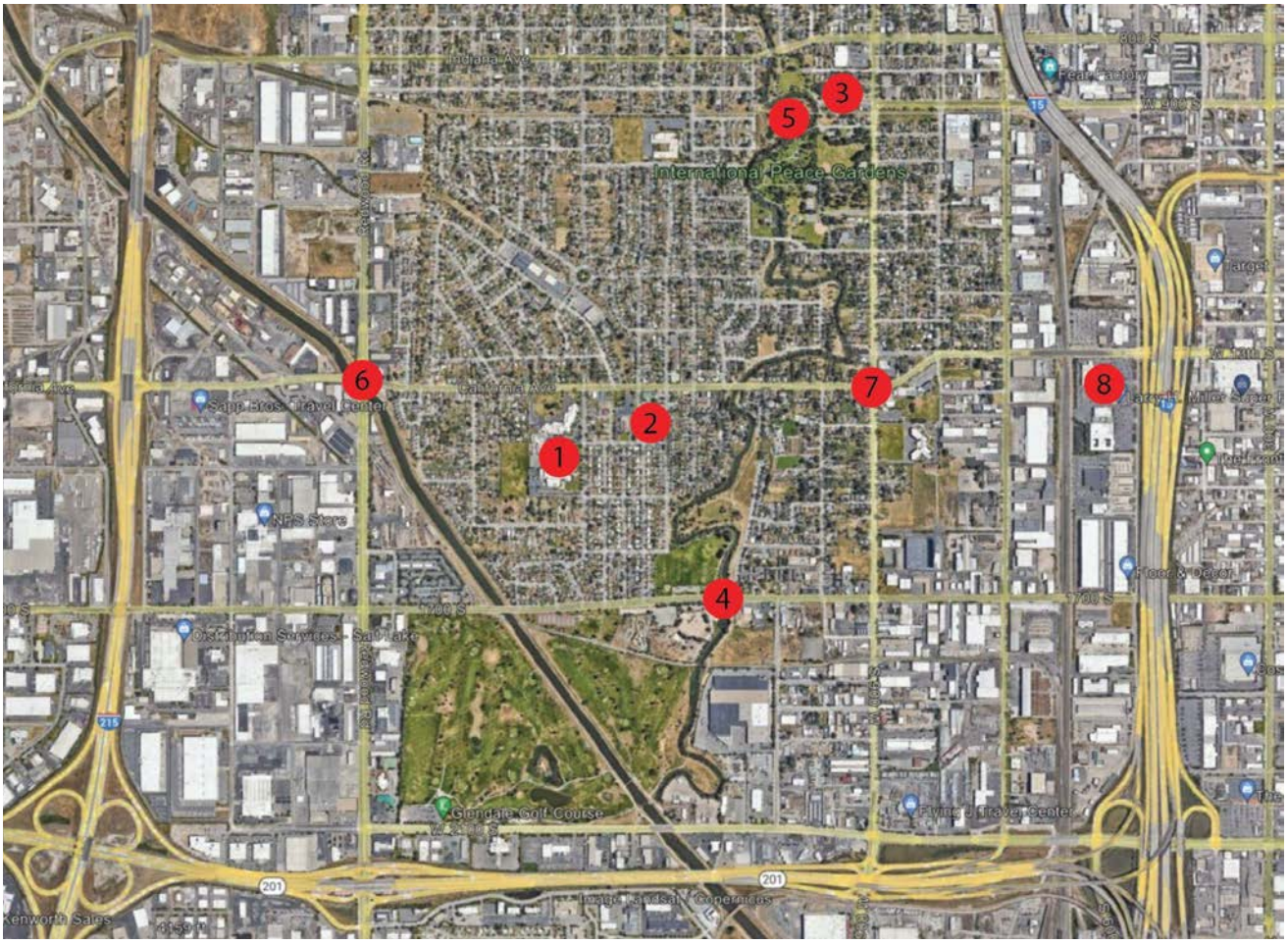
The neighborhood council board of Glendale provided us with insight about where they believe their community is at in terms of light pollution. They had concerns about light pollution near single-family neighborhoods. They expressed these neighborhoods typically had poor street lighting and fluctuations in private lights. The fluctuations in private lights are from people installing their own lighting on the exterior of their houses varying in aspects such as brightness, color temperature, and the angle of lighting. A challenge with looking at lighting in these neighborhoods is the light fixtures are on private properties and there is little to no regulation on what lighting people may install on their property. We measured the lighting in the streets and sidewalks around 900 South and found there is a lot of light trespass (light from an outside source entering into a home and disrupts sleep) happening from both the street lamps and the individually owned lights of neighbors. We also found the two lights we measured, one of them was brighter when farther away from the light and dimmer when standing under the light which contributed to the light trespass into the neighboring houses.

Turner Bitton, the Chair of the Neighborhood Council of Glendale, and Paolo Aguilera, Vice Chair of the Neighborhood council, listed other locations they believe had poor lighting within the community of Glendale. These locations included the Fife Wetlands, the large intersection between Redwood Road and California Avenue, schools, and various intersections along the Jordan River Trail. They also agreed to the points made about residential areas in the community and expressed concern regarding general lighting in neighborhoods. Given these suggestions, we measured these locations as well.

Our capstone class at the Glendale Neighborhood Council Meeting on April 19, 2023 where we presented our findings.

Measurement Sites

1. Glendale Middle School
2. Glendale Library
3. Single Family Neighborhood at 900 South
4. Jordan River Trail & 1700 South
5. Fife Wetlands
6. Redwood Road & California Avenue
7. 900 West & California Avenue
8. Car dealership by I-15



Measurement Site Observations

Site 1: Glendale Middle School

Observations

Standing in the crosswalk going across Navajo Street there are notable contrast issues on either side (north or south) of the crosswalk. This is exacerbated by overhead lights which are overly luminous and wash out the lit environment and reduced effective night vision stepping out of the cone of light enveloping the crosswalk. Along with this all three lights within the immediate vicinity of where we investigated had no sort of shielding to reduce their glare, which increased eye strain when traveling by bicycle or motor vehicle. This could be interpreted as a safety concern for vulnerable road users during early morning or evening hours, especially in the winter seasons.

Above: Standing in the middle of the crosswalk on Navajo Street and Andrew Avenue.

Justifications

During certain times of the year, school may begin before sunrise. The quality of lighting around the school is a large component of childrens' safety. Making sure crosswalks and sidewalks are well lit will help increase young students' safety coming to and from school. Additionally students participating in after school activities may be leaving around or after the time the sun is setting in the winter months.

Site 2: Glendale Library

Observations

The parking lot and sidewalk were well lit, but there was a harsh edge where the lighting stopped. This made the sides of the parking lot and street very dark. The sidewalk and building had different lighting than the parking lot.

Above: Two of us standing on the sidewalk. Poor lighting makes it hard to see us from the street.

Justifications

The Glendale library stays open until 8 pm on some days. Patrons and staff may be leaving after dark. Safety of people leaving the library is a concern.

Site 3: Single-Family Neighborhood at 900 South

Observations

We measured two lights and found one of the lights is brighter when standing away from it rather than directly under the light. This is a sign of poor lighting design and can cause things like light trespass in the nearby homes.

Left image: West light
Right image: East light standing towards the middle of the two lights

Justifications

We wanted to get an idea of the residential lighting within the Glendale Area. Misdirected lighting of a neighbors porch lights or street lamps can cause light trespass into neighboring windows. This can cause disrupted sleep cycles for the people living in these neighborhoods.

Site 4: Jordan River Trail and 17th South

Observations

Trail was very bright, so bright a pedestrian walking along the trail couldn't see anything off the trail. There could have been a person standing off to the side of the trail and we wouldn't have been able to tell because of the contrast in lighting.

Left image: The light on the southeast corner
Right image: Off-trail was very dark. Pedestrians, cyclists, dogs, and critters are hard to see if off path.

Justifications

We chose this location at the request of the community council board, however it's important to note the safety concerns of lighting areas with pedestrian and automotive traffic intermingling. This area experiences high contrast issues between the spaces being lit by overly bright lamps and light, and the unlit areas lining the Jordan River. To be clear, we are not advocating for an INCREASE in lighting around the Jordan River, but rather a decrease in overall lighting. Biking this area late at night it's clear the lighting in this area is too bright and creates visibility issues for bikers, especially for those heading northbound on the Jordan River Trail. Going into the less lit areas across the street where night vision is mandatory for safe biking. This particular intersection served as a good analog for many of the Jordan River Trail crossings, and

indeed other pedestrian intersections where there is improper lighting resulting in glare or high contrast issues.

Site 5: Fife Wetlands

Observations

There is no lighting on the trail at Fife Wetlands. The only lighting came from the nearby Jordan River Trail, across the river; making it difficult to see people walking or biking at the Fife Wetlands trail.

Left image: Jordan River Trail is lit up but not the Fife Wetlands Trail
Right image: Hard to see a person walking on the trail

Justifications

While most of Glendale is urban development, the Fife Wetlands can show us the impact of artificial light on plants, and we can compare this to the more developed locations.

Site 6: Redwood Rd. and California Ave.

Observations

The Chase bank on the northeast corner has bright lights on the building and a sign lighting the area up. However the bright flood lights turned off around 9 pm. We were able to get measurements before and after these lights were turned off. There was an incomplete sidewalk next to the bank, and street corners which have single overhead lights for cars and no pedestrian-scale lights. The southwest and southeast corners of the intersection were dark.

Above: Two of us under the bright lights on the bank at the intersection of Redwood Rd. and California Ave.

Justifications

We chose this location because it is a busy intersection and good lighting is important for pedestrian safety. If the lights for the street and businesses are too bright, they can cause glare and interfere with drivers' vision which in turn jeopardizes pedestrian safety.

Site 7: 9th West and California Ave.

Observations

This was a smaller intersection than the previous at Redwood Rd. and California Ave. However, it was still a busy intersection with overall poor lighting. There are only streetlights on two of the four corners of the intersection. The Sorensen Center is located at this intersection as well as many single-family homes.

Left image: The light on the southwest corner

Right image: View of the intersection from the southeast corner

Justifications

Although this intersection was slightly smaller, it still greatly influences pedestrian safety. There are also many single-family homes where light trespass could be an issue.

Site 8: Car dealership by I-15

Observations

There is an excessive amount of lighting at the car dealership. However, many of the light fixtures had missing burned out lights. Even with these burned out lights, the overall parking lot was brightly lit. These lights are high from the ground and are so bright it compares to daylight hours.

Top left: Fully lit light by crosswalk
Top right: Burnt out light by the crosswalk
Bottom left: Half-way lit light in parking lot
Bottom middle: Fully lit light in parking lot
Bottom right: Burnt out light in parking lot

Justifications

We chose this location because it provides a very candid look at how some businesses choose to light their spaces. We determined this because of its proximity to I-15. We also looked at this location because car dealerships typically use excessive lighting to attract business and overall perceived safety.

Justifications

We measured illuminance, color temperature, PAR, and luminance because we believed these to be the best ways to measure light pollution. We looked at locations with busy intersections, schools, the community center, a natural wetlands area, car dealerships, and residential neighborhoods to get an understanding of the diverse land uses and different aspects of lighting in these areas. Places like schools and crosswalks have many people walking, typically before sunrise in the winter for schools. These areas need good lighting for pedestrian safety. The Fife Wetlands allowed us to see how lighting affects plants and compare the lighting in denser urban areas to a more natural environment.

Illuminance is the quantity of light falling on a unit area of a surface. Measuring illuminance shows us what surfaces are well-lit and which ones are lacking. Places with activity need to have higher illuminance so people can see their surroundings.

Color temperature is the measure of color of white light in degrees Kelvin (K). Warmer lights have a lower temperature and are better for vision. Higher temperature blue lights are harmful to human health. Nighttime exposure to blue light disrupts natural circadian rhythms more than warmer color temperatures.

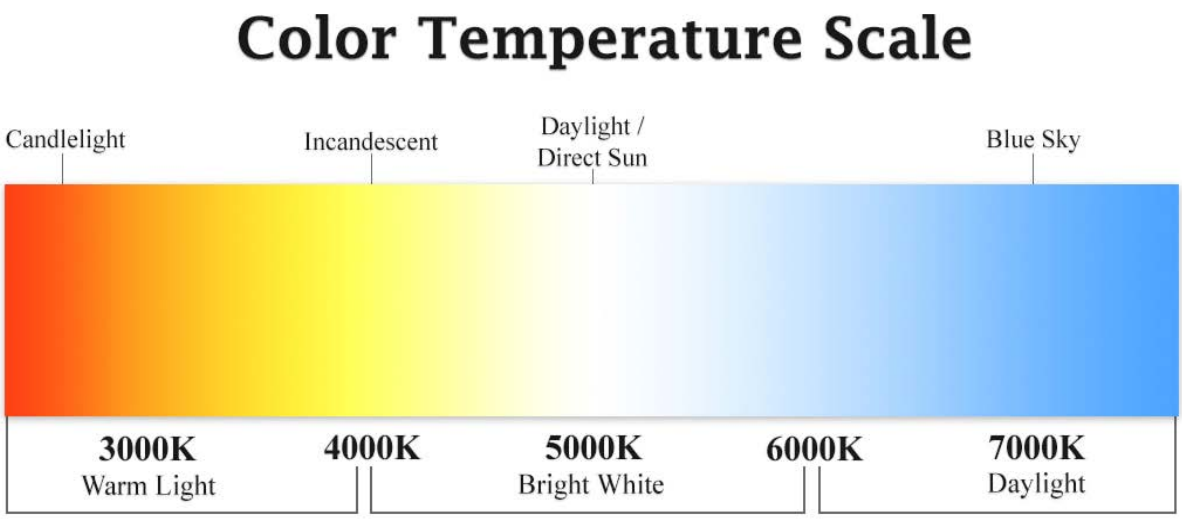


Image Source: commercialledlights.com

Photosynthetically Active Radiation (PAR) is the spectral range of solar radiation from 400 to 700 nanometers that photosynthetic organisms are able to use in the process of photosynthesis. Placing streetlights near plants can disrupt the photosynthesis cycle and cause an “early spring” where they bloom in winter and

become susceptible to frost damage.

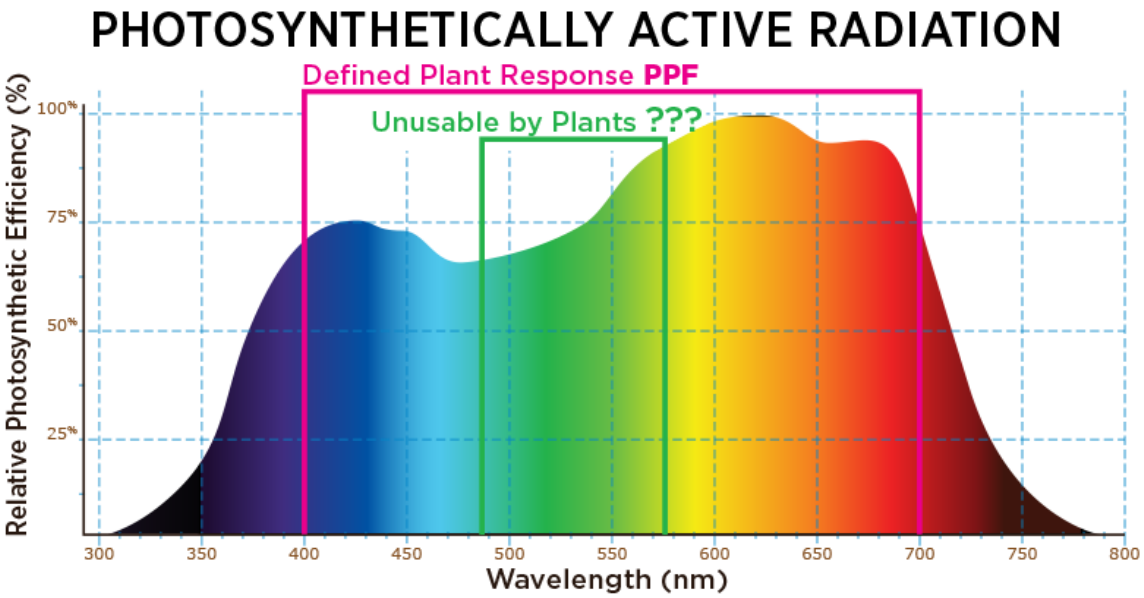


Image source: albopepper.com

Luminance is the intensity of light emitted from a surface per unit area in a given direction. When lights have a high luminance in a dark area, this contrast creates glare. Glare can be dangerous in areas with automobile traffic, such as the major intersections. Glare interferes with a drivers' ability to see the road and notice pedestrians.

Measurements

Site	Distance (Meters) or Location	Illuminance (Lux)	Color Temp (Kelvin)	PAR (μmol/m²/s)	Luminance (c*d/m²)
1 (Glendale Middle)	1 meter away	21	5155	0.00029	61580
1 (Glendale Middle)	2 meters away	19.61	5158	0.00027	40430
1 (Glendale Middle)	5 meters away	14.06	5157	0.00019	12300
1 (Glendale Middle)	10 meters away	3.181	5114	0.00044	17950
1 (Glendale Middle)	Middle of Crosswalk	2.505	3600	0.00033	17630
2 (Library)	Crosswalk 1	0.922	3967	0.01214	65380
2 (Library)	Crosswalk 2	0.144	6793	0.00095	28250
2 (Library)	In parking lot	10.18	3944	0.1337	171000
3 (Single Family Homes)	West Light	9.125	1829	0.1122	36530
3 (Single Family Homes)	East Light	11.24	2025	0.1351	31610
3 (Single Family Homes)	In Middle of Two Lights	0.563	1851	0.00651	15380 (Facing toward west light)
3 (Single Family Homes)	In Middle Facing East Light	n/a	n/a	n/a	75560
4 (Jordan River Trail & 1700 S Crossing)	North Side	0.584	3820	0.00796	9666
4 (Jordan River Trail & 1700 S Crossing)	Middle	24.51	4088	0.00039	16430

Site	Distance (Meters) or Location	Illuminance (Lux)	Color Temp (Kelvin)	PAR (μmol/m²/s)	Luminance (c*d/m²)
4 (Jordan River Trail & 1700 S Crossing)	South Side	12.79	1284	0.00017	30879
4 (Jordan River Trail & 1700 S)	Directly Under Light	89.7	3099	0.00119	104500
4 (Jordan River Trail & 1700 S)	5 Meters North	46.301	3100	0.00061	163330
4 (Jordan River Trail & 1700 S)	5 Meters South	42.50	3075	0.00056	149700
5 (Fife Wetlands)	Off Trail	0.303	3083	0.00426	4960
5 (Fife Wetlands)	Trail Corner	n/a	n/a	n/a	1349
6 (Redwood & California)	By bank with bank light	10.95	4120	0.1473	1080 (looking at light across street)
6 (Redwood & California)	By bank without bank light	0.324	4024	0.00443	n/a
6 (Redwood & California)	Northeast crosswalk	15.25	3560	0.1974	7989
6 (Redwood & California)	Northwest crosswalk	10.37	3709	0.134	8661
6 (Redwood & California)	Northwest crosswalk	n/a	n/a	n/a	**2022** (looking at Southwest corner) **2625** (looking at Southeast corner)
7 (9th W & California)	Southwest Corner	10.12	3946	0.1394	34230
7 (9th W & California)	Southwest corner (facing southeast light)	n/a	n/a	n/a	53620
7 (9th W & California)	Middle of crosswalk	12.94	3799	0.1809	55620 (facing right light)
7 (9th W & California)	Middle of Crosswalk	n/a	n/a	n/a	50280 (facing left light)

Site	Distance (Meters) or Location	Illuminance (Lux)	Color Temp (Kelvin)	PAR (μmol/m²/s)	Luminance (c*d/m²)
7 (9th W & California)	Southeast Corner	9.365	3952	0.1278	11570
7 (9th W & California)	Southeast corner (facing southwest light)	n/a	n/a	n/a	36090
8 (Dealership)	Light by sidewalk (no working bulbs)	2.3051	4558	0.03523	82.45
8 (Dealership)	Light by sidewalk (all working bulbs)	73.96	4654	0.9484	18460
8 (Dealership)	Light in lot (two working bulbs)	40.76	4410	0.5218	13910
8 (Dealership)	Light in lot (no working bulbs)	2.728	4448	0.03497	0.25
8 (Dealership)	Light in lot (all working bulbs)	83.89	4630	1.078	17730

Maximum Measurements

Measurement	**Location**
Illuminance: 89.7 [Lux]	Jordan River Trail & 1700 S (Directly under light)
Color Temperature: 6793 [Kelvin]	Glendale Library (Crosswalk 2)
PAR: 1.078 [μmol/m²/s]	Car Dealership (Light in lot with all working bulbs)
Luminance: 163330 [c*d/m²]	Jordan River Trail & 1700 S (5 meters north of light)

Detailed Maps of the Measurement Sites

• Measurement Site • Light Source

Glendale Middle School

Glendale Middle School Crosswalk

Glendale Library

Single Family Neighborhood

Jordan River Trail & 1700 S Crossing

Jordan River Trail at 1700 S

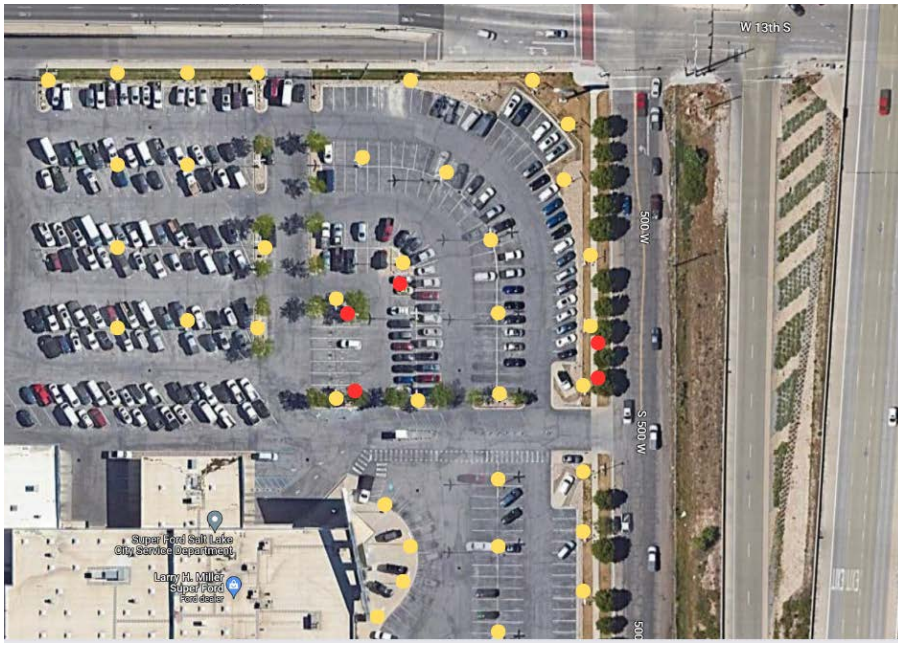
Fife Wetlands

Redwood Rd. and California Ave. Chase Bank

Redwood Rd. and California Ave. Intersection

9th West and California Intersection

Car Dealership by I-15



All maps acquired from Google Maps

Interpretations

One of our main takeaways from our research was the discovery of the inconsistency in lighting across the Jordan River Trail running through Glendale. There are “peaks” and “troughs” of lighting across the trail, creating a situation where a user, perhaps on a bike like in our case, is moving between very brightly lit spaces and very dark, unlit spaces. This can decrease the overall effective night vision of trail users and decrease safety.

Within the context of the Jordan River Trail (JRT) one way to interpret how users might interact and see the lighting is from the perspective of safety; brighter lights along the JRT intrinsically make it safer. From our experiences taking measurements and experiencing the JRT at night we understand there are serious concerns regarding the safety of this area when it is dark. However, what we have found is punitive, bright lighting has the opposite effect, creating a more dangerous and imbalanced environment for JRT users. As mentioned previously, inconsistent lighting makes for an unpleasant user experience and could increase the chances of collision.

It’s understandable the recommendations we will make come with sticker shock, however, this is usually an upfront investment into infrastructure with derivative, positive effects. International Dark Sky Association (IDA) compliant lighting (not using lights with a color temperature above 3000 kelvin, having shielding on lights so no upward skyglow can occur, and should only be on when needed) comes with the massive benefit of requiring less electricity. An optimization in lighting across Glendale could significantly cut the amount of electricity used to light spaces. A study done by the city of Moab found even marginal changes in their lighting infrastructure in a pursuit of IDA compliance would save them about $170,000 a year in electricity. This is a saving with no consequence on safety. Altering lighting patterns also has a positive mental and physical health impact on the general public. Reducing light pollution has the derivative effect of reducing the impact on human health, which can increase overall population health.

Recommendations

We have developed a few short term and long term recommendations to create more consistent and comfortable lighting in the community of Glendale.

SHORT TERM ALTERATIONS

Perhaps one of the simplest short term alterations is to reduce the overall luminosity of existing lighting. This can be done through either an existing lighting control system, the integration of a lighting control system or one-by-one electronically reducing the luminosity of existing lights manually. This will have a huge impact on the contrast and glare issues and could help with visibility and the "scatter" of light during inclement weather (snow and rain will refract light, scattering it everywhere. Hence why when it is snowing late at night it can almost be as bright as twilight).

Shielding lights will direct the light to the intended area and prevent light trespass and reduce skyglow. For existing lights, adding dimmers and motion sensors reduces luminosity and saves energy. These can be as simple as 3D printing blinders clipping to the sides of existing lighting infrastructure.

A simple way to adjust the color temperature of existing lighting infrastructure is to use a Vinyl film to fit over the existing lighting fixture. This DIY alteration will act as a filter only allowing particular colors through. Using a red or orange filter will turn a bright white light into an orange or redder colored light. This is a simple alteration to help to resolve many issues that come with PAR or improper temperature color.

LONG TERM INFRASTRUCTURE

Long term changes to lighting will often result in the most efficient and effective utilization of resources. Retrofits and alterations to existing infrastructure can only go so far, and could potentially have a shorter life span. Our overall recommendation to changes in Glendale's lighting infrastructure is to replace lights as they are phased out with modern, IDA compliant lighting, instead of just continually retrofitting temporary additions on existing infrastructure. With the observations we made exploring Glendale's current lighting infrastructure we have established a list of lighting fixtures we think would act as great analogs to compare other lighting infrastructure to, or as lighting systems to seriously consider.

Our first analog is the Lampas MIRUM L1400 – Street light fixture. This "post style" street light was designed by a Danish firm, creating modern and IDA compliant

lighting systems for public and private use. Their systems are robust and well suited for climates like Utah. These were recommended to us by someone focusing on Utah IDA compliance within Utah's State Parks. This particular series of lamps maintains great color rendering (how well light renders the colors in objects) all while having satisfactory color temperature options of either 2200 K or 2700 K. These lamps also have a great luminous efficacy of 122 lumens per watt consumed. For comparison most street lamps are between 40 and 125 lumens per watt consumed. Lastly, these lights can be easily integrated into a wide range of lighting control systems, ensuring these fit into many projects a city might find themselves working on.

Above: Lampas MIRUM L1400

Another overhead post style light we would recommend as a fantastic analog to compare lighting systems against, or to potentially use in any current or future lighting projects is the Structura Kila - Street light. We chose to demonstrate this light because of the fact it was designed with IDA compliance in mind. There are many lights which can meet IDA compliance, however arguably few of them were designed from the start with IDA compliance in mind. The Structura Kila meets all of the requirements we and the IDA recommend all while maintaining flexible mounting options. These lights can be had with an optimal color temperature of 2700k and still maintain excellent color rendering. These lights also have great luminous efficacy, and much like the Lampas MIRUM L1400 counterpart can easily integrate into existing lighting control systems, or new projects. These lights also can be equipped with motion sensing and adjustable luminosity.

Above: Structura Kila - street light

For areas with pedestrians and bicyclists, such as the Jordan River Trail, low bollard lights create human-focused lighting reducing glare and sharp contrasts. With this in mind we have also assembled a couple examples of bollard lighting systems meeting the needs of trail users.

Lampas NYE L1004 and L1002 series bollard lights (series L1004 is seat, series L1002 is bollard). These lights are IDA compliant and meet many of the same requirements outlined with the overhead “post” style lighting. However, these have a reduced luminosity and a different “throw” (distance light travels outwards) of light. The L1004 and L1002 series bollards are a great solution for lighting a pedestrian trail due to their versatility. First is a multiuse design is important within flexible spaces like the walkway (imagine someone sitting on this lamp whilst tying a pair of running shoes, or stopping mid bike ride).

Above: Lamas NYE L1004 series bollard light

Next, we recommend the NYE L1002 series bollard lamps as they meet the same requirements the L1004 series bollard does, but function as a taller, more obvious barrier between pedestrian and automotive traffic. They also have the same low watt consumption as the L1004 series lights, making them just as economical to run. These act more as a barrier between pedestrians and vehicular traffic by increasing visibility of the markings of a pedestrian - only space through raising the lighting systems and establishing a segregation of lighting types for different road users.

Above: Lampas NYE L1002 series bollard light

Lastly, with respect to bollard lighting in pedestrian spaces, is the Structura Duo bollard. This light meets the requirements of the IDA to be dark skies compliant. With 2700 K color temperature options, great luminous efficacy, and a great overall height of 36 inches. We recommend many of Structura's bollard lighting fixtures, as they can meet a wide range of requirements, be it having structural bollards that are rebar and concrete reinforced for protection against automotive collisions with pedestrians. Structura offers solar lighting for situations when trenched wiring is simply too expensive or too complicated. The Structura Ata and Zora are both solar and trenched lighting. These would be excellent for areas like the Fife Wetlands where trenched lighting may be too impactful on the environment.

Above: Sturtura Duo Bollard

These lighting alterations are undoubtedly expensive, however we recommend rolling these out as replacements as existing systems are phased out due to age or any other reason. A concise and efficient transition between DIY and short term alterations to existing infrastructure to dedicated IDA compliant lighting will result in a smooth and affordable transition to greener, safer and more human-focused lighting design within the city boundaries of Glendale.

Acknowledgements

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www.google.com/maps

PAR scale: www.albopepper.com/PAR-light-spectral-quality-in-horticulture.php
Color Temperature Figure:
https://commercialledlights.com/blog/lighting-articles/color-temperature/

IDA Outside Lighting Basics:
https://www.darksky.org/our-work/lighting/lighting-for-citizens/lighting-basics/#:~:text=IDA%20recommends%20using%20lighting%20that,are%20rich%20in%20blue%20light.

IDA Fixture Seal of Approval Program (Fixture Recommendations):
https://www.darksky.org/our-work/lighting/lighting-for-industry/fsa/fsa-products/

Recommended Lights:
Lampas MIRUM L1400:
https://lampas.com/products/mirum-l1400-street-light-fixture/

Structura Kila - street light:
www.structura.com/products/kila

Lampas NYE L1002 and L1004 series bollard lights:
www.lampas.com/products/nye-l1004-bollard-light-with-seat/www.lampas.com/products/nye-l1002-bollard-light/

Sturtura Duo bollard light:
https://structura.com/products/duo-bollard