APPENDIX E
Biological Review of Impacts of Wharf Lighting

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MEMORANDUM

To: Stephanie Strelow
From: Brock Ortega
Subject: Analysis of Impacts to Near-Shore Marine Biological Resources due to Lighting Associated with the Planned Santa Cruz Wharf Master Plan Improvements, Santa Cruz, California
Date: October 13, 2016

Attachment(s): Figure 1 – Proposed Master Plan Lighting
Figure 2 – Existing Lighting
Figure 3 – Lighting Analysis for Santa Cruz Wharf Expansion – Before and After Comparison

This memorandum analyzes the potential impact of light on near-shore biological resources associated with proposed Santa Cruz Wharf Master Plan (Master Plan) improvements. The intent is to address general public comments related to potential lighting impacts associated with the project. The analysis is based on general information provided within the Wharf Master Plan (Roma Design Group, October 2014), literature review, review of aerial and other photographic evidence, and known biological information from the site and vicinity. No specific design lighting layouts or lighting specifications/modeling (e.g., light contours) were completed or provided as part of this assessment.

INTRODUCTION

The Santa Cruz Wharf (Wharf) is located at the northern edge of Monterey Bay, in the City of Santa Cruz (see Figure 1-1 in the Initial Study). It is at the hub of many retail, recreational and commercial uses in the Beach Area. Lighthouse Point is situated approximately 0.65 mile to the west, and the Santa Cruz Beach Boardwalk is situated to the east near the Wharf entrance and faces the Main Beach and Monterey bay. The Boardwalk and its many rides, including the "Giant Dipper" rollercoaster, is illuminated every night between May and September and weekends and holidays during the rest of the year. The Wharf is currently illuminated at numerous locations along its entire length and width. Lighting includes overhead street-type and parking lot-type lighting, lighting for pedestrians, and business lighting. Much of the existing lighting is located along the eastern edge of the Wharf immediately adjacent to the bay waters.

Three strategies have been developed and discussed within the Master Plan to address the economic development potential of the Wharf and other community objectives for the enhancement and preservation of this landmark. The first strategy calls for the physical expansion of the perimeter of the Wharf for public access, recreation, fishing and boating. Planned improvements include a wide promenade on the east side of the Wharf as well as new boat landings, overlooks and the completion of a west side walkway. The second strategy calls for enhancing the existing public spaces on the Wharf. This includes areas currently devoted to vehicular circulation and parking which currently occupies the largest portion of the Wharf. It also includes three public spaces at the point where the deck widens to accommodate commercial uses. This strategy includes the reorganization of the parking areas for greater efficiency and effectiveness, to reduce pedestrian/vehicular conflicts, and to enhance experience. The third strategy calls for expanding the number, mix and attractiveness of commercial uses on the Wharf within the existing footprint devoted to these purposes.

PROPOSED WHARF LIGHTING

Excerpts from the Wharf Master Plan that provide descriptions of the proposed lighting on the Wharf are summarized below. However, at this time, a specific lighting plan has not been developed. A diagram of the proposed lighting is included as Figure 1.

1) Page 12 & 13: policies 6 & 8:
    a. Under Policy 6: Provide for a row of efficient high quality light fixtures on the east side of the parking spine and remove the light fixtures on the west side that constrain pedestrian movement. Incorporate lighting onto the building frontages and storefronts for the sidewalk area.

    b. Under Policy 8: Promote a continuous permanent canopy over the sidewalk with integrated lighting and signage for comfort and convenience to the pedestrian in inclement weather and during evening hours.

2) Page 18: The lighting concept for the vehicular and parking areas on the Wharf calls for the placement of light fixtures along the inland edge of the East Promenade and on both interior sides of the East Parking Lot extension. This will result in the placement of twenty-six light fixtures at 75 feet on center and in line with the seat wall along the parking lot edge and an additional six light fixtures on the opposite side in the East Parking Lot, for a total of 32 light fixtures. The light fixtures will incorporate features to discourage bird perching and will be approximately 18 feet in height. The features will

provide adequate lighting for the East Promenade as well as the vehicular access and parking areas, and with additional canopy lighting along the sidewalk, will eliminate the need for light fixtures on the sidewalk adjacent to commercial uses. Nesting low-level way-finding lights will be provided along the bayside edge in the proposed step-down area. The lighting concept is designed to protect the night sky, enhance views to the shore and highlight the commercial storefronts.

3) Page 19: No lighting along the new Westside Walkway is anticipated. Because ambient light levels will be high from adjacent commercial uses and because generally it is not anticipated that the Westside Walkway would be accessible in the late evening hours, it is not anticipated that lighting will be provided along its length.

4) Page 24: Lighting will be provided on the (boat) ramps and platform so that access after dark can be accommodated if desired.

5) Page 35: Overhead lighting will be provided on the relocated entrance structure in the overhead beam of the support columns.

6) Page 40: Shows existing lighting at the Wharf.

7) Page 44: A continuous canopy that extends from existing storefronts over the sidewalk is proposed, which would also incorporate lighting.

8) Page 49: Design Standards-Sidewalk Canopy: A sidewalk canopy or roof overhang of a 12-foot depth and 12 to 15 foot height is required over the entire sidewalk adjacent to and the length of each of the premises to provide continuous weather protection for pedestrians. The canopy shall be structured to be a permanent part of the façade. Awnings or fabric extensions are not an acceptable alternative. Lighting must be incorporated in the overhang to improve the uniformity ratio of parking area lighting, and provide for sidewalk illumination.

ANALYSIS THRESHOLDS

This analysis addresses the thresholds identified under the mandatory findings of significance section of the CEQA initial study. Under the mandatory standards of significance, when a lead agency is determining whether to prepare an MND or an EIR, it must find that a project will have a significant effect on the environment, and require that an EIR be prepared, if the project has the potential to (Guidelines, § 15065(a)(1)) :

- Reduce substantially the habitat of a fish or wildlife species;
- Cause a fish or wildlife population to drop below self-sustaining levels;
- Threaten to eliminate a plant or animal community; or
- Reduce substantially the number or restrict the range of an endangered, rare, or threatened species.

EXISTING CONDITIONS

Currently, the Wharf and surrounding area includes a variety of lighting sources. According to City staff, existing lighting on the Wharf consists of 83 pedestrian lights and 32 street lights for a total of 115 existing lights that stand between 22 feet tall (street lights) and 14 feet tall (pedestrian lights). This includes lights on the western edge of the Wharf from the parking gates to approximately 1,100 feet; along the entire eastern edge; along an approximate 1,800-foot long strip internally next to the business facades; and, another 400-foot strip within the East Parking Lot. Other lighting consists of business façade building lighting along the sidewalk adjacent to the buildings (Figure 2).

Existing light fixtures include LED lights that are rated at 3100 lumens for the street light fixtures and 1875 lumens for pedestrian lights. Existing building lights are generally in the range of 900-1025 lumens each. The 2014 Wharf Engineering Report also notes that the Santa Cruz Wharf is clearly identified on the nautical chart, is well lit, and has two "obstruction" lights on each corner of the end and indicates that with these fixed aids to navigation (on chart, light and horn) the risk from collision due navigation error is low.

LITERATURE RESEARCH

Commenters discussed the potential for lighting impacts and cited scientific literature. We reviewed these and other papers. In summary, the literature is varied in both scope and conclusion. In some instances and for some species, artificial lighting may be harmful, while for others beneficial. For example, lighting has been shown to have no effect to a positive effect on larval and young grunion (Reynolds and Thomson 1974, Reynolds et al. 1977) where they prefer between 10000 and 32000 lux (929 – 2974 FC). The level of harm or benefit is variable and may be dependent on a variety of factors including wave motion, turbidity, moon phase and other factors. In some cases the results may be statistically significant while not in others.

The topics studied may be directly applicable (e.g., marine microfauna), while others may not be at the Wharf's location (e.g., sea turtles, coral reef, upland species and habitats; Rich and

Longicore 2005). Moore et al. (2000) studied the effect or artificial light on freshwater species in low oxygen content freshwater lakes. Moore et al. (2000) concluded that the effects of suppression of zooplankton diel vertical migration by light pollution was most likely to occur in lakes with fish and relatively clear water. They concluded that penetration of light pollution and its effects should be greater in clear lakes with low concentrations of dissolved oxygen content and algae. This is not similar to this site or situation where this is a marine environment with high dissolved oxygen content and comparably cloudy waters.

Finally, the situational location of the studies might not be applicable (e.g., light studies in pristine waters). The effects of lighting on phytoplankton and zooplankton have been studied on aquatic (freshwater) and marine organisms, but much of this is focused on the effects of UV-B solar radiation (Hader et al. 1998). Marine zooplankton migrate up the water column during the night, but these migrations occur through water columns of many meters and over a wide area. In the location of the Wharf, the water depth is relatively shallow (to 30 feet). Absorption or attenuation of the minimal light would occur as soon as light enters the water column. Certain wavelengths are attenuated sooner than others and attenuation is caused by particulate matter and water (Yentch 1962). In this situation, the water column is in constant flux, caused by wave action. This flux increases the amount of particulate matter in the water column. Thus, light attenuation would be higher in this area.

Regardless, what is known is that artificial light may cause some level of effect, whether good or bad, and the importance of that impact is poorly understood at this time.

ANALYSIS - LIGHTING ISSUES

Potential impacts are characterized as resulting from two main different sources: (1) short-term construction-related impacts and (2) long-term impacts related to implementation of the proposed Wharf Master Plan projects.

Lighting may affect essential behavioral activities, physiology, population ecology, and ecosystems of both diurnal and nocturnal wildlife. Longcore and Rich (2004) call these effects "ecological light pollution" and identify three types of effects: (1) chronic or periodically increased illumination; (2) unexpected changes in lighting; and (3) direct glare. Chronic increased illumination includes sky glow, lighted buildings and towers, streetlights, and security lights. Unexpected changes may occur from vehicle lights or other discrete events such as flares or spotlighting by law enforcement helicopters. Direct glare may be chronic or unexpected. Because of the existing condition, none of these effects are expected to increase as a result of this project.

Longcore and Rich (2004) address the ecological effects of ecological light pollution at three levels: (1) behavioral and population ecology; (2) community ecology; and (3) large-scale ecosystem functions. Effects at the behavioral and population ecology level include orientation/disorientation and attraction/repulsion, reproduction, and communication.

Orientation and disorientation are responses to ambient light levels, while attraction and repulsion are responses to the source of light (*e.g.*, moths attracted to a light bulb). Orientation includes artificially expanding behavioral repertoires of normally diurnal or crepuscular species, such as foraging or territorial advertisement or mate attraction (*e.g.*, singing birds), into nighttime periods. Disorientation may occur in nocturnal species that normally orient during dark periods and whose visual systems are adapted to low light levels. Attraction to lights affects birds that may suffer injury or mortality due to collisions with lighted structures. Many insects are attracted to light sources, resulting in high numbers of prey being taken by nocturnal insectivores, such as bats. Repulsion of nocturnal wildlife by lights is probably quite common and may cause them to avoid lighted areas in their normal home ranges. This is more likely to occur in pristine natural environments versus a built environment such as the Wharf.

Wildlife reproduction may be affected by lighting in various ways. Movement to breeding areas, chorus behavior, and mate selection by some amphibians may be affected (Longcore and Rich 2004). Lighting may disturb the nighttime rest and sleep periods of diurnal species, including most passerine (perching) birds, having similar effects as noise, including annoying individuals and causing them to abandon nests that are otherwise perfectly suitable. Nest site selection by some birds may be affected by light, with nests being established farther from light sources (Longcore and Rich 2004). Artificial light may simulate increased day length, affecting reproductive cycles by triggering premature reproductive activity at a time when environmental conditions are not conducive to successful reproduction (*e.g.*, cold temperatures and/or poor food resources). Because light may interfere with sleep, it can be stressful and may disrupt normal biological rhythms and raise the level of stress hormones, which may in turn affect reproductive capacity. However, there is a pre-existing condition on the Wharf and the revised lighting is not anticipated to increase the overall lighting, and may actually reduce lighting in adjacent areas.

At the level of community ecology, ecological light pollution may affect competition and predation (Longcore and Rich 2004). Behavioral interactions by groups of species may be affected by lighting, as species move into the "light niche" (Longcore and Rich 2004). Species groups that normally partition foraging periods in relation to ambient light levels may be in direct competition under artificial light conditions. Likewise, species that are adapted to higher

light levels (*e.g.*, crepuscular species) may outcompete strictly nocturnal species that normally forage in the darkest part of the night.

Lighting may increase the risk of predation of both nocturnal and diurnal species because they may be more detectable to nocturnal predators. Some species, such as fish, may be attracted to light because invertebrate prey may congregate around light sources, which may in turn increase the risk of the fish being preyed upon by other species such as mammals. Longcore and Rich (2004) characterize this as a tradeoff in the benefit of foraging longer (or at richer sources) with the cost of higher predation risk. Many small species, actually forage at lower rates at high illumination levels (Longcore and Rich 2004), which may be a biological adaptation to high levels of moonlight. Overall, chronic ecological light pollution may favor light-tolerant species over those that are dark-adapted (Longcore and Rich 2004).

The various levels of ecological light pollution ultimately may affect large-scale ecosystem functions in ways not yet understood, as effects at the behavioral and population ecology and community ecology levels reverberate through the system (Longcore and Rich 2004).

Short-term Impacts Related to Construction of the proposed Project

Lighting during construction is not anticipated as construction will not occur at night. Any security lighting will focus on equipment and will be situated such that it focused on equipment and not the surrounding habitat and lighting will not be more intense at the surrounding habitat than it will be post construction or than it currently is. Given these project features, short-term lighting impacts related to construction are considered to be less-than-significant.

Long-term Impacts Related to Build-Out of the Proposed Projects

As reviewed above, ecological light pollution can have effects at the behavioral and population ecology level, the community ecology level, and the ecosystem level (Longcore and Rich 2004). These effects generally include orientation/disorientation and attraction/repulsion, reproduction, and communication at the behavioral and population ecology level, and competition and predation at the community ecology level, the effects of which would be expected to reverberate to the ecosystem level (Longcore and Rich 2004). These effects are likely different in a marine environment. However, while there will be the addition of downward-directed entrance lighting at the relocated parking

gates, overall lighting improvements proposed by the the Wharf Master Plan would be reduced from the current condition as discussed below.

1. Construction of the East Promenade will move parking lot lighting further from the edge of the Wharf along most of the eastern side of the Wharf. Light structures along the eastern side of the Wharf where the East Promenade will be constructed will be set back from it's edge by approximately 28 feet whereas they are currently situated at the eastern edge of the Wharf directly adjacent to the bay. This will result in greater or total shading of the marine environment from the downward glare of the lights as shown on Figures 1 and 3. The Master Plan indicates that 32 new light fixtures in this area generally will be the same type and intensity as existing lights. It also appears that the new lights would replace some of the existing street lights along the eastern edge.

2. Limited specific low-level way-finding lights will be installed in the East Promenade seat wall to accommodate pedestrian safety.

3. Limited lighting will occur along the boat ramps, and no lighting will be placed along the new western walkway.

4. Existing light structures adjacent to the commercial buildings will no longer be required as they will be replaced by lights inserted into the continuous canopy adjacent to the building facades. These new lights will direct light to the pedestrian paths only and will not be directly visible by the surrounding marine environment. The store-front pedestrian lights will be changed from overhead lamp-post type lighting to integrated and shielded lighting within the pedestrian canopies.

5. No additional lighting is proposed for the western edge of the Wharf. The overall goal of the Master Plan is to protect the night sky, which will also result in a beneficial impact on the adjacent marine environment.

Due to some reduction of lighting on the west side and better placement of lighting, the long-term impacts related to project lighting on marine species are considered to be less-than-significant.

CEQA MANDATORY FINDING OF SIGNIFICANCE ANALYSIS

Based on the above information, the following findings regarding significance is determined related to each guideline:

- Reduce substantially the habitat of a fish or wildlife species. Because the current baseline condition already includes lighting and the new plan will reduce the number of light sources and will more effectively shield those light sources that are proposed, the project is expected to enhance habitat for any species in the vicinity, primarily with construction of the East Promenade that will move existing parking lot lights further from the edge of the water. Therefore, no significant impacts are expected.
- Cause a fish or wildlife population to drop below self-sustaining levels. For the reasons stated above, and the fact that the location is currently a functioning active development, no significant impacts are expected.
- Threaten to eliminate a plant or animal community. As discussed above, lighting at the edge of the Wharf would be set back along most of the east side, and no significant impacts have been identified as discussed above. Thus, lighting would not threaten to eliminate a marine community. For the reasons stated above, and the fact that the location is currently a functioning active development, no significant impacts are expected.
- Reduce substantially the number or restrict the range of an endangered, rare, or threatened species. Special status species known in the area include fish species (coho salmon, steelhead, green sturgeon), marine mammals (California sea lion, harbor seal, southern sea otter, and occasional gray whale), and California pelicans. The proposed lighting component of the Wharf Master Plan would not would not be expected to substantially reduce or restrict the range of any of them for the reasons outlined above. No significant impacts are expected.

LITERATURE CITED AND REFERENCES

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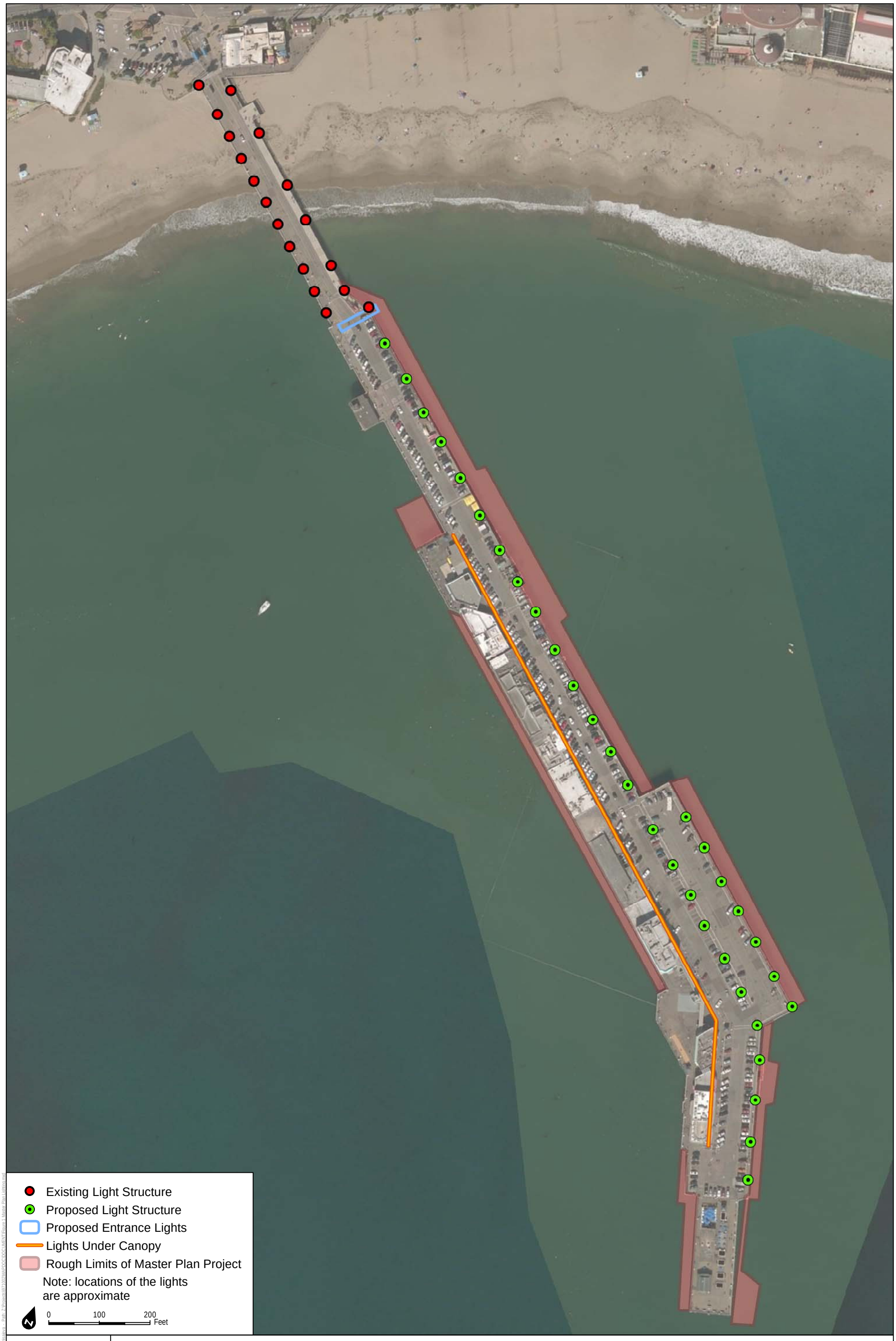

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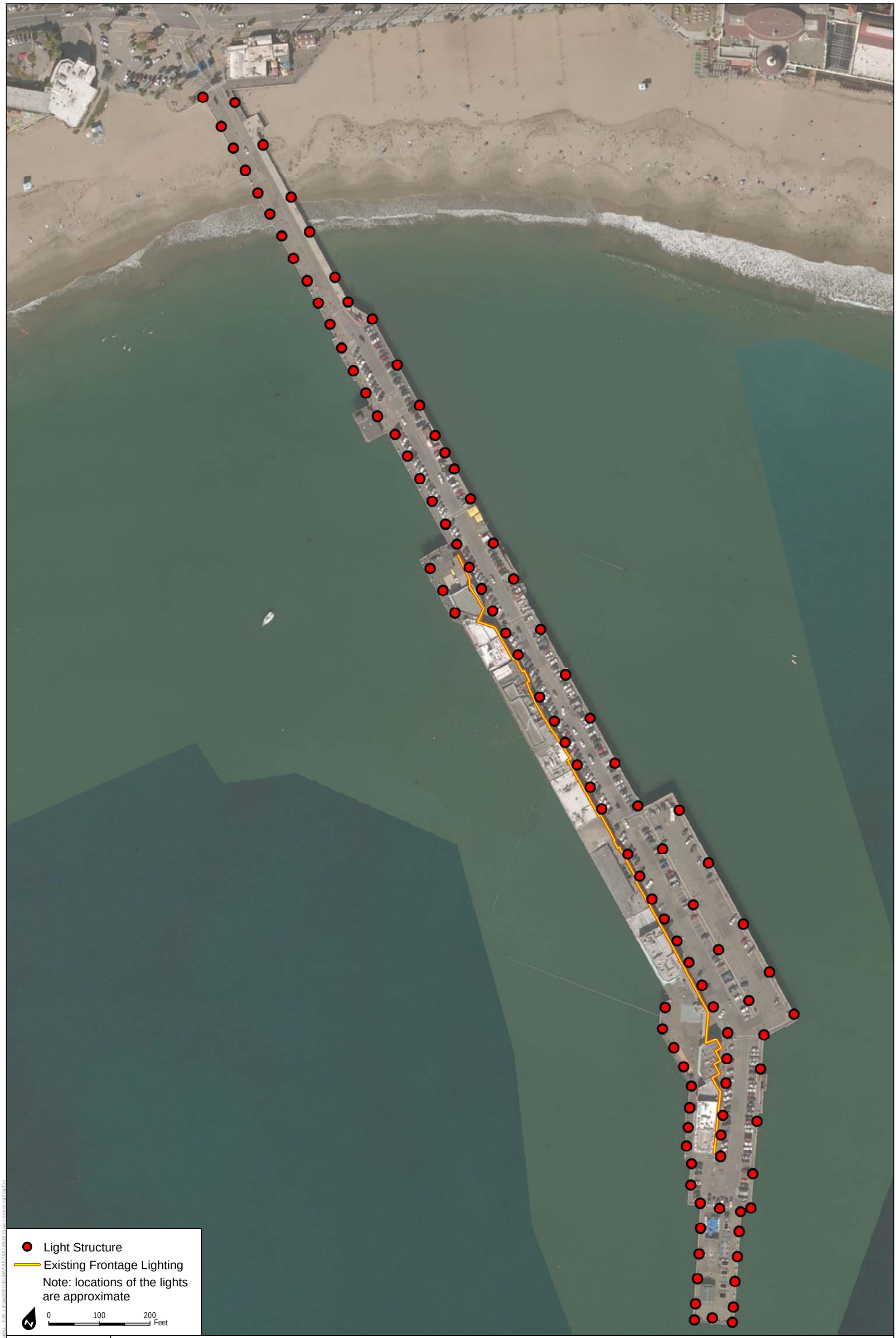
SOURCE: Bing Maps (Accessed in 2016)

FIGURE 1

Proposed Master Plan Lighting

Santa Cruz Wharf Project



SOURCE: Bing Maps (Accessed in 2016)

FIGURE 2
Existing Lighting

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Santa Cruz Wharf Project

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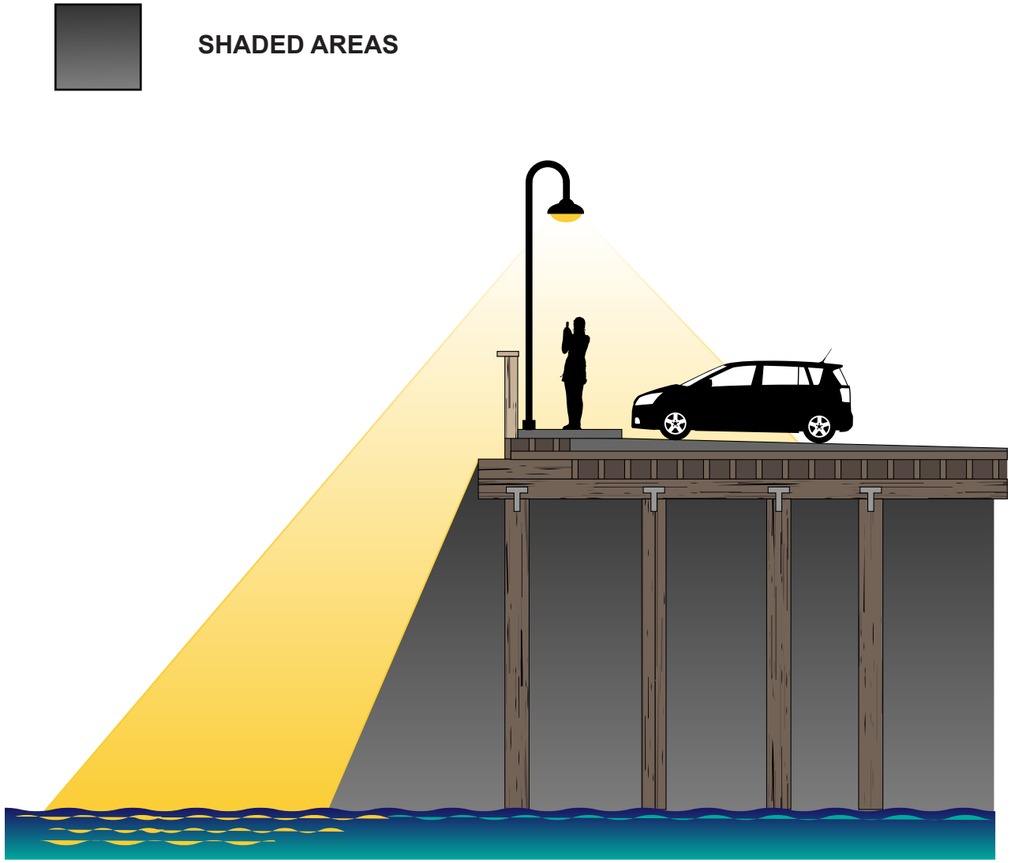
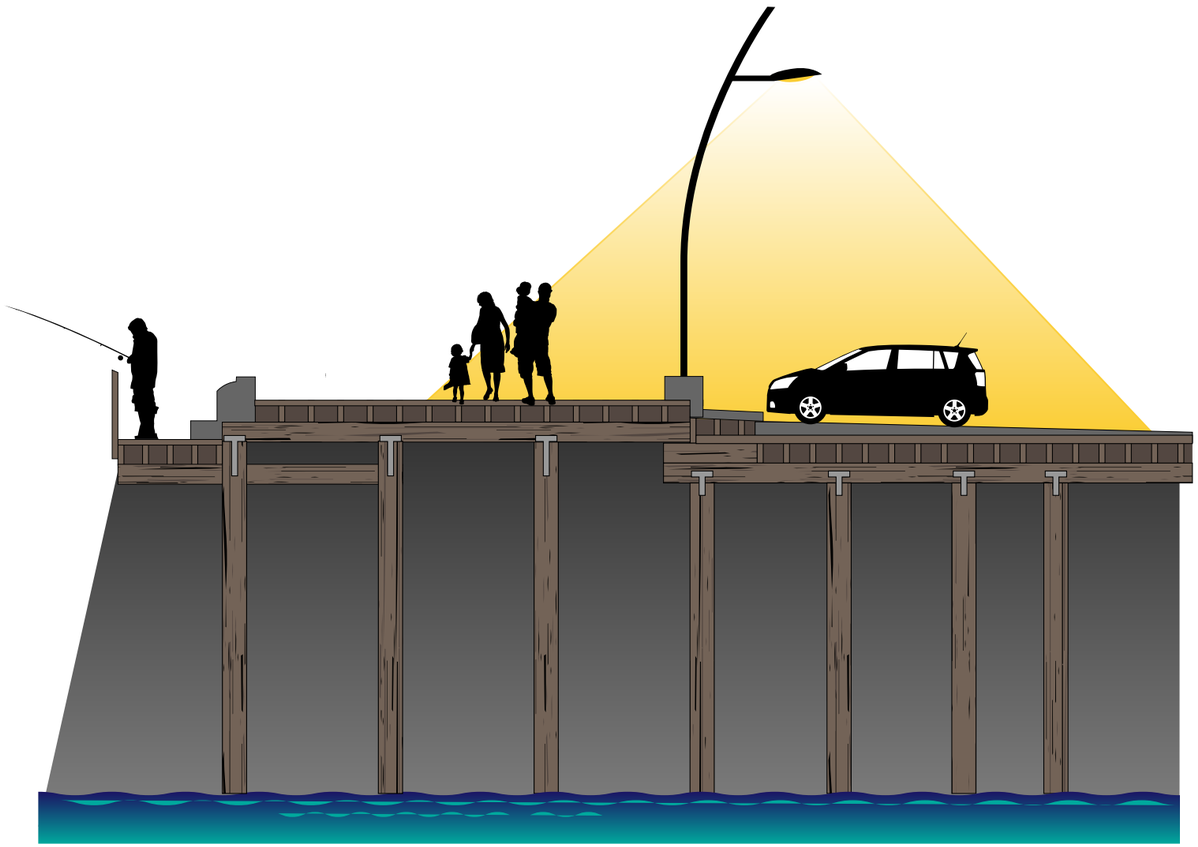
SHADED AREAS



BEFORE: CURRENT LIGHTING AT EDGE OF WHARF



AFTER: PROPOSED WHARF EXPANSION AND NEW LIGHT POSITIONING

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9711, 9710
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SOURCE:

FIGURE 3
Lighting Analysis for Santa Cruz Wharf Expansion – Before and After Comparison